THE UNIVERSITY OF HULL

THE UPPER CRETACEOUS AND LOWER TERTIARY OSTRACODA FROM NORTHWESTERN OFFSHORE LIBYA

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by

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ABSTRACT

Ostracod faunas from the Upper Cretaceous, Palaeocene and Eocene of Northwestern Libya (Well B1-NC41, Well C1-NC41, Well K1-NC41, Well B1a-137, Well D2-NC41, Well H1-NC41, Well J1-NC41, Well N1-NC41, Well F1-NC41 and Well L1-NC41) are described in detail.

One hundred and thirty-three ostracod species and subspecies belonging to fifty-five genera and subgenera are described in the present study. Of these seventy-seven species are new, twenty-three species are related to taxa previously described from adjacent areas. Two species are regarded as having affinities with species described in other areas and thirty-one species and four new genera are left under open nomenclature, mainly because of lack of material or the impossibility of observing the internal features.

Five ostracod biostratigraphical zones are proposed for the Tellil Group (Harsha, Dahman and Samdun Formations); four zones belong to the Middle Eocene and one zone is established for the Upper Eocene. The ostracod zones have been studied in each Well of the study area. The age of these formations has been determined by the ostracod zones. The ostracod faunas from the Middle and Upper Eocene of the Ghalil Formation, the Palaeocene and the Maastrichtian of the Al Jurf Formation, from Late Palaeocene of the lower part of the Farwah Group and the Maastrichtian of Bu Isa Formation have been studied in detail. Their age is also determined by the ostracod species.

The affinities of the Libyan Ostracoda genera and species to those from other parts of the world, largely North and West Africa are discussed.

The environment of deposition of the formations studied has been determined by the using the characteristic species of ostracods and other fauna and the type of the sediments.

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CHAPTER 1

INTRODUCTION TO THE GEOLOGY OF LIBYA:

Libya is situated on the Mediterranean foreland of the African shield. A large part of Libya is covered by moving sand dunes and the remainder of it is capped by rock formations represented by metamorphic, sedimentary and igneous rocks ranging from the Precambrian to the Tertiary. Structural and stratigraphical studies indicate that the area was uplifted and metamorphosed during the Precambrian. Major diastrophic disturbances include the Caledonian, Hercynian and the disturbances during the Cretaceous to Middle Tertiary (Oligocene through Miocene) and Holocene time (Conant & Goudarzi, 1967 and Goudarzi, 1980). These events caused uplift, subsidence, tilting, faulting and intrusions. East-West and North trending faults are present, but two major fault systems trend parallel to the Red Sea and the other African rifts. These faults trend northwest and northeast and intersect near the central part of the country, the site of the largest outpouring of lava in Libya.

Three periods of volcanic activity are recognized dating from the post-Eocene to the Holocene. These volcanic activities are believed to have been concurrent with movements along deep-seated fractures, perhaps associated with the Alpine orogeny. Early in the geological history of Libya a long period of the erosion prevailed throughout North Africa from the Atlantic to the Red Sea. By the beginning of the Paleozoic Era, a great part of Libya had been peneplained. Precambrian crystalline rocks are exposed in limited and comparatively small areas in South-central Libya. From the Early Palaeozoic through to at least the Oligocene, several orogenies affected the Libyan tableland.

On the other hand, the basins were intermittently covered and uncovered by the Sea which was transgressing mainly from the North, with the consequent deposition of alternating marine and continental sediments. These sediments were interrupted by unconformities, some of which are local, but others are regional. Furthermore the rock formations that are deposited in these basins are represented by clastics, carbonates, organic reefs and evaporites.

The major tectonic elements of Libya are represented by a series of uplifted areas and basins (fig. 1.1). The most important are the Jabel Nefusa and Jabel Al Akhdar uplifts in the Northwest and Northeast. Both uplifts trend in an East-West direction. The Jabel Nefusa escarpment was probably formed by a combination of folding, faulting and erosional processes. The Jabel Al Akhdar uplift is marked by a group of escarpments that trend more or less parallel to the coastline. The Gargaf arch is situated between the Ghadames (Al Hamada Al Hamra) and Murzuq basins and was uplifted during Mid-Palaeozoic time. The Tibesti uplift divided the Sirte basin from the Kufra basin in East Libya. It is well-defined on the surface near the Libyan Egyptian border along which are exposed rock formations that range in age from the Palaeozoic to the Tertiary. The Awenat uplift is located in the southeastern part of the country.

The Libyan basins are represented by the Sirte and Kufrah basins in north-central and southeastern Libya, the Ghadames and Murzuq basins in West Libya and the Tarabulus basin in the northwestern region offshore of Libya. The Al Kufrah, Ghadames (Al Hamada al Hamra) and Murzuq basins were formed during the Palaeozoic and were filled mainly by Palaeozoic and Mesozoic sediments, composed of continental and marine clastic rocks. In the Ghadames basin, these clastic rocks are associated with carbonates and evaporites. Recent geological investigations in these basins include the work of: Conant & Goudarzi (1964, 1967), Bellini & Massa (1980), Goudarzi (1980), Turner (1980) and Lorenz (1980).

The Sirte Basin is the youngest sedimentary basin in the country. The first stage of deformation of this basin occurred during the Late Cretaceous as a result of active subsidence and block faulting. The Sirte graben and horsts probably formed as a result of the Sahara platform moving along the Mediterranean during the Late Cretaceous (Klitzsch 1971), but Dewey ***et al.***, (1973) stated that the Sirte basin faults started moving during the Aptian to delineate these horst and graben systems.

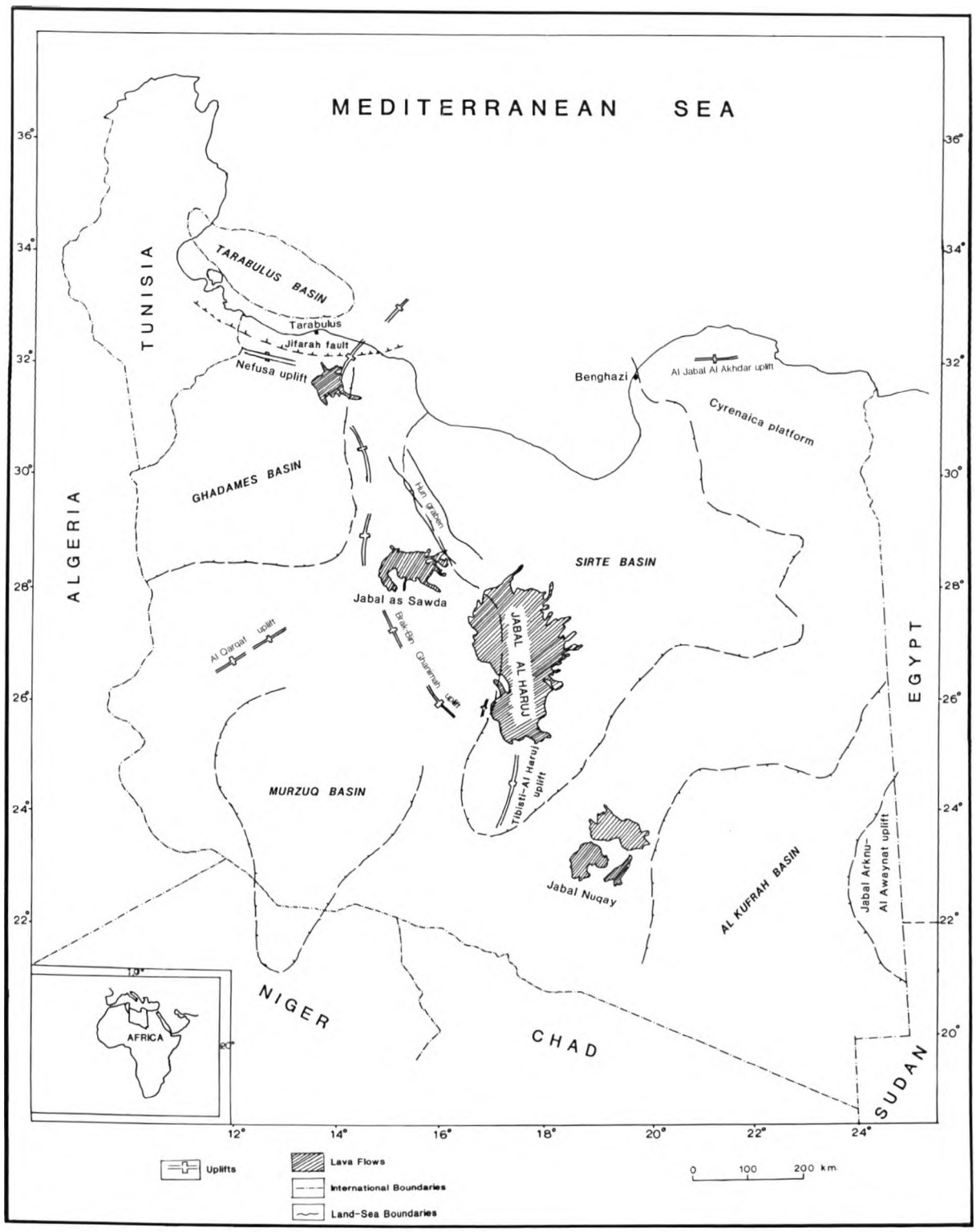

FIG. 1.1 MAP SHOWING TECTONIC FRAMEWORK OF LIBYA.

According to (Goudarzi, 1980) these relations probably recorded vertical crustal movements. During the Late Cretaceous and Palaeocene time this basin received large quantities of fine grained material rich in organic matter which were sources for oil formation in the basin. The stratigraphy of this basin is complicated by the abrupt facies changes that resulted from the environmental differences occurring because of contemporaneous faulting (Conant & Goudarzi, 1967).

The Tarabulus Basin is located in the northwestern offshore region of Libya, and ranges in age from the Late Triassic to Recent. Late Triassic deposits are unconformably overlain by shallow marine Triassic and Jurassic sandstones, red beds, carbonates, shales, dolomites and evaporites. From the Late Jurassic until the Late Eocene, the NW trending Tarabulus Basin and the Jifarah trough subsided receiving marine sequences of carbonates, marls and shales, intercalated with volcanic rocks Jongsma ***et al.***, (1985). Faulting in the Tarabulus basin, Jifarah trough and Misurata Valley has resulted in a complex horst and graben system (Jongsma ***et al.***, 1985). This fault system became established during the Mesozoic and Early Tertiary and shows dextral shearing motion (Ziegler, 1978). This movement was probably associated with the major shearing between the African and the Eurasian plates that occurred until the Palaeogene Dewey ***et al.***, (1973).

CHAPTER 2

2.1 LOCATION OF THE AREA STUDIED:

Since the exploration for oil and gas from offshore Libya began in 1970, more than 40 wells have been drilled. The area is divided between three operators namely, Agip (NC41), Elf Aquitaine (137) and Sirte (NC35A). A further discovery in the Bouri field which is jointly owned by the National Oil Corporation and Agip is being developed.

The material which forms the basis of this study was obtained from offshore north-west Libya. This region consists of the Pelagian block of the continental shelf between the Gulf of Gabes in Tunis and the Gulf of Sirte, Libya. The study area is located between 33° N and 34° N and 12° E and 15° E. The position of the area studied is shown in figure 2.1. This study has been conducted on the samples from the following wells:-

Well	Latitude	Longitude
1. C1-NC41	33° 41' 15" N	12° 27' 49" E
2. F1-NC41	33° 17' 51" N	13° 30' 39" E
3. K1-NC41	33° 14' 48" N	12° 28' 30" E
4. L1-NC41	33° 18' 13" N	13° 39' 09" E
5. N1-NC41	33° 17' 14" N	13° 14' 09" E
6. B1-NC41	33° 54' 12" N	12° 30' 20" E
7. D2-NC41	34° 00' 58" N	12° 32' 42" E
8. J1-NC41	32° 54' 29" N	14° 01' 08" E
9. H1-NC41	33° 26' 05" N	12° 43' 07" E
10. B1a-137	33° 51' 48" N	12° 04' 38" E

2.2 AIMS OF RESEARCH:

The main aim of this study has been to provide systematic descriptions of the Ostracoda recovered from the Upper Cretaceous, Palaeocene and Eocene deposits of these wells from NW offshore Libya. Following this the most important aim was to set up a biostratigraphical scheme using these Ostracoda.

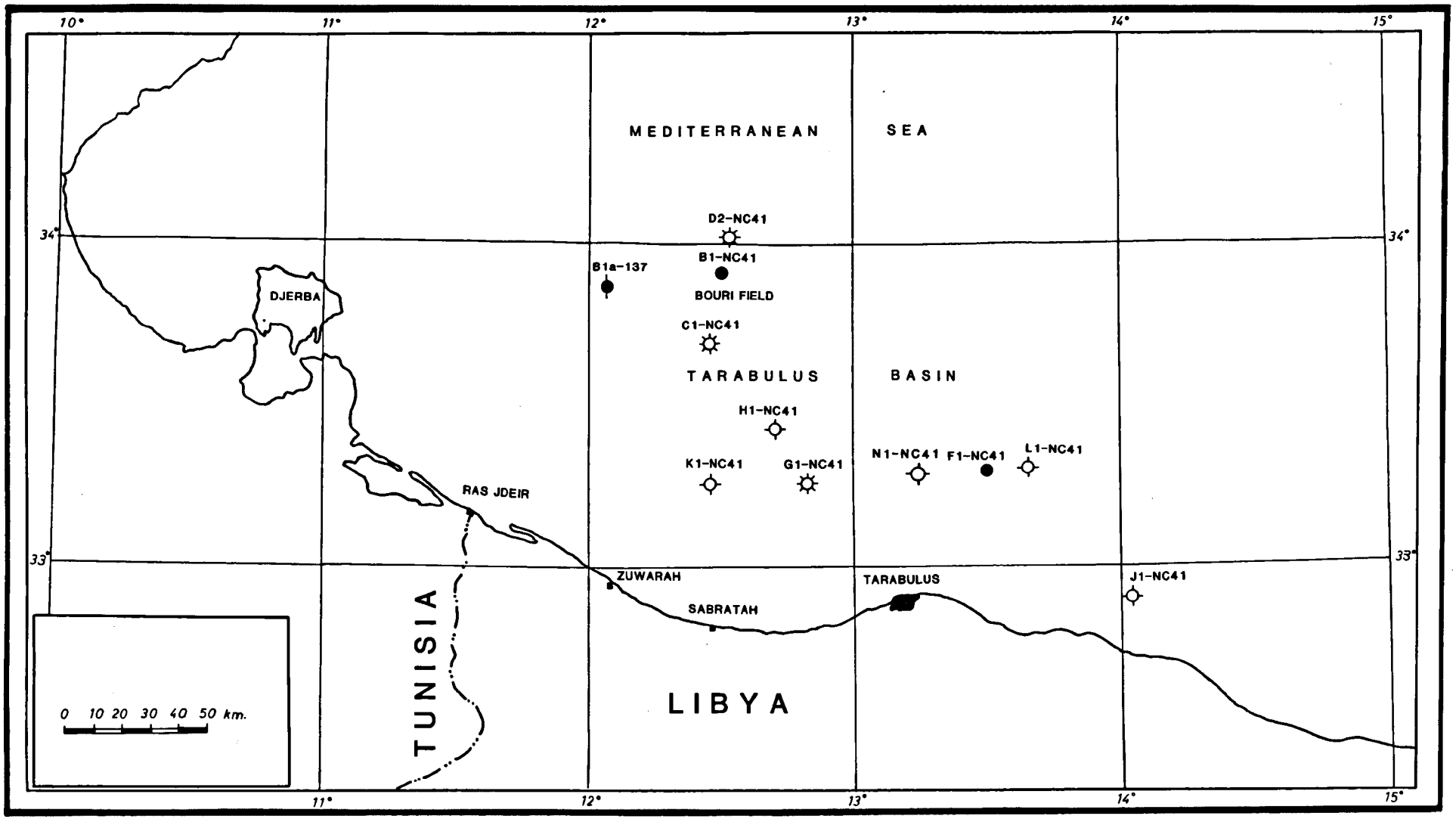

FIG. 2.1 LOCATION MAP.

Subsequently, on the basis of the ostracod fauna, it was proposed to establish the nature of the depositional environments of the studied formations.

2.3. PREVIOUS WORK ON MAASTRICHTIAN AND TERTIARY OSTRACODA FROM LIBYA AND ADJACENT AREAS:

There is a paucity of previous work on NW offshore Libya and as far as the author is aware no published records from the area exist. Generally until the present study of the Upper Cretaceous and Lower Tertiary, ostracods from Libya have received little attention from micropalaeontologists.

A literature survey shows that most micropalaeontological work has been carried out on Foraminifera. This is mainly due to a shortage of ostracodologists working in Libya. The first description of Ostracoda from Libya was given by Barsotti (1963) who studied the Palaeocene ostracods of Libya (Sirte Basin) and their wider African distributions. He recognised the occurrence of some of the same species in both Libya and the Sudan District, and a lesser number of species in common with the Ivory Coast Basin , the Dahomey - Togo Basin and the Senegal Basin. He suggested and these common occurrences have great biostratigraphical value although none of the three species common in the Sirte and Senegal Basins correspond in horizon. Again on the basis of the planktonic foraminiferal zones the common species from the other two West African Basins differ in horizon to a considerable extent. On the other hand the Sudan species show an identical distribution with those in the Sirte Basin.

Salahi (1966) has investigated Upper Cretaceous, Palaeocene, early Eocene and Oligocene Ostracoda from the Zelten region and over this wider stratigraphical range he established the occurrence of sixty species of which forty-five were new but not named.

Higher in the stratigraphical column, Bellini (1969) dealt with the biostratigraphy of the Miocene Al Jaghbub (Giarabub) Formation in eastern

Cyrenaica. He listed twenty species and their distribution in the G 7 section but left them under open nomenclature and gave no illustrations, making comparison difficult.

Bonaduce and Pugliese (1975) gave details of sixty-two species, including one new species of ***Semicytherura***, from a beach sand collected from Tripoli. Some of the species are illustrated but the fauna consists of extant species and is thus of no real significance in dealing with the material covered in this study. Benson (1977) recorded a new species, ***Paleocosta libyaensis*** probably from the Middle Eocene. El Khoudary and Helmdach (1980) studied the biostratigraphy of the Middle Eocene of Al Jabel Al Akhdar, NE Libya where they listed seventeen species of Ostracoda belonging to thirteen genera. They subdivided the section into four zones based on the planktonic Foraminifera. The accompanying ostracod faunas indicate a general Eocene age for the studied section, but some of the recorded Ostracoda species are diagnostic of the Middle Eocene.

Helmdach and El Khoudary (1980) investigated the Ostracoda and the planktonic Foraminifera of the Late Eocene Appolonia Formation exposed in the area of Wadi Al Bakur, NW Al Jabel Al Akhdar. They recorded nineteen Ostracoda species for the first time in this area, many of their species are found to be related to the forms described from the Eocene of Egypt and Jordan by Bassiouni (1969a,b,c).

Reyment, R. A. and Reyment, E. R.. (1980) have investigated the Palaeocene Trans-Saharan Transgression and its ostracod fauna and mentioned at least twenty-four West African Ostracoda species from the Palaeocene of Libya. Szczechura (1980) recorded a new ostracod species of ***Paijenborchellina*** from the Upper Miocene of Libya; she mentioned that this species was the first representative of this genus from central North Africa and also discussed the palaeoecology and palaeogeography of this genus.

El Khoudary and Helmdach (1981) analysed the samples collected from the Upper Eocene Appolonia Formation of Wadi Bakur, and recorded an abundant

benthonic Foraminifera assemblage. This was associated with twenty-one species of planktonic Foraminifera and nineteen species and subspecies of Ostracoda.

Hinte, Van *et al.*, (1980) have investigated the micropalaeontology (Foraminifera and Ostracoda) of the Messinian event recorded in well B1-NC35A drilled by Esso Libya Inc., on the Pelagian platform of offshore Libya. They analysed the ostracod and foraminiferal faunas of seven samples above and below the evaporites, marking the Messinian, where twenty-eight Ostracoda species were recorded and illustrated.

Helmdach and El Khoudary (1982) recorded three new ostracod species from the Middle Eocene Appolonia Formation of the northern coastal escarpment of Al Jabel Al Akhdar. These three new species of Ostracoda provide additional evidence for dating the sequence.

