LITHOSTRATIGRAPHY, FORAMINIFERAL BIOSTRATIGRAPHY AND GEOLOGICAL HISTORY OF THE UPPER CRETACEOUS IN WEST JORDAN

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This research programme was carried out in collaboration with the University of Jordan

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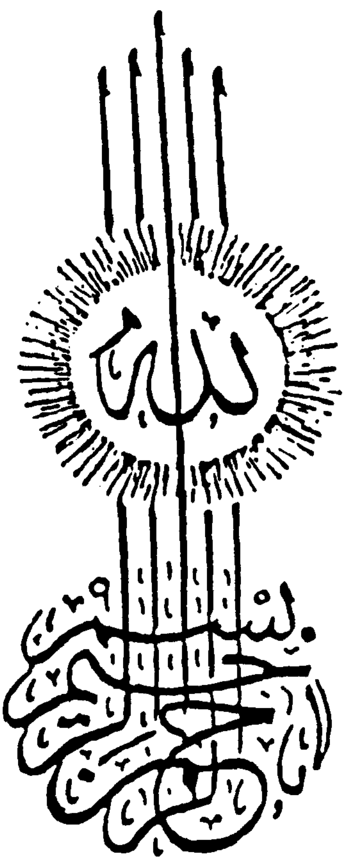

In the Name of Allah The Most Gracious and The Most Merciful

Holy Koran

To My

Late Parents

Wife Nariman

Daughters Reem, Samar and Riham

Son Bashar

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ABSTRACT

The stratigraphy of the Upper Cretaceous (Cenomanian - Lower Maastrichtian) rocks in West Jordan is described based on four measured sections: Ajlun/Jerash (north); Wadi Mujib (central); Wadi Mussa and Ras en-Naqb (south). Over 285 samples collected from these sections were processed for microfossils; 214 samples were thin sectioned for microfacies analysis. Despite significant lithofacies changes southward, eight formations and six members have been recognised and correlated across the region. The thickest marine strata are located in the northern and central areas; thicknesses decrease and the sand content gradually increases towards the south.

Microfossil, principally foraminiferal, biostratigraphy has been used for detailed stratigraphic correlation. Over 420 species constituting 170 genera are documented, many for the first time from the area. Microfossil species identified include 80 planktonic and 331 benthic foraminifera (104 calcareous and 227 agglutinated), and 10 radiolaria. Taxonomic analyses of all foraminiferal and radiolarian species are presented, including remarks on each species and its geographic and stratigraphic distribution. Most species are illustrated by Scanning Electron Microscope (SEM) photographs.

Microfossil range charts are presented for each measured section, based on detailed analysis of each microfossil sample, and local assemblage zones are described. Six regional foraminiferal assemblage zones are proposed: *Conorboides umiatensis / Haplophragmoides* spp. Zone (lower to mid-Cenomanian); *Heterohelix calabarflanki / Whiteinella inornata* Zone (upper Cenomanian); *Gavelinella stephensoni / Whiteinella archaeocretacea* Zone (Turonian); *Archaeoglobigerina blowi / Concavatotruncana concavata* Zone (upper Coniacian - Santonian); *Rugotruncana subcircumnodifer* Zone (upper Campanian); *Globotruncanella havanensis* Zone (lower Maastrichtian), based largely on evidence from Wadi Mujib, which is proposed as a reference section for the area.

Palaeoenvironmental studies, including microfacies analyses and the quantitative evaluation of foraminiferal assemblages (planktonic and benthic), provide evidence of four major marine sedimentary sequences: (1) early - mid Cenomanian; (2) late Cenomanian - middle Turonian; (3) late Coniacian - late Santonian; (4) early Campanian to early Maastrichtian, each separated by hiatuses caused either by global falls in sea level and/or local tectonic activity.

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GENERAL		LITHOLOGIC		ROCK UNITS	
Ammob.	Ammobaculites	**Anhyd.**	Anhydrite	**A / J**	Ajlun/Jerash
Ammom.	Ammomarginulina	**Aren.**	Arenaceous	**Assmb.**	Assemblage
Ammon.	Ammonite	**Arg.**	Argillaceous	**Cen.**	Cenomanian
Benth.	Benthonic	**Cly.**	Clay	**cf.**	Comparable
Bucc.	Buccicrenata	**Ch.**	Chert	**Coniac.**	Coniacian
Clvhed.	Clavihedbergella	**Dol.**	Dolomite	**Cret.**	Cretaceous
Cun.	Cuneolina	**Fer.**	Ferruginous	**Fm.**	Formation
Disc.	Discorbis	**Glauc.**	Glauconitic	**Fhs.**	Fuheis
Ech.	Echinoid	**Gypsf.**	Gypsiferous	**Gh.**	Ghudran
Feur.	Feurtillia	**Ls.**	Limestone	**Gp.**	Group
Gab.	Gabonita	**Ml.**	Marl	**Hmr.**	Hummar
Glg.	Globigerina	**Mly.**	Marly	**Kr.**	Kurnub
Glt.	Globotruncana	**Nod.**	Nodular	**M.**	Wadi Mujib
Hap.	Haplophragmoides	**Ool.**	Oolitic	**Maastr.**	Maastrichtian
Hed.	Hedbergella	**Phos.**	Phosphate	**Nr.**	Na'ur
Hem.	Hemicyclammina	**Py.**	Pyrite	**N.R.A.**	Nat.Res.Auth
Het.	Heterohelix	**Ss.**	Sandstone	**P.**	Wadi Mussa
Lent.	Lenticulina	**Sdy.**	Sandy	**Q.**	Ras en-Naqb
Mars.	Marssonella	**Sh.**	Shale	**Sant.**	Santonian
Nez.	Nezzazata	**Sil.**	Siltstone	**Shb.**	Shueib
Orb.	Orbitulina	**Stn.**	Siliceous	**Sp.**	Species
Ostr.	Ostracoda	**Xlln.**	Crystalline	**Tk.**	Thickness
Plank.	Planktonic			**Turon.**	Turonian
Praeb.	Praebulimina			**WS.**	Wadi es-Sir
Pralv.	Praealveolina			**Z.**	Zone
Praeg.	Praeglobotruncana				
Rph.	Reophax				
Rh.	Rhapydionina				
Text.	Textularia				
Th.	Thomasinella				

CHAPTER 1

INTRODUCTION

1.1 Geology of Jordan

Jordan is considered, from a geological standpoint, to be a continuation of the north-western part of Arabia (Abed, 1982a). The northern part of the Arabo-Nubian Shield, with its intrusive igneous rocks of Precambrian age, outcrops in the SW of Jordan. In some areas these rocks are covered with metamorphic and sedimentary deposits of Proterozoic-Cambrian age, forming the so-called Basement Complex, which in turn is overlain by marine and continental sediments of Cambrian, Ordovician and Silurian age. These Lower Palaeozoic sediments consist mostly of shales and sandstones, and attain a total thickness of 1800 m in some areas.

Mesozoic and Cainozoic sediments outcrop throughout most of central and SE Jordan (Fig. 1.1), the former representing deposition on the stable margins of the Tethyan Ocean. Transgressive and regressive cycles can be determined in these sequences from alternations of continental and marine deposits, from lateral lithofacies variation within individual units, and by the presence of unconformities in the stratigraphic column. The thickness of these post-Proterozoic sedimentary rocks increases to the north and west, but generally ranges from 2000 - 3000 m. The thickness reaches 4000 m in the Jafr Basin of southern Jordan, and 5000 m in the Azraq Basin, south of Northern Plateau, and in the Sirhan Valley, east of the Central Plateau. Mesozoic deposits in the northern and north-western areas and parts of eastern Jordan, represent shelf and slope deposition, and are characterised by more complete sequences and less lateral lithofacies variation than other areas.

The area has been subjected to several tectonic episodes during its geological history, resulting in tilting, faulting, folding and thrusting of the sedimentary cover. A major phase of volcanic activity occurred between the end of the Proterozoic and the beginning of the Cambrian. Evidence for this activity is provided by quartz porphyries in Wadi Arabah, a rift extending from the Gulf of Aqaba, 360 km to the north. In addition, some mafic and intermediate volcanic activity occurred during the latest Jurassic and earliest Cretaceous around Wadi Arabah, and in some areas west of the Jordan River and east of the Dead Sea. Basaltic volcanism also occurred during the Tertiary, mostly in the Azraq and Jebel El-Arab areas, in the north and on the northern boundary with Syria, respectively.

1.2 Main structural and geomorphological features of Jordan

Jordan is situated in the north-western part of the Arabian Peninsula. It covers an area of approximately 96,500 km^2 (Fig. 1.1). It can be divided into the following six physiographic provinces:

1. The Northern Plateau Basalt Province, covers an area of approximately 11,000 km^2. It forms an almost inaccessible landscape of lava flows and isolated volcanoes. This basaltic shield gradually falls from altitudes of above 1,100 m at the Syrian-Jordanian border in the north, to approximately 550 m in the south.

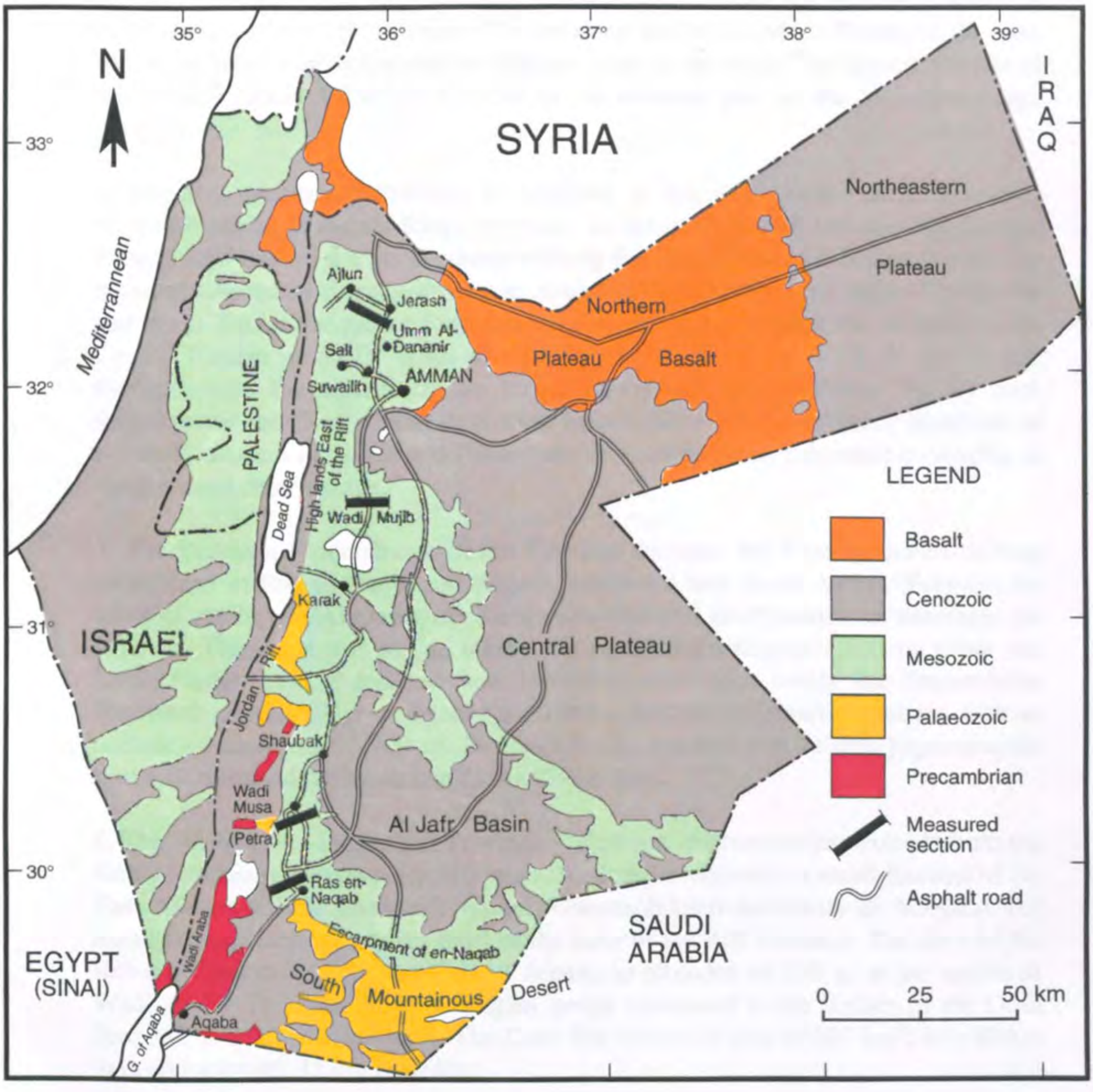

Fig. 1.1 Geologic map of the study area, showing the locations of sampled sections.

(Modified from Bender - 1968a)

(—·—·—·—) New international border 1966.

2. The Northeastern Plateau Province is situated east of the Basalt Plateau and extends as a mountainous quasipeneplained landscape eastward across the Iraqi border, north to Syria, and south to Saudi Arabia. This area is almost entirely occupied by calcareous and siliceous lower Tertiary sedimentary rocks, locally covered by upper Tertiary limestones and sandstones and Quaternary unconsolidated sediments.

3. The Mountain Ridge and Northern Highlands east of the Rift province, stretches north-northeast to north for about 370 km along the Northeastern Plateau in the east, and slopes very steeply towards the Rift province in the west. The highest altitude in the country (about 1,850 m) is found in the southern part of the Mountain Ridge province.

4. The Central Plateau Province is bordered to the west by the slope that rises westward to the Mountain Ridge province. In the north and in the east, the Central Plateau falls toward a wide southeast-striking flat area known the Sirhan Basin. The horizontal or gently dipping limestone, marl and chert beds of the Upper Cretaceous and lower Tertiary sequence form tableland scarps. To the south, the altitude of the Central Plateau gradually drops down to about 85 m in the Wadi Al Jafr Basin. Further south, the altitude of the Upper Cretaceous and overlying Tertiary rock sequences of the Central Plateau is more than 1,500 m. Areas of many hundreds of square kilometers in the Central Plateau are covered by desert pavement consisting of wind-eroded chert residue.

5. The Southern Mountainous Desert Province includes the west-northwest-striking escarpment of Ras en-Naqb, and extends southward into Saudi Arabia. Between the cities of Aqaba and Al Quwayrah the igneous rocks of the Precambrian basement are exposed. The country is rough, with steep mountains rising to 1,500 m above sea level. Farther east, Palaeozoic and Mesozoic sandstones overly the Precambrian basement complex. The sandstones form steep, bizarre cliffs and mountains with an altitude of more than 1,700 m. Drainage in the western part of this physiographic province is toward the south into the Gulf of Aqaba.

6. The Wadi Araba-Jordan Rift Province is a narrow depression that extends from the Gulf of Aqaba, approximately 360 km north. It represents only a small fraction of the East African-Asiatic linear rift system. Unconsolidated sediments of Neogene and mainly Quaternary age occupy most of the floor of the Rift Province. The floor of the Rift rises gradually from the Gulf of Aqaba, to altitudes of 250 m at the center of Wadi Araba. Then, the floor falls again gently northward to the surface of the Dead Sea, 392 m below the sea level. The Dead Sea covers an area of 997 km^2; it is 80 km long and averages 15 km in width.

1.3 Tectonic setting of Jordan

Jordan lies across the northern rim of the Precambrian Nubian-Arabian Shield which forms the western part of the Arabian Peninsula along the Red Sea. Epeirogenic movements that effected the shield, here permitted several transgressions of the ancient Tethys sea.

Geophysical evidence indicates that sea-floor spreading occur in the axial trough of the Red Sea (Le Pichon, 1968). The Palestine-Sinai block is a plate margin that is separated from the Arabian Plate section along the Gulf of Aqaba and the Jordan Rift valley (Freund et al., 1968). Left-lateral displacement of the Arabian plate section along the Jordan Rift valley has opened the Dead Sea basin (Bonnert and Kedar, 1971).

According to Quennell (1959), the Cretaceous structural features comprise folds and faults, sometimes referred to as "Syrian arc" structures. The folds are broad and symmetrical, arranged en echelon with a north-northeasterly trend in central and northern Palestine and northern Jordan, and north-easterly trend in Sinai. To the east of the Rift, the main fold structure is the Ajlun anticline, and to the west of the Rift the most conspicuous fold is the Judean arch. The fault pattern of these structures has four main element: monoclines (which are reflections in the sedimentary cover of faults in the rigid basement with a general north-easterly trend); the major fractures of the rift system, trending a little east of north; transverse faults which dislocate the margins of the blocks, tension faults, trending northwestwards.

The sinistral movement of the eastern Jordanian block relative to the western Palestine block has been a point of arguments amongst various authors to explain the generation of these structures (Quennell, 1956; Bender, 1968b; Freund et al., 1968).

1.4 Importance of Upper Cretaceous sediments in Jordan

Upper Cretaceous sediments in Jordan consist mainly of carbonate rocks which are highly resistant to weathering. They constitute the main highlands to the east of the Dead Sea Rift Valley (referred to hereafter as the "Rift"), in which the capital Amman and most of the settlements and agricultural lands of the country are situated. The Jordanian Highlands contain several important aquifers, which undergo seasonal recharge and produce springs that feed semi-permanent or permanent streams, and are essential for agricultural productivity in the area.

Since the end of World War II, the Jordanian authorities have become increasingly interested in studying their groundwater resources in order to plan efficiently for the development of agriculture and urbanisation in the country. They appointed various foreign experts, at first mainly British, but then also Germans (working for the Geological Survey of Germany), to carry out geological and hydrogeological research in the region. These studies, including those of Koch (1968), Bayliss (1973) and Bender (1974), led to the establishment of a stratigraphic subdivision of exposures in the Jordanian Highlands east of the Rift. The aim of these subdivisions (concerning mainly Upper Cretaceous rocks) was to differentiate good groundwater reservoirs from less permeable strata.

The subdivisions established by previous geologists (Table 1.1), particularly Masri (1963), for the Upper Cretaceous of Jordan are based mainly on lithology. Finer palaeontological subdivision was first attempted in the late 1960s (e.g. Koch, 1968), but this was only carried out on scattered samples collected during a regional mapping programme. Since that time, tremendous advances have been made in the use of microfossils for the subdivision and correlation of Upper Cretaceous sequences,

Table 1.1 Stratigraphic subdivisions of the Upper Cretaceous in the Jordanian Highlands, east of the Dead Sea Rift.

<table>
<tr><th colspan="2">Geologic age *</th><th>Quennell (1951,1956)</th><th>Burdon (1959)</th><th>Masri (1963)</th><th>Bender (1968, 1974)</th><th>Basha (1975, 1979)</th><th colspan="2">This work</th></tr>
<tr><td rowspan="11">UPPER
CRETACEOUS</td><td rowspan="2">Maastrichtian</td><td rowspan="4">BELQA
GROUP
(B)</td><td>B3</td><td>Muwaqqar Formation</td><td>Chalk-Marl Unit</td><td>Not studied</td><td colspan="2">Not studied</td></tr>
<tr><td rowspan="2">B2</td><td rowspan="2">Amman Formation</td><td>Phosphorite Unit</td><td rowspan="3">Amman Formation</td><td rowspan="2">Amman Formation</td><td>Phosphatic Silicified Limestone Member</td></tr>
<tr><td>Campanian</td><td>Silicified Limestone Unit</td><td>Silicified Limestone Member</td></tr>
<tr><td>Coniacian-Santonian</td><td rowspan="3">B1
A7

A6
A5</td><td rowspan="3">Wadi Sir Formation

Shueib Formation</td><td rowspan="2">Massive Limestone Unit</td><td>Ghudran Formation</td><td>Chalk and marl “B1”</td></tr>
<tr><td rowspan="2">Turonian</td><td rowspan="7">AJLUN
GROUP
(A)</td><td>Wadi Sir Formation</td><td>Wadi Sir Formation</td><td>Massive dolomitic limestone & shale “A7”</td></tr>
<tr><td rowspan="3">Echinoidal Limestone Unit
______</td><td>Upper Shueib</td><td rowspan="2">Shueib Formation</td><td>Upper Calcareous Member “A6”</td></tr>
<tr><td rowspan="5">Cenomanian</td><td rowspan="2">A4
______</td><td rowspan="2">Hummar Formation
______</td><td>Lower Shueib</td><td>Lower Marly Member “A5”</td></tr>
<tr><td>Hummar Formation</td><td>Hummar Formation</td><td>Massive limestone and shale “A4”</td></tr>
<tr><td>A3</td><td>Fuheis Formation</td><td rowspan="3">Nodular Limestone Unit</td><td>Fuheis Formation</td><td>Fuheis Formation</td><td>Marly limestones and shales “A3”</td></tr>
<tr><td rowspan="2">A2
A1</td><td rowspan="2">Na’ur Formation</td><td>Upper Na’ur</td><td rowspan="2">Na’ur Formation</td><td>Upper Calcareous Member “A2”</td></tr>
<tr><td>Lower Na’ur</td><td>Lower Marly Member “A1”</td></tr>
<tr><td>L. CRET.</td><td>? Albian</td><td colspan="7">Subeihi Formation (Kurnub Sandstone)</td></tr>
</table>

* Ages assumed *a priori* in this work.

mainly through studies of planktonic (Caron, 1985) and benthonic foraminifera (Hamaoui, 1979a, b; Schroeder & Neumann, 1985), but only limited attempts have been made to apply these techniques to the Jordanian Upper Cretaceous (e.g. the works of Futyan, 1968 on the boundary between the Upper Cretaceous - Lower Tertiary; Basha, 1975 on the Cenomanian - Turonian rocks; Al-Harithi, 1986 on the palaeoecology of fauna from Upper Cretaceous sediments in North Jordan).

1.5 Review of the Upper Cretaceous of Jordan

The literature dealing with the geology of Jordan is extensive. In this study only the most important geologic works, with special emphasis on the Upper Cretaceous stratigraphy of the region, will be discussed.

1.5.1 Short history of work

Geological reconnaissance in the country started at the beginning of the last century with the work of geographers like Seetzen (1810). The first published map of the region is the "geognositic" map of Arabia Petrae of Russegger, a German traveler (Russegger, 1847), but Hull (1886), a British geologist, was the first to publish a geologic map of the region. This was a geologic map of Wadi Araba, which incorporated much information gathered by previous nineteenth century workers.

Blanckenhorn, the famous German geologist, was among the first to provide a comprehensive account of the geology of Jordan and Palestine. He visited the region from about 1890 to 1914, and presented his observations in several publications (Blanckenhorn, 1903, 1912, 1914 and 1937). After the construction of the Hedjaz Railroad from Damascus to Medina, via Amman, Ma'an and Al-Mudawwarah, Jordan became more accessible to geologic investigations and publications on the area increased noticeably (Musil, 1907, 1911; Krusch, 1911; Fuchs, 1916; Kober, 1919; Schwobel, 1921).

During the period of the British Mandate several studies were completed. Among these, it is worth mentioning the work of Blake, who carried out systematic surveys on mineral and ground-water resources, particularly of Cretaceous rocks (Blake, 1928, 1930, 1936, 1939; Ionides and Blake, 1939; Blake and Goldschmidt, 1947). Willis (1928) and Wellings (in Willis, 1938) investigated the evolution of the Jordan Rift. Structural phenomena were also discussed by Dubertret (1932), who published geological maps of the region (Dubertret, 1959, 1962, 1970). Important contributions to our knowledge of the geology of Jordan were also made by Picard (1928, 1931, 1941, 1943, 1953, 1965).

The modern development of geology in Jordan started with the publication of the geologic map of Transjordan by Quennell (1951, 1956). Burdon's "Handbook of the Geology of Jordan" (1959), the works of Wetzel & Morton (1959) on stratigraphic correlation based on macro- and microfossil determination, were extended by investigations carried out by the German Geological Survey of Hannover, led by Bender. The last of these studies resulted in the publication of a seminal book on the "Geology of Jordan" (Bender, 1968a), accompanied by four geological maps at a scale of 1:250,000. These maps still form an essential basis for any geological investigation in the country. During the last twenty years, the Jordanian Authority for Mineral and Water Resources (JAMWR) has published several works, with special emphasis on economic aspects of the regional geology. Some of these studies produced geologic maps on a scale of 1:25,000 (e.g. Jordan Office for Geological & Engineering Services, 1965).

Daniel (1963) divided the Jordanian sediments into three main divisions:
(1) Older Palaeozoic sediments, essentially arenaceous and predominantly of fluviatile or deltaic origin.
(2) Mesozoic-Lower Cainozoic sediments, essentially calcareous, of marine origin.
(3) Younger Neogene sediments, consisting of relatively coarse clastics, alternating with playa-type deposits in the south, and with limnic deposits in the north, occurring only in inland depressions.

According to many workers (Quennell, 1951; Wetzel & Morton, 1959; Masri, 1963; McDonald & Hunting, 1965a, b; German Geological Mission, 1961-1966; INAS, 1968-1972), the Cretaceous system of Jordan is divided into two major units:
1. Lower Sandstone "Series" (Kurnub Sandstone), mainly continental sediments of Albian and pre-Albian age;
2. Upper Calcareous "Series" (Ajlun and Belqa Groups), fossiliferous marine deposits of Cenomanian and post-Cenomanian age (Table 1.1). This classification is only applicable to central Jordan. To the northwest, sandy calcareous marine sediments of Albian age appear (Wetzel & Morton 1959), and to the southeast, deposition of mainly continental alluvial sandstones continued until the Santonian (Bender, 1968).

Other studies related to Upper Cretaceous stratigraphy, include the works of Futyan (1968a) and Parker (1969). Staff members of the Jordanian universities (e.g. Basha, 1975, 1978b, 1979, 1985; Al-Harithi, 1986a, 1986b, 1990) have also published work on the Upper Cretaceous geology of Jordan. The most significant of these are summarised in a text book on the "Geology of Jordan" published in Arabic by Abed (1982a).

1.5.2 Upper Cretaceous stratigraphy

The first major stratigraphic subdivision of the Upper Cretaceous of Jordan was given by Blanckenhorn (1914; quoted in Picard 1943), who recognised Cenomanian, Turonian and Senonian strata in the country. This author also noticed that Upper Cretaceous marine sediments overlap a sequence of continental sandstones. The sandstones were assigned to the "Nubia Sandstone" by the German geologist, on account of their resemblance to similar sequences exposed in southern Egypt and in Sinai. Later, Picard (1943) and Dubertret (1962) used the same stratigraphic subdivisions recognised by Blanckenhorn (op. cit.). Subsequently, the most important works relating to the stratigraphic subdivision of the Upper Cretaceous exposures in Jordan are those of Shaw (1947), Quennell (1951, 1959), Burdon (1959), Masri (1963), McDonald et al. (1965a, b), Bender (1974) and Basha (1975, 1979).

Quennell (1951, 1956) was the first to introduce a local lithostratigraphic subdivision for Upper Cretaceous rocks in Jordan. He designated the Lower Cretaceous sandstones, formerly referred to as "Nubia Sandstone", as the Kurnub Sandstone, to differentiate it from other similar continental sediments of older age. The marine Cretaceous was subdivided into two lithostratigraphic "Groups" as follows, from base to top:

(1) The Ajlun Group, an alternating sequence of nodular limestones and marls of Cenomanian, Turonian and Santonian age; (according to the stratigraphic scheme of Quennell (1951), the Coniacian is missing in Jordan).

(2) The Belqa Group, a sequence of limestone and chert beds, yielding in its middle part layers of phosphorite, which are sometimes exploitable, and in its upper part, sequences of chalks, marls and locally massive crystalline limestones. This group ranges in age from Campanian to Danian (early Paleocene).

In 1959, Burdon used the same major lithostratigraphic units of Quennell (1951), but introduced more detailed subdivisions. The former author noticed that the Upper Cretaceous succession consists of alternating sequences of massive calcareous lithologies and softer marly beds. The hard calcareous sequences constitute good aquifers (they are often highly cracked and strongly subjected to dissolution), while the predominantly marly sequences, constitute good soils for agriculture. The Ajlun Group was subdivided into 7 units designated, A1 to A7 (A1 and A2 being massive limestones, A3 marly rocks, A4 massive limestones, A5 and A6 marly sequences and A7 a massive limestone). The Belqa Group of Quennell (1951) was subdivided by Burdon (1959) into three units: B1 is a chalky unit; B2 is a silicified limestone unit with chert bands and phosphatic beds; B3 is a sequence of chalks and marls (Table 1.1).

Masri (1962) assigned a formal lithostratigraphic nomenclature to the subdivisions of Burdon (1959) by choosing a type section for each unit. Most subdivisions of Burdon were considered as formations. Masri (1963) divided the Cenomanian (Table 1.1) into four main formations as follows (from bottom to top):

(1) Na'ur Formation, which is mainly dolomitic; the facies become more sandy towards the bottom and more marly towards the top;

(2) Fuheis Formation, consists of marly limestones with some clay intercalations;

(3) Hummar Formation, characterised by soft to medium-indurated limestones with marly intercalations;

(4) Lower Shueib Formation, consisting mainly of thin-bedded marly limestones and marls, with some thin beds of clay, dolostone and dolomitic limestone. In these Cenomanian formations, rapid facies changes are observed all over the country. INAS (1968-1972) accepted Masri's stratigraphy but applied some minor alterations to the lower part. The same scheme has been adopted in this work.

Koch (1968) carried out a micropalaeontological analysis of Cenomanian and Turonian strata in Jordan from six sections, and recorded the following foraminiferal species:

(1) *Marssonella trochus, Flabellamina omarai* KOCH, 1968, *Nezzazata* sp., *Praealveolina cretacea, Cisalveolina fallax, Maendropsina* sp., *Taberina* sp. and *Edomia* sp. from Cenomanian strata.

(2) *Gabonita levis* (KLAZ, MARIE & RERAT, 1961), *Heterohelix* sp., *Neobulimina* sp. and *Praebulimina* sp. from Turonian strata.

Bender (1974), in his account on the results of the work of the German geological mission in Jordan, did not mention the subdivisions of Masri or Burdon. The German author introduced his own subdivisions (Table 1.1), namely (older to younger):

(1) Nodular limestones of Cenomanian age;
(2) Echinoid limestones of late Cenomanian and Turonian age;
(3) Massive limestones of Turonian and Santonian age;
(4) Silicified limestones of Campanian age;
(5) Phosphorite unit of Campanian-Maastrichtian age;
(6) Chalk-marl unit of Maastrichtian to Danian age.

Bender (1974) based his age determinations largely on the work of previous authors, such as Blanckenhorn (1914) and Wetzel and Morton (1959), but the German team also collected their own fossil material, which was submitted to various German palaeontologists for identification. A chronostratigraphic framework was developed from the biostratigraphic work of Koch (1968), based on foraminifera.

For mapping purposes, Jordanian geologists generally follow the lithostratigraphic subdivisions (Table 1.1) of Masri (1963): Na'ur Formation (uppermost Lower Cenomanian); Fuheis Formation (Upper Cenomanian); Hummar Formation (? Lower Turonian); Shueib Formation (Middle Turonian); Wadi Sir Formation (Middle Turonian); Ghudran Formation (Upper Coniacian); Amman Formation (Upper Campanian). This lithostratigraphic nomenclature is adopted in the present work, but a revised and much refined biostratigraphic framework has been established.

The above sequence includes four sedimentary cycles separated by gaps representing either falls of sea level and/or phases of tectonic activity. Differences in the lithostratigraphic schemes is due in-part to facies changes, since the sequence is marine in the north-west, but becomes increasingly continental towards the south and south-east, a reflection of the palaeogeography of the Arabo-Nubian margin during the Late Cretaceous. The facies pattern is further complicated by variations in thickness caused by differing rates of uplift and subsidence during deposition.

1.6 Upper Cretaceous of Palestine and Sinai

A huge amount of work has been published since the end of the last century on the Upper Cretaceous stratigraphy of Palestine (Israel) and Sinai (Table 1.3). In these areas, different lithostratigraphic schemes have been adopted. It is outside the scope of this thesis to discuss this literature in detail, but a regional comparison will be undertaken during the later stages of the work. The stratigraphy of the Upper Cretaceous of Palestine (Table 1.2) has been summarised by Bartov & Steinitz (1977), and that of Sinai by Cherif et al. (1989).

Table 1.2 Suggested relations between the stratigraphic subdivisions of the Upper Cretaceous for Sinai, Palestine and Jordan.

<table>
<tr><th colspan="2">GEOLOGIC AGE</th><th colspan="2">SINAI (Central) *</th><th colspan="2">PALESTINE (Southern & Central) **</th><th colspan="2">JORDAN (This work)</th></tr>
<tr><td rowspan="12">UPPER CRETACEOUS</td><td>Maastrichtian</td><td colspan="2">Sudr Chalk Formation</td><td colspan="2">Ghareb Formation</td><td rowspan="2">Amman Formation</td><td>Phosphatic Silicified Limestone Member</td></tr>
<tr><td>Campanian</td><td rowspan="3">Matulla Group</td><td>Duwi Formation</td><td rowspan="2">Sayarim Formation</td><td>Mishash Member</td><td>Silicified Limestone Member</td></tr>
<tr><td>Santonian</td><td>Qosseir Shale Formation</td><td>Menuha Member</td><td colspan="2" rowspan="2">Ghudran Formation</td></tr>
<tr><td>Coniacian</td><td>Taref Sandstone Fm.</td><td colspan="2">Zihor Formation</td></tr>
<tr><td rowspan="2">Turonian</td><td colspan="2">Wata Formation</td><td colspan="2">Gerofit Formation</td><td colspan="2" rowspan="2">Wadi Sir Formation</td></tr>
<tr><td colspan="2">Abu Qada Formation</td><td colspan="2">Ora Shale Formation</td></tr>
<tr><td rowspan="6">Cenomanian</td><td rowspan="6">Raha Formation</td><td rowspan="3">Ekma Member</td><td rowspan="6">Hazera Formation</td><td rowspan="3">Yotava Member</td><td rowspan="2">Shueib Formation</td><td>Upper Calcareous Mb.</td></tr>
<tr><td>Lower Marly Member</td></tr>
<tr><td colspan="2">Hummar Formation</td></tr>
<tr><td>Mukattab Member</td><td>Zafit Member</td><td colspan="2">Fuheis Formation</td></tr>
<tr><td rowspan="2">Abu Had Member</td><td>En Yorqeam Member</td><td rowspan="2">Na'ur Formation</td><td>Upper Calcareous Member</td></tr>
<tr><td>Hevyon Member</td><td>Lower Marly Member</td></tr>
<tr><td colspan="2">LOWER CRETACEOUS</td><td colspan="2">Malha Formation</td><td colspan="2">Hathira Formation</td><td colspan="2">Subeihi Formation</td></tr>
</table>

* Cherif et al. (1989, 1990), ** Bartov & Steinitz (1977).

Fm. = Formation; Mb. = Member.

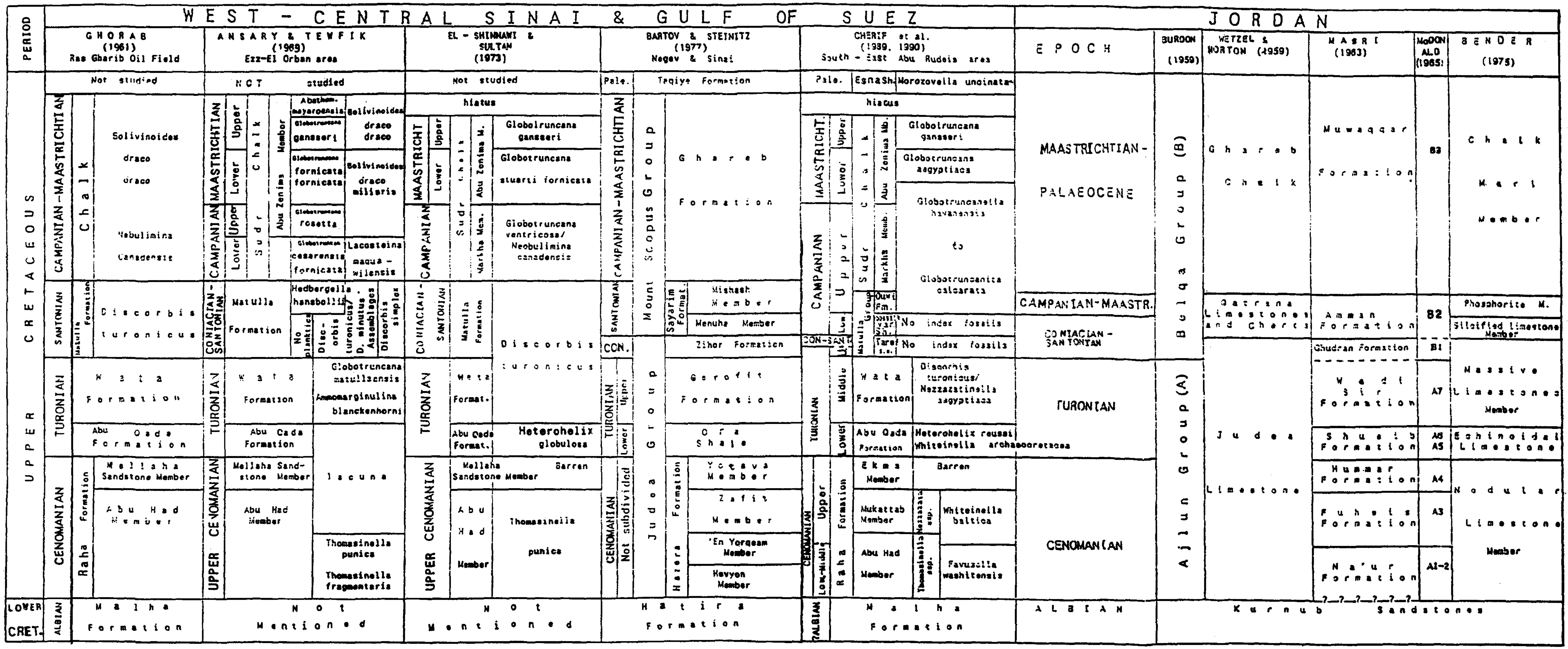

Table 1.3 Stratigraphic schemes composed for the Upper Cretaceous of West-Central Sinai, southern Gulf of Suez and Jordan.

CHAPTER 2

AIMS, OBJECTIVES AND METHODOLOGY

2.1 Aims and objectives

The present study has utilised recent advances in foraminiferal biostratigraphy to subdivide, date and correlate representative Upper Cretaceous sections from northern, central and southern Jordan. The initial aims of the investigation were to document the foraminiferal assemblages, to produce a coherent integrated stratigraphic scheme for the Upper Cretaceous of West Jordan, and to correlate these sequences with their lateral equivalents to the north and south of the country. Sedimentological, palaeoecological and biostratigraphic data have been combined to study the environmental factors affecting the distribution of key foraminiferal taxa. A better understanding of these factors has provided new criteria for the recognition of biostratigraphically and environmentally significant marker species.

It is beleived that the present research forms a basis for correlations that may take place in the future between the Upper Cretaceous of Jordan and successions elsewhere in the Middle East. This work may enable the development of regional palaeogeographic and tectonic models which may be used to describe the geological history of the area and place the Jordanian sequences in a regional context. These new models may fundamentally improve our understanding of the Middle East geology and will prove useful for current and future petroleum and other mineral exploration programmes.

2.2 Methodology

2.2.1 Field Work

To present a clear picture of the vertical and lateral stratigraphic changes which occur in the area, the following investigations have been undertaken:

(1) Four stratigraphic sections representing the entire marine Upper Cretaceous sequence exposed in the area, were measured, described and sampled:

- (i) Ajlun/Jerash, 404 m logged, 62 samples
- (ii) Wadi Mujib, 741 m logged, 114 samples
- (iii) Wadi Mussa, 218 m logged, 62 samples
- (iv) Ras en-Naqb, 190 m logged, 47 samples

These sections demonstrate the main lithostratigraphic sequences, and detailed study of their foraminiferal contents has facilitated the interpretation of their depositional environments. To obtain a complete succession, it was necessary to collect samples from as number of different localities and produce a composite section for each area.

Table 2.1 List of the rock samples collected from the four measured sections, located with respect to their relative rock formations, thicknesses, ages and distances.

Stage	Formation	Ajlun/Jerash (J) > 404.0 m	Wadi Mujib (M) > 741.0 m	Wadi Mussa (P) >218.0 m	Ras en-Naqb (Q) >190.0 m
U. Camp.- Lower Maastricht.	Amman B2	Not studied	M75-M110 & M 48 >180.5 m	P57 - P62 >54.0 m	Q45 - Q47 >5.0 m
U. Coniac. - Santonian	Ghudran B1	Not studied	M47 & M70 - M74 > 24.0 m	P53 - P56 12.0 m	Q40 - Q44 9.5 m
Turonian	Wadi Sir A7	J57 - J60 & J54, J55 > 45.0 m	M62 - M69 128.0 m	P45 - P52 30.5 m	Q32 - Q39 54.5 m
Upper Cenom- anian	Shueib A5 & A6	J56, J44 - J53 50.0 m	M49 - M61 M33 - M46 104.0 m	P36 - P44 21.5 m	Q26 - Q31 29.0 m
	Hummar A4	J25 - J39 J42, J13, J14 35.0 m	Absent	Absent	Absent
Lower - Middle Cenom- anian	Fuheis A3	J15 - J24 & J 41 69.0 m	M20 - M32 124.5 m	P31 - P35 32.0 m	Q 25 1.0 m
	Na'ur A1 & A2	J43 & J40 J3 - J12 175.0 m	M5 - M19 109.5 m	P1 - P30 68.0 m	Q3 - Q24 69.5 m
? Albian	Kurnub K2	J1 & J2 > 30.0 m	M1 - M4 >70.5 m	Not studied	Q1 & Q2 >22.0 m

Distances between sections ------------→ **100** km **125** km **34** km

Camp. = Campanian; Coniac. = Coniacian; Maastricht. = Maastrichtian; U. = Upper.

Four detailed geological maps were constructed by the author using a combination of published data, aerial photographs and field evidence.

(2) All samples (285) collected from the measured sections were prepared by routine micropalaeontological methods; 123 indurated samples were thin sectioned for microfacies examination.

(3) The foraminiferal fauna (comprising more than 80,000 specimens) was picked and identified, and representative specimens were photographed using a scanning electron microscope. A total of 421 species, comprising 170 genera have been identified, and over 1500 SEM photomicrographs have been taken.

(4) The taxonomy of the identified fossils has been studied, and the geographic and stratigraphic distribution of all species has been documented.

(5) Four range charts for the identified foraminiferal species have been constructed to establish biostratigraphic units.

(6) The biostratigraphy has been used to subdivide and correlate the studied sequences with coeval sediments elsewhere.

(7) It is hoped that the litho- and biostratigraphic results obtained in this study from Jordan may be integrated with published data from elsewhere in the Middle East to develop an improved regional model for the geological development of the area during the Late Cretaceous.

2.2.2 Laboratory Work

The 285 rock samples (500 g) collected were processed in the laboratory for routine micropalaeontological investigation and thin-section microfacies analysis.

2.2.2.1 Disintegration of samples for micropalaeontological examination

To ensure optimum disintegration of samples for the extraction of calcareous microfossils, each sample was subjected to several consecutive procedures, as follows:

(1) Indurated or moderately cemented samples were crushed to about 2 - 4 mm fragments; soft samples of 150 gram were left uncrushed.

(2) Samples were placed in a 400-ml beaker and immersed in 50 ml of dilute acetic acid (0.5 % v/v) and left overnight, to ensure disintegration (method of Ingram and Galehouse, 1971).

(3) If a sample was not adequately disintegrated, it was then immersed in 50 ml H_2O_2 solution (10 % v/v), left overnight, and then boiled to remove excess H_2O_2.

(4) Still indurated and insufficiently disintegrated samples were dried and heated to about 60° C, immersed in kerosene, covered by a layer of water and left overnight.

(5) The kerosene was removed from the samples by placing each material in a 200 mesh sieve, and washing with a moderate current of tap water with some drops of liquid soap; the samples were then boiled for one hour in a 20 gm of Na_2CO_3 solution until they became reasonably disintegrated (samples not treated with kerosene were boiled in 20 gm of Na_2CO_3 solution after performing step 3).

(6) Lastly, if a sample was insufficiently disintegrated, it was poured into water and frozen overnight and then washed again (over the above mentioned 200 mesh sieve).

Loose samples were simply washed over the 200 mesh sieve, under a moderate current of tap water, without being subjected to any of the previously discussed treatments.

After completing procedures 2, 4 and 5, the samples were usually washed over the 200 mesh sieve. The residue was dried in an oven at 100° C and then the fauna was picked and mounted.

2.2.2.2 Preparation of thin sections

Thin sections were prepared according to the method of Ireland (In: Carver, 1971) using a Micro-Trim thin-section machine. Chipped rock hard-samples were mounted on 25 x 76 mm glass-slides using Lakeside 70 cement. Particularly friable samples were not thin sectioned.

Two hundred and fourteen thin sections were prepared from samples collected from the four sections.

2.2.3 Examination of Other Material

The author, through personal contacts, has examined the Upper Cretaceous collections of planktonic and benthic foraminifera of Cherif (1989), Ismail (1989) and Akarish (1990) from Egypt, and Al-Bakri (1990) from Jordan, and the different or corresponding species compared where possible. In addition to this, there has been personal discussion and examination of most of the foraminiferal fauna with the following individuals: Prof. Cherif from Egypt, Dr. Al-Rifaiy from Kuwait, Prof. Flexer from Israel, Prof. Moody and Dr. Radford from Kingston University, Mr. Sandman from England, and Prof. Basha and Dr. Al-Harithi from Jordan.

CHAPTER 3

SECTION DESCRIPTIONS AND LITHOSTRATIGRAPHY

3.1 Introduction

This chapter deals with the description of the stratigraphic sections measured and sampled for this project. These sections constitute the entire Upper Cretaceous successions exposed at four locations (Fig. 1.1) representing a North - South transect across West Jordan. To obtain a complete succession, each section was measured at several different localities. The locations of the measured sections were determined after taking into consideration the geological structure of each study area. This was essential in order to have a reasonable coverage of the stratigraphic succession.

The following descriptions of the four measured sections include the macroscopic and lithological characters of the beds as observed in the field, the microscopic features of the rocks in thin sections, and a complete list of foraminifera found in the samples obtained from each bed. Taxonomic details of these are presented in Chapter 4. Data provided for each group of beds include bed numbers, rock-sample numbers, bed thicknesses and cumulative thicknesses of the sequences in metres. Illustrations include maps, field and thin-section photographs, with white scale-bars on figures representing 500 μm.

3.2 Ajlun / Jerash

This section was measured during June - July, 1988. It starts in a track on the right side of the road from Amman to Jerash, crossing through the Zarqa river (Fig. 1.1). This study involved the field description and logging of the sequence, and the microfacies and micropalaeontological analysis of 62 samples (S1-S4, Fig. 3.1). The succession (404 m) is described from base to top, as follows:

3.2.1 Subeihi (Kurnub) Formation "K2"

The Kurnub Formation was originally defined by Quennell (1951) for the rock units, East of Jordan River, that resemble the Wadi Hathira Sandstone south-west of the Dead Sea (Shaw, 1947). The Kurnub Formation rests unconformably on the Basal Conglomerate, which forms the base for the known Kurnub Sandstone. It was easily recognised in the four studied sections, and sampled at three locations (excluding Wadi Mussa). It consists mainly of friable, variegated sandstones. As the formation lies between the Jurassic and Cenomanian, it is believed to be ?Lower Cretaceous.

(1) White sandstone, cross-bedded. Near the top, intercalated by glauconitic sandstone and limestone beds (75 cm each).
Sample J1: white sandstone. Well-sorted submature fine-medium quartz arenite with a patchy argillaceous matrix, grains are about 90 %, matrix = 10 %, grains are angular to subrounded, all quartz, well packed with some sutured contacts (Fig. 3.2).

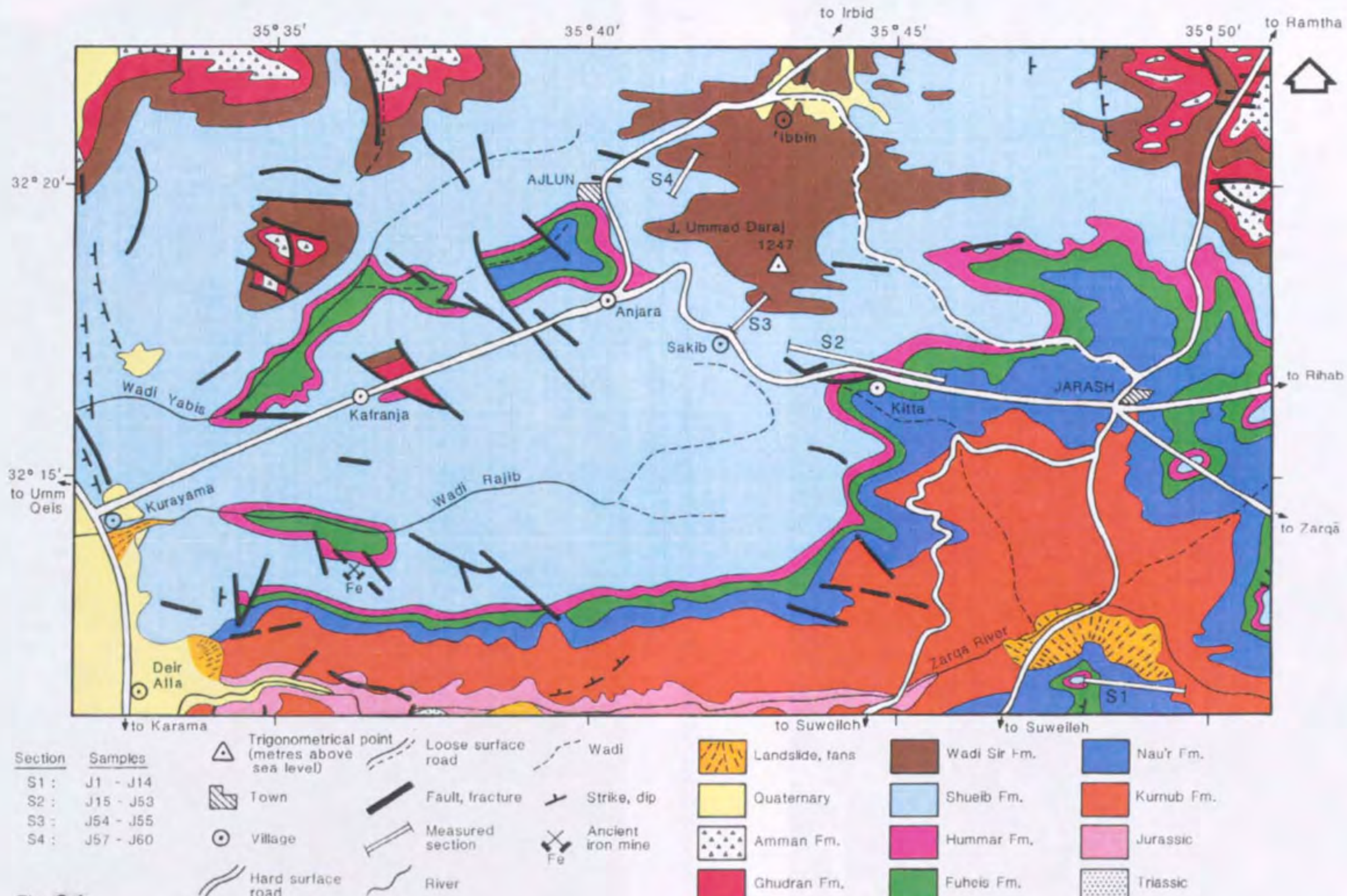

Fig. 3.1
Geological map of Ajlun / Jarash area
(modified from Geological map of Jordan, sheet Amman, 1 : 250 000, 1968a)

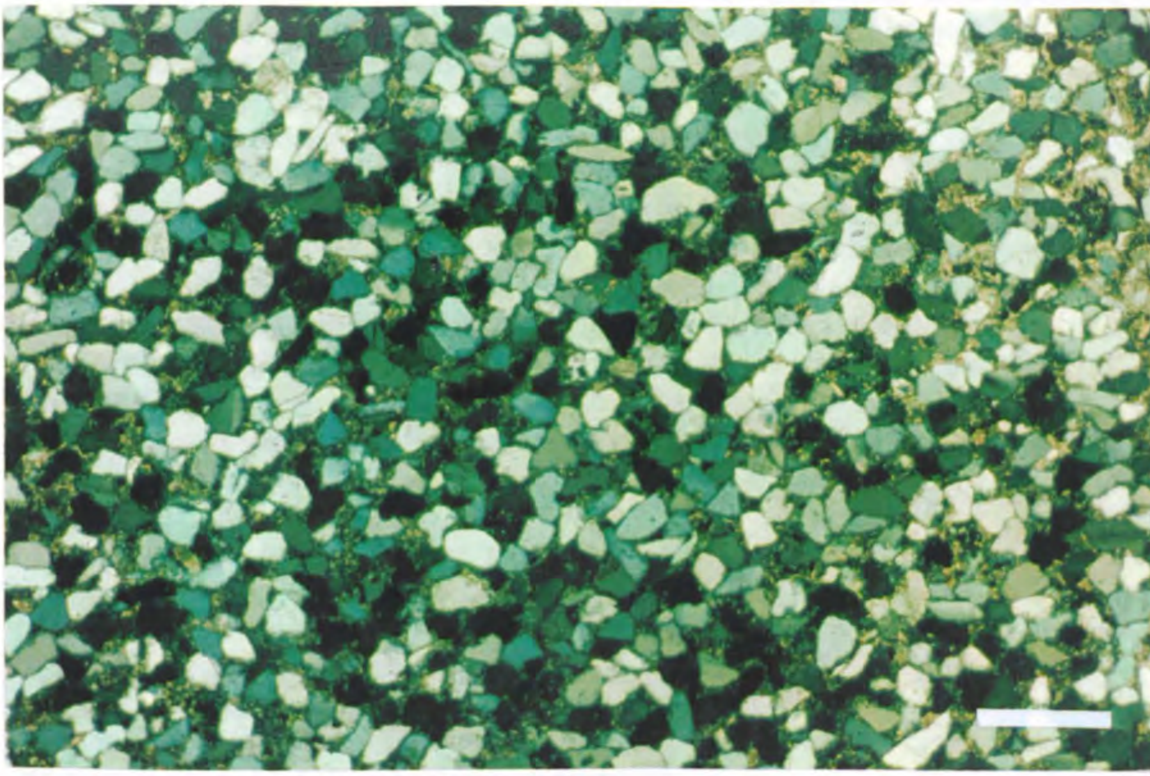

Fig. 3.2 Well-sorted submature fine-medium quartz arenite with a patchy argillaceous matrix. Sample J1, Kurnub Formation "K2", Ajlun-Jerash (XPL, X 35).

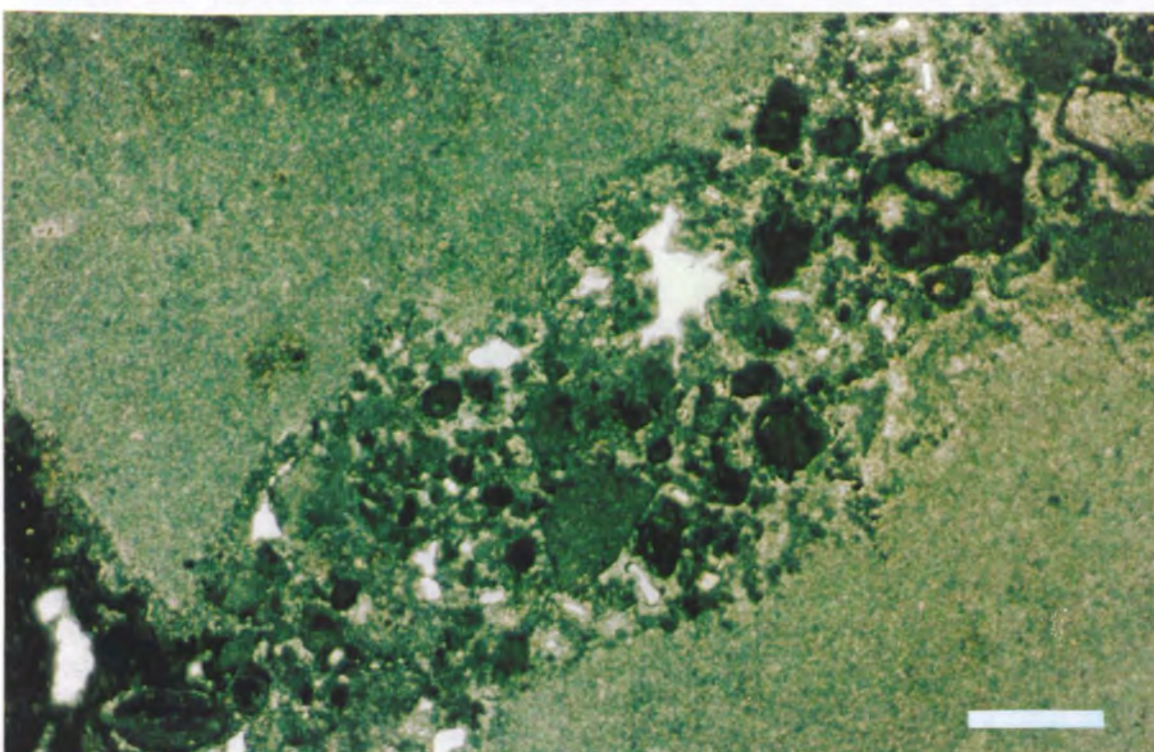

Fig. 3.3 Neomorphosed mudstone, peloids and coated grains occur in a fracture fill. Sample J6, Upper Calcareous Member "A2", Na'ur Formation, Ajlun-Jerash (XPL, X 35).

Sample J2: glauconitic sandstone. A bioclastic wackestone, partially neomorphosed, rare miliolids, algae or bryozoans and arenaceous foraminifera. The matrix may be peloidal; there are also large microfractures.

3.2.2 Na'ur Formation "A1-A2"

This formation was originally defined by Masri (1963) for the rock units outcropping at Na'ur area, 13 km south-west of Amman. It can be recognised easily in the field at Ajlun/Jerash, Wadi Mujib, Wadi Mussa and Ras en-Naqb by the end of the variegated sandstone of Subeihi Formation and, at its top, by the beginning of the marly sequence of the Fuheis Formation. The Na'ur Formation is impermeable and generally constitutes the agricultural lands. It consists of a sequence of nodular limestones intercalated with beds of marls, which are thicker and more frequent in the lower part. The formation is subdivided into two members:

3.2.2.1 Lower Marly Member "A1"

This member is equivalent to unit "A1" of Burdon (1959). It consists of marl at Ajlun/Jerash and a sequence of alternating limestone and shale, with massive dolomitic limestones and burrows at the base at Wadi Mujib. At Wadi Mussa it consists of thinly bedded marly limestone, while at Ras en-Naqb the facies changes to a sequence of sandy shale and calcareous sandstone.

(2) Soft, yellowish marl exposed in a road-cut by the side of a track crossing a slope covered by regolith and soil. Thickness of unit = 21 m; cumulative thickness = 51 m.
Sample J3: yellowish marl; microcrystalline dolostone with some hydrocarbon staining. This bed yielded: *Thomasinella aegyptia* and *T. fragmentaria,* associated with ornamented ostracods, echinoid spines, molluscs and vertebrate remains.

3.2.2.2 Upper Calcareous Member "A2"

This member is equivalent to unit "A2" of Burdon (1959). It consists of a sequence of thick grey nodular dolomitic limestone beds intercalated with thinner marls and marly limestone beds at Jerash/Ajlun. At Wadi Mujib, this member consists of nodular limestone with marly bands, at Wadi Mussa it consists of nodular limestone and at Ras en-Naqb it consists of massive nodular limestone. The marly beds in this member do not exceed by far 5 m in thickness, while each limestone bed may reach more than 30 m in thickness. The limestones often yield macrofossils such as oysters and large gastropods.

(3) Indurated nodular dolomitic limestone, grey, crystalline and yielding common macrofossils. This unit, outcropping on a slope, is followed by a sequence of indurated nodular limestones intercalated by softer marly beds. The only beds sampled were the nodular limestones, as the marly intervals were always covered by regolith and soil. The indurated outcrops are often covered by caliche-like pavement. The whole succession is characterised by the presence of widely-spaced indurated, limestone ledges. Thickness of unit = 93 m; cumulative thickness = 144 m.
Sample J4: dolomitic sandstone at the base of the succession, about 1 m thick. Phosphatic sandstone, angular to subangular grains, well - moderately sorted,

glauconite grains = 15 %, the rock is moderately well-sorted, the matrix is argillaceous, possibly carbonaceous.
Sample J5: soft caliche. An altered bioclastic claystone, associated with echinoid spines, and vertebrate remains.
Sample J6: indurated caliche. Neomorphosed mudstone with peloids and coated grains occurring in fracture fills (Fig. 3.3).
Sample J7: dolomitic limestone, at 37 m above the base of the sequence. Bioclastic wackestone with abundant bivalve, echinoid and ostracod bioclasts, mud matrix, spar replacement of the bivalves. Bivalves = 40 %, echinoid = 15%, ostracod and debris = 20 %, foraminifera and algae = 25 %. Stylolites and possible hydrocarbons along healed microfractures.
Sample J8: silicified dolostone within nodular limestone, 52 m above J7. Microcrystalline dolostone, euhedral to anhedral rhombs, interlocked to give an even texture.
Sample J8a: nodular limestone. Neomorphosed bioclastic peloidal wackestone - packstone with scattered silt-sized quartz grains. The matrix is altered to microspar and pseudospar (Fig. 3.4).
Sample J9: limestone 1.5 m above J8 and 2 m below the top of bed 3. Bioclastic wackestone-packstone, with bivalve oysters, possible rudists and gastropod bioclasts = 80 %. Some porosity solution enhanced, and selective replacement of some bioclasts with chalcedonic silica (Fig. 3.5).

(4) Sequence of limestone and marly limestone beds, mostly covered by caliche. The limestone beds are approximately 30 cm thick, while the marly beds are thinner. Thickness of unit = 56 m; cumulative thickness = 200 m.
Sample J10: microcrystalline dolostone from the base of the succession. This bed is quite poor in foraminiferal content and yielded only *Ammobaculites agglutinans.*
Sample J11: dolomitic nodular limestone with oysters and chert nodules, 24 m above the base of the succession. A ferruginous bioclastic wackestone with dissolution vugs and extensive chalcedonic silica replacement of bivalve clasts. Iron replaces the abundant benthic foraminifera (Fig. 3.6).
Sample J12: marly limestone, taken across a track on the hill, 32 m above **J11.** Bioclastic wackestone with abundant bivalves, rare - common coiled arenaceous foraminifera and some silica replacement of bivalve debris.

(5) Indurated limestone band, 5 m thick, constituting the top of the Na'ur Formation, just below the marls of the Fuheis Formation on the road from Jerash to Ajlun. Thickness of unit = 5 m; cumulative thickness = 205 m.
Sample J43: bioclastic foraminiferal wackestone - packstone with abundant echinoid fragments, bivalve debris and benthic foraminifera (?orbitoid); neomorphosed matrix.
Sample J40: indurated grey dolomitic limestone bed, base covered (taken on the asphalt road, few km before Jerash). Quartz silt-rich mudstone - wackestone with ostracod debris. This bed yielded: *Ammobaculites turonicus, Charentia cuvillieri, Planispirinella barnardia* and *Psammonyx* sp. 1, associated with ostracods, echinoid spines and vertebrate remains.

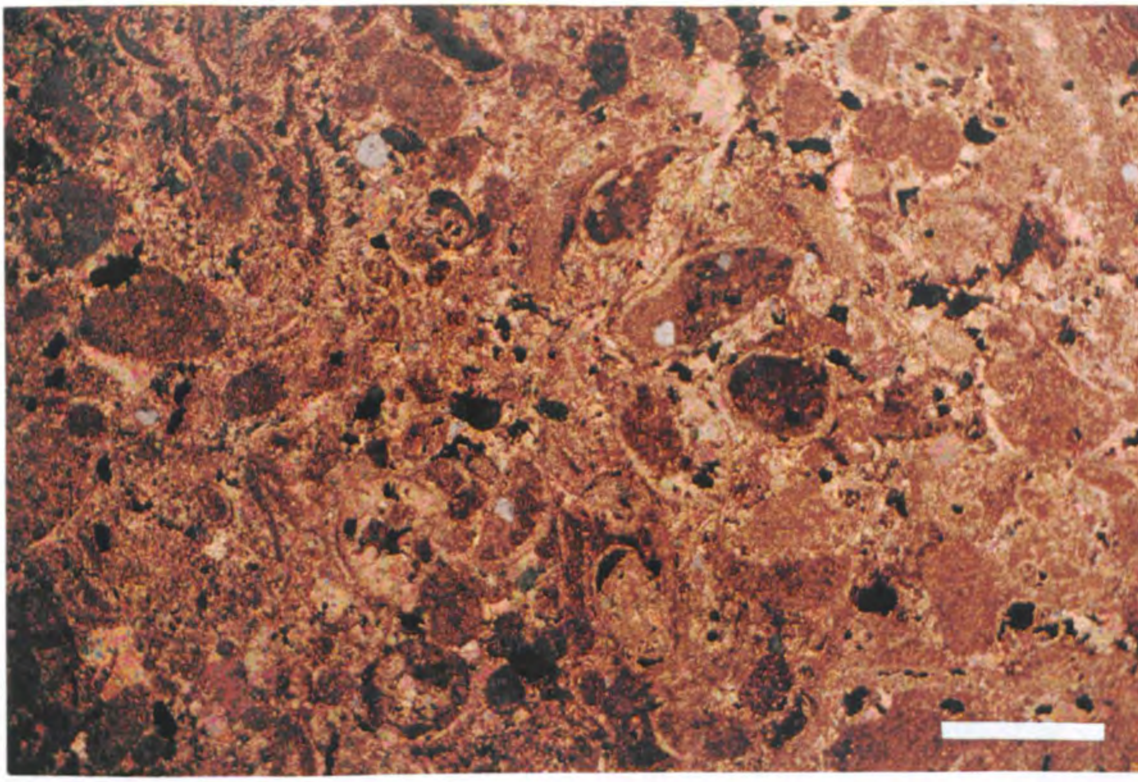

Fig. 3.4 Bioclastic peloidal packstone with scattered silt-size quartz grains. The matrix is altered to microspar and pseudospar. Sample J8a, Upper Calcareous Member "A2", Na'ur Formation, Ajlun-Jerash (XPL, X 43).

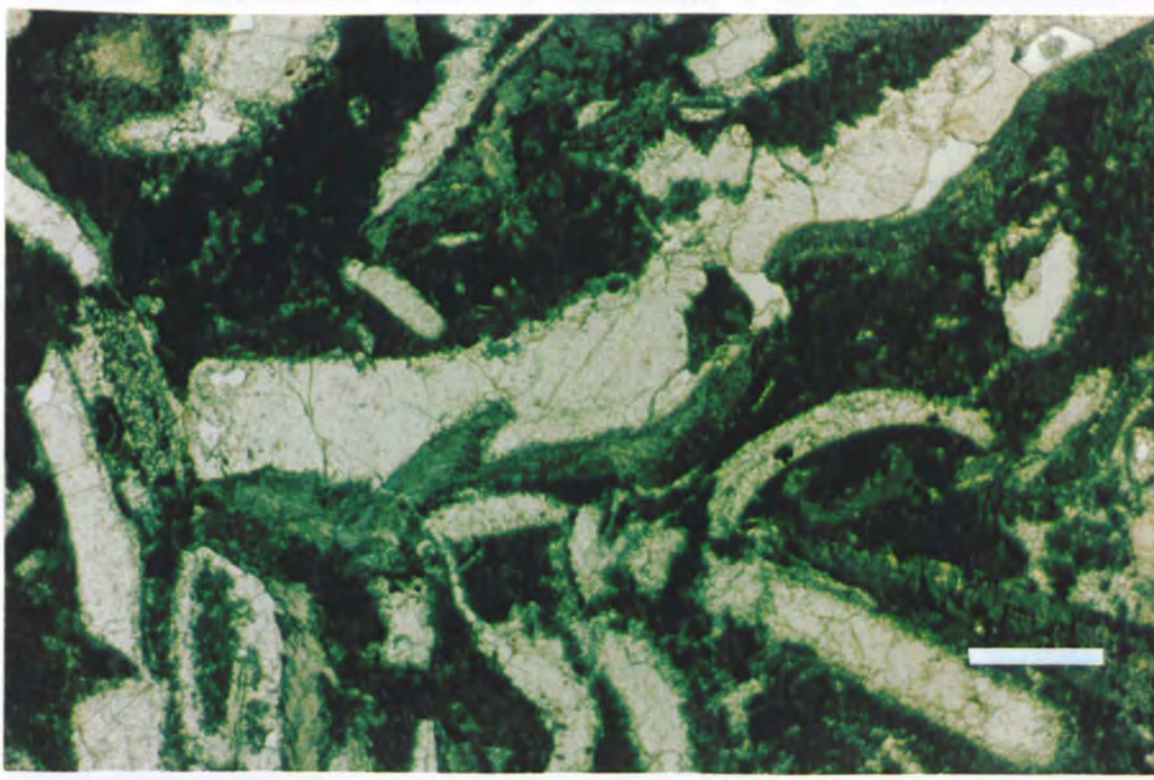

Fig. 3.5 Bioclastic packstone with abundant bivalve and gastropod bioclasts. Sample J9, Upper Calcareous Member "A2", Na'ur Formation, Ajlun-Jerash (PPL, X 35).

3.2.3 Fuheis Formation "A3"

This formation was defined by Masri (1963) for the rock units outcropping at Fuheis, NW of Amman. The formation is equivalent to unit "A3" of Burdon (1959). The Fuheis Formation is recognised at Ajlun/Jerash, Wadi Mujib, Wadi Mussa and Ras en-Naqb. It consists mainly of a sequence of light-coloured brownish marly beds, often showing a blocky fracturing giving the rock a brick-wall-like appearance, with a few thin marly limestone beds and oyster banks in which gastropods are also found. The formation is impermeable and its outcrop constitutes much of the agricultural lands at Ajlun in the north and Wadi Mujib in the centre. Although it is easy to recognise this formation at Ajlun/Jerash, it is difficult to differentiate it from the overlying Shueib Formation in other sections. However, in this study the criteria used to differentiate between the Fuheis Formation and the overlying Shueib Formation at Wadi Mujib is the lithofacies change from intercalated marly limestones and shales to intercalated nodular limestones and shales. At Wadi Mussa the lithofacies changes from marly, sandy and nodular limestone to silicified dolomitic limestone, while at Ras en-Naqb the facies changes from marly limestone to sandy dolomitic limestone.

(6) Sequence of thick marl and marly limestone beds, intercalated by thin indurated limestone ledges. The beds exhibit columnar jointing perpendicular to bedding planes, producing a characteristic brick-like pattern. The limestone and marl beds are about 0.5 m thick each. Thickness of unit = 21 m; cumulative thickness = 226 m.

Sample J41: clay, base of Fuheis Formation. This bed yielded: *Ammoastuta nigeriana, Ammobaculites advenus, A. agglutinans, A.* sp. 2, *Ammomarginulina blanckenhorni, A. cragini, Eoguttulina anglica, Evolutinella subevoluta, Globulina* sp. 1, *Guttulina cuspidata, Haplophragmoides famosus, H. fraseri, H. rugosa, Hemicyclammina sigali, Kutsevella labythnangensis, Placopsilina cenomana, Polymorphina zeuschneri, Scherochorella minuta, Triplasia goodlandensis, Trochammina afikpensis, T. boehmi* and *T. rummanensis*, associated with ostracods and vertebrate remains.

Sample J15: marlstone near base of the Fuheis Formation. Microcrystalline dolostone replacive of a dolomitic claystone; euhedral and anhedral dolomite rhombs, common to abundant filaments which are slightly silicified, may be of algal origin. This bed yielded: *Ammobaculites fragmentarius, A. pagodensis, A. turonicus, Ammomarginulina aburoashensis, Ammosiphonia* sp., *Ammotium hasaense, Charentia evoluta, Haplophragmoides excavatus* and *Ismailia neumannae.*

Sample J16: marlstone about 1 m above J15.

Sample J17: marlstone about 1 m above J16. Neomorphosed mudstone with 20 % micro-vuggy porosity in a pseudospar texture. This bed yielded: *Adelungia* sp. 1, *Ammobaculites fragmentarius, A. naqbensis, A.* sp. 2, *A. subcretaceus, Ammomarginulina naqbensis, Astacolus liebusi, Bulbophragmium aequale, Charentia hasaensis, Evolutinella subevoluta, Haplophragmoides kirki, Hemicyclammina evoluta, Lituola nautiloidea, L.* sp. 1, *Placopsilina cenomana, Planispirinella barnardia* and *Psammonyx* sp. 1, associated with gastropods and vertebrate remains.

Sample J18: marl. This bed is quite poor in foraminiferal content and yielded only *Ammobaculites stephensoni*, associated with ostracods and vertebrate remains.

Sample J19: microcrystalline limestone.

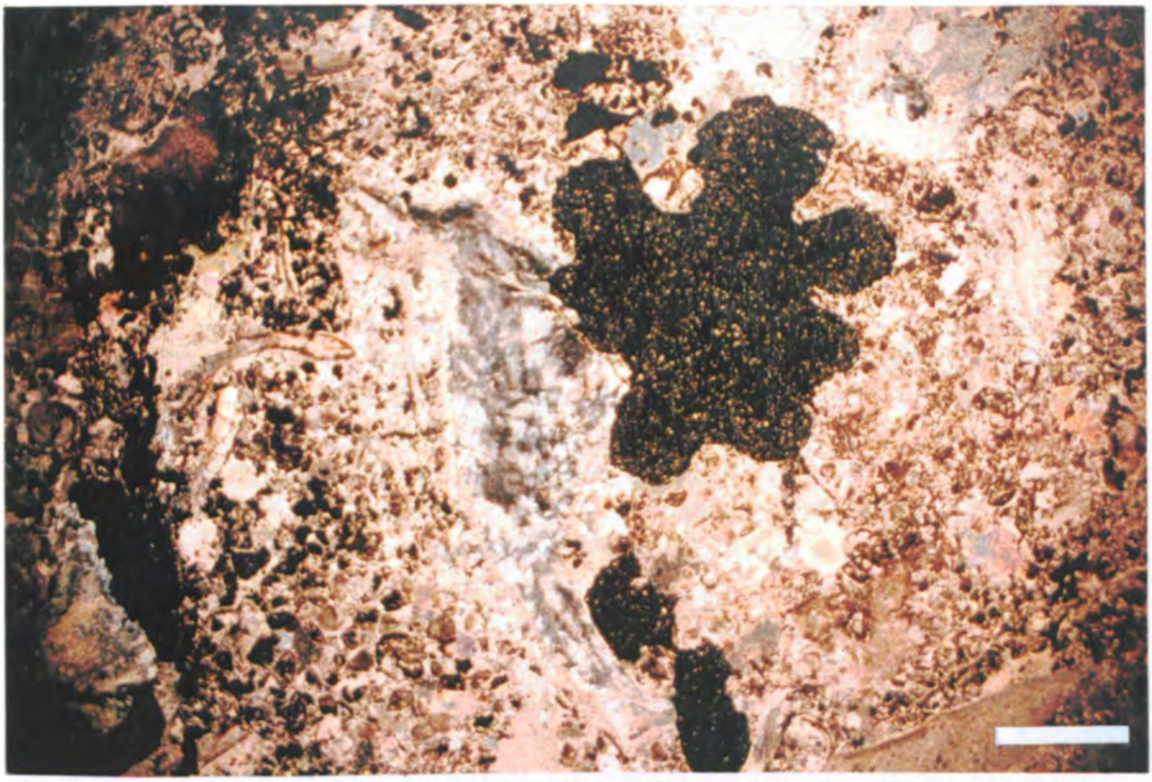

Fig. 3.6 Ferruginous bioclastic wackestone with dissolution vugs and chalcedonic silica replacement of bivalve bioclasts. Sample J11, Upper Calcareous Member "A2", Na'ur Formation, Ajlun-Jerash (XPL, X 35).

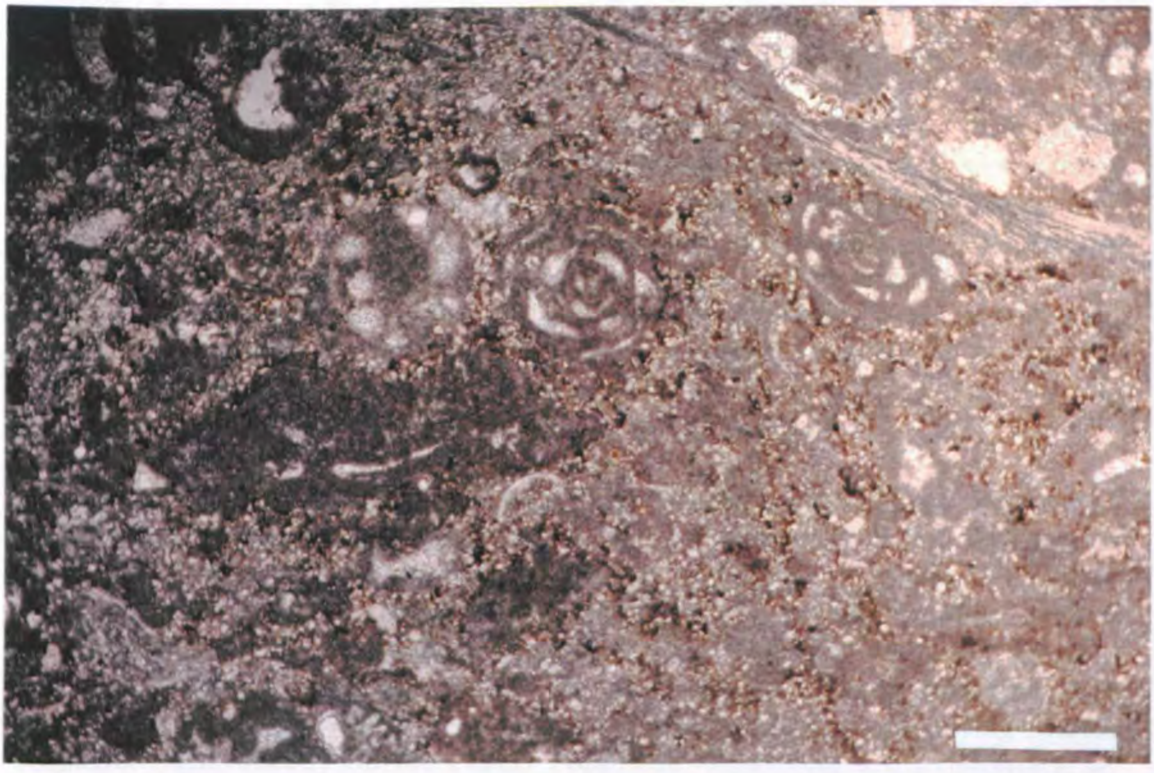

Fig. 3.7 Neomorphosed dolomitic miliolid wackestone with peloids and bivalve fragments. Sample J31, Hummar Formation "A4", Ajlun-Jerash (PPL, X 43).

(7) Marly sequence, covered by agricultural land (not sampled). Thickness of unit = 48 m; cumulative thickness = 274 m. A second road-cut, located further toward Ajlun, was sampled near a locality called El-Kitta (S2, Fig. 3.1):

Sample J20: marl.

Sample J21: marl.

Sample J22: marl and dolomitic limestone. Microcrystalline dolostone, occurs in a neomorphosed mudstone. This bed yielded: *Cibicides beadnelli* and *Gavelinella intermedia*, associated with smooth ostracods and vertebrate remains.

Sample J23: fissile, grey shale bed. Neomorphosed mudstone - wackestone with silica replacement of bivalve clasts. This bed is quite poor in foraminiferal content and yielded only *Scherochorella minuta*, associated with bivalves and vertebrate remains. Further towards Ajlun (S3, Fig. 3.1), samples taken are:

Sample J24: shale, associated with light greenish pellets.

Sample J25: limestone with *Pecten* and ammonites. Neomorphosed bioclastic wackestone with fine ostracod and echinoid debris. This bed yielded: *Ammobaculites agglutinans, Ammodiscoides turbinatus, Ammodiscus cretaceus, Arenobulimina chapmani, Charentia cuvillieri, C. rummanensis, Conorboides beadnelli, Dentalina* sp. 1, *Eponides* cf. *plummerae, Flabellammina elongata, Gavelinella baltica, G. semipustulosa, Gavelinopsis tourainensis, Guttulina symploca, Haplophragmoides neolinki, Hedbergella delrioensis, H. simplex, Hemicyclammina evoluta, Ismailia neumannae, Kutsevella labythnangensis, Laevidentalina gracilis, Lituola nautiloidea, Mucronina* sp., *Neodiscorbinella* sp. 1, *Nezzazata convexa, N. simplex, Polychasmina pawpawensis, Polymorphina zeuschneri, Poroeponides praeceps, Pseudopolymorphina eichenbergi, P.* sp. 1, *Quadrimorphina camerata, Ramulina globulifera, Reophax* cf. *nodulosus, R. constrictus, Scherochorella minuta, Serovaina orbicella, S. turonicus, Thomasinella punica, Trochammina afikpensis, T. boehmi* and *Whiteinella inornata*, associated with smooth and ornamented ostracods, bryozoans, echinoid spines and vertebrate remains.

Sample J26: marly limestone with internal moulds of large bivalves. Ferruginous argillaceous wackestone with bivalve, echinoid and vertebrate debris. Solution-enhanced porosity up to 15 %, matrix selective. This bed yielded: *Ammobaculites difformis, A. subcretaceus, Ammomarginulina barthouxi, A. naqbensis, Flabellammina alexanderi, Hemicyclammina whitei, Mayncina hasaensis, M. orbignyi, Pseudolituonella mariea* and *Pterammina israelensis*, associated with smooth and ornamented ostracods, gastropods and vertebrate remains.

3.2.4 Hummar Formation "A4"

This formation was defined by Masri (1963) for the rock units outcropping at Hummar, NW of Amman. It is equivalent to unit "A4" of Burdon (1959). In this study the formation is recognised only at Ajlun/Jerash. The formation consists mainly of massive and dolomitic light to deep grey limestone, with a few intercalations of marly beds and occasional macrofossils (*Exogyra*). This formation seems to be well developed only at Ajlun/Jerash, it thins gradually towards the south, and disappears totally at Wadi Mujib, Wadi Mussa and Ras en-Naqb, where the overlying Shueib Formation rests directly on the Fuheis Formation, suggesting a disconformity, as observed in the field at Wadi Mujib.

Sample J42: limestone band, caliche overlying the Fuheis Formation. Quartz silt-rich mudstone - wackestone, bioturbated and scoured. The scours have coarse bioclastic fills. This bed yielded: *Ammobaculites agglutinans* and *Psammonyx* sp. 1, associated with smooth ostracods, gastropods and echinoid fragments.

(8) Indurated, massive dolomitic limestones. Occasional thin beds, showing algal lamination in parts. Base of the succession mainly covered by talus. Thickness of unit = 34.5 m; cumulative thickness = 308.5 m.

Sample J13: dolostone at base of cliff-forming sequence. Microcrystalline dolostone in neomorphosed mudstone.

Sample J27: ledge at the base of talus, indurated, dense reddish limestone. Neomorphosed bivalve (rudistid) wackestone with solution-enhanced porosity.

Sample J27a: as J27, but with more peloids and coated grains in the more mud-rich laminae.

Sample J28: coquinal limestone. Bioclastic lumachelle wackestone with abundant oyster debris and solution-enhanced, micro-vuggy porosity of about 10 %. Some chalcedonic silica replacive of the bivalves.

Sample J29: indurated, dense, laminated fossiliferous algal limestone. Neomorphosed, dolomitic and ferruginous wackestone with micritised and recrystallised ostracods, rare foraminifera and recrystallised bivalve debris. The matrix has been dolomitised but retains traces of argillaceous and ferruginous staining.

Sample J30: limestone at base of sequence, in a quarried cliff. Miliolid bioclastic wackestone with bivalve debris, including radiolitid rudists. Miliolids = 50 % of the grains, bivalve bioclasts and algae = 40 %.

Sample J31: limestone with algal lamination, in a quarry on the northern side of the asphalt road to Ajlun; 7.5 m exposed in the quarry. Neomorphosed dolomitic miliolid wackestone (Fig. 3.7) with peloids and bivalve clasts. Euhedral dolomite rhombs are replacive of the ferruginous mud matrix which contains microfractures.

Sample J31a: as J31.

Sample J32: marl bed, 10 cm thick. Algal foraminiferal boundstone or wackestone with porosity along laminae; dissolution phenomena. Benthic foraminifera, probably *Quinquiloculina* sp. and *Cuneolina* sp., bivalve debris and amorphous algae. This bed is quite poor in foraminiferal content and yielded only *Ammobaculites euides* from processed samples.

Sample J33: massive limestone. Neomorphosed wackestone with coated grains, rare micrite envelops, small *Cuneolina* sp. and bivalve clasts. This bed yielded: *Hedbergella delrioensis* and *Trochammina boehmi*, associated with echinoid fragments.

Sample J14: dolostone at top of hill. Microcrystalline dolomite in neomorphosed mudstone with relic grain textures.

3.2.5 Shueib Formation "A5" & "A6"

This formation was erected by Masri (1963) based on the sequence exposed at Wadi Shueib, 30 km west of Amman. The Shueib Formation found at Ajlun/Jerash was measured across a hill covered with agricultural land, in the vicinity of Ajlun (Fig, 3.1). The formation may be subdivided into two: a Lower Marly Member; Upper Calcareous Member. These members correspond broadly to units "A5" and "A6" of Burdon (1959), it is difficult to differentiate these subdivisions in most parts of

Jordan. The formation can be distinguished from the underlying Hummar Formation at Ajlun/Jerash by an increased proportion of marl.

3.2.5.1 Lower Marly Member "A5"

This is a sequence of alternating grey limestone and marly limestone beds. Each of the limestone beds is about 1 - 1.5 m thick, while the marly beds may reach a thickness of 4 m. The limestone beds are sometimes calcarenites displaying fine and thinly bedded cross lamination. They often include broken fragments of rudists and other molluscs.

(9) Sequence of alternating limestone and marl beds. Each bed is about 30 cm thick. The limestone beds are display two sets of fractures, one parallel to bedding and the other vertical.

Sample J34: base of soft marl bed. This bed yielded: *Ammobaculites agglutinans, Ammodiscoides turbinatus, Anaticinella multiloculata, Conorboides hofkeri, C. mitra, C. umiatensis, Coryphostoma plaitum, Eponides* cf. *plummerae, Favusella washitensis, Flabellammina alexanderi, Fursenkoina squammosa, Gabonita levis, Gavelinella semipustulosa, Guttulina cuspidata, Hedbergella delrioensis, H. simplex, Heterohelix calabarflanki, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Marssonella kummi, M. oxycona, Neodiscorbinella* sp. 1, *Nezzazata simplex, Poroeponides praeceps, Pseudopolymorphina eichenbergi, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Ramulina globulifera, Reissella ramonensis, Reophax parvulus, Serovaina orbicella, S. turonicus, Textularia depressa, Triplasia goodlandensis, Tristix poignanti, Ventilabrella glabrata, Whiteinella brittonensis* and *W. inornata*, associated with smooth and ornamented ostracods, molluscs, echinoid spines and vertebrate remains.

Sample J35: same as J34, but taken 500 m away, towards Ajlun. This bed yielded: *Ammobaculites difformis, A. naqbensis, Ammomarginulina barthouxi, A. cragini, Bulbobaculites problematicus, Charentia cuvillieri, C. hasaensis, Conorboides beadnelli, Flabellammina alexanderi, F. elongata, F. negevensis, Fursenkoina squammosa, Gabonita levis, G. obesa, Hedbergella delrioensis, Heterohelix globulosa, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Lenticulina gaultina, L. modesta, Pterammina israelensis, Triplasia murchisoni* and *Thomasinella punica*, associated with smooth and ornamented ostracods and echinoid fragments.

Sample J36: neomorphosed mudstone with abundant bioclasts. This bed yielded: *Ammobaculites* sp. 1, *Arenobulimina chapmani, Biconcava bentori, Biplanata peneropliformis, Bolivinopsis clotho, Choffatella decipiens, Conorboides beadnelli, C. hofkeri, C. umiatensis, Eponides whitei, Flabellammina alexanderi, F. elongata, Gavelinella semipustulosa, Gavelinopsis tourainensis, Globulina lacrima, Haplophragmoides kirki, Hedbergella delrioensis, Kutsevella labythnangensis, Lingulogavelinella globulosa, L. turonica, Neodiscorbinella* sp. 1, *Nezzazata simplex, Plectina ruthenica, Poroeponides praeceps, Quadrimorphina camerata, Quasispiroplectammina nuda, Reissella ramonensis, Serovaina orbicella, Simplorbitolina* sp., *Thomasinella aegyptia* and *T. fragmentaria*, associated with the radiolarian ?*Praeoconocaryomma universa* and ornamented ostracods.

Sample J37: marly limestone with "nodular" weathering, 1.5 m above J35. Macrofossils include solitary corals. Foraminiferal algal rudist wackestone with phosphatic bone fragments. Fractures are filled with equant spar, abundant miliolids and cuneolinids. This bed yielded: *Biconcava bentori, Biplanata peneropliformis, Choffatella decipiens, Eponides* cf. *frankei, E. sibericus, E. sigali, E. whitei, Marssonella oxycona, Nezzazata conica, N. convexa, N. gyra, N. simplex, Nezzazatinella adhami* and *Trochospira avnimelichi*, associated with smooth ostracods.

Sample J38: highly fossiliferous marly limestone. Similar to J37, but with some calcispheres and ostracods, no phosphate, plus scattered quartz grains. This bed yielded: *Ammobaculites turonicus, Bulbobaculites problematicus, Choffatella decipiens, Eponides* cf. *plummerae, Nezzazata convexa, N. gyra, N. simplex* and *Trochospira avnimelichi*, associated with smooth and ornamented ostracods and echinoid fragments.

Sample J39: limestone. This bed yielded: *Ammobaculites naqbensis, Conorboides beadnelli, C. hofkeri, C. mitra, C. umiatensis, Dentalina* sp. 1, *Eponides sibericus, Flabellammina elongata, Haplophragmoides fraseri, Hedbergella trocoidea, Ismailia neumannae, Mucronina* sp., *Neodiscorbinella* sp. 1, *Poroeponides praeceps* and *Quadrimorphina camerata*, associated with smooth and ornamented ostracods and echinoid fragments.

Sample J44: soft marl, yellowish. Neomorphosed carbonate mudstone. This bed yielded: *Evolutinella subevoluta, Flabellammina elongata, Gavelinella semipustulosa, Globulina lacrima, Guttulina cuspidata, Hedbergella delrioensis, Hemicyclammina evoluta, Lingulogavelinella tormarpensis, Nezzazata convexa, Quadrimorphina camerata, Serovaina turonicus, Simplorbitolina* sp., *Trochammina rummanensis* and *Whiteinella baltica*, associated with ostracods, echinoid spines and vertebrate remains.

Sample J45: nodular marly limestone, highly weathered. Similar to J44, but containing orbitoid and gastropod debris; the matrix is neomorphosed. This bed yielded: *Nezzazata concava, N. convexa, N. gyra* and *N. simplex*, associated with smooth ostracods, gastropods and echinoid fragments.

Sample J46: soft marl, yellowish. This bed yielded: *Biconcava bentori, Biplanata peneropliformis, Eponides* cf. *plummerae, E. whitei, Nezzazata gyra, N. simplex, Nezzazatinella adhami, Quinqueloculina globigerinaeformis* and *Trochospira avnimelichi*, associated with smooth ostracods and gastropods.

Sample J47: massive, ledge-forming, fossiliferous limestone. Extensively neomorphosed foraminiferal wackestone, with abundant benthic foraminifera in a pseudospar matrix. This bed yielded: *Ammobaculites obliquus, Eponides* cf. *plummerae, Guttulina adherens, Hedbergella delrioensis, Nezzazata conica, N. simplex, Nezzazatinella adhami, Peneroplis parvus, Praeammoastuta* sp. 1 and *Reissella ramonensis*, associated with smooth and ornamented ostracods and echinoid fragments.

Sample J48: massive, ledge-forming limestone. Very similar to J43 & J45, but shows extensive dissolution with a vuggy porosity of 20 %.

Sample J49: soft marl, yellowish. Neomorphosed carbonate mudstone. This bed yielded: *Hedbergella delrioensis* and *Quadrimorphina camerata*, associated with smooth ostracods.

Sample J50: limestone. Neomorphosed wackestone with small calcispheres planktonic foraminifera and rare ostracod fragments.

Sample J51: massive limestone. Neomorphosed bioturbated peloidal packstone with patchy matrix replaced by pseudospar. Quartz silt about 2 %. Micritised grains include benthic foraminifera, ostracods and bivalves.

Sample J51a: soft marl. This bed yielded: *Arenobulimina advena, A. chapmani, Biconcava bentori, Clavulinopsis gaultina, Guembelitria cenomana, Hedbergella simplex, Heterohelix globulosa, H. moremani, Kutsevella labythnangensis* and *Sculptobaculites goodlandensis*, associated with smooth ostracods and echinoid fragments.
Sample J52: marly limestone. Neomorphosed mudstone - wackestone, homogenous texture with microfractures, ostracod and rare foraminifera debris.

3.2.5.2 Upper Calcareous Member "A6"

This is a sequence of thickly bedded hard nodular limestones intercalated with thin marl beds yielding oysters, other bivalves and large ammonites. It yields massive crystalline limestones with numerous fossil fragments.

Sample J53: crystalline, massive limestone, 20 m below top of Shueib Formation. Neomorphosed mudstone with 1 % silt-grade quartz.
Sample J56: soft marl with bivalves, thickness 2 m. This bed yielded: *Adelungia marginulinaeformis, Ammobaculites albertensis, A. fragmentarius, A. mastersi, A. subcretaceus, Ammomarginulina cragini, Astacolus richteri, Evolutinella* sp. 1, *Globulina lacrima, Guttulina cuspidata, Haplophragmoides calculus, H. excavatus, H. famosus, H. kirki, Hemicyclammina evoluta, H. sigali, Heterohelix reussi, Lituola nautiloidea, Scherochorella* sp. and *Vernonina* sp., associated with the radiolarian ?*Praeoconocaryomma universa*, ostracods, bivalves, bryozoans, echinoid spines and vertebrate remains.

3.2.6 Wadi Sir Formation "A7"

This formation was originally defined by Masri (1963) for the rock units outcropping at Wadi Sir, west of Amman. The formation is equivalent to unit "A7" of Burdon (1959). It is considered an index horizon through out the country. The formation is recognised at Ajlun/Jerash, Wadi Mujib, Wadi Mussa and Ras en-Naqb, where it consists of massive, dolomitized and cliff-forming coquinal limestones, with rare intercalations of relatively thin marly beds yielding ammonites. The limestones are generally highly fossiliferous, containing bivalves, gastropods and echinoids. Macrofossils identified in this unit include: *Ostreidae, Plicatula* sp., *Micraster* sp., *Exogyra* sp. and ammonites.

(10) Sequence of indurated, nodular, dolomitic, fossiliferous limestone, forming a high cliff at the entrance of the village of Sakib, on the Ajlun-Jerash road (Fig. 3.1). Thickness of unit is more than 45 m; cumulative thickness = > 403.5 m.
Sample J54: crystalline limestone, bedded and jointed with two sets of joints, one horizontal, parallel to bedding, and the other vertical. Algal bioclastic wackestone with miliolids; 20-25 % solution-enhanced porosity (Fig. 3.8).
Sample J55: fossiliferous nodular limestone with burrows. Neomorphosed bioclastic wackestone with matrix altered to microspar. Common echinoids, bivalve and ostracod clasts with 25-30 % solution-enhanced matrix-selective porosity.

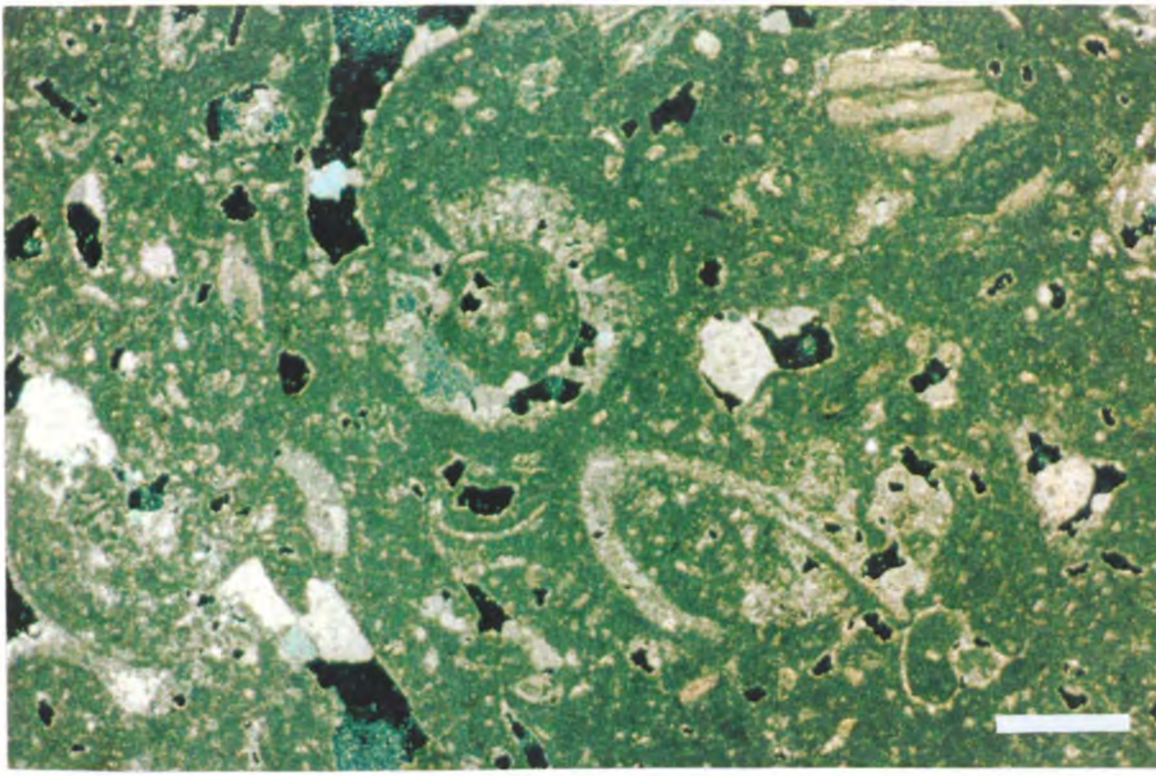

Fig. 3.8 Algal bioclastic wackestone with 20-25 % solution-enhanced porosity. Sample J54, Wadi Sir Formation "A7", Ajlun-Jerash (XPL, X 35).

Near the top of the hill (S4, Fig. 3.1), in the vicinity of Ajlun, the Wadi Sir Formation is constituted by cliff-forming limestones and dolomitic limestones, exposed above the covered Shueib. The following samples were collected:

Sample J57: well-bedded marly limestone with oysters and other bivalves, base of Wadi Sir Formation. Miliolid, cuneolinid, neomorphosed wackestone with micritised bioclasts. Thin-shelled bivalves and *Nezzazata* sp. This bed also yields *Reissella ramonensis*, associated with echinoid fragments.

Sample J58: marl bed, 10 cm thick. Neomorphosed mudstone to phosphatic, slightly argillaceous, wackestone. Rare small planktonic foraminifera. Chalcedonic silica replacive of bivalve bioclasts, phosphate calcispheres and echinoids. This bed yielded: *Ammodiscoides turbinatus, Anaticinella multiloculata, Biplanata peneropliformis, Charentia cuvillieri, Coryphostoma plaitum, Flabellammina elongata, F. negevensis, Gaudryina rugosa, Gavelinella semipustulosa, Hedbergella delrioensis, H. simplex, Heterohelix globulosa, H. nkporoensis, H. reussi, Lenticulina modesta, Lingulogavelinella globulosa, L. turonica, Marssonella kummi, M. oxycona, M. trochus, Mayncina orbignyi, Peneroplis parvus, Pseudorhapydionina dubia, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Ramulina globulifera, Reissella ramonensis, Serovaina orbicella, S. turonicus, Textularia depressa, T. subconica, Triplasia goodlandensis, Tristix poignanti, Trochammina rummanensis, Whiteinella archaeocretacea* and *W. inornata*, associated with smooth and ornamented ostracods, echinoid spines and vertebrate remains.

Sample J59: oyster coquina with echinoids. Wackestone with abundant bivalve fragments, mudstone matrix is neomorphosed to microspar. Chalcedonic silica replacement of bioclasts. Pyrite cubes occur growing in the bivalve debris. This bed yielded: *Adelungia* sp. 1, *Ammobaculites advenus, Hedbergella delrioensis, Lituola nautiloidea, Pseudorhapydionina dubia, Reissella ramonensis, Reophax parvulus* and *Scherochorella minuta,* associated with smooth and ornamented ostracods, gastropods and echinoid fragments.
Sample J60: crystalline dolostone, top of the hill. Foraminiferal bioclastic wackestone with abundant miliolids, cuneolinids and *Orbitulina* sp.

3.3 Wadi Mujib

Wadi Mujib lies to the south of Amman and may be reached via the old asphalt road to Karak, approximately 90 km from Amman. The sampled section is situated 8 km away from the asphalt road, and it may be accessed by a 4-wheel-drive car following an un-paved track (Fig. 1.1). This locality displays the thickest, best-preserved and most complete sequence exposed in central Jordan, and consequently was chosen to provide a reference section for the Upper Cretaceous of the area (Figs. 3.9, 10). Sampling took place in June 1988. A total of 117 samples were collected through the succession. The sequence (741 m) is described from base to top, as follows:

3.3.1 Subeihi (Kurnub) Formation "K2"

The Kurnub Formation is easily recognised at Wadi Mujib, consisting of friable, red, cross-bedded, variegated sandstones.

(1) Glauconitic sandstone. Beginning of transitional sequence between Kurnub and Na'ur Formations. Thickness of unit = 0.9 m.
Sample M1: glauconitic sandstone. Sandstone, very fine to fine-sand size, moderately to poorly sorted, subangular quartz grains, very dark fine-grained matrix, probably clay 5-10 %, microcrystalline, no faunal content.
Sample M2: white sandstone above glauconitic sandstone.

(2) Cross-bedded red and varicoloured sandstone. Thickness of unit = 35 m; cumulative thickness = 35.9 m.

(3) Glauconitic sandstone. Thickness of unit = 1 m; cumulative thickness = 36.9 m.
Sample M3: glauconitic sandstone. Medium to coarse-sand size, well-rounded grains, contains about 10 % glauconite, with some oxidation, few grains are totally oxidised to limonite. The remaining dominant grains are rounded to subangular quartz grains. The cement is dolomite, 15 % which has an equigranular crystalline fabric (0.05 mm in diameter). Moderately to well-sorted, with no fauna.

(4) Glauconitic shale. Thickness of unit = 0.5 m; cumulative thickness = 37.4 m.
Sample M4: greenish shale.

(5) Cross-bedded variegated sandstone. Thickness of unit = 4.5 m; cumulative thickness = 41.9 m.

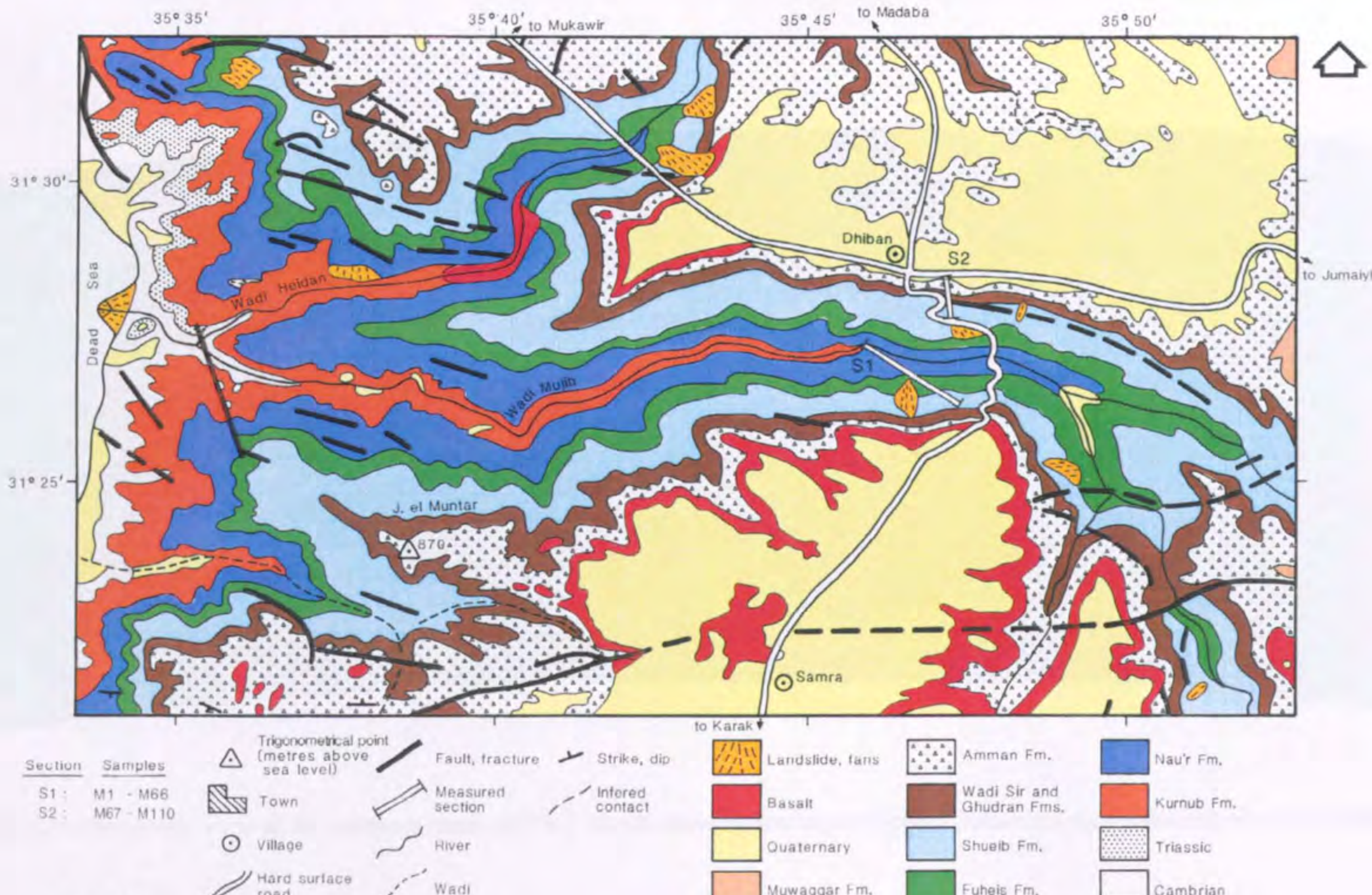

Fig. 3.9

Geological map of Wadi Mujib area

(modified from Geological map of Jordan, sheet Amman, 1 : 250 000, 1968)

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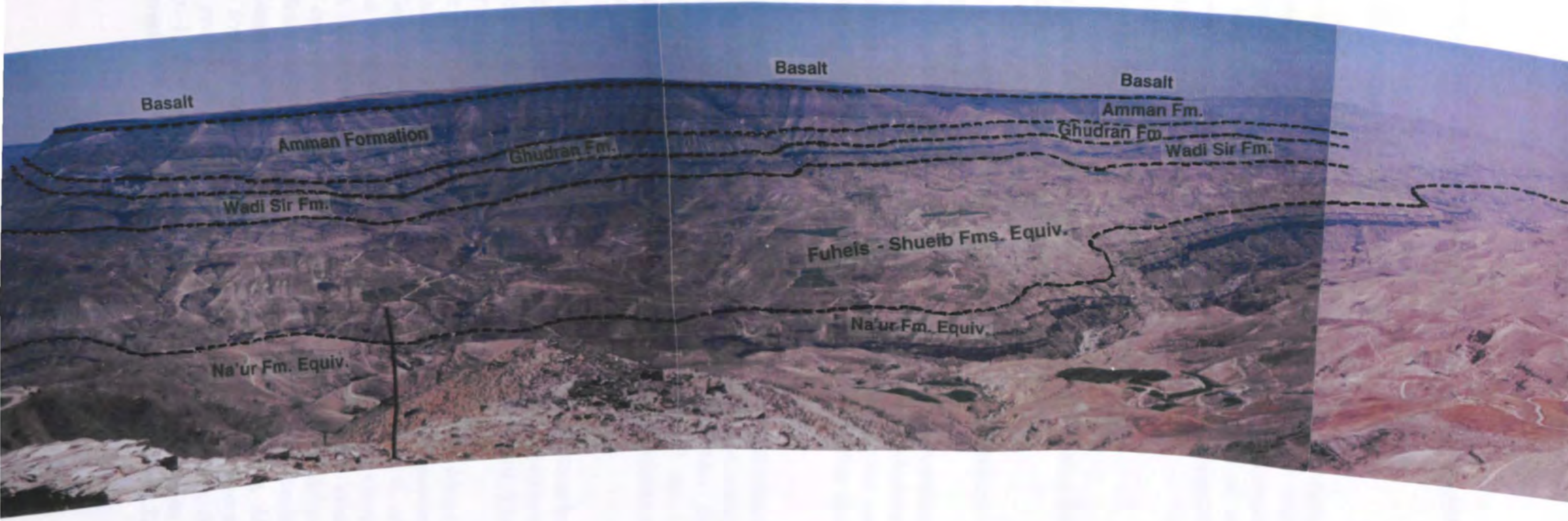

Fig. 3.10 Panoramic view of the southern flank of Wadi Mujib showing the whole Upper Cretaceous succession (seven formations).

(6) Slope covered with talus. Thickness of rock unit = 28.5 m; cumulative thickness = 70.4 m.

3.3.2 Na'ur Formation "A1" & "A2"

This formation was recognised easily in the field at Wadi Mujib, lying above the variegated sandstones of the Kurnub Formation and below the marly sequence of the Fuheis Formation. The formation is impermeable and generally constitutes the agricultural lands of the area. It consists of a sequence of nodular limestones intercalated with beds of marls, which are thicker and more frequent in the lower part. The Na'ur Formation is subdivided into two members:

3.3.2.1 Lower Shaly Member "A1"

This member consists at Wadi Mujib of a sequence of alternating limestone and shale (Fig. 14), with massive dolomitic limestones, as follows:

(7) Massive dolomitic limestone, yellowish-brown. Thickness of unit = 1 m; cumulative thickness = 71.4 m.
Sample M5: packstone composed almost entirely of recrystallised sponge debris; sponge skeletons are dissolved and filled with calcite spar. Moderately sorted, fine to medium-sand size, carbonate bioclastic material 1.0 % angular quartz grains of silt size. The cement is calcite spar predominantly filling voids after dissolution of sponge debris.

(8) Shale, dark green. Thickness of unit = 0.5 m; cumulative thickness = 71.9 m.
Sample M6: this bed yielded: *Ammobaculites agglutinans, A. obliquus, A. turonicus, A.* sp. 2, *Ammomarginulina naqbensis, Haplophragmoides famosus, H. kirki, Polychasmina pawpawensis, Pseudotextulariella cretosa, P.* sp. 1, *Sculptobaculites loshkharvicus, Trochammina afikpensis* and *T. boehmi*, associated with ostracods and echinoid fragments.

(9) Sequence of alternating shales and limestones. Each limestone bed is around 70 cm thick and each shale bed is less than 50 cm thick and is fossiliferous, yielding small oysters. The top of the sequence is a 50 cm thick limestone bed. Thickness of unit = 6 m; cumulative thickness = 77.9 m.
Sample M7a: shaly limestone. This bed yielded: *Blowiella blowi, Bulimina exigua robusta, Cassidella tegulata, Charentia cuvillieri, C. hasaensis, Coryphostoma neumannae, Dentalinoides canulina, Eponides* cf. *plummerae, E. sibericus, E. whitei, Flabellammina elongata, Gabonita levis, G. levis aegyptiaca, Gavelinella baltica, G. semipustulosa, Globigerinelloides ultramicra, Guembelitria cenomana, Guttulina adherens, G. cuspidata, Gyroidinoides nitida, Hedbergella delrioensis, Hensonina lenticularis, Heterohelix* sp. 1, *Laevidentalina* sp., *Lenticulina gaultina, L. rotulata, L. spachholtzi, Lingulogavelinella turonica, Marssonella oxycona, Mayncina orbignyi, Neobulimina irregularis, Ophthalmidium minimum, Polymorphina zeuschneri, Praebulimina prolixa, P. prolixa longa, P. reussi navarroensis, Pseudotextulariella cretosa, P.* sp. 1, *Psilocitharella leptoteicha, Pyramidina rudita, Quinqueloculina globigerinaeformis, Serovaina turonicus, Spiroloculina cretacea, Textularia depressa*

and *Whiteinella brittonensis*, associated with ostracods, molluscs and vertebrate remains.
Sample M7b: Sandy dolostone composed of subhedral to euhedral rhombs of dolomite (0.1-0.2 mm in size); 10-15 % quartz, rounded to subrounded grains, fine to medium-sand size.
Sample M8: shale. Samples M8a, b & c taken east of bed M8 and at the same level: M8a & M8b are sandstone with subrounded quartz grains; M8c is dolostone (silt-size), equigranular mosaic, minor subangular (about 0.2 mm in size) quartz 1.0 %. Sample M8 yielded: *Ammobaculites fragmentarius, A. naqbensis, A. subcretaceus, Ammotium oertlii, Charentia cuvillieri, C. rummanensis, Haplophragmoides fraseri, H. kirki, H. rugosa* and *Mayncina orbignyi*, associated with ostracods, gastropods and vertebrate remains.
Sample M8n: shale taken at the same level with bed M8. This bed yielded: *Adelungia marginulinaeformis, Adelungia* sp. 1, *Ammoastuta nigeriana, Ammobaculites agglutinans, A. euides, A. fragmentarius, A. naqbensis, A. obliquus, A.* sp. 1, *A.* sp. 2, *A. stephensoni, A. subcretaceus, Ammotium aegyptica, Ammovertillina* sp. 1, *Cyclammina haydeni, Eoguttulina anglica, Globulina* sp. 1, *Guttulina adherens, G. symploca, Haplophragmoides excavatus, H. famosus, H. fraseri, H. kirki, H. rugosa, Kutsevella labythnangensis, Polymorphina zeuschneri, Praeammoastuta* sp. 1, *Pseudopolymorphina eichenbergi, P.* sp. 1, *Scherochorella minuta, Sculptobaculites loshkharvicus, Thomasinella aegyptia, T. fragmentaria, T. punica, Uvigerinammina jankoi* and *Vernonina* sp., associated with ostracods, gastropods, echinoid spines and vertebrate remains.

(10) Shale, constituting an oyster bank with *Ostrea flabellata*. Thickness of unit = 0.3 m; cumulative thickness = 78.2 m.
Sample M9: this bed yielded: *Ammobaculites agglutinans, Ammomarginulina cragini, Cyclammina haydeni, Haplophragmoides calculus, H. famosus, H. kirki, Hemicyclammina evoluta, H. sigali, Mayncina orbignyi, Pseudolituonella mariea* and *Sculptobaculites loshkharvicus*, associated with ostracods, gastropods, echinoid spines and vertebrate remains.

(11) Limestone, grey, indurated, coarsely crystalline. Thickness of unit = 0.5 m; cumulative thickness = 78.7 m.
Sample M10: bivalve, ostracod, textularid, foraminiferal grainstone to packstone. The aragonitic material is dissolved leaving margins preserved as micrite envelopes, grain-size medium-sand size (shallow-water deposit due to the presence of micrite envelopes on fossils). This bed is quite poor in foraminiferal content and yielded only *Pseudolituonella mariea*, associated with ostracods and bivalves.

(12) Shale. Thickness of unit = 0.3 m; cumulative thickness = 79 m.
Sample M11: green shale.

3.3.2.2 Upper Nodular Member "A2"

This member consists at Wadi Mujib (Fig. 3.12) of nodular limestone, with marly bands, as follows:

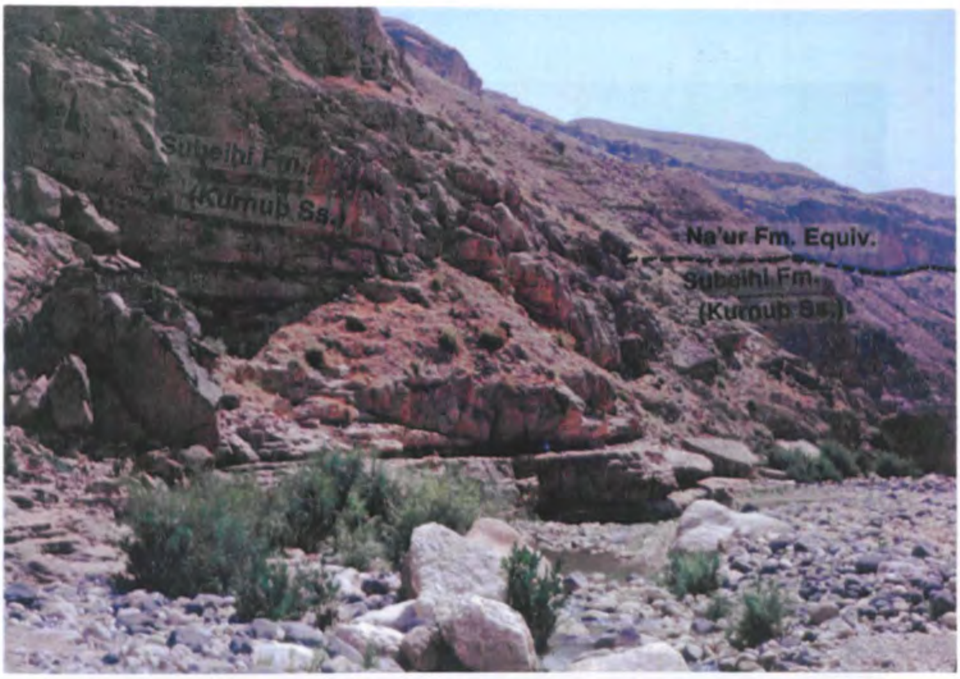

Fig. 3.11 Close up view of the Subeihi Formation (Kurnub Sandstone), Lower Cretaceous and the Lower Shaly Member of Na'ur Formation (Upper Cretaceous) at Wadi Mujib.

Fig. 3.12 Photograph showing the contact between the Subeihi Formation (Kurnub Sandstone), Lower Cretaceous and the Na'ur Formation (Upper Cretaceous) at Wadi Mujib.

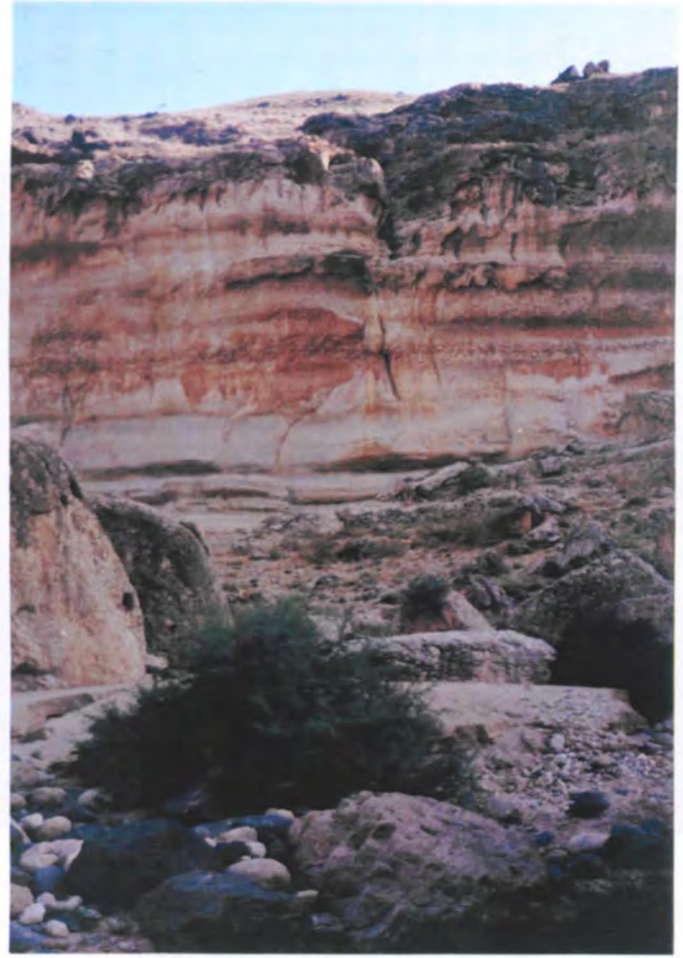

Fig. 3.13 Two photographs showing the upper part of Na'ur Formation, consisting mainly of the Nodular limestone in the Wadi Mujib area (hieght of cliff is 10 m).

Fig. 3.14 Two photographs showing the Nodular Limestone (middle part of the Na'ur Formation) in the Wadi Mujib area.

(13) Nodular limestone, massive, with bands of softer marly limestone. The indurated beds are approximately 2 m thick, the softer beds are less than 1 m thick. Thickness of unit = 92 m; cumulative thickness = 171 m.
Sample M12: base of succession, capped by a bed rich in echinoids, with some ammonites. Wackestone, fine to medium sand-size bioclastic grains, including foraminifera (textularids and globotruncanids), echinoids and echinoid spines.
Sample M13': conglomeratic limestone, above an erosion surface in nodular limestone.
Sample M13: coquina, 1.55 m thick, 20 m above M12. Limestone with common thick bivalve (?rudist) shells, abundant coarse silt-size carbonate in micritic matrix 20 %, glauconite, bioclasts including benthic and planktonic foraminifera and echinoderms. This bed yielded: *Ammotium aegyptica, Biplanata peneropliformis, Choffatella decipiens, Nezzazata simplex, Orbitolina sefini, Pseudotextulariella cretosa, P.* sp. 1 and *Trochospira avnimelechi*, associated with ostracods and echinoid fragments.
Sample M14: nodular limestone, 3.1 m above M13. Packstone containing a range of benthic foraminifera, echinoderm and other bioclastic debris of medium-sand size. The cement is microspar, filling the recrystallised tests.
Sample M14a, b: taken from an unconformity surface, above the nodular limestone, associated with vertebrate remains (teeth). Dolomitised carbonate mudstone with moderate grain size. Dolomite crystals are zoned and stained with iron oxides, no grains or particles available, highly porous because of dolomitization.
Sample M15: nodular limestone, 42 m above M14. Packstone texture, poorly preserved fossil debris, most of which is echinoderms and textularid foraminifera. Regular shaped, angular fragments 20 %, medium sand sized with micritic matrix.
Sample M16: nodular limestone, 26 m above M15. Wackestone texture, very fine sand to silt-size bioclasts, with micrite carbonate matrix. Fossils observed include orbitulinids, ostracods and echinoid fragments. This bed yielded: *Aaptotoichus clavellatus, Choffatella decipiens, Conorboides beadnelli, C. umiatensis, Gavelinella baltica, Globorotalites hiltermanni, Marssonella kummi, M. oxycona, Mayncina hasaensis, M. orbignyi, Nezzazata conica, N. convexa, N. gyra, N. simplex, Plectinella aegyptiaca, Poroeponides praeceps, Quasispiroplectammina nuda, Serovaina* sp. 1, *Textularia depressa* and *Trochospira avnimelichi*, associated with ostracods and echinoid fragments.

(14) Continuation of the section. Sequence of alternating soft and indurated nodular limestones, similar to those below, but with thinner beds. The sequence is fossiliferous and yields oysters and small bivalves. The limestone beds are about 20 - 30 cm thick each and the softer (?marly) beds are about 10 - 20 cm thick. Thickness of unit = 9 m; cumulative thickness = 180 m.
Sample M17: limestone. Porous texture, foraminiferal packstone, coarse to silt-sized grains. Fossils include abundant small planktonic foraminifera and echinoderms. This bed yielded: *Eponides sibericus, Gavelinella baltica, G. semipustulosa, Gyroidinoides nitida* and *Trochospira avnimelichi*, associated with ostracods, molluscs and echinoid fragments.
Sample M18: limestone. Wackestone to packstone fabric, coarse silt-sized grains. Fauna include very thin-walled planktonic foraminifera, bivalves and echinoderms.
Sample M19: limestone. Foraminiferal packstone, semi-porous, silt-sized bioclastic grains. Fauna include foraminifera, echinoderms, bivalves and ostracods. This bed

yielded: *Anomalinoides pinguis, Conorboides beadnelli, Fissurina laevigata, Gavelinella baltica, G. intermedia, G. nacatochensis, G. semipustulosa, Gyroidinoides nitida, Lagena acuticosta, L. paucicosta, Lenticulina gaultina* and *Quadrimorphina camerata*, associated with ostracods, bivalves, bryozoans and echinoid fragments.
Sample M20: limestone. Very porous, dark heavily iron-stained matrix, packstone, fine to medium sand-sized grains, poorly sorted. Fauna include echinoderms, bryozoans and larger foraminifera. This bed yielded: *Arenobulimina advena, A. chapmani, Blowiella blowi, Conorboides mitra, Coryphostoma neumannae, Evolutinella* sp. 1, *Fissurina laevigata, Gavelinella semipustulosa, Glogigerinelloides eaglefordensis, Hedbergella delrioensis, Heterohelix globulosa, Lenticulina spissocostata, Marssonella oxycona, Pravoslavlevia pravoslavlevi, Serovaina turonicus, Triplasia bonnefousi, T. goodlandensis, T. murchisoni* and *Whiteinella brittonensis*, associated with ostracods, bryozoans, echinoid spines and vertebrate remains.

(15) Greenish shale, flaky, with gypsum veins, fossiliferous with oysters. The fossils are concentrated in distinct levels. Thickness of rock unit = 18 m; cumulative thickness = 198 m.
Sample M21: lumachelle with bivalves, including *Ostrea olisiponensis,* near the base of succession. This bed yielded: *Arenobulimina chapmani, Blowiella blowi, Cassidella tegulata, Charentia cuvillieri, Clavulinopsis gaultina, Conorboides hofkeri, Coryphostoma neumannae, Costellagerina bulbosa, Daxia cenomana, Dentalinoides canulina, Ellipsoglandulina laevigata, Eponides sigali, Fissurina laevigata, F. oblonga, Gabonita levis, G. levis aegyptica, Gavelinella baltica, Globigerinelloides bentonensis, G. eaglefordensis, G. ultramicra, Hedbergella delrioensis, H. trocoidea, Heterohelix globulosa, H. moremani, Lagena paucicosta, Lenticulina gaultina, L. spissocostata, Marssonella oxycona, Pravoslavlevia pravoslavlevi, Pseudotextularia plummerae, Quadrimorphina camerata, Quinqueloculina globigerinaeformis, Sculptobaculites goodlandensis, Serovaina orbicella, S. turonicus, Textularia depressa, Triplasia murchisoni, Trochospira avnimelichi* and *Valvulineria loetterlei*, associated with ostracods, bivalves, echinoid spines and vertebrate remains.
Sample M22: lumachelle. This bed yielded: *Ammobaculites agglutinans, A. difformis, Arenobulimina advena, Bulimina exigua robusta, Charentia cuvillieri, Conorbina conica, Conorboides hofkeri, C. umiatensis, Costellagerina bulbosa, Dentalina hammensis, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Fissurina oblonga, Gabonita levis aegyptiaca, G. sumaya, Gavelinella awunensis, G. cenomanica, G. intermedia, G. semipustulosa, Globigerinelloides eaglefordensis, Guembelitria cenomana, Haplophragmoides calculus, H. kirki, H. umbilicata, Hedbergella delrioensis, H. hoelzli, H. simplex, H. trocoidea, Hemicyclammina evoluta, Hensonina* sp. 1, *Heterohelix globulosa, H. moremani, Kutsevella labythnangensis, Lenticulina californiensis, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Loxostomoides cushmani, Marssonella trochus, Neobulimina canadensis, Nezzazata conica, N. convexa, Praebulimina* cf. *arabica, P. prolixa, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Pseudotextulariella cretosa, P.* sp. 1, *Psilocitharella leptoteicha, Quadrimorphina camerata, Reissella ramonensis, R. ramonensis, Sculptobaculites goodlandensis, Serovaina orbicella, S. turonicus, Stensioeina pokornyi, Trochammina afikpensis, T. rummanensis* and *Whiteinella brittonensis*, associated with ostracods, bivalves and echinoid fragments.

Sample M23: lumachelle. Wackestone, medium to fine-sand size bioclastic grains, moderately sorted, constituting 15 - 20 %, the remainder is a micritic matrix which is slightly dolomitised. Fauna include bivalves, foraminifera, ostracods and echinoid bioclasts. This bed yielded: *Ammoastuta nigeriana, Ammobaculites albertensis, A. difformis, A. naqbensis, A. stephensoni, Ammovertillina* sp. 1, *Charentia cuvillieri, Choffatella decipiens, Conorboides* sp. 1, *C. umiatensis, Coryphostoma plaitum, Costellagerina bulbosa, Donsissonia* sp., *Eponides sigali, Flabellammina negevensis, Gabonita levis aegyptiaca, Gavelinella semipustulosa, Gavelinopsis proelevata, Globigerinelloides eaglefordensis, Guembelitria cenomana, Guttulina symploca, Hedbergella delrioensis, H. simplex, H. trocoidea, Hemicyclammina evoluta, H. sigali, H. whitei, Heterohelix globulosa, H. moremani, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Lagena hexagona, Lenticulina* sp. 1, *L. spissocostata, Lingulogavelinella turonica, Placopsilina cenomana, Polychasmina pawpawensis, Praebulimina prolixa, P. prolixa longa, Pravoslavlevia pravoslavlevi, Quadrimorphina camerata, Scherochorella minuta, Sculptobaculites goodlandensis, Serovaina orbicella, S. turonicus, Sestronophora* sp., *Stensioeina pokornyi, Trochamminoides parva, Vernonina* sp. and *Whiteinella brittonensis*, associated with ostracods, bivalves and echinoid fragments.

3.3.3 Fuheis Formation Equivalent "A3"

The facies of this formation changes from intercalating marly limestones and shales in the north to intercalated nodular limestones and shales at Wadi Mujib in the centre. Therefore, it is suggested that a new name should be given to this formation in the centre and south of Jordan. Temporarily, the author uses the term "Equivalent" to indicate the need for change.

(16) Sequence of dolomitic limestones, shales and marls, exposed sporadically on a covered hill slope. Thickness of unit = 43.5 m; cumulative thickness = 241.5 m.
Sample M24: indurated dolostone (4.5 m thick). Miliolid wackestone with medium to fine sand-sized grains. Fauna include benthic foraminifera (miliolids), bivalves fragments, ostracods and echinoderms. This bed yielded: *Quinqueloculina triangulata* and *Reissella ramonensis.*
Sample M25: greenish shale (21 m thick), mostly obscured. This bed yielded: *Conorboides beadnelli, C. hofkeri, C. mitra, C.* sp. 2, *Gavelinella nacatochensis, Hemicyclammina sigali, Oolina globulosa, Polychasmina pawpawensis* and *Vernonina* sp., associated with ostracods.
Sample M26: marl, sandstone and limestone intercalations (12 m thick), below a covered slope. Dolomitised carbonate mudstone, grains constituting 30 % dolomite crystals, moderately sorted, fine sand to silt-grain size, with no fauna.
Sample M27: indurated limestone (6 m thick). Dolomitised carbonate mudstone - wackestone, dolomite crystals fine sand to silt size. Grains are 15 % bivalves and ostracods, with smaller quartz grains; the grains are of medium-sand grain size. This bed yielded: *Hormosina* cf. *velascoensis, Placopsilina cenomana* and *Tristix poignanti*, associated with ostracods and bivalves.

(17) Unexposed interval (thickness = 10 m; cumulative thickness = 251.5).

(18) Ledge-forming limestone, fossiliferous. Thickness of unit = 15 m; cumulative thickness = 266.5 m.
Sample M28: brick-like limestone, massive, crystalline, with *Cyphozoma* sp. (echinoid). Echinoid wackestone, coarse to medium sand-sized grains, forming 10 - 15 %, moderately sorted. Faunal content includes echinoid tests and spines, bivalves and ostracods.

(19) Unexposed interval (thickness = 15 m; cumulative thickness = 281.5).

(20) Limestone, silicified. Thickness of unit = 9 m; cumulative thickness = 290.5 m.
Sample M29: massive crystalline limestone (4.5 m thick) with chert nodules. Dolomitised echinoidal packstone, particles coarse to medium sand-sized, forming 40 % of sediments, poorly sorted. Faunal content includes echinoid bioclasts, silicified and dolomitised bivalves and miliolids.
Sample M30: indurated fossiliferous silicified limestone (4.5 m thick) ?coquinal. Bioclastic packstone, coarse to medium sand-sized, forming 50 %, poorly sorted; the matrix is partially dolomitised. Faunal content includes echinoid tests and silicified bivalves.

(21) Dolomitic limestone, highly fractured, fossiliferous. Thickness of unit = 1.5 m; cumulative thickness = 292 m.
Sample M31: limestone. Wackestone, coarse to medium sand-sized grains, forming about 20 %, moderately sorted. Faunal content includes ostracods, bivalves, foraminifera and echinoids, with sparse alveolinids. This bed yielded: *Ammobaculites albertensis, A. difformis, A. euides, A. naqbensis, Ammomarginulina barthouxi, A. naqbensis, Ammotium oertlii, Ammovertillina* sp. 1, *Arenobulimina advena, A. d'orbignyi, Biplanata peneropliformis, Bulimina exigua robusta, Charentia hasaensis, C. rummanensis, C.* sp. 1, *Choffatella decipiens, Daxia cenomana, Evolutinella* sp. 1, *Fursenkoina squammosa, Gabonita levis aegyptiaca, Globigerinelloides eaglefordensis, Guembelitria cenomana, Haplophragmoides calculus, H. kirki, H. neolinki, Hedbergella delrioensis, H. trocoidea, Hemicyclammina sigali, H.* sp. 1, *Heterohelix globulosa, H. moremani, Ismailia aegyptica, I. neumannae, Lagena hexagona, L. paucicosta, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Mayncina hasaensis, Merlingina cretacea, Nodosaria naumanni, Placopsilina cenomana, Planispirinella barnardia, Praebulimina* cf. *arabica, P.* cf. *bantu lata, P. prolixa, P. prolixa longa, P. reussi navarroensis, P. venusae, Praeoconocaryomma universa, Pseudotextulariella* sp. 1, *Scherochorella minuta, Thomasinella aegyptia, T. punica, Trochamminoides parva, Whiteinella aprica, W. baltica* and *W. brittonensis*, associated with ornamented ostracods.

(22) Green shale, mostly covered. Thickness of unit = 22.5 m; cumulative thickness = 314.5 m.
Sample M32: sample taken from base of unit. This bed yielded: *Ammobaculites mastersi, A. stephensoni, Conorboides* sp. 2, *Gabonita levis aegyptiaca, Haplophragmoides calculus, H. kirki, Hedbergella delrioensis, H. hoelzli, Hemicyclammina evoluta, Heterohelix globulosa, H. moremani, Lenticulina* sp. 1, *Lingulogavelinella turonica, Poroeponides praeceps, Pseudotextularia plummerae, P.* sp. 1, *Serovaina orbicella, Sestronophora* sp. and *Trochamminoides parva*, associated with ostracods.

3.3.4 Shueib Formation Equivalent "A5" & "A6"

The facies of this formation changes from being marly at Ajlun/Jerash to becoming more shaly at Wadi Mujib. Therefore, it is suggested that a new name should be given to this formation in the centre and south of Jordan. Temporarily, the author uses the term "Equivalent" to indicate the need for change.

3.3.4.1 Lower Marly Member "A5"

This is a sequence of alternating limestone and marly limestone beds. Each of the limestone beds is about 1-1.5 m thick, while the marly beds may reach a thickness of 4 m. The limestone beds often include broken fragments of molluscs.

(23) Marly limestone, yellowish-brown. Thickness of rock unit = 1.5 m; cumulative thickness = 316 m.
Sample M33: This bed yielded: *Arenobulimina chapmani, A. d'orbignyi, Bulimina kirri, Conorboides beadnelli, Fissurina laevigata, Gabonita sumaya, Gavelinella awunensis, G. nacatochensis, Hedbergella simplex, H. trocoidea, Heterohelix globulosa, H. moremani, H. striata compressa, Pseudoplanoglobulina nakhitschevanica, Pyramidina rudita, Valvulineria loetterlei, Whiteinella brittonensis* and *W. inornata*.

(24) Bituminous black shales, with marly ledges, 10 cm thick each. Thickness of unit = 5.8 m; cumulative thickness = 321.8 m.
Sample M34: marly limestone. Mudstone, bioclastic particles forming less than 10 %.
Sample M35: This black shale yielded: *Arenobulimina chapmani, A. d'orbignyi, Bulimina kirri, Conorboides beadnelli, Fissurina laevigata, Gabonita sumaya, Gavelinella awunensis, G. nacatochensis, Hedbergella simplex, H. trocoidea, Heterohelix globulosa, H. moremani, H. striata compressa, Pseudoplanoglobulina nakhitschevanica, Pyramidina rudita, Valvulineria loetterlei, Whiteinella brittonensis* and *W. inornata*.

(25) Ammonitic nodular limestone with large ammonites, yellowish in colour, forming a cliff transecting a small wadi. Thickness of unit = 6 m; cumulative thickness = 327.8 m.
Sample M36: limestone. Bioclastic wackestone, particles forming 20 %, poorly sorted. Faunal content includes bivalves, foraminifera, echinoid bioclasts and few ostracods.

(26) Green laminated shale, becoming brown upward. The sequence includes fibrous gypsum veinlets (most of this sequence is covered by talus). Thickness of unit = 12.6 m; cumulative thickness = 340.4 m.
Sample M37: This bed yielded: *Arenobulimina d'orbignyi, Blowiella blowi, Bulimina kirri, Clavulinopsis gaultina, Conorboides hofkeri, C.* sp. 2, *C. umiatensis, Coryphostoma neumannae, Fissurina laevigata, Gabonita obesa, Gavelinella intermedia, G. nacatochensis, Gavelinopsis proelevata, Globigerinelloides bentonensis, G. ultramicra, Globospirillina condensa, Guembelitria cenomana, Gyroidinoides nitida, G.* sp., *Hedbergella delrioensis, Heterohelix globulosa, H.*

moremani, Lagena hexagona, Lingulogavelinella tormarpensis, Marssonella oxycona, M. trochus, Neobulimina canadensis, Nezzazata convexa, Planispirinella barnardia, Poroeponides praeceps, Praebulimina prolixa, P. reussi navarroensis, Pristinosceptrella sp., *Pseudotextularia plummerae, Serovaina minutus* and *S. orbicella*, associated with ostracods and vertebrate remains.
Sample M38: This bed yielded: *Fissurina oblonga, Hedbergella delrioensis, H. simplex, Heterohelix calabarflanki, H. globulosa, H. punctulata, H. vistulaensis, Praebulimina* cf. *arabica* and *Whiteinella baltica*, associated with molluscs and vertebrate remains.

(27) Sequence of shale and nodular marly intercalations, light reddish in colour, with gypsum veins and bivalve casts. Thickness of unit = 4.5 m; cumulative thickness = 344.9 m.
Sample M39: This bed yielded: *Fissurina laevigata, Gabonita levis aegyptiaca, G. sumaya, Gavelinella baltica, G. nacatochensis, Globigerinelloides bentonensis, Hedbergella delrioensis, H. simplex, Heterohelix calabarflanki, H. globulosa, H. moremani, H. punctulata, H. striata compressa, Neobulimina canadensis, N. irregularis, Neodiscorbinella* sp. 1, *Nonionella austinana, Oolina globulosa, Poroeponides praeceps, Praebulimina prolixa, P. prolixa longa, Pseudotextularia plummerae, Pyramidina rudita* and *Whiteinella inornata*, associated with vertebrate remains.

(28) Nodular marly limestone, greyish on fresh surface and highly fossiliferous. It yields oysters, other bivalves and ammonites. The sequence grades upward into a sequence of alternated marls and limestones, also yielding fossils and secondary gypsum veins. Thickness of unit = 3.7 m; cumulative thickness = 348.6 m.
Sample M40: lower marly limestone. Bioclastic wackestone to packstone, particles forming 25 %, poorly sorted. Faunal content includes bivalves, ostracods and foraminifera. This bed yielded: *Bulimina exigua robusta, Gabonita sumaya, Guembelitria cenomana, Heterohelix moremani, Neobulimina canadensis, Praebulimina carseyae, Pseudotextularia plummerae* and *Thomasinella punica*, associated with ostracods and mollusc fragments.
Sample M41: limestone. Mudstone, microsparite, matrix altered to microspar, very few bioclastic particles, often replaced by blocky spar. Faunal content includes a few planktonic foraminifera, mainly unkeeled globular planktonics. This bed yielded: *Ammobaculites advenus, Hedbergella delrioensis, Heterohelix calabarflanki, H. globulosa, H. moremani, Neobulimina canadensis alpha, Praebulimina prolixa, P. prolixa longa, Pristinosceptrella* sp., *Whiteinella aprica, W. brittonensis* and *W. inornata*, associated with ostracods, molluscs, echinoid spines and vertebrate remains.

(29) Green shale, mostly obscured by talus. Thickness of unit = 19.5 m; cumulative thickness = 368.1 m.
Sample M42: shale, with gypsum, calcite crystals and vertebrate remains (teeth).
Sample M43: top of exposed shale. Mudstone, matrix is slightly micritic, fragments of bioclasts, ?discreet dolomite rhombs and very rare echinoidal bioclasts. This bed yielded: *Ammobaculites advenus, Haplophragmoides kirki, H. neolinki* and the radiolarian sp. ?*Praeoconocaryomma universa*, associated with ostracods.

(30) Two nodular limestone beds (1.5 m thick each) separated by a creamy to yellowish marl bed (1.5 m thick). Thickness of unit = 4.5 m; cumulative thickness = 372.6 m.
Sample M44: dolomitic mudstone in which much of the matrix has been converted to microspar and pseudospar 30 %, mud matrix 10 - 20 %, micro dolomite-rhombs up to 50 % (discreet, well-formed and euhedral). Faunal content includes ostracods and echinoid fragments.

(31) Sequence of thinly-bedded nodular limestone with brick-like fractures, capped by an indurated dolomitic limestone (1 m thick), of light brown colouration. Thickness of unit = 10.5 m; cumulative thickness = 383.1 m.
Sample M45: limestone. Bivalve wackestone, matrix about 60 %, rich in bioclastic fragments 30 - 40 %. Faunal content includes mostly bivalves, with some unaltered oyster tests and ostracods. The majority have been replaced by blocky and equant spars, with some healed fractures (quiet-water inshore platform environments). This bed yielded: *Dicyclina schlumbergeri* and *Psammonyx* sp. 1, associated with ostracods.
Sample M46: indurated dolomitic limestone. Dolomitic mudstone, dolomite euhedral rhombs are corrosive of the matrix. It is a dirty interstitial mud, fracture set has been healed by calcite and anhydrite or gypsum.

Above sequence 31, the slope is covered by slumped blocks. The thickness of the sequence, covered by slumps up to the base of Wadi Sir Formation, is 124.5 m. The section continues on the asphalt road in the direction of Amman, on the northern flank of Wadi Mujib (Fig. 3.15). Here the succession corresponds to part of the covered sequence.

(32) Marl bed between two dolomitic limestone beds, above a massive nodular limestone. Thickness of unit = 0.5 m; cumulative thickness = 383.6 m.
Sample M57: marl. Euhedral dolomite, fine-grained, probably replacive of a mudstone, intercrystalline porosity of about 20 %. This bed yielded: *Ammobaculites advenus, A. subcretaceus, Ammomarginulina aburoashensis, A. cragini, Conorboides hofkeri, C.* sp. 2, *Evolutinella* sp. 1, *Haplophragmoides rugosa, Hemicyclammina evoluta* and *Serovaina orbicella,* associated with ostracods and ooids.

(33) Gypsum, greyish, massive and nodular, capped by a dolostone bed. Thickness of unit = 1.5 m; cumulative thickness = 385.1 m.
Sample M58: dolostone with some semi-rounded quartz grains and vertebrate remains.

(34) Gypsum, nodular. Thickness of unit = 1.5 m; cumulative thickness = 386.6 m.
Sample M59: gypsum.

(35) Marly limestone. Thickness of unit = 1.5 m; cumulative thickness = 388.1 m.
Sample M60: limestone. Wackestone, with silt-size grains, matrix has been changed to microspar - pseudospar. Faunal content includes abundant globular planktonic and some benthic foraminifera, ?*Globigerinelloides* sp., vertebrate remains, dissolution of the clasts.

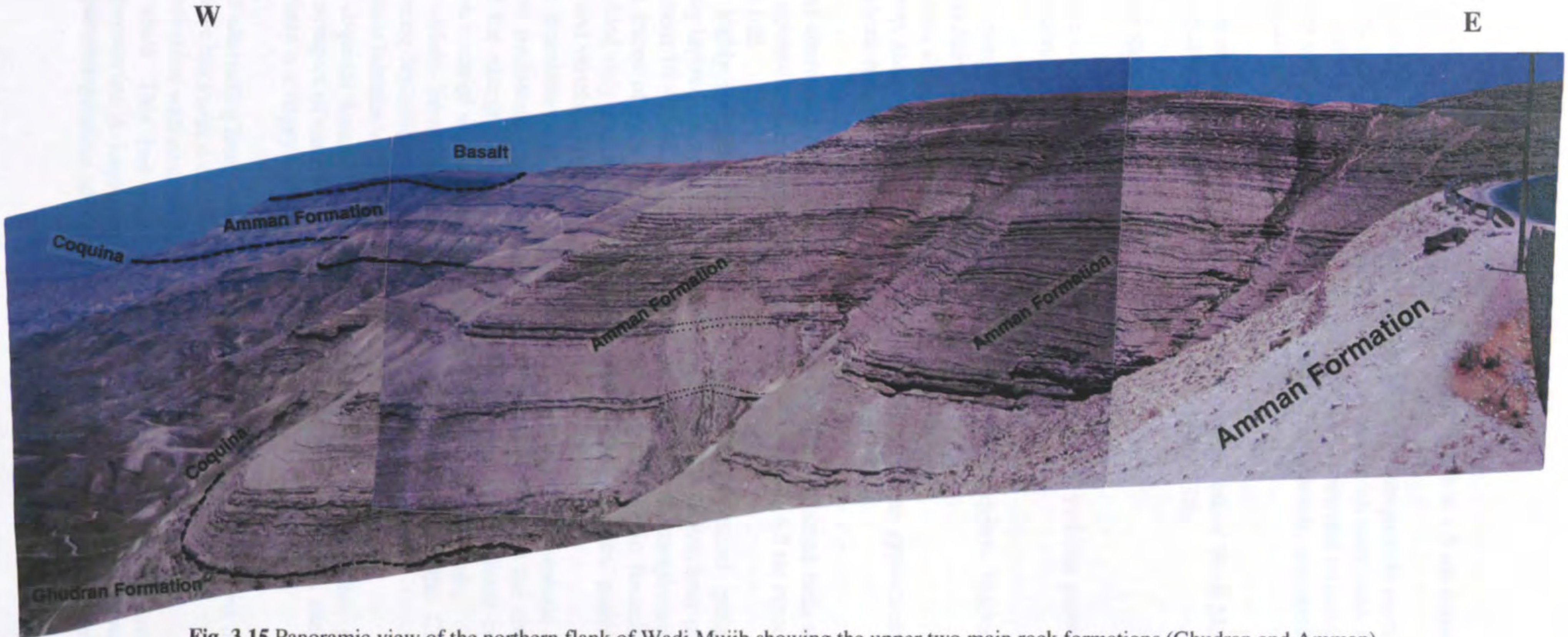

Fig. 3.15 Panoramic view of the northern flank of Wadi Mujib showing the upper two main rock formations (Ghudran and Amman).

(36) Gypsum bed capped by a limestone bed. Thickness of unit = 1.5 m; cumulative thickness = 389.6 m.
Sample M61: limestone. Peloidal micritised packstone with inter-particle porosity of about 30 %, and ?gypsum cement, some of the grains are coated, all micritised. Faunal content includes some ostracods and bivalves, possible gastropods and miliolids; rare quartz grains. This bed yielded: *Conorboides* sp. 2 and *C. umiatensis*, associated with ostracods and echinoid fragments.

The sequence continues in a section measured on the southern bank of Wadi Mujib, in a location situated about 2 km to the west of sequence 31 (Fig. 3.10).

3.3.4.2 Upper Shaly Member "A6"

This is a sequence of alternating beds of shales and limestones, yielding gastropods, oysters, other bivalves and vertebrate remains, as follows:

(37) Shale beds, sporadically exposed on a slope covered by talus debris. Thickness of unit = 21 m; cumulative thickness = 410.6 m.
Sample M49: base, shale with some irregular quartz grains.
Sample M50: top, shale with fine irregular quartz grains and some gypsum crystals, with some vertebrate remains (mainly teeth).

(38) Sequence of alternating beds of shale and limestone. The limestone beds tend to become thicker upward (reaching about 0.5 m). Thickness of unit = 4.5 m; cumulative thickness = 415.1 m.
Sample M51: highly fossiliferous limestone, with oysters. Ostracod grainstone, banded (distinctly layered), alternations of fragmented and whole valves; inter-particle porosity up to about 10 - 15 %. Both matrix and tests have been neomorphosed, with rare quartz and traces of mud (Fig. 3.15). This bed is quite poor in foraminiferal content and yielded only *Psammonyx* sp. 1, associated with ostracods, gastropods, echinoid spines and vertebrate remains.
Sample M52a: limestone with prominant bivalves at the base of limestone ledge. Ostracod bivalve packstone - grainstone, mud matrix remains inside the ostracod shells. Most of the matrix changed to microspar and pseudospar. Faunal content includes bivalves, some of which have been changed to quartz and ostracods.
Sample M52: oolitic limestone above the zone yielding trace fossils. Chert - anhydrite containing ?miliolids.
Sample M53: shale laminae with some gypsum grains.
Sample M54: coquinal limestone, with oysters. Mudstone - wackestone, poorly laminated with stringers of ostracod valves, bioclasts 10 - 15 %, matrix is altered to microspar, and there is a vuggy porosity due to dissolution.

(39) Sequence of alternating limestone (1.5 m) and shale (1 m) beds. Thickness of unit = 4.4 m; cumulative thickness = 419.5 m.
Sample M55: limestone with some irregular quartz grains.
Sample M56: shale. This bed yielded: *Ammoastuta nigeriana, Ammobaculites advenus, A. fragmentarius, A. naqbensis, A. obliquus, A. pagodensis, A. subcretaceus, A. turonicus, Ammomarginulina aburoashensis, A. barthouxi, A. blanckenhorni, A.*

cragini, A. sp. 1, *Ammomassilina* sp., *Ammotium hasaense, Astacolus liebusi, A.* sp. 1, *Bulbobaculites problematicus, Bulbophragmium aequale, Conorboides mitra, Cuneolina pavonia parva, Cyclammina haydeni, Evolutinella* sp. 1, *E. subevoluta, Flabellammina kaskapauensis, F.* sp. 1, *F.* sp. 2, *Gabonita levis aegyptiaca, Guembelitria cenomana, Haplophragmoides neolinki, H. fraseri, H. neolinki, Hormosina excelsa, Lituola nautiloidea, Massilina ginginensis, Placopsilina cenomana, Poroeponides praeceps, Pseudorhapydionina dubia, Pseudotextularia plummerae, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Reophax constrictus, R. parvulus, Scherochorella* sp., *Sculptobaculites loshkharvicus, Serovaina minutus, S. struvei, S. turonicus* and *Simplorbitolina* sp., associated with ostracods, gastropods and vertebrate remains.

3.3.5 Wadi Sir Formation "A7"

This formation is considered an index horizon through out the country. At Wadi Mujib, it consists of massive, dolomitised, cliff-forming coquinal limestones, with marly beds yielding ammonites. The limestones are often highly fossiliferous, yielding bivalves, gastropods and echinoids.

(40) Sequence of alternating soft and indurated limestone beds, each about 1.5 m thick. Thickness of unit = 76 m; cumulative thickness = 495.5 m.
Sample M62: indurated limestone, near the base of the succession. Wackestone with bioclasts 40 %, matrix slightly micritised, most clasts have been replaced by spar. Faunal content includes bivalves, small benthic foraminifera, echinoid spines, sponges and ostracod fragments.
Sample M63: marl, 1 m thick. This bed yielded: *Conorboides hofkeri, Donsissonia* sp., *Flabellammina alexanderi, Gavelinopsis tourainensis, Nezzazata concava, Poroeponides praeceps, Serovaina minutus, S. pseudoscopus, S. simplex* and *S. turonicus*, associated with ostracods, molluscs, echinoid spines and vertebrate remains.
Sample M64: oyster bank near the base of an indurated limestone bed, 0.5 m thick. Bioclastic wackestone - mudstone, bioclasts have been partially replaced by silica (chalcedony). Faunal content includes echinoid and bivalve debris. This bed yielded: *Conorboides* sp. 2, *Donsissonia* sp., *Gavelinella nacatochensis, G. umbilicata, Gavelinopsis proelevata, G. tourainensis, Poroeponides praeceps, Serovaina struvei, Trochospira avnimelichi* and *Valvulineria loetterlei*, associated with ostracods, molluscs, bryozoans and echinoid fragments.
Sample M65: limestone, 0.5 m thick. Wackestone - grainstone, some glauconitic grains, abundant echinoid, sponges and bivalves, forming 50 - 60 %, that have been partially replaced and changed to microspar. Matrix forming about 50 - 55 %, (open marine environments). This bed yielded: *Eponides whitei, Gavelinopsis tourainensis, Nezzazata concava* and *Poroeponides praeceps*, associated with ostracods, gastropods, bivalves and echinoid fragments.
Sample M66: marl, 1.5 m thick. Total thickness of sequence not measured. This bed yielded: *Ammobaculites advenus, Conorboides* sp. 2, *Gavelinopsis proelevata, G. tourainensis* and *Serovaina minutus*, associated with ostracods, bivalves and echinoid fragments.

At a higher stratigraphic horizon, on the road from Karak to Amman (S2, Fig. 3.9):

(41) Sequence of marly limestones and limestones, highly fossiliferous (mainly oysters). Thicknesses of limestones are about 0.5 m and marls about 1 m. Thickness of unit = 52 m and the total thickness of Wadi Sir Formation is estimated after Abed (1982) to be 128 m; cumulative thickness = 547.5 m.
Sample M67: highly fossiliferous limestone with oysters, 1 m thick. Wackestone with mud matrix. Faunal content includes echinoids, bivalves, ostracods and gastropods. Chalcedonic silica is growing as spheres with the bioclasts.
Sample M68: shale with echinoids and oysters, 1 m thick. Mudstone with rare bivalve clasts, partially replaced by silica. This bed yielded: *Conorboides* sp. 2, *Gavelinopsis tourainensis, Poroeponides praeceps* and *Serovaina minutus*, associated with ostracods, bivalves, gastropods and echinoid spines.

Stopped at a stratigraphic horizon lying about 20 m above sequence 40 (Fig. 3.9):
Sample M69: macrofossils, from a sequence as 41. Dolomitic wackestone with discreet euhedral rhombs growing in a mud matrix and locally corrosive of the bioclasts, which are partially replaced by silica. Bioclasts constituting 40 % and the matrix 20 %. Faunal content includes bivalves, echinoids and worm tubes. This bed yielded: *Gavelinella stephensoni, Gavelinopsis abudurbensis, Poroeponides praeceps, Reissella ramonensis* and *Serovaina pseudoscopus*, associated with ostracods, gastropods and echinoid spines.

3.3.6 Ghudran Formation "B1"

This formation was originally called the Ruseifa Formation Abed, 1982, p. 88), although it does not outcrop in the Ruseifa area. It consists of soft white chalks and marls which are well exposed at Wadi Ghudran Al-Deib, NW of Amman, and hence the unit has been renamed the Ghudran Formation. The formation is equivalent to the unit "B1" of Burdon (1959). The thickness of this formation, in its type section, is 52 m, consisting wholely of chalk and marl. It is considered one of the most important aquifers in Jordan. The formation is well developed at Wadi Mujib (Figs. 3.15), where it consists of soft white chalks and marls.

Above sequence 31, the slope is covered by slumped blocks. Among the blocks, it was possible to recognise the chalk of the Ghudran Formation, capped by chert beds of the Amman Formation in stratigraphic continuity.
Sample M47: chalk of Ghudran Formation. This bed yielded: *Ammoastuta nigeriana, Anomalinoides pinguis, Archaeoglobigerina blowi, Concavatotruncana asymetrica, C. concavata, C. imbricata, Dentalinoides canulina, Eoheterohelix* sp., *Fissurina laevigata, Frondicularia clarki, F. lanceolata, Gabonita distorta, Gavelinella burlingtonensis, G. farafraensis, G. involuta, G. lorneina, G. pertusa, G. sandidgei, G. whitei, Gavelinopsis abudurbensis, Globigerinelloides caseyi, G. prairiehillensis, G. ultramicra, Globotruncana linneiana, Hedbergella delrioensis, H. flandrini, Heterohelix calabarflanki, H. dentata, H. globulosa, H. pseudotessera, H. reussi, H.* sp. 1, *Laevidentalina* sp., *Lenticulina modesta, Marginotruncana marginata, Mucronina* sp., *Neoflabellina kypholateris, N. suturalis, Pseudotextularia nuttalli, Pseudotextulariella* sp. 1, *Textularia subconica, Vaginulina cretacea, V. plummerae, V. recta, V. trilobata, Valvalabamina lenticula, Whiteinella aprica, W. archaeocretacea* and *W. inornata*, associated with ostracods.

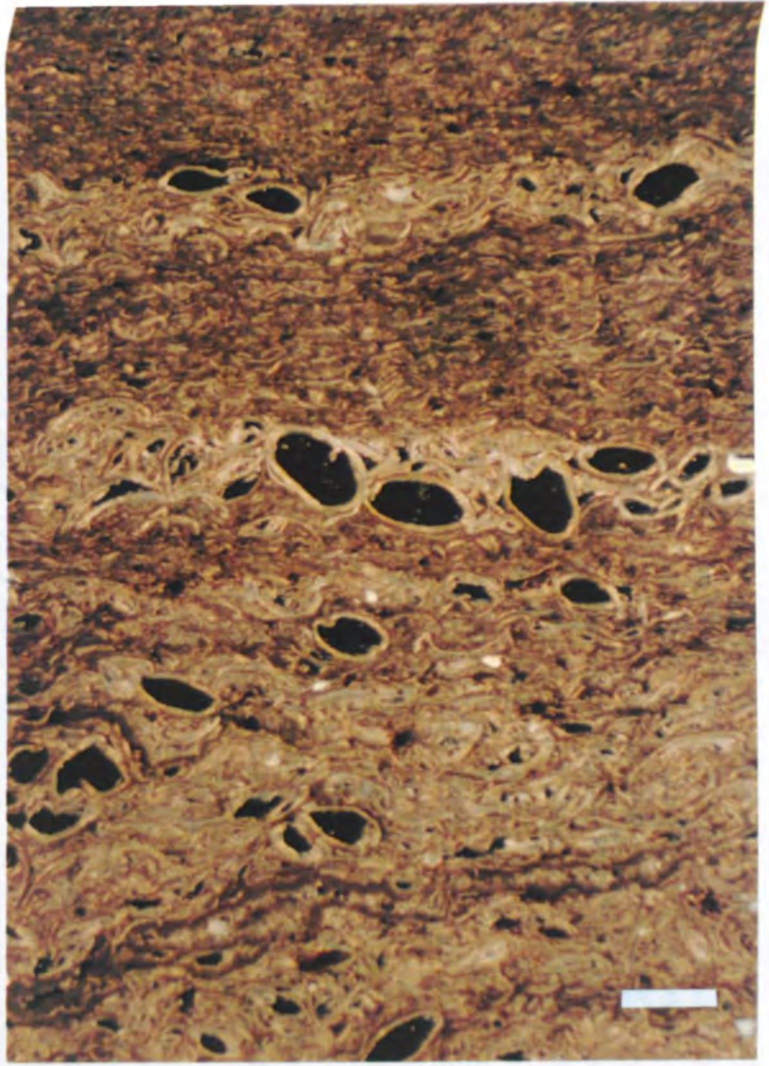

Fig. 3.16 Banded ostracod grainstone. Sample M51, and
Upper Shaly Member "A6", Shueib Formation,
Wadi Mujib (XPL, X 25).

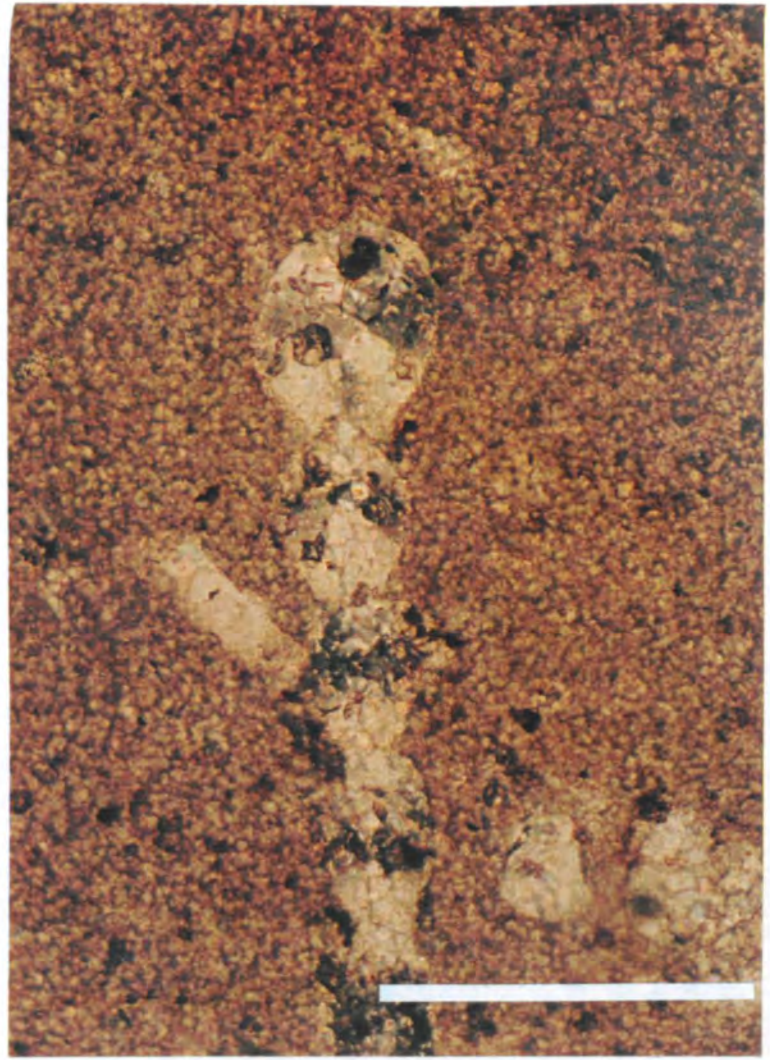

Fig. 3.17 Ostracod foraminiferal wackestone with echinoid clasts, uniserial

globular foraminifera, locally replaced by spar. Matrix microspar and Sample
pseudospar. M72, Ghudran Formation "B1", Wadi Mujib (PPL, X 100).

(42) Chalk, white. Thickness of unit = 6 m; cumulative thickness = 553.5 m.
Sample M70: This bed yielded: *Cibicides beadnelli, Frondicularia lanceolata, Gavelinella burlingtonensis, G. cristata, G. lorneina, Gavelinopsis abudurbensis, Globotruncana linneiana, G. orientalis, G. rugosa, Hedbergella monmouthensis, H. simplex, Heterohelix nkporoensis, H. reussi, H. striata compressa, Hopkinsina arabina, Lenticulina californiensis, Marginotruncana marginata, Neobulimina canadensis, Neoflabellina suturalis, Pseudotextularia nuttalli, Vaginulina cretacea, V. recta, Valvalabamina lenticula, Whiteinella aprica, W. baltica* and *W. inornata*, associated with ostracods and vertebrate remains.
Sample M71: This bed yielded: *Ammodiscoides turbinatus, Bolivinopsis clotho, Cassidella navarroana, Costellagerina bulbosa, Dorothia pontoni, Gavelinella burlingtonensis, G. cristata, G. involuta, G. lorneina, G. pertusa, G. stephensoni, Gavelinopsis abudurbensis, G. proelevata, Globotruncana orientalis, G. rugosa, Hedbergella delrioensis, H. flandrini, H. monmouthensis, H. simplex, Heterohelix globulosa, H. pseudotessera, H. reussi, Hopkinsinella* sp., *Lenticulina californiensis, L. rotulata, Marginotruncana paraconcavata, M. pseudolinneina, M. renzi, Nonionella cretacea tamilensis, N. robusta, Planoglobulina brazoensis, Poroeponides praeceps, Praebulimina reussi, Quasispiroplectammina navarroana, Q. nuda, Sigalitruncana pileoliformis, Textularia subconica, Vaginulina plummerae* and *V. recta*, associated with ostracods, echinoid spines and vertebrate remains.

(43) Sequence of limestone and marl, with chert nodules. Thickness of unit = 6 m; cumulative thickness = 559.5 m.
Sample M72: limestone. Ostracod foraminiferal wackestone with echinoid clasts, some vertebrate remains, uniserial and globular foraminifera, locally replaced by spar. Matrix microspar and pseudospar (Fig. 3.17).
Sample M73: marl, 0.5 m thick, with vertebrate remains (mainly teeth).
Sample M74: marly limestone. Dolomitic wackestone - mudstone, discreet dolomite rhombs in the matrix, abundant globular foraminifera (microscopic in size), indicating open-marine environments. This bed yielded: *Anaticinella multiloculata, Bolivinopsis clotho, Brizalina lowmani, Contusotruncana fornicata, Dorothia pontoni, Elhasaella alanwoodi, Fissurina laevigata, F. oblonga, Gavelinella lorneina, Globigerinelloides alvarezi, G. bentonensis, Hedbergella flandrini, H. hoelzli, H. holmdelensis, H. monmouthensis, H. simplex, Heterohelix dentata, H. globocarinata, H. pseudotessera, H. reussi, H. striata compressa, Hiltermannella* cf. *kochi, Lagena paucicosta, Lenticulina rotulata, Loxostomoides cushmani, Neoflabellina suturalis, Plectina ruthenica, Praebulimina aspera, Pseudotextularia plummerae* and *Pyramidulina distans*, associated with ostracods, gastropods, echinoid spines and vertebrate remains.

3.3.7 Amman Formation "B2"

This formation was originally defined by Masri (1963), and is equivalent to unit "B2" of Burdon (1959). The formation is well developed at Wadi Mujib where it consists of a sequence of fossiliferous recrystallised limestones and dolostones with numerous intercalations of bedded chert. The Amman Formation may be subdivided into two: a Lower Silicified Limestone Member; an Upper Phosphatic Silicified Limestone Member (designated as the Phosphorite Unit by Bender, 1974).

3.3.7.1 Lower Silicified Limestone Member

This is the lower sequence of Amman Formation, yielding very rare phosphatic beds. It can be differentiated from other Upper Cretaceous rock units by the presence of chert beds which are typically up to 2 m thick in areas like Ruseifa and Amman, or more than 5 m at Wadi Mujib (Fig. 3.15). The base of this member (Bed M75) is taken as the incoming of bedded cherts above the massive limestone beds below. The lower part of this member includes also some thin beds of shales (Bed M86)

(44) Silicified coquinal limestone. Thickness of unit = 1 m; cumulative thickness = 560.5 m.
Sample M75: coarse dolostone replacive burrows, gastropods or colonial bryozoan (Fig. 3.18), with some vertebrate remains, mainly teeth.

(45) Dolomitised coquinal limestone, with oysters. Some dissolution cavities parallel to bedding are observed. The cavities are filled with calcite crystals. Thickness of unit = 3 m; cumulative thickness = 563.5 m.
Sample M76: Dolostone replacement of probably bivalve wackestone with some vuggy porosity.

The Amman Formation was further sampled on the asphalt road from Amman to Ma'an (Fig. 3.9, 19):

(46) Sequence of cross-bedded phosphatic calcarenite, with fish teeth, alternating with calcareous siltstone and chert beds. Thickness of unit = 20 m; cumulative thickness = 583.5 m.
Sample M77: cross-bedded dolostones and calcarenite. Dolomitic wackestone with quartz fragments and replaced bioclasts, euhedral and anhedral dolomite with a few quartz grains. The fauna includes vertebrate remains.
Sample M77a: a partially dolomitised mudstone, fractures have been filled with calcite (blocky spar), dolomite replacement is patchy and follows burrows, occuring as distinct rhombs or as anhedral masses, with rare ostracod fragments and fine siliceous matrix.
Sample M78: limestone. Dolomitic wackestone with quartz fragments and replaced bioclasts, similar to sample M77a with the exception of the presence of phosphate. This bed is quite poor in foraminiferal content and yielded only *Gublerina ornatissima*, associated with vertebrate remains and oolites.
Sample M79: chert. Banded mudstone and wackestone stringer, very fine bioclasts, possibly phosphatic carbonaceous material.
Sample M80: dolostone with siliceous mud. Dolomitic mudstone with euhedral rhombs constituting 70 %, matrix is calcareous mud replaced by the growth of dolomite rhombs, quartz-sand grains constituting 2 % of the rock, grains subangular to subrounded; phosphate and common vertebrate material.
Sample M48: banded mudstone which has been partially changed or altered to microspar - pseudospar. Faunal content includes vertebrate teeth.
Sample M81: phosphatic bed with common vertebrate remains.

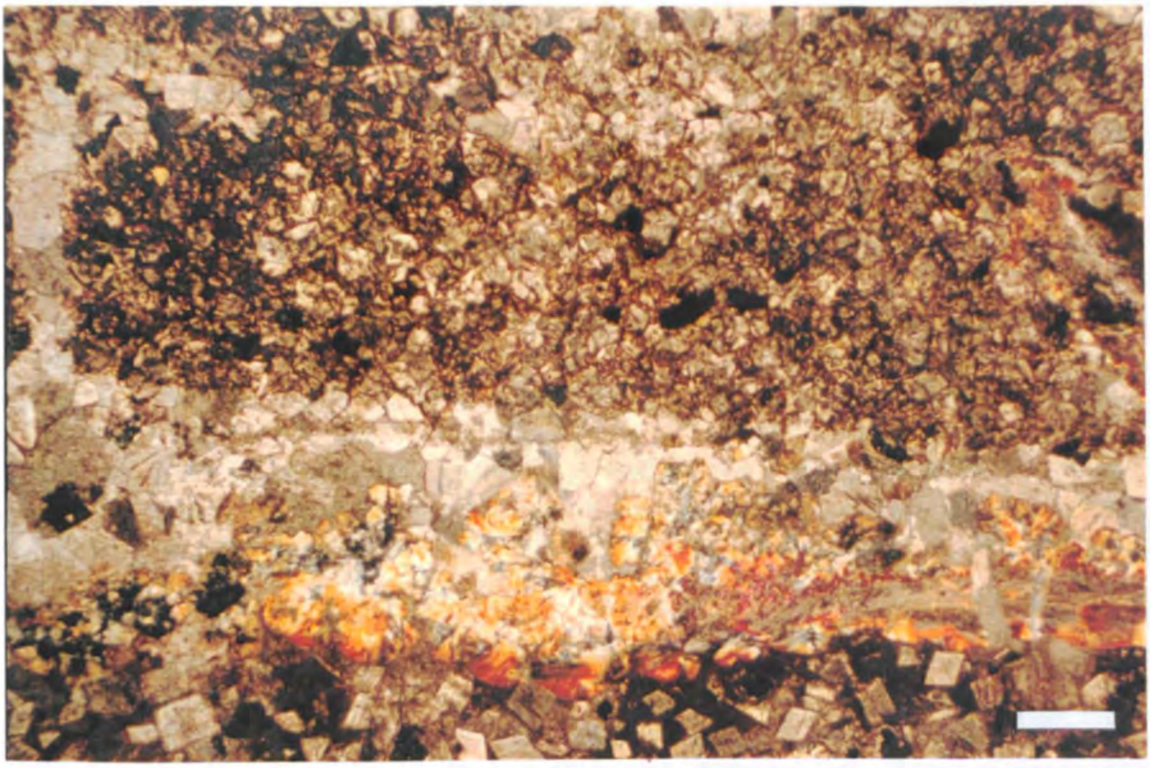

Fig. 3.18 Coarse dolomite replacing burrow-fills and gastropod shell. Sample M75, Lower Silicified Limestone Member, Amman Formation "B2", Wadi Mujib (XPL, X 25).