Innocenti and Pertusati (1984) studied the area belonging to the Southwestern Sirte Basin which consists of Oligocene, Early Middle Miocene, Late Miocene, Plio-Pleistocene and Pleistocene-Holocene age outcrops (NH34-5 sheet). They used this work in an attempt to establish a stratigraphy on the basis of the lithology and palaeontology (Foraminifera, Ostracoda and macrofossils). In the course of this study they listed thirty-nine ostracod species with their distribution in the area studied but gave no illustrations.

Recently El Waer (1985, 1988 and in press) has investigated Miocene Ostracoda from the Al Khums Formation , exposed in the area of Qabilat Awlad Omar, Qabilat Ashurfah and 2 km. north of Qabilat Ashurfah, NW Libya. These areas yielded abundant Ostracoda comprising forty-eight species belonging to twenty-nine genera and subgenera. They included thirteen new species.

Salaj and Nairn (1987) studied the Upper Cretaceous Ostracoda from the Al Hamada Al Hamra (Ghadames) Basin.

Concerning adjacent areas, work is limited and the information given here is confined to studies related to Libyan Ostracoda. West of Libya most work has been carried out in Tunisia. Esker (1968) studied the Palaeocene (Danian) Ostracoda,

where he recorded eleven new species of ostracods from the Zebbeus Formation near Le Kef. He mentioned that the ostracod fauna here appears to be more closely related to northern European Late Maastrichtian faunas than to other previously described African ostracod faunas.

Oertli, (1973a,b,c) reported some Eocene Ostracoda from the Gulf of Gabes. Benson (1976) provided a more detailed study of the Ostracoda of the Mediterranean, in connection with the Messinian salinity crisis. This work also mentioned some ostracod species from Tunisia. Oertli (1976) has investigated the evolution of the genus ***Loculicytheretta*** from the Eocene of Tunisia. Benson (1977) reported some new species from the Palaeocene of the Kef Section, during his study of the evolution of ***Oblitacythereis*** during the Cenozoic in the Mediterranean and Atlantic.

Bismuth ***et al.***, (1978) studied the genus ***Loculicytheretta*** from the Middle and Upper Eocene of Tunisia, Sicily, Algeria, Libya, Jordan and Saudi Arabia with eleven species described or mentioned. Said (1978) studied the biostratigraphy of the Cretaceous, Palaeocene and Early Eocene ostracods from central Tunisia, where she recorded fifty-seven Ostracoda species belonging to thirty-three genera.

A more detailed study was made by Mechmeche (1981) on the Eocene Ostracoda; forty-two ostracod species were recorded, of which sixteen species were left under open nomenclature. Donze ***et al.***, (1982) made a detailed study of the ostracod faunas from the Late Campanian to Early Eocene, in the Kef section, where they recorded fifty species belonging to thirty-five genera. Several of these species were new and they also described the three new genera, ***Aphrikanecythere***, ***Kefiella***, ***Megommatocythere***. The stratigraphical distribution of all the species was also given.

Peypouquet (1983) has also investigated the Cretaceous-Tertiary boundary Ostracoda in the Kef section (northeastern Tunisia). Carbonel and Colin (1982) studied the morphology of some species of the genus ***Loculicytheretta*** from Tunisia. Recently a more detailed study was carried by Bonaduce ***et al.***, (1988) on the marine ostracod fauna of the Late Miocene from an offshore well in the Gulf of Gabes.

In Algeria, Apostolescu and Magne (1956) have investigated the Ostracoda from the Middle and Upper Eocene. Later, Grekoff (1969) studied the Cretaceous, Palaeocene and Early Eocene Ostracoda where he recorded forty-nine species. Sissingh (1972b) reported some ostracod species from the Miocene of the Sahelian near Carnut.

East of Libya the most relevant work has been carried out in Egypt. Bassiouni (1965) studied the Pliocene Ostracoda from the Kom el Shelul area, Gizeh south of Cairo where he described thirteen species and subspecies, three species and subspecies of which were new. Bassiouni (1969a) studied the genus ***Costa*** and ***Carinocythereis*** from the Palaeocene and Eocene of Jordan where he recorded seven species and subspecies described as new.

The same author (1969b) described fifteen species and subspecies from the Egyptian Eocene belonging to six genera. More detailed work was also carried out by Bassiouni (1969c,d and 1971). Cronin and Khalifa (1979) looked at the Eocene Ostracoda from Gebel El Mereir where they recorded twenty-six species of marine Ostracoda, of which eight were new.

Khalifa and Cronin (1979) also described twenty-two ostracod species, including nine new species from the Eocene of the El Sheikh Fald section, East of Beni Mazar, Upper Egypt. The ostracod assemblages were characterised by forms possessing strong ornamentation that showed taxonomic affinities with other Middle Eocene faunas from Europe and Lower Egypt. Boukhary ***et al.***, (1982a) studied the Palaeocene ostracods from the Gebal Dandara section (Qena, Nile Valley) and mentioned that some of the species are identical with those described from Tunisia by Esker (1968) and Said (1978) and from Jordan by Bassiouni (1970). Boukhary ***et al.***, (1982b) investigated the Middle Eocene ostracods of the El Sheikh Fadl section near Beni Mazar in the Nile Valley. The ostracod assemblages were characterised by highly ornamented forms.

In West Africa more work was carried out by Apostolescu (1961), Reyment (1960, 1963, 1966 and 1981), Foster *et al.*, (1983), Carbonnel (1986, 1988) and Diop *et al.*, (1982).

In the Mediterranean, Ruggieri (1972) erected the two new genera, ***Falsocythere*** and ***Graptocythere*** in his work on the marine Ostracoda from the Neogene, Quaternary and the Recent of the Mediterranean. Sissingh (1974) reported twenty-six species and subspecies of ostracods from the section of the Upper Miocene Tellil Formation, central Crete. Most of the associations of the samples are inferred to represent a shallow to very shallow marine environment and he gave no illustration.

Benson (1976) described the ostracod changes in the Mediterranean during the Messinian salinity crisis. and also studied the evolution of ***Oblitacythereis*** from ***Paleocosta*** during the Cenozoic (1977). The same author in a joint paper with Ruggieri (1974) studied the end Miocene crisis in Tethys-Mediterranean history. They also mentioned that in the early and middle Miocene, the ostracod fauna of the rapidly changing Western Tethys Mediterranean Sea complex included a few genera typical of the margins of the world Ocean Basins.

Russo and Bossio (1976) investigated the biostratigraphy and palaeocology of the Miocene from the Maltese Archipelago and distinguished eight different faunal assemblages from upper bathyal and shelf types. Uliczny (1969) studied the Neogene Ostracoda from the eastern Mediterranean including the ***Hemicytheridae*** and ***Trachyleberididae***. More detailed work by Sissingh (1972a) on the late Cenozoic Ostracoda of Aegean Islands Arc, gave a detailed account of the brackish and marine faunas encountered in the Miocene, Pliocene and Pleistocene sediments of the South Aegean Islands of Crete, Karpathos, Gavodes and Rhodes.

In a later study (Sissingh 1976), on the stratigraphical distribution of the late Cenozoic Ostracoda in the central and eastern Mediterranean basin, he established nineteen tentative zones characteristic of the successions in brackish infralittoral, circalittoral to upper bathyal and deeper environments of depositions. Ciampo (1980)

investigated Miocene Ostracoda of Ragusa, Sicily, where he recorded five new species and one new subspecies.

As this brief synopsis shows, much of the Tertiary work has been in the Neogene and has little direct bearing on the problem under investigation. This, then, is the general data of our present knowledge of Tertiary and Maastrichtian Ostracoda from Libya and adjacent areas.

CHAPTER 3

METHODS OF STUDY

3.1 SAMPLING

The samples used in this study are from northwestern offshore, Libya. They were kindly provided by the National Oil Corporation. Well localities were chosen across the basin on the basis of two main criteria: firstly to have a good aerial distribution of well points and secondly to obtain a complete or almost complete section of the Eocene deposits.

More than six hundred cutting samples were collected from ten wells of the Tarabulus basin. One well (J1-NC41) was situated outside the basin. The sample interval in most wells was twenty feet, but in some case was smaller or larger. The geographical situation of these wells is as follows:

3.1.1 WELL H1-NC41 SECTION (Fig. 3.1).

Lat. 33° 26' 05" N

Long. 12° 43' 07" E

This well lies in the central part of the study area and has been drilled through 2044 feet of Tellil Group sediments which range from Middle to Upper Eocene in age. Here in this well, the Group is represented by three Formations.

3.1.1.1 Samdun Formation:

This Formation is 1211 feet thick and dated as Middle to Upper Eocene. In the upper part it consists of mudstone, wackestone which is partly recrystalized, fossiliferous, hard to medium argillaceous with dark grey and brown shales whilst the lower part is characterised by grey shale interbedded with mudstone and wackestone.

3.1.1.2 Dahman Formation:

In this Well, the thickness of this Formation is 42 feet and dated as Middle Eocene, it is characterised by nummulitic limestone beds.

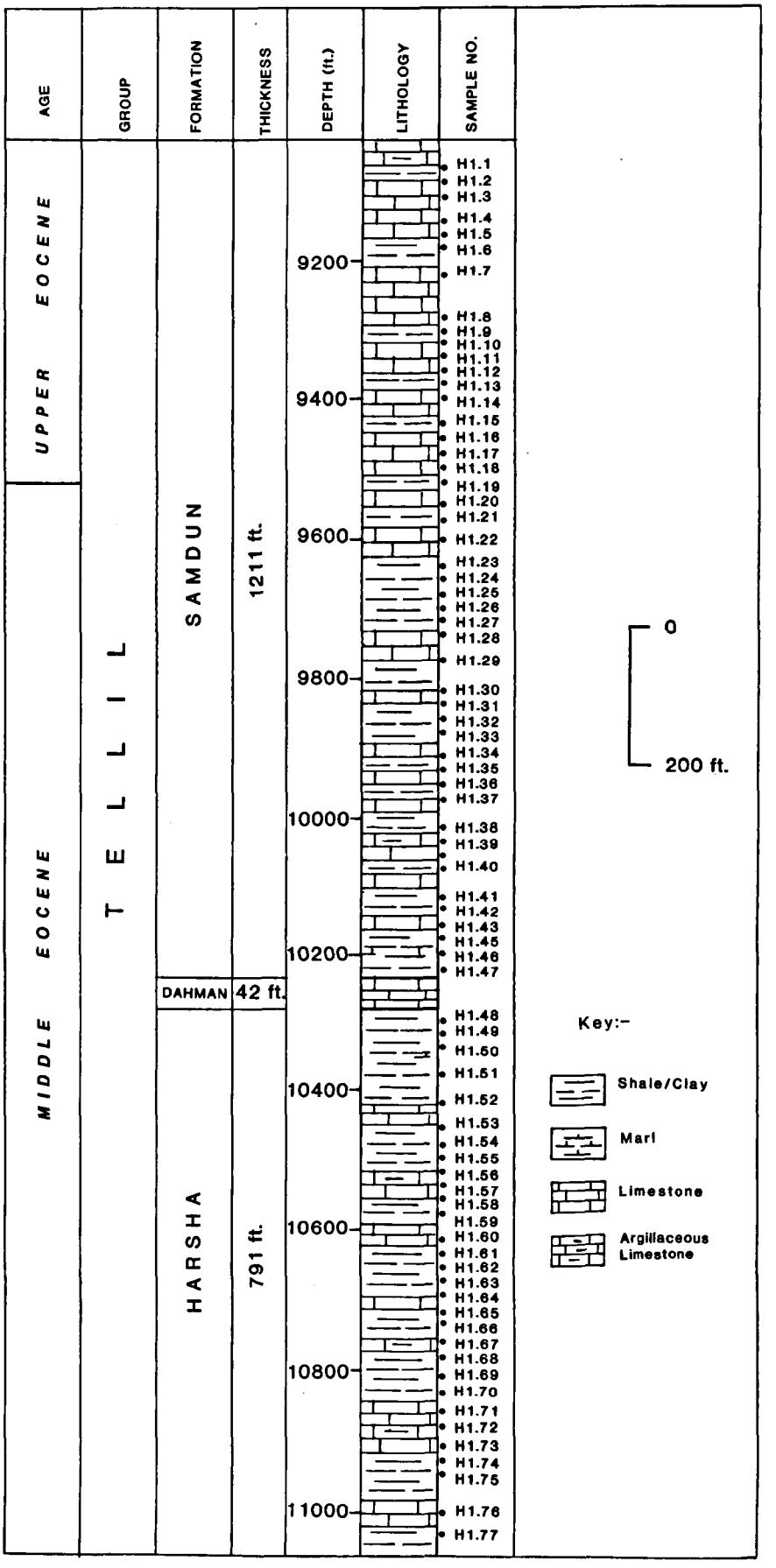

FIG. 3.1 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL H1-NC41.

3.1.1.3 Harsha Formation:

In this Well, the Harsha Formation has a thickness of 791 feet and is dated as Middle Eocene. The formation consists of grey to light-brown shales, grey to brown limestone which is partly recrystallised and also contains, medium-hard argillaceous rocks which grade into marl. This Formation is highly fossiliferous.

3.1.2 WELL B1-NC41 SECTION (Fig. 3.2).

Lat. 33° 54' 12" N

Long. 12° 30' 20" E

This Well is situated in the Bouri field North of the study area and represented by the Samdun Formation of the Tellil Group and by the Ghalil Formation. This section is ranges in age from Middle to Upper Eocene.

3.1.2.1 Samdun Formation:

This Formation is 300 feet thick and dated as Middle and Upper Eocene. It consists dark-grey shale, with intercalations of white and greenish soft mudstone and wackestone.

3.1.2.2 Ghalil Formation:

The thickness of this Formation is 519 feet dated as Middle Eocene. It is mainly composed of dark grey shale, hard sometimes grading to marl with levels of hard white mudstone and wackestone and also contains fossils.

3.1.3 WELL C1-NC41 SECTION (Fig. 3.3).

Lat. 33° 41' 15" N

Long. 12° 27' 49" E

This Well is situated in the central part of the Tarabulus basin and has been drilled through the 1489 feet of the Tellil Group which range from the Middle to Upper Eocene. Tellil Group is represented in this Well by three Formations as follows.

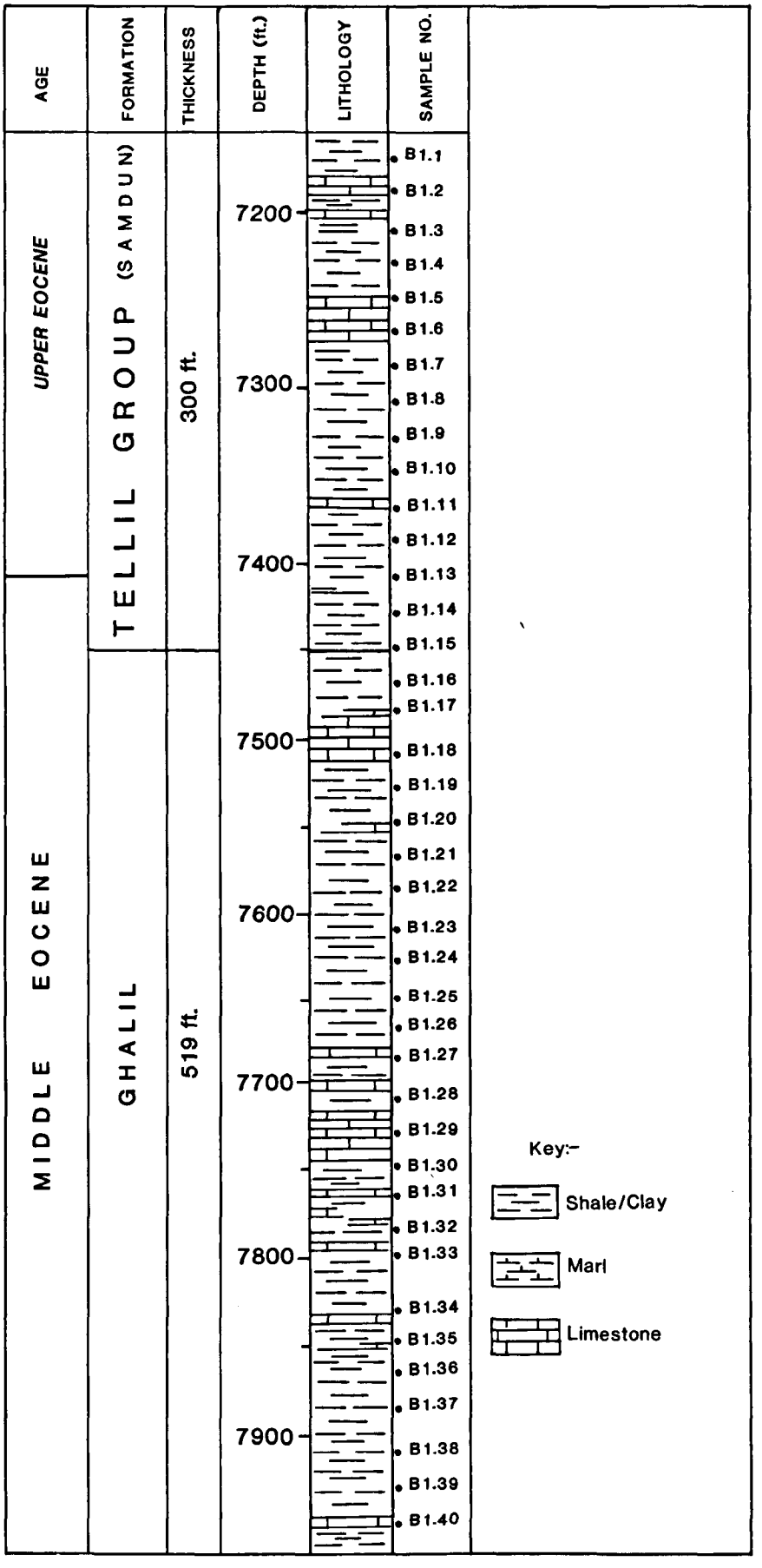

FIG. 3.2 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL B1-NC41.

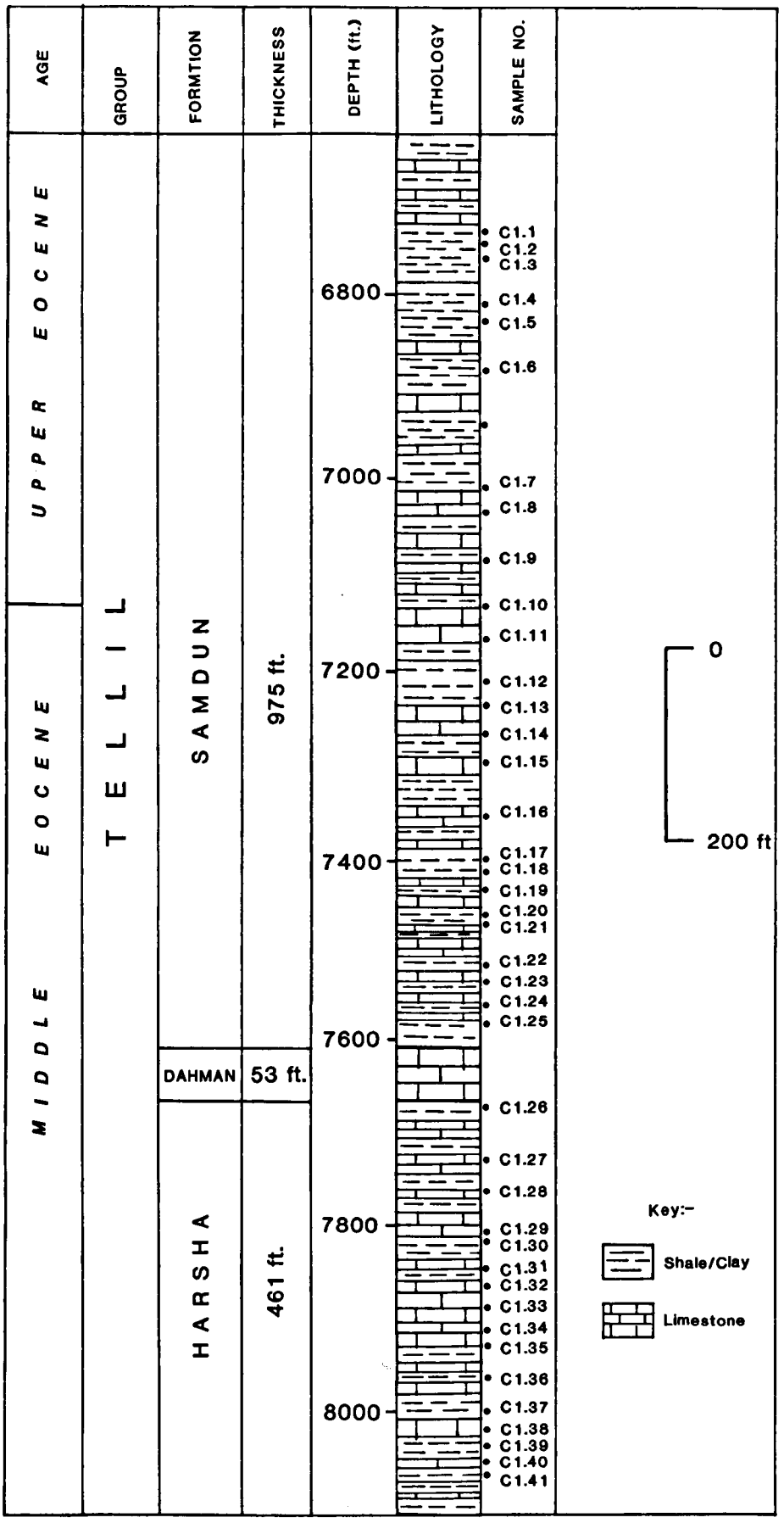

FIG. 3.3 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL C1-NC41.

3.1.3.1 Samdun Formation:

In this Well the Samdun Formation has a thickness of 975 feet and is dated as Middle to Upper Eocene. It consists of dark to green shale with intercalations of limestone.

3.1.3.2 Dahman Formation:

The thickness is 53 feet and dated as Middle Eocene. It is characterised by its limestone beds.

3.1.3.3. Harsha Formation:

In this Well the Harsha Formation has a thickness of 461 feet and is dated as Middle Eocene. It is mainly composed of dark-grey shale frequently interbedded with various white-grey limestones grading to mudstone with locally chalk.

3.1.4 WELL B1a-137 SECTION (Fig. 3.4).

Lat. 33^{o} 51' 48" N

Long. 12^{o} 04' 48" E

This Well lies the northwest of the study area and has been drilled trough 1822 feet of sediments of the Tellil group, represented by the Samdun, Dahman and Harsha Formations.

3.1.4.1 Samdun Formation:

The Formation is 910 feet and dated as Middle to Upper Eocene. In the upper part it is mainly composed of grey-greenish pyritic and calcareous shale whilst the lower half contains limestone interbedded by shales in some places.

3.1.4.2 Dahman Formation:

In this Well the Formation has a thickness of 70 feet and dated as Middle Eocene. It consists cream to white limestone with some shale.

3.1.4.3 Harsha Formation:

In this Well, the Harsha Formation has a thickness of 842 feet. It is mainly calcareous grey shale interbedded with limestone, cream, white, very hard chalk. This Formation is dated as Middle Eocene.

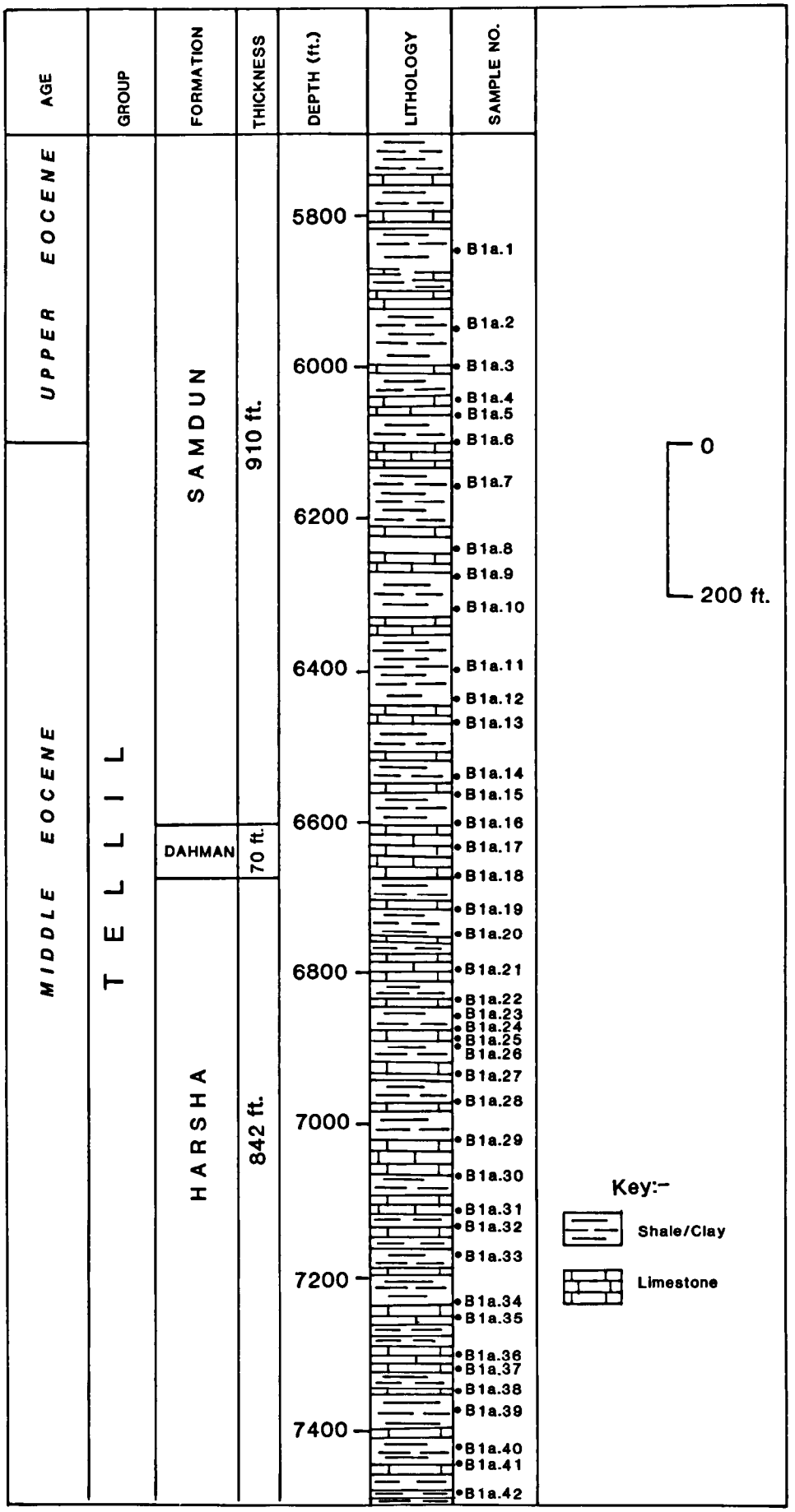

FIG. 3.4 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL B1a-137.

3.1.5 WELL F1-NC41 SECTION (Fig. 3.5).

Lat. 33° 17' 51" N

Long. 13° 30' 39" E

This Well is situated in the eastern part of the Tarabulus Basin and has been drilled through 1236 feet of Tellil Group sediments ranging in age from Middle to Upper Eocene.

3.1.5.1 Samdun Formation:

In this Well, the thickness of this Formation is 678 feet. It mainly consists of wackestone grading to packstone which is whitish and medium-hard intercalated with grey-green shale.

3.1.5.2 Dahman Formation:

The Dahman Formation is 52 feet thick. It consists of beds of nummulitic limestone.

3.1.5.3 Harsha Formation:

In this section, the formation has a thickness of 506 feet and is dated as Middle Eocene. The Formation is composed wackestone grading to medium to hard mudstone interbedded with grey-green, fossiliferous, more or less calcareous, shale.

3.1.6 WELL D2-NC41 SECTION (Fig. 3.6).

Lat. 34° 00' 58" N

Long. 12° 32' 42" E

This section is situated north of the Well B1-NC41 of the Bouri oil field and has been drilled through 666 feet of sediments of the Ghalil Formation which range in age from Middle to Upper Eocene. Several samples were obtained from older Formations such as the Late Palaeocene of the Farwah Group and the Al Jurf Formation.

3.1.6.1 Ghalil Formation:

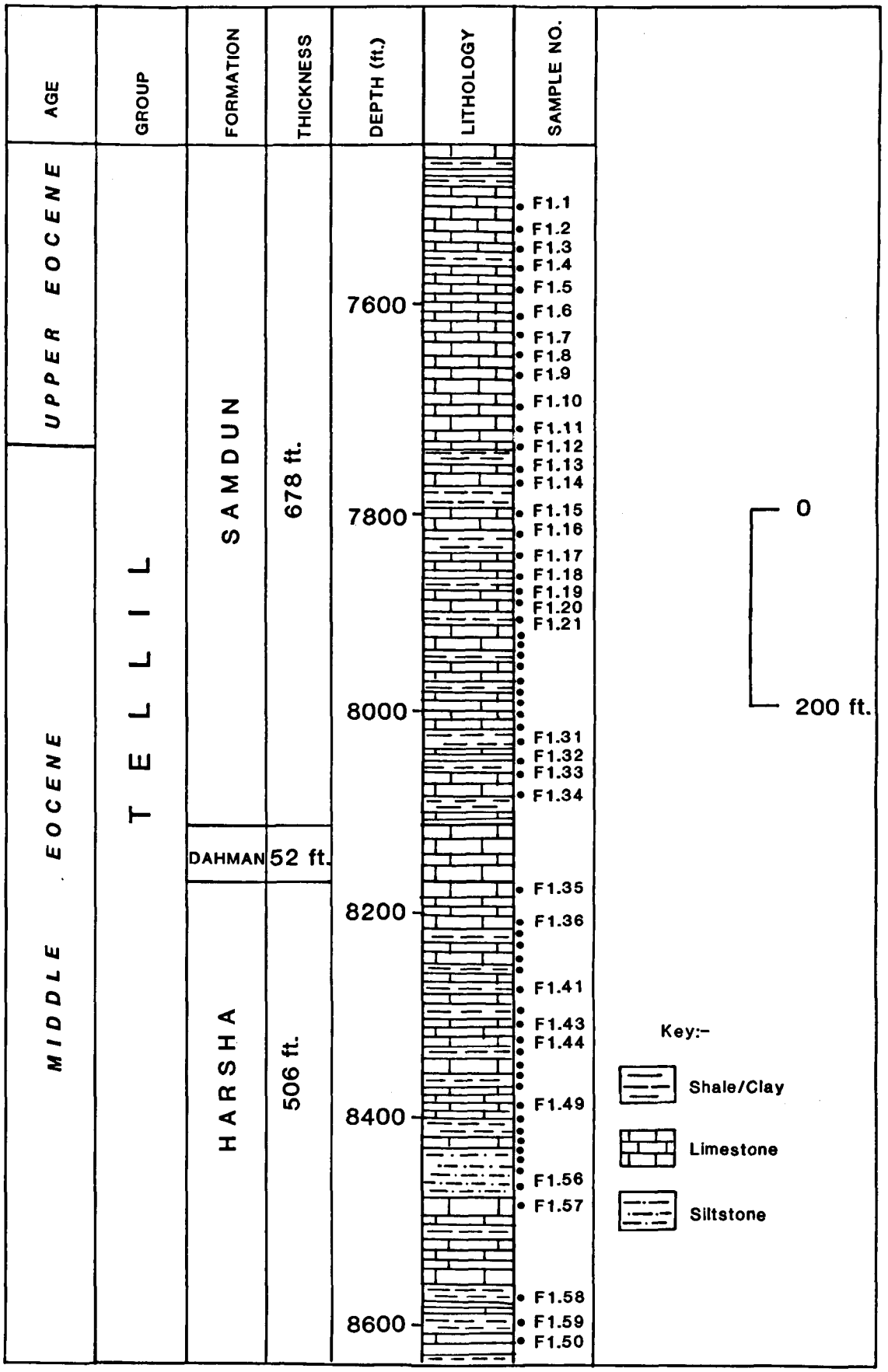

FIG. 3.5 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL F1-NC41.

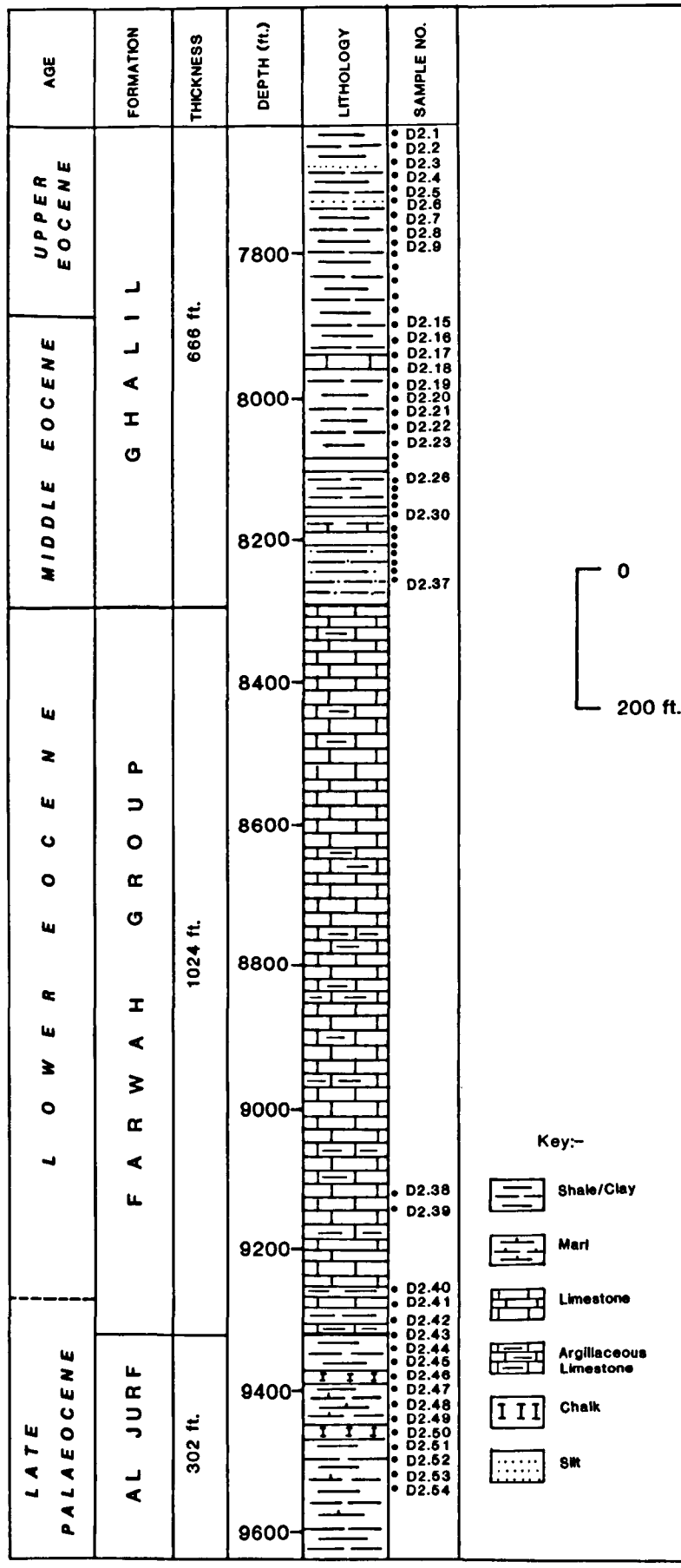

FIG. 3.6 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL D2-NC41.

The Formation is 666 feet and dated as Lower to Upper Eocene. The lithology is mainly composed of grey, hard, fissile shale, with some levels of grey, friable, very fine grained sandstone and brown wackestone. It is characterised by its chalky limestone in the lowermost part of the Formation.

3.1.6.2 Al Jurf Formation:

Several samples were available for study from the Palaeocene of the Al Jurf Formation between the depths of (9300-9570'). It consists of marl and shale which are interbedded with chalk in some places.

3.1.7 WELL K1-NC41 section (Fig. 3.7).

Lat. 33° 14' 48" N

Long. 12° 28' 30" E

This Well lies in the southern flank of the Tarabulus basin and has been drilled through 2356 feet of sediments of the Tellil Group. Here the Group is represented by Samdun, Dahman and Harsha Formations.

3.1.7.1 Samdun Formation:

In this Well the Formation has a thickness of 1106 feet and is dated as Middle to Upper Eocene. It consists of fossiliferous, medium, splintery, grey-green shale with pyrite and glauconite and nodules, interbedded with levels of argillaceous partly recrystallised, whitish, medium, hard limestone with calcareous cement.

3.1.7.2 Dahman Formation:

The thickness of this Formation is 64 feet and dated as middle Eocene. It is mainly composed of fossiliferous, partly recrystallised limestone with white to light brown anhydrite.

3.1.7.3 Harsha Formation:

In this Well, the Formation has a thickness of 1186 feet and is dated as Middle Eocene. it consists of medium to hard, whitish, slightly sandy mudstone grading to fossiliferous, friable to medium hard, whitish to light brown limestone interbedded with levels of grey-green to dark grey shale and also with some brown sand.

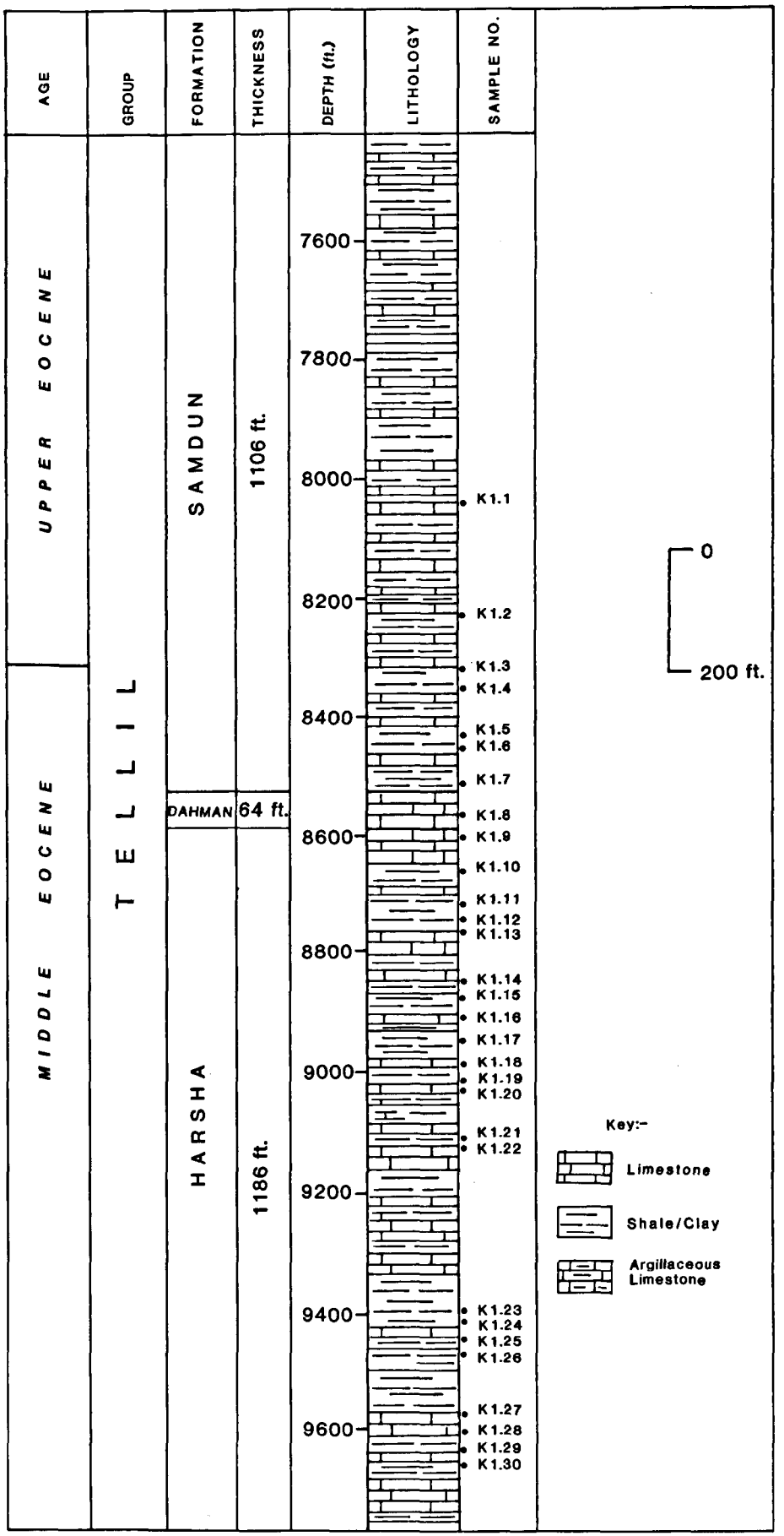

FIG. 3.7 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL K1-NC41.