Fig. 3.19 Photograph showing Unit "3" of the Amman Formation at Wadi Mujib (height of section is 6 m).

(47) Beds of "tripoli" (fine-grained siliceous deposit) intercalated with chert bands. At top of the succession the chert bands are more frequent. Thickness of unit = 6 m; cumulative thickness = 589.5 m.
Sample M82: dolomitic replacive rock, euhedral rhombs constituting 75 - 80 % of the rock, silica replacement of vertebrate material, phosphatic material constitutes 10 % of the rock.
Sample M83: tripoli. Banded mudstone with vertebrate material, some other phosphatic material.
Sample M84: white chert. Very fine grained mud-siltstone, with no distinguishable grains or bioclasts.
Sample M85: tripoli. The matrix is mud siltstone, argillaceous mudstone, dolomitic material constitutes 30 % of rock.
Sample M85a: dolomitised mudstone - wackestone with phosphate; vertebrate material (?shark's teeth) is common to abundant. Phosphate pellets constituting 2 % and the dolomite rhombs 85 % of the rock; the rhombs are distinct euhedral-shaped (zoned or cored).

(48) Sequence of marl and shale beds intercalated by chert bands. Thickness of unit = 20 m; cumulative thickness = 609.5 m.
Sample M86: shale. This bed yielded: *Ammodiscus cretaceus, Concavatotruncana concavata, Costellagerina bulbosa, Gabonita billmani, G. bipyramidata, G. multituberculata, G. parva, G. sumaya, G. zigzaga, Globigerinelloides bollii, Globotruncana orientalis, G. rugosa, Gublerina ornatissima, G. robusta, Hedbergella holmdelensis, H. monmouthensis, Heterohelix dentata, H. glabrans, H.* sp. 1, *H. striata compressa, H. vistulaensis, Marginotruncana marginata, Nonionella robusta, Planoglobulina brazoensis, P. multicamerata, Rugotruncana subcircumnodifer, Tristix coloi* and *Ventilabrella glabrata.*
Sample M87: shale taken from top of the sequence. This bed yielded: *Archaeoglobigerina blowi, Contusotruncana fornicata, C. patelliformis, Fissurina laevigata, Gabonita sumaya, Globotruncana mariei, Globotruncanita stuartiformis, Gublerina ornatissima, G. robusta, Hedbergella holmdelensis* and *Lenticulina californiensis*, associated with ostracods and vertebrate remains.

(49) Coralline limestone, overlying a hardground, with a lenticular nature. Thickness of unit = 0.3 m; cumulative thickness = 609.8 m.
Sample M88: coralline limestone. Fractured mudstone - siltstone, local and partial replacement with dolomite, very fine-grained ?siliceous and benthic foraminifera that have been filled with silica, indicating marine environments. This bed yielded: *Costellagerina bulbosa, Eponides* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Gavelinella cristata, G. whitei, Gavelinopsis abudurbensis, G. tourainensis, Globigerinelloides messinae, Hedbergella monmouthensis, Heterohelix globulosa, Lenticulina modesta, Marssonella oxycona, M. trochus, Nonionella cretacea tamilensis, Plectina ruthenica, Serovaina orbicella, Valvalabamina lenticula* and *Valvulineria loetterlei*, associated with ostracods, echinoid spines and vertebrate remains.

(50) Chalky limestone with fossil fragments. Thickness of unit = 0.5 m; cumulative thickness = 610.3 m.

Sample M89: limestone. Banded silty mudstone, forming a very distinct boundary with packstone /grainstone which includes abundant vertebrate remains and some phosphates; the matrix is dolomitised. Bioclasts constitute 90 % of the rock, and the dolomitised matrix forms only 5 - 10 %. This bed yielded: *Cassidella navarroana, Gavelinella whitei, Gavelinopsis abudurbensis, Gublerina ornatissima, Gyroidinoides nitida, Hedbergella holmdelensis, H. monmouthensis, Heterohelix glabrans, H. globulosa, H. nkporoensis, Lenticulina carlsbadensis, Marginotruncana marginata, Nonionella robusta* and *Valvalabamina lenticula*, associated with ostracods, vertebrate remains and ooids.

(51) Chalk with disseminated calcite crystals. The bed includes vertebrates teeth and *Baculites* sp. at its top. Thickness of unit = 20 m; cumulative thickness = 630.3 m.
Sample M90: chalk. This bed yielded: *Archaeoglobigerina blowi, Arenobulimina amanda, Contusotruncana fornicata, C. plummerae, Dentalina hammensis, D.* sp. 1, *Dentalinoides canulina, Elhasaella alanwoodi, Gabonita tiarella, Gaudryina rugosa, Gavelinella burlingtonensis, G. lorneina, G. stephensoni, G. whitei, Gavelinopsis abudurbensis, Globigerinelloides alvarezi, G. bollii, G. messinae, G. prairiehillensis, Globotruncana arca, G. bulloides, G. mariei, G. orientalis, G. rugosa, Globotruncanita subspinosa, Gyroidinoides nitida, G. muwaqqarensis, Hedbergella holmdelensis, H. monmouthensis, Heterohelix glabrans, H. globulosa, H. globocarinata, H. nkporoensis, H. striata compressa, Hopkinsina arabina, Laevidentalina catenula, L. gracilis, L.* sp., *Lagena paucicosta, Lenticulina carlsbadensis, L. muensteri, L. taylorensis, Marginotruncana coronata, M. marginata, Neoflabellina leptodisca, N. suturalis, Nodosaria limbata, Nonionella cretacea tamilensis, Praebulimina angulata, P. aspera, P. carseyae, P. trihedra, Pseudotextulariella* sp. 1, *Pyramidina triangularis, Pyramidulina distans, P. latejugata, P. proboscidea, P. septemcostata, P. zippei, Rugotruncana subcircumnodifer, Vaginulinopsis directa, Valvalabamina lenticula, Valvulineria loetterlei* and *Ventilabrella glabrata*, associated with ostracods, vertebrate remains and oolites.
Sample M91: chalk from the middle of the succession. Foraminiferal wackestone, matrix is argillaceous, slightly silicified mudstone. Faunal content includes uniserial elongate foraminifera and abundant coiled planktonic and benthic foraminifera, likely either phosphatic or carbonaceous filling of the individual grain rings, constituting 20 %, matrix is 80 % (Fig. 3.20). This bed yielded: *Archaeoglobigerina blowi, A. cretacea, Bolivina decurrens, B. incrassata, Citharina suturalis, Contusotruncana fornicata, Dentalina marcki, D.* sp. 1, *Frondicularia lanceolata, Gabonita levis, Gavelinella stephensoni, Globigerinelloides volutus, Globotruncana arca, G. mariei, G. orientalis, G. rosetta, G. rugosa, Globotruncanella havanensis, Globotruncanita elevata, G. subspinosa, Gyroidinoides muwaqqarensis, Heterohelix glabrans, H. striata compressa, Hopkinsina arabina, Kyphopyxa christneri, Laevidentalina aphelis, L. gracilis, L. longiscata, L.* sp., *L. vistulae, Lenticulina carlsbadensis, L. mellahensis, Marginotruncana marginata, M. sinuosa, Mucronina* sp., *Neoflabellina kypholateris, N. leptodisca, Nodogerina bradyi, Nodomorphina* sp. 1, *Praebulimina trihedra, Pyramidulina distans, P. raphinistrum, Rugoglobigerina jordani, R. pilula, R. rugosa, Vaginulinopsis directa* and *Valvulinoides umovi*, associated with ostracods, echinoid spines, vertebrate remains and ooids.
Sample M92: chalk, near the top of succession.

3.3.7.2 Upper Phosphatic Silicified Limestone Member

This member consists of a sequence of recrystallised limestones and dolostones with intercalations of chert and phosphatic beds. The sequence at Wadi Mujib yields frequent phosphate beds. This member is differentiated from the underlying unit in having less chert and a higher percentage of phosphatic deposits (Fig. 3.15). When the phosphates are not appreciably silicified, they constitute valuable exploitable phosphate deposits (as at Ma'an in the south).

(52) Alternating beds of chert, chert breccia and dolostone. Thickness of unit = 80 m; cumulative thickness = 710.3 m.

Sample M93: chert. Banded mudstone, fractures filled partially with calcite and anhydrite, indistinct pellets (?carbonaceous).

Sample M94: dolostone with cross-lamination. Mudstone with rare bioclasts, bivalves replaced by blocky calcite spar.

Sample M95: chert breccia. Mainly replacement of dolostone, with 15 % intercrystalline porosity.

Sample M96: marl (?biomicrite), 5 m thick. Neomorphosed rock, probably mudstone - wackestone, slightly dolomitised matrix, with peloidal structure, forming 50 % of the highly altered rock, phosphate pellets constituting 15 %, fine-grained matrix 35 %. This bed yielded: *Fissurina alveolata, Globigerinelloides alvarezi, G. caseyi, G. prairiehillensis, G. volutus, Hedbergella holmdelensis, Neodiscorbinella* sp. 1, *Oolina globulosa* and *Stensioeina exsculpta*, associated with ostracods and vertebrate remains.

Sample M97: silicified coquina. Mudstone - wackestone, probably included originally foraminifera and possibly ostracods. The rock includes euhedral dolomite rhombs, patches of amorphous-structured carbonate grains and silt-size quartz. This bed yielded: *Ceratobulimina cretacea, Fissurina alveolata, F. oblonga, Globigerinelloides volutus* and *Lenticulina modesta*, associated with ostracods and vertebrate remains.

Sample M98: marl. This bed yielded: *Bulimina kirri, Globigerinelloides alvarezi, G. volutus, Hedbergella holmdelensis, Heterohelix globocarinata, H. globulosa, H. pseudotessera, H. striata compressa, H. vistulaensis, Neodiscorbinella* sp. 1, *Nonion jarvisi, Nonionella robusta, Planoglobulina multicamerata, Protelphidium martinii, Valvalabamina lenticula* and *Ventilabrella glabrata*, associated with ostracods, gastropods and vertebrate remains (teeth).

Sample M99: marl. Silty mudstone, very fine-grained, with rare foraminifera and euhedral dolomite rhombs, the matrix constitutes 95 % of the rock. This bed yielded: *Bulimina kirri, Globigerinelloides messinae, G. multispinata, G. ultramicra, Oolina globulosa* and *Ventilabrella glabrata*, associated with bivalves and vertebrate remains.

Sample M100: phosphatic bed, 1 m thick. Bivalve lumachelle with abundant large phosphate pellets, with mud matrix constituting about 10 %, bivalves 60 - 70 % and phosphate 20 - 25 % of the rock (Fig. 3.21). This bed yielded: *Fissurina alveolata, Globigerinelloides volutus, Heterohelix globulosa, H. pseudotessera* and *Protelphidium martinii*, associated with ostracods, bivalves, gastropods, echinoid spines and vertebrate remains (teeth).

Sample M101: limestone, 1 m thick. Banded peloidal packstone, phosphate pellets, abundant foraminifera, ?echinoid and ostracod fragments; the rock is very

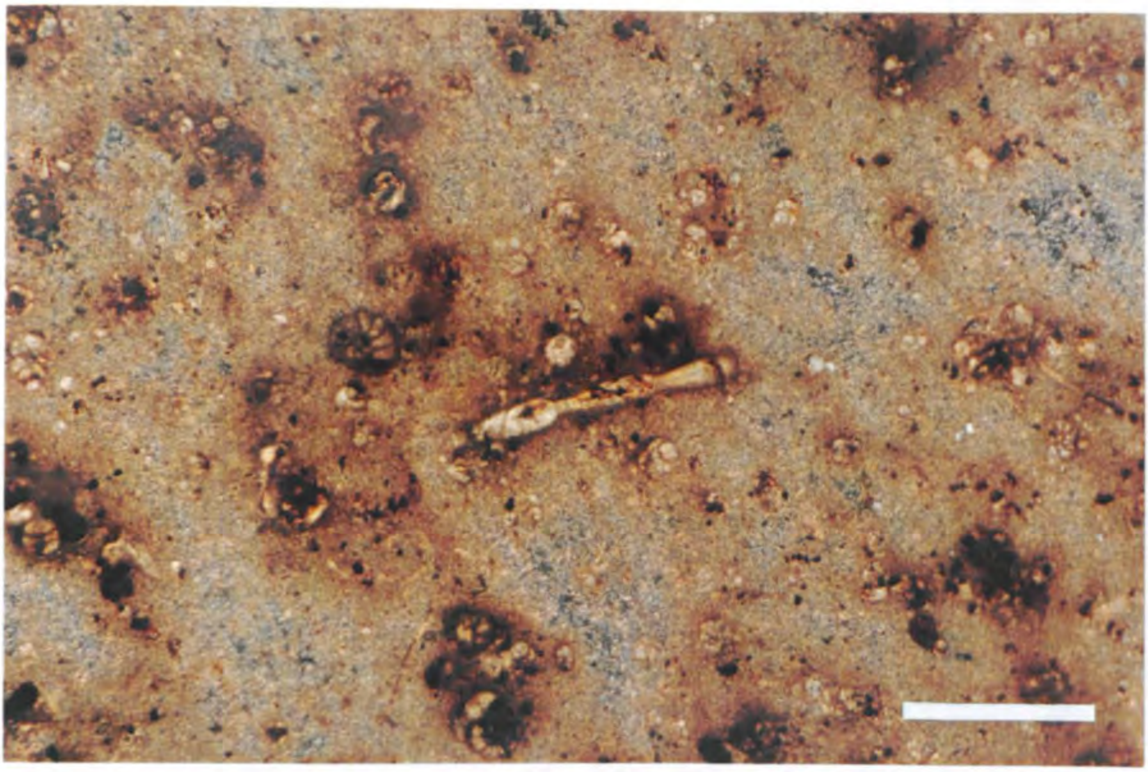

Fig. 3.20 Foraminiferal wackestone, matrix is an argillaceous, slightly silicified mudstone. Faunal content includes uniserial elongate foraminifera and abundant coiled planktonic and benthonic foraminifera. Sample M91, Lower Silicified Limestone Member, Amman Formation "B2", Wadi Mujib (XPL, X 50).

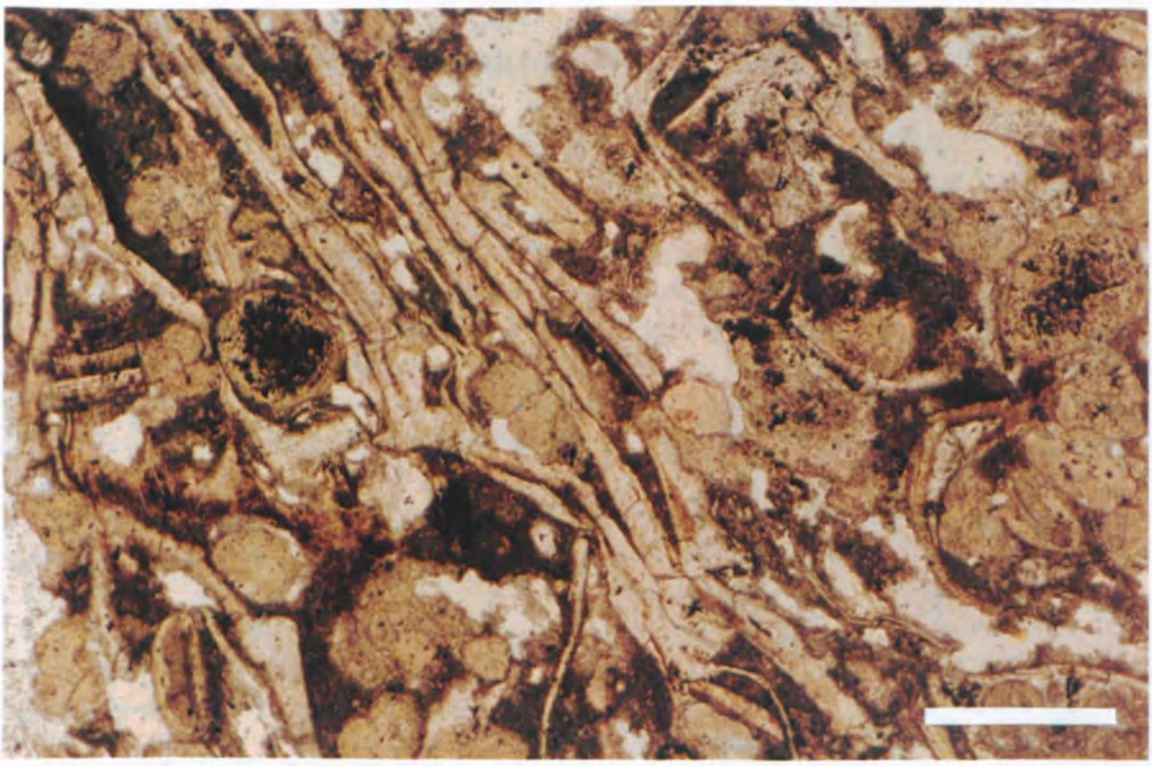

Fig. 3.21 Bivalve lumachelle with abundant large phosphate peloids. Sample M100, Upper Phosphatic Silicified Limestone Member, Amman Formation "B2", Wadi Mujib (PPL, X 50).

distinctively banded (Fig. 3.22). This bed yielded: *Ceratolamarckina parva, Nonion jarvisi, Protelphidium martinii, Stensioeina exsculpta, S. exsculpta gracilis* and *Valvulineria correcta.*
Sample M102: dolomitised limestone. Replacement banded dolostone, with calcite and quartz filling of the fractures. Euhedral dolomite having cored and dirty rhombs, constituting 95 %, with abundant silica.

(53) Sequence of marly limestone beds with thin chert bands (each 30 cm thick). Thickness of unit = 30 m; cumulative thickness = 740.3 m.
Sample M103: marl. This bed yielded: *Cribroelphidium vulgare, Fissurina alveolata, Gyroidinoides nitida, Nonion jarvisi* and *Protelphidium martinii*, associated with ostracods and vertebrate remains.
Sample M104: limestone. Wackestone, neomorphosed, probably dolomitised, rich in ?calcispheres and probable ostracod fragments. Calcispheres constitute 30 % of the rock, some of which have phosphate fills, have been fractured and filled with quartz. This bed yielded: *Ceratolamarckina parva, Fissoelphidium operculiferum, Gavelinella whitei, Nonion jarvisi* and *Protelphidium martinii.*
Sample M105: marly limestone. Silicified foraminiferal siliceous-sponge wackestone. Faunal content includes abundant monaxon-sponge spicules, common uniserial and biserial foraminifera, and ostracods (Fig. 3.23). This bed yielded only *Gavelinella whitei*, associated with echinoid spines and vertebrate remains.
Sample M106: silicified limestone. Mudstone - wackestone, mud matrix rare, dolomite rhombs, with common to abundant foraminifera (mostly biserial), rare sponge spicules, many foraminifera have chambers filled by silica.
Sample M107: chalk. Laminated wackestone - packstone, with very distinct lamination. Faunal content includes foraminifera, ostracods, rare calcispheres; bioclasts constituting 60 - 65 % of the rock.
Sample M108: phosphatic chert bed. Bivalve-rich foraminiferal wackestone. Bivalves constitute 60 % of the rock, foraminifera 5 % and mud matrix 35 % which is locally peloidal. Bivalves are replaced either completely or with discrete spheres of chalcedonic silica (Fig. 3.24). This bed yielded: *Ceratolamarckina parva, Cribroelphidium vulgare, Fissoelphidium operculiferum, Gavelinella cristata, G. whitei, Nonion jarvisi, Protelphidium hofkeri* and *P. martinii.*
Sample M109: marly limestone. Silicified banded wackestone, with common large foraminifera, algal clasts, slightly silicified (Fig. 3.25). This bed yielded: *Ammodiscoides turbinatus, Ceratolamarckina parva, Dictyopsella cuvillieri, Planoglabratella* sp., *Protelphidium hofkeri* and *P. martinii*, associated with ostracods.
Sample M110: oolitic limestone. Oolitic limestone with semi-rounded quartz grains and calcite crystals.

3.4 Wadi Mussa

The section was sampled in July 1988. It starts at the mouth of a Wadi on the left side of the road coming from Shubak, at the entrance of the village of Wadi Mussa (Fig. 1.1). A total of 60 samples were collected through the sequence (Figs. 3.26, 27). The sequence (218 m) is described from base to top (Fig. 3.28), as follows:

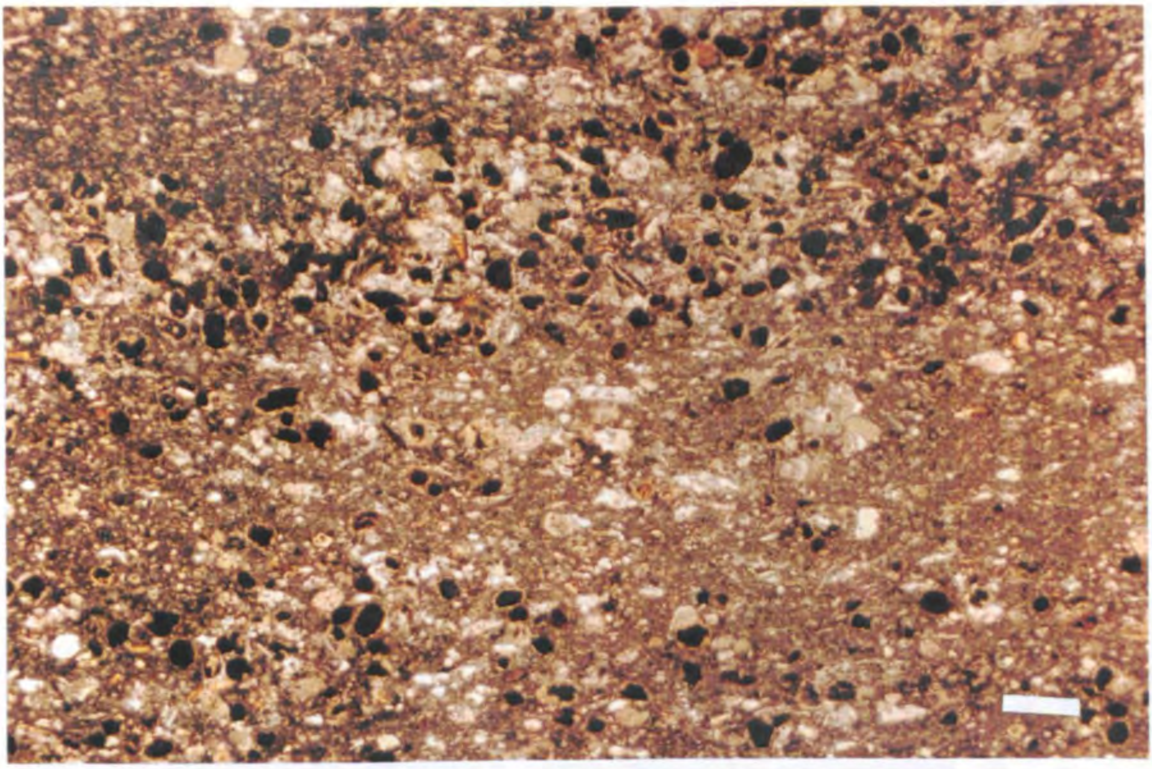

Fig. 3.22 Banded peloidal packstone composed of phosphate peloids, foraminifera, ?echinoid and ostracod fragments. Sample M101, Upper Phosphatic Silicified Limestone Member, Amman Formation "B2", Wadi Mujib (XPL, X 20).

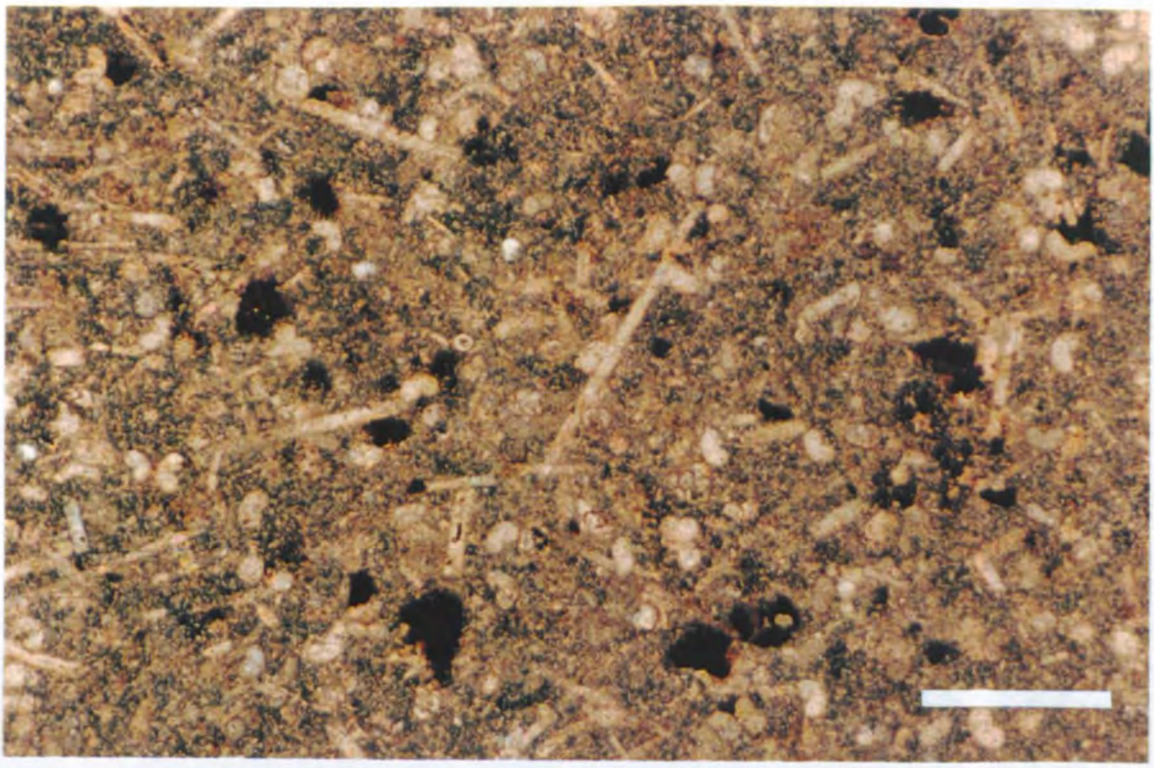

Fig. 3.23 Silicified foraminiferal siliceous-sponge wackestone. Sample M105, Upper Phosphatic Silicified Limestone Member, Amman Formation "B2", Wadi Mujib (XPL, X 50).

Fig. 3.24 Silicified bivalve bioclast in a foraminiferal wackestone. Sample M108, Upper Phosphatic Silicified Limestone Member, Amman Formation, Wadi Mujib (XPL, X 20).

Fig. 3.25 Banded silicified wackestone, with common large benthic foraminifera, algal clasts, and silicified shell debris. Sample M109, Upper Phosphatic Silicified Limestone Member, Amman Formation, Wadi Mujib (XPL, X 50).

3.4.1 Na'ur Formation "A1" & "A2"

This formation was recognised easily in the field at Wadi Mussa, above the variegated sandstone of Kurnub Formation (Fig. 3.29), and below the marly sequence of the Fuheis Formation.

3.4.1.1 Lower Marly Member "A1"

This member consists at Wadi Mussa (Figs. 3.28, 29) of thinnly bedded marly limestones, as follows:

(1) Sequence of thin beds of marly limestone, cliff-forming, capped by a thicker bed of massive, nodular limestone. Thickness of unit = 1.5 m.
Sample P1: thinly bedded marly limestone. This bed yielded: *Arenobulimina chapmani, Cassidella tegulata, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, Haplophragmoides excavatus, H. famosus, H. kirki, Plectina ruthenica, Praebulimina prolixa longa, P. reussi navarroensis, Pyramidina triangularis, Quadrimorphina camerata, Quasispiroplectammina navarroana, Sestronophora* sp., *Trochammina afikpensis, T. boehmi* and *T. rummanensis*, associated with ostracods.
Sample P2: nodular limestone. This bed is quite poor in fauna and yielded only the arenaceous foraminifera *Astacolus liebusi.*

(2) Soft yellowish marl. Thickness of unit = 0.3 m; cumulative thickness = 1.8 m.
Sample P3: marl. This bed yielded: *Ammobaculites naqbensis, Bolivinopsis clotho, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, Gavelinopsis tourainensis, Globigerinelloides bentonensis, Haplophragmoides kirki, Quasispiroplectammina navarroana, Quinqueloculina antiqua angusta, Spiroloculina cretacea, Trochammina afikpensis, T. boehmi* and *Valvulineria camerata*, associated with smooth and ornamented ostracods, molluscs, echinoid spines and vertebrate remains.

(3) Massive succrosic dolostone, cliff-forming. Thickness of unit = 1 m; cumulative thickness = 2.8 m.
Sample P4: replacement dolostone, variable rhomb-size distribution with coarser rhombs replacive of bioclasts and filling fractures; traces of mud matrix, some rhombs with dirty cores, 98 % dolomite. There is an inter-crystalline vuggy porosity of 4 - 5 % and anhydrite in fractures.

(4) Marly limestone, thinly bedded. The sequence includes intervals of alternating soft marly beds, with ledge-forming, more indurated limestones. The whole succession is cliff-forming. Thickness of unit = 2 m; cumulative thickness = 4.8 m.
Sample P5: marly limestone at the base of the succession, 1 m thick. Dolomitic neomorphosed mudstone - wackestone, partially dolomitised with euhedral rhombs growing in the mud matrix, the bioclasts include indistinct and rare ostracod fragments, rare benthic and ?planktonic foraminifera, and echinoids. The matrix is neomorphosed to a microspar (Fig. 3.30). This bed yielded: *Ammobaculites difformis, Gabonita levis, Plectina ruthenica* and *Quasispiroplectammina navarroana*, associated with ostracods and echinoid fragments.

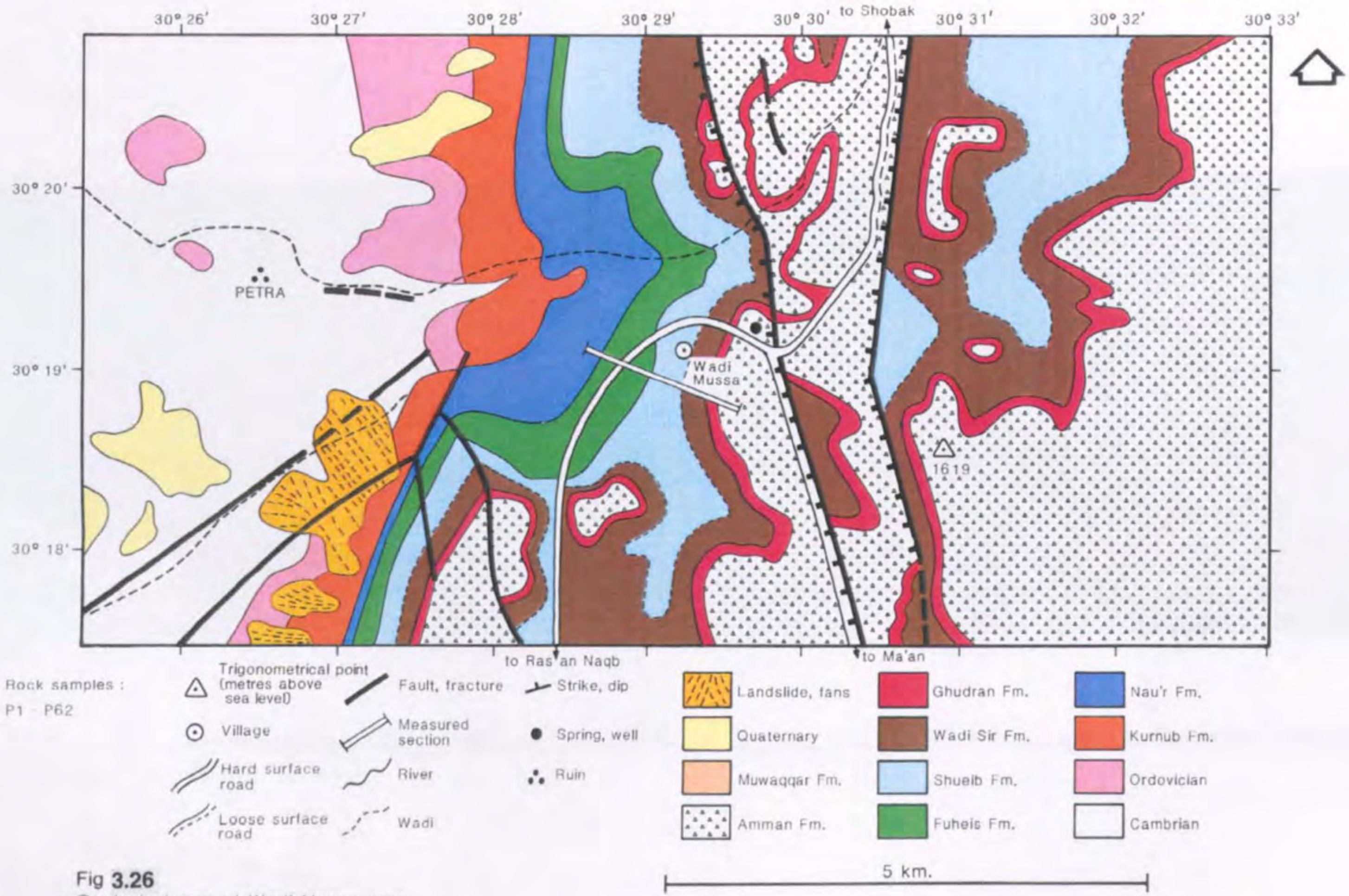

Fig **3.26**

Geological map of Wadi Mussa area

(modified from Geological map of Jordan, sheet Aqaba - Ma'an, 1 : 250 000, 1968)

E W

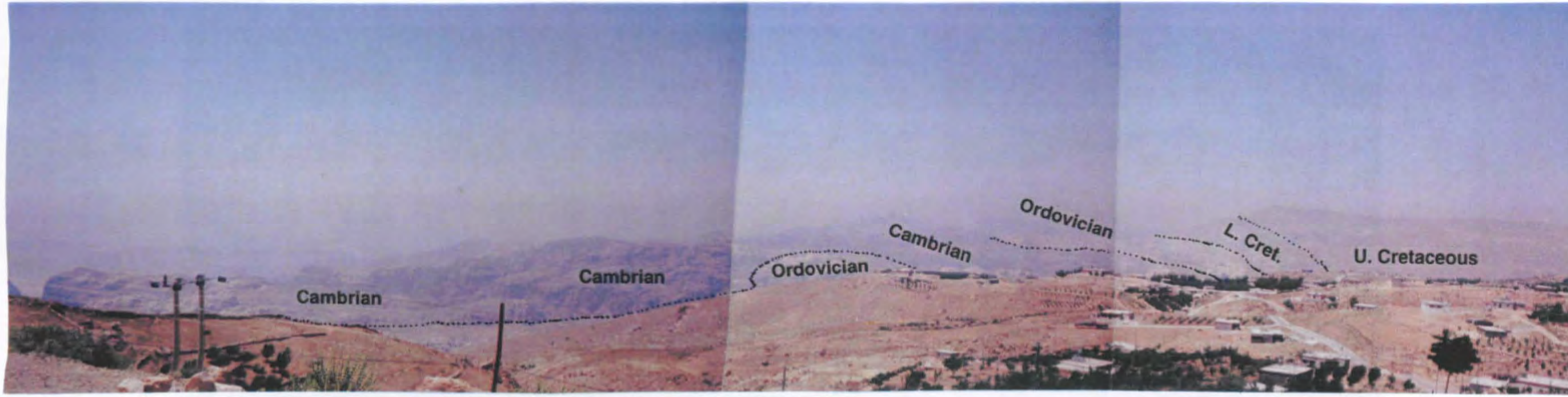

Fig. 3.27 Panoramic view near Taibeh village, adjacent to Wadi Mussa, showing successions belonging to the Cambrian, Ordovician, Lower and Upper Cretaceous.

W

E

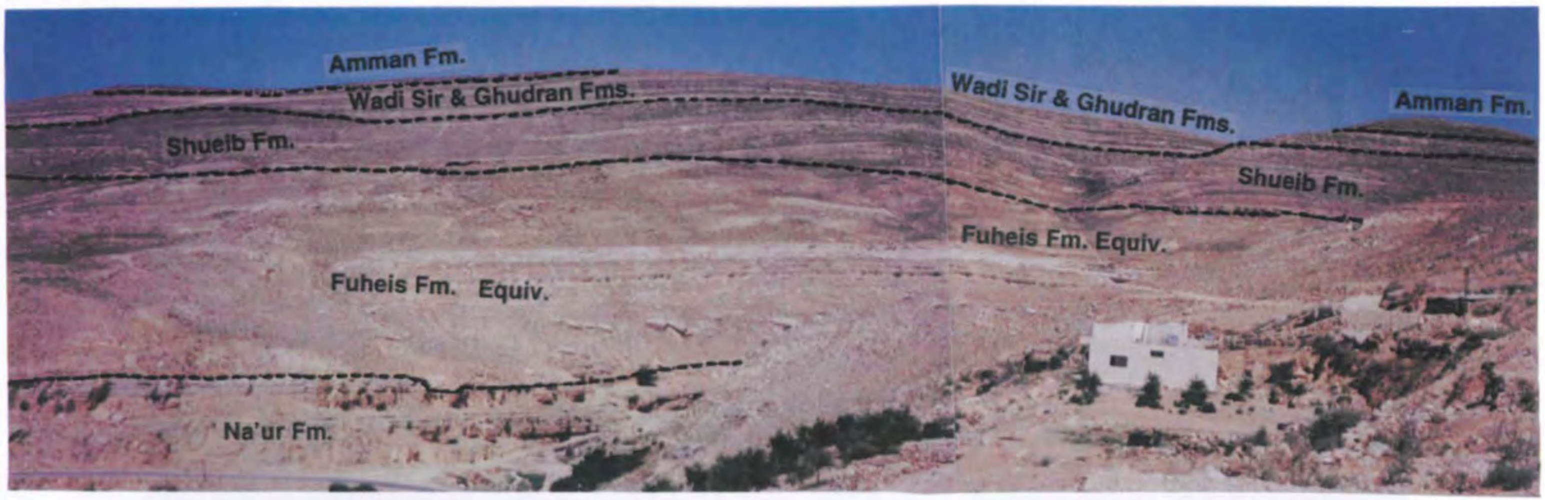

Fig. 3.28 General view of the Upper Cretaceous (Na'ur to Amman Formations) at a distance of about one km, looking north from Wadi Mussa.

W E

Fig. 3.29 Main Upper Cretaceous section (Na'ur to Amman Formations) sampled at Wadi Mussa.

Sample P6: bioclastic wackestone with microspar matrix, foraminifera, ostracods and echinoids (Fig. 3.31). This bed yielded: *Quinqueloculina antiqua angusta* and *Q. laevigata*, associated with smooth ostracods, echinoid spines and vertebrate remains.
Sample P7: limestone with some vertebrate remains. Foraminiferal ostracod wackestone that has been extensively replaced by dolomite euhedral rhombs. The rock matrix outside burrows is considerably more dolomitised than within the burrows. Dolomite rhombs vary in size and are larger inside the burrows. The original sediment was slightly peloidal and has been replaced by microspar. Faunal content includes small benthic and planktonic foraminifera (miliolids, *Globigerinelloides* sp. & ?*Hedbergella* sp. (Fig. 3.32) , associated with vertebrate remains and ooids.

3.4.1.2 Upper Nodular Member "A2"

This member consists of nodular limestones (Fig. 3.29), as follows:

(5) Sequence of nodular limestone with burrows, dolostone and fossiliferous limestone (coquina) beds. All beds are indurated, dolomitic and cliff-forming. Thickness of unit = 40.5 m; cumulative thickness = 45.3 m.
Sample P8: nodular limestone. Mudstone - wackestone, most of the bioclasts are replaced either by dolomite or coarse spar. The burrows are filled with finer crystalline dolomite.
Sample P9: dolomitic limestone. Replacement dolomite euhedral rhombs, fine-medium crystalline texture.
Sample P10: dolomitic limestone. Bivalve, algal (solenoporacean) wackestone - packstone. The rock has large euhedral rhombs of dolomite in both matrix and corrosive of the bioclasts fills of calcareous worm-tubes (Fig. 3.33).
Sample P11: nodular limestone. Micritised bioclastic peloidal packstone with composite grains of mud, foraminifera, bivalve fragments, ?gastropods and small silt-size quartz. The lithoclasts = 40 %; grains constitute 90 % and echinoid-rich matrix is 10 %. The bioclasts are foraminiferal-cored or pellets, the matrix is peloidal and the deposit replaces dolomite (Fig. 3.34). The faunal content includes vertebrate remains.
Sample P12: laminated limestone. Dolomitised mudstone with dolomite rhombs replacive of the matrix. They constitute 60-70 % of the rock, having dirty cores (Fig. 3.35).
Sample P13: nodular limestone, 15 m above base of succession. Foraminiferal ostracodal wackestone, the foraminifera constitute 25-30 % of the rock and the mud matrix 65 % that has been altered to microspar. Faunal content includes small benthic and planktonic foraminifera and smooth fragmental ostracods (Fig. 3.36).
Sample P14: fossiliferous limestone with *Cyphosoma* (echinoid), 11 m above P13. Oolitic packstone - grainstone with some lithoclasts and possible fill of gastropod tests. The matrix is single-phase spar, bivalve clasts provide a shelter texture (Fig. 3.37). This bed is poor in foraminiferal content and yielded only *Quinqueloculina triangulata* and the radiolaria *Follicucullus* cf. *scholasticus*, associated with ostracods and echinoid spines.
Sample P15: oolitic limestone, 3.5 m above P14. Oolitic grainstone. The matrix has been totally altered to dolomite cores of foraminifera (Fig. 3.38). This bed yielded: *Gavelinella baltica, Marssonella oxycona, Massilina ginginensis, Quinqueloculina laevigata, Serovaina turonicus, Spiroloculina cretacea* and *Valvulineria camerata*, associated with ostracods, gastropods and vertebrate remains.

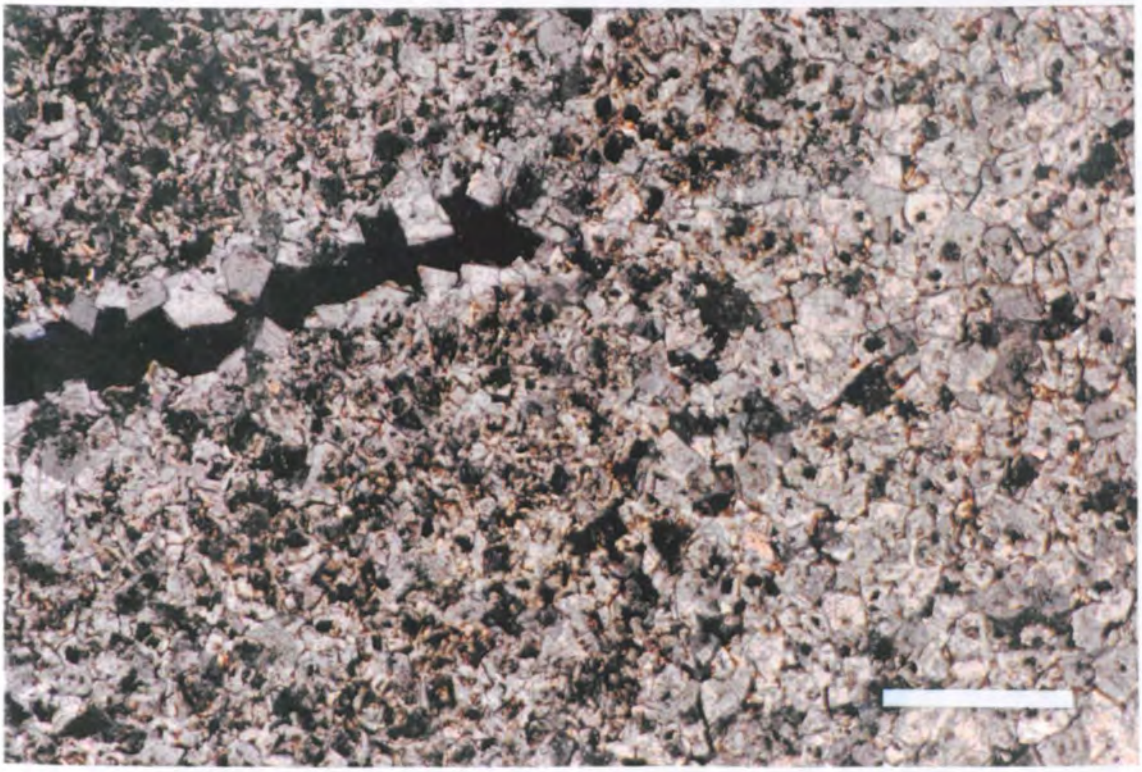

Fig. 3.30 Dolomitic neomorphosed mudstone - wackestone, partially dolomitised with euhedral rhombs growing in the mud matrix; bioclasts include indistinct ostracod fragments, foraminifera, and echinoderm debris. Sample P5, Lower Marly Member "A1", Na'ur Formation, Wadi Mussa (XPL, X 50).

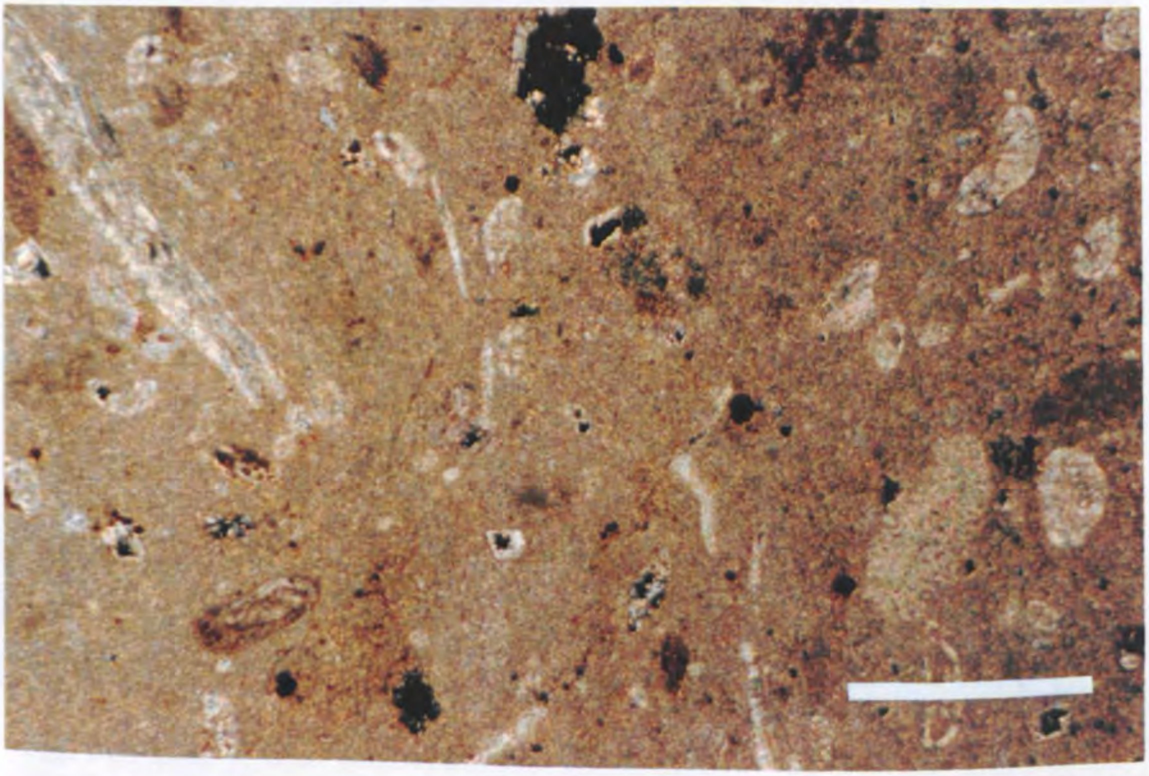

Fig. 3.31 Bioclastic wackestone with microspar matrix, foraminifera, ostracods and echinoid debris. Sample P6, Lower Marly Member "A1", Na'ur Formation, Wadi Mussa (XPL, X 65).

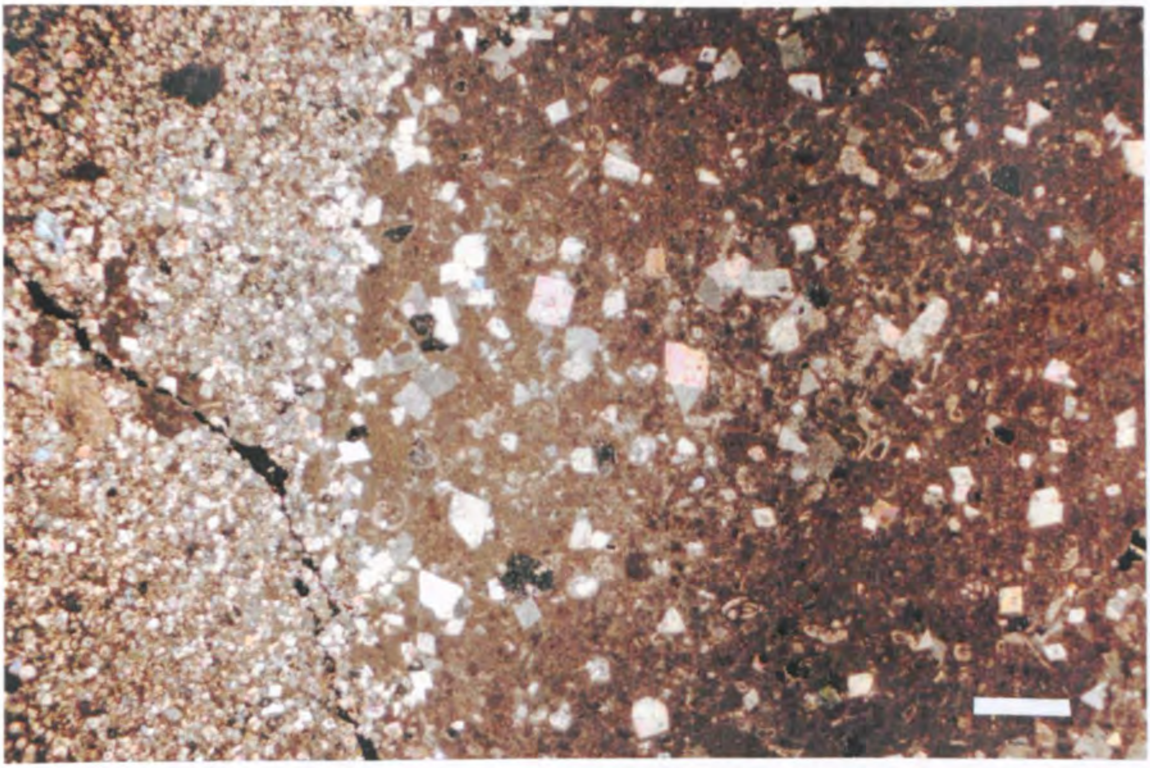

Fig. 3.32 Burrowed mudstone that has been extensively replaced with dolomite euhedral rhombs. The rock matrix outside burrows is much more dolomitised than the burrows. Sample P7, Lower Marly Member "A1", Na'ur Formation, Wadi Mussa (XPL, X 25).

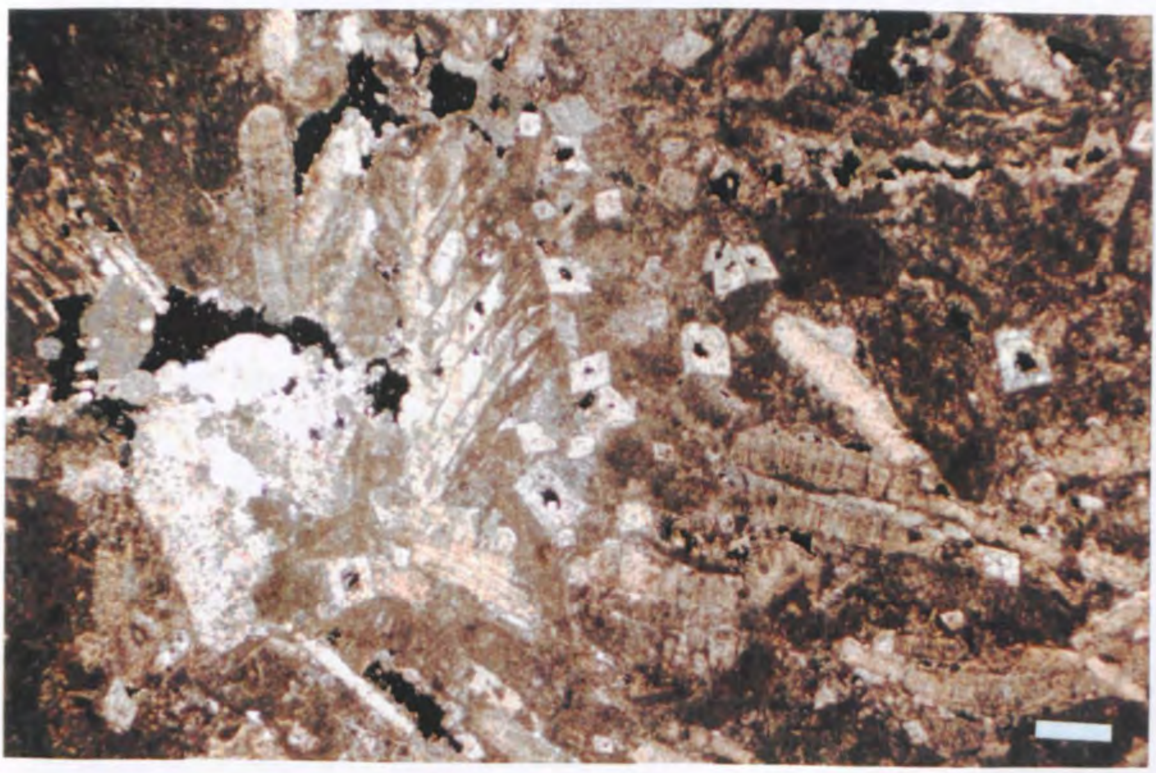

Fig. 3.33 Bivalve, algal (solenoporacean) wacke-packstone. The rock has large euhedral rhombs of dolomite in both matrix and corrosive of the bioclasts. Sample P10, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 20).

Sample P16: flaky limestone, laminated calcarenite, 6 m above P15. Laminated peloidal ostracodal packstone - grainstone, traces of mud matrix may be slightly argillaceous, rounded-subrounded quartz grains constitute less than 1 %. Patchy distribution of grains, locally peloids dominant, elsewhere peloid matrix and ostracod are of equal importance. Fauna includes fragmented ostracod valves, with rare whole specimens, and associated vertebrate debris. The matrix is recrystallised to pseudospar. Healed microfractures with calcite, rare dolomite rhombs in the matrix.
Sample P17: marl, 4 m above P16. Mudstone. This bed yielded: *Gavelinella baltica, Massilina ginginensis, Planispirinella barnardia, Sculptobaculites goodlandensis* and *Serovaina minutus*, associated with smooth ostracods, gastropods and vertebrate remains.
Sample P18: indurated marly limestone with some ostracod fragments, top of succession, 1.5 m above P17. This bed is poor in foraminiferal content and yielded only *Quinqueloculina laevigata.*

(6) Grey shale. Thickness of unit = 1.5 m; cumulative thickness = 46.8 m.
Sample P19: banded mudstone. This bed yielded: *Adelungia* sp. 1, *Ammobaculites agglutinans, A. stephensoni, Evolutinella subevoluta, Gavelinella baltica, Haplophragmoides excavatus, H. fraseri, H. kirki, Lingulogavelinella tormarpensis, Neodiscorbinella* sp. 1, *Placopsilina cenomana, Serovaina minutus, S. struvei* and *S. turonicus*, associated with smooth ostracods, gastropods, bivalves and vertebrate remains.

(7) Limestone bed, with three dark shale bands. The limestone is fossiliferous and sometimes marly. Thickness of unit = 4 m; cumulative thickness = 50.8 m.
Sample P20: fossiliferous limestone. Gastropodal limestone with mud matrix and peloids infilling gastropod chambers. The matrix is peloidal with replacement by coarse equantspar (Fig. 3.39). The fauna includes high-spired gastropods (*Cirithium, Potamides*) and smooth ostracods.
Sample P21: silicified limestone. Chert.
Sample P22: marly limestone. Ostracodal peloidal packstone, passing into a calcispheric foraminiferal wackestone. This bed is poor in microfossil content and yielded only *Quinqueloculina laevigata* and smooth ostracods.

(8) Indurated limestone, grey, highly fossiliferous with echinoids and gastropods. Thickness of unit = 1.5 m; cumulative thickness = 52.3 m.
Sample P23: limestone. Peloidal lithoclastic packstone - grainstone with micrite envelopes, matrix changed to a blocky spar. Faunal content of low-spired gastropods, biserial foraminifera and algal filaments (Fig. 3.40). This bed yielded: *Quinqueloculina laevigata* and *Spiroloculina cretacea*, associated with echinoid spines and vertebrate remains.

(9) Soft marl bed. Thickness of unit = 0.5 m; cumulative thickness = 52.8 m.
Sample P24: dolomitic limestone. Neomorphosed mudstone to very fine grained wackestone. It has rare - common dolomite rhombs growing in the matrix, poorly laminated, bioclastic debris equal to 10 %, mainly ostracods. This bed yielded: *Ammodiscoides turbinatus* and *Bolivinopsis clotho*, associated with smooth ostracods, molluscs and vertebrate remains.

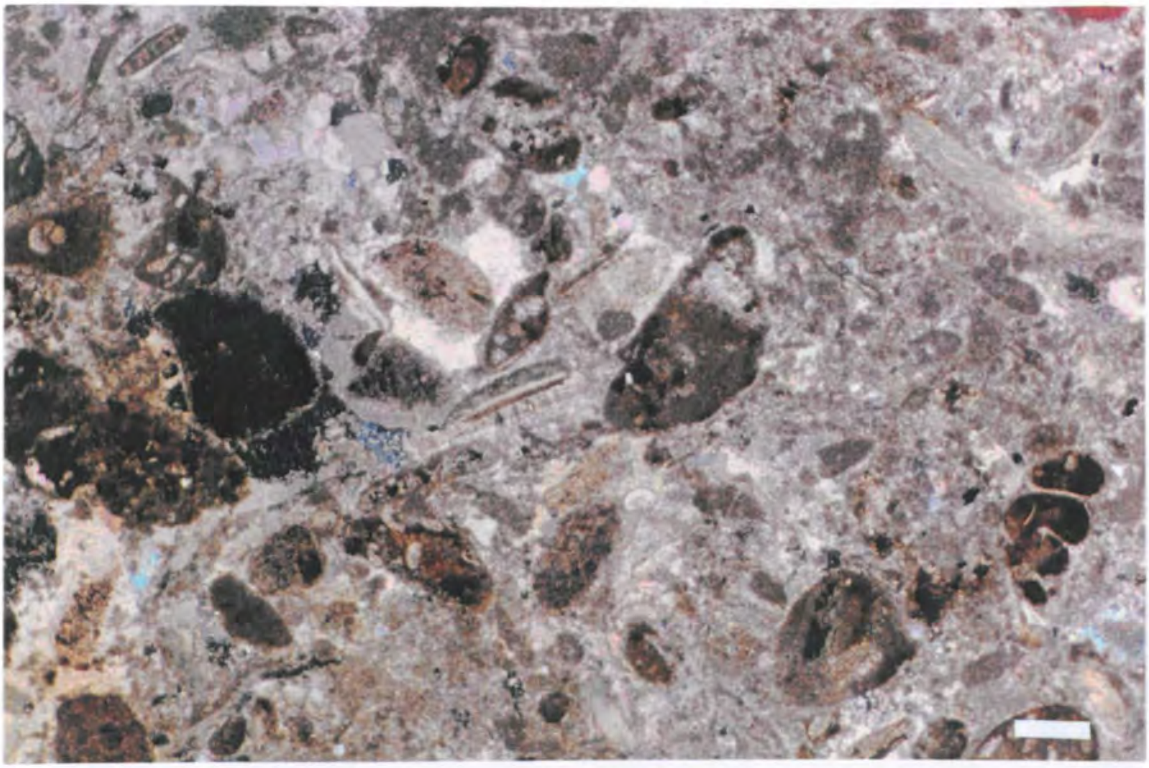

Fig. 3.34 Micritised bioclastic peloidal packstone with composite grains of mud, foraminifera, bivalve fragments, ?gastropods and small silt-size quartz. Sample P11, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 20).

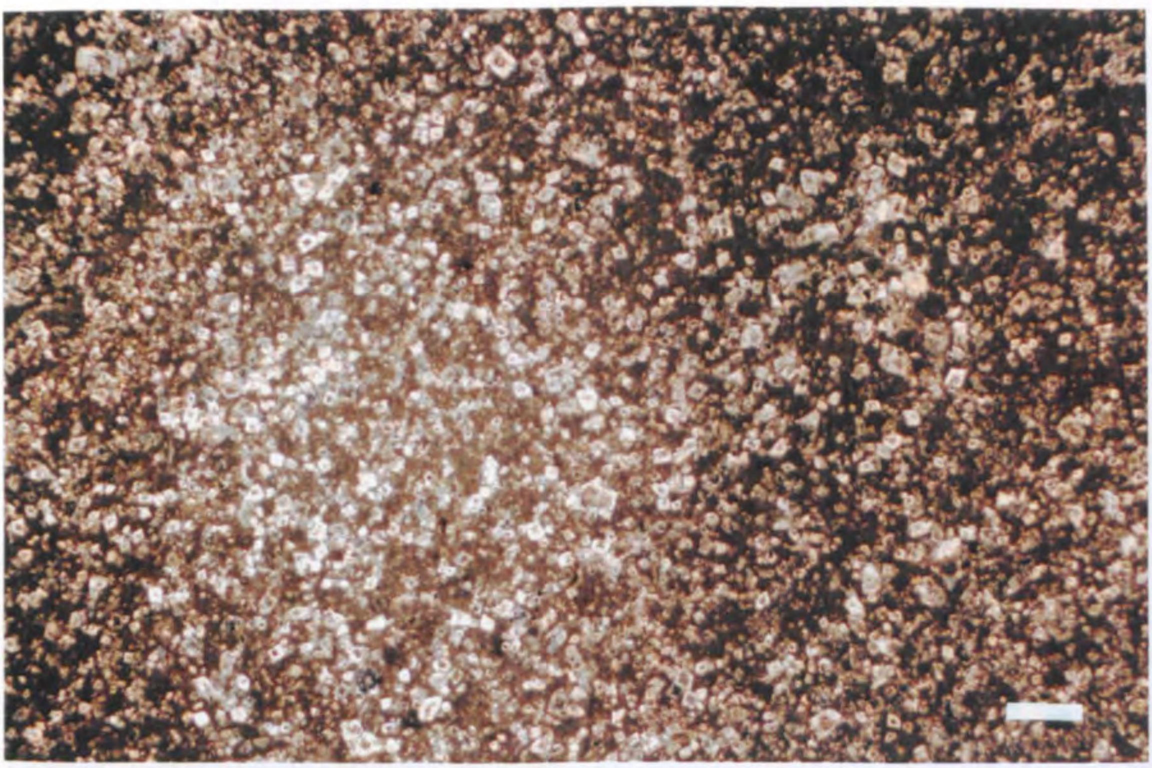

Fig. 3.35 Dolomitic mudstone with dolomite rhombs replacive of the matrix. Sample P12, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 20μ).

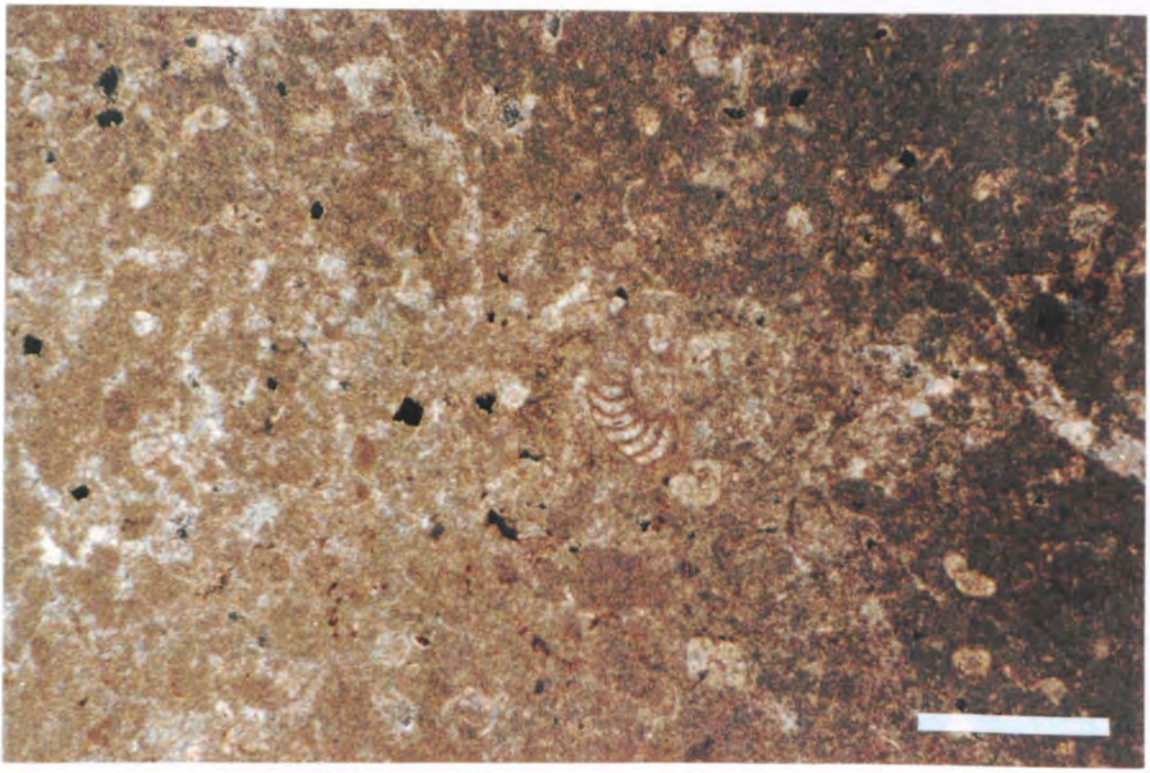

Fig. 3.36 Foraminiferal ostracodal wackestone, faunal content includes small benthonic and planktonic foraminifera, and fragmental ostracods. Sample P13, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 50).

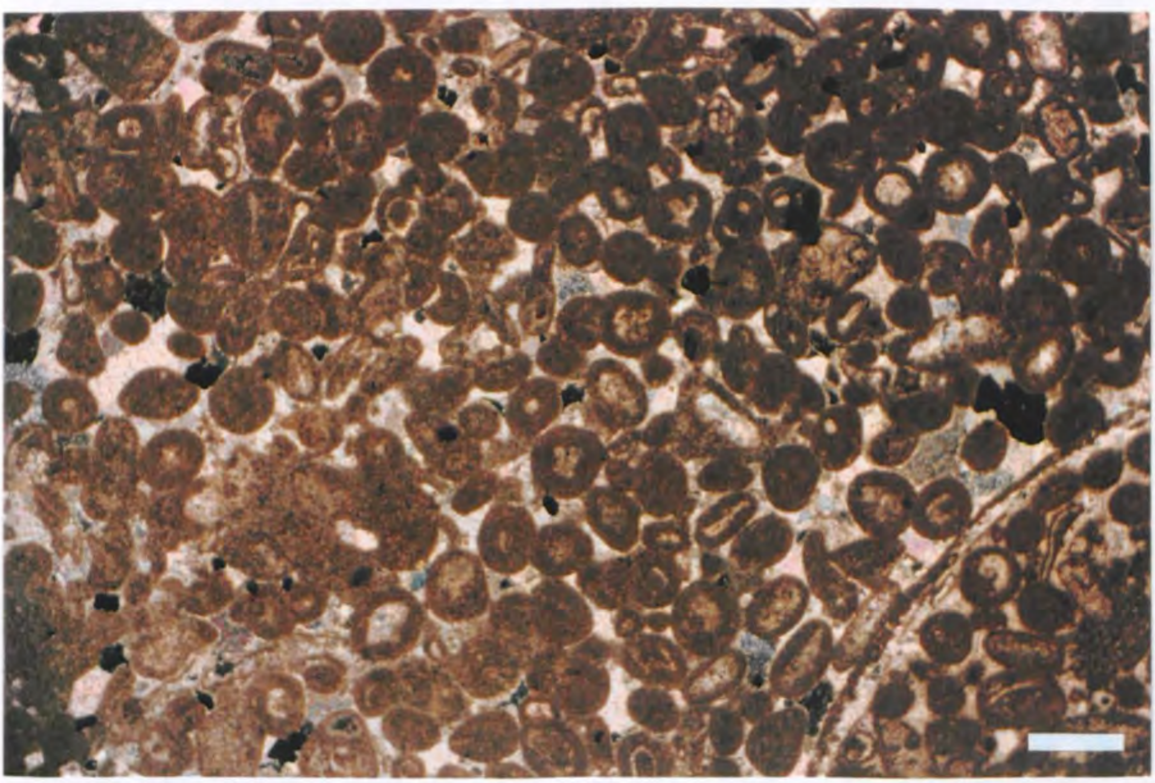

Fig. 3.37 Oolitic packstone - grainstone. Sample P14, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 25).

(10) Nodular marly limestone, with burrows. Thickness of unit = 1 m; cumulative thickness = 54.3 m.
Sample P25: marly limestone with some fish teeth. Originally similar to the underlying mudstone - wackestone. The matrix is neomorphosed and 50 % replaced by euhedral dolomite rhombs.

(11) Soft marl bed. Thickness of unit = 0.5 m; cumulative thickness = 54.3 m.
Sample P26: soft marl bed. This bed yielded: *Ammodiscoides turbinatus, Conorboides hofkeri, C. umiatensis, Gavelinella baltica, Lingulogavelinella tormarpensis, Serovaina simplex, S. struvei* and *S. turonicus*, associated with smooth ostracods and echinoid fragments.

(12) White, chalky limestone, nodular and fossiliferous, forming a distinct ledge. Thickness of unit = 9 m; cumulative thickness = 63.3 m.
Sample P27: limestone. Calcispheric foraminiferal ostracodal wackestone with miliolids and some rare gastropods. This bed yielded: *Quinqueloculina globigerinaeformis* and *Q. laevigata*, associated with smooth ostracods and gastropods.
Sample P28: limestone with echinoid spines. Echinoid ostracodal bivalve wackestone.

(13) Indurated crystalline limestone, cliff-forming, yellowish-white in colour, marly at its base and containing chert nodules at its top. Thickness of unit = 4.7 m; cumulative thickness = 68 m.
Sample P29: marly base. Similar to P28, but containing more mud, associated with smooth ostracods, echinoids, bivalves, gastropods and vertebrate remains. Dolomite rhombs are developed in patches and vary from fine - coarse in size.
Sample P30: crystalline limestone. Ostracodal echinoid and foraminiferal wackestone, with peloids and rare burrows, that appear to include some miliolids.

3.4.2 Fuheis Formation Equivalent "A3"

This formation can only be easily differentiated from the overlying Shueib Formation in the north; at Wadi Mussa it is difficult to do so. However, in this study the top of the Fuheis Formation is taken at the lithofacies change from marly, sandy and nodular limestones, below to silicified dolomitic limestones, above. It is also suggested that a new name should be given to this formation at Wadi Mussa.

(14) White, sandy-marly dolostone, highly fractured and fossiliferous, slope-forming and mostly covered. Thickness of unit = 7 m; cumulative thickness = 75 m.
Sample P31: dolomitic limestone with some vertebrate remains. Completely fine replacement dolomite forming interlocking euhedral rhombs.

(15) Yellowish-grey, indurated nodular limestone, with fossil fragments and burrows. Thickness of unit = 5 m; cumulative thickness = 80 m.
Sample P32: limestone with some fish teeth. Foraminiferal ostracodal mudstone - wackestone.

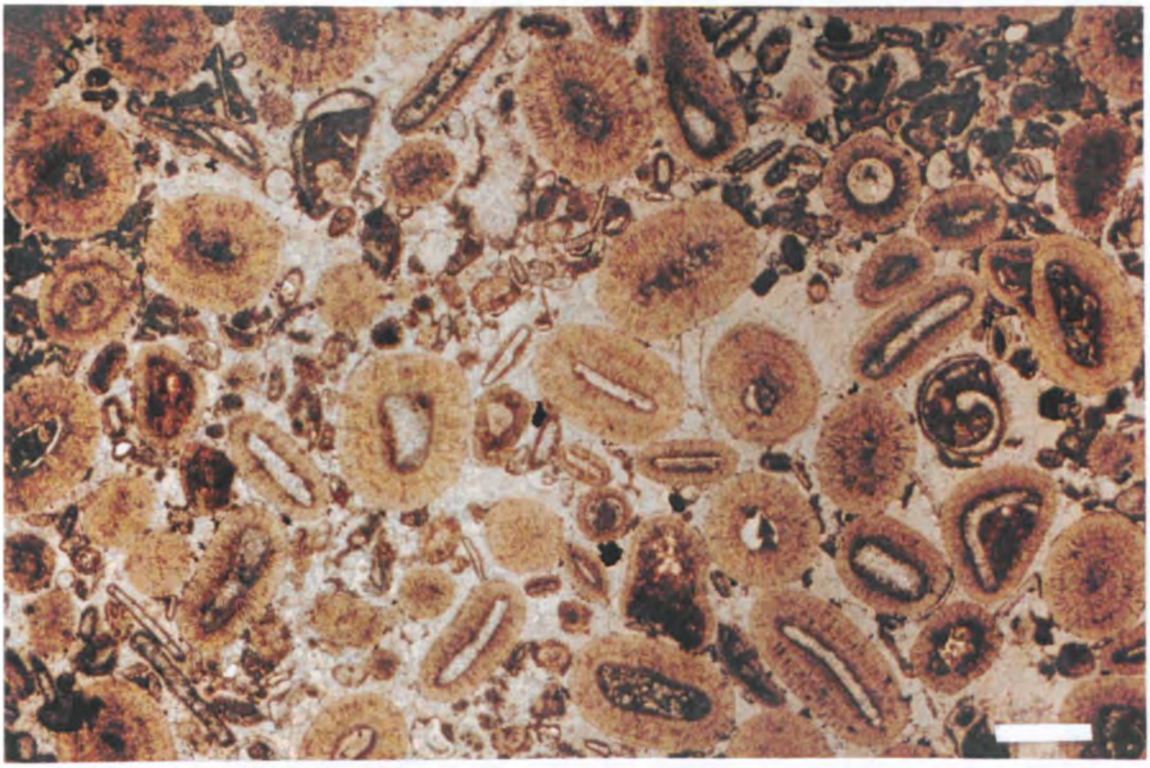

Fig. 3.38 Oolitic grainstone. Sample P15, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (PPL, X 25).

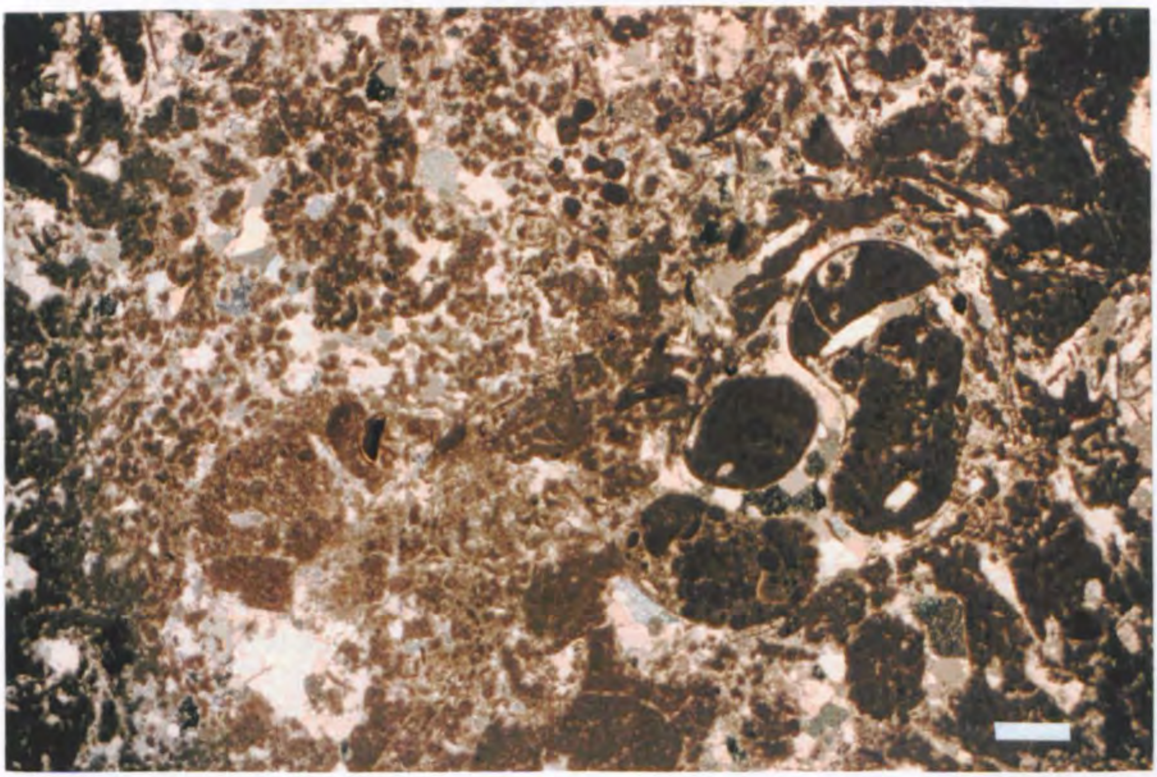

Fig. 3.39 Gastropodal limestone with mud matrix and peloids infilling gastropod chambers. Sample P20, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 20).

(16) Light green, creamy dolostone with chert nodules at its top. Thickness of unit = 5 m; cumulative thickness = 85 m.
Sample P33: argillaceous dolostone or dolomitic claystone; euhedral rhombs 60 % and claystone matrix 40 %.

(17) Light coloured, yellowish-brown, cross-bedded, dolomitic limestone, with chert nodules and bands. The chert bands are about 10 - 20 cm thick each. The sequence also includes two marl bands, 0.5 m thick each. Thickness of the rock unit = 15 m; cumulative thickness = 100 m.
Sample P34: dolomitic limestone with some vertebrate teeth, 1.5 m above base of succession. Replacement dolomite with fine crystalline texture euhedral rhombs and dirty cores. This bed is poor in foraminiferal content and yielded only *Ammobaculites agglutinans* and echinoid fragments.
Sample P35: marly limestone, 9 m above base of succession.
Sample P36: cross-bedded dolomitic limestone. Replacement dolomite, possibly laminated, rhombs euhedral - anhedral, dirty cores, rare silt-size quartz grains, relic peloids, porosity 30 % intercrystalline.

(18) Soft marl. Thickness of unit = 1.5 m; cumulative thickness = 101.5 m.
Sample P37: soft marl with some echinoid spines, worm-tubes and vertebrate remains.

(19) Indurated, dolomitic limestone. Thickness of unit = 1 m; cumulative thickness = 102.5 m.
Sample P38: limestone. This bed is poor in foraminiferal content and yielded only *Ammobaculites agglutinans.*

(20) Alternation of soft marly limestone and indurated sandy limestone, thinly bedded (each bed 50 cm thick, marly beds thinner than limestone beds). Thickness of unit = 11 m; cumulative thickness = 113.5 m.
Sample P39: marl with some vertebrate remains. Iron-stained replacement dolomite, interlocking euhedral and anhedral rhombs of various sizes, intercrystalline porosity 15 %. This bed is poor in foraminiferal content and yielded only *Ammobaculites agglutinans* and vertebrate remains.
Sample P40: indurated ledge-forming sandy limestone. Intercrystalline porosity 15 %. This bed is poor in foraminiferal content and yielded only *Ammobaculites agglutinans.*
Sample P41: marl at top of the sequence. Dolomitic claystone with homogenous texture, very fine euhedral rhombs constituting 60 %. This bed yielded: *Cassidella tegulata, Conorboides beadnelli, C. mitra, Fursenkoina squammosa, Gabonita levis, Gavelinopsis tourainensis, Plectina ruthenica, Quasispiroplectammina navarroana* and *Quinqueloculina antiqua angusta*, associated with echinoid spines and vertebrate remains.

(21) Fossiliferous limestones and dolostones displaying a nodular weathering and including quartz geodes. Thickness of unit = 1 m; cumulative thickness = 114.5 m.
Sample P42: dolostone with some vertebrate teeth. Mudstone - wackestone, matrix is completely dolomitised, with rare bioclasts and common sand-size subangular to rounded quartz (Fig. 3.41).

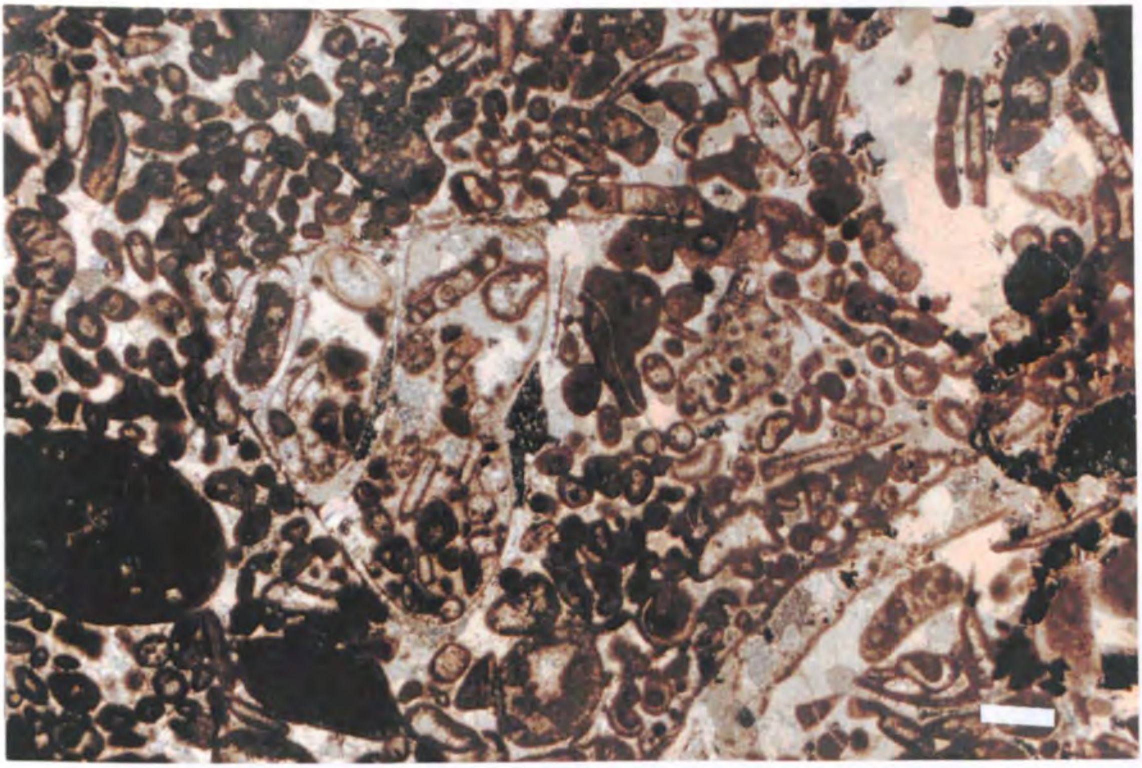

Fig. 3.40 Peloidal lithoclastic packstone - grainstone. Faunal content includes low-spired gastropods, biserial foraminifera and algal filaments. Sample P23, Upper Nodular Member "A2", Na'ur Formation, Wadi Mussa (XPL, X 20).

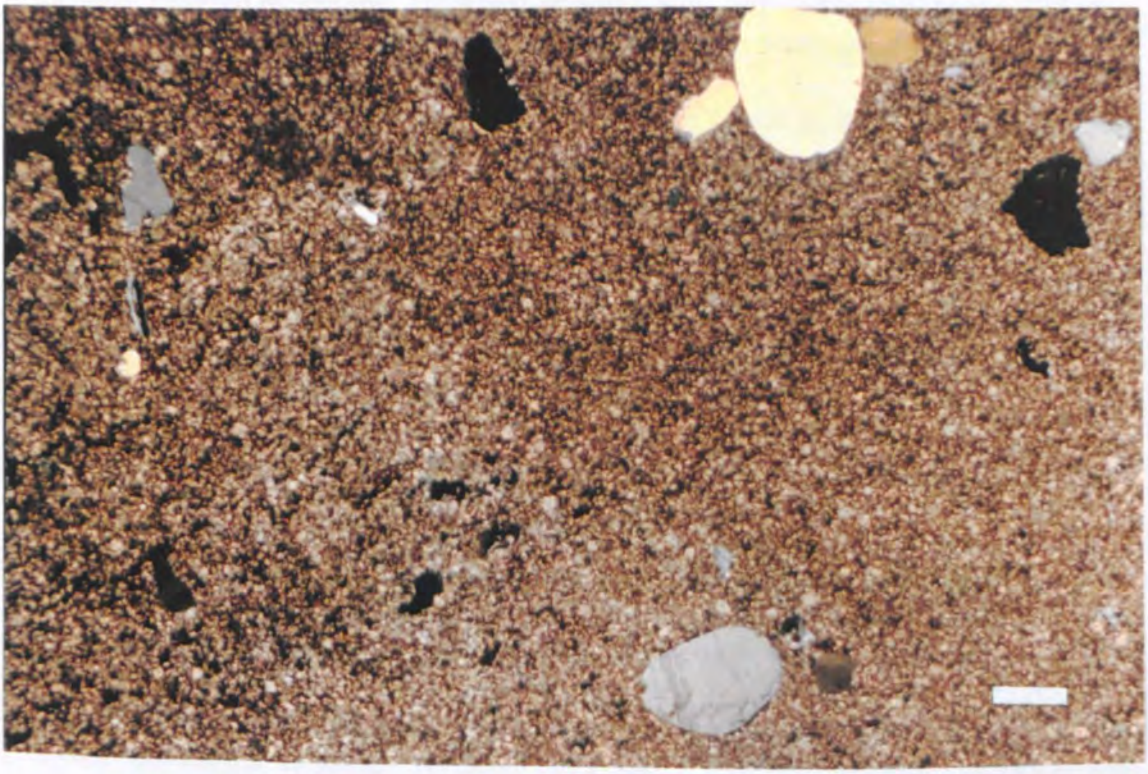

Fig. 3.41 Dolomitised mudstone - wackestone, with rare bioclasts and common sand-size subangular to rounded quartz. Sample P42, Fuheis Formation "A4", Wadi Mussa (XPL, X 20).

3.4.3 Shueib Formation Equivalent "A5" & "A6"

At Wadi Mussa (Fig. 3.28), this formation may be subdivided into: **3.4.3.1 Lower Sandy Limestone Member "A5"**

(22) Alternation of soft marly limestone and indurated sandy limestone and dolostone. Thickness of unit = 5 m; cumulative thickness = 119.5 m.
Sample P43: fine - medium replacement dolostone with quartz grains and iron disseminated between crystals.

3.4.3.2 Upper Marly Limestone Member "A6"

(23) Cliff-forming limestone, indurated, constituting a ledge. Thickness of unit = 1.5 m; cumulative thickness = 121 m.
Sample P44: sandy limestone. Dolomitic sandy siltstone, initially was argillaceous siltstone, with rare bioclasts; the matrix is completely dolomitised, with subangular to subrounded quartz constituting 40 % (Fig. 3.42).

3.4.4 Wadi Sir Formation "A7"

At Wadi Mussa (Fig. 3.27), the Wadi Sir Formation consists mainly of massive, sandy and dolomitic limestones, as follows:

(24) Sequence of indurated sandy limestone beds, each about 1 m thick, slope-forming, covered by caliche. Thickness of unit = 6 m; cumulative thickness = 127 m.
Sample P45: sandy limestone. Sandy peloidal dolomitic wackestone.

(25) Cliff-forming limestone, indurated, with chert bands at the base. Thickness of unit = 7.5 m; cumulative thickness = 134.5 m.
Sample P46: sandy limestone, taken from the base on the side of a vehicle track. Similar to P45, except dolomite rhombs are larger in the matrix which is composed of neomorphosed spar.
Sample P47: sandy bioturbated dolostone at the top of succession. Dolomite rhombs are euhedral - anhedral, they fill the burrow system and replace the matrix, some rhombs are zoned, quartz is angular - subrounded (Fig. 3.43).

(26) Unexposed interval. Thickness of unit = 12 m; cumulative thickness = 146.5 m.

(27) Indurated limestone ledge, fossiliferous, with irregular chert nodules, softer near the base of the succession. Thickness of unit = 4.5 m; cumulative thickness = 151 m.
Sample P50: sandy limestone. Dolomitic mudstone, with common - abundant quartz grains, having argillaceous laminae, banded, no bioclasts, quartz grains variable in size from silt to fine sand.
Sample P51: dolomitic limestone with vertebrate remains and ooids. Similar to P50, except the matrix is totally replaced by a fine - medium dolomite, euhedral and anhedral rhombs. Carbonaceous material or iron staining form distinct laminae.

(28) Yellow marl. Thickness of unit = 0.5 m; cumulative thickness = 151.5 m.
Sample P52: dolomitic claystone. The faunal content includes vertebrate remains.

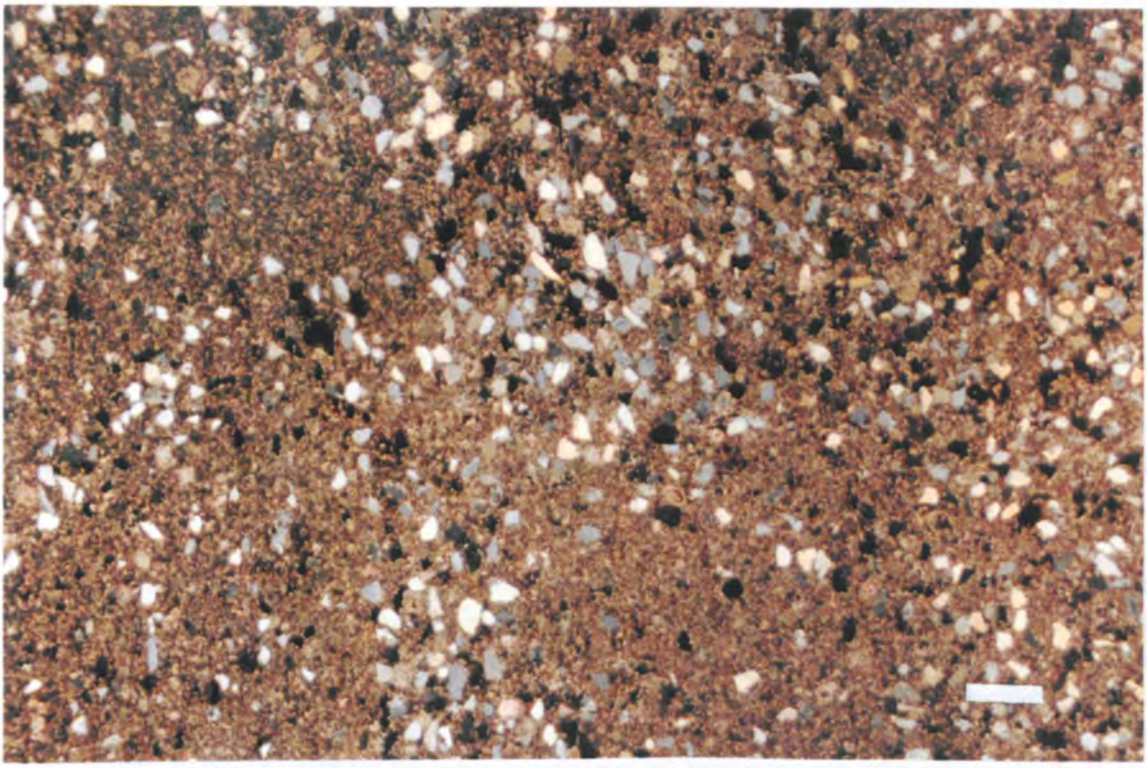

Fig. 3.42 Dolomitic sandy siltstone, with dolomitised matrix. Sample P44, Shueib Formation "A5" & "A6", Wadi Mussa (XPL, X 20).

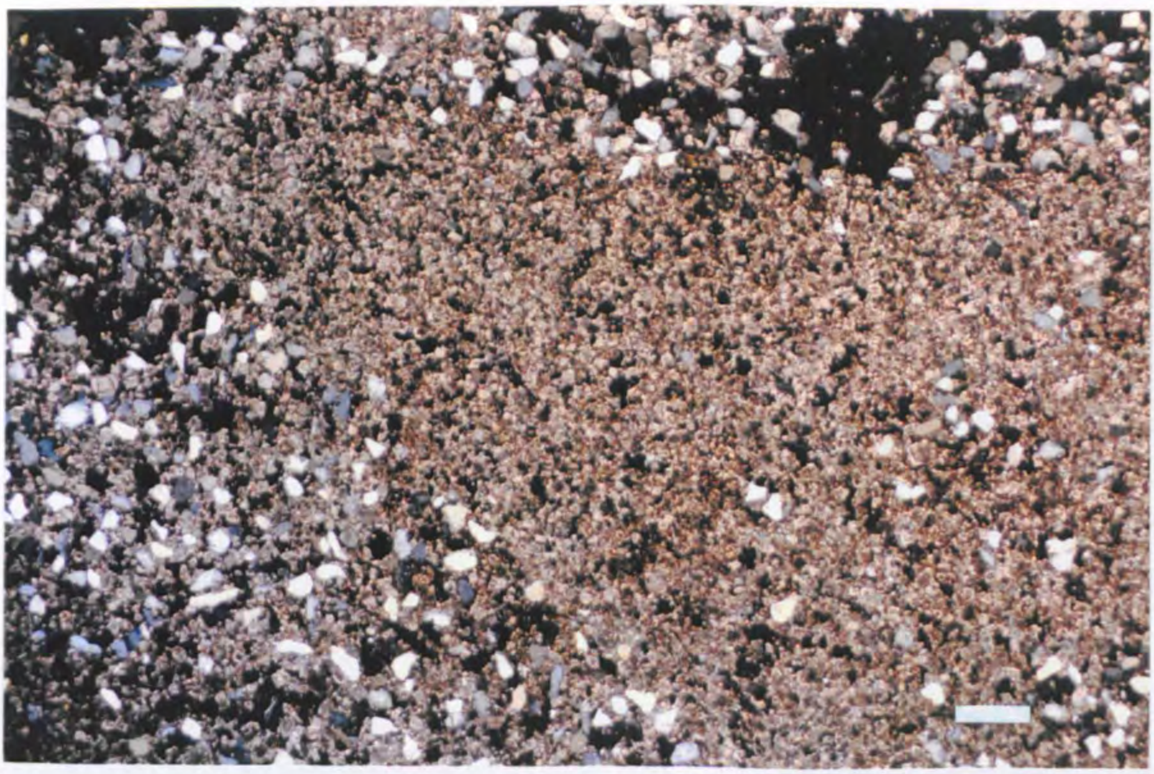

Fig. 3.43 Bioturbated sandy dolostone, dolomite rhombs are euhedral - anhedral, they fill the burrow system and replace the matrix. Sample P47, Wadi Sir Formation "A7", Wadi Mussa (XPL, X 20).

3.4.5 Ghudran Formation "B1"

At Wadi Mussa (Fig. 3.29) this formation consists of sandstones and marly limestones, as follows:

(29) Yellowish-brown, highly calcareous cross-bedded sandstone, intercalated with fossiliferous limestone beds containing chert nodules and bands. Thickness of unit = 7 m; cumulative thickness = 158.5 m.
Sample P53: limestone. Neomorphosed mudstone, microspar replacement of matrix.
Sample P54: limestone. Neomorphosed mudstone with rare quartz grains, silt to fine sand size. The faunal content includes vertebrate remains.

(30) Brown quartz-rich sandstone. Unit thickness = 1 m; cumulative thickness = 159.5 m.

Sample P55: bioclastic submature sandstone with argillaceous mud matrix, bivalve bioclasts replaced by rare dolomite rhombs in matrix, common - abundant vertebrate remains, occasional phosphate peloids (Fig. 3.44). This bed yielded: *Ammotium aegyptica, Astacolus liebusi, A.* sp. 1, *Biconcava bentori, Biplanata peneropliformis, Conorboides beadnelli, C. mitra, Cribroelphidium vulgare, Gabonita levis, Gavelinella baltica, G. stephensoni, Gavelinopsis proelevata, G. tourainensis, Massilina ginginensis, Nezzazatinella adhami, Plectina ruthenica, Quinqueloculina laevigata, Serovaina pseudoscopus, S.* sp. 1, *S. turonicus, Sestronophora* sp. and *Trochospira avnimelichi*, associated with smooth and ornamented ostracods, molluscs and echinoid fragments.

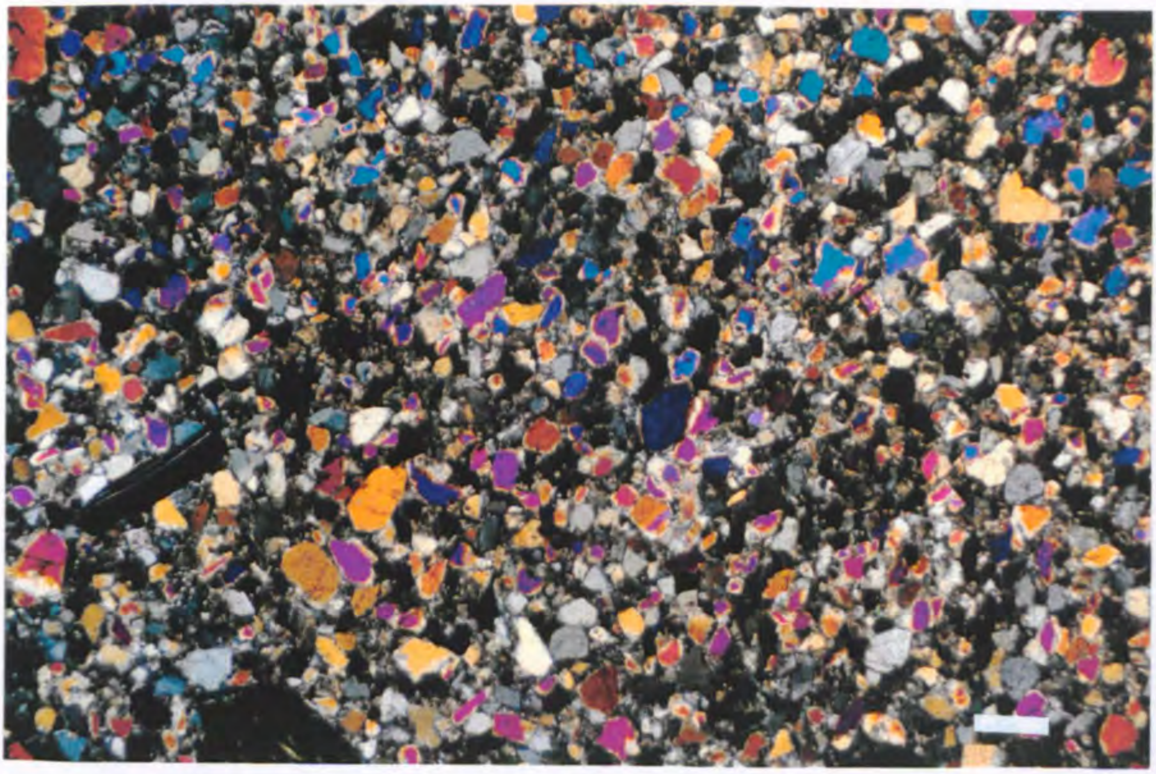

Fig. 3.44 Bioclastic submature sandstone with argillaceous mud matrix. Sample P55, Ghudran Formation "B1", Wadi Mussa (XPL, X 20).

(31) Khaki marly limestone. Thickness of unit = 4 m; cumulative thickness = 163.5 m.
Sample P56: marly limestone. Poorly laminated microcrystalline with some replacement dolomite. This bed is poor in foraminiferal content and yielded only *Haplophragmoides kirki*, associated with ostracods.

3.4.6 Amman Formation "B2"

This formation is characterised by the presence of numerous intercalations of chert (Figs. 3.29). It may be subdivided at Wadi Mussa into the following members:

3.4.6.1 Lower Silicified Limestone Member

This member consists of the following:

(32) Brown silicified coquina with abundant oysters. Thickness of unit = 4.5 m; cumulative thickness = 168 m.
Sample P57: dolomitic limestone, associated with ostracods, vertebrate remains and ooids. Coarse replacement dolomite with possible relicts after bivalves and ostracods, iron stains along the fractures, 10 - 15 % solution-enhanced porosity, argillaceous matrix = 20 %.

(33) Chert breccia displaying a brown and milky-white colour, with 1 m thick silicified phosphate bed, 4.5 m from the base of the succession. Thickness of unit = 33 m; cumulative thickness = 201 m.
Sample P58: chert. The original lithology was mudstone. It appears to be heavily affected with progressive silicification and development of coarse quartz in silicified areas.
Sample P59: silicified phosphate. Calcareous carbonaceous sandstone with peloids and possible soil-lithic clasts and common vertebrate remains and burrows. Matrix is microspar, quartz = 40 %, matrix = 20 %, grains = 40 %.

3.4.6.2 Upper Phosphatic Silicified Limestone Member

This member, at Wadi Mussa, consists of the following:

(34) Chalky limestone with chert nodules. Thickness of unit = 1.5 m; cumulative thickness = 202.5 m.
Sample P60: neomorphosed mudstone. This bed yielded: *Ammodiscoides turbinatus, Arenobulimina amanda, Bolivina decurrens, B. incrassata, Brizalina lowmani, Bulimina exigua robusta, Cassidella navarroana, C. tegulata, Coryphostoma neumannae, Dorothia pontoni, Gabonita levis, Gaudryina rugosa, Guembelitria cenomana, Heterohelix nkporoensis, Laevidentalina vistulae, Neobulimina canadensis, N. canadensis alpha, Nonionella cretacea tamilensis, N. robusta, Planispirinella* sp. 1, *Plectina ruthenica, Praebulimina angulata, P. aspera, P. bantu, P. carseyae, P.* cf. *arabica, P.* cf. *bantu lata, P. reussi, P. trihedra, Pyramidina rudita* and *Quasispiroplectammina navarroana.* This bed also yields the following radiolaria: *Acaeniotyle starka, Amphibracchium* sp. 1, *Amphipyndax pseudoconulus, A. stocki,*

Fig. 3.45 Silicified mudstone. Sample P61, Upper Phosphatic Silicified Limestone Member, Amman Formation "B2", Wadi Mussa (XPL, X 20).

Fig. 3.46 Laminated silicified mudstone. Sample P62, Upper Phosphatic Silicified Limestone Member, Amman Formation "B2", Wadi Mussa (XPL, X 20).

A. tylotus, Archaeodictyomitra lamellicostata and *Pseudoaulophacus lenticulatus*, associated with vertebrate remains and oolites.

(35) Successive bands of white, yellowish-brown and brown chert beds with thin laminae of silictified phosphate. Thickness of unit = 15 m; cumulative thickness = 217.5 m.
Sample P61: laminated chert. Silictified mudstone, laminae appear carbonaceous, quartz replacement of ostracods (Fig. 3.45).
Sample P62: silictified phosphatic mudstone. Laminated mudstone, with coarser laminae and peloids, abundant carbonaceous material, scattered phosphate pellets and rare planktonic foraminifera, the carbonaceous material = 50 % (Fig. 3.46).

3.5 Ras en-Naqb

The section was sampled in June 1988. It starts on an uplifted fault block on the left side of the road towards Aqaba (coming from Ma'an), on an old road leading to a Rest House, 50 m above the main asphalt road towards Aqaba (Fig. 1.1). A total of 46 samples were collected through the sequence (S1-S2, Figs. 3.47 - 49). The succession (190 m) is described from base to top, as follows:

3.5.1 Subeihi (Kurnub) Formation "K2"

This formation was easily recognised at Ras en-Naqb (Fig. 50). It consists mainly of variegated sandstones, as follows:

(1) Sequence composed of reddish, non-calcareous siltstone, with five bands of ferruginous coarse-grained sandstone, 30 cm thick each. Thickness of unit = 4.5 m.
Sample Q1: sandstone. Rounded to subrounded quartz grains with fragments of *Thomasinella* sp. This bed also yielded *Charentia cuvillieri.*

(2) Varicoloured siltstone and sandstone, cross-bedded at top. Thickness of unit = 16.5 m; cumulative thickness = 21 m.
Sample Q2: siltstone. Rounded to subrounded quartz grains.

(3) Varicoloured sequence of alternating sandstone and siltstone beds displaying red, yellow, purple and brown colouration. Thickness of unit = 0.8 m; cumulative thickness = 21.8 m (not sampled).

3.5.2 Na'ur Formation "A1" & "A2"

This formation consists of shales and sandstones, and massive nodular and dolomitic limestones. The Na'ur Formation is subdivided into two members:

3.5.2.1 Lower Shaly Sandstone Member "A1"

This member consists of a sequence of sandy shales and calcareous sandstones (Figs. 3.51, 52), as follows:

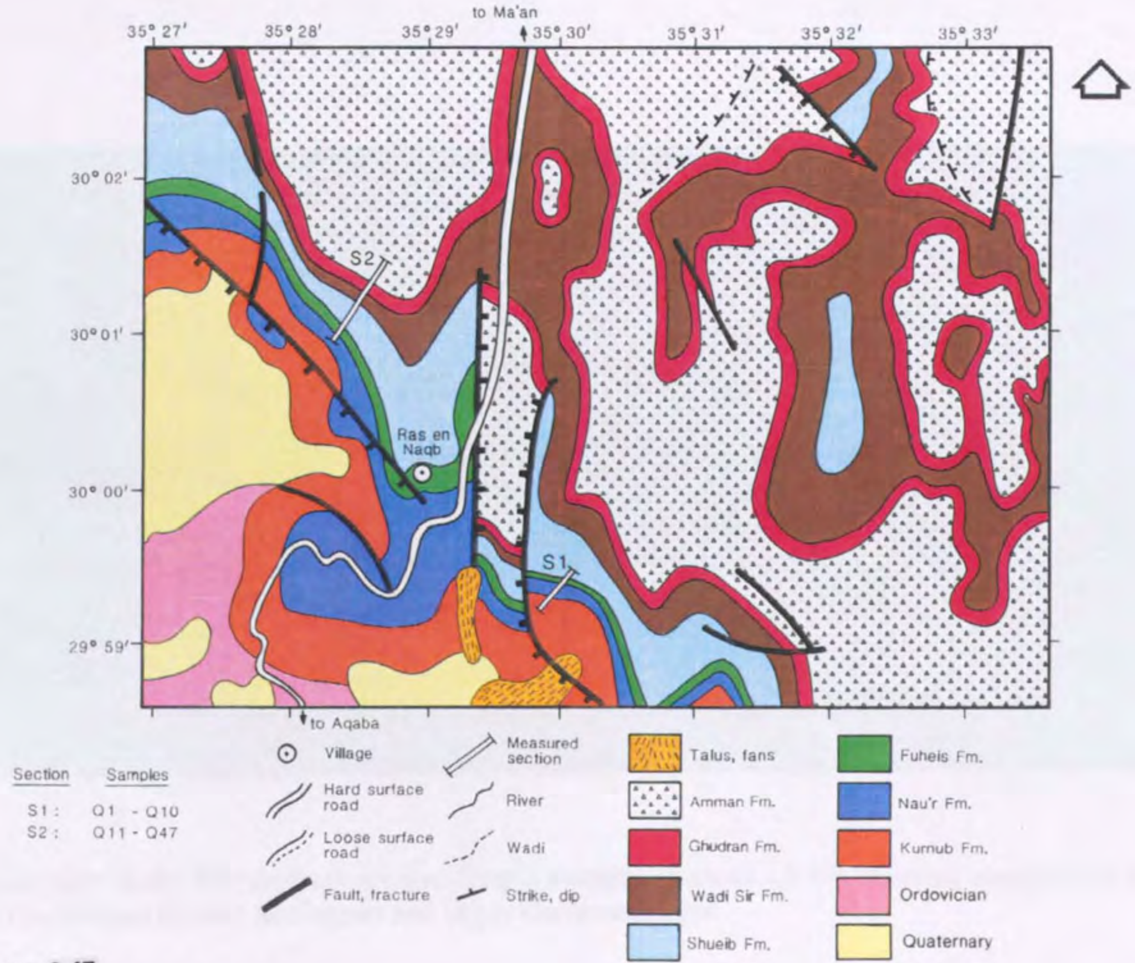

Fig. **3.47**
Geological map of Al-Naqb area
(modified from Geological map of Jordan, sheet Aqaba - Ma'an, 1 : 250 000, 1968)

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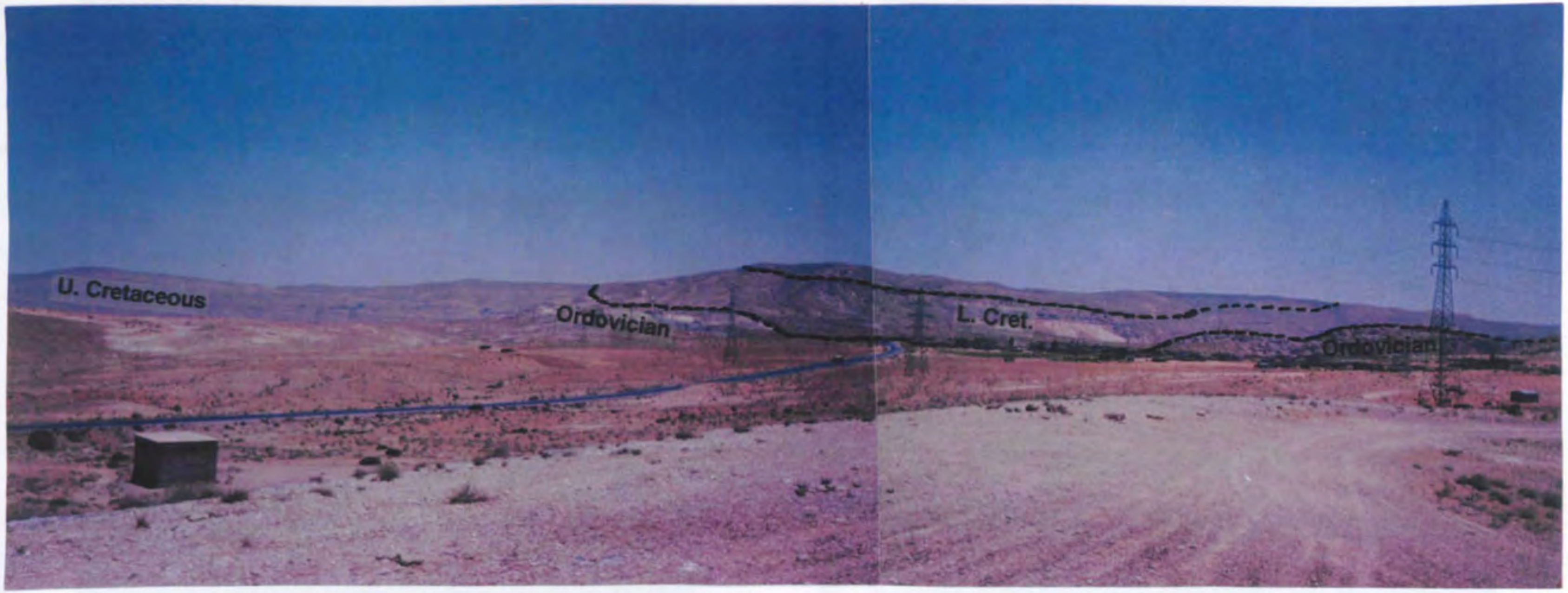

Fig. 3.48 Panoramic view of the Ras en-Naqb section, from a distance of about 2.5 km, showing approximate contacts between Ordovician white sandstone, Lower Cretaceous (Kurnub Sandstone) and Upper Cretaceous beds.

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Fig. 3.49 General view in a south-eastern direction showing Palaeozoic (Cambrian and Ordovician) and Cretaceous formations in the Ras en-Naqb area.

Fig. 3.50 Photograph showing cross-bedding in the Subeihi Formation (Lower Cretaceous) at Ras en-Naqb.

(**4**) Shale, lightly coloured, yellowish - brown. Thickness of unit = 0.5 m; cumulative thickness = 22.3 m.
Sample Q3: shale.

(**5**) Black to variegated sandstone, forming a ledge. Thickness of unit = 1.5 m; cumulative thickness = 23.8 m.

Fig. 3.51 Photograph showing the contact between Lower Cretaceous sandstone (Subeihi Formation) and Upper Cretaceous formations in the Ras en-Naqb area.

Sample Q4: sandstone. Rounded to subrounded quartz grains with ferruginous cement.
Sample Q5: sandstone. This bed yielded: *Ammobaculites agglutinans, Cyclammina haydeni, Placopsilina cenomana, Thomasinella aegyptia, T. fragmentaria* and *T. punica.*

(**6**) Sequence of alternating beds of calcareous sandstone (ledge-forming) and shale (Fig. 3.53). The calcareous sandstone beds are about 0.5 m thick each and the shale beds are 10 cm thick each. Thickness of unit = 4 m; cumulative thickness = 27.8 m. This bed is quite poor in foraminiferal content and yielded only *Cyclammina haydeni.*
Sample Q6: sandstone.
Sample Q7: shale.

(**7**) Calcareous sandstone with burrows. Thickness of unit = 0.5 m; cumulative thickness = 28.3 m.
Sample Q8: sandstone. Dolomitic quartz sandstone with matrix composed of anhedral - euhedral dolomite rhombs. Medium - coarse sand grains are poorly sorted, angular - rounded quartz of mono and polycrystalline type (Fig. 3.54).

(**8**) Shale bed. Thickness of unit = 0.5 m; cumulative thickness = 28.8 m.
Sample Q9: shale. This bed yielded: *Ammobaculites agglutinans, A. albertensis, A. naqbensis, Ammomarginulina barthouxi, A. naqbensis, Biconcava bentori, Charentia*

Fig. 3.52 Two photographs showing the contact between the Lower and Upper Cretaceous formations in the Ras en-Naqb area.

Fig. 3.53 Two photographs showing a general view of the Upper Cretaceous successions in Ras en-Naqb area.

hasaensis, C. rummanensis, Haplophragmoides excavatus, H. famosus, H. kirki, H. neolinki, H. umbilicata, Hemicyclammina evoluta, H. whitei, Ismailia aegyptica, I. neumannae, Merlingina cretacea, Thomasinella aegyptia, T. fragmentaria, T. punica and *Trochamminoides parva*, associated with echinoid spines and vertebrate remains.

3.5.2.2 Upper Nodular Member "A2"

At Ras en-Naqb this member yields common macrofossils, particularly oysters and large gastropods. It consists of massive nodular limestones, as follows:

(9) Massive nodular limestone, cliff-forming, fossiliferous, with oyster banks and chert nodules. Thickness of unit = 12 m; cumulative thickness = 40.8 m.
Sample Q10: dolomitic limestone, from the base of sequence. Bioturbated dolomitic wackestone; mud matrix is partially to totally replaced by euhedral rhombs; common to abundant echinoid and bivalve debris.
Sample Q11: from top of massive nodular limestone, yielding gastropods. Foraminiferal peloidal bioclastic wacke - packstone, possible gastropods, miliolids, quinqueloculinids and agglutinated - arenaceous foraminifera are among the main constituents. The matrix is partly replaced by a pseudo-spar and there is some carbonaceous material present (Fig. 3.55). This bed yielded: *Ammodiscoides turbinatus, Cribroelphidium* sp. 1, *Eponides* cf. *frankei, E. sibericus, E. sigali, Nezzazata conica, N. convexa, N. gyra, N. simplex, Quinqueloculina antiqua angusta* and *Chrysalidina gradata* (Fig. 3.55), associated with smooth ostracods.

The sequence continues on a down-faulted block, on the right side of the road to Aqaba, in a "farm" developed around a source of water flowing through the rocks of the Na'ur Formation.

(10) Limestone, massive and jointed, with predominant fractures parallel to bedding, and minor fractures perpendicular to bedding. The surfaces of bedding planes show broad ripples. The base of the succession is a 0.5 m marly limestone bed with bands of indurated crystalline limestone. Thickness of unit = 12 m; cumulative thickness = 52 m.
Sample Q12: marly limestone from base of the succession. Dolomitic foraminiferal and peloidal wackestone, matrix mostly pseudo-spar with some dolomite rhombs. Peloids and micritised arenaceous foraminifera are the main constituents, with some bivalve debris.
Sample Q13: marly limestone. Foraminiferal peloidal wackestone - packstone, benthic foraminifera, mainly arenaceous, miliolids, *Nezzazata* sp. Peloids are micritised, matrix is replaced by equant and pseudo-spars (Fig. 3.56). This bed yielded: *Biconcava bentori, Biplanata peneropliformis, Eponides* cf. *plummerae, E. sigali, E. whitei, Nezzazata concava, N. conica, N. convexa, N. gyra, N. simplex, Nezzazatinella adhami* and *Reissella ramonensis*, associated with smooth ostracods and echinoid fragments.
Sample Q14: limestone near the top of the succession.
Sample Q15: sandy, cross-bedded limestone at the top of the succession. Wackestone - packstone; algal, foraminiferal and micritised peloids and grains. Foraminifera = 30 - 40 %, micritised peloids = 40 %, micrite envelops and coated grains = 20 %, silt-size quartz is rare with anhydrite traces and the matrix is almost totally replaced by spar. The foraminifera are miliolids and arenaceous forms.

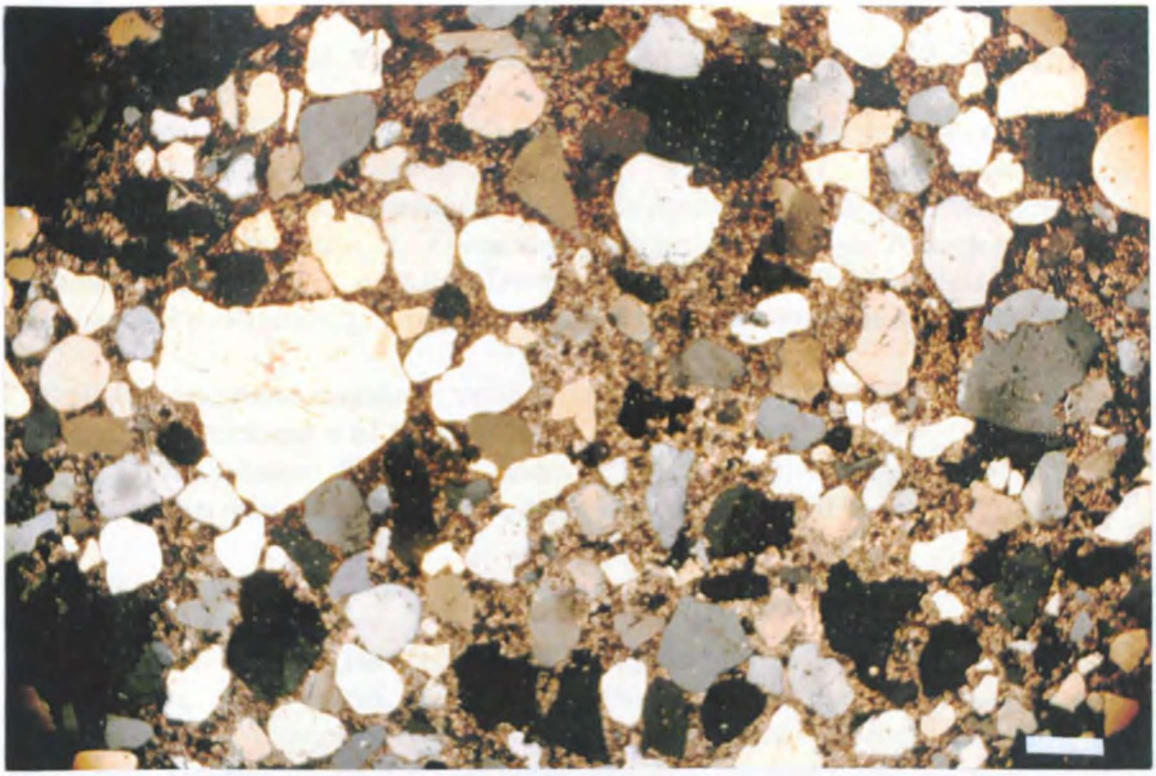


Fig. 3.54 Dolomitic quartz sandstone. Sample Q8, Lower Marly Member "A1", Na'ur Formation, Ras en-Naqb (XPL, X 20).

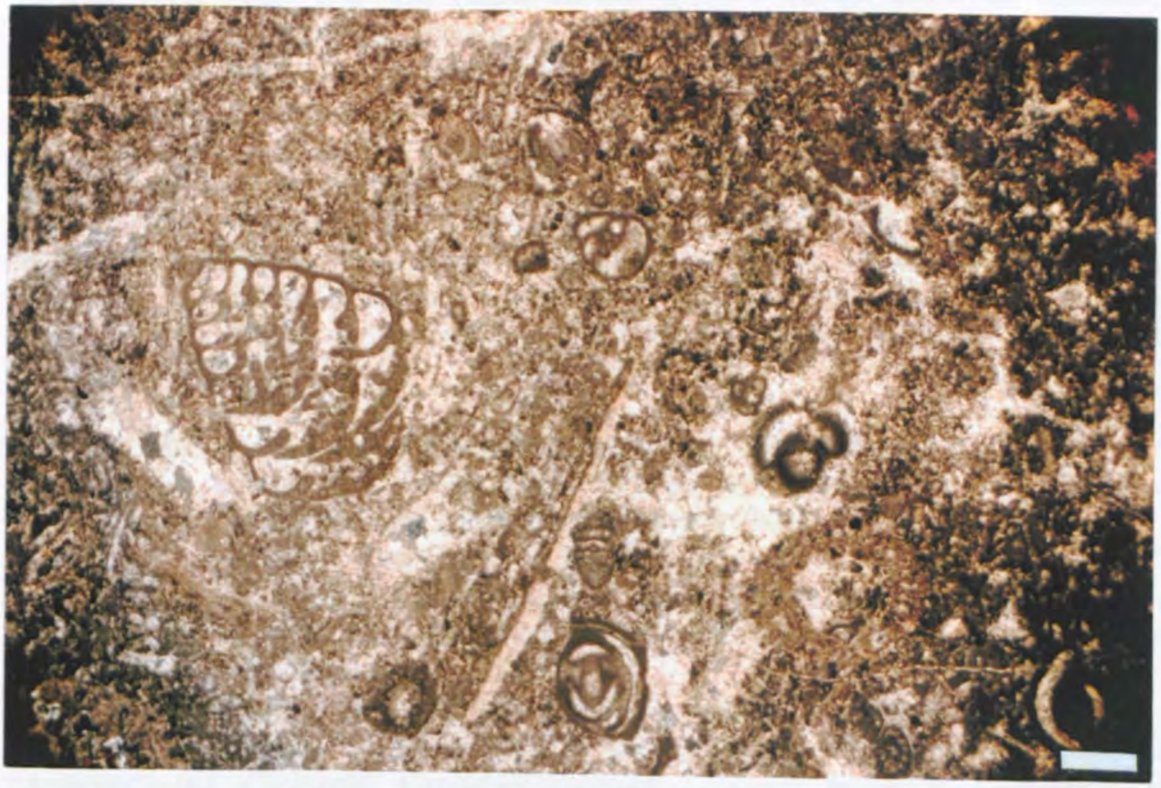


Fig. 3.55 Foraminiferal peloidal bioclastic wacke - packstone. Sample Q11, Upper Nodular Member "A2", Na'ur Formation, Ras en-Naqb (XPL, X 20).

(11) Soft, greenish shale with gypsum veins. Thickness of unit = 7.2 m; cumulative thickness = 60 m.
Sample Q16: shale. This bed yielded: *Ammobaculites difformis, Ammomarginulina barthouxi, A. cragini, Charentia cuvillieri, C. hasaensis, C. rummanensis, Daxia cenomana, Evolutinella subevoluta, Haplophragmoides rugosa, Hemicyclammina whitei, Ismailia aegyptica, I. neumannae, Mayncina orbignyi, Psammonyx* sp. 1, *Quinqueloculina antiqua angusta, Sestronophora* sp. and *Trochammina afikpensis*, associated with ostracods, gastropods, echinoid spines and vertebrate remains (teeth).

(12) Highly calcareous sandstone, cross-bedded, with burrows. Thickness of unit = 1.5 m; cumulative thickness = 61.5 m.
Sample Q17: sandstone. Submature sandstone with angular - subrounded quartz grains and argillaceous matrix. Quartz = 70 %, argillaceous matrix = 30 %.

(13) Soft, greenish shale with oyster banks. Thickness of unit = 3 m; cumulative thickness = 64.5 m.
Sample Q18: shale. This bed yielded: *Ammoastuta nigeriana, Ammobaculites fragmentarius, A. turonicus, Ammomarginulina aburoashensis, Ammosiphonia* sp., *Astacolus liebusi, Charentia evoluta, Conorboides beadnelli, C. hofkeri, C. mitra, C. umiatensis, Gavelinella baltica, Haplophragmoides excavatus* and *Hemicyclammina evoluta.*

(14) Alternating thin shale beds with thick, indurated oyster beds in nodular limestone. Slope-forming. Thickness of unit = 14 m; cumulative thickness = 78.5 m.
Sample Q19: oyster bed. The faunal content includes smooth ostracods, molluscs, echinoid spines and vertebrate remains.
Sample Q20: shale. This bed yielded: *Ammotium aegyptica, A. hasaense, Arenobulimina chapmani, Cibicides beadnelli, Conorboides hofkeri, C. umiatensis, Dorothia pontoni, Favusella washitensis, Gabonita billmani, G. levis, G. parva, Gaudryina rugosa, Gavelinella intermedia, G. semipustulosa, Guembelitria cenomana, Neobulimina canadensis, N. irregularis, Neodiscorbinella* sp. 1, *Planispirinella barnardia, Poroeponides praeceps, Praebulimina* cf. *arabica, Pseudolituonella mariea, Serovaina pseudoscopus, Uvigerinammina jankoi* and *Zotheculifida* sp., associated with the ?radiolarian *Praeoconocaryomma universa*, ostracods, molluscs, echinoid spines and vertebrate remains.

(15) Alternating indurated, ledge-forming limestone beds with soft marl beds. The sequence is highly fossiliferous and yields oysters, gastropods and echinoids (*Cyphosoma*). Thickness of unit = 6.5 m; cumulative thickness = 85 m.
Sample Q21: marly laminated limestone. Bioclastic wackestone with mostly bivalve and echinoid bioclasts. There is a solution-enhanced porosity of about 2 - 5 %, some of the solution appears to be after dolomite, with some smooth ostracods. The matrix is neomorphosed - microspar.
Sample Q22a: shale. This bed yielded: *Ammobaculites agglutinans, A. euides, A. obliquus, A. stephensoni, A. subcretaceus, Ammomarginulina blanckenhorni, A. cragini, Arenobulimina d'orbignyi, Cassidella tegulata, Cibicides beadnelli, Coryphostoma neumannae, Cyclammina haydeni, Dorothia pontoni, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, G. obesa, G. parva, Gaudryina rugosa, Gavelinella baltica, Globospirillina condensa, Guembelitria*

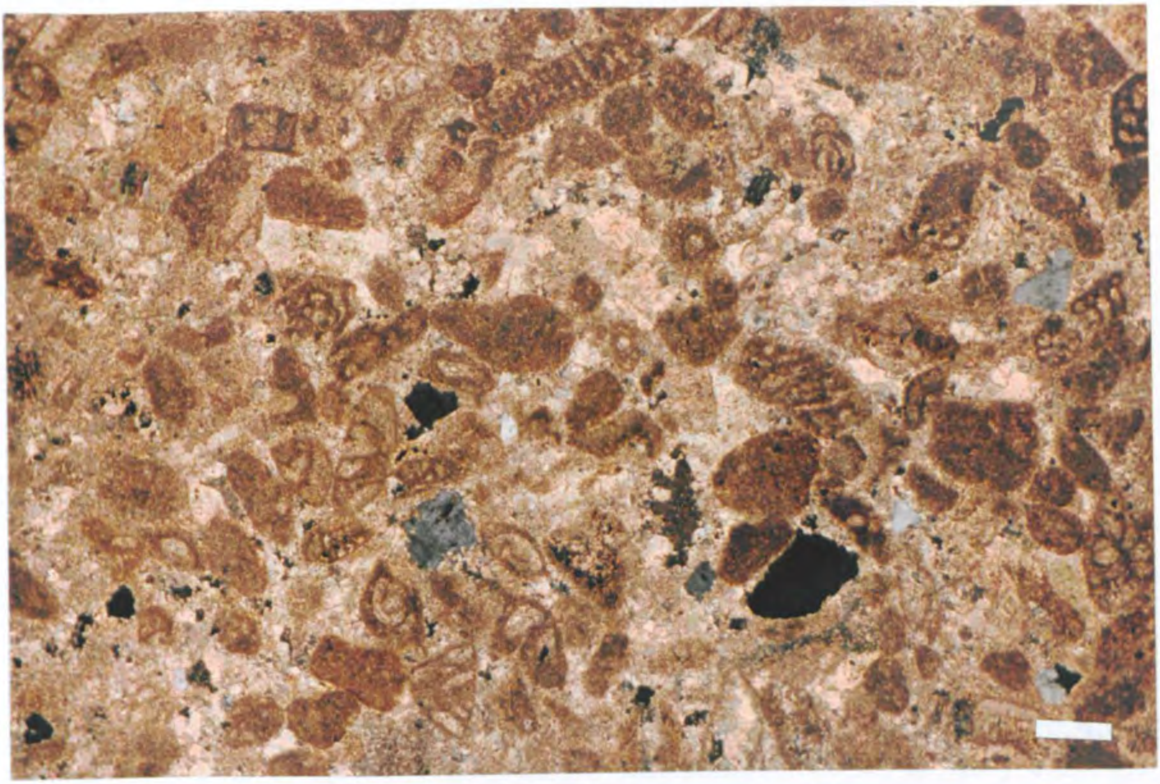


Fig. 3.56 Foraminiferal peloidal wackestone with abundant benthic foraminifera and matrix replaced by equant and pseudo-spars. Sample Q13, Upper Nodular Member "A2", Na'ur Formation, Ras en-Naqb (XPL, X 20).

Fig. 3.57 Mudstone - wackestone with dolomite rhombs concentrated in a burrow. Sample Q26, Fuheis Formation Equivalent "A3", Ras en-Naqb (XPL, X 35).

cenomana, Haplophragmoides calculus, H. excavatus, H. fraseri, Hemicyclammina evoluta, H. sigali, Hiltermannella cf. *kochi, Laevidentalina gracilis, Neobulimina canadensis, N. canadensis alpha, N. irregularis, Placopsilina cenomana, Plectina ruthenica, Praebulimina carseyae, P.* cf. *bantu lata, P. prolixa, P. prolixa longa, P. reussi navarroensis, P. venusae, Praeoconocaryomma universa, Pyramidina rudita, Quasispiroplectammina navarroana, Q. nuda, Reophax* cf. *nodulosus, R. constrictus, Serovaina pseudoscopus, Textularia depressa, Thomasinella aegyptia, Trochammina afikpensis, T. boehmi, Uvigerinammina jankoi, Ventilabrella glabrata* and *Vernonina* sp., associated with ostracods and mollusc fragments.
Sample Q22: ledge-forming limestone. Bioclastic wackestone, tending towards packstone. Similar to the Q22a, but coarser-grained, microfractured.
Sample Q23: top of ledge, highly fossiliferous, nodular, with burrows. Similar to Q22, but more extensively fractured with coarse-spar - fill fractures and may have brachiopod material. This bed is quite poor in foraminiferal content and yielded only *Laevidentalina gracilis*, associated with ostracods and echinoid fragments.

3.5.3 Fuheis Formation Equivalent "A3"

At Ras en-Naqb this formation consists mainly of marly beds and sandy limestone intercalations (Fig. 3.53). The facies changes from marly limestone to sandy dolomitic limestone upward towards the overlying Shueib Formation, as follows:

(16) Yellowish-brown marl with gastropod and bivalves. Thickness of unit = 7.5 m; cumulative thickness = 92.5 m.
Sample Q24: marl. The faunal content includes gastropods and echinoid fragments.

(17) Calcareous siltstone, the base constituting a re-entrant, but the top constituting a ledge; non-fossiliferous. Thickness of unit = 1 m; cumulative thickness = 93.5 m.
Sample Q25: yellowish siltstone.

(18) Unexposed interval. Thickness of unit = 15 m; cumulative thickness = 108.5 m.

(19) Sandy limestone with burrows and recrystallised fossil remains, finely bedded, cliff-forming. The weathering gives the slope a step-like appearance. Thickness of unit = 1.5 m; cumulative thickness = 110 m.
Sample Q26: dolomitic limestone. Mudstone - wackestone, with stylolites which are partially open and dolomite rhombs in the matrix and in burrow systems. Rare to common arenaceous foraminifera (Fig. 3.57).

(20) Marl and limestone intercalations, with burrows, each bed is about 0.5 m thick. Thickness of unit = 1.5 m; cumulative thickness = 111.5 m.
Sample Q27: limestone with burrows. Oolitic bioclastic packstone - grainstone. The matrix is mostly equant spar with relic textures in places. Ooids = 25 %, bioclasts with micrite envelopes and peloids = 60 %, lithoclasts = 5 %, matrix = 10 - 15 % (Fig. 3.58). This bed yielded: *Conorboides mitra, Lingulogavelinella tormarpensis, Quinqueloculina laevigata, Q. globigerinaeformis* and *Serovaina struvei*, associated with ostracods and gastropods.
Sample Q28: marl. This bed yielded: *Adelungia* sp. 1, *Ammobaculites advenus, Ammomarginulina barthouxi, Arenobulimina chapmani, Cassidella tegulata, Gabonita*

levis aegyptiaca, Hemicyclammina sigali, Praebulimina reussi navarroensis and *Pyramidina rudita*, associated with ostracods and vertebrate remains.

3.5.4 Shueib Formation Equivalent "A5" & "A6"

At Ras en-Naqb, this formation consists of dolomitic limestones and shaly sandstones. It may be subdivided into two members, as follows:

3.5.4.1 Lower Dolomitic Limestone Member "A5"

(21) Cross-bedded, sandy, dolomitic limestone, cliff-forming. Thickness of unit = 6 m; cumulative thickness = 117.5 m.
Sample Q29: dolomitic limestone. Replacement dolomite with dirty cores to rhombs and 10 - 15 % intercrystalline porosity (Fig. 3.59).

3.5.4.2 Upper Shaly Sandstone Member "A6"

(22) Sequence of red, fine grained sandstones and shales. Thickness of unit = 5 m; cumulative thickness = 122.5 m.
Sample Q30: shale.
Sample Q31: dolomitic sandstones with some gastropod shells. Arenaceous dolomitic claystone. The quartz grains are angular to rounded, well-sorted and the matrix is locally replaced by zoned dolomite rhombs (Fig. 3.60).

3.5.5 Wadi Sir Formation "A7"

At Ras en-Naqb, the Wadi Sir Formation consists of indurated, dolomitised and cliff-forming coquinal limestone (Figs. 3.28, 60), as follows:

(23) Grey, indurated, dolomitised limestone with *Cyphosoma* (echinoid). Thickness of unit = 1.5 m; cumulative thickness = 124 m.
Sample Q32: oolitic bioclastic packstone - grainstone with gastropods, composite grains and lithoclasts. Ooids and coated grains = 70 %, bioclastic fragments include echinoids, bivalves and gastropods = 5 % (Fig. 3.61). This bed yielded: *Ammomassilina* sp., *Follicucullus* cf. *scholasticus, Quinqueloculina laevigata, Q. triangulata* and *Valvulineria loetterlei*, associated with ostracods, bivalves, gastropods, echinoid spines and vertebrate remains.

(24) Unexposed interval. Thickness of unit = 7 m; cumulative thickness = 131 m.

(25) Indurated, grey, dolomitic limestone, fossiliferous, with small gastropods and small burrows. Thickness of unit = 1 m; cumulative thickness = 132 m.

Sample Q33: bivalve, coated grain silty wackestone - packstone. Bivalve fragments = 30 %, coated grains and algae = 20 %, quartz silt = 5 %, cement = 35 - 45 % (Fig. 3.62). This bed yielded: *Massilina ginginensis, Nezzazata convexa* and *Valvulineria camerata*, associated with ostracods and gastropods.

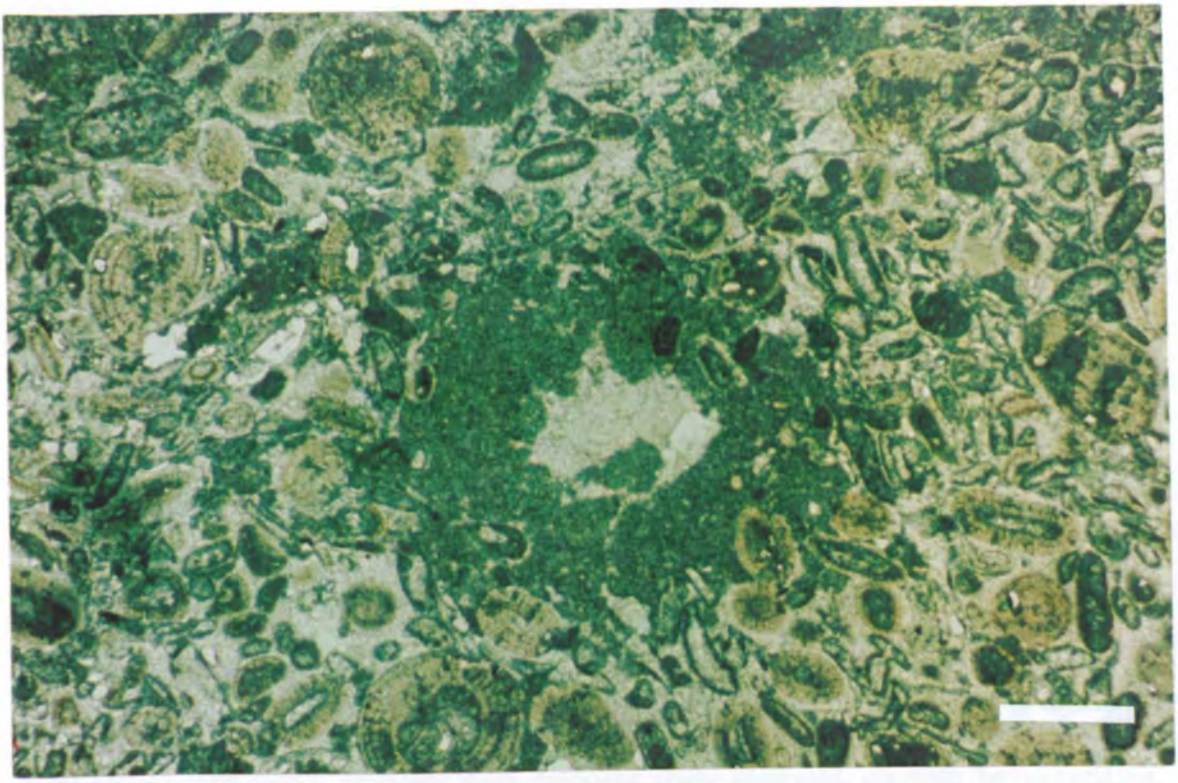


Fig. 3.58 Oolitic bioclastic packstone. Sample Q27, Fuheis Formation Equivalent "A3", Ras en-Naqb (PPL, X 35).

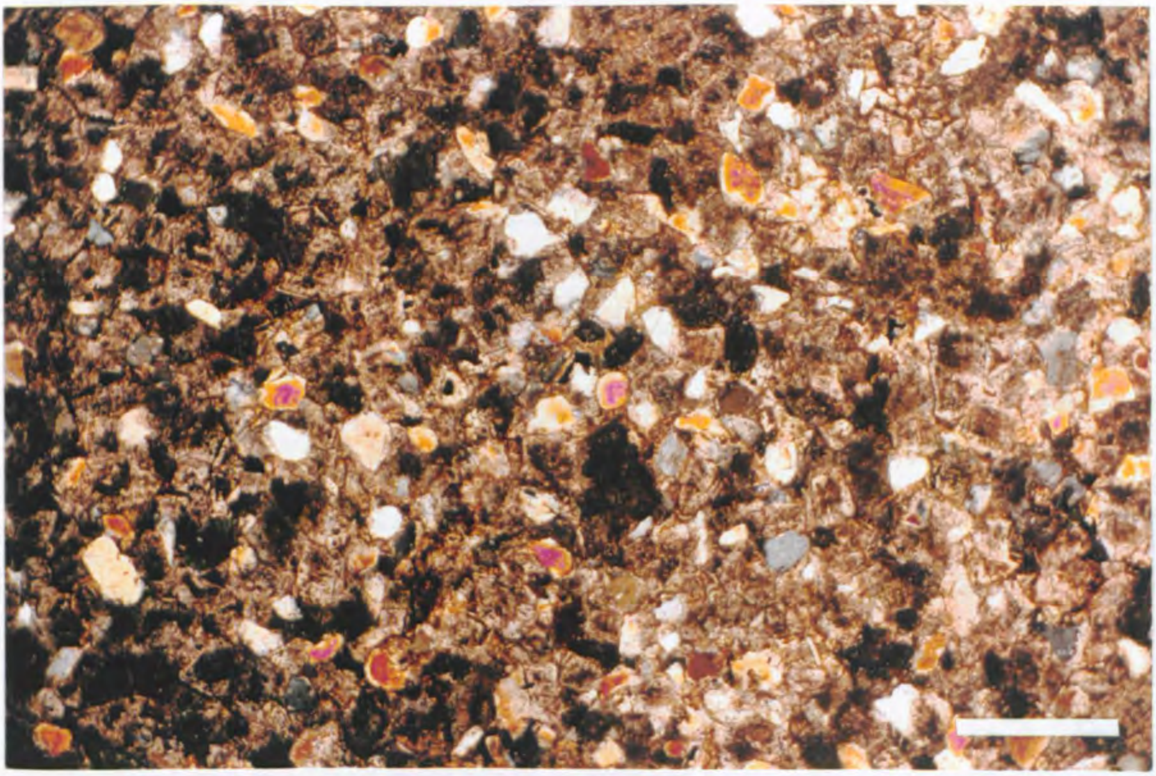


Fig. 3.59 Replacement dolomite with dirty cores to the rhombs. Sample Q29, Fuheis Formation Equivalent "A3", Ras en-Naqb (PPL, X 43).

Sample Q34: laminated foraminiferal wackestone with packstone stringers, ostracod debris and *Concavatotruncana algeriana*. Scattered dolomite rhombs display dissolution of their cores (Fig. 3.63). This bed yielded: *Gavelinella baltica, Quadrimorphina camerata* and *Serovaina pseudoscopus*, associated with ostracods, bivalves, gastropods and vertebrate remains.

The sequence continues after crossing the asphalt road to Aqaba, on the left side of the road (Fig. 3.47).

(26) Ledge-forming sequence of dolomitic limestones with thin marl bands. Thickness of unit = 1 m; cumulative thickness = 133 m.
Sample Q35: dolomitic limestone with gastropod fragments.

(27) Unexposed interval. Thickness of unit = 1.5 m; cumulative thickness = 134.5 m.

(28) Indurated, ledge-forming calcareous dolostone. Thickness of unit = 3 m; cumulative thickness = 137.5 m.
Sample Q36: yellowish calcareous dolostone. Banded argillaceous dolostone, probably microcrystalline, euhedral and anhedral rhombs.

(29) Unexposed slope, probably with frequent shaly intervals, covered by vegetation. Thickness of unit = 30 m; cumulative thickness = 167.5 m.

(30) Indurated calcareous sandstone ledge. Thickness of unit = 6 m; cumulative thickness = 173.5 m.

(31) Limestone with echinoids (*Cyphosoma*), alternating with softer, marly beds. Thickness of unit = 0.5 m; cumulative thickness = 174 m.
Sample Q37: limestone. Dolomitic bioclastic oolitic wackestone - packstone, ooids = 60 % of the grains, lithoclasts = 10 %, bivalve bioclasts = 20 %. The matrix has undergone dissolution with local spar replacement, but euhedral and anhedral dolomite rhombs corrode or replaced both grains and matrix. Dolomite varies from 20 - 80 % of the rock (Fig. 3.64). This bed yielded: *Eponides* cf. *plummerae, Poroeponides praeceps, Quinqueloculina globigerinaeformis, Thomasinella aegyptia* and *T. fragmentaria*, associated with ostracods, gastropods and echinoid fragments.
Sample Q38: softer marly dolostone. Microcrystalline, poorly laminated dolostone, associated with ostracods.

(32) Unexposed interval, talus observed at top of a marly, yellow exposure. Thickness of unit = 3 m; cumulative thickness = 177 m.
Sample Q39: marl. Dolomitic mudstone with euhedral dolomite crystals = 50 %.

3.5.6 Ghudran Formation "B1"

At Ras en-Naqb, this formation consists of chalky, massive, dolomitic limestones, intercalated with marly and shaly bands, as follows:

(33) Chalky limestone. Thickness of unit = 3 m; cumulative thickness = 180 m.

Fig. 3.60 Arenaceous dolomitic claystone. Quartz grains are angular to rounded, well-sorted and the matrix is locally replaced by zoned dolomite rhombs. Sample Q31, Fuheis Formation Equivalent "A3", Ras en-Naqb (XPL, X 43).

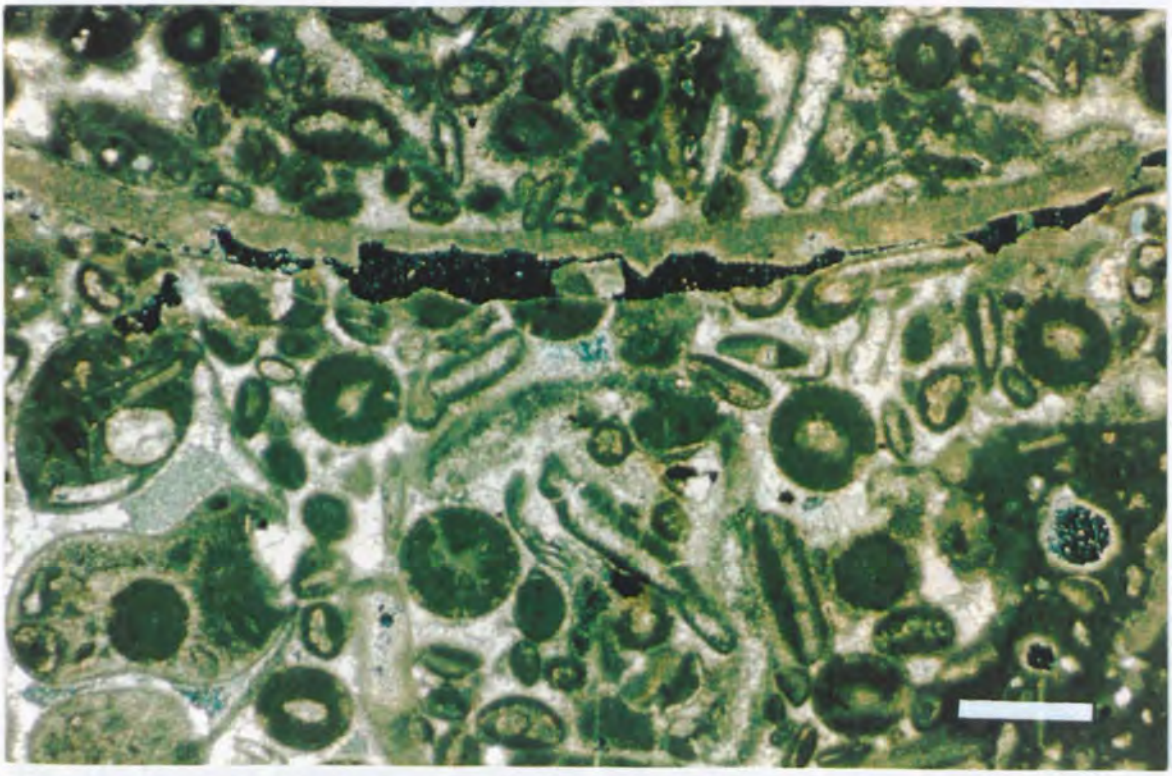


Fig. 3.61 Oolitic bioclastic packstone - grainstone with composite grains and lithoclasts. Sample Q32, Wadi Sir Formation "A7", Ras en-Naqb (XPL, X 35).

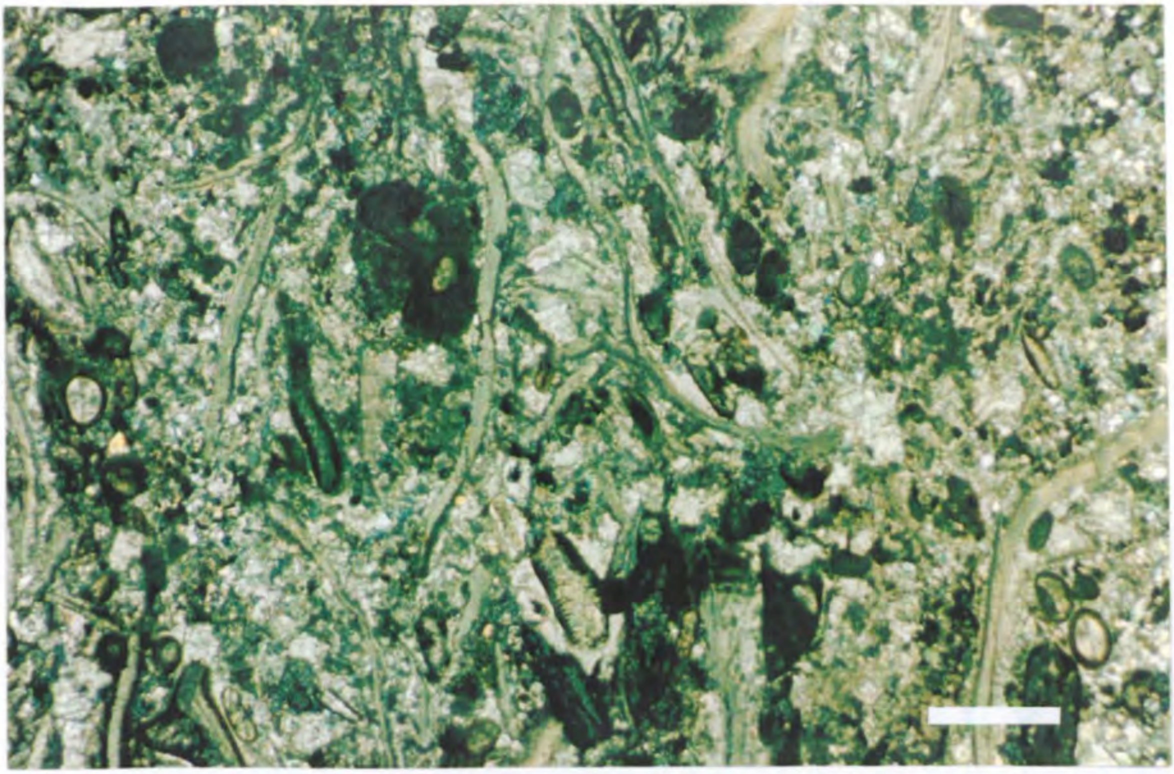


Fig. 3.62 Bivalve, coated grain wackestone - packstone. Sample Q33, Wadi Sir Formation "A7", Ras en-Naqb (XPL, X 35).

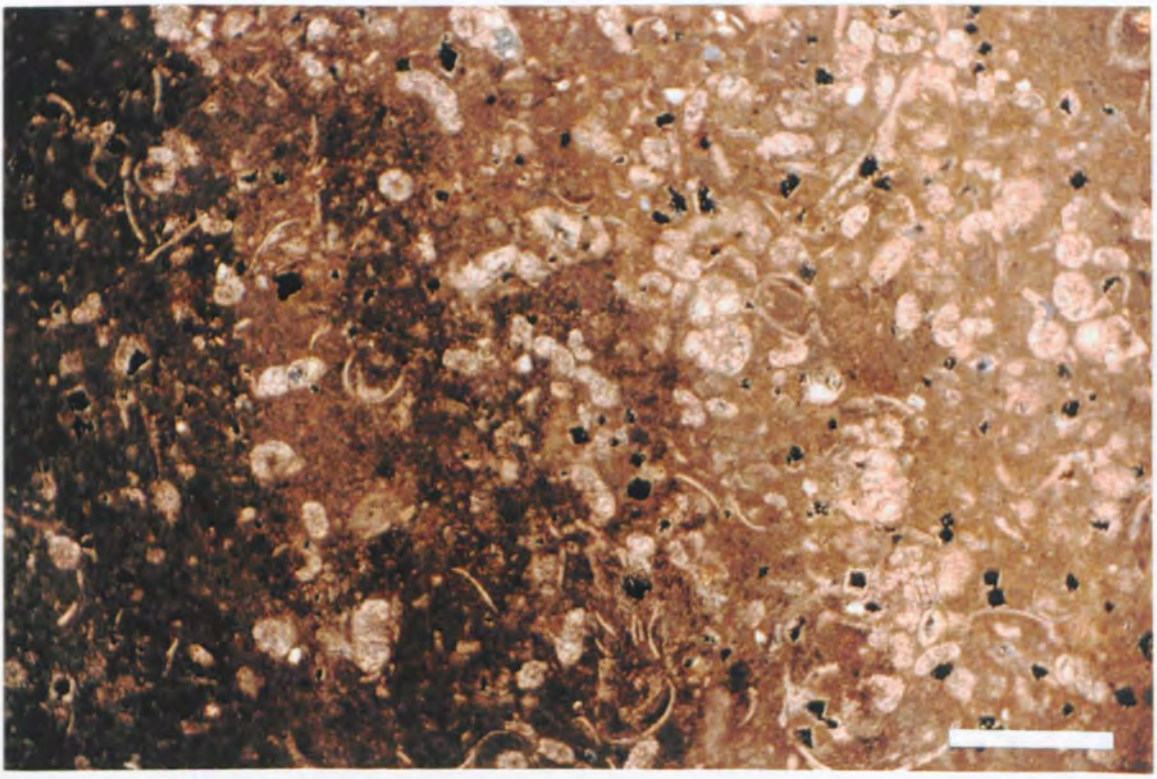


Fig. 3.63 Dolomitic Foraminiferal wackestone with packstone stringers, ostracod debris and *Concavatotruncana algeriana*. Sample Q34, Wadi Sir Formation "A7", Ras en-Naqb (XPL, X 43).

Sample Q40: chalky dolostone. Microcrystalline dolostone, replacement dolomite composed of euhedral and anhedral rhombs. The faunal content includes ostracods and vertebrate remains.
Sample Q41: from a thin marly band, 1 cm thick. Similar to Q40, except there may be possible lamination with iron staining on laminae. The faunal content includes ostracods.

(34) Massive limestone with fossils. Thickness of rock unit = 3 m; cumulative thickness = 183 m.
Sample Q42: limestone with some vertebrate remains. Neomorphosed gastropodal mudstone - wackestone with relic peloids. Gastropods are recrystallised and inner chambers are filled with spar and chalcedonic silica, some bivalve clasts are selectively replaced by silica (Fig. 3.65).

(35) Shale (1 m thick), covered with weathering debris. Thickness of unit = 2 m; cumulative thickness = 185 m.
Sample Q43: shale. This bed yielded: *Ammobaculites advenus, Archaeoglobigerina blowi, Cibicides beadnelli, Conorboides beadnelli, C. hofkeri, Gavelinella baltica, G. burlingtonensis, G. farafraensis, G. semipustulosa, Gavelinopsis proelevata, Hemicyclammina sigali, Lingulogavelinella tormarpensis, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Q. triangulata, Serovaina minutus, S. orbicella, S. pseudoscopus, S.* sp. 1, *S. struvei, S. turonicus* and *Spiroloculina cretacea*, associated with smooth ostracods, gastropods, bivalves, echinoid spines and vertebrate remains.

(36) Limestone bed with chert nodules. Unit thickness = 1 m; cumulative thickness = 186 m.
Sample Q44: yellowish dolomitic limestone. Bivalve gastropodal wackestone, peloids in the matrix, widespread replacement by coarse spar and partial silicification. There are also dolomite rhombs growing in the matrix and replacive of spar in the bioclasts, the matrix is still mud and contains possible hydrocarbon stains.

3.5.7 Amman Formation "B2"

This formation, at Ras en-Naqb, consists of a sequence of recrystallised limestones and dolostones with numerous intercalations of chert. It may be subdivided into two members, but only the lower member was studied, as follows:

3.5.7.1 Lower Silicified Limestone Member

(37) Alternation of phosphatic beds with silicified phosphatic rocks and chert. Sometimes, horizons of chert breccia are observed. Thickness of unit = 4 m; cumulative thickness = 190 m.
Sample Q45: phosphatic limestone with vertebrate remains, ooids and burrows. Microfractured amorphous cryptocrystalline rock with fish scales and possible hydrocarbon stains in the fractures.
Sample Q46: silicified phosphate and chert. Dolomitic limestone with chalcedonic silica nodules replacive of the vertebrate remains. There is mouldic porosity after gastropods and bivalves. The original lithology is bioturbated.

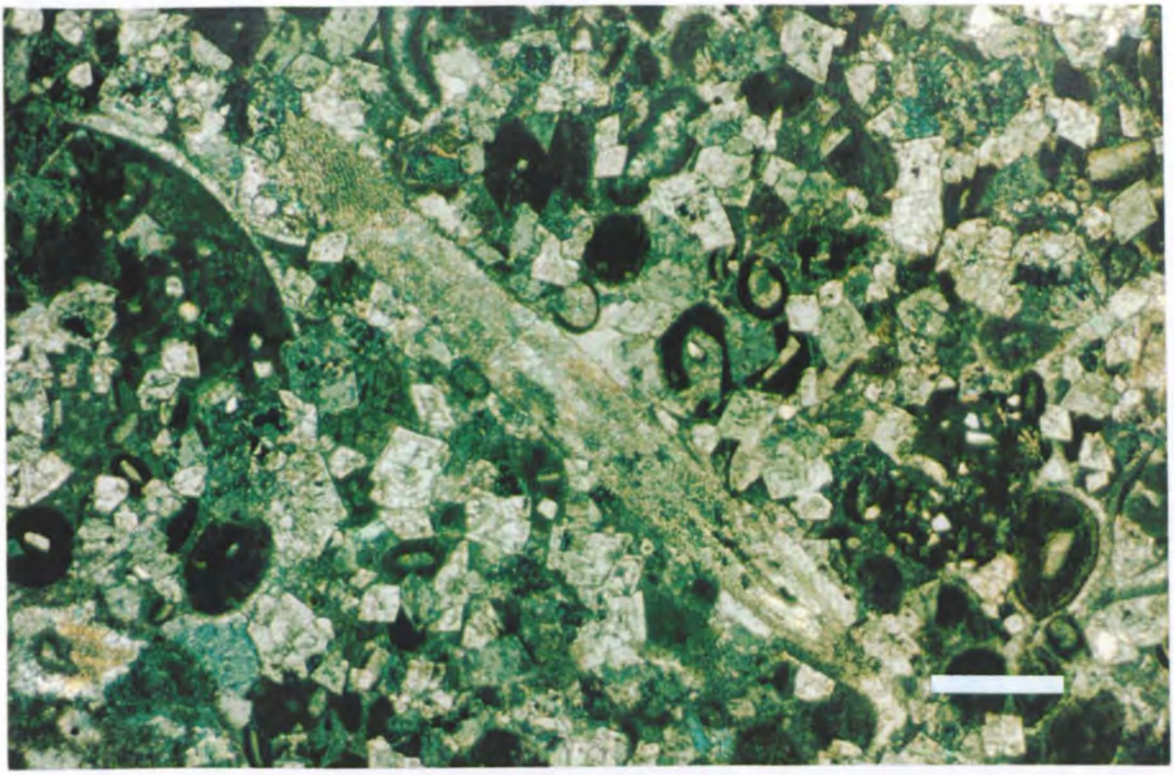


Fig. 3.64 Dolomitic bioclastic oolitic wackestone - packstone. Euhedral and anhedral dolomite rhombs corrode or replaced both grains and matrix. Sample Q37, Wadi Sir Formation "A7", Ras en-Naqb (XPL, X 35).

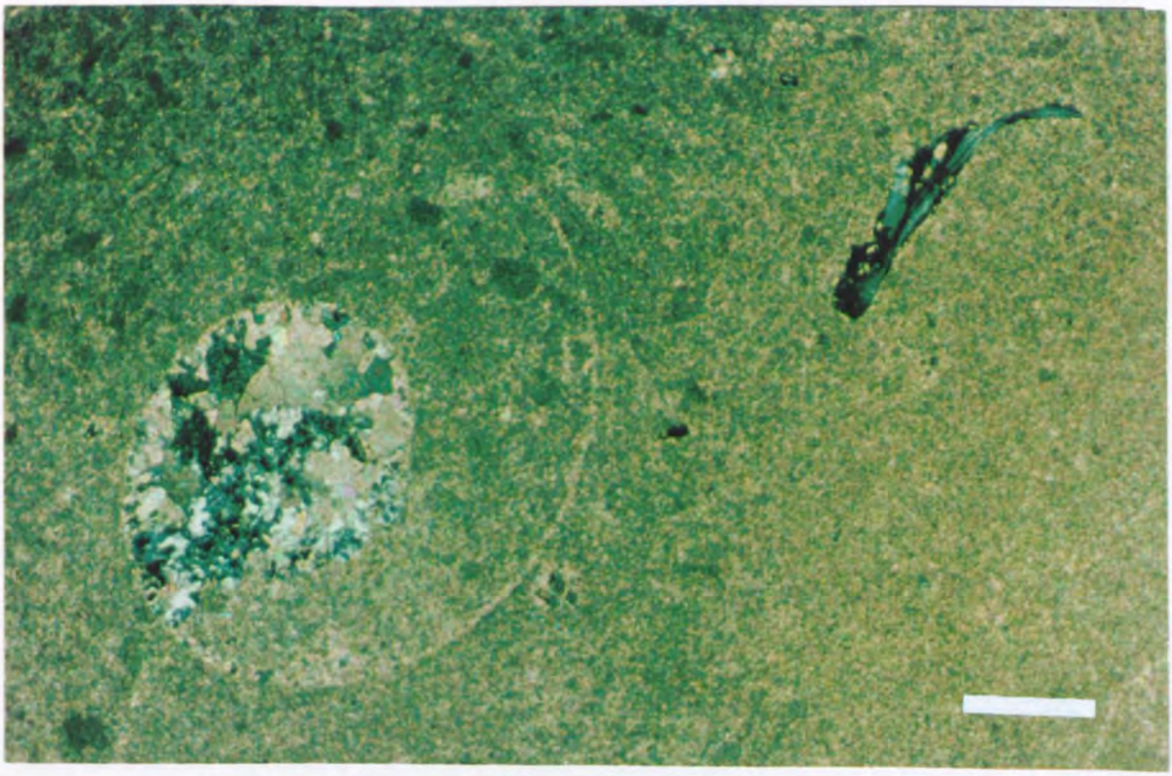


Fig. 3.65 Neomorphosed gastropodal mudstone - wackestone. Gastropods are recrystallised and inner chambers are filled with spar and chalcedonic silica. Sample Q42, Ghudran Formation "B1", Ras en-Naqb (XPL, X 35).

Sample Q47: silicified phosphate. Silicified argillaceous wackestone with peloids or lithoclasts, plant-material, quartz grains and chert nodules.

3.6 Lithostratigraphic correlation

The Upper Cretaceous sequences, represented by the Ajlun and Belqa Groups, outcrop extensively along the Western Highlands east of the Jordan River. They are represented in northern and central Jordan by thick non-clastic carbonate sediments, which conformably lie over the Lower Cretaceous Kurnub Sandstone Group. This facies is gradually replaced south and southeast of Wadi Mujib by arenaceous facies, associated with a decrease in thickness (Enclosure 5). The thickness of Cenomanian sequences (Na'ur, Fuheis, Hummar and Shueib Formations) from "A1-A5" in the north (Ajlun) is 330 m, in the centre (Wadi Mujib) 325 m, and in the south (Wadi Mussa and Ras en-Naqb) 140 m. The thickness of Turonian sediments (Wadi Sir Formation) is estimated to comprise more than 70 m in the north, about 170 m in the centre, and 35 m in the south. The increasing thickness in the northern and central areas and the gradual decrease in the southern, south-eastern and eastern areas is directly related to the palaeogeography of the Tethys Sea, combined with the interaction between sedimentation and tectonic subsidence during different stages of the Late Cretaceous.

The Upper Cretaceous is characterised by a large-scale transgression towards the south and SE of Jordan, as Late Cretaceous sedimentation covered the extreme SE part of Jordan. The lower part of these sediments is mostly calcareous, while chert and phosphate become more important constituents upwards. Arenaceous sediments are less-widespread, except in southern and SE areas of Jordan, where the thickness of the sediments generally decreases.

Quennell (1951, 1956) subdivided the Upper Cretaceous sediments into two groups: the lower called the Ajlun Group and the upper, called the Belqa Group. Later, workers in the field of hydogeology, particularly Burdon (1959), Masri (1963), McDonald et al. (1965a, b) and Baker (1969), gave each group an abbreviation, "A" for Ajlun Group and "B" for Belqa Group. They have also subdivided each group into a number of formations termed A1 - A7 and B1 - B3 (Table 1.1). These formations and members may be summarised and correlated (Enclosure 5), as follows:

3.6.1 Subeihi (Kurnub) Formation "K2"

This formation was recognised in the four studied sections and may be considered to represent the top of the Lower Cretaceous succession. The upper part of the Kurnub Sandstone is varicoloured and cross-bedded. In the northern and central areas it consists of glauconitic sandstone, shale and limestone beds, while in the South it is intercalated by non-calcareous siltstone.

3.6.2 Na'ur Formation "A1 and A2"

This formation represents the oldest Upper Cretaceous rocks and consists of a sequence of massive dolostones and alternating shales, with limestones at the base, nodular limestone in the middle and at the top of succession, intercalated with beds of marl. The formation can be recognised easily in the field throughout the region. It rests on variegated sandstones of the Subeihi (Kurnub) Formation and is overlain by marls of the Fuheis Formation. The Na'ur formation may be subdivided into:

3.6.2.1 Lower Member "A1"

This member is probably conformable with the underlying Lower Cretaceous Subeihi Formation "K2". It consists dominantly of 21 m of soft marl at Ajlun/Jerash, and a sequence of 15 m of alternating limestones and shales, with a massive dolomitic limestone containing burrows at the base, at Wadi Mujib. In Wadi Mussa, the thickness of this member is reduced to 10 m and is composed of thinly bedded marly limestones, while at Ras en-Naqb the facies changes to a sequence of sandy shales and calcareous sandstones.

3.6.2.2 Upper Member "A2"

This member is conformable with the underlying Lower Na'ur Member "A1". It consists of thick grey nodular dolomitic limestones intercalated with thinner marls and marly limestones with a thickness of 170 m at Ajlun/Jerash. At Wadi Mujib the member attains 110 m and is composed of a sequence of alternating soft and indurated nodular limestone with marly bands; at Wadi Mussa the thickness of the member is reduced to 65 m, and it consists of nodular marly and dolomitic limestone with some shale bands. At Ras en-Naqb it remains about 65 m thick but consists of massive nodular sandy limestones. The marly intervals in this member do not generally exceed 5 m in thickness, while limestones may reach more than 30 m in thickness. The limestones yield common macrofauna, particularly oysters and large gastropods.

3.6.3 Fuheis Formation "A3"

This formation is conformable with the underlying Na'ur Formation and can be easily recognised at Ajlun/Jerash; its base has been identified at Wadi Mujib, Wadi Mussa and Ras en-Naqb. In the North, it consists mainly of a 90 m-thick sequence of light-coloured brownish marly beds (commonly showing a blocky fracturing, giving the rock a brick wall-like appearance), with a few thin marly limestones and oyster banks containing common gastropods. The formation is impermeable and its outcrop forms the agricultural lands between Ajlun in the north and Wadi Mujib in central Jordan.

Although it is easy to recognise both the bottom and top of the Fuheis Formation at Ajlun/Jerash, it is difficult to separate it from the overlying Shueib Formation in the other three sections. In this study, the boundary between the two formations at Wadi Mujib is taken at the lithofacies change from intercalated marly limestones and shales, to intercalated nodular limestones and shales, giving a thickness of 135 m. In Wadi Mussa, the base of the Shueib is taken at the change from marly, sandy and nodular limestones to silicified dolomitic limestones, giving a thickness of 45 m, while at Ras en-Naqb it is marked by the facies change from marly limestones to sandy dolomitic limestones, giving a thickness of 30 m.

3.6.4 Hummar Formation "A4"

This formation is recognisable only at Ajlun/Jerash, where it consists mainly of massive and dolomitic light to dark grey limestones with a few intercalated marls and occasional macrofossils (*Exogyra*), attaining 35 m in thickness. The facies disappears towards the south and is absent at Wadi Mujib, Wadi Mussa and Ras en-Naqb, where the overlying Shueib Formation rests directly on the Fuheis Formation.

3.6.5 Shueib Formation "A5 and A6"

This formation may be recognised at Ajlun/Jerash, where it is distinguished from the underlying Hummar Formation by an increase in the amount of marl. The formation may be subdivided into the following members, but it is difficult to differentiate these subdivisions in most other parts of Jordan.

3.6.5.1 Lower Member "A5"

This member is conformable with the underlying Hummar Formation in the North. It consists of 32 m sequence of alternating grey limestones and marly limestones. Each limestone is about 1-1.5 m thick, while the marly beds attain a thickness of 4 m. The limestones are sometimes calcarenites displaying fine and thinly bedded cross lamination; they commonly contain broken fragments of rudist bivalves and other molluscs. The thickness increases at Wadi Mujib to 80 m, where the facies changes to a sequence of shales, nodular limestones and marly limestones. Further towards the South, this member also lies directly on the Fuheis Formation, and the thickness declines to 8 m at Wadi Mussa and attains only 5 m at Ras en-Naqb. The facies also changes to sandy and marly limestone at Wadi Mussa, and to sandy and dolomitic limestone at Ras en-Naqb.

3.6.5.2 Upper Member "A6"

This member is conformable with the underlying Lower Shueib Member in the four studied sections. The thickness of this member ranges from 20 m at Ajlun to 38 m at Wadi Mujib, and attains only 5 m in both Wadi Mussa and Ras en-Naqb. The facies at Ajlun is a sequence of thickly bedded hard nodular limestones intercalated with thin marl beds yielding oysters, other bivalves and large ammonites. It includes massive crystalline limestones containing numerous fossil fragments. In Wadi Mujib, the facies changes to a sequence of alternating marls, shales, dolomitic and oolitic limestones, with bands of dolomite and gypsum. Southwards, the facies changes to marly limestones at Wadi Mussa and to a sequence of sandstones and shales at Ras en-Naqb.