3.1.8 WELL J1-NC41 SECTION (Fig. 3.8)

Lat. 32° 54' 29" N

Long. 14° 01' 08" E

In this Well, the Tellil Group has a thickness of 566 ft. and is dated as Eocene age. In the lower part, it mainly consists of grey to white, fossiliferous, occasionally argillaceous, friable limestone with levels of dark-grey shale. In the middle part, the lithology consists blackish, friable pyroclastic rocks to medium hard, shale with levels of limestone. In the upper part, it consists of green to dark green, silty, fossiliferous, medium hard shale, with thin layers of whitish to grey limestone. A few samples were obtained from the Al Jurf Formation and from the upper part of the older formation (Bu Isa Formation). It consists mainly of limestone with layers of fossiliferous shale.

3.1.9 WELL N1-NC41 SECTION (Fig. 3.9).

Lat. 13° 14' 09" N

Long. 33° 17' 14 E

This Well is situated in the eastern part of the Tarabulus Basin and is drilled through 250 ft. (75 m) of sediments of the Al Jurf Formation. The Formation consists of dark, grey and grey-green, medium to hard shale with thin interbedded argillaceous limestones. The age of this Formation in this well is Maastrichtian.

3.1.10. WELL L1-NC41 SECTION (Fig. 3.10).

Lat. 33° 18' 13" N

Long. 13° 39' 09" E

Only samples available were from the lower part of the Tellil Group in this Well, which is represented by the Harsha Formation.

3.1.10.1 Harsha Formation:

The formation is 1008 feet thick and dated as Middle Eocene. In the lower part, the formation consists of white, fossiliferous, medium-hard limestone interbedded with dark-green, splintery shale.

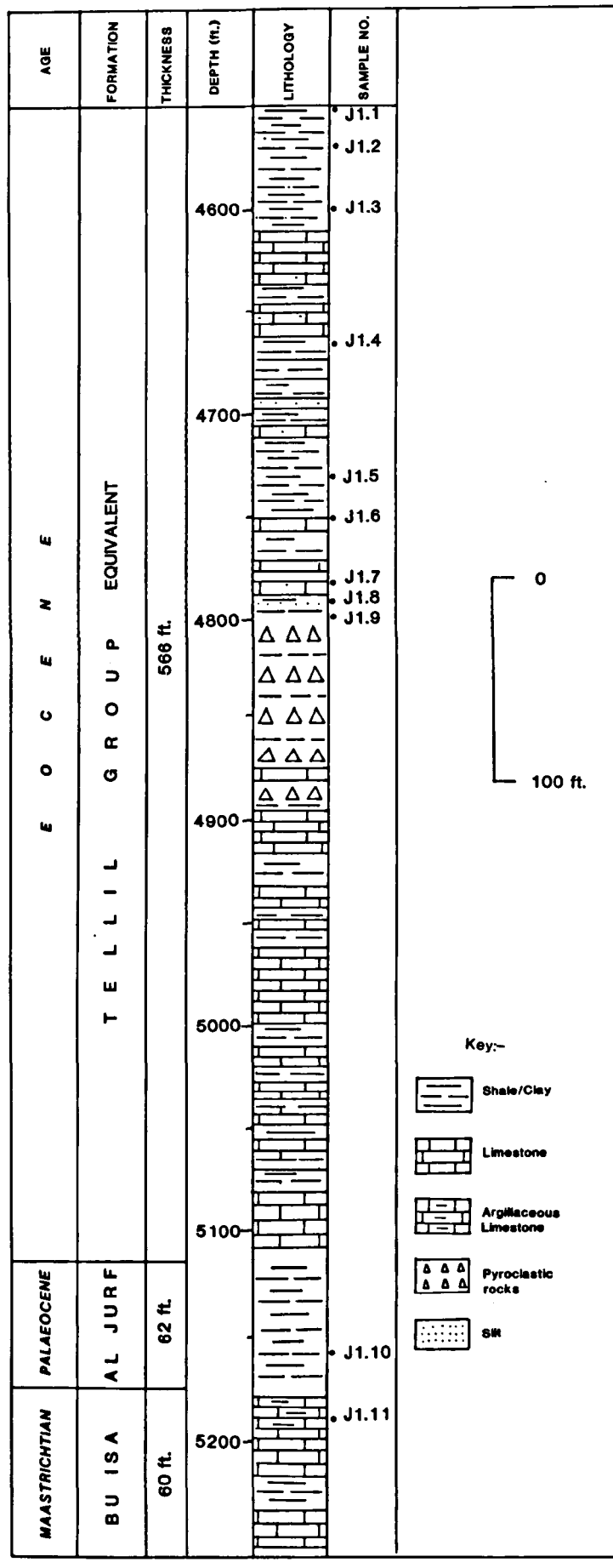

FIG. 3.8 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL J1-NC41.

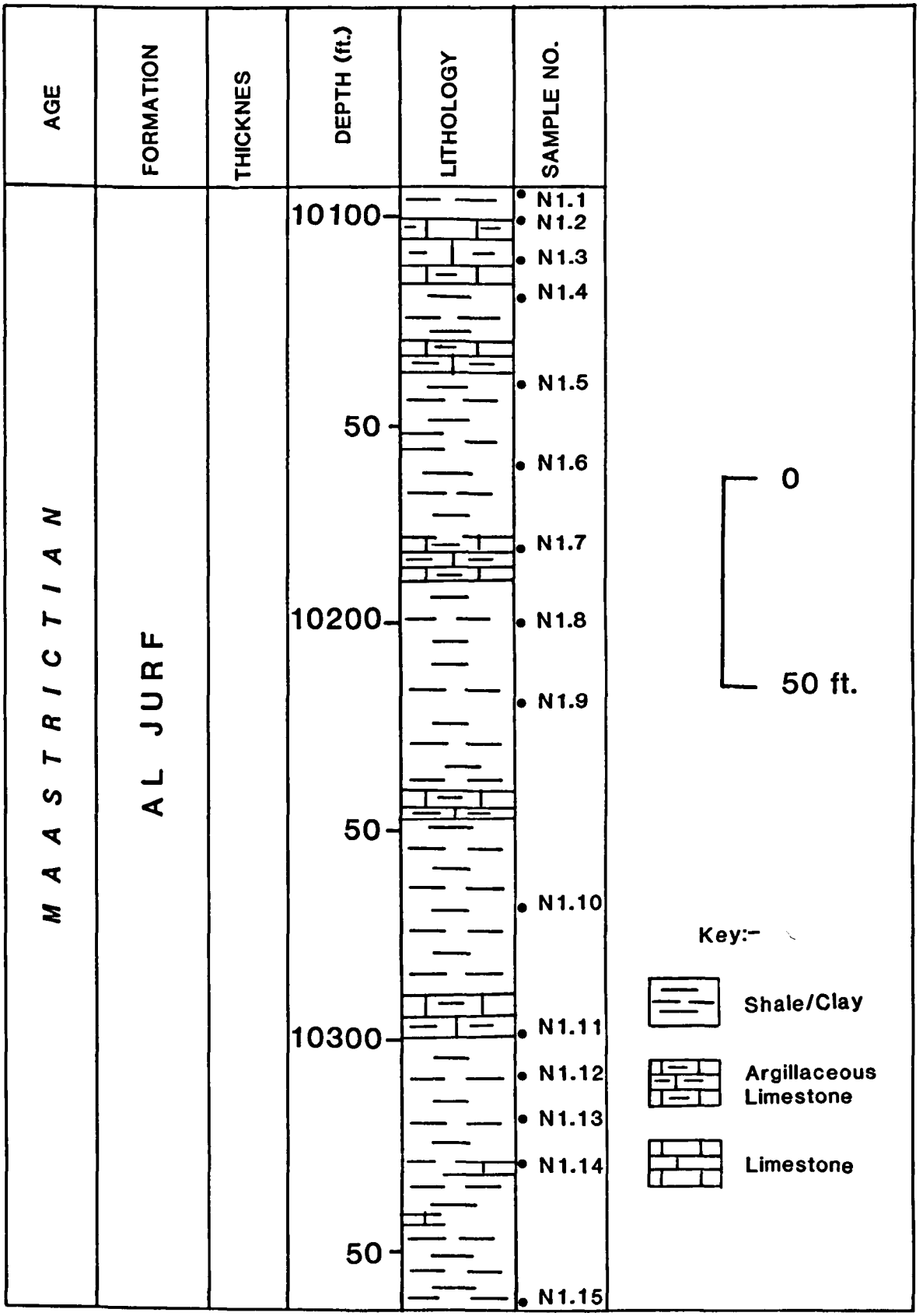

FIG. 3.9 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL N1-NC41.

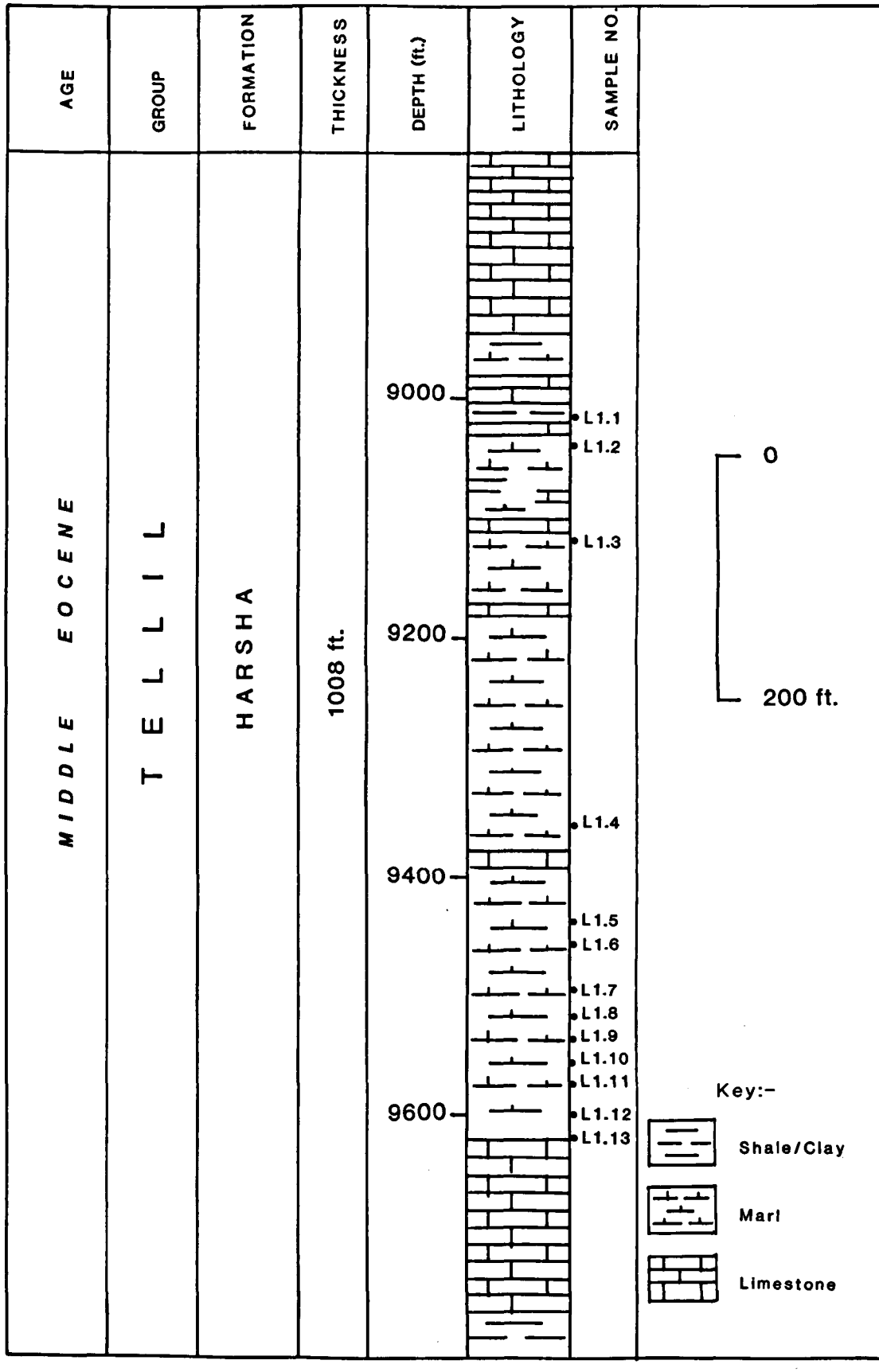

FIG. 3.10 STRATIGRAPHIC SECTION SHOWING POSITION OF SAMPLES IN WELL L1-NC41.

The middle part is mainly composed of grey, soft, marl locally grading to shale with some thin beds of greyish, fossiliferous limestone, whilst the upper part consists of white, fossiliferous, hard wackestone and packstone interbedded with grey to greenish , fissile shale.

3.2- TECHNIQUE

3.2.1 Processing:

To obtain ostracods from the different sediments, various methods were used depending on the sediment type. The sample was first weighed and then boiled in water in a stainless steel bowl with two spoonfuls of sodium carbonate added as a defloculent. Boiling and sieving has to be repeated until a few grains of insoluble residue remains. Sample of indurated shale or siltstone were heated on an electric iron plate, cooled then covered with Kerosene, after half an hour the Kerosene was returned to the container and the sample dried. Kerosene was effective on the shales which were mostly broken but harder limestones were not much affected. In cases where samples failed to break down after adding the Kerosene, two spoonfuls of sodium carbonate were added and boiling and sieving carried out to get a residue.

For limestone, hydrogen peroxide (15% solution) was tried. After the dried sample is soaked in hydrogen peroxide overnight, the water and sodium carbonate are then added, followed by boiling and sieving. This method did not prove completely successful. Freezing and thawing using sodium acetate was also tried. In this method the sample is covered with sodium acetate, a few drops of water are added and the sample is heated slowly. It is then removed from the heat and placed suddenly in a pan of cold water. This method is repeated several times.

All these processes were of limited success, only the repeated boiling with sodium carbonate and sieving gave comparatively better results. The boiled samples were then washed through a 60 μm aperture no. 16 mesh sieve, taking care to clean it between the washing of different samples. The residue were finally dried and stored in plastic bags with reference numbers such as depth and Well no. according to the position of the sample in the section.

3.2.2 Picking:

The residues were spread out on a flat bottomed black tray with a white grid. The ostracods are picked out with a moistened sable brush at low magnification and removed to Franke slides.

3.2.3 Sorting:

After preliminary indentification of the ostracods, the different species were mounted in slides. Each slide represented one sample. The number of the locality and the depth were written on the slide. Furthermore, a data sheet was completed to accompany each slide giving location, age, formation and the number of specimens from each sample.

3.2.4 Treatment of individual specimens:

Individual specimens which had material stuck to their exterior and interior were cleaned manually with a fine tungsten needle mounted in a glass rod. If the valve was strongly calcified it was glued on the glass slide, this prevents the specimens from being lost when touched with the needle after adding a drop of water to the soften matrix. In some cases, where there were a large number of specimens an ultrasonic cleaner (Soniclean Generator) was used. However, this method of cleaning is not entirely successful, as the specimens are often broken and damaged the ornamentation destroyed.

Malachite green was used to study the external characters of the specimens under reflected light, but mostly the external features were best studied by means of the Scanning Electron Microscope.

3.2.5 Photography:

The specimens were examined and photographed using the Cambridge 600 and 360 Scanning Electron Microscope. After cleaning, the specimens chosen for photography were mounted on special SEM stubs, using either Kodaflat solution, or double-sided sellotape. The kodaflat solution, gives a good photographic background

and it is easy to remove the specimens after use. The specimens were mounted with the dorsal margin parallel to the edge of the stub. The stub was then placed in a vaccum coating unit to coat the specimens for observation using the SEM. A gold coating was found to give best results. The specimens were normally photographed at a magnification of 40, 100 and 200 using Ilford F.P.4 black and white film. Stereo-pairs were made of each of the ostracods which were mounted to show dorsal, ventral and external views with high magnification for views of ornamentation.

Finally the photographic prints were cut to small size and mounted using mounting tissue and the plates were made up and rephotographed for final reproduction at A4 size.

3.2.6 Repository:

All the figured specimens are deposited in the Hull University, Geology Department collection with prefix HU.T.

CHAPTER 4

STRATIGRAPHY

4.1. INTRODUCTION:

The oldest rocks represented in offshore Libya are from the Bir Al-Ghanam Formation of Late Triassic age and were reached in the L1-137 well. Triassic beds are also reported from the onshore wells, and are composed of a clastic sequence of sandstones, grey and reddish shale with a few limestones beds belonging to the Al-Guder Formation. This is followed by carbonates and clastic sediments of the Kurrush Formation and carbonates of the Al-Aziziyah Formation.

The Late Triassic is represented by the basal beds of the Bir-Alghanam evaporites in the offshore well L1-137, and by the beds of the Abu-Ghaylan carbonate. There is present a thick sequence of Triassic, Jurassic, Cretaceous and Tertiary in the Pelagian Block (Pitman *et al.*, 1981). The Early and Middle Jurassic is represented in well L1-137, which is one of the deepest wells drilled in offshore Libya, and consists of anhydrite with shales and dolomites. This sequence is equivalent to the Bir Al-ghanam Formation of Jabel Nefusa. Middle to Late Jurassic is observed in the Kiklah Formation in well L1-137. The lower part is mainly composed of sandstones with pyritic shale, dolomite and limestone, whereas the upper part contains dolomitic sandstone, shale and siltstone. The Kiklah Formation of L1-137 is unconformably overlain by volcanic rocks and sedimentary strata of Early Cretaceous age and underlain by the Early Jurassic of the Bir Al-ghanam Formation.

The Cretaceous is represented in northwest offshore Libya and is well developed, including the upper section of Kiklah sandstone which is thought to be Early Cretaceous. This is composed mainly of fine dolomitic sandstone, shale and siltstone, overlain by grey carbonates, with locally a sequence of the Turghat Formation and, also locally, the grey to cream sandy and silty fossiliferous shales of the Massid Formation. The Massid Formation contains planktonic and benthonic Foraminifera, indicative of an Aptian to Albian age. The Turghat Formation is highly

fossiliferous containing benthonic Foraminifera. The Late Cretaceous is represented by the Alalgah, Makhbaz, Jamil and Bu Isa Formations. The Late Cretaceous is terminated by the deposition of the Al Jurf Formation covering almost all of the Pelagian Block. It consists of dark grey to black shale, sandstone and sandy shale.

The Al Jurf Formation ranges from Maastrichtian to Palaeocene. During the Tertiary, the Palaeocene is represented only in the wells drilled in the northern and eastern sector. This Palaeocene strata is represented in the Al Jurf Formation which consists of clay, shale and carbonates. During the Late Palaeocene and Eocene thick sequences of carbonates, shale, dolomites and evaporites are represented by two major transgressive-regressive units namely the Farwah Group and Tellil Group.

The Oligocene of the Pelagian Block is characterised by the appearance of the ***Nummulites vascus*** bed. To the west the Oligocene consists mainly of carbonates. The Early Miocene strata are over 2700 feet thick and the end of the Miocene is characterised by the occurrence of beds of carbonates and evaporites. The Miocene strata are represented by the Al Mahyah, Bir Sharuf, Sidi Bonnour, Tubtah and Marsa Formations.

4.2 Tellil Group:

The name of the Tellil Group was introduced by Hammuda ***et al.***, (1985), the Group consisting of a shallow platform deposit of varying lithology in the subsurface of the southern flank of the Tarabulus Basin. The name is derived from a well known beach area about 10 kms. west of Sabratha and 30 kms. southwest of the type section. The type section is located in the N.O.C.-Elf-Aquitaine H1-137 well (12^{o} 37' 43" E and 33^{o} 01' 50" N) at a drill depth of 6142-8020 feet; this corresponds to a subsea depth of (6065- 8003 feet). The Tellil Group ranges in age from the Middle to the Late Eocene. The group is divided by Hammuda ***et al.***, (1985) into three formations: from the base to the top.

4.2.1 Harsha Formation. Base

4.2.2 Dahman Limestone.

4.2.3 Samdun Formation. Top

This group consists a variety of interbedded lithologies including shale, siltstone, dolomite, sandstone, anhydrite and micritic lenses. Shales and carbonates predominate north of the type section, replacing evaporites and clastic sediments. It is widely recognised in most of the wells drilled in the southern and central parts of the Tarabulus Basin and it attains a maximum known thickness in its type locality at H1-137 of 1938 feet. It thins to the west where it reaches a thickness 1236 feet at F1-NC41 and north-east of the type locality where it reaches a thickness of 300 feet at B1-NC41 before it changes to the pelagic facies of the Ghalil Formation.