3.6.6 Wadi Sir Formation "A7"

This formation is conformable with the underlying Shueib Formation and is considered to be an index horizon throughout the country. The upper part of this formation is characterised by the extensive appearance of cherts. The thickness of the formation is more than 45 m at Ajlun, increases to 128 m at Wadi Mujib, then thins to 32 m at Wadi Mussa, before increasing to 60 m at Ras en-Naqb.

The facies at Ajlun consists of massive, nodular, dolomitic limestone, and well-bedded marly limestone, with a cliff-forming oyster bank. In Wadi Mujib, the facies consists of a sequence of alternating indurated limestones and marly limestone beds, with an oyster bank near the base of the indurated limestone bed. The samples at the top of the lower part of the unit contain numerous ostracods. The limestones (biosparites) are commonly highly fossiliferous, yielding bivalves, gastropods, echinoids, dasycladacean algae, arenaceous foraminifera, bryozoan, and rare planktonic foraminifera. Macrofossils identified in the unit include *Plicatula* sp., *Exogyra* sp. and other oysters, *Micraster* sp. and ammonites. In Wadi Mussa, the facies consists of a sequence of indurated sandy limestone beds with irregular chert nodules and some marls. In Ras en-Naqb, the facies consists of a sequence of indurated, dolomitic limestone and calcareous sandstone with alternating marly beds.

3.6.7 Ghudran Formation "B1"

In the northern area, this formation consists of 10 - 25 m of soft chalky marly limestones; these are well exposed at Wadi Ghudran Al-Deib, NW of Amman. The Ghudran Formation lies conformably on the underlying Wadi Sir Formation and is overlain conformably by the Amman Formation. The formation has been removed by post-Cretaceous erosion in the Ajlun area, but has been recognised at Wadi Mujib, Wadi Mussa and Ras en-Naqb.

In Wadi Mujib, the Ghudran Formation consists of 15 m of chalk, and a sequence of limestone and marl, with chert nodules and some vertebrate remains (mainly teeth). In Wadi Mussa, the facies changes to 10 m of calcareous, cross-bedded sandstone, intercalated with marly limestone beds and chert nodules. Further towards South, at Ras en-Naqb, the thickness remains the same, but the facies changes to chalky and massive limestone, with shales and chert nodules.

3.6.8 Amman Formation "B2"

This formation consists of fossiliferous recrystallised limestones and dolostones with numerous chert intercalations. The formation may be recognised at Wadi Mujib, Wadi Mussa and Ras en-Naqb, and may be subdivided into:

3.6.8.1 Lower Silicified Limestone Member

This member contains only rare phosphatic beds. It may be differentiated from other Upper Cretaceous units by the presence of prominent chert-rich horizons, which are up to 2 m thick in areas like Ruseifa and Amman, and attain more than 5 m at Wadi Mujib. The base of the member is taken at the bottom of the first major silicified coquinal limestone layer. The lower part of the member includes some thin shale beds, followed by a sequence of cross-bedded phosphatic calcarenites with fish teeth, alternating with calcareous siltstone and chert beds, and beds of porcelanite, ("tripoli"). These are followed by a sequence of marl and shale beds, intercalated by chert bands and coralline limestone and chalky limestone and chalk. At Wadi Mussa, the lower part of the member consists of silicified coquinal limestone bed, and the upper part consists of chert breccia and silicified phosphate. At Ras en-Naqb, only this member was sampled and consists of altered phosphatic limestones with silicified phosphatic rocks and cherts.

3.6.8.2 Upper Phosphatic Silicified Limestone Member

This sequence of recrystallised limestones and dolostones with intercalated cherts and common beds of granular phosphate was studied only at Wadi Mujib and Wadi Mussa. The member is differentiated from the underlying unit by having less chert and a greater proportion of granular phosphate. Where the phosphates are not appreciably silicified, they constitute valuable economic deposits (as in the Al-Ruseifa, Al-Katrana, Al-Hasa and Ma'an areas). The limestone beds include an oyster coquina. This member passes upwards into soft beds of yellowish marl representing the overlying Muwaqqar Formation "B3" of Maastrichtian - Danian age. At Wadi Mussa, this member consists of chalky limestone with chert nodules and successive beds of cherts, with silicified phosphate laminae.

The chronology of the sequences belonging to the Ajlun and Belqa Groups is characterised by the presence of lateral differences in the facies (Enclosure 5). The lithological differences of these sequences have been clearly noticed in the four studied sections. They exhibit internal lateral facies changes and therefore they were differentiated into a number of formations and members. They can be recognised not only by their peculiar lithological properties, but also by their diagnostic faunal content (Enclosure 5).

CHAPTER 4

TAXONOMY

4.1 Introduction

The chapter deals with the taxonomy of the identified (411) foraminifera and (10) radiolarian species found in samples of the Upper Cretaceous succession exposed at four locations in western Jordan. The identified taxa include 80 planktonic, 331 benthic foraminifera (104 calcareous, 227 agglutinated) and 10 radiolarian species. Most of the taxa considered are well known and described in the literature. Publications including diagnosic descriptions used to identify the different species, together with the publications recording these taxa from the Upper Cretaceous (Cenomanian - Maastrichtian) of the Middle East, are given in the synonymy lists.

The revised supra-generic classification of foraminifera proposed by Loeblich & Tappan (1988) is generally followed. For planktonic foraminifera, the specific and generic classification used here is based mainly on the studies of Robaszynski and Caron (1979) and Caron (1985). For many of the arenaceous benthonic foraminifera and Nezzazatinae, the species are identified according to the scheme presented in Schroeder and Neumann (1985).

The stratigraphic range of each species in the study areas is given, as well as its world-wide distribution. Locations of the Jordanian samples are: J, Ajlun / Jerash; M, Wadi Mujib; P, Wadi Mussa; Q, Ras en-Naqb. For the foraminiferal species found in the studied samples, four stratigraphical range charts have been constructed (Enclosures 1-4). These will be discussed in detail in Chapter 5.

4.2 Mixed benthic FORAMINIFERA (textularids)

Systematics

Phylum: **PROTISTA**
Subphylum: **SARCODINA** SCHMARDA, 1871
Class: **RHIZOPODEA** VON SIEBOLD, 1845
Subclass: **LOBOSIA** CARPENTER, 1861
Order: **FORAMINIFERIDA** ECHWALD, 1830

4.2.1 Suborder: **TEXTULARIINA** DELAGE & HÉROUARD, 1896

Superfamily: **AMMODISCACEA** REUSS, 1862
Family: **AMMODISCIDAE** REUSS, 1862
Subfamily: **AMMOVOLUMMININAE** CHERNKH, 1967

Genus: **Psammonyx** DÖDERLEIN, 1892

Psammonyx sp. 1
Pl. 1, Fig. 1 a-b.

Remarks: The rare tests belonging to *P.* sp. 1 in the studied material resemble those of *P. vulcanicus* of Holocene age, in having a rounded proloculus, followed by rapidly expanding tubular second chamber which is loosely planispirally coiled and tending to uncoil. *P.* sp. 1 differs in having a less laterally compressed test, agglutinated wall, and an aperture in the form of a slit at the open end of the tubular chamber.

Distribution: *P. vulcanicus* DÖDERLEIN was recorded from the Holocene of the Pacific Ocean and Japan: (Loeblich & Tappan, 1988, p. 47). In the studied material *P.* sp. 1 is found in: Q16, M22, J40, (lower to middle Cenomanian); J17, Fuheis Formation (middle Cenomanian); J42, Hummar Formation (upper Cenomanian); M45, 51 Shueib Formation Equivalent (upper Cenomanian).

Subfamily: **AMMODISCINAE** REUSS, 1862
Genus: **Ammodiscoides** CUSHMAN, 1909

Ammodiscoides turbinatus CUSHMAN, 1909
Pl. 1, Fig. 2 a-b.

1909 *Ammodiscoides turbinatus* CUSHMAN, p. 424.
1988 *Ammodiscoides turbinatus* CUSHMAN. - LOEBLICH & TAPPAN, p. 47, pl. 36, figs. 10-12.

Remarks: The test in the microspheric form with a proloculus, followed by a long, coiled, undivided, tubular chamber; young stage forming a hollow cone, later nearly planispiral, gradually increasing in diameter toward the periphery which is rounded or somewhat flattened; megalospheric form without early conical portion; wall of fine sand grains, smoothly and firmly cemented, the surface smooth. Microspheric form is easily distinguished by having a low cone on one side in the centre and on the opposite side a distinct depression, the succeeding coils following in nearly a single plane.

Distribution: *A. turbinatus* was recorded from the Pennsylvanian of Texas, USA, Turonian of Trinidad; Palaeogene of Japan; Holocene of the Gulf of Mexico, South Atlantic and Brazil (Loeblich & Tappan, 1988). In the studied material it is found in: P24, 26, Q11, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); J34, Shueib Formation (upper Cenomanian); J58, Wadi Sir Formation (Turonian); M71, Ghudran Formation (Coniacian to Santonian); M109, P60 Amman Formation (lower Maastrichtian).

Genus: **Ammodiscus** REUSS, 1862
Ammodiscus cretaceus (REUSS, 1845)
Pl. 1, Fig. 3 a-b.

1845 *Operculina cretacea* REUSS, p. 35, pl. 13, figs. 64, 65.

1983 *Ammodiscus cretaceus* (REUSS). - BASOV et al., p. 760, pl. 5, fig. 3.
1985 *Ammodiscus cretaceus* (REUSS). - ROBASZYNSKI et al., p. 26, t-f. 16-17.
1988 *Ammodiscus cretaceus* (REUSS). - LÜGER, pl. 1, fig. 2.
1988 *Ammodiscus cretaceus* (REUSS). - JARVIS et al., pl. 24, fig. 11a, text-Fig. 7.
1989 *Ammodiscus cretaceus* (REUSS). - ISMAIL, p. 121, pl. 1, fig. 1.
1990 *Ammodiscus cretaceus* (REUSS). - HART et al., fig. 3a.
1990 *Ammodiscus cretaceus* (REUSS). - CHARNOCK et al., p. 154, pl. 2, figs. 1-3; pl. 14, fig. 3.

Description: Test free, large, evolute, discoidal, globular proloculus followed by an undivided, planispiral, relatively wide tubular chamber, partially overlapping preceeding whorl, with 8-10 whorls; sutures distinct, depressed; wall finely agglutinated, surface smooth; aperture at the open end of the chamber.

Distribution: *A. cretaceus* was recorded from the: Upper Cretaceous of the Atlantic, India and Indian Ocean; Upper Cretaceous to Palaeogene of the Labrador Shelf; Albian to Oligocene of the North Sea (Charnock et al., 1990); Cenomanian to Turonian of England (Jarvis et al., 1988); Albian to lower Cenomanian of Japan; Campanian to lower Maastrichtian of the Apennines, Italy, Alaska and California (Sliter, 1973); Campanian of Netherlands (Robaszynski et al., 1985); lower Maastrichtian of Egypt (Ismail, 1989). In the studied material, rare tests have been found in: J25, Fuheis Formation (middle Cenomanian) and M86 Amman Formation (Campanian).

Subfamily: **AMMOVERTELLININAE** SAIDOVA, 1981
Genus: **Ammovertellina** SULEYMANOV, 1959

Ammovertellina sp. 1
Pl. 1, Figs. 4-5.

Remarks: Proloculus followed by streptospirally wound tubular second chamber, later becoming planispiral, final stage uncoiling and with zigzag or irregular growth; wall agglutinated; aperture a slit at the open end of the tube.

Distribution: *A.* sp. 1 resembles *A. prima* SULEYMANOV from the Palaeocene of Kyzyl Kum, Uzbekistan (Loeblich & Tappan, 1988, p. 50) in the external appearance, but differs in the stratigraphic occurrence. In the studied material, *A.* sp. 1 is found in: M8n, 23, Na'ur Formation, (lower to middle Cenomanian) and M31, Fuheis Formation Equivalent (middle Cenomanian).

Superfamily: **HORMOSINACEA** HAECKEL, 1894
Family: **HORMOSINIDAE** HAECKEL, 1894
Subfamily: **REOPHACINAE** CUSHMAN, 1910
Genus: **Adelungia** SULEYMANOV, 1966

Adelungia marginulinaeformis (SULEYMANOV, 1963)
Pl. 1, Fig. 6.

1963 *Pseudoreophax marginulinaeformis* SULEYMANOV, p. 88.

1988 *Adelungia marginulinaeformis* (SULEYMANOV). - LOEBLICH & Tappan, p. 57, pl 44, figs. 12-14.

Remarks: Test small, rounded in an arcuate series of gradually enlarging chambers, sutures strongly oblique; wall fine-grained agglutinated; aperture a simple terminal, eccentric opening.

Distribution: *A. marginulinaeformis* was recorded from the Albian of Kyzyl Kum (Loeblich & Tappan, 1988). In the studied material, it is found in: M8n, Na'ur Formation (lower Cenomanian) and J56, Shueib Formation (Turonian).

Adelungia sp. 1
Pl. 1, Fig. 7.

Description: Test small, ovoid with compressed chambers, increasing gradually in size; sutures strongly oblique, extending distally toward the outer margin of the test and extending back toward the proloculus at the inside of the arc; wall agglutinated; aperture a simple terminal opening, slightly offset toward the outer margin of the arcuate test. *A.* sp. 1 resembles *A. marginulinaeformis* (SULEYMANOV) from the Albian of Kyzyl Kum (Loeblich & Tappan, 1988, p. 57), in the external appearance, but differs in having an ovoid instead of rounded test.

Distribution: In the studied material, *A.* sp. 1 is found in: M8n; P19, Na'ur Formation (lower to middle Cenomanian); Q28, J17, Fuheis Formation (middle Cenomanian); J59, Wadi Sir Formation (Turonian).

Genus: **Reophax** MONTFORT, 1808

Reophax constrictus (REUSS, 1874)
Pl. 1, Fig. 9 a-b.

1874 *Haplostiche constricta* REUSS. - REUSS, p. 122, pl. 24, figs. 9-12.
1944 *Reophax constrictus* (REUSS). - CUSHMAN, p. 1, pl. 1, fig. 1.
1971 *Reophax constrictus* (REUSS). - MORRIS, p. 265-266, pls. 1, 12, text-fig. 4.

Description: Test free, elongate, rectilinear, consisting of 2-3 uniserial, inflated chambers, rounded in outline and which have broken off at the suture, usually of equal height and breadth; sutures horizontal and depressed, marked by constrictions in the test wall between chambers; wall fine to medium grained arenaceous; aperture rounded, terminal at constricted end of last chamber.

Distribution: *R. constrictus* was recorded from the Cenomanian and Turonian of Saxony, Germany, Texas and Alabama, USA (Morris, 1971). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Reophax parvulus HUSS, 1966
Pl. 1, Fig. 8 a-b.

1966 *Reophax parvulus* HUSS, p. 21, pl. 1, figs. 26-30.
1981 *Reophax minutus* HUSS. - MORGIEL & OLSZEWSKA, p. 9, pl. 2, fig. 5.
1984 *Reophax minutus* HUSS. - GEROCH and NOWAK, pl. 1, fig. 9.
1988 *Reophax minutus* HUSS. - DECKER and RÖGL, pl. 1, fig. 15.
1990 *Reophax parvulus* HUSS. - NEAGU, p. 249, pl. 4, figs. 25-26, text-fig. 2.

Description: Test free, elongate, slightly compressed, with few rounded to ovoid chambers in a regular series, chambers usually having more breadth than height; sutures depressed and oblique; fine to medium grained arenaceous wall; aperture terminal, rounded, produced on a short and prominent neck.

Distribution: *R. parvulus* was recorded from the Albian to Turonian of the Eastern Carpathians, Romania (Neagu, 1990). In the studied material, it is found in: J34, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian); J59, Wadi Sir Formation (Turonian).

Reophax sp. cf. ***nodulosus*** (BRADY, 1879)
Pl. 1, Fig. 10.

1879 *Reophax nodulosa* BRADY. - BRADY, p. 52, pl. 4, figs. 7-8.
1898 *Reophax subnodulosa* GRZYBOWSKI. - GRZYBOWSKI, p. 279, pl. 10, figs. 17-18.
1984 *Reophax subnodulosa* GRZYBOWSKI. - GEROCH et al., p. 4, pl. 1, 5, fig. 7.
1990 *Reophax* sp. cf. *subnodulosus* GRZYBOWSKI. - KUHNT & KAMINSKI, pl. 3, fig. 6.
1960 *Reophax nodulosus* (BRADY). - BARKER, pl. 31, figs. 6-7, 9.
1982 *Reophax nodulosus* (BRADY). - MILLER et al., p. 20, pl. 1, fig. 23.
1990 *Reophax nodulosus* (BRADY). - CHARNOCK et al., p. 165, pl. 4, fig. 17; pl. 15, fig. 15.

Description: Test free, elongate, rectilinear, consisting of 4-5 rounded chambers, growing gradually, the final one being the largest; sutures horizontal and depressed; wall fine to medium grained arenaceous; aperture rounded, terminal at the end of the last chamber.

Distribution: *R. nodulosus* was recorded from the Campanian to Eocene of the North Sea (Charnock & Jones, 1990); Campanian to Maastrichtian of the western Tethys (Kuhnt & Kaminski, 1990). In the studied material, *R.* sp. cf. *nodulosus* is found in: Q22a, Na'ur Formation (lower to middle Cenomanian) and J25, Fuheis Formation (middle Cenomanian).

Genus: **Scherochorella** LOEBLICH and TAPPAN, 1984

Scherochorella minuta (TAPPAN, 1940)
Pl. 1, Fig. 11.

1940 *Reophax minuta* TAPPAN, p. 94, pl. 14, fig. 3.
1981 *Reophax minuta* TAPPAN. - BUTT, p. 113, pl. 16, fig. O.
1981 *Reophax minuta* TAPPAN. - MORGIEL & OLSZEWSKA, p. 13, pl. 2, fig. 5.
1988 *Reophax minuta* TAPPAN. - MORLOTTI, p. 279.
1988 *Scherochorella minuta* (TAPPAN). - LOEBLICH & TAPPAN, p. 58, pl. 44, figs. 15-16.

Description: Test tiny, subglobular proloculus followed by relatively broad and low closely appressed chambers, gradually increasing in breadth as added and forming a rectilinear series; sutures distinct, depressed, horizontal; wall fine-grained agglutinated; aperture terminal, rounded, not produced on a neck. *S. minuta* is a deep water cosmopolitan form.

Distribution: *S. minuta* was recorded from the Albian of Texas, USA (Tappan, 1945, 1988); Lower Cretaceous of the North Atlantic (Sliter, 1980); Upper Cretaceous of the eastern Alps (Butt, 1981), Barremian to Turonian of the Polish Carpathians (Morgiel & Olszewska, 1981); Aptian of England (Crittenden, 1983); upper Campanian to lower Maastrichtian of the Apennines, Italy (Morlotti, 1988). In the studied material, it is found in: M8n, 23, Na'ur Formation (lower to middle Cenomanian); M31, J41, 23, 25, Fuheis Formation (middle Cenomanian); J59, Wadi Sir Formation (Turonian).

***Scherochorella* sp.**
Pl. 1, Fig. 12.

Description: Test with a globular proloculus followed by subglobular chambers, gradually increasing in breadth as well as in height as added and forming a rectilinear series; sutures distinct, depressed, horizontal; wall fine-grained agglutinated; aperture terminal, rounded, not produced on a neck. *S* sp. differs from *S minuta* in having chambers increasing almost equally in breadth as well as in height.

Distribution: The genus *Scherochorella minuta* (TAPPAN) ranges from the Mississippian to Holocene (Loeblich & Tappan, 1988, p. 58). In the studied material, *S*. sp. is found in: M56 and J56, Shueib Formation (Turonian).

Subfamily: **CUNEATINAE** LOEBLICH and TAPPAN, 1984
Genus: **Polychasmina** LOEBLICH and TAPPAN, 1946

Polychasmina pawpawensis LOEBLICH and TAPPAN, 1946
Pl. 1, Fig. 13 a-b.

1946 *Polychasmina pawpawensis* LOEBLICH & TAPPAN, p. 242.
1964 *Polychasmina pawpawensis* LOEBLICH and TAPPAN. - LOEBLICH and TAPPAN, p. C 215, figs. 128.6 a-b, 7.
1988 *Polychasmina pawpawensis* LOEBLICH and TAPPAN. - LOEBLICH and TAPPAN, p. 59, pl. 45, figs. 15-17.

Description: Test free, elongate, flattened, small rounded proloculus followed by a rectilinear series of broad and low chambers; sutures nearly horizontal to broadly arched in the middle of the flat sides of the test; wall thin, coarsely arenaceous; aperture terminal, a single row of elongate slits that parallel the flat sides of the test.

Distribution: *P. pawpawensis* was recorded from the Cenomanian of Texas, USA (Loeblich & Tappan, 1988). In the studied material, it is found in: M23, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian).

Subfamily: **HORMOSININAE** HAECKEL, 1894
Genus: **Hormosina** BRADY, 1879

Hormosina excelsa (DYLAZANKA, 1923)
Pl. 1, Fig. 14 a-b.

1923 *Hyperammina excelsa* DYLAZANKA, p. 66, pl. 1, fig. 3.
1960 *Hormosina excelsa* (DYLAZANKA). - POKORNY, p. 11, pl. 21, figs. 6, 8.
1981 *Hormosina excelsa* (DYLAZANKA). - GEROCH et al., pl. 1, fig. 8; pl. 5, figs. 23-24.
1981 *Hormosina excelsa* (DYLAZANKA). - MORGIEL et al., p. 9, pl. 2, figs. 6-7.
1988 *Hormosina excelsa* (DYLAZANKA). - MORLOTTI, p. 278.
1990 *Hormosina excelsa* (DYLAZANKA). - KUHNT & KAMINSKI, p. 472, pl. 1, figs. f-i.

Description: Test uniserial, rectilinear, consisting of several elongate, pear-shaped chambers, broad at the lower end and tapering in the upper portion, connected by narrow necks, later chambers overlapping the previous ones to enclose the neck; wall glassy, and smoothly finished; aperture terminal at the end of the last chamber. Usually fragmented into single chambers.

Distribution: *H. excelsa* was recorded from the Cretaceous of Poland; Upper Senonian to lower Eocene of the Polish Carpathians; Coniacian to Santonian of the Moroccan Rif (Morgiel and Olszewska, 1981); lower Maastrichtian of the Apennines, Italy (Morlotti, 1988). In our material, the forms resemble those of the Moroccan specimens and are found in: M56, Shueib Formation Equivalent (Turonian).

Hormosina sp. cf. ***velascoensis*** (CUSHMAN, 1926)
Pl. 1, Fig. 15 a-b.

1926 *Nodosinella velascoensis* CUSHMAN, p. 583, pl. 20, figs. 9 a-b.
1984 *Reophax velascoensis* (CUSHMAN). - HEMLEBEN et al., p. 521, pl. 2, f. 12.
1988 *Nodellum velascoensis* (CUSHMAN). - KAMINSKI et al., p. 187, pl. 1, figs. 21-22.
1970 *Hormosina velascoensis* (CUSHMAN). - NEAGU, p. 35, pl. 2, fig. 16.
1990 *Hormosina velascoensis* (CUSHMAN).-KUHNT et al., p. 475, pl. 1, figs. k-l.

Description: Test with linear arrangement of distinctly overlapping flattened chambers, often compressed; wall finely agglutinated, glassy and smoothly finished;

aperture terminal at the end of the last chamber. *H. velascoensis* occurs in mixed calcareous and agglutinated assemblages of the North African margin in the Moroccan Rift (Kaminski et al., 1988). It is characteristic of flysch assemblages, but absent from North Atlantic abyssal assemblages.

Distribution: *H.* sp. cf. *velascoensis* was recorded from the Maastrichtian of Trinidad; lower to middle Maastrichtian of the Moroccan Rift (Kuhnt & Kaminski, 1990). In the studied material, it is found in: M27, Fuheis Formation Equivalent (middle Cenomanian).

Family: **THOMASINELLIDAE** LOEBLICH and TAPPAN, 1984
Genus: **Thomasinella** SCHLUMBERGER, 1893

Thomasinella aegyptia OMARA, 1956
Pl. 2, Fig. 1 a-b.

1956 *Thomasinella aegyptia* OMARA, p. 884, pl. 1, figs. 1-6.
1975 *Thomasinella aegyptia* OMARA. - BASHA, pp. 67-68, pl. 3, figs. 5-8.
1979 *Thomasinella aegyptia* OMARA. - BASHA, p. 68, pl. 1, figs. 1-5.
1985 *Thomasinella aegyptia* OMARA. - ABDEL-KAREEM et al., pp. 2-12, figs. 4-5.
1989 *Thomasinella aegyptia* OMARA. - ISMAIL, p. 121, pl. 1, fig. 2.
1989a *Thomasinella aegyptia* OMARA. - CHERIF et al., pl. 1, fig. 1.

Description: Test large, large globular proloculus followed by uniserial broad and low cylindrical chambers in rectilinear series; wall thick, coarsely agglutinated, smoothly finished; aperture simple, rounded to ovoid, terminal at the end of the rows of chambers

Distribution: *T. aegyptia* was reported by Omara and later workers from the Albian to the uppermost Cenomanian in Egypt, Algeria, Tunisia, Libya, Israel, France, Venezuela and India. In Jordan it was recorded from the lower Cenomanian (Basha, 1975, 1979). In the studied material, it is found in: J3, M8n, Q5, Q9, 22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J36, Shueib Formation (upper Cenomanian).

Thomasinella fragmentaria OMARA, 1956
Pl. 2, Fig. 2.

1956 *Thomasinella fragmentaria* OMARA, pp. 888-890, pl. 101, fig. 1, t-f.1-6.
1975 *Thomasinella fragmentaria* OMARA. - BASHA, p. 69, pl. 3, figs. 9, 10.
1976 *Thomasinella fragmentaria* OMARA. - ANDRAWIS, pp. 17, 34, pl. II, fig. 9.
1979 *Thomasinella fragmentaria* OMARA. - BASHA, p. 69, pl. 1, figs. 6-7.
1989 *Thomasinella fragmentaria* OMARA. - ISMAIL, p. 121, pl. 1, fig. 3.
1989a *Thomasinella fragmentaria* OMARA. - CHERIF et al., pl. 1, fig. 2.

Remarks: Test usually broken, uniserial to bifurcating, chambers slightly distinct, discoidal or polygonal, increasing in size as added; sutures distinct to obscure; wall thick made of very coarse grains (calcites, quartz and shell fragments); aperture terminal, rounded.

Distribution: *T. fragmentaria* was recorded from the lower Cenomanian of Egypt (Omara, 1956; Andrawis, 1976; Ismail, 1989). In Jordan, it is reported from the lower and upper Cenomanian (Basha, 1975, 1979). In the studied material, it is found in: J3, M8n, Q5 and 9, Na'ur Formation, (lower Cenomanian); J36, Shueib Formation (upper Cenomanian).

Thomasinella punica SCHLUMBER, 1893
Pl. 2, Fig. 3 a-b.

1893 *Thomasinella punica* SCHLUMBERGER, pp. 5-7, pl. 14, figs. 12-4.
1975 *Thomasinella punica* SCHLUMBERGER. - SAINT-MARC, p. 215, pl. I, f. 8.
1976 *Thomasinella punica* SCHLUMBERGER. - ANDRAWIS, p. 17, 34, pl. II, fig. 8.
1979 *Thomasinella punica* SCHLUMBERGER. - BASHA, pp. 69-70, pl. 1, figs. 8-10.
1987 *Thomasinella punica* SCHLUMBERGER. - BENKHEROUF, p. 75, text-fig. 5.
1989 *Thomasinella punica* SCHLUMBERGER. - ISMAIL, p. 122, pl. 1, fig. 4.
1989a *Thomasinella punica* SCHLUMBERGER. - CHERIF et al., p. 1: 3.
1990 *Thomasinella punica* SCHLUMBERGER. - WEIDICH and AL-HARITHI, p. 597, pl. 3, figs. 16-17; pl. 4, figs. 20; pl. 6, figs. 1-13.

Description: Test large, uniserial to bifurcating, periphery lobate; chambers successively increasing in size as added, slightly inflated, circular slightly compressed in transverse; sutures distinct, either with gentle indentations or chevron shape; wall thick made of sand grains, calcite crystals and shell remains embedded in calcareous material; aperture terminal, a single irregular opening in the last chamber.

Distribution: *T. punica* was recorded from the upper Cenomaian of Tunisia and Libya (Schlumberger 1893; Gohrbandt, 1966); lower to upper Cenomanian of Algeria, Egypt and Lebanon (Benkherouf, 1987; Omara, 1956; Andrawis, 1976; Saint-Marc, 1975). In Jordan, it was reported from the Albian to upper Cenomanian (Basha, 1975, 1979; Weidich & Al-Harithi, 1990). In the studied material, it is found in: Q5, 9, M8n, Na'ur Formation (lower Cenomanian); M31, J25, Fuheis Formation (middle Cenomanian); M40, J35, Shueib Formation (upper Cenomanian).

Superfamily: **LITUOLACEA** BLAINVILLE, 1827
Family: **HAPLOPHRAGMOIDIDAE** MAYNC, 1952
Genus: **Ammosiphonia** HE, 1977

Ammosiphonia sp.
Pl. 2, Fig. 4 a-b.

Description: Test planispiral, symmetrical, and nearly completely involute but with depressed central umbilicus on each side, chambers somewhat inflated near the umbilicus, periphery subangular; wall finely agglutinated; aperture a single rounded areal opening somewhat elevated on a short tubular neck.

Distribution: *A.* sp. resembles *A. vulgaris* HE from the upper Triassic of China (Loeblich & Tappan, 1988, p. 65), in the external appearance, but differs in the apertural face where the later is much inflated. In the studied material, *A.* sp. is found in: Q18, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian).

Genus: **Evolutinella** MYATLYUK, 1971

Evolutinella sp. 1
Pl. 2, Fig. 6 a-b, 7.

Remarks: *E.* sp. 1 resembles *E. subevoluta* NIKITINA and MYATLYUK in the external appearance (Loeblich & Tappan, 1988, p. 66), but differs in having a completely evolute test with nodose chambers and large excavated umbilicus.

Distribution: *E.* sp. 1 is found in the studied material in: M20, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M57, Shueib Formation Equivalent (upper Cenomanian), M56; J56, Shueib Formation (Turonian).

Evolutinella subevoluta NIKITINA and MYATLYUK, 1971
Pl. 2, Fig. 5 a-b.

1971 *Evolutinella subevoluta* NIKITINA and MYATLYUK, p. 23, pl. 24, fig. 1.
1971 *Schleiferella schleiferi* BULYNNIKOVA. - BULYNNIKOVA, p. 14.
1988 *Evolutinella subevoluta* NIKITINA and MYATLYUK. - LOEBLICH and TAPPAN, p. 66, pl. 48, figs. 11-16.

Description: Test free, planispiral, almost to completely evolute and biumbilicate, about 10 chambers, gradually increasing in size as added; wall agglutinated, fine-grained and smoothly finished; aperture equatorial at base of the final chamber.

Distribution: *E. subevoluta* is a cosmopolitan form that ranges from the Jurassic to upper Cretaceous. In the studied material, it is found in: P3, 19, Q16, 22a, Na'ur Formation (lower to middle Cenomanian); J41, 17, Fuheis Formation (middle Cenomanian), J44, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Genus: **Haplophragmoides** CUSHMAN, 1910

Haplophragmoides calculus CUSHMAN and WATERS, 1927
Pl. 2, Fig. 12 a-b.

1927 *Haplophragmoides calcula* CUSHMAN and WATERS, p. 19, pl. 2, f. 11-12.
1988 *Haplophragmoides calculus* CUSHMAN & WATERS.- LÜGER, pl. 1, fig. 8.

1989a *Haplophragmoides calculus* CUSHMAN and WATERS. - CHERIF et al, pl. 1, fig. 4

Description: Test small, closely coiled, evolute, planispiral, very strongly compressed; chambers and sutures usually indistinct; wall fine to medium grained arenaceous.

Distribution: *H. calculus* was recorded from the upper Cretaceous of the Gulf Coast, USA (Cushman, 1927); lower Cenomanian and Maastrichtian of Egypt (Cherif et al., 1989; Lüger, 1988). In the studied material, it is found in: M9, 22, Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J56, Shueib Formation (Turonian).

Haplophragmoides excavatus CUSHMAN and WATERS, 1927
Pl. 2, Fig. 14 a-b.

1927 *Haplophragmoides excavata* CUSHMAN & WATERS, p. 82, pl. 10, fig. 3.
1968 *Haplophragmoides excavatus* CUSHMAN & WATERS. - SLITER, p. 44, pl. 1, fig. 16.
1971 *Haplophragmoides excavatus* CUSHMAN & WATERS. - MORRIS, p. 266, pl. 2, figs. 3-9.
1975 *Haplophragmoides* sp. cf. *excavata* CUSHMAN & WATERS. - BASHA, p. 41.
1990 *Haplophragmoides* sp. cf. *excavata* CUSHMAN et al-NAGY et al, p. 991, pl. 2, figs. 6-7.

Description: Test free, planispiral, involute, compressed, bilaterally symmetric, periphery acute; 6-8 chambers visible in final whorl, commonly distorted and centrally depressed; sutures distinct (when test is wet), septa slightly curved; wall fine to medium grained arenaceous, surface smoothly finished; aperture narrow equatorial interiomarginal slit. The described specimens resemble those of Cushman and Waters (1927), but differ in having fewer chambers.

Distribution: *H. excavata* was recorded from the upper Cretaceous of Texas; Coniacia to Santonian and Campanian to Maastrichtian of California (Trujillo, 1960; Martin, 1964); lower Turonian of Egypt and lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: P1, 19, M8n, Q9, 18, 22a, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian), J56, Shueib Formation (Turonian).

Haplophragmoides formosus TAKAYANAGI, 1960
Pl. 2, Fig. 11.

1960 *Haplophragmoides formosus* TAKAYANAGI, p. 71, pl. 1, fig. 22.
1968 *Haplophragmoides formosus* TAKAYANAGI. - SLITER, p. 44, pl. 1, fig. 17.
1973 *Haplophragmoides formosus* TAKAYANAGI. - SLITER, p. 178, t-figs. 6-8.
1975 *Haplophragmoides formosus* TAKAYANAGI. - BASHA, p. 43 (not figured).
1994 *Haplophragmoides formosus* TAKAYANAGI. - BOLLI et al., p. 75, f. 20.7.

Description: Test free, planispiral, compressed, not completely involute, periphery subacute; 6-7 chambers in final whorl; sutures distinct, slightly depressed, radial to gently curved; wall finely agglutinated, surface smooth; aperture a low arch at base of final chamber.

Distribution: *H. formosus* was recorded from the lower Cretaceous to the upper Campanian in Japan (Takayanagi, 1960); upper Albian to lower Cenomanian of Trinidad (Bolli et al., 1994); from the Santonian to Campanian of the British Columbia (Sliter, 1973); Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M6, 8n; Q9; P1, Na'ur Formation (lower Cenomanian); J41, Fuheis Formation (middle Cenomanian), J56, Shueib Formation (Turonian).

Haplophragmoides fraseri WICKENDEN, 1932
Pl. 2, Fig. 10.

1932 *Haplophragmoides fraseri* WICKENDEN, p. 86, pl. 1, fig. 2.
1960 *Haplophragmoides fraseri* WICKENDEN. - TRUJILLO, p. 305, pl. 43, fig. 6.
1968 *Haplophragmoides fraseri* WICKENDEN. - SLITER, p. 44, pl. 2, fig. 1.
1989a *Haplophragmoides fraseri* WICKENDEN. - CHERIF et al., pl. 1, fig. 6.

Description: Test small, free, planispiral, partially evolute, biumbilicate, periphery lobulate and rounded; 7-8 globular chambers, inflated; sutures distinct, depressed, slightly curved; wall finely-coarsely agglutinated, surface smoothly finished; aperture obscure. The specimens allocated to this form resemble those described by Sliter (1968) from the Campanian to Maastrichtian of California, but differ in being coarsely agglutinated.

Distribution: *H. fraseri* was recorded from the upper Cretaceous of Canada, later from the Turonian and Senonian of northern California (Trujillo, 1960; Sliter, 1968); and also from the Cenomanian of West-Central Sinai, Egypt and Jordan (Cherif et al., 1989; Al-Bakri, 1990). In the studied material, it is found in: M8n, M8c, P19; Q22a, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian), J39, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Haplophragmoides kirki WICKENDEN, 1932
Pl. 2, Fig. 8-9.

1932 *Haplophragmoides kirki* WICKENDEN, p. 85, pl. 1, fig. 1.
1968 *Haplophragmoides kirki* WICKENDEN. - SLITER, p. 44, pl. 2, fig. 2.
1983 *Haplophragmoides kirki* WICKENDEN.-VERDENIUS et al., p. 193, pl. 5, fig. 13.
1988 *Haplophragmoides kirki* WICKENDEN.- LOEBLICH et al, p. 66, pl. 49, figs. 14-16.
1989 *Haplophragmoides kirki* WICKENDEN. - KING, p. 455, pl. 9.1, fig. 19.
1990 *Haplophragmoides kirki* WICKENDEN. - CHARNOCK and JONES, p. 170, pl. 5, figs. 17-18; pl. 16, fig. 10.
1994 *Haplophragmoides kirki* WICKENDEN. - BOLLI et al., p. 75, pl. 20, fig. 10.

Description: Test free, planispirally enrolled, involute, 5-6 inflated chambers, biumbilicate, rounded periphery, sides flattened, margin lobulate; sutures distinct, depressed, straight; wall finely agglutinated, surface smoothly finished; aperture a low equatorial interiomarginal arch at base of final chamber. *H. kirki* differs from *H. excavatus* in the rounded periphery and the less numerous, more inflated chambers.

Distribution: *H. kirki* was recorded from the upper Cretaceous of Canada and central California (Martin, 1964); lower Cenomanian to Campanian of Trinidad (Bolli et al., 1994); Campanian to middle Miocene of the North Sea (Charnock et al., 1990). In the studied material, it is found in: M6, 8n, 8c, 9, 22, Q9, P1, 3, 19, Na'ur Formation (lower to middle Cenomanian); J17, M31, 32, Fuheis Formation (middle Cenomanian); M43 Wadi Mujib, J36, Shueib Formation (upper Cenomanian); J56, Shueib Formation (Turonian); P56, Amman Formation (Campanian).

Haplophragmoides neolinki STELCK and WALL, 1955
Pl. 2, Fig. 13 a-b.

1955 *Haplophragmoides neolinki* STELCK, WALL, p. 50, pl. 2, figs. 28-29.
1975 *Haplophragmoides* sp. cf. *neolinki* STELCK & WALL. - BASHA, p. 44, pl. 1, fig. 13.

Description: Test small, compressed, planispiral, nearly involute, umbilical side flattened, spiral side very slightly convex due to the presence of umbilical depression; periphery subacute and finally lobulate 7 chambers in outerwhorl, final 2-3 ones slightly inflated and large; sutures indistict, flush with walls; wall finely arenaceous, smoothly finished; aperture an opening at the base of the last chamber.

Distribution: *H. neolinki* was recorded from the uppermost Cenomanian of Canada and the Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: Q9, Na'ur Formation (lower Cenomanian); M31, J25, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Haplophragmoides rugosa CUSHMAN and WATERS, 1927
Pl. 3, Fig. 2.

1927 *Haplophragmoides rugosa* CUSHMAN & WATERS, p. 83, pl. 10, fig. 4.
1975 *Haplophragmoides rugosa* CUSHMAN & WATERS. - BASHA, p. 46.
1989a *Haplophragmoides rugosa* CUSHMAN and WATERS. - CHERIF et al, pl. 1, fig. 7.

Description: Test close-coiled, planispiral, deeply umbilicate, rounded periphery, 6 to 7 chambers in outer whorl; sutures depressed, radial; wall rugose; aperture rounded at base of last chamber. Jordan specimens differ from the original in being smaller and having indistinct sutures.

Distribution: *H. rugosa* was recorded from the upper Cretaceous of USA; lower Cenomanian of Egypt (Cherif et al., 1989); middle Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, 8c; Q16, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian); M57, Shueib Formation Equivalent (upper Cenomanian).

Haplophragmoides umbilicata DAIN, 1934
Pl. 3, Fig. 1.

1934 *Haplophragmoides umbilicata* DAIN, p. 55, pl. 1, fig. 2 a-b.
1975 *Haplophragmoides excavata* v. *umbilicata* DAIN. - BASHA, p. 42, pl. 1, figs. 10-12.

Description: Test close-coiled, involute, planispiral, biumbilicate, subacute margins; 10 or more chambers in the outer whorl, centrally excavated and with raised borders; sutures distinct, depressed, straight to slightly curved; wall finely arenaceous, smoothly finished; curved aperture at the base of the final chamber.

Distribution: *H. umbilicata* was recorded from the uppermost Aptian to Albian in Temir (Dain, 1934); lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: Q9; M22, Na'ur Formation (lower to middle Cenomanian).

Family: **LITUOTUBIDAE** LOEBLICH and TAPPAN, 1984
Genus: **Trochamminoides** CUSHMAN, 1910

Trochamminoides parva (SEIBOLD and SEIBOLD, 1960)
Pl. 3, Fig. 3 a-c.

1960 *Trochammina parva* SEIBOLD & SEIBOLD, p. 344.
1975 *Trochamminoides parva* (SEIBOLD & SEIBOLD). - BASHA, p. 38, pl. 1, figs. 3-5.

Description: Test free, dicoidal, spirally coiled in 2-3 whorls, evolute on both sides, bilaterally symmetric; early portion periphery narrow, later broad, lobulate, raised above surface; 12-14 chambers in the final whorl, trapezoidal in shape, the final 3-5 chambers are nodose, raised and corrugated in shape; sutures straight to slightly curved; wall finely arenaceous, smoothly finished; aperture small opening at the apertural face of the final chamber.

Distribution: *T. parva* was recorded from the upper Jurassic of south Germany (Seibold & Seibold, 1960); basal Turonian of Jordan (Basha, 1975). In the studied material, it is found in: Q9, M23, Na'ur Formation (lower to middle Cenomanian); M31, 32, Fuheis Formation Equivalent (middle Cenomanian).

Family: **MAYNCINIDAE** LOEBLICH and TAPPAN, 1985
Genus: **Biconcava** HAMAOUI, 1965

Biconcava bentori HAMAOUI, 1965
Pl. 3, Fig. 4 a-b.

1965 *Biconcava bentori* HAMAOUI, p. 7, 14, pl. 1, figs. 12; pl. 5, figs.14; pl.14, figs.7

1970 *Biconcava bentori* HAMAOUI. - HAMAOUI et al., p. 298-306, figs. 18-21.
1975 *Biconcava bentori* HAMAOUI. - SAINT-MARC, P. 232, pl. IV, figs. 1-8.
1975 *Biconcava bentori* HAMAOUI.- BASHA, pp. 176-178, pl. 12, figs. 18-20; pl. 13, fig. 1.
1981 *Biconcava bentori* HAMAOUI. - NEUMANN & SCHROEDER, p. 384-385.
1989a *Biconcava bentori* HAMAOUI. - CHERIF et al., p. 1, fig. 25.
1990 *Biconcava bentori* HAMAOUI. - WEIDICH & AL-HARITHI, p. 600, pl. 4, fig. 19.

Description: Test planispirally enrolled, partially evolute, biumbilicate, bilaterally symmetrical; periphery subacute; up to 24 chambers in the final whorl, later ones overlap the earlier ones; sutures elevated, slightly curved, limbate; wall calcareous, microgranular, imperforate; aperture an interiomarginal arch with extension up the triangular apertural face. *Biconcava* is very close in appearance to *Daxia,* but differs in being more evolute and in the aperture located in a vertical groove in the apertural face.

Distribution: was reported by different workers from the lower, middle and upper Cenomanian to lower Turonian of Israel, Egypt, Lebanon, Iran and Italy (Hamaoui, 1979; Saint-Marc, 1975; Neumann & Schroeder, 1981). In Jordan, it was reported from the Albian to Cenomanian, in association with *Praealveolina cretacea - Nezzazata simplex* assemblages (Basha, 1975; Weidich and Al-Harithi, 1990). In the studied material, it is found in: Q9, 13, Na'ur Formation, (lower to middle Cenomanian); J36, 37, 46, 51a, Shueib Formation (upper Cenomanian); P55, Ghudran Formation (Coniacian to Santonian).

Genus: **Daxia** CUVILLIER and SZAKAL, 1949

Daxia cenomana CUVILLIER and SZAKAL, 1949
Pl. 3, Fig. 5 a-b.

1949 *Daxia cenomana* CUVILLIER and SZAKAL, p. 8, pl. 2, figs. 4-6
1952 *Daxia cenomana* CUVILLIER and SZAKAL. - MAYNC, p. 36, 47, pl. 11, figs. 3-4.
1988 *Daxia cenomana* CUVILLIER and SZAKAL. - LOEBLICH, p. 72, pl. 55, figs. 5-9.
1990 *Daxia cenomana* CUVILLIER & SZAKAL. - WEIDICH et al., p. 600, pl. 4, fig. 10.

Description: Test lenticular and biumbonate to flattened with a relatively acute periphery, planispirally enrolled and involute, with numerous broad, low chambers per whorl; sutures arched centrally; apertural face truncated to slightly excavated centrally; wall finely agglutinated; aperture small, an areal opening in thins with thickened border.

Distribution: *D. cenomana* was recorded from ? Aptian to Cenomanian of France; Cenomanian of Israel and Jordan (Hamaoui, 1979; Weidich & Al-Harithi, 1990). In the studied material, it is found in: M21, Q16, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Mayncina** NEUMANN, 1965

Mayncina hasaensis BASHA, 1975
Pl. 3, Fig. 7 a-b.

1975 *Mayncina hasaensis* BASHA, pp. 76-77, pl. 4, figs. 12-16.
1978 *Mayncina hasaensis* BASHA. - BASHA, p. 77, pl. 2, figs. 7-11.

Description: Test free, compressed, early planispiral involute, later tending to uncoil, bilaterally symmetrical and centrally depressed, periphery narrow subacute; 3L whorls, 3-5 chambers in last uniserial portion, longer than broad; sutures distinct, depressed, straight in early stage, later gently curved; wall finely arenaceous, smoothly finished, aperture cribrate.

Distribution: *M. hasaensis* was recorded from the Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: M31, J26, Fuheis Formation (middle Cenomanian).

Mayncina orbignyi (CUVILLIER and SZAKALL, 1949)
Pl. 3, Fig. 6 a-b.

1949 *Daxia d'orbignyi* CUVILLIER & SZAKALL, pp. 8-9, pl. 2, fig. 1
1975 *Mayncina d'orbignyi* (CUVILLIER & SZAKALL). - BASHA, pp. 77-78, pl. 4, figs. 17-19.
1979 *Mayncina d'orbignyi* (CUVILLIER and SZAKALL). - BASHA, p. 62.
1989a *Mayncina orbignyi* (CUVILLIER & SZAKALL). - CHERIF et al., pl. 1, f. 10
1990 *Mayncina* sp. cf. *orbignyi* (CUVILLIER and SZAKALL). - WEIDICH and AL-HARITHI, p. 600, pl. 4, fig. 23.

Description: Test planispiral, involute, biconvex, centrally depressed umbilicus, bilaterally symmetric; 18-24 segments in the outer whorl; rounded narrow peripheral margins; distinct, depressed, straight to arcuate sutures; finely arenaceous walls; cribrate aperture at the triangular oral face. *M. orbignyi* differs from *M. hasaensis* in being more inflated and possessing larger dimensions.

Distribution: *M. orbignyi* was recorded from the middle Cenomanian of France; middle to upper Cenomanian in Egypt (Cherif et al., 1989); upper Cenomanian of Jordan (Basha, 1975, 1979; Weidich & Al-Harithi, 1990). In the studied material, it is found in: M7a, 8c, 9, 16, Q16, Na'ur Formation, (lower to middle Cenomanian); J26, Fuheis Formation (middle Cenomanian), J58, Wadi Sir Formation (Turonian).

Family: **LITUOLIDAE** BLAINVILLE, 1827
Subfamily: **AMMOMARGINULININAE** PODOBINA, 1978
Genus: **Ammobaculites** CUSHMAN, 1910

Ammobaculites advenus CUSHMAN and APPLIN, 1947
Pl. 3, Fig. 9.

1947 *Ammobaculites advenus* CUSHMAN & APPLIN, p. 53, pl. 13, fig. 1.
1962 *Haplophragmoides advenus* (CUSHMAN & APPLIN)-ANSARY, Rpt. 24 B2
1975 *Ammobaculites advenus* CUSHMAN & APPLIN. - BASHA, p. 53, pl. 2, figs. 9-11.

Description: Test close-coiled, compressed, partly evolute, oftenly umbilicate; 6-8 chambers in outer whorl; sutures in the last 2-3 chambers slightly distinct, depressed, curved; fine to medium grained arenaceous walls; terminal rounded or elliptical aperture.

Distribution: *A. advenus* was recorded from the Turonian of Egypt; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: Q28, J41, Fuheis Formation (middle Cenomanian); M41, 43, 57, Shueib Formation Equivalent (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian); M66, J59, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Ammobaculites agglutinans (D'ORBIGNY, 1846)
Pl. 4, Fig. 6.

1846 *Spirolina agglutinans* D'ORBIGNY, p. 137.
1985 *Ammobaculites agglutinans* (D'ORBIGNY). - THOMAS, p. 78, pl. 3, fig. 3.
1986 *Ammobaculites agglutinans* (D'ORBIGNY). - SCHRÖDER, p. 50, pl. 21, figs. 1-4.
1990 *Ammobaculites agglutinans* (D'ORBIGNY). - WIGHTMAN, p. 753.
1990 *Ammobaculites agglutinans* (D'ORBIGNY). - KUHNT et al., pp. 461-462, pl. 3, figs. e-f.

Description: Test free, elongate, early portion close-coiled, later rectilinear, rounded in; wall coarsely agglutinated; aperture terminal, rounded. Deep water assemblage, cosmopolitan (Cenomanian specimens from Northern Atlantic and Western Tethys have a more evolute spiral part and a narrower uniserial part, Kuhnt and Kaminski, 1990).

Distribution: *A. agglutinans* was originally described from the upper Miocene of the Vienna Basin; upper Cretaceous of the Labrador Margin, and has subsequently been reported to range from the Jurassic to Recent (Kuhnt & Kaminski, 1990). In the studied material, it is found in: J10, M6, 8n, 9, 22, P19, Q5, 9, 22a, Na'ur Formation, (lower to middle Cenomanian); P34, 38, 39, 40, J41, 25, Fuheis Formation (middle Cenomanian); J42, Hummar Formation Equivalent, J34, Shueib Formation (upper Cenomanian).

Remarks: In the modern oceans, *A. agglutinanas* occurs in bathyal to upper abyssal depths on area with coarse substrate along the continental margins (Thomas, 1985; Schroeder, 1986).

Ammobaculites albertensis STELCK and WALL, 1954
Pl. 3, Fig. 12 a-b.

1954 *Ammobaculites albertensis* STELCK and WALL, pl. 18, figs. 12-14, 18-19, 21-22.
1975 *Ammobaculites albertensis* STELCK & WALL. - BASHA, p. 54, pl. 2, figs. 12-14.
1976 *Ammobaculites albertensis* STELCK and WALL. - ANDRAWIS, p. 13, 34.

Description: Test flattened, close-coiled, biumbilical symmetric, with a central depression on both sides, periphery rounded, slightly lobulate; 5-6 chambers, final 1-2 tend to uncoil, cylindrical in cross, trapezoidal in shape, final portion nearly bent; sutures depressed, straight to slightly curved; wall arenaceous, fine to medium grained, smoothly finished; aperture elliptical, slit-like or a round opening at the last chamber.

Distribution: *A. albertensis* was recorded from the Turonian of Egypt (Andrawis, 1976); Cenomanian of Canada and Jordan (Basha, 1975). In the studied material, it is found in: Q9, M23, Na'ur Formation, (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J56, Shueib Formation (Turonian).

Ammobaculites difformis HAMAOUI, 1965
Pl. 3, Fig. 8 a-b.

1965 *Haplophragmoides difformis* HAMAOUI, p. 17, pl. 3, figs. 5-8; pl. 6, fig. 9.
1990 *Haplophragmoides? difformis* HAMAOUI. - WEIDICH et al., p. 599, pl. 4, fig. 6.
1979a *Ammobaculites difformis* HAMAOUI. - HAMAOUI, pp. 338-340, t-fig. 1 a-f.
1979b *Ammobaculites difformis* HAMAOUI. - HAMAOUI, p. 78, text-figs. 38 a-e.

Remarks: The rare tests belonging to *A. difformis* in the studied material have a more rapid pace of coiling than the forms illustrated by Hamaoui (1965, 1979). In the apertural view, the last chamber projects across the umbilicus.

Distribution: *A. difformis* was recorded from the upper Cenomanian of Israel (Hamaoui, 1965). It seems to have lived in warm neritic seas in either open marine or littoral environments. It is interesting to notice that this species was found in the Negev, in association with Heterohelicidae and *Hedbergella* spp., indicating an open marine facies (Hamaoui, 1979).

In the studied material, it is found in: P5; M22, 23; Q16, Na'ur Formation, (lower to middle Cenomanian); M31, J26, Fuheis Formation (middle Cenomanian); J35, Shueib Formation (upper Cenomanian).

Ammobaculites euides LOEBLICH and TAPPAN, 1949
Pl. 4, Fig. 4.

1949 *Ammobaculites euides* LOEBLICH & TAPPAN, p. 250, pl. 46, fig. 8.

1975 *Ammobaculites euides* LOEBLICH & TAPPAN. - BASHA, pp. 57-58, pl. 2, fig. 15.
1981 *Ammobaculites euides* LOEBLICH & TAPPAN. - SLITER, p. 368, pl. 2, figs. 10-12.
1990 *Ammobaculites euides* LOEBLICH & TAPPAN.-WIGHTMAN, p. 754, pl. 1, fig. 8

Description: Test planispiral, early close-coiled of 4-5 chambers followed by straight to curvilinear portion of 3-4 chambers with straight sutures; coiled diameter slightly greater than the width of the uncoiling portion, producing a lobate outline; wall finely arenaceous to silt-agglutinated; aperture terminal and elliptical. Distinguished from *A. obliquus* by the small tight coil, straight sutures and slightly lobate curvilinear uncoiling portion.

Distribution: *A. euides* was recorded from the lower Cretaceous of Portugal and Kansas, USA; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, Q22a, Na'ur Formation, (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J32, Hummar Formation (upper Cenomanian).

Ammobaculites fragmentarius CUSHMAN-CUSHMAN, 1927
Pl. 4, Fig. 8.

1927 *Ammobaculites fragmentaria* CUSHMAN, p. 130, pl. 1, fig. 8.
1967 *Ammobaculites fragmentarius* CUSHMAN. - WALL, p. 55, pl. 1, figs. 7-9; pl. 7, figs. 18-20.
1971 *Ammobaculites fragmentarius* CUSHMAN. - MORRIS: 269: 3: 1-2.
1975 *Ammobaculites fragmentarius* CUSHMAN. - BASHA, p. 58: 2: 16.
1988 *Ammobaculites fragmentarius* CUSHMAN. - LÜGER, pl. 1, fig. 10.
1994 *Ammobaculites fragmentarius* CUSHMAN. - BOLLI et al., p. 78, pl. 20, figs. 31-33.

Description: Test free, elongate, cylindrical in cross, with a tightly coiled early portion of 4-5 chambers, followed by uniserial compressed portion of 5 chambers, terminal chamber attaining the largest size, uniserial portion not offset from coil; sutures straight in uniserial portion, not too distinct, slightly depressed; wall arenaceous of medium to coarse grains with moderate to rough finish; aperture terminal, rounded.

Distribution: *A. fragmentarius* was recorded from the Albian of Alaska and USA; Cenomanian of Alberta and Australia; Maastrichtian of Southern Egypt; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, 8c, Q18, Na'ur Formation, (lower to middle Cenomanian); J15, 17, Fuheis Formation (middle Cenomanian), J56, M56, Shueib Formation Equivalent (Turonian).

Ammobaculites mastersi MORRIS, 1971
Pl. 3, Fig. 11 a-b.

1971 *Ammobaculites mastersi* MORRIS, p. 269, pl. 3, figs. 3-5, text-fig. 4.

Description: Test small, evolute forming compressed to slightly rounded planispiral coil, later uncoiled, open umbilical area; chambers 5-7 and two more crescentic to arcuate in shape; sigmoidal sutures, depressed; wall finely arenaceous and smoothly finished; aperture a slit-like opening in the apertural face of the last chamber.

Distribution: *A. mastersi* was recorded from the Campanian of north-western Colorado, USA (Morris, 1971). In the studied material, it is found in: M32, Fuheis Formation Equivalent (middle Cenomanian); J56, Shueib Formation (Turonian).

Ammobaculites naqbensis BASHA, 1975
Pl. 3, Fig. 10 a-b.

1975 *Ammobaculites naqbensis* BASHA, p. 62, pl. 2, figs. 20-23.
1978 *Ammobaculites naqbensis* BASHA. - BASHA, pp. 74-75, pl. 1, figs. 5-7.

Description: Test free, oval, early portion close-coiled, involute, later uniserial, oval in transverse; periphery rounded, slightly lobulate; outer whorl contains 10-12 segments, 1-2 in the uniserial portion which is much inflated, globulose, the coiled chambers trapezoidal in shape; sutures straight, gently curved, depressed; wall finely arenaceous, smoothly finished; aperture terminal, oval, on a very short neck.

Distribution: *A. naqbensis* was originally described from the lower Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: P3; Q9, M8n, 8c, M23, Na'ur Formation, (lower to middle Cenomanian); M31, J17, Fuheis Formation (middle Cenomanian); J35, 39, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammobaculites obliquus LOEBLICH and TAPPAN, 1949
Pl. 4, Fig. 5 a-b.

1949 *Ammobaculites obliquus* LOEBLICH and TAPPAN-SKOLNICK. - 250: 46: 4-5.
1957 *Ammobaculites obliquus* LOEBLICH and TAPPAN. - SKOLNICK: 281, pl. 36, fig. 3.
1981 *Ammobaculites obliquus* LOEBLICH and TAPPAN-SKOLNICK. - CRITTENDEN, p. 20, pl. 2, figs. 4-6.
1990 *Ammobaculites obliquus* LOEBLICH and TAPPAN-SKOLNICK. - WIGHTMAN, pp. 754-55, pl. 1, fig. 9.

Description: Test involute, close-coiled portion consists of 5-7 chambers followed by uncoiled portion of 1-4 chambers, generally higher than broad and inflated at proximal sutures, constricted distally; sutures straight in the uncoiled portion, olique in the uncoiled portion; wall agglutinated with silt; aperture simple terminal.

Distribution: *A. obliquus* was recorded from the lower Cretaceous of Kansas, USA and Portugal (Wightman, 1990). In the studied material, it is found in: M6, 8n, Q22a, Na'ur Formation, (lower to middle Cenomanian); J47, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammobaculites pagodensis MORRIS, 1971
Pl. 4, Fig. 1.

1971 *Ammobaculites pagodensis* MORRIS, pp. 269-270, pl. 2, figs. 12, 15, t-f. 4.

Description: Test free, small, early portion closely coiled, slightly compressed, later uniserial portion becoming more rounded in, 6-7 chambers in the coil, increasing in size, followed by 2-3 uniserial ones, distinctly tapered terminal chamber; sutures straight, distinct, depressed, oblique to long axis in uniserial portion; wall finely agglutinated, smoothly finished; aperture terminal on final tapered chamber.

Distribution: *A. pagodensis* was recorded from the upper Cretaceous of north-western Colorado, USA (Morris, 1971). In the studied material, it is found in: J15, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammobaculites sp. 1
Pl. 4, Fig. 9 a-b.

Description: Test subevolute, strongly compressed, flattened, 6-7 chambers in the early portion and 2-3 in the uniserial part, forming rounded planispiral coil, later uncoiled; sutures indistinct; wall fine to medium grained agglutinated, roughly finished; aperture terminal, a slit-like opening in the last chamber. *A.* sp. 1 resembles *A. stephensoni* in the outer appearance, but the later has a more lobulate periphery, and differs from *A. mastersi* in being much compressed and does not possess the sigmoidal or depressed sutures.

Distribution: *A.* sp. 1 is found in the studied material in: M8n, Na'ur Formation (lower Cenomanian) and J36, Shueib Formation (upper Cenomanian).

Ammobaculites sp. 2
Pl. 4, Fig. 10.

Description: Test free, planispiral, early portion close-coiled, involute, later uniserial, discoidal in transverse; periphery rounded, slightly lobulate; outer coil contains10-12 segments, 4-5 in the uniserial portion which are much inflated, shorter in height than breadth, discoidal; sutures straight or gently curved, depressed, chevron-shaped in the uniserial portion; wall medium to coarse-grained agglutinated, roughly finished; aperture terminal, a slit-like opening in the last chamber. *A.* sp. 2 resembles *A. naqbensis*, in the external appearance, but differs in being more compressed, rounded periphery, having more chambers in the uniserial portion, which are discoidal, and having chevron-shaped sutures in the uniserial portion.

Distribution: *A.* sp. 2 is found in the studied material in: M6, 8n, Na'ur Formation (lower Cenomanian); J41, 17, Fuheis Formation (middle Cenomanian).

Ammobaculites stephensoni CUSHMAN, 1933
Pl. 4, Fig. 3.

1933 *Ammobaculites stephensoni* CUSHMAN, pp. 49-50, pl. 5, fig. 2a-b.
1954 *Ammobaculites stephensoni* CUSHMAN. - FRIZZELL, p. 62, pl. 2, f. 26 a-b.
1975 *Ammobaculites stephensoni* CUSHMAN. - BASHA, pp. 64-65, pl. 2, fig. 28.

Description: Test small, strongly compressed, flattened, 6-7 chambers in the early portion and 2-3 uniserial ones; sutures depressed; wall finely arenaceous, smoothly finished; aperture terminal and elliptical.

Distribution: *A. stephensoni* was recorded from the upper Cretaceous of USA; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, M23, P19 and Q22a, Na'ur Formation, (lower to middle Cenomanian); M32 and J18, Fuheis Formation (middle Cenomanian).

Ammobaculites subcretaceus CUSHMAN and ALEXANDER, 1930
Pl. 4, Fig. 7.

1930 *Ammobaculites subcretacea* CUSHMAN & ALEXANDER, p. 6,pl. 2, figs. 9-10.
1990 *Ammobaculites subcretacea* CUSHMAN & ALEXANDER. - HART et al, p. 951, pl. 1, fig. h; pl. 3, fig. s.
1970 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - HART, pl. 1, figs. 12-13.
1976 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - ANDRAWIS, p. 34.
1987 *Ammobaculites* gr. *subcretaceus* CUSHMAN & ALEXANDER. BENKHEROUF, p. 75, text-fig. 5.
1988 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - LÜGER, pl. 1, fig. 11.
1989 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - ISMAIL, p. 122, pl. 1, fig. 6.
1989a *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - CHERIF et al., pl. 1, fig. 8.
1990 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - WIGHTMAN, p. 755, pl. 1, figs. 11-13.
1994 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER. - BOLLI et al., pp. 78-79, pl. 20, fig. 34.

Description: Test compressed flattened planispiral of 5-6 chambers in the early close-coiled portion and 1-4 uncoiled and inflated ones, coil partially evolute with excavated umbilical region; sutures indistinct; coiled portion is agglutinated from fine sand to silt size grains, while the uncoiled portion consists of coarser sand grains and does not commence as a simple uncoiling of the planispire, but it angles back on itself at a 90-120° tangent to the coil, resulting in a biserial appearance; aperture rounded, terminal.

Distribution: *A. subcretaceus* was recorded from the lower to middle Cretaceous of North America; Aptian to Albian of France; upper Albian to lower Cenomanian of

England (Hart et al., 1990); Cenomanian to Maastrichtian of Egypt (Andrawis, 1976); Cenomanian of Algeria and Jordan (Benkherouf, 1987; Basha, 1975). In the studied material, it is found in: M8n, 8c, Q22a, Na'ur Formation, (lower to middle Cenomanian); J17, J26, Fuheis Formation (middle Cenomanian); M57, Shueib Formation Equivalent (upper Cenomanian); J56, M56, Shueib Formation Equivalent (Turonian).

Ammobaculites turonicus SAID and KENAWY, 1957
Pl. 4, Fig. 2 a-b.

1957 *Ammobaculites turonicus* SAID & KENAWY, pl. 79, fig. 2; pl. 13, fig. 2.
1962 *Ammobaculites* sp. cf. *turonicus* SAID & KENAWY-ANSARY, v.vi,n.2, tb.1
1969 *Ammobaculites turonicus* SAID & KENAWY.-ANSARY & TEWFIK, tble I.
1975 *Ammobaculites turonicus* SAID & KENAWY. - BASHA, p. 67, pl. 3, fs. 3, 4.
1976 *Ammobaculites turonicus* SAID & KENAWY. -ANDRAWIS, figs. 13-15, 34.
1979 *Ammobaculites turonicus* SAID and KENAWY. - BASHA, pp. 61-62.

Description: Test early close-coiled, deeply umbilicate, early involute portion with 6 chambers, followed by 3 uniserial ones; peripheral margin rounded, lobulate; sutures distinct, depressed; wall coarsely arenaceous, smoothly finished; aperture terminal, slit-like opening.

Distribution: *A. turonicus* was recorded from the Turonian to Santonian of Egypt (Andrawis, 1976; Ansary & Tewfik, 1969); lower Turonian of Jordan (Basha, 1975, 1979). In the studied material, it is found in: M6, Q18, J40, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian), J38, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Genus: **Ammomarginulina** WIESNER, 1931

Ammomarginulina aburoashensis SAID and KENAWY, 1957
Pl. 4, Fig. 12 a-b.

1957 *Ammomarginulina aburoashensis* SAID & KENAWY.-SAID et al., p.2, pl.78
1975 *Ammomarginulina aburoashensis* SAID & KENAWY. - BASHA, p. 48, pl. 1, fig. 22.
1979 *Ammomarginulina aburoashensis* SAID & KENAWY. - BASHA, pp. 61-62.

Description: Test small, free, early coiled portion globular, later uniserial, periphery subacute lobulate; chambers 5-7 in the early globular portion, 2-3 in the uniserial portion; wall finely arenaceous, smoothly finished; aperture terminal, oval, slit-like opening at the last chamber.

Distribution: *A. aburoashensis* was recorded from the lower Turonian of Egypt; lower Turonian of Jordan (Basha, 1975, 1979). In the studied material, it is found in: Q18, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian); M57, Shueib Formation Equivalent (upper Cenomanian) and M56, Shueib Formation Equivalent (Turonian).

Ammomarginulina barthouxi (SAID and BARAKAT, 1958)
Pl. 4, Fig. 13 a-b.

1958 *Haplophragmoides barthouxi* SAID & BARAKAT. - SAID & BARAKAT, p. 240
1975 *Ammomarginulina barthouxi* (SAID & BARAKAT). - BASHA, p. 49, pl. 1, figs. 23-35.

Description: Test free, planispiral, partially evolute, compressed, biumbilical and bilaterally symmetrical; periphery subrounded, lobate; 10-13 chambers in the last whorl, last five ones slightly inflated and the last 1-2 chambers uncoiled; sutures distinct, depressed; wall fine to medium grained arenaceous; aperture an elongate slit-like opening at the apertural face.

Distribution: *A. barthouxi* was recorded from the middle Jurassic of Egypt; lower Cenomanian to lower Turonian of Jordan (Basha, 1975). In the studied material, it is found in: Q9, 16, Na'ur Formation, (lower to middle Cenomanian); M31, Q28, J26, Fuheis Formation (middle Cenomanian); J35, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammomarginulina blanckenhorni SAID and KENAWY, 1957
Pl. 4, Fig. 14.

1957 *Ammomarginulina blanckenhorni* SAID & KENAWY, p. 78, pl. 13, fig. 9.
1975 *Ammomarginulina* sp. cf. *blanckenhorni* SAID & KENAWY-BASHA, p. 49, pl. 1, fig. 26.

Description: Test free, early portion close-coiled, evolute, compressed, later portion uniserial, rounded, periphery lobate, 4-5 chambers in the early coiled portion and 3 in the uniserial one; sutures distinct, depressed, slightly curved towards the early portion; wall finely arenaceous, smoothly finished; aperture terminal, rounded opening at the last oval chamber.

Distribution: *A. blanckenhorni* was recorded from the lower Turonian of Egypt and Jordan (Basha, 1975). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammomarginulina cragini LOEBLICH and TAPPAN, 1950
Pl. 4, Fig. 15 a-b.

1950 *Ammomarginulina cragini* LOEBLICH & TAPPAN, p. 6.
1975 *Ammomarginulina cragini* LOEBLICH & TAPPAN. - BASHA, p. 50-51, pl. 1, figs. 27-28.

Description: Test close-coiled, biumbilicate, 7-9 chambers in the early stage, followed by 2-4 rectilinear narrow chambers; sutures distinct; wall fine to medium grained arenaceous; aperture terminal, slit-like opening at the compressed apertural face.

Distribution: *A. cragini* was recorded from the lower Cretaceous of USA; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M9, Q16, 22a, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian); J35, M57, Shueib Formation Equivalent (upper Cenomanian); J56 and M56, Shueib Formation Equivalent (Turonian).

Ammomarginulina naqbensis BASHA, 1975
Pl. 4, Fig. 11 a-b.

1975 *Ammomarginulina naqbensis* BASHA, pp. 51-52, pl. 2, figs. 1-4.
1978 *Ammomarginulina naqbensis* BASHA. - BASHA, p. 74, pl. 1, figs. 1-4.

Description: Test large, early stage planispiral, later tending to uncoil, biumbilicate, bilaterally symmetrical, umbilical region thickest; 12 segments in the outer coil and 2-3 chambers in the uncoiled uniserial portion, last chamber inflated and large; sutures distinct, depressed, straight to slightly curved; wall finely arenaceous, smoothly finished; aperture narrow, linear and terminal.

Distribution: *A. naqbensis* was originally described from the lower Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: M6, Q9, Na'ur Formation (lower Cenomanian); M31, J17, 26, Fuheis Formation (middle Cenomanian).

Ammomarginulina sp. 1
Pl. 4, Fig. 16.

Description: Test free, small, early portion closely coiled, planispiral, partially evolute, biumbilicate and bilaterally symmetric, periphery rounded; sutures straight, slightly depressed; 5-6 chambers in the early portion, 1-2 in the uniserial portion; wall fine to medium grained arenaceous, smoothly finished; aperture terminal, rounded opening at the last chamber. *A.* sp. 1 differs from *A. aburoashensis* in having close-coiled early portion, more evolute test, and from *A. blanckenhorni* in having lesser number of chambers in the uniserial portion and possessing a rounded periphery.

Distribution: *A.* sp. 1 is rare in the studied material and was only found in: M56, Shueib Formation Equivalent (Turonian).

Genus: **Ammotium** LOEBLICH and TAPPAN, 1953

Ammotium aegyptica (NAKKADY and EISSA, 1960)
Pl. 5, Fig. 1 a-b.

1960 *Ammovaginulina aegyptica* NAKKADY & EISSA, p. 13.
1988 *Ammotium aegyptica* (NAKKADY, EISSA). - LOEBLICH et al., pp. 74-5, pl. 60, figs. 3-4.

Description: Test free, compressed, ovate in outline, planispirally enrolled and evolute, with a tendency to uncoil; proloculus completely surrounded by enrolled chambers; wall coarsely agglutinated; aperture simple, rounded, terminal at the dorsal angle of the final chamber.

Distribution: *A. aegyptica* was recorded from the lower Cretaceous of Egypt. In the studied material, it is found in: M8n, 13, Q20, Na'ur Formation, (lower to middle Cenomanian); P55, Ghudran Formation (Coniacian to Santonian).

Ammotium hasaense BASHA, 1979
Pl. 5, Fig. 3 a-b.

1975 *Ammotium* sp. BASHA, pp. 52-53, pl. 2, figs. 5-8.
1979 *Ammotium hasaense* BASHA, pp. 63-65, pl. 1, figs. 1-2; pl. 3, figs. 26-27.
1982 *Ammotium hasaense* BASHA. - AL-HARITHI, pp. 61-62, pl. 1, fig, 3.

Description: Test small, lenticuline, compressed, early portion planispiral, evolute, later portion tending to uncoil, central part slightly depressed, bilaterally symmetrical; periphery narrow, rounded, lobulate; 3-5 chambers in the final uncoiled portion; sutures distinct, depressed, curved; wall very finely agglutinated; aperture elliptical and terminal.

Distribution: *A. hasaense* was recorded from the Turonian of Jordan (Basha, 1975, 1979; Al-Harithi, 1982). In the studied material, it is found in: Q20, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Ammotium oertlii HAMAOUI, 1979
Pl. 5, Fig. 2 a-b.

1979 *Ammotium oertlii* HAMAOUI. - HAMAOUI, pp. 61-63, text-fig. 31.
1989 *Ammotium oertlii* HAMAOUI. - CHERIF, et al., p. 1, fig. 13.

Description: Test free, ovate in outline, planispirally enrolled and evolute, biumbilicate, bilaterally symmetrical; periphery rounded to subrounded with 6-8 chambers in the spire; wall arenaceous; aperture terminal, slit-like opening at the last chamber.

Distribution: *A. oertlii* was recorded from the lower Cenomanian of Egypt and middle Cenomanian of Israel (Hamaoui, 1979). In the studied material, it is found in: M8c, Na'ur Formation (lower Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Kutsevella** DAIN, 1978

Kutsevella labythnangensis DAIN, 1972
Pl. 5, Fig. 4 a-b, 5.

1972 *Ammobaculites labythnangensis* DAIN, p. 67.
1978 *Kutsevella labythnangensis* DAIN. - DAIN, p. 131.

1988 *Kutsevella labythnangensis* DAIN. - LOEBLICH & TAPPAN, p. 75, pl. 59, figs. 7-12.

Description: Test free, flattened, ovoid in outline, elongate early chambers that are close-coiled in an evolute spire, later chambers of more nearly equal length and breadth; sutures curved; wall agglutinated; aperture areal, oval.

Distribution: *K. labythnangensis* was recorded from the upper Jurassic to Eocene of Siberia, Russian Platform (Loeblich & Tappan, 1988). In the studied material, it is found in: M8n, 22, 23, Na'ur Formation, (lower to middle Cenomanian); J41, 25, Fuheis Formation (middle Cenomanian), J35, 36, 51a, Shueib Formation (upper Cenomanian).

Genus: **Sculptobaculites** LOEBLICH and TAPPAN, 1984

Sculptobaculites goodlandensis (CUSHMAN and ALEXANDER, 1930)
Pl. 5, Fig. 6 a-b.

1930 *Ammobaculites goodlandensis* CUSHMAN et al. - p. 8, pl. 2, figs. 7-8.
1975 *Ammobaculites goodlandensis* CUSHMAN et al. - BASHA, p. 59, pl. 2, figs. 17-18.
1987 *Ammobaculites goodlandensis* CUSHMAN et al. - BENKHEROUF, t-fig. 5.
1988 *Ammobaculites goodlandensis* CUSHMAN et al. - DECKER & RÖGL: pl. 1, fig. 17.
1988 *Sculptobaculites goodlandensis* (CUSHMAN and ALEXANDER). - LOEBLICH and TAPPAN, p. 76. pl. 60, figs. 12-16.

Description: Test free, large and robust, planispirally enrolled, slightly evolute, central area depressed to excavated and umbilicate, periphery broad and truncate; chambers 5-7 in the last whorl, inflated to lobulate, 1-2 in the rectilinear portion; sutures depressed, oblique; wall fine to medium grained arenaceous; aperture a low arch, terminal and round in the uncoiled chambers.

Distribution: *S. goodlandensis* was recorded from the Albian to Cenomanian of USA and Russia; Cenomanian of Algeria (Benkherouf, 1987); upper Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M21, 22, 23, P17, Na'ur Formation (lower to middle Cenomanian); J51a, Shueib Formation (upper Cenomanian).

Sculptobaculites loshkharvicus (KORCHAGIN, 1985)
Pl. 5, Fig. 7.

1985 *Evobaculites loshkharvicus* KORCHAGIN. - KORCHAGIN: 602.
1988 *Sculptobaculites loshkarvicus* (KORCHAGIN). - LOEBLICH et al. p. 76, pl. 60, figs. 5-6.

Description: Test free, planispirally enrolled, evolute to advolute, depressed to excavated umbilical region, periphery broad and truncate; chambers 5-7 in the last whorl, 1-2 in the rectilinear portion; wall fine to medium grained arenaceous; aperture terminal and round opening in the last chamber. *S. loshkarvicus* differs from *S. goodlandensis* in being smaller in size and having indistinct sutures and round periphery.

Distribution: *S. loshkarvicus* was recorded from the upper Cenomanian of Russia (Loeblich & Tappan, 1988). In the studied material, it is found in: M6, 8n, 9, Na'ur Formation (lower Cenomanian), M56, Shueib Formation Equivalent (Turonian).

Subfamily: **FLABELLAMMININAE** PODOBINA, 1978
Genus: **Flabellammina** CUSHMAN, 1928

Flabellammina alexanderi CUSHMAN, 1928
Pl. 5, Fig. 11 a-b.

1928 *Flabellammina alexanderi* CUSHMAN, pp. 1-2, pl. 1, figs. 3, 4.
1932 *Flabellammina alexanderi* CUSHMAN. - ALEXANDER et al., p. 300, pl. 45, figs. 1-5, 15.
1975 *Flabellammina alexanderi* CUSHMAN. - BASHA, pp. 82-83, pl. 5, fig. 4.
1988 *Flabellammina alexanderi* CUSHMAN. - LOEBLICH, p. 77, pl. 62, figs. 10-13.
1990 *Flabellammina alexanderi* CUSHMAN. - WEIDICH and AL-HARITHI, p. 601, pl. 1, figs. 1-6; pl. 2, figs. 6-7; pl. 3, figurs 3-5.

Description: Test elongate, lanceolate, compressed, bilaterally symmetrical, early chambers planispirally coiled, later elongate, strongly curved to inverted V-shaped; sutures distinct when wet; wall fine to medium grained arenaceous; aperture terminal, elliptical.

Distribution: *F. alexanderi* was recorded from the Albian to Cenomanian of Canada and USA, France and Lebanon (Cushman et al., 1928; Stead, 1951; Loeblich & Tappan, 1964; Saint-Marc, 1970-1972); Cenomanian of Jordan (Basha, 1975; Weidich & Al-Harithi, 1990). In the studied material, it is found in: J26, Fuheis Formation (middle Cenomanian), J34, 35, 36, Shueib Formation (upper Cenomanian); M63, Wadi Sir Formation (Turonian).

Flabellammina elongata HAMAOUI, 1979
Pl. 5, Fig. 8 a-b.

1965 *Flabellammina* sp. 1 HAMAOUI. - HAMAOUI, p. 16, pl. 1, fig. 8a-c; pl. 4, fig. 4.
1979 *Flabellammina elongata* HAMAOUI. - HAMAOUI, pp. 71-73, t-figs. 35 a-d.

Description: Test elongate, compressed, biconvex, bilaterally symmetrical, early stage planispirally enrolled, later uncoiling and rectilinear, with broad chevron-shaped chambers; periphery subangular; sutures slightly depressed, difficult to observe but distinct when wet; wall coarsely arenaceous; aperture terminal, ovate, at the midpoint of the apertural face.

Distribution: *F. elongata* was recorded from the Cenomanian to Turonian of Israel, in association with *Hemicyclammina sigali*, Miliolidae, Ophthalmiidae, echinoidal debris, molluscs and algae (Hamaoui, 1979). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian); J25, Fuheis Formation (middle Cenomanian), J35, 36, 39, 44, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Flabellammina kaskapauensis STELCK and WALL, 1954
Pl. 5, Fig. 10.

1954 *Flabellammina kaskapauensis* STELCK & WALL, p. 10.
1955 *Flabellammina kaskapauensis* STELCK and WALL. - STELCK and WALL, pl. 39, figs. 22-23.
1975 *Flabellammina kaskapauensis* STELCK & WALL. - BASHA, p. 84, pl. 5, figs. 8-10.

Description: Test compressed, lenticuline, close-coiled, early portion fairly small, periphery rounded; chambers about 7 in the final portion, early ones triangular in shape, later ones enlarging and the final chamber is trapezoidal in shape; sutures distinct, depressed, slightly arcuate; wall fine to medium grained arenaceous; aperture terminal, elliptical at the distal end of the final chamber.

Distribution: *F. kaskapauensis* was recorded from the upper Cenomanian of western Canada (Stelck & Wall, 1955); lower to upper Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M56, Shueib Formation Equivalent (Turonian).

Flabellammina negevensis HAMAOUI, 1979
Pl. 5, Fig. 9.

1965 *Flabellammina* sp. 2 HAMAOUI, p. 16, pl. 1, fig. 3; pl. 4, figs. 5-6.
1979 *Flabellammina negevensis* HAMAOUI. - HAMAOUI, p. 73-76, t-figs. 36 a-e.

Description: Test large, compressed, biconvex, bilaterally symmetrical, early stage planispirally enrolled, later uncoiling and rectilinear, with chevron-shaped chambers; periphery subangular to subrounded; sutures visible, depressed; wall coarsely arenaceous; aperture terminal, ovate, at the midpoint of the apertural face. *F. negevensis* differs from *F. elongata* in having regular rounded outline and visible sutures.

Distribution: *F. negevensis* was recorded from the upper Cenomanian to Turonian of Israel, in association with Lituolidae, *Nezzazata simplex, Triplasia bonnefousi, Gabonita levis, Fursenkoina* sp., *Pterammina israelensis, Haplophragmoides difformis, Hedbergella asterospinosa, Heterohelix* spp., Molluscs and echinid debris (Hamaoui, 1979). In the studied material, it is found in: M23, Na'ur Formation (lower to middle Cenomanian); J35, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Flabellammina sp. 1
Pl. 5, Fig. 12.

Description: Test robust, slightly compressed, early portion close-coiled, later rectilinear, periphery rounded, oval in transverse; chambers about five in the final portion; sutures distinct, depressed, slightly arcuate; wall fine to medium grained arenaceous; aperture terminal, elliptical at the distal end of the final chamber. *F.* sp. 1 differs from *F. kaskapauensis* in being robust and having lesser number of chambers in the rectilinear portion.

Distribution: *F.* sp. 1 is rare in the studied material and was only found in: M56, Shueib Formation Equivalent (Turonian).

Flabellammina sp. 2
Pl. 5, Fig. 13.

Description: Test large, elongate, compressed, early portion close-coiled, later rectilinear, periphery rounded; chambers about 3 in the rectilinear portion; sutures distinct, depressed, arcuate; wall medium to coarse-grained arenaceous; aperture terminal, elliptical at the distal end of the final chamber. *F.* sp. 2 differs from *F.* sp. 1 in being larger in size, more compressed, having lesser number of chambers in the rectilinear portion and coarser arenaceous wall.

Distribution: *F.* sp. 2 is rare in the studied material and was only found in: M56, Shueib Formation Equivalent (Turonian).

Genus: **Pterammina** HAMAOUI, 1965

Pterammina israelensis HAMAOUI, 1965
Pl. 6, Fig. 1 a-b.

1965 *Pterammina israelensis* HAMAOUI, p. 20, pl. 6, figs. 20-24.
1968 *Flabellammina omarai* KOCH. - KOCH, pp. 640-641, pl. 58, figs. 1-6; pl. 61, fig. 1.
1979 *Pterammina israelensis* HAMAOUI. - HAMAOUI, p.89, text-fig. 48 a-c.
1987 *Pterammina israelensis* HAMAOUI. - AL RIFAIY et al., p. 186, pl. II, fig. 8.
1988 *Pterammina israelensis* HAMAOUI. - LOEBLICH & TAPPAN, p. 77, pl. 61, figs. 1-3.
1990 *Pterammina israelensis* HAMAOUI. - WEIDICH and AL-HARITHI, p. 601, pl. 1, figs. 9-13; pl. 3, figs. 10-12; pl. 4, figs. 4-5.

Description: Test pulmonate in outline, lenticular in, planispirally coiled in the early stage, later uncoiled; numerous broad, low and arched U-shaped chambers, strongly overlapping the former chambers, resulting in the axial thickening in the center of the test on both sides; wall agglutinated; aperture terminal, single, rounded.

Distribution: *P. israelensis* was recorded from the upper Cenomanian of Israel (Hamaoui, 1965); Cenomanian of Jordan (Koch, 1968; Al Rifaiy & Cherif, 1987; Weidich & Al-Harithi, 1990). In the studied material, it is found in: J26, Fuheis

Formation (middle Cenomanian), J34, 35, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Genus: **Triplasia** REUSS, 1854

Triplasia bonnefousi HAMAOUI, 1979
Pl. 6, Fig. 4 a-b.

1965 *Triplasia* sp. 1 HAMAOUI, p. 21, pl. 1, figs. 5-6; pl. 4, figs. 7-8.
1979 *Triplasia bonnefousi* HAMAOUI. - HAMAOUI, p. 91-93, text-figs. 51 a-d.

Description: Test elongate, somewhat tapering, early stage planispirally enrolled, later uncoiled, uniserial, triangular in, cocave faces, rounded to subangular; sutures indistinct; wall fine-grained arenaceous, smoothly finished; aperture terminal, subrounded at the apertural face.

Distribution: *T. bonnefousi* was recorded from middle and upper Cenomanian of Israel, in association with Lituolidae, *Flabellammina negevensis: elongata, Hemicyclammina evoluta, Thomasinella* sp., *Tristx coloi, T. poignanti,* and echinid and Mollusc fragments (Hamaoui, 1979). In the studied material, it is found in: M20, Na'ur Formation (lower to middle Cenomanian).

Triplasia goodlandensis (CUSHMAN and ALEXANDER, 1929)
Pl. 6, Fig. 2 a-b.

1929 *Frankeina goodlandensis* CUSHMAN et al., p. 62, pl. 10, figs. 1-2.
1932 *Frankeina goodlandensis* CUSHMAN et al. - ALEXANDER et al., p. 307, pl. 47, fig. 8.
1988 *Triplasia goodlandensis* (CUSHMAN et al.). - LOEBLICH & TAPPAN, p. 77, pl. 62, figs. 4-7.

Description: Test small, elongate, somewhat tapering, early stage planispirally enrolled, later uncoiled, uniserial, triangular in, cocave sides with rounded angles; 4-5 chambers in the uniserial portion; sutures slightly depressed, arched strongly toward apertural end at the middle of each concave face; wall finely agglutinated, surface roughly finished; aperture terminal, rounded, may be slightly produced on a neck, at the midpoint of the apertural face.

Distribution: *T. goodlandensis* was recorded from the Albian of Texas, USA. In the studied material, it is found in: M20, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian), J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Triplasia murchisoni REUSS, 1854
Pl. 6, Fig. 3 a-b.

1854 *Triplasia murchisoni* REUSS, p. 65.
1968 *Triplasia* sp. cf. *murchisoni* REUSS. - KOCH, p. 630.
1975 *Triplasia murchisoni* REUSS. - BASHA, pp. 95-96, pl. 6, fig. 3.

1988 *Triplasia murchisoni* REUSS. - LOEBLICH & TAPPAN, p. 77, pl. 62, f. 8-9.

Description: Test free, regular, flaring, early stage planispirally enrolled, later uncoiled, uniserial, triangular in, sides excavated, angles subacute, chambers low and broad, increasing in height and size as added; sutures nearly distinct, slightly depressed, arched toward apertural end at the middle of each concave face; wall arenaceous, fine to medium grained, roughly finished; aperture terminal, rounded, may be slightly produced on a neck at the apertural face.

Distribution: *T. murchisoni* was recorded by Reuss and later workers to range from the Cretaceous to lower Palaeocene. In Jordan it was reported from the upper Cenomanian of (Koch, 1968; Basha, 1975). In the studied material, it is found in: M20, 21, Na'ur Formation (lower to middle Cenomanian); J35, 47, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Subfamily: **LITUOLINAE** BLAINVILLE, 1827
Genus: **Lituola** LAMARCK, 1804

Lituola nautiloidea LAMARCK, 1804
Pl. 6, Fig. 5 a-b.

1804 *Lituola nautiloidea* LAMARCK, p. 242.
1920 *Lituolites nautiloidea* (LAMARCK). - CUSHMAN, p. 69.
1952 *Lituolites nautiloidea* (LAMARCK). - MAYNC, p. 37-39, 46, pl. 9, figs. 1-8.
1964 *Lituola nautiloidea* LAMARCK. - LOEBLICH & TAPPAN, p. C238, figs. 151, 1-3.
1988 *Lituola nautiloidea* LAMARCK. - LOEBLICH & TAPPAN, pp. 78-9, pl. 64, figs. 1-5.

Description: Test free, large, early portion with 3 planispirally enrolled whorls, later uncoiling and rectilinear, chambers numerous, broad and low in the enrolled portion and subcylindrical in the rectilinear stage; wall agglutinated; aperture multiple, areal in the face of the final chamber.

Distribution: *L. nautiloidea* was recorded from the Campanian of France (Loeblich & Tappan, 1988). In the studied material, it is found in: J17, 25, Fuheis Formation (middle Cenomanian), J56, M56, Shueib Formation Equivalent (Turonian), J59, Wadi Sir Formation (Turonian).

Lituola sp. 1
Pl. 6, Fig. 6 a-b.

Description: Test free, large, early portion with few planispirally enrolled whorls, later uncoiling and rectilinear, chambers numerous, broad and low in the enrolled portion and compressed in the rectilinear stage; wall fine to medium grained arenaceous; aperture multiple, areal in the apertural face of the final chamber. *L.* sp. 1 differs from *L. nautiloidea* in having a flaring up final two chambers, being much more compressed and being more finely agglutinated.

Distribution: *L.* sp. 1 is found in the studied material only in: J17, Fuheis Formation (middle Cenomanian).

Subfamily: **AMMOASTUTINAE** LOEBLICH and TAPPAN, 1984
Genus: **Ammoastuta** CUSHMAN and BRÖNNIMANN, 1948

Ammoastuta nigeriana PETTERS, 1979
Pl. 6, Fig. 7.

1979 *Ammoastuta nigeriana* PETTERS, pp. 460-461, pl. 10, figs. 1, 6.
1983 *Ammoastuta nigeriana* PETTERS. - PETTERS, p. 249.
1988 *Ammoastuta nigeriana* PETTERS. - LOEBLICH and TAPPAN, p. 79.

Description: Test ovate to flabelliform, semi-enrolled, compressed, peripheral margin narrow, bilaterally symmetric, proloculus followed by second chamber growing in an incipient tight coil, then uniserial, with few small rectilinear chambers that increase in length, the bulging basal part of chamber enclosing the corresponding part of earlier adult chamber, chambers narrow, elongate, and curved, last chamber constitutes one-half of test; sutures curved, depressed; wall finely arenaceous, surface smoothly finished; primary aperture a slit mid-way on the last chamber; secondary cribrate openings at the proximal end mentioned by Petters, 1979, are not clearly defined on the Jordanian specimens probably due to preservation.

Distribution: *A. nigeriana* was recorded from the Turonian to Santonian of Nigeria and South Chad (Petters, 1979; Loeblich & Tappan, 1988). In the studied material, it is found in: Q18, Na'ur Formation (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Genus: **Praeammoastuta** BURSCH, 1952

Praeammoastuta sp. 1
Pl. 6, Fig. 8 a-b.

Description: Test compressed, subflabelliform in outline, chambers of early stage uniserial and arcuate, lengthening as added, adult chambers elongate, compressed and tending to uncoil; wall agglutinated, fine, siliceous; aperture a very small opening near the midpoint of apertural face.

Distribution: *P. alberdingi* BURSCH was recorded from the Oligocene of Venezuela (Loeblich & Tappan, 1988, p. 79). In the studied material, *Praeammoastuta* sp. 1 is found in: M8n, 23, Na'ur Formation, (lower to middle Cenomanian); J47, Shueib Formation (upper Cenomanian).

Family: **PLACOPSILINIDAE** RHUMBLER, 1913
Subfamily: **PLACOPSILININAE** RHUMBLER, 1913
Genus: **Placopsilina** D'ORBIGNY, 1850

Placopsilina cenomana D'ORBIGNY, 1850
Pl. 6, Fig. 9 a-b.

1850 *Placopsilina cenomana* D'ORBIGNY. - D'ORBIGNY, p. 185, 259.
1970 *Placopsilina cenomana* D'ORBIGNY. - HART, pl. 2, fig. 1.
1975 *Placopsilina sp. cf. cenomana* D'ORBIGNY. - SAINT-MARC, p. 216, pl. II, fig. 14.
1988 *Placopsilina cenomana* D'ORBIGNY.-LOEBLICH et al., p. 80, pl. 65, figs. 11-12.
1990 *Placopsilina cenomana* D'ORBIGNY. - HART et al., p. 953, pl. 2, fig. b.

Description: Test attached, early stage planispirally enrolled, later uncoiling and rectilinear; wall agglutinated, simple in structure; aperture terminal and rounded.

Distribution: *P. cenomana* was recorded from the Cenomanian of Czechoslovakia (Loeblich & Tappan, 1988), from upper Albian of Lebanon (Saint-Marc, 1975); upper Albian to lower Cenomanian of England (Hart, 1970; Hart et al., 1990). In the studied material, it is found in: Q5, 22a, P19, M23, Na'ur Formation, (lower to middle Cenomanian); M27, 31, J41, 17, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Superfamily: **HAPLOPHRAGMIACEA** EIMER and FICKERT, 1899
Family: **AMMOBACULINIDAE** SAIDOVA, 1981
Genus: **Bulbobaculites** MAYNC, 1952

Bulbobaculites problematicus NEAGU, 1962
Pl. 6, Fig. 10 a-b.

1962 *Ammobaculites agglutinans problematicus* NEAGU, p. 61, pl. 2, figs. 22-24.
1981 *Ammobaculites problematicus* NEAGU. - MORGIEL et al., p. 14, pl. 4, f. 16.
1984 *Ammobaculites problematicus* NEAGU. - GEROCH, NOWAK, pl. 1, fig.17; pls. 6, 23.
1990 *Bulbobaculites problematicus* NEAGU. - NEAGU, p. 251, pl. 4, figs. 21-23, text-fig. 2.
1990 *Bulbobaculites problematicus* NEAGU. - KUHNT et al., p. 465, pl. 4, figs. A-H.

Description: Streptospirally coiled initial part with globular and inflated chambers, followed by an uncoiled and rectilinear part; wall fine to medium agglutinated, simple; aperture small, rounded and terminal. *B. problematicus* is one of the typical deep water flysch assemblages. *Bulbobaculites* differs from *Ammobaculites* in possessing a streptospiral initial part.

Distribution: *B. problematicus* was recorded from the lower Cenomanian to upper Turonian of Poland and Romania (Morgiel et al., 1981; Neagu, 1990); Turonian of North Atlantic and Western Tethys (Kuhnt & Kaminski, 1990). In the studied material, it is found in: J35, 38, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Family: **LABYRINTHIDOMATIDAE** LOEBLICH and TAPPAN, 1988
Genus: **Bulbophragmium** MAYNC, 1952

Bulbophragmium aequale MAYNC, 1952
Pl. 6, Fig. 11 a-b.

1952 *Bulbophragmium aequale* MAYNC, p. 46, pl. 10, figs. 7-10.
1970 *Bulbophragmium aequale* MAYNC. - HART, p. 1, fig. 11.
1988 *Bulbophragmium aequale* MAYNC. - LOEBLICH & TAPPAN, p. 85, pl. 71, figs. 7-12.
1990 *Bulbophragmium aequale* MAYNC. - HART et al., p. 952, pl. 1, fig. 1.

Description: Test elongate, early chambers streptospirally enrolled, later uncoiled and rectilinear; sutures straight and depressed; wall coarsely agglutinated, thick; aperture terminal and cribrate.

Distribution: *B. aequale* was recorded from the upper Albian to lower Cenomanian of England (Hart, 1970; Hart et al., 1990); Campanian of Germany (Loeblich & Tappan, 1988). In the studied material, it is found in: J17, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Family: **NEZZAZATIDAE** HAMAOUI and SAINT-MARC, 1970
Subfamily: **NEZZAZATINAE** HAMAOUI and SAINT-MARC, 1970
Genus: **Biplanata** HAMAOUI and SAINT-MARC, 1970

Biplanata peneropliformis HAMAOUI and SAINT-MARC, 1970
Pl. 7, Fig. 1 a-b.

1970 *Biplanata peneropliformis* HAMAOUI et al. - HAMAOUI et al., pp. 280-282, figs. 1-11.
1975 *Biplanata peneropliformis* HAMAOUI et al. - BASHA, pp. 178-179, pl. 13, figs. 2-4.
1975 *Biplanata peneropliformis* HAMAOUI et al. - SAINT-MARC, p. 233, pl. V, figs. 1-11.
1981 *Biplanata peneropliformis* HAMAOUI et al. - NEUMANN and SCHROEDER, p. 386.
1985 *Biplanata peneropliformis* HAMAOUI et al. - SCHROEDER et al., pp. 36-38, pl. 14, figs. 1-7.
1988 *Biplanata peneropliformis* HAMAOUI et al. - LOEBLICH et al., p. 86, pl. 72, figs. 1-7.

Description: Test free, planispirally enrolled and semi-involute, bilaterally symmetrical, with a small concave umbilical depression on both sides, numerous low and very broad chambers per whorl, increasing from about 8 in the first whorl up to 30 in the final; sutures distinct, depressed, limbate; wall calcareous; aperture consists of a row of openings along apertural face.

Remarks: *B. peneropliformis* differs from *Biconcava bentori* in having small umbilical central depression. It is a Tethyan form which lived in inner neritic to reefal marine environments in association with other Nezzazatinae denoting normal salinities (Schroeder and Neumann, 1985).

Distribution: *B. peneropliformis* was reported by several workers from the lower Cenomanian to Turonian of Israel, Lebanon, Jordan, Italy and Iran (Saint-Marc, 1975; Neumann & Schroeder, 1985; Al-Bakri, 1990); lower Turonian of Egypt (Said & Kenawy, 1957). In the studied material, it is found in: M13, Q13, Na'ur Formation (lower to middle Cenomanian); J36, 37, 46, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); P55, Ghudran Formation (Coniacian to Santonian).

Genus: **Merlingina** HAMAOUI, 1965

Merlingina cretacea HAMAOUI and SAINT-MARC, 1970
Pl. 7, Fig. 2 a-b.

1970 *Merlingina cretacea* HAMAOUI, pp. 307-20, pl. 4, figs. 22-27.
1975 *Merlingina cretacea* HAMAOUI and SAINT-MARC. - SAINT-MARC, p. 230, pl. 6, figs. 1-9.
1981 *Merlingina cretacea* HAMAOUI and SAINT-MARC. - NEUMANN & SCHROEDER, p. 387.
1985 *Merlingina cretacea* HAMAOUI and SAINT-MARC. - SCHROEDER et al., pp. 37-38, pl. 15, figs. 1-9.
1988 *Merlingina cretacea* HAMAOUI and SAINT-MARC. - LOEBLICH et al., p. 86, pl. 73, figs. 4-9.

Description: Test free, with numerous broad and low chambers almost planispirally enrolled but test asymmetrical, semi-evolute, and planoconvex in the early stage, later nearly bilaterally asymmetrical, and finally tending to uncoil; sutures oblique; wall calcareous, probably agglutinated; aperture round in the early stage.

Distribution: *M. cretacea* was recorded from lower to upper Cenomanian and lower Turonian of Israel, Lebanon and Egypt (Hamaoui, 1979; Neumann & Schroeder, 1981; Akarish, 1990). In the studied material, it is found in: Q9, Na'ur Formation (lower Cenomanian) and M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Nezzazata** OMARA, 1956

Nezzazata concava (SMOUT, 1956)
Pl. 7, Fig. 7 a-c.

1956 *Begia concava* SMOUT, p. 341, pl. 1, figs. 15-18.
1965 *Nezzazata concava* (SMOUT). - OMARA and STRAUCH, pp. 555-556.
1985 *Nezzazata concava* (SMOUT). - SCHROEDER & NEUMANN, pl. 12, figs. 7, 10.

Remarks: *N. concava* deviates from the typical shape of *Nezzazata* by having strongly and very smoothly concave dorsal side and a corresponding smoothly convex ventral side without an umbilicus or depression of the sutures; test is composed of 2-3 whorls with 8 chambers in the last one; acute periphery; internal plate inconspicuous.

Distribution: *N. concava* was recorded from the Cenomanian to upper Turonian of Iraq and Iran. In the studied material, it is found in: Q13, Na'ur Formation (lower to middle Cenomanian); J45, Shueib Formation (upper Cenomanian), M63; 65, Wadi Sir Formation (Turonian).

Nezzazata convexa (SMOUT, 1956)
Pl. 7, Fig. 6 a-b; Pl. 39, Fig. 5 a-b.

1956 *Begia convexa* SMOUT, p. 341, pl. 1, figs. 26-28.
1965 *Nezzazata convexa* (SMOUT). - OMARA and STRAUCH, p. 555.
1975 *Nezzazata convexa* (SMOUT). - BASHA, p. 181, pl. 13, figs. 8, 9.

Description: Test unequally biconvex, composed of about two whorls with 6 chambers in the last; dorsal side convex or conical, with corresponding flattened to slightly convex ventral side; aperture a slit at the base of the final chamber; a weak punctate ornamentation usually occurs.

Distribution: *N. convexa* was reported by several workers from the Cenomanian and Turonian of Iraq, Germany, Greece and Jordan. In the studied material, it is found in: M16, 22, Q11, 13, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J37, 38, 44, 45, M37, Shueib Formation Equivalent (upper Cenomanian); Q33, Wadi Sir Formation (Turonian).

Nezzazata conica (SMOUT, 1956)
Pl. 7, Fig. 5 a-b.

1956 *Begia conica* SMOUT. - SMOUT, p. 340, pl. 1, figs. 10-14.
1965 *Nezzazata gyra conica* (SMOUT). - OMARA and STRAUCH, pp. 554-555.
1969 *Nezzazata conica* (SMOUT). - SAMPO, pl. XIV, figs. 19-24.
1975 *Nezzazata conica* (SMOUT). - BASHA, p. 179-180, pl. 13, figs. 5-7.
1985 *Nezzazata conica* (SMOUT). - SCHROEDER & NEUMANN, pl. 12, fs. 1-5.

Description: Test trochiform, dorsal side flat to slightly planoconvex, evolute; ventral side strongly conical, involute without umbilicus; periphery entire and acute; 7-8 chambers in each of the three whorls; sutures distinct, short, straight and slightly curved dorsally, and straight, not idented, very slightly depressed ventrally; wall smooth, calcareous, finely punctate; aperture ventral, angled, and shows the presence of a tooth-plate only by a small lobe at its upper end.

Distribution: *N. conica* was recorded from the middle Cretaceous of Iraq; lower Turonian of Iran; Cenomanian to Turonian of Jordan (Basha, 1975). In the studied material, it is found in: M16, 22, Q11, 13, Na'ur Formation (lower to middle Cenomanian), J37, 47, Shueib Formation (upper Cenomanian).

Nezzazata gyra (SMOUT, 1956)
Pl. 7, Fig. 4 a-b.

1956 *Begia gyra* SMOUT, p. 340, pl. 1, figs. 1-9, text-fig. 1.
1965 *Nezzazata gyra gyra* (SMOUT). - OMARA and STRAUCH: 554.
1968 *Nezzazata* sp. cf. *gyra* (SMOUT). - KOCH: 630.
1975 *Nezzazata gyra* (SMOUT). - BASHA, pp. 181-183, pl. 13, figs. 10-11.
1985 *Nezzazata gyra* (SMOUT). - SCHROEDER & NEUMANN, p. 34, pl. 12, figs. 6, 9, 11.
1988 *Nezzazata gyra* (SMOUT). - LOEBLICH & TAPPAN, p. 86, pl. 72, figs. 11-15.
1989a *Nezzazata gyra* (SMOUT). - CHERIF et al., pl. 1, fig. 21.

Description: Test composed of about 3 whorls, with 9 chambers in the last; dorsal side planoconvex, evolute, ventral surface conical to convex, involute; periphery, acute to subacute, slightly lobate; ventral sutures slightly depressed, radial, straight with a gentle identation in the middle; dorsal sutures more highly inclined, slightly limbate; wall perforate, composed of granular calcite; aperture a large ventral sutural slit with a tooth-plate attached to the septum.

Distribution: *N. gyra* was recorded from the lower Cenomanian to lower Turonian of Iran, Iraq, Jordan, Israel, Lebanon and Egypt (Koch, 1968; Neumann & Schroeder, 1981). In the studied material, it is found in: M16, Q11, 13, Na'ur Formation (lower to middle Cenomanian); J37, 38, 45, 46, Shueib Formation (upper Cenomanian).

Nezzazata simplex OMARA, 1956
Pl. 7, Fig. 3 a-b.

1956 *Nezzazata simplex* OMARA, p. 889, pl. 102, figs. 7-13, text-fig. 6.
1976 *Nezzazata simplex simplex* OMARA. - ANDRAWIS, pp. 17, 34.
1975 *Nezzazata simplex* OMARA. - BASHA, pp. 184-186, pl. 13, figs. 15-17.
1981 *Nezzazata simplex* OMARA. - NEUMANN & SCHROEDER, p. 387.
1988 *Nezzazata simplex* OMARA. - LOEBLICH & TAPPAN, p. 86, pl. 72, f. 8-10.
1989a *Nezzazata simplex* OMARA. - CHERIF et al., pl. 1, fig. 22.
1990 *Nezzazata simplex* OMARA. - WEIDICH et al., p. 602, pl. 2, figs. 3-5; pl. 3, figs. 13-15.

Description: Test subcircular to oval in outline, ventrally convex and involute, dorsally slightly convex to nearly flat and evolute, three whorls with 8-9 chambers in each whorl, increasing slightly in size as added; ventral sutures radial slightly depressed and gently curved, dorsal sutures nearly straight, oblique, faintly limbate; umbilical area closed; periphery acute; wall calcareous, granulate, finely perforate; aperture ventral, angled, typically with a tooth-plate.

Distribution: *N. simplex* was recorded from the lower and upper Cenomanian of Egypt (Omara, 1956; Andrawis, 1976); upper Cenomanian to lower Turonian of Israel; Albian to Cenomanian of Iran, Lebanon and Jordan (Sampo, 1969; Saint-Marc, 1975; Basha, 1975; Weidich & Al-Harithi, 1990). In the studied material, it is found in: M13, 16, Q11, 13, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis

Formation (middle Cenomanian), J34, 36, 37, 38, 45, 46, 47, Shueib Formation (upper Cenomanian).

Genus: **Nezzazatinella** DARMOIAN, 1976

Nezzazatinella adhami DARMOIAN, 1976
Pl. 7, Fig. 8 a-b.

1976 *Nezzazatinella adhami* DARMOIAN, p. 524.
1988 *Nezzazatinella adhami* DARMOIAN. - LOEBLICH and TAPPAN, p. 87, pl. 73, figs.1-3.

Description: Test low trochospiral, planoconvex, with flattened spiral side, the final whorl with 10-14 elogate chambers and curved sutures, final chambers flaring as if tending to uncoil, opposite side convex and involute; sutures nearly radial, sinuate; wall calcareous, granular, imperforate; aperture a large curved slit extending from the umbilical region up the apertural face and bending sharply toward the umbilical side.

Distribution: *N. adhami* was recorded from the lower Cretaceous to upper Turonian of Iraq, Romania and France (Loeblich & Tappan, 1988). In the studied material, it is found in: Q13, Na'ur Formation (lower to middle Cenomanian); J37, 46, 47, Shueib Formation (upper Cenomanian); P55, Ghudran Formation (Coniacian to Santonian),

Genus: **Trochospira** HAMAOUI, 1965

Trochospira avnimelechi HAMAOUI and SAINT-MARC, 1970
Pl. 7, Fig. 9 a-c.

1970 *Trochospira avnimelechi* HAMAOUI and SAINT-MARC, pp. 282-296, pls. 12-17.
1975 *Trochospira avnimelechi* HAMAOUI and SAINT-MARC. - SAINT-MARC, pp. 229-230, pl. 7, figs. 1-7.
1981 *Trochospira avnimelechi* HAMAOUI and SAINT-MARC. - NEUMANN, SCHROEDER, p. 391.
1985 *Trochospira avnimelechi* HAMAOUI and SAINT-MARC. - SCHROEDER et al., p. 38, pl. 16, figs. 1-7.
1988 *Trochospira avnimelechi* HAMAOUI and SAINT-MARC. - LOEBLICH, p. 87, pl. 74, figs. 1-7.
1989a *Trochospira avnimelechi* HAMAOUI and SAINT-MARC. - CHERIF et al., pl. 1, fig. 23.

Description: Test free, lenticular to inequally biconvex, 17 chambers in the last whorl, trochospirally enrolled with tendency to uncoil, periphery subacute; sutures strongly oblique spirally, gently curved and subradial umbilically; wall imperforate, microgranular to agglutinated; aperture an areal slit in the depression of the apertural face.

Distribution: *T. avnimelechi* was recorded from the Cenomanian to Turonian of Israel, Lebanon, Egypt and Iran (Hamaoui et al., 1970, 1979; Saint-Marc, 1975;

Neumann & Schroeder, 1981; Cherif et al., 1989). In the studied material, it is found in: M13, 16, 17, 21, Na'ur Formation (lower to middle Cenomanian); J37, 46, Shueib Formation (upper Cenomanian); M64, Wadi Sir Formation (Turonian); P55, Ghudran Formation (Coniacian to Santonian).

Superfamily: **BIOKOVINACEA** CUSIC, 1977
Family: **CHARENTIIDAE** LOEBLICH & Tappan, 1985

Genus: **Charentia** NEUMANN, 1965

Charentia cuvillieri NEUMANN, 1965
Pl. 8, Fig. 1 a-b.

1965 *Charentia cuvillieri* NEUMANN, pp. 93-94, pl. 2, figs. 6-12.
1975 *Charentia cuvillieri* NEUMANN. - BASHA, p. 71, pl. 3, fs. 13-15;pl. 4, f. 1.
1975 *Charentia cuvillieri* NEUMANN. - SAINT-MARC, p. 214, pl. I, figs. 9-11.
1985 *Charentia cuvillieri* NEUMANN. - SCHROEDER et al., p. 17, pl. 3, fs. 1-11.
1987 *Charentia cuvillieri* NEUMANN. - BENKHEROUF, p. 75, text-fig. 5.
1988 *Charentia cuvillieri* NEUMANN. - LOEBLICH & TAPPAN, p. 89, pl. 78, figs. 1-10.
1989a *Charentia cuvillieri* NEUMANN. - CHERIF et al., pl. 1, figs. 11-12.
1990 *Charentia* sp. cf. *cuvillieri* NEUMANN. - WEIDICH et al., p. 602, pl. 4, figs. 25-27.

Description: Test free, planispiral involute, biumbilically depressed, bilaterally symmetrical, maximum thickness in umbilical region; peripheral margin compressed, subacute to rounded, slightly lobulate, outer whorl with 12 chambers, the last three whorls uncoiled rectilinear, trapezoidal to rectangular in shape; sutures curved, later nearly oblique, depressed; wall finely arenaceous, smoothly finished; aperture a long slit-like opening at the compressed last chamber.

Distribution: *C. cuvillieri* was recorded from the upper Albian of Lebanon (Saint-Marc, 1975); lower to upper Cenomanian of Algeria (Benkherouf, 1987); upper Cenomanian of France, Egypt and Jordan (Basha, 1975, 1979); middle Albian of Jordan (Weidich & Al-Harithi, 1990). In the studied material, it is found in: M7a, 8c, 21, 22, 23, Q1, 16, J40, Na'ur Formation, (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J35, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Charentia evoluta (GORBACHIK, 1968)
Pl. 8, Fig. 4 a-c.

1968 *Tonasia evoluta* GORBACHIK, p. 7.
1988 *Charentia evoluta* (GORBACHIK). - LOEBLICH & TAPPAN, p. 89, pl. 79, figs. 1-3.

Description: Test free, planispiral involute, biumbilically inflated, bilaterally symmetrical, maximum thickness in the umbilical region; peripheral margin compressed, subacute to rounded; chambers numerous, the last 2-3 uncoiled rectilinear; sutures curved, later nearly oblique, depressed; wall finely arenaceous, smoothly finished; aperture elongate slit on the last chamber.

Distribution: *C. evoluta* was recorded from the lower Cretaceous to Cenomanian of Crimea, Russia, Texas, USA, Spain, France and Egypt (Gorbachik, 1968; Loeblich & Tappan, 1988). In the studied material, it is found in: Q18, Na'ur Formation (lower to middle Cenomanian); J15, Fuheis Formation (middle Cenomanian).

Charentia hasaensis BASHA, 1975
Pl. 8, Fig. 2.

1975 *Charentia hasaensis* BASHA, p. 72, pl. 3, figs. 15-19.
1978 *Charentia hasaensis* BASHA. - BASHA, pp. 75-76, pl. 1, figs. 9-12.

Description: Test free, nautiloid, early portion planispirally coiled, biconvex, centrally depressed, bilaterally symmetrical, later uniserial; periphery subacute in the coiled and rounded to elliptical in the uniserial stage, 10-18 trapezoidal chambers and 3 rounded later ones; sutures straight to slightly curved, depressed; wall arenaceous, smoothly finished; aperture elliptical or slit-like opening at the last chamber. It differs from *C. cuvillieri* NEUMANN in having compressed early portion, followed by an inflated, corrugated uniserial stage.

Distribution: *C. hasaensis* was recorded from the upper Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: Q9, 16, Na'ur Formation, (lower to middle Cenomanian); M31, J17, Fuheis Formation (middle Cenomanian), J35, Shueib Formation (upper Cenomanian).

Charentia rummanensis BASHA, 1975
Pl. 8, Fig. 3.

1975 *Charentia rummanensis* BASHA, p. 73, pl. 4, figs. 2-7.
1978 *Charentia rummanensis* BASHA. - BASHA, p. 67, pl. 2, figs. 1-6.

Description: Test free, compressed, early portion planispirally involute, partly evolute, later tends to uncoil, bilaterally symmetric; periphery compressed, lobulate, depressed umbilical region; 10-12 chambers in the outer coil, triangular to rectangular in shape, later 1-3 chambers tend to uncoil, rectilinear; sutures depressed, curved to oblique later; wall fine-grained arenaceous, smoothly finished; aperture a long slit-like opening at the last chamber. *C. rummanensis* differs from *C cuvillieri* in having an early coiled, planispiral and partly evolute test; rounded lobulate peripheral margin and slightly depressed umbilical region.

Distribution: *C. rummanensis* was recorded from the uppermost Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: Q9, 16, Na'ur Formation, (lower to middle Cenomanian); M31, J25, Fuheis Formation (middle Cenomanian).

Charentia sp. 1
Pl. 8, Fig. 5 a-b.

Description: Test free, compressed, early portion planispirally evolute, later flaring up and uncoil; periphery rounded, strongly lobulate with depressed umbilical area; 7-8 rectangular chambers, three in the uncoiled portion; sutures curved to oblique, depressed; wall fine to medium grained arenaceous, smoothly finished; aperture a long slit-like. Differs from *C. rummanensis* in having a planispirally evolute early portion and lesser number of chambers.

Distribution: *Charentia* sp. 1 is rare in the studied material and was only found in M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Ismailia** EL-DAKKAK, 1974

Ismailia aegyptica (EL-DAKKAK, 1975)
Pl. 8, Fig. 7 a-b.

1975 *Sinainella aegyptica* EL-DAKKAK, p. 107.
1988 *Ismailia aegyptica* (EL-DAKKAK). - LOEBLICH & TAPPAN, p. 89, pl. 77, figs. 8-11.

Description: Test free, planispirally enrolled and semi-involute, with open umbilicus, later tending to become slightly evolute, periphery subacute; wall agglutinated; aperture a vertical slit in the face. *I. aegyptica* is smaller in size than *I. neumannae.*

Distribution: *I. aegyptica* was recorded from the Cenomanian of Sinai, Egypt (El-Dakkak, 1975). In the studied material, it is found in: Q9, 16, M23, Na'ur Formation, (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J35, Shueib Formation (upper Cenomanian).

Ismailia neumannae EL-DAKKAK, 1974
Pl. 8, Fig. 6 a-b.

1974 *Ismailia neumannae* EL-DAKKAK, p. 173, pl. 1, figs. 1-5.
1988 *Ismailia neumannae* EL-DAKKAK. - LOEBLICH & TAPPAN, p. 89, pl. 77, figs. 4-7.

Description: Test free, planispirally enrolled and semi-involute, with open umbilicus, later tending to become evolute, periphery subacute; wall agglutinated; aperture a vertical slit in the face as inverted Y (λ) and larger in size than *I. aegyptica. I. neumannae* resembles externally *Charentia cuvillieri* Neumann (1965), from which it differs in being less inflated.

Distribution: *I. neumannae* was recorded from the Cenomanian of Egypt (El-Dakkak, 1974); upper Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: Q9, 16, M23, Na'ur Formation, (lower to middle Cenomanian); M31, J15, 25, Fuheis Formation (middle Cenomanian), J35, 39, Shueib Formation (upper Cenomanian).

Superfamily: **LOFTUSIACEA** BRADY, 1884
Family: **CYCLAMMINIDAE** MARIE, 1941
Subfamily: **HEMICYCLAMMININAE** BANNER, 1966
Genus: **Hemicyclammina** HAMAOUI, 1979

Hemicyclammina evoluta HAMAOUI, 1979
Pl. 8, Fig. 8 a-b.

1979 *Hemicyclammina evoluta* HAMAOUI, p. 81, fig. 41.
1989a *Hemicyclammina evoluta* HAMAOUI. - CHERIF et al., pl. 1, fig. 9.
1990 *Hemicyclammina evoluta* HAMAOUI. - AL-BAKRI, p. 28, pl. 1, figs. 7-9.

Description: Test evolute, compressed, periphery angular to subangular, 9 chambers, two and a half whorls; wall agglutinated, short septa, high median elongate aperture. *H. evoluta* differs from *H. sigali* in being more flattened, evolute and coarsely agglutinated.

Distribution: *H. evoluta* was recorded from the Cenomanian of Israel, Egypt and Jordan (Hamaoui, 1979; Cherif et al., 1989; Al-Bakri, 1990). In the studied material, it is found in: Q9, 18, 22a, M22, 23, Na'ur Formation, (lower to middle Cenomanian); M32, J17, 25, Fuheis Formation (middle Cenomanian); M57, J44, Shueib Formation Equivalent (upper Cenomanian), J56, Shueib Formation (Turonian).

Hemicyclammina sigali MAYNC, 1953
Pl. 8, Fig. 9 a-b.

1953 *Hemicyclammina sigali* MAYNC, p. 148, text-figs. 1-5.
1967 *Hemicyclammina sigali* MAYNC. - ARKIN and HAMAOUI, Rept. 1014.
1975 *Hemicyclammina sigali* MAYNC. - BASHA, pp. 103-104, pl. 6, figs. 22-24.
1975 *Hemicyclammina sigali* MAYNC. - SAINT-MARC, p. 212, pl. I, figs. 1-6.
1988 *Hemicyclammina sigali* MAYNC. - LOEBLICH & TAPPAN, p. 101, pl. 99, figs. 7-9.
1990 *Hemicyclammina sigali* MAYNC. - WEIDICH and AL-HARITHI, p. 602, pl. 2, figs. 8-11; pl. 4, figs. 2-3, 7-9, 12-13.

Description: Test free, planispiral, compressed, involute, biumbilicate, subacute to subrounded periphery, 8-10 chambers; discontinuous, short semi-septa, straight to slightly curved, slightly distinct sutures; wall fine to roughly arenaceous; slit-like aperture in the oval face. *H. sigali* is more inflated and less evolute than *H. evoluta*.

Distribution: *H. sigali* was recorded from the middle Cenomanian of Algeria (Maync, 1953); Aptian to Cenomanian of Lebanon, Qatar and Iran; Albian to Turonian of Israel; Albian to Cenomanian of Jordan (Saint-Marc, 1972, 1975; Sampo, 1969; Arkin et al., 1967; Hamaoui, 1967, 1979; Koch, 1968; Basha, 1975; Weidich & Al-Harithi, 1990).

In the studied material, it is found in: M9, 23, Q22a, Na'ur Formation, (lower to middle Cenomanian); J41, M25, 31, Q28, Fuheis Formation Equivalent (middle

Cenomanian); J56, Shueib Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Hemicyclammina sp. 1
Pl. 8, Fig. 11 a-b.

Description: Test free, planispiral, compressed, involute, biumbilicate; periphery subrounded, lobulate; 5-7 chambers; discontinuous, short semi-septa, straight to slightly curved, slightly distinct sutures; wall fine arenaceous, smoothly finished; aperture slit-like in the compressed apertural face. *H.* sp. 1 resembles *H. Sigali* in the edge view, but differs from it in having a lobate peripheral margin, smoothly finished surface and fewer chambers.

Distribution: *H.* sp. 1 is found in the studied material only in: M31, Fuheis Formation Equivalent (middle Cenomanian).

Hemicyclammina whitei (HENSON, 1948)
Pl. 8, Fig. 10 a-b.

1948 *Cyclammina whitei* HENSON, p. 13pl. XXIII, figs. 3, 12-14.
1970 *Hemicyclammina whitei* (HENSON). - BANNER, p. 275, pl. X, figs. 1-2.
1975 *Hemicyclammina whitei* (HENSON). - BASHA, pp. 104-106, pl. 6,figs. 25-27.

Description: Test lenticular, planispirally coiled, involute, biumbilicate with remarkable thickening towards the poles, compressed peripheral margin; 7-9 chambers in the final whorl; sutures indistinct; wall fine to medium grained arenaceous, smoothly finished; aperture slit-like at the triangular face.

Distribution: *H. whitei* was recorded from the Albian and lower Cenomanian of Qatar, Arabia (Henson, 1948; Banner, 1970); Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: Q9, 16, M23, Na'ur Formation, (lower to middle Cenomanian); J26, Fuheis Formation (middle Cenomanian).

Subfamily: **CHOFFATELLINAE** MAYNC, 1958
Genus: **Choffatella** SCHLUMBERGER, 1905

Choffatella decipiens SCHLUMBERGER, 1905
Pl. 9, Fig. 1 a-b.

1905 *Choffatella decipiens* SCHLUMBERGER, p. 763.
1952 *Choffatella decipiens* SCHLUMBERGER. - MAYNC, p. 50, pl. 11, figs. 9-10.
1967 *Choffatella decipiens* SCHLUMBERGER. - HOTTINGER, pp. 1-168.
1988 *Choffatella decipiens* SCHLUMBERGER. - LOEBLICH and TAPPAN, p. 102, pl. 101, figs. 1-2; pl. 102, figs. 1-3.

Description: Test planispirally enrolled, compressed, partially evolute, whorls enlarging rapidly, chambers numerous, later tend to uncoil; aperture a single areal row of large openings extending up the apertural face in the plane of coiling.

Distribution: *C. decipiens* was reported from the Cenomanian of the Mediterranean region, North Africa, Morocco, Portugal, Mexico, Central America, Venezuela and Caribbean (Loeblich & Tappan, 1988). In the studied material, it is found in: M13, 16, 23, Na'ur Formation (lower to middle Cenomanian); J36, 37, 38, Shueib Formation (upper Cenomanian).

Subfamily: **CYCLAMMININAE** MARIE, 1941
Genus: **Cyclammina** BRADY, 1879

Cyclammina haydeni MORRIS, 1971
Pl. 9, Fig. 2 a-b.

1971 *Cyclammina haydeni* MORRIS, p. 268, pl. 2 figs. 13-14, text-fig. 4.

Description: Test free, large, robust, planispiral, involute; periphery margin broadly rounded, outline rounded, slightly lobate; 7-9 chambers; sutures straight, usually thick, slightly depressed, radial; wall finely agglutinated with a smooth glassy finish; alveolar nature of outer wall resulting in a spotted external appearance; aperture indistinct, interpreted as a low arch at the base of the final chamber. It differs from *Haplophragmoides* in its large robust test and its "spotted" external appearance.

Distribution: *C. haydeni* was recorded from the Turonian of Colorado, USA (Morris, 1971). In the studied material, it is found in: M8n, 9, Q5, 22a, Na'ur Formation, (lower to middle Cenomanian); M56, Shueib Formation Equivalent (Turonian).

Family: **SPIROCYCLINIDAE** MUNIER-CHALMAS, 1887
Genus: **Reissella** HAMAOUI, 1963

Reissella ramonensis HAMAOUI, 1963
Pl. 9, Fig. 3; Pl. 12, Fig. 3 a-b.

1963 *Reissella ramonensis* HAMAOUI, pp. 58-64.
1967 *Reissella ramonensis* HAMAOUI. - ARKIN & HAMAOUI, Rpt. 1014, f. 16.
1975 *Reissella ramonensis* HAMAOUI. - BASHA, pp. 167-168, pl. 11, figs. 24-25.
1979 *Reissella ramonensis* HAMAOUI. - HAMAOUI, p. 90, text-fig. 49.
1988 *Reissella ramonensis* HAMAOUI. - LOEBLICH & TAPPAN, p. 107, pl. 112, figs. 1-5.

Description: Test planispirally enrolled and involute in the early stage, later tending to uncoil and flare, up to 10 triangular chambers in the final whorl, last one inflated; sutures radial, distinct, depressed; wall of imperforate microgranular calcite; primary aperture elliptical to slitlike, areal, slightly produced on a necklike elevation, near the base of the apertural face in the early stage, later becoming central, numerous secondary apertural pores scattered over the apertural face.

Distribution: *R. ramonensis* was recorded from the Cenomanian to Turonian of Israel, Lebanon and Jordan (Hamaoui, 1979; Basha, 1975). In the studied material, it is found in: Q13, M22, Na'ur Formation (lower to middle Cenomanian); M24, Fuheis Formation Equivalent (middle Cenomanian); J34, 36, 47, Shueib Formation (upper Cenomanian), J57, 58, 59, Wadi Sir Formation (Turonian).

Superfamily: **SPIROPLECTAMMINACEA** CUSHMAN, 1927
Family: **SPIROPLECTAMMINIDAE** CUSHMAN, 1927
Subfamily: **SPIROPLECTAMMININAE** CUSHMAN, 1927
Genus: **Bolivinopsis** YAKOVLEV, 1891

Bolivinopsis clotho (GRZYBOWSKI, 1901)
Pl. 9, Fig. 4 a-b.

1901 *Spiroplecta clotho* GRZYBOWSKI, pp. 283-284, pl. 7, fig. 18.
1928 *Bolivinopsis clotho* (GRZYBOWSKI). - CUSHMAN et al., p. 101, pl. 14, figs. 13-14.
1956 *Bolivinopsis clotho* (GRZYBOWSKI). - SAID & KENAWY, p. 138, pl. 3, fig. 20.

Description: Test free, elongate, biserial, large early planispiral coil; sutures commonly oblique in the later stage; wall finely agglutinated, smoothly finished surface; aperture an interiomarginal arch. Some badly preserved internal casts of a biserial calcareous foraminiferal form with possibly an initial planispiral stage is tentatively assigned to this genus.

Distribution: *B. clotho* was recorded from the Cretaceous of Poland; upper Cretaceous of Europe, North America and South America. In the studied material, it is found in: P3, 24, Na'ur Formation, (lower to middle Cenomanian); J36, Shueib Formation (upper Cenomanian); M71, 74, Ghudran Formation (Coniacian to Santonian).

Genus: **Quasispiroplectammina** LOEBLICH and TAPPAN, 1982

Quasispiroplectammina navarroana (CUSHMAN, 1932)
Pl. 9, Fig. 6.

1932 *Spiroplectammina navarroana* CUSHMAN, p. 96, pl. 11, fig. 14 a-b.
1981 *Spiroplectammina navarroana* CUSHMAN. - GRADSTEIN et al., p. 260, pl. 3, figs. 11-12.
1988 *Spiroplectammina navarroana* CUSHMAN. - KAMINSKI et al., p. 193, pl. 7, figs. 13-15.
1990 *Spiroplectammina (Spiroplectammina) navarroana* CUSHMAN. - GRADSTEIN and KAMINSKI, p. 189, pl. 9, figs. 11-12; pl. 21, fig. 1.
1988 *Quasispiroplectammina* LOEBLICH & TAPPAN. - LOEBLICH & TAPPAN, p. 111.

Description: Test free, elongate, very slightly tapering with a small initial spire, followed by a straight biserial portion, chambers as high as broad, rounded at periphery, somewhat inflated; sutures distinct, slightly depressed; wall rather coarsely arenaceous, but with fairly smooth finish; aperture somewhat oblique, a narrow arched opening.

Distribution: *Q. navarroana* was recorded from the upper Cretaceous of Texas, USA (Cushman, 1946); Santonian and Campanian to lower Eocene of the North Sea (Charnock et al., 1990); Maastrichtian of Trinidad (Kaminski et al., 1988). In the studied material, it is found in: P1, 3, 5, Q22a, Na'ur Formation, (lower to middle Cenomanian); P41, Fuheis Formation Equivalent (middle Cenomanian); M71, Ghudran Formation (Coniacian to Santonian); P60, Amman Formation (lower Maastrichtian).

Quasispiroplectammina nuda (LALICKER, 1935)
Pl. 9, Fig. 5.

1935 *Spiroplectammina nuda* LALICKER, p. 4.
1982 *Quasispiroplectammina nuda* (LALICKER). - LOEBLICH & TAPPAN, p. 60.
1988 *Quasispiroplectammina nuda* (LALICKER). - LOEBLICH & TAPPAN, pp. 111-112, pl. 119, figs. 5-7.

Description: Test free, elongate, oval to circular in, enlarging gradually with growth, early planispiral coil of lesser breadth than the later biserial portion; wall very finely agglutinated; aperture a low arch at the base of the last chamber.

Distribution: *Q. nuda* is cosmopolitan and was recorded from the Albian to Cenomanian of Texas, USA (Loeblich & Tappan, 1988). In the studied material, it is found in: M16, Q22a, Na'ur Formation (lower to middle Cenomanian); J34, 36, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); M71, Ghudran Formation (Coniacian to Santonian).

Family: **TEXTULARIOPSIDAE** LOEBLICH and TAPPAN, 1982
Genus: **Aaptotoichus** LOEBLICH and TAPPAN, 1982

Aaptotoichus clavellatus (LOEBLICH and TAPPAN, 1946)
Pl. 9, Fig. 7.

1946 *Bigenerina clavellata* LOEBLICH & TAPPAN, p. 245.
1982 *Aaptotoichus clavellatus* (LOEBLICH & TAPPAN). - LOEBLICH & TAPPAN, p. 62.
1988 *Aaptotoichus clavellatus* (LOEBLICH & TAPPAN). - LOEBLICH & TAPPAN, p. 114, pl. 22, figs. 1-4.

Description: Test free, elongate, short biserial stage followed by longer uniserial stage of broad low chambers of nearly constant breadth; wall of siliceous agglutinated particles; aperture terminal, small and rounded.

Distribution: *A. clavellatus* was recorded from the Cenomanian of Texas, USA (Loeblich & Tappan, 1988). In the studied material, it is found in: M16, Na'ur Formation (lower to middle Cenomanian).

Genus: **Plectinella** MARIE, 1956

Plectinella aegyptiaca (SAID and BARAKAT, 1958)
Pl. 9, Fig. 8.

1958 *Arenovirgulina aegyptiaca* SAID & BARAKAT, p. 243.
1988 *Plectinella aegyptiaca* (SAID & BARAKAT). - LOEBLICH, p. 115, pl. 122, figs. 22-23.

Remarks: Test biserial, slightly twisted, chambers relatively high; wall agglutinated; aperture subterminal, areal, slitlike, and may be slightly curved.

Distribution: *P. aegyptiaca* was recorded from the Callovian to Maastrichtian of Egypt, France, Belgium, Russia, Australia and Texas, USA (Loeblich & Tappan, 1988). In the studied material, it is found only in: M16, Na'ur Formation (lower to middle Cenomanian).

Superfamily: **PAVONITINACEA** LOEBLICH and TAPPAN, 1961
Family: **PAVONITINIDAE** LOEBLICH and TAPPAN, 1961
Subfamily: **PAVONITININAE** LOEBLICH and TAPPAN, 1961
Genus: **Zotheculifida** LOEBLICH and TAPPAN, 1957

Zotheculifida sp.
Pl. 9, Fig. 9 a-b.

Description: Test free, small, compressed, palmate in outline; chambers numerous broad, low and biserially arranged, 6-7 pairs, strongly recurved laterally with height about one-fourth their breadth, surface slightly excavated; sutures distinct, limbate and flush, strongly arched; wall calcareous; aperture a high narrow interiomarginal arch at the base of the final chamber. *Z.* sp. is very close in its external appearance to *Z. lirata*, but differs in having calcareous wall, flush sutures and lesser number of chambers.

Distribution: *Z. lirata* CUSHMAN & JARVIS was recorded from the upper Oligocene of Trinidad, West Indies (Loeblich & Tappan, 1988, p. 119). *Z.* sp. is found in the studied material only in: Q20, Na'ur Formation (lower to middle Cenomanian).

Superfamily: **TROCHAMMINACEA** SCHWAGER, 1877
Family: **TROCHAMMINIDAE** SCHWAGER, 1877
Subfamily: **TROCHAMMININAE** SCHWAGER, 1877
Genus: **Trochammina** PARKER and JONES, 1859

Trochammina boehmi FRANKE, 1928
Pl. 9, Fig. 10.

1928 *Trochammina boehmi* FRANKE, p. 174, pl. 15, fig. 24.
1960 *Trochammina boehmi* FRANKE. - TRUJILLO, p. 304, pl. 44, fig. 1.
1968 *Trochammina boehmi* FRANKE. - SLITER, p. 46, pl. 2, fig. 10.
1973 *Trochammina boehmi* FRANKE. - SLITER, p. 183, text-fig. 8.
1989a *Trochammina boehmi* FRANKE. - CHERIF et al., pl. 1, fig. 15.

Description: Test free, trochospiral, periphery rounded; sutures radial; wall agglutinated, surface smoothly finished; chambers increasing gradually in siz; aperture an interiomarginal umbilical to extraumbilical arch with narrow bordering lip. *T. boehmi* differs from *T. texana* in having a more rapid pace of coiling.

Distribution: *T. boehmi* was recorded from the upper Cretaceous of Germany (Franke, 1928); Campanian to Maastrichtian of California (Sliter, 1968, 1973); upper Cenomanian of Sinai, Egypt (Cherif et al., 1989); lower Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M6, P1, 3, Q22a, Na'ur Formation, (lower to middle Cenomanian); J41, 25, Fuheis Formation (middle Cenomanian), J33, Hummar Formation (upper Cenomanian).

Trochammina afikpensis PETTERS, 1979
Pl. 9, Fig. 11.

1979 *Trochammina afikpensis* PETTERS, p. 467, pl. 9, fig. 1, text-fig. 3 a-b,.
1985 *Trochammina afikpensis* PETTERS. - LÜGER, p. 77, pl. 3, figs. 5-6.
1988 *Trochammina afikpensis* PETTERS. - LÜGER, pl. 2, fig. 8.
1990 *Trochammina afikpensis* PETTERS. - AL-BAKRI, p. 29, pl. 2, figs 1-2.

Description: Test small, low to high trochospiral coiling, consisting of two whorls, the outer coil comprising 4-6 inflated chambers, increasing rapidly in size as added, the last one equals one-half of the test size, peripheral outline oval, strongly lobulate, the spiral side low to high, slightly evolute, umbilical side concave, compressed, umbilicus wide and shallow; sutures depressed and radially arranged; wall finely arenaceous, smoothly finished; aperture low arch.

Distribution: *T. afikpensis* was recorded from the Campanian to Maastrichtian of Nigeria (Petters, 1979); Maastrichtian and Palaeocene of Egypt (Lüger, 1985, 1988); Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M6, M22, P1, 3, Q16, 22a, Na'ur Formation, (lower to middle Cenomanian); J25, 41, Fuheis Formation (middle Cenomanian).

Trochammina rummanensis BASHA, 1975
Pl. 9, Fig. 12.

1975 *Trochammina rummanensis* BASHA, pp. 146-147, pl. 10, figs. 1-4.
1978 *Trochammina rummanensis* BASHA. - BASHA, pp. 80-81, pl. 4, figs. 1-4.

Description: Test small, trochospiral, consisting of two whorls, early peripheral margin compressed, acute, later broad, flattened, outer coil contains 4-5 chambers, nodulose, enlarged, corrugated and raised above the surface of the test; sutures depressed, straight to slightly curved; wall fine to medium grained arenaceous, smoothly finished; aperture an arched slit-like opening at the base of the inner margin of the last chamber.

Distribution: *T. rummanensis* was recorded from the Cenomanian of Jordan (Basha, 1975, 1978). In the studied material, it is found in: P1, M22, Na'ur Formation, (lower to middle Cenomanian); J41, Fuheis Formation (middle Cenomanian), J44, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Superfamily: **VERNEUILINACEA** CUSHMAN, 1911
Family: **PROLIXOPLECTIDAE** LOEBLICH and TAPPAN, 1985
Genus: **Plectina** MARSSON, 1878

Plectina ruthenica (REUSS, 1851)
Pl. 9, Fig. 13 a-b.

1851 *Gaudryina ruthenica* REUSS, p. 41.
1977 *Gaudryina mariae* (FRANKE). - CARTER & HART, p. 13, pl. 2, fig. 8.
1948 *Plectina ruthenica* (REUSS). - WILLIAMS-MITCHELL, p. 97, pl. 8, fig. 3.
1962 *Plectina ruthenica* (REUSS). - JEFFERIES, p. 78, fig. 12.
1964 *Plectina ruthenica* (REUSS). - LOEBLICH & TAPPAN, p. C283, figs. 189, 3 a-b.
1988 *Plectina ruthenica* (REUSS). - LOEBLICH & TAPPAN, p. 131, pl. 140, figs. 19-21.
1990 *Plectina ruthenica* (REUSS). - AL-BAKRI, p. 30, pl. 2, fig. 3.

Description: Test elongate, slightly flattened to ovate in, with short early trochospiral stage, later biserial and with nearly parallel sides so that the adult test is relatively narrow and elongae; chambers up to 5 pairs per whorl, subglobular to slightly appressed; sutures depressed; wall finely agglutinated; aperture areal, subterminal, rounded or ovate.

Remarks: *P. ruthenica* differs from *P. mariae* in possessing a more elongate test with many more pairs of biserial chambers, 5-6 pairs instead of 3-4 ones.

Distribution: *P. ruthenica* was originally described from the Senonian of Central Europe (Loeblich & Tappan, 1964); Turonian to Maastrichtian of Europe and North America (Loeblich & Tappan, 1988); upper Cenomanian of England and Jordan (Carter & Hart, 1977; Al-Bakri, 1990).

In the studied material, it is found in: P1, 5, Q22a, Na'ur Formation, (lower to middle Cenomanian); P41, Fuheis Formation Equivalent (middle Cenomanian); J36, Shueib Formation (upper Cenomanian); P55, M74, Ghudran Formation (Coniacian to Santonian); M88, (Campanian), P60, Amman Formation (lower Maastrichtian).

Family: **VERNEUILINIDAE** CUSHMAN, 1911
Subfamily: **VERNEUILINOIDINAE** SULEYMANOV, 1973
Genus: **Uvigerinammina** MAJZON, 1943

Uvigerinammina jankoi MAJZON, 1943
Pl. 9, Fig. 14.

1943 *Uvigerinammina jankoi* MAJZON, p. 158, pl. 11, figs. 15 a-b.
1981 *Uvigerinammina jankoi* MAJZON. - MORGIEL et al., p. 20, pl. 5, figs. 7-8.
1983 *Uvigerinammina jankoi* MAJZON. - BASOV et al., p. 760, pl. 1, fig. 8.
1988 *Uvigerinammina jankoi* MAJZON. - MOULLADE et al., p. 367, pl. 10, figs. 1-6.
1988 *Uvigerinammina jankoi* MAJZON. - LOEBLICH & TAPPAN, p. 134, pl. 141, figs. 13-20.
1990 *Uvigerinammina jankoi* MAJZON. - MALATA et al., p. 519, pl. 3, figs. 12-13.
1990 *Uvigerinammina jankoi* MAJZON. - NEAGU, p. 255: 4: 7-15, txt-fig. 2.

Description: Test trochoid, irregularly triserial, slightly compressed with three somewhat inflated chambers per whorl, increasing rapidly in size as added; sutures depressed; wall finely agglutinated; aperture terminal, rounded, simple and flush. *Uvigerinammina* is typically restricted to the flysch facies in which crushing and distortion is frequent.

Distribution: *U. jankoi* was recorded from the upper Albian of the southwestern Atlantic (Basov & Krasheninnikov, 1983); Cenomanian to lower Campanian of Poland (Morgiel et al., 1981); Turonian to Coniacian of North Sea (King et al., 1989); upper Turonian to middle Campanian of Romania (Neagu, 1990); Campanian to lower Maastrichtian of the northern Apennines, Italy (Morlotti, 1988). In the studied material, it is found in: M8n, Q20, 22a, Na'ur Formation, (lower to middle Cenomanian).

Subfamily: **VERNEUILININAE** CUSHMAN, 1910
Genus: **Gaudryina** D'ORBIGNY, 1839

Gaudryina rugosa D'ORBIGNY, 1840
Pl. 9, Fig. 15.

1840 *Gaudryina rugosa* D'ORBIGNY, p. 44: 4: 20-21.
1964 *Gaudryina rugosa* D'ORBIGNY. - LOEBLICH & TAPPAN, p. C269, figs. 179, 5 a-b.
1988 *Gaudryina rugosa* D'ORBIGNY. - LOEBLICH & TAPPAN, p. 136, pl. 144, figs. 1-3.
1990 *Gaudryina rugosa* D'ORBIGNY. - ALMOGI-LABIN et al., p. 578, pl. 1, figs. 5-7, 3.
1994 *Gaudryina rugosa* D'ORBIGNY. - BOLLI et al., p. 90, pl. 24, figs. 7-8.

Description: Test free, elongate, early stage triserial and triangular in, later becoming biserial and triangular to rounded in; wall agglutinated, solid; aperture an arch at the inner margin of the final chamber.

Distribution: *G. rugosa* was recorded from the Maastrichtian of Norwich, England and Germany (Loeblich & Tappan, 1964); upper Coniacian to upper Campanian of Israel (Almogi-Labin et al., 1990); Palaeocene of Trinidad (Bolli et al., 1994). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian); J58, Wadi Sir Formation (Turonian); M90 (Campanian); P60, Amman Formation (lower Maastrichtian).

Superfamily: **ATAXOPHRAGMIACEA** SCHWAGER, 1877
Family: **ATAXOPHRAGMIIDAE** SCHWAGER, 1877
Subfamily: **ATAXOPHRAGMIINAE** SCHWAGER, 1877
Genus: **Arenobulimina** CUSHMAN, 1927

Arenobulimina advena (CUSHMAN, 1936)
Pl. 10, Fig. 1.

1936 *Hagenowella advena* CUSHMAN, p. 43, pl. 6, figs. 21 a-b.
1977 *Arenobulimina advena* (CUSHMAN). - CARTER & hartT, p. 14, pl. 2, fig. 4.
1988 *Arenobulimina advena* (CUSHMAN). - LOEBLICH and TAPPAN, p. 139.
1988 *Arenobulimina advena* (CUSHMAN). - JARVIS et al., p. 151, t-f. 2, fig. 10 a.
1989 *Arenobulimina advena* (CUSHMAN). - HART et al., p. 316, pl. 7.1, fig. 5.
1990 *Arenobulimina advena* (CUSHMAN). - HART et al., pl. 2, fig. q.

Description: Test free, trochospiral, with the last three chambers occupying over half of the test; chambers slightly inflated; sutures distinct, depressed; wall arenaceous; aperture interiomarginal arch in the last chamber.

Distribution: *A. advena* was recorded from the upper Albian to upper Cenomanian of England (Carter & Hart, 1977; Hart et al., 1989; Jarvis et al., 1988). In the studied material, it is found in: M20, 22, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian); J51a, Shueib Formation (upper Cenomanian).

Arenobulimina amanda VOLOSHINA, 1961
Pl. 10, Fig. 4 a-b.

1961 *Arenobulimina amanda* VOLOSHINA, p. 76.
1965 *Arenobulimina (Harena) amanda* VOLOSHINA. - VOLOSHINA, p. 149.
1972 *Arenobulimina (Harena) amanda* VOLOSHINA. - VOLOSHINA, p. 71.
1988 *Arenobulimina amanda* VOLOSHINA. - LOEBLICH and TAPPAN, p. 139, pl. 145, figs. 10-2.

Description: Test free, trochospiral, proximal end broad, widening gradually distally, sides almost parallel, rounded in cross; adult test consists of 5 whorls, 4 chambers in each; sutures slightly depressed; wall medium grained agglutinated; aperture a loop shaped in a trough-like depression, running from top of test to edge of last chamber.

Distribution: *A. amanda* was recorded from the lower Campanian of Ukraine, Russia (Loeblich & Tappan, 1988). In the studied material, it is found in: M90 (Campanian); P60, Amman Formation (lower Maastrichtian).

Arenobulimina chapmani CUSHMAN, 1936
Pl. 10, Fig. 2.

1936 *Arenobulimina chapmani* CUSHMAN, p. 26, pl. 4, fig. 7 a-b.
1970 *Arenobulimina chapmani* CUSHMAN. - HART, pl. 4, figs. 4-5.
1977 *Arenobulimina chapmani* CUSHMAN. - CARTER & HART, p. 15, pl 1, f. 4.
1989 *Arenobulimina chapmani* CUSHMAN. - HART et al., p. 316, pl. 7.1, fig 7.
1990 *Arenobulimina chapmani* CUSHMAN. - HART et al., p. 952, pl. 4, figs. r-s.

Description: Test free, trochospiral, proximal end pointed, widening rapidly distally, rounded in cross; adult test consists of 5 whorls, 4 chambers in each, the last one having 4; sutures depressed; aperture loop shaped in a trough-like depression, running from top of test to edge of last chamber; wall fine to medium grained agglutinated.

Distribution: *A. chapmani* was recorded from the upper Albian to lower Cenomanian of England (Hart, 1970, 1989 & 1990). In the studied material, it is found in: P1, M20, 21, Q20, Na'ur Formation, (lower to middle Cenomanian); Q28, J25, Fuheis Formation (middle Cenomanian); M33, J36, 51a, Shueib Formation (upper Cenomanian).

Arenobulimina d'orbignyi (REUSS, 1845)
Pl. 10, Fig. 3.

1845 *Bulimina d'orbignyi* REUSS, p. 38, pl. 13, fig. 74.
1981 *Arenobulimina d'orbignyi* (REUSS). - GRADSREIN et al., p. 261, pl. 5, figs. 5-7.
1984 *Arenobulimina d'orbignyi* (REUSS). - HEMLEBEN et al., p. 517, pl. 4, fig. 21.
1988 *Arenobulimina d'orbignyi* (REUSS). - KAMINSKI et al., p. 194, pl. 8, fig. 9.
1988 *Arenobulimina d'orbignyi* (REUSS). - LOEBLICH & TAPPAN, p. 194, pl. 8, fig. 9.
1990 *Arenobulimina d'orbignyi* (REUSS). - KUHNT & KAMINSKI, p. 464, table 1.

Description: Test small, trochospiral, four chambers per whorl; wall finely agglutinated, smoothly finished; aperture interiomarginal, a simple loop.

Distribution: *A. d'orbignyi* was recorded from the Maastrichtian of Trinidad (Kaminski et al., 1988); Campanian to Maastrichtian of North Atlantic (Kuhnt & Kaminski, 1990); Coniacian of Ukraine, Russia and Jordan (Loeblich & Tappan, 1988; Basha, 1975). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian), M33, 37, Shueib Formation Equivalent (upper Cenomanian).

Family: **CUNEOLINIDAE** SAIDOVA, 1981
Subfamily: **CUNEOLININAE** SAIDOVA, 1981
Genus: **Cuneolina** D'ORBIGNY, 1839

Cuneolina pavonia parva HENSON, 1948
Pl. 10, Fig. 5 a-b.

1948 *Cuneolina pavonia* var. *parva* HENSON, p. 624, pl. 14, figs. 1-6; pl. 17, figs. 7-12.
1973 *Cuneolina pavonia parva* HENSON. - SAINT-MARC, pp. 409-410.
1975 *Cuneolina pavonia parva* HENSON. - BASHA, pp. 126-127, pl. 8, figs. 10-13.
1979 *Cuneolina pavonia parva* HENSON. - BASHA, p. 60, pl. 1, fig. 3 a-b.
1981 *Cuneolina pavonia parva* HENSON. - TRONCHETTI, pp. 77-78, pl. 18, figs. 1-11.
1986 *Cuneolina pavonia parva* HENSON. - AL-HARITHI, pl. 4, fig. 19; pl. 13, fig. 14.

Description: Test flabelliform, compressed, chambers numerous, increasing in breadth as added, subdivided by longitudinal partions that extend from one chamber to another; sutures distinct, slghtly depressed and curved; wall arenaceous, smoothly finished; aperture an elongate slit at the base of the last chamber.

Distribution: *C. pavonia parva* was recorded from the Albian to Turonian of Lebanon (Saint-Marc, 1973, 1974); Santonian of Egypt and Cenomanian to Turonian of Palestine and Jordan (Bayliss, 1973; Basha 1975; Al-Harithi, 1982, 1986). In the studied material, it is found in: M56, Shueib Formation Equivalent (Turonian).

Genus: **Pseudotextulariella** BARNARD, 1953

Pseudotextulariella cretosa (CUSHMAN, 1932)
Pl. 10, Fig. 6 a-b.

1932 *Textulariella cretosa* CUSHMAN, p. 97.
1977 *Pseudotextulariella cretosa* (CUSHMAN). - CARTER & HART, p. 23, pl. 2, fig. 12.
1988 *Pseudotextulariella cretosa* (CUSHMAN). - JARVIS et al., p. 151, pl. 156, text-fig. 2.
1988 *Pseudotextulariella cretosa* (CUSHMAN). - LOEBLICH and TAPPAN, p. 148, pl. 156, figs. 7-11.
1990 *Pseudotextulariella cretosa* (CUSHMAN). - HART et al., pl. 3, fig. 1.

Description: Test free, conical, early trochospiral stage with 4-5 chambers, later triserial, and adult wholly biserial, increasing rapidly in size as added; wall finely agglutinated, surface smoothly finished; aperture interiomarginal, a low opening at the base of flattened apertural face.

Distribution: *P. cretosa* was recorded from the Cenomanian of Jordan (Al-Bakri, 1990) and England (Carter & Hart, 1977; Jarvis et al., 1988; Loeblich & Tappan, 1988). In the studied material, a large number of tests belonging to this species was found in: M6, 7a, 13, 22, Na'ur Formation, (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Pseudotextulariella sp. 1
Pl. 10, Fig. 7.

Description: Test free, compressed, elongate, early trochospiral stage with 3-4 chambers, later biserial throughout, chambers enlarging more in breadth than in height; wall finely agglutinated, surface smoothly finished; aperture interiomarginal, a low depression at the base of the last chamber in the apertural face. *P.* sp. 1 differs from *P. cretosa* in having a test increasing gradually in size as added and the conical shape being slightly compressed laterally.

Distribution: *P.* sp. 1 is found in the studied material in: M7a, 13, 22, Na'ur Formation, (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); M47, Ghudran Formation (Coniacian to Santonian); M90, Amman Formation (Campanian).

Family: **DICYCLINIDAE** LOEBLICH and TAPPAN, 1964
Genus: **Dicyclina** MUNIER-CHALMAS, 1887

Dicyclina schlumbergeri MUNIER-CHALMAS, 1887
(Figure not given)

1887 *Dicyclina schlumbergeri* MUNIER-CHALMAS, p. 127, fig.. 31.
1975 *Dicyclina* sp. SAINT-MARC. - SAINT-MARC, p. II, fig. 13.
1975 *Dicyclina schlumbergeri* MUNIER-CHALMAS. - BASHA, p. 127, pl. 8, figs. 14-15.
1987 *Dicyclina schlumbergeri* MUNIER-CHALMAS. - AL RIFAIY et al., p. II, fig. 11.
1988 *Dicyclina schlumbergeri* MUNIER - CHALMAS. - LOEBLICH and TAPPAN, p. 149, pl. 157, figs. 7-10.

Remarks: *D. schlumbergeri* is characterized by a flattened discoidal test that possesses early planispiral chambers in two parallel layers, subdivided by radial partitions into chamberlets perpendicular to median layer; walls of chambers recurved in toward centre of test, consisting of fine to medium grained agglutinated calcite deposits; aperture a single median row of openings at the peripheral margin.

Distribution: *D. schlumbergeri* was recorded from the Albian to Santonian of France, Spain, Yugoslavia and some Middle East countries (Loeblich & Tappan, 1988); lower Cenomanian to upper Turonian of Israel and Jordan (Saint-Marc, 1975; Basha, 1975; Al Rifaiy & Cherif, 1987). In the studied material, it is found in: M45, Shueib Formation Equivalent (upper Cenomanian) and M64, Wadi Sir Formation (Turonian).

Family: **DICTYOPSELLIDAE** BRONNIMANN, ZANINETTI, WHITTAKER,1983
Genus: **Dictyopselloides** LOEBLICH and TAPPAN, 1985

Dictyopselloides cuvillieri (GENDROT, 1968)
Pl. 10, Fig. 8 a-b.

1968 *Dictyopsella cuvillieri* GENDROT, p. 682.
1985 *Dictyopselloides cuvillieri* (GENDROT). - LOEBLICH and TAPPAN, p. 183.
1988 *Dictyopselloides cuvillieri* (GENDROT). - LOEBLICH and TAPPAN, p. 150, pl. 160, figs. 1-7

Description: Test flattened lenticular, trochospiral with evolute spiral side and involute umbilical side; chambers crescentic, broad and low, as observed from the spiral side, but subtriangular with slightly curved and radial sutures on umbilical side; wall of finely agglutinated calcareous grains; aperture a low arch at the midpoint of the base of the apertural face on the umbilical side.

Distribution: *D. cuvillieri* was recorded from the upper Santonian of France and Spain (Loeblich & Tappan, 1988). In the studied material, it is only found in: M109, Amman Formation (lower Maastrichtian).

Family: **COSKINOLINIDAE** MOULLADE, 1965
Genus: **Pseudolituonella** MARIE, 1955

Pseudolituonella mariea CECILE, 1968
Pl. 10, Fig. 9.

1968 *Pseudolituonella mariea* CECILE, pp, 678-679, pl. VI, figs. 8-12.
1975 *Pseudolituonella mariea* CECILE. - BASHA, pp. 153-154, pl. 11, figs. 1-3.

Description: Test elongate, conical, early stage trochospiral twisted to one side, later uniserial, apex convex, base concave, circular or elliptical in transverse; sutures straight to slightly curved; wall imperforate, microdranular, slightly arenaceous; aperture rounded openings at the central base of the last chamber.

Distribution: *P. mariea* was recorded from the Senonian of Switzerland (Cecile 1968); Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M9, 10, Q20, Na'ur Formation, (lower to middle Cenomanian); J26, Fuheis Formation (middle Cenomanian).

Superfamily: **ORBITOLINACEA** MARTIN, 1890
Family: **ORBITOLINIDAE** MARTIN, 1890
Subfamily: **DICTYOCONINAE** MOULLADE, 1965
Genus: **Simplorbitolina** CIRY and RAT, 1953

Simplorbitolina sp.
Pl. 10, Fig. 10.

Description: Test a small high cone-like with flattened base, adult chambers uniserial, low, and discoidal, increasing gradually in size as added; aperture consists of scattered pores on the base of the test. *S.* sp. resembles *S. manasi* CIRY & RAT in the external appearance (Loeblich & Tappan, 1988, p. 162), but differs in having longitudinal striations and having a less flaring test.

Distribution: *S.* sp. is found in the studied material in: J36, 44, Shueib Formation (upper Cenomanian) and M56, Shueib Formation Equivalent (Turonian).

Subfamily: **ORBITOLININAE** MARTIN, 1890
Genus: **Orbitolina** D'ORBIGNY, 1850

Orbitolina sefini HENSON, 1948
Pl. 10, Fig. 11 a-b.

1948 *Orbitolina concava* (LMRK) v. *sefini* HENSON, p. 64, pl. 4, fig. 11; pl. 5, figs. 1-6.
1975 *Orbitolina concava* (LAMARK) v. *sefini* HENSON. - BASHA, pp. 152-153, pl. 10, figs. 14-16.
1981 *Orbitolina concava* (LAMARK). - NEUMANN and SCHROEDER, p. 338.
1985 *Orbitolina concava* (LAMARK). -SCHROEDER & NEUMANN, p. 66, f. 30.

Remarks: Test is characterized by a low convexo-concave shape, with flat, rounded and pustular apex. In a few specimens the primary chamber structures can be seen; wall calcareous and slightly arenaceous.

Distribution: *O. concava* was recorded from the middle Cretaceous of Iraq and Iran (Henson, 1948); Cenomanian of the Mediterranian Region (Neumann & Schroeder, 1981); Cenomanian of Palestine and Jordan (Bayliss, 1966; Olexcon Int. 1963-1965; Basha, 1975). In the studied material, it is found in: M13, Na'ur Formation (lower to middle Cenomanian).

Superfamily: **TEXTULARIACEA** EHRENBERG, 1838
Family: **EGGERELLIDAE** CUSHMAN, 1937
Subfamily: **DOROTHIINAE** BALAKHMATOVA, 1972
Genus: **Dorothia** PLUMMER, 1931

Dorothia pontoni CUSHMAN, 1933
Pl. 10, Fig. 12 a-b.

1933 *Dorothia pontoni* CUSHMAN, p. 55, pl. 6, fig. 8 a-c.
1946 *Dorothia pontoni* CUSHMAN. - CUSHMAN, p. 46, pl. 12, fig. 20.
1956 *Dorothia pontoni* CUSHMAN. - SAID and KENAWY, p. 128, pl. 1, fig. 51.

Description: Test small, with conical appearance, early portion tapering, later broadly flaring, earliest stage with more than 3 chambers, whorl then triserial and later ones strongly depressed; chambers increasing rapidly in size in the biserial stage; wall finely arenaceous, smoothly finished, later chambers becoming almost entirely calcareous; aperture arched opening at the base of inner margin of the last chamber.

Distribution: *D. pontoni* was recorded from the Campanian to Maastrichtian of Egypt and the Gulf Coastal region (Said & Kenawy, 1956; Cushman, 1946). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian); M71, 74, Ghudran Formation (Coniacian to Santonian); P60, Amman Formation (lower Maastrichtian).

Genus: **Marssonella** CUSHMAN, 1933

Marssonella kummi ZEDLER, 1980
Pl. 10, Fig. 16.

1961 *Marssonella kummi* ZEDLER, p. 31, pl. 7, fig. 1.
1980 *Marssonella kummi* ZEDLER. - ZEDLER, p. 38.
1990 *Marssonella kummi* ZEDLER. - KOUTSOUKOS et al., pl. III, figs. 13-14.
1994 *Marssonella kummi* ZEDLER. - BOLLI et al., p. 21, figs. 7.32-34.

Description: Test free, large, characterized by the rapid increase in the size of its chambers, giving the test a regular, conical shape, globular proloculus followed by 3-4 chambers, later stage biserial, the final two chambers flaring and large, distinct chambers and sutures; wall finely agglutinated, smoothly finished; aperture an arched slit at the base of the inner margin of the last chamber.

Distribution: *M. kummi* is restricted to lower Aptian of Trinidad (Bolli et al., 1994) and was recorded from the uppermost Cenomanian of NE Brazil (Koutsoukos et al., 1990). In the studied material, it is found in: M16, Na'ur Formation (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Marssonella oxycona (REUSS, 1860)
Pl. 10, Fig. 14.

1860 *Gaudryina oxycona* REUSS, p. 33, pl. 12, fig. 3.
1973 *Dorothia oxycona* (REUSS). - SLITER, pp. 180-183, text-figs. 7-8.
1988 *Dorothia oxycona* (REUSS). - KAMINSKI et al., p. 195, pl. 9, fig. 9.
1971 *Marssonella oxycona* (REUSS). - MORRIS, p. 275, pl. 5, fig. 11.
1980 *Marssonella oxycona* (REUSS). - SCHREIBER, p. 141, pl. 6, figs. 5-6.
1985 *Marssonella oxycona* (REUSS). - ROBASZYNSKI et al., p. 26, t-figs. 16-17.
1988 *Marssonella trochus v. oxycona* (REUSS). - JARVIS et al., p. 151, pl. 11c, text-fig. 2.
1990 *Marssonella oxycona* (REUSS). - CHARNOCK et al., p. 191, pl. 12, figs. 5-6; pl. 24, fig. 6.
1994 *Marssonella oxycona* (REUSS). - BOLLI et al., p. 93, figs.. 25.1-2.

Description: Test free, large, characterized by the rapid increase in the size of its chambers, giving the test a regular, conical shape, wall finely agglutinated, surface smooth, with aperture a deep re-entrant at the base of the last chamber.

Distribution: *M. oxycona* is known to occur world-wide in the temperate and tethyan realms from upper Albian to upper Cretaceous; it was also recorded from the lower Cenomanian of Algeria (Benkherouf, 1987); Coniacian to Maastrichtian of California and British Columbia (Sliter, 1968, 1973); lower Campanian to Maastrichtian of

Netherlands (Robaszynski et al., 1985) and Trinidad (Bolli et al., 1994); Campanian to lower Eocene of the North Sea (Charnock et al., 1990); Cenomanian to lower Turonian of England and Jordan (Jarvis et al., 1988; Koch, 1968; Al-Harithi, 1982; Al-Bakri, 1990). In the studied material *M. oxycona* is found in: M7a, 16, 20, 21, P15, Na'ur Formation, (lower to middle Cenomanian); M37, J34, 37, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); M88, Amman Formation (Campanian).

Marssonella trochus (D'ORBIGNY, 1840)
Pl. 10, Fig. 15.

1840 *Textularia trochus* D'ORBIGNY, p. 45, pl. 4, figs. 25-26.
1968 *Marssonella trochus* (D'ORBIGNY). - KOCH, pp. 630, 649, fig. 62.
1968 *Marssonella trochus* (D'ORBIGNY). - FUTYAN, pp. 61-62, pl. 3, fig.7.
1970 *Marssonella trochus* (D'ORBIGNY). - HART, pl. 5, figs. 8-9.
1975 *Marssonella trochus* (D'ORBIGNY). - BASHA, pp. 124-125, pl. 8, figs. 5-6.
1988 *Marssonella trochus* (D'ORBIGNY). - JARVIS et al., p. 24, text-fig. 7.
1990 *Marssonella trochus* (D'ORBIGNY). - HART et al., pl. III, fig. 15.

Description: Test small, conical in shape, broadest at its apertural end, globular initial proloculus followed by 3-4 chambers, later continues biserially, the final two chambers flare out and large; indistinct chambers and sutures; wall finely arenaceous, smoothly finished; aperture an arched slit at the base of the inner margin of the last chamber.

Distribution: *M. trochus* was recorded from the lower Cretaceous of Trinidad; upper Cenomanian to lower Turonian of England and France (Jarvis et al., 1988; Hart, 1989; Butt, 1966); Cenomanian and Maastrichtian to lower Eocene of Jordan (Koch, 1968; Basha, 1975; Futyan, 1968).

In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian), M37, Shueib Formation Equivalent (upper Cenomanian); J58, Wadi Sir Formation (Turonian); M88, Amman Formation (Campanian).

Family: **TEXTULARIIDAE** EHRENBERG, 1838
Subfamily: **TEXTULARIINAE** EHRENBERG, 1838
Genus: **Textularia** DEFRANCE, 1824

Textularia depressa KÜBLER and ZWINGLI, 1866
Pl. 11, Fig. 1 a-b.

1866 *Textularia depressa* KÜBLER & ZWINGLI, p. 16, pl. 3, fig. 7.
1975 *Textularia depressa* KÜBLER and ZWINGLI. - BASHA, p. 110, pl. 7, figs. 7-8.

Description: Test free, small, short, attenuate in the early portion, later broad; periphery rounded, very slightly lobate, 6 pairs of biserial chambers; sutures distinct depressed; wall calcareous, slightly arenaceous; aperture an arched opening at the base of the final chamber.

Distribution: *T. depressa* was recorded from the lower Cretaceous of Germany; Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M7a, 16, 21, Q22a, Na'ur Formation (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Textularia subconica FRANKE, 1928
Pl. 11, Fig. 2.

1928 *Textularia subconica* FRANKE, pp. 1-207.
1981 *Textularia subconica* FRANKE. - TRONCHETTI, p. 45, pl. 9, figs. 4-6.
1986 *Textularia subconica* FRANKE. - AL-HARITHI, pl. 6, fig. 25, text-fig. 15.
1990 *Textularia* ex gr. *subconica* FRANKE. - KOUTSOUKOS et al., p. 162, pl. II, fig. 11.

Description: Test small, triangular in outline on both side views, rhomboidal at the end view, thickest along the median line; periphery compressed, acute; biserial throughout consisting of 6-7 pairs of chambers, increasing gradually in size as added; sutures distinct, slightly curved and meet at the median line to form a definite high ridge; wall arenaceous; aperture a low arch or slit at the base of the apertural face.

Distribution: *T. subconica* was recorded from the uppermost Cenomanian of England (Banner, 1981); Santonian of Israel (Reiss, 1952); lower Campanian of Jordan (Al-Harithi, 1986, 1989). In the studied material, it is found in: J58, Wadi Sir Formation (Turonian) and M71, Ghudran Formation (Coniacian to Santonian).

Family: **PSEUDOGAUDRYINIDAE** LOEBLICH and TAPPAN, 1985
Subfamily: **PSEUDOGAUDRYININAE** LOEBLICH and TAPPAN, 1985
Genus: **Clavulinopsis** BANNER and DESAI, 1985

Clavulinopsis gaultina (MOROZOVA, 1940)
Pl. 11, Fig. 3.

1940 *Clavulina gaultina* MOROZOVA, p. 123.
1948 *Clavulina gaultina* MOROZOVA. - MOROZOVA, p. 45.
1989 *'Clavulina' gaultina* MOROZOVA. - KING et al., p. 408, pl. 8.1, fig. 2, text-fig. 13.

Description: Test free, elongated, an arrow-shaped pyramidal triserial with acute angles, followed by a uniserial triangular, chambers simple; sutures slightly depressed, horizontal to slightly arched at the center of the flattened sides; wall moderately finely agglutinated, with cosiderable calcareous groundmass; aperture cribrate at the end of a slightly produced neck.

Distribution: *C. gaultina* was recorded from the middle Albian to Cenomanian of the North Sea (King et al., 1989). In the studied material, it is found in: M21, Na'ur Formation (lower to middle Cenomanian), M37; J51a, Shueib Formation (upper Cenomanian).

4.3 CALCAREOUS BENTHIC FORAMINIFERA
(involutinids, miliolids, lagenids)

4.3.1 Suborder: **INVOLUTININA** HOHENEGGER and PILLER, 1977

Family: **INVOLUTINIDAE** BÜTSCHLI, 1880
Subfamily: **INVOLUTININAE** BÜTSCHLI, 1880
Genus: **Globospirillina** ANTONOVA, 1964

Globospirillina condensa ANTONOVA, 1964
Pl. 11, Fig. 4.

1964 *Globospirillina condensa* ANTONOVA, p. 68.
1988 *Globospirillina condensa* ANTONOVA. - LOEBLICH & TAPPAN, p. 299, pl. 313, figs. 8-9.

Description: Test small, globular proloculus followed by undivided tubular enrolled second chamber, planispirally coiled; wall calcareous, glassy, with pseudopores in the central region; aperture at the open end of the tubular chamber.

Distribution: *G. condensa* was recorded from the upper Jurassic to lower Cretaceous of Russia, France and Romania (Loeblich et al., 1988). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian).

Genus: **Hensonina** MOULLADE and PEYBERNES, 1974

Hensonina lenticularis (HENSON, 1948)
Pl. 11, Fig. 5 a-b.

1948 *Trocholina lenticularis* HENSON, p. 452, fig. 3.
1975 *Trocholina lenticularis* HENSON. - BASHA, pp. 194-195, pl. 14, fig. 6.
1988 *Hensonina lenticularis* (HENSON). - LOEBLICH & TAPPAN, p. 299, pl. 312, figs. 9, 10.

Description: Test lenticular, subglobular, dorsal side evolute, flattened to slghtly convex showing an early proloculus followed by spirally enrolled tubular second chamber, ventral side nearly umbilical, concave; periphery rounded; sutures distinct, slightly depressed; wall calcareous; aperture distinct at the open end of the last tube.

Distribution: *H. lenticularis* was recorded from the lower Cenomanian of Qatar, Arabia and Jordan (Henson, 1948; Basha, 1975). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian).

Hensonina sp. 1
Pl. 11, Fig. 6 a-b.

Description: *H.* sp. 1 resembles *H. lenticularis*, in the external appearance, but differs in being more compressed, biconvex with acute peripheral margin. It also resembles *Involutinella*, but differs in having external surface covered with a prominent reticular network on both sides; aperture distinct, elliptical at the open end of the last tube.

Distribution: *Hensonina* sp. 1 is found in the studied material only in: M22, Upper Nodular, Na'ur Formation (lower to middle Cenomanian).

4.3.2 Suborder: **MILIOLINA** DELAGE and HÉROUARD, 1896

Superfamily: **CORNUSPIRACEA** SCHULTZE, 1854
Family: **FISCHERINIDAE** MILLETT, 1898
Subfamily: **FISCHERININAE** MILLETT, 1898
Genus: **Planispirinella** WIESNER, 1931

Planispirinella barnardia BASHA, 1975
Pl. 11, Fig. 7.

1975 *Planispirinella barnardia* BASHA, pp. 141-142, pl. 9, figs. 15-19.

Description: Test free, discoidal, much compressed, planispiral, partly evolute, bilaterally symmetrical; peripheral margin rounded, narrow; early rounded proloculus followed by low broad, septate tube; sutures distinct, depressed, septa thin, curved; wall calcareous; aperture a high, elongate opening at the apertural face of last chamber.

Distribution: *P. barnardia* was recorded from the Cenomanian reef limestone of Ras en-Naqb (Basha, 1975). In the studied material, it is found in: J40, Q20, P17, Na'ur Formation (lower to middle Cenomanian); M31, J17, Fuheis Formation (middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian).

Planispirinella sp. 1
Pl. 11, Fig. 8.

Remarks: *P.* sp. 1 resembles *P. barnardia* in being planispiral, partly evolute, but differs in being smaller in size, less compressed, calcareous but more coarse-grained wall and with surface ornamentation.

Distribution: *P.* sp. 1 is found in the studied material only in: P60, Amman Formation (lower Maastrichtian).

Family: **OPHTHALMIDIIDAE** WIESNER, 1920
Genus: **Ophthalmidium** KÜBLER and ZWINGLI, 1866

Ophthalmidium minimum TAPPAN, 1943
Pl. 11, Fig. 9.

1943 *Ophthalmidium minima* TAPPAN, p. 491, pl. 78, figs. 36-37.
1951 *Ophthalmidium minima* TAPPAN. - STEAD, pp. 593-594, pl. 2, fig. 2.
1954 *Ophthalmidium minimum* TAPPAN. - FRIZZELL, p. 68, pl. 7, fig. 6 a-b.
1975 *Ophthalmidium minimum* TAPPAN. - BASHA, pp. 139-140, pl. 9, fs. 11-12.