The group for the most part is unconformable with the underlying and overlying formations in the southern and central parts of the Tarabulus Basin. It is equivalent to the Ghalil Formation in the northern and north-eastern parts of the Basin and there it is conformable with the underlying unit and conformably overlain by the succeeding stratigraphic unit. In the southwest, the equivalent unit consists of a marginal facies with a thick development of evaporites and argillaceous carbonates similar to the Gir Formation and equivalent to the Gedari Formation of the western Sirte Basin.

The group is laterally equivalent to the Ghalil Formation of the pelagic northern parts of the Tarabulus Basin. In Tunisia the Tellil Group is equivalent to the Cherahil A & B (Fournie 1978). In the Sirte Basin the Tellil Group is equivalent to the Gedari Formation of the West and to the Gialo and Aguila Formations of the central and eastern parts of the Basin (Barr & Weeger, 1972) (fig. 4.1). The Tellil Group is equivalent to the Derna Formation in Al Jabel Al Akhdar (Barr & Berggren, 1980). The group contains Foraminifera including nummulites, ostracods, algae and pelecopods.

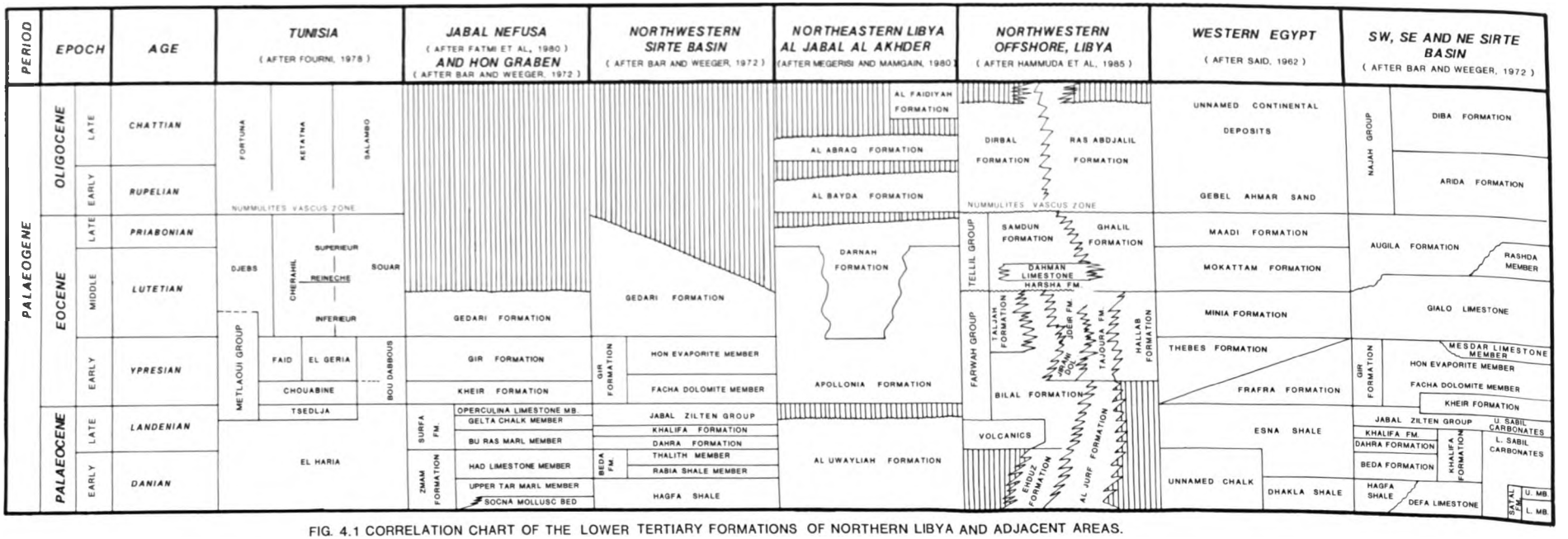

FIG. 4.1 CORRELATION CHART OF THE LOWER TERTIARY FORMATIONS OF NORTHERN LIBYA AND ADJACENT AREAS.

4.2.1 Harsha Formation:

The name of the Harsha Formation was introduced by Hammuda *et al.*, (1985), as a member of the Tellil Group in the surface of the southern flank of the Tarabulus Basin in offshore northwest Libya. It was named after an area known as Harsha located 5 km. west of Zawyah. The type section is located in the NOC-Aquitaine H1-137 (12° 37' 43.03" E and 33° 01' 50.72" N) at a drill depth of 7323-8080 feet which corresponds to a subsea depth 7246-8003 feet. It consists mainly of dolomitic limestone marl, and minor streaks of green-grey shale in the south of the basin. The limestone is generally of microsparite or pelmicrite with soft chalk, argillaceous material and, locally, dolomite and pyrite. The marls are white to light grey. At the studied area shale predominates with few limestone beds. The formation is rich in benthonic Foraminifera, pelecypods and, locally, nummulites and ostracods. In its type section the Harsha Formation is unconformably underlain by the Talijah or Jdeir Formations of the Farwah Group in most of the south-central flank and the central portion of the Tarabulus Basin.

The Harsha Formation is overlain by the Dahman Formation throughout the Basin, except the northern and eastern edges of the studied area where the Dahman Formation is missing, and the Samdun Formation overlies the Harsha Formation.

The Harsha Formation of the Tellil Group attains a maximum thickness of about 837 feet in the type section in well H1-137. Its maximum thickness is about 1186 feet at K1-NC41. It becomes gradually thinner eastwards toward the F1-NC41 well and disappears into equivalent volcanics in well J1-NC41. The Harsha Formation is equivalent to the Cherahil A in Tunisia (Fournie, 1978).

4.2.2 Dahman Formation:

The Dahman Formation was introduced as a Formation of the Tellil Group by Hammuda *et al.*, (1985), the name being derived from a small village 5 km. to the east of Sabratha. The type section is located in H1-137 at a drill depth of 7247-7232 feet

corresponding to a subsea depth of 7170-7246 feet. The Dahman Formation is a persistent horizon in thickness and lithological character throughout the area. The sequence contains nummulites and ostracods.

The Dahman Formation rests comformably on the Harsha Formation of the Tellil Group throughout the southern flank and central parts of the Tarabulus Basin.

It is overlain conformably by the Samdun Formation of the Tellil Group in the area of the type section and in most areas of the central parts of the Basin. The Dahman Formation is widely distributed throughout the southern flank of the Tarabulus Basin. The thickness in the type section is 76 feet. It changes facies laterally in the east, northeast, west and southwest of the Basin. To the north and northwest of the Basin the Dahman Formation is equivalent to parts of the Ghalil Formation where it changes from a shallow platform neritic facies to a pelagic one.

4.2.3 Samdun Formation:

This formation was introduced as a unit of the newly proposed Tellil Group in the subsurface of the Tarabulus Basin of offshore Libya by Hammuda *et al.*, (1985) and was named after the Sabkhat Samdun a few kilometres south-east of Bukammash. The type section is located in the NOC-Aquitaine H1-137 (12° 37' 43.03" E and 33° 01' 50.72" N) at a drill depth of 6142-7247 feet which corresponds to a subsea depth of 6065-7170 feet. The formation in the type locality consists of greenish-grey, glauconitic shales with interbedded siltstone, clay and limestone whilst the shales and clays predominate in the north and centre.

The formation in some places is rich in benthonic Foraminifera (especially milioliids) and ostracods. The Samdun Formation conformably overlies the Dahman Formation or the Harsha Formation. It passes generally into the Harsha Formation through vertical facies changes in the west and southwest where the intervening Dahman Limestone is missing or poorly developed. The Samdun Formation is equivalent to the upper part of the Ghalil Formation found to the north and northeast forming the pelagic facies of the Tarabulus Basin. The formation is well developed in

the west and southwest, where it passes vertically into the upper part of the Harsha Formation and westward into the equivalent Djebs of Tanit. According to Hammuda *et al.*, (1985) the Samdun Formation contains gas and oil shows which were reported in well F1-NC41.

4.3 Ghalil Formation:

The name of the Ghalil Formation was proposed by Hammuda *et al.*, (1985) for a pelagic marine facies and was derived from an area near Dahman Village east of Sabratha. The type section of the formation is located in the NOC.-Agip D2-NC41 well (12° 32' 42" 40 E and 34° 00' 58" 05 N) at a drill depth of 7680-8284 feet which corresponds to a subsea depth of 7627-8231 feet. The Formation consists of grey and greenish-grey, silty shale grading to white, soft, fossiliferous, silty marl. The lower part contains lenses of dark brown limestone.

The Ghalil Formation is represented lithologically by the deeper portion of marine deposits which are absent from the nearshore and shallow shelf of the F1-NC41, H1-NC41, G1-NC41, L1-NC41 and K1-137 wells in southern flanks of Tarabulus Basin.

This formation occurs only in the north section of the study area where it attains a thickness of 666 feet in the D2-NC41 well and 375 feet at the B2-NC41 well. The Ghalil Formation conformably overlies the Farwah Group or Hallab Formation. In some areas due to this facies relationship the Ghalil Formation is found overlying portions of the Samdun Formation of the Tellil Group. According to Hammuda *et al.*, (1985) the formation represents the pelagic, deeper marine facies of the east and northeast of the Tarabulus Basin which is laterally equivalent to the Tellil Group. The shallow shelf and nearshore marine facies is found to the south and southwest of the Tarabulus Basin.

In the central and eastern Sirte Basin, the Ghalil Formation is equivalent to the Gialo and Aguila Formations (Barr & Weeger, 1972). In Tunisia to the west, the equivalent unit is the Sour Formation (Fournie, 1978). According to Hammuda *et al.*,

(1985), only planktonic Foraminifera are recorded from this formation, of which the most important are: ***Morozovella cooki, M. rex, Truncorotalia topilensis, Globorotalia cooki, M. cerroazulensis, Truncorotaloides neni, Bulimina alazanansis, Globigerina eocaena, Globigerapsis mexicana, Globigerinoides higginsi, Globorotalia centralis, Clavulinoides szaboi*** and ***Spirolactammina carinataina.***

4.4 Al Jurf Formation:

The name for the Al Jurf Formation was newly introduced by Hammuda ***et al.***, (1985) as a formation from offshore northern Libya. It derives its name from the Arabic term "Al Jurf" which means the continental shelf where the type section is located. The type section is located in the NOC.-Agip C1-NC41 well (12^{o} 27' 49" E and 33^{o} 41' 15" N) at a drill depth of 9412-10565 feet which corresponds to a subsea depth of 9131-10468 feet.

The lithology of the Al Jurf Formation varies considerably, but mainly consists of medium to hard, fissile shale, dark grey to black in colour, with levels of white to pale grey, chalky limestone. The Al Jurf Formation ranges in age from the Maastrichtian to the Palaeocene. The formation is well developed towards the deeper side of the Basin where its reaches about 1357 feet at C1-NC41 well. In contrast, it thins out towards the south and southwest of the Basin where it measures 52 feet at well G1-NC41. In the Hon Graben area and Jabal Nefusa, the Al Jurf Formation is equivalent to the Zmam and Sarfa Formations (Barr & Weeger, 1972 and Fatmi ***et al.***, 1980). In Tunisia, the Al Jurf Formation is equivalent to the El Haria Formation (Fournie, 1978).

The Al Jurf Formation is underlain by the Bu Isa Formation and overlain by the Farwah Group. However, in some localities the Ehduz and Bilal Formations, which are the lateral equivalent of the uppermost part of the Al Jurf Formation, overstep this unit to the east and separate it from the Farwah Group.

Eliagoubi (1986) studied the planktonic Foraminifera of the Maastrichtian-Palaeocene interval of the Al Jurf Formation from four wells (J1-NC41, C1-NC41, B1-NC41 and D2-NC41) in the Tarabulus Basin. He recorded thirty-two species, especially in the Maastrichtian interval. These included: ***Heterohelix globulosa, Pseudoguembalina costulata, Planoglobulina carseyae carseyae, P. carseyae talahi, Globotruncana arca, G. conica, G. contusa, G. falsosturati, G. gagnebini, G. rosetta, G. stuarti, Acarinia mckannai, A. spiralis, Morozovella acuta, M. aequa, M. angulata, M. occlusa, M. trinidadensis, M. velascoensis, Rugoglobigerina rugosa, Planorotalites compressa, P. pseudomenardi, Subbotina pseudobulloides, S. triloculinoides, Bolivina incrassata, Pseudotextularia elegans*** and ***Racemiguembelina powelli.***

Eliagoubi (1986) suggested a shoaling environment of deposition for the upper part of the Bu Isa Formation which was followed by a deep shelf environment for the lower Al Jurf Formation , followed by a further deeper water environment which was interrupted by a localised shallower period of deposition. This formation is the most probable source for the oil reservoirs in the overlying Farwah Group.

4.5 Bu Isa Formation:

The name of the Bu Isa was introduced by Hammuda ***et al.***, (1985) for a formation from NW offshore Libya. The type section is located in the NOC-Aquitaine H1-137 Well. Long. 12^{o} 37' 43" and Lat. 33^{o} 01' 50" at a drill depth of 9150-10102 feet which corresponds to a subsea depth of 9073-10015 feet.

The lithology of the Bu Isa Formation consists of cream to light coloured, micrite to varying biomicritic dark brown, highly argillaceous material and marl overlain by light grey micrite to pelmicrite, highly argillaceous, fossiliferous. This Formation ranges in age from Maastrichtian to Campanian.

In Tunisia the formation is equivalent to the Berda, Merfeg and Aboid Formations and the uppermost part of the Kef Formation. In the eastern part of the Basin in the C1-NC41 Well, the Bu Isa Formation is overlain by the Al Jurf

Formation and underlain by the Jamil Formation. However, in Well G1-137 the Formation is conformably overlain by the Farwah Group.

CHAPTER 5

SYSTEMATIC DESCRIPTIONS

Subclass Ostracoda Latreille, 1806

Order Podocopida Müller, 1894

Suborder Platycopa Sars, 1866

Family Cytherellidae Sars, 1866

Genus ***CYTHERELLA*** Jones, 1849

Type species: ***Cytherina ovata*** Roemer, 1840.

Remarks:

Eight species were found in the Tarabulus Basin, NW offshore, Libya, which show some affinities with species recorded from Africa (Reyment 1963, Foster ***et al.*** 1983, Helmdach & El Khoudary, 1980, Cronin & Khalifa 1979 and Esker 1968), from Europe (Swain 1984, Ducasse 1967, Ducasse ***et al.*** 1985 and Deltel 1962) and from India (Neale & Singh 1985) placed in genera ***Cytherella*** and ***Cytherelloidea.*** ***Cytherella*** was erected by Jones (1849) with the sub-genus ***Cytherella*** to accommodate all forms which were ovate to egg-shaped. In (1963) Morkhoven considered that variation in punctate surface ornamentation occurs regularly. He also considered ***Cytherella*** and ***Cytherelloidea*** as two distinct genera. Many workers follow this view, Neale (1962, 1975), Keij (1957), Keen (1978) and etc. On the other hand Hartmann & Puri (1974), Sissingh (1972a) and the Treatise of Invertebrate Paleontology Volume Q (1961) consider ***Cytherelloidea*** as a subgenus of ***Cytherella.***

Cytherelloidea was erected by Alexander (1929) to include species sculptured with ridges, pits and tubercles and differs from ***Cytherella*** in ornamentation and in

outline. Furthermore, the dorsal and ventral margins are straight rather than ovate. Therefore this form is considered as a distinct genus in this study.

Platella was proposed by Coryell and Fields (1937) from the Miocene of Panama, but since then its status has been disputed. The American Treatise (1961) questionably described this taxon as a new genus. Morkhoven (1963) considered ***Platella*** as synonymous with ***Cytherella***. Bate (1972) stated that all species having a strongly pitted surface belong to the genus ***Platella***. Hartmann and Puri (1974) also considered ***Platella*** as a distinct genus. Going back to the type species of this disputed genus, the measurement of the length and the height is 420 μm and 200 μm which suggests that the type species is probably a juvenile. In this study the genus ***Platella*** is not used pending further study of the type species.

Cytherella angulata sp. nov.

(Pl. 1, figs. 1-7)

Figured specimens:

Pl. 1, fig. 1, female carapace HU.201.T.1. From Well B1a-137 at 6600 ft., Pl. 1, fig. 2, female carapace, paratype HU.201.T.2. Pl. 1, fig. 3, female carapace, holotype HU.201.T.3. Pl. 1, fig. 4, male carapace, paratype HU.201.T.4. From Well C1-NC41 at 7810 ft., Pl. 1, fig. 5, female carapace HU.201.T.5. From Well B1a-137 at 6600 ft., Pl. 1, fig. 6, male carapace, paratype HU.201.T.6. Pl. 1 fig. 7, female carapace, paratype HU.201.T.7. From Well C1-NC41 at 7590 ft.

Derivation of name:

In reference to its angulated dorsal margin.

Holotype:

A female carapace HU.201.T.3

Paratypes:

Four specimens HU.201.T.2, 4, 6-7

Type locality:

Well C1-NC41 section, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 7810 ft.

Stratigraphic range:

Middle Eocene.

Material:

446 specimens. In Well B1a-137 section, 52 specimens were found, 37 specimens in the Samdun Formation at drilling depths of 6400-6600 ft., five specimens in the Dahman Formation at a depth of 6440 ft. In the Harsha Formation, 10 specimens were found at depths of 6680-6720 ft. In Well C1-NC41 section, 42 specimens were reported. Seven specimens from the Samdun Formation at drilling depths of 7270-7590 ft., and 35 specimens from the Harsha Formation, at drilling depths of 7680-8040 ft. In Well H1-NC41 section, three specimens were found. The first two specimens from the lower bed of the Samdun Formation, at a drilling depth of 10180 and 10200 ft., and the other specimen from the upper part of the Harsha Formation, at a depth of 10300 ft. In Well B1-NC41 section, 24 specimens have been reported from the Ghalil Formation at drilling depths of 7590-7670 ft. In Well F1-NC41 section, 313 specimens were found, 84 specimens from the Samdun Formation at depths of 7900-8080 ft., and 229 specimens were found throughout the Harsha Formation, at drilling depths ranging from 8180-8570 ft. In Well K1-NC41 section, 12 specimens were found, three specimens from the Dahman Formation at 8564 ft. and nine specimens from the Harsha Formation, at drilling depths of 8780-8950 ft.

Diagnosis:

A species of *Cytherella* in which the right valve strongly overlaps the left, especially at the dorsal and ventral margins. Dorsal margin arched and angular at about mid-height. Sexual dimorphism is pronounced.

Description:

A large, elongate, thick-shelled carapace, subovate in lateral view, its greatest height developed at the angulated area of the dorsal margin. Maximum length occurs at about the middle of the valves. Dorsal margin is arched and angular at about the middle especially in the right valve with slightly concave antero-dorsal area in the left valve. The angular point of the right valve is higher than the left. Ventral margin slightly convex in the right valve of the female and almost straight in the left valves in both sexes. The anterior margin is narrower and more rounded than the posterior margin which is obliquely rounded and sharply curved in its dorsal half. The lateral surface is smooth. The right valve is larger and overlaps the left along its entire margin, especially along the middle of the dorsal and ventral margins in both sexes. Sexual dimorphism is pronounced, the females are elongate, wider and have a more arched dorsal margin.

In dorsal view, the greatest width and thickness lies in the posterior half. No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.201.T.1	(Pl. 1, fig. 1)	700	466	390
Paratype, ♀ carapace HU.201.T.2	(Pl. 1, fig. 2)	684	495	353
Holotype, ♀ carapace HU.201.T.3	(Pl. 1, fig. 3)	675	460	425
Paratype, ♂ carapace HU.201.T.4	(Pl. 1, fig. 4)	691	416	375
♀ carapace HU.201.T.5	(Pl. 1, fig. 5)	676	480	323
Paratype, ♂ carapace HU.201.T.6	(Pl. 1, fig. 6)	630	369	280
Paratype, ♀ carapace HU.201.T.7	(Pl. 1, fig. 7)	583	376	305

Differences and affinities:

The present species shows some similarities to ***Cytherella*** aff. ***Cytherella paucipunctata*** Pietrzeniuk (1969) as figured by Helmdach & El Khoudary (1980) from the Late Eocene of Al Jabal Al Akhdar, NE Libya, but differs in having a straight dorsal margin and slightly concave ventral margin. In addition ***C. angulata*** differs in other respects; the anterior end is narrower and it has smoother surface. ***C.***

sylvesterbradleyi Reyment (1963) was described from the Maastrichtian and Palaeocene of Nigeria. Recently this species has been recorded by Foster *et al.*, (1983) from the Late Palaeocene of Nigeria. It resembles the present species in general outline, but the latter differs in having a well pronounced angulated point in the middle of the dorsal margin and a convex ventral margin especially in the right valve. *C. fusiforma* Ducasse (1967) from the Middle Eocene of the Aquitaine basin as figured by Ducasse *et al.*, (1985) is closely related to *C. angulata*, but the Libyan specimens differ in being more convex in the ventral margin and in having a smooth surface; Ducasse's species has a pitted surface.