Description: Test free, flattened, periphery bluntly rounded; oval proloculus followed by tubular chamber and then by two chambers to a coil; sutures indistinct; wall calcareous, porcellaneous;aperture an opening at the tubular end of the final chamber.

Distribution: *O. minimum* was recorded from the lower Cretaceous of Texas, USA; Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian).

Superfamily: **MILIOLACEA** EHRENBERG, 1839
Family: **SPIROLOCULINIDAE** WIESNER, 1920
Genus: **Spiroloculina** D'ORBIGNY, 1826

Spiroloculina cretacea REUSS, 1854
Pl. 11, Fig. 10 a-c.

1854 *Spiroloculina cretacea* REUSS, p. 72, pl. 26, fig. 9.
1946 *Spiroloculina cretacea* REUSS. - CUSHMAN, p. 49, pl. 14, figs. 19-23.
1968 *Spiroloculina cretacea* REUSS. - SLITER, p. 51, pl. 4, fig. 4.
1986 *Spiroloculina cretacea* REUSS. - AL-HARITHI, p. 9, pl. 12, text-figs. 13, 15.
1987 *Spiroloculina cretacea* REUSS. - BENKHEROUF, p. 75, text-fig. 5.
1989 *Spiroloculina cretacea* REUSS. - ISMAIL, p. 130, pl. 2, figs. 11-12.

Description: Test free, small, compressed, broadly elliptical in outline, periphery rounded to truncate; chambers distinct, two per whorl; sutures distinct, slightly depressed; wall calcareous, surface smooth; aperture terminal, rounded.

Distribution: *S. cretacea* was recorded from Campanian of California (Sliter, 1968); Turonian to lower Senonian of Germany; Albian to upper Cenomanian of England (Hart, 1989); lower to upper Cenomanian of Algeria and Maastrichtian of Egypt (Benkherouf, 1987); Cenomanian and lower Campanian of Jordan (Al-Harithi, 1986 a, b). In the studied material, it is found in: M7a, P3, 15, 23, Na'ur Formation, (lower to middle Cenomanian); Q43, Ghudran Formation (Coniacian to Santonian).

Family: **HAUERINIDAE** SCHWAGER, 1876
Subfamily: **SIPHONAPERTINAE** SAIDOVA, 1975
Genus: **Ammomassilina** CUSHMAN, 1933

Ammomassilina sp.
Pl. 11, Fig. 11 a-b.

Remarks: Chambers one-half coil in length, early stage quinqueloculine, later chambers added on opposite sides of the test in a single plane; wall calcareous, imperforate, with surface layer of agglutinated quartz particles. *A.* sp. resembles *A. alveoliniformis* (MILLETT) from the Holocene, in the external appearance (Loeblich & Tappan, 1988, p. 332), but differs in the stratigraphic occurrence and having less compressed test.

Distribution: *A.* sp. is found in the studied material in: M56, Shueib Formation Equivalent (Turonian); Q32, Wadi Sir Formation (Turonian).

Subfamily: **HAUERININAE** SCHWAGER, 1876
Genus: **Massilina** SCHLUMBERGER, 1893

Massilina ginginensis CHAPMAN, 1917
Pl. 11, Fig. 12 a-b.

1917 *Massilina ginginensis* CHAPMAN, p. 76.
1960 *Massilina ginginensis* CHAPMAN. - BELFORD, p. 23, pl. 6, figs. 2-7.
1986 *Massilina ginginensis* CHAPMAN. - AL-HARITHI, pl. 13, fig. 9.

Description: Test ovate in outline, slightly flattened and fusiform in, early chambers quinqueloculine, later added in a single plane on alternate sides as in *Spiroloculina*, periphery rounded; wall calcareous; aperture terminal, ovate.

Distribution: *M. ginginensis* was recorded from the Maastrichtian of Jordan (Al-Harithi, 1983, 1986). In the studied material, it is found in: P15, 17, Na'ur Formation (lower to middle Cenomanian); M56, Shueib Formation Equivalent (Turonian); Q33, Wadi Sir Formation (Turonian); P55, Ghudran Formation (Coniacian to Santonian).

Genus: **Quinqueloculina** D'ORBIGNY, 1826

Quinqueloculina antiqua angusta (FRANKE, 1928)
Pl. 12, Fig. 1 a-b.

1928 *Miliolina (Quinqueloculina) antique* FRANKE, p. 126, pl. 11, fig. 26.
1975 *Quinqueloculina antiqua* (FRANKE). - BASHA, p. 130-131, pl. 8, fs. 20-21.
1957 *Quinqueloculina antiqua* var. *angusta* (FRANKE). - HOFKER, p. 435, text-fig. 492.
1976 *Quinqueloculina antiqua angusta* (FRANKE). - ANDRAWIS, pp. 12, 34.
1986 *Quinqueloculina antiqua* var. *angusta* (FRANKE). - AL-HARITHI, pl. 14, fig. 11.

Remarks: The recorded specimens of *Q. antiqua angusta* are very close to FRANKE's in the shape and size of the test, number of chambers and in the apertural shape and position.

Distribution: *Q. antiqua angusta* was recorded from the Turonian of Egypt (Andrawis, 1976); Cenomanian to Turonian of Jordan (Basha, 1975; Al-Harithi, 1982, 1986). In the studied material, it is found in: P3, 6, Q11, 16, Na'ur Formation, (lower to middle Cenomanian); P41, Fuheis Formation Equivalent (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Quinqueloculina globigerinaeformis (KRASHENINNIKOV, 1973)
Pl. 11, Fig. 13.

1973 *Praecystammina globigerinaeformis* KRASHENINNIKOV. - KRASHENINNIKOV, p. 211, pl. 3, fig. 1 a-c, 2.
1988 *Praecystammina globigerinaeformis* KRASHENINNIKOV. - MOULLADE et al., p. 356, pl. 7, fig. 6.
1988 *Praecystammina globigerinaeformis* KRASHENINNIKOV. - LOEBLICH and TAPPAN, p. 82, pl. 67, figs. 4-7.
1990 *Praecystammina* sp. cf. *globigerinaeformis* KRASHENINNIKOV. - MALATA and OSZCZYPKO, p. 517, pl. 2, figs. 1-5, text-fig. 5.

Description: Test tiny, globose, streptospiral, with few chambers, commonly 3 per whorl, visible on one side and 4 on the other one, periphery broadly ovate; wall calcareous, surface smoothly finished; aperture areal, oval, slightly above the base of the apertural face, and bordered by a distinct lip.

Distribution: *G. globigerinaeformis* was recorded from the Santonian to Campanian of NW Pacific (Krashininnikov, 1973); Turonian to lower Maastrichtian of the Carpathians, Poland (Malata & Oszczypko, 1990). In the studied material, it is found in: M7a, 21, P27, Na'ur Formation, (lower to middle Cenomanian); Q27, Fuheis Formation Equivalent (middle Cenomanian); J46, Shueib Formation (upper Cenomanian); Q37, Wadi Sir Formation (Turonian), Q43, Ghudran Formation (Coniacian to Santonian).

Quinqueloculina triangulata STEAD, 1951
Pl. 11, Fig. 14 a-b.

1951 *Quinqueloculina triangulata* STEAD, p. 593.
1954 *Quinqueloculina triangulata* STEAD. - FRIZZELL, p. 77.
1975 *Quinqueloculina triangulata* STEAD. - BASHA, p. 133, pl. 8, fig. 24.

Remarks: *Q. triangulata* resembles STEAD's specicimens in most of the characters, but the bifid tooth at the apertural end could not be observed in the Jordanian specimens.

Distribution: *Q. triangulata* was recorded from the Albian of Texas, USA (Stead, 1951); lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: P14, Na'ur Formation (lower to middle Cenomanian); M24, Fuheis Formation Equivalent (middle Cenomanian); Q32, Wadi Sir Formation (Turonian), Q43, Ghudran Formation (Coniacian to Santonian).

Quinqueloculina laevigata (D'ORBIGNY, 1826)
(Figure not given)

1826 *Triloculina laevigata* D'ORBIGNY emend. SCHLUMBERGER 1893, p. 63, pl. 9; pl. 1, figs. 45-47.
1878 *Triloculina laevigata* TERQUEM. - TERQUEM, p. 57.
1970 *Triloculina (Pseudotriloculina)* CHERIF. - CHERIF, p. 113.
1988 *Pseudotriloculina lecalvezae* (KAASCHIETER). - LOEBLICH & TAPPAN, p. 342, pl. 352, figs. 13-14.
1973 *Quinqueloculina (Pseudotriloculina) laevigata* (D'ORBIGNY emend. SCHLUMBERGER). - CHERIF, p. 87, pl. 10, fig. 6; p. 92, pl. 15, fig. 10.

Description: Test ovate in outline, periphery broadly rounded, chambers one-half coil in length, broadly overlap preceding chambers so that only 2-3 are visible from the exterior; wall calcareous; aperture large, rounded, at the end of the final chamber. This species is not figured.

Distribution: *T. laevigata* was recorded from the upper Pliocene of Greece (Kaaschieter, 1961). In the studied material, specimens close to Kaaschieter's ones were found in P6, 15, 18, 22, 23, 27, Na'ur Formation, (lower to middle Cenomanian); Q27, Fuheis Formation Equivalent (middle Cenomanian), Q32, Wadi Sir Formation (Turonian); P55, Q43, Ghudran Formation (Coniacian to Santonian).

Superfamily: **SORITACEA** EHRENBERG, 1839
Family: **PENEROPLIDAE** SCHULTZE, 1854
Genus: **Peneroplis** MONTFORT, 1808

Peneroplis parvus DE CASTRO, 1965
Pl. 12, Fig. 2 a-c.

1965 *Peneroplis parvus* DE CASTRO, pp. 317-372.
1975 *Peneroplis* sp. cf. *turonicus* SAID & KENAWY. - SAINT-MARC, p. 235, pl. 8, figs. 5-9.
1985 *Peneroplis parvus* DE CASTRO. - SCHROEDER & NEUMANN, pl. 86, fig. 39.

Description: Test free, large, compressed, early stage planispiral and involute, later chambers increasing more rapidly in breadth, strongly arched and tending to uncoil; sutures distinct, depressed, curved; wall calcareous; aperture multiple pores at the flaring face of last chamber.

Distribution: *P. parvus* was recorded from the lower and middle Cenomanian of Italy (De Castro, 1965); middle Cenomanian to lower Turonian of Lebanon (Saint-Marc, 1975). In the studied material, it is found in: J47, Shueib Formation (upper Cenomanian) and J58, Wadi Sir Formation (Turonian).

Family: **SORITIDAE** EHRENBERG, 1839
Subfamily: **PRAERHAPYDIONININAE** HAMAOUI & FOURCADE, 1973
Genus: **Pseudorhapydionina** CASTRO, 1971

Pseudorhapydionina dubia (CASTRO, 1965)
Pl. 12, Fig. 4 a-b.

1965 *Rhapydionina dubia* CASTRO, pp. 348-352, figs 2-6, 16-17, 20-22, t-f. 8.
1975 *Rhapydionina dubia* CASTRO. - BASHA, pp. 168-169, pl. 11, figs. 26-8; pl. 12, fig. 1.
1975 *Pseudorhapydionina dubia* (CASTRO). - SAINT-MARC, p. 240-241, pl. 13, fig. 8.
1981 *Pseudorhapydionina dubia* (CASTRO). - NEUMANN & SCHROEDER, p. 390.
1985 *Pseudorhapydionina dubia* (CASTRO). - SCHROEDER et al., p. 88, figs. 40-43.

Description: Test free, early portion close-coiled and biumbilicate, later uncoiled and cylindrical; periphery rounded; outer coil having 7-9 chambers in the coiled portion and 3-4 in the uncoiled one; sutures curved, flush with the surface; septa thick chevron-shaped in the uncoiled portion; wall calcareous, surface smooth; aperture terminal, cribrate.

Distribution: *P. dubia* was reported in the Mediterranean Region from the lower Cenomanian to Turonian (Hamaoui et al., 1970; Saint-Marc, 1975; Basha, 1975; Neumann & Schroeder, 1981, 1985). In the studied material, it is found in: M56, Shueib Formation Equivalent (Turonian) and J58, 59, Wadi Sir Formation (Turonian).

4.3.3 Suborder: **LAGENINA** DELAGE and HÉROUARD, 1896

Superfamily: **NODOSARIACEA** EHRENBERG, 1838
Family: **NODOSARIIDAE** EHRENBERG, 1838
Subfamily: **NODOSARIINAE** EHRENBERG, 1838
Genus: **Laevidentalina** LOEBLICH and TAPPAN, 1986

Laevidentalina aphelis LOEBLICH and TAPPAN, 1986
Pl. 13, Fig. 6.

1986 *Laevidentalina aphelis* LOEBLICH & TAPPAN, p. 242
1988 *Laevidentalina aphelis* LOEBLICH and TAPPAN. - LOEBLICH and TAPPAN, p. 396, pl. 439, figs. 22-24.

Description: Test elongate, arcuate, proloculus rounded to fusiform, later chambers uniserial, increasing gradually in size as added, chambers moderate in number and every chamber seems to be slightly elongated; sutures distinct, slightly depressed, straight, horizontal to slightly oblique; wall calcareous, hyaline, surface smooth and nonornamented; aperture terminal, a series of radial slits that are closed at the apex.

Remarks: *L. aphelis* resembles *L. longiscata*, in the external appearance, but differs in having lesser elongated chambers, lesser depressed sutures and in increasing more rapidly in size as added. All specimens encountered in the studied material were broken off into 1-2 chambers.

Distribution: *L. aphelis* is cosmopolitan and was recorded from the Cretaceous to Holocene of E. Gulf of Mexico (Loeblich & Tappan, 1988). In the studied material, it was only found only in M91, Amman Formation (Campanian).

Laevidentalina catenula (REUSS, 1860)
Pl. 12, Fig. 9.

1860 *Dentalina catenula* REUSS, p. 185, pl. 3, fig. 6.
1956 *Dentalina catenula* REUSS. - SAID and KENAWY, p. 132, pl. 2, fig. 24.
1960 *Dentalina catenula* REUSS. - TRUJILLO, p. 327, pl. 47, fig. 3.
1968 *Dentalina catenula* REUSS. - SLITER, p. 57, pl. 5, fig. 14.
1989 *Dentalina catenula* REUSS. - ISMAIL, p. 131, pl. 2, fig. 16.
1994 *Laevidentalina catenula* (REUSS). - BOLLI et al., p. 99, figs. 26.12-13.

Description: Test free, elongate, gently arcuate, uniserial; chambers subglobular to pyriform, slightly overlapping; sutures distinct, depressed, may be initially limbate; wall calcareous, finely perforate, surface smooth; aperture terminal, slightly eccentric in position, radiate.

Remarks: *L. catenula* is distinguished by the relatively large size, subglobular chambers and smooth surface. All specimens encountered had broken segments of tests with single chambers.

Distribution: *L. catenula* was originally reported from the upper Cretaceous of Germany, later recorded from the lower Cenomanian to upper Palaeocene of Trinidad (Bolli et al., 1994), Campanian and Maastrichtian of Texas (Cushman, 1946), middile and upper Campanian of the Gulf Coast, USA (Sliter, 1968) and Maastrichtian of Egypt (Ismail, 1989). In the studied material, it is found in: M90, Amman Formation (Campanian).

Laevidentalina gracilis (D'ORBIGNY, 1840)
Pl. 12, Fig. 13 a-b.

1840 *Nodosaria (Dentalina) gracilis* D'ORBIGNY, p. 14, pl. 1, fig. 6.
1968 *Dentalina gracilis* (D'ORBIGNY). - SLITER, p. 57, pl. 5, figs. 15-16.
1968 *Dentalina gracilis* (D'ORBIGNY). - FUTYAN, p. 95, pl. 5, figs. 14-15.
1973 *Dentalina gracilis* (D'ORBIGNY). - SLITER, p. 181, text-figs. 6-7.
1986 *Dentalina gracilis* (D'ORBIGNY). - AL-HARITHI, p. 6, pl. 10, t-figs. 13, 15.
1989 *Dentalina gracilis* (D'ORBIGNY). - ISMAIL, p. 132, pl. 2, fig. 18.
1990 *Dentalina gracilis* (D'ORBIGNY). - AL-BAKRI, p. 33, pl. 3, fig. 1.
1994 *Laevidentalina gracilis* (D'ORBIGNY). - BOLLI et al., p. 100, figs. 26. 14.

Description: Test free, elongate, arcuate, slender; chambers numerous, initially overlapping, later becoming elongated and inflated; sutures distinct, initially transverse, flush, somewhat limbate, later oblique, depressed; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, somewhat produced, eccentric, radiate.

Remarks: Specimens referred to this species are characterized by a slender, arcuate test, oblique sutures and pyriform chambers.

Distribution: *L. gracilis* is a long ranging cosmopolitan species (Cushman, 1946; Takayanagi, 1960). It was recorded from the upper Aptian to lower Albian and from Campanian to lower Eocene of Trinidad (Bolli et al., 1994), Santonian to Campanian of British Columbia (Sliter, 1973), Campanian to Maastrichtian of Egypt and Jordan (Ismail, 1989; Futyan, 1968; Al-Harithi, 1986) and also lower Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: Q22a, 23, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); M90, M91, Amman Formation (Campanian).

Laevidentalina hammensis (FRANKE, 1928)
Pl. 12, Fig. 7.

1928 *Marginulina hammensis* FRANKE, p. 77, pl. 7, figs. 9, 10.
1970 *Dentalina* sp. cf. *hammensis* (FRANKE). - HART, pl. 9, fig. 3.
1994 *Laevidentalina hammensis* (FRANKE). - BOLLI et al., p. 101, fig. 26.17.

Description: Test elongate, gently arcuate, uniserial; proloculus apiculate, chambers cylindrical to ovate, enlarging gradually as added; sutures horizontal, depressed; wall calcareous, finely perforate, surface hispid or ornamented with numerous longitudinal costae; aperture terminal, eccentric, radiate with a short neck.

Distribution: *Dentalina* is a cosmopolitan genus that ranges from the lower Cretaceous to Holocene (Loeblich & Tappan, 1988). *D. hammensis* was reported from the middle to upper Albian of England (Hart, 1970); Turonian to Palaeocene of Trinidad (Bolli et al., 1994). In the studied material, forms very close to *D. hammensis* were found in M22, Na'ur Formation (lower to middle Cenomanian), M90, Amman Formation (Campanian).

Laevidentalina sp.
Pl. 12, Fig. 6 a-b.

Description: Test elongate, uniserial, a few closely appressed inflated to subglobular chambers in a rectilinear to slightly arcuate test, base broken in all specimens observed; sutures horizontal to slightly oblique, constricted; wall calcareous, surface smooth and unornamented, finely perforate; aperture terminal, somewhat eccentric, radiate, produced on a neck, giving a petaloid appearance to the apertural view. *L.* sp. differs from *L. gracilis* in having subglobular chambers and in the apertural view.

Distribution: *L.* sp. is found in the studied material in: M7a, Na'ur Formation (lower Cenomanian), M47, Ghudran Formation (Coniacian to Santonian), M90, M91, Amman Formation (Campanian).

Laevidentalina vistulae (POZARYSKA, 1957)
Pl. 12, Fig. 5.

1957 *Nodosaria vistulae* POZARYSKA, pl. 89, fig. 18; pl. 7, fig. 10.
1965 *Nodosaria vistulae* POZARYSKA. - POZARYSKA, p. 70, pl. 6, figs. 6-7.
1968 *Chrysalogonium vistulae* (POZARYSKA). - FUTYAN, pp. 114-115, pl. 6, figs. 22-23.
1968 *Dentalina vistulae* (POZARYSKA). - SLITER, p. 59, pl. 5, fig. 25.
1973 *Dentalina vistulae* (POZARYSKA). - SLITER, p. 183, text-fig. 8.

Description: Test free, elongate, slender, arcuate to rectilinear; chambers uniserial, elongate, 3-4 times as long as broad, cylindrical, angular at their bases, slightly inflated, increasing rapidly in length; sutures distict, depressed, straight, horizontal to slightly oblique; wall calcareous, finely perforate, surface smooth and unornamented; aperture terminal, somewhat eccentric, radiate.

Remarks: *Laevidentalina* differs from *Dentalina* in lacking longitudinal costae (Loeblich & Tappan, 1988: 396) and from *Nodosaria* in having an arcuate test and an aperture radiate, but not produced on a neck. *L. vistulae* has fewer, more elongated chambers and a less arcuate test than the associated *L. gracilis* (Pl. 12: 13).

Distribution: *L. vistulae* was recorded from the Campanian to Maastrichtian of California and Mexico, USA (Sliter, 1968, 1973); Palaeocene of Poland and Egypt; uppermost Maastrichtian to Eocene of Jordan (Futyan, 1968). In the studied material, it is found in: M91, Amman Formation (Campanian); P60, Amman Formation (lower Maastrichtian).

Genus: **Dentalina** RISSO, 1826

Dentalina marcki REUSS, 1860
Pl. 12, Fig. 8.

1860 *Dentalina marcki* REUSS, P. 44, pl. 2. fig. 7.
1960 *Dentalina marcki* REUSS. - BELFORD, p. 31, 9, figs. 1-3.
1968 *Dentalina marcki* REUSS. - SLITER, p. 58, pl. 5, fig. 19.
1968 *Dentalina marcki* REUSS. - FUTYAN, p. 97, PL. 5, fig. 18.
1973 *Dentalina marcki* REUSS. - SLITER, p. 183, text-fig. 8.

Description: Test free, elongate, gently arcuate, with apical spine; chambers initially overlapping, later becoming inflated and elongate; sutures distinct, initially nearly flush, later depressed; wall calcareous, finely perforate, surface ornamented by 10 longitudinal costae on all but final chamber; aperture terminal, eccentric, radiate.

Distribution: *D. marcki* was recorded from the upper Cretaceous of Europe and Trinidad; upper Coniacian to Maastrichtian of California, Mexico (Sliter, 1968); Campanian to Maastrichtian of British Columbia (Sliter, 1973) and the middle Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M91, Amman Formation (Campanian).

Dentalina sp. 1
Pl. 13, Fig. 7 a-b.

Description: Test elongate, gently arcuate, uniserial, proloculus bluntly apiculate, chambers 3-4 subcylindrical to ovate, increasing regularly in size as added, circular in cross section; sutures horizontal, depressed; wall calcareous, perforate, surface with 5-6 distinct longitudinal costae; aperture terminal, circular, at the end of a short neck.

Distribution: The genus *Dentalina* is cosmopolitan and ranges from the lower Cretaceous to Holocene (Loeblich & Tappan, 1988). *D.* sp. 1 is found in the studied material only in: M90, 91, Amman Formation (Campanian).

Genus: **Dentalinoides** MARIE, 1941

Dentalinoides canulina MARIE, 1941
Pl. 12, Fig. 11-12.

1941 *Dentalinoides canulina* MARIE, pp. 207, 256.
1988 *Dentalinoides canulina* MARIE. - LOEBLICH & TAPPAN, p. 395, pl. 439, figs. 20-21.

Description: Test elongate, straight to slightly arcuate, proloculus rounded, later chambers uniserial, circular in; sutures straight, horizontal; wall calcareous, hyaline, finely perforate, surface smooth and nonornamented; aperture terminal, large, round, slightly eccentric in position and opening toward the concave side of the test. *Dentalinoides* is characterized by having smooth surface and a large, terminal and round aperture.

Distribution: *D. canulina* was recorded from the Senonian of France and North America (Loeblich & Tappan, 1988). In the studied material, it is found in: M7a, M21, Na'ur Formation, (lower and middle Cenomanian), M47, Ghudran Formation (Coniacian to Santonian), M90, M91,, Amman Formation (Campanian).

Genus: **Mucronina** EHRENBERG, 1839

Mucronina sp.
Pl. 12, Fig. 14.

Description: Test narrow, elongate, laterally carinate, chambers uniserial and rectilinear; sutures straight and horizontal; wall hyaline, surface ornamented with numerous longitudinal sriae; aperture terminal, produced on a neck. *M.* sp. differs from *M. hasta* (D'ORBIGNY) from the Pliocene (Loeblich & Tappan, 1988, p. 397) in having a polygonal cross rather than elliptical.

Distribution: *M.* sp. is found in the studied material in: J25, Fuheis Formation (middle Cenomanian), J39, Shueib Formation (upper Cenomanian); M47, Ghudran Formation (Coniacian to Santonian), M91, Amman Formation (Campanian).

Genus: **Nodomorphina** CUSHMAN, 1927

Nodomorphina sp. 1
Pl. 12, Fig. 10.

Description: Test elongate, uniserial, and rectilinear, early stage compressed and rectangular in, later chambers more inflated and oval to subcircular in; sutures distinct, straight and horizontal, early ones flush, later slightly constricted; wall calcareous, surface with 5 longitudinal costae at the test angles; aperture terminal, rounded, slightly produced, not radiate.

Remarks: *N.* sp. 1 resembles *N. compressiuscula* (NEUGEBOREN) from the Miocene of Austria (Loeblich & Tappan, 1988, p. 397), in the external appearance, but differs in having much smaller number of chambers and a larger, elongate initial portion.

Distribution: *N.* sp. 1 was found in the studied material only in: M91, Amman Formation (Campanian).

Genus: **Nodosaria** LAMARCK, 1921

Nodosaria limbata D'ORBIGNY, 1840
Pl. 12, Fig. 16.

1840 *Nodosaria limbata* D'ORBIGNY, p. 12, pl. 1, fig. 1.
1968 *Nodosaria limbata* D'ORBIGNY. - SLITER, p. 53, pl. 4, fig. 15.
1987 *Nodosaria limbata* D'ORBIGNY. - ANAN, p. 220, pl. 1, fig. 6.
1989 *Nodosaria limbata* D'ORBIGNY. - ISMAIL, p. 136, pl. 3, fig. 11.

Description: Test free, large, elongate, uniserial, chambers subglobular, inflated, of nearly equal size; sutures distinct, deeply depressed, limbate; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, radiate, produced on a neck.

Remarks: *Nodosaria* is characterized by having a smooth and unornamented rectilinear test with a terminal aperture, produced on a neck. All tests belonging to *Nodosaria*, encountered in the studied material, were broken into solitary or double chambers.

Distribution: *N. limbata* was recorded from the Coniacian to Santonian of Trinmidad (Bolli et al., 1994), Campanian to Maastrichtian of California, USA (Sliter, 1968) and Maastrichtian to Palaeocene of Egypt (Ismail, 1989). In the studied material, it is found in: M90, Amman Formation (Campanian).

Nodosaria longiscata D'ORBIGNY, 1846
Pl. 12, Fig. 15.

1846 *Nodosaria longiscata* D'ORBIGNY, p. 32, pl. 1, figs. 10-12.
1985 *Nodosaria longiscata* D'ORBIGNY. - LÜGER, p. 81, pl. 4, fig. 8.
1987 *Nodosaria longiscata* D'ORBIGNY. - ANAN, p. 220, pl. 1, fig. 7.

1989 *Nodosaria longiscata* D'ORBIGNY. - ISMAIL, p. 137, pl. 3, fig. 12.
1989a *Nodosaria longiscata* D'ORBIGNY. - CHERIF et al., pl. 2, fig. 1.
1994 *Nodosaria* (?) *longiscata* D'ORBIGNY. - BOLLI et al., p. 102, fs. 26.35-36.

Description: Test free, elongate, slender, gently arcuate, chambers uniserial, moderate in number and size, and every chamber seems to be elongated, twice as long as broad; sutures thick, depressed, horizontal to slightly oblique; wall calcareous, finely perforate, surface smooth and unornamented; aperture simple opening with slightly thickened rim, slightly asymetric.

Distribution: *L. longiscata* was recorded from the upper Maastrichtian of Trinidad (Bolli et al., 1994), and upper Cenomanian, Maastrichtian and Palaeocene of Egypt (Cherif et al., 1989a; Ismail, 1989). In the studied material, it is found in: M91, Amman Formation (Campanian).

Nodosaria naumanni REUSS, 1874
Pl. 13, Fig. 4.

1874 *Nodosaria naumanni* REUSS, p. 82, pl. II (20), fig. 11.
1928 *Nodosaria naumanni* REUSS. - FRANKE, p. 42, pl. 3, fig. 29.
1940 *Nodosaria naumanni* REUSS. - CUSHMAN, p. 89, pl. 16, fig. 7.
1946 *Nodosaria naumanni* REUSS. - CUSHMAN, p. 72, pl. 26, fig. 11.

Description: Test elongate, tapering, uniserial and rectilinear; chambers few closely appressed, slightly inflated to subglobular, somewhat overlapping, more broad than high, increasing gradually in size as added; sutures straight, horizontal, depressed; wall calcareous, surface smooth and unornamented, finely perforate; aperture terminal, rounded, with no neck. The initial part of the test in all specimens observed was broken off.

Distribution: *N. naumanni* was recorded from the Campanian of Texas, USA (Cushman, 1946). In the studied material, it is found only in: M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Pyramidulina** FORNASINI, 1894

Pyramidulina distans (REUSS, 1855)
Pl. 13, Fig. 1 a-b.

1855 *Nodosaria distans* REUSS, p. 264, pl. 8, fig. 5.
1946 *Nodosaria distans* REUSS. - CUSHMAN, p. 71, pl. 26, figs. 1-2.
1968 *Nodosaria distans* REUSS. - SLITER, p. 53, pl. 4, fig. 18.
1973 *Nodosaria distans* REUSS. - SLITER, pp. 178, 183, text-figs. 6, 8.

Description: Test free, elongate, gradually tapering; chambers inflated, subglobular, somewhat separated, increasing gradually in size; sutures distinct, depressed, limbate; wall calcareous, finely perforate, surface ornamented by longitudinal costae; aperture terminal, radiate, somewhat projecting.

Distribution: *N. distans* was recorded from the Turonian of Germany; Coniacian to Maastrichtian of the Gulf Coast, USA; Santonian to Campanian of the British Columbia (Sliter, 1968, 1973). In the studied material, it is found in: M91, Amman Formation (Campanian).

Pyramidulina latejugata (GÜMBELL, 1868)
Pl. 12, Fig. 17.

1868 *Nodosaria latejugata* GÜMBEL, p. 619, pl. 1, fig. 32; pl. 1, fig. 13.
1968 *Nodosaria latejugata* GÜMBEL. - FUTYAN, pp. 104-105, pl. 6, fig. 8.
1986 *Nodosaria latejugata* GÜMBEL. - ADNAN & HEWAIDY, p. 22, pl. 1, f. 13.
1989 *Nodosaria latejugata* GÜMBEL. - ISMAIL, p. 136, pl. 3, fig. 10.
1989 *Nodosaria latejugata* GÜMBEL. - MURRAY et al., p. 522, pl. 10.7, fig. 14.
1989 *Nodosaria latejugata* GÜMBEL. - KING, p. 464, pl. 9.4, fig. 3, t-figs. 9, 11.

Description: Test large, uniserial, circular in, chambers inflated, with stout longitudinal ribs that cross the depressed sutures; it is characterized by longitudinal costae with slight extensions and decreasing chamber size toward the end.

Remarks: *Pyramidulina* includes species previously placed in *Nodosaria* but with prominent longitudinal ribs rather than a smooth surface (Loeblich & Tappan, 1988: 398). *P. latejugata* resembles *Pyramidulina (Nodosaria) affinis*, but differs in possessing more inflated chambers and without having sharply edged costae.

Distribution: *P. latejugata* was recorded from the upper Palaeocene to upper Eocene of the North Sea (King, 1989); Maastrichtianof Poland (Pozaryska, 1957); Maastrichtian and Palaeocene of Egypt (Ismail, 1989); uppermost Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M90, Amman Formation (Campanian).

Pyramidulina proboscidea (REUSS, 1851)
Pl. 12, Fig. 18.

1851 *Nodosaria proboscidea* REUSS, p. 7, pl. 1, fig. 6.
1946 *Nodosaria proboscidea* REUSS. - CUSHMAN, p. 72, pl. 26, figs. 12-13.
1968 *Nodosaria proboscidea* REUSS. - SLITER, p. 54, pl. 4, figs. 12-13.
1970 *Nodosaria proboscidea* REUSS. - HART, p. 7, fig. 14.

Description: Test free, uniserial, rectilinear, elongate; chambers distinct, subglobular, inflated; sutures strongly depressed, slightly limbate, broad; wall calcareous, surface costae, displaying up to 10 coarse longitudinal ribs; aperture terminal, radiate, produced on distinct neck. All tests observed were broken off into solitary chambers.

Distribution: *P. proboscidea* was recorded from the middle to upper Albian of England (Hart, 1970); upper Cretaceous of Poland; Campanian of California (Sliter, 1968). In the studied material, it is only found in: M90, Amman Formation (Campanian).

Pyramidulina raphinistrum (LINNE, 1758)
Pl. 13, Fig. 3.

1758 *Nautilus raphinistrum* LINNE, p. 710, pl. 1, fig. 6.
1980 *Nodosaria raphinistrum* (LINNE). - SCHREIBER, p. 147, pl. 8, figs. 3, 5.
1985 *Nodosaria raphinistrum* (LINNE). - LÜGER, p. 81, pl. 4, fig. 7.
1989 *Nodosaria raphinistrum* (LINNE). - ISMAIL, p. 137, pl. 3, fig. 14.

Remarks: Specimens encountered represent the megalospheric form with very large proloculus and only 2 or 3 succeeding chambers that become rapidly much smaller toward the apertural end; wall calcareous, surface ornamented with few thick longitudinal ribs, crossing the depressed sutures; aperture produced on a neck. *P. raphinistrum* differs from *P. latejugata* (Pl. 12: 17) in having a rapid decrease in the size of chambers as added.

Distribution: *P. raphinistrum* was recorded from the Maastrichtian and Palaeocene of Egypt (Lüger, 1985; Ismail, 1989). In the studied material, it is only found in: M91, Amman Formation (Campanian).

Pyramidulina septemcostata (GEINITZ, 1842)
Pl. 12, Fig. 19.

1842 *Nodosaria septemcostata* GEINITZ, p. V, 69, pl. 17, fig. 20.
1946 *Nodosaria affinis* REUSS - CUSHMAN, p. 70, pl. 25, figs. 11, 13-17, 20-23.
1951 *Nodosaria septemcostata* GEINITZ. - BANDY, p. 502, pl. 73, fig. 14.
1968 *Nodosaria septemcostata* GEINITZ. - SLITER, p. 54, pl. 4, fig. 16.
1989a *Nodosaria septemcostata* GEINITZ. - CHERIF et al., p. 2, pl. 2, text-fig. 5.

Description: Test free, large, elongate, gradually tapering; chambers inflated, subglobular throughout, increasing gradually in size; sutures distinct, limbate, depressed; wall calcareous, finely perforate, surface with 7-13 longitudinal costae; aperture terminal, radiate.

Distribution: *P. septemcostata* was recorded from the Coniacian to Maastrichtian of the American Gulf Coast (Sliter, 1968); middle Turonian of Egypt (Cherif et al., 1989a); Santonian to middle Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M90, Amman Formation (Campanian).

Pyramidulina zippei (REUSS, 1845)
Pl. 13, Fig. 2.

1845 *Nodosaria zippei* REUSS, p. 25, pl. 8, figs. 1-3.
1936 *Nodosaria zippei* REUSS. - BROTZEN, pp. 82-84, pl. 5, fig. 12.
1952 *Nodosaria zippei* REUSS. - NAKKADY, p. 424, pl. 7, fig. 5.
1957 *Nodosaria zippei* REUSS. - POZARYSKA, p. 72, pl. 9, fig. 13.
1968 *Nodosaria zippei* REUSS. - FUTYAN, p. 108, pl. 6, fig. 12.
1970 *Nodosaria zippei* REUSS. - HART, p. 7, fig. 16.

Description: Test free, elongate, very slightly tapering; chambers of fairly uniform size, increasing slightly in length and diameter as added; sutures distinct, depressed; wall calcareous, finely perforate, surface ornamented with 7-13 longitudinal, platelike costae, continuous over adjacent chambers, usually broken at the sutures; aperture radiate, terminal.

Remarks: The forms, encountered in this study, with numerous sharply-edged costae and strongly inflated chambers are identical with those of Brotzen (1936), Nakkady (1952) and Pozaryska (1957), and are referred to this species. They are easily breakable, due to the much-contracted necks, therefore the final chambers are usually missing.

Distribution: *P. zippei* was recorded from the middle to upper Albian of England (Hart, 1970); upper Cretaceous of Europe, Gulf Coast, USA, and Egypt,; middle Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M90, Amman Formation (Campanian).

Subfamily: **FRONDICULARIINAE** REUSS, 1860
Genus: **Frondicularia** DEFRANCE, 1826

Frondicularia clarki BAGG, 1895
Pl. 13, Fig. 9 a-b.

1895 *Frondicularia clarki* BAGG, p. 11.
1898 *Frondicularia clarki* BAGG. - BAGG, p. 48, pl. 3, fig. 4.
1946 *Frondicularia clarki* BAGG. - CUSHMAN, p. 92, pl. 38, figs. 1-5.
1954 *Frondicularia clarki* BAGG. - FRIZZELL, p. 98, pl. 12, figs. 21-24.
1956 *Frondicularia* sp. cf. *F. clarki* BAGG. - SAID & KENAWY, p. 136, pl. 2, fig. 37.
1968 *Frondicularia clarki* BAGG. - FUTYAN, pp. 125-126, pl. 7, fig. 12.
1994 *Frondicularia clarki* BAGG. - BOLLI et al., p. 105, figs. 27.18-19.

Description: Test free, large, broad, compressed, periphery truncate, chambers elongate, low, enlarging gradually; sutures distinct, flush, limbate, oblique, gently curved; wall calcareous, surface smooth; aperture terminal, radiate.

Distribution: *F. clarki* was originally described from the upper Cretaceous of the Atlantic highlands, New Jersey, and later recorded from the Santonian to lower Maastrichtian of Trinidad (Bolli et al., 1994), Maastrichtian of the Gulf Coast, USA and Jordan (Cushman, 1946; Futyan, 1968). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian).

Frondicularia lanceola REUSS, 1860
Pl. 13, Fig. 8 a-b.

1860 *Frondicularia lanceola* REUSS, p. 198, pl. 5, fig. 1 a-b.
1946 *Frondicularia lanceola* REUSS. - CUSHMAN, p. 85, pl. 33, figs. 1-4.
1952 *Frondicularia lanceolata* PERNER. - NAKKADY, p. 429, pl. 8, fig. 5.
1968 *Frondicularia lanceolata* PERNER. - FUTYAN, pp. 128-129, pl. 7, fs. 14-15.

1982 *Frondicularia lanceola* REUSS. - AL-HARITHI, pp. 67-68, pl. 2, figs. 4-5.

Description: Test elongate, slender, much compressed, gently tapering with the greatest breadth towards the apertural end; periphery truncate on the last chamber and distinctly lobulate for the rest of the test; chambers distinct, narrow, highly inclined, increasing gradually in size as added; sutures distinct, slightly depressed; wall smooth; aperture terminal, radiate with a neck.

Distribution: *F. lanceola* was recorded from the Coniacian to Maastrichtian of Texas, USA (Cushman, 1946); Palaeocene of Egypt (Nakkady, 1952),; Santonian to Campanian and Palaeocene of Jordan (Al-Harithi, 1982; Futyan, 1968). In the studied material, it is found in: M91, Amman Formation (Campanian).

Genus: **Tristix** MACFADYEN, 1941

Tristix coloi HAMAOUI, 1979
Pl. 13, Fig. 10 a-b.

1979 *Tristix coloi* HAMAOUI, pp. 94-96, figs. 53, 55.

Description: Test free, uniserial, peripheral outline subrounded to subangular, triangular in; sutures distinct, sinuous; wall calcareous, perforate; aperture terminal. The rare tests assigned to this species in the studied material are characterized by their long and slender shape.

Distribution: *T. coloi* was recorded from the middle and upper Cenomanian of Israel (Hamaoui, 1979). In the studied material, rare tests of *T. coloi* were found in: M86, Amman Formation (Campanian).

Tristix poignanti HAMAOUI, 1979
Pl. 13, Fig. 11 a-b.

1979 *Tristix poignanti* HAMAOUI, pp. 93-94, text-fig. 52.

Remarks: *T. poignanti* differs from *T. coloi* by having less visible sutures, more oval aperture and more sharply carinate lateral angles. The forms assigned to *T. poignanti* in the present study are also shorter than *T. coloi*.

Distribution: *T. poignanti* was recorded from the inner to outer neritic sediments of the Cenomanian of Israel (Hamaoui, 1979); lower Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M27, Fuheis Formation Equivalent (middle Cenomanian).

Family: **VAGINULINIDAE** REUSS, 1860
Subfamily: **LENTICULININAE** CHAPMAN, PARR and COLLINS, 1934
Genus: **Lenticulina** LAMARCK, 1804

Lenticulina californiensis TRUJILLO, 1960
Pl. 14, Fig. 3 a-b.

1960 *Lenticulina californiensis* TRUJILLO, p. 311, pl. 45, fig. 7.
1963 *Lenticulina californiensis* TRUJILLO. - GRAHAM & CHURCH, p. 34, pl. 3, fig. 14.
1968 *Lenticulina californiensis* TRUJILLO. - SLITER, p. 65: 7: 3.
1973 *Lenticulina californiensis* TRUJILLO. - SLITER, p. 178: 1: 4, t-fig. 6.

Description: Test free, planispiral, biumbonate, umbones flattened, wide, periphery with thin, ragged carina; chambers 10-12 in the final whorl, increasing very gradually in size; sutures distinct, strongly curved, limbate; wall calcareous, finely perforate, surface smooth; aperture at peripheral angle, radiate.

Distribution: *L. californiensis* was recorded from the Coniacian to Maastrichtian of California (Sliter, 1968, 1973). In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian), M70, 71, Ghudran Formation (Coniacian to Santonian), M87, Amman Formation (Campanian).

Lenticulina carlsbadensis SLITER, 1968
Pl. 14, Fig. 8 a-b.

1968 *Lenticulina carlsbadensis* SLITER, pp. 65-66, pl. 8, figs. 1-3.

Description: Test free, large, compressed, initial portion planispirally coiled, later stage may uncoil, periphery rounded to subrounded; chambers increasing rapidly in size, may become slightly inflated in final stage; sutures distinct, curved, limbate, usually flush but later ones may be depressed; wall calcareous, finely perforate, surface smooth; aperture at peripheral margin, radiate, with extension on apertural face.

Distribution: *L. carlsbadensis* was recorded from the middle to upper Campanian of California, USA (Sliter, 1968). In the studied material, it is found in: M89, 90, 91, Amman Formation (Campanian).

Lenticulina gaultina (BERTHELIN, 1880)
Pl. 13, Fig. 15.

1880 *Cristellaria gaultina* BERTHELIN, p. 49, pl. 3 (26), figs. 15-17.
1965 *Lenticulina gaultina* (BERTHELIN). - TAPPAN, p. 903, pl. 106, fig. 5.
1970 *Lenticulina gaultina* (BERTHELIN) f. *gaultina* (BERTH.). - HART, pl. 10, figs. 1-2.
1970 *Lenticulina gaultina* (BERTHELIN). - EICHER et al., p. 286, pl. 2, figs. 14-5, 19.

Description: Test free, large, compressed, initial portion planispirally coiled, later stage may uncoil, periphery subrounded or with peripheral edges when specimens well-preserved; chambers increasing rapidly in size, inflated in late stage; sutures distinct, curved, raised, usually flush but later ones may be depressed; wall calcareous, finely perforate, surface smooth; aperture at peripheral margin, radiate, with extension on apertural face.

Distribution: *L. gaultina* was recorded from the middle to upper Albian of England (Hart, 1970); Cenomanian of the Great Plains, USA (Eicher & Worstell, 1970). In the studied material, it is found in: M7a, 19, 21, Na'ur Formation (lower to middle Cenomanian); J35, Shueib Formation (upper Cenomanian).

Lenticulina mellahensis (NAKKADY, 1950)
Pl. 14, Fig. 4 a-b.

1950 *Robulus mellahensis* NAKKADY, p. 683, pl. 89, figs. 8-9.
1968 *Lenticulina mellahensis* (NAKKADY). - FUTYAN, p. 68, pl. 3, fig. 15.

Remarks: Test free, lenticular, planispiral, closely-coiled, keeled; sutures thick, slightly curved; aperture with a supplementary slit extending down the median line of the apertural face. *L. mellahensis* is similar in the external appearance to *L. midwayensis*, from which it differs in being smaller in size, having thicker, less curved sutures and less conspicuous umbonal boss.

Distribution: *L. mellahensis* was recorded from the Maastrichtian of Egypt and Jordan (Nakkady 1950; Futyan, 1968). In the studied material, it is found in: M91, Amman Formation (Campanian).

Lenticulina modesta (BANDY, 1951)
Pl. 14, Fig. 2 a-b.

1951 *Robulus modestus* BANDY, p. 493, pl. 72, fig. 9.
1960 *Lenticulina modesta* (BANDY). - TRUJILLO, p. 313, pl. 45, fig. 3.
1968 *Lenticulina modesta* (BANDY). - SLITER, p. 66, pl. 7, fig. 5.
1990 *Lenticulina modesta* (BANDY). - AL-BAKRI, p. 130, pl. 3, figs. 5-6.

Description: Test free, planispiral, lenticular, biumbonate, periphery acute; chambers 7-9 in the final whorl, increasing gradually in size; sutures distinct, flush, gently curved, limbate; wall calcareous, finely perforate, surface smooth; aperture at peripheral angle, radiate, with apertural extension.

Distribution: *L. modesta* was recorded from the Turonian to Campanian of California, USA (Sliter, 1968); lower to middle Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: J35, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); M47, Ghudran Formation (Coniacian to Santonian), M88, Amman Formation (Campanian), M97, Amman Formation (lower Maastrichtian).

Lenticulina muensteri (ROEMER, 1839)
Pl. 13, Fig. 14.

1839 *Robulina münsteri* ROEMER, p. 48, pl. 22, fig. 29.

1963 *Lenticulina exarata* (von HAGENOW) REUSS. - GRAHAM et al., p. 34, pl. 3, fig. 9.
1968 *Lenticulina muensteri* (ROEMER). - SLITER, p. 66, pl. 7, figs. 9, 13.
1989 *Lenticulina muensteri* (ROEMER). - HART et al., p. 350, pl. 7.18, fig. 2.

Description: Test free, biumbonate, planispiral, periphery smooth, subangular to acute, but not keeled; test involute with 8-12 chambers in the last whorl, increasing gradually in size; sutures limbate, gently curved and tangential, flush to slightly raised; large clear calcite boss, flush with surface; wall calcareous, finely perforate, surface smoothly finished; aperture radiate, usually at peripheral angle, but sometimes on a small extension.

Distribution: *L. muensteri* was recorded from the Jurassic and lower Cretaceous of England (Hart et al., 1989); Coniacian to Maastrichtian of the American Gulf Coast (Sliter, 1968). In the studied material, it is found in: M90, Amman Formation (Campanian).

Lenticulina rotulata (LAMARCK, 1804)
Pl. 13, Fig. 12 a-b.

1804 *Lenticulites rotulatus* LAMARCK, p. 188, pl. 62, fig. 11.
1968 *Lenticulina rotulata* (LAMARCK). - FUTYAN, pp. 75-76, pl. 4, figs. 9-10.
1970 *Lenticulina gaultina* (BERTHELIN) f. *rotulata* (LAMARCK). - HART, pl. 10, fig. 4.
1988 *Lenticulina rotulata* var B (LAMARCK). - JARVIS et al., text-fig. 6, 8, figs. 11 i-j.
1988 *Lenticulina rotulata* (LAMARCK). - LOEBLICH & TAPPAN, p. 405, pl. 446, figs. 1-2.
1990 *Lenticulina rotulata* (LAMARCK). - KOUTSOUKOS et al., p. III, figs. 1-2.
1990 *Lenticulina rotulata* (LAMARCK). - AL-HARITHI, p. 522, pl. 3, figs. 15-16.

Description: Test free, planispiral, lenticular, with bluntly-keeled periphery and distinct umbo; sutures slightly curved and tangential; wall calcareous, surface smoothly finished. The last portion in the adult tends to become more evolute and the central boss more conspicuous.

Distribution: *L. rotulata* was recorded from the uppermost Cenomanian of NE Brazil and southern England (Hart, 1970; Koutsoukos et al., 1990); Senonian of France (Loeblich & Tappan, 1988); upper Cretaceous of Germany, Poland, Egypt, Palestine and Japan; Santonian to Maastrichtian; Maastrichtian to Palaeocene of Jordan (Al-Harithi, 1990; Futyan, 1968). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian), M71, 74, Ghudran Formation (Coniacian to Santonian).

Lenticulina sp. 1
Pl. 14, Fig. 7.

Remarks: *L.* sp. 1 is very close to *L. mellahensis* NAKKADY in the shape, size and external appearance (Loeblich & Tappan, 1988, p. 683), from which it differs in having flush sutures and more circular and laterally compressed test.

Distribution: *L.* sp. 1 is found in the studied material in: M23, Na'ur Formation (lower to middle Cenomanian) and M32, Fuheis Formation Equivalent (middle Cenomanian).

Lenticulina spachholtzi (REUSS, 1851)
Pl. 13, Fig. 13.

1851 *Cristellaria spachholtzi* REUSS, p. 33, pl. 3, fig. 10.
1968 *Lenticulina spachholtzi* (REUSS). - SLITER, p. 67, pl. 7, fig. 6.
1973 *Lenticulina spachholtzi* (REUSS). - SLITER, p. 183, text-fig. 8.

Description: Test free, planispiral, lenticular, relatively compressed, somewhat biumbilicate, periphery subacute; chambers 7-10 in final whorl, increasing gradually in size, becoming somewhat evolute; sutures distinct, initially flush, limbate, slightly depressed; wall calcareous, finely perforate, surface smoothly finished; aperture radiate, at peripheral angle of final chamber.

Distribution: *L. spachholtzi* was recorded from the upper Cretaceous of Poland; Campanian to Maastrichtian of California, USA and British Columbia (Sliter, 1968, 1973). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian).

Lenticulina spissocostata (CUSHMAN, 1938)
Pl. 14, Fig. 1, 6 a-b.

1938b *Robulus spisso-costatus* CUSHMAN, p. 32, pl. 5, fig. 2.
1968 *Lenticulina spissocostatus* (CUSHMAN). - SLITER, pp. 67-68, pl. 7, fs. 7-8.
1968 *Lenticulina spissocostatus* (CUSHMAN). - FUTYAN p. 77, pl. 4, fig. 11.
1973 *Lenticulina spissocostatus* (CUSHMAN). - SLITER, p. 178, text-fig. 6.
1990 *Lenticulina spissocostatus* (CUSHMAN). - AL-BAKRI, p. 34, pl. 3, figs. 7-8.

Description: Test free, large, lenticular, planispiral, biumbonate, periphery subacute to carinate; chambers 9-12 in the final whorl, increasing gradually in size; sutures distinct, curved, strongly limbate, raised, becoming thickened toward umbo; wall calcareous, finely perforate, surface smooth; aperture at peripheral angle, radiate.

Distribution: *L. spissocostatus* was recorded from the Campanian to Maastrichtian of California, USA and British Columbia (Sliter, 1968, 1970),; Cenomanian and upper Coniacian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M20, 21, 23, Na'ur Formation (lower to middle Cenomanian).

Lenticulina taylorensis (PLUMMER, 1931)
Pl. 14, Fig. 5 a-b.

1931 *Astacolus taylorensis* PLUMMER, p. 143, pl. 11, fig. 16; pl. 15, figs 8-11.
1946 *Robulus taylorensis* (PLUMMER). - CUSHMAN, p. 53, pl. 18, fig. 20.
1968 *Lenticulina taylorensis* (PLUMMER). - SLITER, p. 68, pl. 7, figs. 14-15.
1973 *Lenticulina taylorensis* (PLUMMER). - SLITER, p. 183, pl. 1, figs. 5-6, text-figs. 2, 8.

Description: Test free, lenticular, planispiral, becoming slightly evolute, biumbonate, periphery subacute, with slight keel; chambers 7-9 in final whorl, increasing moderately in size, becoming slightly inflated, final chamber elongated; sutures distinct, gently curved, initially limbate, flush, later depressed; wall calcareous, finely perforate, surface smooth; aperture at peripheral angle, radiate, somewhat produced.

Distribution: *L. taylorensis* was recorded from the Campanian to Maastrichtian of California, USA and British Columbia (Sliter, 1968, 1973); Campanian of Jordan (Al-Harithi, 1982). In the studied material, it is found in: M90, Amman Formation (Campanian).

Genus: **Pravoslavlevia** PUTRYA, 1970

Pravoslavlevia pravoslavlevi (FURSENKO and POLENOVA, 1950)
Pl. 14, Fig. 9.

1950 *Saracenaria pravoslavlevi* FURSENKO and POLENOVA, p. 45
1970 *Pravoslavlevia pravoslavlevi* (FURSENKO and POLENOVA). - PUTRYA, p. 37.
1988 *Pravoslavlevia pravoslavlevi* (FURSENKO and POLENOVA). - LOEBLICH and TAPPAN, p. 407, pl. 448, figs. 4-9.

Description: Test elongate, triangular in with very broad apertural face, angles sharp to carinate, early chambers in a planispiral coil, later ones broad and low, highest at the dorsal margin; sutures gently curved; flush on sides, constricted on the apertural face and resulting in a lobulate ventral margin; wall calcareous, perforate; aperture radiate at the dorsal angle.

Distribution: *P. pravoslavlevi* is cosmopolitan and recorded from lower Jurassic to Miocene (Loeblich & Tappan, 1988). In the studied material, it is found in: M20, 21, 23, Na'ur Formation (lower to middle Cenomanian), M35, Shueib Formation Equivalent (upper Cenomanian).

Subfamily: **PALMULINAE** SAIDOVA, 1981
Genus: **Kyphopyxa** CUSHMAN, 1929

Kyphopyxa christneri (CARSEY, 1926)
Pl. 14, Fig. 10 a-b.

1926 *Frondicularia christneri* CARSEY, p. 41, pl. 6, fig. 7.

1968 *Kyphopyxa* sp. cf. *christneri* (CARSEY).- KOCH: 652: 58: 14; pl. 61: 4-5.
1971 *Kyphopyxa christneri* (CARSEY). - FLEXER, text-fig. 3.
1973 *Kyphopyxa christneri* (CARSEY). - BAYLISS: 5, 15.
1982 *Kyphopyxa christneri* (CARSEY). - AL-HARITHI, p. 66: 2: 2-4, text-fig. 9.
1986 *Kyphopyxa christneri* (CARSEY). - AL-HARITHI, p. 8: 11.
1988 *Kyphopyxa christneri* (CARSEY). - LOEBLICH & TAPPAN, p. 408: 445: 16-18.

Description: Test large, broad, flattened, palmate, thicker and biserial in early portion, later with broad, low, chevron-shaped and equitant chambers in a rectilinear uniserial series, the chambers extending far down the lateral margins of test; wall calcareous, surface smooth between the limbate and elevated sutures and carinate on each margin of truncate periphery; aperture produced on a short neck.

Distribution: *K. christneri* was recorded from Coniacian to Campanian of the Gulf Coast, USA and Venezuela (Loeblich et al., 1988); Santonian to Campanian of Israel (Reiss, 1952; Flexer, 1971); Coniacian to Maastrichtian of Palestine and Jordan (Koch, 1968; Bayliss, 1973; Al-Harithi, 1982, 1986). In the studied material, it is found in: M91, Amman Formation (Campanian).

Genus: **Neoflabellina** BARTENSTEIN, 1948

Neoflabellina kypholateris KOCH, 1968
Pl. 15, Fig. 1 a-b, 3 a-b.

1968 *Neoflabellina kypholateris* KOCH, pp. 641-643, pl. 58, fig. 15; pl. 61, fs. 2-3.
1982 *Neoflabellina kypholateris* KOCH. - AL-HARITHI, p. 67, pl. 2, figs. 4-5.

Description: Test compressed, periphery truncate; early chambers planispirally enrolled and slightly inflated, later chevron-shaped, increasing gradually as added; sutures depressed; wall smooth; aperture simple opening, terminal, produced on a slight neck. *N. kypholateris* differs from *N. suturalis* in being smaller in size and having depressed sutures.

Distribution: *N. kypholateris* was recorded from the Turonian to Campanian of Jordan (Koch, 1968; Al-Harithi, 1982). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian), M91, Amman Formation (Campanian).

Neoflabellina leptodisca (WEDEKIND, 1940)
Pl. 14, Fig. 12 a-b.

1940 *Flabellina leptodisca* WEDEKIND, p. 200, pl. 9, figs. 11-15.
1973 *Neoflabellina rugosa* (D'ORBIGNY). - SLITER, p. 169, pl. 1, fig. 12, text-fig. 2.
1985 *Neoflabellina rugosa* (D'ORBIGNY). - REISS, text-fig. 4.
1989 *Neoflabellina rugosa* (D'ORBIGNY). - ISMAIL, p. 144, pl. 5, fig. 6.
1990 *Neoflabellina rugosa* (D'ORBIGNY). - ALMOGI-LABIN et al., p. 46, t-f. 5.

1957 *Neoflabellina rugosa* (D'ORBIGNY) *leptodisca* (WEDEKIND). - HILTERMANN et al., p. 278, pl. 7, figs. 1-9; pl. 10, figs. 28-32; pl. 11, figs. 36; pl. 14, figs. 41-42.
1968 *Neoflabellina rugosa leptodisca* (WEDEKIND). - FUTYAN, p. 124, pl. 7, figs. 10-16.
1985 *Neoflabellina leptodisca* (WEDEKIND). - ROBASZYNSKI et al., p. 26, t-f. 16.

Desciption: Test free, large, palmate, compressed, periphery truncate, sides flat; chambers initially planispiral, later rectilinear, elongate, narrow, equitant; sutures distinct, elevated, acute, continuous; wall calcareous, perforate, surface between sutures papillate; aperture terminal, radiate, produced on a slight neck.

Distribution: *N. leptodisca* was recorded from the Senonian of Europe and Canada; Coniacian to Maastrichtian of California, USA (Sliter, 1968, 1973); Santonian to Campanian of Israel (Almogi-Labin et al., 1991; Reiss, 1962, 1985); Campanian of Netherlands and North Sea (Robaszynski et al., 1985; King et al., 1989); Campanian to Maastrichtian of Egypt (Andrawis, 1976; Ismail, 1989); Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M90, 91, Amman Formation (Campanian).

Neoflabellina suturalis (CUSHMAN, 1935)
Pl. 14, Fig. 11 a-b; Pl. 15, Fig. 2 a-b.

1935 *Flabellina suturalis* CUSHMAN, p. 86, pl. 13, figs. 9-18.
1990 *Palmula suturalis* (CUSHMAN). - AL-HARITHI, p. 518, pl. 3 (7-11).
1968 *Neoflabellina suturalis* (CUSHMAN). - KOCH, p. 666, pl. 61, fig. 6.
1969 *Neoflabellina suturalis* (CUSHMAN). - ANSARY & TEWFIK, p. 98, table I.
1973 *Neoflabellina suturalis* (CUSHMAN). - BAYLISS, p. 5, 15.
1985 *Neoflabellina suturalis* (CUSHMAN). - MIMRAN et al., p. 233, 235, tf. 2, 4.

Description: Test rhomboid, much compressed, periphery truncate; chambers of the early portion coiled, then chevron-shaped, increasing gradually in size; sutures very distinct and raised; wall smooth, surface polished; aperture radiate, terminal, with a slight neck.

Distribution: *N. suturalis* was recorded from the Coniacian to Maastrichtian of USA (Cushman, 1946); Santonian of Egypt (Ansary & Tewfik, 1969); Santonian to upper Campanian of Jordan, Israel and Palestine (Koch, 1968; Mimran et al.1985; Bayliss, 1973; Al-Harithi, 1990). In the studied material, it is found in: M47, 70, 74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian).

Subfamily: **MARGINULININAE** WEDEKIND, 1937
Genus: **Astacolus** MONTFORT, 1808

Astacolus liebusi BROTZEN, 1936
Pl. 15, Fig. 4 a-b, 6.

1936 *Astacolus liebusi* BROTZEN, p. 59, pl. 3, figs. 1-2.

1968 *Astacolus liebusi* BROTZEN. - SLITER, p. 55.
1973 *Astacolus* sp. BROTZEN. - SLITER, p. 181, text-fig. 7.

Description: Test free, elongate, slightly compressed, periphery broadly rounded, slightly lobulate, initial portion planispirally coiled, later uncoiling, rectilinear; chambers elongate, broadly truncate; sutures distinct, gently curved, flush to slightly depressed; wall calcareous, finely perforated, surface smoothly finished; aperture terminal, radiate.

Distribution: *A. liebusi* was recorded from the Senonian of Sweden; Campanian to Maastrichtian of California, USA (Sliter, 1968); Campanian of British Columbia (Sliter, 1973). In the studied material, it is found in: P2, Q18, Na'ur Formation (lower to middle Cenomanian); J17, Fuheis Formation (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian); P55, Ghudran Formation (Coniacian to Santonian).

Astacolus richteri (BROTZEN, 1936)
Pl. 15, Fig. 5 a-b.

1936 *Planularia richteri* BROTZEN, p. 59, pl. 3, fig. 3.
1968 *Astacolus* sp. cf. *A. richteri* (BROTZEN). - SLITER, p. 55, pl. 5, figs. 3-4.

Description: Test free, elongate, compressed, outer margin subacute, inner margin broadly truncate, slightly lobulate, initial portion in loose planispiral coil, later uncoiling; chambers elongate, narrow, increasing rapidly in length; sutures distinct, gently curved, flush; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, marginal, radiate.

Distribution: *A. richteri* was recorded from the Senonian of Sweden; Campanian to Maastrichtian of California, USA (Sliter, 1968). In the studied material, it is found in: J56, Shueib Formation (Turonian).

Astacolus sp. 1
Pl. 15, Fig. 7.

Description: Test free, elongate, slightly compressed, with umbonal thickening, periphery broadly rounded, initial portion planispirally coiled, later uncoiling; chambers elongate, broadly truncate; sutures distinct, gently curved, flush; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, radiate. *A.* sp. 1 differs from *A. liebusi* BROTZEN (Loeblich & Tappan, 1988, p. 59) in the distinctive umbonal thickening.

Distribution: *A.* sp. 1 is found in the studied material only in: M56, Shueib Formation Equivalent (Turonian).

Genus: **Vaginulinopsis** SILVESTRI, 1904

Vaginulinopsis directa (CUSHMAN, 1951)
Pl. 15, Fig. 8-9 a-b.

1937a *Marginulina austiniana* var. *directa* CUSHMAN, p. 93, pl. 13, figs. 5-8.
1954 *Marginulina directa* CUSHMAN. - FRIZZELL, p. 84, pl. 8, figs. 42-43.
1968 *Vaginulinopsis directa* (CUSHMAN). - SLITER, p. 75, pl. 9, fig. 9.
1968 *Vaginulinopsis directa* (CUSHMAN). - FUTYAN, p. 86, pl. 5, fig. 4.

Description: Test free, elongate, compressed, early coiled portion followed by rectilinear uniserial one; chambers numerous, increasing gradually in size, slightly inflated; sutures distinct, gently curved, initially flush, limbate, later depressed, limbate throughout; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, marginal, radiate.

Distribution: *V. directa* is recorded from the Coniacian to Campanian of Texas, USA (Sliter, 1968); upper Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M90, M91, Amman Formation (Campanian).

Subfamily: **VAGINULININAE** REUSS, 1860
Genus: **Citharina** D'ORBIGNY, 1839

Citharina suturalis (CUSHMAN, 1937)
Pl. 15, Fig. 10.

1937 *Vaginulina suturalis* CUSHMAN, p. 102, pl. 15, figs. 6-7.
1960 *Citharina suturalis* (CUSHMAN). - BELFORD, p. 41, pl. 11, figs. 16, 17.
1968 *Citharina suturalis* (CUSHMAN). - SLITER, p. 56, pl. 5, fig. 7.
1968 *Citharina suturalis* (CUSHMAN). - FUTYAN, p. 140, pl. 9, fig. 3.
1973 *Citharina suturalis* (CUSHMAN). - SLITER, p. 183, text-fig. 8.

Description: Test free, elongate, slender, compressed, tapering on both sides, periphery subrounded; chambers broad, low, curved; sutures distinct, slightly raised, strongly oblique; wall calcareous, finely perforate, surface costate over sutures; aperture terminal, radiate.

Distribution: *C. suturalis* was recorded from the Santonian to Maastrichtian of Arkansas, California, USA and British Columbia (Sliter, 1968, 1973); upper Cretaceous of Australia; Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M91, Amman Formation (Campanian).

Genus: **Psilocitharella** LOEBLICH and TAPPAN, 1986

Psilocitharella leptoteicha LOEBLICH and TAPPAN, 1946
Pl. 15, Fig. 11 a-b.

1946 *Vaginulina leptoteicha* LOEBLICH & TAPPAN, p. 253.
1986 *Psilocitharella leptoteicha* LOEBLICH & TAPPAN. - LOEBLICH & TAPPAN, p. 246.

1988 *Psilocitharella leptoteicha* LOEBLICH and TAPPAN. - LOEBLICH and TAPPAN, p. 413, pl. 453, figs. 8-10.

Description: Test subtriangular in outline, elongate, and strongly compressed, periphery truncate and angles carinate, globular to fusiform proloculus followed by broad and low chambers; sutures slightly elevated, gently arched; wall calcareous, perforate, surface of the flat sides smooth and unornamented; aperture round at the dorsal angle, produced on a short neck.

Distribution: *P. leptoteicha* was recorded from the Cenomanian of Texas, USA (Loeblich & Tappan, 1988). In the studied material, it is found in: M7a, M22, Na'ur Formation (lower and middle Cenomanian).

Genus: **Vaginulina** D'ORBIGNY, 1826

Vaginulina cretacea PLUMMER, 1927
Pl. 15, Fig. 14 a-b.

1927 *Vaginulina gracilis* PLUMMER v. *cretacea* PLUMMER, p. 172, pl. 2, fig. 8.
1968 *Vaginulina cretacea* PLUMMER. - FUTYAN, p. 109, pl. 6, fig. 13.
1970 *Vaginulina cretacea* PLUMMER. - EICHER & WORSTELL, p. 288, pl. 3, figs. 5-6.
1985 *Vaginulina cretacea* PLUMMER. - LÜGER, p. 85, pl. 6, fig. 10.
1989 *Vaginulina cretacea* PLUMMER. - ISMAIL, p. 145, pl. 5, fig. 8.

Description: Test elongate, moderately compressed with parallel sides, ovate in transverse, periphery broadly rounded; chambers numerous, distinct, slightly inflated and increasing gradually more in breadth than height; sutures broad and horizontal; aperture terminal, radiate.

Distribution: *V. cretacea* was reported from the lower Campanian to middle Maastrichtian of Jordan (Futyan, 1968; Al-Harithi, 1986). In the studied material, it is found in: M47, 70, Ghudran Formation (Coniacian to Santonian).

Vaginulina plummerae (CUSHMAN, 1937)
Pl. 15, Fig. 12.

1937a *Marginulina plummerae* CUSHMAN, p. 97, pl. 13, figs. 21-23.
1951 *Vaginulina plummerae* (CUSHMAN). - BANDY, p. 494, pl. 72, fig. 15.
1968 *Vaginulina plummerae* (CUSHMAN). - SLITER, pp. 74-75, pl. 9, fig 8.
1973 *Vaginulina plummerae* (CUSHMAN). - SLITER, p. 183, text-fig. 8.
1990 *Vaginulina plummerae* (CUSHMAN). - AL-BAKRI, p. 34, pl. 3, fig. 9 a-b.

Description: Test free, elongate, straight to gently arcuate, compressed; chambers numerous, initially overlapping, later inflated; sutures distinct, especially limbate in the middle portion, later depressed; wall calcareous, surface smoothly finished; aperture terminal, radiate.

Distribution: *V. plummerae* was recorded from the Campanian to Maastrichtian of Texas (Sliter, 1968, 1973); upper Coniacian of Jordan (Al-Bakri, 1990). In the studied material, few tests have been found in M47, 71, Ghudran Formation (Coniacian to Santonian).

Vaginulina recta REUSS, 1863
Pl. 15, Fig. 13 a-b.

1863 *Vaginulina recta* REUSS, p. 48, pl. 3, figs. 14-15.
1946 *Vaginulina recta* REUSS. - CUSHMAN, p. 78, pl. 28, fig. 23.
1975 *Vaginulina recta* REUSS. - BASHA, pp. 162-163, pl. 11, fig. 16.
1987 *Vaginulina recta* REUSS. - BENKHEROUF, p. 75, text-fig. 5.

Description: Test free, elongate, straight, moderately compressed, with small early proloculus followed by uniserial chambers, ovate in transverse, margins nearly parallel and rounded; 9 chambers, increasing more in breadth than height; sutures distinct, limbate, raised; wall calcareous; aperture terminal, radiate.

Distribution: *V. recta* was recorded from the Cenomanian to Santonian of many areas in the world; upper Cenomanian of Algeria (Benkherouf, 1987); Turonian of Jordan (Basha, 1975). In the studied material, it is found in: M47, 70, 71, Ghudran Formation (Coniacian to Santonian).

Vaginulina trilobata (D'ORBIGNY, 1840)
Pl. 15, Fig. 15.

1840 *Marginulina trilobata* D'ORBIGNY, p. 16, pl. 1, figs. 16-17.
1990 *Marginulina trilobata* D'ORBIGNY. - AL-HARITHI, p. 522, pl. 3 (1-3).
1968 *Vaginulina trilobata* (D'ORBIGNY). - FUTYAN, pp. 113-114, pl. 6, figs. 19-20.
1980 *Vaginulina trilobata* (D'ORBIGNY). - SCHREIBERp. 167, pl. 9, fig. 1.
1985 *Vaginulina trilobata* (D'ORBIGNY). - LÜGER, p. 86, pl. 6, figs. 11-12.
1989 *Vaginulina trilobata* (D'ORBIGNY). - ISMAIL, p. 145, pl. 6, fig. 1.

Description: Test elongate, compressed with nearly parallel sides, periphery rounded; chambers distinct, noninflated, rather uniform in size and shape; sutures distinct, limbate and thickening, slightly inclined; wall between sutures smooth; aperture terminal, radiate.

Distribution: *V. trilobata* was recorded from the upper Cretaceous of Europe, Egypt and Palestine; Santonian to middle Maastrichtian of Jordan (Fytyan, 1968; Al-Harithi, 1982, 1986, 1990). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian).

Family: **LAGENIDAE** REUSS, 1862
Genus: **Lagena** WALKER and JACOB, 1798

Lagena acuticosta REUSS, 1862
Pl. 13, Fig. 5.

1862 *Lagena acuticosta* REUSS. - REUSS, p. 305, pl. 1, fig. 4.
1956 *Lagena sulcata* (WALKER & JACOB). - SAID & KENAWY, pp. 136-37, pl. 3, fig. 6.
1989 *Lagena sulcata* (WALKER & JACOB). - ISMAIL, p. 135, pl. 3, fig. 8, text-fig. 57.
1990 *Lagena grahami* SLITER. - AL-BAKRI, p. 34, pl. 3, fig. 10, text-fig. 8.
1946 *Lagena acuticosta* REUSS. - CUSHMAN, p. 94, pl. 39, figs. 14-15.
1968 *Lagena acuticosta* REUSS. - SLITER, pp. 63-64, pl. 6, figs. 22-23.

Description: Test free, unilocular, subglobular; wall calcareous, finely perforate, surface ornamented with 11-19 longitudinal costae; aperture terminal, rounded, produced on a short tubular neck. Rare specimens may have double chambers, connected by the apertural neck.

Remarks: *L. acuticosta* differs from *L. gahami* in having the costae covering all surface of the test and not only the lower two-third, and from *L. sulcata* as the later possess costae divided on the middle portion of the test, forming a ring at the base.

Distribution: *L. acuticosta* was recorded from the Cretaceous of Netherlands; Coniacian to Maastrichtian of the American Gulf Coast (Sliter, 1968); Danian and Palaeocene of Egypt (Said & Kenawy, 1956; Ismail, 1989); lower to middle Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found only in M19, Na'ur Formation (lower to middle Cenomanian).

Lagena hexagona (WILLIAMSON) SIDDALL, 1878
Pl. 16, Fig. 2.

1848 *Lagena gracilis* WILLIAMSON, pp. 1-20.
1878 *Lagena hexagona* (WILLIAMSON) SIDDALL. - SIDDALL, pp. 42-56.
1946 *Lagena hexagona* (WILLIAMSON) SIDDALL. - CUSHMAN, p. 95, pl. 39, fig. 16.
1990 *Lagena hexagona* (WILLIAMSON) SIDDALL. - AL-BAKRI, p. 82, pl. 3, fig. 10.

Description: Test free, unilocular, globular; wall calcareous, surface network consists of hexagonal depressed areas with raised borders; aperture terminal, rounded, produced on a short neck.

Distribution: *L. hexagona* was recorded from the upper Campanian of Alabama and Maastrichtian of Tennessee (Cushman, 1946), and from lower to middle Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M23, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M37, Shueib Formation Equivalent (upper Cenomanian).

Lagena paucicosta FRANKE, 1928
Pl. 16, Fig. 1.

1928 *Lagena amphora* REUSS v. *paucicosta* FRANKE, p. 87, pl. 7, fig. 38.
1960 *Lagena amphora* REUSS v. *paucicosta* FRANKE.-BELFORD, p. 54, pl. 14, figs. 10-11.
1964 *Lagena amphora* REUSS v. *paucicosta* FRANKE. - MARTIN, p. 62, pl. 5, fig. 5.
1968 *Lagena paucicosta* FRANKE. - SLITER, p. 64, pl. 6, figs. 16-18.

Description: Test free, unilocular, pyriform; wall calcareous, finely perforate, surface ornamented with 5-8 longitudinal costae; aperture terminal, rounded, produced at the end of a short neck. It differs from *L. acuticosta* REUSS in being pyriform and having fewer costae.

Distribution: *L. paucicosta* was originally described from the upper Cretaceous of Germany, later recorded from the Coniacian to Maastrichtian of the Gulf Coast, USA (Sliter, 1968). In the studied material, it is found in: M19, 21, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian).

Family: **POLYMORPHINIDAE** D'ORBIGNY, 1839
Subfamily: **POLYMORPHININAE** D'ORBIGNY, 1839
Genus: **Eoguttulina** CUSHMAN and OZAWA, 1930

Eoguttulina anglica CUSHMAN and OZAWA, 1930
Pl. 16, Fig. 3 a-b, 7 a-b.

1930 *Eoguttulina anglica* CUSHMAN & OZAWA. - CUSHMAN & OZAWA, p. 16, pl. 1, fig. 3.
1956 *Eoguttulina anglica* CUSHMAN & OZAWA. - SAID, KENAWY, p. 137, pl. 3, fig. 14.
1988 *Eoguttulina anglica* CUSHMAN & OZAWA. - BENKHEROUF, p. 75, t-f. 5.
1988 *Eoguttulina anglica* CUSHMAN & OZAWA. - LOEBLICH, p. 418, pl. 456, figs. 27-29.

Description: Test elongate, ovate, rounded to ovate in, chambers elongate, inflated at the proximal end; sutures oblique, depressed, resulting in a lobulate margin; wall calcareous, surface smooth; aperture terminal, radiate.

Distribution: *E. anglica* was recorded from the Cenomanian of Europe, North and South America (Loeblich & Tappan, 1988); lower Cenomanian of Algeria (Benkherouf, 1987); Danian of Egypt (Said & Kenawy, 1956). In the studied material, it is found in: M8n, Na'ur Formation (lower Cenomanian) and J41, Fuheis Formation (middle Cenomanian).

Genus: **Globulina** D'ORBIGNY, 1839

Globulina lacrima REUSS, 1851
Pl. 16, Fig. 6 a-b.

1851 *Globulina lacrima* REUSS, p. 27, pl. 4, fig. 9.
1968 *Globulina lacrima* REUSS. - SLITER, p. 77, pl. 9, fig. 17; pl. 10, 1.
1970 *Globulina lacrima* REUSS. - HART, pl. 13, figs 5-9.
1973 *Globulina lacrima* REUSS. - SLITER, p. 183, text-fig. 8.
1983 *Globulina lacrima* REUSS. - BASOV et al., p. 763, pl. 6, fig. 11.
1985 *Globulina lacrima* REUSS. - ROBASZYNSKI et al., p. 26, text-fig. 16.

Description: Test subglobular, droplike in shape, tending to become elongate, semitransparent; chambers few strongly appressed, extending nearly to the base, sutures indistinct flush; wall calcareous, finely perforate, surface covered by small spines; aperture terminal, radiate.

Distribution: *G. lacrima* was recorded from the upper Cretaceous of Europe and North America; Campanian of the Atlantic Ocean and Netherlands (Basov, 1983; Robaszynski et al., 1985); Maastrichtian of the British Columbia (Sliter, 1973). In the studied material, it is found in: J36 and J44, Lower Marly, Shueib Formation (upper Cenomanian) and J56, Upper Calcareous, Shueib Formation (Turonian).

Sigmomorphina sp. 1
Pl. 16, Fig. 5 a-b.

Description: Test oval, rounded in outline, elongate, broader in the middle, much compressed laterally, oval in cross-section; chambers elongate; sutures flush, slightly depressed; wall calcareous, surface smooth; aperture terminal, radiate.

Remarks: *Sigmomrphina* sp. 1 differs from *S. trinitatensis* CUSHMAN & OZAWA (Bolli, et al., 1994, p. 337)in having much more compressed test and flush sutures.

Distribution: *Sigmomrphina trinitatensis* was recorded from the Oligocene of Trinidad (Bolli et al., 1994). *S.* sp. 1 is found in the studied material in: M8n, Na'ur Formation (lower Cenomanian) and J41, Fuheis Formation (middle Cenomanian).

Genus: **Guttulina** D'ORBIGNY, 1839

Guttulina adherens (OLSZEWSKI, 1875)
Pl. 16, Fig. 9 a-b.

1875 *Polymorphina adherens* OLSZEWSKI, p. 119, pl. 1, fig. 11.
1968 *Guttulina adherens* (OLSZEWSKI). - SLITER, p. 78, pl. 10, figs. 4, 7.
1969 *Guttulina adherens* (OLSZEWSKI). - HANZLIKOVA, p. 29, pl. 5, fig. 1.
1970 *Guttulina adherens* (OLSZEWSKI). - HART, pl. 13, fig. 12.
1986 *Guttulina adherens* (OLSZEWSKI). - AL-HARITHI, pl. 15, fig. 15.

Description: Test free, compressed, ovate in outline, tending to become elongate; chambers distinct, inflated, added in quinqueloculine series, increasing rapidly in size, the earlier ones tend to project from one side while the other side is concave; sutures distinct, slightly depressed; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, radiate.

Distribution: *G. adherens* was recorded from the Senonian of Poland; Coniacian to Maastrichtian of California, USA (Sliter, 1968); lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M7a, 8n, Na'ur Formation (lower Cenomanian), J47, Shueib Formation (upper Cenomanian).

Guttulina cuspidata CUSHMAN and OZAWA, 1930
Pl. 16, Fig. 10 a-c.

1930 *Guttulina adherens* (OLSZEWSKI) var. *cuspidata* CUSHMAN and OZAWA, p. 37, pl. 6, fig. 6.
1957 *Guttulina caudata* D'ORBIGNY. - HOFKER, pp. 166, 205.
1968 *Guttulina cuspidata* CUSHMAN & OZAWA. - SLITER, p. 78, pl. 10, fig. 5.
1970 *Guttulina adherens* (OLSZEWSKI) var. *cuspidata* CUSHMAN & OZAWA. - HART, pl. 13, figs. 13-14.

Description: Test free, compressed, flattened on one side, generally with distinct basal spine; chambers inflated, in quinqueloculine arrangement, increasing rapidly in size; sutures distinct, depressed; wall calcareous, finely perforate, surface smoothly finished; aperture terminal, radiate. *G. cuspidata* is distinguished from *G. adherens* by its smaller size, more depressed sutures, relatively thicker test, and distinct basal spine.

Distribution: *G. cuspidata* was originally described from the Cretaceous (Albian) of England; Campanian to Maastrichtian of California, USA (Sliter, 1968). In the studied material, it is found in: M7a, Na'ur Formation (lower Cenomanian); J41, Fuheis Formation (middle Cenomanian), J34, 44, Shueib Formation (upper Cenomanian), J56, Shueib Formation (Turonian).

Guttulina symploca LOEBLICH and TAPPAN, 1949
Pl. 16, Fig. 4 a-b, 8 a-b.

1949 *Guttulina symploca* LOEBLICH & TAPPAN, p. 260, pl. 50, figs. 1-2
1975 *Guttulina symploca* LOEBLICH & TAPPAN. - BASHA, pp. 163-64, pl. 11, figs. 17-18.

Description: Test elongate, fusiform, inflated at the middle, ovate to subcircular in; 4 elongated chambers in the outer coil, inflated at the proximal end, nearly overlapping; sutures distinct, oblique, depressed, resulting in a lobulate margin; wall calcareous, finely perforate, surface smooth; aperture terminal, radiate.

Distribution: *G. symploca* was recorded from the Albian of Texas and Oklahoma, USA (Loeblich & Tappan, 1949); lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, 23, Na'ur Formation (lower to middle Cenomanian); J25, 41, Fuheis Formation (middle Cenomanian).

Genus: **Polymorphina** D'ORBIGNY, 1826

Polymorphina zeuschneri REUSS, 1867
Pl. 16, Fig. 11 a-b.

1867 *Polymorphina zeuschneri* REUSS, p. 90.
1975 *Polymorphina zeuschneri* REUSS. - BASHA, p. 165, pl. 11, fig. 20.

Description: Test free, ovate, slightly compressed, twisted, rounded in outline; chambers 5-6, biserial, increasing gradually in size; sutures distinct, depressed, oblique; wall calcareous, surface smoothly finished; aperture terminal, radiate.

Distribution: *P. zeuschneri* was recorded from the Miocene of Poland; Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M7a, 8n, Na'ur Formation (lower Cenomanian) and J41, 25, Fuheis Formation (middle Cenomanian).

Genus: **Pseudopolymorphina** CUSHMAN and OZAWA, 1928

Pseudopolymorphina eichenbergi TEN DAM, 1948
Pl. 16, Fig. 12 a-b.

1948 *Pseudopolymorphina eichenbergi* TEN DAM, p. 186, pl. 32, fig. 22.
1975 *Pseudopolymorphina eichenbergi* TEN DAM. - BASHA, p. 164, pl. 11, f. 19.

Description: Test free, ovate, compressed, lobulate, rounded in outline; early portion rounded obscure, followed by inflated chambers, arranged biserially, the last one constituting about half of the test; wall calcareous, perforate, surface smoothly finished; aperture terminal, radiate.

Distribution: *P. eichenbergi* was recorded from the Hauterivian of Netherlands; lower Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: M8n, Na'ur Formation (lower Cenomanian), J25, Fuheis Formation (middle Cenomanian), J34, Shueib Formation (upper Cenomanian).

Pseudopolymorphina sp. 1
Pl. 16, Fig. 13 a-b.

Description: Test free, ovate, rounded in outline, subcircular in, early portion rounded obscure, followed by inflated chambers, arranged biserially, the last one constituting about one-half the test; wall calcareous, perforate, surface smoothly finished; aperture terminal, radiate. *P.* sp. 1 differs from *P. eichenbergi* in being larger in size and subcircular in.

Distribution: *P.* sp. 1 is found in the studied material in: M8n, Na'ur Formation (lower Cenomanian) and J25, Fuheis Formation (middle Cenomanian).

Subfamily: **RAMULININAE** BRADY, 1884
Genus: **Ramulina** T. R. JONES, 1875

Ramulina globulifera BRADY, 1884
Pl. 17, Fig. 1.

1884 *Ramulina globulifera* BRADY, p. 587, pl. 76, figs. 22-28.
1943 *Ramulina globulifera* BRADY. - TAPPAN, p. 406, pl. 81, figs. 8-9.
1968 *Ramulina* sp. cf. *globulifera* BRADY. - FUTYAN, p. 145, pl. 8, fig. 11.
1970 *Ramulina globulifera* BRADY. - EICHER & WORSTELL, p. 289, pl. 3, fig. 23.

Remarks: Most of the specimens encountered consist only of irregularly branching and bifurcating tubular chambers, but varying in arrangement. Some have a slightly inflated central area, with 4 tubular projections, others having more inflated branches at the ends than at the central area; walls generally smooth, but occasionally hispid.

Distribution: *R. globulifera* was recorded from the Cenomanian and Turonian of Great Plains, USA (Eicher & Worstell, 1970); Palaeocene of Jordan (Futyan, 1968). In the studied material, it is found in: J25, Fuheis Formation (middle Cenomanian), J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Family: **ELLIPSOLAGENIDAE** A. SILVESTRI, 1923
Subfamily: **OOLININAE** LOEBLICH and TAPPAN, 1961
Genus: **Oolina** D'ORBIGNY, 1839

Oolina globosa (MONTAGU, 1803)
Pl. 17, Fig. 2-3.

1803 *Vermiculum globosum* MONTAGU, p. 523.
1953 *Lagena globosa* (MONTAGU). - HAGN, p. 68, pl. 2, fig. 30.
1968 *Oolina globulosa* (MONTAGU). - SLITER, pp. 80-81, pl. 10, fig. 14.
1973 *Oolina globulosa* (MONTAGU). - SLITER, pp. 178, 181-183, text-figs. 6-8.
1986 *Lagena globosa* (MONTAGU). - BARTENSTEIN & BOLLI, p. 960, pl. 3, figs. 46-48.
1994 *Oolina globosa* (MONTAGU). - BOLLI et al., pp. 178, 181-183, t-figs. 6-8.

Description: Test free, unilocular, large, subglobular; wall calcareous, finely perforate, radial in structure, surface smoothly finished; aperture terminal and radiate.

Distribution: *O. globulosa* was recorded from the Recent of England; upper Cretaceous of Poland, upper Campanian to Maastrichtian of California, USA (Sliter, 1968), Turonian to upper Palaeocene and upper Aptian to lower Albian of Trinidad (Bolli et al., 19094), and Santonian to Maastrichtian of the British Columbia (Sliter, 1973). In the studied material, it is found in: M25, Fuheis Formation Equivalent (middle Cenomanian), M35, M39, Shueib Formation Equivalent (upper Cenomanian), M96, 99, Amman Formation (lower Maastrichtian).

Genus: **Pristinosceptrella** PATTERSON and RICHARDSON, 1987

***Pristinosceptrella* sp.**
Pl. 17, Fig. 4.

Description: Test unilocular, globular, circular in; wall calcareous, translucent, perforate, surface pustulose; aperture round to radiate at the end of a distinct and relatively narrow and elongate neck.

Remarks: *Pristinosceptrella* differs from *Oolina* in the distinct neck and hispid surface, from *Pseudoolina* in the round rather than fissurine aperture, and from *Lagenosolenia* in being globular rather than compressed. *P.* sp. differs from *P. hispida* PATERSON & RICHARDSON of Quaternary (Loeblich & Tappan, 1988, p. 427) in having a pustulose surface rather than smooth and a round neck rather than polygonal.

Distribution: *P.* sp. is found in the studied material in: M22, Na'ur Formation (lower to middle Cenomanian), M37, 41, Shueib Formation Equivalent (upper Cenomanian).

Subfamily: **ELLIPSOLAGENINAE** A. SILVESTRI, 1923, 1923
Genus: **Fissurina** REUSS, 1850

Fissurina alveolata (BRADY, 1870)
Pl. 17, Fig. 7 a-c.

1870 *Lagena alveolata* BRADY, p. 283.
1946 *Lagena alveolata* BRADY. - CUSHMAN, p. 95, pl. 40, fig. 2.

Description: Test small, rounded to ovate in outline, oval to lenticular in, periphery with a very strongly developed keel on the basal portion of the test, where it splits, leaving an elongate depression in the median line between the two plate-like portions of the keel.

Distribution: *L. alveolata* was recorded from the upper Campanian to Maastrichtian of Texas, USA (Cushman, 1946). In the studied material, it is found in: M96, 97, 100, 103, Amman Formation (lower Maastrichtian).

Fissurina laevigata REUSS, 1850
Pl. 17, Fig. 6.

1850 *Fissurina laevigata* REUSS, p. 366, pl. 6, fig. 1.
1946 *Lagena laevigata* (REUSS). - CUSHMAN, p. 95, pl. 40, fig. 1.
1964 *Fissurina laevigata* REUSS. - LOEBLICH and TAPPAN, p. C541.
1988 *Fissurina laevigata* REUSS. - LOEBLICH & TAPPAN, p. 428, pl. 465, figs. 8-9.
1994 *Fissurina laevigata* REUSS. - BOLLI et al., p. 126, pl. 34, figs. 9-10.

Description: Test somewhat compressed, pyriform in front view, rounded to ovate in outline, oval to lenticular in, periphery with one or more keel; wall calcareous, finely perforate, surface smooth, with random punctae; aperture terminal ovate to slit-like within a slightly depressed fissure at the test apex.

Distribution: *F. laevigata* was recorded from the Campanian to Maastrichtian of Texas, USA (Cushman, 1946) and upper Maastrichtian to lower Eocene of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M19, 20, 21, Na'ur Formation (lower to middle Cenomanian), M33, 35, 37, 39, Shueib Formation Equivalent (upper Cenomanian), M47, 74, Ghudran Formation (Coniacian to Santonian), M87, Amman Formation (Campanian).

Fissurina oblonga REUSS, 1863
Pl. 17, Fig. 5 a-b.

1863 *Fissurina oblonga* REUSS, p. 339, pl. 7, fig. 89.
1968 *Fissurina oblonga* REUSS. - SLITER, p. 82, pl. 10, figs. 18-19.

Description: Test free, ovate, compressed, periphery subrounded to subacute; apertural end elongated; wall calcareous, finely perforate, surface smooth; aperture terminal, ovate. Distinguished by its elongate tapering form.

Distribution: *F. oblonga* was recorded from the Campanian of California, USA (Sliter, 1968). In the studied material, it is found in: M21, 22, Na'ur Formation (lower to middle Cenomanian), M38, Shueib Formation Equivalent (upper Cenomanian), M74, Ghudran Formation (Coniacian to Santonian), M97 Amman Formation (lower Maastrichtian).

Superfamily: **CERATOBULIMINACEA** CUSHMAN, 1927
Family: **CERATOBULIMINIDAE** CUSHMAN, 1927
Subfamily: **CERATOBULIMININAE** CUSHMAN, 1927
Genus: **Ceratobulimina** TOULA, 1915

Ceratobulimina cretacea CUSHMAN and HARRIS, 1927
Pl. 17, Fig. 8 a-b.

1927 *Ceratobulimina cretacea* CUSHMAN & HARRIS, p. 173, pl. 29, fig. 1.
1960 *Ceratobulimina cretacea* CUSHMAN & HARRIS. - TRUJILLO, p. 338, pl. 49, fig. 2
1964 *Ceratobulimina cretacea* CUSHMAN & HARRIS. - McGUGAN, p. 947, pl. 152, fig. 5.
1968 *Ceratobulimina cretacea* CUSHMAN & HARRIS. - SLITER, pp. 127-128, pl. 24, fig. 8.
1973 *Ceratobulimina cretacea* CUSHMAN & HARRIS. - SLITER, p. 6, pls. 12-14, text-fig. 2.

Description: Test free, trochospiral, axial periphery broadly rounded, spiral side slightly convex, opposite side deeply umbilicate; chambers about 7, increasing rapidly in size, ultimate chamber commonly inflated; sutures distinct, curved, slightly depressed; wall calcareous, finely perforate; surface smooth and polished; aperture an umbilical, arched opening in the final chamber with apertural lip.

Distribution: *C. cretacea* was recorded from the upper Campanian to Maastrichtian of Texas, USA (Sliter, 1968, 1973). In the studied material, it is found in: M97, Amman Formation (lower Maastrichtian).

Genus: **Ceratolamarckina** TROELSEN, 1954

Ceratolamarckina parva (EICHER and WORSTELL, 1970)
Pl. 17, Fig. 9 a-b.

1970 *Ceratobulimina ? parva* EICHER & WORSTELL, p. 295, pl. 7, figs. 3, 5.

Description: Test small, low trochospiral coil, biconvex, periphery rounded, a boss filling the umbilicus; 7-8 inflated chambers, higher than wide on spiral side, about equidimensional and slightly inflated on umbilical side; sutures essentially flush and slightly curved on spiral side, straight and slightly depressed on umbilical side; wall calcareous, surface smooth; aperture a large arch at the base of final chamber.

Distribution: *C. parva* was recorded from the Turonian of the Great Plains, USA (Eicher & Worstell, 1970). In the studied material, it is found in: M101, 104, 108, 109, Amman Formation (lower Maastrichtian).

Superfamily: **CONORBOIDACEA** THALMANN, 1952
Family: **CONORBOIDIDAE** THALMANN, 1952
Genus: **Conorboides** HOFKER, 1952

Conorboides beadnelli (SAID and BARAKAT, 1957)
Pl. 18, Fig. 3 a-c.

1957 *Discorbis beadnelli* SAID & BARAKAT, p. 44, pl. 1, fig. 21.
1989a *Discorbis beadnelli* SAID and BARAKAT. - CHERIF et al., pl. 2, fig. 18.
1990 *Discorbis beadnelli* SAID & BARAKAT. - AL-BAKRI, p. 13, pl. 3, figs. 11-13.

Remarks: The form, described by Said and Barakat (1957) as *Discorbis beadnelli*, does not have the distinct apertural flaps around the umbilicus which characterize this genus. Furthermore, the Discorbinidae only appeared since the middle Eocene. The specimens encountered in this study seem to fit reasonably the diagnosis of the genus *Conorboides*. This species is characterized in having a very low trochospire to nearly flat, 5 chambers in the last whorl; sutures depressed spirally as well as ventrally.

Distribution: The genus *Conorboides* HOFKER was erected for forms found in the Albian of North America. *"Discorbis" beadnelli* was recorded from the early Cretaceous (Said and Barakat), Cenomanian and Turonian of Egypt (Cherif et al., 1989) and also from the upper Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, this species is common in Q18, M16, 19, Na'ur Formation (lower to middle Cenomanian); M25, P41, J25, Fuheis Formation (middle Cenomanian); M33, J34, 35, 36, 39, Shueib Formation (upper Cenomanian); P55, Q43, Ghudran Formation (Coniacian to Santonian).

Conorboides hofkeri (BARTENSTEIN and BRAND, 1951)
Pl. 18, Figs. 4 a-c, 6.

1951 *Conorbis hofkeri* BARTENSTEIN & BRAND, p. 325.
1968 *Conorboides* sp. 1, aff. *hofkeri* (BARTENSTEIN & BRAND). - KOCH, p. 630.
1975 *Conorboides hofkeri* (BARTENSTEIN & BRAND). - BASHA, p. 204, pl. 14, figs. 29-31.
1979 *Conorboides hofkeri* (BARTENSTEIN and BRAND). - BASHA, pp. 60-61.

Description: Test small, low trochospiral; dorsally convex and inflated showing a small proloculus, two whorls, ventrally umbilicate, concave and conical; periphery acute, chambers visible dorsally, last five are seen ventrally; dorsal sutures limbate and oblique, depressed on both sides; wall calcareous; aperture ventral, interiomarginal, umbilical arc with thin flap.

Distribution: *C. hofkeri* was recorded from the lower Cretaceous of Germany; Cenomanian of Jordan (Koch, 1968; Basha, 1975, 1979). In the studied material, it is found in: M21, 22, P26, Q18, 20, Na'ur Formation (lower to middle Cenomanian); M25, Fuheis Formation Equivalent (middle Cenomanian); M37, 57, J34, 36, 39, Shueib Formation (upper Cenomanian); Q43, Ghudran Formation (Coniacian to Santonian).

Conorboides mitra (HOFKER, 1951)
Pl. 18, Fig. 1 a-b.

1951 *Conorbis mitra* HOFKER. - HOFKER, p. 357.
1988 *Conorboides mitra* (HOFKER). - LOEBLICH & TAPPAN, p. 448, pl. 480, figs. 1-4.

Description: Test conical, trochoid throughout; ventral side flat; early chambers spirally arranged, later chambers longer and tend to become more than two chambers in a coil; walls opaque, yellowish; ventral sutures show a distinct indentation at the aperture, which is an open slit at the ventral umbilical suture.

Distribution: *C. mitra* was recorded from the Albian of Netherlands (Loeblich & Tappan, 1988). In the studied material, it is found in: Q18, M20, Na'ur Formation (lower to middle Cenomanian); M25, P41, Q27, Fuheis Formation Equivalent (middle Cenomanian); J34, 39, Shueib Formation (upper Cenomanian); P55, Ghudran Formation (Coniacian to Santonian).

Conorboides sp. 1
Pl. 18, Fig. 5.

Description: Test low to moderately high trochospiral, planoconvex and umbilicate; chambers low, very compressed and crescentic; sutures strongly oblique on spiral side, on umbilical side sutures radial and strongly overlapping earlier chambers, final chamber nearly hemispherical; wall calcareous, finely perforate, surface smooth; aperture low interiomarginal umbilicate slit, partially covered by broad short flap.

Distribution: *C.* sp. 1 is found in the studied material only in: M23, Na'ur Formation (lower to middle Cenomanian).

Conorboides sp. 2
Pl. 18, Fig. 7 a-b.

Description: Test free, trochoid, plano to concavoconvex, low-spired, ventrally umbilicate, periphery rounded, lobulate; chambers semilunate dorsally, commonly 6 in the final whorl; sutures depressed, oblique and limbate dorsally, ventrally depressed and radial; wall calcareous, surface smooth; aperture ventral, low arch with narrow apertural flap. Differs from *C. umiatensis* in having a lobulate periphery, more chambers in the last whorl, and depressed, oblique and limbate spiral sutures.

Distribution: *C.* sp. 2 is found in the studied material in: M32, Fuheis Formation Equivalent (middle Cenomanian), M37, 57, 61, Shueib Formation Equivalent (upper Cenomanian), M64, 66, 68, Wadi Sir Formation (Turonian).

Conorboides umiatensis (TAPPAN, 1957)
Pl. 18, Figs. 2 a-b, 8.

1957 *Nanushukella umiatensis* TAPPAN, pp. 218-219, pl 69. figs. 1-10.
1988 *Conorboides umiatensis* (TAPPAN). - LOEBLICH & TAPPAN, p. 448, pl. 480, figs. 5-9.
1990 *Conorboides umiatensis* (TAPPAN). - AL-BAKRI, p. 35, pl. 3, fig. 14.

Description: Test free, trochoid, planoconvex, low-spired, ventrally umbilicate, periphery rounded; chambers semilunate dorsally, commonly 4 in the final volution, last chamber equals one third of ventral side; sutures distinct, flush dorsally, oblique and somewhat limbate, ventrally depressed and radial; wall calcareous, surface smooth; aperture ventral, low arch with narrow apertural flap. *C. umiatensis* differs from *C. beadnelli* in having more flush sutures.

Distribution: *C. umiatensis* was recorded from the Albian of Alaska, USA (Tappan, 1957); lower to middle Cenomanian of Jordan (Al-Bakri, 1990). In the studied material, this is the most frequent *Conorboides* of Na'ur Formation, it is found in: M16, 22, 23, P26, Q18, 20, Na'ur Formation (lower to middle Cenomanian); M37, J34, 36, 39, Shueib Formation (upper Cenomanian).

4.4 PLANKTONIC FORAMINIFERA

4.4.1 Suborder: **GLOBIGERININA** DELAGE and HÉROUARD, 1896

Superfamily: **HETEROHELICACEA** CUSHMAN, 1927
Family: **GUEMBELITRIIDAE** MONTANARO GALLITELLI, 1957

Genus: **Guembelitria** CUSHMAN, 1933

Guembelitria cenomana (KELLER, 1935)
Pl. 18, Figs. 9-12.

1935 *Guembelina cenomana* KELLER, p. 547, pl. 3, figs. 13-14.
1975 *Guembelitria cenomana* (KELLER). - HELLER, pl. 1, fig. 15.
1977 *Guembelitria cenomana* (KELLER). - MASTERS, p. 326, pl. 27, figs. 1, 3, table 5.
1980 *Guembelitria cenomana* (KELLER). - PERYT, pp. 32-33, pl. 1, figs. 2-6.
1985 *Guembelitria cenomana* (KELLER). - CARON, p. 57, pl. 24 (3-4).
1988 *Guembelitria cenomana* (KELLER). - JARVIS et al., p. 151, text-fig. 2.

Description: Test free, small, triserial, elongate, tapering throughout; chambers inflated, subspherical; sutures depressed; wall calcareous, mesoperforate, smooth and surface decorated with pore mounds; aperture a low arch at the base of final chamber, with slight lip. *G. cenomana* differs from *G. cretacea* in its low apertural arch and the stratigraphic occurrence.

Distribution: *G. cenomana* was recorded from the Albian to Cenomanian of Russia (Caron, 1985); upper Cenomanian and Maastrichtian of USA (Smith and Pessagno, 1973; Masters, 1977); upper Cenomanian of England (Jarvis et al., 1988); Albian to Cenomanian and Maastrichtian of Poland (Peryt, 1980). In the studied material, it is found in: M7a, 22, 23, Q20, 22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); J51a, M37, 40, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian); P60, Amman Formation (lower Maastrichtian).

Family: **HETEROHELICIDAE** CUSHMAN, 1927
Subfamily: **HETEROHELICINAE** CUSHMAN, 1927
Genus: **Heterohelix** EHRENBERG, 1843

Heterohelix calabarflanki ODÉBÒDÉ, 1982
Pl. 19, Fig. 12 a-b.

1982 *Heterohelix calabarflanki* ODÉBÒDÉ, p. 238, pl. I, figs. 1-5.

Description: Test small, biserial, strongly compressed, expanding rapidly, maximum breadth at last pair of chambers, median line zigzag, periphery lobate throughout; chambers 5-7 pairs, initially small, moderately compressed, subsequently fairly large, strongly compressed, final chamber large, ovoid; sutures deeply depressed, slightly curved; wall calcareous, perforate, surface striated; aperture a tiny lunate, low interiomarginal opening on the final chamber.

Distribution: *H. calabarflanki* was recorded from the Coniacian to Maastrichtian of Nigeria (Olaniyi, 1982). In the studied material, it is found in: J34, M38, 39, 41, Shueib Formation Equivalent (upper Cenomanian); M47, Ghudran Formation (Coniacian to Santonian).

Heterohelix dentata STENESTAD, 1968
Pl. 19, Fig. 9 a-b.

1968 *Heterohelix dentata* STENESTAD, pp. 67-68, pl. 1, figs. 3-6, 8,9; pl. 2, figs. 1-3.
1969 *Heterohelix dentata* STENESTAD. - STENESTAD, p. 658, pl. I, figs. 9, 9a, 9b, 10, 14; pl. III, figs. 4, 4 a-b; text-fig. 12 a-c.
1977 *Pseudoguembelina dentata* STENESTAD. - MASTERS, p. 323, table 2.
1989 *Heterohelix dentata* STENESTAD. - NEDERBRAGT, p. 194, pl. 1, figs. 4-7.

Description: Test biserial, broad, compressed, with low, compressed chambers, adult chambers nearly reniform; with an initial tiny coil; periphery acute to subacute, normally slightly keeled or moderately idented; chambers elongate in the side view, straight to reniform; sutures slightly depressed, flush or slightly limbate; wall finely perforate, smooth; aperture high arch, bordered by distinct flanges.

Remarks: *H. dentata* differs from *H. glabrans* in its more reniform chambers, broadly rounded and never subacute margin, and from *H. pulchra* in its less compressed test, more acute periphery and smaller apertural flanges.

Distribution: *H. dentata* was recorded from the Maastrichtian of NW Atlantic, where it is thought to have been tolerant to cold waters (Nedrbragt, 1989). In the studied material, it is found in: M47, 74, Ghudran Formation (Coniacian to Santonian), M86, Amman Formation (Campanian).

Heterohelix glabrans (CUSHMAN, 1938a)
Pl. 19, Fig. 8 a-b.

1938a *Gümbelina glabrans* CUSHMAN, p. 15, pl. 3, figs. 1-2.
1968 *Heterohelix glabrans* (CUSHMAN). - SLITER, p. 94, pl. 13, fig. 17.
1978 *Heterohelix glabrans* (CUSHMAN). - YASSINI, p. 22, pl. 1, figs. 14-15.
1983 *Heterohelix glabrans* (CUSHMAN). - KRASHENINNIKOV et al., p. 807, pl.1 2, figs. 9-10.
1984 *Heterohelix glabrans* (CUSHMAN). - WEIDICH, p. 77, pl. 1, figs 7, 11.
1986 *Heterohelix glabrans* (CUSHMAN). - AL-HARITHI, pl. 7, figs. 1-2, text-figs. 12, 14.
1989 *Heterohelix glabrans* (CUSHMAN). - NEDERBRAGT, p. 194, pl. 2, fs. 1-2.

Description: Test free, slightly compressed, biserially arranged chambers gradually enlarging in size as added, periphery subacute, slightly lobulate; chambers subrectangular, 5-7 pairs; sutures distinct, depressed, slightly curved; wall calcareous, mesoperforate, surface smooth, polished, with striae, last chamber with mounds; aperture a broad, low arch at inner margin of final chamber, with small lip and lateral flanges extending onto previous chamber.

Remarks: *H. glabrans* resembles *H. globulosa*, but differs in the subacute periphery, subrectangular chambers, and polished surface. The former is thought to be tolerant to colder waters (Nederbragt, 1989).

Distribution: *H. glabrans* was recorded from the upper Campanian of DSDP (Sliter, 1977); Coniacian of Germany (Weidich, 1984); lower Maastrichtian of the Mediterranean region and NW Atlantic (Weiss, 1983; Nederbragt, 1989); Campanian to Maastrichtian of Jordan (Yassini, 1978; Al-Harithi, 1986). In the studied material, it is found in: M86, 89, 90, 91, Amman Formation (Campanian).

Heterohelix globocarinata (CUSHMAN, 1938)
Pl. 19, Fig. 10 a-b.

1938 *Gümbelina globocarinata* CUSHMAN, pp. 10-11, pl. 2, figs. 4-5.
1967 *Heterohelix globocarinata* (CUSHMAN). - PESSAGNO, pp. 259-260, pl. 86, figs, 5-6.
1969 *Heterohelix* sp. cf. *H. globocarinata* (CUSHMAN). - DOUGLAS, pp. 157-58, pl. 11, fig. 5.
1986 *Heterohelix globocarinata* (CUSHMAN). - AL-HARITHI, p. 7, pls. 3, 4, 6; text-fig. 12.

Description: Test biserial, about one and a half times as long as broad, greatest width at last pair of chambers, periphery slightly indented, early portion gradually tapering; chambers initially compressed, later inflated, last pair greatly enlarged; sutures depressed, limbate; wall calcareous, perforate, surface with very fine longitudinal striations; aperture a low arch on the inner margin of last chamber.

Distribution: *H. globocarinata* was recorded from Coniacian to Campanian of California, USA (Douglas, 1969); lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian), M98, Amman Formation (lower Maastrichtian).

Heterohelix globulosa (EHRENBERG, 1840)
Pl. 18, Fig. 13 a-b; Pl. 19, Fig. 2 a-b, 3; Pl. 20, Fig. 10 a-b.

1840 *Textularia globulosa* EHRENBERG, p. 135, pl. 4, figs. 2, 4-5, 7-8.
1971 *Heterohelix globulosa* (EHRENBERG). - MORRIS, p. 280, pl. 7, fig. 3.
1973 *Heterohelix globulosa* (EHRENBERG). - BAYLISS, pl. 3, fig.. 6.
1976 *Heterohelix globulosa* (EHRENBERG). - ANDRAWIS, pp. 15-16, 34, pl. II, fig. 6.
1979 *Heterohelix globulosa* (EHRENBERG). - BASHA, p. 61, 63, pl. 1, fig. 12.
1980 *Heterohelix globulosa* (EHRENBERG). - PERYT, p. 35, pl. 2, figs. 11-12; pl. 5, figs. 5-7; pl. 7, fig. 12.
1983 *Heterohelix globulosa* (EHREN.). - KRASHENINNIKOV et al., p. 807, pl. 12, figs. 13-15.
1984 *Heterohelix globulosa* (EHRENBERG). - WEIDICH, p. 77, pl. 1, figs. 1-3.
1985 *Heterohelix globulosa* (EHRENBERG). - CARON, p. 60, pl. 24 (5).
1990 *Heterohelix globulosa* (EHRENBERG). - AL-BAKRI, p. 131, pl. 3, fig. 15; pl. 4, fig. 3.

Description: Test free, biserial throughout, with to 5-7 pairs of globular chambers increasing gradually in size, late chambers increase more rapidly; wall calcareous, mesoperforate, surface smooth, sometimes with faint costae; aperture a broad low arch with slight lip. *H. globulosa* differs from *H. striata* in being smaller, more slowly tapering and with globular chambers.

Distribution: *H. globulosa* was recorded from the Cenomanian to Turonian and Santonian to Maastrichtian of USA (Eicher, 1969; Sliter, 1968); Albian to Maastrichtian of the Gulf Coast, western interior, Alaska and East Coast, USA, and Europe (Morris, 1971); Cenomanian to Maastrichtian of Canada and Nigeria (Masters, 1977; Peryt, 1980; Olaniyi, 1982); Cenomanian to Turonian and Coniacian of Germany (Weidich, 1984); lower Turonian and Maastrichtian of Egypt (Andrawis, 1976; Ismail, 1989); Turonian to Maastrichtian of North Atlantic and Poland (Dobson et al., 1976); Coniacian to lower Maastrichtian of Libya (Barr, 1972); lower to upper Campanian of Europe, Mediterranean region and Atlantic (Weiss, 1983); Campanian to lower Maastrichtian (lower part of the *Globotruncana aegyptiaca* zone, sensu Caron, 1985); Turonian to Santonian of Palestine (Bayliss, 1973); Turonian to Maastrichtian of Jordan (Koch, 1968; Basha, 1975, 1979; Al-Harithi, 1986).

In the studied material, it is found in: M20, 21, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, 32, Fuheis Formation Equivalent (middle Cenomanian); M33, 35, 37, 38, 39, 41, J51a, Shueib Formation Equivalent (upper Cenomanian); J58, Wadi Sir Formation (Turonian); M71, Ghudran Formation (Coniacian to Santonian), M88, 89, 90 (Campanian), M98, 100, Amman Formation (lower Maastrichtian).

Heterohelix moremani (CUSHMAN, 1938)

Pl. 18, Fig. 14 a-b; Pl. 19, Fig. 4; Pl. 20, Fig. 12 a-b.

1938 *Guembelina moremani* CUSHMAN, p. 10: 2: 1-3.
1975 *Heterohelix moremani* (CUSHMAN). - BASHA, pp. 211-212, pl. 15, fig. 8.
1982 *Heterohelix moremani* (CUSHMAN). - ODÉBÒDÉ, pp. 239-240, pl. I, fig. 12.
1985 *Heterohelix moremani* (CUSHMAN). - CARON, p. 60, pl. 24 (6-7).
1986 *Heterohelix moremani* (CUSHMAN). - AL-HARITHI, p. 8, pl. 4, text-figs. 12, 14.
1987 *Heterohelix moremani* (CUSHMAN). - BENKHEROUF, p. 73, text-fig. 4.
1989 *Heterohelix moremani* (CUSHMAN). - ISMAIL, p. 147, pl. 8, fig. 2.
1989 *Heterohelix moremani* (CUSHMAN). - HART, p. 346, pl. 7.16, fig. 9.
1990 *Heterohelix moremani* (CUSHMAN). - AL-BAKRI, p. 133, pl. 4, figs. 1-2.

Desription: Test free, biserial, with slender aspect gradually tapering; surface smooth; chambers spherical, slightly laterally flattened, increasing moderately in size as added; 6-9 pairs of chambers; sutures depressed; aperture low to moderately high interiomarginal arch, bordered by narrow imperforate lip. *H. moremani* is distinguished by its slender-shaped test with 6-9 pairs of globular chambers that increase moderately in size.

Distribution: *H. moremani* was recorded from the upper Albian to middle Turonian (Caron, 1985); middle Albian to upper Cenomanian of England and Algeria (Hart, 1989; Benkherouf, 1987); middle Albian to Maastrichtian (Masters, 1977);

Cenomanian to lower Santonian (Bandy, 1967; Darmoian, 1975); Turonian to Coniacian of Germany (Weidich, 1984); lower Campanian to Maastrichtian of Egypt and Jordan (El Naggar & Ashour, 1983; Al-Harithi, 1986) and also from the upper Cenomanian of Jordan (Al-Bakri, 1990).

In the studied material, a very large number of tests belonging to the species was found in M21, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, 32, Fuheis Formation Equivalent (middle Cenomanian); M33, 37, 39, 40, 41 and J51a, Shueib Formation (upper Cenomanian).

Heterohelix nkporoensis ODÉBÒDÉ, 1982
Pl. 19, Fig. 13 a-b.

1982 *Heterohelix nkporoensis* ODÉBÒDÉ, p. 240, pl. II, figs. 2-5.
1986 *Heterohelix nkporoensis* ODÉBÒDÉ. - AL-HARITHI, p. 42, pl. 14, fig. 7.

Description: Test small, biserial, expanding moderately except at the top, median line zigzag, periphery lobate; chambers 6-9 pairs, initialy small, subglobular, later increasingly inflated, final chamber globose, highly inflated, constituting one-third to one-half the test size; sutures curved, depressed, inclined all through length of test; wall calcareous, perforate, surface striated; aperture a small oval interiomarginal opening on final chamber.

Distribution: *H. nkporoensis* was recorded from the Coniacian to Maastrichtian of Nigeria (Olaniyi, 1982); Campanian to lower Maastrichtian of Jordan (Al-Hatithi, 1986). In the studied material, it is found in: J58, Wadi Sir Formation (Turonian); M70, Ghudran Formation (Coniacian to Santonian), M89, 90 (Campanian); P60, Amman Formation (lower Maastrichtian).

Heterohelix pseudotessera (CUSHMAN, 1938)
Pl. 19, Fig. 7 a-b.

1938 *Gümbelina pseudotessera* CUSHMAN, p. 14, pl. 2, figs. 19-21.
1972 *Heterohelix pseudotessera* (CUSHMAN). - BARR, text-fig. 2.
1977 *Heterohelix pseudotessera* (CUSHMAN). - MASTERS, p. 323, pl. 1, fig. 11, table. 2.
1983 *Heterohelix pseudotessera* (CUSHMAN). - WEISS, p. 7, figs. 1-3.
1983 *Heterohelix pseudotessera* (CUSHMAN). - EL NAGGAR, pl. 11, figs 10-11; pl. 12, 17.
1984 *Heterohelix pseudotessera* (CUSHMAN). - WEIDICH, pp. 43, 78, pl. 1, f. 12.
1986 *Heterohelix pseudotessera* (CUSHMAN). - AL-HARITHI, p. 7, pls. 7-8, text-figs. 12, 14

Description: Test compressed, generally triangular, greatest breadth at the last pair of chambers, periphery idented throughout; chambers inflated, broader than high throughout; sutures depressed, somewhat curved in the last portion; wall calcareous, smooth and polished, mesoperforate; aperture a high arched opening with slight lip and distinct flanges. *H. pseudotessera* differs from *H. globulosa* in the compressed test, broader chambers, particularly in the last portion and the curved sutures.

Distribution: *H. pseudotessera* was recorded from the Coniacian to Campanian of the Gulf Coast, USA (Cushman, 1946); Coniacian to Santonian of Germany (Weidich, 1984); upper Campanian of Mediterranean region and Atlantic (Weiss, 1983); Campanian to lower Maastrichtian of Libya (Barr, 1972); Coniacian to lower Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: J56, Shueib Formation (Turonian); M47, 71, 74, Ghudran Formation (Coniacian to Santonian), M98, 100, Amman Formation (lower Maastrichtian).

Heterohelix punctulata (CUSHMAN, 1938)
Pl. 19, Fig. 11; Pl. 20, Fig. 4 a-b.

1938a *Gümbelina punctulata* CUSHMAN, p. 13, pl. 2, figs. 15-16.
1983 *Pseudoguembelina punctulata* (CUSHMAN). - WEISS, p. 21, fig. 1.
1968 *Heterohelix punctulata* (CUSHMAN). - SLITER, p. 96, pl. 14, fig. 7.
1980 *Heterohelix* aff. *punctulata* (CUSHMAN). - PERYT, p. 38, pl. 7, figs. 10-11.
1986 *Heterohelix punctulata* (CUSHMAN). - AL-HARITHI, p. 97, txt-figs. 12, 14.
1989 *Heterohelix punctulata* (CUSHMAN). - NEDERBRAGT, p. 198, pl. 3, figs. 5-7.

Description: Test free, large, biserial, terminal chambers globular, faintly costate, uniform, chambers increasing rapidly in size, initially slightly compressed, commonly costate, in the middle portion pitted, lightly striate, ultimately lightly striated to smooth; sutures distinct, initially flush, limbate, later depressed; wall calcareous, mesoperforate, surface often coarsely punctate; aperture a low, broad arch with slight lip and small lateral flanges.

Distribution: *H. punctulata* was recorded from the Santonian to Maastrichtian in many parts of the world (Masters, 1977); upper Campanian of Europe, Mediterranean region and Atlantic (Weiss, 1983) and from lower Turonian to the lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M38, 39, Shueib Formation Equivalent (uppermost Cenomanian).

Heterohelix reussi (CUSHMAN, 1938)
Pl. 20, Fig. 11 a-b.

1938 *Güembelina reussi* CUSHMAN, p. 11, pl. 2, figs. 6 a-b.
1975 *Heterohelix reussi* (CUSHMAN). - BASHA, pp. 212-213, pl. 15, fig. 9.
1979 *Heterohelix reussi* (CUSHMAN). - BASHA, p. 61, 63, pl. 1, fig. 14.
1980 *Heterohelix reussi* (CUSHMAN). - PERYT, p. 39, pl. 3, fig. 10; pl. 7, fig. 13.
1982 *Heterohelix reussi* (CUSHMAN). - ODÉBÒDÉ, p. 241, pl. II, figs. 11-12.
1983 *Heterohelix reussi* (CUSHMAN). - EL NAGGAR, p. 11, pls. 3, 5, 9; pl. 12, figs. 4, 6.
1985 *Heterohelix reussi* (CUSHMAN). - CARON, p. 60, pl. 24 (10-11).
1986 *Heterohelix reussi* (CUSHMAN). -AL-HARITHI, pl. 7, fig. 9-10, pl. 9, fig. 2.

Description: Test biserial, tapering; chambers globular, between terminal chambers characteristic depressed triangular area, showing some tendency to overlap each other;

sutures slightly depressed; wall calcareous, smooth to finely costate; aperture semicircular, bordered by thickened rim.

Remarks: *H. reussi* differs from *H. globulosa* in slightly more compressed chambers and less broad apertural arch, and differs from *H. striata* in the much finer costae.

Distribution: *H. reussi* was recorded from the Turonian to Santonian (Caron, 1985); lower Turonian to Campanian of Texas, USA, Trinidad and Poland (Frizzell, 1954; Peryt, 1980); lower Turonian of Egypt and France (Said & Kenawy, 1957; Babinot & Tronchetti, 1973); upper Coniacian to lower Santonian of Iraq and Czechoslovakia (Kassab, 1974); lower Turonian to Maastrichtian of Jordan and Nigeria (Basha, 1975, 1979; Al-Harithi, 1986; Olaniyi, 1982). In the studied material, it is found in: J56, Shueib Formation (Turonian), J58, Wadi Sir Formation (Turonian); M47, 70, 71, 74, Ghudran Formation (Coniacian to Santonian).

Heterohelix sp. 1
Pl. 19, Fig. 14 a-b.

Description: Test small, biserial throughout, broader than higher; chambers about 5 pairs, initially compressed, later rapidly enlarging, becoming globular, the ultimate pair equals two-third of the test size; wall calcareous, mesoperforate, surface rough, with strong cancellate ornamentation on all chambers which gives the test a honeycomb appearance; aperture a low arch at the base of final chamber.

Distribution: *H.* sp. 1 is found in the studied material in: M7a, Na'ur Formation (lower Cenomanian), M47, Ghudran Formation (Coniacian to Santonian), M86, Amman Formation (Campanian).

Heterohelix striata compressa (NAKKADY, 1950)
Pl. 19, Figs. 1 a-b, 5, 6 a-b.

1950 *Guembelina striata* var. *compressa* NAKKADY, p. 682.
1952 *Guembelina striata* (EHRENBERG). - REISS, pp. 42, 50.
1978 *Heterohelix aff. striata* (EHRENBERG). - YASSINI, p. 22, pl 1, figs. 11-13.
1986 *Heterohelix striata* (EHRENBERG). - AL-HARITHI, pl. 97, figs. 7, 5, 12, 14-17.
1975 *Heterohelix striata compressa* (NAKKADY). - BASHA,p p. 213-214, pl. 15, figs. 10-11.

Remarks: *H. striata compressa* is distinguished by having an elongate biserial and laterally compressed test; chambers 5-7 pairs, globular to subglobular, increasing rapidly in size as added and meeting centrally at a zigzag line; wall calcareous, surface finely striated; aperture low to high arch at the base of the last chamber, with a distinct lip, lateral flanges poor or lacking. It differs from *H. globulosa* in possessing fewer, much more strongly developed striae; sutures distinct, deeper and straight.

Distribution: *H. striata compressa* was recorded from the upper Cretaceous of Egypt; Turonian and Santonian to middle Maastrichtian of Israel and Jordan (Reiss, 1952; Basha, 1975; Al-Harithi, 1986). In the studied material, it is found in: M33, 39, Shueib Formation Equivalent (upper Cenomanian), M70, M74, Ghudran Formation (Coniacian to Santonian), M86, 90, 91 (Campanian), M98, Amman Formation (lower Maastrichtian).

Heterohelix vistulaensis PERYT, 1980
Pl. 19, Fig. 16 a-b.

1980 *Heterohelix vistulaensis* PERYT, p. 42, pl. 4, figs. 1-9; pl. 21, fig. 4.

Description: Test biserial, usually consisting of 4-6 pairs of subglobular chambers, slightly inflated, increasing regularly in size as added with the exception of chambers of ultimate pair which are flattened, reniform, overlapping, and increase sharply in size and constitute one-half to one-third of test length and nearly twice as wide as long; sutures distinctly depressed, slightly oblique in regard to test axis; wall calcareous, mesoperforate, surface appears smooth on worn specimens, but discontinuous, delicate costae are present; aperture interiomarginal high arch.

Distribution: *H. vistulaensis* was originally described from the upper Maastrichtian of Central Poland (Peryt, 1980). In the studied material, it is found in: M86 (Campanian), M98 Amman Formation (lower Maastrichtian).

Genus: **Planoglobulina** CUSHMAN, 1927

Planoglobulina brazoensis MARTIN, 1972
Pl. 19, Fig. 15.

1972 *Planoglobulina brazoensis* MARTIN, pp. 82-83, pl. 3, fig. 7a-c; pl. 4, figs. 1a-2.
1973 *Planoglobulina brazoensis* MARTIN. - SMITH et al., p. 20: 4: 5-10; pl.5: 1-2
1980 *Planoglobulina brazoensis* MARTIN. - PERYT, pp. 46-47, pl. 5, fig. 4 a-b.
1983 *Planoglobulina brazoensis* MARTIN. - WEISS, p. 51, pl. 13, figs. 1-3.
1986 *Planoglobulina brazoensis* MARTIN. - AL-HARITHI, p. 43-44, pl. 6, fig. 22.
1988 *Planoglobulina brazoensis* MARTIN. - LOEBLICH, p. 455, pl. 488, figs. 4, 5, 7-10.

Description: Test flabelliform, initially biserial, later multiserial; chambers in biserial portion flattened, increasing slowly in size as added, in multiserial portion rapidly enlarging, globular, followed by a proliferation of chambers in the same plane; sutures depressed, indistinct, in biserial portion depressed zigzag sutures between pairs of chambers; wall calcareous, microperforate.

Distribution: *P. brazoensis* was reported from the upper Maastrichtian of Europe, Mediterranean region and Atlantic Ocean (Weiss, 1983; Almogi-Labin et al., 1990); lower Campanian to middle Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian), M86, Amman Formation (Campanian).

Planoglobulina multicamerata (KLASZ, 1953)
Pl. 20, Figs. 1, 2 a-b.

1953 *Ventilabrella multicamerata* KLASZ, p. 230, pl. 5, fig. 1 a-b.
1986 *Ventilabrella multicamerata* KLASZ. - AL-HARITHI, p. 45, pl. 5, fig. 15; pl. 8, fig. 1.
1982 *Planoglobulina multicamerata* (KLASZ). - ELSER, p. 147-148, pl. 8, fig. 23.
1983 *Planoglobulina multicamerata* (KLASZ). - WEISS, p. 16, fig. 1-4.
1989 *Planoglobulina multicamerata* (KLASZ). - NEDERBRAG, p. 200, pl. 5, figs. 6-7.

Remarks: Test initially compressed, biserial, then inflated and multiserial throughout with multiple apertures, ultimately becomes more compressed and broad.

Distribution: *P. multicamerata* was recorded from the upper Maastrichtian of Europe, Mediterranean region and Atlantic (Weiss, 1983); Campanian to Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M86 (Campanian), M98, Amman Formation (lower Maastrichtian).

Genus: **Pseudoplanoglobulina** ALIYULLA, 1977

Pseudoplanoglobulina nakhitschevanica ALIYULLA, 1977
Pl. 20, Fig. 3 a-b.

1977 *Pseudoplanoglobulina nakhitschevanica* ALIYULLA, p. 204.
1988 *Pseudoplanoglobulina nakhitschevanica* ALIYULLA. - LOEBLICH & TAPPAN, p. 455, pl. 488, figs. 11-12.

Description: Test subtriangular in outline, chambers globular, biserial in the early stage, later with proliferation in one row of three chambers; sutures distinct, depressed; wall calcareous, finely perforate, surface smooth on worn specimens, but very fine and closely spaced irregular costae are present; arched basal apertures on both outer chambers in the multiserial stage.

Distribution: *P. nakhitschevanica* was recorded from the Turonian to Campanian of USA and Russia (Loeblich & Tappan, 1988). In the studied material, it is found in: M33, 35, Shueib Formation Equivalent (upper Cenomanian).

Genus: **Pseudotextularia** RZEHAK, 1891

Pseudotextularia nuttalli (VOORWIJK, 1937)
Pl. 20, Figs. 7 a-b, 9 a-b.

1937 *Guembelina nuttalli* VOORWIJK, p. 192, pl. 2, fig. 1-9.
1969 *Pseudotextularia cushmani* BROWN. - BROWN, pp. 55-56, pl. 2, figs. 2-3; pl. 3, fig. 4.
1973 *Pseudotextularia elegans* (RZEHAK). - SMITH et al., pp. 30-32, pl. 9, figs. 5-15; pl. 10, figs. 2-6.

1989 *Pseudotextularia nuttalli* (VOORWIJK). - NEDERBRAGT, p. 204, pl. 8, figs. 2-3.

Description: Test biserial, bi-concave in edge view; initial planispiral coil rarely present; chambers much deeper than wide, ultimate chambers range from subglobular to elongate, subrectangular in edge view; surface finely costate; aperture a wide, low arch. *P. nuttalli* differs from *P. plummerae* in having coarser striae and from *P. elegans* in having finer striae.

Distribution: *P. nuttalli* was recorded from the Campanian (Brown, 1969); Maastrichtian of NW Atlantic (Nederbragt, 1989). In the studied material, it is found in: M47, 70, Ghudran Formation (upper Coniacian to lower Santonian.

Pseudotextularia plummerae (LOETTERLE, 1937)
Pl. 20, Figs. 5 a-b, 6 a-b.

1937 *Gümbelina plummerae* LOETTERLE, pp. 33, pl. 5, figs. 1-2.
1952 *Gümbelina plummerae* LOETTERLE. - REISS, pp. 40, 50.
1956 *Gümbelina plummerae* LOETTERLE. - SAID and KENAWY, p. 139, pl. 3, fig. 33.
1969 *Pseudotextularia plummerae* (LOETTERLE). - BROWN et al., p. 56, pl. 4, figs. 6-7.
1984 *Pseudotextularia plummerae* (LOETTERLE). - WEIDICH, pp. 69, 79, pl. 1, figs. 14-17.
1988 *Pseudotextularia plummerae* (LOETTERLE). - LOEBLICH and TAPPAN, p. 455, pl. 87, figs. 13-15.

Description: Test stout, gradually tapering in the adult early portion; 5-8 pairs of biserially arranged, closely appressed primary chambers; thickness often greater than the breadth, later primary chambers strongly inflated; sutures depressed; wall of the early portion distinctly costate, becoming faint in the later chambers and appears smooth on worn specimens, but striae are present; aperture a low, broad arch with slight lip.

Distribution: *P. plummerae* was recorded from the Coniacian to Santonian of Texas, USA (Brown & Noel, 1969), Santonian to Maastrichtian of Israel (Reiss, 1952); Santonian to lower Campanian of Germany (Weidich, 1984). In the studied material, it is found in: M21, Na'ur Formation (lower to middle Cenomanian), M32, Fuheis Formation Equivalent (middle Cenomanian), M35, 37, 39, 40, Shueib Formation Equivalent (upper Cenomanian), M56, Shueib Formation Equivalent (Turonian) and M74, Ghudran Formation (Coniacian to Santonian).

Pseudotextularia sp. 1
Pl. 20, Fig. 8 a-b.

Remarks: *P.* sp. 1 resembles *P. deformis* (KIKOINE) in the external appearance (Al-Harithi, 1986, p. 9) as having biserial test; apical portion sharply pointed (broken off), followed by sharp expansion of chambers in width, but differs in the stratigraphic occurrence. The final chamber, in the material examined, seems to be displaced and embraces the penultimate chambers; sutures depressed, straight to slightly curved; wall ornamented by discontinuous costae; aperture wide, low arched opening at the base of final chamber.

Distribution: *P. deformis* was recorded from the upper Maastrichtian of Europe, Mediterranean region and Atlantic (Weiss, 1983; Almogi-Labin et al., 1990); Maastrichtian of Jordan (Yassini, 1978; Al-Harithi, 1986). In the studied material sp. 1 is found only in: M32, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Ventilabrella** CUSHMAN, 1928

Ventilabrella glabrata CUSHMAN, 1928
Pl. 10, Fig. 13.

1928 *Ventilabrella eggeri* v. *glabrata* CUSHMAN, p. 26, pl. 4, figs. 15-17.
1973 *Gaudryina glabrata* (CUSHMAN). - SLITER, p. 181, text-fig. 7.
1972 *Ventilabrella glabrata* CUSHMAN. - MARTIN, pp. 86-87, pl. 1, fig. 8-9.
1978 *Ventilabrella glabrata* CUSHMAN. - YASSINI, p. 23, pl. 2, fig. 14.
1982 *Ventilabrella glabrata* CUSHMAN. - ODÉBÒDÉ, p. 244, pl. III, figs. 6-10.
1985 *Ventilabrella glabrata* CUSHMAN. - REISS, p. 155, text-fig. 4.
1991 *Ventilabrella glabrata* CUSHMAN. - ALMOGI-LABIN et al., p. 45, t-fig. 4.

Description: Test free, small, elongate, tapering, laterally compressed, early triserial, subtriangular in, later biserial; chambers increasing in thickness, more rapidly than in height, moderately inflated, overlapping; sutures distinct, depressed; wall calcareous, finely agglutinated, surface smoothly finished; aperture interiomarginal arched opening.

Distribution: *V. glabrata* was recorded from the Campanian of the British Columbia (Sliter, 1973); Coniacian to Santonian (Darmoian, 1975); Coniacian to Maastrichtian of Nigeria (Olaniyi, 1982); Santonian to lower Campanian of Israel (Reiss, 1985; Almogi-Labin et al., 1991); Campanian to lower Maastrichtian of Jordan (Yassini, 1978). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian); M86, 90, 91 (Campanian), M98, Amman Formation (lower Maastrichtian).

Subfamily: **GUBLERININAE** ALIYULLA, 1977
Genus: **Gublerina** KIKOÏNE, 1948

Gublerina ornatissima (CUSHMAN and CHURCH, 1929)
Pl. 21, Fig. 6.

1929 *Ventilabrella ornatissima* CUSHMAN & CHURCH, p. 512, pl. 39, fs. 12-15.
1968 *Ventilabrella ornatissima* CUSHMAN and CHURCH. - ELLIS and MESSINA, pp. 12-15.
1969 *Ventilabrella ornatissima* CUSHMAN & CHURCH. - BROWN, p. 41, pl. 3, figs. 6-7.
1968 *Planoglobulina ornatissima* (CUSHMAN and CHURCH). - SLITER, p. 97, pl. 14, fig. 10.

1973 *Planoglobulina ornatissima* (CUSHMAN & CHURCH). - SLITER, p. 169, pl. 2, fig. 1, text-fig. 2.
1964 *Gublerina ornatissima* (CUSHMAN & CHURCH). - MARTIN, p. 86, pl. 11, fig. 3a-c.
1965 *Gublerina ornatissima* (CUSHMAN & CHURCH). - TAKAYANAGI, pp. 200-201, pl. 20, figs. 6-8.

Description: Test free, initially biserial, flaring, later flabelliform, with numerous chambers in biserial plane, compressed; chambers subglobular, initially more inflated, periphery of biserial portion subrounded; sutures distinct, limbate, initially depressed, later flush to slightly elevated; wall calcareous, finely perforate, surface initially costate, later smooth (all specimens examined were worn out); apertures low, interiomarginal arches.

Distribution: *G. ornatissima* was recorded from the Coniacian to Campanian and also from the Maastrichtian of California, USA (Ellis & Messinae, 1968; Sliter, 1968, 1973; Brown, 1969). In the studied material, it is found in: M78, 86, 87, 89 Amman Formation (Campanian).

Gublerina robusta KLASZ, 1953
Pl. 21, Fig. 5 a-b.

1953 *Gublerina robusta* KLASZ. - KLASZ, p. 247, pl. 8, fig. 4 a-b, fig. 5 a-b.
1973 *Gublerina robusta* KLASZ. - SMITH and PESSAGNO, p. 2, figs. 4-7.
1983 *Gublerina robusta* KLASZ. - WEISS, pp. 41-42, pl. 3, figs. 1-3.
1986 *Gublerina robusta* KLASZ. - AL-HARITHI, pp. 41-42, pl. 5, figs. 10-11, text-fig. 12.

Description: Test outline triangular, compressed, moderately increasing in width, with a small initial planispiral coil, later biserial, diverging, may become irregular, producing a flabelliform test; chambers 5-7 pairs, increasing moderately in size, initially globular, later reniform or irregular, compressed; sutures depressed to flush, oblique to curved; surface pitted; apertures low, interiomarginal arches.

Distribution: *G. robusta* was recorded from the upper Maastrichtian of Europe, Mediterranean region and Atlantic (Weiss, 1983); lower Campanian to middle Maastrichtian of Jordan (A-Harithi, 1986). In the studied material, it is found in: M86, 87, Amman Formation (Campanian).

Superfamily: **PLANOMALINACEA** BOLLI, LOEBLICH & TAPPAN, 1957
Family: **GLOBIGERINELLOIDIDAE** LONGORIA, 1974
Subfamily: **GLOBIGERINELLOIDINAE** LONGORIA, 1974
Genus: **Blowiella** LOEBLICH and TAPPAN 1988

Blowiella blowi (BOLLI, 1959)
Pl. 22, Fig. 2.

1959 *Planomalina blowi* BOLLI, p. 260, pl. 20, fig. 2 a-b.
1977 *Globigerinelloides blowi* (BOLLI). - MASTERS, p. 11, fig. 3.

1985 *Globigerinelloides blowi* (BOLLI). - CARON, p. 47, fig. 29 (10-11).
1988 *Blowiella blowi* (BOLLI). - LOEBLICH & TAPPAN, p. 459, pl. 493, figs. 13-18.

Description: Test small, planispirally coiled, slightly evolute and umbilicate, periphery broadly rounded, peripheral outline lobulate; chambers globular to subglobular, enlarging rapidly, 4-5 in the final whorl; sutures depressed, radial; wall calcareous, microperforate; aperture a low interiomarginal and equatorial opening, bordered by a narrow rim. *B. blowi* differs from *Globigerinelloides* in the simple globular and rapidly enlarging chambers and few chambers per whorl, the last two chambers equal one-half of the test size.

Distribution: *B. blowi* was recorded from the Barremian to Aptian of Trinidad, West Indies; upper Albian of SE Atlantic (Loeblich & Tappan, 1988; Caron, 1978, 1985); Aptian to Albian of Texas, USA (Masters, 1977). In the studied material, it is found in: M7a, 20, 21, Na'ur Formation (lower to middle Cenomanian), M 37, Shueib Formation Equivalent (upper Cenomanian).

Genus: **Globigerinelloides** CUSHMAN and TEN DAM, 1948

Globigerinelloides alvarezi (ETERNOD OLVERA, 1959)
Pl. 22, Fig. 1.

1959 *Planomalina alvarezi* ETERNOD OLVERA, p. 91, pl. 4, figs. 5-7.
1964 *Planomalina alvarezi* ETERNOD OLVERA. - MARTIN, p. 84, pl. 10, figs. 8-9.
1972 *Globigerinelloides asper* (EHRENBERG). - BARR, p. 11, pl. 1, fig. 3 a-b.
1976 *Globigerinelloides asper* (EHRENBERG). - ANDRAWIS, pp. 11, 34.
1968 *Globigerinelloides alvarezi* (ETERNOD OLVERA). - SLITER, pp. 98-99, pl. 15, figs. 1-2.
1977 *Globigerinelloides alvarezi* (ETERNOD OLVERA). - MASTERS, p. 9, pl. 3; pl. 10, fig. 1.
1983 *Globigerinelloides alvarezi* (ETERNOD OLVERA). - EL NAGGAR & ASHOUR, pl. 6, figs. 1, 5, 7-8; pl. 7, fig. 10.

Description: Test free, small, planispiral, biumbilicate, periphery moderately lobate; chambers 6-8 in the final whorl, inflated, globular, slightly overlapping; sutures depressed, radial; wall calcareous, microperforate, surface smooth to finely hispid; aperture moderately high arch at the base of final chamber with small lip. *G. alvarezi* differs from *G. messinae* in the greater number of chambers, thinner test and commonly greater diameter.

Distribution: *G. alvarezi* was recorded from Santonian to Maastrichtian of California, USA (Sliter, 1968), from Coniacian to Maastrichtian of Libya (Barr, 1972); Turonian to Coniacian of Egypt (Andrawis, 1976); Albian to Campanian of Texas, USA (Masters, 1977). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M90 (Campanian), M96, 98, Amman Formation (lower Maastrichtian).

Globigerinelloides bentonensis (MORROW, 1934)
Pl. 21, Fig. 8.

1934 *Anomalina bentonensis* MORROW, p. 201, pl. 30, fig. 4 a-b.
1975 *Globigerinelloides bentonensis* (MORROW). - SAINT-MARC, table 3.
1980 *Globigerinelloides bentonensis* (MORROW). - PERYT, p. 48, pl. 7, figs. 5 a-b, 6, 9.
1985 *Globigerinelloides bentonensis* (MORROW). - CARON, p. 47, figs. 29 (8-9).
1988 *Globigerinelloides bentonensis* (MORROW). - GASINSKI, p. 223, figs. 11 f-k.
1989a *Globigerinelloides* sp. cf. *bentonensis* (MORROW). - CHERIF et al., p. 2, figs. 6, 8.
1990 *Globigerinelloides bentonensis* (MORROW). - HART et al., p. 3, figs. e-f.

Description: Test free, planispiral, involute to partially evolute, biumbilicate 6-8 chambers increasing gradually in size, early ones closely appressed, later less appressed and tending to become evolute, periphery outline lobate;umbilicus shallow, wide; sutures depressed, oblique to radial; wall papillose, surface muricate, ultimate chamber almost smooth; aperture a broad low interiomarginal, equatorial arch, bordered by a thin lip. *G. bentonensis* differs from *G. eaglefordensis* in being larger, more inflated, more involute, with more rapidly increasing chambers and usually overlapping later chambers, the last one usually longer than high.

Distribution: *G. bentonensis* was recorded from the Coniacian to Santonian of Canada; upper Cenomanian to Santonian of Poland (Peryt, 1980); middle Albian to uppermost Cenomanian of England (Jarvis et al., 1988; Gasinski, 1988); lower Turonian of Egypt (Cherif et al., 1989); Cenomanian of Algeria, Lebanon and Israel (Benkherouf, 1987; Saint-Marc, 1975; Hamaoui, 1979; Caron, 1985). In the studied material, it is found in: P3, M21, Na'ur Formation (lower to middle Cenomanian); M37, M39, Shueib Formation Equivalent (upper Cenomanian), M74, Ghudran Formation (Coniacian to Santonian).

Globigerinelloides bollii PESSAGNO, 1967
Pl. 21, Fig. 13.

1967 *Globigerinelloides bollii* PESSAGNO, p. 275, pl. 62, fig. 5; pl. 81, figs. 7-8; pl. 97, fig. 1-2; pl. 100, fig. 3.
1978 *Globigerinelloides bollii* PESSAGNO. - FRERICHS et al., pp. 302-305, pl. 1, figs. 15-16.
1983 *Globigerinelloides bollii* PESSAGNO. - KRASHENINNIKOV et al., p. 803, pl. 1, figs. 12-14.
1986 *Globigerinelloides bollii* PESSAGNO. - AL-HARITHI, pl. 12, fig. 21; pl. 14, fig. 6.

Description: Test free, small, compressed, planispiral, biumbilicate, broad and shallow umbilicus; 6-8 chambers in the last whorl, increasing gradually in size, peripheral margin lobulate; sutures depressed, straight, radial; wall calcareous, surface perforate, smooth with a few muricae; aperture a medium equatorial, interiomarginal arch at base of last chamber.

Distribution: *G. bollii* was recorded from the upper Campanian to Maastrichtian of North America and Falkland Plateau, DSDP (Pessagno, 1967; Krasheninnikov et al., 1983); lower Campanian to middle Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M86, 90, Amman Formation (Campanian).

Globigerinelloides caseyi (BOLLI, LOEBLICH and TAPPAN, 1957)
Pl. 21, Fig. 10.

1957 *Planomalina caseyi* BOLLI, LOEBLICH & TAPPAN, p. 24, pl. 1, fs. 4-5a, b.
1969 *Globigerinelloides caseyi* (BOLLI et al.).- DOUGLAS, p. 161, pl. 5, fig. 9a-b.
1971 *Globigerinelloides caseyi* (BOLLI et al.). - BELFORD et al., pl. 3, fig. 17-19.
1972 *Globigerinelloides caseyi* (BOLLI et al.). - BARR, pp. 11-12, pl. 1, fig. 2 a-b.
1975 *Globigerinelloides caseyi* (BOLLI et al.). - SAINT-MARC, table 3.
1979 *Globigerinelloides caseyi* (BOLLI et al.). - BASHA, pp. 61, 63, pl. 2, fig. 15.
1980 *Globigerinelloides caseyi* (BOLLI et al.). - PERYT, p. 48, pl. 7, fig. 3, 4.
1986 *Globigerinelloides caseyi* (BOLLI et al.). - AL-HARITHI, p. 94, text-fig. 14.

Description: Test free, small, planispiral, biumbilicate, umbilici shallow, wide, involute to partially evolute; axial periphery rounded, equatorial periphery lobate; 6-8 subglobular chambers, increasing gradually in size; sutures depressed, straight to gently curved; wall calcareous, finely perforate, surface smooth to muricate; aperture low, broad interiomarginal equatorial, semicircular arch, bordered by thin lip, relict supplementary apertures around umbilical region.

Remarks: *G. caseyi* differs from *G. bentonensis* in being smaller, more evolute coil, open umbilicus, less ornamented and slowly increasing and less inflated chambers. It also differs from *G. multispinata* in being evolute, smaller in size and smooth.

Distribution: *G. caseyi* was recorded from the Albian and Coniacian of England; Cenomanian of Libya and Lebanon (Barr, 1972; Saint-Marc, 1975); upper Cenomanian to lower Turonian of Mexico and from lower Turonian to Coniacian of California (Pessagno, 1967; Douglas, 1969); Turonian of Australia (Belford & Scheibnerova, 1971); Cenomanian to Turonian of Jordan (Basha, 1975, 1979; Al-Harithi, 1982, 1986). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian).

Globigerinelloides eaglefordensis (MOREMAN, 1927)
Pl. 21, Fig. 15.

1927 *Anomalina eaglefordensis* MOREMAN, p. 99, pl. 16, fig. 9a-b.
1946 *Planulina eaglefordensis* (MOREMAN).-CUSHMAN, p. 156, pl. 64, fig. 8-9.
1946 *Planulina eaglefordensis* (MOREMAN). -PESSAGNO, p. 243, pl. 48, t-f. 63.
1983 *Globigerinelloides eaglefordensis* (MOREMAN). - KRASHENINNIKOV & BASOV, p. 803, pl. 1, figs. 8-9.

Description: Test free, small, planispiral, partially evolute, compressed biumbilicate, periphery rounded, peripheral outline lobulate, 6-8 subglobular chambers increasing gradually in size; sutures distinct, depressed straight to gently curved, radial; wall calcareous, finely perforate, surface smooth to very finely hispid; aperture a low interiomarginal equatorial arch, bordered by a narrow lip.

Remarks: *G. eaglefordensis* is regarded by some authers as a benthic foraminifer (Pessagno, 1967).

Distribution: *G. eaglefordensis* was recorded from the Cenomanian of North America, Israel and Europe (Loeblich, 1961; Hamaoui, 1979; Magniez-Jannin, 1975); upper Cenomanian of Falkland Plateau, DSDP (Krasheninnikov et al., 1983). In the studied material, it is found in: M20, 21, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian).

Globigerinelloides messinae (BRÖNNIMANN, 1952)
Pl. 22, Fig. 3 a-b.

1952 *Globigerinella messinae messinae* BRÖNNIMANN, pp. 42-45, pl. 1, figs. 6-7, text-figs. 20-21.
1978 *Globigerinelloides messinae messinae* BRÖNNIMANN. - YASSINI, p. 24, pl. 2, figs. 1-3.
1967 *Globigerinelloides messinae* (BRÖNNIMANN). - BANDY, p. 22, t-f. 10, 9.
1968 *Globigerinelloides messinae* (BRÖNNIMANN). - KOCH, p. 655.
1968 *Globigerinelloides messinae* (BRÖNNIMANN). - SLITER, p. 99, pl. 15, figs. 3-5.
1972 *Globigerinelloides messinae* (BRÖNNIMANN-GOVINDAN, p. 172, pl. 2, figs. 20-23.

Description: Test free, small, planispiral, biumbilicate, umbilici small, shallow, evolute to involute, equatorial periphery lobate, axial periphery rounded; 5-6 globular chambers, increasing rapidly in size; sutures radial, depressed; wall calcareous, microperforate, surface hispid; aperture a broad, low interiomarginal, equatorial arch bordered by a thin lip.

Distribution: *G. messinae* was recorded from the upper Campanian to lower Maastrichtian of North America (Olsson, 1964; Sliter, 1968); lower Maastrichtian of Jordan (Koch, 1968; Yassini, 1978). In the studied material, it is found in: M88, M90 (Campanian), M99, Amman Formation (lower Maastrichtian).

Globigerinelloides multispinata (LALICKER, 1948)
Pl. 22, Fig. 4.

1948 *Biglobigerinella multispina* LALICKER, p. 624, pl. 92, figs. 1-3.
1978 *Globigerinelloides multispina* (LALICKER). - YASSINI, p. 24, pl. 3, fs. 3-6.
1980 *Globigerinelloides multispinus* (LALICKER). - PERYT, pp. 49-50, pl. 8, figs. 5-11.
1983 *Globigerinelloides multispinatus* (LALICKER). - KRASHENINNIKOV and BASOV, p. 803, pl. 2, figs. 7-9.
1985 *Globigerinelloides multispinata* (LALICKER).-.ROBASZYNSKI et al, p. 26, text-fig. 16.

1986 *Globigerinelloides multispinata* (LALICKER). - AL-HARITHI, pl. 12, figs. 18-19.

Description: Test free, small, planispiral, slightly involute, biumbilicate, umbilici small and shallow; axial periphery rounded; equatorial periphery lobate; 5-6 subglobular chambers, increasing rapidly in size; early chambers spherical, final ones elongate in axial cross; sutures depressed, straight, radial; wall calcareous, perforate, surface finely hispid, papillose on early chambers; aperture interiomarginal, equatorial a low arch bordered by a narrow lip.

Distribution: *G. multispinata* was recorded from the upper Campanian to Maastrichtian of Europe, USA and Canada (Peryt, 1980; Robaszynski et al., 1985); lower Campanian to middle Maastrichtian of Jordan (Yassini, 1975, 1978; Harithi, 1986). In the studied material, it is found in: M99, Amman Formation (lower Maastrichtian).

Globigerinelloides prairiehillensis PESSAGNO, 1967
Pl. 21, Figs. 12 a-b, 14.

1967 *Globigerinelloides prairiehillensis* PESSAGNO, pp. 277-278, pl. 90, figs. 1-2, 4.
1976 *Globigerinelloides prairiehillensis* PESSAGNO. - DOBSON et al., pl. 2, figs. 10-11, text-fig. 3.
1983 *Globigerinelloides prairiehillensis* PESSAGNO. - EL NAGGAR et al., p. 6, figs. 2-4; pl. 7, figs. 5, 7-9, 11-12.
1985 *Globigerinelloides prairiehillensis* PESSAGNO. - CARON, p. 47, fig. 29 (14-15).
1989b *Globigerinelloides prairiehillensis* PESSAGNO. - CHERIF et al., pl. 1, fig. 2.
1990 *Globigerinelloides prairiehillensis* PESSAGNO. - AL-HARITHI, p. 518, fig. 3 (11-2).

Description: Test free, planispiral, partially evolute, biumbilicate, small deep umbilici, lobate periphery; 6-7 subglobular chambers, increasing regularly in size; sutures depressed, radial, straight; wall calcareous, surface perforate, papillose; aperture a low, broad interiomarginal arch with a bordering lip.

Remarks: *G. prairiehillensis* differs from *G. ferreolensis* in possessing fewer chambers, which increase more rapidly in size in the last whorl; from *G. volutus* in having a deeper, narrower umbilicus and chambers increasing sharply in size as added and from *G. ultramicra* in possessing a larger and more evolute test.

Distribution: *G. prairiehillensis* was recorded from the middle Campanian to upper Maastrichtian (Caron, 1985); upper Santonian to lower Maastrichtian of USA; upper Campanian to Maastrichtian of Poland (Peryt, 1980); Campanian of N. Atlantic and Egypt (Dobson et al., 1976; Cherif et al, 1989); Santonian of Jordan (Al-Harithi, 1990). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian), M90 (Campanian), M96, Amman Formation (lower Maastrichtian).

Globigerinelloides ultramicra (SUBBOTINA, 1949)
Pl. 21, Fig. 11 a-b.

1949 *Globigerinella ultramicra* SUBBOTINA, p. 33, pl. 2, figs. 17-18.
1977 *Globigerinelloides ultramicra* (SUBBOTINA). - MASTERS, pl. 12, figs. 3-5, table 3.
1985 *Globigerinelloides ultramicra* (SUBBOTINA). - CARON, p. 47, pl. 29 (18-19).
1987 *Globigerinelloides ultramicra* (SUBBOTINA). - AL RIFAIY et al, pl. II, fig. 17, text-fig. 3.
1989b *Globigerinelloides ultramicra* (SUBBOTINA). - CHERIF et al., p. 1, fig. 4.
1990 *Globigerinelloides ultramicra* (SUBBOTINA). - AL-BAKRI, p. 36, pl. 3, fig. 16; pl. 4, figs. 4, 6-10, text-fig. 8.

Remarks: *G. ultramicra* differs from other *Globigerinelloides* species essentially by its small size and greater number of chambers (6-8). The number of chambers in case of the Egyptian and Jordanian specimens ranges 6-7 only.

Distribution: *G. ultramicra* was recorded from the upper Albian to lower Maastrichtian (Masters, 1977; Caron, 1985); Campanian of Egypt (Cherif et. al., 1989); upper Cenomanian to lower Maastrichtian of Jordan (Al Rifaiy & Cherif, 1987; Al-Bakri, 1990). In the studied material, a large number of tests belonging to this species was found in M7a, 21, Na'ur Formation (lower to middle Cenomanian), M37, Shueib Formation Equivalent (upper Cenomanian), M47, Ghudran Formation (Coniacian to Santonian), M99, Amman Formation (lower Maastrichtian).

Globigerinelloides volutus (WHITE, 1928)
Pl. 21, Fig. 9 a-b.

1928 *Globigerina voluta* WHITE, pp. 197-198, pl. 28, fig. 5 a-b.
1977 *Globigerinelloides volutus* (WHITE). - HAMAM, p. 41, pl. 1, figs. 9-10.
1978 *Globigerinelloides volutus* (WHITE). - FRERICHS et al., p. 305, pl. 2, figs. 4-6.
1978 *Globigerinelloides volutus* (WHITE). - YASSINI, p. 24, pl. 3, figs. 1-2.
1980 *Globigerinelloides volutus* (WHITE). - PERYT, p. 50, pl. 7, figs. 1-2.
1986 *Globigerinelloides volutus* (WHITE). - AL-HARITHI, text-fig. 12.

Description: Test free, planispiral, partially evolute, biumbilicate, umbilici shallow, broad, axial periphery rounded; 5-6 globular chambers increasing gradually in size; sutures depressed, straight, radial; wall calcareous, surface macroperforate, ornamented by small muricae; aperture a low to medium, broad interiomarginal arch with a thin bordering lip.

Distribution: *G. volutus* was recorded from the upper Campanian to Maastrichtian of USA, Mexico and Poland (Peryt, 1980); lower Campanian to middle Maastrichtian of Jordan and Israel (Yassini, 1978; Al-Harithi, 1982, 1986; Hamaoui, 1979). In the studied material, it is found in: M91 (Campanian), M96, 97, 98, 100, Amman Formation (lower Maastrichtian).

Superfamily: **ROTALIPORACEA** SIGAL, 1958
Family: **HEDBERGELLIDAE** LOEBLICH and TAPPAN, 1961
Subfamily: **HEDBERGELLINAE** LOEBLICH and TAPPAN, 1961
Genus: **Costellagerina** PETTERS, EL-NAKHAL and CIFELLI, 1983

Costellagerina bulbosa (BELFORD, 1960)
Pl. 22, Fig. 5.

1960 *Rugoglobigerina (Rugoglobigerina) bulbosa* BELFORD, p. 94, pl. 26, figs. 1-10, text-fig. 7.
1964 *Rugoglobigerina bulbosa* BELFORD. - SAID & SABRY, p. 386, pl. 3, f. 15.
1983 *Costellagerina bulbosa* (BELFORD). - PETTERS et al., p. 248.
1988 *Costellagerina bulbosa* (BELFORD). - LOEBLICH & TAPPAN, p. 462, pl. 495, figs. 1-6.

Description: Test with low to medium trochospiral coil of few, rapidly enlarging, spherical chambers; periphery rounded, peripheral margin lobulate; sutures radial, depressed; wall calcareous, finely perforate, surface with meridionally aligned pustules and costellae, resulting from fusion of adjacent pustules; aperture a low interiomarginal, umbilical to slightly extraumbilical arch, with a narrow bordering lip.

Distribution: *C. bulbosa* was recorded from the Cenomanian to Campanian of Nigeria and Tunisia (Loeblich & Tappan, 1988); Maastrichtian of Egypt (Said & Sabry, 1964). In the studied material, it is found in: M21, 22, 23, Na'ur Formation (lower to middle Cenomanian), M71, Ghudran Formation (Coniacian to Santonian), M86, 88, Amman Formation (Campanian).

Genus: **Hedbergella** BRÖNNIMANN and BROWN, 1958

Hedbergella delrioensis (CARSEY, 1926)
Pl. 22, Fig. 6, 8.

1926 *Globigerina cretacea* D'ORBIGNY var. *delrioensis* CARSEY, p. 43.
1975 *Hedbergella delrioensis* (CARSEY). - BASHA, p. 219-220, pl. 15, fig. 20-22.
1977 *Hedbergella delrioensis* (CARSEY). - CARTER & HART, p. 35, pl. 4, figs. 1-3.
1979 *Hedbergella delrioensis* (CARSEY). - ROBASZYNSKI, CARON, p. 128, pls. 22-23.
1983 *Hedbergella delrioensis* (CARSEY). - KRASHENINNIKOV et., p. 804, pl. 3, figs. 1-4.
1985 *Hedbergella delrioensis* (CARSEY). - CARON, p. 57, pl. 25 (6-7).
1988 *Hedbergella delrioensis* (CARSEY). - GASINSKI, p. 230, pl. 11 l-o, 12 a-i.
1989a *Hedbergella delrioensis* (CARSEY). - CHERIF et al., p. 2, fig. 9.
1990 *Hedbergella delrioensis* (CARSEY). - AL-HARITHI, p. 518, fig. 5 (13-5, 20, 21).

Description: Test low trochospiral, lateral view slightly asymmetrical, spiral side slightly convex, last chamber displaced towards the umbilicus which is small, deep; equatorial periphery lobate, axial periphery rounded; chambers 5-6 subglobular, increasing slowly in size as added; sutures depressed, curved spirally, radial to slightly curved umbilically; wall calcareous, macroperforate, surface pustulose; primary aperture interiomarginal, extraumbilical to umbilical arch, with a relatively large apertural flap.

Distribution: *H. delrioensis* ranges from the Aptian to the Coniacian (Caron, 1985); it was recorded from the Cenomanian to Coniacian of Germany (Weidich, 1984); lower Cenomanian to Turonian of Algeria and England (Benkherouf, 1987; Jarvis et al., 1988); Cenomanian to Santonian of Canada, Israel, Palestine, Lebanon, Egypt and Jordan (Peryt, 1980; Hamaoui & Arkin, 1967; Saint-Marc, 1975; Andrawis, 1976; Bayliss, 1973; Basha, 1975, 1979; Al-Harithi, 1990).

In the studied material, it is found in: M7a, 21, 22, 23, Na'ur Formation (lower to middle Cenomanian); M31, 32, J25, Fuheis Formation (middle Cenomanian); J33, Hummar Formation Equivalent (upper Cenomanian); J34, 35, 36, 44, 47, 49, M37, 38, 39, 41, Shueib Formation Equivalent (upper Cenomanian); J58, 59, Wadi Sir Formation (Turonian); M47, 71, Ghudran Formation (Coniacian to Santonian).

Hedbergella flandrini PORTHAULT, 1970
Pl. 22, Fig. 11.

1970 *Hedbergella flandrini* PORTHAULT, pp. 64-65, pl. 10, figs. 1-3.
1979 *Hedbergella flandrini* PORTHAULT. - ROBASZYNSKI and CARON, p. 134, figs. 24-25.
1985 *Hedbergella flandrini* PORTHAULT. - CARON, p. 57, fig. 25 (12-14).
1990 *Hedbergella flandrini* PORTHAULT. - AL-BAKRI, p. 37, pl. 5, fig. 4 a-b, text-fig. 8.

Description: Test compressed, slightly biconvex, almost symmetrical, last chambers displaced towards spiral side, chamber outline ogival; equatorial periphery very lobulate; chambers 5-6, spatulate in shape, except the first which is globular, increasing very rapidly in size; sutures radial and depressed; surface smooth; primary aperture extraumbilical to umbilical extending to periphery, bordered by a well developed lip.

Remarks: *H. flandrini* differs from *H. hoelzli* in having a smooth surface, chamber outline ogival, chambers spatulate and increasing more rapidly in size; from *H. simplex* in having compressed test, spatulate chambers with ogival outline.

Distribution: *H. flandrini* ranges from the upper Turonian (*sigali* zone) to the lower Santonian (base of the *assymetrica* zone) (Caron, 1985) and it was repoted in Jordan from the middle Turonian (Al-Bakri, 1990). In the studied material, it is found in: M47, 71, 74, Ghudran Formation (Coniacian to Santonian).

Hedbergella hoelzli (HAGN and ZEIL, 1954)
Pl. 22, Fig. 12.

1954 *Globigerina hoelzli* HAGN and ZEIL, pp. 32, 50, pl. 2, fig. 8.

1984 *Rugoglobigerina hoelzli* (HAGN and ZEIL). - WEIDICH, pp. 107-108, pl. 19, fig. 16-18; pl. 20, fig. 1-18; pl. 21, fig. 1-4, text-fig. 26.

1972 *Hedbergella hoelzli* (HAGN and ZEIL). - BARR, pp. 13-14, pl. 1, figs. 10-11.

1979a *Hedbergella hoelzli* (HAGN and ZEIL). - ROBASZYNSKI and CARON, 138, 26, figs. 1-3.

1983 *Hedbergella hoelzli* (HAGN and ZEIL). - KRASHENINNIK. et al, p. 805, pl. 5, figs. 12-4.

1988 *Hedbergella hoelzli* (HAGN and ZEIL). - LIPSON-BENITAH et al., p. 332, fig. 5a, text-fig. 2

Description: Test very low trochospiral, compressed, nearly planispiral, with flattened, sometimes depressed spiral side and more convex umbilical side, umbilicus large and deep; axial periphery rounded, equatorial periphery lobulate, sometimes last chamber radially elongate; 5-7 trapezoidal chambers, increasing gradually in size; sutures depressed and radial umbilically and slightly curved spirally; surface papillate on both sides; primary aperture a low arch extraumbilical-umbilical bordered by a lip.

Distribution: *H. hoelzli* was recorded from the lower Turonian to lower Santonian of Europe, Falkland Plateau, South Atlantic and Middle Asia (Weidich, 1984; Krasheninnikov, 1983; Maslakova, 1978); Coniacian of Libya (Barr, 1972); middle Turonian of Israel (Lipson-Benitah et al., 1988). In the studied material, it is only ound in: M74, Ghudran Formation (Coniacian to Santonian).

Hedbergella holmdelensis OLSSON, 1964
Pl. 22, Fig. 9.

1964 *Hedbergella holmdelensis* OLSSON, pp. 160-161, pl. 1, figs. 1-2 a-c.

1972 *Hedbergella holmdelensis* OLSSON. - BARR: 13, pl. 1, fig. 7 a-c.

1984 *Hedbergella holmdelensis* OLSSON. - ROBASZYNSKI et al., p. 261, pl. 43, fig. 1 a-c.

1985 *Hedbergella holmdelensis* OLSSON, p. 59, fig. 25 (10-11).

1989 *Hedbergella holmdelensis* OLSSON. - ISMAIL, p. 150, pl. 8, fig. 9.

1989b *Hedbergella holmdelensis* OLSSON. - CHERIF et al., p. 2, fig. 3.

Description: Test free, small, compressed, trochospire very low to flat, umbilicus wide, deep; axial periphery rounded to semi-ovate, equatorial periphery lobate; chambers 5-6, slightly compressed to subspherical, increasing rapidly in size; sutures distinct, depressed, spirally radial to slightly curved, umbilically radial; wall calcareous, surface finely perforate, smooth to hispid; aperture a low arch, interiomarginal, umbilical to extraumbilical, arcuate, bordered by a thin lip.

Remarks: *H. holmdelensis* is very similar to the Cenomanian species *H. planispira*, but differs by having a smaller number of chambers, higher trochospiral coil, smaller, shallower umbilicus and a smoother test surface; from *H. monmouthensis* in having a smooth, flattened chamber surface and a lower apertural opening; from *H. delrioensis* in the more robust, larger test size and the more compact arrangement of the subglobular chambers and the sparse, small perforations on chamber surface.

Distribution: *H. holmdelensis* ranges from the Coniacian to the end of Maastrichtian (Caron, 1985). It was recorded from the Campanian of S Atlantic, lower Maastrichtian of Libya and New Jersey, USA (Barr, 1972; Caron, 1985); upper Coniacian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M86, 87, 89, 90 (Campanian), M96, 98, Amman Formation (lower Maastrichtian).

Hedbergella monmouthensis (OLSSON, 1960)
Pl. 22, Fig. 7.

1960 *Globorotalia monmouthensis* OLSSON, p. 47, pl. 9, figs. 22-24.
1986 *Globotruncanella monmouthensis* (OLSSON). - AL-HARITHI, p. 34, pl.5, fig. 4, 6-7
1968 *Hedbergella monmouthensis* (OLSSON). - SLITER, p. 101, pl. 15, fig. 4
1969 *Hedbergella monmouthensis* (OLSSON). - DOUGLAS: 167-8, pl. 9, fig. 4.
1983 *Hedbergella monmouthensis* (OLSSON). - KRASHENINNIKOV et al., p. 804, pl. 6, figs. 5-8.
1984 *Hedbergella monmouthensis* (OLSSON). - ROBASZYNSKI et al., p. 262, pl. 43, figs. 2-4.

Description: Test free, small, trochospire very low to flat, compressed, umbilicus narrow, deep; axial periphery rounded; equatorial periphery lobate; 4½-5 subspherical to spherical chambers, increasing rapidly in size; sutures depressed, slightly curved, umbilically radial; wall calcareous, surface macroperforate, smooth to muricate; primary aperture a low arch, interiomarginal, umbilical to extraumbilical, bordered by a thin lip. *H. monmouthensis* differs from *H. holmdelensis* in its more spherical chambers and more muricate surface.

Distribution: *H. monmouthensis* ranges from the Campanian to Maastrichtian of California, Falkland Plateau, South Atlantic (Sliter, 1968; Krashininnikov & Basov, 1983; Robaszynski et al., 1984) and was recorded from the lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M70, 71, 74, Ghudran Formation (upper Santonian), M86, 87, 88, 89, 90, Amman Formation (Campanian).

Hedbergella simplex (MORROW, 1934)
Pl. 22, Fig. 10.

1934 *Hastigerinella simplex* MORROW, p. 198, pl. 30, fig. 6.
1979 *Clavihedbergella simplex* (MORROW). - BASHA, p. 61, 63, pl. 2, fig. 19.
1979 *Hedbergella simplex* (MORROW). - ROBASZYNSKI & CARON, p. 150, figs. 29-30.
1984 *Hedbergella simplex* (MORROW). - WEIDICH: 82, pl. 3, fig. 9-13.
1985 *Hedbergella simplex* (MORROW). - CARON: 59, fig. 25 (15-16).
1988 *Hedbergella simplex* (MORROW). - GASINSKI: 232, pl. 12 m, 13 a-d.
1988 *Hedbergella simplex* (MORROW). - LIPSON-BENITAH et al. p. 324, text-fig. 2.

Description: Test in lateral view slightly asymmetrical tending to be concavo-convex; equatorial periphery strongly lobulate to digitate, axial periphery rounded; umbilicus shallow, narrow; 4-6 globular to subclavate chambers, increasing rapidly in size; wall calcareous, finely perforate, surface initially spinose, later smooth to slightly hispid; sutures typically radial and depressed; primary aperture interiomarginal arch, extraumbilical to umbilical, extendung to periphery, bordered by a well-developed lip.

Remarks: *H. simplex* is similar to and synonym of *H. amabilis*, though the later has less elongated chambers; distinguished from *H. delrioensis* in having more compressed test, wide umbilicus and subclavate chambers. Similar to *H. flandrini,* from which it differs in the still stronger and more distinct elongation of the last chambers. *H. planispira* is much smaller in size and has more chambers and less constricted sutures.

Distribution: *H. simplex* was recorded from the Cenomanian to Coniacian of Texas, Libya and Germany; Turonian of California (Barr, 1972; Loeblich et al., 1961; Douglas, 1969; Weidich, 1984); Cenomanian of Tunisia (Dalbies, 1955); Turonian of Palestine (Bayliss, 1973) and the middle Turonian of Israel (Hamaoui, 1979; Lipson-Benitah et al., 1988); lower Aptian to Santonian of Jordan and Algeria (Basha, 1975, 1979; Al-Harithi, 1990; Benkherouf, 1987).

In the studied material, it is found in: M22, 23, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); M33, 35, 38, 39, J34, 51a, Shueib Formation (upper Cenomanian); J58, Wadi Sir Formation (Turonian), M70, 71, 74, Ghudran Formation (Coniacian to Santonian).

Hedbergella trocoidea (GANDOLFI, 1942)
Pl. 22, Fig. 13 a-b.

1942 *Anomalina lorneiana* D'ORBIGNY var. *trocoidea* GANDOLFI, p. 99, pl. 2, fig. 1 a-c; pl. 4, fig.2-3; pl. 13, fig. 2 a-b, 5 a-b.
1972 *Hedbergella trocoidea* (GANDOLFI). - BARR: 14, pl. 4, fig. 2 a-c, t-fig. 2.
1980 *Hedbergella trocoidea* (GANDOLFI). - WEISS, pp. 115-116, pl. 1, fig. 4.
1983 *Hedbergella trocoidea* (GANDOLFI)-KRASHENINNIKOV et al., p. 804, pl. 4, figs. 7-9.
1985 *Hedbergella trocoidea* (GANDOLFI). - CARON, p. 60, pl. 25 (17-18).
1986 *Hedbergella trocoidea* (GANDOLFI). - AL-HARITHI, pp. 47-48, pl. 12, fig. 20.

Description: Test medium size, low trochospiral coil of two volutions, early whorls not elevated above later chambers on the spiral side, opposite side with deep and narrow umbilicus; periphery broadly rounded, peripheral outline lobulate; 6-7 subglobular, inflated chambers, increasing gradually in size; sutures distinct, depressed, radial and straight; wall calcareous, distinctly macroperforate, surface initially finely muricate, finally smooth; aperture low interiomarginal extraumbilical to umbilical arch. Differs from *H. planispira* in being three times larger, slightly higher trochospire, having greater increase in chamber size with muricate surface.

Distribution: *H. trocoidea* is common in the Albian and Cenomanian of different continents and oceans (Barr, 1972; Masters, 1977; Krasheninnikov, 1983) and was also recorded from the Cenomanian to Santonian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M21, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M33, J39, Shueib Formation (upper Cenomanian).

Genus: **Whiteinella** PESSAGNO, 1967

Taxonomic note: *Whiteinella* should be restricted to forms without keel (Pessagno, 1967, p. 298; Lipson-Benitah, 1988, p. 330) and with globular to slightly compressed chambers (*W. aprica, W. archaeocretacea, W. baltica, W. brittonensis* and *W. paradubia*).

Whiteinella aprica (LOEBLICH and TAPPAN, 1961)
Pl. 22, Fig. 16.

1961 *Ticinella aprica* LOEBLICH & TAPPAN, p. 292, pl. 4: 14-16.
1970 *Whiteinella aprica* (LOEBLICH and TAPPAN). - EICHER and WORSTELL: 314, 316, pl. 11, fig. 7 a-c; pl. 12, fig. 1 a-c.
1977 *Whiteinella aprica* (LOEBLICH & TAPPAN). - MASTERS, p. 326, pl. 20, figs. 1-3, table 5.
1979a *Whiteinella aprica* (LOEBLICH & TAPPAN). - ROBASZYNSKI & CARON, p. 160, pl. 32, fig. 1-2.
1984 *Whiteinella aprica* (LOEBLICH & TAPPAN). - WEIDICH, p. 83, pl. 4, figs. 1-4.
1988 *Whiteinella aprica* (LOEBLICH & TAPPAN). - LIPSON-BENITAH et al., p. 334, fig. 5 g, h
1988 *Whiteinella aprica* (LOEBLICH & TAPPAN). - LOEBLICH & TAPPAN, p. 462, pl. 496, figs. 10-15.