The present species is very similar to *C. deopanica* Neale & Singh (1985) from the Middle Eocene of Assam but has a more arched dorsal margin. Furthermore the Indian species is characterised by its nearly straight ventral margin and finely pitted surface.

Occurrence:

This species has been recorded from the Middle Eocene of Well H1-NC41, Well B1a-137, Well F1-NC41, Well C1-NC41, Well K1-NC41 and Well B1-NC41.

Cytherella ghalilae sp. nov.

(Pl. 1, figs. 8-12, Pl. 2, fig. 1)

Figured specimens:

Pl. 1, fig. 8, male carapace, paratype HU.201.T.8. Pl. 1, fig. 9, female carapace, paratype HU.201.T.9. Pl. 1, fig. 10, male carapace, holotype HU.201.T.10. Pl. 1, fig. 11, female carapace, paratype HU.201.T.11. Pl. 1, fig. 12, male carapace, paratype HU.201.T.12. Pl. 2, fig. 1, female carapace, paratype HU.201.T.13. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A male carapace HU.201.T.10

Paratypes:

Five specimens HU.201.T.8, 9, 11-13

Type locality:

Well B1-NC41 section, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Middle Eocene depth 7590 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

698 specimens. In Well D2-NC41 section, 11 specimens were found in the Ghalil Formation at drilling depths of 7700-7940 ft. In Well C1-NC41 section, 21 specimens have been recorded from Samdun Formation at depths of 7270-7590. In Well B1-NC41 section, 148 specimens were found in the Ghalil Formation at a depth of 7570-7910 ft. In Well F1-NC41 section 96 specimens were found, 56 specimens from the Samdun Formation at drilling depths of 7870-8030 ft., and 40 specimens from the Harsha Formation at 8230-8450 ft. In Well H1-NC41 section 138 specimens were found, 88 specimens in the Samdun Formation at the depth of 9640-10020 ft., and 50 specimens in the Harsha Formation at 10300-10730 ft. In Well K1-NC41 section, 253 specimens were recorded, 85 specimens from the Samdun Formation at drilling depths of 8020-8500, six specimens from the Dahman Formation at 8564 ft., and 162 specimens from the Harsha Formation at depths of 8740-9590 ft. In Well L1-NC41, 31 specimens were found in the Harsha Formation at drilling depths of 9440-9580 ft.

Diagnosis:

This species is characterised by its finely pitted surface, a small depression which is present between the centre of the carapace and the dorsal margin and by a faint marginal rim along the anterior margin.

Description:

Carapace sub-rectangular in side view, greatest height in the anterior half, maximum length at approximately mid-height. The anterior margin is broadly rounded with a faint marginal rim, whilst the posterior margin is narrower and rounded. The dorsal margin is slightly convex in the middle and slopes down in the posterior half. The ventral margin is slightly concave in the middle of the right valve and straight in the left valve. The lateral surface is finely pitted. The right valve is larger and overlaps the left along almost all margins.

In dorsal view, the carapace is biconvex with maximum width and thickness in the middle. The anterior end is rounded whilst the posterior end is truncated. Sexual dimorphism is marked, the presumed females being higher in proportion to the length and more rectangular in shape than the narrower males. Internal features were not seen.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♂ carapace HU.201.T.8	(Pl. 1, fig. 8)	606	385	233
Paratype, ♀ carapace HU.201.T.9	(Pl. 1, fig. 9)	571	350	270
Holotype, ♂ carapace HU.201.T.10	(Pl. 1, fig. 10)	585	328	265
Paratype, ♀ carapace HU.201.T.11	(Pl. 1, fig. 11)	517	350	230
Paratype, ♂ carapace HU.201.T.12	(Pl. 1, fig. 12)	571	328	250
Paratype, ♀ carapace HU.201.T.13	(Pl. 2, fig. 1)	557	432	265

Differences and affinities:

Cytherella sp. ***1*** Cronin & Khalifa (1979) from the Middle Eocene Qarara Formation, Gebel El Mereir, Egypt, shows some similarities to ***C. ghalilae*** in general outline, but differs in being narrower and less elongate with well rounded anterior and posterior ends and also in having a straight dorsal margin and more pitted surface.

C. ghalilae closely resembles ***C. meijeri*** Esker (1968) from the Danian of Tunisia but the present species differs in having a slightly convex dorsal margin and also a straight ventral margin. In addition in the Libyan species the right valve is strongly overlapped by the left valve in the posterior and ventral margins. ***C. hastata***

Neale & Singh (1985) from the Middle Eocene of Assam, India, differs from the present species in being smaller and possessing a straight ventral margin. Also in dorsal view the carapace is strongly arched in the anterior half, whilst in ***C. ghalilae*** it is convex.

The present species is very similar to ***Cytherella*** sp. ***1*** Khalifa & Cronin (1979) from the Middle Eocene of the Maghagha Formation, Egypt, but the latter differs in its dorsal margin which is convex rather than concave, and it has a compressed posterior end.

Occurrence:

This species is reported so far from the Middle and Upper Eocene of Well K1-NC41, D2-NC41, and from the Middle Eocene of Well L1-NC41, Well B1-NC41, Well F1-NC41, Well H1-NC41 and Well C1-NC41.

Cytherella tarabulusensis sp. nov.

(Pl. 2, fig. 2-7)

Figured specimens:

Pl. 1, fig. 2, carapace, paratype HU.201.T.14, Pl. 2, fig. 3, carapace, paratype HU.201.T.15, Pl. 2, fig. 4, carapace, holotype HU.201.T.16, Pl. 2, fig. 5, carapace, paratype HU.201.T.17. Pl. 2, fig. 6, carapace, paratype HU.201.T.18, Pl. 2, fig. 7, carapace, paratype HU.201.T.19. All specimens from the same type locality and horizon.

Derivation of name:

With reference to the Libyan capital "Tarabulus"

Holotype:

A carapace HU.201.T.16

Paratypes:

Five specimens HU.201.T.14, 15, 17-19

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7590 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

442 specimens. In Well B1-NC41, 13 specimens were found, two specimens in the Samdun Formation at depths of 7350-7390 ft., and 11 specimens in the Ghalil Formation at 7450-7610 ft. In Well C1-NC41 section, 79 specimens were found, 42 specimens in the Samdun Formation at drilling depths of 7010-7430 ft., 37 from the Harsha Formation at 7770-8000 ft. In Well B1a-137 section, 60 specimens have been reported, 29 specimens from the Samdun Formation at depths of 6040-6600 ft., six from the Dahman Formation at 6640 ft., and 25 from the Harsha Formation at 6760-7190 ft. In Well D2-NC41 section, 11 specimens were found in the Ghalil Formation at drilling depths of 7740-8190 ft. In Well F1-NC41 section 92 specimens were recorded, 28 specimens from the Samdun Formation at depths of 7870-8050 ft., and 64 specimens from the Harsha Formation at 8180-8480 ft. In Well H1-NC41 section, 25 specimens were found, 16 specimens in the Samdun Formation at depths of 9640-10220 ft., nine in the Harsha Formation at 10340-10730 ft. In Well K1-NC41 section, 123 specimens have been found, 51 specimens from the Samdun Formation at 8220-8500 ft. Four specimens from the Dahman Formation at a drilling depth of 8564 ft., and 68 specimens from the Harsha Formation at depths of 8600-9590 ft. In Well L1-NC41, 39 specimens were found in the Harsha Formation at 9120-9600 ft.

Diagnosis:

A species of the genus *Cytherella* characterised by its smooth surface except in the posterior half. The carapace has a distinct oblique, postero-dorsal outline. In dorsal view, the maximum width and thickness occurs within the posterior half.

Description:

In lateral view, the carapace is oblique-ovate with its greatest height developed in the posterior half. The anterior margin is evenly rounded, whilst the posterior margin is broadly rounded and higher than the anterior. The dorsal margin is straight sloping gently towards the anterior end. The ventral margin is slightly concave to straight in the left valve and convex in the right.

The lateral surface is smooth except in the posterior half which is finely pitted. The right valve is larger than the left, overreaching it along its entire periphery. The central muscle scar is marked by a shallow depression.

In dorsal view, the carapace is subpyriform with the greatest width and thickness occurring in the posterior half, sloping more gently towards the anterior end than the posterior. Internal features were not observed.

Dimensions of figured specimens (μm):

		L	H	W
Paratype, carapace HU.201.T.14	(Pl. 2, fig. 2)	657	450	314
Paratype, carapace HU.201.T.15	(Pl. 2, fig. 3)	585	342	270
Holotype, carapace HU.201.T.16	(Pl. 2, fig. 4)	683	416	380
Paratype, carapace HU.201.T.17	(Pl. 2, fig. 5)	658	460	375
Paratype, carapace HU.201.T.18	(Pl. 2, fig. 6)	600	357	280
Paratype, carapace HU.201.T.19	(Pl. 2, fig. 7)	616	391	370

Differences and affinities:

The present species shows some similarities to ***Cytherella ghalilae*** in general outline but the latter differs in having a narrower posterior margin, whilst the greatest width in dorsal view lies in the middle of the carapace. In ***C. tarabulusensis*** this lies in the posterior half.

Occurrence:

Known so far from the Middle and Upper Eocene of Well B1a-137, Well D2-NC41, Well C1-NC41 and Well K1-NC41, and from the Middle Eocene of Well H1-NC41, Well B1-NC41, Well L1-NC41 and Well F1-NC41.

Cytherella aljurfae sp. nov.

(Pl. 2, figs. 8-12)

Figured specimens:

Pl. 2, fig. 8, male carapace, paratype HU.201.T.20, Pl. 2, fig. 9, female carapace, holotype HU.201.T.21, Pl. 2, fig. 10, female carapace, paratype HU.201.T.22, Pl. 2, fig. 11, female carapace paratype HU.201.T.23, Pl. 2, fig. 12, male carapace, paratype HU.201.T.24. All specimens from the same locality and horizon.

Derivation of name:

After the arabic term " Al Jurf" which means the continental shelf.

Holotype:

A female carapace HU.201.T.21

Paratypes:

Four specimens HU.201.T.20, 22-24

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

AL Jurf Formation, Late Palaeocene, depth 9540 ft.

Stratigraphic range:

Late Palaeocene.

Material:

71 specimens were found in Well D2-NC41 section, all from the Al Jurf Formation. Two specimens occurred at a depth of 9400 ft., 15 specimens at 9460 ft, 12 at 9500 ft., 15 at 9520 ft., 20 at 9540 ft., and seven specimens at 9560 ft.

Diagnosis:

A species of ***Cytherella*** with an ovate outline, straight ventral margin in the males and convex in the females. The large right valve accommodates the left.

Description:

An oval carapace with a rounded anterior margin and with an obliquely-sloping, narrower, rounded posterior end. Greatest height behind the middle, maximum length passes through the mid-point. Dorsal margin broadly convex, tending to be somewhat angular in outline at about the middle of the dorsal margin. Ventral margin, slightly convex in the females and almost straight in the males. The right valve is larger and overlaps strongly along its entire margin. The female dimorph is more oval and not so elongate as the male form. The surface is smooth.

In dorsal view, the carapace reaches its greatest inflation somewhat posterior of the mid-length, the anterior end is narrowly rounded. Maximum width towards the anterior end. Only complete carapaces were found and it was not possible to observe the internal features.

Dimensions of figured specimens (μm)*:*

		L	H	W
Paratype, ♂ carapace HU.201.T.20	(Pl. 2, fig. 8)	716	520	350
Holotype, ♀ carapace HU.201.T.21	(Pl. 2, fig. 9)	616	400	320
Paratype, ♀ carapace HU.201.T.22	(Pl. 2, fig. 10)	608	416	345
Paratype, ♀ carapace HU.201.T.23	(Pl. 2, fig. 11)	550	430	275
Paratype, ♂ carapace HU.201.T.24	(Pl. 2, fig. 12)	700	425	330

Differences and affinities:

Cytherella aljurfae resembles ***C.*** cf. ***C. londoninesis*** (Jones) as figured by Swain (1984) from the Middle Eocene beds of Spain in lateral outline. The latter species differs in its anterior end being narrower and in having a marginal rim along the left valve; the right valve also overlaps totally except along the posterior margin. However in the present species the right valve overlaps the left along its entire margin. It shows some similarities to ***C. angulata*** in lateral view, but the latter species differs in having a more angulated dorsal margin, a shallow sulcus and well rounded and wider posterior margin.

C. aljurfae differs from *C. consueta* Deltel (1962) from the Middle Eocene of the Aquitaine Basin, in being smaller. In addition, the right valve of Deltel's species overlaps the left in the central region of the dorsal and ventral margins.

Occurrence:

This species has only so far been found in the Late Palaeocene of Well D2-NC41.

Cytherella tellilae sp. nov.

(Pl. 3 , figs. 1-6)

1981 *Cytherella* sp. *1* Mechmeche, p. 54, pl. 4, figs. 2, 3.

Figured specimens:

Pl. 3, figs. 1-3, carapace, holotype HU.201.T.25, Pl. 3, figs. 4-6, carapace, paratype HU.201.T.26. All the specimens from the same type locality and horizon.

Derivation of name:

After a well known beach area "Tellil" about 10 kms. West of Sabratha, Libya.

Holotype:

A carapace HU.201.T.25

Paratype:

A carapace HU.201.T.26

Type locality:

Well J1-NC41, NW offshore, Libya.

Type horizon:

Tellil Group , Eocene, depth 4600 ft.

Stratigraphic range:

Eocene.

Material:

Four specimens were found in Well J1-NC41 section, two specimens at a depth of 4600 ft., one at 4660 ft. and the last specimen has been reported from a depth of 4730 ft.

Diagnosis:

A species of ***Cytherella*** with the following characteristics: carapace elongate-ovate in outline, surface smooth with some fine pits. In dorsal view, carapace pyriform with the greatest width occurring near in the posterior margin.

Description:

Carapace elongate-ovate in outline, greatest length passes through mid-height, greatest height is developed along the posterior margin. The dorsal margin is nearly straight, running smoothly to the anterior end in the right valve but is slightly concave in the left. The ventral margin is fairly straight. The anterior margin is narrow and rounded, the posterior margin is comparatively more rounded. The lateral surface is nearly smooth with some fine pits. The right valve is larger than the left and overlaps along the entire margin. In dorsal view, this pyriform carapace has its greatest width and thickness occurring at the posterior margin, tapering down towards the anterior margin. Sexual dimorphism was not observed.

A few carapaces were obtained and as no single valves were available for study, it is not possible to describe the internal features.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, carapace HU.201.T.25	(Pl. 3, figs. 1-3)	777	511	365
Paratype, carapace HU.201.T.26	(Pl. 3, figs. 4-6)	777	533	365

Differences and affinities:

Mechmeche (1981) illustrated forms from the Middle Eocene of Tunisia which she called ***Cytherella*** sp. ***1*** and which are identical with ***C. tellilae.*** The present species shows some similarities to ***C. tarabulusensis*** in general outline, but the latter differs in other respects, having a convex dorsal margin, an obliquely rounded posterior margin and it also possesses a small depression between the central and the

dorsal margin. No other species found in the literature can be compared with this species.

Occurrence:

Cytherella tellilae occurs in the Eocene of Well J1-NC41 and was also found in the Middle Eocene of Tunisia.

Cytherella samdunae sp. nov.

(Pl. 3, figs. 7-9)

Figured specimens:

Pl. 3, fig. 7, male carapace, holotype HU.201.T.27, Pl. 3 , fig. 8, female carapace, paratype HU.201.T.28, Pl. 3, fig. 9, male carapace, paratype HU.201.T.29. All specimens from the same type locality and horizon.

Derivation of name:

After it occurrence in the Samdun Formation.

Holotype:

A male carapace HU.201.T.27

Paratypes:

Two specimens HU.201.T.28, 29

Type locality:

Well K1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 8220 ft.

Stratigraphic range:

Middle Eocene.

Material:

30 specimens. In Well F1-NC41, 24 specimens were found in the Samdun Formation at drilling depths of 7910-8030 ft. In Well K1-NC41, six specimens were recorded in the Samdun Formation at a drilling depth of 8220 ft.

Diagnosis:

Ovate males are more elongate in lateral view, whilst females are subquadrate. The lateral surface is smooth, with fine pits; the dorsal margin is straight but slightly concave in the middle.

Description:

A medium-sized carapace, the males being ovate and more elongate than the subquadrate females in outline. Greatest height is at the posterior margin and maximum length at the mid-height. Dorsal margin straight with a slightly concave area developed in the middle, with smoothly rounded angles joining the anterior and posterior ends. The ventral margin is slightly concave in the postero-ventral area and runs smoothly into the posterior and anterior margins. Anterior margin rounded, with a faint marginal rim, the posterior margin is obliquely rounded and higher than the anterior margin. The lateral surface is apparently smooth but has very fine pits, and a slight depression is also present in some specimens in the dorso-central part of the carapace. The right valve overlaps the left along all margins. In dorsal view the carapace is biconvex with the greatest width developed centrally.

Sexual dimorphism is marked, the presumed males being narrower, more ovate and shorter than the presumed females. Internal features are not known.

Dimensions of figured specimens (μm)

		L	H	W
Holotype, ♂ carapace HU.201.T.27	(Pl. 3, fig. 7)	586	331	180
Paratype, ♀ carapace HU.201.T.28	(Pl. 3. fig. 8)	592	355	215
Paratype, ♂ carapace HU.201.T.29	(Pl. 3, fig. 9)	567	316	185

Differences and affinities:

Cytherella samdunae shows some similarities to ***C.*** aff. ***C. paucipunctata*** Pietrzeniuk as figured by Helmdach & El Khoudary (1980) from the Late Eocene of

the Al Jabal Al Akhdar, NW Libya. They mentioned that their species was probably new, but, its definition was not possible because of the badly preserved material. However, ***C. samdunae*** differs in its concave dorsal and ventral margins and also in a small depression which is present below the dorsal margin. In addition, it is less elongate and the anterior end is higher.

The dorsal and the ventral margins make this species very distinctive, It differs from all ***Cytherella*** species described in this study in its general outline. There is little in the literature with which this taxon can be compared.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41 and Well K1-NC41.

Cytherella sp. *A*

(Pl. 3 , figs. 10-12)

Figured specimen:

A carapace HU.201.T.30

Locality:

Well C1-NC41, Tarabulus Basin, NW offshore, Libya.

Horizon:

Samdun Formation, Upper Eocene, depth 7010 ft.

Stratigraphic range:

Upper Eocene.

Material:

One specimen was found in Well C1-NC41 section of the Samdun Formation at a drilling depth of 7010 ft.

Description:

In lateral view, the carapace is quadrate, with its greatest height occurring in the posterior half. the anterior margin is rounded and narrower than the posterior which is symmetrically rounded. The dorsal margin is straight whilst the ventral is

concave in the middle, running smoothly into the anterior and posterior ends. The lateral surface is coarsely pitted except in the dorsal and ventral margins and central regions where it is smooth. Unfortunately only one carapace was obtained so that the internal structures could not be seen.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.201.T.30	(Pl. 3, figs. 10-12)	600	338	285

Remarks:

This single specimen comes from Well C1-NC41, depth 7010 ft. and shows some similarities to ***Cytherella libyaensis*** El-Waer (1988) in general outline, but the latter differs in having a small, shallow depression in the muscle scar attachment area and has a narrower anterior end. It is similar to ***C. jonesiana*** Bosquet as figured by Keij (1957) from the Oligocene of Belgium, but Bosquet's species differs in its broad, rounded anterior marginal rim and is also characterised by a ridge which is parallel to the posterior margin.

Occurrence:

Known so far from the Upper Eocene of Well C1-NC41.

Genus ***Cytherelloidea*** Alexander, 1929

Type species: ***Cythere williamsoniana*** Jones, 1849

Cytherelloidea libyaensis sp. nov

(Pl. 4, figs. 1-3)

Figured specimens:

Pl. 4, fig. 1, carapace, holotype HU.202.T.1. From depth 10180 ft., Pl. 4, figs. 2, 3 carapace, paratype HU.202.T.2. From depth 10300 ft. All specimens from the Well N1-NC41.