Description: Test low trochospire, very slightly asymmetrical, the spiral side is flat to slightly convex; chambers outline circular, 5-6 globular chambers per whorl, increasing slowly in size; equatorial periphery lobulate; umbilicus shallow and wide; sutures radial and depressed; surface pustulose; primary aperture extraumbilical to umbilical, extending towards the periphery, bordered by a porticus.

Remarks: *W. aprica* differs from *W. brittonensis* in having a lower spire from which the early spire does not protrude, a wider umbilicus and flaps in the umbilicus; differs from *W. paradubia* in having a lower trochospire.

Distribution: *W. aprica* was recorded from the upper Cenomanian to lower Santonian of Germany (Weidich, 1984); Cenomanian and Turonian of Texas, USA (Eicher & Worstell, 1970; Masters, 1977); middle Turonian of Israel (Lipson-Benitah et al., 1988). In the studied material, it is found in: M31, Fuheis Formation Equivalent (middle Cenomanian), M41, Shueib Formation Equivalent (upper Cenomanian), M47, M70, Ghudran Formation (Coniacian to Santonian).

Whiteinella archaeocretacea PESSAGNO, 1967
Pl. 22, Fig. 15.

1967 *Whiteinella archaeocretacea* PESSAGNO, 298, pl. 51, figs. 2-4; pl. 54, figs. 19-25.
1979 *Praeglobotruncana archaeocretacea* PESSAGNO. - BASHA, p. 63, pl. 2, fig. 20.
1979a *Whiteinella archaeocretacea* PESSAGNO. - ROBASZYNSKI & CARON, p. 167, figs. 33-34.
1984 *Whiteinella archaeocretacea* PESSAGNO. - WEIDICH: 83-84, pl. 4, fig. 5-7.
1985 *Whiteinella archaeocretacea* PESSAGNO. - CARON: 79, fig. 37 (4-5).
1988 *Whiteinella archaeocretacea* PESSAGNO. - BENITAH et al., p. 324, t-f. 2.
1988 *Whiteinella archaeocretacea* PESSAGNO. - LOEBLICH, p. 462, pl. 496, figs. 7-9.
1989a *Whiteinella archaeocretacea* PESSAGNO. - CHERIF et al., p. 2, fig. 12.

Description: Test low trochospire, chambers oval in outline; peripheral border almost imperforate; equatorial periphery lobulate; umbilicus shallow and wide; 4-5 chambers per whorl, increasing rapidly in size as added, initially globular, later elongated; sutures depressed, radial and straight to slightly curved; wall perforate, surface coarsely rugose; primary aperture extraumbilical to umbilical; portici extending to the centre of the umbilicus and partially covering each other.

Remarks: *W. archaeocretacea* differs from *W. inornata* in lacking an acute and true imperforate peripheral margin; differs from *W. aprica* in having elongated and compressed chambers, sutures more curved between the last-formed chamber, a larger umbilicus and generally smaller number of chambers, increasing more rapidly in size as added; differs from *Archaeoglobigerina blowi* and *A. cretacea* in the absence of a wide imperforate peripheral band bordered by two keels.

Distribution: *W. archaeocretacea* ranges from the Cenomanian to Turonian of France, Lebanon and Germany (Babinot & Tronchetti, 1973; Saint-Marc, 1975; Weidich, 1984) and characterizes the Turonian and Coniacian (Caron, 1985) and it was recorded from the Turonian of England, Mexico, Texas, Algeria, Libya, Egypt, Iran, Israel and Jordan (Jarvis et al., 1988; Pessagno, 1967; Sampo, 1969; Lipson-Benitah et al., 1988; Basha, 1975, 1979). In the studied material, it is found in: J58, Wadi Sir Formation (Turonian); M47, Ghudran Formation (Coniacian).

Whiteinella baltica DOUGLAS and RANKIN, 1969
Pl. 23, Fig. 1.

1969 *Whiteinella baltica* DOUGLAS & RANKIN. - p. 197, text-fig. 9 a-c.
1979a *Whiteinella baltica* DOUGLAS and RANKIN. - ROBASZYNSKI and CARON, p. 174, figs. 35-36.
1980 *Whiteinella baltica* DOUGLAS and RANKIN. - PERYT, pp. 70-71, pl. 23, figs. 4-6.
1983 *Whiteinella baltica* DOUGLAS and RANKIN. - KRASHENINNIKOV et al., p. 805, pl. 7, figs. 4-9.
1985 *Whiteinella baltica* DOUGLAS and RANKIN. - CARON, p. 79, fig. 37 (1-3).

1988 *Whiteinella baltica* DOUGLAS and RANKIN. - LOEBLICH and TAPPAN, p. 462, pl. 496, figs. 1-6.
1988 *Whiteinella baltica* DOUGLAS and RANKIN. - BENITAH et al., p. 324, text-fig. 2.
1989a *Whiteinella baltica* DOUGLAS and RANKIN. - CHERIF et al., pl. 2, fig. 11.

Description: Test low trochospiral, almost bilaterally symmetrical, subquadrate, with strongly lobulate rounded periphery; 4-5 inflated globular chambers, increasing rapidly in size as added; sutures radial and depressed; wall coarsely hispid; primary aperture umbilical, bordered by imperforate flap, covering the shallow, small umbilicus. *W. baltica* differs from *W. archaeocretacea* in having more globular chambers and 4 instead of 5 forming last whorl.

Distribution: *W. baltica* ranges from the upper Cenomanian *cushmani* zone to the top of the *concavata* zone at the base of the Santonian (Caron, 1985). It was recorded from the upper Cenomanian to upper Coniacian of Germany (Weidich, 1984); Coniacian to lower Santonian of Denmark and North Sea (King et al., 1989); base of Campanian of Falkland Plateau (Krasheninnikov, 1983); middle Turonian of Algeria, Israel and Jordan (Benkherouf, 1987; Lipson-Benitah et al., 1988; Al-Bakri, 1990).

In the studied material, it is found in: M31, Fuheis Formation Equivalent (middle Cenomanian), M38; J44, Shueib Formation (upper Cenomanian); M70, Ghudran Formation (Coniacian to Santonian).

Whiteinella brittonensis (LOEBLICH and TAPPAN, 1961)
Pl. 22, Fig. 14 a-b; Pl. 23, Fig. 2 a-c.

1961 *Hedbergella brittonensis* LOEBLICH and TAPPAN, pp. 274-275, pl. 4, figs. 1-2, 8.
1975 *Hedbergella brittonensis* LOEBLICH & TAPPAN. - SAINT-MARC, table 3.
1975 *Hedbergella brittonensis* LOEBLICH & TAPPAN.-BASHA, p. 218-9, pl.15:18-19.
1977 *Hedbergella brittonensis* LOEBLICH and TAPPAN. - CARTER & HART, p. 31, pl.4, figs. 13-15.
1979a *Whiteinella brittonensis* (LOEBLICH and TAPPAN). - ROBASZYNSKI & CARON, p. 180, figs. 37-38.
1984 *Whiteinella brittonensis* (LOEBLICH and TAPPAN).-WEIDICH: 84, pl. 4, fig. 8-10.
1987 *Whiteinella brittonensis* (LOEBLICH and TAPPAN)-BENKHEROUF, p.73, text-fig. 4
1988 *Whiteinella brittonensis* (LOEBLICH and TAPPAN). - LIPSON-BENITAH et al, p. 324, fig. 2.

Description: Test moderately high asymmetrical trochospire, chambers outline circular; equatorial periphery lobulate; 5½-7 globular chambers, increasing gradually in size as added; tightly arranged around deep and broad umbilicus; sutures radial and depressed; wall distinctly pustulose; aperture extraumbilical to umbilical, not extended to the periphery, bordered by a porticus; portici of the preceding apertures remaining visible around the umbilicus and overlapping each other. *W. brittonensis* differs from all other *W.* species in having 6-7 instead of 4-5 chambers in the last whorl; it resembles *W. paradubia*, but the later has a higher trochospire.

Distribution: *W. brittonensis* was recorded from the upper Cenomanian to lower Santonian of Germany (Weidich, 1984); middle Turonian of Israel (Lipson-Benitah et al., 1988); Cenomanian to Turonian of Texas, California, Canada, England, Libya, Algeria, Lebanon and Jordan (Loeblich & Tappan, 1961; Carter & Hart, 1977; Barr, 1972; Benkherouf, 1987; Saint-Marc, 1975; Basha, 1975, 1979).

In the studied material, it is found in: M7a, 20, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M33, 41 and J34, Shueib Formation Equivalent (upper Cenomanian).

Whiteinella inornata (BOLLI, 1957)
Pl. 22, Fig. 17 a-b.

1957	*Globotruncana inornata* BOLLI, pp. 57-58, pl. 13, fig. 5 a-c.
1979	*Praeglobotruncana inornata* (BOLLI). - BASHA, p. 64, pl. 5, fig. 22.
1983	*Globotruncanella inornata* (BOLLI). - KRASHENINNIKOV et al., p.805, pl. 7, figs. 1-3.
1988	*Globotruncanella inornata* (BOLLI). - LIPSON-BENITAH et al., p. 330, pl. J1.
1967	*Whiteinella inornata* (BOLLI). - PESSAGNO, pl. 71, figs. 3-5; pl. 100, fig. 5.
1972	*Whiteinella inornata* (BOLLI). - BABINOT et al., text-fig. 277, table: 2.
1975	*Whiteinella inornata* (BOLLI). - SAINT-MARC, p. 264, pl. 14, figs. 10-11.
1985	*Whiteinella inornata* (BOLLI). - CARON, p. 79, pl. 37, figs. (6-7).

Description: Test of medium size, with flattened sides; outline oval, lobulate; 4-5 oval or reniform chambers, increasing rapidly in size as added; keel indistinct, a faint imperforate band along the compressed peripheral margin, visible when the test is wet. *W. inornata* differs from other *Whiteinella* species by its more acute periphery; differs from *W. archaeocretacea* in the acute and imperforate peripheral margin.

Distribution: *W. inornata* ranges from the Turonian *helvetica* zone to the lower part of the Santonian *asymetrica* zone (Caron, 1985). It was recorded from the Turonian of Mexico, Texas, Trinidad, Atlantic Ocean and Egypt (Bandy, 1967; Pessagno, 1967; Krasheninnikov, 1983; Ansary & Emara, 1962); Cenomanian to Turonian of France and Lebanon (Babinot & Tronchetti, 1973; Saint-Marc, 1975); upper Cenomanian to Maastrichtian and also from the middle Turonian of Israel (Reiss, 1957; Lipson-Benitah et al., 1988),; upper Cenomanian to lower Santonian of Jordan (Basha, 1975, 1979; Al-Harithi, 1982; Al-Bakri, 1990; Koch, 1968).

In the studied material, it is found in: J25, Fuheis Formation (middle Cenomanian), J34, M33, 39, 41, Shueib Formation Equivalent (upper Cenomanian); J58, Wadi Sir Formation (Turonian), M47, 70, Ghudran Formation (Coniacian to Santonian).

Subfamily: **HELVETOGLOBOTRUNCANINAE** LAMOLDA, 1976
Genus: **Concavatotruncana** KORCHAGIN, 1982

The genus *Concavatotruncana* includes species referred to *Dicarinella* in Robaszynski & Caron (1979b), and Caron (1985). However, the type species of *Dicarinella* is unrecognizable and of uncertain stratigraphic occurrence Loeblich and Tappan (1988). *Concavatotruncana* differs from *Marginotruncana* HOFKER in having depressed and radial umbilical sutures. In the studied material, the following four species belonging to *Concavatotruncana* were found in Ghudran Formation (Coniacian to Santonian): *C. algeriana, C.* sp. cf. *asymetrica, C. concavata* and *C. imbricata.*

Concavatotruncana algeriana (Caron, 1966)
(Figure not given)

1966 *Globotruncana algeriana* CARON, p. 35, fig. 35.
1979a *Dicarinella algeriana* (CARON). - ROBASZYNSKI and CARON, p. 60, pl. 50.
1985 *Dicarinella algeriana* (CARON). - CARON, p. 43, fig. 17 (1-2).

Description: Test low to moderate trochospiral, biconvex; equatorial perphery lobulate, periphery truncate with two imperforate keels separated by a depressed and narrow imperforate peripheral band; keels indistinct in the last chamber; 5-7 chambers triangular to trapezoidal in shape, with surface covered by pustules mainly in the early chambers; sutures curved on the spiral side, radial and depressed on the umbilical; umbilicus small, one third to one forth of the maximum diameter of the test; primary aperture extraumbilical to umbilical, not extending to the periphery, bordered by a lip.

Remarks: *C. algeriana* differs from *P. stephani* in having two keels clearly separated by a narrow imperforate peripheral band.

Distribution: *C. algeriana* ranges from the top of *R. cushmani* Zone to the top of *H. helvetica* Zone (uppermost Cenomanian to middle Turonian) (Caron, 1985). In the studied material, it is found in: Q27, Fuheis Formation Equivalent (middle Cenomanian), and from Q34 and Q37, Wadi Sir formation (Turonian).

Concavatotruncana sp. cf. ***asymetrica*** (SIGAL, 1952)
Pl. 23, Fig. 5 a-c.

1952 *Globotruncana asymetrica* SIGAL, p. 35, fig. 35.
1955 *Globotruncana (Globotruncana) ventricosa* WHITE subsp. *carinata* DALBIEZ. - DALBIEZ, p. 171, fig. 8 a-c.
1979a *Dicarinella asymetrica* (SIGAL). - ROBASZYNSKI and CARON, p. 66, pl. 51, 52, 55.
1984 *Dicarinella asymetrica* (SIGAL). - WEIDICH, pp. 35, 93, pl. 15, figs. 13-15.
1985 *Dicarinella asymetrica* (SIGAL). - CARON, p. 43, fig. 17 (3-4).
1985 *Dicarinella asymetrica* (SIGAL). - REISS, p. 155, text-fig. 4.
1987 *Dicarinella asymetrica* (SIGAL). - WEIDICH, p. 53, pl. 1, figs. 4-5.
1991 *Dicarinella asymetrica* (SIGAL). - ALMOGI-LABIN et al., p. 45, text-fig. 4.

Description: Test very low trochospiral, asymmetrical, planoconvex to concavoconvex, spiral side most often slightly concave, umbilical side strongly convex; equatorial periphery lobulate with a closely spaced double keel, distinctly beaded; chambers 5-6 petaloid on spiral side, angular subconical, strongly inflated with a rugose surface on the umbilical side, pustules concentrate around the umbilicus forming a periumbilical ridge; sutures on spiral side oblique, slightly thickened to gently beaded, on umbilical side radial and depressed; wall perforate; primary aperture umbilical to slightly extraumbilical bordered by well developed portici.

Remarks: Two closely spaced keels give a typical profile with prolongation of the second keel surrounding the umbilicus. *C. asymetrica* differs from *C. concavata* in the presence of a well developed periumbilical ridge; differs from *Marginotruncana paraconcavata* in having radial sutures and from *Globotruncana ventricosa* in the presence of portici covering the umbilical to extraumbilical primary aperture.

Distribution: *C. asymetrica* is recorded through the Santonian (Caron, 1985) and was reported from the Santonian to lower Campanian of Germany, Israel and Tunisia (Weidich, 1984; Reiss, 1985, Almogi-Labin et al., 1991; Postuma, 1971). In the studied material, it is found only in M47, Ghudran Formation (Santonian).

Concavatotruncana concavata (BROTZEN, 1934)
Pl. 23, Fig. 7 a-c; Pl. 25, Fig. 5 a-c.

1934 *Rotalia concavata* BROTZEN, p. 66, pl. 3, fig. b.
1975 *Marginotruncana concavata* (BROTZEN). - SAINT-MARC, p. 266, pl. 14, figs. 19-20
1990 *Globotruncana concavata* (BROTZEN). - AL-HARITHI, p. 516, pl. 4 (8-10).
1979b *Dicarinella concavata* (BROTZEN). - ROBASZYNSKI & CARON, p. 77-78, pl. 54: 1-2; pl. 55, fig. 1.
1985 *Dicarinella concavata* (BROTZEN). - CARON, p. 45, fig. 17 (7-8).
1985 *Dicarinella concavata* (BROTZEN). - REISS, p. 155, text-fig. 4.
1987 *Dicarinella concavata* (BROTZEN). - WEIDICH, p. 53, pl. 1, figs. 1-3.
1991 *Dicarinella concavata* (BROTZEN). - ALMOGI-LABIN et al., p. 45, t-fig. 4.
1988 *Concavatotruncana concavata* (BROTZEN). - LOEBLICH & TAPPAN, p. 463, pl. 498, figs. 1-3.

Description: Test trochospiral, laterally asymmetrical, plano-convex to cocavo-convex; early chambers globular shaped; periphery bicarinate, lobulate, with two close keels; 5-6 inflated chambers, umbilically sutures radial, curved and depressed around broad umbilicus, spirally petaloid chambers, early chambers elevated above outer whorl with rugose surface; surface of last chamber often somewhat concave; angle between faces of last chambers eaquals 70°-90°, thin imporforate carinal band.

Remarks: Compared with *C. asymetrica* no keel surrounds umbilicus. *C. concavata* differs from *C. primitiva* in having more strongly inflated chambers umbilically. It is similar to *C. canaliculata*, but differs in having two close keels.

Distribution: *C. concavata* is widely reported to range from the middle Coniacian to upper Santonian (Caron, 1985). It was recorded from the upper Senonian of Lebanon, Syria and North Africa (Saint-Marc, 1975; El-Ejel, 1967; Lehman, 1966; Andrawis, 1976); Santonian to lower Campanian of Tunisia and Texas, USA (Postuma, 1971;

Masters, 1977); middle Coniacian to upper Santonian of Israel and Jordan (Reiss, 1985; Almogi-Labin et al., 1991; Koch, 1968; Bayliss, 1973; Al-Harithi, 1982, 1986, 1990). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian), M86 (lower Campanian), Amman Formation.

Concavatotruncana imbricata (MORNOD, 1949)
Pl. 23, Fig. 6 a-c.

1949-50 *Globotruncana (Globotruncana) imbricata* MORNOD, pp. 589-590, text-fig. 5 (II a-c, III a-d); pl. 15, figs. 21-34.
1990 *Globotruncana* sp. cf. *imbricata* MORNOD. - AL-HARITHI, p. 516, fig. 5 (1-3).
1979 *Dicarinella imbricata* (MORNOD). - ROBASZYNSKI & CARON, p. 92, figs. 58-59.
1984 *Dicarinella imbricata* (MORNOD). - WEIDICH, pp. 35, 95, pl. 12, figs. 1-3.
1985 *Dicarinella imbricata* (MORNOD). - CARON, p. 45, fig. 18 (4, 5).
1988 *Marginotruncana imbricata* (MORNOD). - JARVIS et al., pp. 22-23, t-fig. 6.
1988 *Marginotruncana imbricata* (MORNOD). - LIPSON-BENITAH et al., p. 334, f. 5 o.
1990 *Concavatotruncana imbricata* (MORNOD). - AL-BAKRI, p. 6, figs. 13-14; pl. 7, fig. 1.

Description: Test trochospiral, convexo-concave, spiral side convex, umbilical side concave; double keel beaded, dorsal keel running obliquely to horizontal plane, giving an imbricated arrangement of chambers; 4-6 chambers in the final whorl, surface on spiral side flat or slightly convex, trapezoidal on umbilical side; spiral sutures convex, curved, umbilical sutures depressed, straight, radial; umbilicus small, deep; primary aperture extraumbilical to umbilical, portici broken in the material studied.

Remarks: *C. imbricata* has the last formed two chambers shifted towards the umbilicus, which may be without a keel. The keel-band diverges obliquely from one chamber to the next, forming an imbricated sequence. *C. imbricata* differs from other *Concavatotruncana* species by this characteristic imbricated aspect of the sequence of its chambers.

Distribution: *C. imbricata* ranges from the middle of *archaeocretacea* Zone to the middle of *concavata* Zone (lower Turonian to Coniacian) (Caron, 1985). It was reported from the same age in Tunisia and California (Postuma, 1971); upper Cenomanian to Turonian of England (Jarvis et al., 1988); upper Cenomanian to Santonian of Germany (Weidich, 1984); Coniacian to Santonian of Czechoslovakia; lower Turonian of the Gulf Coast Plain, USA, Austrailia, Switzerland, France and Poland (Peryt, 1980); middle Turonian of Israel (Lipson-Benitah et al., 1988); Santonian of Jordan (Al-Harithi, 1982, 1986, 1990; Al-Bakri, 1990). In the studied material, few tests of this species were found in M47, Ghudran Formation (Coniacian to Santonian).

Family: **FAVUSELLIDAE** LONGORIA, 1974
Genus: **Favusella** MICHAEL, 1973

Favusella washitensis (CARSEY, 1926)
Pl. 23, Fig. 8 a-b.

1926 *Globigerina washitensis* CARSEY, p. 44, pl. 7, fig. 10; pl. 8, fig. 2.
1975 *Hedbergella washitensis* (CARSEY). - BASHA, pp. 224-225, pl. 16, fig. 4-5.
1975 *Hedbergella washitensis* (CARSEY). - SAINT-MARC, p. 260, pl. 19, fs. 8-9.
1976 *Hedbergella washitensis* (CARSEY). - ANDRAWIS, p. 18, 34, pl. II, fig. 10.
1977 *Hedbergella washitensis* (CARSEY). - CARTER & HART, pp. 37-38, pl. 2, fig. 16.
1984 *Favusella washitensis* (CARSEY). - WEIDICH, pp. 82-83, pl. 3, figs. 18-20.
1985 *Favusella washitensis* (CARSEY). - CARON, p. 45, pl. 25 (25-26).
1989a *Favusella washitensis* (CARSEY). - CHERIF et al., p. 2, pl. 7.

Description: Test free, small, low to high trochospiral coil, periphery lobate, umbilicus small, shallow; chambers subspherical to spherical, 4-5 in the last whorl; sutures radial to slightly curved, depressed; wall calcareous, microperforate, surface covered by a reticulate network of fine to coarse ridges, giving the test a characteristic honeycomb pattern; aperture a low to moderate, interiomarginal umbilical arch, bordered by a narrow lip. *F. washitensis* is easily recognizable by the strong reticulate ornamentation on all chambers which gives the test a honeycomb appearance.

Distribution: *F. washitensis* was originally described from the Cenomanian of Texas and recorded later from the Albian to Cenomanian at many localities in the Western Hemisphere, Europe, Libya, Egypt, Israel, Lebanon, Algeria and Tunisia (Carter & Hart, 1977; Barr, 1972; Andrawis, 1976; Hamaoui, 1979; Saint-Marc, 1975; Benkherouf, 1987; Postuma, 1971; Weidich, 1984). In the studied material, it is found in: Q20, Na'ur Formation (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian).

Family: **ROTALIPORIDAE** SIGAL, 1958
Subfamily: **TICINELLINAE** LONGORIA, 1974
Genus: **Anaticinella** EICHER, 1973

Anaticinella multiloculata (MORROW, 1934)
Pl. 23, Fig. 9 a-b.

1934 *Globorotalia ? multiloculata* MORROW, p. 200, pl. 31, fig. 3a-b, 5a-b
1970 *Ticinella multiloculata* (MORROW). - EICHER & WORSTELL, p. 312, pl. 13, fig. 2, 4.
1977 *Rotalipora multiloculata* (MORROW). - MASTERS: 34, fig. 2-5.
1988 *Anaticinella multiloculata* (MORROW). - LOEBLICH, p. 467, pl. 501, fig. 7-14

Description: Test free, relatively large, compressed, with a low trochospiral coil, spiral side convex, umbilicus broad and rather deep, peripheral outline lobulate, periphery broadly rounded; 6-9 inflated chambers in the final whorl, commonly 8, not keeled at their periphery, increasing gradually in size; sutures straight to gently curved, radial, strongly depressed; wall calcareous, finely perforate, surface smooth to faintly papillose; primary aperture a low interiomarginal, umbilical to extraumbilical arch, bordered by a narrow lip.

Remarks: *Anaticinella* differs from *Rotalipora* by having a nonkeeled periphery. *A. multiloculata* differs from *A. roberti* in having a very broad umbilical area, and large open-arched supplementary apertures that are almost umbilical in position rather than along the sutures.

Distribution: *A. multiloculata* was recorded from the middle Cenomanian to lower Turonian of Texas and Dakota, USA (Loeblich & Tappan, 1988); Cenomanian of Kansas, USA (Masters, 1977). In the studied material, it is found in: J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); M74, Ghudran Formation (Coniacian to Santonian).

Superfamily: **GLOBOTRUNCANACEA** BROTZEN, 1942
Family: **GLOBOTRUNCANIDAE** BROTZEN, 1942
Subfamily: **GLOBOTRUNCANINAE** BROTZEN, 1942
Genus: **Contusotruncana** KORCHAGIN, 1982

Contusotruncana fornicata (PLUMMER, 1931)
Pl. 24, Figs. 2 a-c, 3 a-b; Pl. 28, Fig. a-c.

1931 *Globotruncana fornicata* PLUMMER, p. 130, pl. 13, fig. 4 a-c.
1990 *Globotruncana fornicata* PLUMMER. - AL-HARITHI, p. 516, fig. 2 (13-14).
1975 *Marginotruncana fornicata* (PLUMMER). - SAINT-MARC, Table 3.
1984 *Rosita fornicata* (PLUMMER). - ROBASZYNSKI et al., p. 250, pl. 38, f. 1-5.
1985 *Rosita fornicata* (PLUMMER). - CARON, p. 67, fig. 28 (3-4).
1989b *Rosita fornicata* (PLUMMER). - CHERIF et al., p. 1, pl. 5; pl. 2, fig. 13.
1991 *Rosita fornicata* (PLUMMER). - ALMOGI-LABIN et al., p. 45, text-fig. 4.
1988 *Contusotruncana fornicata* (PLUMMER). - LOEBLICH & TAPPAN, p. 468, pl. 503, figs. 1-7.

Description: Test low to moderately high trochospiral, spiroconvex, slightly convex to umbilico-concave; axial periphery angular, truncate by well developed double keel, usually reflected umbilically, equatorial periphery nearly circular, slightly lobate; chambers 4-5 increasing slowly in size as added, narrow, elongated spirally, crescent-shaped and crenulate, strongly overlapping on spiral side; spiral sutures strongly curved, very oblique, raised and beaded, umbilical sutures curved, thickened by adumbilical extension of umbilical keel; wall initially pustulose, later smooth on spiral side, slightly pustulose on umbilical side with broad and deep umbilicus; primary aperture interiomarginal, umbilical; tegilla broken in material studied.

Remarks: *C. fornicata* differs from *C. plummerae* in possessing more chambers in the final whorl, a smooth wall, and non-inflated chambers on the spiral side; differs from *C. patelliformis* mainly in being less spiroconvex and in having a rounded equatorial periphery.

Distribution: *C. fornicata* ranges from the top of *concavata* Zone to about the middle of the *gansseri* Zone (Santonian to the middle part of the Maastrichtian)

(Robaszynski, 1984; Caron, 1985). It was recorded from the Coniacian to Maastrichtian of Tunisia, Lebanon and Israel (Postuma, 1971; Saint-Marc, 1975; Reiss, 1985; Almogi-Labin et al., 1991); Coniacian to upper Campanian of Germany (Weidich, 1984); middle Campanian to lower Maastrichtian of Libya and Egypt (Barr, 1972; Andrawis, 1976); Santonian to Maastrichtian of Israel and Jordan (Reiss, 1952; Koch, 1968; Yassini, 1978; Al-Harithi, 1982, 1990). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M87, 90, 91, Amman Formation (Campanian).

Contusotruncana patelliformis (GANDOLFI, 1955)
Pl. 27, Fig. 7 a-c.

1955 *Globotruncana contusa patelliformis* GANDOLFI, p. 54, pl. 4, fig. 2.
1978 *Globotruncana patelliformis* GANDOLFI. - YASSINI, p. 25, pl. 5, figs. 4-5.
1980 *Globotruncana patelliformis* GANDOLFI. - PERYT, pp. 77-78, pl. 20, f. 13.
1984 *Rosita patelliformis* (GANDOLFI). - ROBASZYNSKI et al., p. 252, pl. 39, figs. 1-3.
1982 *Contusotruncana* KORCHAGIN. - LOEBLICH and TAPPAN, p. 119.

Description: Test with high trochospire, spiral side strongly convex, umbilical side flat; equatorial periphery nearly circular with 2 distinct keels, beaded, except the ultimate chamber being poorly marked; 4 chambers narrow, elongate, crenulate and strongly overlapping, crescentic on spiral side; sutures strongly curved, raised and beaded on umbilical side; wall initially pustulose, later smooth; umbilicus very deep, narrow; primary aperture interiomarginal, umbilical, tegilla broken.

Remarks: *C. patelliformis* differs from *C. fornicata* in having a higher trochospire, leading to an asymmetrical profile with a flat to concave umbilical side; differs from *C. contusa* in having generally smaller size, a lower trochospire, a more, nearly circular, peripheral outline and lacking pronounced spiral plications.

Distribution: *C. patelliformis* ranges from the lower Campanian to middle Maastrichtian (Robaszynski et al., 1984) and was recorded from the lower Maastrichtian of Egypt, Poland and Jordan (Peryt, 1980; Yassini, 1978). In the studied material, it is found in: M87, Amman Formation (Campanian).

Contusotruncana plummerae (GANDOLFI, 1955)
Pl. 24, Fig. 4 a-c.

1955 *Globotruncana fornicata plummerae* GANDOLFI, p. 4, pl. 2, figs. 3-4.
1973 *Globotruncana* sp. cf. *plummerae* GANDOLFI. - BAYLISS, p. 2, fig. 2 a-c.
1983 *Globotruncana plummerae* (GANDOLFI). - KRASHENINNIKOV and BASOV, p. 806, pl. 7, figs. 11-13.
1986 *Globotruncana plummerae* (GANDOLFI). - AL-HARITHI, p. 39, pl. 8, figs. 3, 5-6.
1984 *Rosita plummerae* (GANDOLFI). - ROBASZYNSKI et al., p. 256, pl. 41, figs. 1-6.
1990 *Rosita plummerae* (GANDOLFI). - ALMOGI-LABIN et al., p. 45, text-fig. 3.
1982 *Contusotruncana* KORCHAGIN. - LOEBLICH and TAPPAN, p. 119.

Remarks: Characteristic features of *C. plummerae* are small initial whorls, rapidly enlarging final whorl consisting of 4 chambers with inflated surface, and double-keeled periphery with wide intrakeeled band. It differs from *C. fornicata* in possessing vaulted, spinose chambers spirally and in weakly marked, often slightly depressed, curved sutures on both sides.

Distribution: *C. plummerae* ranges from the *elevata* Zone to the lower part of the *gansseri* Zone (Campanian and the lower and middle parts of the Maastrichtian) (Robaszynski et al., 1984). It was recorded from the upper Campanian to lower Maastrichtian of Israel (Almogi-Labin et al., 1990); Santonian to lower Maastrichtian of Palestine and Jordan (Bayliss, 1973; Al-Harithi, 1986). In the studied material, it is found in: M87, 90, Amman Formation (Campanian).

Genus: **Globotruncana** CUSHMAN, 1927

Globotruncana arca (CUSHMAN, 1926)
Pl. 24, Fig. 6 a-c.

1926 *Pulvinulina arca* CUSHMAN, p. 23, pl. 3, fig. 1 a-c.
1984 *Globotruncana arca* (CUSHMAN). - WEIDICH, p. 102, pl. 18, figs. 1-3.
1984 *Globotruncana arca* (CUSHMAN). - ROBASZYNSKI et al., pp. 182-184, pl. 4, figs. 1-3.
1985 *Globotruncana arca* (CUSHMAN). - CARON, p. 50, fig. 19 (4-8).
1985 *Globotruncana arca* (CUSHMAN). - REISS, p. 155, text-fig. 4.
1986 *Globotruncana arca* (CUSHMAN). - AL-HARITHI, pl. 11, figs. 4-5; pl. 15, fig. 8.
1988 *Globotruncana arca* (CUSHMAN). - LOEBLICH & TAPPAN, p. 504, figs. 1-7.
1989 *Globotruncana arca* (CUSHMAN). - ISMAIL, p. 151, pl. 9, fig. 1 a-b.
1989b *Globotruncana arca* (CUSHMAN). - CHERIF et al., p. 1, fig. 7.
1991 *Globotruncana arca* (CUSHMAN). - ALMOGI-LABIN et al., p. 45, t-fig. 4.

Description: *G. arca* is recognized by the presence of 2 keels, separated by a large imperforate peripheral band, trochospiral, asymmetrically biconvex test with more convex spiral side, less convex umbilical one, and wide depressed umbilicus; chambers 6-7 in the final whorl, petaloid on the spiral side; surface pustulose.

Remarks: *G. arca* differs from *G. mariei* in its slower increase of chamber size, its greater number of chambers and its 2 well-marked keels; differs from *G. rosetta* in often having a more convex spiral side, in a slower increase of chamber size, in the presence of 2 keels on all chambers, and separated by a wider imperforate peripheral band; differs from *G. orientalis* in the presence of 2 keels on all chambers, separated by a wider peripheral band, and in having often more curved sutures on the spiral side; differs from *G. linneiana* in its distinctly more convex spiral side and its keel band which is more oblique with respect to the coiling axis.

Distribution: *G. arca* ranges from the top of *asymetrica* Zone to within the *mayaroensis* Zone (Santonian to Maastrichtian) (Caron, 1985). It was recorded from the Coniacian to Campanian of Germany (Weidich, 1984); lower Campanian to upper Maastrichtian of Netherlands, Tunisia, Egypt Israel, Palestine and Jordan (Robaszynski et al., 1985; Postuma, 1971; Ismail, 1989; Reiss, 1985; Almogi-Labin et al., 1991; Koch, 1968; Bayliss, 1973; Yassini, 1978; Al-Harithi, 1986). In the studied material, it is found in: M90, 91, Amman Formation (Campanian).

Globotruncana bulloides VOGLER, 1941
Pl. 25, Fig. 1 a-c.

1941	*Globotruncana linnei* (D'ORBIGNY) subsp. *bulloides* VOGLER, p. 287, pl. 23, figs. 32-39.
1983	*Globotruncana bulloides* VOGLER-KRASHENINNIKOV et al., p. 806, pl. 10, figs. 4-9.
1984	*Globotruncana bulloides* VOGLER. - ROBASZYNSKI et al., p. 186, fig. 6 (1-4).
1985	*Globotruncana bulloides* VOGLER. - CARON, p. 50, fig. 20 (1-2).
1988	*Globotruncana bulloides* VOGLER. - LOEBLICH & TAPPAN, p. 504, figs. 8-10.
1989	*Globotruncana bulloides* VOGLER. - ISMAIL, pp. 151-152, pl. 9, fig. 2 a-b.
1989b	*Globotruncana bulloides* VOGLER. - CHERIF et al., p. 1, fig. 8.
1990	*Globotruncana bulloides* VOGLER. - ALMOGI-LABIN et al., p. 45, t-fig. 3.

Description: Test free, middle-sized, low trochospiral, biconvex, with slightly convex spiral side and almost flat umbilical side, equatorial periphery lobate, umbilicus broad and deep, surface pustulose; 6-7 chambers in the final whorl, petaloid on the spiral side and oval on the umbilical side, distinctly inflated on both sides, with slightly pustulose surface; profile truncated with two well-developed keels, seperated by a widely spaced perforated band, slightly tilted towards umbilicus; spiral sutures curved, weakly beaded, umbilical sutures nearly radial, depressed; primary aperture umbilical, tegilla rarely preserved in the material examined.

Remarks: *G. bulloides* differs from *G. linneiana* in the inflated chambers on both umbilical and spiral sides; differs from *Marginotruncana marginata* in having an umbilical primary aperture and in the presence of tegilla; differs from *C. plummerae* in having less elongated chambers, an almost symmetrical biconvex profile, and in the presence of tegilla.

Distribution: *G. bulloides* ranges from the *asymetrica* Zone to the *falsostuarti* Zone (upper part of the Santonian to the lower part of the Maastrichtian) (Robaszynski et al., 1984; Caron, 1985). It was recorded from the Santonian to Maastrichtian of Tunisia (Postuma, 1971); Santonian to Campanian and Maastrichtian of Israel (Almogi-Labin et al., 1990); Coniacian to Campanian of Germany (Weidich, 1984); Santonian of Jordan (Koch, 1968; Al-Harithi, 1982, 1986). In the studied material, it is found in: M90, Amman Formation (Campanian).

Globotruncana linneiana (D'ORBIGNY, 1839)
Pl. 25, Fig. 3 a-b.

1839	*Rosalina linneiana* D'ORBIGNY, p. 101, pl. 15, figs. 10-12.

1983 *Globotruncana linneiana* (D'ORBIGNY). - KRASHENINN. et al., p. 806, pl. 9, figs. 4-6
1984 *Globotruncana linneiana* (D'ORBIGNY). - ROBASZYNSKI et al., pp. 200-202, pl. 13, figs. 1-4; pl. 14, figs. 1-5.
1985 *Globotruncana linneiana* (D'ORBIGNY). - CARON, p. 50, fig. 20 (5-6).
1987 *Globotruncana linneiana* (D'ORBIGNY). - WEIDICH, p. 54, pl. 1, fig. 9; pl. 2, figs. 1-10.
1988 *Globotruncana linneiana* (D'ORBIGNY). - LOEBLICH & TAPPAN, p. 505, figs. 1-4.
1989b *Globotruncana linneiana* (D'ORBIGNY). - CHERIF et al., p. 1, fig. 10.
1990 *Globotruncana linneiana* (D'ORBIGNY). - ALMOGI-LABIN et al., p. 45, fig. 3.

Remarks: *G. linneiana* is characterized in side view by its box-like shape with two well raised and widely spaced keels. It differs from *G. lapparenti* in its stout keels; differs from *G. bulloides* in the flat to slightly convex, not inflated, chambers; differs from *G. arca* in an almost symmetrical biconvex profile and in a keel band which is parallel to the coiling axis or only very slightly tilted; differs from *G. ventricosa* in having an almost symmetrical biconvex profile; and differs from *Marginotruncana pseudolinneiana* in the umbilical position of the primary aperture, always protected by a well developed tegillum, having larger test, more numerous chambers (6-7), thicker keels, more ornamental sutures on the spiral and umbilical sides; petaloid chambers gradually enlarging in size as added; the arrangement of chambers is more tight and outline is weakly lobulate.

Distribution: *G. linneiana* ranges from the *concavata* Zone to the middle of the *gansseri* Zone (Coniacian to Maastrichtian p.p.) (Robaszynski et al., 1984; Caron, 1985). It was recorded from the Coniacian to upper Campanian of Germany (Weidich, 1984, 1987); Santonian to lower Maastrichtian of many areas of Europe and America,; Santonian to Campanian of the Falkland Plareau, South Atlantic (Dobson et al., 1976; Krasheninnikov, 1983); Santonian to middle Campanian of Libya, Egypt and Israel (Barr, 1972; Andrawis, 1976; Mimran et al., 1985; Almogi-Labin et al., 1990); lower Maastrichtian of Palestine and Jordan (Bayliss, 1973; Yassini, 1978). In the studied material, it is found in: M47, 70, Ghudran Formation (Coniacian to Santonian).

Globotruncana mariei BANNER and BLOW, 1960
Pl. 24, Fig. 7 a-c; Pl. 25, Fig. 2 a-c.

1960 *Globotruncana mariei* BANNER & BLOW, p. 8, pl. 11, fig. 6 a-c.
1968 *Globotruncana mariei* BANNER and BLOW. - SLITER, p. 105, pl. 17, figs. 7-8.
1972 *Globotruncana mariei* BANNER & BLOW. - BARR, p. 22, pl. 5, fig. 6 a-c.
1984 *Globotruncana mariei* BANNER and BLOW. - ROBASZYNSKI et al., p. 204, pl. 15, figs. 1-6.
1990 *Globotruncana mariei* BANNER and BLOW. - ALMOGI-LABIN et al, p. 45, text-fig. 3.

Description: Test low trochospiral, biconvex, axial periphery acute to slightly truncate, initially with two keels, umbilical keel being weaker; chambers 5-6 in the last whorl, increasing gradually in size, broadly petaloid on spiral side, subpetaloid on umbilical side; sutures curved, limbate, flush to slightly elevated, beaded on spiral side, radial to slightly curved, depressed on umbilical side; wall calcareous, perforate, surface initially beaded, later smooth; umbilicus moderately wide and deep; primary aperture interiomarginal, umbilical, covered by tegilla.

Remarks: *G. mariei* differs from *G. rosetta* in the presence of two keels on all chambers and often in more convex spiral side; differs from *G. arca* in its narrow keel band which is less tilted towards the umbilical side, and in a more rapid increase in chamber size, in having less chambers in the final whorl and smaller size; differs from *G. linneiana* in having a narrow keel band, a more rapid increase in chamber size, more elongated chambers on the umbilical side and acute angles formed by the sutures and the spiral suture at the spiral side.

Distribution: *G. mariei* ranges from the top of the *asymetrica* Zone to the middle part of the *gansseri* Zone (uppermost part of the Santonian to Maastrichtian p. p.) (Robaszynski et al., 1984). It was recorded from the lower and middle of Maastrichtian and Santonian/Campanian boundary of Israel (Almogi-Labin et al., 1990, 1991); Maastrichtian of Libya (Barr, 1972). In the studied material, it is found in: M87, 90, 91, Amman Formation (Campanian).

Globotruncana orientalis EL NAGGAR, 1966
Pl. 23, Figs. 3, 4 a-b.

1966 *Globotruncana orientalis* EL NAGGAR, p. 125, pl. 12, fig. 4a-d, text-fig. 16.
1967 *Globotruncana stephensoni* PESSAGNO. - PESSAGNO, pp. 354-356, pl. 69, figs. 4-6.
1977 *Globotruncana orientalis* EL NAGGAR. - LINARES, pp. 8-10.
1980 *Globotruncana orientalis* EL NAGGAR. - WONDERS, p. 136.
1983 *Globotruncana orientalis* EL NAGGAR. - EL NAGG., ASHOUR, p. 4, pl. 1, 5, fig. 12.
1984 *Globotruncana orientalis* EL NAGGAR. - ROBASZYNSKI et al., pp. 206-208, figs. 16-17.
1991 *Globotruncana orientalis* EL NAGGAR. - ALMOGI-LABIN et al., p. 45, text-fig. 4.

Description: Test with moderately high trochospiral coil, profile symmetrical to slightly asymmetrical, two parallel keels, separated by a narrow imperforate peripheral band, tilted towards the umbilical side; outline slightly lobate to subcircular; chambers 5-7, increasing slowly to moderately in size as added, spirally crescent-shaped to petaloid, surface initially sometimes pustulose, later smooth and flat, umbilically chambers rectangular to trapezoidal with smooth surface; umbilical sutures curved, depressed, spirally slightly curved to straight, raised and beaded, joining the spiral suture at almost right angles, sutures and peripheral keel forming an obtuse angle, adumbilical ridges developed in the first chambers, tangential to oblique, forming a horse-shoe shaped pattern; primary aperture umbilical, with a system composed of large tegilla.

Remarks: *G. orientalis* differs from *G. arca* in its closely-spaced keels, the single keel often present on the last chamber, in its less lobate periphery, and its spiral sutures being staighter; differs from *G. rosetta* essentially in having a slower increase in chamber size; differs from *G. falsostuarti* mainly in having parallel keels which do not join at the middle of the chambers, and in less petaloid spiral chamber form.

Distribution: *G. orientalis* ranges from the middle of the *elevata* Zone to the middle of the *gansseri* Zone (Campanian p.p. and Maastrichtian p. p.) (Robaszynski et al., 1984). It was recorded from the lower Campanian to middle Maastrichtian in Egypt, USA, Spain and southern Atlantic (El Naggar, 1966; Pessagno, 1967; Wonders, 1980; Linares, 1977; Weiss, 1980); Santonian to Campanian of Israel (Almogi-Labin et al., 1991). In the studied material, it is found in: M70, 71, Ghudran Formation (Santonian), M86, 90, 91, Amman Formation (Campanian).

Globotruncana rosetta (CARSEY, 1926)
Pl. 24, Fig. 5 a-c.

1926 *Globigerina rosetta* CARSEY, p. 44, pl. 5, fig. 3 a-c.
1987 *Globotruncana rosetta rosetta* (CARSEY). - EL-NAKHAL et al., p. 68, pl. 5, figs. 8-10.
1968 *Globotruncana rosetta* (CARSEY). - SLITER, pp. 105-106, pl. 18, figs. 3-4.
1977 *Globotruncana rosetta* (CARSEY). - MASTERS, p. 52, fig. 1.
1984 *Globotruncana rosetta* (CARSEY). - ROBASZYNSKI et al., p. 210, f. 51-53.
1986 *Globotruncana rosetta* (CARSEY). - AL-HARITHI, pl. 14, figs. 3-5; pl. 15, figs. 10, 19.
1990 *Globotruncana rosetta* (CARSEY). - ALMOGI-LABIN et al., text-fig. 3.

Description: Test low trochospiral, planoconvex, umbilical side convex with wide, deep umbilicus; 4-6 chambers in each whorl on the spiral side broadly petaloid to crescentic with a flat surface, outline subcircular, slightly lobate, early chambers globular; sutures strongly curved, raised, beaded and oblique on spiral side, radial and depressed on umbilical side; distict single or double peripheral keel on the edge of spiral side, the umbilical periphery margin consists of a row of pustules; wall calcareous, perforate, surface smooth to pustulose specially on umbilical side, adumbilical ridges absent; aperture interiomarginal, umbilical, covered by tegilla.

Remarks: *G. rosetta* differs from *G. orientalis* in a more rapid increase in chamber size, in having less chambers in the last whorl and in the crescent shaped chambers on the spiral side; differs from *G. mariei* in the presence of only one keel or two close keels on one or more final chambers and in a less convex spiral side; differs from *Globotruncanita elevata* in having depressed sutures, pustulose first chamber on the umbilical side and the absence of adumbilical ridges.

Distribution: *G. rosetta* ranges from the *ventricosa* Zone through the *mayaroensis* Zone (upper part of the Campanian through the Maastrichtian) (Robaszynski et al., 1984). It was recorded from the middle and upper Maastrichtian of Tunisia and Libya (Postuma, 1971; Barr, 1972); upper Campanian to middle Maastrichtian of Egypt, Israel, Palestine and Jordan (Said & Sabry, 1964; Andrawis, 1976; Almogi-Labin et al., 1990; Bayliss, 1973; Koch, 1968; Yassini, 1978; A-Harithi, 1986). In the studied material, it is found in: M91, Amman Formation (Campanian).

Globotruncana rugosa (MARIE, 1941)
Pl. 25, Fig. 4 a-c; Pl. 27, Fig. 3 a-c.

1941 *Rosalinella rugosa* MARIE, p. 240, pl. 36, fig. 240 a-b-c.
1968 *Globotruncana churchi* MARTIN. - SLITER, p. 102, pl. 16, fig. 2 a-c.
1973 *Globotruncana churchi* MARTIN. - SLITER, p. 169, pl. 2, figs. 11-13, t-f. 2.
1980 *Globotruncana churchi* MARTIN. - PERYT, p. 73, pl. 16, fig. 3 a-c.
1984 *Globotruncana rugosa* (MARIE). - ROBASZYNSKI et al., p. 212, pl. 19, figs. 1-5.
1985 *Globotruncana rugosa* (MARIE). - ROBASZYNSKI et al., p 26, text-fig. 16.

Description: Test moderately high trochospiral, umbilical side slightly concave, umbilicus wide; equatorial periphery lobulate, axial periphery truncate, with two keels on all chambers, separated by a wide imperforate peripheral band; final whorl consisting of 5-7 kidney-shaped chambers, slightly inflated, increasing regularly in size as added; spiral sutures curved, raised, beaded, limbate, umbilical sutures depressed, slightly curved, nearly radial; wall calcareous, perforate, surface initially pustulose, later smooth; aperture interiomarginal, umbilical.

Remarks: The Jordanian specimens differ from the holotype in being slightly less trochospiral and in possessing 5-6 chambers in the final whorl. *G. rugosa* differs from *G. arca* in being smaller, having more petaloid chambers, with initial pustules on both sides and in having pronounced keels; and differs from *G. bulloides* in its higher trochospire.

Distribution: *G. rugosa* ranges from ? *ventricosa* Zone through the *calcarata* Zone (about upper half of the Campanian) (Robaszynski et al., 1984). It was recorded from the Campanian of Canada, Austria, Bulgaria and Poland (Peryt, 1980); upper Santonian to Campanian of California, USA (Sliter, 1968); upper Campanian to ? Maastrichtian of Netherlands (Robaszynski et al., 1985). In the studied material, it is found in: M70, 71, Ghudran Formation (Coniacian to Santonian), M86, 90, 91, Amman Formation (Campanian).

Genus: **Globotruncanita** REISS, 1957

Globotruncanita elevata (BROTZEN, 1934)
Pl. 26, Fig. 2 a-c.

1934 *Globorotalia elevata* BROTZEN, p. 66: 3, fig. c.
1986 *Globotruncana elevata* (BROTZEN). - AL-HARITHI, pl. 12, figs. 2, 3, 5; pl. 15, fig. 7.
1987 *Globotruncana elevata* (BROTZEN). - WEIDICH, p. 53, pl. 1, figs. 7-8.
1983 *Globotruncanita elevata* (BROTZEN). - PERYT, pp. 83-84, pl. 20, figs. 2-4.
1984 *Globotruncanita elevata* (BROTZEN). - ROBASZYNSKI et al., pp. 228-230, pl. 27, figs. 1-3; pl. 28, figs. 1-3.
1985 *Globotruncanita elevata* (BROTZEN). - REISS, p. 155, text-fig. 4.

1985 *Globotruncanita elevata* (BROTZEN). - CARON, p. 51, fig. 22 (3-4).
1990 *Globotruncanita elevata* (BROTZEN). - ALMOGI-LABIN et al., p. 45, t-f. 4.

Description: Test arranged in a low trochospiral, characterized by a nearly plano-convex shape. The spiral side is nearly flat except for a small conical central portion. The umbilical side is strongly convex, umbilicus relatively small; sutures on umbilical side radial and depressed; surface smooth except the earliest 3-4 chambers that are coarsely hispid.

Remarks: *G. elevata* differs from *G. stuartiformis* in its distinctly asymmetrical plano-convex profile and crescent-shaped instead of triangular last chambers on the spiral side. It differs from *G. pettersi* and *G. angulata* in a larger number of chambers in the final whorl and in a pronounced central cone on the spiral side. *G. subspinosa* has a more irregular outline and crescent-shaped chambers, which tend to extend backwards.

Distribution: *G. elevata* ranges from the top of the *asymetrica* Zone to the middle of *elevata* Zone (upper Santonian to lower Campanian) (Robaszynski et al., 1984). It was recorded from the Campanian of Germany (Weidich, 1984, 1987); Santonian to Campanian of Israel (Reiss, 1985; Almogi-Labin et al., 1990); upper Coniacian to upper Campanian of Tunisia and Egypt (Postuma, 1971; Barr, 1972; Andrawis, 1976); Campanian to lower Maastrichtian of Libya and South Africa; lower Maastrichtian of Poland (Peryt, 1980),; Santonian to lower Maastrichtian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M91, Amman Formation (Campanian).

Globotruncanita stuartiformis (DALBIEZ, 1955)
Pl. 24, Fig. 1 a-b.

1955 *Globotruncana* (*Globotruncana*) *elevata stuartiformis* DALBIEZ, p. 169, text-fig. 10.
1987 *Globotruncana stuarti stuartiformis* DALBIEZ. - EL-NAKHAL et al., p. 71, pl. 6, figs. 1-3
1968 *Globotruncana stuartiformis* DALBIEZ. - SLITER, pp. 106-107, pl. 18, figs. 5-6.
1971 *Globotruncana stuartiformis* DALBIEZ. - POSTUMA, p. 62, fig. 63.
1978 *Globotruncana stuartiformis* DALBIEZ. - YASSINI, p. 25, pl. 5, figs. 6-12.
1984 *Globotruncana stuartiformis* DALBIEZ. - ROBASZYNSKI et al., p. 238, fig. 32.
1985 *Globotruncana stuartiformis* DALBIEZ. - CARON et al., p. 51, fig. 23 (4-5).
1989 *Globotruncanita stuartiformis* (DALBIEZ). - ISMAIL, p. 154, pl. 10, fig. 3.
1990 *Globotruncanita stuartiformis* (DALBIEZ). - ALMOGI-LABIN et al., p. 45, text-fig. 4.

Description: Test free, low trochospiral, biconvex, profile symmetrical to slightly asymmetrical, axial periphery acute with prominent single keel and sporadic row of pustules simulating second keel; chambers 5-7 in the final whorl, increasing gradually in size, broadly petaloid to subangular on spiral side, subrectangular on umbilical side, with moderately large and deep umbilicus; sutures curved, elevated, limbate and keeled on spiral side, slightly curved, depressed on umbilical side; wall calcareous, perforate, surface smooth on spiral side, smooth to pustulose on umbilical side; primary aperture umbilical, tegilla rarely preserved.

Remarks: *G. stuartiformis* differs from *G. elevata* in a more symmetrical profile, less projected umbilically and in the triangular shape of chambers on the spiral side; differs from *G. stuarti* in having triangular instead of trapezoidal chambers and differs from *G. rosetta* by the more umbilicoconvex test, subangular chambers, and larger size.

Distribution: *G. stuartiformis* ranges from the top of the *asymetrica* Zone through the *mayaroensis* Zone (upper Santonian through Maastrichtian) (Robaszynski, 1984; Caron, 1985). It was reported from the Campanian to middle Maastrichtian of W. Tunisia (Postuma, 1971); Campanian to lower Maastrichtian of Egypt and Israel (Andrawis, 1976; Reiss, 1985; Almogi-Labin et al., 1990); Campanian through Maastrichtian of Jordan (Koch, 1968; Al-Harithi, 1982; Yassini, 1978). In the studied material, it is found in: M87, Amman Formation (Campanian).

Globotruncanita subspinosa (PESSAGNO, 1960)
Pl. 26, Fig. a-c.

1960 *Globotruncana (Globotruncana) subspinosa* PESSAGNO, p. 101, pl. 1, figs. 4-6.
1984 *Globotruncanita subspinosa* (PESSAGNO). - ROBASZYNSKI et al., pp. 240-242, pl. 33, figs. 1-3; pl. 34, figs. 1-3.
1985 *Globotruncanita subspinosa* (PESSAGNO). - REISS, p. 155, text-fig. 4.
1985 *Globotruncanita subspinosa* (PESSAGNO). - CARON, p. 51, fig. 22 (5-8).
1989 *Globotruncanita subspinosa* (PESSAGNO). - ISMAIL, p. 155, pl. 10, fig. 4 a-b.

Remarks: *G. subspinosa* differs from *G. elevata* and from *G. stuartiformis* mainly in the radial elongation of the (5-8) chambers and in the ensuing polygonal outline with concave sides. It differs from *G. stuartiformis* in having crescent-shaped chambers with undulating surfaces and a tendency to extend backwards. These features result in an extremely irregular outline of the test. It also differs from *G. calcarata* principally in the absence of tubulospines.

Distribution: *G. subspinosa* ranges from the middle and upper parts of the Campanian to lower part of Maastrichtian (Robaszynski et al., 1984). It was recorded from the Campanian of Israel (Reiss, 1985). In the studied material, it is found in: M90, 91, Amman Formation (Campanian).

Genus: **Marginotruncana** HOFKER, 1956

The genus *Marginotruncana* comprises forms which started to appear during the Turonian *Helvetoglobotruncana helvetica* zone and which became extinct at the advent of the Campanian. *Marginotruncana* differs from *Concavatotruncana*, which has almost the same stratigraphic range, in its umbilical sigmoidal and raised sutures. In the studied material the following 6 species of *Marginotruncana* were found in Ghudran Formation (upper Coniacian):

M. coronata, M. Marginata, M. paraconcavata,
M. Pseudolinneiana, M. Renzi **and** *M. sinuosa.*

Marginotruncana coronata (BOLLI, 1945)
Pl. 27, Figs. 1 a-c, 2 a-c.

1945 *Globotruncana lapparenti* BROTZEN, subsp. *coronata* BOLLI, figs. 21-22; pl. 9, figs. 14-15, text-fig. 1.
1983 *Globotruncana coronata* BOLLI. - KRASHENINNIKOV et al., p. 806, pl. 9, figs. 7-9.
1990 *Globotruncana coronata* BOLLI. - AL-HARITHI, p. 516, pl. 4 (19).
1975 *Marginotruncana coronata* (BOLLI). - SAINT-MARC, p. 14, figs. 12-13.
1979b *Marginotruncana coronata* (BOLLI). - ROBASZYNSKI and CARON, p. 106, pl. 62, figs. 1-2.
1984 *Marginotruncana coronata* (BOLLI). - WEIDICH, pp. 35, 97, pl. 16, figs. 12-14.
1985 *Marginotruncana coronata* (BOLLI). - CARON, pp. 60-61, fig. 26 (1-2).
1990 *Marginotruncana coronata* (BOLLI). - ALMOGI-LABIN et al., p. 45, fig. 4.

Description: Test large, trochospiral, biconvex, equatorial periphery lobate, axial periphery rounded; test bordered by well developed double keel; 6-8 chambers increasing gradually in size as added, petaloid on spiral side, subrectangular on umbilical side; sutures curved, raised, beaded on spiral side, sigmoidal on umbilical side; umbilicus shallow, broad, bordered by weakly developed, only slightly raised umbilical shoulder; primary aperture extraumbilical to umbilical, covered by portici with accessory apertures.

Remarks: *M. coronata* differs from *M. pseudolinneiana* in its generally larger test size, in having a more compressed profile, apparent most clearly in the final chamber, petaloid chambers on the spiral side and keels closer together.

Distribution: *M. coronata* ranges from the middle Turonian to lower Campanian (Caron, 1985). It was recorded from the Coniacian to Campanian of Tunisia (Postuma, 1971); Coniacian to Santonian of Egypt (Andrawis, 1976); Senonian of Lebanon (Saint-Marc, 1975); Santonian to Campanian of Palestine (Almogi-Labin et al., 1990; Bayliss, 1973); Turonian to Santonian of Libya, Germany and Jordan (Barr, 1972; Weidich, 1984; Koch, 1968; Al-Harithi, 1982, 1986, 1990). In the studied material, it is found in: M90, Amman Formation (Campanian).

Marginotruncana marginata (REUSS, 1845)
Pl. 25, Fig. 6 a-c; Pl. 26, Fig. 6 a-c.

1845 *Rosalina marginata* REUSS, p. 36, pl. 8, figs. 54, 74; pl. 13, fig. 18 a-b.
1982 *Globotruncana marginata* REUSS. - AL-HARITHI, pp. 99-100, pl. 8, fs. 4-6.
1983 *Globotruncana marginata* (REUSS). - KRASHENINNIKOV and BASOV, p. 806, pl. 9, figs. 10-14.
1975 *Marginotruncana marginata* (REUSS). - SAINT-MARC, p. 266, pl. 14, f. 18.

1979b *Marginotruncana marginata* (REUSS). - ROBASZYNSKI and CARON, pp. 113-114, pl. 63, figs. 1-2; pl. 64, figs. 1-2.
1984 *Marginotruncana marginata* (REUSS). - WEIDICH, pp. 35, 98, pl. 16, figs. 1-6.
1985 *Marginotruncana marginata* (REUSS). - CARON, p. 61, fig. 26 (3-4).
1988 *Marginotruncana marginata* (REUSS). - JARVIS et al., text-fig. 8, fig. 12 i-j.
1988 *Marginotruncana marginata* (REUSS). - LIPSON-BENITAH et al., p. 324.
1988 *Marginotruncana marginata* (REUSS). - LOEBLICH & TAPPAN, p. 469, pl. 503, figs. 9-11.
1990 *Marginotruncana marginata* (REUSS). - ALMOGI-LABIN et al., p. 45, text-fig. 4.

Description: Test low trochospiral, biconvex, lobulate; chambers 5-8, petaloid on spiral side, globular and inflated on both sides, with surface smooth or very slightly rugose; spiral sutures oblique, depressed to slightly raised and beaded, umbilical sutures depressed, marked by largely U-shaped sigmoidal rims; two weekly developed keels separated by a narrow peripheral band that sometimes does not truncate the globular profile of the chambers; primary aperture extraumbilical to umbilical, with more or less well developed portici.

Remarks: *M. marginata* differs from other *Marginotruncana* species in having inflated chambers both spirally and umbilically; differs from *C. canaliculata* in umbilical sigmoidal U-shaped and raised sutures; and differs from *G. bulloides*, which has similarly inflated chambers, in the presence of portici.

Distribution: *M. marginata* ranges from the *sigali* Zone to *asymetrica* Zone (upper Turonian to upper Santonian) (Caron, 1985). It was originally described from the upper Turonian and Coniacian of Bohemia, later recorded from the Turonian to Santonian of England, Sweden, Poland and Libya (Jarvis et al., 1988; Peryt, 1980; Barr, 1972); Coniacian to Santonian of Egypt (Andrawis, 1976); Senonian of Lebanon (Saint-Marc, 1975); middle Turonian to upper Campanian of Israel (Lipson-Benitah, 1988; Almogi-Labin et al., 1990); Turonian to Campanian of Germany and Jordan (Weidich, 1984; Al-Harithi, 1982). In the studied material, it is found in: M47, 70, Ghudran Formation (Coniacian to Santonian), M86, 89, 90, 91, Amman Formation (Campanian).

Marginotruncana paraconcavata PORTHAULT, 1970
Pl. 26, Fig. 3 a-c.

1970 *Marginotruncana paraconcavata* PORTHAULT, p. 77, pl. 10, figs. 21-23.
1977 *Marginotruncana paraconcavata* PORTHAULT. - LINARES RODRIGUEZ, pp. 164-166, pl. 15, figs. 1-2.
1979b *Marginotruncana paraconcavata* PORTHAULT. - ROBASZYNSKI and CARON, p. 122, pl. 66, figs. 1-2.
1980 *Marginotruncana paraconcavata* PORTHAULT. - PERYT, p. 63, pl. 14, figs. 3-5.
1984 *Marginotruncana paraconcavata* PORTHAULT. - ROBASZYNSKI et al., text-fig. 8.

1984 *Marginotruncana paraconcavata* PORTHAULT. - WEIDICH, p. 99, pl. 14, figs. 4-6.

Description: Test low trochospiral, planoconvex to biconvex, equatorial periphery subcircular, truncated by closely spaced double keel; 5-7 chambers in the final whorl, petaloid, very slightly elongated in the direction of coiling, subtrapezoidal on umbilical side; spiral sutures curved, raised, obliquely joining the preceding spiral sutures, umbilical sutures slightly curved, raised, beaded, umbilicus broad, bordered by slightly elevated umbilical shoulders; primary aperture extraumbilical to umbilical, portici with accessory infralaminal apertures.

Remarks: *M. paraconcavata* differs from *M. renzi* in being planoconvex; and from *C. concavata* in having sigmoidal sutures on the umbilical side.

Distribution: *M. paraconcavata* ranges from the Turonian to Santonian (Robaszynski et al., 1984). It was recorded from the upper Coniacian to lower Santonian of SE France; upper Turonian to lowermost Campanian of Central Poland (Peryt, 1980). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian).

Marginotruncana pseudolinneiana PESSAGNO, 1967
Pl. 26, Fig. 4 a-c.

1967 *Globotruncana pseudolinneiana* PESSAGNO, p. 310, pl. 65, figs. 24-27; pl. 76, figs. 1-3.
1983 *Globotruncana pseudolinneiana* PESSAGNO. - KRASHENINNIKOV & BASOV, p. 806, pl. 9, figs. 1-3.
1975 *Marginotruncana pseudolinneiana* PESSAGNO. - SAINT-MARC, p. 14, figs. 14-15.
1979b *Marginotruncana pseudolinneiana* PESSAGNO. - ROBASZYNSKI and CARON, p. 128, pls. 67-68, figs. 1-2.
1984 *Marginotruncana pseudolinneiana* PESSAGNO. - WEIDICH, p. 100, pl. 16, figs. 8-11.
1985 *Marginotruncana pseudolinneiana* PESSAGNO. - CARON, p. 61, fig. 26 (7, 8).
1990 *Marginotruncana pseudolinneiana* PESSAGNO. - ALMOGI-LABIN et al., text-fig. 4.

Remarks: *M. pseudolinneiana* is characterized by its strongly developed, widely spaced two keels, rather flat spiral side and 5-7 reniform chambers. It has the same general shape as *G. linneiana*, but differs in having an umbilical to extraumbilical primary aperture. Its portici tend to develop into tegilla with infra-and intra-laminal accessory apertures. Differs from *M. coronata* in its more strongly developed double keel, divided by a wider peripheral band, in having more crescent-shaped chambers, its smaller size, and in its typical rectangular axial profile. Differs from *M. marginata* in having sigmoidal umbilical sutures, stronger and more spaced keels, and in its typical rectangular side view.

Distribution: *M. pseudolinneiana* ranges from the middle Turonian to upper Santonian (Caron, 1985). It was recorded from the upper Turonian to Santonian of Texas, California, USA, Mexico, France and Poland (Peryt, 1980); Turonian to Campanian of Germany (Weidich, 1984); upper Turonian to lower Senonian of Lebanon (Saint-Marc, 1975); Santonian to Campanian of Israel (Almogi-Labin et al., 1991). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian).

Marginotruncana renzi (GANDOLFI, 1942)
Pl. 26, Fig. 5 a-c.

1942 *Globotruncana renzi* GANDOLFI. - GANDOLFI, pp. 124-125, pl. 3, fig. 1; pl. 4, figs. 16, 28-29.
1975 *Globotruncana renzi* GANDOLFI. - BASHA, pp. 236-238, pl. 16, figs. 26-28.
1990 *Globotruncana* sp. cf. *renzi* GANDOLFI. - AL-HARITHI, p. 516, fig. 4 (15-18).
1979b *Marginotruncana renzi* (GANDOLFI). - ROBASZYNSKI and CARON, p. 133, pl. 69, figs. 1-2.
1984 *Marginotruncana renzi* (GANDOLFI). - WEIDICH, pp. 69, 100, pl. 13, figs. 13-15.
1985 *Marginotruncana renzi* (GANDOLFI). - CARON, p. 61, fig. 27 (1-2).
1988 *Marginotruncana renzi* (GANDOLFI). - LIPSON-BENITAH et al., p. 332, text-fig. 2.

Remarks: It may be difficult to separate *M. renzi* from *M. sinuosa*. Typically the former has a biconvex, fairly low trochospiral test, with 5-6 chambers forming the final whorl and increasing slowly in size; two closely spaced keels merging into a single keel on the ultimate or the last few chambers; sutures curved and raised on both spiral and umbilical sides. *M. renzi* differs from *M. sinuosa* in its more petaloid-shaped chambers, with a flat surface on the spiral side, and in having U-shaped sigmoid sutures on the umbilical side. It differs from *M. coronata* by its closely joined keels and in having fewer chambers in the final whorl; also differs from *M. paraconcavata* in being biconvex and in having two closely joined keels.

Distribution: *M. renzi* ranges from the lower part of the *helvetica* Zone to *concavata* Zone (middle Turonian to lower Santonian) (Caron, 1985). It was reported from the Turonian to Santonian of Germany (Weidich, 1984); middle Turonian of France, Iraq, Palestine and Israel (Kureshy, 1967; Bayliss, 1973; Lipson-Benitah et al., 1988); Coniacian to Santonian of Tunisia and Syria (Postuma, 1971; Ejel, 1967); upper Turonian to Coniacian of Iran, Switzerland, Austria and Central Poland (Yassini, 1978; Peryt, 1980); Turonian to Santonian of Jordan (Al-Harithi, 1982, 1990). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian).

Marginotruncana sinuosa PORTHAULT, 1970
Pl. 27, Fig. 4 a-c.

1970 *Marginotruncana sinuosa* PORTHAULT, p. 81, pl. 11, figs. 11-13.

1979b *Marginotruncana sinuosa* PORTHAULT. - ROBASZYNSKI and CARON, p. 153, pl. 74, figs. 1-2; pl. 75, figs. 1-2.
1984 *Marginotruncana sinuosa* PORTHAULT. - ROBASZYNSKI et al., txt-fig. 8.
1985 *Marginotruncana sinuosa* PORTHAULT. - CARON, p. 61, fig. 27 (9-11).
1985 *Marginotruncana sinuosa* PORTHAULT. - REISS, text-fig. 4.
1990 *Marginotruncana sinuosa* PORTHAULT. - AL-BAKRI, pl. 6, figs. 6-8.
1990 *Marginotruncana sinuosa* PORTHAULT. - ALMOGI-LABIN et al., p. 45, fig. 4.

Description: Test trochospiral, biconvex, with strongly convex spiral side, equatorial periphery subcircular, lobulate, truncated by well developed double keel; carinal band of sigmoid shape in apertural view; chambers semilunar, crenulate, overlapping on spiral side with a flat or undulated surface, subrectangular on umbilical side; final whorl consisting of 5-6 chambers, increasing moderately in size as added, strongly elongated in the direction of coiling; spiral sutures curved, raised; umbilical sutures sigmoid, raised; umbilicus broad, shallow; primary aperture extraumbilical to umbilical.

Remarks: *M. sinuosa* is generally considered as ancestral and transitional to *C. (Rosita) fornicata* from which it differs in a lower trochospire, more widely spaced double keel and the absence of prominent globular chambers in the early whorls. The Jordanian specimens resemble very much the holotype, but differ in possessing only four chambers.

Distribution: *M. sinuosa* was recorded from the upper Turonian to upper Santonian of France (Caron, 1985); Coniacian to lowermost Campanian (Robaszynski et al., 1984); upper Turonian to lowermost Campanian of Israel (Reiss, 1985; Almogi-Labin et al., 1991); upper Turonian to Coniacian of Poland; Coniacian to Santonian of Switzerland and Jordan (Peryt, 1980; Al-Bakri, 1990). In the studied material rare tests were found in M91, Amman Formation (Campanian).

Genus: **Rugotruncana** BRÖNNIMANN and BROWN, 1956

Rugotruncana subcircumnodifer (GANDOLFI, 1955)
Pl. 27, Fig. 5 a-c.

1955 *Globotruncana (Rugoglobigerina) circumnodifer* (FINLAY) subsp. *subcircumnodifer* GANDOLFI, p. 44, pl. 2, fig. 8 a-c.
1972 *Globotruncana subcircumnodifer* GANDOLFI. - BARR, p. 25, pl. 10, fig. 2 a-c.
1983 *Globotruncana subcircumnodifer* GANDOLFI. - EL NAGGAR & ASHOUR, pp. 1, 8; pl. 3, figs. 1, 11.
1967 *Rugotruncana subcircumnodifer* (GANDOLFI). - PESSAGNO, p. 369-370, pl. 62, figs. 14-16; pl. 74, figs. 1-3.
1978 *Rugotruncana subcircumnodifer* (GANDOLFI). - FRERICHS, ATHERTON and SHIVE, p. 310, pl. 4, figs 10-12.
1985 *Rugotruncana subcircumnodifer* (GANDOLFI). - CARON, p. 76, fig. 34 (11-12).

Description: Test medium, trochospiral of 5-6 chambers in the final whorl, subglobular, compressed, ornamented with rugosites and more commonly papillate; equatorial periphery lobate, axial periphery subrounded, with double keel; sutures limbate, curved on spiral side, depressed, radial on umbilical side, umbilicus moderately wide; aperture interiomarginal, umbilical. *R. subcircumnodifer* differs from *R. subpennyi* in having 4-5 instead of 6 chambers forming the last whorl.

Distribution: *R. subcircumnodifer* ranges from the *calcarata* Zone to *mayaroensis* Zone (upper Campanian throughout Maastrichtian) (Caron, 1985). It was recorded from the upper Campanian to middle Maastrichtian of Lybia (Barr, 1972); upper Campanian to upper Maastrichtian of the Gulf Coastal Plain, USA (Frerichs et al., 1978). In the studied material, it is found in: M86, 90, Amman Formation (Campanian).

Genus: **Sigalitruncana** KORCHAGIN, 1982

Sigalitruncana pileoliformis (LAMOLDA, 1977)
Pl. 27, Fig. 6 a-b.

1977 *Marginotruncana pileoliformis* LAMOLDA, p. 399.
1978 *Marginotruncana pileoliformis* LAMOLDA. - LAMOLDA, p. 472.
1988 *Sigalitruncana pileoliformis* (LAMOLDA). - LOEBLICH & TAPPAN, p. 470, pl. 833, figs. 5-12.

Description: Test low trochospiral, planoconvex, with arched spiral side and flattened umbilical side; peripheral keel formed by 2 rows of closely spaced pustules in the early part that grade into a simple imperforate band on the final chamber; sutures curved, elevated on the spiral side, sinuate and depressed around the small umbilicus on the umbilical side; wall calcareous, perforate, surface smooth except for the keel and sutures; primary aperture extraumbilical to umbilical and with a porticus.

Distribution: *S. pileoliformis* is cosmopolitan and ranges from the Turonian to lower Campanian (Loeblich & Tappan, 1988). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian).

Subfamily: **GLOBOTRUNCANELLINAE** MASLAKOVA, 1964
Genus: **Globotruncanella** REISS, 1957

Globotruncanella havanensis (VOORWIJK, 1937)
Pl. 28, Fig. 6 a-c.

1937 *Globotruncana havanensis* VOORWIJK, p. 195, pl. 1, figs. 25, 26, 29.
1983 *Praeglobotruncana havanensis* VOORWIJK. - ELNAG. & ASHOUR, pl. 5, figs. 4-5
1972 *Globotruncanella havanensis* VOORWIJK. - BARR, p. 32, pl. 1, fig. 8.
1984 *Globotruncanella havanensis* VOORWIJK. - ROBASZYNSKI et al., p. 265, pl. 44, figs. 4-6.
1985 *Globotruncanella havanensis* VOORWIJK. - CARON, p. 51, fig. 21 (3-4).
1985 *Globotruncanella havanensis* VOORWIJK. - REISS, p. 152, text-fig. 3 a-b.

1989b *Globotruncanella havanensis* VOORWIJK. - CHERIF et al., p. 180, pl. 1, fig. 12.
1989 *Globotruncanella havanensis* VOORWIJK. - ISMAIL, pp. 156-157, t-fig. 57.
1990 *Globotruncanella havanensis* VOORWIJK. - ALMOGI-LABIN et al., p. 45, fig. 3.

Description: Test low to moderately high trochospiral, outline lobate, axial periphery acute, unkeeled; 5-6 petaloid chambers in the last whorl, increasing moderately in size, subglobular, compressed, with a pustulose and rarely rugose surface, the last ones oval to pinched; spiral sutures radial to curved, depressed, may be slightly limbate, beaded to smooth, umbilical sutures radial to slightly curved, depressed; wall calcareous, finely perforate, surface finely hispid to smooth; primary aperture extraumbilical to umbilical.

Remarks: *G. havanensis* differs from *G. citae* only in having an imperforate margin or aligned pustules instead of a true keel; from *G. minuta* in having less globular chambers; from *G. petaloidea* in having more than 4 chambers and being less lobate; from *G. pschadae* in the unkeeled periphery.

Distribution: *G. havanensis* ranges from the *calcarata* Zone throughout the *mayaroensis* Zone (uppermost part of the Campanian to Maastrichtian) (Robaszynski et al., 1984). It was recorded from the upper Campanian to upper Maastrichtian of Libya (Barr, 1972); lower Maastrichtian of Israel (Reiss, 1985; Almogi-Labin, 1990); lower Campanian and middle Maastrichtian of Jordan (Koch, 1968; Yassini, 1978; Al-Harithi, 1986). In the studied material, it is found in: M91, Amman Formation (Campanian).

Family: **RUGOGLOBIGERINIDAE** SUBBOTINA, 1959
Genus: **Archaeoglobigerina** PESSAGNO, 1967

Archaeoglobigerina blowi PESSAGNO, 1967
Pl. 25, Fig. 7 a-b; Pl. 28, Figs. 2 a-b, 3 a-c; Pl. 29, Fig. 3 a-b.

1967 *Archaeoglobigerina blowi* PESSAGNO, p. 316, pl. 59, figs. 1-10; pl. 94, figs. 2, 3.
1979b *Archaeoglobigerina blowi* PESSAGNO. - ROBASZYNSKI and CARON, p. 172, pl. 79, figs. 1-2.
1984 *Archaeoglobigerina blowi* PESSAGNO. - ROBASZYNSKI et al., p. 276, pl. 47, figs. 1-2.
1985 *Archaeoglobigerina blowi* PESSAGNO. - CARON, p. 43, fig. 16 (3-4).
1986 *Archaeoglobigerina* sp. cf. *blowi* PESSAGNO. - AL-HARITHI, pp. 34-35, text-fig. 12.
1988 *Archaeoglobigerina blowi* PESSAGNO. - LOEBLICH et al., p. 471, pl. 510, figs. 1-5.

Description: Test low to flat trochospiral, spiral side slightly convex, strongly lobulate peripherally; chambers 4-5 in the final whorl, spherical, increasing sharply in size as added, surface rugose, never meridionally alighned; spiral sutures depressed, oblique, umbilical sutures radial; umbilicus medium sized; primary aperture umbilical; tegilla broken in material examined. *A. blowi* differs from *A. cretacea* in possessing more spherical chambers, increasing more rapidly in size as added, and having a more lobulate peripheral outline.

Distribution: *A. blowi* ranges from the *concavata* Zone throughout the *mayaroensis* Zone (upper part of the Coniacian to upper part of the Maastrichtian) (Robaszynski & Caron, 1979; Robaszynski et al., 1984). It was recorded from the Campanian of Mexico; Coniacian to Santonian of Germany, Texas and Poland (Weidich, 1984; Peryt, 1980); lower Maastrichtian of Netherlands (Robaszynski et al., 1985); Santonian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M47, Q43, Ghudran Formation (Coniacian to Santonian); M87, 90, 91, Amman Formation (Campanian).

Archaeoglobigerina cretacea (D'ORBIGNY, 1840)
Pl. 28, Fig. 5 a-c.

1840 *Globigerina cretacea* D'ORBIGNY, p. 34, pl. 3, figs. 12-14.
1983 *Globotruncana cretacea* (D'ORBIGNY). - KRASHENINN. et al., p. 806, pl. 8, figs. 13-15.
1975 *Archaeoglobigerina cretacea* (D'ORBIGNY). - SAINT-MARC, p. 268, pl. 14, figs. 23-28.
1979b *Archaeoglobigerina cretacea* (D'ORBIGNY). - ROBASZYNSKI and CARON, p. 176, pl. 80, fig. 1a-e.
1980 *Archaeoglobigerina cretacea* (D'ORBIGNY). - PERYT, pp. 82-83, pl. 21, figs. 5-7.
1984 *Archaeoglobigerina cretacea* (D'ORBIGNY). - WEIDICH, p. 106, pl. 21, figs. 5-7.
1984 *Archaeoglobigerina cretacea* (D'ORBIGNY). - ROBASZYNSKI et al., p. 278, pl. 47, figs. 3-6; pl. 48, fig. 2.
1985 *Archaeoglobigerina cretacea* (D'ORBIGNY). - CARON, p. 43, fig. 16 (1, 2).

Description: Test low trochospiral, biconvex, equatorial periphery lobate, axial periphery ovate, umbilicus wide, deep; 5-6 subspherical chambers, increasing gradually in size as added, final one commonly slightly compressed; spiral sutures slightly curved, depressed, umbilical sutures radial, depressed; wall calcareous, perforate, surface coarsely hispid, final chamber nearly smooth; primary aperture interiomarginal, umbilical in position with tegillum.

Remarks: *A. cretacea* differs from *A. blowi* in having 6 instead of 4 chambers, increasing slowly in size as added; differs from *A. bosquensis* in being a more delicately ornamented. The rounded periphery is marked by imperforate band that may be absent on the final chamber.

Distribution: *A. cretacea* evolved from *Whiteinella archaeocretacea* during the Coniacian (Caron, 1985); it ranges from the Coniacian to lower Maastrichtian *havanensis* zone (Pessagno, 1970). It was recorded from the Coniacian to upper Campanian of Germany (Weidich, 1984);Turonian to Maastrichtian (Porthault, 1970); Turonian to lower Senonian of Lebanon (Saint-Marc, 1975); Campanian of Poland, Netherlands and Jordan (Peryt, 1980; Robaszynski et al., 1985; Al-Harithi, 1982; Al-

Bakri, 1990). In the studied material, tests with transitional characters towards *Rugoglobigerina rugosa* have been found in: M91, Amman Formation (Campanian).

Genus: **Rugoglobigerina** BRÖNNIMANN, 1952

Rugoglobigerina jordani AL-HARITHI, 1986
Pl. 29, Fig. 2.

1986 *Rugoglobigerina jordani* AL-HARITHI. - AL-HARITHI, p. 98, pl. 14, figs. 15-16.

Description: Test free, low to moderately trochospiral, biconvex, equatorial periphery lobate, axial periphery broadly rounded; umbilicus wide and deep; chambers 4 in the final whorl, globular, hemispherical, increasing regularly in size as added; spiral sutures depressed, slightly curved, umbilical sutures distinctly depressed, radial, surface finely spinose, weaker on the final chamber; aperture interiomarginal, umbilical, with bordering apertural lip.

Remarks: *R. jordani* differs from *R. rugosa* in having lesser number of chambers, slower increase in chamber size and the absence of rugosites; and differs from *R. pilula* in having fewer chambers and slower increase in the size and inflation of chambers.

Distribution: *R. jordani* was originally described from the lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it was only found in: M91, Amman Formation (Campanian).

Rugoglobigerina pilula BELFORD, 1960
Pl. 28, Fig. 4 a-c.

1960 *Rugoglobigerina pilula* BELFORD. - BELFORD, p. 92, pl. 25, figs. 7-13; text-figs. 6 (1-6).
1966 *Rugoglobigerina pilula* BELFORD. - DOUGLAS & SLITER, p. 116, pl. 1, fig. 3-4.
1969 *Rugoglobigerina pilula* BELFORD. - DOUGLAS, p. 175, pl. 6, figs. 8-9.
1973 *Rugoglobigerina pilula* BELFORD. - SLITER, p. 173, pl. 4, figs. 7-9, t-f. 2.
1983 *Rugoglobigerina pilula* BELFORD. - KRASHENINNIKOV et al., p. 807, pl. 11, figs. 3-6.

Description: Test free, small, low to moderately trochospiral, equatorial periphery lobate; chambers 5 globular, subcircular on spiral side, subsectorial on umbilical side, increasing regularly in size; sutures depressed, gently curved on spiral side, depressed, curved to radial on umbilical side; surface finely spinose; umbilicus wide and deep; aperture interiomarginal, umbilical, with bordering apertural lip; tegilla not preserved in examined specimens.

Remarks: *R. pilula* is distinguished from *R. rugosa* by its more spiroconvex test, more numerous and spherical chambers and less distinct ornamentation. It differs from *R. pustulata* by a more convex spiral side, more inflated chambers, comparatively loose arrangement, and less pronounced pustulose ornamentation.

Distribution: *R. pilula* was recorded from the Santonian to lower Campanian of California and Australia (Douglas, 1969; Belford, 1960); Santonian to upper Campanian of British Columbia (Sliter, 1973); upper Campanian to Maastrichtian of the Falkland Plateau, South Atlantic (Krasheninnikov & Basov, 1983). In the studied material, it is found in: M91, Amman Formation (Campanian).

Rugoglobigerina rugosa (PLUMMER, 1926)
Pl. 28, Fig. 7 a-c; Pl. 29, Fig. 1 a-c.

1926 *Globigerina rugosa* PLUMMER, p. 38, pl. 2, fig. 10 a-d.
1986 *Gaudryina rugosa* (PLUMMER). - AL-HARITHI, p. 10, pls. 14-16, text-figs. 13, 15.
1978 *Rugoglobigerina rugosa* (PLUMMER). - YASSINI, p. 26, pl. 3, figs. 10-12.
1984 *Rugoglobigerina rugosa* (PLUMMER). - ROBASZYNSKI et al., p. 288, pl. 49, figs. 4, 6.
1985 *Rugoglobigerina rugosa* (PLUMMER). - CARON, p. 72, pl. 34, figs. (9-10).
1988 *Rugoglobigerina rugosa* (PLUMMER). - LOEBLICH & TAPPAN, p. 473, pl. 511, figs. 13-15.
1989 *Rugoglobigerina rugosa* (PLUMMER). - ISMAIL, pl. 11, fig. 5 a-b.
1989b *Rugoglobigerina rugosa* (PLUMMER). - CHERIF et al., pl. 2, fig. 15.

Description: Test low to flat trochospiral, biconvex, moderately convex spiral side, equatorial periphery lobate, axial periphery broadly rounded; umbilicus large, deep; chambers 4-5 in the final whorl, globular, hemispherical, increasing sharply in size as added; spiral sutures depressed, slightly curved, umbilical sutures distinctly depressed, radial; wall covered by meridionally arranged rugosites, weaker and more widely spaced on the final chamber, variable degree of ornamentation; primary aperture umbilical with tegilla.

Remarks: *R. rugosa* differs from all other *Rugoglobigerina* species in the almost flat trochospire, the rapid increase in chamber size, 4-5 chambers in the final whorl, and the absence of spines.

Distribution: *R. rugosa* ranges from the top of the lower Campanian *elevata* Zone to the upper part of the Maastrichtian (Caron, 1985). It was recorded from the Coniacian to Santonia of Germany (Weidich, 1984); Campanian to upper Maastrichtian of Tunisia and Libya (Postuma, 1971; Barr, 1972); upper Campanian to Maastrichtian of India and Poland (Peryt, 1980),; lower Campanian to middle Maastrichtian of Jordan (Bayliss, 1973; Yassini, 1978; Al-Harithi, 1986). In the studied material, a large number of tests of *R. rugosa* was found in M91, Amman Formation (Campanian).

4.5 CALCAREOUS BENTHIC FORAMINIFERA (rotalids)

4.5.1 Suborder: **ROTALIINA** DELAGE and HÉROUARD, 1896

Superfamily: **BOLIVINACEA** GLAESSNER, 1937
Family: **BOLIVINIDAE** GLAESSNER, 1937
Genus: **Bolivina** D'ORBIGNY, 1839

Bolivina decurrens (EHRENBERG, 1854)
Pl. 29, Fig. 4.

1854 *Grammostomum ? decurrens* EHRENBERG, p. 30, fig. 17.
1960 *Bolivina decurrens* (EHRENBERG). - HILTERMANN & KOCH, table 19.
1968 *Bolivina decurrens* (EHRENBERG). - SLITER, p. 87, pl. 12, fig. 16.
1973 *Bolivina decurrens* (EHRENBERG). - SLITER, p. 183, pl. 1, fig. 17.
1985 *Bolivina decurrens* (EHRENBERG). - REISS, text-figs. 3-4.
1989 *Bolivina decurrens* (EHRENBERG). - HART et al., p. 322, pl. 7.4, figs. 6-7.

Description: Test free, elongate, slender, initially bluntly pointed, occasionally spinose, compressed, margins sub-acute, spinose; chambers biserial throughout, overlapping, initially indistinct, but becoming inflated; aperture elongate, elliptical slit, extending from basal suture of final chamber; sutures distinct, oblique to straight. Distinguished from *B. incrassata* by its smaller size, more oblique sutures, and elongated slender form. Specimens allocated to this species in the studied material seem to be more inflated than those illustrated by Sliter (1968).

Distribution: *B. decurrens* was recorded from the Campanian to Maastrichtian in many places of Europe and America (Sliter, 1968, 1973). It was also reported from the lower Maastrichtian of Netherlands and England (Robaszynski et al., 1985; Hart et al., 1989); upper Campanian to upper Maasstrichtian of Germany and Israel (Hiltermann & Koch, 1960; Reiss, 1985). In the studied material, it is found in: M91 (Campanian), P60 (lower Maastrichtian), both from Amman Formation.

Bolivina incrassata REUSS, 1851
Pl. 29, Fig. 5 a-b.

1851 *Bolivina incrassata* REUSS, p. 45, pl. 5, fig. 13.
1968 *Bolivina incrassata* REUSS. - SLITER, p. 88, pl. 12, fig. 14.
1971 *Bolivina incrassata* REUSS. - FLEXER, text-fig. 3.
1973 *Bolivina incrassata* REUSS. - SLITER, pp. 169, 183, pl. 1, fig. 18, text-figs. 2, 8.
1976 *Bolivina incrassata* REUSS. - ANDRAWIS, p. 34.
1985 *Bolivina incrassata* REUSS. - ROBASZYNSKI et al., p. 26, text-fig. 16.
1989 *Bolivina incrassata* REUSS. - ISMAIL, p. 170, pl. 6, fig. 3.

Description: Test free, elongate, biserial, compressed, varying in length from long slender to robust with subrounded margins, occasionally becoming slightly lobate; chambers numerous, slightly inflated; sutures distinct, slightly depressed, gently curved, steeply inclined; aperture elongate, loop at base of final chamber, wide ovate, highly inclined sub-terminal opening. Recognized by its elongate compressed test, chamber diameter, limbate sutures and larger size.

Distribution: *B. incrassata* was recorded from the upper Campanian of British Columbia (Sliter, 1973); lower Maastrichtian of California, Egypt and Netherlands (Sliter, 1968, 1973; Andrawis, 1976; Robaszynski et al., 1985); upper Campanian to Maastrichtian of Germany, Jordan and Israel (Hiltermann & Koch, 1960; Futyan, 1968; Reiss, 1962; Flexer 1971). In the studied material, it is found in: M91 (Campanian), P60, Amman Formation (lower Maastrichtian).

Genus: **Brizalina** COSTA, 1856

Brizalina lowmani (PHLEGER and PARKER, 1951)
Pl. 29, Fig. 6.

1942 *Bolivina paula* CUSHMAN and PONTON. - CUSHMAN and MCCULLOCH, p. 202, pl. 24, figs. 11-12.
1951 *Bolivina lowmani* PHLEGER & PARKER. - PHLEGER & PARKER, p. 13, pl. 6, figs. 20-21.
1970 *Brizalina lowmani* (PHLEGER & PARKER). - SLITER, p. 166, pl. 7, figs. 1-4; pl. 8, figs. 17-18.

Description: Test elongate, nearly parallel-sided, compressed, subrounded periphery; chambers broad, low, slightly inflated; sutures distinct, curved, depressed; pores fine throughout; surface smooth, glossy and semitransparent to reveal the internal tooth plate; apertural end blunt. *B. lowmani* occurs in the subtidal depth zone. *Bolivina paula* CUSHMAN is synonymn. *Bolivina quadrata* resembles this species, but it is distinguished by its ovate cross-section, higher chambers and less oblique sutures.

Distribution: *B. lowmani* is cosmopolitan and was reported from the Campanian to Holocene of the eastern Pacific and western Atlantic margins (Sliter, 1970). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian); P60, Amman Formation (lower Maastrichtian).

Genus: **Gabonita** DIENI, 1974

Gabonita billmani (ROVEDA, 1969)
Pl. 29, Fig. 12 a-b.

1969 *Gabonella billmani* ROVEDA, p. 197, pl. 1, figs. 18-27, text-figs. 2-3.

Remarks: Test medium in its size, elongated, subcylindrical, circular in transverse, increasing rapidly in size toward terminal portion; borders lobulate; chambers 10-12, broad and low, inflated, the last two chambers relatively high, forming a large cone; sutures profoundly depressed; aperture semicircular, at the base of the final chamber.

Distribution: *G. billmani* was originally described from the Turonian to upper Coniacian of Sahara espagnol, NW. Africa (Roveda, 1969). In the studied material, it is found in: Q20, Na'ur Formation (lower to middle Cenomanian); M86, Amman Formation (Campanian).

Gabonita bipyramidata (EL-SHINNAWI, 1971)
Pl. 29, Fig. 10 a-b.

1971 *Gabonella bipyramidata* EL-SHINNAWI, p. 237, pl. 1, fig. 2.

Description: Test biserial bipyramidal, stubby, slightly compressed, borders lobulate rather terraced; lower part more acute than the upper and regularly decurrently stepping; transverse subhexagonal; chambers 11 in number, broad and low, increasing rapidly in breadth over two-thirds of the test, last two chambers conical occupying the upper third of test, initial chamber prominent, spherical; base of chambers undulated into rather high, narrow saddles and broader, rounded, sometimes straight-edged lobes imbricating preceeding chambers; biseriality plane laterally displaced; sutures profoundly depressed; wall calcareous, perforate, surface smooth; aperture crescentic, low, broadly extending along basal suture of final chamber.

Remarks: *G. bipyramidata* is distinguished from *Gabonita (Gabonella) tiarella* by its relatively shorter, more compressed test with a subhexagonal, non-circular, and well differentiated, not irregularly denticulated lobes and saddles.

Distribution: *G. bipyramidata* was originally described from the Maastrichtian of Egypt (El-Shinnawi, 1971). In the studied material, it is found in: M86, Amman Formation (Campanian).

Gabonita klaszi (ROVEDA, 1964)
Pl. 30, Fig. 2.

1964 *Gabonella klaszi* ROVEDA, p. 197, pl. 1, figs. 1-6.
1994 *Gabonella* sp. cf. *klaszi* (ROVEDA). - BOLLI et al., p. 128, figs. 34.22-23.

Description: Test conical, elongate, highly twisted in the early stage, then increasing regularly; chambers subglobular, inflated, biserially arranged, initially increasing gradually in size as added, later more rapidly; sutures depressed, distinctly inverted saddle-shaped; wall calcareous, finely perforate, surface smooth; aperture crescentic, simple opening, at the base of final chamber. The sutures are less deeply incised than in *G. kugleri* (BECKMANN, 1974).

Distribution: *G. klaszi* ranges from the Coniacian to Santonian of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian).

Gabonita levis (KLASZ, MARIE and RERAT, 1961)
Pl. 30, Fig. 4.

1961 *Gabonella levis* KLASZ, MARIE & RERAT, p. 77, text-fig. 2 a-b.
1965 *Gabonella levis* KLASZ et al. - HAMAOUI, pp. 202-204, pl. 1, figs. 7-12.
1968 *Gabonella levis* KLASZ, MARIE & RERAT. - KOCH, pp. 630, 650, pl. 85, fig. 13.
1975 *Gabonella levis* KLASZ, MARIE & RERAT. - BASHA, pp. 206-207, pl. 15, fig. 2.
1979 *Gabonella levis* KLASZ, MARIE & RERAT. - BASHA, p. 61, pl. 1, fig. 7; pl. 3, figs. 28-29.
1990 *Gabonita levis* KLASZ, MARIE & RERAT. - KOUTSOUKOS et al., p. II, figs. 1-4.

Description: Test free, small, elongate, tapering, biserially arranged on a slightly twisted plane, periphery rounded, lobulate; chambers 6-7 pairs, increasing gradually in size as added, subglobular to mammillary in shape; sutures distinct, depressed, curved; wall calcareous, finely perforate, surface smooth; aperture slightly curved hook-shaped, with a thin lip.

Distribution: *G. levis* was recorded from the Cenomanian to Turonian of Gabon, Angola and Israel (Klasz et al., 1961; Klasz & Rerat, 1963; Hamaoui, 1965, 1968 & 1979); lowermost Turonian of southern England (Koutsoukos et al., 1990); Turonian to Santonian of Sahara, West Africa (Roveda, 1964); Turonian; upper Cenomanian to Campanian of Jordan (Koch, 1968; Basha, 1975, 1979).

In the studied material, it is found in: P1, 3, 5, M7a, 21, Q20, 22a, Na'ur Formation (lower to middle Cenomanian); P41, Fuheis Formation Equivalent (middle Cenomanian); J34, 35, Shueib Formation (upper Cenomanian); P55, Ghudran Formation (Coniacian to Santonian); M91, Amman Formation (Campanian); P60, Amman Formation (lower Maastrichtian).

Gabonita levis aegyptiaca (KERDANY and FAHMY, 1969)
Pl. 30, Fig. 3.

1969 *Gabonella levis* subsp. *aegyptiaca* KERDANY et al., pp. 489-490.
1975 *Gabonella levis aegyptiaca* KERDANY & FAHMY. - ELLIS and MESSINA, Supplement 1.

Remarks: *G. levis aegyptiaca* is characterized in being large in size, less compressed laterally; last pair of chambers enlarged and equals one-third of the test diameter and aperture being comparatively longer and lower.

Distribution: *G. levis aegyptiaca* was recorded from the Cenomanian to lower Turonian; Coniacian to lower Santonian of Egypt (Kerdany and Fahmy, 1969), and from middle Turonian of Jordan (Basha, 1975). In the studied material, it is found in: P1, 3, M7a, 21, 22, 23, Q22a, Na'ur Formation (lower to middle Cenomanian); Q28, M31, 32, Fuheis Formation Equivalent (middle Cenomanian); M39, Shueib

Formation Equivalent (upper Cenomanian), M56, Shueib Formation Equivalent (Turonian).

Gabonita multituberculata (KLASZ and MEIJER, 1960)
Pl. 30, Fig. 1.

1960 *Gabonella multituberculata* KLASZ & MEIJER, p. 173, pl. 2, fig. 1.
1963 *Gabonella multituberculata* KLASZ & MEIJER. - KLASZ & RERAT, p. 326, text-fig. 1.
1968 *Gabonella multituberculata* KLASZ & MEIJER. - KOCH, pp. 637, 651, pl. 58, fig. 11.

Remarks: Test elongated, subcircular to triangular in transverse, initial portion tapering; chambers 10-12, broad and low, inflated, the last two chambers relatively high, forming a large cone; sutures profoundly depressed; wall calcareous, finely perforate, surface smooth; aperture low, broad arch, at the base of the final chamber.

Distribution: *G. multituberculata* was recorded from the Senonian and Maastrichtian of Gabon (Klasz & Rerat, 1963); Campanian to Maastrichtian of Jordan (Koch, 1968). In the studied material, it is found in: M86, Amman Formation (Campanian).

Gabonita obesa (KLASZ, MARIE, and RERAT, 1961)
Pl. 29, Fig. 7.

1961 *Gabonella obesa* KLASZ, MARIE & RERAT, p. 202, pl. 1, figs. 13-17.
1965 *Gabonella obesa* KLASZ et al., - HAMAOUI, p. 33-35, pl. 1, fig. 4-6, 11-12.
1968 *Gabonella obesa* KLASZ, MARIE & RERAT. - KERDANY & FAHMY, p. 489, pl. 1, fig. 10.
1975 *Gabonella obesa* KLASZ, MARIE & RERAT. - BASHA, pp. 208-209, pl. 15, fig. 4.
1979 *Gabonella obesa* KLASZ, MARIE & RERAT. - BASHA, pp. 61-62, pl. 1, fig. 10.
1990 *Gabonita obesa* KLASZ, MARIE & RERAT. - KOUTSOUKOS et al., p. II, figs. 5-7.

Remarks: *G. obesa* is characterized by a short, stout test, with short tapering initial portion and noticeable inflated ultimate portion; chambers biserially arranged, increasing gradually in breadth as added, with curved central inner margins; wall calcareous, surface smooth; aperture hook-shaped with a bordering rim.

Distribution: *G. obesa* was recorded from the lowermost Turonian of southern England (Koutsoukos et al., 1990),; uppermost Cenomanian to lower Turonian of Gabon and Angola, W. Africa, Israel, Egypt and Jordan (Roveda, 1964; Klasz & Rerat, 1963; Hamaoui, 1965; Kerdany and Fahmy, 1968; Basha, 1975, 1979). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M35, 37, J35, Shueib Formation (upper Cenomanian).

Gabonita parva (KLASZ and MEIJER, 1960)
Pl. 29, Fig. 8 a-b.

1960 *Gabonella parva* KLASZ and MEIJER, p. 171, pl. 2, pl. 4a-b.
1968 *Gabonella parva* KLASZ and MEIJER. - KOCH, p. 651, pl. 58, fig. 7, 12.
1975 *Gabonella parva* KLASZ and MEIJER. - BASHA, p. 209, pl. 15, fig. 5.
1979 *Gabonella parva* KLASZ and MEIJER. - BASHA, pp. 61-62, pl. 1, fig. 11.
1982 *Gabonella parva* KLASZ and MEIJER. - AL-HARITHI, pp. 72-73, pl. 4, figs. 7-9.
1986 *Gabonella parva* KLASZ and MEIJER. - AL-HARITHI, p. 1, pl. 16; pl. 3, fig. 8.

Description: Test short, conical, biserial, chambers broad, irregular and slightly inflated; sutures curved, strongly depressed, forming saddle-like centres; wall calcareous, very finely perforated; aperture large, crescentic and lipped opening at the base of final chamber.

Distribution: *G. parva* was recorded from the lower Turonian to Santonian of Gabon, West Africa (Klasz & Rerat, 1963; Roveda, 1964); Coniacian to Santonian of Egypt (Kerdany & Fahmy, 1969),; Turonian to lower Campanian of Jordan (Koch, 1968; Basha, 1975, 1979; Al-Harithi, 1982, 1986). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian); M86, Amman Formation (Campanian).

Gabonita sumaya (BASHA, 1979)
Pl. 21, Figs. 1 a-b, 4 a-b, 7.

1979 *Gabonella sumaya* BASHA, p. 65, pl. 1, fig. 7; pl. 3, figs. 28-29.

Description: Test small, elongate, biserially compressed, plane of growth somewhat twisted; periphery rounded, lobulate; chambers 5-6 pairs, subpherical, much inflated near apertural end, increasing gradually in size as added; sutures curved, depressed; wall calcareous, finely perforate; aperture hook-shaped, extending upward from the base of the last chamber, then curving to run parallel to suture.

Remarks: *G. sumaya* differs from *G. levis* and *G. parva* in possessing fewer inflated chambers and having much wider apertural end. It is considered an intermediate form, between *G. levis* and *G. obesa*, in its development and arrangement of chambers as well as in its outline (Basha, 1979: 63).

Distribution: *G. sumaya* was originally described from the Turonian of Jordan (Basha, 1979). In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian), M33, 35, 39, 40, Shueib Formation Equivalent (upper Cenomanian).

Gabonita tiarella (MARIE, 1960)
Pl. 29, Fig. 9 a-c.

1960 *Gabonella tiarella* MARIE, p. 177, pl. 2, fig. 5.

1968 *Gabonella tiarella* MARIE. - ELLIS and MESSINA, catalougue-1, Supplement-1966, no. 1.
1968 *Gabonella tiarella* MARIE. - KOCH, p. 634, pl. 651.

Description: Test biserial, ovoid, with a conical base, subcircular in, outline rounded; chambers broad and inflated, the last two chambers forming one-half of the test size; sutures horizontal, strongly depressed; wall calcareous, finely perforate, surface with irregular and angular indentations; aperture large opening, at the base of final chamber.

Distribution: *G. tiarella* was recorded from Santonian of central Morocco (Ellis & Messinae, 1968); Santonian to Campanian of Jordan (Koch, 1968). In the studied material, it is found in: M90, Amman Formation (Campanian).

Gabonita zigzaga (EL-SHINNAWI, 1971)
Pl. 29, Fig. 11 a-b.

1971 *Gabonella zigzaga* EL-SHINNAWI, p. 245, pl. 3, fig. 4.

Description: Test biconical, laterally compressed, flaring terminally; borders diverge over two-thirds of the test, thence converge towards terminal margin; about three times as long as broad, breadth nearly three times its thickness; transverse ovoid; chambers 12, broad and low, inflated, increasing rapidly in size, last 2 chambers relatively high, forming a large cone, occupying more than the third of the test; base of chambers zigzag, forming regularly angled and aligned saddles and lobes; biseriality plane markedly displaced; sutures strongly depressed; wall calcareous, perforate, surface smooth; aperture crescentic, bordered by a narrow lip, at the base of last chamber.

Remarks: *G. zigzaga* differs from *G. parva* in its lobulate, non-dentate, rapidly diverging borders; by its ovoid, non-quadrate, and its angular zigzag sutures. It also differs from *G. bipyramidata* by the type of the of test and the angular zigzag sutures.

Distribution: *G. zigzaga* was originally described from the Maastrichtian of Egypt (El-Shinnawi, 1971). In the studied material, it is found in: M86, Amman Formation (Campanian).

Genus: **Loxostomoides** REISS, 1957

Loxostomoides cushmani (WICKENDEN, 1932)
Pl. 30, Fig. 5 a-b.

1932 *Loxostomum cushmani* WICKENDEN, p. 91, pl. 1, fig. 6 a-b.
1946 *Loxostoma cushmani* WICKENDEN. - CUSHMAN, p. 129, pl. 53, figs. 24-31.
1957 *Loxostomoides cushmani* (WICKENDEN). - REISS, p. 241.
1962 *Loxostomoides cushmani* (WICKENDEN). - ELLIS and MESSINA, Supplement no. 1.

Description: Test elongate, narrow, oval in, slightly tapering, slightly compressed, periphery broadly rounded; earlier portion distinctly biserial, tending to become uniserial in the adult; chambers distinct, particularly in the later portion, inflated toward the apertural end, slightly overlapping; sutures distinct, in the early portion not depressed, gradually becoming deeply depressed in the adult, sutures in the early portion nearly horizontal, later more oblique; wall calcareous, perforate, surface smooth; aperture a basal loop in the early stage, becoming rounded and terminal, slightly eccentric, in the adult.

Distribution: *L. cushmani* was recorded from the Coniacian to Maastrichtian of Texas and Arkansas, USA (Cushman, 1946); Senonian to Palaeocene of both hemispheres (Loeblich & Tappan, 1988). In the studied material, it is found only in M74, Ghudran Formation (Coniacian to Santonian).

Superfamily: **EOUVIGERINACEA** CUSHMAN, 1927
Family: **LACOSTEINIDAE** SIGAL, 1952
Genus: **Elhasaella** HAMAM, 1976

Elhasaella alanwoodi HAMAM, 1976
Pl. 30, Fig. 6.

1976 *Elhasaella alanwoodi* HAMAM, p. 454, pl. 1, figs. 1-7; pl. 2, figs. 1-8.
1979 *Jordania arabica* HAMAM and HAYNES. - HAMAM, p. 161, pl. 2, fig. 12.
1979 *Ruseifaella jordanensis* HAMAM. - HAMAM, p. 163, pl. 2, fig.11.
1977 *Elhasaella alanwoodi* HAMAM. - HAMAM & HAYNES, pp. 49-68, pl. 1, fig. 17.
1986 *Elhasaella alanwoodi* HAMAM. - AL-HARITHI, pp. 338-339, pl. 2, figs. 3-15; pl. 3, figs. 17; pl. 4, figs. 4, 11.
1988 *Elhasaella alanwoodi* HAMAM. - LOEBLICH & TAPPAN, p. 509, pl. 486, figs. 6-12; pl. 580, figs. 10-12.

Description: Test elongate, planispiral initial stage of less than one whorl, then biserial with changed axis of growth and finally uniserial; chambers inflated, gradually enlarging; sutures distinctly constricted; wall calcareous, perforate; surface covered with minute short spines; aperture terminal, rounded, bordered by a distinct neck.

Distribution: *E. alanwoodi* was recorded from the lower Campanian to middle Maastrichtian; Coniacian to Santonian of Jordan (Hamam & Haynes, 1977; Al-Harithi, 1986; Loeblich & Tappan, 1988). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian).

Superfamily: **TURRILINACEA** CUSHMAN, 1927
Family: **TURRILINIDAE** CUSHMAN, 1927
Genus: **Neobulimina** CUSHMAN and WICKENDEN, 1928

Neobulimina canadensis CUSHMAN and WICKENDEN, 1928
Pl. 30, Fig. 7 a-b.

1928 *Neobulimina canadensis* CUSHMAN et al., p. 13, pl. 1, fig. 1-2.
1968 *Neobulimina canadensis* CUSHMAN et al. - SLITER, p. 82-3, pl. 11, figs. 10-14.
1973 *Neobulimina canadensis* CUSHMAN & WICKENDEN. - SLITER, p. 183, text-fig. 8.
1973 *Neobulimina canadensis* CUSHMAN and WICKENDEN. - BAYLISS, p. 15.
1976 *Neobulimina canadensis* CUSHMAN & WICKENDEN. - ANDRAWIS, pp. 16, 34.
1977 *Neobulimina canadensis* CUSHMAN & WICKENDEN. - HAMAM, p. 36, pl. 2, fig. 13.
1986 *Neobulimina canadensis* CUSHMAN & WICKENDEN. - AL-HARITHI, pl. 1, fig. 6.
1988 *Neobulimina canadensis* CUSHMAN and WICKENDEN. - LOEBLICH and TAPPAN, p. 511, pl. 562, figs. 8-11.

Description: Test elongate, spindle-shaped, large, roughly triangular triserial initial part, and later small biserial adult part, ovate in; chambers subglobular, inflated, test slightly twisted; sutures distinct, depressed, nearly horizontal; wall calcareous, coarsely perforate, surface smoothly finished; aperture loop shaped, extending upward from base of final chamber.

Distribution: *N. canadensis* was recorded from the Campanian of British Columbia (Sliter, 1973); lower Turonian of Egypt and Russia (Andrawis, 1976); Maastrichtian of Palestine (Bayliss, 1973); Albian and Turonian to Maastrichtian of Jordan (Hamam, 1976, 1977; Al-Harithi, 1986).

In the studied material, it is found in: Q20, 22a, M22, Na'ur Formation (lower to middle Cenomanian); M37, 39, 40, Shueib Formation Equivalent (upper Cenomanian); the species is abundant in M70, Ghudran Formation (Coniacian to Santonian); rare in P60, Amman Formation (lower Maastrichtian).

Neobulimina canadensis alpha MELLO, 1969
Pl. 30, Fig. 8.

1928 *Neobulimina canadensis* CUSHMAN et al., p. 13, pl. 1, figs. 1-2.
1969 *Neobulimina canadensis* v. *alpha* MELLO. - MELLO, pp. 78, 79.
1969 *Neobulimina canadensis* v. *alpha* MELLO. - ELLIS and MESSINA, Book 86, Supplement 2, 84.

Description: Test small, elongate, initially trochoid, later biserial, greatest breadth at final pair of chambers; early chambers in an approximately triserial arrangement, slightly twisted; larger specimens develop a biserial stage; chambers distinct, subglobular, and inflated throughout, sutures distinct, depressed; wall roughened to slightly rugose, except for the upper parts; aperture in the triserial part a small comma-shaped to oval opening at the base of final chamber.

Remarks: *N. canadensis alpha* differs from *N. canadensis* in having a roughened to slightly rugose wall, perforations of only moderate size, and smaller average specimen size.

Distribution: *N. canadensis alpha* was recorded from the Coniacian to Campanian of many places in America and Canada (Ellis & Messinae, 1969). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M41, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Neobulimina irregularis CUSHMAN and PARKER, 1936
Pl. 30, Fig. 9 a-b.

1936 *Neobulimina irregularis* CUSHMAN & PARKER, p. 9, pl. 2, fig. 8.
1946 *Neobulimina irregularis* CUSHMAN & PARKER. - CUSHMAN, p. 125, pl. 52, fig. 13.
1976 *Neobulimina irregularis* CUSHMAN & PARKER. - HAMAM, p. 36, pl. 2, fig. 10.
1985 *Neobulimina irregularis* CUSHMAN. - MIMRAN et al., p. 235, text-fig. 4.

Description: Test elongate, practically the same width throughout except for the initial end, which is tapering; about 5 times as long as broad in the microspheric form, shorter in the megalospheric one; chambers distinct, globular, irregular; sutures distinct, depressed; wall coarsely perforate; aperture broadly loop shaped, extending from the base of the final chamber.

Remarks: *N. irregularis* is found in association with *Globigerinelloides volutus* (White). The proportion of length to width, in the Jordanian specimens, is 3: 1 instead of 5: 1 in the original.

Distribution: *N. irregularis* was recorded from the Turonian to lower Campanian of Canada, Texas, and Kansas, USA (Cushman, 1946); Santonian of Israel (Mimran et al., 1985),; Maastrichtian of Jordan (Hamam, 1976). In the studied material, it is found in: M7a, Q20, 22a, Na'ur Formation (lower to middle Cenomanian); M39, Shueib Formation Equivalent (upper Cenomanian).

Genus: **Praebulimina** HOFKER, 1953

Praebulimina angulata SLITER, 1968
Pl. 31, Fig. 3.

1968 *Praebulimina angulata* SLITER, p. 83, pl. 12, fig. 6.

Description: Test free, small, transverse subtriangular with nearly flat sides; chambers distinct, inflated, higher than broad, increasing rapidly in size as added; sutures distinct, gently depressed; wall calcareous, finely perforate, surface smooth; aperture loop shaped. *P. angulata* differs from *P. trihedra* in being smaller and having a reduced spire

Distribution: *P. angulata* was recorded from the Campanian to Maastrichtian of California and Mexico (Sliter, 1968). In the studied material, it is found in: M90 (Campanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina aspera (CUSHMAN and PARKER, 1940)
Pl. 30, Fig. 12.

1940 *Bulimina aspera* CUSHMAN and PARKER, p. 44, pl. 8, figs. 18-19.
1986 *Bulimina aspera* CUSHMAN and PARKER. - AL-HARITHI, p. 51, pl. 4, fig. 13.
1968 *Praebulimina aspera* (CUSHMAN & PARKER). - FUTYAN, p. 177, pl. 10, fig. 27.
1968 *Praebulimina aspera* (CUSHMAN & PARKER). - SLITER, p. 83, pl. 11, figs. 11-13.
1973 *Praebulimina aspera* (CUSHMAN & PARKER). - SLITER, p. 183, t-fs. 7-8.

Description: Test free, elongate, gently tapering, circular in cross; chambers inflated, subrectangular, arranged directly above one another or slightly offset in spiral fashion; sutures distinct, depressed; wall calcareous, finely perforate, surface initially roughened, later smooth; aperture loop shaped, at the base of last chamber.

Distribution: *P. aspera* was recorded from the Campanian to Maastrichtian of California (Sliter, 1968, 1973); Coniacian to Maastrichtian of Jordan (Futyan, 1968; Al-Harithi, 1986). In the studied material, it is found in: M74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina bantu (KLASZ, MAGNE and RERAT, 1963)
Pl. 31, Fig. 5 a-b.

1963 *Bulimina (Praebulimina ?) bantu* KLASZ, MAGNE and RERAT, pp. 145-146, pl. 1, fig. 2; pl. 2, fig. 3, table 1.

Description: Test small, subpyramidal, quadriserial throughout, initial end rounded; chambers globular, slightly inflated, increasing gradually in size as added, last chamber most often on the same level as the penultimate; sutures distinct, profoundly depressed; wall calcareous, finely perforate, surface smooth; aperture an opening, at the base of final chamber. *P. bantu* differs from *P. bantu lata* in having a rounded initial portion and gradually enlarging test.

Distribution: *P. bantu* was originally described from the Maastrichtian of Gabon, Africa (Klasz et al., 1963). In the studied material, it is only ound in: P60, Amman Formation (lower Maastrichtian).

Praebulimina* sp. cf. *bantu lata (KLASZ, MAGNE and RERAT, 1963)
Pl. 31, Fig. 4.

1963 *Bulimina (Praebulimina ?) prolixa* CUSHMAN & PARKER *longa* KLASZ, MAGNE & RERAT. - KLASZ et al., p. 146, pl. 1, fig. 3; pl. 2, fig. 4, table 1.

Description: Test small, conical, triserial throughout, moderately inflated, tapering initial part, sides of the test moderately lobate; chambers inflated, globular, wider than higher, last chamber most often on the same level as the penultimate; sutures distinct, profoundly depressed; wall calcareous, finely perforate, surface smooth; aperture a wide opening, at the base of final chamber. *P. bantu lata* differs from *P. bantu* in having more pointed initial portion and more rapidly enlarging test.

Distribution: *P. bantu lata* was originally described from the Maastrichtian of Gabon, Africa (Klasz et al., 1963). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina carseyae (PLUMMER, 1931)
Pl. 30, Fig. 13; Pl. 31, Fig. 8 a-b.

1931 *Buliminella carseyae* PLUMMER, p. 179, pl. 8, fig. 7.
1968 *Praebulimina carseyae* (PLUMMER). - FUTYAN, p. 179, pl. 11, fig. 1.
1968 *Praebulimina carseyae* (PLUMMER). - SLITER, p. 83, pl. 11, fig. 16.
1971 *Praebulimina carseyae* (PLUMMER). - FLEXER, text-fig. 3.
1973 *Praebulimina carseyae* (PLUMMER). - SLITER, p. 183, pl. 1: 15, text-fig. 8.
1989 *Praebulimina carseyae* (PLUMMER). - HART et al., p. 356, pl. 7.20, figs. 15-16.

Description: Test free, subfusiform, initial end rounded, then rapidly flaring, untill final whorl; 3-4 whorls, commonly 4 chambers in each; chambers slightly inflated, with sutures flush to slightly depressed; wall calcareous, finely perforate, surface smooth; apertural face of final chamber elongate, aperture variable, subterminal, loop shaped, bordered by a thin, indistinct, lip.

Remarks: *P. carseyae* can be identified by its step like outline, quadriserial chamber arrangement, and slightly inflated chambers; early forms are smaller, slender with less inflated chambers. It differs from *P. cushmani* in being smaller, more compact and with less inflated chambers, from *Sitella laevis* in having much smaller test and slightly more inflated chambers.

Distribution: *P. carseyae* was recorded from the Coniacian to Campanian and lower Maastrichtian of Gulf Coast and California, USA (Sliter, 1968, 1973); Campanian of Germany and Maastrichtian of Egypt, Israel and Jordan (Futyan, 1968; Flexer, 1971). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M40, Shueib Formation Equivalent (upper Cenomanian), M90 (Campanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina prolixa (CUSHMAN and PARKER, 1935)
Pl. 30, Fig. 10.

1935 *Bulimina prolixa* CUSHMAN & PARKER, p. 98, pl. 15, fig. 5 a-b.
1976 *Bulimina prolixa* CUSHMAN and PARKER. - ANDRAWIS, pp. 16, 34.
1986 *Bulimina prolixa* CUSHMAN and PARKER. - AL-HARITHI, p. 1, fig. 15, 17.
1970 *Praebulimina prolixa* (CUSHMAN et al). - NORTH et al., p. 39-40, pl. 3, fig. 17 a-b.
1973 *Praebulimina prolixa* (CUSHMAN and PARKER). - BAYLISS. pp. 5, 15.
1975 *Praebulimina prolixa* (CUSHMAN & PARKER). - BASHA, pp. 187-89, pl. 13, fig. 25.
1990 *Praebulimina prolixa* (CUSH. & PARKER). - ALMOGI-LABIN et al., p. 45, text-fig. 4.

Description: Test free, small, elongate, narrow, height 2½ times breadth, triangular in with rounded angles, initially slightly twisted to generally regular; chambers three rounded in each successive whorl that are positioned directly above one other resulting in three vertical rows of chambers; wall calcareous, surface smooth; aperture nearly terminal, loop shaped.

Distribution: *P. prolixa* was recorded from the lower Turonian of Egypt (Andrawis, 1976); Campanian of Israel (Almogi-Labin, 1990); lower Turonian to Maastrichtian of Jordan (Basha, 1975; Al-Harithi, 1986). In the studied material, it is found in: M7a, 22, 23, Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian), M35, 37, 39, 41, Shueib Formation Equivalent (upper Cenomanian).

Praebulimina prolixa longa (KLASZ, MAGNE and RERAT, 1963)
Pl. 30, Fig. 11.

1935 *Bulimina prolixa* CUSHMAN & PARKER, p. 98, pl. 15, fig. 5 a-b.
1963 *Bulimina prolixa* CUSHMAN & PARKER *longa* KLASZ, MAGNE & RERAT. - KLASZ et al., pp. 147-148, pl. 1, fig. 7; pl. 2, figs. 10-11, table 1.

Remarks: Test free, elongate, triserial throughout, narrow, height 2½ times breadth, triangular in with rounded angles; chambers three rounded in each successive whorl that are positioned directly above one other resulting in three vertical rows of chambers; wall calcareous, surface smooth; aperture nearly terminal, loop shaped. *P. prolixa longa* differs from *P. prolixa* in being much longer, less broad and having much profoundly depressed sutures.

Distribution: *P. prolixa longa* was originally described from the Coniacian to Maastrichtian of Gabon, Africa (Klasz et al., 1963). In the studied material, it is found in: M7a, M23, P1, Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian), M39, M41, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina reussi (MORROW, 1934)
Pl. 30, Fig. 15.

1934 *Bulimina reussi* MORROW, p. 195, pl. 29, fig. 12.
1986 *Bulimina reussi* MORROW. - AL-HARITHI, p. 4, pl. 9, text-figs. 13, 15.
1968 *Praebulimina reussi* (MORROW). - SLITER, p. 85, pl. 12, figs. 1a-b & 2a-b.
1971 *Praebulimina reussi* (MORROW). - FLEXER, text-fig. 3.
1973 *Praebulimina reussi* (MORROW). - BAYLISS, p. 5.
1975 *Praebulimina reussi* (MORROW). - BASHA, pp. 189-190, pl. 13, fig. 26.
1985 *Praebulimina reussi* (MORROW). - LUGER, p. 107, pl. 7, fig. 7.
1988 *Praebulimina reussi* (MORROW). - LOEBLICH & TAPPAN, p. 511, pl. 563, figs. 1-3, 5.
1989 *Praebulimina reussi* (MORROW). - HART et al., p. 356, pl. 7.21, figs. 5-6.
1990 *Praebulimina reussi* (MORROW). - AL-BAKRI, p. 143, pl. 7, figs. 12-13.

Description: Test free, small, ovate in outline, subcircular in cross, tapering; 4-5 whorls, chambers distinct, inflated, triserial throughout, increasing rapidly in size; sutures distinct, slightly depressed; wall calcareous, finely perforate, surface smoothly finished; aperture variable, normally a narrow terminal slit at the inner margin of final chamber.

Remarks: *P. reussi* is distinguished by its noticeably short, flaring test and large final chamber. It differs from *P. venusae* in being smaller and more ovate in outline and in having a more widely flaring test.

Distribution: *P. reussi* was recorded from the Turonian to Maastrichtian of North America and British Columbia (Sliter, 1968, 1973); Santonian and Campanian of England (Hart et al., 1989); Maastrichtian and Palaeocene of Egypt (Said & Kenawy, 1956; Ismail, 1989); upper Coniacian to Turonian of Palestine (Bayliss, 1973); upper Coniacian to upper Maastrichtian of Israel and Jordan (Reiss, 1962; Flexer, 1971; Basha, 1975, 1979; Al-Harithi, 1986; Al-Bakri, 1990). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian); P60, Amman Formation (lower Maastrichtian).

Praebulimina reussi navarroensis (CUSHMAN and PARKER, 1935)
Pl. 31, Fig. 1; Pl. 32, Fig. 3.

1935 *Bulimina reussi* MORROW var. *navarroensis* CUSHMAN and PARKER, p. 100, pl. 15, fig. 11.
1956 *Bulimina reussi navarroensis* CUSHMAN & PARKER. - SAID & KENAWY, p. 143, pl. 4, fig. 10.
1966 *Bulimina navarroensis* CUSHMAN & PARKER. - HOFKER, p. 287, pl. 63, figs. 85; pl. 64, fig. 113.
1968 *Bulimina navarroensis* CUSHMAN & PARKER. - FUTYAN, p. 185, pl. 11, fig. 9.
1969 *Bulimina reussi navarroensis* CUSHMAN & PARKER. - MELLO, p. 75, pl. 9, fig. 1a-c.
1979 *Praebulimina reussi navarroensis* (CUSHMAN & PARKER). - HAMAM, p. 160, pl. 2, fig. 14.

Description: Test very small, ovate, subcircular in transverse, with greatest breadth above the middle; chambers triserial throughout, enlarging gradually in size as added; sutures depressed; wall calcareous, finely perforate, surface smooth; aperture small, subterminal. *P. reussi navarroensis* differs from the typical forms in the smaller size of the test and in the much slighter inflation of the last-formed chambers; the last whorl occupying more than half of the test size. The megalospheric form is stouter and less tapering than the microspheric one.

Distribution: *P. reussi navarroensis* was recorded from the Maastrichtian of Texas, USA (Cushman, 1946); Palaeocene of Egypt (Said & Kenawy, 1956); Turonian to Maastrichtian of Jordan (Basha, 1975; Futyan, 1968). In the studied material, it is found in: M7a, P1, Q22a, Na'ur Formation (lower to middle Cenomanian); Q28, M31, Fuheis Formation Equivalent (middle Cenomanian), M33, 35, 37, Shueib Formation Equivalent (upper Cenomanian).

Praebulimina sp. cf. ***arabica*** HAMAM, 1977
Pl. 30, Fig. 14.

1977 *Praebulimina arabica* HAMAM, p. 38, pl. 2, figs. 3, 4, 9.
1969 *Praebulimina arabica* HAMAM. - ELLIS and MESSINA, Book 89, Supplement 1, 1987, figs. 3, 4, 9.

Description: Test small to medium sized, slightly twisted along its longitudinal axis, twice as long as wide, moderately inflated, slightly tapering initial part, sides of the test moderately lobate; chambers inflated, subglobular, as high as wide, last chamber most often on the same level as the penultimate; sutures distinct; wall calcareous, finely perforate, surface smooth; aperture a small opening, wide, at the base of final chamber.

Remarks: This species differs from Hamam's form in being less twisted along its longitudinal axis and in occuring at a much lower stratigraphic level, in addition to the same level as well. It differs from *P. prolixa* in having a smaller, more inflated test, broader aperture and lacking the triangular cross. *P. venusae* has comparatively distinct sutures, but with a comma-shaped opening on the inner face of final chamber.

Distribution: *P. arabica* was recorded from the lower Maastrichtian of Jordan (Hamam, 1977). In the studied material, it is found in: Q20, M22, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian), M35, M38, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina trihedra CUSHMAN, 1926
Pl. 31, Fig. 2 a-b.

1926 *Bulimina trihedra* CUSHMAN, p. 591, pl. 17, fig. 6 a-b.
1935 *Bulimina trihedra* CUSHMAN. - CUSHMAN, p. 100, pl. 15, fig. 9 a-b.
1946 *Bulimina trihedra* CUSHMAN. - CUSHMAN, p. 122, pl. 51, fig. 17.

Description: Test small, distinctly trihedral, angles rounded, sides nearly flat or slightly convex; chambers numerous, distinct, inflated, somewhat higher than broad; sutures distinct, depressed; wall calcareous, very finely perforate, smooth and polished; aperture elongate and oval.

Distribution: *P. trihedra* was recorded from the Campanian of Texas, USA (Cushman, 1946). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M90, 91, Amman Formation (Campanian); P60, Amman Formation (lower Maastrichtian).

Praebulimina venusae (NAUSS, 1947)
Pl. 31, Fig. 6.

1947 *Bulimina venusae* NAUSS, pp. 334-335, pl. 48, fig. 10.
1967 *Praebulimina venusae* (NAUSS). - WALL, p. 94, pl. 15, figs. 19-22.
1968 *Praebulimina venusae* (NAUSS). - SLITER, p. 86, pl. 12, fig. 5.
1971 *Praebulimina venusae* (NAUSS). - MORRIS, p. 278, pl. 6, fig. 7.
1973 *Praebulimina venusae* (NAUSS). - SLITER, p. 1, pl. 16, text-figs. 2, 6.

Description: Test free, small, elongate, triserial throughout, rapidly flaring, rounded in; chambers triserially arranged in about 4 whorls, increasing quickly in size and becoming inflated; sutures distinct, depressed; wall calcareous, finely perforate, smoothly finished; aperture a loop shaped opening, extending up the face of the final chamber. *P. venusae* is more elongate than *P. cushmani* and has 3 inflated chambers in the final whorl.

Distribution: *P. venusae* was originally described from the Senonian of Canada and Alaska, later recorded from the Santonian to lower Campanian of California and British Columbia (Sliter, 1968, 1973). In the studied material, it is found in: Q22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian).

Genus: **Pyramidina** BROTZEN, 1948

Pyramidina rudita (CUSHMAN and PARKER, 1936)
Pl. 31, Fig. 7 a-b.

1936 *Bulimina rudita* CUSHMAN and PARKER, p. 45.
1946 *Bulimina rudita* CUSHMAN and PARKER. - CUSHMAN, p. 122, pl. 51, fig. 24.
1968 *Pyramidina rudita* CUSHMAN and PARKER. - SLITER, pp. 86-87, pl. 12, fig. 12.
1973 *Pyramidina rudita* CUSHMAN and PARKER. - SLITER, p. 183, text-fig. 8.

Description: Test free, small, tapering, triangular in transverse, with rounded angles, concave sides; chambers distinct, slightly inflated, arranged in regular triserial pattern; sutures distinct, depressed, becoming sigmoidal; wall calcareous, finely perforate; aperture nearly terminal, loop shaped, at base of final chamber, with slight lip.

Distribution: *P. rudita* was recorded from the Coniacian to Maastrichtian of the American Gulf Coast and British Columbia (Sliter, 1968, 1973). In the studied material, it is found in: M7a, Q22a, Na'ur Formation (lower to middle Cenomanian); Q28, Fuheis Formation Equivalent (middle Cenomanian); M33, 39, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Pyramidina triangularis (CUSHMAN and PARKER, 1935)
Pl. 32, Fig. 2.

1935 *Bulimina triangularis* CUSHMAN & PARKER, p. 97, pl. 15, fig. 4.
1946 *Bulimina triangularis* CUSHMAN & PARKER. - CUSHMAN, p. 122, pl. 51, fig. 23.
1960 *Bulimina triangularis* CUSHMAN & PARKER. - BELFORD, p. 65, pl. 16, figs. 10-12.
1968 *Pyramidina triangularis* (CUSHMAN & PARKER). - SLITER, p. 87, pl. 12, fig. 11.

Description: Test free, small, flaring, robust, tapering, triangular in transverse with rounded angles; chambers somewhat indistinct, very slightly inflated, increasing rapidly in size; sutures commonly indistinct, slightly depressed; wall calcareous, distinctly perforate, surface initially smooth to slightly spinose, later smooth; aperture nearly terminal, loop shaped, at base of final chamber. *P. triangularis* differs from *P. rudita* in being proportionately shorter, but more widely flaring and having a coarser surface texture.

Distribution: *P. triangularis* was recorded from the Coniacian to Santonian of Mississippi; Campanian to Maastrichtian of Texas and Gulf Coast, USA (Cushman, 1946; Sliter, 1968). In the studied material, it is found only in M90, Amman Formation (Campanian).

Family: **STAINFORTHIIDAE** REISS, 1963
Genus: **Hopkinsina** HOWE and WALLACE, 1932

Hopkinsina arabina FUTYAN, 1968
Pl. 31, Fig. 9 a-b.

1968 *Hopkinsina arabina* FUTYAN, pp. 161-162, pl. 10, figs. 8-10, 21.
1976 *Hopkinsina arabina* FUTYAN. - FUTYAN, pp. 529-530, pl. 82, fig. 7-9.

Description: Test elongate, greatest width in middle; chambers slightly inflated, increasing in size as added, early stage triserial, later biserial; sutures depressed; wall calcareous, striate, rarely with nodes; aperture terminal, elliptical, not protruding, bound by short rims; upper portion irregularly triserial or uniserial, without neck.

Distribution: *H. arabina* was originally described from Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M70, Ghudran Formation (Coniacian to Santonian), M90, 91, Amman Formation (Campanian).

Superfamily: **BULIMINACEA** JONES, 1875
Family: **SIPHOGERINOIDIDAE** SAIDOVA, 1981
Subfamily: **SIPHOGERINOIDINAE** SAIDOVA, 1981
Genus: **Hiltermannella** BERTELS, 1971

Hiltermannella sp. cf. ***kochi*** BERTELS, 1970
Pl. 31, Fig. 10 a-b.

1970 *Hiltermannia kochi* BERTELS, p. 169.
1971 *Hiltermannella kochi* BERTELS. - BERTELS, p. 104.
1988 *Hiltermannella kochi* BERTELS. - LOEBLICH & TAPPAN, p. 516, pl. 566, figs. 16-18.

Description: Test elongate, laterally compressed, oval in, margins rounded, periphery lobulate; chambers broad, low and inflated, in a sinuate biserial arrangement, later chambers proportionately higher and final chamber tending to become central in position, as if uniserial; sutures curved, oblique, depressed; wall calcareous, finely perforate, surface smooth; aperture comma-shaped opening, arising from the base of the apertural face.

Distribution: *H. kochi* was recorded from the middle Maastrichtian of Argentina (Loeblich & Tappan, 1988). The Jordanian specimens resemble those of Bertels in their external appearance, but differ in the their stratigraphic occurrence. In the studied material, they are found in Q22a, Na'ur Formation (lower to middle Cenomanian); M74, Ghudran Formation (Coniacian to Santonian).

Genus: **Hopkinsinella** BERMUDEZ and FUENMAYOR, 1966

Hopkinsinella sp.
Pl. 31, Fig. 11.

Description: Test tiny, elongate, flattened ovate in, biserial throughout, but with tendency for final chamber to become terminal; chambers increasing in relative height as added; sutures oblique, depressed; wall calcareous, finely perforate, surface smooth; aperture terminal. *H.* sp. resmbles *H. glabra* (MILLETT) from the Holocene of Malay (Loeblich & Tappan, 1988, p. 516), in its external appearance, but differs in the stratigraphic occurrence.

Distribution: *H.* sp. is found in the studied material only in: M71, Ghudran Formation (Coniacian to Santonian).

Family: **BULIMINIDAE** JONES, 1875
Genus: **Bulimina** D'ORBIGNY, 1826

Bulimina exigua robusta KLASZ, MAGNE and RERAT, 1963
Pl. 32, Fig. 1.

1935 *Bulimina exigua* CUSHMAN & PAKER, p. 99, pl. 15, fig. 7.

1963 *Bulimina (Praebulimina ?) exigua* CUSHMAN & PAKER ssp. *robusta* KLASZ, MAGNE & RERAT, p. 147, pl. 1, fig. 5; pl. 2, fig. 6-8, table 1.

Description: Test very small, about twice as long as broad, consisting usually of 5 whorls; chambers subglobular, overlapping, somewhat inflated; sutures profoundly depressed throughout; wall calcareous, finely perforate, surface smooth to slightly striated; aperture simple rounded opening at the end of final chamber.

Remarks: *B. exigua robusta* differs from *Praebulimina reussi* in its smaller size, in the more gradual increase in the size of chambers toward the apertural end and in the different shape of the aperture; the large specimens resemble very much *P. bantu*, so that they may be confused.

Distribution: *B. exigua robusta* was originally described from the Turonian to Maastrichtian of Gabon, Africa (Klasz et al., 1963). In the studied material, it is found in: M7a, 22, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian), M40, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Bulimina kirri AL-HARITHI, 1986
Pl. 32, Fig. 4.

1986 *Bulimina kirri* AL-HARITHI, p. 99, pl. 3, pl. 3-5, text-figs. 13, 15.
1986 *Bulimina kirri* AL-HARITHI. - AL-HARITHI, pp. 334-336, fig. 3 (10, 14-15).

Description: Test triserial throughout, rather elongate than inflated, with somewhat overlapping chambers; sutures deep and highly folded; wall calcareous, finely perforated, surface smooth to very finely beaded; aperture a simple opening at the end of last chamber..

Distribution: *B. kirri* was originally described from the Santonian to lower Campanian of Jordan (Al-Harithi, 1986). In the studied material, it is found in: M33, 37, Shueib Formation Equivalent (upper Cenomanian), M98, 99, Amman Formation (lower Maastrichtian).

Superfamily: **FURSENKOINACEA** LOEBLICH, and TAPPAN, 1961
Family: **FURSENKOINIDAE** LOEBLICH, and TAPPAN, 1961
Genus: **Cassidella** HOFKER, 1951

Cassidella navarroana (CUSHMAN, 1933)
Pl. 32, Fig. 5 a-b.

1933 *Virgulina navarroana* CUSHMAN, p. 63, pl. 7, fig. 9-10.
1946 *Virgulina navarroana* CUSHMAN. - CUSHMAN, p. 126, pl. 63, figs. 5-7.
1956 *Virgulina navarroana* CUSHMAN. - SAID & KENAWY, p. 143, pl. 4, fig. 16.
1960 *Virgulina navarroana* CUSHMAN. - OLSSON, p. 5, pl. 10.
1968 *Cassidella navarroana* (CUSHMAN). - FUTYAN, pp. 165-166, pl. 9, fig. 21.

Description: Test elongate, tapering, greater breadth towards aperture; periphery broadly rounded, some specimens with short spine; chambers distinct, slightly inflated, irregularly spiral in the early portion, becoming distinctly biserial in adult; last-formed chamber somewhat more elongate than earlier ones; sutures distinct, slightly depressed; wall calcareous, surface smooth; aperture broadly elliptical, comma-shaped with slight rim.

Distribution: *C. navarroana* was recorded from the Maastrichtian of Texas, Arkansas, New Jersey and Sinai, Egypt (Cushman, 1946; Said & Kenawy, 1956); Maastrichtian to lower Palaeocene of Jordan (Futyan, 1968). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian), M89 (Campanian); P60, Amman Formation (lower Maastrichtian).

Cassidella tegulata (REUSS, 1846)
Pl. 32, Fig. 6 a-b.

1846 *Virgulina tegulata* REUSS, p. 40, pl. 13, fig. 81.
1975 *Virgulina tegulata* (REUSS). - BASHA, pp. 191-192, pl. 14, fig. 3.
1979 *Virgulina tegulata* (REUSS). - BASHA, pp. 61-62, pl. 1, fig. 6.
1982 *Virgulina tegulata* (REUSS). - AL-HARITHI, pp. 75-76, pl. 4, fig. 1.
1988 *Cassidella tegulata* (REUSS). - LOEBLICH & TAPPAN, p. 530, pl. 578, figs. 26, 27.
1990 *Cassidella tegulata* (REUSS). - AL-HARITHI, p. 522, fig. 1 (4-6).

Description: Test elongate, slender, compressed, ovate in, slightly twisted; early proloculus follwed by biserial rhomboidal chambers, gradually enlarging in size as added; last-formed chamber encloses the preceding one and the last two chambers equal one-third of the test diameter; sutures depressed, slightly oblique; wall calcareous, finely perforate; aperture loop shaped, at the oral face of final chamber.

Distribution: *C. tegulata* was recorded from the Turonian to Campanian of Germany and USA (Cushman, 1946; Frizzell, 1954); lower Turonian of Egypt (Ansary & Emara, 1962); lower Turonian to Santonian of Jordan (Basha, 1975, 1979; Al-Harithi, 1982, 1990). In the studied material, it is found in: P1, M7a, 21, Q20, 22a, Na'ur Formation (lower to middle Cenomanian); Q28, P41, Fuheis Formation Equivalent (middle Cenomanian); P60, Amman Formation (lower Maastrichtian).

Genus: **Coryphostoma** LOEBLICH, and TAPPAN, 1962

Coryphostoma neumannae (HAMAOUI, 1979)
Pl. 32, Fig. 8 a-b.

1979 *Laterostoma neumannae* HAMAOUI, p. 86, text-fig. 44.
1988 *Coryphostoma neumannae* (HAMAOUI). - LOEBLICH & TAPPAN, p. 530, pl. 578, figs. 13-7

Description: Test free, elongate, narrow, twisted, rounded to oval in; early chambers biserially arranged and closely appressed, broad and low, strongly oblique, later chambers higher and cuneate in shape, with a tendancy to become uniserial; wall calcareous, finely perforate, surface smooth; aperture in the early stage an interiomarginal loop extending up from the base of the last chamber.

Distribution: *C. neumannae* is cosmopolitan and was recorded from the Cenomanian of Israel; Holocene (Hamaoui, 1979; Loeblich & Tappan, 1988). In the studied material, it is found in: M7a, 20, 21, Q22a, Na'ur Formation (lower to middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian); P60, Amman Formation (lower Maastrichtian).

Coryphostoma plaitum (CARSEY, 1926)
Pl. 32, Fig. 7.

1926 *Bolivina plaitum* CARSEY, p. 26, pl. 4, fig. 2.
1964 *Coryphostoma plaita* (CARSEY). - LOEBLICH & TAPPAN, p. C733, pl. 600, no. 8.
1968 *Coryphostoma plaita* (CARSEY). - FUTYAN, pp. 173-174, pl. 10, fig. 20.
1968 *Coryphostoma plaitum* (CARSEY). - SLITER, p. 112, pl. 19, fig. 13.
1988 *Coryphostoma plaitum* (CARSEY). - LOEBLICH & TAPPAN, p. 530, pl. 578, fig. 1-3.

Description: Test free, elongate, slender, narrow, slightly compressed, ovate, periphery rounded, biserial throughout; chambers initially subrectangular, later cuneiform, increasing gradually in size as added; sutures distinct, slightly depressed, oblique; wall calcareous, finely perforate, smoothly finished; aperture subterminal, elongate, with tooth-plate.

Distribution: *C. plaitum* is cosmopolitan and was recorded from the Cenomanian to Holocene (Loeblich & Tappan, 1988),; Coniacian to Maastrichtian of the Gulf Coast and Texas, USA (Sliter, 1968). In the studied material, it is found in: M23, Na'ur Formation (lower to middle Cenomanian); J34, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Genus: **Fursenkoina** LOEBLICH and TAPPAN, 1961

Fursenkoina squammosa (D'ORBIGNY, 1826)
Pl. 32, Fig. 9.

1826 *Virgulina squammosa* D'ORBIGNY, p. 267.
1988 *Fursenkoina squammosa* (D'ORBIGNY). - LOEBLICH & TAPPAN, p. 530, pl. 578, figs. 18-23.

Description: Test narrow, elongate, rounded to ovate in; chambers high narrow, slightly inflated, biserial throughout, plane of biseriality twisted about the test axis; sutures oblique, depressed; wall calcareous, very finely perforate, surface smooth; aperture narrow, elongate, comma-shaped.

Distribution: *F. squammosa* is cosmopolitan and was recorded from the upper Cretaceous to Holocene (Loeblich & Tappan, 1988). In the studied material, it is found in: P1, 3, Q22a, Na'ur Formation (lower to middle Cenomanian); P41, M31, Fuheis Formation Equivalent (middle Cenomanian); J34, 35, Shueib Formation (upper Cenomanian).

Superfamily: **PLEUROSTOMELLACEA** REUSS, 1860
Family: **PLEUROSTOMELLIDAE** REUSS, 1860
Subfamily: **PLEUROSTOMELLINAE** REUSS, 1860
Genus: **Ellipsoglandulina** SILVESTRI, 1900

Ellipsoglandulina laevigata SILVETRI, 1900
Pl. 32, Fig. 10.

1900 *Ellipsoglandulina laevigata* SILVETRI, p. 12.
1988 *Ellipsoglandulina laevigata* SILVETRI. - LOEBLICH & TAPPAN, p. 536, pl. 583, figs. 17-21.

Description: Test elongate, flaring, circular in, uniserial throughout, strongly overlapping chambers, increasing rapidly in size, but do not completely envelop the test; final chamber comprising up to two-thirds the test length; sutures nearly straight and horizontal, slightly depressed; wall calcareous, surface smooth; aperture terminal, semilunate.

Distribution: *E. laevigata* is cosmopolitan and was recorded from the Turonian to Holocene (Loeblich & Tappan, 1988). In the studied material, it is found in: M21, Na'ur Formation (lower to middle Cenomanian).

Superfamily: **STILOSTOMELLACEA** FINLAY, 1947
Family: **STILOSTOMELLIDAE** FINLAY, 1947
Genus: **Nodogerina** CUSHMAN, 1927

Nodogerina bradyi CUSHMAN, 1927
Pl. 32, Fig. 11 a-b.

1927 *Nodogerina bradyi* CUSHMAN, p. 79.
1964 *Sagrina virgula* BRADY. - LOEBLICH and TAPPAN, p. C 569.
1988 *Nodogerina bradyi* CUSHMAN. - LOEBLICH & TAPPAN, p. 539, pl. 585, figs. 13-15.

Description: Test narrow, elongate, uniserial, and rectilinear; chambers campanulate in form, widest at the shoulder near the base of the chamber, sharply curving inward to the suture below, upper part of the chamber domed; sutures constricted; wall calcareous, finely perforate, commonly with a row of small spines at the edge of the chamber shoulder; aperture terminal and ovate, bordered by a produced lip.

Distribution: *N. bradyi* is cosmopolitan and was recorded from the Campanian to Holocene (Loeblich & Tappan, 1988). In the studied material, it is found in: M91, Amman Formation (Campanian).

Superfamily: **DICORBACEA** EHRENBERG, 1838
Family: **DISCORBINIDAE** REISS, 1963
Genus: **Conorbina** BROTZEN, 1936

Conorbina conica LOZO, 1944
Pl. 33, Fig. 1 a-b.

1944 *Conorbina conica* LOZO, p. 141.
1968 *Conorbina* sp. cf. *conica* LOZO. - KOCH, p. 630.
1988 *Conorbina conica* LOZO. - LOEBLICH and TAPPAN, p. 541.

Desription: Test planoconvex, trochospiral, chambers crescentic and sutures oblique as seen from the spiral side; wedgelike with nearly radial and slightly curved sutures on the flat umbilical side; wall calcareous, roughened; aperture a low extraumbilical and interiomarginal slit.

Distribution: *C. conica* was recorded from the lower Cretaceous to Coniacian of Europe and North America (Loeblich & Tappan, 1988); Cenomanian of Jordan (Koch, 1968). In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian).

Family: **BAGGINIDAE** CUSHMAN, 1927
Subfamily: **SEROVAININAE** SLITER, 1968
Genus: **Serovaina** SLITER, 1968

Serovaina minutus (SAID and KENAWY, 1957)
Pl. 33, Fig. 8 a-b; Pl. 36, Fig. 5 a-c.

1957 *Discorbis minutus* SAID & KENAWY, p. 83, pl. 13, fig. 19 a-b.
1969 *Discorbis minutus* SAID & KENAWY. - ANSARY & TEWFIK, p. 98, tbl. I.
1975 *Discorbis minutus* SAID and KENAWY. - BASHA, pp. 197-198, pl. 14, figs. 11-13.
1976 *Discorbis minutus* SAID & KENAWY. - ANDRAWIS, pp. 11-12, 34, 1 chart.
1979 *Discorbis minutus* SAID and KENAWY. - BASHA, pp. 61-62.
1990 *Serovaina minutus* (SAID and KENAWY). - AL-BAKRI, p. 42, pl. 8, fig. 1.

Description: Test small, planoconvex-concavoconvex, more convex and evolute dorsally, involute ventrally with large plugged umbilicus and rounded peripheral margin; 5-7 chambers, encircling a small proloculus; sutures oblique, flush dorsally and depressed ventrally; wall calcareous; aperture curved slit at the base of last chamber.

Remarks: The genus *Discorbis* appeared only in the middle Eocene. The species assigned to this genus by Said and Kenawy (1957) does not possess the characteristic umbilical flaps of *Discorbis* but they are very close to the Cretaceous genus *Serovaina* erected by Sliter (1968).

Distribution: *S. minutus* was recorded from the upper Cenomanian to Santonian of Egypt (Said & Kenawy, 1957, 1969; Andrawis, 1976); Cenomanian, Turonian and upper Coniacian of Jordan (Koch, 1968; Basha, 1975, 1979; Al-Bakri, 1990). In the studied material, it is found in: P17, P19, Na'ur Formation (lower to middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian), M56, Shueib Formation Equivalent (Turonian), M63, 66, 68, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Serovaina orbicella (BANDY, 1951)
Pl. 33, Figs. 2 a-b, 4 a-c.

1951 *Gyroidina globosa* (HAGENOW) v. *orbicella* BANDY, p. 505, pl. 74, fig. 2.
1971 *Gyroidina globosa* (HAGENOW) v. *orbicella* BANDY. - MORRIS, p. 279, pl.7, fig. 7-8
1968 *Serovaina orbicella* (BANDY). - SLITER, p. 92, pl. 13, fig. 12.
1973 *Serovaina orbicella* (BANDY). - SLITER, pp. 178, 180, text-figs. 6-7.
1988 *Serovaina orbicella* (BANDY). - LOEBLICH & TAPPAN, p. 545, pl. 590, figs. 13-15.

Description: Test trochospiral, spiral side partially evolute, gently convex to flattened, umbilical side involute, convex with small umbilicus; periphery rounded; 5-8 chambers, later inflated; sutures radial, slightly depressed, slightly curved; wall calcareous, smoothly finished; aperture low interiomarginal slit extending from near periphery to umbilicus.

Distribution: *S. orbicella* was recorded from the Campanian to Maastrichtian of California and Mexico (Sliter, 1968); Santonian to lower Campanian of Texas, USA (Sliter, 1973). In the studied material, it is found in: M21, 22, 23, Na'ur Formation (lower to middle Cenomanian); M32, J25, Fuheis Formation (middle Cenomanian); M37, 57, J34, 36, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian); M88, Amman Formation (Campanian).

Serovaina pseudoscopus (NAKKADY, 1950)
Pl. 33, Fig. 9 a-b; Pl. 36, Fig. 6 a-c.

1950 *Discorbis pseudoscopus* NAKKADY, p. 688, pl. 90, figs. 2-4.
1958 *Discorbis pseudoscopus* NAKKADY. - ANSARY & FAKHRI, p. 131, pl. 2, fig. 9.
1989 *Discorbis pseudoscopus* NAKKADY. - ISMAIL, p. 175, pl. 6, fig. 13.

Remarks: *S. pseudoscopus* is distinguished by its slightly convex involute umbilical side and a more convex evolute spiral side; 8-9 chambers forming the final whorl, increasing gradually in size as added, the last two chambers constituting about one-half the test size.

Distribution: *S. pseudoscopus* was recorded from the Maastrichtian to Palaeocene of Egypt (Ansary et al., 1958; Ismail, 1989). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian), Q34; M63, 69, Wadi Sir Formation (Turonian); P55, Q43, Ghudran Formation (Coniacian to Santonian).

Serovaina simplex (ANSARY and TEWFIK, 1966)
(Figure not given)

1966 *Discorbis simplex* ANSARY & TEWFIK, p. 71, pl. 9, fig. 4a-c
1969 *Discorbis simplex* ANSARY & TEWFIK. - ANSARY and TEWFIK, p. 98, pl. 2, fig. 5, table I.
1982 *Discorbis simplex* ANSARY and TEWFIK. - AL-HARITHI, p. 77, pl. 4, figs. 12-13.

Description: Test very small, much compressed, dorsal side slightly convex, evolute, ventral side slightly convex, semi-evolute; equatorial periphery subrounded; chambers distinct, 8-9 in the last whorl, increasing gradually in size as added; sutures distinct, radial, depressed; wall finely perforate, surface smooth; aperture ventral, a distinct slit extending from the periphery to the base of last chamber.

Distribution: *S. simplex* was recorded from the Coniacian to Santonian of Egypt (Ansary & Tewfik, 1966, 1969); Turonian to Maastrichtian of Jordan (Al-Harithi, 1982). In the studied material, it is found in: P26, Na'ur Formation (lower to middle Cenomanian); M63, Wadi Sir Formation (Turonian).

Serovaina sp. 1.
Pl. 33, Figs. 5 a-b, 6 a-b.

Remarks: This species may be distinguished by its slightly convex evolute spiral side and a concave involute umbilical side; 5-6 chambers forming the final whorl, increasing gradually in size as added, the final chamber being highly compressed and forming about one-half the test size. *S.* sp. 1 differs from *S. pseudoscopus* in having a concave umbilical side, lesser number of chambers and highly compressed final chamber.

Distribution: *S.* sp. 1 was found in the studied material in: M16, Na'ur Formation (lower to middle Cenomanian); Q43, P55, Ghudran Formation (Coniacian to Santonian).

Serovaina struvei (MITTERMAIER, 1896)
Pl. 36, Fig. 4 a-c.

1896 *Discorbina struvei* MITTERMAIER, p. 20, fig. 3 a-c.
1975 *Discorbis struvei* (MITTERMAIER). - BASHA, p. 199, pl. 14, figs. 18-19.

Description: Test large, dorsally convex, periphery lobulate, ventrally concave, supplemented with angular chambers; sutures strongly oblique on both sides; wall calcareous; aperture slit-like opening. *S. struvei* differs from *S. turonicus* and *S. minutus* in possessing 5-6 large chambers, compressed test, acute peripheral margin and strongly oblique sutures.

Distribution: *S. struvei* was recorded from the upper Cenomanian of Jordan (Basha, 1975). In the studied material, it is found in: P19, P26, Na'ur Formation (lower to middle Cenomanian); Q27, Fuheis Formation Equivalent (middle Cenomanian); M56, Shueib Formation Equivalent (Turonian), M64, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Serovaina turonicus (SAID and KENAWY, 1957)
Pl. 33, Fig. 3 a-b; Pl. 36, Fig. 3 a-c.

1957 *Discorbis turonicus* SAID & KENAWY, p. 83-4, pl. 13, fig. 22a-b
1975 *Discorbis turonicus* SAID & KENAWY. - BASHA, pp. 200-201, pl. 14, figs. 20-21.
1976 *Discorbis turonicus* SAID & KENAWY. - ANDRAWIS, p. 34, pl. II, fig. 1 a-c.
1986 *Discorbis turonicus* SAID & KENAWY. - AL-HARITHI, pp. 53-54, pl. 10, figs. 10-11.
1989a *Discorbis turonicus* SAID & KENAWY. - CHERIF et al., p. 260, pl. 2, fig. 19.
1990 *Discorbis turonicus* SAID & KENAWY. - AKARISH, p. 200, pl. III, fig. 11.
1990 *Serovaina turonicus* SAID & KENAWY. - AL-BAKRI, p. 42, pl. 8, figs. 2-3.

Description: Test low trochospiral, spiral side partially evolute, gently convex to flattened, umbilical side involute, flattened to concave with small depressed umbilicus; periphery rounded, lobulate; 5-6 chambers in the last whorl, later inflated; sutures radial, depressed in the ventral side, slightly depressed in the dorsal side; wall calcareous, finely perforate, surface smooth; aperture low interiomarginal slit extending from near periphery to umbilicus. *S. turonicus* differs from *S. orbicella* in having flattened to concave umbilical side. The absence of the umbilical flaps and the Cretaceous age of this form excludes the possibility of assigning it to the genus *Discorbis*.

Distribution: *S. turonicus* was recorded from the upper Cenomanian to Santonian; Turonian of Egypt (Said & Barakat, 1957; Ansary & Tewfik, 1969; Andrawis, 1976; Akarish, 1990); upper Cenomanian to Santonian of Jordan (Basha, 1975; Al-Harithi, 1986; Al-Bakri, 1990).

In the studied material, it is found in: P15, 19, 26, M7a, 20, 21, 22, 23, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J34, 44, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian), M63, J58, Wadi Sir Formation (Turonian); P55, Q43, Ghudran Formation (Coniacian to Santonian).

Subfamily: **BAGGININAE** CUSHMAN, 1927
Genus: **Valvulineria** CUSHMAN, 1926

Valvulineria camerata BROTZEN, 1936
Pl. 34, Fig. 2 a-c.

1936 *Valvulineria camerata* BROTZEN, p. 155, pl. 10, figs. 1-2.

1968 *Quadrimorphina camerata* (BROTZEN). - SLITER, p. 114, pl. 20, fig. 9.
1983 *Valvulineria camerata* BROTZEN. - BASOV et al., p. 763, pl. 8, figs. 2-4.

Description: Test small, trochospiral, biconvex, ovate in outline with evolute spiral side and involute umbilical side; chambers 4-5 in last whorl, increasing rapidly in size as added; sutures distinct, gently curved on spiral side, radial on umbilical side, depressed slightly on both sides; wall calcareous, finely perforate, surface smooth; aperture an interiomarginal arch extending to umbilicus, partially covered by triangular apertural flap.

Distribution: *V. camerata* was originally described from the Senonian of Sweden, later found in the Campanian of North America (Sliter, 1968), and recorded from Turonian to Campanian of SW Atlantic (Basov et al., 1983). In the studied material, it is found in: P3, 15, Na'ur Formation (lower to middle Cenomanian); Q33, Wadi Sir Formation (Turonian).

Valvulineria correcta (CARSEY, 1926)
Pl. 34, Fig. 3 a-b.

1926 *Discorbis correcta* CARSEY, p. 45, pl. 3, fig. 5.
1946 *Planulina correcta* (CARSEY). - CUSHMAN, p. 158, pl. 65, fig. 1.
1960 *Planulina correcta* (CARSEY). - OLSSON, p. 54, pl. 12, figs. 16-18.
1968 *Valvulineria correcta* (CARSEY). - FUTYAN, pp. 209-210, pl. 12, figs. 16-17.

Description: Test much compressed, one side more flattened than the other, periphery slightly rounded, lobulate; chambers 5-9, distinct, very slightly inflated, earlier ones low and broad, later much higher; sutures distinct, initially strongly limbate, later not limbate and slightly depressed, curved; wall calcareous, smooth, finely but distinctly perforate; aperture a low elongate, curved slit at the base of final chamber, extending to umbilicus and covered by a thin apertural flap.

Distribution: *V. correcta* was recorded through the Maastrichtian of the Gulf Coast, USA, Egypt and Jordan (Sliter, 1968; Nakkady, 1950; Futyan, 1968). In the studied material, it is found in: M101, Amman Formation (lower Maastrichtian).

Valvulineria loetterlei (TAPPAN, 1940)
Pl. 34, Fig. 1 a-b.

1940 *Gyroidina loetterlei* TAPPAN, p. 120, pl. 19, fig. 10.
1966 *Valvulineria loetterlei* (TAPPAN). - EICHER, p. 26, pl. 5, fig. 11.
1970 *Valvulineria loetterlei* (TAPPAN). - EICHER et al., p. 291, pl. 4, figs. 13 a-b, 14 a-b.

Description: Test free, trochospiral, biconvex, periphery rounded, chambers indistinct except in the last whorl, composed of 7-8; sutures poorly visible, flush except in later stages, radial, curving slightly at margins;wall calcareous, finely perforate; aperture a narrow, slit-like opening along the inner margin of last chamber; umbilical area covered by distinct apertural flap.

Distribution: *V. loetterlei* was recorded from the Cenomanian and Turonian of the Great Plains, USA (Eicher & Worstell, 1970). In the studied material, it is found in: M21, Na'ur Formation (lower to middle Cenomanian), M33, Shueib Formation Equivalent (upper Cenomanian); Q32, M64, Wadi Sir Formation (Turonian); M88, 90, Amman Formation (Campanian).

Genus: **Valvulinoides** PODOBINA, 1975

Valvulinoides umovi (KIPRIYANOVA, 1960)
Pl. 34, Fig. 8 a-c.

1960 *Valvulineria umovi* KIPRIYANOVA. - KIPRIYANOVA, p. 125.
1975 *Valvulinoides umovi* (KIPRIYANOVA). - PODOBINA, p. 86.
1988 *Valvulinoides umovi* (KIPRIYANOVA). - LOEBLICH, p. 548, pl. 593, figs. 1-8.

Description: Test trochospiral, with two and a half whorls, spiral side flattened, umbilical side convex; 8-9 chambers; periphery subangular, with subangular shoulder on umbilical side; sutures depressed, oblique and strongly arched on spiral side, radial on umbilical side; wall calcareous, surface smooth; aperture basal, umbilical to extraumbilical slit, extending on spiral side with valvelike umbilical extension.

Distribution: *V. umovi* was recorded from the Senonian of Siberia and Urals, Russia (Loeblich & Tappan, 1988). In the studied material, it is found only in M91, Amman Formation (Campanian).

Family: **EPONIDIDAE** HOFKER, 1951
Subfamily: **EPONIDINAE** HOFKER, 1951
Genus: **Donsissonia** McCULLOCH, 1977

Donsissonia sp.
Pl. 34, Figs. 6 a-b, 7 & 9 a-c.

Description: Test planoconvex with low trochospiral coil of two and a half whorls, spiral side convex and evolute with curved and oblique sutures, umbilical side flat to concave and involute; 6-7 chambers in the last whorl; sutures sraight, radiate and depressed; central area of umbilical side excavated, umbilicus small and open; periphery narrowly rounded, outline weekly lobulate; wall calcareous, finely perforate, surface smooth; aperture interiomarginal, extending from umbilicus to periphery. *D.* sp. resembles *D. florae* McCULLOCH from the Holocene (Loeblich & Tappan, 1988, p. 549), in its external appearance, but differs in the stratigraphic occurrence.

Distribution: *D.* sp. is found in the studied material in: M23, Na'ur Formation (lower to middle Cenomanian), M63, 64, Wadi Sir Formation (Turonian).

Genus: **Eponides** MONTFORT, 1808

Eponides sibericus NYETSKAYA, 1948
Pl. 35, Fig. 1 a-c.

1948 *Eponides sibericus* NYETSKAYA,
1989a *Eponides sibericus* NYETSKAYA. - CHERIF et al., p. 2, pl. 22, txt-figs. 2, 4.

Description: Test biconvex, periphery angular to carinate, a low trochospiral coil of 2-3 whorls, with about 6-7 chambers; umbilicus closed; sutures curved and limbate on spiral side, continuing into the keel, nearly radial on umbilical side; wall calcareous, surface smooth; aperture a broad low interiomarginal arch extending from umbilicus to periphery, bordered by a narrow lip. *E. sibericus* differs from *Poroeponides praeceps* in possessing a lower convex spiral side and a higher convex umbilical side.

Distribution: *E. sibericus* was recorded from the Cenomanian and Turonian of Sinai, Egypt (Cherif et al., 1989a). In the studied material, it is found in: M7a, 17, 22, Q11, Na'ur Formation (lower to middle Cenomanian); J37, 39, Shueib Formation (upper Cenomanian); M88, Amman Formation (Campanian).

Eponides sigali SAID and KENAWY, 1956
Pl. 35, Fig. 4 a-c.

1956 *Eponides sigali* SAID & KENAWY. - SAID & KENAWY, p. 148, pl. 5, f. 6.

Description: Test large, biconvex, subcircular in outline, dorsal side slightly lower than ventral; periphery strongly rounded; chambers about 7, indistinct in the earlier dorsal part, slightly inflated ventrally; sutures depressed and indistinct; wall smooth, finely perforate; aperture ventral, elongate between the umbilicus and the periphery.

Distribution: *E. sigali* was recorded from the Maastrichtian of Egypt (Said & Kenawy, 1956). In the studied material, it is found in: Q11, 13, M21, 22, 23, Na'ur Formation (lower to middle Cenomanian); J37, Shueib Formation (upper Cenomanian); M88, Amman Formation (Campanian).

Eponides sp. cf. *frankei* BROTZEN, 1940
Pl. 35, Fig. 2 a-c.

1940 *Eponides frankei* BROTZEN, pp. 32-33, pl. 27, text-fig. 8, fig. 3 a-c.
1965 *Eponides frankei* BROTZEN. - POZARYSKA, p. 109, pl. 18: 4.
1966 *Eponides frankei* BROTZEN. - HOFKER, p. 44, pl. 16, figs. 55-56; p. 127, pl. 18, fig. 18; p. 149, pl. 23, fig. 112.
1968 *Eponides frankei* BROTZEN. - FUTYAN, pp. 214-215, pl. 13, figs. 8-10.
1969 *Eponides frankei* BROTZEN. - ELLIS and MESSINA, figs. 1-3 a-c.

Description: Test biconvex, spiral side more convex than umbilical, circular outline, acute non-keeled periphery; chambers slightly inflated on umbilical side, indistinct on dorsal side; sutures radiate on umbilical side, straight, slightly curved on spiral side.

Distribution: *E. frankei* was originally described from the upper Maastrichtian of Sweden, later from Belgium (Ellis & Messinae, 1969) and was also recorded from the

Maastrichtian of Jordan (Futyan, 1968). In the studied material, *E.* sp. cf. *frankei* is found in M22, Q11, Na'ur Formation (lower to middle Cenomanian); J37, Shueib Formation (upper Cenomanian).

Eponides sp. cf. ***plummerae*** CUSHMAN, 1948
Pl. 35, Figs. 5 a-c, 6 a-b.

1948 *Eponides plummerae* CUSHMAN, p. 44, pl. 8, fig. 9.
1962 *Eponides plummerae* CUSHMAN. - SCHMID, p. 341, pl. 5, fig. 2.
1965 *Eponides plummerae* CUSHMAN. - KELLOUGH, p. 120, pl. 13, fig. 7.
1968 *Eponides plummerae* CUSHMAN. - FUTYAN, pp. 215-216, pl. 13, figs. 6-8.

Description: Test equally biconvex or ventrally more convex than dorsally; periphery non lobulate, bluntly keeled; sutures limbate, flush or very slightly raised on ventral side, slightly curved and limbate on spiral side; chambers non-inflated dorsally, umbilicus absent; aperture elongate, narrow, running from periphery to umbilical area, with a very slight lip.

Distribution: *E. plummerae* was recorded from Palaeocene of Jordan (Futyan, 1968). In the studied material, *E.* sp. cf. *plummerae* is found in M7a, 22, Q13, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J34, 38, 46, 47, Shueib Formation (upper Cenomanian); Q37, Wadi Sir Formation (Turonian); M88, Amman Formation (Campanian).

Eponides whitei BROTZEN, 1936
Pl. 35, Fig. 3 a-c.

1936 *Eponides whitei* BROTZEN, p. 160.
1989a *Eponides whitei* BROTZEN. - CHERIF et al., p. 255, pl. 2, fig. 21, text-fig. 2.

Description: Test low trochospiral, outline circular, biconvex, both sides equally high, periphery acute non-keeled; chambers 5-6 and sutures indistinct in earlier whorls, ventrally sutures depressed and radiate; wall calcareous, surface smooth; aperture a low interiomarginal arch extending from umbilicus to periphery, bordered by a narrow lip.

Distribution: *E. whitei* was recorded from the Cenomanian to upper Turonian of Egypt (Cherif et al., 1989a). In the studied material, it is found in: M7a, 22, Q13, Na'ur Formation (lower to middle Cenomanian); J36, 37, 46, Shueib Formation (upper Cenomanian); M65, Wadi Sir Formation (Turonian), M88, Amman Formation (Campanian).

Genus: **Poroeponides** CUSHMAN, 1944

Poroeponides praeceps (BROTZEN, 1936)
Pl. 35, Fig. 7 a-c.

1936 *Eponides praeceps* BROTZEN. - BROTZEN, p. 155.

1989a *Eponides praeceps* BROTZEN. - CHERIF, et al., p. 1, fig. 20; pl. 2, fig. 20, text-figs. 2, 4.

Description: Test trochospiral, planoconvex-biconvex with strongly elevated spiral side, periphery carinate; sutures curved and oblique on the spiral side, nearly radial on umbilical side, meeting at a clear calcite boss; final few chambers tending to flare and failing to reach the centre, resulting in a depressed umbilical region or pseudoumbilicus; wall calcareous, surface smooth; primary apertures interiomarginal reaching peripheral keel, narrow lip, scattered areal pores.

Distribution: *P. praeceps* was recorded from the middle to upper Cenomanian; lower to middle Turonian of Egypt (Cherif et al., 1989a). In the studied material, it is found in: Q20, M16, Na'ur Formation (lower to middle Cenomanian); M32, J25, Fuheis Formation (middle Cenomanian); J34, J36, 39, M35, 37, 39, Shueib Formation Equivalent (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian); Q37, M63, 64, 65, 68, 69, Wadi Sir Formation (Turonian); M71, Ghudran Formation (Coniacian to Santonian).

Genus: **Vernonina** PURI, 1957

Vernonina sp.
Pl. 36, Fig. 1 a-b.

Description: Test low trochospiral, planoconvex, with convex spiral side; periphery angular; sutures oblique but obscured by the surface ornamentation; umbilical side flattened to concave, sutures straight, slightly oblique to nearly radial and depressed, umbilical region with central plug; wall calcareous, perforate, thickened and with strongly tuberculate surface on the spiral side; aperture interiomarginal, about midway between the umbilicus and the periphery.

Distribution: *V. tuberculata* PURI was recorded from the upper Eocene of Florida, USA, New Zealand and Australia (Loeblich & Tappan, 1988, p. 550). *V.* sp. is found in the studied material in: M8n, M23, Q22a, Na'ur Formation (lower to middle Cenomanian); M25, Fuheis Formation Equivalent (middle Cenomanian); J56, Shueib Formation (Turonian).

Subfamily: **SESTRONOPHORINAE** SAIDOVA, 1981
Genus: **Sestronophora** LOEBLICH and TAPPAN, 1957

Sestronophora sp.
Pl. 36, Fig. 2 a-c

Description: Test large, trochospiral, planoconvex, strongly convex spiral side with broad crescentic chambers and thickened, flush and oblique sutures, somewhat flattened umbilical side with depressed radial sutures around broad umbilicus; periphery acute-carinate; wall calcareous, surface smooth. *Sestronophora* differs from *Eponides* in being about twice as large, with broad crescentic chambers and in having a distinct and wide umbilicus covered by apertural umbilical flaps with accessory openings.

Distribution: *S. arnoldi* LOEBLICH & TAPPAN was recorded from the Pliocene to Pleistocene of California, USA and England (Loeblich & Tappan, 1988, p. 552). *S.* sp. is found in the studied material in: P1, Q16, M23, Na'ur Formation (lower to middle Cenomanian); M32, Fuheis Formation Equivalent (middle Cenomanian); P55, Ghudran Formation (Coniacian to Santonian).

Family: **DISCORBIDAE** EHRENBERG, 1838
Genus: **Neodiscorbinella** McCULLOCH, 1977

Neodiscorbinella sp. 1
Pl. 33, Fig. 7 a-b; Pl. 36, Fig. 7 a-b.

Description: Test small, ovate to auriculate in outline, spiral side weekly convex, umbilical side flat to concave, low trochospiral of one and a half whorls; chambers 6-7, rapidly enlarging; sutures curved and slightly depressed to nearly flush, may grade interceptibly into the peripheral keel; wall calcareous, finely perforate, surface smooth; aperture a small looplike reentrant of umbilical final chamber. *N.* sp. 1 resembles *N. circinata* McCULLOCH (Loeblich & Tappan, 1988, p. 557) from the Holocene, in its external appearance, but differs in the stratigraphic occurrence.

Distribution: *N.* sp. 1 is found in the studied material in: P19, Q20, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); J34, J36, J39, M39, Shueib Formation Equivalent (upper Cenomanian); M96, 98, Amman Formation (lower Maastrichtian).

Family: **ROSALINIDAE** REISS, 1963
Genus: **Gavelinopsis** HOFKER, 1951

Gavelinopsis abudurbensis (NAKKADY, 1950)
Pl. 37, Fig. 3 a-c.

1950 *Cibicides abudurbensis* NAKKADY, p. 691, pl. 90, figs. 35-38.
1958 *Cibicides* sp. cf. *abudurbensis* NAKKADY. - ANSARY & FAKHR, p. 145: II, fig. 23.
1989 *Cibicides abudurbensis* NAKKADY. - ISMAIL, p. 178, text-fig. 57.
1990 *Angulogavelinella abudurbensis* (NAKKADY). - ALMOGI-LABIN et al., p. 45, pl. 4.
1968 *Gavelinopsis abudurbensis* (NAKKADY). - FUTYAN, pp. 250-251, pl. 15, figs. 21-23.

Description: Test planoconvex, dorsally partially evolute with small central boss, ventrally strongly convex and involute; sutures limbate, raised on both sides terminating centrally in fine beads surrounding small boss; aperture small slit straight at the base of last chamber. In some specimens small dorsal boss transparent showing inner whorl chambers.

Distribution: *G. abudurbensis* was recorded from the Campanian to Maastrichtian of Israel (Reiss, 1952; Almogi-Labin, 1990); middle Maastrichtian of Egypt and Jordan

(Ismail, 1989; Futyan, 1968). In the studied material, it is found in: M69, Wadi Sir Formation (Turonian), M47, 70, 71, Ghudran Formation (Coniacian to Santonian), M88, 89, 90, Amman Formation (Campanian).

Gavelinopsis proelevata KOCH, 1968
Pl. 37, Fig. 1 a-c.

1968 *Gavelinopsis (?) proelevata* KOCH, pp. 643-645, pl. 60, figs. 5-6, text-fig. 3.
1986 *Gavelinopsis proelevata* KOCH. - AL-HARITHI, p. 10, figs. 2-3, text-figs. 13, 15.

Description: Test planoconvex to inequally biconvex, trochospiral, chambers crescentic; sutures thickened and flush on the evolute and convex spiral side with umbo, whereas on the involute umbilical side, chambers subtriangular and sutures radial and depressed around umbilical plug; wall calcareous, no visible pores spirally; aperture low interiomarginal extraumbilical slit surrounded by narrow lip.

Distribution: *G. proelevata* was recorded from the lower Maastrichtian of Jordan (Koch, 1968) and later reported to range from the Turonian to Maastrichtian (Al-Harithi, 1986 a, b). In the studied material, it is found in: M23, Na'ur Formation (lower to middle Cenomanian), M37, Shueib Formation Equivalent (upper Cenomanian), M64, 66, Wadi Sir Formation (Turonian); M71, P55, Q43, Ghudran Formation (Coniacian to Santonian).

Gavelinopsis tourainensis BUTT, 1966
Pl. 37, Fig. 2 a-c.

1966 *Gavelinopsis tourainensis* BUTT, p. 176, pl. 4, figs. 1-3.
1989 *Gavelinopsis tourainensis* BUTT. - KING et al., p. 414, pl. 8.2, figs. 16-17.

Description: Test planoconvex to unequally convex, ventral side flattened; commonly more involute on the ventral side than on the dorsal, dorsally strongly evolute and convex with central raised knob, ventrally more or less flat with distinct central umbilical knob; outline smooth, periphery subacute; chambers about ten in the final whorl, evolute ones indistinct, only the last four to five chambers distinct; sutures slightly curved and depressed on dorsal side; limbate and depressed on ventral side; wall calcareous; wall calcareous; aperture interiomarginal, extending along the spiral suture.

Distribution: *G. tourainensis* was recorded from the Turonian of France (Butt, 1966); Turonian to Coniacian of England and North Sea (Hart et al., 1989; King et al., 1989). In the studied material, it is found in: P3, Na'ur Formation (lower Cenomanian); P41, J25, Fuheis Formation (middle Cenomanian); J36, Shueib Formation (upper Cenomanian); M63, 64, 65, 66, 68, Wadi Sir Formation (Turonian); P55, M71, Ghudran Formation (Coniacian to Santonian); M88, Amman Formation (Campanian).

Superfamily: **GLABRATELLACEA** LOEBLICH and TAPPAN, 1964
Family: **GLABRATELLIIDAE** LOEBLICH and TAPPAN, 1964
Genus: **Planoglabratella** SEIGLIE and BERMÚDEZ, 1965

Planoglabratella sp.
Pl. 37, Fig. 4 a-c.

Description: Test of medium size, compressed planoconvex with subconical spiral side and flat umbilical side, very low trochospiral, about two rapidly enlarging whorls; chambers 10-12 in the last whorl, broad and low, strongly curved back at the periphery; sutures strongly curved on both sides, flush, umbilicus closed, periphery subangular; wall calcareous, finely perforate, surface smooth on spiral side, umbilical side centrally granulose; aperture a low interiomarginal slit near the peripheral margin of the final chamber on the umbilical side. *P.* sp. differs from *P. nakamurai* ASANO (Loeblich & Tappan, 1988, p. 568) in its smaller size, lower trochospire and without radial striae on the umbilical side.

Distribution: *P. nakamurai* was recorded from the Miocene to Holocene of Japan, Australia, Cuba and Ukraine, Russia (Loeblich & Tappan, 1988, p. 568). In the studied material: sp. is only found in: M109, Amman Formation (lower Maastrichtian).

Superfamily: **PLANORBULINACEA** SCHWAGER, 1877
Family: **CIBICIDIDAE** CUSHMAN, 1927
Subfamily: **CIBICIDINAE** CUSHMAN, 1927
Genus: **Cibicides** MONTFORT, 1808

Cibicides beadnelli LE ROY, 1953
Pl. 37, Fig. 5 a-c.

1953 *Cibicides beadnelli* LE ROY, p. 25, pl. 10.
1989 *Cibicidoides* sp. cf. *beadnelli* (LE ROY). - CHERIF et al, p. 260, pl. 2, fig. 27, text-fig. 2.

Remarks: Test small, trochospiral and planoconvex, spiral side flat to concave, evolute, umbilical side strongly convex and involute; chambers 10-12 in the final whorl, gradually increasing; apertural face angular, periphery subcarinate; sutures depressed; wall calcareous, spiral side coarsely perforate, umbilical side finely perforate and apertural face and peripheral keel imperforate, surface smooth; aperture a low interiomarginal equatorial opening that extends a short distance onto the umbilical side but continues along the spiral suture on the spiral side.

Distribution: *C. beadnelli* was recorded from the lower Turonian of Egypt (Cherif et al., 1989). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian); J22, Fuheis Formation (middle Cenomanian); M70, Q43, Ghudran Formation (Coniacian to Santonian).

Superfamily: **NONIONACEA** SCHULTZE, 1854
Family: **NONIONIDAE** SCHULTZE, 1854
Subfamily: **NONIONINAE** SCHULTZE, 1854

Genus: **Nonionella** CUSHMAN, 1926

Nonionella austinana CUSHMAN, 1933
Pl. 38, Fig. 4 a-c.

1933b *Nonionella austinana* CUSHMAN. - CUSHMAN, p. 57, pl. 7, fig. 2 a-c.
1968 *Nonionella austinana* CUSHMAN. - SLITER, p. 115, pl. 20, fig. 11.
1971 *Nonionella austinana* CUSHMAN. - MORRIS, p. 281-282, pl. 7, fig. 4.
1994 *Nonionella austinana* CUSHMAN. - BOLLI et al., p. 151, figs. 41.16-18.

Description: Test free, small, trochospiral, somewhat compressed, periphery rounded, spirally evolute, umbilically convex and involute with final chamber asymmetrically produced toward umbilical side; chambers 6-7, slightly inflated; sutures gently curved, depressed; wall calcareous, surface smooth; aperture interiomarginal arch extending onto umbilical side, with small lip.

Remarks: *N. robusta* differs from this species in having a longer, thinner test and more numerous chambers (about 8); *N. austinana* differs from *N. cretacea* by the much more round form, very highly rounded periphery and the smaller number of chambers (6 instead of 10).

Distribution: *N. austinana* was recorded from the Coniacian to Campanian of the American Gulf Coast (Sliter, 1968; Morris, 1971) and Santonian to Campanian of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M39, Shueib Formation Equivalent (upper Cenomanian).

Nonionella cretacea tamilensis TEWARI and SRIVASTAVA, 1968
Pl. 38, Fig. 6 a-b.

1968 *Nonionella cretacea* CUSHMAN v. *tamilensis* TEWARI & SRIVASTAVA, p. 43, pl. 13, fig. 10 a-c.
1968 *Nonionella* sp. cf. *cretacea* CUSHMAN. - KOCH, p. 637.
1968 *Nonionella cretacea* CUSHMAN v. *tamilensis* TEWARI & SRIVASTAVA. - ELLIS and MESSINA, Supplement-1980, fig. 10 a-c.

Description: Test free, small, low trochospiral, moderately compressed, biconvex, periphery rounded, spirally evolute, umbilically involute with final chamber produced over umbilicus; 7-8 chambers in the last whorl, increasing rapidly in length as added, gently inflated; sutures distinct, slightly depressed and flush with test, somewhat curved; wall calcareous, surface smooth; aperture a low slit on the base of the apertural face.

Distribution: *N. cretacea tamilensis* was originally described from the lower Maastrichtian of India and Jordan (Tewari & Srivastava, 1968; Koch, 1968). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian), M88, 90, Amman Formation (Campanian); P60, Amman Formation (lower Maastrichtian).

Nonionella robusta PLUMMER, 1931
Pl. 38, Fig. 5 a-c.

1931 *Nonionella robusta* PLUMMER, p. 175, pl. 14, fig. 12.
1946 *Nonionella robusta* PLUMMER. - CUSHMAN, p. 100, pl. 43, figs. 21-23.
1958 *Nonionella robusta* PLUMMER. - ANSARY & FAKHR, p. 144, pl. I, fig. 21 a-c.
1994 *Nonionella robusta* PLUMMER. - BOLLI et al., p. 151, figs. 41. 19, 25.

Description: Test very small, moderately compressed, about equally biconvex, but asymmetrically developed; periphery narrowly rounded, and bluntly angular in maturity, even curved to slightly lobate in later portion; about 8 chambers, rapidly lengthening, gently inflated; sutures slightly depressed or flush, somewhat curved, umbilicus on dorsal side small, narrow, depressed, shallow, on the ventral side the umbilical depression filled irregularly with extensions of chambers; wall calcareous; aperture a low slit at the base of final chamber. *N. robusta* differs from *N. cretacea* by having smaller number of chambers, in the peripheral view the test is much broader and the whole test is shorter and thicker.

Distribution: *N. robusta* was recorded from the Maastrichtian of Texas, USA and Egypt (Cushman, 1946; Ansary & Fakhr, 1958); middle Palaeocene of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M71, Ghudran Formation (Coniacian to Santonian), M86, M89, Amman Formation (Campanian); M98; P60, Amman Formation (lower Maastrichtian).

Genus: **Protelphidium** HAYNES, 1956

Protelphidium hofkeri HAYNES, 1956
Pl. 38, Fig. 2 a-c.

1956 *Protelphidium hofkeri* HAYNES. - HAYNES, p. 86.
1988 *Protelphidium hofkeri* HAYNES. - LOEBLICH & TAPPAN, p. 618, pl. 693, figs. 1-5.
1989 *Protelphidium hofkeri* HAYNES. - KING, p. 480, pl. 9.8, fig. 14.
1989 *Protelphidium hofkeri* HAYNES. - MURRAY et al., p. 526, pl. 10.8, figs. 14-15.

Description: Test planispiral, periphery broadly rounded, slightly lobate; 8-9 chambers in the outer whorl; sutures depressed, backward curving, excavated; umbilici filled with granular calcite that extends along the sutures; aperture a low slit.

Distribution: *P. hofkeri* was recorded from the upper Palaeocene to lower Eocene of England (Haynes, 1956; King, 1989). In the studied material, it is found in: M108, M109, Amman Formation (lower Maastrichtian).

Protelphidium martinii KOCH, 1968
Pl. 39, Fig. 1 a-b.

1968 *Protelphidium martinii* KOCH, p. 645-647, pl. 60, figs. 3-4; pl. 61, figs. 7-15; text-fig. 4.
1973 *Protelphidium martinii* KOCH. - BAYLISS, p. 12.
1977 *Protelphidium martinii* KOCH. - HAMAM, p. 41, pl. 2, figs. 12, 14.
1982 *Protelphidium martinii* KOCH. - AL-HARITHI, p. 79, pl. 2, figs. 13-15.
1986 *Protelphidium martinii* KOCH. - AL-HARITHI, p. 14, figs. 18, 19.

Description: Test medium to large size, planispiral, compressed, partially evolute to involute, periphery broadly rounded, bilaterally symmetrical, 12-15 chambers tending to slightly lobate; sutures depressed, radial, curved interiomarginal reaching the periphery; umbilicus filled by granular calcite that extends along the sutures; aperture multiple openings on the interior of the final chamber.

Distribution: *P. martinii* was recorded from the lower Maastrichtian of Palestine (Bayliss, 1973); lower Campanian to lower Maastrichtian of Jordan (Koch, 1968; Hamam, 1977; Al-Harithi, 1982, 1986). In the studied material, it is found in: M98, 100, 101, 103, 104, 108, 109, Amman Formation (lower Maastrichtian).

Superfamily: **CHILOSTOMELLACEA** BRADY, 1881
Family: **QUADRIMORPHINIDAE** SAIDOVA, 1981
Genus: **Quadrimorphina** FINLAY, 1939

Quadrimorphina camerata (BROTZEN, 1936)
Pl. 39, Figs. 2 a-b, 3 a-c.

1936 *Valvulineria camerata* BROTZEN, p. 155, pl. 10, figs. 1-2.
1968 *Quadrimorphina camerata* (BROTZEN). - SLITER, p. 114, pl. 20, fig. 9.
1973 *Quadrimorphina camerata* (BROTZEN). - SLITER, p. 182, text-fig. 8.
1989a *Quadrimorphina camerata* (BROTZEN). - CHERIF et al., p. 2, fig. 24.

Description: Test ovate in outline, biconvex, low trochospiral coil, 3-6 slightly elongated chambers; sutures curved back at periphery on spiral side, nearly radial around open umbilicus, slightly depressed, periphery rounded; wall calcareous, optically granular, surface smooth; aperture interiomarginal and umbilical.

Distribution: *Q. camerata* was recorded from the middle Turonian of Egypt (Cherif et al., 1989a); Campanian to Maastrichtian of British Columbia (Sliter, 1973). In the studied material, it is found in: P1, M19, 21, 22, 23, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J34, 36, 39, 44, 49, Shueib Formation (upper Cenomanian); M56, Shueib Formation Equivalent (Turonian); J58, Q34, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Family: **ALABAMINIDAE** HOFKER, 1951
Genus: **Valvalabamina** REISS, 1963

Valvalabamina lenticula (REUSS, 1845)
Pl. 39, Fig. 4 a-c.

1845 *Rotalina lenticula* REUSS. - REUSS, p. 35.
1952 *Valvulineria* sp. cf. *lenticula* (REUSS). - REISS, p. 40.
1963 *Valvalabamina lenticula* (REUSS). - REISS, p. 62.
1988 *Valvalabamina lenticula* (REUSS). - LOEBLICH & TAPPAN, p. 628, pl. 706, figs. 4-12.

Description: Test in a low trochospiral coil, flattened, two gradually enlarging whorls visible on evolute spiral side, 9-12 chambers; sutures depressed, curved and oblique; umbilically involute, convex; sutures radial, short and flush, periphery subacute; wall calcareous, surface smooth; aperture a narrow elongate umbilical-extraumbilical slit in the depressed apertural face.

Distribution: *V. lenticula* was recorded from the Coniacian to Santonian of Texas; Maastrichtian of Arkansa, USA (Loeblich & Tappan, 1988),; Santonian of Israel (Reiss, 1952, 1963). In the studied material, it is found in: M47, 70, Ghudran Formation (Coniacian to Santonian), M88, 89, 90, Amman Formation (Campanian), M98, Amman Formation (lower Maastrichtian).

Family: **HETEROLEPIDAE** GONZA'LES-DONOSO, 1969
Genus: **Anomalinoides** BROTZEN, 1942

Anomalinoides pinguis (JENNINGS, 1936)
Pl. 39, Fig. 6 a-c.

1936 *Anomalina pinguis* JENNINGS, p. 37, pl. 5, fig. 1.
1968 *Gavelinella velascoensis* CUSHMAN. - SLITER, pp. 125-126, pl. 23, fig. 9 a-c.
1946 *Anomalina pinguis* JENNINGS. - CUSHMAN, p. 156, pl. 64, fig. 7.
1963 *Anomalinoides pinguis* (JENNINGS). - GRAHAM & CHURCH, p. 65, pl. 8, fig. 2.
1988 *Anomalinoides pinguis* (JENNINGS). - LOEBLICH & TAPPAN, p. 631, pl. 708, figs. 18-20.

Description: Test free, nearly equally biconvex, ventral side slightly more convex, completely involute, almost so on dorsal, periphery broadly rounded; 8-9 chambers in final whorl, later chambers distinctly inflated; sutures distinct, initially flush, limbate, later depressed on spiral side, slightly curved; wall calcareous, coarsely perforate; aperture a low interiomarginal equatorial slit with narrow bordering lip, extending along spiral suture on evolute side under umbilical margin of later chambers.

Distribution: *A. pinguis* was recorded from the Campanian to Palaeocene of Texas, New Jersey, Mexico, U. S. A. (Cushman, 1946; Sliter, 1968; Loeblich & Tappan, 1988). In the studied material, it is found in: M19, Na'ur Formation (lower to middle Cenomanian), M47, Ghudran Formation (Coniacian to Santonian).

Family: **GAVELINELLIDAE** HOFKER, 1956
Subfamily: **GYROIDINOIDINAE** SAIDOVA, 1981
Genus: **Gyroidinoides** BROTZEN, 1942

Gyroidinoides grahami
Pl. 40, Fig. 3 a-b.

1964 *Gyroidinoides grahami* MARTIN, p. 95, pl. 13, fig. 1.
1994 *Gyroidinoides grahami* MARTIN. - BOLLI et al., p. 160, figs. 45.4-6.

Description: Test planoconvex, dorsally flattened or slightly concave, ventrally strongly convex; peripheral margin bluntly angled and slightly raised above the flat level of dorsal side; partially evolute on spiral side, involute umbilically, umbilicus open, small and deep; chambers 5-6 in the final whorl, enlarging gradually as added, except the last one which is highly inflated; sutures on spiral side indistinct, flush, on umbilical side distinct, radial and slightly depressed; wall calcareous, perforate, surface smooth; aperture a low interiomarginal slit extending from the periphery to the umbilicus. *G. grahami* differs from *G. nitidus* of upper Turonian in having smaller number of chambers, indistinct spiral sutures and highly inflated final chamber.

Distribution: *G. grahami* ranges from the Santonian to Maastrichtian of Trinidad (Bolli et al., 1994). In the studied material, it is only ound in: M37, Shueib Formation Equivalent (upper Cenomanian).

Gyroidinoides muwaqqarensis FUTYAN, 1968
Pl. 40, Fig. a-c.

1968 *Gyroidinoides muwaqqarensis* FUTYAN, pp. 222-223, pl. 14, figs. 1-3.

Description: Test planoconvex, dorsally flattened or slightly concave, ventrally strongly convex with large deep umbilicus and high rectangular apertural face; peripheral margin bluntly angled and slightly raised above the flat level of dorsal side; 8-9 chambers; sutures limbate, oblique dorsally and radiate ventrally, slightly raised dorsally specially between chambers of inner whorls, flush ventrally; thin apertural flap that widens towards umbilicus.

Distribution: *G. muwaqqarensis* was originally described from the Maastrichtian of Jordan (Futyan, 1968). In the studied material, it is found in: M90, 91, Amman Formation (Campanian).

Gyroidinoides nitidus (REUSS, 1845)
Pl. 39, Fig. 7 a-c.

1844 *Rotalina nitida* REUSS, p. 214.
1845 *Rotalina nitida* REUSS. - REUSS, p. 35, pl. 8, fig. 52; pl. 12, figs. 8, 20.
1985 *Gyroidinoides nitida* (REUSS). - ROBASZYNSKI et al., pp. 26-28, text-figs. 16-17.
1988 *Gyroidinoides nitida* (REUSS). - LOEBLICH & TAPPAN, p. 633, pl. 713, figs. 7-9.

1973 *Gyroidinoides nitidus* (REUSS). - SLITER, p. 183, pl. 5, figs. 13-15, t-fig. 8.
1983 *Gyroidinoides nitidus* (REUSS). - BASOV et al., p. 764, pl. 9, figs. 2-3.
1987 *Gyroidinoides nitidus* (REUSS). - BENKHEROUF, p. 75, text-fig. 5.
1994 *Gyroidinoides nitidus* (REUSS). - BOLLI et al., p. 160, figs. 45.13-16.

Description: Test subspherical, trochospiral, planoconvex, with flat or slightly convex spiral side and strongly convex umbilical side; evolute spirally, involute umbilically, umbilicus open; chambers 5-7 in the final whorl, enlarging gradually as added; sutures on spiral side initially flush to finally slightly distinct, on umbilical side distinct, radial and slightly depressed between last chambers; wall calcareous, perforate, surface smooth; aperture a low interiomarginal slit extending from the periphery to the umbilicus. *G. nitidus* is similar to *G. muwaqqarensis*, but lacks the bluntly angled periphery, the raised limbate and oblique sutures on spiral side and the wide open umbilicus.

Distribution: *G. nitidus* was recorded from the lower to upper Cenomanian of Algeria (Benkherouf, 1987); upper Turonian of Sweden (Loeblich et al., 1988); Santonian to Maastrichtian of SW Atlantic (Basov et al., 1983) from the lower Campanian to lower Maastrichtian of California, British Columbia and Netherlands (Sliter, 1973; Robaszynski et al., 1985); Santonian to Campanian of Israel (Reiss, 1952). In the studied material, it is found in: M7a, 17, 19, Na'ur Formation (lower to middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian), M89, 90 (Campanian) and M103, Amman Formation (lower Maastrichtian).

Genus: **Stensioeina** BROTZEN, 1936

Stensioeina exsculpta (REUSS, 1860)
Pl. 40, Fig. 4 a-b.

1860 *Rotalia exsculpta* REUSS, p. 222.
1977 *Stensioeina exsculpta exsculpta* (REUSS). - KOCH, table I.
1960 *Stensioeina exsculpta* (REUSS). - HILTERMANN and KOCH, table 19.
1964 *Stensioeina exsculpta* (REUSS). - LOEBLICH & TAPPAN, p. C763, fig. 627.7.
1988 *Stensioeina exsculpta* (REUSS). - LOEBLICH & TAPPAN, p. 635, pl. 715, figs. 4-6.

Description: Test small, coiled in a low trochospiral, planoconvex, spirally flat to slightly convex and evolute with about two volutions; sutures curved, limbate, elevated in irregular ridges, resulting in a reticulose surface; on the flattened opposite side, chambers inflated into ridges near umbilicus; sutures initially nearly radial, ultimately slightly depressed; periphery broadly rounded; wall calcareous, coarsely perforate, surface with prominent irregular sutural ridges on the spiral side; aperture a low interiomarginal opening between the umbilicus and periphery. *S. exsculpta* differs from *S. gracilis* in having a planoconvex test and lesser number of volutions.

Distribution: *S. exsculpta* was recorded from the Senonian of Germany (Hiltermann & Koch, 1960); Coniacian to lower Campanian (Koch, 1977); Turonian to

Maastrichtian (Loeblich & Tappan, 1988). In the studied material, it is found in: M96, 101 (lower Maastrichtian) Amman Formation.

Stensioeina exsculpta gracilis BROTZEN, 1945
Pl. 40, Fig. 5 a-b.

1945 *Stensioeina exsculpta gracilis* BROTZEN. - BROTZEN, p. 62.
1960 *Stensioeina exsculpta gracilis* BROTZEN. - HILTERMANN & KOCH, table 19.
1976 *Stensioeina exsculpta gracilis* BROTZEN. - KOCH, table 80/77.
1977 *Stensioeina exsculpta gracilis* BROTZEN. - KOCH, table I.
1989 *Stensioeina exsculpta gracilis* BROTZEN. - HART et al., p. 362, pl. 7.24, figs. 1-3.

Description: Test small, trochospiral, inequally biconvex, spirally convex and evolute with about three volutions; sutures curved, limbate, elevated in irregular ridges, resulting in a reticulose surface; on the convex opposite side, chambers inflated and elevated into ridges near umbilicus; sutures initially nearly radial, ultimately slightly depressed; periphery broadly rounded; wall calcareous, coarsely perforate, surface with prominant irregular sutural ridges on the spiral side; aperture a low interiomarginal opening between the umbilicus and periphery. *S. exsculpta gracilis* differs from *S. exsculpta* in in having a biconvex test and larger number of volutions.

Distribution: *S. exsculpta gracilis* was recorded from the Turonian to Maastrichtian; Coniacian to Santonian of Germany (Hiltermann & Koch, 1960); Santonian to middle Campanian of Germany and England (Koch, 1976, 1977; Hart et al., 1989). In the studied material, it is found in: M101 (lower Maastrichtian) Amman Formation.

Stensioeina pokornyi SCHEBNEROVA, 1963
Pl. 34, fig. 5; Pl. 37, Figs. 6 a-b, 7 a-b.

1963 *Stensioeina pokornyi* SCHEBNEROVA, p. 213.
1977 *Stensioeina pokornyi* SCHEBNEROVA. - KOCH, table I.
1989 *Stensioeina pokornyi* SCHEBNEROVA. - HART et al., p. 414, pl. 8.2, figs. 21-22.

Description: Test small, low trochospiral, planoconvex, compressed; periphery rounded, with weak sutural ribs and an irregular low umbilical boss on the spiral side; chambers enlarging gradually; sutures limbate, elevated in the form of irregular ridges on the spiral side, slightly depressed, curved to nearly radial on the umbilical side; wall calcareous, coarsely perforate, surface with prominent irregular sutural ridges on the spiral side; aperture a low interiomarginal opening between the umbilicus and periphery.

Distribution: *S. pokornyi* was recorded from the lower Turonian of Germany (Koch, 1977); upper Cenomanian to lower Turonian of the North Sea (Hart et al., 1989). In the studied material, it is found in: M22, 23, Na'ur Formation (lower to middle Cenomanian).

Subfamily: **GAVELINELLINAE** HOFKER, 1956
Genus: **Gavelinella** BROTZEN, 1942

Gavelinella awunensis TAPPAN, 1960.
Pl. 34, Fig. 4 a-b.

1960 *Gavelinella awunensis* TAPPAN, p. 296, pl. 2, fig. 15-16 a-c.
1969 *Gavelinella awunensis* TAPPAN. - ELLIS and MESSINA, catalougue-3, Supplement-1965 no. 1.

Description: Test free, trochospiral, planoconvex, spiral side flattened, partly evolute, umbilical side convex, umbonate; chambers 7-10 in the last whorl, increasing gradually in size; sutures distinct, gently curved, depressed on the umbilical side; wall calcareous, distinctly perforate, surface smooth; aperture a low interiomarginal slit extending from the peripheral margin onto the umbilical side.

Distribution: *G. awunensis* was recorded from the Albian of northern Alaska (Loeblich, 1960). In the studied material, it is found only in M22, Na'ur Formation (lower to middle Cenomanian).

Gavelinella baltica BROTZEN, 1942
Pl. 42, Fig. 5 a-c.

1942 *Gavelinella baltica* BROTZEN, p. 50, pl. 1, fig. 7.
1970 *Gavelinella baltica* BROTZEN. - HART, p. 22, figs. 11-13.
1975 *Gavelinella baltica* BROTZEN. - BASHA, p. 201-202, pl. 14, figs. 22-23.
1977 *Gavelinella baltica* BROTZEN. - CARTER & HART, p. 46, pl. 1, fs. 36-38.
1988 *Gavelinella baltica* BROTZEN. - JARVIS et al., p. 22-23, t-figs. 6, fig. 10 (1).
1989 *Gavelinella baltica* BROTZEN. - HART et al., p. 334, pl. 7.10, figs. 3-5.

Description: Test free, low trochospiral, biconvex, sides flattened, periphery rounded; 8-10 chambers in the last whorl, enlarging gradually in size as added, the last 3-4 ones enlarge more markedly; sutures distinct, slightly depressed; wall calcareous, perforate, surface smooth; aperture a low interiomarginal slit, extending from periphery to umbilicus.

Distribution: *G. baltica* was recorded from the uppermost Albian to upper Cenomanian of England (Carter & Hart, 1977; Jarvis et al., 1988; Hart et al., 1989); upper Cenomanian to lower Turonian of Germany (Brotzen 1942; Hiltermann & Koch, 1960); Turonian of Jordan (Basha, 1975).

In the studied material, it is found in: M7a, 16, 17, 19, 21, Q18, 22a, P15, 17, 19, 26, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian); M39, Shueib Formation Equivalent (upper Cenomanian); Q34, Wadi Sir Formation (Turonian); Q43, P55, Ghudran Formation (Coniacian to Santonian).

Gavelinella burlingtonensis (JENNINGS, 1936)
Pl. 38, Fig. a-c; Pl. 41, Fig. 4 a-c.

1936 *Cibicides burlingtonensis* JENNINGS. - JENNINGS, p. 314.
1968 *Cibicides burlingtonensis* JENNINGS. - SLITER, p. 125.
1990 *Gavelinella burlingtonensis* (JENNINGS). - AL-BAKRI, p. 43, pl. 8, fig. 5, text-fig. 8.

Description: Test low trochospiral, plano-convex, spirally convex, partially evolute with umbonate boss, umbilically flat to gently concave, involute, with umbilical boss, periphery subacute; chambers 7-8 in the final whorl, increasing gradually in size as added; sutures distinct, curved, more strongly curved on umbilical side, initially limbate, flush to gently elevated, later depressed; wall calcareous, surface smooth to granular; aperture low interiomarginal arch at the base of last chamber. *G. burlingtonensis* differs from *G. sandigei* in having lesser number of chambers in the final whorl.

Distribution: *G. burlingtonensis* was recorded from the upper Cretaceous of New Jersey, USA (Jennings, 1936); Campanian to Maastrichtian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: Q43, M47, 70, 71, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian).

Gavelinella cenomanica (BROTZEN, 1945)
Pl. 40, Fig. 6 a-c.

1945 *Cibicidoides (Cibicides) cenomanica* BROTZEN-BROTZEN, pp. 10, 12, 54, pl. 2, fig. 2
1969 *Gavelinopsis cenomanica* (BROTZEN). - ROBASZYNSKI & CARON., v. 3, figs. 1-2a-e.
1970 *Gavelinella cenomanica* (BROTZEN). - HART, p. 23, pl. 1-3.
1977 *Gavelinella cenomanica* (BROTZEN). - CARTER & HART, p. 46-8, pl. 1, figs. 27-28.
1988 *Gavelinella cenomanica* (BROTZEN). - JARVIS et al., p. 151, text-fig. 2, fig. 10 m.
1989 *Gavelinella cenomanica* (BROTZEN). - HART et al., p. 334, pl. 7.10, figs. 9-11.
1994 *Gavelinella cenomanica* (BROTZEN). - BOLLI et al., p. 162, figs. 46.7-10.

Description: Test free, trochospiral, biconvex, periphery rounded to slightly angled; 8-10 chambers in the last whorl, increasing gradually in size as added; sutures distinct, slightly depressed, umbilicus filled with calcite rim around the central depression; wall calcareous, perforate; aperture a low, interiomarginal slit, extending to umbilicus.

Distribution: *G. cenomanica* was recorded from the Cenomanian of Holland and Germany (Hofker, 1957), upper Albian to lower Cenomanian of Trinidad (Bolli et al., 1994), uppermost Albian to upper Cenomanian of England (Carter & Hart, 1977; Jarvis et al., 1988; Hart et al., 1989) and upper Albian to lower Turonian (Hiltermann & Koch, 1960). In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian).

Gavelinella cristata (GOEL, 1965)
Pl. 41, Fig. 7 a-c.

1965 *Pseudovalvulineria cristata* GOEL, p. 72.
1989 *Gavelinella cristata* (GOEL). - HART et al., p. 336, pl. 7.11, figs. 4-6.

Description: Test free, low trochospiral, periphery rounded; umbilicus filled with calcite boss; chambers 9-10 in the final whorl, distinct, weakly inflated, increasing gradually in size as added; sutures distinct, raised, thickened, becoming flush or slightly depressed; wall calcareous, surface smooth; aperture a low interiomarginal slit, extending from periphery to umbilicus, covered by a distinct lip.

Distribution: *G. cristata* was recorded from the upper Santonian and lower Campanian of England (Hart et al., 1989). In the studied material, it is found in: M70, 71, Ghudran Formation (Coniacian to Santonian), M88, Amman Formation (Campanian), M108, Amman Formation (lower Maastrichtian).

Gavelinella farafraensis (LE ROY, 1953)
Pl. 41, Fig. 5 a-c.

1953 *Cibicides farafraensis* LE ROY. - LE ROY, p. 24, pl. 10, figs. 1-3.
1956 *Cibicides farafraensis* LE ROY. - SAID & KENAWY, p. 154, pl. 7, fig. 6 a-c.
1990 *Gavelinella farafraensis* (LE ROY). - AL-BAKRI, p. 26, pl. 8: 6, text-fig. 8.

Description: Test unequally biconvex, spirally evolute and gently convex, umbilically involute, more convex; sutures curved more strongly on the umbilical side, with umbilical depression; last 4 chambers are more inflated, 8 chambers in the final whorl, increasing gradually in size as added. The genus *Cibicides* appeared in the Palaeocene and is generally plano-convex. The species described by Le Roy is unequally biconvex and cannot belong to *Cibicides*.

Distribution: *G. farafraensis* was recorded from the lower Palaeocene of Egypt (Le Roy, 1953); Coniacian of Jordan (Al-Bakri, 1990). Our specimens closely resemble the forms of Le Roy and were found in M47 and Q43, Ghudran Formation (Coniacian to Santonian).

Gavelinella intermedia (BERTHELIN, 1880)
Pl. 40, Fig. 8 a-b.

1880 *Anomalina intermedia* BERTHELIN, p. 67, pl. 4, fig. 14 a-b.
1970 *Gavelinella intermedia* (BERTHELIN). - HART, p. 23, figs. 4-6.
1977 *Gavelinella intermedia* (BERTHELIN). - CARTER & HARTT, p. 48, pl. 1, figs. 33-35.
1987 *Gavelinella intermedia* (BERTHELIN). - BENKHEROUF, p. 75, text-fig. 5.
1988 *Gavelinella intermedia* (BERTHELIN). - JARVIS et al., text-fig. 6, fig. 10 n.
1989 *Gavelinella intermedia* (BERTHELIN) . - HART et al., p. 336, pl. 7.11, figs. 7-9.

Description: Test free, trochospiral, biconvex, periphery rounded to slightly angled; dorsally semi-involute with one and a half to two whorls; 10-12 chambers in the last whorl; sutures distinct, depressed to slightly raised, slightly arcuate; wall calcareous, perforate; aperture interiomarginal to equatorial, with a wide lip.

Distribution: *G. intermedia* was recorded from the Albian to upper Cenomanian of England (Hart, 1970; Carter & Hart, 1977; Jarvis et al., 1988; Hart et al., 1989); lower Cenomanian of Algeria (Benkherouf, 1987). In the studied material, it is found in: Q20, M19, 22, Na'ur Formation (lower to middle Cenomanian); J22, Fuheis Formation (middle Cenomanian); M37, Shueib Formation Equivalent (upper Cenomanian).

Gavelinella involuta HOFKER, 1957
Pl. 41, Fig. 6 a-c.

1957 *Gavelinella involuta* HOFKER, p. 315.
1975 *Gavelinella involuta* HOFKER. - BASHA, p. 202-203, pl. 14, figs. 24-26.
1985 *Gavelinella involuta* HOFKER. - ROBASZYNSKI et al., p. 26, text-fig. 16.
1990 *Gavelinella involuta* HOFKER. - AL-BAKRI, p. 26, pl. 8, figs. 7-8, txt-fig. 8.

Description: Test free, subcircular in outline, plano-convex to biconvex, spirally flattened to slightly convex and evolute, umbilically more convex and involute, with open umbilicus, usually filled with sediments, periphery rounded, gently lobulate; 9-10 chambers forming the final whorl, triangular to trapezoidal in shape, increasing gradually in size as added; sutures thick, spirally raised, more curved and umbilically flush; wall calcareous, surface smooth; aperture a low interiomarginal arch at the base of last chamber, extending from periphery to umbilicus.

Distribution: *G. involuta* was recorded from the lower Campanian of Netherlands (Hofker, 1957, Robaszynski et al., 1985); Maastrichtian of Egypt; upper Turonian and Coniacian of Jordan (Basha, 1975; Al-Bakri, 1990). In the studied material, it is found in: M47 and M71, Ghudran Formation (Coniacian to Santonian).

Gavelinella lorneina (D'ORBIGNY, 1840)
Pl. 42, Fig. 2 a-c.

1840 *Rosalina lorneina* D'ORBIGNY, p. 36.
1988 *Gavelinella lorneina* (D'ORBIGNY). - LOEBLICH & TAPPAN, p. 638, pl. 718, figs. 13-15.
1989 *Gavelinella lorneina* (D'ORBIGNY). - HART et al., p. 336, pl. 7.11, figs. 10-12.

Description: Test free, low trochospiral, outline subcircular, becoming lobate, periphery rounded to sub-acute; chambers distinct, 8-10 in the final whorl, increasing gradually as added; sutures depressed; aperture a low interiomarginal slit, bordered by an indistinct lip, extending into the narrow umbilicus.

Distribution: *G. lorneina* was recorded from the Turonian to upper Campanian of England (Hart et al., 1989); Senonian of France (Loeblich & Tappan, 1988). In the studied material, it is found in: M47, 70, 71, 74, Ghudran Formation (Coniacian to Santonian), M90, Amman Formation (Campanian).

Gavelinella nacatochensis (CUSHMAN, 1938)
Pl. 40, Fig. 9 a-b.

1938b *Planulina nacatochensis* CUSHMAN, p. 50, pl. 8, fig. 9.
1982 *Planulina nacatochensis* CUSHMAN. - AL-HARITHI, p. 9, figs. 16-18.
1968 *Gavelinella nacatochensis* (CUSHMAN). - SLITER, p. 124, pl. 23, figs. 4-5.
1973 *Gavelinella nacatochensis* (CUSHMAN). - SLITER, p. 5, pl. 19-20, t-f. 2, 8.
1990 *Gavelinella nacatochensis* (CUSHMAN). - AL-BAKRI, p. 145, pl. 8, fig. 9, text-fig. 8.

Description: Test low trochospire, nearly planispiral, spirally partially evolute, umbilically nearly involute, umbilicate; periphery rounded to slightly angled, 9-11 chambers, increasing gradually in size, may become slightly inflated; sutures gently curved, initially may be limbate, flush to slightly elevated, later depressed; wall calcareous, surface smooth; aperture low interiomarginal arch at the base of final chamber. *G. nacatochensis* differs from other *G.* species in being compressed, nearly planispiral, and lacking the spiral umbonate thickening.

Distribution: *G. nacatochensis* was recorded from the Campanian to lower Maastrichtian of California and British Columbia (Sliter, 1968, 1973); Cenomanian and Campanian of Jordan (Al-Harithi, 1982; Al-Bakri, 1990). In the studied material, it is found in: M19, Na'ur Formation (lower to middle Cenomanian), M25, Fuheis Formation Equivalent (middle Cenomanian), M33, M37, Shueib Formation Equivalent (upper Cenomanian), M64, Wadi Sir Formation (Turonian).

Gavelinella pertusa (MARSSON, 1878)
Pl. 42, Fig. 1a-c.

1878 *Discorbina pertusa* MARSSON, p. 166.
1956 *Gavelinella* sp. cf. *pertusa* (MARSSON). - SAID & KENAWY, p. 148, pl. 5, fig. 1.
1969 *Gavelinella pertusa* (MARSSON). - ELLIS and MESSINA, figs. 6-7 a-c.
1985 *Gavelinella pertusa* (MARSSON). - ROBASZYNSKI et al., p. 26, t-figs. 16-17.
1988 *Gavelinella pertusa* (MARSSON). - LOEBLICH & TAPPANp. 638, pl. 718, figs. 16-18.
1989 *Gavelinella pertusa* (MARSSON). - HART et al.p. 338, pl. 7.12, figs. 4-6.

Description: Test free, low trochospiral, partially evolute, especially on the spiral side, periphery rounded; 8-9 chambers in the final whorl, increasing gradually in size as added; sutures flush to slightly depressed, indistinct, radial; wall calcareous, surface coarsely perforate; aperture an arcuate slit, extending from periphery to umbilicus which is broad and deep.

Distribution: *G. pertusa* was recorded from the Coniacian to Maastrichtian of England (Hart et al., 1989); upper Campanian to Maastrichtian of Netherlands (Robaszynski et al., 1985); Maastrichtian of Egypt (Said & Kenawy, 1956); Santonian to Maastrichtian of Denmark and Israel (Loeblich & Tappan, 1988). In the studied material, it is found in: M47, 71, Ghudran Formation (Coniacian to Santonian).

Gavelinella sandidgei (BROTZEN, 1936)
Pl. 40, Fig. 10 a-c.

1936 *Cibicides sandidgei* BROTZEN, p. 191, pl. 14, figs. 2-4.
1968 *Gavelinella sandidgei* (BROTZEN). - SLITER, p. 124, pl. 23, figs. 7-8.
1973 *Gavelinella sandidgei* (BROTZEN). - SLITER, pp. 178, 181-183, t-figs. 6-8.
1990 *Gavelinella sandidgei* (BROTZEN). - AL-BAKRI, p. 8, pl. 10-11, text-fig. 8.
1994 *Gavelinella* sp. cf. *sandidgei* (BROTZEN). - BOLLI et al., p. 8, pl. 163, figs. 47.1-5.

Description: Test low trochospiral, plano-convex, spiral side convex, partially evolute with umbonate boss, umbilically flat to gently concave, involute, with umbilical boss, periphery subacute; chambers 9-11 in the final whorl, increasing gradually in size, slightly inflated; sutures distinct, curved, more strongly curved umbilically, initially limbate, flush to gently elevated, later depressed; wall calcareous, surface smooth to granular; aperture a low interiomarginal arch at the base of the final chamber.

Distribution: *G. sandidgei* was recorded from the Campanian to Maastrichtian of North America and British Columbia (Sliter, 1968, 1973), from upper Albian to lower Cenomanian of Trinidad (Bolli et al., 1994); upper Coniacian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian).

Gavelinella semipustulosa HAMAOUI, 1965
Pl. 41, Fig. 1 a-c.

1965 *Gavelinella semipustulosa* HAMAOUI. - HAMAOUI, p. 16, pl. 13, fig. 12.
1979 *Gavelinella semipustulosa* HAMAOUI. - HAMAOUI, p. 77, fig. 37.
1990 *Gavelinella semipustulosa* HAMAOUI. - AL-BAKRI, p. 9, pl. 1-2, text-fig. 8.

Description: Test free, low trochospiral, characterized by the presence of pustules on the convex spiral side, umbilical side simple, concave, pustules rare; 5-7 inflated chambers in the last whorl, increasing gradually in size as added; sutures depressed, radial.

Distribution: *G. semipustulosa* was recorded from the Cenomanian of Israel and Jordan (Hamaoui, 1965; Al-Bakri, 1990). In the studied material, it is found in: M7a, 17, 19, 20, 22, 23, Q20, Na'ur Formation (lower to middle Cenomanian); J25, Fuheis Formation (middle Cenomanian), J34, 36, 44, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian); Q43, Ghudran Formation (Coniacian to Santonian).

Gasvelinella sp. cf. *sibirica* (DAIN, 1954)
Pl. 38, Fig. 3 a-c.

1954 *Anomalina (Pseudovalvulineria) sibirica* DAIN. - VNIGRI, p. 103, pl. 14, fig. 1.
1994 *Gavelinella* sp. cf. *sibirica* (DAIN). - BOLLI et al., p. 164, figs. 47.6-7, 14-15.

Description: Test closely coiled, compressed, very slightly umbilicate, periphery subacute to rounded; 8 distinct chambers; sutures distinct, limbate, very slightly curved; wall smooth, the central umbilical region corvered with a layer of calcareous material; aperture narrow, at the base of the last-formed chamber. The Jordanian form is distinguished by having more depressed sutures and a peculiar arrangement of umbilical region. It resembles the type in the general shape of the test, number and arrangement of the chambers.

Distribution: *S. sibirica* was recorded from the lower Cenomanian to Coniacian-Santonian of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M98, 101, 103, 104, 108, Amman Formation (lower Maastrichtian).

Gavelinella sp. cf. *vesca* (BYKOVA, 1939)
Pl. 40, Fig. 7 a-c.

1939 *Discorbis vescus* BYKOVA, p. 28, pl. 3, figs. 1-6.
1994 *Gavelinella* sp. cf. *vesca* (BYKOVA). - BOLLI et al., p. 164, figs. 47.11-13.

Description: Test free, low trochospiral, concavo-convex to biconvex, periphery rounded; 8-10 chambers in the last whorl, enlarging gradually in size as added, the last 3-4 ones enlarge more markedly; sutures distinct, depressed; wall calcareous, perforate, surface smooth; aperture a low interiomarginal slit, extending from periphery to umbilicus. The Jordanian specimens differ from *G. vesca* in often having slightly raised and limbate chamber sutures, specially in the early chambers of the last whorl.

Distribution: *G. vesca* was recorded from the lower Cenomanian of Trinidad (Bolli et al., 1994). In the studied material, it is found in: M16, 19, 21, Na'ur Formation (lower to middle Cenomanian).

Gavelinella stephensoni (CUSHMAN, 1938)
Pl. 41, Fig. 2 a-c.

1938c *Cibicides stephensoni* CUSHMAN. - CUSHMAN, p. 70, pl. 12, fig. 5.
1968 *Gavelinella stephensoni* (CUSHMAN). - SLITER, p. 125, pl. 23, fig. 3.
1973 *Gavelinella stephensoni* (CUSHMAN). - SLITER, p. 6, pl. 1-2, t-figs. 2, 6-8.
1983 *Gavelinella stephensoni* (CUSHMAN). - BASOV et al., p. 765, pl. 10, figs. 5-6.
1990 *Gavelinella stephensoni* (CUSHMAN). - AL-BAKRI, p. 147, pl. 9, figs. 3-5, text-fig. 8.

Description: Test trochospiral, biconvex, compressed, nearly involute on both sides, umbilical side more convex, spirally flat-convex with umbonate boss, periphery rounded; chambers narrow, 10-11 in the final whorl, increasing gradually in size; sutures curved, initially limbate, flush, later depressed; wall calcareous, surface smooth, polished; aperture equatorial interiomarginal slit extending to umbilicus, with slight lip.

Distribution: *G. stephensoni* ranges from the Santonian to Maastrichtian of the West Coast, Mexico, California and British Columbia (Sliter, 1968, 1973); Coniacian to Campanian of SW Atlantic (Basove et al., 1983); Coniacian to Maastrichtian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M69, Wadi Sir Formation (Turonian), M71, Ghudran Formation (Coniacian to Santonian), M90, 91, Amman Formation (Campanian).

Gavelinella umbilicata (BROTZEN, 1948)
Pl. 42, Fig. 3 a-b.

Remarks: Test free, low trochospiral, planoconv

1948 *Cibicides umbilicata* BROTZEN. - BROTZEN, p. 78.
1969 *Gavelinella umbilicata* (BROTZEN). - HANZLIKOVA, [i]P. 66, pl. 20, fs. 1-2.
1986 *Gavelinella umbilicata* (BROTZEN). - AL-HARITHI, p. 100, pl. 10, fs. 4-6.

ex to biconvex, both sides flattened, spiral side partially evolute, umbilical side involute; periphery subrounded, becoming lobulate; 8-10 chambers in the final whorl, increasing gradually in size as added; sutures initially flush, later slightly depressed on umbilical side; wall calcareous, finely perforate; aperture a low interiomarginal slit, extending into the narrow umbilicus.

Distribution: *G. umbilicata* was recorded from the Turonian to Maastrichtian of Jordan (Al-Harithi, 1986 a, b). In the studied material, it is found in: M64, Wadi Sir Formation (Turonian).

Gavelinella whitei (MARTIN, 1928)
Pl. 40, Fig. 2; Pl. 41, Fig. 3 a-c.

1928 *Rotalia beccariiformis* var. *whitei*, MARTIN, p. 287, pl. 39, fig. 4.
1968 *Gavelinella whitei* (MARTIN). - SLITER, p. 126, pl. 24, fig. 1.
1973 *Gavelinella whitei* (MARTIN). - SLITER, p. 6, pl. 6-8, text-figs. 2, 7.
1983 *Gavelinella whitei* (MARTIN). - BASOV et al., p. 765, pl. 10, figs. 7-9.
1990 *Gavelinella whitei* (MARTIN). - AL-BAKRI, p. 44, pl. 9: 6-7, text-fig. 8.

Description: Test free, trochospiral, nearly biconvex, spirally evolute, flattened, all chambers visible, umbilically involute, slightly concave, periphery broadly rounded; 9-11 chambers in the last whorl, becoming slightly inflated; sutures distinct, curved, initially limbate, later depressed on spiral side, indistinct, radial, flush, later depressed on umbilical side; wall calcareous, coarsely perforate, surface smooth to granular; aperture a low interiomarginal slit, extending from the periphery to umbilicus with small lip.

Distribution: *G. whitei* was recorded form the Santonian to Maastrichtian of California, USA and British Columbia (Sliter, 1968, 1973); Campanian to Maastrichtian of SW Atlantic (Basov et al., 1983); Coniacian of Jordan (Al-Bakri, 1990). In the studied material, it is found in: M47, Ghudran Formation (Coniacian to Santonian), M88, 89, 90 Amman Formation (Campanian), M104, 105, 108, Amman Formation (lower Maastrichtian).

Genus: **Lingulogavelinella** MALAPRIS, 1965

Lingulogavelinella globosa (BROTZEN, 1945)
Pl. 42, Fig. 6 a-c.

1945 *Anomalinoides globosa* BROTZEN, p. 58, pl. 2, fig. 6 a-c.
1970 *Lingulogavelinella globosa* (BROTZEN). - HART, p. 24, figs. 7-9.
1977 *Lingulogavelinella globosa* (BROTZEN). - CARTER & HART, p. 49, pl. 1, figs. 12-14.
1989 *Lingulogavelinella globosa* (BROTZEN). - HART et al., p. 350, pl. 7.18, figs. 8-10.
1988 *Lingulogavelinella globosa* (BROTZEN). - JARVIS et al., p. 152, text-fig. 2.
1990 *Lingulogavelinella globosa* (BROTZEN). - KOUTSOUKOS et al., p. I, figs. 17-18.

Description: Test free trochospiral, equally biconvex; periphery broadly rounded, lobate, spiral side centrally depressed, two to two and a half whorls, 6-8 inflated chambers in the final whorl, increasing gradually in size as added; sutures distinct, depressed, curved; wall calcareous; aperture interiomarginal, slit-like, bordered by a lip. *L. globosa* is recognized by the apertural flaps which cover the edges of the chambers on the ventral side, forming a star-shaped pattern.

Distribution: *L. globosa* was recorded from upper Cenomanian to middle Turonian of England (Carter & Hart, 1977; Jarvis et al., 1988; Hart et al., 1989). In the studied material, it is found in: M22, Na'ur Formation (lower to middle Cenomanian), M31, Fuheis Formation Equivalent (middle Cenomanian); J34, 36, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Lingulogavelinella tormarpensis (BROTZEN, 1942)
Pl. 43, Fig. 1a-c.

1942 *Gavelinella tormarpensis* BROTZEN, p. 52, pl. 1, fig. 6.
1970 *Gavelinella tormarpensis* BROTZEN. - HART, p. 24, figs. 1-3.
1977 *Gavelinella tormarpensis* BROTZEN. - CARTER & HART, p. 48, pl. 1, figs. 31-32.
1990 *Lingulogavelinella tormarpensis* (BROTZEN). - KOUTSOUKOS et al, pl. I, figs. 15-16.

Description: Test very small, low trochospiral, plano to concavo-convex, spiral side convex, partially evolute with a small boss or plug, giving the test a slightly domed appearance, umbilical side flat to gently concave, involute, periphery rounded, lobate;

chambers 5-6 in the final whorl, increasing gradually in size as added; sutures distinct, depressed, curved on the spiral side, radial on the umbilical side; wall calcareous, surface smooth to granular; aperture a low interiomarginal, slit-like, extending from periphery to umbilicus, bordered by a lip.

Distribution: *L. tormarpensis* was recorded from the Albian and Turonian of England (Hart, 1970; Carter & Hart, 1977 respectively) and also reported from the uppermost Cenomanian to lowermost Turonian (Koutsoukos et al., 1990). In the studied material, it is found in: P19, 26, M22, Na'ur Formation (lower to middle Cenomanian); M31, Q27, Fuheis Formation Equivalent (middle Cenomanian); M37, J34, 44, Shueib Formation (upper Cenomanian); Q43, Ghudran Formation (Coniacian to Santonian).

Lingulogavelinella turonica (BUTT, 1966)
Pl. 42, Fig. 7 a-c.

1962 *Gavelinella aumalensis* SIGAL. -SIGAL & DARDENNE, p. 222, pl. 13, f. 6.
1966 *Orostella turonica* BUTT. - BUTT, p. 178, 180, pl. 3, fig. 6 a-c; pl. 4, f. 4 a-c.
1970 *Lingulogavelinella turonica* (BUTT). - HART, p. 25, figs. 1-3.
1977 *Lingulogavelinella turonica* (BUTT). - CARTER and HART, p. 47, txt-fig. 8.
1988 *Lingulogavelinella turonica* (BUTT). - LOEBLICH & TAPPAN, p. 641, pl. 721, figs. 8-13.

Description: Test flat trochospiral, nearly planispiral, periphery broadly rounded, slightly lobate, spiral side partially evolute, umbilical side concave to flat, umbilicus deep depression, closed, covered by elongations of the chambers; 5-6 chambers in the final whorl, globular, inflated on both sides; sutures depressed; wall calcareous; aperture slit-like interiomarginal, extending from periphery to umbilicus, covered by a lip. *L. turonica* differs from *L. globosa* in having lesser number of chambers in the final whorl.

Distribution: *L. turonica* was recorded from the Cenomanian of England (Hart, 1970, Carter & Hart, 1977); upper Cenomanian and lower Turonian of Algeria (Sigal, 1962, 1965); Turonian of France (Butt, 1966; Loeblich & Tappan, 1988). In the studied material, it is found in: M7a, 22, 23, Na'ur Formation (lower to middle Cenomanian), M31, 32, Fuheis Formation Equivalent (middle Cenomanian); J34, 36, Shueib Formation (upper Cenomanian), J58, Wadi Sir Formation (Turonian).

Family: **ROTALIIDAE** EHRENBERG, 1839
Subfamily: **CUVILLIERININAE** LOEBLICH and TAPPAN, 1964
Genus: **Fissoelphidium** SMOUT, 1955

Fissoelphidium operculiferum SMOUT, 1955
Pl. 43, Fig. 2 a-b.

1955 *Fissoelphidium operculiferum* SMOUT, p. 208.
1964 *Fissoelphidium operculiferum* SMOUT. - LOEBLICH et al., p. C 617, fig. 490.5.
1988 *Fissoelphidium operculiferum* SMOUT. - LOEBLICH and TAPPAN, p. 657, pl. 753, figs. 1-5.

Description: Test lenticular, planispiral, bilaterally symmetrical, chambers numerous, septa radial, slightly curved, sutures deeply fissured in dendritic pattern, secondarily doubled by the septal flap; periphery rounded, outline entire to gently lobulate; wall calcareous, distinctly perforate, surface with umbonal mass, final chambers smooth; aperture equatorial interiomarginal, of numerous pores.

Distribution: *F. operculiferum* was recorded from the Maastrichtian of Qatar and Iraq (Loeblich & Tappan, 1988). In the studied material, it is found in: M104, 108, Amman Formation (lower Maastrichtian).

Family: **ELPHIDIIDAE** GALLOWAY, 1933
Subfamily: **ELPHIDIINAE** GALLOWAY, 1933
Genus: **Cribroelphidium** CUSHMAN and BRÖNNIMANN, 1948

Cribroelphidium sp. 1
Pl. 43, Fig. 5 a-b.

Description: Test planispiral, involute, periphery rounded, noncarinate, lobulate; chambers numerous, inflated, up to 14 in the final whorl, increasing gradually in size as added; sutures radial, deeply depressed, with numerous short septal bridges; wall calcareous, perforate; aperture multiple, interiomarginal at base of last chamber.

Remarks: *C.* sp. 1 resembles *C. longipontis* (SCHEDRINA) of Holocene, in its external appearance (Loeblich & Tappan, 1988, p. 673), but differs in its stratigraphic occurrence and in having more lobate periphery, much larger and more depressed umbilical and spiral areas. It also differs from *C. vulgare* in having greater number of chambers, more deeply depressed sutures, lobulate periphery and having short septal bridges.

Distribution: *C.* sp. 1 was found in the studied material only in: Q11, Na'ur Formation (lower to middle Cenomanian).

Cribroelphidium vulgare (VOLOSHINOVA, 1952)
Pl. 43, Figs. 3 a-c, 4 a-c.

1952 *Elphidium vulgare* v. *vulgare* VOLOSHINOVA, p. 53.
1988 *Cribroelphidium vulgare* (VOLOSHINOVA). - LOEBLICH and TAPPAN, p. 673, pl. 785, figs. 17-18
1989 *Cribroelphidium vulgare* (VOLOSHINOVA). - KING et al., p. 474, pl. 9.6, figs. 14-15.

Description: Test compressed, planispiral and involute with rounded noncarinate periphery; about 8-11 slightly inflated chambers in the final whorl; sutures nearly radial, slightly depressed, with depressed umbilical area, may have vertical canals; wall calcareous, perforate but apertural face smooth and entirely imperforate; aperture multiple, interiomarginal.

Distribution: *C. vulgare* is cosmopolitan and was recorded from the upper Miocene of Sakhalin Island, Russia (Loeblich & Tappan, 1988); lower Pliocene of North Sea (King et al., 1989). In the studied material, it is found in: P55, Ghudran Formation (Coniacian to Santonian); M103, M108, Amman Formation (lower Maastrichtian).

4.6 Foraminiferal Genera of Uncertain Status

Genus: **Eoheterohelix** FUCHS, 1973

Eoheterohelix sp. 1
Pl. 43, Fig. 6 a-c.

Description: Test with early trochospiral and later irregular coil; the last whorl consisting of 5 inflated and irregular chambers; sutures deeply depressed on both sides; wall calcareous, surface finely to moderately perforated; aperture interiomarginal slit, extending to umbilicus.

Remarks: *E.* sp. 1 resembles *E. prima* FUCHS of the upper Jurassic in its external appearance (Loeblich & Tappan, 1988, p. 700), but differs in its stratigraphic occurrence and in having smaller test, the last two chambers forming one-half, instead of two-third, the test size

Distribution: *E.* sp. 1 was found in the studied material only in: M47, Ghudran Formation (Coniacian to Santonian).

4.7 RADIOLARIA

Phylum: **PROTISTA**
Subphylum: **SARCODINA** SCHMARDA, 1871
Class: **RHIZOPODEA** VON SIEBOLD, 1845
Subclass **RADIOLARIA** MÜLLER, 1858

4.7.1 Suborder: **POLYCYSTINA** EHRENBERG, 1838

Order: **SPUMELLARIA** EHRENBERG, 1875
Family: **ACTINOMMIDAE** HAECKEL, 1862
Genus: **Praeconocaryomma** PESSAGNO, 1976

Praeoconocaryomma universa PESSAGNO, 1976
Pl. 43, Fig. 7.

1976 *Praeoconocaryomma universa* PESSAGNO, p. 437.

1985 *Praeoconocaryomma universa* PESSAGNO. - SANFILIPPO & RIEDEL, p. 586.
1988 *Praeoconocaryomma universa* PESSAGNO. - GASINSKI, p. 237, fig. 15 m.

Remarks: *P. universa* consists from three medullary shells, having a spherical form with tuberculate cortical shells, and spines arising from each mamma, when present.

Distribution: *P. universa* is restricted to the Mesozoic, becoming extinct in the upper Campanian (Sanfilippo & Riedel, 1985) and was recorded from the Cenomanian of the Carapathian Mountains, Poland (Gasinski, 1988). In the studied material, it is found in: Q20, 22a, Na'ur Formation (lower to middle Cenomanian); M31, Fuheis Formation Equivalent (middle Cenomanian); M43, J36, Shueib Formation (upper Cenomanian); J56, Shueib Formation (Turonian).

Genus: **Acaeniotyle** FOREMAN, 1973b

Acaeniotyle starka EMPSON-MORIN, 1981
Pl. 43, Fig. 10.

1981 *Acaeniotyle starka* EMPSON-MORIN, p. 248.
1985 *Acaeniotyle starka* EMPSON-MORIN. - SANFILIPPO and RIEDEL, p. 587.

Description: The circular shell has a nodose surface, and two three-bladed polar spines generally unequal in length. A small medullary shell is rarely visible. Equatorial diameter of shell 80-120 μm. Length of longer spine 40-60 μm, of shorter spine 25-50 μm. *A. starka* is characterized in having a nodose rather than mammiform surface and fewer and more widely spaced pores.

Distribution: *A. starka* has so far been recorded from the Campanian (Sanfilippo & Riedel, 1985). In the studied material, it is only ound in: P60 (lowermost Maastrichtian), Amman Formation.

Family: **PSEUDOAULOPHACIDAE** RIEDEL, 1967a
Genus: **Pseudoaulophacus** PESSAGNO, 1963

Pseudoaulophacus lenticulatus (WHITE, 1928)
Pl. 43, Fig. 12.

1928 *Baculogypsina (?) lenticulata* WHITE, p. 306, pl. 41, figs. 9, 11.
1963 *Pseudoaulophacus lenticulatus* (WHITE). - PESSAGNO, p. 202, pl. 2, figs. 8, 9.
1973 *Pseudoaulophacus lenticulatus* (WHITE). - DINKELMAN, p. 790, pl. 1, fig. 12.
1982 *Pseudoaulophacus lenticulatus* (WHITE). - KLING, p. 548, pl. 1, fig. 12.
1985 *Pseudoaulophacus lenticulatus* (WHITE).- SANFILIPPO et al., p. 596, fig. 6.4 a, b.

Description: The outline is generally circular, with approximately 12 short, massive spines circular in. The tholi occupy about a third to a half of the disk diameter. Total diameter (excluding spines) 185-280 μm. *P. lenticulatus* differs from many spongodiscids, that have a similar general shape, in having pseudoaulophacid meshwork. *P. pargueraensis* differs in possessing a lobate margin.

Distribution: *P. lenticulatus* is restricted to the *A. pseudoconulus* Zone (Campanian), and is recorded from the eastern Indian Ocean, Japan, central Pacific, California, the Caribbean region, W. central Atlantic, Cyprus and doubtfully northern Italy (Vishnevskaya, 1986). In the studied material, it is found only in P60, Amman Formation (lower Maastrichtian).

Order: **NASSELLARIA** EHRENBERG, 1875
Family: **AMPHIPYNDACIDAE** RIEDEL, 1967a
Genus: **Amphipyndax** FOREMAN, 1966

Amphipyndax stocki (CAMPBELL & CLARK) var. **B** VISHNEVSKAYA, 1986
Pl. 43, Fig. 11.

1954 *Amphipyndax stocki* CAMPBELL & CLARK, p. 237.
1986 *Amphipyndax stocki* (CAMPBELL and CLARK) var. B VISHNEVSKAYA. - VISHNEVSKAYA, p. 140, pl. II, figs. 2, 4.

Distribution: *A. stocki* var. B was recorded from the Campanian of Bering region, Russia (Vishnevskaya, 1986). In the studied material, it is found in: P60, Amman Formation (lower Maastrichtian).

Amphipyndax pseudoconulus (PESSAGNO, 1963)
Pl. 17, Fig. 10 a-b.

1963 *Lithostrobus pseudoconulus* PESSAGNO, p. 210, pl. 1, fig. 8; pl. 5, figs. 6, 8.
1966 *Amphipyndax enesseffi* FOREMAN. - FOREMAN: 356, text-figs. 10, 11.
1982 *Amphipyndax pseudoconulus* (PESSAGNO). - EMPSON-MORIN, p. 510, pl. 1, fig. 5; pl. 2, figs. 1-4, 5, 9, 10, 12.
1985 *Amphipyndax pseudoconulus* (PESSAGNO). - SANFILIPPO et al., p. 596, fig. 7.1a-c

Description: Acutely conical shell, becoming cylindrical distally, composed of 6-8 segments. The abdomen and post-abdominal segments have pores tending to be arranged in transverse rows, with third segment having 3-5 rows of pores. At each segmental division is a row of promonent nodes (12-15 on distal circumference), frequently connected with a network of intersecting ridges on the shell surface. Length of 7 segments 180-200 μm, maximum breadth 85-120 μm. *A. pseudoconulus* is distinguished from its descendant *A. tylotus* by possessing a single row of prominent tubercles at the segmental divisions.

Distribution: *A. pseudoconulus* is practically restricted to the *A. pseudoconulus* Zone (Campanian), and has been recorded from W. Australia, Indonesia, Japan, central Pacific, Alaska, California, the western interior of north America, the Caribbean region, E. Atlantic and southern Europe (Vishnevskaya, 1986). In the studied material, it is only ound in: P60, Amman Formation (lower Maastrichtian).

Amphipyndax tylotus FOREMAN, 1978b
Pl. 17, Fig. 11 a-b.

1978b *Amphipyndax tylotus* FOREMAN, p. 745, pl. 4, figs. 1, 2.
1981 *Amphipyndax tylotus* FOREMAN. - NAKASEKO & NISHIMURA, p. 17, fig. 13.
1982 *Amphipyndax pseudoconulus* (PESSAGNO). - EMPSON-MORIN, pl. 2, figs. 6-8, 11
1985 *Amphipyndax tylotus* FOREMAN. - SANFILIPPO et al., p. 598, fig. 7.2 a, b.

Description: Shell of usually 6-10 segments, conical above and becoming subcylindrical below. Pores on post-thoracic segments small, numerous, generally irregularly arranged but sometimes tending to transverse alignment, 3-5 rows per segment. All post-thoracic segments have prominent, irregularly arranged nodes developing from randomly arranged ridges on shell surface. Length of 7 segments 185-220 μm, width of seventh segment 85-110 μm. *A. pseudoconulus* (Pessagno) has the surface nodes restricted to the boundaries between the segments.

Distribution: *A. tylotus* is restricted to the *A. tylotus* Zone (approximately upper Campanian and Maastrichtian), and has been recorded from the central Pacific, and western and eastern central Atlantic (Vishnevskaya, 1986). *A. tylotus* co-occurs with *A. pseudoconulus* near the end of its range, and thus may be descended from the latter (Foreman, 1978b). In the studied material, it is only ound in: P60, Amman Formation (lower Maastrichtian).

Genus: **Amphibracchium** BAUMGARTNER, 1984

Amphibracchium sp. 1
Pl. 43, Fig. 9.

Distribution: *A.* sp. 1 resembles *A.* sp. BAUMGARTNER, from middle Jurassic to lower Cretaceous of Greece (Baumgartner, 1984), in its external appearance but differs in the stratigraphic occurrence. In the studied material, *A.* sp. 1 is found in P60, Amman Formation (lower Maastrichtian).

Family: **ARCHAEODICTYOMITRIDAE** PESSAGNO, 1976
Genus: **Archaeodictyomitra** PESSAGNO, 1976

Archaeodictyomitra lamellicostata (FOREMAN, 1968)
Pl. 17, Fig. 12 a-b.

1968 *Dictyomitra lamellicostata* FOREMAN, p. 65, pl. 7, fig. 8a, b.
1978b *Dictyomitra lamellicostata* FOREMAN. - FOREMAN, p. 747, pl. 4: 13, 14.
1972 *Dictyomitra* aff. *regina* CAMPBELL & CLARK. - PETRUSHEVSKAYA & KOZLOVA: 550, pl. 8, fig. 11.
1985 *Archaeodictyomitra lamellicostata* (FOREMAN). - SANFILIPPO and RIEDEL, p. 599, fig. 7.5 a-d.

Description: The generally conical shell is subcylindrical distally, of 6-12 segments which increase gradually in length. Longitudinal costae on the proximal segments are wide, blade-like, producing a smooth contour, continuing on the distal segments as low, well seperated ribs (14-20 around the widest segment). A single transverse row of large, circular pores occurs at each stricture. Tota length 150-360 μm, maximum breadth 70-140 μm.

Remarks: *Lithomitra regina* CAMPBELL & CLARK (1944) differs from *A. lamellicostata* in having more ribs around the circumference and a greater number of pores per segment.

Distribution: *A. lamellicostata* ranges from the *A. pseudoconulus* Zone through the *A. tylotus* Zone (Campanian through Maastrichtian), and has been recorded from California, the Caribbean region, and E. and W. Atlantic (Vishnevskaya, 1986). In the studied material, it is only ound in: P60, Amman Formation (lower Maastrichtian).

Genus: **Follicucullus** ORMISTON and BABCOCK, 1979

Follicucullus sp. cf. ***scholasticus*** ORMISTON and BABCOCK, 1979
Pl. 43, Fig. 8.

1979 *Follicucullus scholasticus* ORMISTON et al., p. 332, pl. 1, figs. 6-14.
1986 *Follicucullus scholasticus* ORMISTON et al. - CARIDROIT, WEVER, p. 59, pl. II, figs. 17-9.

Distribution: *F. scholasticus* was recorded from the upper Permian of SW Japan (Caridroit & Wever, 1986). In the studied material: sp. cf. *scholasticus* is found in P14, Na'ur Formation (lower to middle Cenomanian) and Q32, Wadi Sir Formation (Turonian).

Genus: **Pseudodictyomitra**

Pseudodictyomitra sp.
(Figure not given)

CHAPTER 5

BIOSTRATIGRAPHY

5.1 Introduction

The biostratigraphy of the Upper Cretaceous sequences studied in West Jordan is discussed here. A biostratigraphic framework is established on the basis of a detailed study of composite stratigraphic sections constructed for four different sites (Fig. 1.1). Data were obtained by the micropalaeontological analysis of 285 samples collected from the four measured sections. The micropalaeontological analysis and study of vertical variations in the foraminiferal assemblages have enabled us to establish a series of biostratigraphic subdivisions. Ranges of taxa, together with lithological and biostratigraphic subdivisions obtained as a result of these investigations are given in four stratigraphical charts (Enclosures 1-4).

Biostratigraphic units established in the present work are not intended to define world-wide zonal standards. They are used only to subdivide the sequence into biostratigraphic zones according to the foraminiferal content of the strata. In intervals lacking planktonic foraminifera, it has not always been possible to establish a precise zonation using international nomenclature. Nevertheless, world-wide index species have been selected to designate various intervals. The micropalaeontological analysis has provided a basis for dating the Upper Cretaceous sequences with greater precision than possible previously. Furthermore, the foraminiferal fauna of each stage or substage is given and used for the discussion of the biostratigraphic subdivisions and the determination of geologic age and environment of sedimentation. The criteria used in designating the stages and substages depends on the first occurrence (F.O.) of index planktonic foraminifera, then calcareous benthic and lastly arenaceous benthic taxa. The last occurrence (L.O.) of certain species was also taken into account to help in designating the upper boundary of each stage or substage.

5.2 Ajlun / Jerash

5.2.1 Stage boundaries

Micropalaeontological analysis of the Ajlun/Jerash section (Enclosure 1) indicates the following stratigraphic subdivisions:

5.2.1.1 Cenomanian (samples J3 - 52)

This may be subdivided into:

5.2.1.1.1 Lower to mid-Cenomanian

Samples from lithostratigraphic units A1-A3 (J3 - 12, 15 - 24, 40, 41, 43) originate from several thick sequences of different lithologies (Enclosure 1) which are assigned to the lower - mid-Cenomanian. Only benthic foraminifera are encountered in this interval, particularly:

Adelungia sp. 1, *Ammoastuta nigeriana, Ammobaculites advenus, A. agglutinans, A. difformis, A. fragmentarius, A. naqbensis, A. pagodensis, A.* sp. 2, *A. stephensoni, A. subcretaceus, A. turonicus, Ammodiscoides turbinatus, Ammodiscus cretaceus, Ammomarginulina aburoashensis, A. barthouxi, A. blanckenhorni, A. cragini, A. naqbensis, Ammosiphonia* sp., *Ammotium hasaense, Arenobulimina chapmani, Astacolus liebusi, Bulbophragmium aequale, Charentia cuvillieri, C. evoluta, C. hasaensis, C. rummanensis, Cibicides beadnelli, Conorboides beadnelli, Dentalina* sp. 1, *Eoguttulina anglica, Eponides* cf. *plummerae, Evolutinella subevoluta, Flabellammina alexanderi, F. elongata, Gavelinella baltica, G. intermedia, G. semipustulosa, Gavelinopsis tourainensis, Globulina* sp. 1, *Guttulina cuspidata, Guttulina symploca, Haplophragmoides excavatus, H. formosus, H. fraseri, H. kirki, H. neolinki, H. rugosa, Hedbergella delrioensis, H. simplex, Hemicyclammina evoluta, H. sigali, H. whitei, Ismailia neumannae, Kutsevella labythnangensis, Laevidentalina gracilis, Lituola nautiloidea, L.* sp. 1, *Mayncina hasaensis, M. orbignyi, Mucronina* sp., *Neodiscorbinella* sp. 1, *Nezzazata convexa, N. simplex, Placopsilina cenomana, Planispirinella barnardia, Polychasmina pawpawensis, Polymorphina zeuschneri, Poroeponides praeceps, Psammonyx* sp. 1, *Pseudolituonella mariea, Pseudopolymorphina eichenbergi, P.* sp. 1, *Pterammina israelensis, Quadrimorphina camerata, Ramulina globulifera, Reophax* cf. *nodulosus, R. constrictus, Scherochorella minuta, Serovaina orbicella, S. turonicus, Thomasinella aegyptia, T. fragmentaria, T. punica, Triplasia goodlandensis, Trochammina afikpensis, T. boehmi* and *T. rummanensis*, associated with smooth and ornamented ostracods.

Macrofossils include: oysters (*Ostrea flabellate*), gastropods, some ammonites, echinoids and possible rudists, together with sponge spicules, algal, bryozoan and vertebrate fragments.

Most of the benthic foraminiferal species listed above are found commonly in the Lower and Middle Cenomanian of the Eastern Mediterranean and other regions (including *Ammobaculites naqbensis, A. stephensoni, Haplophragmoides excavatus, Hemicyclammina evoluta, H. sigali, Gavelinella semipustulosa, Mayncina hasaensis, M. orbignyi, Ismailia neumannae, Placopsilina cenomana*); other species (such as *Ammobaculites difformis, Charentia cuvillieri, Conorboides beadnelli, Haplophragmoides formosus, H. fraseri, Thomasinella punica*) may extend into the Upper Cenomanian (Hamaoui, 1979a, b; Basha, 1975).

At Ajlun/Jerash, in view of the absence of planktonics, it is suggested that the Lower to mid-Cenomanian is best delimited by the first appearance of *Thomasinella aegyptia* and *T. fragmentaria* (*R. brotzeni* Zone of Caron, 1985), associated with *Ammobaculites* spp. and *Planispirinella barnardia*. The upper boundary of this interval is marked by the L.O. of *Mayncina hasaensis* and *Planispirinella barnardia* (top *R. reicheli* Zone of Caron, 1985).

5.2.1.1.2 Upper Cenomanian

Samples from lithostratigraphic units A4, A5 & A6 (J13, 14, 25 - 39, 42 & 44 - 53) are assigned to the Upper Cenomanian. Characteristic planktonic species encountered in this interval are: *Anaticinella multiloculata, Favusella washitensis, Guembelitria* *cenomana, Hedbergella delrioensis, H. simplex, H. trocoidea, Heterohelix globulosa, H. moremani, Ventilabrella glabrata, Whiteinella baltica, W. brittonensis* and *W. inornata.*

Benthic taxa include: *Ammobaculites agglutinans, A. difformis, A. euides, A. naqbensis, A. obliquus, A.* sp. 1, *A. turonicus, Ammodiscoides turbinatus, Ammomarginulina barthouxi, A. cragini, Arenobulimina chapmani, Biconcava bentori, Biplanata peneropliformis, Bolivinopsis clotho, Bulbobaculites problematicus, Charentia cuvillieri, C. hasaensis, Choffatella decipiens, Clavulinopsis gaultina, Conorboides beadnelli, C. hofkeri, C. mitra, C. umiatensis, Coryphostoma plaitum, Cuneolina* sp., *Dentalina* sp. 1, *Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Evolutinella subevoluta, Flabellammina alexanderi, F. elongata, F. negevensis, Fursenkoina squammosa, Gabonita levis, G. obesa, Gavelinella semipustulosa, Gavelinopsis tourainensis, Globulina lacrima, Guttulina adherens, G. cuspidata, Haplophragmoides kirki, H. fraseri, Hemicyclammina evoluta, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Lenticulina gaultina, L. modesta, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Marssonella kummi, M. oxycona, Mucronina* sp., *Neodiscorbinella* sp. 1, *Nezzazata concava, N. conica, N. convexa, N. gyra, N. simplex, Nezzazatinella adhami, Peneroplis parvus, Plectina ruthenica, Poroeponides praeceps, Praeammoastuta* sp. 1, *Psammonyx* sp. 1, *Pseudopolymorphina eichenbergi, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Quinqueloculina globigerinaeformis, Quinquiloculina* sp., *Ramulina globulifera, Reissella ramonensis, Reophax parvulus, Sculptobaculites goodlandensis, Serovaina orbicella, S. turonicus, Simplorbitolina* sp., *Textularia depressa, Thomasinella aegyptia, T. fragmentaria, T. punica, Triplasia goodlandensis, T. murchisoni, Tristix poignanti, Trochammina boehmi, T. rummanensis, Trochospira avnimelichi* and miliolids.

The foraminiferal assemblage is associated with smooth and ornamented ostracods, the radiolarian *Praeoconocaryomma universa,* echinoids, bivalves, gastropods, algae and vertebrate fragments.

Some of the above benthonic foraminiferal species are found commonly in the Middle Cenomanian of the Eastern Mediterranean and elsewhere (particularly *Hemicyclammina evoluta, Gavelinella semipustulosa, Ismailia neumannae*), while others such as *Ammobaculites difformis, Charentia cuvillieri* and *Thomasinella punica* extend into the Upper Cenomanian (Hamaoui, 1979a, b; Basha, 1975). *Whiteinella inornata* and *W. brittonensis* have been reported to have first occurrence in the Upper Cenomanian of France, Germany, England, Lebanon, Israel and Jordan (Babinot & Trochetti, 1973; Weidich, 1984; Carter & Hart, 1977; Saint-Marc, 1975; Lipson-Benitah et al., 1988; Koch, 1968; Basha, 1975, 1979; Al-Harithi, 1982; Al-Bakri, 1990). Therefore, it is suggested that the Upper Cenomanian is best delimited at Ajlun/Jerash by the F.O. of *Whiteinella inornata,* associated with *W. baltica* and *W. brittonensis* (base *R. cushmani* Zone of Caron, 1985), and the disappearance of *Mayncina hasaensis* (top *R. cushmani* Zone of Caron, 1985).

5.2.1.2 Turonian

Samples from lithostratigraphic unit A7 (J54, 55 & 57 - 60) are assigned to the Turonian. The basal part is rich in planktonic foraminifera, often associated with few calcareous benthonics. Abundance and species diversity decreases progressively upward through the sequence, and few species were recovered from the crystalline limestone horizons at the summit. Characteristic planktonic species encountered in this interval are: *Anaticinella multiloculata, Hedbergella delrioensis, H. simplex, Heterohelix globulosa, H. nkporoensis, H. reussi, Whiteinella archaeocretacea* and *W. inornata.*

Benthic foraminifera include: *Adelungia marginulinaeformis, A.* sp. 1, *Ammobaculites advenus, A. albertensis, A. fragmentarius, A. mastersi, A. subcretaceus, Ammodiscoides turbinatus, Ammomarginulina cragini, Astacolus richteri, Biplanata peneropliformis, Charentia cuvillieri, Coryphostoma plaitum, Cuneolina* sp., *Evolutinella* sp. 1, *Flabellammina elongata, F. negevensis, Gaudryina rugosa, Gavelinella semipustulosa, Globulina lacrima, Guttulina cuspidata, Haplophragmoides calculus, H. excavatus, H. formosus, H. kirki, Hemicyclammina evoluta, H. sigali, Lenticulina modesta, Lingulogavelinella globulosa, L. turonica, Lituola nautiloidea, Marssonella kummi, M. oxycona, M. trochus, Mayncina orbignyi, Nezzazata* sp., *Orbitulina* sp., *Peneroplis parvus, Pseudorhapydionina dubia, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Ramulina globulifera, Reissella ramonensis, Reophax parvulus, Scherochorella minuta, S.* sp., *Serovaina orbicella, S. turonicus, Textularia depressa, T. subconica, Triplasia goodlandensis, Tristix poignanti, Trochammina rummanensis, Vernonina* sp., cuneolinids and miliolids.

Associated fossils include *Plicatula* sp., *Micraster* sp. and ammonites, smooth and ornamented ostracods, the radiolarian ?*Praeoconocaryomma universa,* oysters, gastropods, echinoids, bryozoan, vertebrate and dasycladacean algal fragments.

Some of the above mentioned foraminiferal species range from the Upper Cenomanian to Turonian of the Eastern Mediterranean (Hamaoui, 1979 a, b) and elsewhere (such as Heterohelicidae, *Flabellammina negevensis* and *F. elongata*). The first appearance of *Whiteinella archaeocretacea* in this faunal assemblage indicates the Lower Turonian, while the first appearance of *Heterohelix reussi* indicates the Middle Turonian (Caron, 1985). Most of the above mentioned planktonic foraminiferal species are Turonian marker species. *Quadrimorphina camerata* is reported in Egypt from the Middle Turonian (Said & Kenawy, 1957; Cherif et al., 1989a) and *Serovaina turonicus* is restricted in Jordan to the same substage (Basha, 1975, 1978; Harithi, 1986). Therefore, it is suggested that the Turonian is best delimited at Ajlun/Jerah by the F.O. of *W. archaeocretacea* (Caron, 1985).

5.2.2 Foraminiferal Assemblages

The proposed assemblage zones are mainly local and based solely on the foraminiferal fauna recovered from this sequence (Enclosure 1). They may be differentiated from bottom to top as:

5.2.2.1 Lower to mid-Cenomanian

In view of the complete absence of planktics in the lower and mid-Cenomanian, the following index benthic assemblages are suggested:

***Thomasinella aegyptia / T. fragmentaria* Zone** (sample J3)

This zone is characterised by the presence of only the benthic foraminiferal species: *Thomasinella aegyptia* and *T. fragmentaria.*

***Planispirinella barnardia* Zone** (samples J4 - 12, 40 & 43)

The index species is associated with *Ammobaculites agglutinans, A. turonicus, Charentia cuvillieri* and *Psammonyx* sp. 1, some of which range into the overlying zones.

***Mayncina hasaensis* Zone** (samples J41, 15 - 26)

This zone is characterised by a diverse and abundant fauna, including: *Ammoastuta nigeriana, Ammobaculites pagodensis, A.* sp. 2, *A. stephensoni, Ammodiscus cretaceus, Ammomarginulina aburoashensis, A. blanckenhorni, A. naqbensis, Ammosiphonia* sp., *Ammotium hasaense, Astacolus liebusi, Bulbophragmium aequale, Charentia evoluta, C. rummanensis, Cibicides beadnelli, Eoguttulina anglica, Gavelinella baltica, G. intermedia, Globulina* sp. 1, *Guttulina symploca, Haplophragmoides neolinki, H. rugosa, Hemicyclammina whitei, Laevidentalina gracilis, Lituola* sp. 1, *Mayncina hasaensis, Placopsilina cenomana, Polychasmina pawpawensis, Polymorphina zeuschneri, Pseudolituonella mariea, Pseudopolymorphina* sp. 1, *Reophax* cf. *nodulosus, R. constrictus* and *Trochammina afikpensis.*

In addition to the above, the following foraminiferal species are also found in this interval, but may range into the overlying beds: *Hedbergella delrioensis, H. simplex, Ammobaculites difformis, Ammomarginulina barthouxi, Charentia hasaensis, Conorboides beadnelli, Dentalina* sp. 1, *Flabellammina alexanderi, Gavelinopsis tourainensis, Mucronina* sp., *Neodiscorbinella* sp. 1, *Poroeponides praeceps, Pseudopolymorphina eichenbergi, Thomasinella punica* and *Trochammina boehmi. Planispirinella barnardia* disappears at the top of this zone.

5.2.2.2 Upper Cenomanian

***Whiteinella inornata* Zone** (samples J13, 14, 27 - 33, 42)

This zone is characterised by the presence of *Ammobaculites euides* and *Whiteinella inornata. Psammonyx* sp. 1 and *Trochammina boehmi* disappears towards the top of the zone. *Conorboides hofkeri* is found in this zone and ranges into the overlying zone.

***Heterohelix calabarflanki* Zone** (samples J34 - 52)

This zone is characterised by a presence of the planktonics: *Favusella washitensis, Guembelitria cenomana, Hedbergella trocoidea, Heterohelix calabarflanki, H. globulosa, H. moremani, Ventilabrella glabrata, Whiteinella baltica* and *W. brittonensis.*

Benthic taxa include: *Ammobaculites obliquus, A.* sp. 1, *Arenobulimina advena, Biconcava bentori, Bolivinopsis clotho, Bulbobaculites problematicus, Choffatella decipiens, Clavulinopsis gaultina, Conorboides hofkeri, C. mitra, C. umiatensis, Eponides* cf. *frankei, E. sibericus, E. sigali, E. whitei, Fursenkoina squammosa, Gabonita levis, G. obesa, Guttulina adherens, Ismailia aegyptica, Lenticulina gaultina, L. taylorensis, Lingulogavelinella tormarpensis, Quinqueloculina globigerinaeformis, Sculptobaculites goodlandensis, Simplorbitolina* sp. and *Trochospira avnimelichi.*

In addition to the above, the following foraminiferal species are also found in this interval, but may range into the overlying beds: *Anaticinella multiloculata, Biplanata peneropliformis, Coryphostoma plaitum, Flabellammina negevensis, Globulina lacrima, Marssonella kummi, M. oxycona, Nezzazata conica, N. gyra, Nezzazatinella adhami, Peneroplis parvus, Plectina ruthenica, Praeammoastuta* sp. 1, *Pseudotextulariella cretosa, Quasispiroplectammina nuda, Reissella ramonensis, Reophax parvulus, Textularia depressa, Triplasia murchisoni* and *Tristix poignanti.*

The benthic species disappearing within this interval include: *Ammobaculites agglutinans, A. difformis, A. naqbensis, A. turonicus, Ammomarginulina barthouxi, Arenobulimina chapmani, Charentia hasaensis, Conorboides beadnelli, Dentalina* sp. 1, *Eponides* cf. *plummerae, Evolutinella subevoluta, Flabellammina alexanderi, Gavelinopsis tourainensis, Haplophragmoides fraseri, Ismailia neumannae, Kutsevella labythnangensis, Lenticulina modesta, Lingulogavelinella globulosa, L. turonica, Mucronina* sp., *Neodiscorbinella* sp. 1, *Nezzazata concava, N. convexa, N. simplex, Poroeponides praeceps, Pseudopolymorphina eichenbergi, Thomasinella aegyptia, T. fragmentaria* and *T. punica.*

***Heterohelix reussi* Zone** (samples J53, 56)

This zone is characterised by an abundance of the benthic species: *Adelungia marginulinaeformis, Ammobaculites albertensis, A. mastersi, Astacolus richteri, Evolutinella* sp. 1, *Haplophragmoides calculus, Scherochorella* sp. and *Vernonina* sp. *Heterohelix reussi* first appears in this zone, and ranges upwards into the overlying beds.

The following benthic species last appear in this zone: *Ammobaculites fragmentarius, A. subcretaceus, Ammomarginulina cragini, Globulina lacrima, Guttulina cuspidata, Haplophragmoides excavatus, H. formosus, H. kirki, Hemicyclammina evoluta* and *H. sigali.*

5.2.2 Turonian

***Whiteinella archaeocretacea* Zone** (samples J54, 55, 57 - 60)

This zone is characterised by a presence of the planktonic species: *Hedbergella simplex, Heterohelix nkporoensis* and *Whiteinella archaeocretacea*, and an abundance of the benthic species: *Gaudryina rugosa, Marssonella trochus, Pseudorhapydionina dubia, Textularia subconica*, associated with *Orbitulina* sp., cuneolinids and miliolids.

The following planktonic species last appear in this zone: *Anaticinella multiloculata, Hedbergella delrioensis, Heterohelix reussi* and *Whiteinella inornata*. The benthic species include: *Adelungia* sp. 1, *Ammobaculites advenus, Ammodiscoides turbinatus, Biplanata peneropliformis, Charentia cuvillieri, Coryphostoma plaitum, Flabellammina elongata, F. negevensis, Gavelinella semipustulosa, Lenticulina modesta, Lingulogavelinella globulosa, L. turonica, Lituola nautiloidea, Marssonella kummi, M. oxycona, Mayncina orbignyi, Peneroplis parvus, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Ramulina globulifera, Reissella ramonensis, Reophax parvulus, Scherochorella minuta, Serovaina orbicella, S. turonicus, Textularia depressa, Triplasia goodlandensis, T. murchisoni, Tristix poignanti* and *Trochammina rummanensis*.

5.3 Wadi Mujib

5.3.1 Stage boundaries

The lithological and micropalaeontological analyses of the Wadi Mujib (Enclosure 2) suggest the following possible time subdivisions:

5.3.1.1 Cenomanian

Samples from lithostratigraphic units A1-A6 (M5-46, 49-61) are assigned to the Cenomanian Stage. This may be subdivided into:

5.3.1.1.1 Lower to mid-Cenomanian

Samples from lithostratigraphic units A1-A3 (M5 - 32) are assigned to Lower to mid-Cenomanian. Characteristic planktonic species encountered are: *Costellagerina bulbosa, Globigerinelloides bentonensis, G. blowi, G. eaglefordensis, G. ultramicra, Guembelitria cenomana, Hedbergella delrioensis, H. hoelzli, H. simplex, H. trocoidea, Heterohelix globulosa, H. moremani, H.* sp. 1, *Pseudotextularia plummerae, P.* sp. 1, *Whiteinella aprica, W. baltica* and *W. brittonensis*.

Benthic taxa include: *Aaptotoichus clavellatus, Adelungia marginulinaeformis, Adelungia* sp. 1, *Ammoastuta nigeriana, Ammobaculites agglutinans, A. albertensis, A. difformis, A. euides, A. fragmentarius, A. mastersi, A. naqbensis, A. obliquus, A.* sp. 1, *A.* sp. 2, *A. stephensoni, A. subcretaceus, A. turonicus, Ammomarginulina barthouxi, A. cragini, A. naqbensis, Ammotium aegyptica, A. oertlii, Ammovertillina* sp. 1, *Anomalinoides pinguis, Arenobulimina advena, A. chapmani, A. d'orbignyi, Biplanata peneropliformis, Bulimina exigua robusta, Cassidella tegulata, Charentia* *cuvillieri, C. hasaensis, C. rummanensis, Choffatella decipiens, Clavulinopsis gaultina, Conorbina conica, Conorboides beadnelli, C. hofkeri, C. mitra, C.* sp. 1, *C.* sp. 2, *C. umiatensis, Coryphostoma neumannae, C. plaitum, Cyclammina haydeni, Daxia cenomana, Dentalina hammensis, Dentalinoides canulina, Donsissonia* sp., *Ellipsoglandulina laevigata, Eoguttulina anglica, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Evolutinella* sp. 1, *Fissurina laevigata, F. oblonga, Flabellammina elongata, F. negevensis, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, G. sumaya, Gavelinella awunensis, G. baltica, G. cenomanica, G. intermedia, G. nacatochensis, G. semipustulosa, Gavelinopsis proelevata, Globorotalites hiltermanni, Globulina* sp. 1, *Guttulina adherens, G. cuspidata, G. symploca, Gyroidinoides nitida, Haplophragmoides calculus, H. excavatus, H. formosus, H. fraseri, H. kirki, H. neolinki, H. rugosa, H. umbilicata, Hemicyclammina evoluta, H. sigali, H.* sp. 1, *H. whitei, Hensonina lenticularis, H.* sp. 1, *Hormosina* cf. *velascoensis, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Laevidentalina* sp., *Lagena acuticosta, L. hexagona, L. paucicosta, Lenticulina californiensis, L. gaultina, L. rotulata, L.* sp. 1, *L. spachholtzi, L. spissocostata, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Loxostomoides cushmani, Marssonella kummi, M. oxycona, M. trochus, Mayncina hasaensis, M. orbignyi, Merlingina cretacea, Neobulimina canadensis, N. irregularis, Nezzazata conica, N. convexa, N. gyra, N. simplex, Nodosaria naumanni, Oolina globulosa, Ophthalmidium minimum, Orbitolina sefini, Placopsilina cenomana, Planispirinella barnardia, Plectinella aegyptiaca, Polychasmina pawpawensis, Polymorphina zeuschneri, Poroeponides praeceps, Praeammoastuta* sp. 1, *Praebulimina* cf. *arabica, P.* cf. *bantu lata, P. prolixa, P. prolixa longa, P. reussi navarroensis, P. venusae, Pravoslavlevia pravoslavlevi, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Pseudolituonella mariea, Pseudopolymorphina eichenbergi, P.* sp. 1, *Pseudotextulariella cretosa, P.* sp. 1, *Psilocitharella leptoteicha, Pyramidina rudita, Quadrimorphina camerata, Quasispiroplectammina nuda, Quinqueloculina globigerinaeformis, Quinqueloculina triangulata, Reissella ramonensis, R. ramonensis, Scherochorella minuta, Sculptobaculites goodlandensis, S. loshkharvicus, Serovaina orbicella, S.* sp. 1, *S. turonicus, Sestronophora* sp., *Spiroloculina cretacea, Stensioeina pokornyi, Textularia depressa, Thomasinella aegyptia, T. fragmentaria, T. punica, Triplasia bonnefousi, T. goodlandensis, T. murchisoni, Tristix poignanti, Trochammina afikpensis, T. boehmi, T. rummanensis, Trochamminoides parva, Trochospira avnimelechi, Uvigerinammina jankoi, Valvulineria loetterlei, Vernonina* sp., orbitulinids, miliolids and alveolinids, associated with ornamented ostracods, the radiolarian sp. ?*Praeoconocaryomma universa.*

Macrofossils include: oysters (*Ostrea flabellata, O. olisiponensis*), gastropods, echinoids(*Cyphozoma* sp.), bryozoans, sponge and vertebrate fragments.

Most of the above benthic species (including *Hemicyclammina evoluta, H. sigali, Pseudotextulariella cretosa, Gavelinella semipustulosa, Mayncina hasaensis, M. orbignyi, Trochospira avnimelechi* and *Ismailia neumannae*) are found commonly in the Lower and Middle Cenomanian of the eastern Mediterranean and other areas (Hamaoui, 1979a, b; Basha, 1975), but some extend into the Upper Cenomanian (e.g. *Ammobaculites difformis, Charentia cuvillieri, Tristix poignanti, Thomasinella punica* and *Whiteinella baltica*).

In view of the absence of index planktonic species, it is suggested that this substage is best delimited by the first appearance of *Haplophragmoides excavatus, H. formosus, H. kirki, Thomasinella aegyptia and T. fragmentaria* (base *R. brotzeni* Zone of Caron, 1985). The upper limit of the unit is marked by the disappearance of *Daxia cenomana, Mayncina hasaensis, Merlingina cretacea* and *Planispirinella barnardia* (top *R. reicheli* Zone of Caron, 1985).

5.3.1.1.2 Upper Cenomanian

Samples from lithostratigraphic units A5 & A6 (M33 - 46, 49 - 61) are assigned to the Upper Cenomanian. Characteristic planktonic species encountered in this interval are: *Globigerinelloides bentonensis, G. blowi, G.* sp., *G. ultramicra, Guembelitria cenomana, Hedbergella delrioensis, H. simplex, H. trocoidea, Heterohelix calabarflanki, H. globulosa, H. moremani, H. punctulata, H. striata compressa, H. vistulaensis, Pseudoplanoglobulina nakhitschevanica, Pseudotextularia plummerae, Whiteinella aprica, W. baltica, W. brittonensis* and *W. inornata.*

Benthic taxa include: *Ammobaculites advenus, A. subcretaceus, Ammomarginulina aburoashensis, A. cragini, Arenobulimina chapmani, A. d'orbignyi, Bulimina exigua robusta, B. kirri, Clavulinopsis gaultina, Conorboides beadnelli, C. hofkeri, C.* sp. 2, *C. umiatensis, Coryphostoma neumannae, Dicyclina schlumbergeri, Evolutinella* sp. 1, *Fissurina laevigata, F. oblonga, Gabonita levis aegyptiaca, G. obesa, G. sumaya, Gavelinella awunensis, G. baltica, G. intermedia, G. nacatochensis, Gavelinopsis proelevata, Globospirillina condensa, Gyroidinoides nitida, G.* sp., *Haplophragmoides kirki, H. neolinki, rugosa, Hemicyclammina evoluta, Lagena hexagona, Lingulogavelinella tormarpensis, Marssonella oxycona, M. trochus, Neobulimina canadensis, N. canadensis alpha, N. irregularis, Neodiscorbinella* sp. 1, *Nezzazata convexa, Nonionella austinana, Oolina globulosa, Planispirinella barnardia, Poroeponides praeceps, Praebulimina* cf. *arabica, P. carseyae, P. prolixa, P. prolixa longa, P. reussi navarroensis, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Pyramidina rudita, Serovaina minutus, S. orbicella, Thomasinella punica, Valvulineria loetterlei,* associated with miliolids.

Other microfauna include the radiolarian sp. ?*Praeoconocaryomma universa* and ostracods. Macrofossils consist of large ammonites, echinoid spines, oysters, gastropods, vertebrate fragments.

Some of the above benthonic foraminiferal species are found commonly in the Middle Cenomanian of the Eastern Mediterranean and other regions (particularly *H. evoluta*), (Basha, 1975; Hamaoui, 1979a, b). *Whiteinella inornata* and *W. brittonensis* have been reported to have first occurrence in the Upper Cenomanian of France, Germany, England, Lebanon, Israel and Jordan (Babinot & Trochetti, 1973; Weidich, 1984; Carter & Hart, 1977; Saint-Marc, 1975; Lipson-Benitah et al., 1988; Koch, 1968; Basha, 1975, 1979; Al-Harithi, 1982; Al-Bakri, 1990). Therefore, it is suggested that the Upper Cenomanian is best delimited at Wadi Mujib by the F.O. of *Whiteinella baltica* (base *R. cushmani* Zone of Caron, 1985) and the disappearance of *Daxia cenomana, Merlingina cretacea* and *Mayncina hasaensis* (top *R. cushmani* Zone of Caron, 1985).

5.3.1.2 Turonian

Samples from lithostratigraphic unit A7 (M62 - 69) are dated as Turonian. The basal part is rich in planktonic foraminifera, often associated with a few calcareous benthonics. Abundances and species diversity decrease progressively upwards through the sequence, and few species were recovered from the crystalline limestone horizons. Characteristic planktonic species encountered in this interval are: *Guembelitria cenomana, Heterohelix reussi, Pseudotextularia plummerae* and *Whiteinella archaeocretacea.*

Benthic species include: *Adelungia marginulinaeformis, Ammoastuta nigeriana, Ammobaculites advenus, A. fragmentarius, A. naqbensis, A. obliquus, A. pagodensis, A. subcretaceus, A. turonicus, Ammomarginulina aburoashensis, A. barthouxi, A. blanckenhorni, A. cragini, A.* sp. 1, *Ammomassilina* sp., *Ammotium hasaense, Astacolus liebusi, A.* sp. 1, *Bulbobaculites problematicus, Bulbophragmium aequale, Conorboides hofkeri, C. mitra, C.* sp. 2, *Cuneolina pavonia parva, Cyclammina haydeni, Donsissonia* sp., *Eponides whitei, Evolutinella* sp. 1, *E. subevoluta, Flabellammina alexanderi, F. kaskapauensis, F.* sp. 1, *F.* sp. 2, *Gabonita levis aegyptiaca, Gavelinella nacatochensis, G. stephensoni, G. umbilicata, Gavelinopsis abudurbensis, G. proelevata, G. tourainensis, Haplophragmoides neolinki, H. fraseri, H. neolinki, Hormosina excelsa, Lituola nautiloidea, Massilina ginginensis, Nezzazata concava, Placopsilina cenomana, Poroeponides praeceps, Psammonyx* sp., *Pseudorhapydionina dubia, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Reissella ramonensis, Reophax constrictus, R. parvulus, Scherochorella* sp., *Sculptobaculites loshkharvicus, Serovaina minutus, S. pseudoscopus, S. simplex, S. struvei, S. turonicus, Simplorbitolina* sp., *Trochospira avnimelichi* and *Valvulineria loetterlei,* associated with smooth and highly ornamented ostracods and miliolids.

Macrofossils include: bivalves, oysters, gastropods, echinoid spines, worm tubes, bryozoans, sponges and vertebrate fragments.

Some of the above foraminiferal species (e.g. *Flabellammina negevensis, F. elongata, Gavelinella* spp., *Nezzazata concava, Poroeponides praeceps* and *Valvulineria loetterlei*) range from the upper Cenomanian to Turonian of the Eastern Mediterranean and elsewhere (Eicher & Worstell, 1970; Basha, 1975, 1978; Harithi, 1986; Hamaoui, 1979 a, b). But most of the above mentioned planktonic foraminiferal species are world-wide indicators of the Turonian Stage. *Flabellammina alexanderi* and *Quadrimorphina camerata* were reported in Egypt from the Middle Turonian (Said & Kenawy, 1957; Cherif et al., 1989a), while *Serovaina turonicus, S. minutus* and *Conorboides hofkeri* are restricted in Jordan to the Middle Turonian (Basha, 1975, 1978; Harithi, 1986). Therefore, it is suggested that the Turonian is best delimited at Wadi Mujib by the F.O. of *Whiteinella archaeocretacea* (Caron, 1985).

5.3.1.3 Upper Coniacian - Santonian

Samples from lithostratigraphic unit B1 (M47, 70 - 74) are assigned to the Upper Coniacian - Santonian. Characteristic planktonic species encountered are:

Anaticinella multiloculata, Archaeoglobigerina blowi, Concavatotruncana asymetrica, C. concavata, C. imbricata, Contusotruncana fornicata, Costellagerina bulbosa, Globigerinelloides alvarezi, G. bentonensis, G. caseyi, G. prairiehillensis, G. ultramicra, Globotruncana linneiana, G. orientalis, G. rugosa, Hedbergella delrioensis, H. flandrini, H. hoelzli, H. holmdelensis, H. monmouthensis, H. simplex, Heterohelix calabarflanki, H. dentata, H. globocarinata, H. globulosa, H. nkporoensis, H. pseudotessera, H. reussi, H. sp. 1, *H. striata compressa, Marginotruncana marginata, M. paraconcavata, M. pseudolinneina, M. renzi, Pseudotextularia nuttalli, P. plummerae Sigalitruncana pileoliformis, Whiteinella aprica, W. archaeocretacea, W. baltica* and *W. inornata.*

Benthic taxa include: *Ammoastuta nigeriana, Ammodiscoides turbinatus, Anomalinoides pinguis, Bolivinopsis clotho, Brizalina lowmani, Cassidella navarroana, Cibicides beadnelli, Dentalinoides canulina, Dorothia pontoni, Elhasaella alanwoodi, Eoheterohelix* sp., *Fissurina laevigata, F. oblonga, Frondicularia clarki, F. lanceolata, Gabonita distorta, Gavelinella burlingtonensis, G. cristata, G. farafraensis, G. involuta, G. lorneina, G. pertusa, G. sandidgei, G. stephensoni, G. whitei, Gavelinopsis abudurbensis, G. proelevata, Hiltermannella* cf. *kochi, Hopkinsina arabina, Laevidentalina* sp., *Lagena paucicosta, Lenticulina californiensis, L. modesta, L. rotulata, Loxostomoides cushmani, Mucronina* sp., *Neobulimina canadensis, Neoflabellina kypholateris, N. suturalis, Nonionella cretacea tamilensis, N. robusta, Planoglobulina brazoensis, Plectina ruthenica, Poroeponides praeceps, Praebulimina aspera, P. reussi, Pseudotextulariella* sp. 1, *Pyramidulina distans, Quasispiroplectammina navarroana, Q. nuda, Textularia subconica, Vaginulina cretacea, V. plummerae, V. recta, V. trilobata* and *Valvalabamina lenticula,* associated with ostracods. Macrofossils include: gastropods, echinoid spines and vertebrate fragments.

At Wadi Mujib, it is suggested that the Upper Coniacian to Santonian is best delimited by the first appearance of *Archaeoglobigerina blowi* (top *C. primitiva* Zone of Caron, 1985) and *Concavatotruncana concavata* (base *C. concavata* Zone of Caron, 1985), associated with *Whiteinella inornata, Concavatotruncana imbricata, Hedbergella delrioensis, Globotruncana linneiana, Globigerinelloides* spp. and *Gavelinella* spp. The upper boundary of this interval is marked by the L.O. of *Whiteinella archaeocretacea* and *Heterohelix calabarflanki* (top *C. asymetrica* Zone of Caron, 1985).

5.3.1.4 Upper Campanian

Samples from the lower part of lithostratigraphic unit B2 (M75 - 90) are assigned to the upper Campanian. Characteristic planktonic species encountered in this interval are: *Archaeoglobigerina blowi, Contusotruncana fornicata, C. plummerae, Globigerinelloides alvarezi, G. bollii, G. messinae, G. prairiehillensis, Globotruncana arca, G. bulloides, G. mariei, G. orientalis, G. rugosa, Globotruncanita subspinosa, Hedbergella holmdelensis, H. monmouthensis, Heterohelix glabrans, H. globocarinata, H. globulosa, H. nkporoensis, H. striata compressa, Marginotruncana coronata, M. marginata, Rugotruncana subcircumnodifer* and *Ventilabrella glabrata.*

Benthic species include: *Arenobulimina amanda, Dentalinoides canulina, Elhasaella alanwoodi, Gabonita tiarella, Gaudryina rugosa, Gavelinella burlingtonensis, G. lorneina, G. stephensoni, G. whitei, Gavelinopsis abudurbensis, Gyroidinoides muwaqqarensis, G. nitida, Hopkinsina arabina, Laevidentalina catenula, L. gracilis L. hammensis, L.* sp., *Lagena paucicosta, Lenticulina carlsbadensis, L. muensteri, L. taylorensis, Neoflabellina leptodisca, N. suturalis, N.* sp. 1, *Nodosaria limbata, Nonionella cretacea tamilensis, Praebulimina angulata, P. aspera, P. carseyae, P. trihedra, Pseudotextulariella* sp. 1, *Pyramidina triangularis, Pyramidulina distans, P. latejugata, P. proboscidea, P. septemcostata, P. zippei, Vaginulinopsis directa, Valvalabamina lenticula* and *Valvulineria loetterlei.* Other fauna include: ostracods, gastropods, echinoid spines, bryozoans, corals and vertebrate fragments.

Globigerinelloides bollii, Heterohelix globulosa and *H. striata compressa* have been reported from the Lower Campanian or younger sediments in many localities of the World (Caron, 1985). *Elhasaella alanwoodi, Contusotruncana plummerae* and *Heterohelix glabrans* are reported in Jordan from the Lower Campanian or younger sediments (Al-Harithi, 1986). *Globotruncanita subspinosa* is reported from Middle Campanian or younger sediments in many areas (Caron, 1985).

At Wadi Mujib, it is suggested that the Upper Campanian is best delimited by the F.O. of *Rugotruncana subcircumnodifer* (base *G. calcarata* Zone of Caron, 1985), associated with *Archaeoglobigerina blowi, Contusotruncana fornicata, C. plummerae, Elhasaella alanwoodi, Globotruncana arca, G. bulloides, G. mariei, G. orientalis, G. rugosa,* and *Globotruncanita subspinosa.* The upper boundary of this interval is marked by the L.O. of *Rugotruncana subcircumnodifer* and *H. nkporoensis* (top *G. calcarata* Zone of Caron, 1985).

5.3.1.5 Lower Maastrichtian

Samples from the upper part of the lithostratigraphic unit B2 (M91 - 110) are assigned to the Lower Maastrichtian. Characteristic planktonic species encountered in this interval are: *Archaeoglobigerina cretacea, Concavatotruncana concavata, Contusotruncana patelliformis, Costellagerina bulbosa, Globigerinelloides alvarezi, G. caseyi, G. messinae, G. multispinata, G. prairiehillensis, G. ultramicra, Globotruncana rosetta, G. volutus, Globotruncanella havanensis, Globotruncanita elevata, G. stuartiformis, Gublerina ornatissima, G. robusta, Hedbergella holmdelensis, Heterohelix dentata, H. globocarinata, H. globulosa, H. pseudotessera, H. striata compressa, H.* sp. 1, *H. vistulaensis, Marginotruncana sinuosa, Planoglobulina brazoensis, P. multicamerata, Rugoglobigerina jordani, R. pilula, R. rugosa* and *Ventilabrella glabrata.*

Benthic species include: *Ammodiscoides turbinatus, Ammodiscus cretaceus, Bolivina decurrens, B. incrassata, Bulimina kirri, Cassidella navarroana, Ceratobulimina cretacea, Ceratolamarckina parva, Citharina suturalis, Cribroelphidium vulgare, Dentalina hammensis, Dictyopselloides cuvillieri, Eponides* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Fissoelphidium operculiferum, Fissurina alveolata, F. laevigata, F. oblonga, Frondicularia lanceolata, Gabonita billmani, G. bipyramidata, G.* cf. *sibiricus, G. levis, G. multituberculata, G. parva, G. sumaya, G. zigzaga, Gavelinella cristata, G. tourainensis, G. whitei, Gyroidinoides nitida, Kyphopyxa* *christneri, Laevidentalina aphelis, L. marcki, L. longiscata, L.* sp. 1, *L. vistulae, Lenticulina californiensis, L. mellahensis, L. modesta, Marssonella oxycona, M. trochus, Mucronina* sp., *Neodiscorbinella* sp. 1, *Neoflabellina kypholateris, Nodogerina bradyi, Nodomorphina* sp. 1, *Nonionella robusta, Oolina globulosa, Planoglabratella* sp., *Plectina ruthenica, Protelphidium hofkeri, P. martinii, Pyramidulina raphinistrum, Serovaina orbicella, Tristix coloi, Stensioeina exsculpta, S. exsculpta gracilis, Valvalabamina lenticula, Valvulineria correcta* and *Valvulinoides umovi.* Other fauna include: ostracods, bivalves, gastropods, echinoids, algal clasts and vertebrate fragments.

Globotruncana arca, Globotruncanita subspinosa, Heterohelix striata compressa, H. globulosa, Bolivina incrassata, Citharina suturalis, Frondicularia clarki, Gavelinopsis abudurbensis, Gyroidinoides muwaqqarensis, G. nitida, Hopkinsina arabina, Laevidentalina gracilis, L. vistulae, Lenticulina mellahensis, Neoflabellina leptodisca, Praebulimina aspera, P. carseyae, Pyramidulina latejugata, P. zippei, Vaginulina cretacea, V. trilobata, Vaginulinopsis directa and *Valvulineria correcta* are found commonly in the Lower Campanian or younger sediments in many localities of the World (Atlas, 1984; Caron, 1985) and especially in Jordan (Futyan, 1968), Israel (Reiss, 1985) and Egypt (Nakkady, 1959; Le Roy, 1953; Said & Kenawy, 1956; Cherif, 1989). *Globotruncanella havanensis* is known from the Lower Maastrichtian (base *G. havanensis* Zone of Caron, 1985) or younger sediments in many localities of the World (Caron, 1985). *Protelphidium martinii* was recorded from the Lower Maastrichtian of Palestine (Bayliss, 1973) and from the Lower Campanian to Lower Maastrichtian of Jordan (Koch, 1968; Hamam, 1977; Al-Harithi, 1982, 1986). However, *Globigerinelloides ultramicra* is known to range no higher than the Lower Maastrichtian (base *G. aegyptiaca* Zone of Caron, 1985).

It is suggested that the Lower Maastrichtian is best delimited at Wadi Mujib by the F.O. of *Globotruncanella havanensis* (base *G. havanensis* Zone of Caron, 1985), associated with *Rugotruncana subcircumnodifer, Heterohelix globulosa, H. striata compressa, Valvulineria correcta, Globigerinelloides prairiehillensis, G. multispinata, G. volutus* and *Hedbergella holmdelensis*. The upper boundary of this interval is marked by the L.O. of *Archaeoglobigerina cretacea* (top *G. havanensis* Zone of Caron, 1985).

5.3.2 Foraminiferal Assemblages

The proposed assemblage zones are mainly local and based solely on the foraminiferal fauna recorded from this sequence (Enclosure 2). They may be differentiated from bottom to top as:

5.3.2.1 Lower to mid-Cenomanian

***Haplophragmoides* spp. Zone** (samples M5 - 11)

This zone is characterised by a presence of the following benthic species in the four studied sections: *Adelungia marginulinaeformis, Adelungia* sp. 1, *Ammobaculites agglutinans, A. naqbensis, A.* sp. 1, *A.* sp. 2, *Eoguttulina anglica, Flabellammina elongata, Gabonita levis aegyptiaca, Globulina* sp. 1, *Guttulina adherens, G.*

cuspidata, Haplophragmoides excavatus, H. formosus, H. kirki, Hensonina lenticularis, Lenticulina spachholtzi, Ophthalmidium minimum, Polymorphina zeuschneri, Praebulimina reussi navarroensis, Pseudolituonella mariea, Pseudopolymorphina eichenbergi, P. sp. 1, *Spiroloculina cretacea, Thomasinella fragmentaria, T. punica, Trochammina boehmi* and *Uvigerinammina jankoi.*

In addition to the above, the following planktonic species are also found in this interval, but may range into the overlying beds: *Blowiella blowi, Globigerinelloides bentonensis, G. ultramicra, Guembelitria cenomana, Hedbergella delrioensis, Heterohelix* sp. 1 and *Whiteinella brittonensis.*

Similarly longer ranging benthic species include: *Ammobaculites agglutinans, A. euides, A. fragmentarius, A. naqbensis, A. obliquus, A. stephensoni, A. subcretaceus, A. turonicus, Ammomarginulina cragini, A. naqbensis, Ammotium aegyptica, A. oertlii, Ammovertillina* sp. 1, *Bulimina exigua robusta, Cassidella tegulata, Charentia cuvillieri, C. hasaensis, C. rummanensis, Coryphostoma neumannae, Cyclammina haydeni, Dentalinoides canulina, Eponides* cf. *plummerae, sibericus, E. whitei, Gabonita levis, G. levis aegyptiaca, Gavelinella baltica, G. semipustulosa, Guttulina symploca, Gyroidinoides nitida, Haplophragmoides calculus, H. fraseri, H. kirki, H. rugosa, Hemicyclammina sigali, Kutsevella labythnangensis, Laevidentalina* sp., *Lenticulina gaultina, L. rotulata, Lingulogavelinella turonica, Marssonella oxycona, Mayncina orbignyi, Neobulimina irregularis, Praeammoastuta* sp. 1, *Praebulimina prolixa, P. prolixa longa, reussi navarroensis, Pseudotextulariella cretosa, P.* sp. 1, *Psilocitharella leptoteicha, Pyramidina rudita, Quinqueloculina globigerinaeformis, Scherochorella minuta, Sculptobaculites loshkharvicus, Serovaina turonicus, Textularia depressa, Thomasinella aegyptia, T. punica, Trochammina afikpensis* and *Vernonina* sp.

***Conorboides umiatensis / Planispirinella barnardia* Zone** (samples M12-23)

These index species are associated with the following benthics: *Aaptotoichus clavellatus, Ammoastuta nigeriana, Ammobaculites stephensoni, Anomalinoides pinguis, Biplanata peneropliformis, Choffatella decipiens, Conorbina conica, Conorboides hofkeri, C.* sp. 1, *C. umiatensis, Coryphostoma neumannae, Ellipsoglandulina laevigata, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Flabellammina negevensis, Gabonita levis aegyptiaca, Gavelinella awunensis, G. cenomanica, G. intermedia, Haplophragmoides calculus, Hemicyclammina whitei, Hensonina* sp. 1, *Lagena acuticosta, Lenticulina spissocostata, Lingulogavelinella tormarpensis, Marssonella kummi, M. oxycona, Neobulimina canadensis, Nezzazata conica, N. gyra, N. simplex, Orbitolina sefini, Planispirinella barnardia, Plectinella aegyptiaca, Polychasmina pawpawensis, Praebulimina* cf. *arabica, P. prolixa, P. prolixa longa, Psammonyx* sp. 1, *Quasispiroplectammina nuda, Reissella ramonensis, Sculptobaculites goodlandensis, Stensioeina pokornyi, Triplasia bonnefousi, T. goodlandensis, T. murchisoni, Trochammina rummanensis* and *Vernonina* sp.

In addition to the above, the following planktonic species are also found in this interval, but may range into the overlying beds: *Blowiella blowi, Costellagerina* *bulbosa, Globigerinelloides bentonensis, G. eaglefordensis, Hedbergella simplex, H. trocoidea, Heterohelix globulosa, H. moremani* and *Pseudotextularia plummerae.*

Longer ranging benthic species include: *Ammobaculites albertensis, A. difformis, A. naqbensis, Anomalinoides pinguis, Arenobulimina advena, A. chapmani, Clavulinopsis gaultina, Conorboides hofkeri, C.* sp. 1, *C. umiatensis, Daxia cenomana, Dentalina hammensis, Donsissonia* sp., *Eponides sigali, Evolutinella* sp. 1, *Fissurina laevigata, F. oblonga, Gabonita sumaya, Gavelinella intermedia, G. nacatochensis, Gavelinopsis proelevata, Ismailia aegyptica, I. neumannae, Lagena hexagona, L. paucicosta, Lenticulina californiensis, L.* sp. 1, *Lingulogavelinella globulosa, L. tormarpensis, Neobulimina canadensis, Placopsilina cenomana, Poroeponides praeceps, Praebulimina* cf. *arabica, Pravoslavlevia pravoslavlevi, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Quadrimorphina camerata, Serovaina orbicella, Sestronophora* sp., *Trochamminoides parva* and *Valvulineria loetterlei.*

Blowiella blowi is the only planktonic species disappearing within this interval, while the benthic species disappearing include: *Ammobaculites agglutinans, Ammotium aegyptica, Cassidella tegulata, Charentia cuvillieri, Gavelinella semipustulosa, Guttulina symploca, Kutsevella labythnangensis, Lenticulina gaultina, Mayncina orbignyi, Praeammoastuta* sp. 1, *Pseudotextulariella cretosa, Psilocitharella leptoteicha, Quinqueloculina globigerinaeformis, Textularia depressa* and *Trochammina afikpensis.*

***Mayncina hasaensis* Zone** (samples M24 - 32)

This zone is characterised by a diverse and abundant fauna, including: *Ammobaculites mastersi, Charentia hasaensis, C. rummanensis, C.* sp. 1, *Fursenkoina squammosa, Hemicyclammina* sp. 1, *Hormosina* cf. *velascoensis, Mayncina hasaensis, Merlingina cretacea, Nodosaria naumanni, Praebulimina* cf. *bantu lata, P. venusae, Pseudotextulariella* sp. 1 and *Tristix poignanti*, associated with alveolinids.

In addition to the above, the planktonic species *Whiteinella aprica* is found in this interval, but ranges into the overlying beds. Longer ranging benthic species include: *Ammomarginulina barthouxi, Arenobulimina d'orbignyi, Haplophragmoides neolinki, Oolina globulosa,* and *Planispirinella barnardia*, associated with the radiolarian *?Praeoconocaryomma universa.*

The following benthic species disappear within this interval: *Ammobaculites albertensis, A. difformis, A. euides, A. stephensoni, Ammomarginulina naqbensis, Ammotium oertlii, Ammovertillina* sp. 1, *Arenobulimina advena, Daxia cenomana, Globigerinelloides eaglefordensis, Haplophragmoides calculus, Hemicyclammina sigali, Ismailia aegyptica, I. neumannae, Lenticulina* sp. 1, *Lingulogavelinella globulosa, L. turonica, Scherochorella minuta, Sestronophora* sp., *Thomasinella aegyptia, Trochamminoides parva* and *Vernonina* sp.

5.3.2.2 Upper Cenomanian

***Heterohelix calabarflanki / Whiteinella inornata* Zone** (samples M33-46, 57-61)

This zone is characterised by a diverse and abundant fauna, including the planktonics: *Heterohelix punctulata, Pseudoplanoglobulina nakhitschevanica, Whiteinella baltica* and *W. inornata*. Benthic taxa include: *Dicyclina schlumbergeri, Gabonita obesa, Globospirillina condensa, Gyroidinoides* sp., *Neobulimina canadensis alpha* and *Nonionella austinana*.

In addition to the above, the following planktonic species are also found in this interval, but may range into the overlying beds: *Heterohelix calabarflanki, H. striata compressa* and *Whiteinella inornata*. Benthic taxa include: *Ammoastuta nigeriana, Ammobaculites advenus, A. pagodensis, Ammomarginulina aburoashensis, A. blanckenhorni, A.* sp. 1, *Ammomassilina* sp., *Ammotium hasaense, Astacolus liebusi, A.* sp. 1, *Bulbobaculites problematicus, Bulbophragmium aequale, Bulimina kirri, Cuneolina pavonia parva, Evolutinella subevoluta, Flabellammina kaskapauensis, F.* sp. 1, *F.* sp. 2, *Hormosina excelsa, Lituola nautiloidea, Massilina ginginensis, Neodiscorbinella* sp. 1, *Praebulimina carseyae, Pseudotextularia dubia, Pyramidina triangularis, Quinqueloculina antiqua angusta, Reophax constrictus, R. parvulus, Scherochorella* sp., *Serovaina minutus, S. struvei* and *Simplorbitolina* sp., associated with miliolids.

The planktonic species disappearing within this interval include: *Hedbergella trocoidea, Heterohelix moremani* and *Whiteinella brittonensis*. Benthic taxa disappearing include: *Ammobaculites fragmentarius, A. naqbensis, A. obliquus, A. subcretaceus, A. turonicus, Ammomarginulina aburoashensis, A. barthouxi, A. cragini, Arenobulimina chapmani, A. d'orbignyi, Bulimina exigua robusta, Clavulinopsis gaultina, Conorboides hofkeri, C. beadnelli, C. umiatensis, Coryphostoma neumannae, Cyclammina haydeni, Eoheterohelix* sp., *Evolutinella* sp. 1, *Gabonita levis aegyptiaca, G. sumaya, Gavelinella baltica, G. intermedia, Guembelitria cenomana, Haplophragmoides fraseri, H. kirki, H. neolinki, H. rugosa, Hemicyclammina evoluta, Lagena hexagona, Lingulogavelinella tormarpensis, Neobulimina irregularis, Nezzazata convexa, Placopsilina cenomana, Planispirinella barnardia, Praebulimina* cf. *arabica, P. prolixa, P. prolixa longa, P. reussi navarroensis, Pravoslavlevia pravoslavlevi, Pristinosceptrella* sp., *Psammonyx* sp., *Pyramidina rudita, Quadrimorphina camerata, Sculptobaculites loshkharvicus, Serovaina orbicella* and *Thomasinella punica.*

5.3.2.3 Turonian

***Whiteinella archaeocretacea / Gavelinella stephensoni* Zone** (samples M62-69)

This zone is characterised by a presence of benthic species: *Flabellammina alexanderi, Gavelinella umbilicata, Nezzazata concava, Serovaina pseudoscopus* and *S. simplex*.

In addition to the above, the following foraminiferal species are also found in this interval, but may range into the overlying beds: *Whiteinella archaeocretacea, Gavelinella stephensoni, Gavelinopsis abudurbensis* and *G. tourainensis*.

The following benthic species disappear within this interval: *Ammobaculites advenus, Conorboides* sp. 2, *Donsissonia* sp., *Gavelinella nacatochensis, Reissella ramonensis,* *Serovaina minutus, S. struvei, S. turonicus, Trochospira avnimelichi* and *Valvulinoides umovi.*

5.3.2.3 Upper Coniacian - Santonian

***Archaeoglobigerina blowi / Concavatotruncana concavata* Zone**
(samples M47, 70-74)

This zone is characterised by a presence of the following planktonics: *Anaticinella multiloculata, Concavatotruncana asymetrica, C. imbricata, Globigerinelloides caseyi, Globotruncana linneiana, Hedbergella flandrini, H. hoelzli, Heterohelix pseudotessera, H. reussi, Marginotruncana paraconcavata, M. pseudolinneina, M. renzi, Pseudotextularia nuttalli, Sigalitruncana pileoliformis* and *Whiteinella archaeocretacea.*

Benthic taxa include: *Bolivinopsis clotho, Brizalina lowmani, Cibicides beadnelli, Dorothia pontoni, Eoheterohelix* sp., *Frondicularia clarki, Gabonita distorta, Gavelinella farafraensis, G. involuta, G. pertusa, G. sandidgei, Hiltermannella* cf. *kochi, Hopkinsinella* sp., *Loxostomoides cushmani, Praebulimina aspera, P. reussi, Quasispiroplectammina navarroana, Pseudotextularia nuttalli, Sigalitruncana pileoliformis, Textularia subconica, Vaginulina cretacea, V. recta* and *V. trilobata.*

In addition to the above, the following planktonic species are also found in this interval, but may range into the overlying beds: *Archaeoglobigerina blowi, Concavatotruncana concavata, Contusotruncana fornicata, Globigerinelloides alvarezi, G. prairiehillensis, Globotruncana orientalis, G. rugosa, Hedbergella holmdelensis, H. monmouthensis, Heterohelix dentata, H. globocarinata, H. nkporoensis, Marginotruncana marginata* and *Planoglobulina brazoensis.*

Benthic taxa ranging upwards include: *Ammodiscoides turbinatus, Cassidella navarroana, Elhasaella alanwoodi, Frondicularia lanceolata, Gavelinella burlingtonensis, G. cristata, G. lorneina, G. whitei, Hopkinsina arabina, Lenticulina modesta, Mucronina* sp., *Neoflabellina kypholateris, N. suturalis, Nonionella cretacea tamilensis, N. robusta, Plectina ruthenica, Pyramidulina distans, Vaginulina plummerae* and *Valvalabamina lenticula.*

The following planktonic species disappear within this interval: *Globigerinelloides bentonensis, Hedbergella delrioensis, H. simplex, Heterohelix calabarflanki, Pseudotextularia plummerae, Whiteinella aprica, W. baltica* and *W. inornata.* Benthics disappearing also include: *Anomalinoides pinguis, Gavelinopsis proelevata, Lenticulina rotulata, Neobulimina canadensis, Poroeponides praeceps* and *Quasispiroplectammina nuda.*

5.3.2.4 Upper Campanian

***Rugotruncana subcircumnodifer* Zone** (samples M75-92)

This zone is characterised by a presence of the following planktonic species: *Archaeoglobigerina cretacea, Contusotruncana patelliformis, C. plummerae,* *Globigerinelloides bollii, Globotruncana arca, G. bulloides, G. mariei, G. rosetta, Globotruncanella havanensis, Globotruncanita elevata, G. stuartiformis, G. subspinosa, Gublerina ornatissima, G. robusta, Heterohelix glabrans, Marginotruncana coronata, M. sinuosa, Rugoglobigerina jordani, R. pilula, R. rugosa, Rugotruncana subcircumnodifer.*

Benthic taxa include: *Ammodiscus cretaceus, Arenobulimina amanda, Bolivina decurrens, B. incrassata, Citharina suturalis, Dentalina marcki, D.* sp. 1, *Gabonita billmani, G. bipyramidata, G. multituberculata, G. parva, G. tiarella, G. zigzaga, Gaudryina rugosa, Gyroidinoides muwaqqarensis, Kyphopyxa christneri, Laevidentalina aphelis, L. catenula, L. gracilis, L. longiscata, L. vistulae, Lenticulina carlsbadensis, L. mellahensis, L. muensteri, L. taylorensis, Neoflabellina leptodisca, N.* sp. 1, *Nodogerina bradyi, Nodomorphina* sp. 1, *Nodosaria limbata, Praebulimina angulata, P. trihedra, Pyramidulina latejugata, P. proboscidea, P. raphinistrum, P. septemcostata, P. zippei, Tristix coloi, Vaginulinopsis directa* and *Valvulinoides umovi.*

In addition to the above, the following planktonic species are also found in this interval, but may range into the overlying beds: *Globigerinelloides messinae, G. volutus, Heterohelix vistulaensis, Planoglobulina multicamerata* and *Ventilabrella glabrata.*

The following planktonic species disappear within this interval: *Archaeoglobigerina blowi, Concavatotruncana concavata, Contusotruncana fornicata, Costellagerina bulbosa, Globotruncana orientalis, G. rugosa, Hedbergella monmouthensis, Heterohelix dentata, H. nkporoensis, H.* sp. 1, *Marginotruncana marginata* and *Planoglobulina brazoensis.*

Benthics disappearing also include: *Cassidella navarroana, Dentalina hammensis, Dentalinoides canulina, Elhasaella alanwoodi, Eponides* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Fissurina laevigata, Frondicularia lanceolata, Gabonita levis, Gavelinella burlingtonensis, G. lorneina, G. stephensoni, Gavelinopsis abudurbensis, G. tourainensis, Hopkinsina arabina, Laevidentalina* sp., *Lagena paucicosta, Lenticulina californiensis, Marssonella oxycona, M. trochus, Mucronina* sp., *Neoflabellina kypholateris, N. suturalis, Nonionella cretacea tamilensis, Plectina ruthenica, Praebulimina carseyae, Pseudotextulariella* sp. 1, *Pyramidina triangularis, Pyramidulina distans, Vaginulina plummerae* and *Valvulineria loetterlei* (Enclosure 2).

5.3.2.5 Lower Maastrichtian

***Globotruncanella havanensis* Zone** (samples M93 - 97)

This zone is characterised by the presence of *Globotruncanella havanensis, Ceratobulimina cretacea* and *Fissurina alveolata. Stensioeina exsculpta* is also found in this interval and ranges into the overlying zones. *Globigerinelloides prairiehillensis, Fissurina oblonga, Lenticulina modesta* and *Oolina globulosa* disappear within this interval.

***Protelphidium martinii / P. hofkeri* Zone** (samples M98 - 110)

This zone is characterised by a diverse abundant fauna including: *Globigerinelloides multispinata, Planoglabratella* sp., *Ceratolamarckina parva, Cribroelphidium vulgare, Dictyopselloides cuvillieri, Fissoelphidium operculiferum, Fissurina alveolata, Gavelinella* cf. *sibiricus, Protelphidium hofkeri, P. martinii, Stensioeina exsculpta, S. exsculpta gracilis* and *Valvulineria correcta.*

The following planktonic species disappear within this interval: *Globigerinelloides alvarezi, G. messinae, G. ultramicra, G. volutus, Hedbergella holmdelensis, Heterohelix globocarinata, H. globulosa, H. striata compressa, H. vistulaensis, Planoglobulina multicamerata,* and *Ventilabrella glabrata.*

Benthics disappearing also include: *Ammodiscoides turbinatus, Bulimina kirri, Gavelinella cristata, G. whitei, Gyroidinoides nitida, Neodiscorbinella* sp. 1, *Nonionella robusta, Oolina globulosa* and *Valvalabamina lenticula* (Enclosure 2).

5.4 Wadi Mussa

5.4.1 Stage boundaries

The lithological and micropalaeontological analyses of the Wadi Mussa section (Enclosures 3) suggest the following possible time subdivisions.

5.4.1.1 Lower to mid-Cenomanian

Samples from lithostratigraphic unit A1-A3 (P1 - 42) are assigned to the Lower to mid-Cenomanian. Characteristic species encountered are:

Globigerinelloides bentonensis, Adelungia sp. 1, *Ammobaculites agglutinans, A. difformis, A. naqbensis, A. stephensoni, Ammodiscoides turbinatus, Arenobulimina chapmani, Astacolus liebusi, Bolivinopsis clotho, Cassidella tegulata, Conorboides beadnelli, C. mitra, C. hofkeri, C. umiatensis, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, Gavelinella baltica, Gavelinopsis tourainensis, Haplophragmoides excavatus, H. formosus, H. fraseri, H. kirki, Lingulogavelinella tormarpensis, Marssonella oxycona, Massilina ginginensis, Neodiscorbinella* sp. 1, *Placopsilina cenomana, Planispirinella barnardia, Plectina ruthenica, Praebulimina prolixa longa, P. reussi navarroensis, Pyramidina triangularis, Quadrimorphina camerata, Quasispiroplectammina navarroana, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Q. triangulata, Sculptobaculites goodlandensis, Serovaina minutus, S. simplex, S. struvei, S. turonicus, Sestronophora* sp., *Spiroloculina cretacea, Trochammina afikpensis, T. boehmi, T. rummanensis* and *Valvulineria camerata,* associated with the radiolarian *Follicucullus* cf. *scholasticus,* and both smooth and ornamented ostracods.

Macrofossils include: bivalves, high-spired gastropods (*Cirithium*), echinoid (*Cyphosoma*), algal clasts, worm-tubes and vertebrate fragments.

Most of the above benthic foraminiferal species are found commonly in the Lower to mid-Cenomanian of Jordan and other areas (Hamaoui, 1979a, b; Basha, 1975), including: *Ammobaculites naqbensis, A. stephensoni, Arenobulimina chapmani, Conorboides mitra, C. hofkeri, C. umiatensis, Haplophragmoides excavatus, Placopsilina cenomana, Planispirinella barnardia* and *Sculptobaculites goodlandensis*), but some may extend into the Upper Cenomanian or even younger beds (e.g. *Globigerinelloides bentonensis, Ammobaculites difformis, Conorboides beadnelli, Gabonita levis, G. levis aegyptiaca, Gavelinella baltica, Gavelinopsis tourainensis, Haplophragmoides formosus, H. fraseri, Lingulogavelinella tormarpensis, Marssonella oxycona, Quinqueloculina antiqua angusta, Serovaina minutus, S. struvei, S. turonicus* and *Trochammina* spp.). It is suggested that this interval is best delimited by the F.O. of *Haplophragmoides excavatus, H. formosus, H. kirki,* associated with *Ammobaculites* spp. and *Conorboides* spp.

5.4.1.2 Upper Cenomanian to Turonian

Samples from lithostratigraphic units A5 & A6 (P43 - 52) are tentatively assigned to the Upper Cenomanian - Turonian. This interval is mainly composed of dolomitic and sandy limestone and some marls, chert nodules and dolomitic claystone, devoid of any foraminiferal fauna, but associated with vertebrate fragments in the upper part of this interval.

5.4.1.3 Upper Coniacian - Santonian

Samples from lithostratigraphic unit B1 (P53 - 56) are assigned to the Upper Coniacian - Santonian. Characteristic species encountered are the following benthics: *Ammotium aegyptica, Astacolus liebusi, A.* sp. 1, *Biconcava bentori, Biplanata peneropliformis, Cribroelphidium vulgare, Gabonita levis, Gavelinella baltica, G. stephensoni, Gavelinopsis proelevata, G. tourainensis, Haplophragmoides kirki, Massilina ginginensis, Nezzazatinella adhami, Plectina ruthenica, Quinqueloculina laevigata, Serovaina pseudoscopus, S.* sp. 1, *S. turonicus, Sestronophora* sp. and *Trochospira avnimelichi*, associated with smooth and ornamented ostracods. Macrofossils include: molluscs, echinoids and vertebrate fragments.

Most of the benthic species listed above are found commonly in the Turonian or younger sediments in many localities of the Middle East and Europe, including *Gabonita levis, Gavelinopsis tourainensis* and *Plectina ruthenica* (Cherif et al., 1989a; Hart et al., 1989; King et al., 1989). *Astacolus liebusi* and *Haplophragmoides kirki* were recorded from the Santonian and younger ages in California and British Colombia (Sliter, 1968, 1973), and *Gavelinella stephensoni* was recorded from the Coniacian to Maastrichtian of Jordan (Al-Bakri, 1990). *Serovaina turonicus* was reported in sediments not younger than Santonian of Jordan and Egypt (Koch, 1968; Basha, 1975, 1979; Al-Bakri, 1990; Said & Kenawy 1957, 1969; Andrawis, 1976).

At Wadi Mussa, in view of the absence of planktonic species, it is suggested that the upper Coniacian to Santonian is best delimited by the first appearance of *Gavelinopsis proelevata* and *Gavelinella stephensoni* (top *C. primitiva* Zone of Caron, 1985), associated with *Gabonita levis* and *Gavelinella* spp. The upper boundary of this interval is marked by the disappearance of *Serovaina turonicus* (top *C. asymetrica* Zone of Caron, 1985).

5.4.1.4 Campanian

Samples from the lower part of the lithostratigraphic unit B2 (P57 - 59) are mainly composed of dolomitic limestone and silicified phosphates. The only fauna encountered comprises of ostracods, oysters and vertebrate fragments. In view of the absence of any foraminiferal evidence, and as this interval lies between the underlying Santonian *Gavelinopsis proelevata* Zone and the overlying *Arenobulimina amanda* Zone of Lower Maastrichtian, it is suggested that this undifferentiated interval be assigned to the Campanian.

5.4.1.5 Lower Maastrichtian

Samples from the upper part of the lithostratigraphic unit B2 (P60 - 62) are assigned to the Lower Maastrichtian. Characteristic planktonic species encountered in this interval are: *Guembelitria cenomana* and *Heterohelix nkporoensis*. Benthic taxa include: *Ammodiscoides turbinatus, Arenobulimina amanda, Bolivina decurrens, B. incrassata, Brizalina lowmani, Bulimina exigua robusta, Cassidella navarroana, C. tegulata, Coryphostoma neumannae, Dorothia pontoni, Gabonita levis, Gaudryina rugosa, Laevidentalina vistulae, Neobulimina canadensis, N. canadensis alpha, Nonionella cretacea tamilensis, N. robusta, Planispirinella* sp. 1, *Plectina ruthenica, Praebulimina angulata, P. aspera, P. bantu, P. carseyae, P.* cf. *arabica, P.* cf. *bantu lata, P. reussi, P. trihedra, Pyramidina rudita* and *Quasispiroplectammina navarroana.* Moreover, this interval yields the radiolarian species: *Acaeniotyle starka, Amphibracchium* sp. 1, *Amphipyndax pseudoconulus, A. stocki, A. tylotus, Archaeodictyomitra lamellicostata* and *Pseudoaulophacus lenticulatus.* These are associated with ostracods and vertebrate fragments.

Heterohelix nkporoensis, Arenobulimina amanda, Bolivina decurrens, B. incrassata, Brizalina lowmani, Dorothia pontoni, Laevidentalina vistulae, Praebulimina aspera, P. carseyae and the radiolarian spp. are found commonly in the early Campanian or younger sediments in many localities of the world (Atlas, 1984; Caron, 1985; Reiss, 1985; Al-Harithi, 1986; Loeblich & Tappan, 1988; Cherif, 1989). *Cassidella navarroana, Gaudryina rugosa* and *Nonionella robusta* are commonly found in the Maastrichtian of Texas, Egypt and Jordan (Cushman, 1946; Said & Kenawy; Futyan, 1968). *Nonionella cretacea tamilensis* and *Praebulimina arabica* are also found commonly in the Lower Maastrichtian of India and Jordan (Tewari & Srivastava, 1968; Koch, 1968). The radiolarian species *Pseudoaulophacus lenticulatus* and *Amphipyndax pseudoconulus* are restricted to the *A. pseudoconulus* Zone of Campanian, but the radiolarian species *A. tylotus* and *Archaeodictyomitra lamellicostata* range from the Campanian through Maastrichtian (Vishnevskaya, 1986).

It is suggested that the Lower Maastrichtian is best delimited at Wadi Mussa by the F.O. of *Arenobulimina amanda* and radiolarian spp. (base *G. havanensis* Zone of Caron, 1985), associated with *Heterohelix nkporoensis, Bolivina incrassata, Laevidentalina vistulae* and *Praebulimina* spp. The upper boundary of this interval is marked by the L.O. of various radiolarian spp., *Nonionella cretacea tamilensis* and *Praebulimina arabica* (top *G. aegyptiaca* Zone of Caron, 1985).

5.4.2 Foraminiferal Assemblages

The proposed assemblage zones are mainly local and based solely on the encontered foraminiferal fauna recorded from this sequence (Enclosure 3). They may be differentiated from bottom to top as:

5.4.2.1 Lower to mid-Cenomanian

***Haplophragmoides* spp. Zone** (samples P1 - 7)

This interval is characterised by a diverse and abundant fauna, including: *Globigerinelloides bentonensis, Ammobaculites difformis, A. naqbensis, Arenobulimina chapmani, Gabonita levis aegyptiaca, Haplophragmoides excavatus, H. formosus, Praebulimina reussi navarroensis, Quadrimorphina camerata, Spiroloculina cretacea, Trochammina boehmi* and *T. Rummanensis.*

In addition to the above, the following benthic species are also found in this interval, but may range into the overlying beds: *Astacolus liebusi, Bolivinopsis clotho, Cassidella tegulata, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita levis, Gavelinopsis tourainensis, Haplophragmoides excavatus, H. kirki, Plectina ruthenica, Praebulimina prolixa longa, Quasispiroplectammina navarroana, Quinqueloculina antiqua angusta, Q. laevigata, Sestronophora* sp., *Spiroloculina cretacea, Trochammina afikpensis* and *Valvulineria camerata.*

***Conorboides umiatensis / Planispirinella barnardia* Zone** (samples P8 - 30)

These index species are associated with the benthic species: *Adelungia* sp. 1, *Ammobaculites stephensoni, Conorboides hofkeri, C. umiatensis, Lingulogavelinella tormarpensis, Marssonella oxycona, Neodiscorbinella* sp. 1, *Planispirinella barnardia, Quinqueloculina triangulata, Sculptobaculites goodlandensis, Serovaina simplex* and *S. Struvei.*

In addition to the above, the following benthic species are also found in this interval, but may range into the overlying beds: *Ammobaculites agglutinans, Ammodiscoides turbinatus, Gavelinella baltica, Massilina ginginensis* and *Serovaina turonicus.*

The following benthic species disappear within this interval: *Bolivinopsis clotho, Evolutinella subevoluta, Haplophragmoides excavatus, Spiroloculina cretacea* and *Valvulineria camerata.*

***Conorboides* spp. Zone** (samples P31 - 42)

This zone is characterised by the presence of *Conorboides beadnelli* and *C. mitra,* which may range into younger beds, while *Ammobaculites agglutinans, Fursenkoina squammosa* and *Quinqueloculina antiqua angusta* disappear within this interval.

Barren Horizon (samples P43 - 52)

This horizon is composed of dolomitic sandy limestone and some marls, devoid of fauna, except some vertebrate fragments.

5.4.2.2 Upper Coniacian - Santonian

***Gavelinopsis proelevata / Gavelinella stephensoni* Zone** (samples P53 - 56)

This zone is characterised by a presence of the following benthics: *Ammotium aegyptica, Astacolus* sp. 1, *Biconcava bentori, Biplanata peneropliformis, Cribroelphidium vulgare, Gavelinella stephensoni, Gavelinopsis proelevata, Nezzazatinella adhami, Serovaina pseudoscopus, S.* sp. 1 and *Trochospira avnimelichi* (Enclosure 3).

The following benthic species disappear within this interval: *Astacolus liebusi, Conorboides beadnelli, C. mitra, Gavelinella baltica, Gavelinopsis tourainensis, Haplophragmoides kirki, Massilina ginginensis, Quinqueloculina laevigata, Serovaina turonicus* and *Sestronophora* sp.

Barren Horizon (samples P57 - 59)

This horizon is composed of dolomitic limestone and silicified phosphates, associated with ostracods, oysters and vertebrate fragments.

5.4.2.3 Lower Maastrichtian

***Arenobulimina amanda* Zone** (samples P60 - 62)

This zone is characterised by a presence of the planktonic species *Guembelitria cenomana* and *Heterohelix nkporoensis.* Benthic taxa include: *Arenobulimina amanda, Bolivina decurrens, B. incrassata, Brizalina lowmani, Bulimina exigua robusta, Cassidella navarroana, Coryphostoma neumannae, Dentalinoides canulina, Dorothia pontoni, Gaudryina rugosa, Laevidentalina vistulae, Neobulimina canadensis, N. canadensis alpha, Nonionella cretacea tamilensis, N. robusta, Planispirinella* sp. 1, *Praebulimina angulata, P. aspera, P. bantu, P.* cf. *bantu lata, P. carseyae, P.* cf. *arabica, P. reussi, P. trihedra* and *Pyramidina rudita.*

Benthic species disappearing within this interval include: *Ammodiscoides turbinatus, Cassidella tegulata, Gabonita levis, Plectina ruthenica, Praebulimina prolixa longa* and *Quasispiroplectammina navarroana.*

In addition to the above foraminiferal species recorded in Wadi Mussa (Enclosure 3), this zone yields the radiolarian species: *Acaeniotyle starka, Amphibracchium* sp. 1, *Amphipyndax pseudoconulus, A. stocki, A. tylotus, Archaeodictyomitra lamellicostata, Pseudoaulophacus lenticulatus* and *Pseudodictyomitra* sp.

5.5 Ras en-Naqb

5.5.1 Stage boundaries

The lithological and micropalaeontological analyses of the Wadi Mussa section (Enclosures 4) suggest the following stage boundaries.

5.5.1.1 Lower to mid-Cenomanian

Samples from lithostratigraphic units A1-A3 (Q3 - 25) are assigned to the lower to mid-Cenomanian. Characteristic planktonic species encountered are: *Favusella washitensis, Guembelitria cenomana* and *Ventilabrella glabrata.*

Benthic taxa include: *Adelungia* sp. 1, *Ammoastuta nigeriana, Ammobaculites advenus, A. agglutinans, A. albertensis, A. difformis, A. euides, A. fragmentarius, A. naqbensis, A. obliquus, A. stephensoni, A. subcretaceus, A. turonicus, Ammodiscoides turbinatus, Ammomarginulina aburoashensis, A. barthouxi, A. blanckenhorni, A. cragini, A. naqbensis, Ammosiphonia* sp., *Ammotium aegyptica, A. hasaense, Arenobulimina chapmani, A. d'orbignyi, Astacolus liebusi, Biconcava bentori, Biplanata peneropliformis, Cassidella tegulata, Charentia cuvillieri, C. evoluta, C. hasaensis, C. rummanensis, Cibicides beadnelli, Conorboides beadnelli, C. hofkeri, C. mitra, C. umiatensis, Cyclammina haydeni, Coryphostoma neumannae, Cribroelphidium* sp. 1, *Cyclammina haydeni, Daxia cenomana, Dorothia pontoni, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita billmani, G. levis, G. levis aegyptiaca, G. obesa, G. parva, Gaudryina rugosa, Gavelinella baltica, G. intermedia, G. semipustulosa, Globospirillina condensa, Haplophragmoides calculus, H. excavatus, H. formosus, H. fraseri, H. kirki, H. neolinki, H. rugosa, H. umbilicata, Hemicyclammina evoluta, H. sigali, H. whitei, Hiltermannella* cf. *kochi, Ismailia aegyptica, I. neumannae, Laevidentalina gracilis, Lingulogavelinella tormarpensis, Mayncina orbignyi, Merlingina cretacea, Neobulimina canadensis, N. canadensis alpha, N. irregularis, Neodiscorbinella* sp. 1, *Nezzazata concava, N. conica, N. convexa, N. gyra, N. simplex, Nezzazatinella adhami, Placopsilina cenomana, Planispirinella barnardia, Plectina ruthenica, Poroeponides praeceps, Praebulimina* cf. *arabica, P.* cf. *bantu lata, P. carseyae, P. prolixa, P. prolixa longa, P. reussi navarroensis, P. venusae, Psammonyx* sp. 1, *Pseudolituonella mariea, Pyramidina rudita, Quasispiroplectammina navarroana, Q. nuda, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Reissella ramonensis, Reophax* cf. *nodulosus, R. constrictus, Serovaina pseudoscopus, S. struvei, Sestronophora* sp., *Textularia depressa, Thomasinella aegyptia, T. fragmentaria, T. punica, Trochammina afikpensis, T. boehmi, Trochamminoides parva, Uvigerinammina jankoi, Vernonina* sp. and *Zotheculifida* sp. These are associated with the radiolarian species ?*Praeoconocaryomma universa,* smooth ostracods, oysters, gastropods, echinoids (*Cyphosoma*) and vertebrate fragments.

Most of the above foraminiferal species are commonly found in the Lower to mid-Cenomanian of the western Hemisphere, Europe, North Africa and eastern Mediterranean (Hamaoui, 1979a, b; Basha, 1975) and elsewhere (e.g. *Favusella washitensis, Hemicyclammina evoluta, H. sigali, Gavelinella semipustulosa,* *Mayncina orbignyi* and *Ismailia neumannae*), but other species may extend into the Upper Cenomanian (such as *Ammobaculites difformis, Charentia cuvillieri* and *Thomasinella punica*). It is suggested that this interval is best delimited in Ras en-Naqb by the F.O. of *Haplophragmoides excavatus, H. formosus* and *H. kirki*, associated with *Favusella washitensis, H. sigali, Gavelinella semipustulosa, Ismailia neumannae* and *Mayncina orbignyi.*

5.5.1.2 Upper Cenomanian

Samples from units A5 & A6 (Q26 - 31) are mainly composed of sandy and dolomitised constituents and characterised by the lack of any foraminiferal fauna. As this interval is confined between the underlying lower to mid-Cenomanian and the overlying Turonian intervals, it is suggested to be assigned to the upper Cenomanian.

5.5.1.3 Turonian

Samples from lithostratigraphic unit A7 (Q30 - 39) are dated as Turonian. Characteristic foraminiferal species encountered are: *Concavatotruncana algeriana, Ammomassilina* sp., *Eponides* cf. *plummerae, Gavelinella baltica, Massilina ginginensis, Nezzazata convexa, Poroeponides praeceps, Quadrimorphina camerata, Quinqueloculina globigerinaeformis, Q. laevigata, Q. triangulata, Serovaina pseudoscopus, Thomasinella aegyptia, T. fragmentaria Valvulineria camerata* and *V. loetterlei*, associated with the radiolarian species *Follicucullus* cf. *Scholasticus* and ornamented ostracods. Macrofossils include: bivalves, gastropods, echinoids (*Cyphosoma*), algal clasts and vertebrate fragments.

Some of the above foraminiferal species range from Upper Cenomanian to Middle Turonian of the Eastern Mediterranean (Eicher & Worstell, 1970; Basha, 1975, 1978; Harithi, 1986) and elsewhere (such as *Gavelinella baltica, Poroeponides praeceps, Nezzazata convexa, Thomasinella* spp. and *Valvulineria loetterlei*). *Concavatotruncana algeriana* is an index foraminiferal species for the Middle Turonian (*H. helvetica* Zone of Caron, 1985), *Quadrimorphina camerata* is also recorded from the same age in Egypt (Cherif et al., 1989a), while *Quinqueloculina globigerinaeformis* and *Valvulineria camerata* are recorded from the Turonian and younger sediments of SW Atlantic and Poland (Basov et al., 1983; Malata & Oszczypko, 1990).

At Ras en-Naqb it is suggested that the Turonian is best delimited by the first appearance of *Concavatotruncana algeriana* (base *W. arhaeocretacea* Zone of Caron, 1985), associated with *Gavelinella baltica, Nezzazata convexa, Poroeponides praeceps, Valvulineria camerata, Quinqueloculina globigerinaeformis* and *Quadrimorphina camerata*. The upper boundary of this interval is marked by the disappearance of *Concavatotruncana algeriana* (top *H. helvetica* Zone of Caron, 1985).

5.5.1.4 Upper Coniacian - Santonian

Samples from lithostratigraphic unit B1 (Q40 - 44) are dated as upper Coniacian - Santonian. Characteristic foraminiferal species encountered in this interval include:

Archaeoglobigerina blowi, Ammobaculites advenus, Cibicides beadnelli, Conorboides beadnelli, C. hofkeri, Gavelinella baltica, G. burlingtonensis, G. farafraensis, G. semipustulosa, Gavelinopsis proelevata, Hemicyclammina sigali, Lingulogavelinella tormarpensis, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Q. triangulata, Serovaina minutus, S. orbicella, S. pseudoscopus, S. sp. 1, *S. struvei, S. turonicus* and *Spiroloculina cretacea*, associated with smooth ostracods. Macrofossils include: bivalves, gastropods, echinoid spines and vertebrate fragments.

Most of the foraminiferal species listed above are found commonly in the Turonian or younger sediments in many localities of the Middle East, including: *Ammobaculites advenus, Cibicides beadnelli, Quadrimorphina camerata* and *Spiroloculina cretacea* (Cherif et al., 1989a). *Serovaina minutus* was reported in sediments not younger than Santonian of Jordan and Egypt (Koch, 1968; Basha, 1975, 1979; Al-Bakri, 1990; Said & Kenawy 1957, 1969; Andrawis, 1976). *Quinqueloculina globigerinaeformis* was recorded from the Santonian to Campanian of NW Pacific (Krashininnikov, 1973) and *Gavelinella burlingtonensis* and *G. farafraensis* were recorded from the Coniacian to Maastrichtian of Jordan (Al-Bakri, 1990).

It is suggested at Ras en-Naqb that the upper Coniacian to Santonian is delimited by the first appearance of *Archaeoglobigerina blowi* (top *C. primitiva* Zone of Caron, 1985), associated with *Gavelinella* spp. and *Gavelinopsis proelevata*. The upper boundary of this interval is marked by the disappearance of *Serovaina minutus* (top *C. asymetrica* Zone of Caron, 1985).

5.5.1.5 Campanian

Samples from the lower part of lithostratigraphic unit B2 (Q45 - 47) are mainly composed of silicified phosphatic rocks and cherts. The fauna consists essentially of vertebrate teeth, bivalves and gastropods. In view of the absence of any foraminiferal evidence, and as this undifferentiated interval directly overlies the *Archaeoglobigerina blowi* Zone of Santonian age, it is suggested that it should be assigned to the Campanian.

5.5.2 Foraminiferal Assemblages

The proposed assemblage zones are mainly local and based solely on the foraminiferal fauna recorded from this sequence (Enclosure 4). They may be differentiated from bottom to top as:

5.5.2.1 Lower to mid-Cenomanian

***Haplophragmoides* spp. Zone** (sample Q3 - 9)

This zone is characterised by a diverse and abundant benthic species, including: *Ammobaculites albertensis, A. naqbensis, Evolutinella subevoluta, Haplophragmoides excavatus, H. formosus, H. kirki, H. neolinki, H. umbilicata, Merlingina cretacea, Thomasinella punica* and *Trochamminoides parva.*

In addition to the above, benthic species that may range into the overlying beds are: *Ammobaculites agglutinans, Ammomarginulina barthouxi, Biconcava bentori, Charentia cuvillieri, C. hasaensis, C. rummanensis, Cyclammina haydeni, Haplophragmoides excavatus, Hemicyclammina evoluta, H. whitei, Ismailia aegyptica, I. neumannae, Placopsilina cenomana, Thomasinella aegyptia* and *T. fragmentaria.*

Conorboides umiatensis / Planispirinella barnardia Zone (samples Q10 - 23)

These index species are associated with the following benthic species: *Ammoastuta nigeriana, Ammobaculites euides, A. fragmentarius, A. obliquus, A. stephensoni, A. subcretaceus, A. turonicus, Ammodiscoides turbinatus, Ammomarginulina aburoashensis, A. blanckenhorni, A. cragini, Ammosiphonia* sp., *Arenobulimina d'orbignyi, Astacolus liebusi, Biplanata peneropliformis, Conorboides umiatensis, Coryphostoma neumannae, Dorothia pontoni, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Favusella washitensis, Fursenkoina squammosa, Gabonita billmani, G. levis, G. levis aegyptiaca, G. obesa, G. parva, Gaudryina rugosa, Gavelinella intermedia, Globospirillina condensa, Haplophragmoides calculus, H. fraseri, H. rugosa, Hiltermannella* cf. *kochi, Laevidentalina gracilis, Neobulimina canadensis, N. canadensis alpha, Neodiscorbinella* sp. 1, *Nezzazata concava, N. conica, N. gyra, N. simplex, Planispirinella barnardia, Praebulimina* cf. *arabica, P.* cf. *bantu lata, P. carseyae, P. prolixa, P. prolixa longa, P. venusae, Psammonyx* sp. 1, *Pseudolituonella mariea, Quasispiroplectammina navarroana, Q. nuda, Reissella ramonensis, Reophax* cf. *nodulosus, R. constrictus, Trochammina boehmi, Ventilabrella glabrata, Vernonina* sp. and *Zotheculifida* sp.

In addition to the above, the following benthic species are also found in this interval, but may range into the overlying beds: *Arenobulimina chapmani, Cassidella tegulata, Cibicides beadnelli, Conorboides beadnelli, C. hofkeri, C. mitra, Gavelinella baltica, G. semipustulosa, Hemicyclammina sigali, Nezzazata convexa, Poroeponides praeceps, Praebulimina reussi navarroensis, Pyramidina rudita, Quinqueloculina antiqua angusta* and *Serovaina pseudoscopus.*

The following benthic species disappear within this interval: *Ammobaculites agglutinans, Biconcava bentori, Charentia cuvillieri, C. hasaensis, C. rummanensis, Cyclammina haydeni, Haplophragmoides excavatus, Hemicyclammina evoluta, Ismailia aegyptica, I. neumannae* and *Placopsilina cenomana.*

***Conorboides* spp. Zone** (samples Q24 - 28)

This zone is characterised by the presence of *Adelungia* sp. 1. Benthics disappearing within this interval include: *Ammomarginulina barthouxi, Arenobulimina chapmani, Cassidella tegulata, Conorboides mitra, Praebulimina reussi navarroensis* and *Pyramidina rudita.* Benthics found in this interval and may range into younger beds are: *Ammobaculites advenus, Lingulogavelinella tormarpensis, Quinqueloculina globigerinaeformis, Q. laevigata* and *Serovaina struvei.*

Barren Horizon (samples Q29 - 31)

This horizon is mainly composed of sandy and dolomitic sandstones and the encountered fauna include only very badly preserved and unidentifiable foraminifera, associated with some gastropod shells.

5.5.2.2 Turonian

***Concavatotruncana algeriana* Zone** (samples Q32 - 39)

This interval is characterised by the presence of the following species: *Concavatotruncana algeriana, Ammomassilina* sp., *Massilina ginginensis, Valvulineria camerata* and *V. loetterlei.*

Quadrimorphina camerata and *Quinqueloculina triangulata* are benthic species commonly found in this interval, but may range into the overlying bed. The benthic species disappearing within this interval include: *Nezzazata convexa, Poroeponides praeceps, Thomasinella aegyptia* and *T. fragmentaria* (Enclosure 4)

5.5.2.3 Upper Coniacian - Santonian

***Archaeoglobigerina blowi / Gavelinopsis proelevata* Zone** (samples Q40 - 44)

This zone is characterised by a presence of the following foraminiferal species: *Archaeoglobigerina blowi, Gavelinella burlingtonensis, G. farafraensis, Gavelinopsis proelevata, Serovaina minutus, S. orbicella, S.* sp. 1, *S. turonicus* and *Spiroloculina cretacea.*

The following benthic species disappear within this interval: *Ammobaculites advenus, Cibicides beadnelli, Conorboides beadnelli, C. hofkeri, Gavelinella baltica, G. semipustulosa, Hemicyclammina sigali, Lingulogavelinella tormarpensis, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Q. triangulata, Serovaina pseudoscopus* and *S. struvei* (Enclosure 4).

Barren Horizon (samples Q45 - 47)

This horizon is mainly composed of silicified phosphatic rocks and cherts, associated with bivalves, gastropods and vertebrate fragments.

5.6 Biostratigraphic Correlation of the Studied Sections

The biostratigraphic correlation of the four studied sections is discussed below. This depends on comparing the range of key taxa in the four sections, and attempting to correlate coeval strata. The presence of lithologic and faunal changes between the north, centre and south of Jordan makes the zonation of the Cenomanian to Maastrichtian sequences in West Jordan difficult. To avoid confusion, the Upper Cretaceous sequences were divided into a number of Formations and Members, by using their lithological properties and faunal content (Chapter 4, Fig. 5.1, Table 5.1).

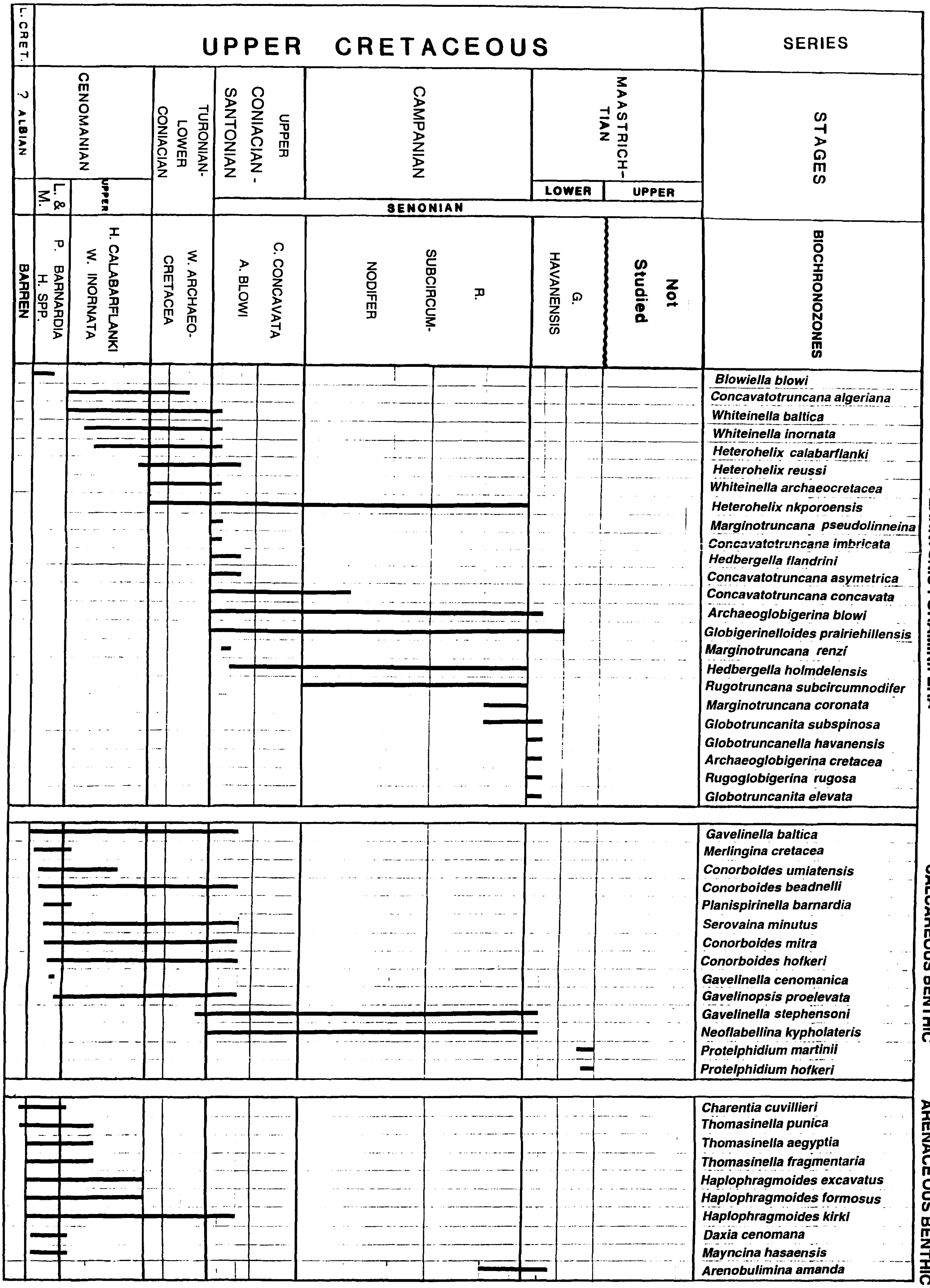


Fig. 5.1 Distribution of selected Upper Cretaceous foraminiferal species from Jordan arranged by order of first and last occurrences.

Table 5.1 Correlation of range zones for Upper Cretaceous sections studied in west Jordan.

Period	Stage	Formation	AJLUN-JERASH		WADI MUJIB		WADI MUSSA		RAS EN-NAQB	
			Member	Suggested Range Zones	Member	Suggested Range Zones	Member	Suggested Range Zones	Member	Suggested Range Zones
UPPER CRETACEOUS	Lower Maastrichtian	Amman Formation	Upper Phos. Silicified Ls.	Not Studied	Upper Phos. Silicified Ls.	*Protelphidium martinii/P. hofkeri* *Globotruncanella havanensis*	Upper Phos. Silicified Ls.	*Arenobulimina amanda*	Upper Phos. Silicified Ls.	Not Studied
	Campanian		L. Silicified Limestone	Not Studied	L. Silicified Limestone	*Rugotruncana subcircumnodifer*	L. Silicified Limestone	Barren Horizon	L. Silicified Limestone	Barren Horizon
	U. Coniacian - Santonian	Ghudran Formation	B1	Not Studied	B1	*Archaeoglobigerina blowi / Concavatotruncana concavata*	B1	*Gavelinopsis proelevata*	B1	*Gavelinopsis proelevata / Archaeoglobigerina blowi*
	Turonian	Wadi Sir Formation	A7	*Whiteinella archaeocretacea*	A7	*Whiteinella archaeocretacea / Gavelinella stephensoni*	A7	Barren Horizon	A7	*Concavatotruncana algeriana*
	Upper Cenomanian	Shueib Formation	U. Calcareous	*Heterohelix calabarflanki / Whiteinella inornata*	Upper Shaly	*Heterohelix calabarflanki / Whiteinella inornata*	U. Marly Ls.		U. Shaly Ss.	Barren Horizon
			Lower Marly		Lower Marly		Lower Sandy Limestone		L. Dolomitic Limestone	
		Hummar	A4							
	Lower & Middle Cenomanian	Fuheis Formation	A3	*Mayncina hasaensis*	Fuheis Fm. Equivalent	*Mayncina hasaensis*	Fuheis Fm. Equivalent	*Conorboides mitra, C. beadnelli, C. hofkeri*	Fuheis Fm. Equivalent	*Conorboides mitra, C. beadnelli, C. hofkeri*
		Na'ur Formation	Upper Calcareous	*Planispirinella barnardia*	Upper Nodular	*Conorboides umiatensis / Planispirinella barnardia*	Upper Nodular	*Conorboides umiatensis / Planispirinella barnardia*	Upper Nodular	*Conorboides umiatensis / Planispirinella barnardia*
			Lower Marly A1	*Thomasinella aegyptia / T. fragmentaria*	Lower Shaly A1	*Haplophragmoides excavatus, H. formosus & H. kirki*	Lower Marly A1	*Haplophragmoides kirki, H. excavatus, H. formosus*	Lower Shaly Sandstone	*Haplophragmoides kirki, H. excavatus, H. formosus*
Lower Cret.	? Albian	Subeihi Formation	K2	Barren Horizon	K2	Barren Horizon	K2	Not Studied	K2	*Charentia cuvillieri*

Cret. = Cretaceous; Fm. = Formation; L. = Lower; Ls. = Limestone; Phos. = Phosphatic; Ss. = Sandstone; U. = Upper.

The Upper Cretaceous has been subdivided in both the northern and central areas into seven formations and a number of members. In the central and southern areas, sequences are characterised by the absence of the Hummar Formation and biostratigraphic evidence of a hiatus (Enclosure 5). This fact is enhanced by direct field observation of a disconformity surface in Wadi Mujib. The benthic and planktonic foraminiferal fauna identified from the studied sections have been correlated with fauna previously described from contemporaneous successions elsewhere in the Middle East. Although each area is characterised by its own sedimentary facies and fauna, five internationally recognised biozones and a number of local foraminiferal assemblage zones of correlative value have been recognised. These zones are discussed in detail in the Wadi Mujib sequence, and are considered here as a basis for correlation with their equivalents at Ajlun, Wadi Mussa and Ras en-Naqb.

In recent years, many workers have been able to recognise specific stage markers in their planktonic foraminiferal studies, whereas most of the benthics are characterised by long-ranges lineages. In this work, however, some range zones are interrupted by, and alternate with, lithologically distinct barren horizons, such as the dolomitic sandy layers and undifferentiated zones that occur at both Wadi Mussa and Ras en-Naqb. These yield only sporadic foraminifera and other fauna (Fig. 5.1). In general, it is observable that different lithofacies are characterised by distinctive foraminiferal assemblages. The most important foraminiferal faunules, which have proved in this study to be of stratigraphical value, will be discussed with respect to their local stratigraphical position and distribution in the studied sections:

5.6.1 Lower to mid-Cenomanian

The following range zones are only recognised from the Na'ur and Fuheis Formations of the Wadi Mujib (Fig. 5.1, Table 5.1, Enclosure 2). These zones are also partly or wholely reported from Ajlun/Jerash, Wadi Mussa and Ras en-Naqb as follows:

Haplophragmoides spp. Zone

This zone is characterised by a presence of the following benthic species recognised in the four studied sections: *Adelungia marginulinaeformis, A.* sp. 1, *Ammobaculites agglutinans, A. albertensis, A. difformis, A. naqbensis, A.* sp. 1, *A.* sp. 2, *Arenobulimina chapmani, Eoguttulina anglica, Flabellammina elongata, Gabonita levis aegyptiaca, Globulina* sp. 1, *Guttulina adherens, G. cuspidata, Haplophragmoides excavatus, H. formosus, H. kirki, H. neolinki, Hensonina lenticularis, Lenticulina spachholtzi, Merlingina cretacea, Ophthalmidium minimum, Polymorphina zeuschneri, Praebulimina reussi navarroensis, Pseudolituonella mariea, Pseudopolymorphina eichenbergi, P.* sp. 1, *Quadrimorphina camerata, Spiroloculina cretacea, Thomasinella fragmentaria, T. punica, Trochammina boehmi, T. rummanensis, Trochamminoides parva* and *Uvigerinammina jankoi.*

In addition to the above, the following planktonic species are also found in this interval, but range into the overlying beds in the four studied sections: *Blowiella blowi, Globigerinelloides bentonensis, G. ultramicra, Guembelitria cenomana, Hedbergella delrioensis, Heterohelix* sp. 1 and *Whiteinella brittonensis.*

Longer ranging benthic species include: *Ammobaculites agglutinans, A. euides, A. fragmentarius, A. naqbensis, A. obliquus, A. stephensoni, A. subcretaceus, A. turonicus, Ammomarginulina barthouxi, A. cragini, A. naqbensis, Ammotium aegyptica, A. oertlii, Ammovertillina* sp. 1, *Astacolus liebusi, Biconcava bentori, Bolivinopsis clotho, Bulimina exigua robusta, Cassidella tegulata, Charentia cuvillieri, C. hasaensis, C. rummanensis, Cyclammina haydeni, Dentalinoides canulina, Eponides* cf. *plummerae, E. sibericus, E. whitei, Evolutinella subevoluta, Fursenkoina squammosa, Gabonita levis, G. levis aegyptiaca, Gavelinella baltica, G. semipustulosa, Gavelinopsis tourainensis, Guttulina symploca, Gyroidinoides nitida, Haplophragmoides calculus, H. excavatus, H. fraseri, H. kirki, H. rugosa, H. umbilicata, Hemicyclammina evoluta, H. sigali, H. whitei, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Lenticulina gaultina, L. rotulata, Lingulogavelinella turonica, Marssonella oxycona, Mayncina orbignyi, Neobulimina irregularis, Placopsilina cenomana, Plectina ruthenica, Praeammoastuta* sp. 1, *Praebulimina prolixa, P. prolixa longa, P. reussi navarroensis, Pseudotextulariella cretosa, P.* sp. 1, *Psilocitharella leptoteicha, Pyramidina rudita, Quasispiroplectammina navarroana, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Q. laevigata, Scherochorella minuta, Sculptobaculites loshkharvicus, Serovaina turonicus, Sestronophora* sp., *Spiroloculina cretacea, Textularia depressa, Thomasinella aegyptia, T. fragmentaria, T. punica, Trochammina afikpensis, Valvulineria camerata* and *Vernonina* sp.

This zone is recognised in Wadi Mujib, Wadi Mussa and Ras en-Naqb. *H.* spp. are absent from Ajlun/Jerash, but the presence of common benthic species (e.g. *Thomasinella aegyptia* and *T. fragmentaria*) made it possible to conclude that the *H.* spp. Zone is equivalent to *T.* spp. Zone of Ajlun/Jerash (Enclosure 1, Table 5.1).