Holotype:

A carapace HU.202.T.1

Paratype:

A carapace HU.202.T.2

Type locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10180 ft.

Stratigraphic range:

Maastrichtian.

Material:

3 specimens were found in Well N1-NC41 section, all of them from the Al Jurf Formation, 2 specimens at a drilling depth of 10180 ft. and one specimen at a depth of 10300 ft..

Diagnosis:

This *Cytherelloidea* species is characterised by a marked concavity in the middle of the dorsal margin, its straight dorsal rib which occupies the middle half of the valve and its gently concave median and ventral ribs which slope slightly obliquely from posterodorsally to anterodorsally.

Description:

A quadrangular carapace in lateral view, with greatest height developed at the posterior end, maximum length occurring at the mid-height. The dorsal margin is concave mid-dorsally. Anterior end is rounded with a faint marginal rim which continues dorsally and ventrally. The posterior margin is almost truncated, narrower and less high than the anterior margin.

The lateral surface consists of several ridges. The ventral ridge starts from a posterior marginal rib, is slightly concave and runs slightly obliquely terminating prior to the anterior marginal rib. The medium ridge begins at mid-height of the posterior margin, is gently concave slopes gently and disappears where the lower ridge does. The dorsal ridge is straight commences at about one-fifth of the length from the anterior margin and slopes gently upward posteriorly. The rest of the surface

is pitted. The right valve is larger than the left overlapping it along the ventral margin and slightly along the anterior end.

In dorsal view the carapace is wedge-shaped with the greatest width and thickness developed at the posterior end. Internal features were not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, carapace HU.202.T.1	(Pl. 4, fig. 1)	565	317	210
Paratype, carapace HU.202.T.2	(Pl. 4, figs. 2, 3)	567	303	232

Differences and affinities:

Cytherelloidea libyaensis has a certain similarity to ***Cytherella (Cytherelloidea) araromiensis*** Reyment (1963) from the Upper Maastrichtian of Nigeria in general outline, but differs in ornamentation. ***Cytherelloidea melleguensis*** Damotte & Said (1982) in Donze ***et al.***, (1982) appears to be closely related in outline, but the present species differs in being smaller in size and also has more prominent longitudinal ridges.

Occurrence:

This species is known so far only from the Maastrichtian of Well N1-NC41.

Suborder Podocopa Sars, 1866

Superfamily Bairdiacea Sars, 1888

Family Bairdiidae Sars, 1888

Genus ***BAIRDIA*** McCoy, 1844

Type species: ***Bairdia curta*** McCoy, 1844

Remarks:

Unfortunately most of the material found in this study consisted of closed carapaces and it was not possible to see the internal details of the carapace. As the internal features aid assignment to the right genus, the placing of these species in ***Bairdia*** is tentative.

Bairdia ilaroensis Reyment & Reyment, 1959

(Pl. 4, figs. 4-9)

1959 ***Bairdia ilaroensis*** Reyment & Reyment, p. 61, pl. 1, figs. 1, 3, 5.

1981 ***Bairdia ilaroensis*** Reyment & Reyment; Reyment, p. 56, pl. 9, figs. 6, 7.

1983 ***Bairdoppilata ilaroensis*** Reyment & Reyment; Foster ***et al.***, p. 109, pl. 1, figs. 5, 7-11.

Figured specimens:

Pl. 4, figs. 4, 5, carapace HU.202.T.3, Pl. 4 , figs.6, 8, carapace HU.202.T.4, Pl. 4, fig. 7, carapace HU.202.T.5, Pl. 4, fig. 9, carapace HU.202.T.6. All specimens from the same locality and horizon.

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian and Palaeocene.

Material:

32 specimens. In Well N1-NC41, 28 specimens were found (including 3 broken carapaces and one broken left valve) in the Al Jurf Formation at drilling depths of 10090-10200 ft. In Well D2-NC41, four specimens were recorded in the Al Jurf Formation at 9480-9520 ft.

Description:

The carapace is subtriangular in lateral view, its greatest height is developed medially to antero-medially, maximum length situated at about two-fifths of the shell height above the ventral margin. The anterior margin is narrowly rounded extended below. The posterior end is bluntly pointed, and strongly extended below. The dorsal margin is strongly convex, nearly flat along the hinge, slightly truncated posteriorly to the mid-length. Ventral margin is nearly straight, curving upwards into the anterior and posterior ends in the left valve, strongly concave in the right valve. The lateral surface is smooth to finely pitted. The left valve is larger than the right, strongly overlaps it along the entire margin and shows the most pronounced overlap ventrally.

In dorsal view the carapace is ovate with convex sides, its greatest width and thickness at the middle. In ventral view, the left valve overlaps the right along the ventral margin.

Dimensions of figured specimens (μm)*:*

		L	H	W
Carapace HU.202.T.3	(Pl. 4, figs. 4, 5)	866	495	480
Carapace HU.202.T.4	(Pl. 4, figs. 6, 8)	742	485	400
Carapace HU.202.T.5	(Pl. 4, fig. 7)	724	457	390
Carapace HU.202.T.6	(Pl. 4, fig. 9)	747	470	434

Remarks:

Bairdia ilaroensis Reyment & Reyment (1959) was originally described from Nigeria. Reyment (1981) found this species in the Palaeocene of the Kalambaine Formation, Nigeria. However, Reyment's species was later transferred to ***Bairdoppilata ilaroensis*** by Foster *et al.*, (1983). In overall shape, size and external appearance, the Libyan specimens agree well with their original description, therefore this species is considered to belong to ***Bairdia.***

Occurrence:

This species is known from the Maastrichtian of Well N1-NC41, from the Late Palaeocene of Well D2-NC41, and from the Palaeocene of Nigeria and the Sirte Basin, Libya.

Bairdia abundans sp. nov.

(Pl. 5, figs. 1-6)

1979 *Bairdia* sp. Cronin & Khalifa, p. 401, pl. 1, figs 4, 5.

1981 *Bairdia* sp. *1* Mechmeche, p. 49, pl. 2, fig. 14.

Figured specimens:

Pl. 5, fig. 1, carapace, holotype HU.202.T.8, Pl. 5, fig. 2, carapace, paratype HU.202.T.9. From depth. 7790 ft., Pl. 5, fig. 3, carapace, paratype HU.202.T.10, Pl. 5, figs. 4, 6, carapace, paratype HU.202.T.11, Pl. 5, fig. 5, carapace, paratype HU.202.T.12. From depth 7770 ft. All specimens are from Well B1-NC41.

Derivation of name:

From its abundance in these beds.

Holotype:

A carapace HU.202.T.8

Paratypes:

Four carapaces HU.202.T.9-12

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7770 ft.

Stratigraphic range:

Lower, Middle and Upper Eocene.

Material:

237 specimens: In Well B1-NC41 section, 119 specimens were found in the Ghalil Formation, at drilling depths of 7570-7910 ft. In Well D2-NC41 section, 112 specimens were reported from the Ghalil Formation, at a depth of 7800-8240 ft. In Well L1-NC41, six specimens were found in the Harsha Formation at drilling depths of 9560-9620 ft.

Diagnosis:

A species of ***Bairdia*** with a convex dorsal margin in the left valve and straight in the right valve. In dorsal view, the carapace is biconvex with its greatest width in front of the middle.

Description:

Left valve, subovoid in lateral view, dorsal margin arched, strongly convex, ventral margin slightly concave, running smoothly into the anterior and posterior ends. Posterior margin is acutely rounded, slightly upturned, concave in the upper part; anterior margin, obliquely rounded. Greatest height at the middle. Right valve in lateral view typically is bairdioid with the dorsal margin nearly straight, horizontal, with a straight antero-dorsal margin. The ventral margin is concave in the middle. The anterior margin is obliquely rounded. Lateral surface smooth. The left valve is larger than the right and overlaps it along the dorsal, ventral and anterior margins; but not conspicuously along the posterior margin.

In dorsal view the carapace is biconvex with its maximum width in front of the mid-length. Only complete carapaces were found, so it was impossible to see the internal features.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, carapace HU.202.T.8	(Pl. 5, fig. 1)	888	588	480
Paratype, carapace HU.202.T.9	(Pl. 5, fig. 2)	819	565	438
Paratype, carapace HU.202.T.10	(Pl. 5, fig. 3)	736	515	415
Paratype, carapace HU.202.T.11	(Pl. 5, figs. 4, 6)	730	490	390
Paratype, carapace HU.202.T.12	(Pl. 5, fig. 5)	709	485	409

Differences and affinities:

Bairdia abundans is similar to forms illustrated by Cronin & Khalifa (1979) from the Late Eocene of the Mereir Formation, Egypt. Also Mechmeche (1981) figured a form from the Lower and Middle Eocene of Tunisia under the name of ***Bairdia*** sp. ***1*** which is identical with the present species. Helmdach & El Khoudary (1980) recorded a ***Bairdia*** sp. from the Late Eocene of the Al Jabal Al Akhdar, NE Libya which shows some similarities, but differs in its larger size, more convex dorsal margin and in having a finely pitted surface. ***B. abundans*** differs from ***Bairdia gliberti*** Keij (1957) and the latter is transferred to ***Bairdia (Bairdoppilata) gliberti*** Keij (1957) by Ducasse ***et. al,*** (1985), as it has a less arched dorsal margin in the left valve and has a more rounded posterior end.

The present species resembles ***Bairdia*** sp. as figured by Ducasse ***et. al.,*** (1985) from the Paris Basin in outline. However, it differs in having a pointed posterior end rather than a rounded one. It also possesses a more arched dorsal margin in the left valve.

Occurrence:

This species is known from the Middle and Upper Eocene of Well D2-NC41, from the Middle Eocene of Well L1-NC41 and Well B1-NC41. ***Bairdia abundans*** has been also found in the Late Eocene of the Mereir Formation, Egypt and was recorded from the Lower and Middle Eocene of Tunisia.

Bairdia buisae sp. nov.

(Pl. 5, figs. 7-12)

Figured specimens:

Pl. 5, figs. 7, 11, carapace, paratype HU.202.T.13, Pl. 5, figs. 8, 9, carapace, paratype HU.202.T.14, Pl. 5, fig. 10, carapace, paratype HU.202.T.15, Pl. 5, fig. 12,

RV holotype HU.202.T.16. All the specimens are from the same type locality and horizon.

Derivation of name:

From its occurrence in the Bu Isa Formation

Holotype:

A carapace HU.202.T.16

Paratypes:

Three carapaces HU.202.T.13-15

Type locality:

Well J1-NC41, NW offshore, Libya.

Type horizon:

Bu Isa Formation, Maastrichtian, depth 5190 ft.

Stratigraphic range:

Maastrichtian, Palaeocene and Eocene.

Material:

9 specimens have been found in Well J1-NC41. The first specimen at drilling depth of 4730 ft., one specimen from depth of 4750 ft., one specimen at a depth of 5160 ft., and six specimens (including one right valve) were found at depth of 5190 ft.

Diagnosis:

A species of ***Bairdia*** with characterised by a strongly pointed posterior end, straight dorsal margin which slopes gently to the postero-dorsal area, and an almost straight antero-dorsal margin.

Description:

A medium-sized, thin-shelled carapace, shape typical of the genus; its greatest length in lateral view occurs below the mid-height. Greatest height lies in the anterior half at the right valve and at the mid-length in the left valve. The ventral margin is nearly straight in the left valve, slightly concave in the middle of the right valve.

The anterior margin is obliquely rounded, with an antero-dorsal slope but almost straight and the antero-ventral also slopes and is convex; the posterior margin is acuminate with a pointed end, postero-dorsal slope, straight. The cardinal angle is rounded in the left valve and well pronounced in the right valve. Lateral surface smooth, with fine pits scattered over the surface. In dorsal view, the carapace is biconvex with its maximum width and thickness at the anterior half.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, carapace HU.202.T.13	(Pl. 5, figs. 7, 11)	652	415	304
Paratype, carapace HU.202.T.14	(Pl. 5, figs. 8, 9)	640	400	311
Paratype, carapace HU.202.T.15	(Pl. 5, fig. 10)	550	335	280
Holotype, Right valve HU.202.T.16	(Pl. 5, fig. 12)	933	533	270

Differences and affinities:

Bairdia buisae resembles ***B. poddari*** (Lyubimova & Mohan) 1960 from the Middle Eocene beds of Kutch and is also recorded by Khosla (1972) from the Lower Eocene of Khuialu Formation, India. However, the present species differs in having more a pointed posterior end and its right valve has less overlap in the dorsal, postero-dorsal and antero-dorsal margins. ***B. buisae*** shows some similarities in general outline to ***B. caraibeensis*** Van den Bold (1946) which was originally described from the Lower Eocene of Bonaire and from the Lower Eocene of Guatemala and from the Eocene of Trinidad, but Bold's species differs in its straight, horizontal dorsal margin and the right valve strongly overlaps the left along all margins. The present species is very similar to ***B. producta*** Ducasse (1967) from the Lower Eocene of the Aquitaine Basin but the latter differs in the antero-dorsal area which is slightly concave in the right valve whilst in the ***B. buisae*** it is straight. The Libyan species also has a less pronounced overlap in the postero-dorsal area.

B. aff. ***B. tenuis*** Deltel as figured by Carbonnel (1975) differs in being more elongate and in having a strongly concave antero-dorsal margin and is also characterised by its more rounded posterior end.

Occurrence:

Known the so far from the Maastrichtian, Palaeocene and Eocene of Well J1-NC41 Section.

Bairdia tarabulusensis sp. nov.

(Pl. 6, figs. 1-12)

Figured specimens:

Pl. 6, figs. 1-3, female carapace, holotype HU.202.T.17, Pl. 6, figs. 4-6, male carapace, paratype HU.202.T.18. From depth 8080 ft., Pl. 6, fig. 7, female carapace, paratype HU.202.T.20, Pl. 6, figs. 9, 10, female carapace, paratype HU.202.T.19. From depth 8180 ft., Pl. 6, fig. 8, female carapace, paratype HU.202.T.21, Pl. 6, fig. 12, female carapace, paratype HU.202.T.22. From depth 8310 ft., Pl. 6, fig. 11, male carapace, paratype HU.202.T.23. From depth 8080 ft. All specimens are from the Well F1-NC41.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A female carapace HU.202.T.17

Paratypes:

Six specimens HU.202.T.18-23

Stratigraphic range:

Middle Eocene.

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 8080 ft.

Material:

17 specimens were found only in the Well F1-NC41 section. Five specimens from the Samdun Formation at drilling depths of 8180-8080 ft., and 12 specimens from the Harsha Formation at depths of 8220-8360 ft.

Diagnosis:

A species showing marked dimorphism. The males are less high than the females, with a strongly convex dorsal margin, concave antero-dorsal slope and slightly upturned posterior end.

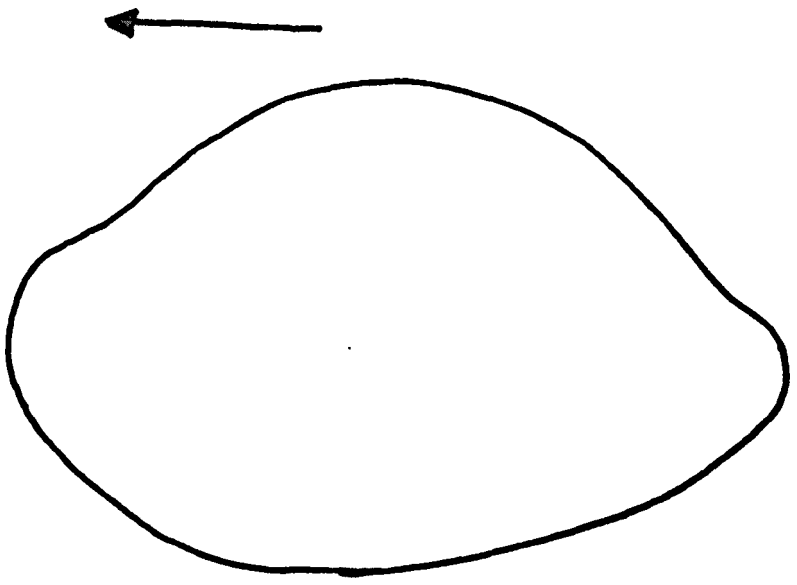

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Fig. 5.1 ***Bairdia tarabulusensis*** sp. nov. Holotype HU.202.T.17, female carapace from left, showing general outline

Description:

A large carapace with a broadly arched dorsal margin and a slightly convex ventral margin in the left valve. A median concavity is present in the right valve. The anterior margin is broadly rounded and slightly upturned in the left valve, the posterior margin is acuminate with an upturned caudal process. In the right valve the dorsal margin is straight to convex with a slight concavity in the antero-dorsal margin, the posterior margin is acuminate and the postero-dorsal slope is slightly concave. Greatest length of the carapace is generally at mid-height in the left valve and generally below mid-height in the right valve. Maximum height is at mid-length.

The lateral surface is smooth with fine pits scattered over the surface. The left valve is larger than the right and overlaps the latter along the entire margin, except at the anterior and posterior ends. Sexual dimorphism is marked, the presumed males are more elongate and less high than the presumed females. In dorsal view, the carapace is elliptical with pointed posterior and anterior ends. Greatest width and thickness occurs in the middle and the right valve is overlapped by the large left valve which is also more strongly developed in the antero-dorsal and postero-dorsal areas.

In the ventral view, the left valve overlaps the right ventro-medially. Only closed carapaces were obtained, so that it was not possible to study the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♀ carapace HU.202.T.17	(Pl. 6, figs. 1-3)	975	600	495
Paratype, ♂ carapace HU.202.T.18	(Pl. 6, figs. 4-6)	1088	511	505
Paratype, ♀ carapace HU.202.T.19	(Pl. 6, figs. 9, 10)	800	505	410
Paratype, ♀ carapace HU.202.T.20	(Pl. 6, fig. 7)	986	580	550
Paratype, ♀ carapace HU.202.T.21	(Pl. 6, fig. 8)	1000	653	550
Paratype, ♀ carapace HU.202.T.22	(Pl. 6, fig. 12)	882	588	500
Paratype, ♂ carapace HU.202.T.23	(Pl. 6, fig. 11)	941	576	500

Differences and affinities:

The present species shows some similarities to ***Bairdia succincta*** Deltel (1962) from the Eocene of France, in general outline, but differs in being larger in size and in having straight ventral margin in the left valve where as in ***B. buisae*** it is convex. ***B. crebra*** Deltel (1962) from the Eocene of the Aquitaine Basin resembles the ***B. tarabulusensis***, but the latter differs in its smaller size, the posterior end is less pointed and it also has an anterior margin that is rounded rather than truncated. ***B. gliberti*** Keij (1957) described from the Middle Eocene of Grigonon, France and other parts of Europe differs from the present species in having a more arched dorsal margin, the posterior and the anterior ends are less upturned and it is also larger. ***Bairdia*** sp. ***3*** Donze ***et al.***, (1982) from the Upper Cretaceous and Lower Tertiary of Tunisia is similar to the Libyan species but it has a strongly arched dorsal margin and it also differs in the outline of the posterior margin.

Occurrence:

This species is recorded so far from the Middle Eocene of Well F1-NC41.

Bairdia samdunae sp. nov.

(Pl. 7, figs. 1-7)

Figured specimens

Pl. 7, figs 1-3, carapace, holotype HU.202.T.24 , Pl. 7 , figs. 4-6, carapace, paratype HU.202.T.25, Pl. 7, fig. 7, carapace, paratype HU.202.T.26. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Samdun Formation.

Holotype:

A carapace HU.202.T.24

Paratypes:

Two specimens HU.202.T.25, 26

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore, Libya.

Type locality:

Samdun Formation, Middle Eocene, depth 8080 ft.

Stratigraphic range:

Middle Eocene.

Material:

Six specimens were found in Well F1-NC41 from the Samdun Formation at a drilling depth of 8080 ft.

Diagnosis:

A ***Bairdia*** species characterised by its evenly arched dorsal margin in the left valve and a strongly concave ventral margin mid-centrally in the right valve.

Description:

In lateral view, the carapace is subtriangular, with greatest height at mid-length and maximum width below the mid-height. The anterior margin is narrowly rounded, and obliquely rounded below; the posterior end is produced sub-ventrally, convex in the upper part and slightly pointed in the middle. The dorsal margin is evenly arched in the left valve sloping gently towards the anterior and posterior margins. In the right valve the dorsal margin is slightly convex or slopes backward, the anterior part is slightly concave and the posterior part slopes gently. The ventral margin is convex upwards merging with the anterior and posterior ends in the left valve, being strongly concave mid-ventrally in the right valve. The left valve over-reaches the right along the entire margin, and is more developed at the ventral margin. The lateral surface is smooth.