Conorboides umiatensis / Planispirinella barnardia Zone

This zone is characterised by a presence of the planktonic species *Blowiella blowi*, which was recorded only in Wadi Mujib, but could not be considered as index sp. because it was recorded elsewhere from Aptian to Albian (Masters, 1977). The zone is also characterised by a presence of the following benthic species (Fig. 5.1, Table 5.1), collected from the four studied sections: *Aaptotoichus clavellatus, Adelungia* sp. 1, *Ammoastuta nigeriana, Ammobaculites euides, A. fragmentarius, A. obliquus, A. stephensoni, A. subcretaceus, A. turonicus, Ammodiscoides turbinatus, Ammomarginulina aburoashensis, A. blanchenhorni, A. cragini, Ammosiphonia* sp., *Anomalinoides pinguis, Arenobulimina d'orbignyi, Astacolus liebusi, Biplanata peneropliformis, Choffatella decipiens, Conorbina conica, Conorboides hofkeri, C.* sp. 1, *C. umiatensis, Coryphostoma neumannae, Dorothia pontoni, Ellipsoglandulina laevigata, Eponides* cf. *frankei, E.* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Favusella washitensis, Flabellammina negevensis, Fursencoina squammosa, Gabonita billmani, G. levis, G. levis aegyptiaca, G. obesa, G. parva, Gaudryina rugosa, Gavelinella awunensis, G. cenomanica, G. intermedia, Globospirillina condensa, Haplophragmoides calculus, H. fraseri, H. rugosa, Hemicyclammina whitei, Hensonina* sp. 1, *Hiltermannella* cf. *kochi, Laevidentalina gracilis, Lagena acuticosta, Lenticulina spissocostata, Lingulogavelinella tormarpensis, Marssonella kummi, M. oxycona, Neobulimina canadensis, N. canadensis alpha, Neodiscorbinella* sp. 1, *Nezzazata concava, N. conica, N. gyra, N. simplex, Orbitolina sefini, Planispirinella barnardia, Plectinella aegyptiaca, Polychasmina pawpawensis, Praebulimina bantu lata, P. carseyae, P.* cf. *arabica, P. prolixa, P. prolixa longa, P. venusae, Psammonyx* sp. 1, *Pseudolituonella mariea, Quasispiroplectammina nuda, Q. navarroana, Quinqueloculina triangulata, Reissella ramonensis, Reophax constrictus, R. nodulosus, Sculptobaculites goodlandensis, Serovaina simplex, S. struvei, Stensioeina pokornyi, Triplasia bonnefousi, T. goodlandensis, T. murchisoni, Trochammina boehmi, T. rummanensis, Vernonina* sp. and *Zotheculifida* sp.

In addition to above, the following planktonic species are also found in this interval and range into the overlying beds in the four studied sections: *Costellagerina bulbosa, Globigerinelloides bentonensis, G. eaglefordensis, Hedbergella simplex, H. trocoidea, Heterohelix globulosa, H. moremani* and *Ventilabrella glabrata.*

Benthic taxa ranging upwards include: *Ammobaculites agglutinans, A. albertensis, A. difformis, A. naqbensis, Ammodiscoides turbinatus, Anomalinoides pinguis, Arenobulimina advena, A. chapmani, Cassidella tegulata, Cibicides beadnelli, Clavulinopsis gaultina, Conorboides beadnelli, C. hofkeri, C. mitra, C.* sp. 1, *C. umiatensis, Daxia cenomana, Dentalina hammensis, Donsissonia* sp., *Eponides sigali, Evolutinella* sp. 1, *Fissurina laevigata, F. oblonga, Gabonita sumaya, Gavelinella baltica, G. intermedia, G. nacatochensis, G. semipustulosa, Gavelinopsis proelevata, Hemicyclammina sigali, Ismailia aegyptica, I. neumannae, Lagena hexagona, L. paucicosta, Lenticulina californiensis, L.* sp. 1, *Lingulogavelinella globulosa, L. tormarpensis, Massilina ginginensis, Neobulimina canadensis, Nezzazata convexa, Placopsilina cenomana, Poroeponides praeceps, Praebulimina* cf. *arabica, P. reussi navarroensis, Pravoslavlevia pravoslavlevi, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Pseudotextularia plummerae, Pyramidina rudita, Quadrimorphina camerata, Quinqueloculina antiqua angusta, Serovaina orbicella, S. pseudoscopus, S. turonicus, Sestronophora* sp., *Trochamminoides parva* and *Valvulineria loetterlei.*

Blowiella blowi is the only planktonic species disappearing within this interval, while the benthic species disappearing include: *Ammobaculites agglutinans, Ammotium aegyptica, Biconcava bentori, Bolivinopsis clotho, Cassidella tegulata, Charentia cuvillieri, C. hasaensis, C. rummanensis, Cyclammina haydeni, Evolutinella subevoluta, Gavelinella semipustulosa, Guttulina symploca, Haplophragmoides excavatus, Hemicyclammina evoluta, Ismailia aegyptica, I. neumannae, Kutsevella labythnangensis, Lenticulina gaultina, Mayncina orbignyi, Placopsilina cenomana, Praeammoastuta* sp. 1, *Pseudotextulariella cretosa, Psilocitharella leptoteicha, Quinqueloculina globigerinaeformis, Spiroloculina cretacea, Textularia depressa, Trochammina afikpensis* and *Valvulineria camerata.*

Mayncina hasaensis Zone

This zone is characterised, in Wadi Mujib only, by a presence of the planktonic species *Globigerinelloides eaglefordensis*. Characteristic benthic species of this zone, collected from the four studied sections, include: *Adelungia* sp. 1, *Ammoastuta nigeriana, Ammobaculites mastersi, A. pagodensis, A.* sp. 2, *A. stephensoni, Ammodiscus cretaceus, Ammomarginulina aburoashensis, A. blanckenhorni, A. naqbensis, Ammosiphonia* sp., *Ammotium hasaense, Astacolus liebusi,* *Bulbophragmium aequale, Charentia evoluta, C. hasaensis, C. rummanensis, C.* sp. 1, *Cibicides beadnelli, Eoguttulina anglica, Fursenkoina squammosa, Hemicyclammina* sp. 1, *Hormosina* cf. *velascoensis, Gavelinella baltica, G. intermedia, Globulina* sp. 1, *Guttulina symploca, Haplophragmoides neolinki, H. rugosa, Hemicyclammina whitei, Laevidentalina gracilis, Lituola* sp. 1, *Mayncina hasaensis, Merlingina cretacea, Nodosaria naumanni, Placopsilina cenomana, Polychasmina pawpawensis, Polymorphina zeuschneri, Praebulimina* cf. *bantu lata, P. venusae, Pseudolituonella mariea, Pseudopolymorphina* sp. 1, *Pseudotextulariella* sp. 1, *Reophax* cf. *nodulosus, R. constrictus, Tristix poignanti* and *Trochammina afikpensis*.

In addition to the above, planktonic species found in this zone and range into the overlying beds include: *Hedbergella delrioensis, H. simplex, Whiteinella aprica, W. baltica* and *W. inornata*.

Benthic taxa ranging upwards include: *Ammobaculites advenus, A. difformis, Ammomarginulina barthouxi, Arenobulimina d'orbignyi, Charentia hasaensis, Conorboides beadnelli, C. mitra, Dentalina* sp. 1, *Flabellammina alexanderi, Gavelinopsis tourainensis, Haplophragmoides neolinki, Lingulogavelinella tormarpensis, Mucronina* sp., *Neodiscorbinella* sp. 1, *Oolina globulosa, Planispirinella barnardia, Poroeponides praeceps, Pseudopolymorphina eichenbergi, Quinqueloculina globigerinaeformis, Q. laevigata, Serovaina struvei, Thomasinella punica* and *Trochammina boehmi*.

Benthic species disappearing within this zone include: *Ammobaculites agglutinans, A. albertensis, A. difformis, A. euides, A. stephensoni, Ammomarginulina barthouxi, A. naqbensis, Ammotium oertlii, Ammovertillina* sp. 1, *Arenobulimina advena, A. chapmani, Cassidella tegulata, Conorboides mitra, Daxia cenomana, Fursenkoina squammosa, Haplophragmoides calculus, Hemicyclammina sigali, Ismailia aegyptica, I. neumannae, Lenticulina* sp. 1, *Lingulogavelinella globulosa, L. turonica, Praebulimina reussi navarroensis, Pyramidina rudita, Quinqueloculina antiqua angusta, Scherochorella minuta, Sestronophora* sp., *Thomasinella aegyptia, Trochamminoides parva* and *Vernonina* sp.

This zone is recognised in Ajlun/Jerash and Wadi Mujib only. In view of the presence of many *Conorboides* spp. (e.g. *Conorboides beadnelli, C. hofkeri, C. mitra*), in addition to other common taxa in the four studied sections, it is suggested that *M. hasaensis* Zone of Ajlun and Wadi Mujib is equivalent to the *C.* spp. Zone of Wadi Mussa and Ras en-Naqb (Table 5.1).

5.6.2 Upper Cenomanian

Heterohelix calabarflanki / Whiteinella inornata Zone

This zone is characterised by a presence of the following planktonic species, collected only from Ajlun/Jerash and Wadi Mujib: *Favusella washitensis, Hedbergella trocoidea, Heterohelix globulosa, H. moremani, H. punctulata, Pseudoplanoglobulina nakhitschevanica, Ventilabrella glabrata, Whiteinella baltica, W. brittonensis* and *W. inornata*.

Characteristic benthic species of this zone include: *Adelungia marginulinaeformis, Ammoastuta nigeriana, Ammobaculites albertensis, A. euides, A. mastersi, A. obliquus, A. pagodensis, A.* sp. 1, *Ammomarginulina blanckenhorni, A.* sp. 1, *Ammomassilina* sp., *Ammotium hasaense, Arenobulimina advena, Astacolus liebusi, A. richteri, A.* sp. 1, *Biconcava bentori, Bolivinopsis clotho, Bulbobaculites problematicus, Bulbophragmium aequale, Choffatella decipiens, Clavulinopsis gaultina, Conorboides hofkeri, C. mitra, C. umiatensis, Cuneolina pavonia parva, Dicyclina schlumbergeri, Eponides* cf. *frankei, E. sibericus, E. sigali, E. whitei, Evolutinella* sp. 1, *E. subevoluta, Flabellammina kaskapauensis, F.* sp. 1, *F.* sp. 2, *Fursenkoina squammosa, Gabonita levis, G. obesa, Globospirillina condensa, Guttulina adherens, Gyroidinoides* sp., *Haplophragmoides calculus, Hormosina excelsa, Ismailia aegyptica, Lenticulina gaultina, L. taylorensis, Lingulogavelinella tormarpensis, Lituola nautiloidea, Massilina ginginensis, Neobulimina canadensis alpha, Nonionella austinana, Pseudorhapydionina dubia, Quinqueloculina antiqua angusta, Q. globigerinaeformis, Reophax constrictus, R. parvulus, Scherochorella* sp., *Sculptobaculites goodlandensis, Simplorbitolina* sp., *Trochospira avnimelichi* and *Vernonina* sp.

In addition to the above, the following planktonic species are found in this zone, but may range into the overlying beds: *Anaticinella multiloculata, Blowiella blowi, Heterohelix calabarflanki, H. striata compressa, H. reussi* and *Whiteinella inornata.*

Benthic taxa ranging upwards include: *Ammobaculites advenus, Ammomarginulina aburoashensis, Biplanata peneropliformis, Bulimina kirri, Conorboides hofkeri, Coryphostoma plaitum, Flabellammina negevensis, Globulina lacrima, Marssonella kummi, M. oxycona, Neodiscorbinella* sp. 1, *Nezzazata conica, N. gyra, Nezzazatinella adhami, Peneroplis parvus, Plectina ruthenica, Praeammoastuta* sp. 1, *Praebulimina carseyae, Pseudotextulariella cretosa, Pyramidina triangularis, Quasispiroplectammina nuda, Reissella ramonensis, Reophax parvulus, Serovaina minutus, S. struvei, Textularia depressa, Triplasia murchisoni* and *Tristix poignanti.*

The following planktonic species disappear within this zone: *Guembelitria cenomana, Hedbergella trocoidea, Heterohelix moremani* and *Whiteinella brittonensis.*

Benthic species disappearing within this zone include: *Ammobaculites agglutinans, A. difformis, A. fragmentarius, A. naqbensis, A. obliquus, A. subcretaceus, A. turonicus, Ammomarginulina aburoashensis, A. barthouxi, A. cragini, Arenobulimina chapmani, A. d'orbignyi, Bulimina exigua robusta, Charentia hasaensis, Clavulinopsis gaultina, Conorboides beadnelli, C. hofkeri, C. umiatensis, Coryphostoma neumannae, Cyclammina haydeni, Dentalina* sp. 1, *Eoheterohelix* sp., *Eponides* cf. *plummerae, Evolutinella* sp. 1, *E. subevoluta, Flabellammina alexanderi, Gabonita levis aegyptiaca, G. sumaya, Gavelinella baltica, G. intermedia, Gavelinopsis tourainensis, Globulina lacrima, Guttulina cuspidata, Haplophragmoides excavatus, H. formosus, H. fraseri, H. kirki, H. neolinki, H. rugosa, Hemicyclammina evoluta, H. sigali, Ismailia neumannae, Kutsevella labythnangensis, Lagena hexagona, Lenticulina modesta, Lingulogavelinella globulosa, L. tormarpensis, L. turonica, Mucronina* sp., *Neobulimina irregularis, Neodiscorbinella* sp. 1, *Nezzazata concava, N. convexa, N. simplex, Placopsilina cenomana, Planispirinella barnardia, Poroeponides praeceps, Praebulimina* cf. *arabica, P. prolixa, P. prolixa longa, P. reussi navarroensis,* *Pravoslavlevia pravoslavlevi, Pristinosceptrella* sp., *Psammonyx* sp. 1, *Pseudopolymorphina eichenbergi, Pyramidina rudita, Quadrimorphina camerata, Sculptobaculites loshkharvicus, Serovaina orbicella, Thomasinella aegyptia, T. fragmentaria, T. punica* and *Trochammina boehmi.*

This zone was recognised in Ajlun/Jerash and Wadi Mujib only, where it is refered to the upper Cenomanian. In view of the absence of any foraminiferal evidence found in the barren Dolomitic Sandy Limestone Horizon of the two southern sections, and as this horizon lies between the *C.* spp. (lower to mid-Cenomanian) and *Concavatotruncana algeriana* Turonian Zones, it is suggested that *H. calabarflanki / W. inornata* Zone of Ajlun/Jerash and Wadi Mujib is equivalent to the barren zone of Wadi Mussa and Ras en-Naqb (Table 5.1).

5.6.3 Turonian

The following range zone is only recognised from the Wadi Sir Formation of Ajlun/Jerash and Wadi Mujib (Enclosures 1, 2, Table 5.1).

Whiteinella archaeocretacea Zone

This zone is characterised by a presence of the following planktonic species, collected from Ajlun/Jerash, Wadi Mujib and Ras en-Naqb: *Concavatotruncana algeriana, Hedbergella simplex, Heterohelix nkporoensis* and *Whiteinella archaeocretacea.*

Characteristic benthic species of this zone, collected from the above sections, include: *Ammomassilina* sp., *Flabellammina alexanderi, Gaudryina rugosa, Gavelinella umbilicata, Marssonella trochus, Massilina ginginensis, Nezzazata concava, Pseudorhapydionina dubia, Serovaina pseudoscopus, S. simplex, Textularia subconica, Valvulineria camerata, V. loetterlei*

In addition to the above, the following benthic species are also found in this zone, but may range into the overlying beds: *Gavelinella stephensoni, Gavelinopsis abudurbensis, G. tourainensis, Quadrimorphina camerata* and *Quinqueloculina triangulata.*

The following planktonic species disappear within this zone: *Anaticinella multiloculata, Hedbergella delrioensis, Heterohelix reussi* and *Whiteinella inornata.*

Benthic species disappearing within this zone include: *Adelungia* sp. 1, *Ammobaculites advenus, Ammodiscoides turbinatus, Biplanata peneropliformis, Charentia cuvillieri, Conorboides* sp. 2, *Coryphostoma plaitum, Donsissonia* sp., *Flabellammina elongata, F. negevensis, Gavelinella nacatochensis, G. semipustulosa, Lenticulina modesta, Lingulogavelinella globulosa, L. turonica, Lituola nautiloidea, Marssonella kummi, M. oxycona, Mayncina orbignyi, Nezzazata convexa, Peneroplis parvus, Poroeponides praeceps, Pseudotextulariella cretosa, Pterammina israelensis, Quadrimorphina camerata, Quasispiroplectammina nuda, Ramulina globulifera, Reissella ramonensis, Reophax parvulus, Scherochorella minuta, Serovaina minutus, S. orbicella, S. struvei, S. turonicus, Textularia depressa, Thomasinella aegyptia, T.*

fragmentaria Triplasia goodlandensis, T. murchisoni, Tristix poignanti, Trochammina rummanensis, Trochospira avnimelichi and *Valvulinoides umovi.*

This zone was recognised in both Ajlun/Jerash and Wadi Mujib and is considered equivalent to the Turonian *Concavatotruncana algeriana* Zone of Ras en-Naqb. In view of the absence of any foraminiferal evidence found in the equivalent barren horizon of Wadi Mussa, and as the later horizon is overlain by the Upper Coniacian *Gavelinopsis proelevata* Zone, it is suggested that the *W. archaeocretacea* Zone of Ajlun and Wadi Mujib is equivalent to the barren horizon of Wadi Mussa (Table 5.1).

5.6.4 Upper Coniacian - Santonian

The following range zone is only recognised from the Ghudran Formation of the Wadi Mujib (Enclosure 2, Table 5.1). This zone was not studied at Ajlun/Jerash, has been partly reported from Ras en-Naqb, and has an equivalent zone at Wadi Mussa as follows:

Archaeoglobigerina blowi / Concavatotruncana concavata Zone

This zone is characterised a presence of the following planktonic species: *Anaticinella multiloculata, Concavatotruncana asymetrica, C. imbricata, Globigerinelloides caseyi, Globotruncana linneiana, Hedbergella flandrini, H. hoelzli, Heterohelix pseudotessera, H. reussi, Marginotruncana paraconcavata, M. pseudolinneina, M. renzi, Sigalitruncana pileoliformis* and *Whiteinella archaeocretacea.*

Characteristic benthic species of this zone, collected from Wadi Mujib and Ras en-Naqb, include: *Ammotium aegyptica, Astacolus liebusi, A.* sp. 1, *Biconcava bentori, Biplanata peneropliformis, Bolivinopsis clotho, Brizalina lowmani, Cibicides beadnelli, Conorboides beadnelli, C. mitra, Cribroelphidium vulgare, Dorothia pontoni, Eoheterohelix* sp., *Frondicularia clarki, Gabonita distorta, G. levis, Gavelinella baltica, G. farafraensis, G. involuta, G. pertusa, G. sandidgei, G. stephensoni, Gavelinopsis proelevata, G. tourainensis, Haplophragmoides kirki, Hiltermannella* cf. *kochi, Hopkinsinella* sp., *Loxostomoides cushmani, Massilina ginginensis, Nezzazatinella adhami, Plectina ruthenica, Praebulimina aspera, P. reussi, Pseudotextularia nuttalli, Quasispiroplectammina navarroana, Quinqueloculina laevigata, Serovaina pseudoscopus, S.* sp. 1, *S. turonicus, Sestronophora* sp., *Textularia subconica, Trochospira avnimelichi, Vaginulina cretacea, V. recta, V. trilobata.*

In addition to the above, the following planktonic species are also found in this zone, but may range into the overlying beds: *Archaeoglobigerina blowi, Concavatotruncana concavata, Contusotruncana fornicata, Globigerinelloides alvarezi, G. prairiehillensis, Globotruncana orientalis, G. rugosa, Hedbergella holmdelensis, H. monmouthensis, Heterohelix dentata, H. globocarinata, H. nkporoensis, Marginotruncana marginata* and *Planoglobulina brazoensis.*

Benthic taxa ranging upwards include: *Ammodiscoides turbinatus, Cassidella navarroana, Elhasaella alanwoodi, Frondicularia lanceolata, Gavelinella burlingtonensis, G. cristata, G. lorneina, G. whitei, Hopkinsina arabina, Lenticulina* *modesta, Mucronina* sp., *Neoflabellina kypholateris, N. suturalis, Nonionella cretacea tamilensis, N. robusta, Plectina ruthenica, Pyramidulina distans, Vaginulina plummerae* and *Valvalabamina lenticula.*

The following planktonic species disappear within this zone: *Globigerinelloides bentonensis, Hedbergella delrioensis, H. simplex, Heterohelix calabarflanki, Whiteinella aprica, W. baltica* and *W. inornata.*

Benthic species disappearing within this zone include: *Anomalinoides pinguis, Astacolus liebusi, Conorboides beadnelli, C. mitra, Gavelinella baltica, Gavelinopsis proelevata, G. tourainensis, Haplophragmoides kirki, Lenticulina rotulata, Massilina ginginensis, Neobulimina canadensis, Poroeponides praeceps, Pseudotextularia plummerae Quasispiroplectammina nuda, Quinqueloculina laevigata, Serovaina turonicus* and *Sestronophora* sp.

A. blowi, in addition to other taxa, is common in Wadi Mujib and Ras en-Naqb, and *Gavelinopsis proelevata,* along with other taxa, is common in Ras en-Naqb and Wadi Mussa. It is suggested, therefore, that the *A. blowi / C. concavata* Zone of Wadi Mujib is equivalent to *G. proelevata* Zone of Wadi Mussa.

5.6.5 Upper Campanian

The following range zone was only recognised from the Lower Silicified Limestone Member of Amman Formation in Wadi Mujib (Enclosure 2, Table 5.1). It was not studied at Ajlun/Jerash, but may have equivalent zones at Wadi Mussa and Ras en-Naqb, as follows:

Rugotruncana subcircumnodifer Zone

This zone is characterised by a presence of the following planktonic species, collected only from Wadi Mujib: *Archaeoglobigerina cretacea, Contusotruncana patelliformis, C. plummerae, Globigerinelloides bollii, Globotruncana arca, G. bulloides, G. mariei, G. rosetta, Globotruncanella havanensis, Globotruncanita elevata, G. stuartiformis, G. subspinosa, Gublerina ornatissima, G. robusta, Heterohelix glabrans, Marginotruncana coronata, M. sinuosa, Rugoglobigerina jordani, R. pilula, R. rugosa* and *Rugotruncana subcircumnodifer.*

Characteristic benthic species of this zone include: *Ammodiscus cretaceus, Arenobulimina amanda, Bolivina decurrens, B. incrassata, Citharina suturalis, Dentalina marcki, D.* sp. 1, *Gabonita billmani, G. bipyramidata, G. multituberculata, G. parva, G. tiarella, G. zigzaga, Gaudryina rugosa, Gyroidinoides muwaqqarensis, Kyphopyxa christneri, Laevidentalina aphelis, L. catenula, L. gracilis, L. longiscata, L. vistulae, Lenticulina carlsbadensis, L. mellahensis, L. muensteri, L. taylorensis, Neoflabellina leptodisca, N.* sp. 1, *Nodogerina bradyi, Nodomorphina* sp. 1, *Nodosaria limbata, Praebulimina angulata, P. trihedra, Pyramidulina latejugata, P. proboscidea, P. raphinistrum, P. septemcostata, P. zippei, Tristix coloi, Vaginulinopsis directa* and *Valvulinoides umovi.*

In addition to the above, the following planktonic species are found in this zone, but may range into the overlying beds: *Globigerinelloides messinae, G. volutus, Heterohelix vistulaensis, Planoglobulina multicamerata* and *Ventilabrella glabrata.*

The following planktonic species disappear within this zone: *Archaeoglobigerina blowi, Concavatotruncana concavata, Contusotruncana fornicata, Costellagerina bulbosa, Globotruncana orientalis, G. rugosa, Hedbergella monmouthensis, Heterohelix dentata, H. nkporoensis, H.* sp. 1, *Marginotruncana marginata* and *Planoglobulina brazoensis.*

Benthic species disappearing within this zone include: *Cassidella navarroana, Dentalina hammensis, Dentalinoides canulina, Elhasaella alanwoodi, Eponides* cf. *plummerae, E. sibericus, E. sigali, E. whitei, Fissurina laevigata, Frondicularia lanceolata, Gabonita levis, Gavelinella burlingtonensis, G. lorneina, G. stephensoni, Gavelinopsis abudurbensis, G. tourainensis, Hopkinsina arabina, Laevidentalina* sp., *Lagena paucicosta, Lenticulina californiensis, Marssonella oxycona, M. trochus, Mucronina* sp., *Neoflabellina kypholateris, N. suturalis, Nonionella cretacea tamilensis, Plectina ruthenica, Praebulimina carseyae, Pseudotextulariella* sp. 1, *Pyramidina triangularis, Pyramidulina distans, Vaginulina plummerae* and *Valvulineria loetterlei.*

5.6.6 Lower Maastrichtian

The following range zone was only recognised from the Upper Phosphatic Silicified Limestone Member of Amman Formation in Wadi Mujib (Enclosure 2, Table 5.1). It was not studied at Ajlun/Jerash or Ras en-Naqb, but is believed to have an equivalent zone (*Arenobulimina amanda*) at Wadi Mussa as follows:

Globotruncanella havanensis Zone

This zone is characterised by a presence of the following planktonic species, collected only from Wadi Mujib: *Globigerinelloides multispinata, Globotruncanella havanensis, Guembelitria cenomana* and *Heterohelix nkporoensis.*

Characteristic benthic species of this zone include: *Arenobulimina amanda, Bolivina decurrens, B. incrassata, Brizalina lowmani, Bulimina exigua robusta, Cassidella navarroana, Ceratobulimina cretacea, Ceratolamarckina parva, Coryphostoma neumannae, Cribroelphidium vulgare, Dentalinoides canulina, Dictyopselloides cuvillieri, Dorothia pontoni, Fissoelphidium operculiferum, Fissurina alveolata, Gaudryina rugosa, Gavelinella* cf. *sibiricus, Laevidentalina vistulae, Neobulimina canadensis, N. canadensis alpha, Nonionella cretacea tamilensis, N. robusta, Planispirinella* sp. 1, *Planoglabratella* sp., *Praebulimina angulata, P. aspera, P.* cf. *arabica, P. bantu, P.* cf. *bantu lata, P. carseyae, P. reussi, P. trihedra, Protelphidium hofkeri, P. martinii, Pyramidina rudita, Stensioeina exsculpta, S. exsculpta gracilis* and *Valvulineria correcta.*

In addition to the above, this zone yielded the following radiolarian spp. at Wadi Mussa: *Acaeniotyle starka, Amphibracchium* sp. 1, *Amphipyndax pseudoconulus, A.*

stocki, A. tylotus, Archaeodictyomitra lamellicostata, Pseudoaulophacus lenticulatus and *Pseudodictyomitra* sp.

The following planktonic species disappear within this zone: *Globigerinelloides alvarezi, G. messinae, G. prairiehillensis, G. ultramicra, G. volutus,, Hedbergella holmdelensis, Heterohelix globocarinata, H. globulosa, H. striata compressa, H. vistulaensis, Planoglobulina multicamerata* and *Ventilabrella glabrata.*

Benthic species disappearing within this zone include: *Ammodiscoides turbinatus, Bulimina kirri, Cassidella tegulata, Fissurina oblonga, Gabonita levis, Gavelinella cristata, G. whitei, Gyroidinoides nitida, Lenticulina modesta, Neodiscorbinella* sp. 1, *Nonionella robusta, Oolina globulosa, Plectina ruthenica, Praebulimina prolixa longa, Quasispiroplectammina navarroana* and *Valvalabamina lenticula.*

CHAPTER 6

UPPER CRETACEOUS PALAEOENVIRONMENTS IN WEST JORDAN

6.1 Introduction

In this chapter, the palaeoenvironments of the studied Upper Cretaceous sequences exposed in West Jordan are dealt with. The interpretations deduced in this study are based on the lithostratigraphy, biostratigraphy and the quantitative distribution of the foraminiferal fauna in the studied sequences, in addition to results of the microfacies analysis.

The principle sources of data used in the environmental interpretation of foraminiferal assemblages are the works of Bandy and Arnal (1957, 1960), Phleger (1960), Bandy (1961, 1963) and Murray (1991). Bandy and Arnal (1960), in their study of modern foraminiferal ecology, established the following four distinct criteria for the reconstruction of marine palaeoenvironments:

1. The number of both species (diversity) and specimens (abundance) increases away from the shore and with increasing depth of water, to maximum values on the outer shelf and in the bathyal zone.
2. Diverse porcelaneous species are abundant in shallow near-shore marine environments.
3. Arenaceous foraminifera with simple interiors may be abundant in shallow waters, whereas more complex types with labyrinthic interiors are more characteristic of bathyal depths.
4. Deposition of planktonic species occurs most abundantly on the outer shelf and in the upper bathyal zone, with even greater abundance in deeper waters under the right conditions.

The palaeobathymetric zones recognised here are based primarily on the work of Murray (1991). For each zone or environment, characteristic foraminiferal genera reported by various authors are listed where these have been encountered in the four sections studied here.

(1) Supratidal environment: this shore zone lies immediately above high tide level, commonly it is kept moist by waves and spray. The zone usually includes bivalve and gastropod shells.

(2) Intertidal, brackish-water, marshy environment: (0 - 10 m) this zone is bounded by high-tide and low-tide levels. The main foraminiferal genera encountered are agglutinated (*Ammobaculites, Ammotium, Haplophragmoides, Trochammina*) and calcareous (*Bolivina, Elphidium, Nonion, Quinqueloculina, Peneroplis*) benthic forms.

(3) Inner-shelf environment: (10 - 50 m; low planktonic abundance = 0 - 8 %) here the main foraminiferal families encountered include the following benthic taxa: **Hauerinidae** (*Ammomassilina, Massilina, Quinqueloculina*); **Lituolidae** (*Ammoastuta, Ammobaculites, Ammomarginulina, Ammotium, Flabellammina,* *Kutsevella, Lituola, Praeammoastuta, Pterammina, Sculptobaculites, Triplasia*); **Nezzazatidae** (*Biplanata, Merlingina, Nezzazata, Nezzazatinella, Trochospira*) and **Textulariidae** (*Textularia*).

(4) Mid-shelf environment: (50 - 100 m; 10 - 25 % planktonic foraminifera) here the main planktonic families encountered include the: **Hedbergellidae** (*Concavatotruncana, Costellagerina, Hedbergella, Whiteinella*); **Heterohelicidae** (*Gublerina, Heterohelix, Planoglobulina, Pseudoplanoglobulina Pseudotextularia, Ventilabrella*). Benthic genera include: **Nodosariidae** (*Dentalina, Dentalinoides, Frondicularia, Laevidentalina, Mucronina, Nodomorphina, Nodosaria, Pyramidulina, Tristix*); **Gavelinellidae** (*Gavelinella, Gyroidinoides, Lingulogavelinella, Stensioeina*). The following foraminiferal genera and species are also typical: *Bolivina, Brizalina, Bulimina, Cibicides, Citharina suturalis, Gaudryina rugosa, Globulina, Lenticulina, Nonionella, Praebulimina aspera, P. carseyae, Reophax, Spiroplectammina, Textularia.*

(5) Outer shelf environment: (100 - 200 m; 30 - 70 % planktonic foraminifera) characterised by an abundance of planktonic foraminifera and the disappearance of many benthic taxa. Planktonic foraminiferal families include: **Heterohelicidae** (*Gublerina, Heterohelix, Planoglobulina, Pseudoplanoglobulina Pseudotextularia, Ventilabrella*); **Hedbergellidae** (*Concavatotruncana, Costellagerina, Hedbergella, Whiteinella*); with some **Globotruncanidae** (*Contusotruncana, Globotruncana, Globotruncanella, Globotruncanita, Marginotruncana, Rugotruncana, Sigalitruncana*). Benthic foraminifera include: *Bolivina incrassata, Bolivinopsis, Cibicides, Coryphostoma plaitum, Epistominella, Fursenkoina, Gyroidinoides nitidus, Loxostomum, Nonionella.*

(6) Upper bathyal environment: (200 - 2000 m; planktonics > 70 %) includes a high proportion of calcareous benthic foraminifera and planktonic foraminifera, particularly **Globotruncanidae** (*Contusotruncana, Globotruncana, Globotruncanella, Globotruncanita, Marginotruncana, Rugotruncana, Sigalitruncana*); reduced abundance of **Turrilinidae** (*Neobulimina, Praebulimina, Pyramidina*), and **Gavelinellidae** (*Gavelinella, Gyroidinoides, Lingulogavelinella, Stensioeina*); absence of shelf forms, such as *Gyroidinoides* and incoming of deep-water agglutinated forms.

(7) Lower bathyal environment: (2000 - 4000 m; planktonic foraminiferal average 90 %), is dominanted the planktonic forms, other foraminiferal genera include: *Cibicides, Gavelinella, Gyroidinoides, Stensioeina.*

(8) Abyssal environment: (4000 - 5000 m), located below the lysocline and at the carbonate compensation depth, the calcareous planktonic foraminiferal assemblages has generally been removed by dissolution, fauna may include remains of Radiolaria and *Hormosina.*

(9) Hadal environment: (5000 - 10000 m), is the deepest water, fauna include only arenaceous foraminifera and occasional radiolarian species.

In order to obtain reasonable results from the analysis of foraminiferal assemblages, vertical variation in the frequency of planktonic and benthic foraminifera was studied. Data obtained included the total number of foraminiferal species present in each lithostratigraphic unit, and the ratio between planktonic, benthic calcareous and arenaceous foraminifera. Some of the benthic species have also been numerically studied, particularly Nodosariidae, Buliminidae and Spiroplectamminidae, as indicators to sea-water depths. Some of the recognised rock units yielded no free foraminifera, thus it is impossible to calculate the relative proportion of the faunal content in these rocks and the microfacies analyses were used in estimating the environmental conditions.

In the following paragraphs, each rock unit will be discussed from older to younger as described in the litho- and biostratigraphic chapters (5 & 6). This discussion includes the sedimentary characters, the quantitative analysis and, whenever possible, the microfacies analysis and the inferred palaeoecological environments.

6.2 Northern area (Ajlun / Jerash)

6.2.1 Subeihi (Kurnub) Formation "K2"

This formation was sampled in all sections, except Wadi Mussa. In the northern area, it consists of glauconitic sandstone, shale and limestone beds and yielded no fossils. The suggested environment for this rock unit seems to be fluviomarine as it commonly displays lenticular cross-bedding, suggesting subaqueous deposition. The presence of glauconite indicates the deposition under marine conditions.

6.2.2 Na'ur Formation "A1" & "A2"

This formation consists of a sequence of massive dolostones and alternating shales and limestones at the base, nodular limestone in the middle and at the top of succession, intercalated with beds of marl. The lithology of the Na'ur Formation reflects the beginning of the Cenomanian marine transgression. This formation has yielded principally arenaceous species (*Ammobaculites agglutinans, A. turonicus, Charentia cuvillieri, Planispirinella barnardia, Psammonyx sp. 1, Thomasinella aegyptia, T. fragmentaria*), associated with ostracods, molluscs, echinoid spines, algae and vertebrate fragments. This faunal assemblage, which is devoid of calcareous foraminifera and contains only few arenaceous foraminiferal species, suggests an intertidal, to shallow subtidal environment.

6.2.3 Fuheis Formation "A3"

This formation consists mainly of a sequence of marly beds with thin marly limestones and oyster banks containing common gastropods. The foraminiferal fauna include the following: **Haplophragmoididae** (*Ammosiphonia, Evolutinella, Haplophragmoides*), **Hormosinidae** (*Adelungia, Polychasmina, Reophax, Scherochorella*), **Lituolidae** (*Ammoastuta, Ammobaculites, Ammomarginulina, Ammotium, Flabellammina, Kutsevella, Lituola, Pterammina, Triplasia*), **Nezzazatatidae** (*Biplanata, Nezzazata*), **Polymorphinidae** (*Globulina, Guttulina, Polymorphina, Pseudopolymorphina*), arenaceous (*Charentia, Hemicyclammina,* *Mayncina, Placopsilina, Planispirinella, Thomasinella, Trochammina*), and calcareous genera (*Conorboides, Dentalina, Gavelinella*). Planktonic foraminifera include only **Hedbergellidae** (*Hedbergella, Whiteinella*).

This foraminiferal assemblage exhibitsa rapid increase in the number of species (from quite few in the underlying Na'ur Formation to 121 species in the Fuheis Formation), and containing a high proportion of arenaceous and microgranular calcareous forms (68 % arenaceous, 29 % calcareous, 3 % planktonic), associated with nodosarids and gavelinellids, suggests deepening water depth (Tables 6.1, 6.2) probably an inner-shelf environment with good open-sea connections (appearance of planktonic foraminifera).

6.2.4 Hummar Formation "A4"

This formation consists mainly of massive and dolomitic limestones with few intercalated marly beds. It is characterised by the presence of *Ammobaculites, Conorboides, Psammonyx, Trochammina*, associated with ostracods, bivalve oysters, gastropods, echinoid spines and algal fragments.

This faunal assemblage is characterised by a sharp decrease in the number of foraminiferal species (from 121 in the underlying Fuheis Formation to only a few species in the Hummar Formation), has a high proportion of arenaceous foraminifera, devoid of calcareous foraminifera and is associated with ostracods, molluscs, echinoids, algae and vertebrate fragments, suggesting shallowing with the return to an intertidal, brackish-water, marshy coastal environment.

The Hummar Formation "A4" is missing in the central and southern areas, indicating that these areas were not reached by the marine transgression during the time of deposition of this formation.

6.2.5 Shueib Formation "A5" & "A6"

This formation is distinguished from the underlying Hummar Formation by an increase in the amount of marl. It may be subdivided into the following members:

6.2.5.1 Lower Marly Member "A5"

This member consists of a sequence of alternating limestones and marly limestones. It contains fragments of rudist bivalves and other molluscs. The foraminiferal fauna include: **Eponididae** (*Eponides, Poroeponides*), **Haplophragmoididae** (*Evolutinella, Haplophragmoides*), **Lituolidae** (*Ammobaculites, Ammomarginulina, Flabellammina, Kutsevella, Sculptobaculites, Triplasia*), **Mayncinidae** (*Biconcava, Mayncina*), **Nezzazatatidae** (*Biplanata, Nezzazata, Nezzazatinella*), **Polymorphinidae** (*Globulina, Guttulina, Pseudopolymorphina*), arenaceous (*Arenobulimina, Bolivinopsis, Charentia, Plectina, Reissella, Reophax, Thomasinella, Trochospira*), and calcareous genera (*Conorboides, Dentalina, Gavelinella, Lingulogavelinella*). Planktonic foraminifera include: **Hedbergellidae** (*Hedbergella, Whiteinella*) and **Heterohelicidae** (*Heterohelix, Ventilabrella*), *Anaticinella, Favusella, Guembelitria*.

Table 6.1 Quantitative analysis of the total number and percentage of foraminiferal species found in the four studied sections of the Upper Cretaceous of West Jordan.

Chrono- and lithostratigraphy			**Ajlun/Jerash**				**Wadi Mujib**				**Wadi Mussa**				**Ras en-Naqb**			
Age	**Formation**	**Member**	**Plk**	**Cal**	**Arn**	**Tot**	**Plk**	**Cal**	**Arn**	**Tot**	**Plk**	**Cal**	**Arn**	**Tot**	**Plk**	**Cal**	**Arn**	**Tot**
Lower Maastrichtian	Amman Formation	Upper	Not studied				35%	60%	5%	**37**	24%	59%	17%	**41**	Not studied			
Campanian		Lower	Not studied				36%	58%	6%	**123**	Ostracods, bivalves and vertebrates				Phosphates, bivalves and gastropods			
U. Coniacian-Santonian	Ghudran	B1	Not studied				43%	49%	8%	**98**	00%	70%	30%	**24**	4%	76%	20%	**25**
Turonian	Wadi Sir	A7	16%	35%	49%	**43**	00%	80%	20%	**21**	Vertebrate fragments				7%	72%	21%	**14**
Upper Cenomanian	Shueib Formation	Upper A6	5%	19%	76%	**21**	4%	19%	77%	**48**	Barren horizon				Gastropod shells			
		Lower A5	12%	44%	44%	**105**	21%	50%	29%	**84**	Barren horizon				Barren horizon			
	Hummar	A4	0%	0%	100	**4**	15%	40%	45%	**76**	00%	60%	40%	**10**	00%	54%	46%	**13**
Lower-Middle Cenomanian	Fuheis	A3	3%	29	68	**121**	(spanned)				(spanned)				(spanned)			
	Na'ur Formation	Upper A2	00%	00%	100%	**5**	10%	53%	37%	**129**	00%	46%	54%	**28**	3%	48%	49%	**109**
		Lower A1	00%	00%	100%	**2**	8%	42%	50%	**87**	4%	43%	53%	**28**	00%	8%	92%	**25**
? Albian	Subeihi	K2	Barren horizon				Barren horizon				Not studied				00%	00%	100%	**2**

Table 6.2 Upper Cretaceous palaeoenvironments in West Jordan.

Age	Formation	Member	Ajlun/Jerash	Wadi Mujib	Wadi Mussa	Ras en-Naqb
Lower Maastrichtian	Amman Formation	Upper	Not studied	Outer shelf	Mid shelf	Not studied
Campanian		Lower	Not studied	Outer shelf	Shallow subtidal	Shallow subtidal
U. Coniacian-Santonian	Ghudran	B1	Not studied	Outer shelf	Inner shelf	Inner shelf with open-sea connections
Turonian	Wadi Sir	A7	Mid shelf	Inner shelf	Very shallow subtidal	Inner shelf with open-sea connections
Upper Cenomanian	Shueib Formation	Upper A6	Inner shelf with open-sea connections	Inner shelf	?Shallow subtidal	?Shallow subtidal
		Lower A5	Mid shelf	Mid shelf	?Shallow subtidal	?Shallow subtidal
	Hummar	A4	Intertidal to shallow	Mid shelf	Inner shelf	Inner shelf
Lower-Middle Cenomanian	Fuheis	A3	Inner shelf, open-sea			
	Na'ur Formation	Upper A2	Intertidal to shallow subtidal	Mid shelf	Inner shelf	Inner shelf with open-sea connections
		Lower A1	Intertidal to shallow subtidal	Inner shelf with open-sea connections	Inner shelf with open-sea connections	Intertidal to shallow subtidal
? Albian	Subeihi	K2	Supratidal	Supratidal	Not studied	Intertidal to shallow subtidal

The above foraminiferal assemblage is characterised by a rapid increase in the number of species (from only four species in the underlying Hummar Formation, to 105 species in this member), and contains a high proportion of arenaceous and microgranular calcareous forms (44 % arenaceous, 44 % calcareous, 12 % planktonic), associated with an appreciable number of planktonic foraminiferal species, suggesting abrupt deepening water depths, which may have reached mid-shelf depths (Tables 6.1, 6.2).

6.2.5.2 Upper Calcareous Member "A6"

This member consists of a sequence of nodular limestones, intercalated with marl beds, yielding: **Haplophragmoididae** (*Evolutinella, Haplophragmoides*), **Hormosinidae** (*Adelungia, Scherochorella*), **Lituolidae** (*Ammobaculites, Ammomarginulina*), **Polymorphinidae** (*Globulina, Guttulina*), occasional other benthic genera (*Astacolus, Hemicyclammina, Vernonina*), and the planktonic form (*Heterohelix*), associated with ostracods, bivalves, bryozoans, echinoids, vertebrate fragments and large ammonites.

This foraminiferal assemblage, with its rapid decrease in the number of foraminiferal species (from 105 species in the underlying Marly Member to 21 species in this Member), and containing a high proportion of arenaceous forms (76 % arenaceous, 19 % calcareous, 5 % planktonic), associated with ostracods and echinoids, suggests shallowing, possibly to inner-shelf depths but retaining good open-sea connections, as indicated by presence of planktonic foraminifera and ammonites (Tables 6.1, 6.2).

6.2.6 Wadi Sir Formation "A7"

This formation consists of nodular, dolomitic and marly limestones, with an oyster bank. The upper part of this index horizon is characterised by the extensive appearance of cherts layers. The foraminiferal fauna encountered in this formation include: *Adelungia, Ammobaculites, Ammodiscoides, Anaticinella, Biplanata, Charentia, Coryphostoma, Flabellammina, Gaudryina, Gavelinella, Hedbergella, Heterohelix, Lenticulina, Lingulogavelinella, Lituola, Marssonella, Mayncina, Peneroplis, Pseudorhapydionina, Pseudotextulariella, Pterammina, Quadrimorphina, Quasispiroplectammina, Ramulina, Reissella, Reophax, Scherochorella, Serovaina, Textularia, Triplasia, Tristix, Trochammina, Whiteinella,* associated with *Orbitulina*, cuneolinids, miliolids, ostracods, bivalve oysters, gastropods, echinoid spines, algal and vertebrate fragments.

The above foraminiferal assemblage, characterised by an increase in the number of species (from 21 in the underlying Member to 43 in this formation), with a high proportion of arenaceous and microgranular calcareous forms, associated with appreciable amount of planktonic foraminifera (49 % arenaceous, 35 % calcareous, 16 % planktonic), suggests a pronounced deepening, again reaching mid-shelf depths (Tables 6.1, 6.2).

Increasing abundances of molluscs, ostracods, echinoids, bryozoans, vertebrate and algal fragments, in the upper part of this formation, suggests slight shallowing. In thin sections the rocks representing this formation appear as a sequence of sparites and rare micrites devoid of Heterohelicidae or other planktonic foraminifera, but rich in fragments of molluscs, ostracods, calcareous algae and intraclasts. These microfacies suggest a marked decrease in water depths by the end of the Turonian.

6.3 Central area (Wadi Mujib)

6.3.1 Subeihi (Kurnub) Formation "K2"

This formation consists of glauconitic sandstone, shale and limestone beds and yielded no fauna. The suggested environment for this rock unit is shallow marine.

6.3.2 Na'ur Formation "A1" & "A2"

6.3.2.1 Lower Shaly Member "A1"

This member consists of a sequence of alternating limestones and shales, with massive dolomitic limestone containing burrows at the base. The benthic foraminiferal fauna includes: **Cyclamminidae** (*Cyclammina, Hemicyclammina*), **Gavelinellidae** (*Gavelinella, Gyroidinoides, Lingulogavelinella*), **Hormosinidae** (*Adelungia, Scherochorella*), **Lituolidae** (*Ammobaculites, Ammomarginulina, Ammotium, Flabellammina, Kutsevella, Praeammoastuta, Sculptobaculites*), **Nodosariidae** (*Dentalinoides, Laevidentalina*), **Polymorphinidae** (*Eoguttulina, Globulina, Guttulina, Polymorphina, Pseudopolymorphina*), **Turrilinidae** (*Neobulimina, Praebulimina, Pyramidina*), other benthic genera recorded are: *Ammovertilina, Bulimina, Cassidella, Charentia, Coryphostoma, Eponides, Gabonita, Haplophragmoides, Lenticulina, Marssonella, Mayncina, Quinqueloculina, Serovaina, Spiroloculina, Textularia, Thomasinella, Trochammina, Vernonia.* Planktonic foraminifera include: *Globigerinelloides, Guembelitria, Hedbergella, Heterohelix, Pseudotextularia, Whiteinella*, associated with ostracods, bivalves, gastropods, sponge debris, echinoid spines and vertebrate fragments.

This foraminiferal assemblage, with an appreciable number of foraminiferal species (87 species), and containing a high proportion of arenaceous and microgranular calcareous forms (50 % arenaceous, 42 % calcareous, 8 % planktonic), associated with Nodosariidae and Gavelinellidae, suggests an inner-shelf environment, with good open-sea connections (Tables 6.1, 6.2).

6.3.2.2 Upper Nodular Member "A2"

This member is composed of a sequence of alternating soft and indurated nodular limestone with marly bands. The foraminiferal fauna includes: **Cyclamminidae** (*Choffatella, Hemicyclammina*), **Eponididae** (*Donsissonia, Eponides, Poroeponides, Sestronophora, Vernonia*), **Gavelinellidae** (*Gavelinella, Gyroidinoides, Lingulogavelinella, Stensioeina*), **Haplophragmoididae** (*Evolutinella, Haplophragmoides*), **Lituolidae** (*Ammoastuta, Ammobaculites, Ammotium, Flabellammina, Kutsevella, Praeammoastuta, Sculptobaculites, Triplasia*), **Mayncinidae** (*Daxia, Mayncina*), **Nezzazatidae** (*Biplanata, Nezzazata*), **Turrilinidae** (*Neobulimina, Praebulimina*); other genera include: *Anomalinoides, Arenobulimina, Cassidella, Charentia, Conorbina, Conorboides, Coryphostoma,* *Dentalina, Fissurina, Gabonita, Gavelinopsis, Guttulina, Hensonina, Ismailia, Lagena, Lenticulina, Marssonella, Orbitolina, Placopsilina, Planispirinella, Plectinella, Polychasmina, Psilocitharella, Quadrimorphina, Quasispiroplectammina, Quinqueloculina, Reissella, Serovaina, Textularia, Trochammina, Trochamminoides, Valvulineria*. Planktonic foraminifera include: Globigerinelloides, **Hedbergellidae** (*Costellagerina, Hedbergella, Whiteinella*) and **Heterohelicidae** (*Heterohelix, Pseudotextularia*), associated with ostracods, bivalves, gastropods, sponge debris, echinoid spines and vertebrate fragments.

The above foraminiferal assemblage, with a rapid increase in the number of species (from 87 in the underlying member to 129 in this member), a high proportion of arenaceous and microgranular calcareous forms (37 % arenaceous, 53 % calcareous, 10 % planktonic), associated with Nodosariidae, Gavelinellidae, and an appreciable number of planktonic foraminifera (mainly Heterohelicidae and Hedbergellidae), suggests a pronounced deepening, reaching the mid-shelf depth (Tables 6.1, 6.2).

6.3.3 Fuheis Formation Equivalent "A3"

This formation consists of a sequence of dolomitic limestones, shales and marls. The benthic foraminiferal fauna includes: **Eponididae** (*Sestronophora, Vernonia*), **Hormosinidae** (*Polychasmina, Scherochorella*), **Lituolidae** (*Ammobaculites, Ammomarginulina, Ammotium*), **Mayncinidae** (*Daxia, Mayncina*), **Nodosariidae** (*Nodosaria, Tristix*); other benthic genera include: *Ammovertillina, Arenobulimina, Charentia, Fursenkoina, Haplophragmoides, Hemicyclammina, Ismailia, Lenticulina, Lingulogavelinella, Merlingina Oolina, Planispirinella, Praebulimina Serovaina, Textularia, Thomasinella, Trochamminoides, Valvulineria*. Planktonic taxa include: *Globigerinelloides, Guembelitria*, **Hedbergellidae** (*Hedbergella, Whiteinella*) and **Heterohelicidae** (*Heterohelix, Pseudotextularia, Pseudotextulariella*), associated with ostracods, bivalves and echinoid spines.

The above foraminiferal assemblage, although exhibiting a decrease in the total number of species (from 129 in the underlying member, to 76 in this formation), still exhibits a comparatively higher proportion of planktonic forms (45 % arenaceous, 40 % calcareous, 15 % planktonic), associated with Gavelinellidae, Nodosariidae, Hedbergellidae and Heterohelicidae, suggesting a continuation of mid-shelf conditions (Tables 6.1, 6.2).

6.3.4 Shueib Formation Equivalent "A5" & "A6"

The Hummar Formation **"A4"** is missing in the Wadi Mujib area, suggesting that this area was not reached by the marine transgression during the time of deposition of this formation. Therefore, the Lower Marly Member **"A5"** of the Shueib Formation Equivalent lies unconformably over Fuheis Formation **"A3"**. The Shueib Formation may be subdivided into the following members:

6.3.4.1 Lower Marly Member "A5"

This member consists of a sequence of shales, nodular limestones and marly limestones with some gypsum beds. The foraminiferal fauna include the benthic genera: *Ammobaculites, Ammomarginulina, Arenobulimina, Bulimina, Clavulinopsis, Conorboides, Coryphostoma, Dicyclina, Eoheterohelix, Gabonita, Gavelinella, Globospirillina, Gyroidinoides, Haplophragmoides, Hemicyclammina, Lagena, Lingulogavelinella, Neobulimina, Neodiscorbinella, Nezzazata, Nonionella, Planispirinella, Praebulimina, Pravoslavlevia, Pristinosceptrella, Pyramidina, Serovaina, Thomasinella*. Planktonic genera consist of: *Globigerinelloides, Hedbergella, Heterohelix, Pseudoplanoglobulina, Whiteinella*, associated with ostracods, bivalves, gastropods, echinoid spines, vertebrate fragments and large ammonites.

The above foraminiferal assemblage, characterised by a slight increase in the total number of species (from 76 in the underlying Fuheis Formation, to 84 in this member), with a comparatively higher proportion of planktonic forms (29 % arenaceous, 50 % calcareous, 21 % planktonic), associated with Gavelinellidae, Nodosariidae, Hedbergellidae and Heterohelicidae, suggests a continuation of dominantly mid-shelf environments. However, the occurrence of some shallow-marine elements (indicating intertidal environment) in the fauna e. g. Nezzazata, ostracods, molluscs, echinoids, vertebrate fragments and ooids suggesting shallow depths (Tables 6.1, 6.2).

6.3.4.2 Upper Shaly Member "A6"

This member consists of a sequence of alternating marls, shales, dolomitic and oolitic limestones, with bands of dolomite and gypsum. The foraminiferal fauna include the benthic genera: *Ammoastuta, Ammobaculites, Ammomarginulina, Ammomassilina, Ammotium, Astacolus, Bulbobaculites, Bulbophragmium, Cuneolina, Cyclammina, Evolutinella, Flabellammina, Gabonita, Haplophragmoides, Hormosina, Lituola, Massilina, Placopsilina, Psammonyx, Pseudorhapydionina, Quadrimorphina, Quinqueloculina, Reophax, Scherochorella, Sculptobaculites, Serovaina, Simplorbitolina*. Planktonic genera consist of *Guembelitria* and *Pseudotextularia*, associated with ostracods, bivalves, gastropods, echinoids and vertebrates.

This foraminiferal assemblage, with a rapid decrease in the number of foraminiferal species (from 84 in the underlying member, to 48 in this member), and the high proportion of arenaceous forms (77 % arenaceous, 19 % calcareous, 4 % planktonic), associated with ostracods and echinoids, suggests shallowing to inner-shelf depths but with open-sea connections being maintained, as indicated by the continuing presence of planktonic foraminifera (Tables 6.1, 6.2).

6.3.5 Wadi Sir Formation "A7"

This formation consists of a sequence of alternating limestones and marly limestone beds, with an oyster bank. The foraminiferal fauna includes only benthic genera: *Ammobaculites, Conorboides, Donsissonia, Flabellammina, Gavelinella, Gavelinopsis, Nezzazata, Reissella, Serovaina, Trochospira, Valvulinoides*, associated with ostracods, bivalves, *Plicatula, Exogyra,* gastropods, echinoids, *Micraster,* worm tubes, bryozoans, sponges and ammonites.

This foraminiferal assemblage, with a continuous decrease in the number of foraminiferal species (from 48 in the underlying member to 21 in this formation), devoid of planktonic forms and with high proportion of arenaceous forms (20 % arenaceous, 80 % calcareous), suggests decreasing water depths, but still within inner-shelf setting (Tables 6.1, 6.2).

The increased abundance of ostracods, molluscs, echinoids, worm tubes, bryozoans, sponges and vertebrate fragments found in the upper part of Wadi Sir Formation, however, suggests a slight shallowing of the sea. In thin sections the rocks representing this part appear as a sequence of sparites and rare micrites that have been partially replaced by silica, rich in fragments of molluscs, ostracods, calcareous algae and intraclasts. These microfacies suggest a marked decrease in the water depths by the end of the Turonian.

6.3.6 Ghudran Formation "B1"

This formation consists of chalk and a sequence of limestones and marls, with chert nodules and vertebrate fragments. The foraminiferal fauna include the benthic genera: *Ammodiscoides, Anomalinoides, Bolivinopsis, Brizalina, Cassidella, Cibicides, Dorothia, Elhasaella, Eoheterohelix, Frondicularia, Gabonita, Gavelinella, Gavelinopsis, Hiltermannella, Hopkinsina, Hopkinsinella, Lenticulina, Loxostomoides, Mucronina, Neobulimina, Neoflabellina, Nonionella, Plectina, Poroeponides, Praebulimina, Pyramidulina, Quasispiroplectammina, Textularia, Vaginulina, Valvalabamina*. Planktonic foraminifera include: **Heterohelicidae** (*Heterohelix, Planoglobulina, Pseudotextularia*), **Globotruncanidae** (*Contusotruncana, Globotruncana, Marginotruncana, Sigalitruncana*) and **Hedbergellidae** (*Concavatotruncana, Hedbergella, Whiteinella*), *Anaticinella, Archaeoglobigerina, Globigerinelloides*, associated with ostracods, gastropods, echinoids and vertebrate fragments.

The above foraminiferal assemblage is characterised by a rapid increase in the number of species (from 21 in the underlying formation to 98 in this formation), together with some benthic families (*Gavelinellidae, Textulariidae*) and a high proportion of planktonic foraminifera, particularly Globotruncanidae, Hedbergellidae and Heterohelicidae (8 % arenaceous, 49 % calcareous, 43 % planktonic), suggesting a marked transgression in the Wadi Mujib area, which reached outer shelf depths (Tables 6.1, 6.2).

6.3.7 Amman Formation "B2"

6.3.7.1 Lower Silicified Limestone Member

This member contains very rare phosphatic beds, and prominent chert bands. The base of the member is taken at the bottom of the first major silicified coquinal limestone. It includes some thin beds of shale, followed by a sequence of cross-bedded phosphatic calcarenites with fish teeth, alternating with calcareous siltstones and cherts, and beds of porcelanite ("tripoli"). These are followed by a sequence of marls and shales, intercalated by chert bands and chalky limestones and chalk.

The foraminiferal fauna includes the benthic genera: *Ammodiscus, Arenobulimina, Bolivina, Cassidella, Citharina, Dentalina, Dentalinoides, Elhasaella, Eponides, Fissurina, Frondicularia, Gabonita, Gaudryina, Gavelinella, Gavelinopsis, Gyroidinoides, Hopkinsina, Kyphopyxa, Laevidentalina, Lagena, Lenticulina, Marssonella, Mucronina, Neoflabellina, Nodogerina, Nodomorphina, Nodosaria, Nonionella, Plectina, Praebulimina, Pyramidina, Pyramidulina, Tristix, Vaginulina, Vaginulinopsis, Valvulineria, Valvulinoides.* Planktonic families consist of **Hedbergellidae** (*Concavatotruncana, Costellagerina, Hedbergella*), **Heterohelicidae** (*Gublerina, Heterohelix, Planoglobulina, Pseudotextularia, Pseudotextulariella*), **Globotruncanidae** (*Contusotruncana, Globotruncana, Globotruncanella, Globotruncanita, Marginotruncana, Rugotruncana, Sigalitruncana*), **Ruguglobigerinidae** (*Archaeoglobigerina, Rugoglobigerina*), together with *Globigerinelloides, Ventilabrella.* These are associated with ostracods, gastropods, bryozoans, corals, echinoids and vertebrate fragments.

The above foraminiferal assemblage, is characterised by a rapid increase in the number of species (from 98 in the underlying formation to 123 in this member), with an appreciable number of calcareous benthic families (Gavelinellidae, Nodosariidae, Polymorphinidae, Textulariidae, Turrilinidae and Vaginulinidae) and the abundant planktonic families, particularly Globotruncanidae, Hedbergellidae, Heterohelicidae and Ruguglobigerinidae (6 % arenaceous, 58 % calcareous, 36 % planktonic), suggesting the continuation of an outer shelf regime (Tables 6.1, 6.2).

The final stage of deposition (with increasing benthic / planktonic ratio) indicates a shallowing trend in the upper part of the Campanian, and the deposition of the phosphates took place in quite shallow-water environments.

6.3.7.2 Upper Phosphatic Silicified Limestone Member

This member consists of a sequence of recrystallised limestones and dolostones with intercalated cherts and common beds of granular phosphate; an oyster coquina bed occurs within the limestones. The foraminiferal fauna include the benthic genera: *Ammodiscoides, Bulimina, Ceratobulimina, Ceratolamarckina, Cribroelphidium, Dictyopselloides, Fissoelphidium, Fissurina, Gavelinella, Gyroidinoides, Lenticulina, Neodiscorbinella, Nonion, Nonionella, Oolina, Planoglabratella, Protelphidium, Stensioeina, Valvalabamina, Valvulineria.* Planktonic genera consist of *Globigerinelloides, Globotruncanella, Hedbergella, Heterohelix, Planoglobulina, Ventilabrella*, associated with ostracods, bivalves, gastropods, echinoids, algal and vertebrate fragments, and phosphate pellets.

The absence of Globotruncanidae and the presence of appreciable quantity of ostracods, molluscs, echinoids, algal and vertebrate fragments and phosphatic pellets in the lower part of this member suggest a marked decrease in water depth compared to conditions prevailing during the Campanian. On the other hand, the overall foraminiferal assemblage include a large number of species (37), and the presence of a rich planktonic and calcareous benthonic assemblage (5 % arenaceous, 60 % calcareous, 35 % planktonic), together with scarce arenaceous and microgranular foraminiferal species, suggest the continuation of an outer shelf regime (Tables 6.1, 6.2).

6.4 Southern area (Wadi Mussa)

6.4.1 Na'ur Formation "A1" & "A2"

This formation is composed of thinly bedded marly limestones and nodular marly and dolomitic limestone with some shale bands. The foraminiferal fauna include the benthic genera: *Adelungia, Ammobaculites, Ammodiscoides, Arenobulimina, Astacolus, Bolivinopsis, Cassidella, Conorboides, Evolutinella, Fursenkoina, Gabonita, Gavelinella, Gavelinopsis, Haplophragmoides, Lingulogavelinella, Marssonella, Massilina, Neodiscorbinella, Planispirinella, Plectina, Praebulimina, Quadrimorphina, Quasispiroplectammina, Quinqueloculina, Sculptobaculites, Sestronophora, Serovaina, Spiroloculina, Trochammina, Valvulineria.* The sole planktonic genus is *Globigerinelloides*, which is associated with ostracods, molluscs, echinoids, algae, worm-tubes and vertebrate fragments.

This foraminiferal assemblages encountered in the lower and upper parts of this formation (28 species for each), exhibit a high proportion of arenaceous and microgranular calcareous forms (53 % arenaceous, 43 % calcareous, 4 % planktonic for the lower part, and 54 % arenaceous, 46 % calcareous for the upper part), associated with Gavelinellidae and ostracods, suggests an inner-shelf environment during the deposition of the Na'ur Formation, with good open-sea connections in the lower part indicated by the presence of rare planktonic foraminifera (Tables 6.1, 6.2).

6.4.2 Fuheis Formation Equivalent "A3"

This formation consists of sandy-marly dolostone, nodular and dolomitic limestone and sandstone, and alternation of marly and sandy limestones, with chert nodules and bands. The foraminiferal fauna include the benthic genera: *Ammobaculites, Cassidella, Conorboides, Fursenkoina, Gabonita, Gavelinopsis, Plectina, Quasispiroplectammina, Quinqueloculina*, associated with ostracods, echinoids, worm-tubes and vertebrate fragments.

The above foraminiferal assemblage, characterised by a decrease in the number of species (from 28 in the underlying formation, to 10 in this formation) and a high proportion of arenaceous and microgranular calcareous forms (40 % arenaceous, 60 % calcareous), and associated with ostracods, echinoids, algal clasts, worm-tubes and vertebrate fragments, suggests a slight shallowing in water depths, but still falling within an inner-shelf setting (Tables 6.1, 6.2).

The Hummar Formation "A4" is missing in Wadi Mussa, suggesting that this area was not reached by the marine transgression during the time of deposition of this formation (mid-Cenomanian).

6.4.3 Shueib Formation Equivalent "A5" & "A6"

This formation lies unconformably over the Fuheis Formation and is mainly composed of dolomitic, sandy and marly limestones. The dolostones were possibly deposited on a gently elevated area within a lagoonal environment, and developed under supratidal conditions (Kafri, 1972). In general, the limestones encountered in this formation have been recrystallised and dolomitised by diagenetic processes.

The dolomitic horizons in the Shueib Formation do not contain any evidence of framework-building organisms. This is largely due to the recrystallisation and dolomitisation which has destroyed most of the faunal evidence, except in rare cases, where few skeletal remains (including bryozoan) have been encountered in the basal dolomitic part of the formation.

The absence of any foraminiferal fauna, however, and the occasional presence of oysters and a few other macro invertebrates, indicate that this formation was laid down under supratidal - shallow subtidal conditions.

6.4.4 Wadi Sir Formation "A7"

This formation consists of a sequence of dolomitic sandy and oolitic limestone, dolomitic mudstone, with irregular chert nodules, and dolomitic claystone contain vertebrate fragments. These facies and the encountered fauna in Wadi Sir Formation suggest supratidal - shallow subtidal environments and shallowing of the sea by the end of the Turonian.

6.4.5 Ghudran Formation "B1"

This formation consists of calcareous, cross-bedded sandstone, intercalated with marly limestone beds and chert nodules. The foraminiferal fauna include only benthic genera: *Ammotium, Astacolus, Biconcava, Biplanata, Conorboides, Cribroelphidium, Gavelinella, Gavelinopsis, Haplophragmoides, Massilina, Nezzazatinella, Quinqueloculina, Serovaina, Sestronophora, Trochospira*, associated with ostracods, molluscs, echinoids and vertebrate fragments.

The above foraminiferal assemblage, characterised by an abrupt increase in the number of species (from being barren in the underlying formation to 24 species in this formation), rich in calcareous benthonic foraminiferal forms (30 % arenaceous, 70 % calcareous) particularly the Gavelinellidae, and with the associated fauna and sediment types suggests a slight deepening in-water depths, within an inner-shelf environment (Tables 6.1, 6.2).

6.4.6 Amman Formation "B2"

6.4.6.1 Lower Silicified Limestone Member

This member consists of dolomitic limestone, chert breccia and calcareous carbonaceous sandstone, with a silicified phosphate bed occuring near the base of succession.

The fauna encountered comprised of only ostracods, bivalves and vertebrate fragments suggesting supratidal -shallow subtidal environments during the Campanian Stage. The cherts and oolites were deposited in shallow basinal or lagoonal settings.

6.4.6.2 Upper Phosphatic Silicified Limestone Member

This member consists of chalky limestone, with porcelanite horizons (Tripoli), and thin laminae of silicified phosphate. The high abundance of cherts, phosphorites and organic-rich carbonates in the middle Campanian to lower Maastrichtian strata in Israel, reflects a peak in productivity levels (Reiss, 1988; Almogi-Labin et al., 1989).

The foraminiferal fauna include the benthic genera: *Ammodiscoides, Arenobulimina, Bolivina, Brizalina, Bulimina, Cassidella, Coryphostoma, Dentalinoides, Dorothia, Gabonita, Gaudryina, Laevidentalina, Neobulimina, Nonionella, Planispirinella, Plectina, Praebulimina, Pyramidina, Quasispiroplectammina.* Planktonic taxa include: *Guembelitria, Heterohelix.* This member also yielded the important radiolarian genera: *Acaeniotyle, Amphibracchium, Amphipyndax, Archaeodictyomitra, Pseudoaulophacus, Pseudodictyomitra,* associated with ostracods and vertebrate fragments.

The absence of Globotruncanidae and the presence of a comparatively large number of calcareous benthic forms (41 species), an appreciable number of planktonic foraminifera, together with a large drop in the number of arenaceous species (17 % arenaceous, 59 % calcareous, 24 % planktonic), suggest sudden deepening of the sea attaining mid-shelf depths. (Tables 6.1, 6.2).

The eight radiolarian species identified in the lower Maastrichtian of Wadi Mussa, are recorded for the first time in Jordan.

6.5 Southern area (Ras en-Naqb)

6.5.1 Subeihi (Kurnub) Formation "K2"

This formation is consists of a sequence of alternating varicoloured sandstone and non-calcareous siltstone beds, intercalated with ferruginous coarse-grained sandstone bands, and yielded *Thomasinella punica* and *Charentia cuvillieri.* The suggested environment for this rock unit seems to be fluviomarine. The presence of some rare agglutinated and arenaceous forms, however, suggests the deposition under intertidal, brackish-water, marshy conditions.

6.5.2 Na'ur Formation "A1" & "A2"

6.5.2.1 Lower Shaly Sandstone Member "A1"

This member consists of a sequence of sandy shales and calcareous sandstones. The foraminiferal fauna include the benthic genera: *Ammobaculites, Ammomarginulina, Biconcava, Charentia, Cyclammina, Evolutinella, Haplophragmoides, Hemicyclammina, Ismailia, Merlingina, Placopsilina, Thomasinella.* P *Trochamminoides,* associated with echinoid spines and vertebrate fragments. Planktonic forms are absent.

This foraminiferal assemblage, characterised by a comparatively sharp increase in the number of foraminiferal species (from only 2 in the underlying Kurnub Formation to

25 in this member), but with a high proportion of arenaceous forms (benthic arenaceous 92 %, calcareous 8 %), and associated with echinoid spines and vertebrate fragments, suggests the continuation of intertidal, brackish-water, marshy coastal conditions (Tables 6.1, 6.2).

6.5.2.2 Upper Nodular Member "A2"

This member consists of a sequence of alternating massive nodular sandy, marly limestones, shales and cross-bedded calcareous sandstones, with oyster bank and chert nodules. The foraminiferal fauna include the benthic genera: *Ammoastuta, Ammobaculites, Ammodiscoides, Ammomarginulina, Ammosiphonia, Arenobulimina, Astacolus, Biconcava, Biplanata, Cassidella, Charentia, Cibicides, Conorboides, Coryphostoma, Cyclammina, Dorothia, Eponides, Favusella, Fursenkoina, Gabonita, Gaudryina, Gavelinella, Globospirillina, Haplophragmoides, Hemicyclammina, Hiltermannella Ismailia, Laevidentalina, Neobulimina Neodiscorbinella, Nezzazata, Placopsilina, Planispirinella, Poroeponides, Praebulimina, Psammonyx, Pseudolituonella, Pyramidina, Quasispiroplectammina, Quinqueloculina, Reissella, Reophax, Serovaina, Trochammina, Vernonina, Zotheculifida*. Planktonic genera consist of *Guembelitria, Ventilabrella*, associated with ostracods, oysters, gastropods, echinoids and vertebrate fragments.

This foraminiferal assemblage of this member is characterised by a sharp increase in species diversity (from only 25 in the underlying member to 109 in this member), and a high proportion of arenaceous and microgranular calcareous forms (arenaceous 49 %, calcareous 48 %, planktonic 3 %), associated with Nodosariidae and Gavelinellidae, indicating an inner-shelf marine environment, with good open-sea connections, as demonstrated by the the presence of some planktonic forms (Tables 6.1, 6.2).

6.5.3 Fuheis Formation Equivalent "A3"

This formation consists of a sequence of marls, calcareous siltstone, sandy and dolomitic limestones, with intercalations of marl and limestone. The foraminiferal fauna include the benthic genera: *Adelungia, Ammobaculites, Ammomarginulina, Arenobulimina, Cassidella, Conorboides, Lingulogavelinella, Praebulimina, Pyramidina, Quinqueloculina, Serovaina*), associated with ostracods, gastropods, bivalves and vertebrate fragments.

The above foraminiferal assemblage is characterised by a sharp decrease in the number of species (from 109 in the underlying member to 13 in this formation) and a high proportion of arenaceous and microgranular calcareous forms (49 % arenaceous, 48 % calcareous, 3 % planktonic), associated with ostracods, gastropods, bivalves and vertebrate fragments suggesting slight shallowing, but still an inner-shelf setting (Tables 6.1, 6.2).

The Hummar Formation "A4" is missing in Ras en-Naqb, suggesting that this area was not reached by the marine transgression during the mid-Cenomasnian.

6.5.4 Shueib Formation Equivalent "A5" & "A6"

This formation lies unconformably over the Fuheis Formation and is mainly composed of cross-bedded, sandy, dolomitic limestone and dolostones, dolomitic sandstones and shales. The dolostones in the lower part of the formation, which are devoid of fauna, were possibly deposited on a gently elevated area within a lagoonal setting (Kafri, 1972).

The dolomitic horizons of this formation do not contain any fauna except in rare cases, where oysters and gastropods have been encountered in the upper part of this formation. The absence of any foraminifera and the occasional presence of a low-diversity macrofauna suggest a slight regression with this formation being laid down under supratidal conditions or at least in an intertidal, brackish-water or marshy environments.

6.5.5 Wadi Sir Formation "A7"

This formation consists of a sequence of indurated, dolomitic limestone and calcareous sandstone with alternating marly limestone beds. The foraminiferal fauna include the benthic genera: *Ammomassilina, Massilina, Quadrimorphina, Quinqueloculina, Nezzazata, Poroeponides, Thomasinella, Valvulineria*, and the index planktonic species *Concavatotruncana algeriana*, associated with ostracods, bivalves, gastropods, echinoids and vertebrate fragments.

This foraminiferal assemblage displays a rapid increase in the number of species (from being absent in the underlying formation to 14 in this formation), with a high proportion of microgranular calcareous and arenaceous forms and rare planktonic forms (21 % arenaceous, 72 % calcareous, 7 % planktonic), suggesting inner-shelf sedimentation during the deposition of this formation, with a possible open-sea connection (presence of rare planktonic foraminifera) (Tables 6.1, 6.2).

However, the relatively more abundant ostracods, molluscs, echinoids, vertebrate fragments, found in the uppermost part of the Wadi Sir Formation, suggest a marked decrease in the water depths by the end of mid-Turonian Stage. This shallowing probably corresponds to the drop of sea level observed in the eustatic curve of Haq et al. (1987), close to the end of mid-Turonian.

6.5.6 Ghudran Formation "B1"

This formation consists of a sequence of chalky and massive limestone, with thin marls, shales and limestones with chert nodules. The foraminiferal fauna include the benthic genera (*Ammobaculites, Cibicides, Conorboides, Gavelinella, Gavelinopsis, Hemicyclammina, Lingulogavelinella, Quadrimorphina, Quinqueloculina, Serovaina, Spiroloculina*), and the planktonic species *Archaeoglobigerina blowi*, associated with ostracods, bivalves, gastropods, echinoids and vertebrate fragments.

The above foraminiferal assemblage, with rapid increase in the number of foraminiferal species (from 14 in the underlying formation to 25 in this formation), together with a high proportion of microgranular calcareous benthonic and rare planktonic forms (20 % arenaceous, 76 % calcareous, 4 % planktonic), associated with Nodosariidae and Gavelinellidae, suggests slightly deeper water environments in comparison to the underlying rock unit, but still falling within the inner-shelf realm, with an open-sea connection (presence of a planktonic form) (Tables 6.1, 6.2).

6.5.7 Amman Formation "B2"

The lower part of this formation, the Lower Silicified Limestone Member, could only be studied at Ras en-Naqb. This part is composed of alternated phosphatic limestone beds with silicified phosphatic rocks and chert breccia. The encountered fauna comprises bivalves, gastropods and vertebrate fragments.

The presence of oolites and cherts in this formation indicates deposition in a shallow basinal or lagoonal area. The fauna encountered in this formation suggest a regressive stage within supratidal - shallow subtidal environments.

CHAPTER 7

GEOLOGICAL HISTORY OF THE UPPER CRETACEOUS IN JORDAN

7.1 Introduction

In this chapter the data, discussed in the litho-, biostratigraphy and palaeoenvironmental chapters, are used to deduce the geological history of the study area during the Late Cretaceous. To establish a reasonably precise geological history, it is necessary to explain the major sedimentological, palaeoenvironmental and tectonic changes that have affected Jordan during the considered geologic time span. One of the most important steps in studying the palaeogeography of an area is the recognition of sedimentary marine sequences. In the following discussion, therefore, each distinct sedimentary sequence recognised in the investigated succession will be discussed separately.

The Upper Cretaceous rocks exposed in West Jordan are entirely marine. Four sedimentary sequences, separated by significant gaps in sedimentation, are recognised. Each gap may have been caused by a global fall in sea-level and/or a phase of local tectonic activity. A correlation has been carried out (Fig. 6.1) between the stratigraphic subdivisions established in the study area and the global palaeobathymetric sea-level curve of Haq et al. (1987). The chronostratigraphic framework derived from the study of foraminifera is not precise enough to obtain a very accurate match with the eustatic curve, particularly for those intervals devoid of planktonics or yielding only a poor planktonic fauna. In these cases, environmental changes (shallowing or deepening of the sea) identified in the succession by changes in the number and diversity of foraminiferal fauna and/or the lithological characteristics of the rocks, have been used to obtain a more precise match with the eustatic sea-level curve.

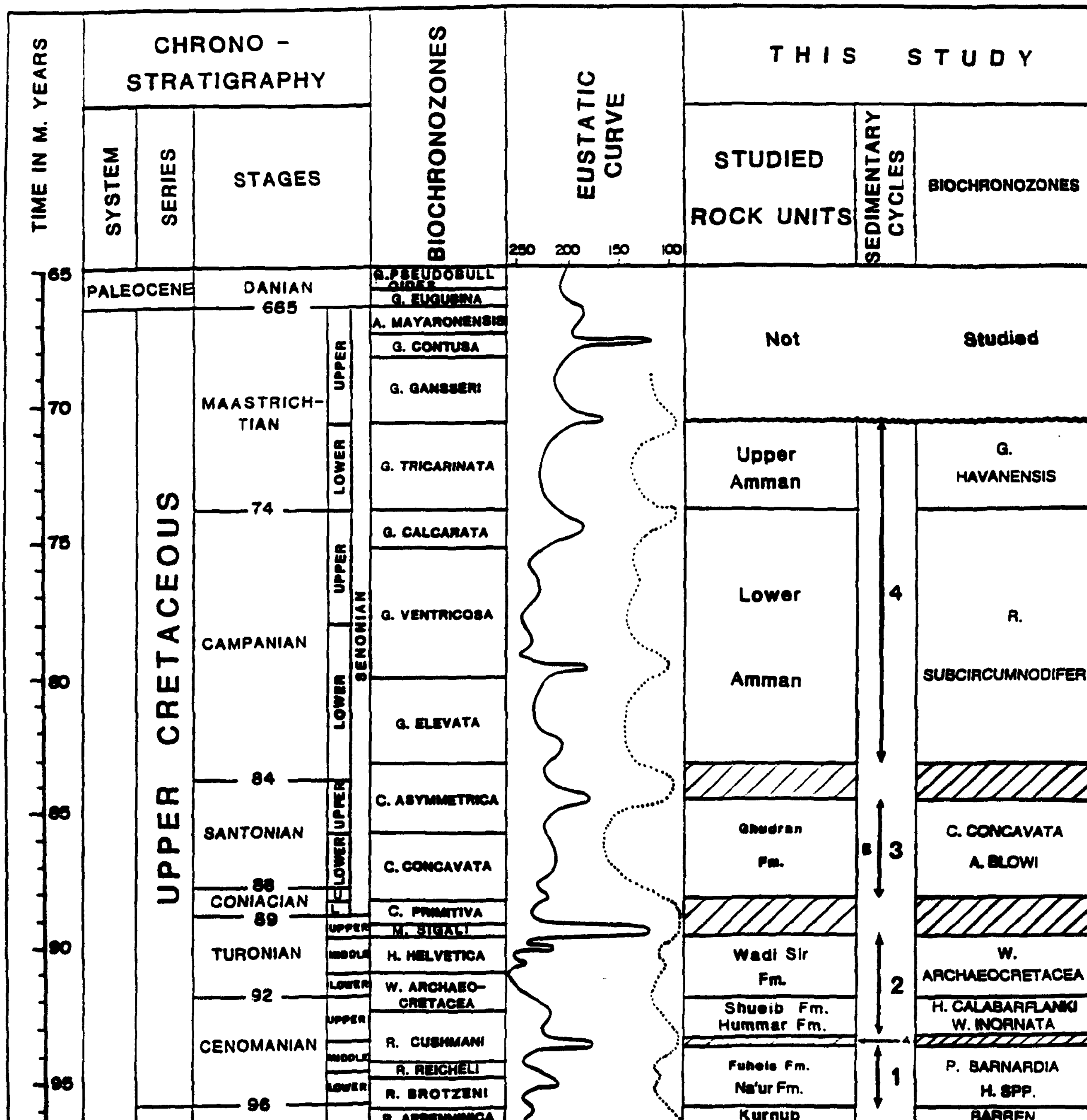
Short-term, major falls in eustatic sea-level, occurred in mid-Cenomanian, late Turonian and late Maastrichtian. These short-term falls are frequently associated with world-wide major unconformities (Haq et al., 1987). The Upper Cretaceous sequences in west Jordan may be subdivided into various rock units reflecting major fluctuations in sea-levels. A comparison of the sequence of these fluctuations with the global eustatic curve of Haq et al. (1987), for the same time interval (Fig. 6.1) strongly suggests that the changes observed in the depth of the sea in the study area are due primarily to global eustatic changes in sea-levels. The oscillations in both graphs are, in general, similar in amplitude and wavelength. Minor differences occurring during the earliest Cenomanian, middle Turonian and latest early Maastrichtian may be explained by local tectonic activity. The following is a discussion of the four sedimentary sequences suggested by analysis of the studied succession, as displayed in Fig. 6.1. The discussion deals with the sequences from older to younger.

7.2 Sedimentary Sequences

7.2.1 Sequence 1 *(early - mid-Cenomanian)*

The first sedimentary sequence identified comprises the Na'ur, Fuheis and Hummar Formations, dated here as being early to mid-Cenomanian. The base of this sequence rests

Fig. 6.1 Relationship between sedimentary sequences in Jordan and the eustatic sea-level curve of Haq et al. (1987). The dotted line represents the Jordanian sea-level curve based primarily on data from Wadi Mujib.



A Tectonic uplift B Widespread tectonic subsidence in Jordan.

on the sediment-stored shelf facies of the Subeihi Formation (Kurnub Sandstone), of probable Albian age. The sediments of the lower part of this sequence are well-developed in Wadi Mujib and Wadi Mussa, with inner to mid-shelf environments, less developed in the north and at Ras en-Naqb in the south, with intertidal to shallow subtidal environments are indicated. Sediments in the upper part of this sequence are best developed in Wadi Mujib, where mid-shelf facies predominate, representing the acme of Sequence 1, less developed in other areas, with inner shelf environments. The foraminiferal fauna of the Hummar Formation in the north suggests shallowing of the sea towards the end of deposition of the formation, it is proposed that uplift to the south preventing the deposition of this formation in the central and southern areas and caused an unconformity between the Shueib and Fuheis Formations. This indicates that we are here within the upper, regressive, part of a sequence that corresponds to the global eustatic fall in sea-level (Fig. 6.1) that occurred at the end of the mid-Cenomanian, around 94 Ma.

7.2.2 Sequence 2 *(late Cenomanian - middle Turonian)*

The second sequence comprises the Shueib and Wadi Sir Formations, of late Cenomanian to middle Turonian age. The sequence starts with an abrupt transgression, reflected by sudden appearance of a relatively deep-water foraminiferal fauna (dominated by Heterohelicidae and Hedbergellidae) in the lower Shueib Formation, which were deposited uniformly in northern and central areas, representing the acme of Sequence 2. Southern areas experienced supratidal to shallow conditions, indicated by an absence of foraminifera and the presence of abundant reworked molluscan fragments. Sediments of this sequence are less developed in the south, where Cenomanian deposits are either of reduced thickness or are missing. This transgression seems to correspond to the global change in sea-level that occurred at the end of the late Cenomanian (Fig. 6.1), at about 92.5 Ma, indicating a hiatus between Sequences 1 and 2 that corresponds to about 1.3 Myr. This hiatus is expressed by the absence of the Hummar Formation in central and southern areas of Jordan.

It is interesting to note that the Na'ur Formation corresponds broadly with the Abu Had Member of the Raha Formation in Sinai, and not to the whole of the Raha Formation (Tables 1.2, 1.3). The small eustatic oscillation in sea level that occurred during the earliest late Cenomanian is not observed in west Jordan, suggesting that sediments corresponding to the upper part of Raha Formation (Mukattab and Ekma Members of Cherif et al., 1989) were not laid down in west Jordan. It is possible that tectonic uplift occurred before this time, and that it did not allow the sea to reach the western areas of Jordan. The occurrence of such tectonic uplift is supported by evidence for the mixing of shallow-water faunal elements with deeper, basinal, fossils in the Shueib Formation. Such mixing is probably due to transportation from a nearby uplifted high structure which affected the bottom topography of the Turonian sea.

Close to the end of the deposition of Wadi Sir Formation, a marked shallowing of the sea is indicated by the disappearance of planktonic foraminifera and the frequent occurrence of reworked molluscan fragments in all four study sections. This shallowing probably corresponds to the drop of sea-level observed in the eustatic curve of Haq et al. (1987) at the end of mid-Turonian (Fig. 6.1), at about 90 Ma.

7.2.3 Sequence 3 *(late Coniacian - late Santonian)*

The third sequence comprises the late Coniacian - late Santonian Ghudran Formation. The sequence corresponds to an abrupt marine transgression that probably lasted 2.5 Myr and occurred around 88 Ma. The absence of late Turonian to early Coniacian sediments in the study areas may be due to the fact that the eustatic rise in sea-level during the late Turonian was insufficient to allow the sea to reach the western areas in Jordan. However, the late Coniacian to late Santonian was not a period of particularly high eustatic sea-levels (Fig. 6.1), especially in the southern areas. Therefore, it is suggested that tectonic subsidence may have been instrumental in allowing the deposition of the Ghudran Formation in the central area where an outer shelf environment, developed during the acme of Sequence 3, whereas to the South, deposition occcurred in inner shelf settings. This subsidence must have affected a vast area of Jordan, as the Ghudran Formation has a wide distribution.

It is noteworthy that the uppermost Coniacian, constituting the lower part of Menuha Formation in northern Sinai, is often separated from the underlying strata by a marked unconformity, suggesting the occurrence of a tectonic uplift at the end of the "middle" Coniacian (Lewy, 1975; Bartov & Steinitz, 1977) (Table 1.3). In Israel, the Coniacian-Santonian stage corresponds with Zihor Formation and with the lower part of Menuha Formation (Bartov & Steinitz, 1977). The last mentioned rock unit is a chalk, very similar to the Ghudran Formation of Jordan (Table 1.2). Thus Jordan may have been affected by a phase of widespread tectonic subsidence following the late mid-Cenomanian phase of limited tectonic uplift. These movements may have been related to the generation of the Syrian arc structures in both Jordan and in neighbouring areas (Israel, northern Sinai and probably northern Egypt; Bartov & Steinitz, 1977; Cherif et al., 1989, 1990).

7.2.4 Sequence 4 *(early Campanian - early Maastrichtian)*

The fourth sequence comprises the Amman Formation, the deposition of which probably lasted 13.5 Myr. The sequence starts with an abrupt transgression indicated by the relatively deep-water foraminiferal fauna of the Lower Silicified Limestone Member of the Amman Formationwhich reached the outer shelf depths in the central area, representing the acme of Sequence 4, whereas in the southern areas, the environments were shallow subtidal, indicated by the presence of ostracods, molluscan fragments and oolites. The transgression in the central area seems to correspond to a global rise in the sea-level that occurred at the end of late Santonian (Fig. 6.1), about 84 Ma. Thus, a hiatus exists between this sequence and the underlying one that seems to correspond to about 1.6 Myr.

A marked shallowing of the sea is observed close to the end of deposition of the Lower Silicified Limestone Member of the Amman Formation. This is indicated by the disappearance of planktonic foraminifera and the deposition of cross-bedded phosphatic calcarenites. The shallowing probably corresponds to the drop in the sea-level observed in the eustatic curve of Haq et al. (1987) at the top of the *G. elevata* Zone of Caron (1985), at about 80 Ma (Fig. 6.1). It is also notable that the following transgression, expressed by the deposition of the lower member of the Amman Formation, seems to correspond with the increase in sea-level that occurred at the base of the *G. ventricosa* Zone of Caron (1985).

The fall in the sea-level observed close to the top of the Campanian (*R. subcircumnodifer* Zone) may be equivalent to the eustatic global drop that occurred after the appearance of the *G. calcarata*, near the end of the Campanian (Fig. 6.1), at around 74.5 Ma. This drop is reflected in the sequence by the disappearance of planktonic foraminifera and the deposition of limestones containing appreciable amounts of molluscan fragments and phosphatic pellets. Two marked global eustatic falls of sea-level have been observed during the early and the late Campanian, at the beginning of the *G. ventricosa* and during the *G. calcarata* Zones of Caron (1985). These falls occurred around 80 and 75.5 Ma respectively. The second fall in the sea-level may correspond to the boundary between the lower and upper members of Amman Formation.

The following transgression is expressed by the deposition of the upper member of the Amman Formation, in outer shelf environment in the central area of Wadi Mujib and in mid-shelf environment in Wadi Mussa area of the south. This transgression seems to correspond with the increase in the sea-level observed in the eustatic curve of Haq et al. (1987) during the lower Maastrichtian (*G. tricarinata* Zone of Caron, 1985).

Another fall in the sea-level is indicated at the end of deposition of the upper member of the Amman Formation (Fig. 6.1), which may correspond with the eustatic global drop in sea-level that occurred at the end of early Maastrichtian (top *G. tricarinata* Zone of Caron, 1985), at about 71 Ma. This fall is reflected in the studied sequence by the disappearance of planktonic foraminifera, the deposition of limestones and the increase in the detrital material, with phosphatic pellets, algal clasts and ostracod shells.

7.3 Tectonic Phases

The above-mentioned four sedimentary sequences of the late Cretaceous, in the study area, are separated by three gaps of sedimentation. The two lower gaps may correspond, in part, to the following phases of tectonic activity:

1. The earliest (lowermost) phase occurred at the end of mid-Cenomanian. It is expressed by the generation of an uneven bottom topography due to local uplift, inducing redeposition of sediments in basins of the late Cenomanian and middle Turonian.

2. The following phase of tectonic activity occurred at the end of early Coniacian. It produced regional subsidance that enabled the widespread deposition of Ghudran Formation (Fig. 6.1).

CHAPTER 8

SUMMARY AND CONCLUSIONS

This chapter summarises the steps followed in this study and indicates the salient results obtained. The present work deals with the lithostratigraphy, foraminiferal biostratigraphy and geological history of the Upper Cretaceous (Cenomanian to Lower Maastrichtian) rocks of West Jordan.

8.1 Summary

The stratigraphy of the Upper Cretaceous (Cenomanian to lower Maastrichtian) in Jordan is reviewed based on published literature, and compared briefly with the Upper Cretaceous stratigraphy of Sinai, Palestine and Israel. Masri's (1963) lithostratigraphic terminology is retained in this study, because of its simplicity and its continued use in geological surveys of Jordan. However, boundaries are defined based on the author's own lithostratigraphic and faunal analysis.

The stratigraphy of the Cenomanian to lower Maastrichtian in the study area is described in detail. The data presented in this part of the thesis are based on four measured sections (one in the north, Ajlun/Jerash; one in the centre, Wadi Mujib; two in the south, Wadi Mussa and Ras en-Naqb). Each section has been logged, described and sampled in the field; 285 samples were processed subsequently in the laboratory for micropalaeontological and petrographic analysis.

Lithostratigraphic subdivisions followed in the study areas are based primarily on field characteristics. Eight Cretaceous formations (Subeihi/Kurnub "K2", Na'ur "A1" & "A2", Fuheis "A3", Hummar "A4", Shueib "A5" & "A6", Wadi Sir "A7", Ghudran "B1", Amman "B2") are described in detail, including their lithological characteristics, stratigraphic thicknesses, and microfossil contents (planktonic and benthic foraminifera, radiolarian). The local distribution of each rock unit is indicated on a series of geological maps, and a lithostratigraphic correlation of the Upper Cretaceous sections studied in West Jordan has been constructed.

Foraminiferal assemblages obtained included more than 80,000 specimens. A total of 170 genera, constituting 331 benthic foraminifera (104 calcareous and 227 agglutinated), 80 planktonic and 10 radiolarian species have been identified. Taxonomic analysis of foraminiferal taxa includes the specific characters of each species and its stratigraphic distribution both universally and in the study area. Identified microfossils were illustrated in 43 plates and their stratigraphic ranges are indicated by four stratigraphic range charts. This part of the work provides a comprehensive catalogue of Upper Cretaceous foraminifera from Jordan, and will provide a sound basis for future micropalaeontological investigations in the area.

Approximately one hundred of the identified foraminiferal species are reported for the first time in Jordan; some of these are believed to be new species. Results confirm the usefulness of both planktonic and benthic foraminifera for age determination and inter- and intra-regional correlation. The microfaunal assemblages are sufficiently characteristic in their generic, specific and numerical compositions, to make fairly exact stratigraphic determinations possible. Biostratigraphic subdivisions have been erected based mainly on planktonic foraminifera. For intervals where planktonic foraminifera are rare or absent, benthic foraminifera have been used. The planktonic foraminiferal zonal scheme of Caron (1985) has been employed wherever possible.

Cretaceous palaeoenvironments in the study area have been determined based largely on analyses of foraminiferal assemblages complemented by microfacies analysis of representative samples. Palaeoenvironmental results have been compared to published data on eustatic changes in sea level to propose a succession of four major depositional sequences for the Upper Cretaceous of West Jordan.

8.2 Conclusions

Detailed litho- and biostratigraphic analysis of the Cenomanian - Lower Maastrichtian in West Jordan has improved our understanding of the late Cretaceous history of the area. Field and laboratory analysis of the measured sections and the stratigraphic distribution of foraminifera have made it possible to establish a detailed, litho-, bio- and chronostratigraphic framework for Jordan. The exposed sequences have been divided into eight formations, and their chronostratigraphy has been elucidated by identification of their contained microfaunal assemblages. Correlation of sequences between the four studied localities has also been accomplished.

Jordanian Upper Cretaceous microfaunas show close similarities to those of similar ages in both the eastern and western hemisphere. Many of the species identified are also found in California, the Gulf Coast and Caribbean areas, North Africa, Middle East, Caucasus - Caspian Sea region, Central Asia, and as far afield as in the East Indies. Some species even occur as far away as Australia and New Zealand. Jordanian Cenomanian - Campanian microfauna are very similar to those recorded from coeval strata in Europe, Africa, Asia, and the Gulf Coast and Caribbean areas. Species occurring in the Jordanian lower Maastrichtian are typical of the European Maastrichtian, and range widely through North Africa, the Middle East countries, and into the Caucasus-Caspian Sea region.

Upper Cretaceous successions in West Jordan have been divided based on their planktonic and benthic foraminiferal contents into six distinct range zones. These (from bottom to top) are:

(1) *Conorboides umiatensis / Haplophragmoides* spp. Zone
(lower - mid-Cenomanian);

(2) *Heterohelix calabarflanki / Whiteinella inornata* Zone
(upper Cenomanian);

(3) *Gavelinella stephensoni / Whiteinella archaeocretacea* Zone
(Turonian);

(4) *Archaeoglobigerina blowi / Concavatotruncana concavata* Zone
(upper Coniacian - Santonian);

(5) *Rugotruncana subcircumnodifer* Zone
(upper Campanian);

(6) *Globotruncanella havanensis* Zone
(lower Maastrichtian).

The present study has proved the existence of a distinct faunal and lithological break between the middle Cenomanian Fuheis Formation "A3" and the overlying upper Cenomanian Shueib Formation "A5", in Wadi Mujib, Wadi Mussa and Ras en-Naqb sections. Other faunal breaks are indicated between the middle Turonian Wadi Sir Formation "A3" and the upper Coniacian to upper Santonian Ghudran Formation "B1" in the four studied sections. Another break, of smaller magnitude, probably exists between the Ghudran Formation and the lower Campanian Amman Formation "B2" in all four sections.

The presence of such breaks is probably due to a combination of eustatic falls in sea level and tectonic movements taking place at the close of middle Cenomanian, Turonian and late Santonian, which were responsible for periods of non-deposition over uplifted areas such as Wadi Mujib, Wadi Mussa and Ras en-Naqb where, for example, the whole of the Hummar Formation "A4" is missing. However, previous suggestions by field geologists of continuous emergence of Wadi Mujib throughout the late Cretaceous have proven to be erroneous.

Analysis of the foraminiferal fauna from the Cenomanian to Maastrichtian of the four studied sections, has enabled the determination of vertical and lateral changes in the bathymetry of the sea during these times. The deposition of the Ajlun Group started with a eustatic transgression of the sea during the Albian - Cenomanian. Flooding occurred across a somewhat unstable shelf, which underwent progressive tilting towards northern and central areas, and uplift to the east, southeast and south. As a consequence, sediment thicknesses are greatest in the centre and north, and thinner in southern areas. Tectonic movement continued throughout late Cretaceous to late Tertiary times.

A remarkable decrease in arenaceous foraminiferal fauna is observed in the uppermost Cenomanian (Lower Shueib "A5"). The foraminiferal fauna is suddenly replaced by calcareous species such as Bolivinacea, Ceratobuliminacea, Conorboidacea, Heterohelicacea, Nodosariacea, Planolinacea and Rotaliporacea, which indicate deepening of the sea. This phase continued in Wadi Mujib throughout the Upper Shueib Member "A6" up to the Amman Formation. An abrupt shallowing of the sea occurred by the end of the deposition of the Wadi Sir Formation "A7" in the four studied sections, which indicates that the area was subjected to tectonic uplift and local emergence after the deposition of the Shueib Formation.

After the termination of the shallowing phase and the deposition of the Wadi Sir Formation, the sea transgressed over the land for a limited period, depositing the Coniacian to Santonian Ghudran Formation, rich in planktonic foraminifera, in central and southern areas. The last sequence of deposition, comprising the Amman Formation "B2", started with an abrupt transgression, reaching outer shelf depths in the central area and producing supratidal - shallow subtidal environments in the south.

The transgression in the central area seems to correspond to a global rise in the sea level that occurred at the end of late Santonian. Thus a hiatus exists between this sequence and the underlying one. Two marked global eustatic falls of sea level have been observed during the early and late Campanian, at the beginning of the *G. ventricosa* and during the *G. calcarata* Zones of Caron (1985). The second fall in the sea level may correspond to the boundary between the lower and upper members of Amman Formation.

The subsequent transgression is expressed by deposition of the upper member of the Amman Formation, in an outer shelf environment at Wadi Mujib and at mid-shelf depths in the Wadi Mussa area. This transgression seems to correspond to the increase in the sea level observed in the eustatic curve of Haq et al. (1987) during the early Maastrichtian (*G. tricarinata* Zone of Caron, 1985).

It is concluded that the Upper Cretaceous of West Jordan may be subdivided into four sequences that reflecting major fluctuations in sea level. A comparison of these sequences with the global eustatic curve established by Haq et al. (1987) for the same time interval, strongly suggests that the changes observed in the study areas are mostly due to global eustatic changes in sea level.

Four marine sedimentary sequences have been identified, separated by hiatuses caused either by global falls in sea level and/or by tectonic activity. The sequences and regressive phases are, from base to top, as follows:

I. **First marine sedimentary sequence** (Na'ur and Fuheis Formations)

1st regressive phase (end of middle Cenomanian)

II. **Second marine sedimentary sequence** (Hummar, Shueib and Wadi Sir Formations)

2nd regressive phase (late Turonian - early Coniacian)

III **Third marine sedimentary sequence** (Ghudran Formation)

3rd regressive phase (latest Santonian - earliest Campanian)

IV **Fourth marine sedimentary sequence** (Amman Formation).

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Appendix I. Plates of foraminiferal genera and species encountered in the four stratigraphic sections. All illustrations are scanning electron micrographs, white scale bars on all figures equal 100 μm unless otherwise mentioned in the figure caption.

PLATE 1

Fig. 1.1 ***Psammonyx*** sp. 1. Sample J17, Fuheis Formation **"A3"** (middle Cenomanian), **a:** apertural view, X 200, Ajlun/Jerash; sample Q16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian), **b:** spiral view, X 350, Ras en-Naqb.

Fig. 1.2 ***Ammodiscoides turbinatus*** CUSHMAN, 1909. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** apertural view, X 750, **b:** umbilical view, X 750, Wadi Mujib.

Fig. 1.3 ***Ammodiscus cretaceus*** (REUSS, 1845). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** apertural view, X 200, **b:** spiral view, X 150, Wadi Mujib.

Fig. 1.4 ***Ammovertillina*** sp. 1. Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 1.5 ***Ammovertillina*** sp. 1. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 1.6 ***Adelungia marginulinaeformis*** (SULEYMANOV, 1963). Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 1.7 ***Adelungia*** sp. 1. Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 1.8 ***Reophax parvulus*** HUSS, 1966. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** apertural view, X 350, **b:** spiral view, X 200, Wadi Mujib.

Fig. 1.9 ***Reophax constrictus*** (REUSS, 1874). Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** spiral view, X 200, **b:** apertural view, X 500, Wadi Mujib.

Fig. 1.10 ***Reophax*** cf. ***nodulosus*** BRADY, 1879. Sample Q22a, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). Side view, X 350, Ras en-Naqb.

Fig. 1.11 ***Scherochorella minuta*** (TAPPAN, 1940). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 1.12 ***Scherochorella*** sp. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 1.13 ***Polychasmina pawpawensis*** LOEBLICH and TAPPAN, 1946. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** dorsal view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 1.14 ***Hormosina excelsa*** (DYLAZANKA, 1923). Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** spiral, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 1.15 ***Hormosina*** cf. ***velascoensis*** (CUSHMAN, 1926). Sample M27, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** apertural view, X 350, **b:** spiral view, X 1008, Wadi Mujib.

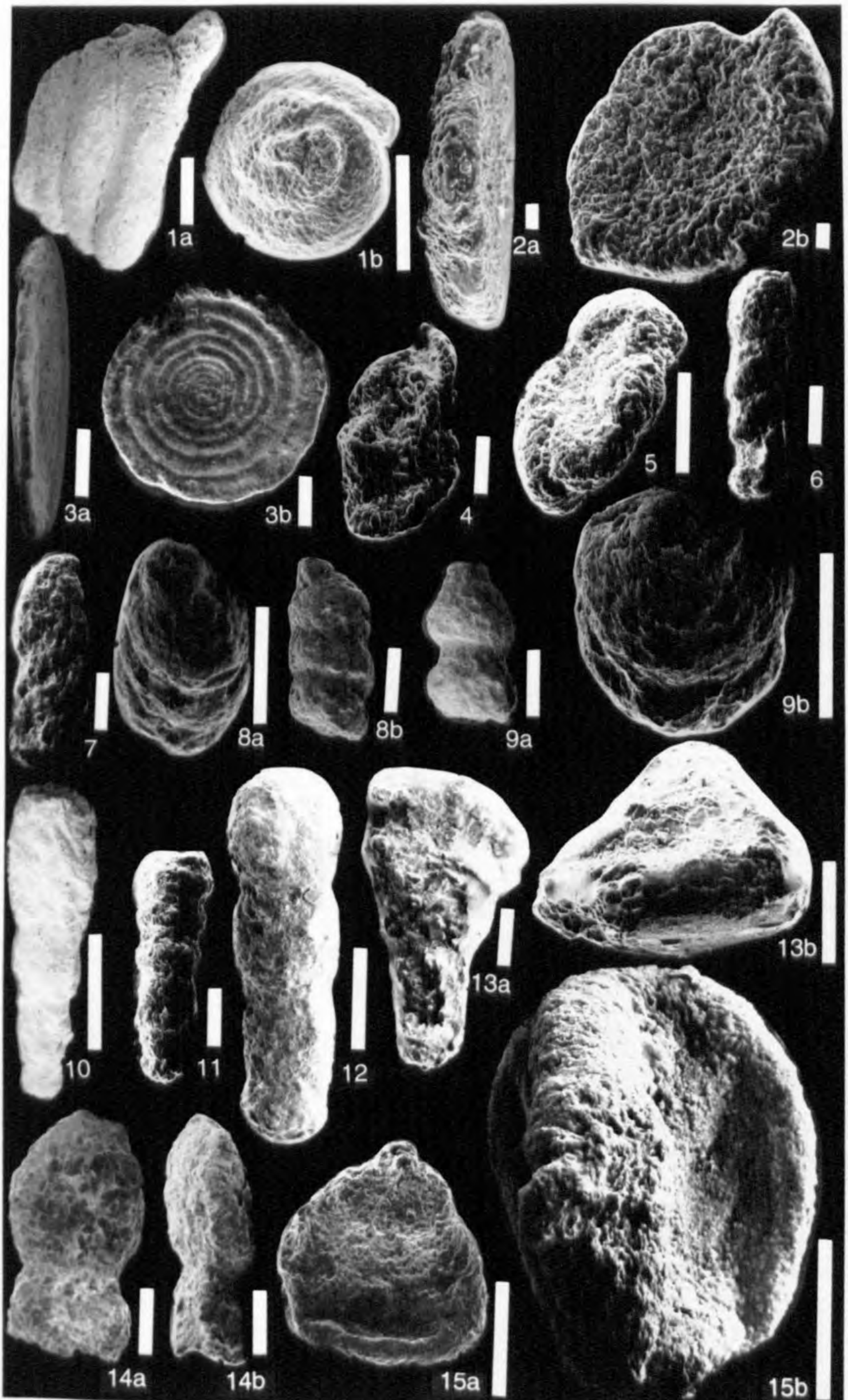

Plate 1

PLATE 2

Fig. 2.1 *Thomasinella aegyptia* OMARA, 1956. Sample Q37, Wadi Sir Formation "A7" (Turonian), **a:** apertural view, X 500, Ras en-Naqb; sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian), **b:** Side view, X 50, Wadi Mujib.

Fig. 2.2 *Thomasinella fragmentaria* OMARA, 1956. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 50, Wadi Mujib.

Fig. 2.3 *Thomasinella punica* SCHLUMBERGER, 1893. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 75, **b:** apertural view, X 100, Wadi Mujib.

Fig. 2.4 *Ammosiphonia* sp. Sample Q18, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 200, Ras en-Naqb.

Fig. 2.5 *Evolutinella subevoluta* NIKITINA and MYATLYUK, 1971. Sample M56, Upper Shaly Member "A6", Shueib Formation Equivalent (upper Cenomanian). **a:** umbilical view, X 150, **b:** apertural view, 200, Wadi Mujib.

Fig. 2.6 *Evolutinella* sp. 1. Sample M20, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 200, **b:** apertural view, 350, Wadi Mujib.

Fig. 2.7 *Evolutinella* sp. 1. Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 2.8 *Haplophragmoides kirki* WICKENDEN, 1932. Sample M8c, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 2.9 *Haplophragmoides kirki* WICKENDEN, 1932. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 2.10 *Haplophragmoides fraseri* WICKENDEN, 1932. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 2.11 *Haplophragmoides famosus* TAKAYANAGI, 1960. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 2.12 *Haplophragmoides calculus* CUSHMAN and WATERS, 1927. Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 2.13 *Haplophragmoides neolinki* STELCK and WALL, 1955. Sample Q9, Lower Shaly Sandstone Member "A1", Na'ur Formation (lower Cenomanian). **a:** umbilical view, X 350, **b:** spiral view, X 350, Ras en-Naqb.

Fig. 2.14 *Haplophragmoides excavatus* CUSHMAN and WATERS, 1927. Sample J15, Fuheis Formation "A3" (middle Cenomanian). **a:** edge view, X 150, **b:** Side view, X 150, Ajlun/Jerash.

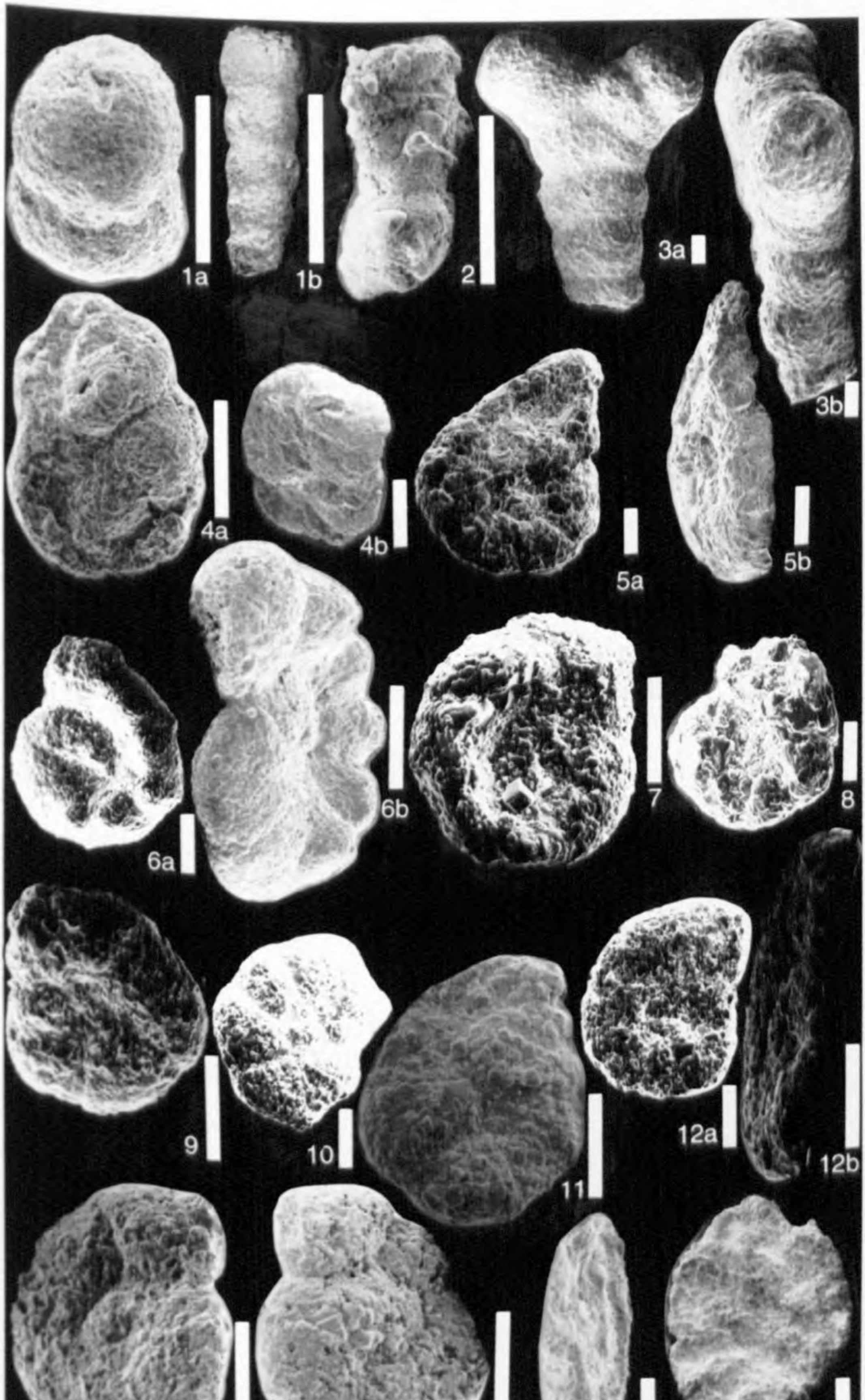

Plate 2

PLATE 3

Fig. 3.1 *Haplophragmoides umbilicata* DAIN, 1934. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 3.2 *Haplophragmoides rugosa* CUSHMAN and WATERS, 1927. Sample M8c, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Umbilical view, X 200, Wadi Mujib.

Fig. 3.3 *Trochamminoides parva* (SEIBOLD and SEIBOLD, 1960). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 150, Wadi Mujib.

Fig. 3.4 *Biconcava bentori* HAMAOUI and SAINT MARC, 1965. Sample Q13, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 350, **b:** edge view, X 500, Ras en-Naqb.

Fig. 3.5 *Daxia cenomana* CUVILLIER and SZAKALL, 1949. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 3.6 *Mayncina orbignyi* (CUVILLIER and SZAKALL, 1949). Sample M9, **a:** apertural view, X 150; sample M8c, **b:** Side view, X 100, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Wadi Mujib.

Fig. 3.7 *Mayncina hasaensis* BASHA, 1975. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** edge view, X 200, **b:** Side view, X 200, Wadi Mujib.

Fig. 3.8 *Ammobaculites difformis* HAMAOUI, 1965. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian), **a:** umbilical view, X 150; sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian), **b:** apertural view, X 200, Wadi Mujib.

Fig. 3.9 *Ammobaculites advenus* CUSHMAN and APPLIN, 1947. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Umbilical view, X 200, Wadi Mujib.

Fig. 3.10 *Ammobaculites naqbensis* BASHA, 1975. Sample Q9, Lower Shaly Sandstone Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** apertural view, X 150, **b:** Side view, X 150, Ras en-Naqb.

Fig. 3.11 *Ammobaculites mastersi* MORRIS, 1971. Sample M32, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X 500, Wadi Mujib.

Fig. 3.12 *Ammobaculites albertensis* STELCK and WALL, 1954. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X 200, Wadi Mujib.

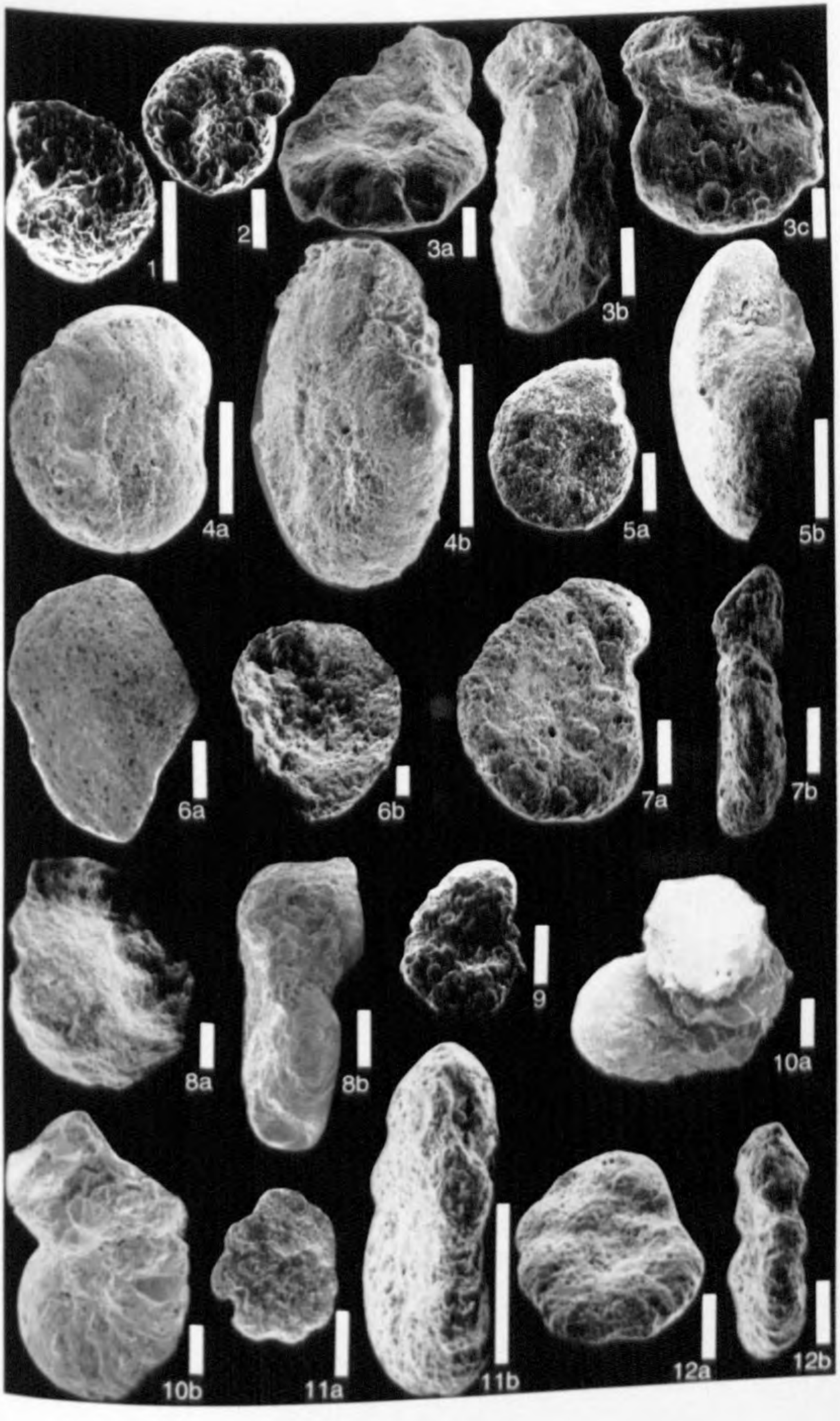

Plate 3

PLATE 4

Fig. 4.1 ***Ammobaculites pagodensis*** MORROS, 1971. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 4.2 ***Ammobaculites turonicus*** SAID and KENAWY, 1957. Sample Q18, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Ras en-Naqb.

Fig. 4.3 ***Ammobaculites stephensoni*** CUSHMAN, 1933. Sample Q22a, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 150, Ras en-Naqb.

Fig. 4.4 ***Ammobaculites euides*** LOEBLICH and TAPPAN, 1949. Sample Q22a, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Ras en-Naqb.

Fig. 4.5 ***Ammobaculites obliquus*** LOEBLICH and TAPPAN, 1949. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** spiral view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 4.6 ***Ammobaculites agglutinans*** (D'ORBIGNY, 1846). Sample J41, Fuheis Formation **"A3"** (middle Cenomanian). Side view, X 200, Ajlun/Jerash.

Fig. 4.7 ***Ammobaculites subcretaceus*** CUSHMAN and ALEXANDER, 1930. Sample M8c, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 4.8 ***Ammobaculites fragmentarius*** CUSHMAN-CUSHMAN, 1927. Sample J56, Upper Calcareous Member **"A6"**, Shueib Formation (upper Cenomanian). Side view, X 350, Ajlun/Jerash.

Fig. 4.9 ***Ammobaculites*** sp. 1. Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 4.10 ***Ammobaculites*** sp. 2. Sample J17, Fuheis Formation **"A3"** (middle Cenomanian). Side view, X 200, Ajlun/Jerash.

Fig. 4.11 ***Ammomarginulina naqbensis*** BASHA, 1975. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:**. Side view, X 150, **b:** apertural view, X 200, Wadi Mujib.

Fig. 4.12 ***Ammomarginulina aburoashensis*** SAID and KENAWY, 1957. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 4.13 ***Ammomarginulina barthouxi*** (SAID and BARAKAT, 1958). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** apertural view, X 200, **b:** Side view, X 100, Wadi Mujib.

Fig. 4.14 ***Ammomarginulina blanckenhorni*** SAID and KENAWY, 1957. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 4.15 ***Ammomarginulina cragini*** LOEBLICH and TAPPAN, 1950. Sample J35, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Ajlun/Jerash.

Fig. 4.16 ***Ammomarginulina*** sp. 1. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Umbilical view, X 150, Wadi Mujib.

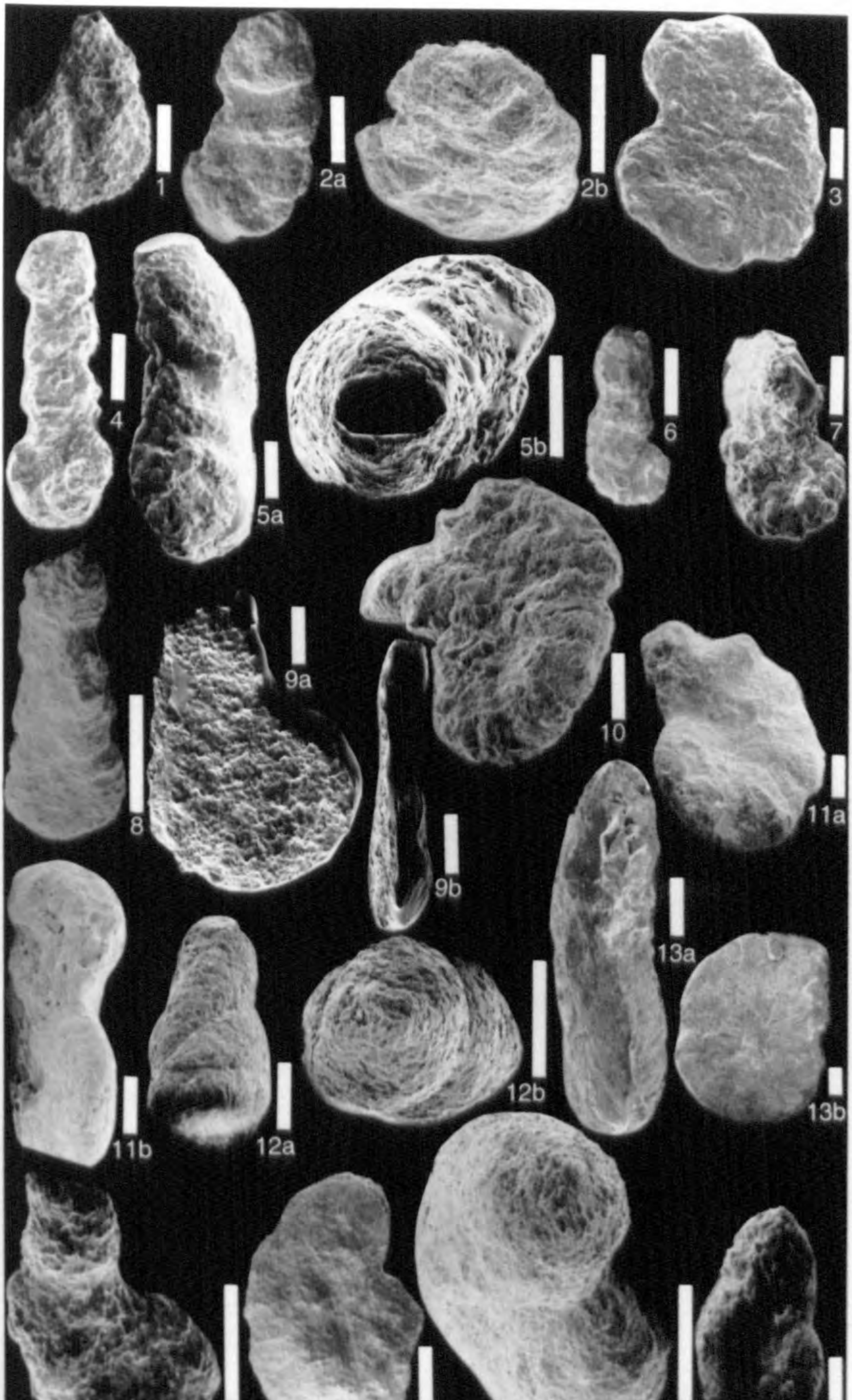

Plate 4

PLATE 5

Fig. 5.1 ***Ammotium aegyptica*** (NAKKADY and EISSA, 1960). Sample P-55, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 75, **b:** apertural view, X 200, Wadi Mussa.

Fig. 5.2 ***Ammotium oertlii*** HAMAOUI, 1979. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 5.3 ***Ammotium hasaense*** BASHA, 1979. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 5.4 ***Kutsevella labythnangensis*** DAIN, 1972. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 5.5 ***Kutsevella labythnangensis*** DAIN, 1972. Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 5.6 ***Sculptobaculites goodlandensis*** (CUSHMAN and ALEXANDER, 1930). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 200, Wadi Mujib.

Fig. 5.7 ***Sculptobaculites loshkarvicus*** (KORCHAGIN, 1985). Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 5.8 ***Flabellammina elongata*** HAMAOUI, 1979. Sample J39, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** Side view, X 100, **b:** apertural view, X 150, Ajlun/Jerash.

Fig. 5.9 ***Flabellammina negevensis*** HAMAOUI, 1979. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 100, Wadi Mujib.

Fig. 5.10 ***Flabellammina kaskapauensis*** STELCK and WALL, 1954. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). apertural view, X 150, Wadi Mujib.

Fig. 5.11 ***Flabellammina alexanderi*** CUSHMAN, 1928. Sample J34, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** Side view, X 75, **b:** apertural view, X 200, Ajlun/Jerash.

Fig. 5.12 ***Flabellammina*** sp. 1. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 5.13 ***Flabellammina*** sp. 2. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 200, Wadi Mujib.

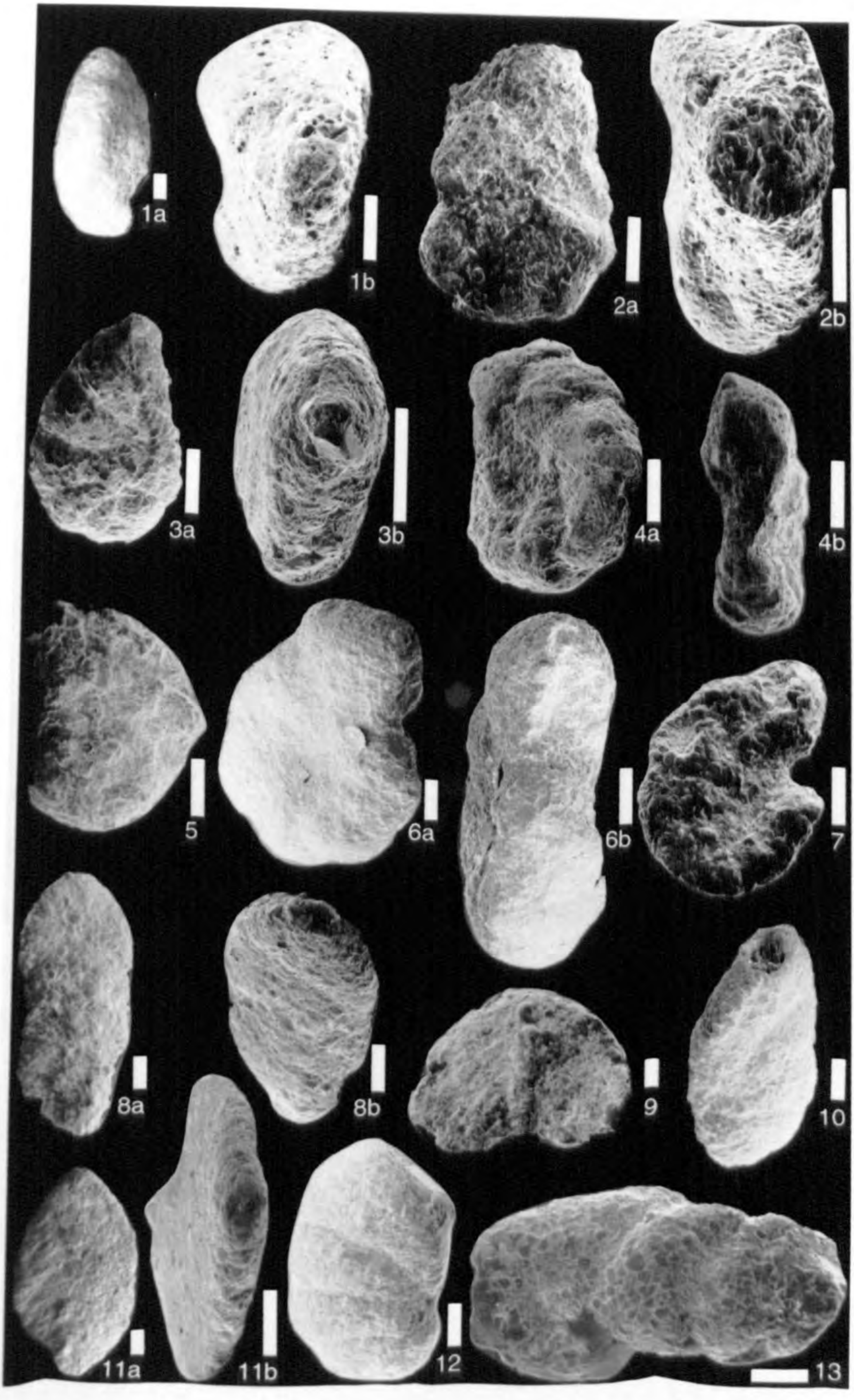

Plate 5

PLATE 6

Fig. 6.1 *Pterammina israelensis* HAMAOUI, 1965. Sample J34, Lower Marly Member "A5", Shueib Formation (upper Cenomanian). **a:** Side view, X 100, **b:** apertural view, X 200, Ajlun/Jerash.

Fig. 6.2 *Triplasia goodlandensis* (CUSHMAN and ALEXANDER, 1929). Sample J34, Lower Marly Member "A5", Shueib Formation (upper Cenomanian). **a:** apertural view, X 200, **b:** Side view, X 150, Ajlun/Jerash.

Fig. 6.3 *Triplasia murchisoni* REUSS, 1854. Sample J35, Lower Marly Member "A5", Shueib Formation (upper Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 200, Ajlun/Jerash.

Fig. 6.4 *Triplasia bonnefousi* HAMAOUI, 1979. Sample M20, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 500, Wadi Mujib.

Fig. 6.5 *Lituola nautiloidea* LAMARCK, 1804. Sample M56, Upper Shaly Member "A6", Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 6.6 *Lituola* sp. 1. Sample J17, Fuheis Formation "A3" (middle Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 200, Ajlun/Jerash.

Fig. 6.7 *Ammoastuta nigeriana* PETTERS, 1979. Sample M56, Upper Shaly Member "A6", Shueib Formation Equivalent (upper Cenomanian). Side view, X 100, Wadi Mujib.

Fig. 6.8 *Praeammoastuta* sp. 1. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 6.9 *Placopsilina cenomana* D'ORBIGNY, 1850. Sample M56, Upper Shaly Member "A6", Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 500, Wadi Mujib.

Fig. 6.10 *Bulbobaculites problematicus* NEAGU, 1962. Sample M56, Upper Shaly Member "A6", Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 6.11 *Bulbophragmium aequale* MAYNC, 1952. Sample J17, Fuheis Formation "A3" (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Ajlun/Jerash.

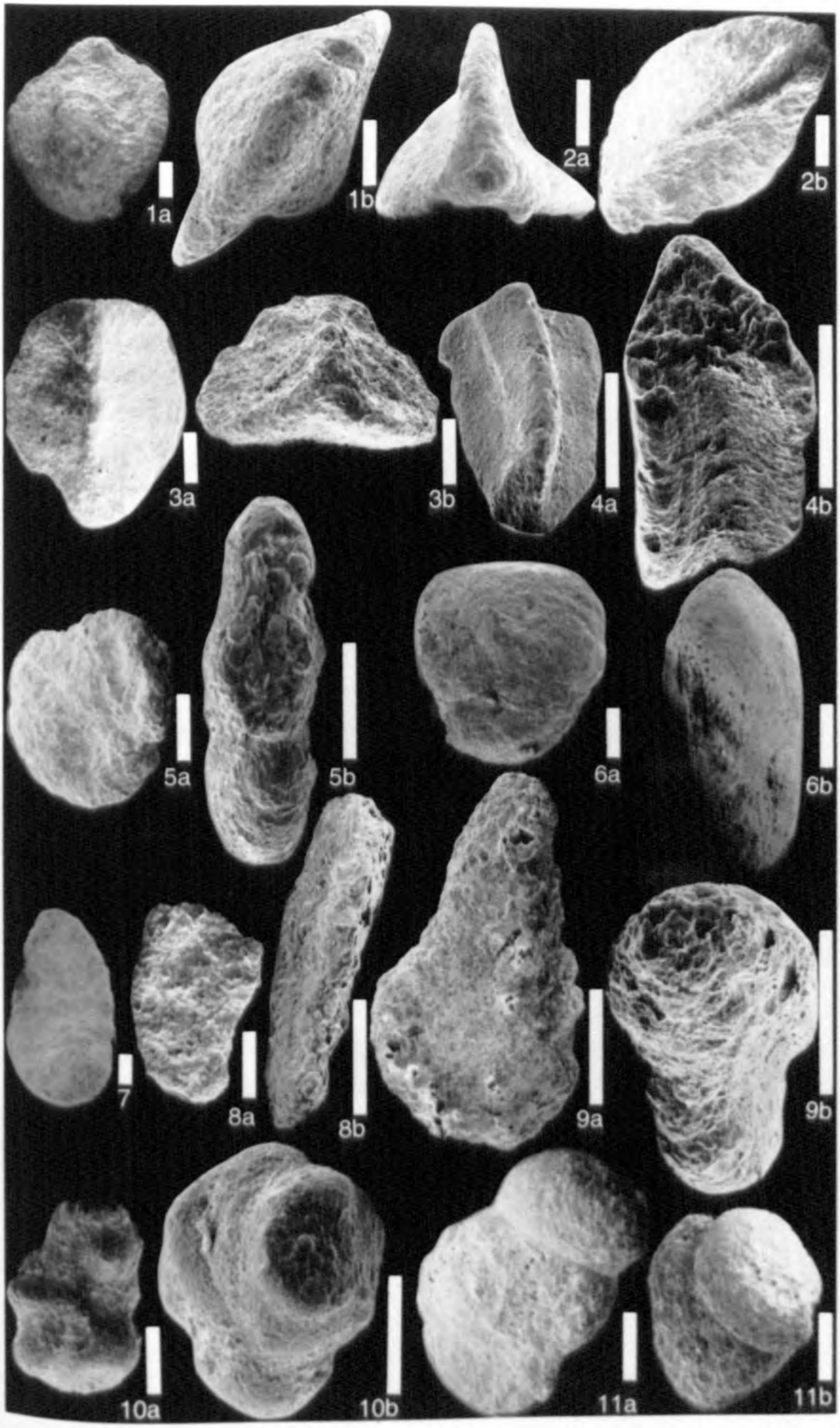

Plate 6

PLATE 7

Fig. 7.1 ***Biplanata peneropliformis*** HAMAOUI and SAINT-MARC, 1970. Sample M13, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X350, Wadi Mujib.

Fig. 7.2 ***Merlingina cretacea*** HAMAOUI and SAINT-MARC, 1970. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 200, Wadi Mujib.

Fig. 7.3 ***Nezzazata simplex*** OMARA, 1956. Sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 7.4 ***Nezzazata gyra*** (SMOUT, 1956). Sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 350, **b:** edge view, X 500, Wadi Mujib.

Fig. 7.5 ***Nezzazata conica*** (SMOUT, 1956). Sample J37, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, Ajlun/Jerash.

Fig. 7.6 ***Nezzazata convexa*** (SMOUT, 1956). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 7.7 ***Nezzazata concava*** (SMOUT, 1956). Sample M63, Wadi Sir Formation **"A7"** (Turonian). **a:** spiral, X 500, **b:** edge view, X 500, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 7.8 ***Nezzazatinella adhami*** DARMOIAN, 1976. Sample J47, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Ajlun/Jerash.

Fig. 7.9 ***Trochospira avnimelichi*** HAMAOUI and SAINT-MARC, 1965. Sample J37, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Ajlun/Jerash.

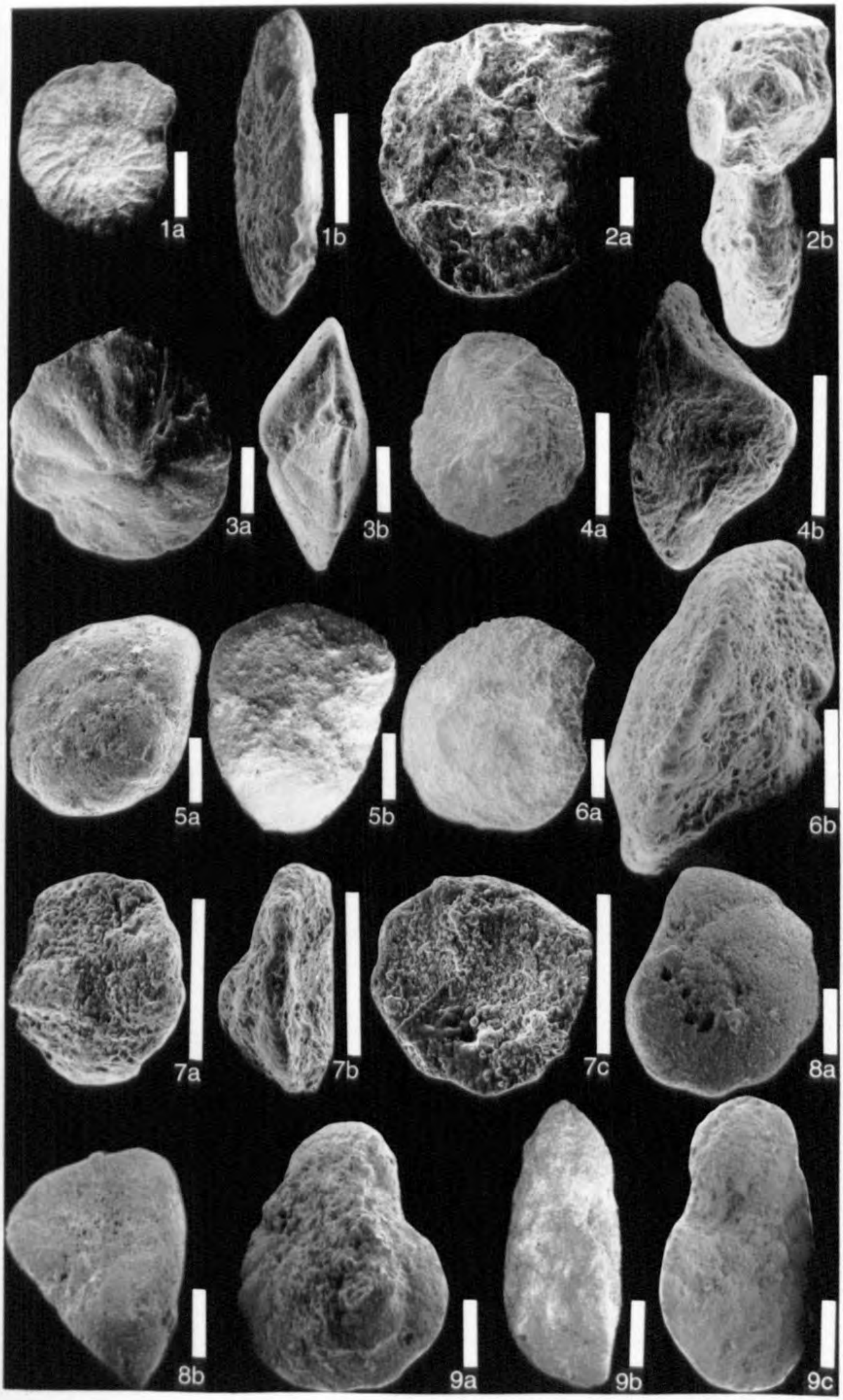

Plate 7

PLATE 8

Fig. 8.1 ***Charentia cuvillieri*** NEUMANN, 1965. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 200, Wadi Mujib.

Fig. 8.2 ***Charentia hasaensis*** BASHA, 1975. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 8.3 ***Charentia rummanensis*** BASHA, 1975. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 8.4 ***Charentia evoluta*** (GORBACHIK, 1968). Sample Q18, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 350, **c:** apertural view, X 350, Ras en-Naqb.

Fig. 8.5 ***Charentia*** sp. 1. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 8.6 ***Ismailia neumannae*** EL-DAKKAK, 1974. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 8.7 ***Ismailia aegyptica*** (EL-DAKKAK, 1975). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 500, Wadi Mujib.

Fig. 8.8 ***Hemicyclammina evoluta*** HAMAOUI, 1979. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 8.9 ***Hemicyclammina sigali*** MAYNC, 1953. Sample J41, Fuheis Formation **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Ajlun/Jerash.

Fig. 8.10 ***Hemicyclammina whitei*** (HENSON, 1948). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 8.11 ***Hemicyclammina*** sp. 1. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

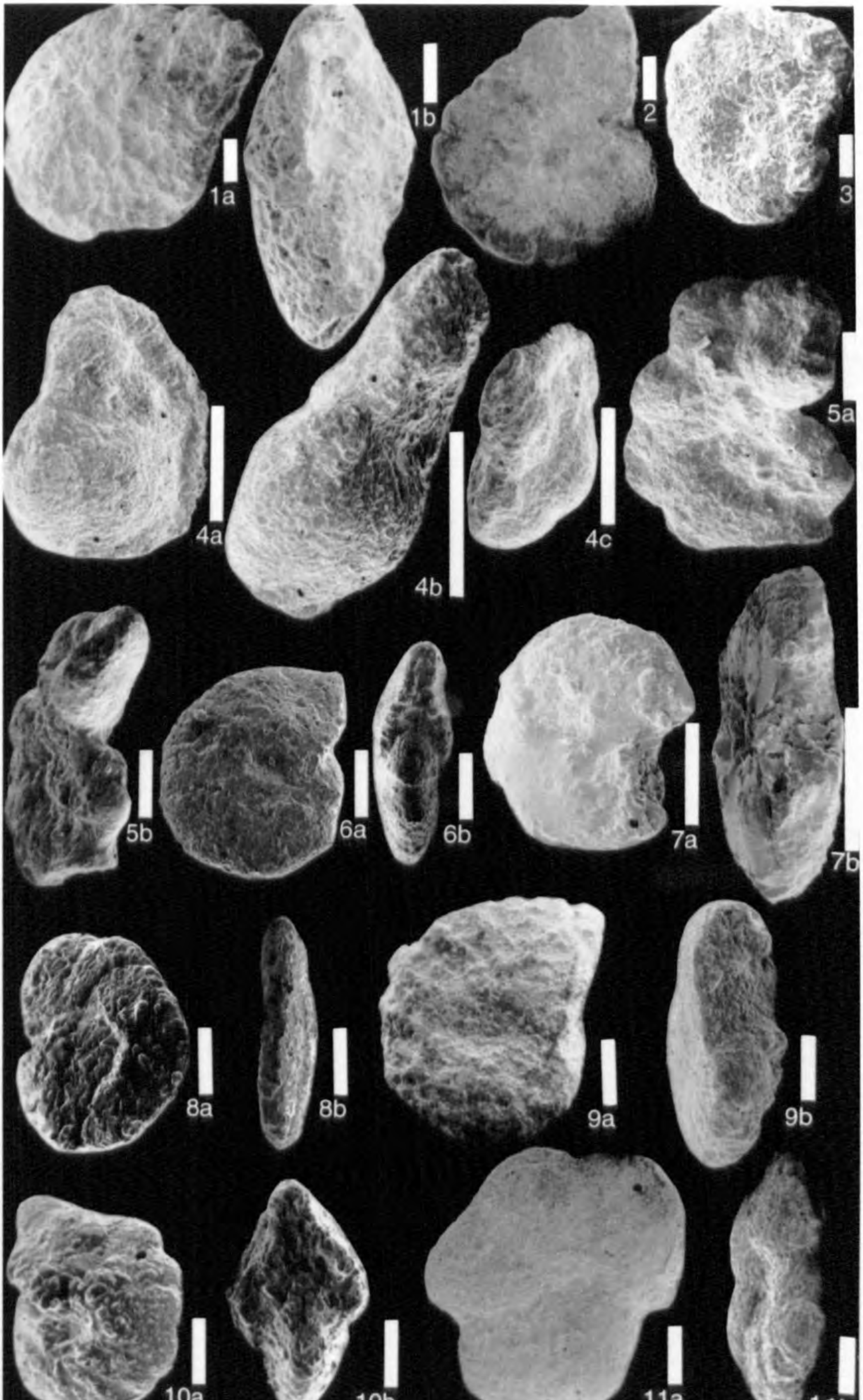

Plate 8

PLATE 9

Fig. 9.1 ***Choffatella decipiens*** SCHLUMBERGER, 1905. Sample M13, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 500, Wadi Mujib.

Fig. 9.2 ***Cyclammina haydeni*** MORRIS, 1971. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 9.3 ***Reissella ramonensis*** HAMAOUI, 1963. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** apertural view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 9.4 ***Bolivinopsis clotho*** (GRZYBOWSKI, 1901). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 9.5 ***Quasispiroplectammina nuda*** (LALICKER, 1935). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 500, Wadi Mujib.

Fig. 9.6 ***Quasispiroplectammina navarroana*** (CUSHMAN, 1932). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 500, Wadi Mujib.

Fig. 9.7 ***Aaptotoichus clavellatus*** (LOEBLICH and TAPPAN, 1946). Sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). apertural view, X 200, Wadi Mujib.

Fig. 9.8 ***Plectinella aegyptiaca*** (SAID and BARAKAT, 1958). Sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). apertural view, X 350, Wadi Mujib.

Fig. 9.9 ***Zotheculifida*** sp. Sample Q20, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 750, **b:** edge view, X 1000, Ras en-Naqb.

Fig. 9.10 ***Trochammina boehmi*** FRANKE, 1928. Sample M6, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Umbilical view, X 350, Wadi Mujib.

Fig. 9.11 ***Trochammina afikpensis*** PETTERS, 1979. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Umbilical view, X 350, Wadi Mujib.

Fig. 9.12 ***Trochammina rummanensis*** BASHA, 1975. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Umbilical view, X 750, Wadi Mujib.

Fig. 9.13 ***Plectina ruthenica*** (REUSS, 19851). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 500, **b:** Side view, X 500, Wadi Mujib.

Fig. 9.14 ***Uvigerinammina jankoi*** MAJZON, 1943. Sample M8n, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** apertural view, X 350, **b:** Side view, X 350, Wadi Mujib.

Fig. 9.15 ***Gaudryina rugosa*** D'ORBIGNY, 1840. Sample J58, Wadi Sir Formation **"A7"** (Turonian). Side view, X 200, Ajlun/Jerash.

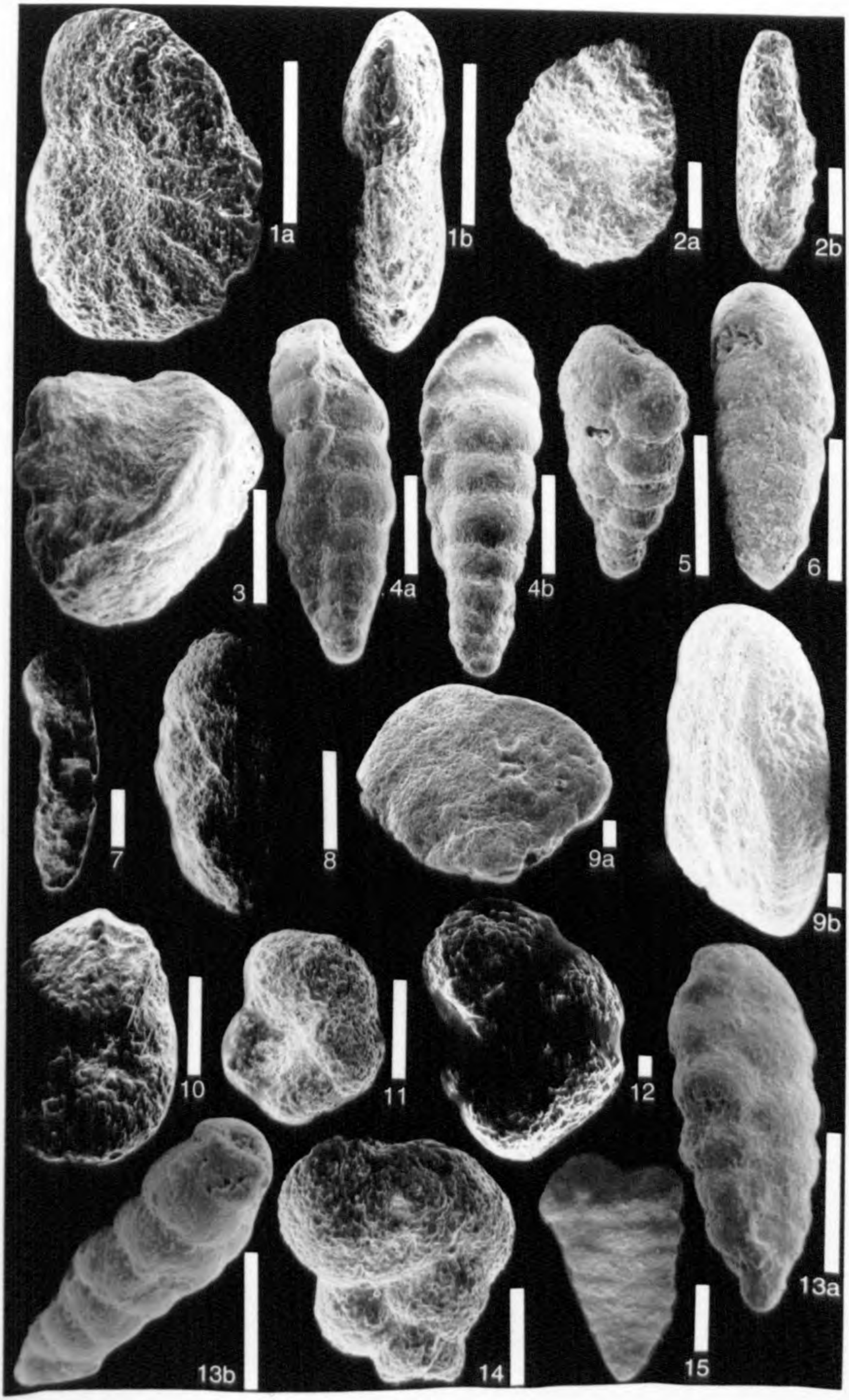

Plate 9

PLATE 10

Fig. 10.1 ***Arenobulimina advena*** (CUSHMAN, 1936). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 750, Wadi Mujib.

Fig. 10.2 ***Arenobulimina chapmani*** CUSHMAN, 1936. Sample M33, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 10.3 ***Arenobulimina d'orbignyi*** (REUSS, 1845). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 10.4 ***Arenobulimina amanda*** VOLOSHINA, 1961. Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 500, **b:** apertural view, X 500, Wadi Mussa.

Fig. 10.5 ***Cuneolina pavonia parva*** HENSON, 1948. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 150, **b:** apertural view, X 350, Wadi Mujib.

Fig. 10.6 ***Pseudotextulariella cretosa*** (CUSHMAN, 1932), BARNARD, 1953. Sample J34, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian), **a:** Side view, X 200, Ajlun/Jerash; sample M6, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian), **b:** apertural view, X 350, Wadi Mujib.

Fig. 10.7 ***Pseudotextulariella*** sp. 1. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 10.8 ***Dictyopsella cuvillieri*** GENDROT, 1968. Sample M109, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 516, **b:** edge view, X 1008, Wadi Mujib.

Fig. 10.9 ***Pseudolituonella mariea*** CECILE, 1968. Sample M9, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 10.10 ***Simplorbitolina*** sp. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 700, Wadi Mujib.

Fig. 10.11 ***Orbitolina sefini*** HENSON, 1948. Sample M13, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Surface view, X 150, **b:** edge view, X 200, Wadi Mujib.

Fig. 10.12 ***Dorothia pontoni*** CUSHMAN, 1933. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 750, **b:** Side view, X 750, Wadi Mujib.

Fig. 10.13 ***Ventilabrella glabrata*** (CUSHMAN, 1938). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Edge view, X 750, Wadi Mujib.

Fig. 10.14***Marssonella oxycona*** (REUSS, 1860). Sample M88, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). apertural view, X 500, Wadi Mujib.

Fig. 10.15 ***Marssonella trochus*** (D'ORBIGNY, 1840). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view, X 350, Wadi Mujib.

Fig. 10.16 ***Marssonella kummi*** ZEDLER, 1980. Sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Wadi Mujib.

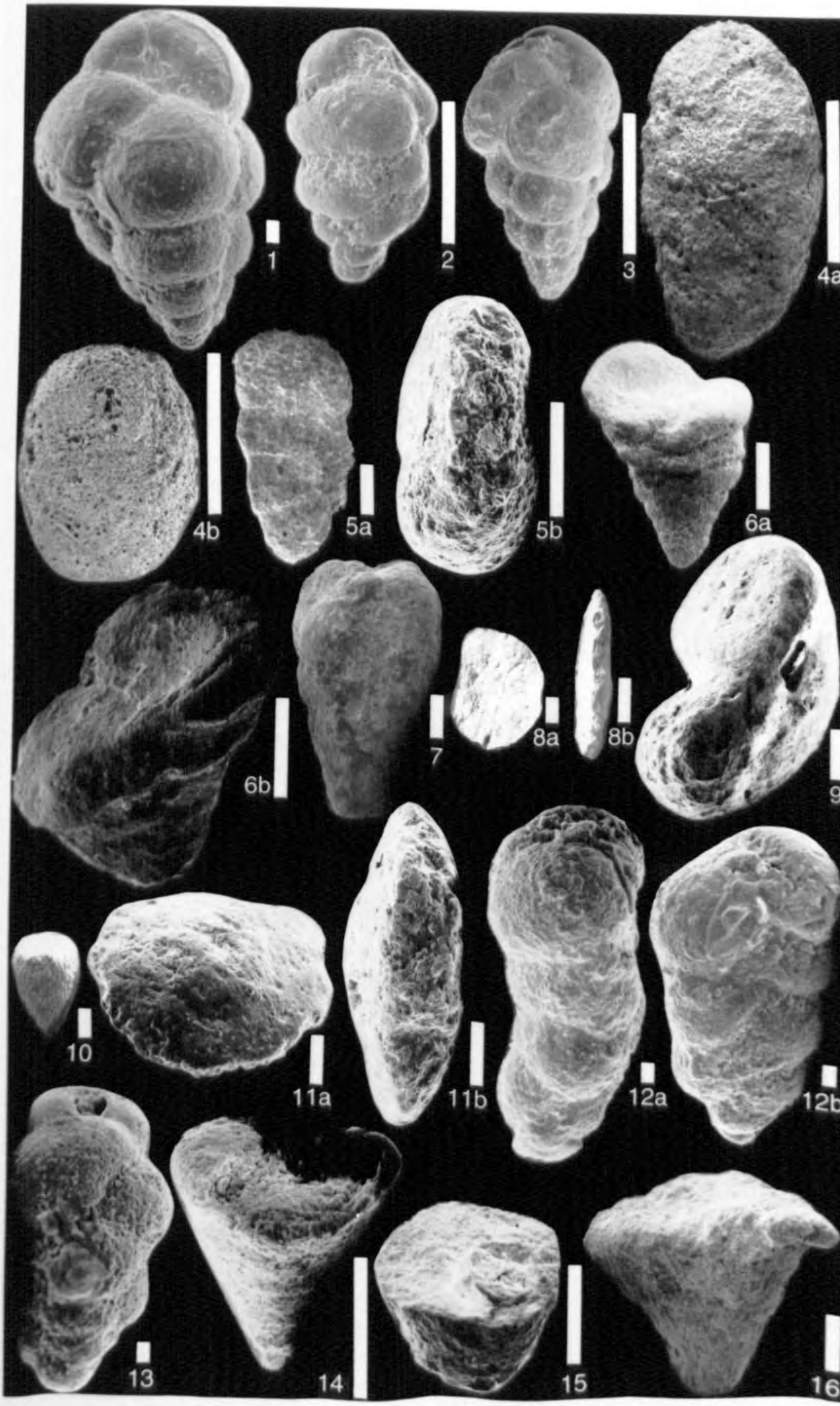

Plate 10

PLATE 11

Fig. 11.1 ***Textularia depressa*** KUBLER and ZWINGLI, 1866. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian), **a:** Side view, X 200; sample M16, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian), **b:** apertural view, X 500, Wadi Mujib.

Fig. 11.2 ***Textularia subconica*** FRANKE, 1928. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 368, Wadi Mujib.

Fig. 11.3 ***Clavulinopsis gaultina*** (MOROZOVA, 1940). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view, X 500, Wadi Mujib.

Fig. 11.4 ***Globospirillina condensa*** ANTONOVA, 1964. Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 11.5 ***Hensonina lenticularis*** (HENSON, 1948). Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 11.6 ***Hensonina*** sp. 1. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 11.7 ***Planispirinella barnardia*** BASHA, 1975. Sample P-17, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 150, Wadi Mussa.

Fig. 11.8 ***Planispirinella*** sp. 1. Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). Edge view, X 750, Wadi Mussa.

Fig. 11.9 ***Ophthalmidium minimum*** TAPPAN, 1943. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 11.10 ***Spiroloculina cretacea*** REUSS, 1854. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian), **a:** Side view, X 350, Wadi Mujib; sample Q43, Ghudran Formation **"B1"** (upper Coniacian to Santonian), **b:** Side view, X 350, **c:** edge view, X 500, Ras en-Naqb.

Fig. 11.11 ***Ammomassilina*** sp. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** spiral view, X 500, **b:** apertural view, X 500, Wadi Mujib.

Fig. 11.12 ***Massilina ginginensis*** CHAPMAN, 1917. Sample P-15, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 350, **b:** edge view, X 500, Wadi Mussa.

Fig. 11.13 ***Quinqueloculina globigerinaeformis*** (KRASHENINNIKOV, 1973). Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 11.14 ***Quinqueloculina triangulata*** STEAD, 1951. Sample M24, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 500, Wadi Mujib.

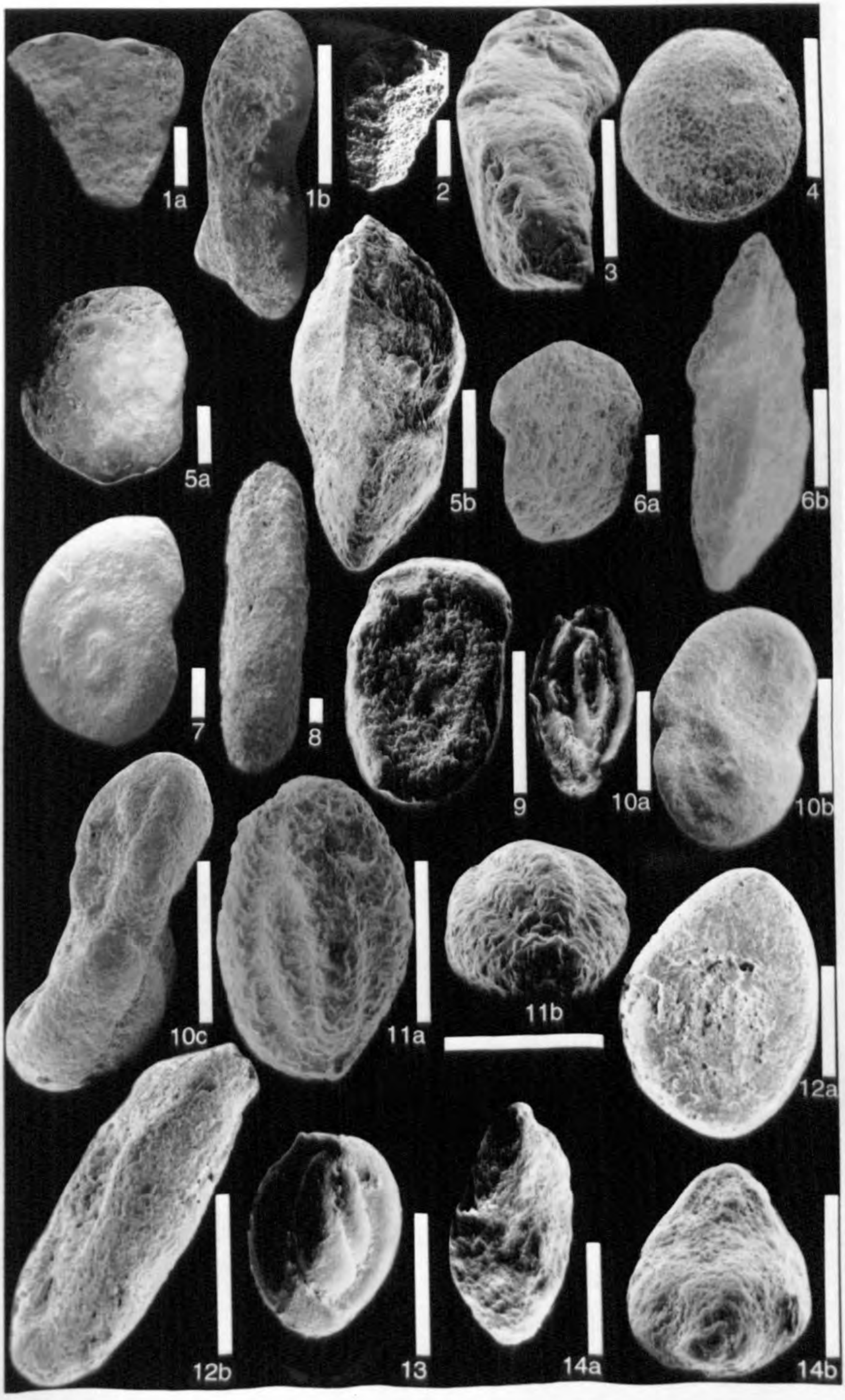

Plate 11

PLATE 12

Fig. 12.1 ***Quinqueloculina antiqua angusta*** (FRANKE, 1931). Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 500, **b:** apertural view, X 500, Wadi Mujib.

Fig. 12.2 ***Peneroplis parvus*** CASTRO, 1965. Sample J47, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Ajlun/Jerash.

Fig. 12.3 ***Reissella ramonensis*** HAMAOUI, 1963. Sample J58, Wadi Sir Formation **"A7"** (Turonian). **a:** Side view, X 200, **b:** edge view, X 150, Ajlun/Jerash.

Fig. 12.4 ***Pseudorhapydionina dubia*** (DE CASTRO, 1965). Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 12.5 ***Laevidentalina vistulae*** (POZARYSKA, 1957). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 12.6 ***Laevidentalina*** sp. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 150, **b:** apertural view, X 750, Wadi Mujib.

Fig. 12.7 ***Dentalina hammensis*** (FRANKE, 1928). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 12.8 ***Dentalina marcki*** REUSS, 1860. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 12.9 ***Laevidentalina catenula*** (REUSS, 1860). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 12.10 ***Nodomorphina*** sp. 1. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 12.11 ***Dentalinoides canulina*** MARIE, 1941. Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 12.12 ***Dentalinoides canulina*** MARIE, 1941. Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 12.13 ***Laevidentalina gracilis*** (D'ORBIGNY, 1840). Sample J25, Fuheis Formation **"A3"** (middle Cenomanian). **a:** Side view, X 350, **b:** apertural view, X 750, Ajlun/Jerash.

Fig. 12.14 ***Mucronina*** sp. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 100, Wadi Mujib.

Fig. 12.15 ***Laevidentalina longiscata*** (D'ORBIGNY, 1846). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 12.16 ***Nodosaria limbata*** D'ORBIGNY, 1840. Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 12.17 ***Pyramidulina latejugata*** (CUMBELL, 1868). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 150, Wadi Mujib.

Fig. 12.18 ***Pyramidulina proboscidea*** (REUSS, 1851). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). apertural view, X 150, Wadi Mujib.

Fig. 12.19 ***Pyramidulina septemcostata*** (GEINITZ, 1842). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 96, Wadi Mujib.

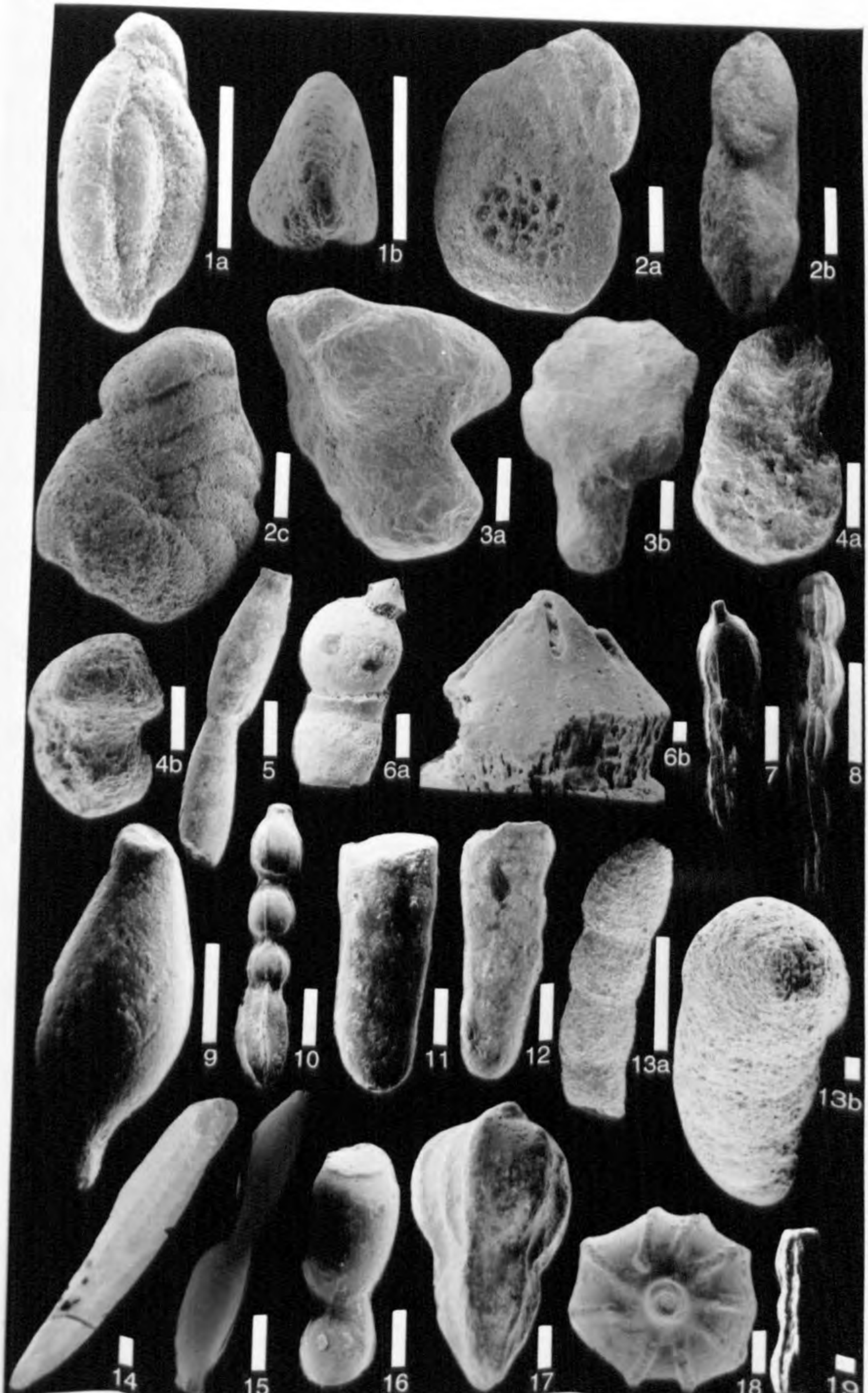
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Plate 12

PLATE 13

Fig. 13.1 ***Pyramidulina distans*** (REUSS, 1855). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 50, **b:** apertural view, X 350, Wadi Mujib.

Fig. 13.2 ***Pyramidulina zippei*** (REUSS, 1845). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 100, Wadi Mujib.

Fig. 13.3 ***Pyramidulina raphinistrum*** (LINNE, 1758). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 150, Wadi Mujib.

Fig. 13.4 ***Nodosaria naumanni*** REUSS, 1874. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 13.5 ***Lagena acuticosta*** REUSS, 1862. Sample M19, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 750, Wadi Mujib.

Fig. 13.6 ***Laevidentalina aphelis*** LOEBLICH and TAPPAN, 1986. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 966, Wadi Mujib.

Fig. 13.7 ***Dentalina*** sp. 1. Sample M91, **a:** Side view, X 350; sample M90, **b:** apertural view, X 1500, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

Fig. 13.8 ***Frondicularia lanceolata*** PERNER, 1892. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 13.9 ***Frondicularia clarki*** BAGG, 1898. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 200, **b:** apertural view, X 500, Wadi Mujib.

Fig. 13.10 ***Tristix coloi*** HAMAOUI, 1979. Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 13.11 ***Tristix poignanti*** HAMAOUI, 1979. Sample M27, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** edge view, X 350, **b:** apertural view, X 350, Wadi Mujib.

Fig. 13.12 ***Lenticulina rotulata*** (LAMARCK, 1804). Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 13.13 ***Lenticulina spachholtzi*** (REUSS, 1851). Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 13.14 ***Lenticulina muensteri*** (ROEMER, 1839). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 150, Wadi Mujib.

Fig. 13.15 ***Lenticulina gaultina*** (BERTHELIN, 1880). Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). Side view, X 200, Wadi Mujib.

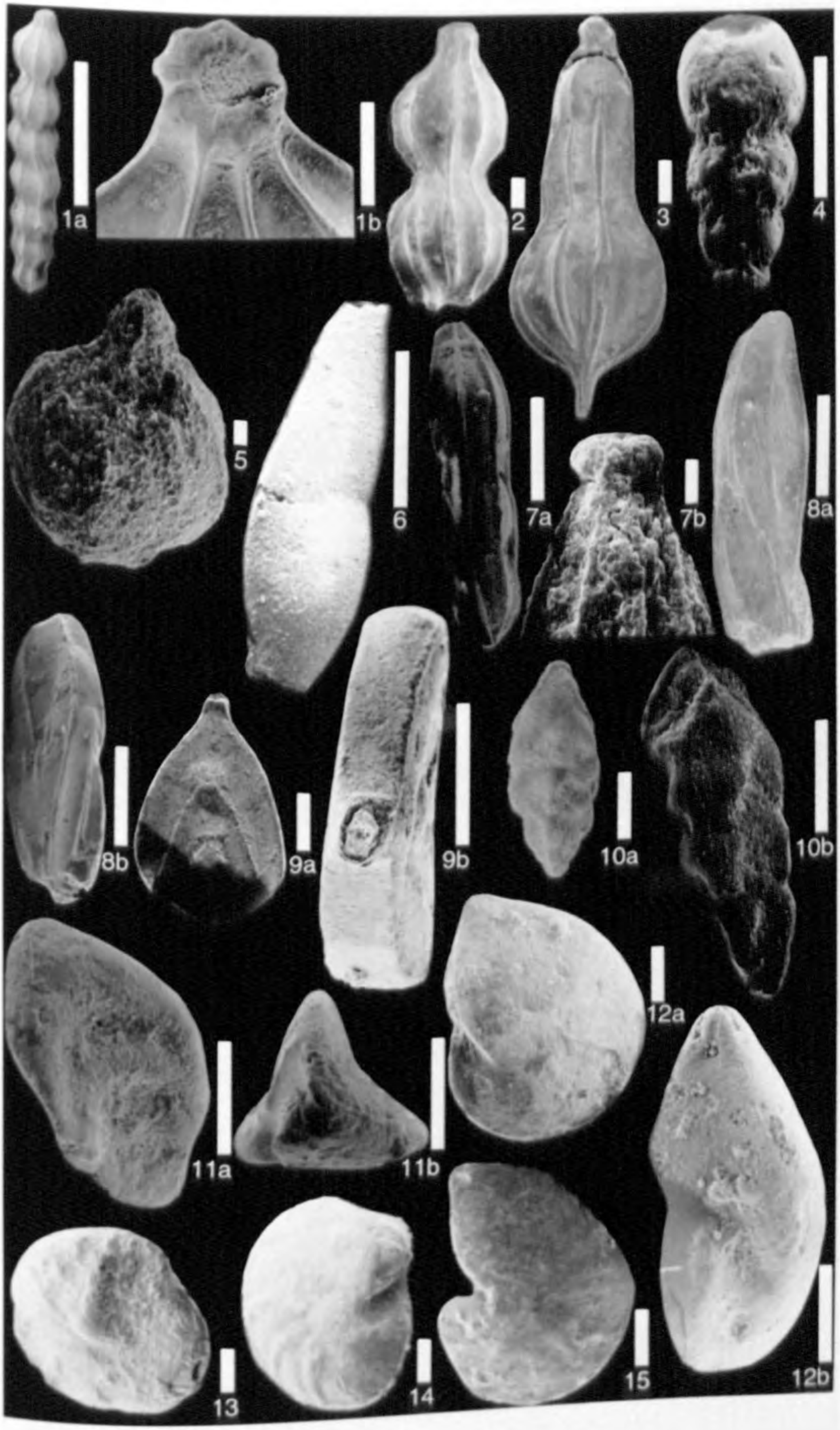

Plate 13

PLATE 14

Fig. 14.1 ***Lenticulina spissocostata*** (CUSHMAN, 1938). Sample M21, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 14.2 ***Lenticulina modesta*** (BANDY, 1951). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 100, **b:** apertural view, X 150, Wadi Mujib.

Fig. 14.3 ***Lenticulina californiensis*** TRUJILLO, 1960. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 100, **b:** apertural view, X 200, Wadi Mujib.

Fig. 14.4 ***Lenticulina mellahensis*** (NAKKADY, 1950). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 14.5 ***Lenticulina taylorensis*** (PLUMMER, 1931). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 14.6 ***Lenticulina spissocostata*** (CUSHMAN, 1938). Sample M20, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 14.7 ***Lenticulina*** sp. 1. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 14.8 ***Lenticulina carlsbadensis*** SLITER, 1968. Sample M90, **a:** Side view, X 150; sample M91, **b:** apertural view, X 150, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

Fig. 14.9 ***Pravoslavlevia pravoslavlevi*** (FURSENKO and POLENOVA, 1950). Sample M21, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). apertural view, X 750, Wadi Mujib.

Fig. 14.10 ***Kyphopyxa christneri*** (CARSEY, 1926). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 100, **b:** apertural view, X 200, Wadi Mujib.

Fig. 14.11 ***Neoflabellina suturalis*** (CUSHMAN, 1935). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 100, **b:** apertural view, X 200, Wadi Mujib.

Fig. 14.12 ***Neoflabellina leptodisca*** (WEDEKIND, 1940). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 150, **b:** apertural view, X 200, Wadi Mujib.

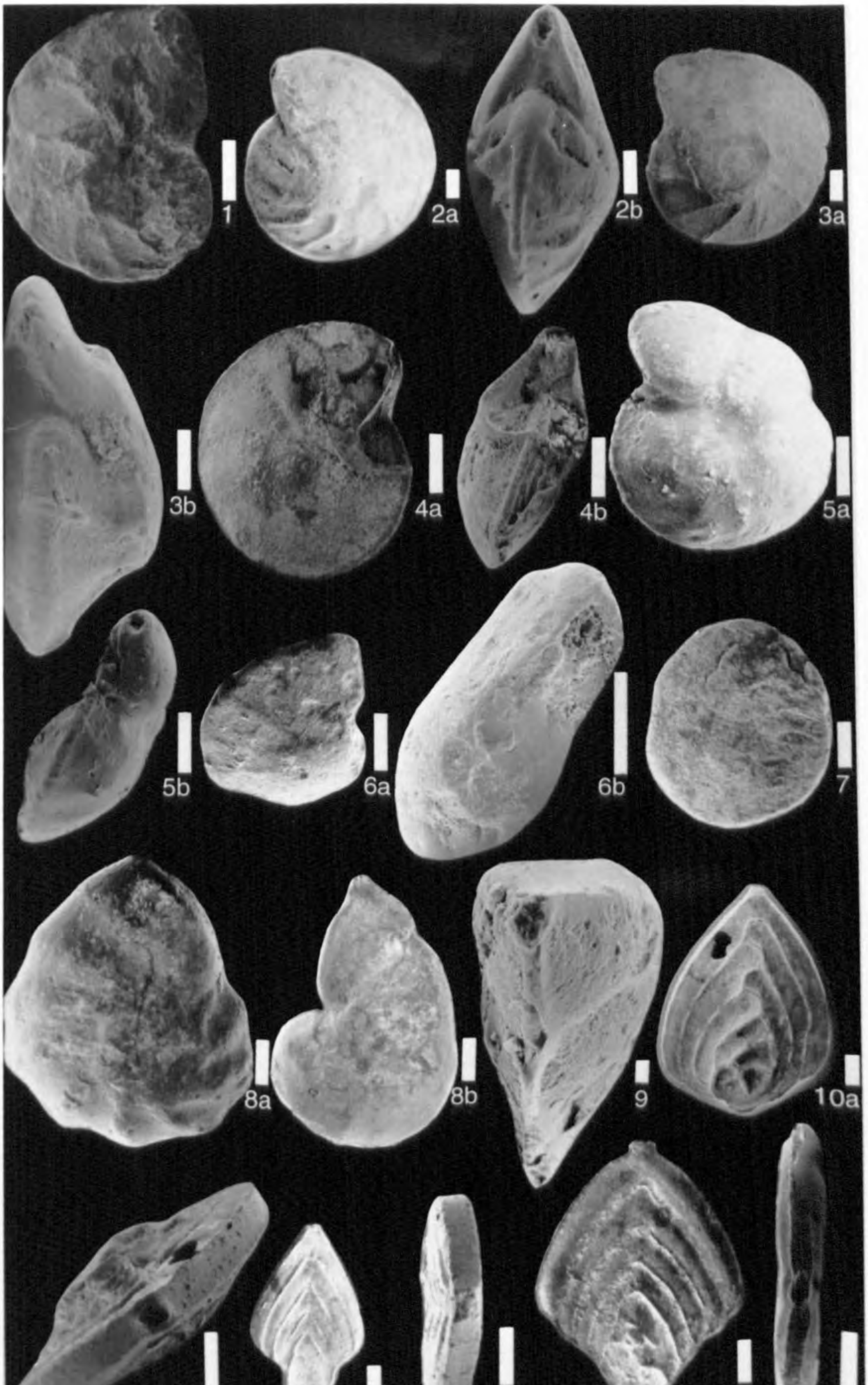

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PLATE 15

Fig. 15.1 ***Neoflabellina kyphoupperris*** KOCH, 1968. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 200, **b:** apertural view, X 200, Wadi Mujib.

Fig. 15.2 ***Neoflabellina suturalis*** (CUSHMAN, 1935). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 200, **b:** apertural view, X 750, Wadi Mujib.

Fig. 15.3 ***Neoflabellina*** sp. 2. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 200, **b:** edge view, X 500, Wadi Mujib.

Fig. 15.4 ***Astacolus liebusi*** BROTZEN, 1936. Sample P-55, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 150, **b:** apertural view, X 200, Wadi Mussa.

Fig. 15.5 ***Astacolus richteri*** (BROTZEN, 1936). Sample J56, Upper Calcareous Member **"A6"**, Shueib Formation (upper Cenomanian). **a:** Side view, X 500, **b:** apertural view, X 750, Ajlun/Jerash.

Fig. 15.6 ***Astacolus liebusi*** BROTZEN, 1936. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 100, Wadi Mujib.

Fig. 15.7 ***Astacolus*** sp. 1. Sample M56, Upper Shaly Member **"A6"**, Shueib Formation Equivalent (upper Cenomanian). Side view, X 150, Wadi Mujib.

Fig. 15.8 ***Vaginulinopsis directa*** (CUSHMAN, 1951). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 150, Wadi Mujib.

Fig. 15.9 ***Vaginulinopsis directa*** (CUSHMAN, 1951). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 100, **b:** apertural view, X 150, Wadi Mujib.

Fig. 15.10 ***Citharina suturalis*** (CUSHMAN, 1937). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 200, Wadi Mujib.

Fig. 15.11 ***Psilocitharella leptoteicha*** LOEBLICH and TAPPAN, 1946. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 15.12 ***Vaginulina plummerae*** (CUSHMAN, 1937). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 100, Wadi Mujib.

Fig. 15.13 ***Vaginulina recta*** REUSS, 1863. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 150, **b:** apertural view, X 500, Wadi Mujib.

Fig. 15.14 ***Vaginulina cretacea*** PLUMMER, 1927. Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 200, **b:** apertural view, X 500, Wadi Mujib.

Fig. 15.15 ***Vaginulina trilobata*** (D'ORBIGNY, 1840). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 150, Wadi Mujib.

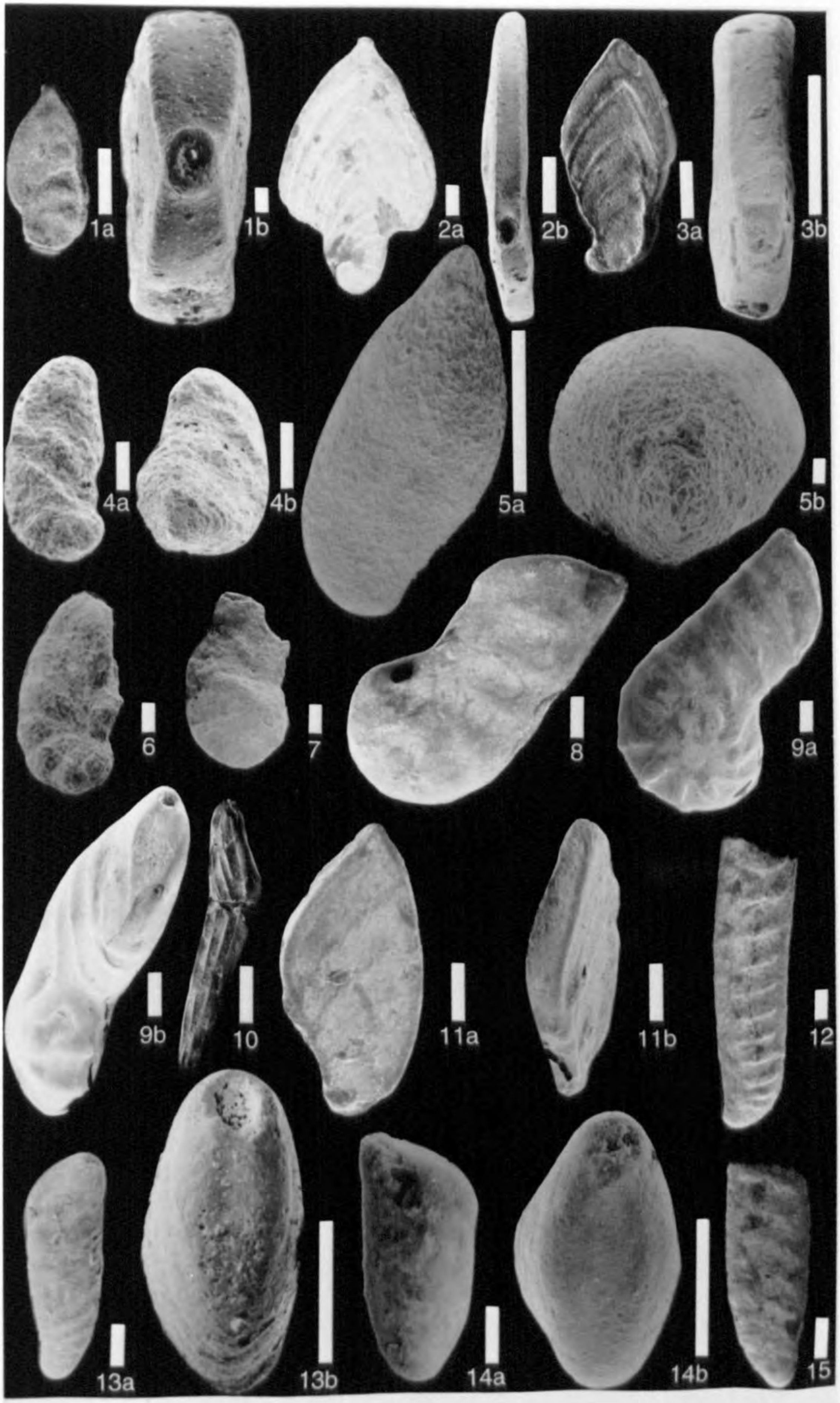
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Plate 15

PLATE 16

Fig. 16.1 *Lagena paucicosta* FRANKE, 1928. Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). Side view, X 750, Wadi Mujib.

Fig. 16.2 *Lagena hexagona* (WILLIAMSON, 1848). Sample M37, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 16.3 *Eoguttulina anglica* CUSHMAN and OZAWA, 1930. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 350, Wadi Mujib.

Fig. 16.4 *Guttulina symploca* LOEBLICH and TAPPAN, 1949. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 350, Wadi Mujib.

Fig. 16.5 *Globulina* sp. 1. Sample J41, Fuheis Formation "A3" (middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 500, Ajlun/Jerash.

Fig. 16.6 *Globulina lacrima* REUSS, 1851. Sample J44, Lower Marly Member "A5", Shueib Formation (upper Cenomanian). **a:** Side view, X 500, **b:** Basal view, X 500, Ajlun/Jerash.

Fig. 16.7 *Eoguttulina anglica* CUSHMAN and OZAWA, 1930. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 350, Wadi Mujib.

Fig. 16.8 *Guttulina symploca* LOEBLICH and TAPPAN, 1949. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 500, Wadi Mujib.

Fig. 16.9 *Guttulina adherens* (OLSZEWSKI, 1875). Sample M7a, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 350, **b:** Basal view, X 750, Wadi Mujib.

Fig. 16.10 *Guttulina cuspidata* CUSHMAN and OZAWA, 1930. Sample M7a, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 500, **b:** Basal view, X 750, **c:** Side view, X 350, Wadi Mujib.

Fig. 16.11 *Polymorphina zeuschneri* REUSS, 1867. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 500, Wadi Mujib.

Fig. 16.12 *Pseudopolymorphina eichenbergi* TEN DAM, 1948. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 200, **b:** Basal view, X 350, Wadi Mujib.

Fig. 16.13 *Pseudopolymorphina* sp. 1. Sample M8n, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** Side view, X 350, **b:** Basal view, X, 500, Wadi Mujib.

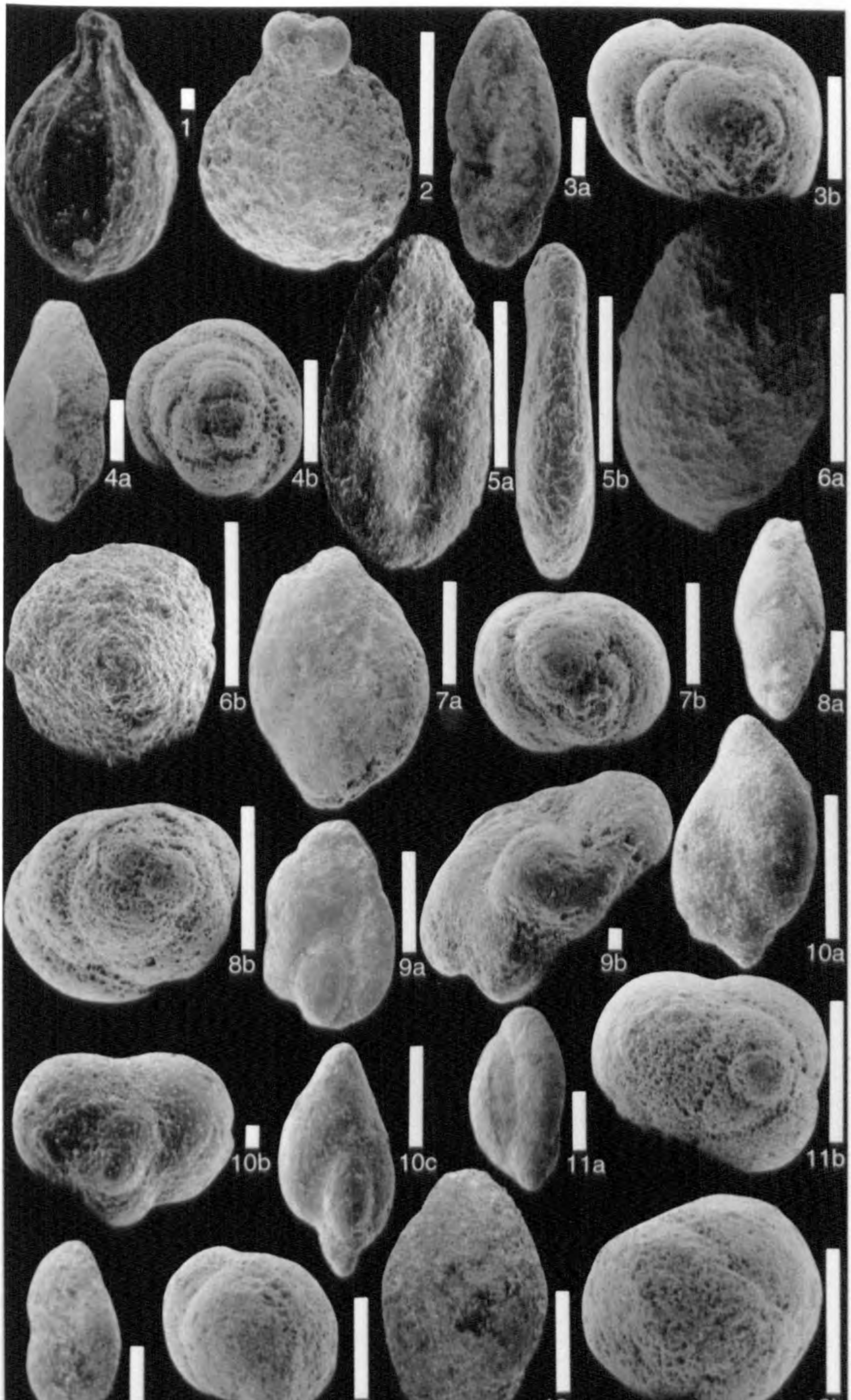

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Plate 16

PLATE 17

Fig. 17.1 ***Ramulina globulifera*** BRADY, 1884. Sample J25, Fuheis Formation **"A3"** (middle Cenomanian). Side view, X 200, Ajlun/Jerash.

Fig. 17.2 ***Oolina globulosa*** (MONTAGU, 1803). Sample M99, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). Edge view X 2464, Wadi Mujib.

Fig. 17.3 ***Oolina globulosa*** (MONTAGU, 1803). Sample M35, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view, X 750, Wadi Mujib.

Fig. 17.4 ***Pristinosceptrella*** sp. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 17.5 ***Fissurina oblonga*** REUSS, 1863. Sample M21, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 200, **b:** apertural view, X 350, Wadi Mujib.

Fig. 17.6 ***Fissurina laevigata*** REUSS, 1850. Sample M87, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Edge view, X 350, Wadi Mujib.

Fig. 17.7 ***Fissurina alveolata*** (BRADY, 1870). Sample M96, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** spiral view, X 500, **b:** edge view, X 750, **c:** apertural view, X 1000, Wadi Mujib.

Fig. 17.8 ***Ceratobulimina cretacea*** CUSHMAN and HARRIS, 1927. Sample M97, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** spiral view, X 750, **b:** umbilical view, X 750, Wadi Mujib.

Fig. 17.9 ***Ceratolamarckina parva*** (EICHER and WORSTELL, 1970). Sample M109, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 350, **b:** apertural view, X350, Wadi Mujib.

Fig. 17.10 ***Amphipyndax pseudoconulus*** (PESSAGNO, 1963). Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 350, **b:** apertural view, X 500, Wadi Mussa.

Fig. 17.11 ***Amphipyndax tylotus*** FOREMAN, 1978b. Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 500, **b:** apertural view, X 750, Wadi Mussa.

Fig. 17.12 ***Archaeodictyomitra lamellicostata*** (FOREMAN, 1968). Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 500, **b:** apertural view, X 1000, Wadi Mussa.

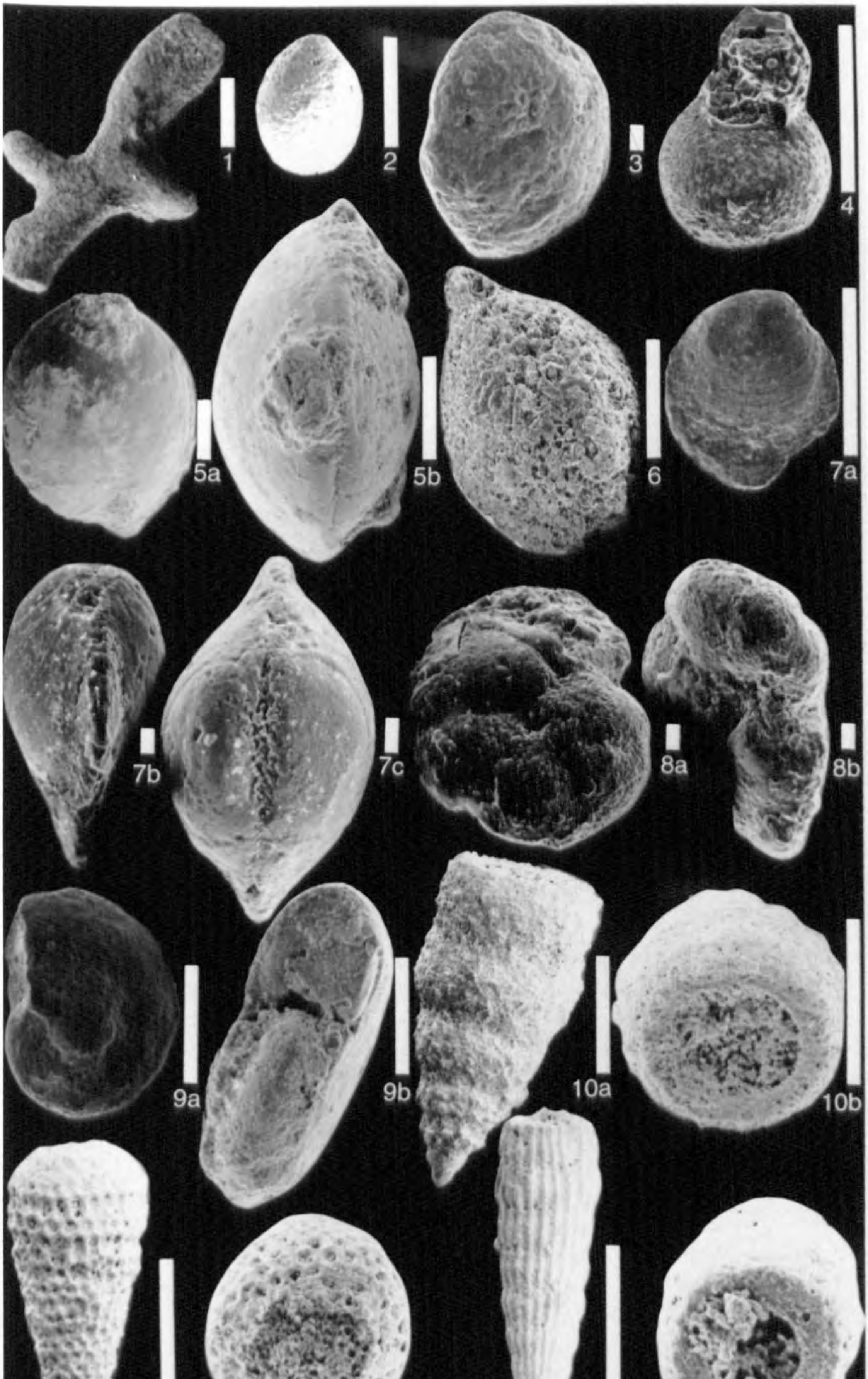

Plate 17

PLATE 18

Fig. 18.1 ***Conorboides mitra*** (HOFKER, 1951). Sample M25, Fuheis Formation equivalent "A3" (middle Cenomanian). **a:** umbilical view, X 500, **b:** edge view, X 750, Wadi Mujib.

Fig. 18.2 ***Conorboides umiatensis*** (TAPPAN, 1957). Sample P-26, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 350, **b:** edge view, X 500, Wadi Mussa.

Fig. 18.3 ***Conorboides beadnelli*** (SAID and BARAKAT, 1957). Sample M16, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** edge view, X 500, **b:** spiral view, X 350, **c:** umbilical, 500, Wadi Mujib.

Fig. 18.4 ***Conorboides hofkeri*** (BARTENSTEIN and BRAND, 1951). Sample P-26, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 350, **b:** edge view, X 500, **c:** umbilical view, X 500, Wadi Mussa.

Fig. 18.5 ***Conorboides*** sp. 1. Sample M23, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). Edge view, X 1190, Wadi Mujib.

Fig. 18.6 ***Conorboides hofkeri*** (BARTENSTEIN and BRAND, 1951). Sample M57, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). Umbilical view, X 500, Wadi Mujib.

Fig. 18.7 ***Conorboides*** sp. 2. Sample M32, Fuheis Formation equivalent "A3" (middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 18.8 ***Conorboides umiatensis*** (TAPPAN, 1957). Sample M37, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). spiral view, X 350, Wadi Mujib.

Fig. 18.9 ***Guembelitria cenomana*** (KELLER, 1935). Sample M23, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). Side view X 556, Wadi Mujib.

Fig. 18.10 ***Guembelitria cenomana*** (KELLER, 1935). Sample M23, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). apertural view X 640, Wadi Mujib.

Fig. 18.11 ***Guembelitria cenomana*** (KELLER, 1935). Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). apertural view, X 604, Wadi Mujib.

Fig. 18.12 ***Guembelitria cenomana*** (KELLER, 1935). Sample M37, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). Side view, X 704, Wadi Mujib.

Fig. 18.13 ***Heterohelix globulosa*** (EHRENBERG, 1840). Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). **a:** Side view X 336, **b:** apertural view X 500, Wadi Mujib.

Fig. 18.14 ***Heterohelix moremani*** (CUSHMAN, 1938). Sample M41, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 476, **b:** apertural view X 500, Wadi Mujib.

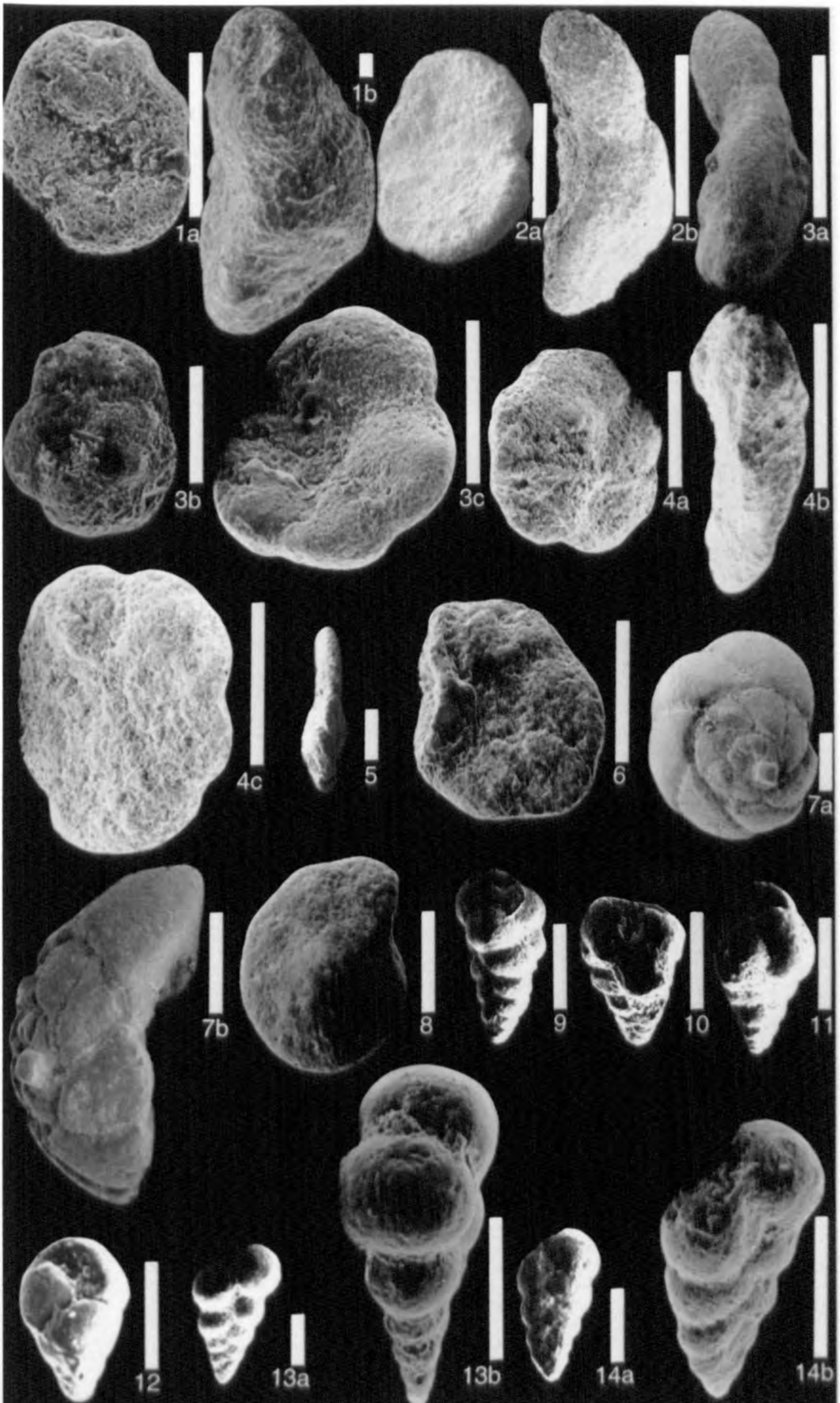

Plate 18

PLATE 19

Fig. 19.1 ***Heterohelix striata compressa*** (NAKKADY, 1950). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view X 399, **b:** apertural view X 500, Wadi Mujib.

Fig. 19.2 ***Heterohelix globulosa*** (EHRENBERG, 1840). Sample M39, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 352, **b:** apertural view X 500, Wadi Mujib.

Fig. 19.3 ***Heterohelix globulosa*** (EHRENBERG, 1840). Sample M32, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 316, Wadi Mujib.

Fig. 19.4 ***Heterohelix moremani*** (CUSHMAN, 1938). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 488, Wadi Mujib.

Fig. 19.5 ***Heterohelix striata compressa*** (NAKKADY, 1950). Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 468, Wadi Mujib.

Fig. 19.6 ***Heterohelix striata compressa*** (NAKKADY, 1950). Sample M33, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view, X 500, **b:** Side view, X 332, Wadi Mujib.

Fig. 19.7 ***Heterohelix pseudotessera*** (CUSHMAN, 1938). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** apertural view, X 500, **b:** Side view, X 468, Wadi Mujib.

Fig. 19.8 ***Heterohelix glabrans*** (CUSHMAN, 1938a). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** apertural view, X 500, **b:** Side view, X 348, Wadi Mujib.

Fig. 19.9 ***Heterohelix dentata*** STENESTAD, 1968. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 350, **b:** Side view, X 272, Wadi Mujib.

Fig. 19.10 ***Heterohelix globocarinata*** (CUSHMAN, 1938). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** apertural view, X 500, **b:** Side view, X 476, Wadi Mujib.

Fig. 19.11 ***Heterohelix punctulata*** (CUSHMAN, 1938). Sample M38, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). Side view, X 228, Wadi Mujib.

Fig. 19.12 ***Heterohelix calabarflanki*** ODE'BO'DE', 1982. Sample M39, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view, X 500, **b:** Side view, X 448, Wadi Mujib.

Fig. 19.13 ***Heterohelix nkporoensis*** ODE'BO'DE', 1982. Sample J58, Wadi Sir Formation **"A7"** (Turonian), **a:** apertural view, X 200, Ajlun/Jerash; sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian), **b:** Side view, X 304, Wadi Mujib.

Fig. 19.14 ***Heterohelix*** sp. 1. **a:** Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian), Side view, X 276; **b:** Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), apertural view, X 500, Wadi Mujib.

Fig. 19.15 ***Planoglobulina brazoensis*** MARTIN, 1972. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 560, Wadi Mujib.

Fig. 19.16 ***Heterohelix vistulaensis*** PERYT, 1980. Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** apertural view, X 500, **b:** Side view, X 350, Wadi Mujib.

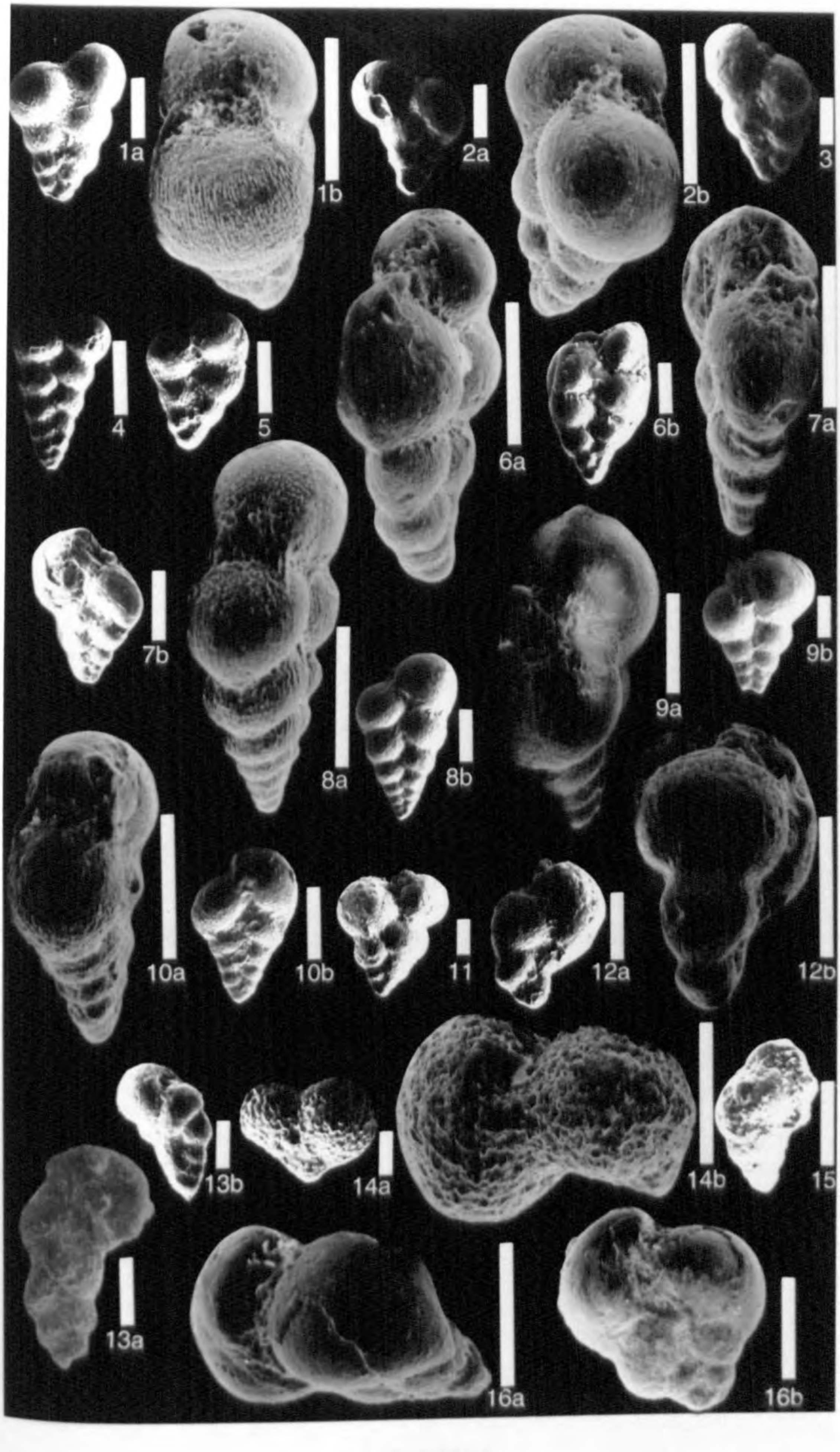
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Plate 19

PLATE 20

Fig. 20.1 ***Planoglobulina multicamerata*** (KLASZ, 1953). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Edge view, X 500, Wadi Mujib.

Fig. 20.2 ***Planoglobulina multicamerata*** (KLASZ, 1953). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 20.3 ***Pseudoplanoglobulina nakhitschevanica*** ALIYULLA, 1977. Sample M35, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 296, **b:** apertural view, X 500, Wadi Mujib.

Fig. 20.4 ***Heterohelix punctulata*** (CUSHMAN, 1938). Sample M38, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view, X 216, **b:** Side view, X 200, Wadi Mujib.

Fig. 20.5 ***Pseudotextularia plummerae*** (LOETTERLE, 1937). Sample M32, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 336, **b:** apertural view, X 500, Wadi Mujib.

Fig. 20.6 ***Pseudotextularia plummerae*** (LOETTERLE, 1937). Sample M39, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 500, **b:** apertural view, X 500, Wadi Mujib.

Fig. 20.7 ***Pseudotextularia nuttalli*** (VOORWIJK, 1937). Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 350, **b:** edge view, X 336, Wadi Mujib.

Fig. 20.8 ***Pseudotextularia*** sp. 1. Sample M32, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 420, Wadi Mujib.

Fig. 20.9 ***Pseudotextularia nuttalli*** (VOORWIJK, 1937). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 288, **b:** Side view, X 350, Wadi Mujib.

Fig. 20.10 ***Heterohelix globulosa*** (EHRENBERG, 1840). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view, X 750, **b:** Side view, X 584, Wadi Mujib.

Fig. 20.11 ***Heterohelix reussi*** (CUSHMAN, 1938). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 350, **b:** Side view, X 284, Wadi Mujib.

Fig. 20.12 ***Heterohelix moremani*** (CUSHMAN, 1938). Sample M39, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 500, **b:** edge view, X 500, Wadi Mujib.

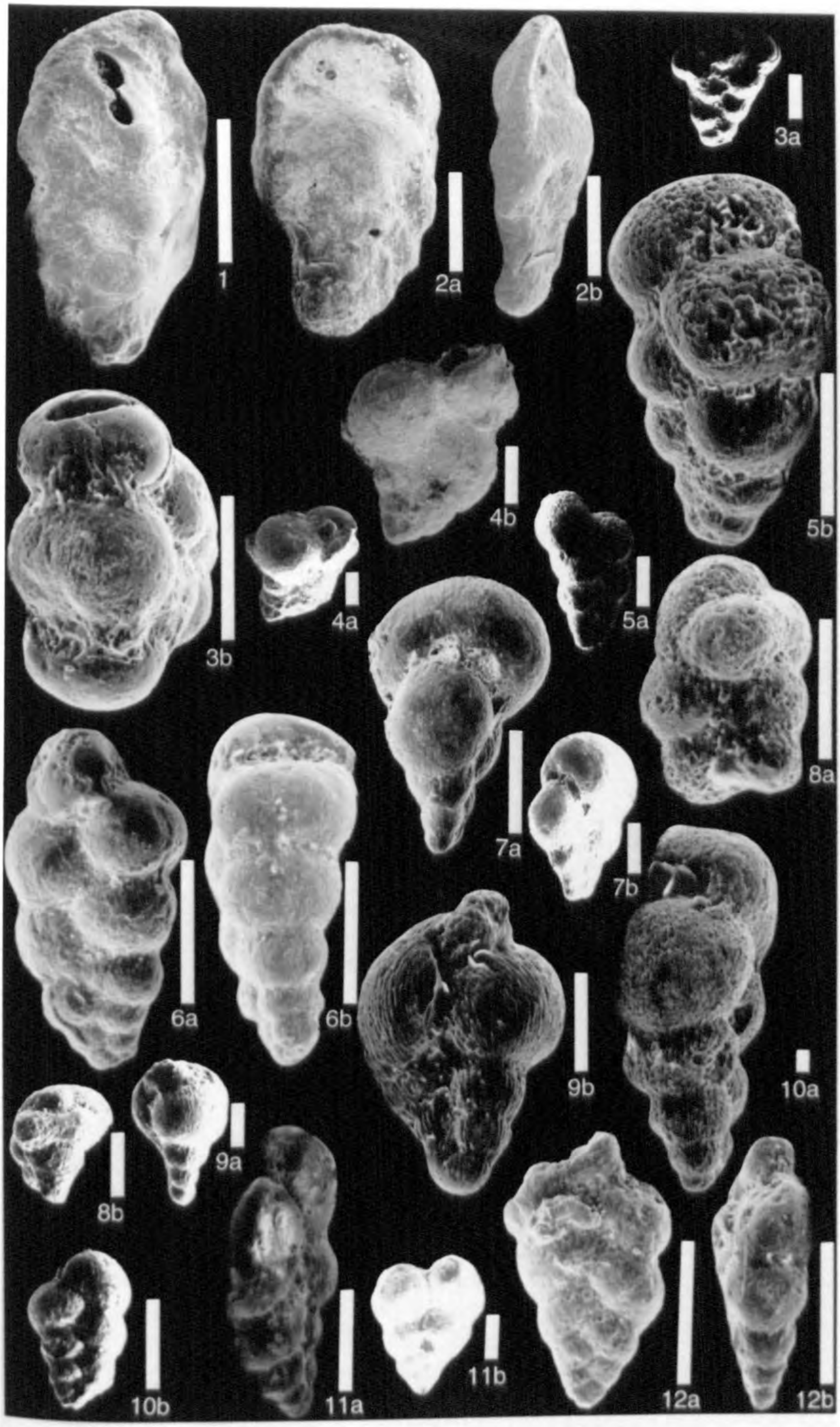
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Plate 20

PLATE 21

Fig. 21.1 ***Gabonita sumaya*** (BASHA, 1979). Sample M22, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). **a:** edge view, X 172, **b:** Side view, X 150, Wadi Mujib.

Fig. 21.2 ***Gabonita sumaya*** (BASHA, 1979). Sample M33, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). Edge view, X 352, Wadi Mujib.

Fig. 21.3 ***Gabonita sumaya*** (BASHA, 1979). Sample M35, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 21.4 ***Gabonita sumaya*** (BASHA, 1979). Sample M35, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). **a:** edge view, X 476, **b:** Side view, X 750, Wadi Mujib.

Fig. 21.5 ***Gublerina robusta*** KLASZ, 1953. Sample M86, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 500, Wadi Mujib.

Fig. 21.6 ***Gublerina ornatissima*** (CUSHMAN and CHURCH, 1929). Sample M86, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 21.7 ***Gabonita sumaya*** (BASHA, 1979). Sample M39, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). Edge view, X 500, Wadi Mujib.

Fig. 21.8 ***Globigerinelloides bentonensis*** (MORROW, 1934). Sample M74, Ghudran Formation "**B1**" (upper Coniacian to Santonian). Edge view, X 350, Wadi Mujib.

Fig. 21.9 ***Globigerinelloides volutus*** (WHITE, 1928). Sample M91, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 21.10 ***Globigerinelloides caseyi*** (BOLLI, LOEBLICH and TAPPAN, 1957). Sample M47, Ghudran Formation "**B1**" (upper Coniacian to Santonian). Side view, X 350, Wadi Mujib.

Fig. 21.11 ***Globigerinelloides ultramicra*** (SUBBOTINA, 1949). Sample M47, Ghudran Formation "**B1**" (upper Coniacian to Santonian). **a:** Side view, X 500, **b:** edge view, X 500, Wadi Mujib.

Fig. 21.12 ***Globigerinelloides prairiehillensis*** PESSAGNO, 1967. Sample M47, Ghudran Formation "**B1**" (upper Coniacian to Santonian). **a:** edge view, X 350, **b:** Side view, X 350, Wadi Mujib.

Fig. 21.13 ***Globigerinelloides bollii*** PESSAGNO, 1967. Sample M90, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). Edge view, X 350, Wadi Mujib.

Fig. 21.14 ***Globigerinelloides prairiehillensis*** PESSAGNO, 1967. Sample M90, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). Side view, X 500, Wadi Mujib.

Fig. 21.15 ***Globigerinelloides eaglefordensis*** (MOREMAN, 1927). Sample M22, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). Edge view, X 500, Wadi Mujib.

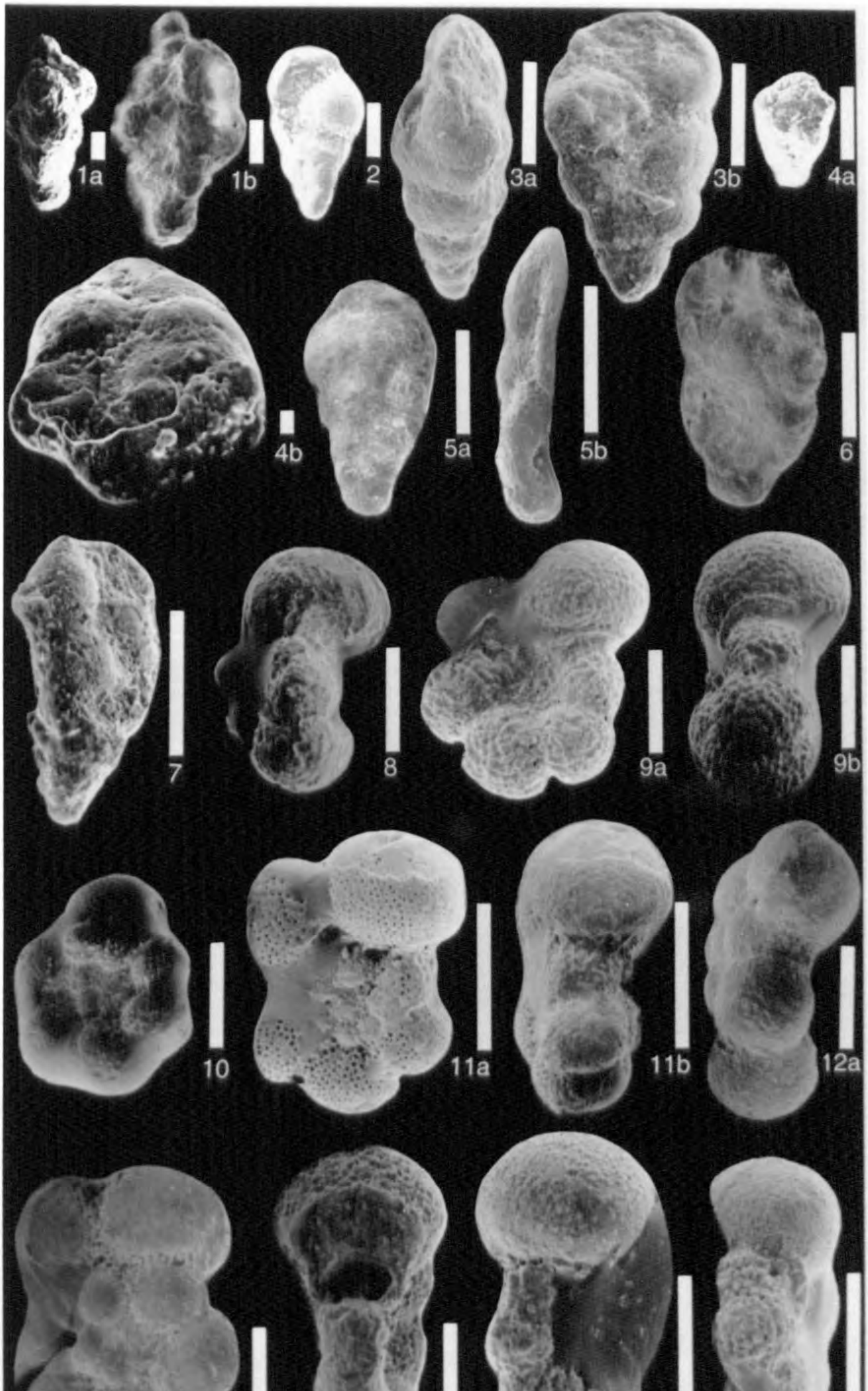

Plate 21

PLATE 22

Fig. 22.1 ***Globigerinelloides alvarezi*** (ETERNOD OLVERA, 1959). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 22.2 ***Blowiella blowi*** (BOLLI, 1959). Sample M21, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 22.3 ***Globigerinelloides messinae*** (BRONNIMANN, 1952). Sample M88, **a:** edge view X 350; sample M90, **b:** edge view, X 500, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

Fig. 22.4 ***Globigerinelloides multispinata*** (LALICKER, 1948). Sample M99, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). apertural view X 750, Wadi Mujib.

Fig. 22.5 ***Costellagerina bulbosa*** (BELFORD, 1960). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 200, Wadi Mujib.

Fig. 22.6 ***Hedbergella delrioensis*** (CARSEY, 1926). Sample M21, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 750, Wadi Mujib.

Fig. 22.7 ***Hedbergella monmouthensis*** (OLSSON, 1960). Sample M74, Ghudran Formation **"B1"** (Santonian). Side view, X 350, Wadi Mujib.

Fig. 22.8 ***Hedbergella delrioensis*** (CARSEY, 1926). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 22.9 ***Hedbergella holmdelensis*** OLSSON, 1964. Sample M96, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). Side view, X 500, Wadi Mujib.

Fig. 22.10 ***Hedbergella simplex*** (MORROW, 1934). Sample M38, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). spiral view, X 200, Wadi Mujib.

Fig. 22.11 ***Hedbergella flandrini*** PORTHAULT, 1970. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). spiral view, X 350, Wadi Mujib.

Fig. 22.12 ***Hedbergella hoelzli*** (HAGN and ZEIL, 1954). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). spiral view, X 350, Wadi Mujib.

Fig. 22.13 ***Hedbergella trochoidea*** (GANDOLFI, 1942). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 22.14 ***Whiteinella brittonensis*** (LOEBLICH and TAPPAN, 1961). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 22.15 ***Whiteinella archaeocretacea*** PESSAGNO, 1967. Sample M47, Ghudran Formation **"B1"** (upper Coniacian). Umbilical view, X 200, Wadi Mujib.

Fig. 22.16 ***Whiteinella aprica*** (LOEBLICH and TAPPAN, 1961). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Umbilical view, X 150, Wadi Mujib.

Fig. 22.17 ***Whiteinella inornata*** (BOLLI, 1957). Sample M33, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** umbilical view, X 200, **b:** edge view, X 350, Wadi Mujib.

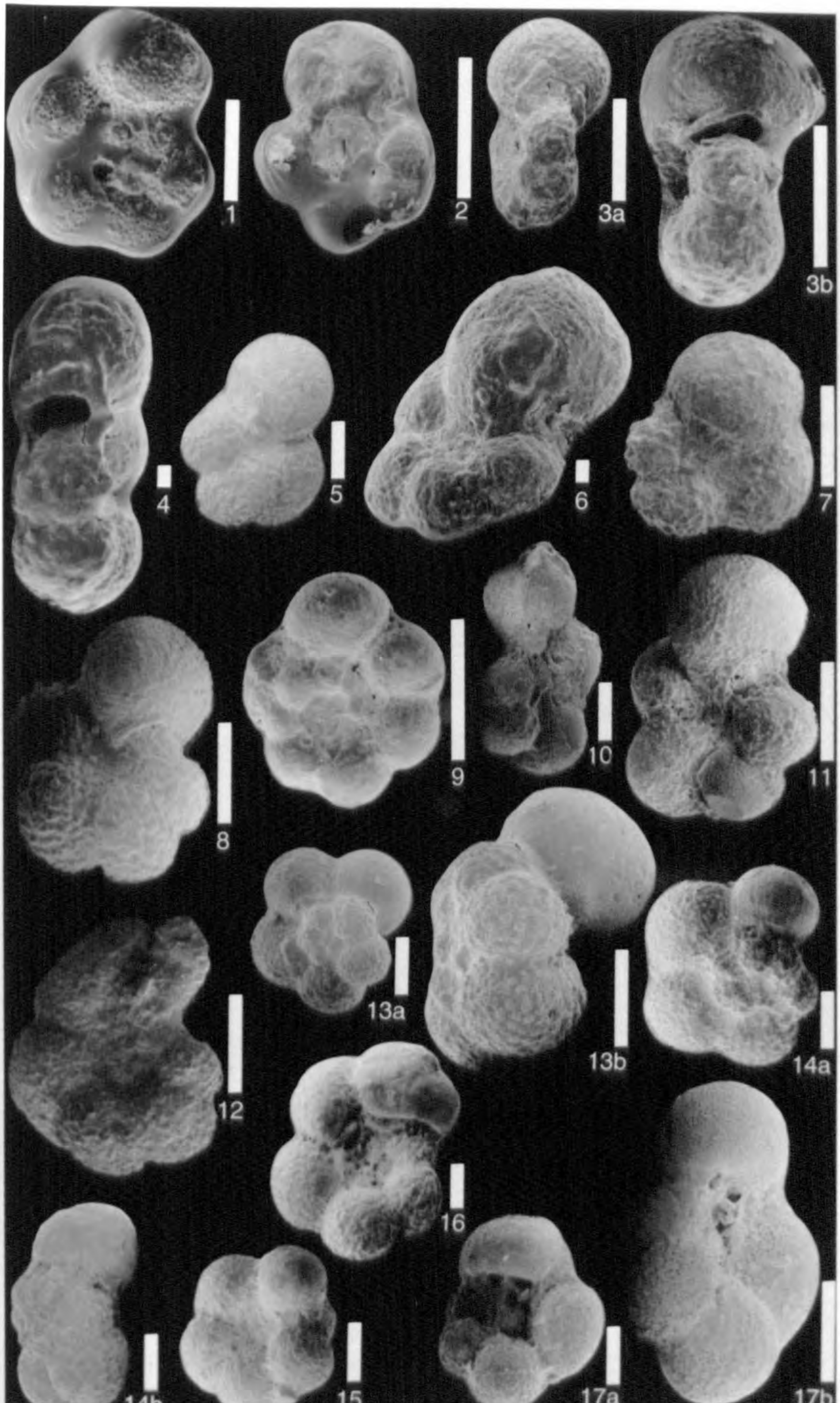

Plate 22

PLATE 23

Fig. 23.1 ***Whiteinella baltica*** DOUGLAS and RANKIN, 1969. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Umbilical view, X 200, Wadi Mujib.

Fig. 23.2 ***Whiteinella brittonensis*** (LOEBLICH and TAPPAN, 1961). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** spiral view, X 350, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 23.3 ***Globotruncana orientalis*** EL NAGGAR, 1966. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Edge view, X 200, Wadi Mujib.

Fig. 23.4 ***Globotruncana orientalis*** EL NAGGAR, 1966. Sample M90, Ghudran Formation **"B1"** (Campanian). **a:** edge view, X 200, **b:** umbilical view, X 200, Wadi Mujib.

Fig. 23.5 ***Concavatotruncana asymetrica*** (SIGAL, 1952). Sample M47, Ghudran Formation **"B1"** (Santonian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 23.6 ***Concavatotruncana imbricata*** (MORNOD, 1950). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 350, **b:** edge view, X 350, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 23.7 ***Concavatotruncana concavata*** (BROTZEN, 1934). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 23.8 ***Favusella washitensis*** (CARSEY, 1926). Sample Q20, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 750, **b:** umbilical view, X 750, Ras en-Naqb.

Fig. 23.9 ***Anaticinella multiloculata*** (MORROW, 1934). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

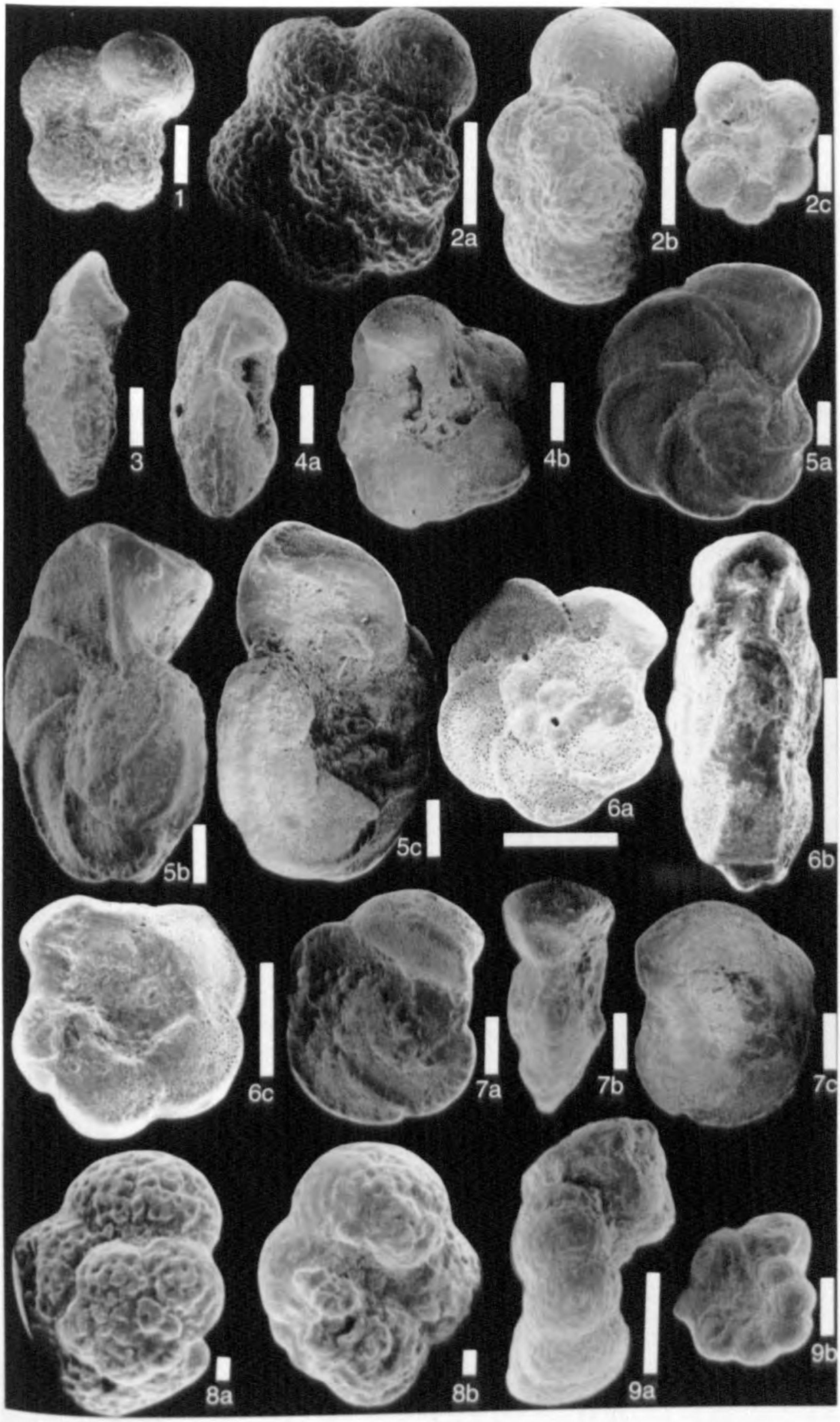

Plate 23

PLATE 24

Fig. 24.1 ***Globotruncanita stuartiformis*** (DALBIEZ, 1955). Sample M87, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 24.2 ***Contusotruncana fornicata*** (PLUMMER, 1931). Sample M90, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 150, Wadi Mujib.

Fig. 24.3 ***Contusotruncana fornicata*** (PLUMMER, 1931). Sample M91, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** umbilical view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 24.4 ***Contusotruncana plummerae*** (GANDOLFI, 1955). Sample M90, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 24.5 ***Globotruncana rosetta*** (CARSEY, 1926). Sample M91, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 24.6 ***Globotruncana arca*** (CUSHMAN, 1926). Sample M90, **a:** spiral view, X 200, **b:** edge view, X 350; sample M91, **c:** umbilical view, X 200, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian), Wadi Mujib.

Fig. 24.7 ***Globotruncana mariei*** BANNER and BLOW, 1960. Sample M91, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 150, Wadi Mujib.

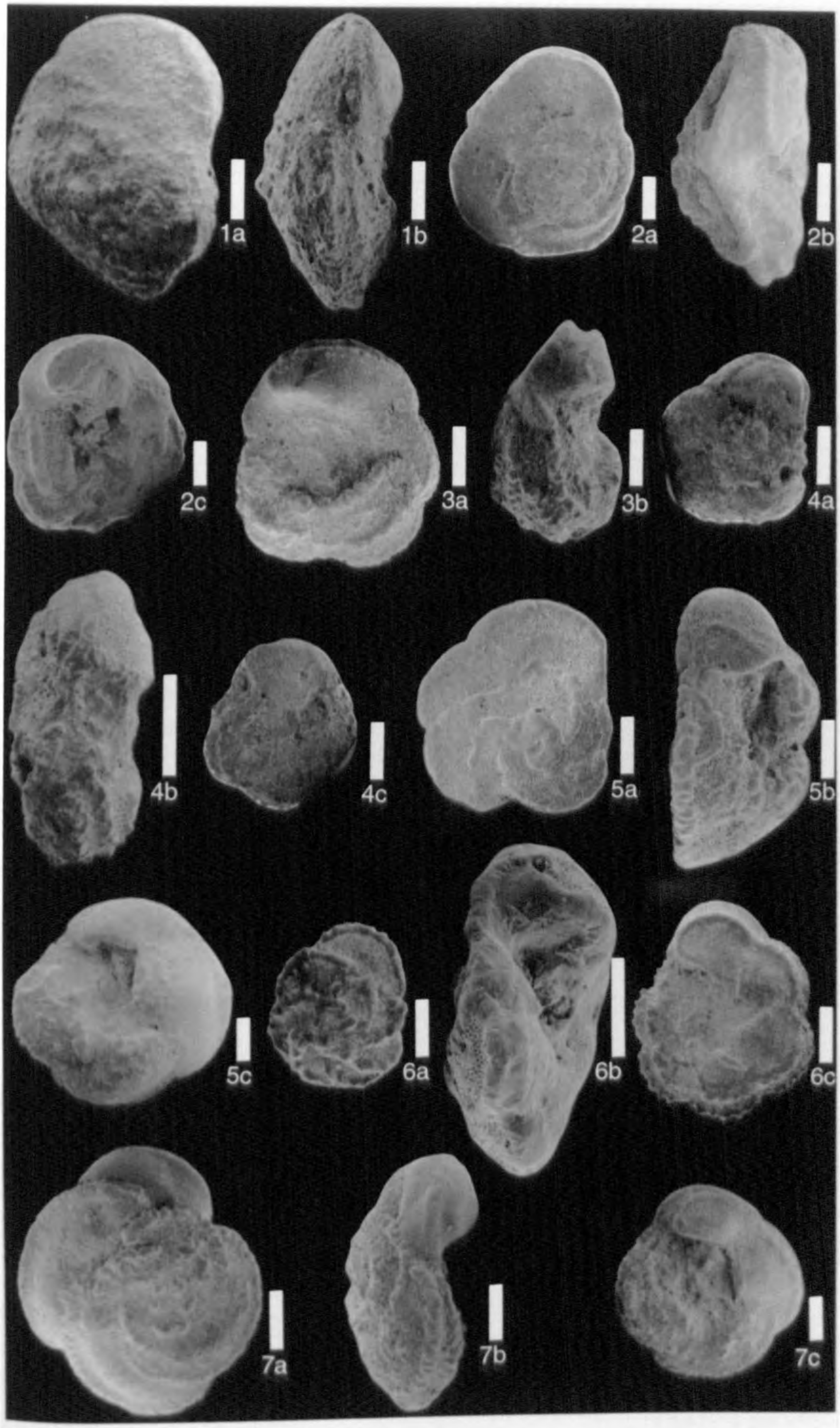

Plate 24

PLATE 25

Fig. 25.1 ***Globotruncana bulloides*** VOGLER, 1941. Sample M90, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 25.2 ***Globotruncana mariei*** BANNER and BLOW, 1960. Sample M90, **a:** spiral view, X 200, **c:** umbilical view, X 200; sample M87, **b:** edge view, X 200, Lower Silicified Limestone Member "B2", Amman Formation (Campanian), Wadi Mujib.

Fig. 25.3 ***Globotruncana linneiana*** (D'ORBIGNY, 1839). Sample M47, Ghudran Formation "B1" (Santonian). **a:** spiral view, X 150, **b:** umbilical view, X 150, Wadi Mujib.

Fig. 25.4 ***Globotruncana rugosa*** (MARIE, 1941). Sample M86, **a:** spiral view, X 350, **b:** edge view, X 500; sample M91, **c:** umbilical view, X 150, Lower Silicified Limestone Member "B2", Amman Formation (Campanian), Wadi Mujib.

Fig. 25.5 ***Concavatotruncana concavata*** (BROTZEN, 1934). Sample M47, Ghudran Formation "B1" (upper Coniacian to Santonian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 25.6 ***Marginotruncana marginata*** (REUSS, 1845). Sample M90, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 150, **b:** edge view, X 500, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 25.7 ***Archaeoglobigerina blowi*** PESSAGNO, 1967. Sample M47, Ghudran Formation "B1" (upper Coniacian to Santonian). **a:** umbilical view, X 350, **b:** edge view, X 927, Wadi Mujib.

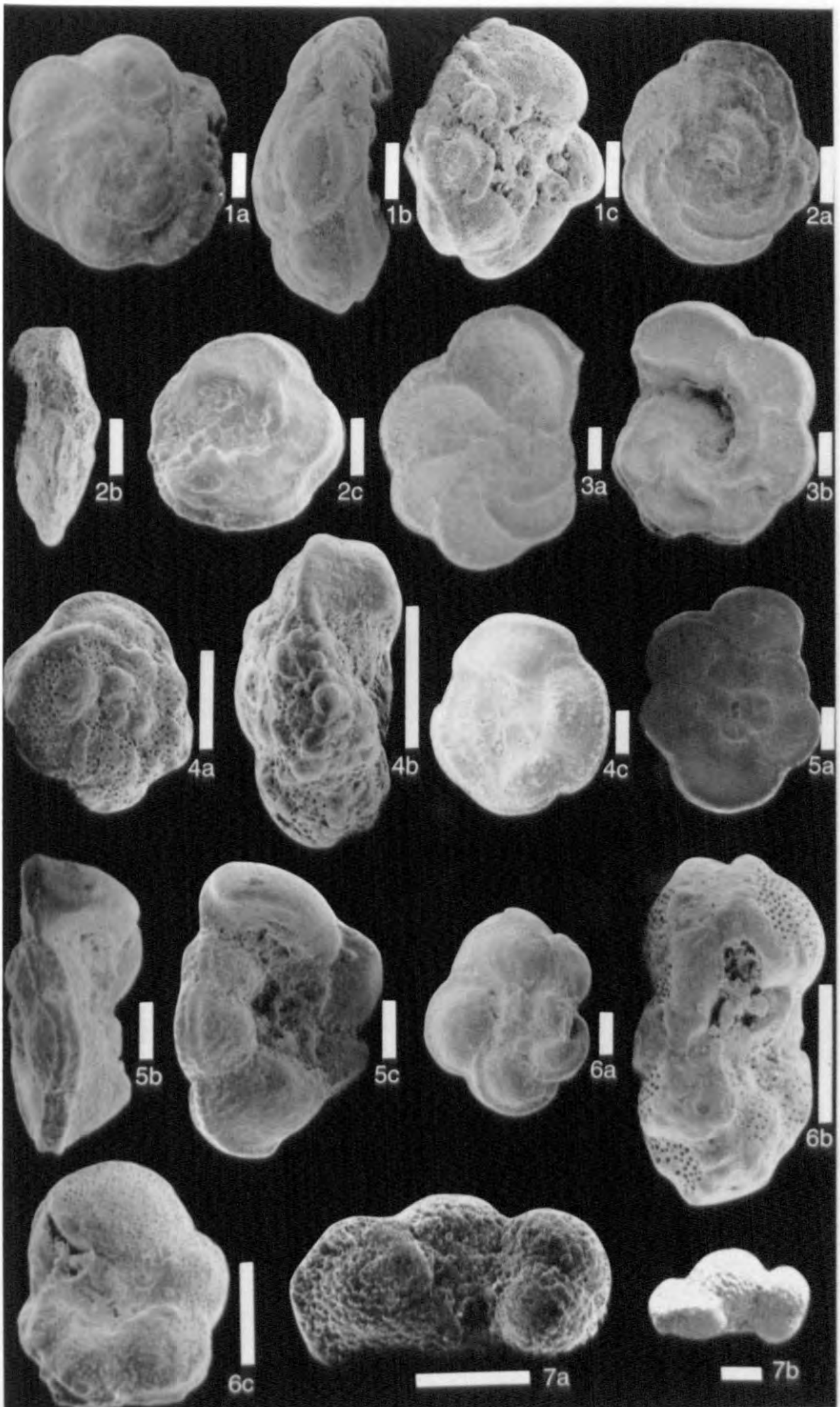

Plate 25

PLATE 26

Fig. 26.1 ***Globotruncanita subspinosa*** (PESSAGNO, 1960). Sample M90, **a:** spiral view, X 150, **b:** edge view, X 200; sample M91, **c:** umbilical view, X 200, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

Fig. 26.2 ***Globotruncanita elevata*** (BROTZEN, 1934). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 100, Wadi Mujib.

Fig. 26.3 ***Marginotruncana paraconcavata*** PORTHAULT, 1970. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 26.4 ***Marginotruncana pseudolinneina*** PESSAGNO, 1967. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 26.5 ***Marginotruncana renzi*** (GANDOLFI, 1942). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 26.6 ***Marginotruncana marginata*** (REUSS, 1845). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian) **a:** spiral view, X 200; sample M90, **b:** edge view, X 200; sample M91, **c:** umbilical view, X 200, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

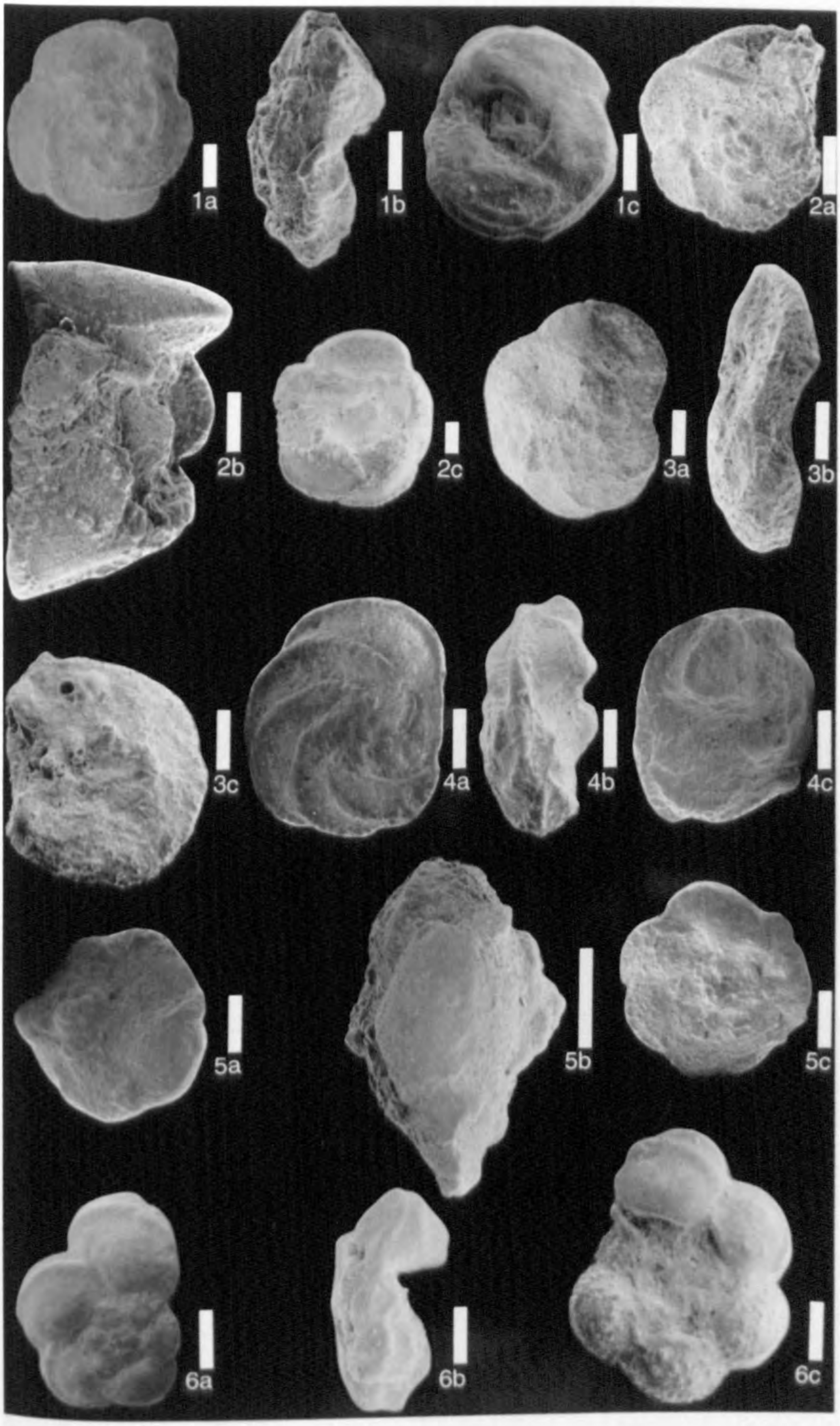

Plate 26

PLATE 27

Fig. 27.1 ***Marginotruncana coronata*** (BOLLI, 1945). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 150, Wadi Mujib.

Fig. 27.2 ***Marginotruncana coronata*** (BOLLI, 1945). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 27.3 ***Globotruncana rugosa*** (MARIE, 1941). Sample M90, **a:** spiral view, X 200; sample M91, **b:** edge view, X 200, **c:** umbilical view, X 200, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian), Wadi Mujib.

Fig. 27.4 ***Marginotruncana sinuosa*** PORTHAULT, 1970. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 27.5 ***Rugotruncana subcircumnodifer*** (GANDOLFI, 1955). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 27.6 ***Sigalitruncana pileoliformis*** (LAMOLDA, 1977). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** umbilical view, X 200, Wadi Mujib.

Fig. 27.7 ***Contusotruncana patelliformis*** (GANDOLFI, 1955). Sample M87, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

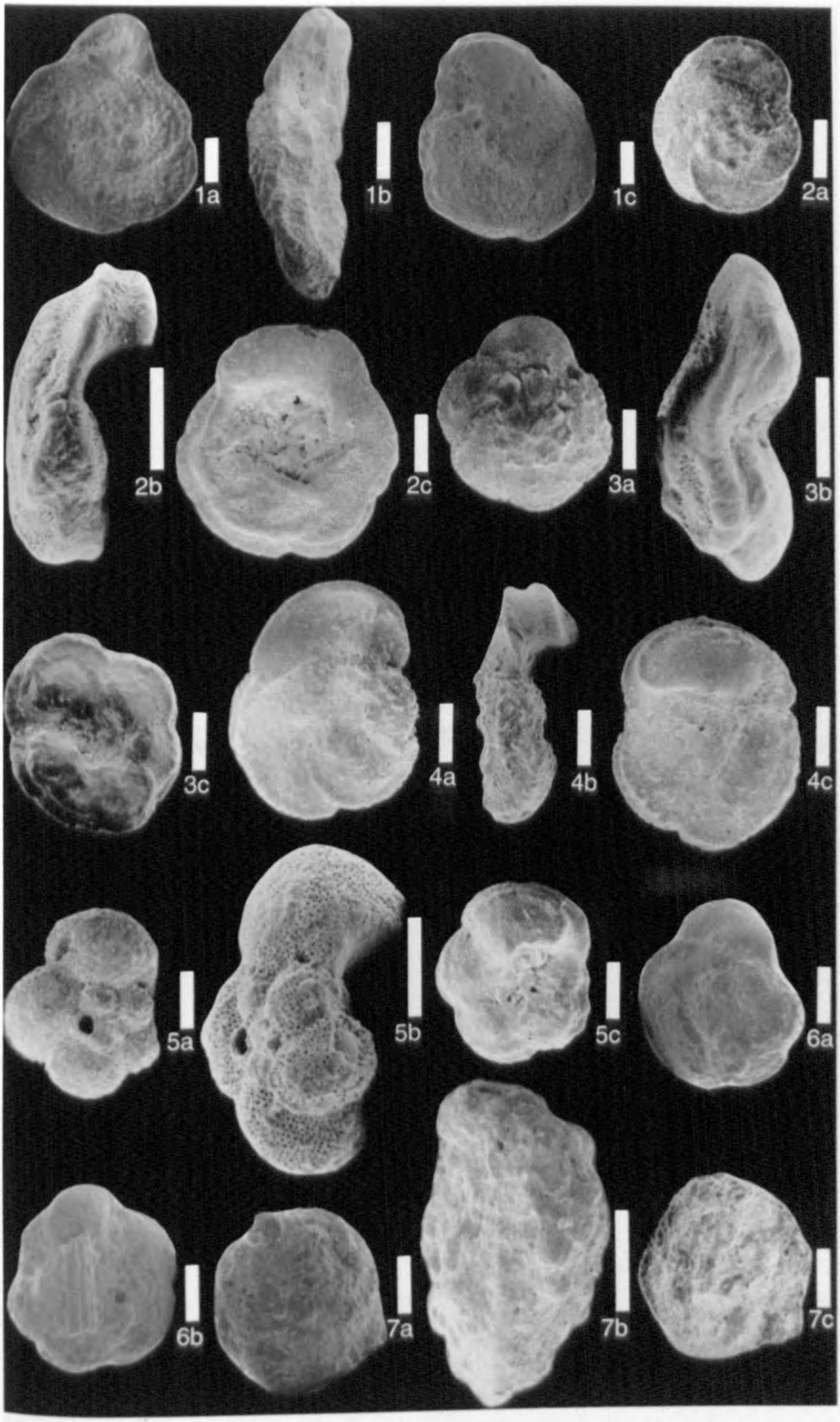

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Fig. 28.1 ***Contusotruncana fornicata*** (PLUMMER, 1931). Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 28.2 ***Archaeoglobigerina blowi*** PESSAGNO, 1967. Sample M87, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** edge view, X 200, **b:** spiral view, X 200, Wadi Mujib.

Fig. 28.3 ***Archaeoglobigerina blowi*** PESSAGNO, 1967. Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 28.4 ***Rugoglobigerina pilula*** BELFORD, 1960. Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 28.5 ***Archaeoglobigerina cretacea*** (D'ORBIGNY, 1840). Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 150, **b:** edge view, X 200, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 28.6 ***Globotruncanella havanensis*** (VOORWIJK, 1937). Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 28.7 ***Rugoglobigerina rugosa*** (PLUMMER, 1926). Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

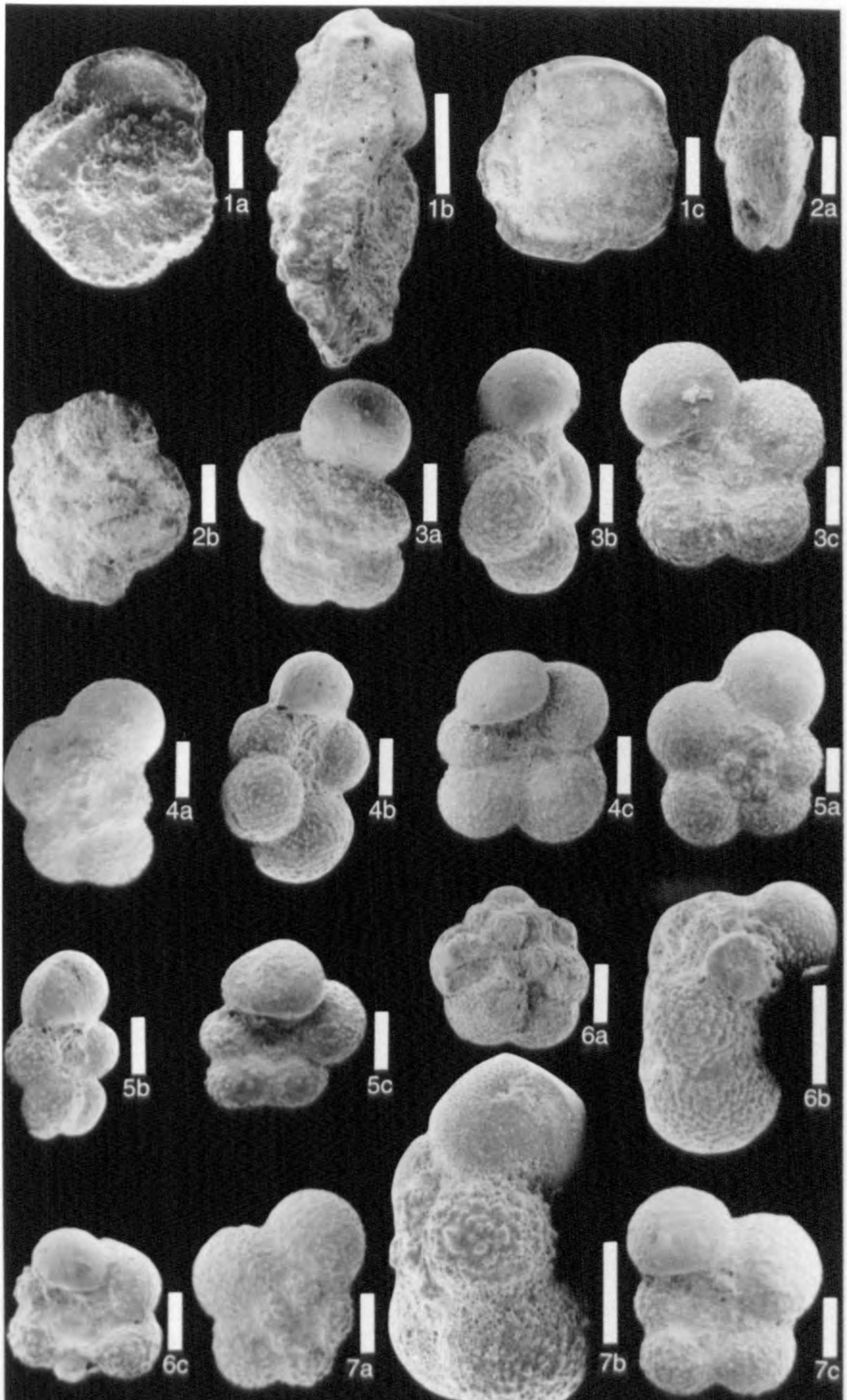

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PLATE 29

Fig. 29.1 ***Rugoglobigerina rugosa*** (PLUMMER, 1926). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 29.2 . Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Umbilical view, X 546, Wadi Mujib.

Fig. 29.3 ***Archaeoglobigerina blowi*** PESSAGNO, 1967. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** umbilical view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 29.4 ***Bolivina decurrens*** (EHRENGERG, 1854). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). apertural view, X 350, Wadi Mujib.

Fig. 29.5 ***Bolivina incrassata*** REUSS, 1851. Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 350, **b:** edge view, X 500, Wadi Mussa.

Fig. 29.6 ***Brizalina lowmani*** (PHLEGER and PARKER, 1951). Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). Side view, X 500, Wadi Mussa.

Fig. 29.7 ***Gabonita (Gabonella) obesa*** (KLASZ, MARIE and RERAT, 1961). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). Edge view, X 500, Wadi Mujib.

Fig. 29.8 ***Gabonita parva*** (KLASZ and MEIJER, 1960). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 29.9 ***Gabonita tiarella*** (MARIE, 1960). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** edge view, X 350, **b:** Side view, X 350, **c:** Side view, X 350, Wadi Mujib.

Fig. 29.10 ***Gabonita bipyramidata*** (EL-SHINNAWI, 1971). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 29.11 ***Gabonita zigzaga*** EL-SHINNAWI, 1976. Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 500, **b:** edge view, X 500, Wadi Mujib.

Fig. 29.12 ***Gabonita billmani*** (ROVEDA, 1969). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** apertural view, X 350, **b:** Side view, X 350, Wadi Mujib.

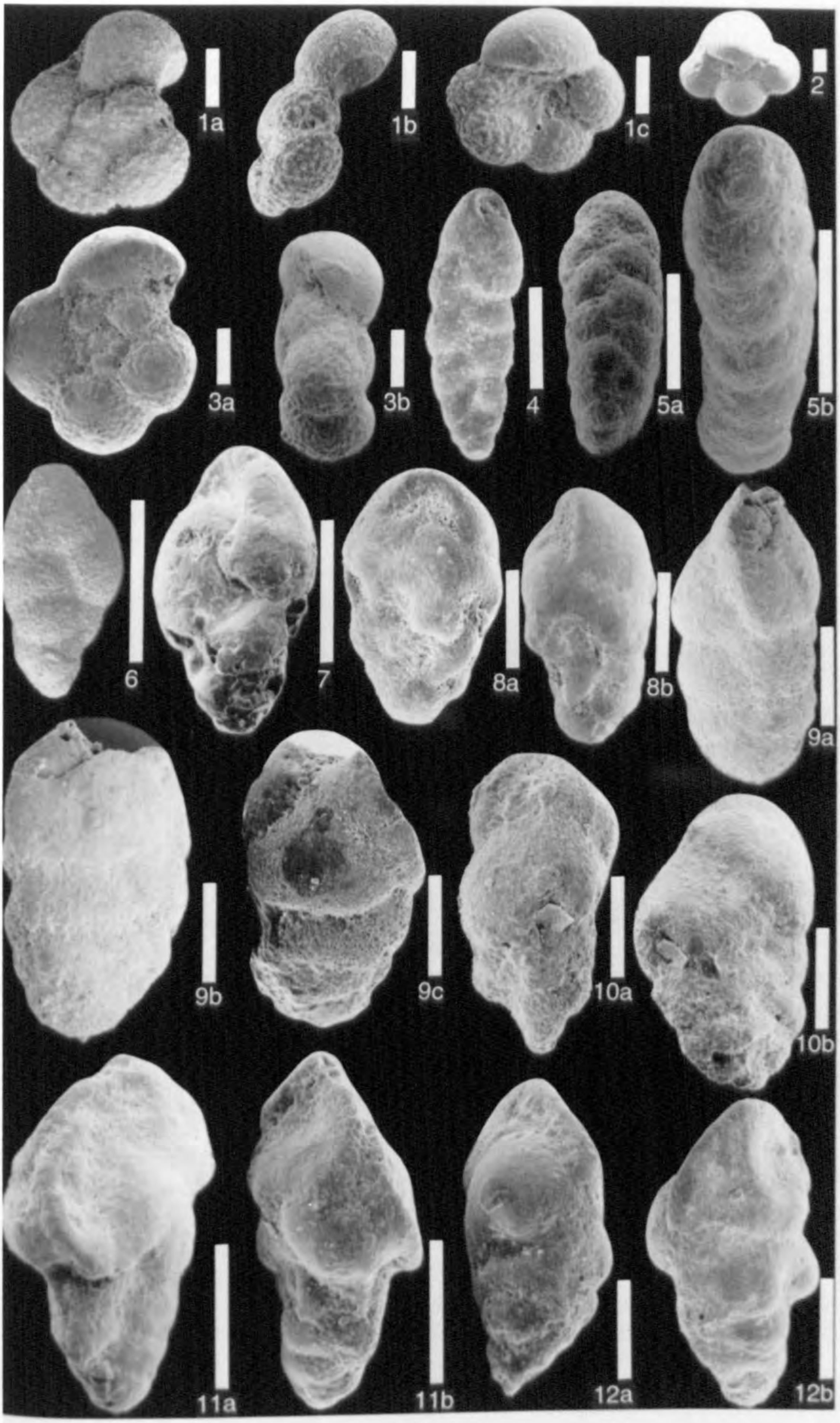

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PLATE 30

Fig. 30.1 ***Gabonita multituberculata*** (KLASZ and MEIJER, 1960). Sample M86, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Side view, X 500, Wadi Mujib.

Fig. 30.2 ***Gabonita distorta*** (KLASZ and MEIJER, 1960). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). apertural view, X 350, Wadi Mujib.

Fig. 30.3 ***Gabonita levis aegyptiaca*** (KERDANY and FAHMY, 1969). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Edge view, X 500, Wadi Mujib.

Fig. 30.4 ***Gabonita levis*** (KLASZ, MARIE and RERAT, 1961). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). Edge view, X 500, Wadi Mujib.

Fig. 30.5 ***Loxostomoides cushmani*** (WICKENDEN, 1932). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** Side view, X 350, **b:** edge view, X 350, Wadi Mujib.

Fig. 30.6 ***Elhasaella alanwoodi*** HAMAM, 1976. Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 350, Wadi Mujib.

Fig. 30.7 ***Neobulimina canadensis*** CUSHMAN and WICKENDEN, 1928. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian), **a:** apertural view, X 500; sample M40, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian), **b:** edge view, X 500, Wadi Mujib.

Fig. 30.8 ***Neobulimina canadensis alpha*** MELLO, 1969. Sample M41, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view X 750, Wadi Mujib.

Fig. 30.9 ***Neobulimina irregularis*** CUSHMAN and PARKER, 1936. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** edge view, X 500, **b:** apertural view, X 750, Wadi Mujib.

Fig. 30.10 ***Praebulimina prolixa*** (CUSHMAN and PARKER, 1935). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). apertural view, X 500, Wadi Mujib.

Fig. 30.11 ***Praebulimina prolixa longa*** (KLASZ, MAGNE and RERAT, 1963). Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). apertural view, X 500, Wadi Mujib.

Fig. 30.12 ***Praebulimina aspera*** (CUSHMAN & PARKER, 1940). Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Edge view, X 500, Wadi Mujib.

Fig. 30.13 ***Praebulimina carseyae*** (PLUMMER, 1931). Sample M40, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view X 500, Wadi Mujib.

Fig. 30.14 ***Praebulimina*** cf. ***arabica*** HAMAM, 1977. Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 30.15 ***Praebulimina reussi*** (MORROW, 1934). Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). apertural view, X 500, Wadi Mujib.

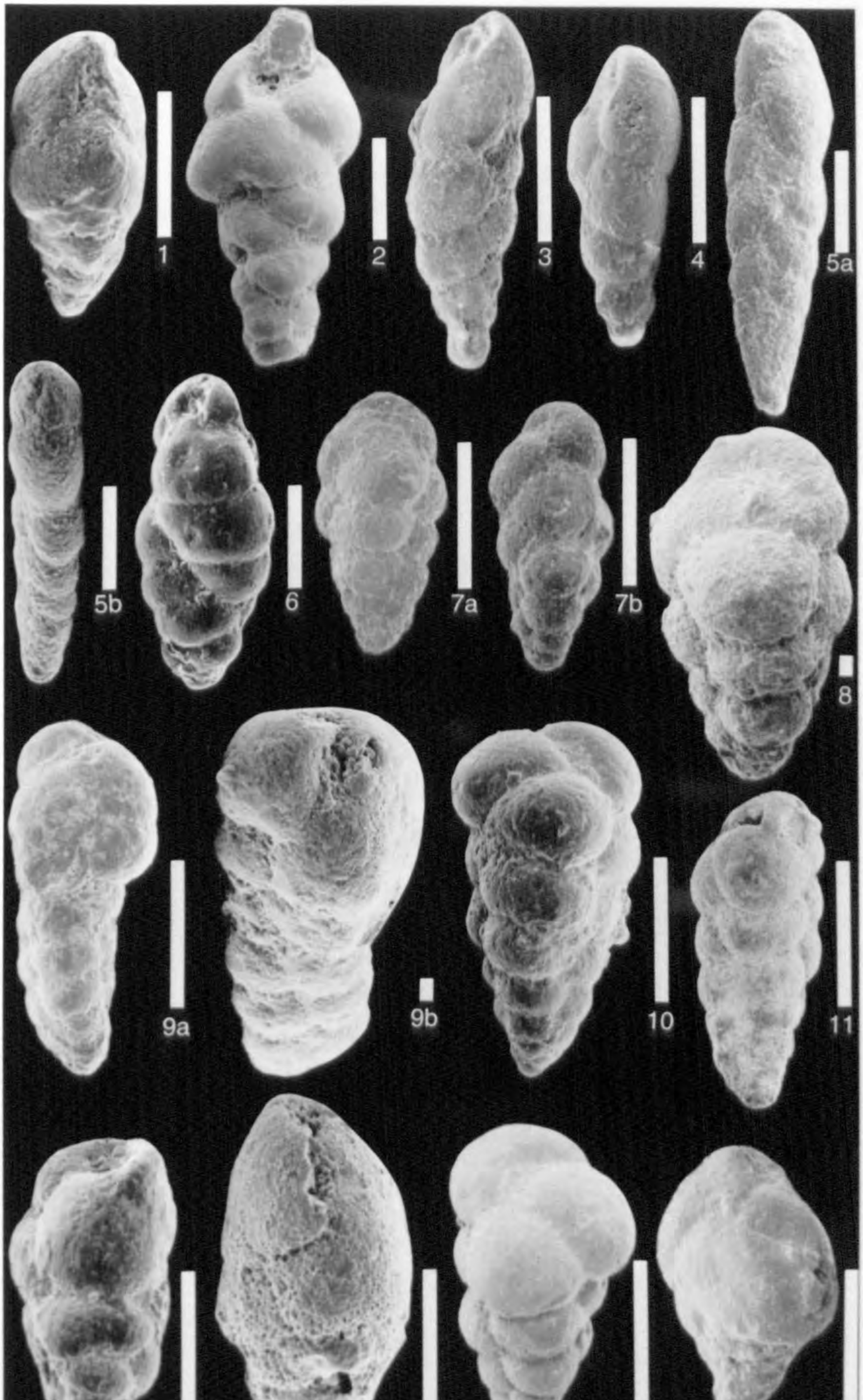

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PLATE 31

Fig. 31.1 ***Praebulimina reussi navarroensis*** (CUSHMAN and PARKER, 1935). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). apertural view, X 750, Wadi Mujib.

Fig. 31.2 ***Praebulimina trihedra*** CUSHMAN, 1927. Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** Side view, X 500, **b:** apertural view, X 500, Wadi Mujib.

Fig. 31.3 ***Praebulimina angulata*** SLITER, 1968. Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). apertural view, X 350, Wadi Mujib.

Fig. 31.4 ***Praebulimina*** cf. ***bantu lata*** (KLASZ, MAGNE and RERAT, 1963). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 31.5 ***Praebulimina bantu*** (KLASZ, MAGNE and RERAT, 1963). Sample P-60, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** Side view, X 500, **b:** apertural view, X 750 , Wadi Mussa.

Fig. 31.6 ***Praebulimina venusae*** (NAUSS, 1947). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). apertural view, X 750, Wadi Mujib.

Fig. 31.7 ***Pyramidina rudita*** (CUSHMAN and PARKER, 1936). Sample M39, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view, X 500, **b:** Side view, X 500, Wadi Mujib.

Fig. 31.8 ***Praebulimina carseyae*** (PLUMMER, 1931). Sample M40, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** apertural view X 500, **b:** Side view, X 500, Wadi Mujib.

Fig. 31.9 ***Hopkinsina arabina*** FUTYAN, 1968. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** edge view, X 350, **b:** Side view, X 500, Wadi Mujib.

Fig. 31.10 ***Hiltermannella*** cf. ***kochi*** BERTELS, 1970. Sample M74, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** edge view, X 500, **b:** Side view, X 750, Wadi Mujib.

Fig. 31.11 ***Hopkinsinella*** sp. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). Side view, X 750, Wadi Mujib.

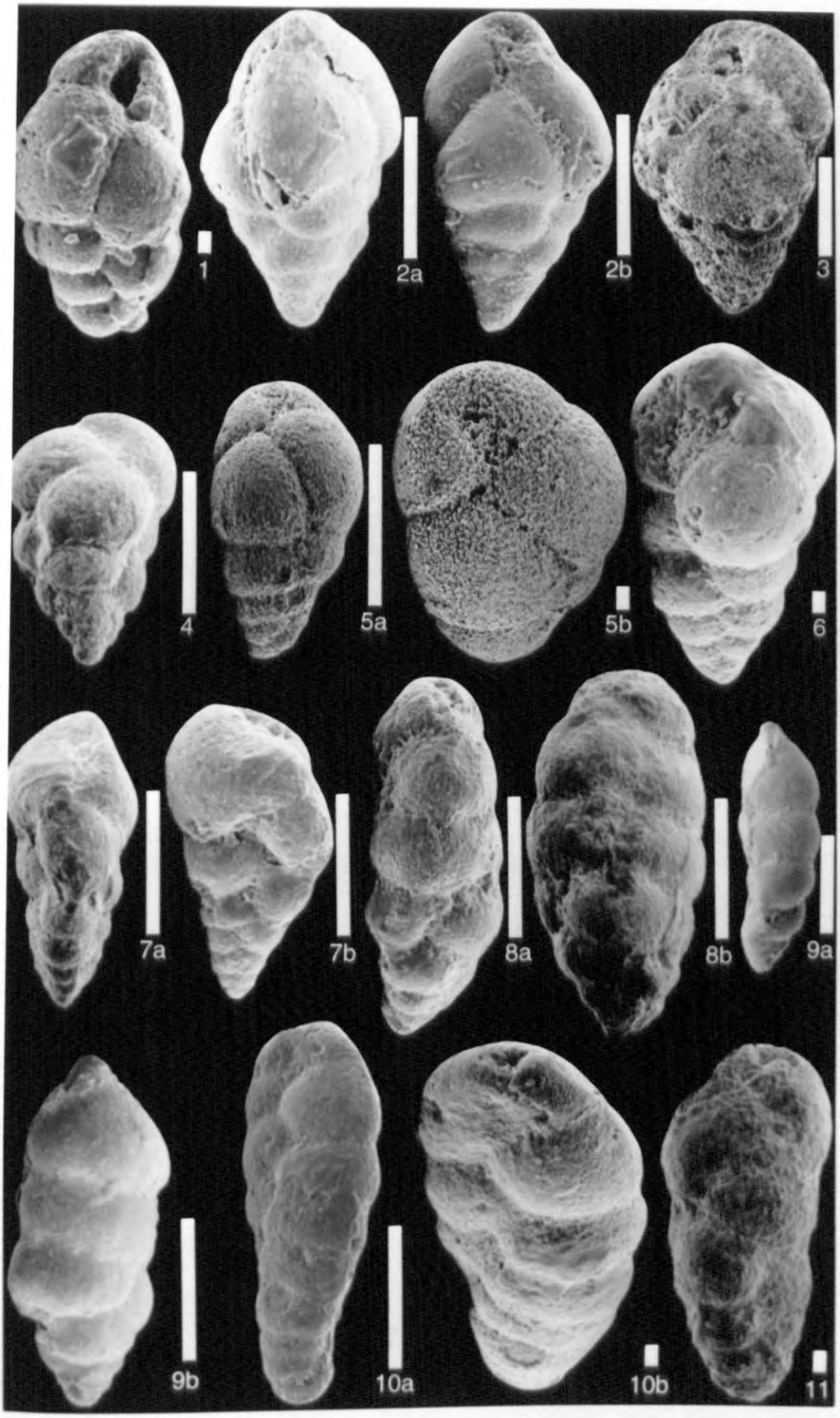

Plate 31

PLATE 32

Fig. 32.1 ***Bulimina exigua robusta*** KLASZ, MAGNE and RERAT, 1963. Sample M31, Fuheis Formation equivalent "**A3**" (middle Cenomanian). Side view, X 350, Wadi Mujib.

Fig. 32.2 ***Pyramidina triangularis*** (CUSHMAN and PARKER, 1935). Sample M90, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). Side view, X 350, Wadi Mujib.

Fig. 32.3 ***Praebulimina reussi navarroensis*** (CUSHMAN and PARKER, 1935). Sample M7a, Lower Shaly Member "**A1**", Na'ur Formation (lower Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 32.4 ***Bulimina kirri*** AL-HARITHI, 1986. Sample M99, Upper Phosphatic Silicified Limestone Member "**B2**", Amman Formation (lower Maastrichtian). apertural view, X 350, Wadi Mujib.

Fig. 32.5 ***Cassidella navarroana*** (CUSHMAN, 1933). Sample M71, Ghudran Formation "**B1**" (upper Coniacian to Santonian). **a:** Side view, X 500, **b:** apertural view, X 1000, Wadi Mujib.

Fig. 32.6 ***Cassidella tegulata*** (REUSS, 1846). Sample M21, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). **a:** apertural view, X 500, **b:** Side view, X 500, Wadi Mujib.

Fig. 32.7 ***Coryphostoma plaitum*** (CARSEY, 1926). Sample M23, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 32.8 ***Coryphostoma neumannae*** (HAMAOUI, 1979). Sample M7a, Lower Shaly Member "**A1**", Na'ur Formation (lower Cenomanian). **a:** edge view, X 500, **b:** Side view, X 500, Wadi Mujib.

Fig. 32.9 ***Fursenkoina squammosa*** (D'ORBIGNY, 1826). Sample M31, Fuheis Formation equivalent "**A3**" (middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 32.10 ***Ellipsoglandulina laevigata*** SILVETRI, 1900. Sample M21, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). Side view, X 500, Wadi Mujib.

Fig. 32.11 ***Nodogerina bradyi*** CUSHMAN, 1927. Sample M91, Lower Silicified Limestone Member "**B2**", Amman Formation (Campanian). **a:** Side view, X 350, **b:** apertural view, X 1000, Wadi Mujib.

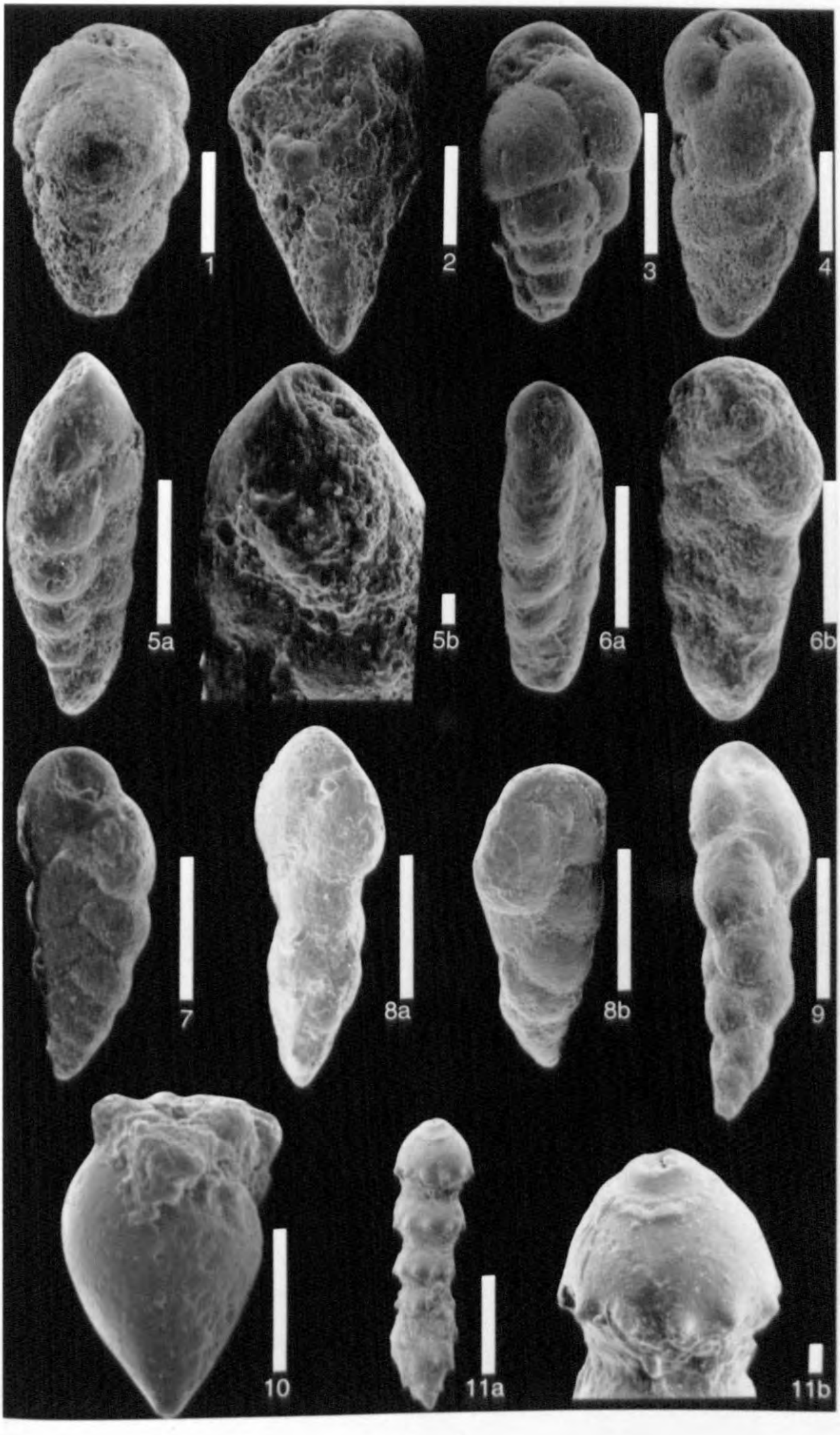

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PLATE 33

Fig. 33.1 *Conorbina conica* LOZO, 1944. Sample M22, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, Wadi Mujib.

Fig. 33.2 *Serovaina orbicella* (BANDY, 1951). Sample M22, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 500, **b:** edge view, X 750, Wadi Mujib.

Fig. 33.3 *Serovaina turonicus* (SAID and KENAWY, 1957). Sample M7a, Lower Shaly Member "A1", Na'ur Formation (lower Cenomanian). **a:** spiral view, X 350, **b:** edge view, X 500, Wadi Mujib.

Fig. 33.4 *Serovaina orbicella* (BANDY, 1951). Sample M23, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 500, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 33.5 *Serovaina* sp. 1. Sample M16, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 33.6 *Serovaina* sp. 1. Sample M16, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 33.7 *Neodiscorbinella* sp. 1. Sample M39, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). **a:** spiral view, X 750, **b:** edge view, X 750, Wadi Mujib.

Fig. 33.8 *Serovaina minutus* (SAID and KENAWY, 1957). Sample M66, Wadi Sir Formation "A7" (Turonian). **a:** edge, X 350, **b:** spiral view, X 500, Wadi Mujib.

Fig. 33.9 *Serovaina pseudoscopus* (NAKKADY, 1950). Sample M69, Wadi Sir Formation "A7" (Turonian). **a:** spiral, X 350, **b:** edge view, X 500, Wadi Mujib.

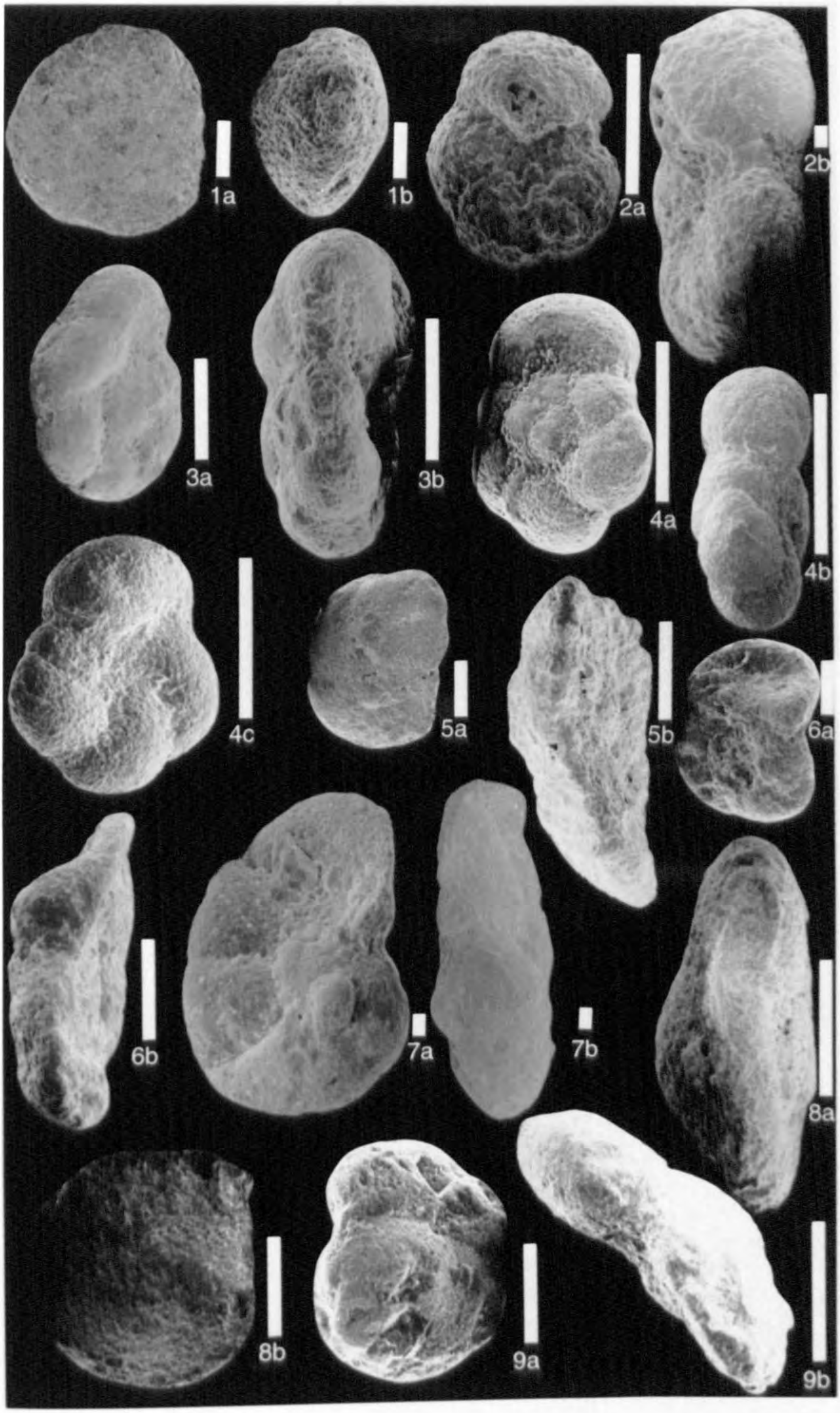

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Fig. 34.1 ***Valvulineria loetterlei*** (TAPPAN, 1940). Sample M90, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** Side view, X 350, **b:** edge view, X 1274, Wadi Mujib.

Fig. 34.2 ***Valvulineria camerata*** BROTZEN, 1936. Sample P-15, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 750, **c:** umbilical, X 500, Wadi Mussa.

Fig. 34.3 ***Valvulineria correcta*** (CARSEY, 1926). Sample M101, Upper Phosphatic Silicified Limestone Member "B2", Amman Formation (lower Maastrichtian). **a:** umbilical view, X 350, **b:** edge view, X 500, Wadi Mujib.

Fig. 34.4 ***Gavelinella awunensis*** TAPPAN, 1960. Sample M22, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 500, Wadi Mujib.

Fig. 34.5 ***Stensioeina pokornyi*** SCHEBNEROVA, 1963. Sample M22, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). Umbilical view, X 500, Wadi Mujib.

Fig. 34.6 ***Donsissonia*** sp. Sample M63, Wadi Sir Formation "A7" (Turonian). **a:** umbilical, X 350, **b:** edge view, X 500, Wadi Mujib.

Fig. 34.7 ***Donsissonia*** sp. Sample M64, Wadi Sir Formation "A7" (Turonian). Umbilical view, X 350, Wadi Mujib.

Fig. 34.8 ***Valvulinoides umovi*** (KIPRIYANOVA, 1960). Sample M91, Lower Silicified Limestone Member "B2", Amman Formation (Campanian). **a:** spiral view, X 500, **b:** umbilical view, X 500, **c:** edge view, X 1358, Wadi Mujib.

Fig. 34.9 ***Donsissonia*** sp. Sample M23, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 350, **b:** edge view, X 350, **c:** umbilical view, X 350, Wadi Mujib.

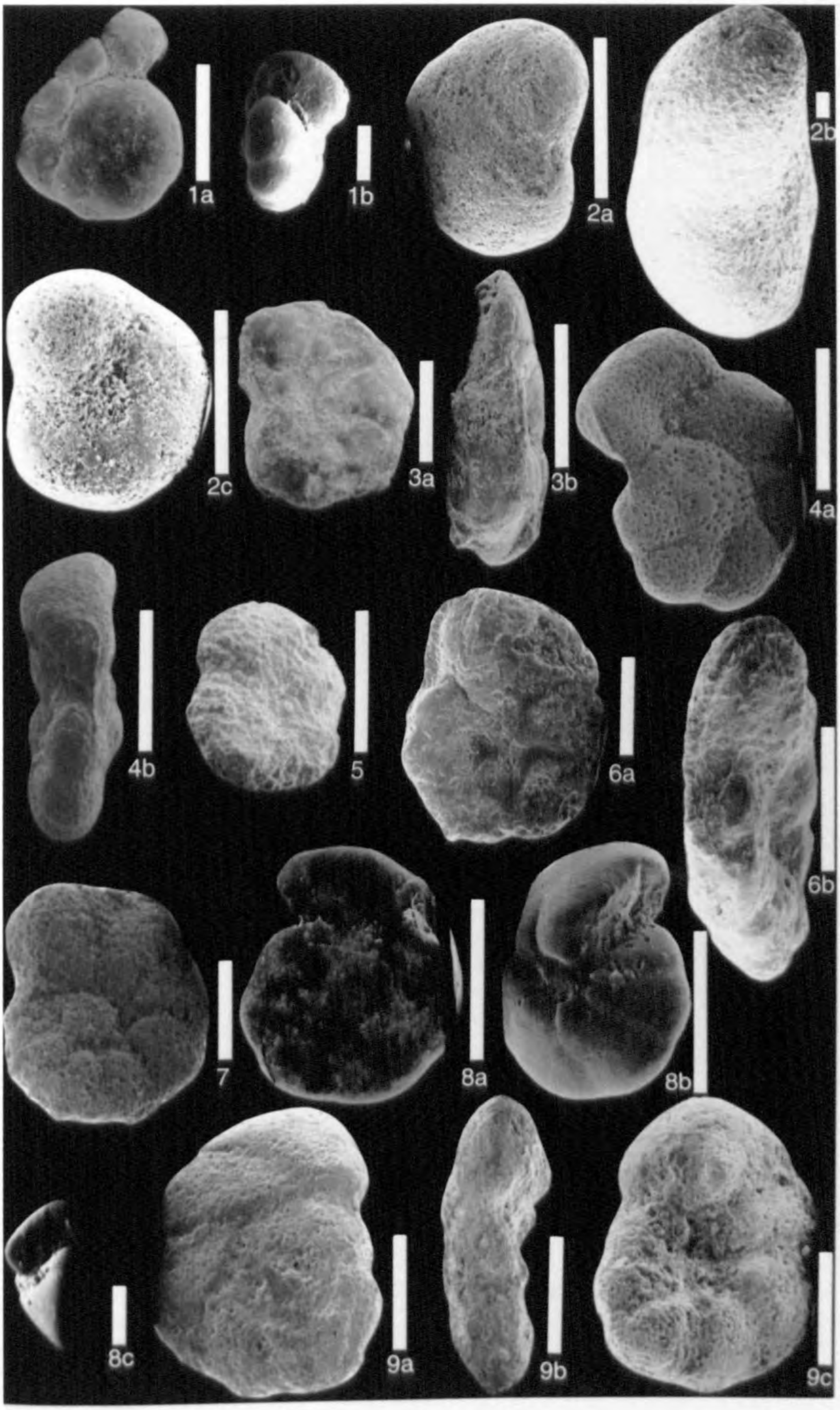

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Fig. 35.1 ***Eponides sibericus*** NYETSKAYA, 1948. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 35.2 ***Eponides*** cf. ***frankei*** BROTZEN, 1940. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 35.3 ***Eponides whitei*** BROTZEN, 1936. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** umbilical view, X 200, **b:** spiral view, X 200, **c:** edge view, X 200, Wadi Mujib.

Fig. 35.4 ***Eponides sigali*** SAID and KENAWY, 1956. Sample M88, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** umbilical view X 350, **b:** edge view, X 350, **c:** spiral view, X 200, Wadi Mujib.

Fig. 35.5 ***Eponides*** cf. ***plummerae*** CUSHMAN, 1948. Sample M7a, Lower Shaly Member **"A1"**, Na'ur Formation (lower Cenomanian). **a:** umbilical view, X 200, **b:** edge view, X 350, **c:** spiral view, X 200, Wadi Mujib.

Fig. 35.6 ***Eponides*** cf. ***plummerae*** CUSHMAN, 1948. Sample Q37, Wadi Sir Formation **"A7"** (Turonian). **a:** apertural view, X 500, **b:** Side view, X 500, Ras en-Naqb.

Fig. 35.7 ***Poroeponides praeceps*** (BROTZEN, 1936). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** edge view, X 750, **b:** umbilical view, X 500, **c:** spiral view, X 500, Wadi Mujib.

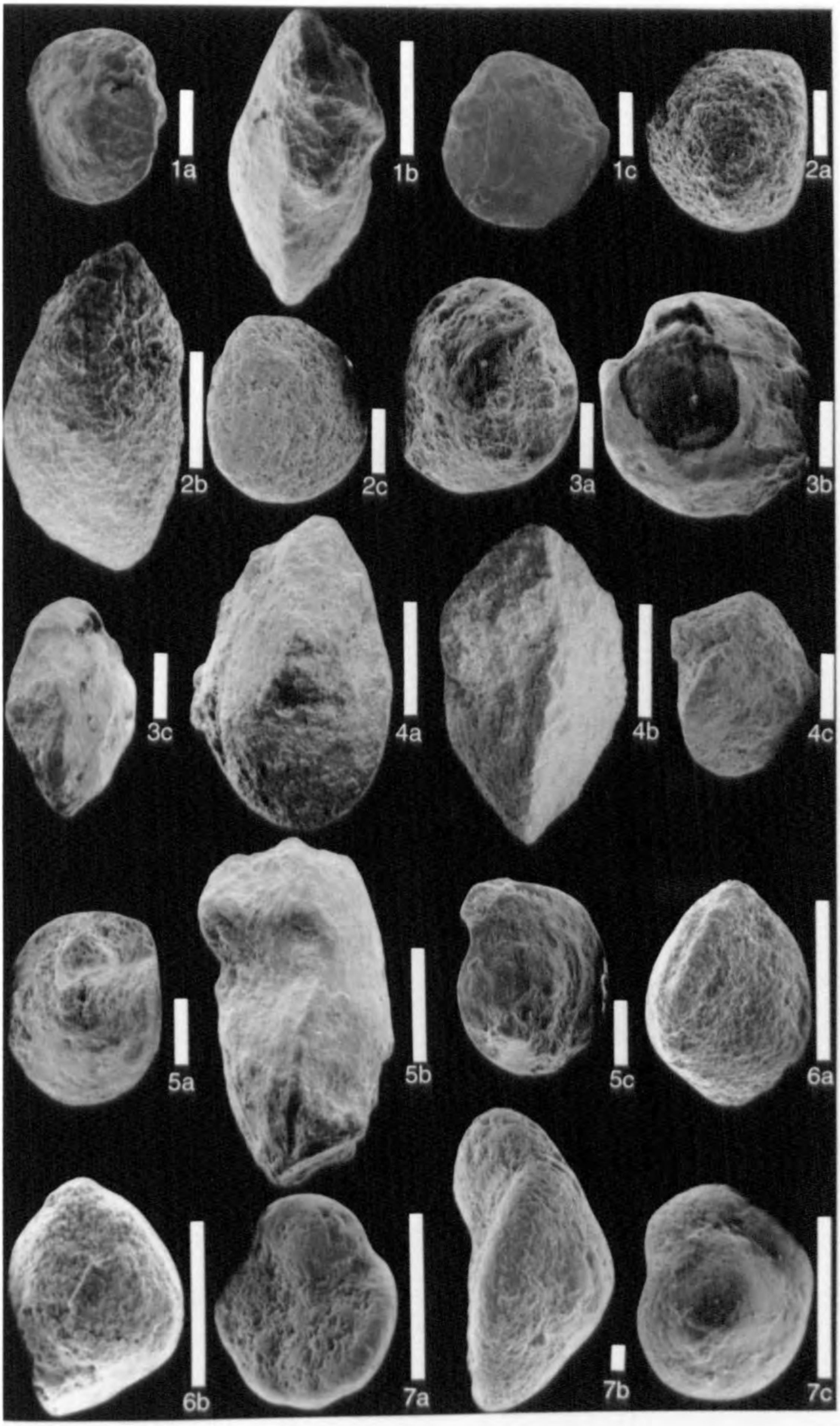

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PLATE 36

Fig. 36.1 ***Vernonina*** sp. Sample M23, Upper Nodular Member "**A2**", Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 500, Wadi Mujib.

Fig. 36.2 ***Sestronophora*** sp. Sample M32, Fuheis Formation equivalent "**A3**" (middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 36.3 ***Serovaina turonicus*** (SAID and KENAWY, 1957). Sample M56, Upper Shaly Member "**A6**", Shueib Formation Equivalent (upper Cenomanian), **a:** spiral view, X 350, **b:** umbilical view, X 350; sample M63, Wadi Sir Formation "**A7**" (Turonian), **c:** edge view, X 500, Wadi Mujib.

Fig. 36.4 ***Serovaina struvei*** (MITTERMAIER, 1896). Sample M64, Wadi Sir Formation "**A7**" (Turonian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 36.5 ***Serovaina minutus*** (SAID and KENAWY, 1957). Sample M68, **a:** spiral view, X 200; sample M66, **c:** umbilical view, X 200, Wadi Sir Formation "**A7**" (Turonian); sample M56, Upper Shaly Member "**A6**", Shueib Formation Equivalent (upper Cenomanian), **b:** edge view, X 500, Wadi Mujib.

Fig. 36.6 ***Serovaina pseudoscopus*** (NAKKADY, 1950). Sample M63, Wadi Sir Formation "**A7**" (Turonian). **a:** spiral, X 500, **b:** edge view, X 750, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 36.7 ***Neodiscorbinella*** sp. 1. Sample M39, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). **a:** spiral view, X 750, **b:** edge view, X 750, Wadi Mujib.

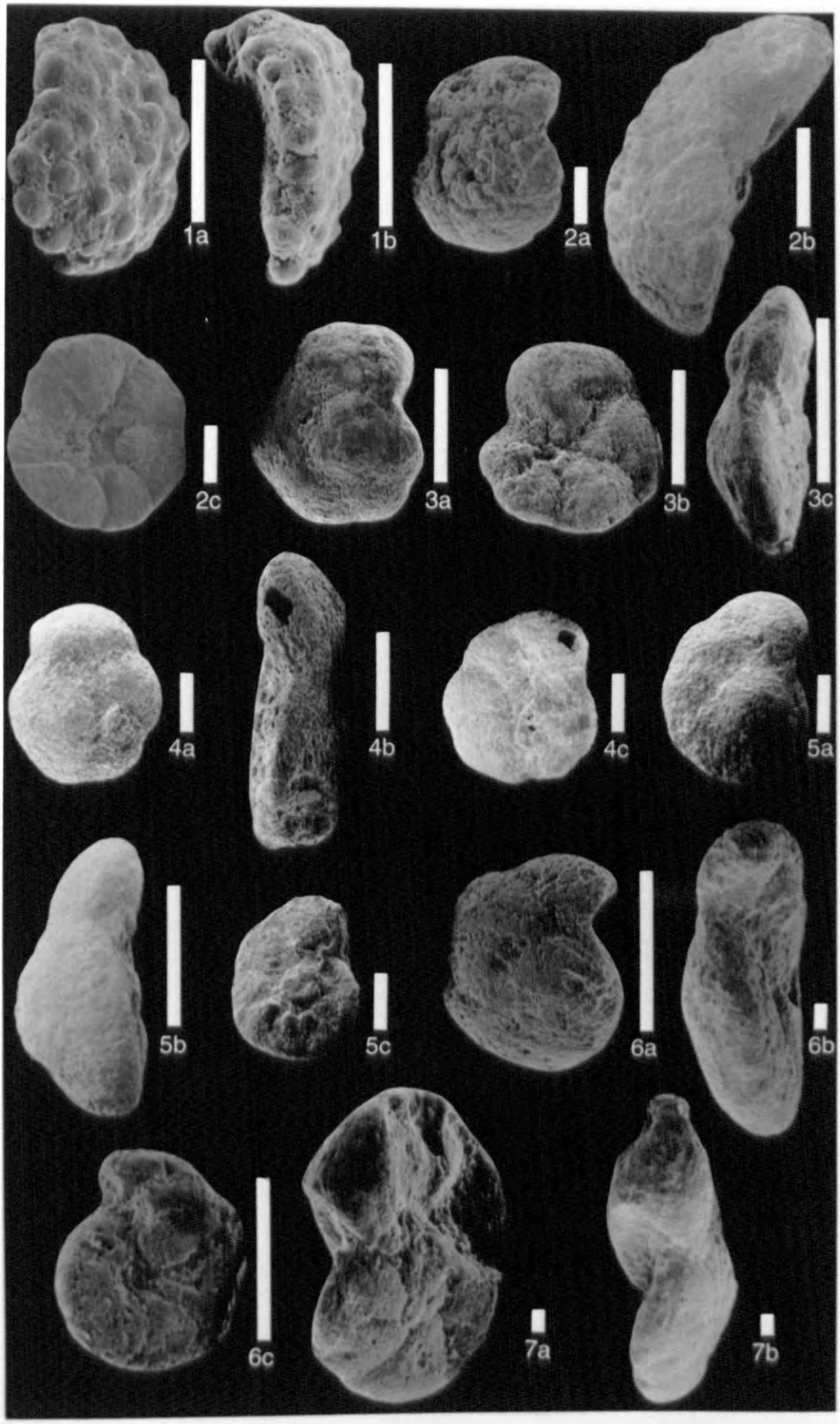

Plate 36

PLATE 37

Fig. 37.1 ***Gavelinopsis proelevata*** KOCH, 1968. Sample M71, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 37.2 ***Gavelinopsis tourainensis*** BUTT, 1966. Sample M66, Wadi Sir Formation "A7" (Turonian). **a:** spiral view, X 350, **b:** edge view, X 500, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 37.3 ***Gavelinopsis abudurbensis*** (NAKKADY, 1950). Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 330, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 37.4 ***Planoglabratella*** sp. Sample M109, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** spiral view, X 350, **b:** edge view, X 500, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 37.5 ***Cibicides beadnelli*** LE ROY, 1953. Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** umbilical view, X 500, **b:** edge view, X 500, **c:** spiral view, X 500, Wadi Mujib.

Fig. 37.6 ***Stensioeina pokornyi*** SCHEBNEROVA, 1963. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** umbilical view, X 200, **b:** edge view, X 350, Wadi Mujib.

Fig. 37.7 ***Stensioeina pokornyi*** SCHEBNEROVA, 1963. Sample M23, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 350, **b:** edge view, X 350, Wadi Mujib.

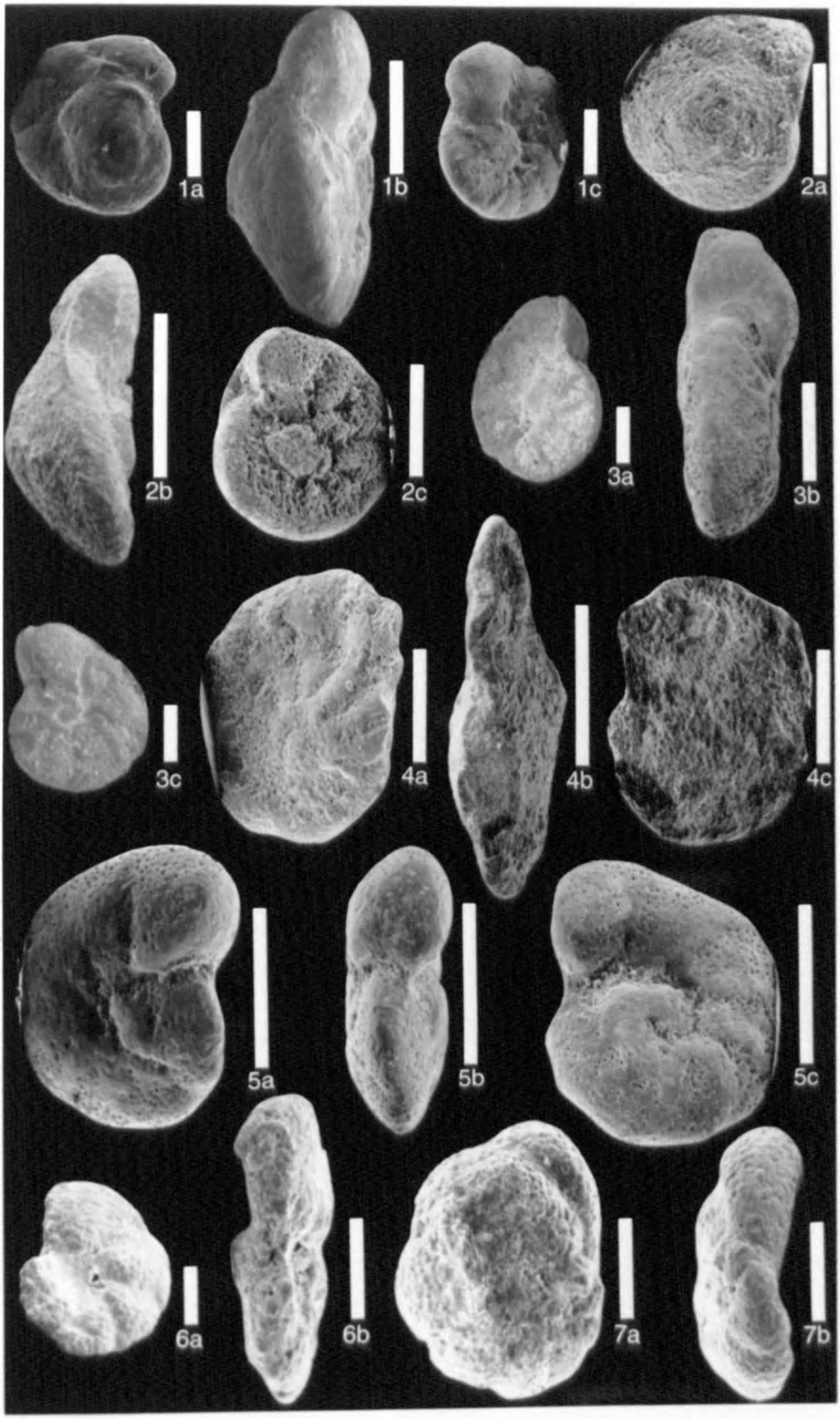

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Fig. 38.1 ***Gavelinella burlingtonensis*** (JENNINGS, 1936). Sample M70, Ghudran Formation "**B1**" (upper Coniacian to Santonian). **a:** umbilical view, X 350, **b:** edge view, X 500, **c:** spiral view, X 500, Wadi Mujib.

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Fig. 38.4 ***Nonionella austinana*** CUSHMAN, 1933. Sample M39, Lower Marly Member "**A5**", Shueib Formation equivalent (upper Cenomanian). **a:** umbilical view, X 500, **b:** edge view, X 500, **c:** spiral view, X 350, Wadi Mujib.

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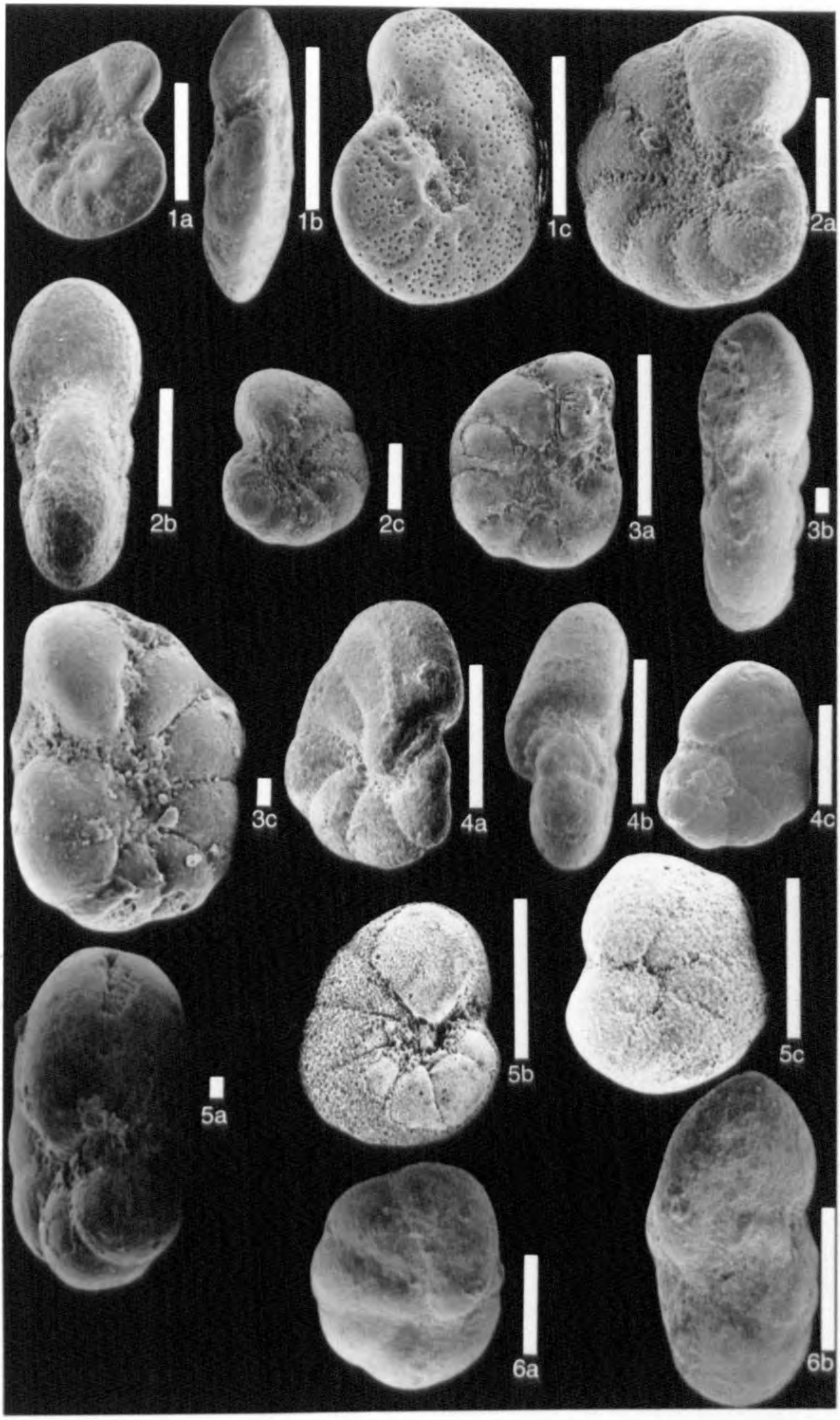

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Fig. 39.2 ***Quadrimorphina camerata*** (BROTZEN, 1936). Sample M19, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 750, Wadi Mujib.

Fig. 39.3 ***Quadrimorphina camerata*** (BROTZEN, 1936). Sample J39, Lower Marly Member **"A5"**, Shueib Formation (upper Cenomanian). **a:** umbilical view, X 500, **b:** edge view, X 750, **c:** spiral view, X 500, Ajlun/Jerash.

Fig. 39.4 ***Valvalabamina lenticula*** (REUSS, 1845). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 200, **b:** edge view, X 910, **c:** umbilical view, X 350, Wadi Mujib.

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Fig. 39.7 ***Gyroidinoides nitida*** (REUSS, 1845). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** edge view, X 750, **b:** spiral view, X 500, **c:** umbilical view, X 500, Wadi Mujib.

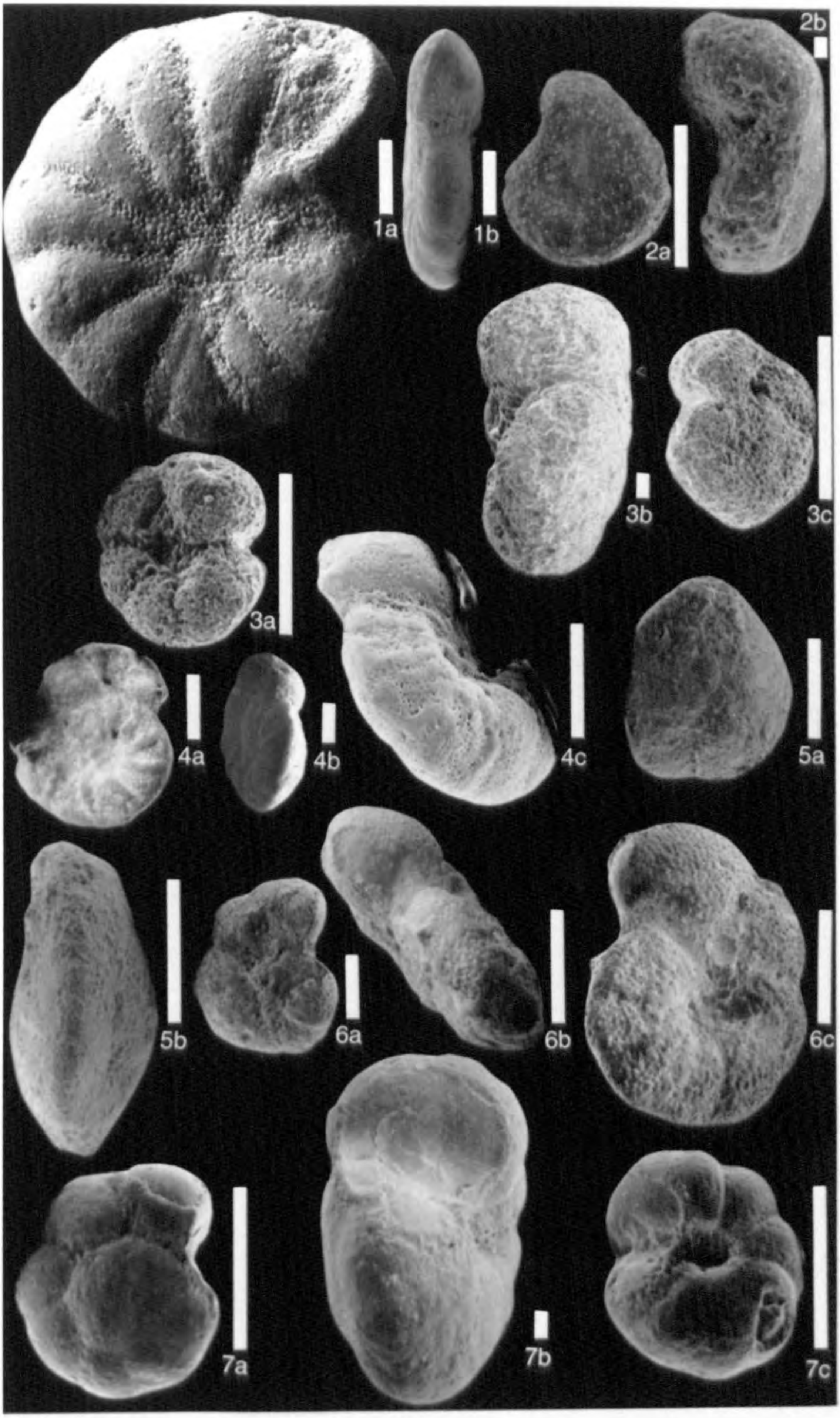

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Fig. 40.1 ***Gyroidinoides muwaqqarensis*** FUTYAN, 1968. Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** umbilical view, X 500, **b:** edge view, X 500, **c:** spiral view, X 500, Wadi Mujib.

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Fig. 40.4 ***Stensioeina exsculpta*** (REUSS, 1860). Sample M96, Upper Phosphatic Silicified Limestone Member **"B2"**, Amman Formation (lower Maastrichtian). **a:** spiral view, X 500, **b:** edge view, X 750, Wadi Mujib.

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Fig. 40.6 ***Gavelinella cenomanica*** (BROTZEN, 1942). Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 750, **c:** umbilical view, X 750, Wadi Mujib.

Fig. 40.7 ***Gavelinella vesca*** (BYKOVA, 1939). Sample M19, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 40.8 ***Gavelinella intermedia*** (BERTHELIN, 1880). Sample M19, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 200, **b:** edge view, X 350, Wadi Mujib.

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Fig. 40.10 ***Gavelinella sandidgei*** (BROTZEN, 1936). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** umbilical view, X 200, **b:** edge view, X 350, **c:** spiral view, X 200, Wadi Mujib.

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Fig. 41.1 ***Gavelinella semipustulosa*** HAMAOUI, 1965. Sample M22, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 500, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 41.2 ***Gavelinella stephensoni*** (CUSHMAN, 1938). Sample M91, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** spiral view, X 200, **b:** edge view, X 350, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 41.3 ***Gavelinella whitei*** (MARTIN, 1928). Sample M90, Lower Silicified Limestone Member **"B2"**, Amman Formation (Campanian). **a:** umbilical view, X 200, **b:** edge view, X 350, **c:** spiral view, X 200, Wadi Mujib.

Fig. 41.4 ***Gavelinella burlingtonensis*** (JENNINGS, 1936). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 350, **b:** edge view, X 500, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 41.5 ***Gavelinella farafraensis*** (LE ROY, 1953). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** umbilical view, X 200, **b:** edge view, X 350, **c:** spiral view, X 200, Wadi Mujib.

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Fig. 41.7 ***Gavelinella cristata*** (GOEL, 1965). Sample M70, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** umbilical view, X 500, **b:** edge view, X 1764, **c:** spiral view, X 500, Wadi Mujib.

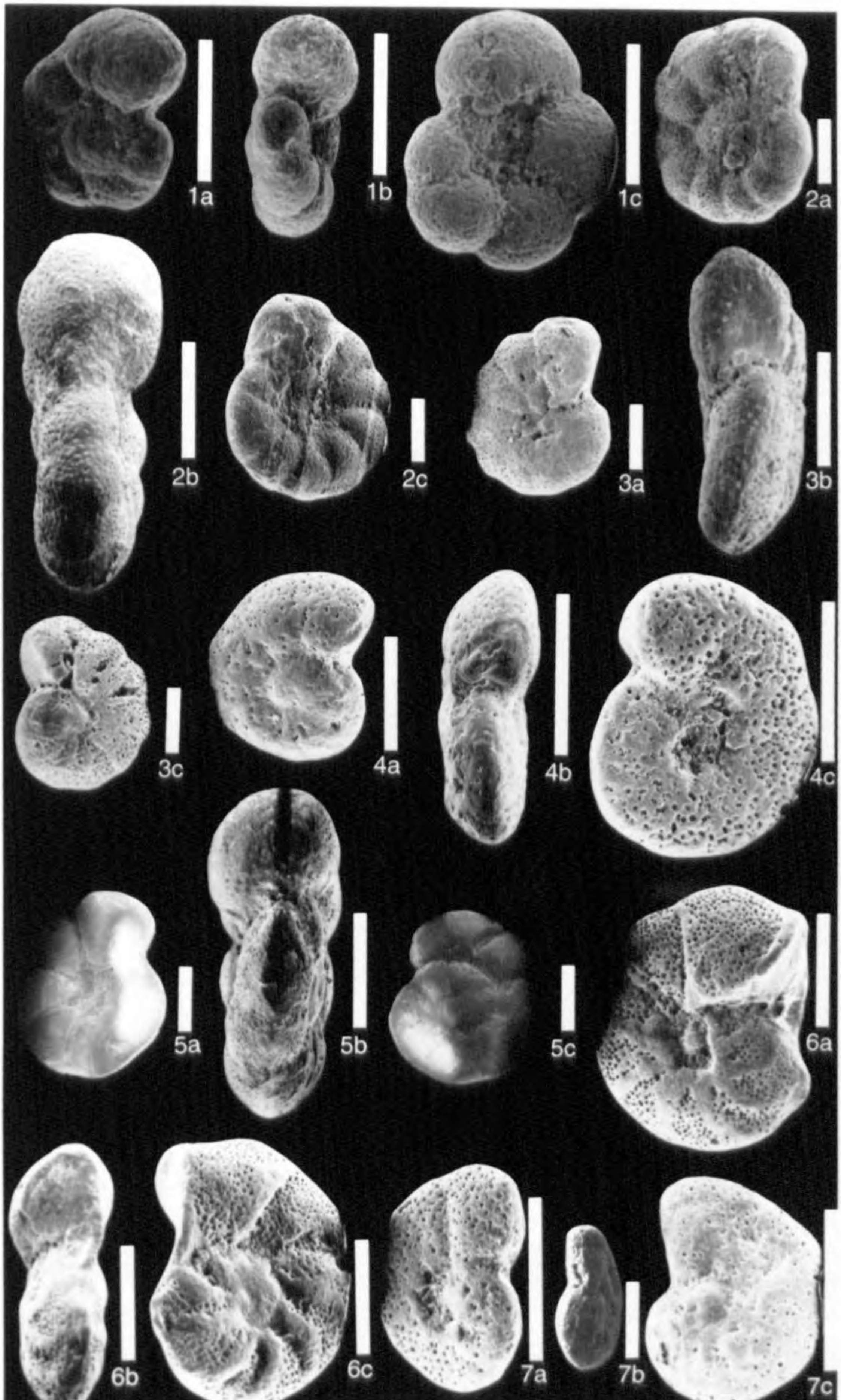

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Fig. 42.1 *Gavelinella pertusa* MARSSON, 1878. Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 350, **b:** edge view, X 500, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 42.2 *Gavelinella lorneina* (D'ORBIGNY, 1840). Sample M47, Ghudran Formation **"B1"** (upper Coniacian to Santonian). **a:** spiral view, X 350, **b:** edge view, X 350, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 42.3 *Gavelinella umbilicata* (BROTZEN, 1948). Sample M64, Wadi Sir Formation **"A7"** (Turonian). **a:** spiral view, X 350, **b:** edge view, X 1764, **c:** umbilical view, X 500, Wadi Mujib.

Fig. 42.4 *Gavelinella nacatochensis* (CUSHMAN, 1938). Sample M37, Lower Marly Member **"A5"**, Shueib Formation equivalent (upper Cenomanian). **a:** spiral view, X 500, **b:** edge view, X 2352, **c:** umbilical view, X 750, Wadi Mujib.

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Fig. 42.6 *Lingulogavelinella globosa* (BROTZEN, 1945). Sample M31, Fuheis Formation equivalent **"A3"** (middle Cenomanian). **a:** spiral view, X 750, **b:** edge view, X 1000, **c:** umbilical view, X 750, Wadi Mujib.

Fig. 42.7 *Lingulogavelinella turonica* (BUTT, 1966). Sample M23, **a:** spiral view, X 350, **b:** edge view, X 500; sample M22, **c:** umbilical view, X 500, Upper Nodular Member **"A2"**, Na'ur Formation (lower to middle Cenomanian), Wadi Mujib.

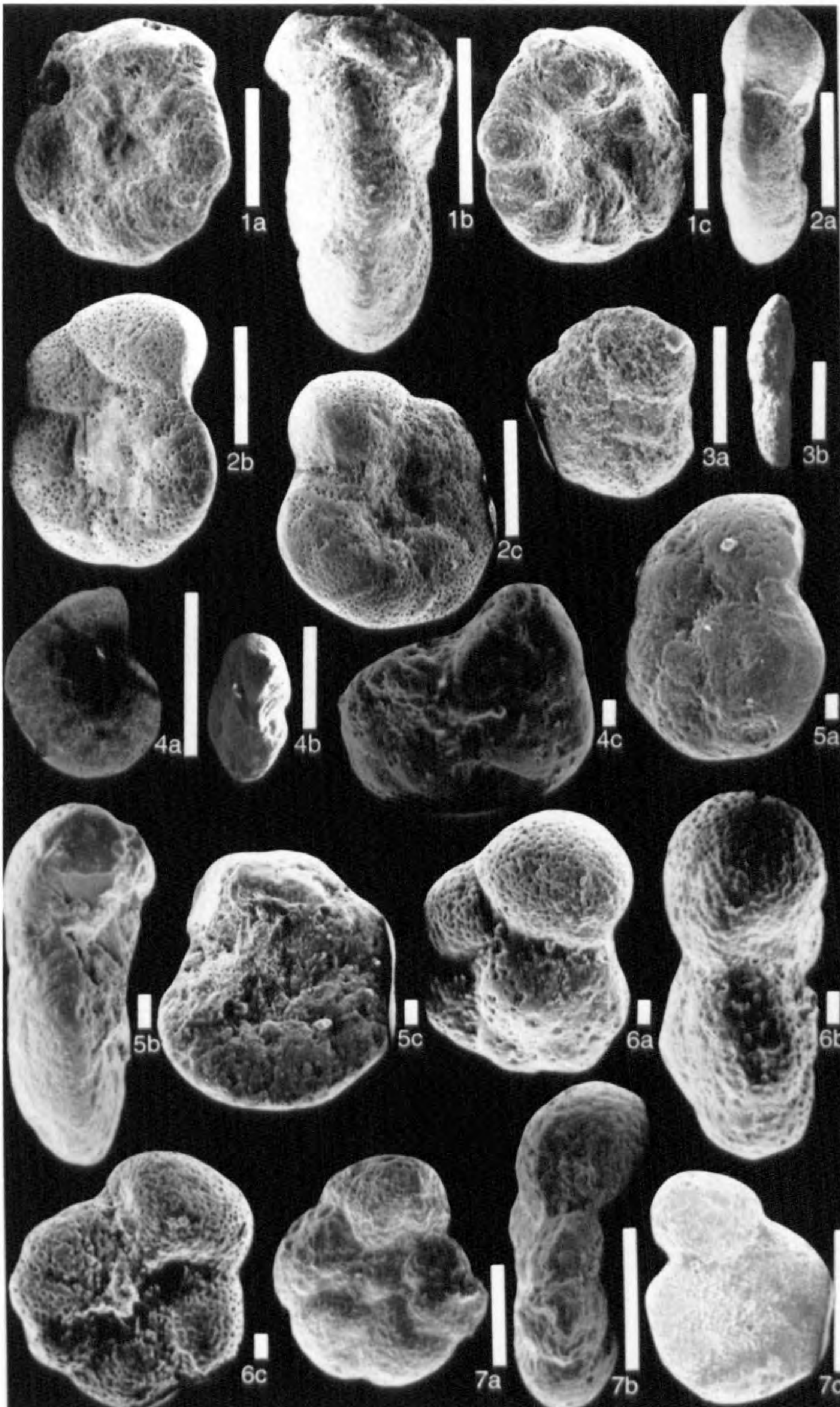

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Fig. 43.1 ***Lingulogavelinella tormarpensis*** (BROTZEN, 1942). Sample M31, Fuheis Formation equivalent "A3" (middle Cenomanian). **a:** umbilical view, X 500, **b:** edge view, X 750, **c:** spiral view, X 500, Wadi Mujib.

Fig. 43.2 ***Fissoelphidium operculiferum*** SMOUT, 1955. Sample M108, Upper Phosphatic Silicified Limestone Member "B2", Amman Formation (lower Maastrichtian). **a:** Side view, X 200, **b:** edge view, X 350, Wadi Mujib.

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Fig. 43.4 ***Cribroelphidium vulgare*** (VOLOSHINOVA, 1952). Sample M108, Upper Phosphatic Silicified Limestone Member "B2", Amman Formation (lower Maastrichtian). **a:** edge view, X 200, **b:** Side view, X 200, **c:** umbilical view, X 200, Wadi Mujib.

Fig. 43.5 ***Cribroelphidium*** sp. 1. Sample Q11, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 500, **b:** edge view, X 500, Ras en-Naqb.

Fig. 43.6 ***Eoheterohelix*** sp. Sample M47, Ghudran Formation "B1" (upper Coniacian to Santonian). **a:** Spiral view, X 350, **b:** edge view, X 200, **c:** umbilical view, X 350, Wadi Mujib.

Fig. 43.7 ? ***Praeoconocaryomma universa*** PESSAGNO, 1967. Sample M43, Lower Marly Member "A5", Shueib Formation equivalent (upper Cenomanian). Surficial view X 1000, Wadi Mujib.

Fig. 43.8 ***Follicucullus*** cf. ***scholasticus*** ORMISTON and BABCOCK, 1979. Sample P-14, Upper Nodular Member "A2", Na'ur Formation (lower to middle Cenomanian). **a:** Side view, X 100, Wadi Mussa.

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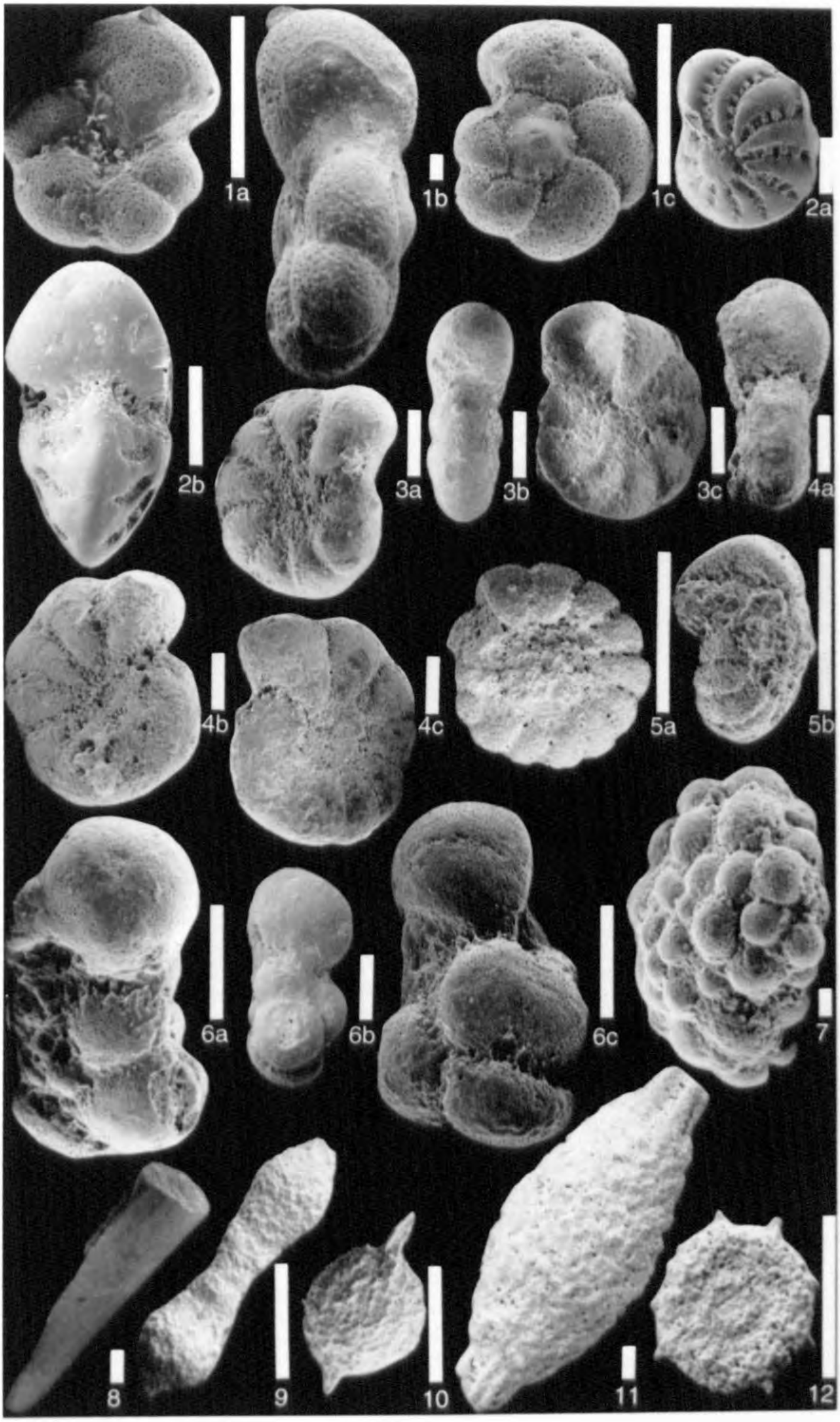
Fig. 43.11 ***Amphipyndax stocki*** (CAMPBELL and CLARK) var. **B** VISHNEVSKAYA, 1986. Sample P-60, Upper Phosphatic Silicified Limestone Member "B2", Amman Formation (lower Maastrichtian). Side view, X 350, Wadi Mussa.

Fig. 43.12 ***Pseudoaulophacus lenticulatus*** (WHITE, 1928). Sample P-60, Upper Phosphatic Silicified Limestone Member "B2", Amman Formation (lower Maastrichtian). Side view, X 500, Wadi Mussa.



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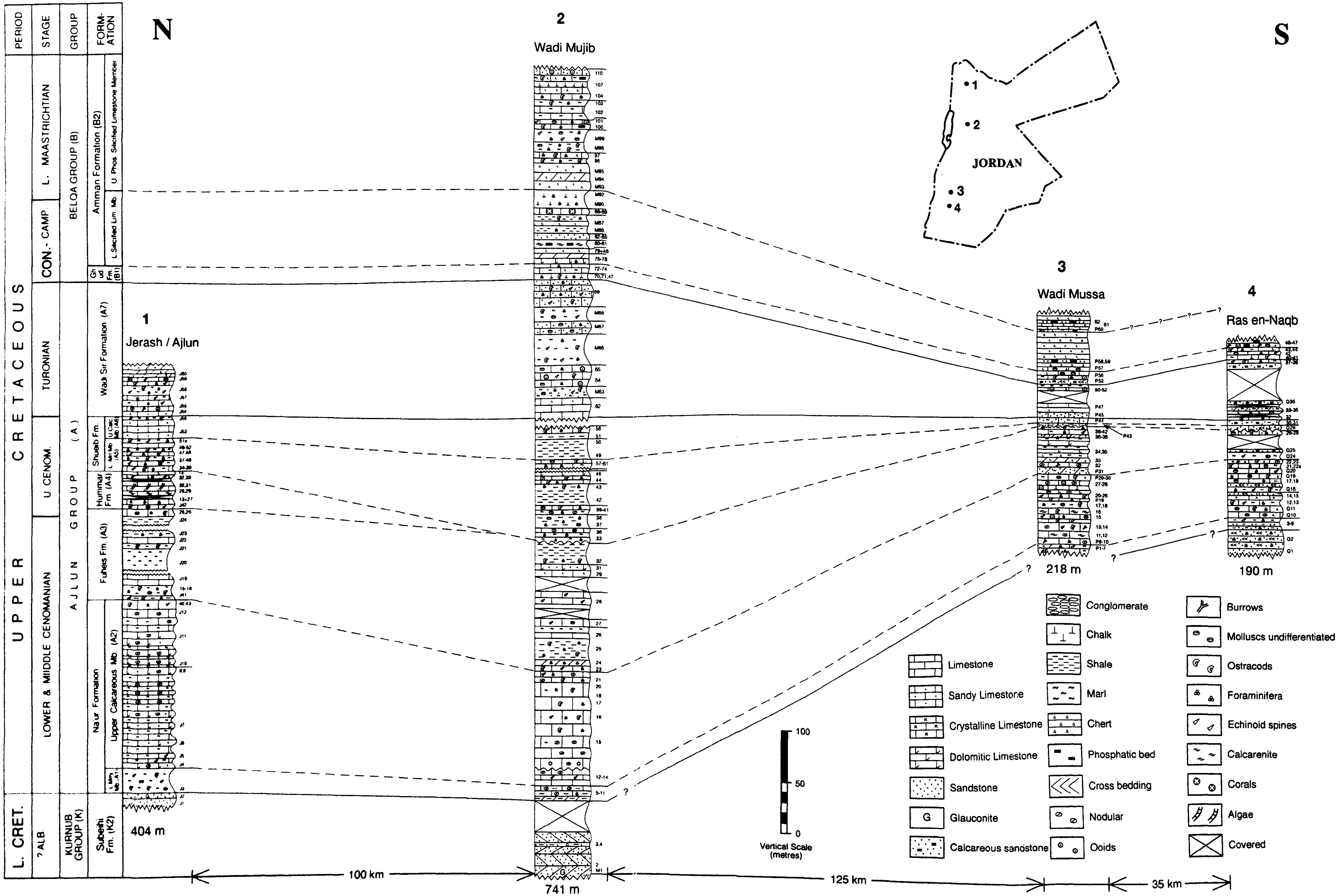
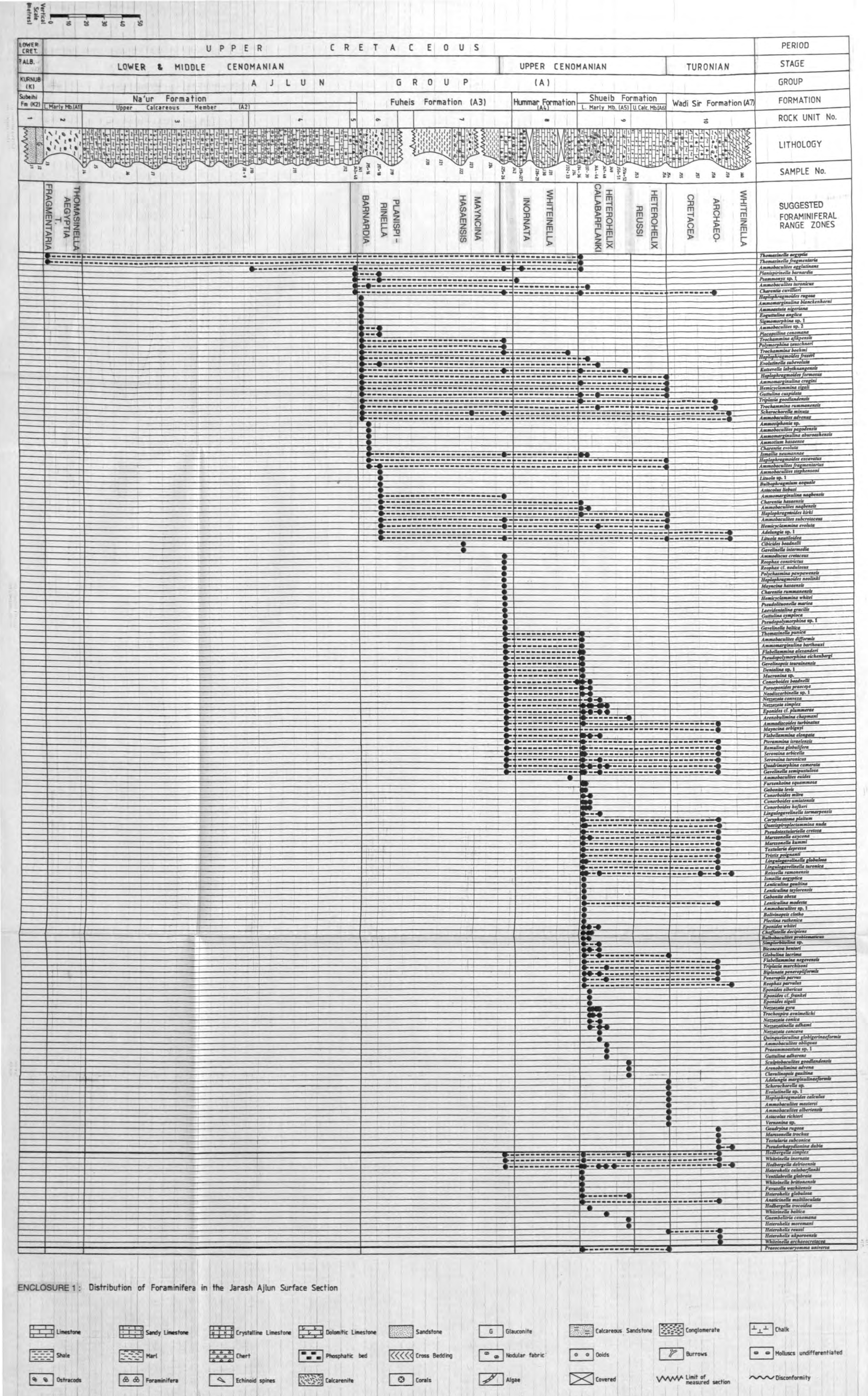
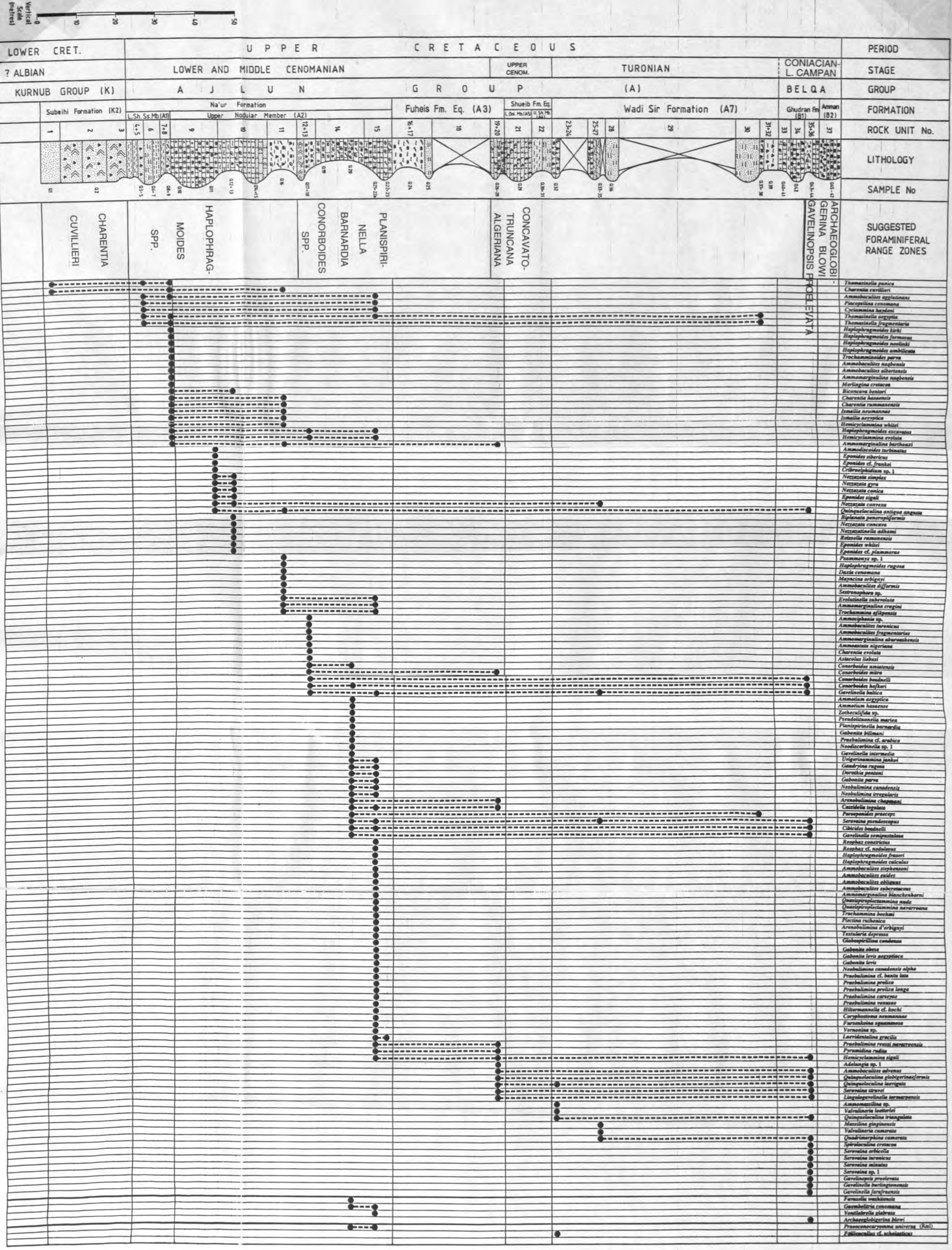


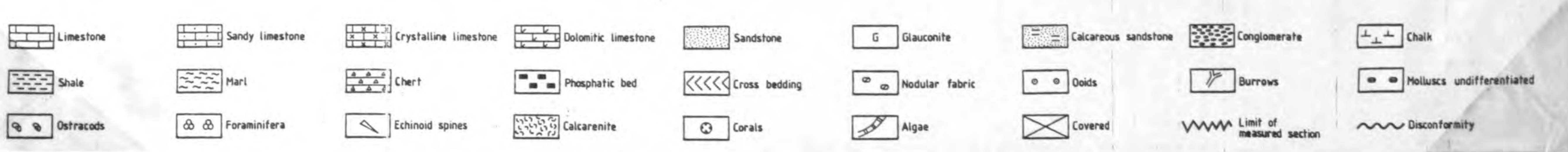
ENCLOSURE: 5 Upper Cretaceous sections studied in West Jordan and their lithostratigraphic correlation.

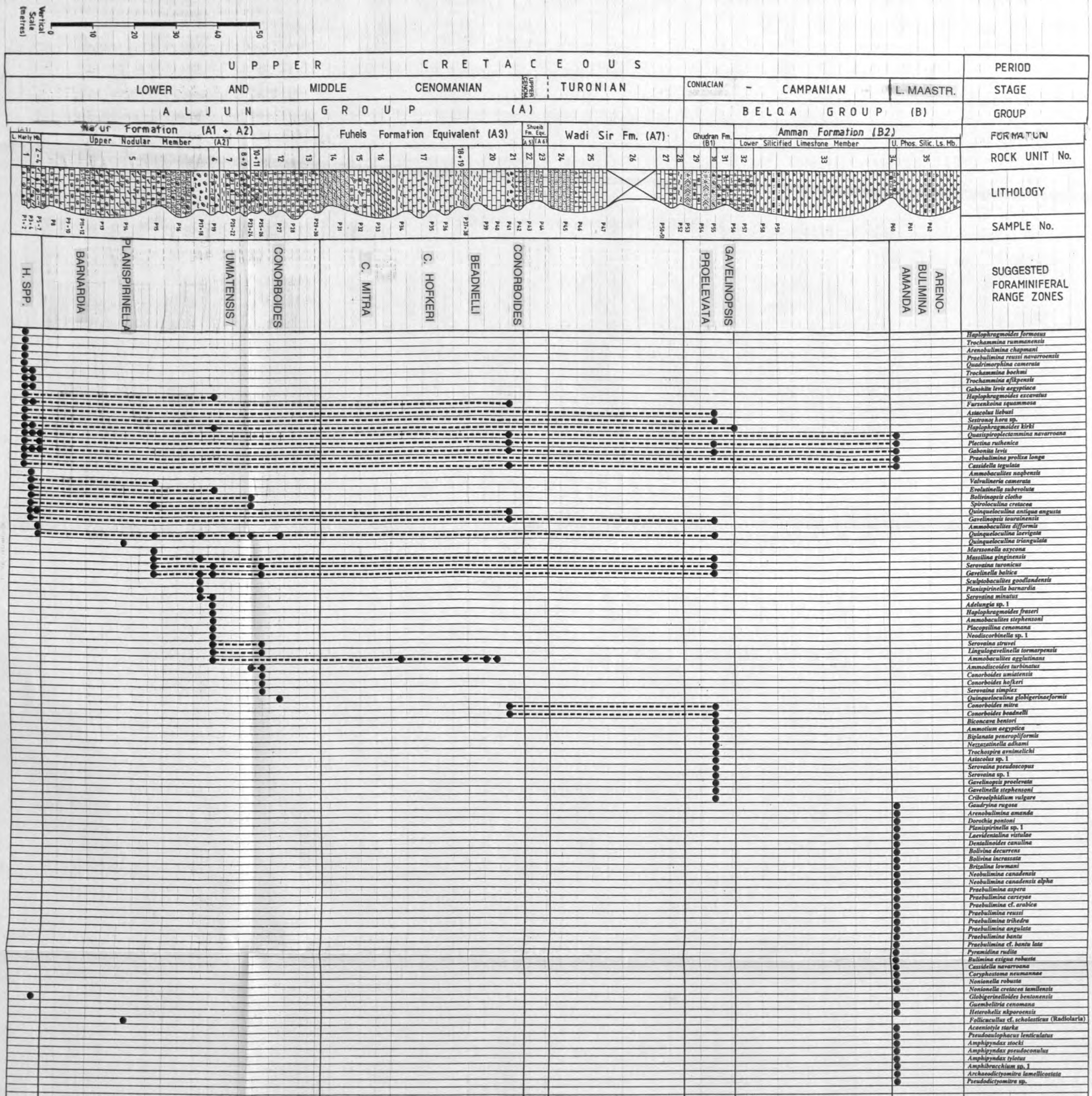


ENCLOSURE 1: Distribution of Foraminifera in the Jarash Ajlun Surface Section

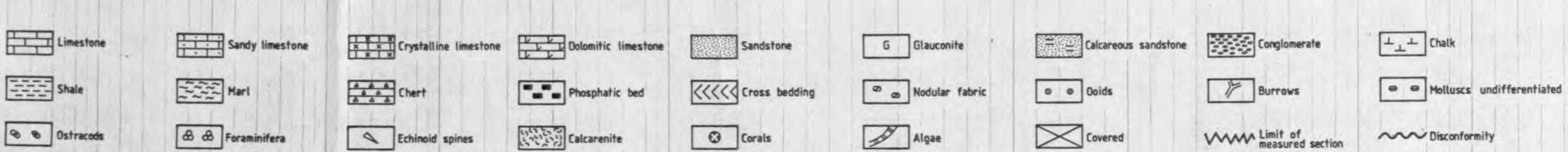


ENCLOSURE 4 Distribution of Foraminifera in the Ras en-Naqb Surface Section





ENCLOSURE 3: Distribution of Foraminifera in the Wadi Mussa Surface Section



ENCLOSURE 2 Distribution of Foraminifera in the Wadi Mujib Surface Section