In dorsal view the carapace is biconvex with its maximum width in front of the middle. No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype, carapace HU.202.T.24	(Pl. 7, figs. 1-3)	1125	750	644

Paratype, carapace HU.202.T.25	(Pl. 7, figs. 4-6)	1125	750	631
Paratype, carapace HU.202.T.26	(Pl. 7, fig. 7)	1000	671	580

Differences and affinities:

Bairdia gliberti Keij (1957) shows some resemblance in outline, but Keij's species has a straight ventral margin in the left valve, is more elongate and has a more pronounced posterior end. ***B. samdunae*** shows some affinities with ***Bairdoppilata*** sp. ***P7*** Carbonnel (1986) from the Senegal and Guinea Bissau. The latter differs having a more angulate dorsal margin, is larger in size and has a concave ventral margin in both valves. Compared with the Libyan material the anterior margin is also more broadly rounded. Furthermore the left valve in Carbonnel's species strongly overlaps the right along the dorsal and the ventral margins, but not conspicuously along the anterior and the posterior ends.

B. samdunae is very similar to ***Bairdia*** cf. ***ilaroensis*** Reyment & Reyment as figured by Reyment (1981) from the Palaeocene of the Kalambaine Formation, NW Nigeria, but the Nigerian species differs in having a more strongly convex ventral margin and is more inflated ventrally.

Occurrence:

This species has been found in the Middle Eocene of Well F1-NC41.

Bairdia rara sp. nov.

(Pl. 7, fig. 8-12)

Figured specimens:

Pl. 7, figs. 8, 10-11, carapace, paratype HU.202.T.28, Pl. 7, figs. 9, 12, carapace, holotype HU.202.T.27. All specimens from the same type locality and horizon.

Derivation of name:

From its rare occurrence in study area.

Holotype:

A carapace HU.202.T.27

Paratype:

A carapace HU.202.T.28

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 8230 ft.

Stratigraphic range:

Middle Eocene.

Material:

11 specimens were found in Well F1-NC41, one specimen from the Samdun Formation at a drilling depth of 7980 ft., ten specimens from the Harsha Formation at depths of 8180-8340 ft.

Diagnosis:

A very large elongate-ovate carapace in lateral view characterised by its strongly arched dorsal margin with angled point at the greatest height. The anterior end is broadly rounded, obliquely below and slightly convex in the upper part.

Description:

A very large, elongate-ovate carapace with its greatest height at the angulated area in the dorsal margin of the right valve an approximately one-third from the anterior end. The dorsal margin is arched and angulate at about one-third length from the anterior end especially in the left valve, with convex postero-dorsal and antero-dorsal areas. In the right valve, the dorsal margin is straight and slopes slightly backward, the anterior part is slightly concave and the posterior part slopes gently. Ventral margin, straight to slightly convex, merging upward with the anterior and posterior margins in the left valve. The ventral margin is concave centrally, running smoothly into the posterior and anterior ends. The anterior margin is rounded obliquely below and slightly arched in the upper part. The posterior end is narrower and slightly convex in the upper part. The left valve is larger and has a thick dorsal

margin, over-reaching the right valve and also overlapping along the ventral margin where it is less pronounced at the anterior and the posterior ends. The lateral surface is smooth with some fine pits.

In dorsal view, the carapace is elliptical with maximum width and thickness in the anterior half. Sexual dimorphism was not observed. Internal details unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, carapace HU.202.T.27	(Pl. 7, figs. 9, 12)	1125	765	615
Paratype, carapace HU.202.T.28	(Pl. 7, figs. 8, 10-11)	1140	750	605

Differences and affinities:

Bairdia rara can be easily distinguished from ***B. abundans***, in being larger and more elongate and in having an angulate dorsal margin at its greatest height.

Occurrence:

Known so far only from the Middle Eocene of Well F1-NC41.

Bairdia sp. ***A***

(Pl. 4, figs. 10-12)

Figured specimens:

A carapace HU.202.T.7

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore, Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10180.

Stratigraphic range.

Maastrichtian.

Material:

Two specimens were found in Well N1-NC41 section of the Al Jurf Formation at a drilling depth of 10180.

Description:

In outline the carapace is subtrapezoidal, its greatest length occurs medially, and greatest height is anterior to the middle. The anterior margin is truncated, slightly angled in the upper part, obliquely rounded in the lower. The posterior end is narrower and pointed in the middle, becoming evenly rounded in the lower part. The dorsal margin is tripartite in the middle of the right valve; the central part is horizontal or slopes slightly backwards, the anterior and posterior parts are strongly concave. In the left valve, the dorsal margin is slightly angled at its greatest height, the middle part sloping gently backward and the anterior part steeply sloping forward with the posterior part curved downwards. The ventral margin is straight to slightly concave centrally, merging smoothly into the anterior and posterior ends. Left valve larger and overreaching the right valve along the entire margin. Lateral surface smooth to finely pitted.

In dorsal view, the carapace is biconvex with its maximum width developed at the middle, the posterior end is more pointed.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.202.T.7	(Pl. 4, fig. 10-12)	687	434	340

Differences and affinities:

The present species differs from ***Bairdia ilaroensis*** Reyment & Reyment (1959) in being less elongate with a strongly concave area at the antero-dorsal and ventro-dorsal margins and in having a well produced anterior end where the antero-dorsal margin meets the antero-ventral margin. This species is also characterised by its more bluntly produced posterior end.

Occurrence:

Known so far only from the Maastrichtian of Well N1-NC41.

Family Bythocyprididae Maddocks, 1969

Genus ***BYTHOCYPRIS*** Brady, 1880

Type species: ***Bythocypris reniformis*** Brady, 1880

Bythocypris urbana sp. nov.

(Pl. 9, figs. 8-9, 11-12)

Figured specimens:

Pl. 9, fig. 8, carapace, paratype HU.202.T.29, Pl. 9, fig. 9, carapace, paratype HU.202.T.30, Pl. 9, fig. 11, carapace, paratype HU.203.T.1, Pl. 9, fig. 12, carapace, holotype HU.203.T.2. All specimens from the same type locality and horizon.

Derivation of name:

L. ***urbanus***- Suave, in reference to its elegant, smooth, streamlined shell.

Holotype:

A carapace HU.203.T.2

Paratypes:

Three specimens HU.202.T.29, 30, HU.203.T.1

Type locality:

Well J1-NC41 section, NW offshore Libya.

Type horizon:

Bu Isa Formation, Maastrichtian, depth 5190 ft.

Stratigraphic range:

Maastrichtian.

Material:

Seven specimens were found only in Well J1-NC41 from the Bu Isa Formation at a drilling depth of 5190 ft.

Diagnosis:

A species of ***Bythocypris*** with a gently arched dorsal margin, and narrow posterior, its greatest height is situated in the middle.

Description:

In lateral view, the carapace is reniform with its greatest height occurring at the middle and equal to half the length, its maximum length is along the ventral margin. The anterior end is obliquely rounded, running smoothly into the ventral margin; the posterior end is narrowly rounded. Dorsal margin gently arched in the middle and slightly concave antero-dorsally, curving and sloping posteriorly, ventral margin slightly concave in the right valve and nearly straight in the left. Lateral surface smooth. Left valve the larger and overlaps the right at the anterior and ventral margins. In dorsal view, the carapace is elliptical with maximum width in the middle.

In ventral view, the carapace is ovate with convex sides and the left valve overlaps the right along the ventral margin. Internal features were not seen as no single valves were obtained. Sexual dimorphism was not observed.

Dimensions of figured specimens (μm)*:*

		L	H	W
Paratype, carapace HU.202.T.29	(Pl. 9, fig. 8)	514	235	194
Paratype, carapace HU.202.T.30	(Pl. 9, fig. 9)	681	296	250
Paratype, carapace HU.203.T.1	(Pl. 9, fig. 11)	460	205	170
Holotype, carapace HU.203.T.2	(Pl. 9, fig. 12)	642	285	235

Differences and affinities:

All specimens recovered were mostly closed carapaces in which no internal details could be seen. This species is placed in the genus ***Bythocypris*** on the basis of its general outline. Esker (1968) tentatively recorded ***Bythocypris*** sp. in which the internal features were not seen except for the muscle scar pattern. The present species shows some affinities with Esker's form, but is smaller in size, with a slightly convex dorsal margin and narrower posterior and anterior ends. ***B.? angulata*** Ducasse (1967) from the Eocene of the Aquitaine is similar but differs in being higher anteriorly and posteriorly and also in having a well angulated point in the anterior half of the dorsal margin. Also the greatest height in the present species occurs in front of the middle. From the general outline Ducasse's species seems to belong to ***Propontocypris*** rather

than *Bythocypris*. *Bythocypris urbana* is smaller than *B. vainganaensis* Hazel & Holden (1971) and relatively less elongate and more bluntly rounded at the posterior margin. In addition *B. vainganaensis* is strongly concave in the middle of the ventral margin.

The present species shows some affinities with *Bythocypris?* sp. Bertels (1975) from the Middle Maastrichtian of Argentina from which it distinguished by its outline, especially at the anterior and posterior ends where Bertels's *Bythocypris?* sp. tends to be lower.

Occurrence:

Known only from the Maastrichtian of Well J1-NC41.

Superfamily Cypridacea Baird, 1845

Family Paracyprididae Sars, 1923

Genus *PARACYPRIS* Sars, 1866

Type species: *Paracypris polita* Sars, 1866

Paracypris buisae sp. nov.

(Pl. 8, figs. 1-6)

Figured specimens:

Pl. 8, figs. 1-3, carapace, holotype HU.203.T.3, Pl. 8, figs. 4-6 carapace, paratype HU.203.T.4. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Bu Isa Formation

Holotype:

A carapace HU.203.T.3

Paratype:

A right valve HU.203.T.4

Type locality:

Well J1-NC41, NW offshore Libya.

Type horizon:

Bu Isa Formation, Maastrichtian, depth 5190 ft.

Stratigraphic range:

Maastrichtian.

Material:

Six specimens have been found in J1-NC41 from the Bu Isa Formation at a drilling depth of 5190 ft.

Diagnosis:

A species of ***Paracypris*** with medium-sized carapace and strongly pointed posterior end. In dorsal view, the carapace is elliptical with maximum width at the middle.

Description:

In lateral view, the carapace is subreniform-lanceolate, highest at one-third the length from the anterior end and with the greatest length ventrally. Anterior margin is obliquely rounded, posterior end is acutely pointed postero-ventrally. Dorsal margin is strongly convex, sloping steeply to the posterior end, slightly concave at the antero-dorsal margin. Ventral margin slightly concave. The left valve is larger than the right, extending strongly beyond the right valve, except at the posterior end where there is little or no overlap. Lateral surface is smooth.

In dorsal view the carapace is elliptical. Maximum width and thickness occurs medially.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, carapace HU.203.T.3	(Pl. 8, figs. 1-3)	707	323	246
Paratype, carapace HU.203.T.4	(Pl. 8, figs. 4-6)	525	228	114

Differences and affinities:

Paracypris buisae shows some marked affinities to ***P. tarabulusensis.*** However, the latter species differs in details of the general outline, especially in having a less pointed postero-ventral extremity and also in lacking a concavity at the antero-dorsal margin. ***Paracypris*** n. sp. ***1*** Salahi (1966) was described originally from the Palaeocene of the Sirte Basin, Libya and shows some similarities to this species in general outline; but Salahi's species differs in being larger in size, less high and in having a straight dorsal margin.

Occurrence:

This species is found so far from the Maastrichtian in Well J1-NC41.

Paracypris tarabulusensis sp. nov.

(Pl. 8, figs. 7-12)

Figured specimens:

Pl. 8, figs. 7, 8, carapace, holotype HU.203.T.5, Pl. 8, figs. 9, 12, carapace, paratype HU.203.T.7, Pl. 8, figs. 10, 11, carapace, paratype HU.203.T.6. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A carapace HU.203.T.5

Paratypes:

Two specimens HU.203.T.6, 7

Type locality:

Well B1-NC41 section, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7850 ft.

Stratigraphic range.

Middle Eocene.

Material:

17 specimens. In Well B1-NC41, six specimens were found in the Ghalil Formation at drilling depths between 7770 and 7850 ft. In Well K1-NC41, one specimen has been reported, from the Samdun Formation at a depth 8430 ft. In Well H1-NC41, three specimens were found in the Harsha Formation at a depth of 10340 ft. In Well L1-NC41, eight specimens (including 3 broken carapaces) were found in the Harsha Formation at depths of 9500 - 9560 ft. In Well F1-NC41, only one specimen was found in the Harsha Formation at a depth of 8230 ft.

Diagnosis:

A species of ***Paracypris*** with an almost subtriangular outline, highest just anterior to one-third of its length.

Description:

In lateral view, the carapace is elongate-subtriangular, greatest length occurs at about one-fifth of the carapace's height, greatest height just anteriorly to one-third of the length. The anterior margin is rounded and extended below, whilst the posterior margin is narrower, very strongly extended below. Dorsal margin is convex, sloping gently towards both the anterior and posterior margins, ventral margin is nearly straight in the left valve and is slightly concave mid-ventrally in the right valve. The left valve is slightly larger than the right, overlapping it at the ventral margin. Lateral surface is smooth.

In dorsal view, the carapace is compressed with a moderate convexity, greatest width and thickness occurs at the anterior half, with a rounded anterior end.

Dimensions of figured specimens(μm) **:**

		L	H	W
Holotype, carapace HU.203.T.5	(Pl. 8, figs. 7, 8)	502	280	172
Paratype, carapace HU.203.T.6	(Pl. 8, figs. 10, 11)	593	280	175
Paratype, carapace HU.203.T.7	(Pl. 8, figs. 9, 12)	580	283	180

Differences and affinities:

Paracypris tarabulusensis differs from ***P. sapperi*** Van den Bold (1961) in its flatter lateral surface and the highest point on the dorsal margin occurs medially whilst in the present species it is situated at one-third of the length from the anterior margin. The new species closely resembles to ***Propontocypris eocaenica*** Neale & Singh (1985) from the Middle Eocene of Assam. However it is smaller in size and less high.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41, Well H1-NC41, Well L1-NC41, Well B1-NC41 and Well K1-NC41.

Paracypris paramaghaghaensis sp. nov.

(Pl. 10, figs. 6-12)

Figured specimens:

Pl. 10, fig. 6, male carapace, paratype HU.203.T.8, Pl. 10, fig. 7, 10, female carapace, holotype HU.203.T.9, Pl. 10, fig. 8, female carapace, paratype HU.203.T.10, Pl. 10, fig. 9, male carapace, paratype HU.203.T.11, Pl. 10, fig. 11, female carapace, paratype HU.203.T.12, Pl. 10, fig. 12, female carapace, paratype HU.203.T.13. All specimens are from the same type locality and horizon except fig. 12 from depth 8250 ft.

Derivation of name:

In reference to the similar ***P. maghaghaensis***

Holotype:

A female carapace HU.203.T.9

Paratypes:

Five specimens HU.203.T.8, 10-13

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8230 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

320 specimens. In Well F1-NC41, 179 specimens were found, 39 specimens in the Samdun Formation at drilling depths of 7910-8080 ft, and 140 specimens from the Harsha Formation at depths of 8180-8590 ft. In Well C1-NC41, 12 specimens were recorded, one specimen from the Samdun Formation at 7470 ft., and 11 specimens from the Harsha Formation at depths of 7690-8020 ft. In Well K1-NC41, 79 specimens were found, 36 from the Samdun Formation at drilling depths of 8220-8450 ft. Four specimens from the Dahman Formation at a depth of 8564 ft., and 39 specimens from the Harsha Formation at 8740-9590 ft. In Well H1-NC41, 16 specimens were recorded only from the Harsha Formation at drilling depths of 10340-10730 ft. In Well B1-NC41, 16 specimens were found in the Ghalil Formation at 7510-7770 ft. In Well B1a-137, 15 specimens were found, three specimens in the Dahman Formation at a drilling depth of 6640 and 12 specimens from the Harsha Formation at 6680-6870 ft. In Well L1-NC41, three specimens were recorded in the Harsha Formation at drilling depths of 9120-9520 ft.

Diagnosis:

A species of genus *Paracypris* which is characterised by the convex dorsal margin in the left valve, the slightly arched dorsal margin in the right valve and the easily distinguishable sexual dimorphism.

Description:

Carapace triangularly elongate in lateral view, greatest height occurs at about the middle of the carapace, maximum length ventrally. Anterior margin obliquely rounded, posterior end narrowly rounded and lower than the anterior. Dorsal margin is convex with a slight concavity in the antero-dorsal margin in the right valve. Ventral margin is concave in the right valve and nearly straight in the left valve. The

left valve is larger than the right valve and overlaps it peripherally, most markedly along the anterior and ventral margins and least along the dorsal margin. Lateral surface smooth. In dorsal view, the carapace is elliptical with its maximum width at its middle.

Sexual dimorphism is marked, the presumed males are less high and more elongate than the presumed females. Only complete carapaces were found and it was not possible to observe the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♂ carapace HU.203.T.8	(Pl. 10, fig. 6)	900	430	360
Holotype, ♀ carapace HU.203.T.9	(Pl. 10, figs. 7, 10)	890	440	370
Paratype, ♀ carapace HU.203.T.10	(Pl. 10, fig. 8)	836	390	345
Paratype, ♂ carapace HU.203.T.11	(Pl. 10, fig. 9)	920	420	375
Paratype, ♀ carapace HU.203.T.12	(Pl. 10, fig. 11)	836	390	336
Paratype, ♀ carapace HU.203.T.13	(Pl. 10, fig. 12)	880	420	360

Differences and affinities:

Paracypris paramaghaghaensis differs from ***P. nigeriensis*** Reyment (1960) as originally described from the Upper Cretaceous and Palaeocene of Nigeria in its more elongate carapace, the dorsal region of which is more broadly regularly rounded, the left valve is indistinctly larger than the right and the greatest overlap occurs along the ventral and dorsal margin; whereas in the Libyan material it is more developed along the ventral and the anterior margins. The present species also resembles ***P. sokotoensis*** Reyment (1981) from the Palaeocene of the Kalambaine Formation, Nigeria, but differs in having an arched dorsal margin and a more pointed posterior end. In addition ***P. paramaghaghaensis*** is more elongate and larger in size.

This new species shows some similarities to ***P. jaguelensis*** Bertels (1975) from the Middle Maastrichtian of Argentina. However, it differs from it in the outline of the posterior and dorsal margins.

Paracypris maghaghaensis Khalifa & Cronin (1979) described from the Eocene of Egypt is related to this species in outline but is easily distinguished by its more elongate carapace, its arched dorsal margin and the posterior and anterior ends which are higher than those in the present species.

Occurrence:

This species is recorded so far from the Middle and Upper Eocene of Well K1-NC41, and from the Middle Eocene of Well H1-NC41, Well B1-NC41, Well L1-NC41, Well C1-NC41, Well F1-NC41 and Well B1a-137.

Paracypris eskeri sp. nov.

(Pl. 11, figs. 1-6)

1968 ***Paracypris*** sp. ***B*** Esker, p. 323, pl. 1, fig. 12.

Figured specimens:

Pl. 11, figs. 1, 2, carapace, holotype HU.203.T.14, Pl. 11, fig. 3, 4, carapace, paratype HU.203.T.15, Pl. 11, figs. 5, 6, carapace, paratype HU.203.T.16. All specimens from the same type locality and horizon.

Derivation of name:

After Esker who first described this species under open nomenclature

Holotype:

A carapace HU.203.T.14

Paratypes:

Two specimens HU.203.T.15, 16

Type locality;

Well F1-NC41 section, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Stratigraphic range:

Danian and Middle Eocene.

Material:

52 specimens. In Well L1-NC41, two specimen was found in the Harsha Formation at a drilling depths of 9460 and 9600 ft. In Well H1-NC41, four specimens were recorded from the Harsha Formation , two specimens at a depth of 10340 ft., and the other two at depth of 10620 ft. In Well K1-NC41, 21 specimens were found in the Harsha Formation at 8740-8930 ft. In Well F1-NC41, 22 specimens have been recorded, 12 specimens from the Samdun Formation at depths of 7970-8080 ft., and 10 from the Harsha Formation at 8180-8360 ft. In Well B1a-137, 3 specimens were found in the Samdun Formation at a drilling depth of 6160 ft.

Diagnosis:

This new species is characterised by its dorsal margin which is angulate at the greatest height.

Description:

In side view, the carapace is elongate-oblong to ovate with the greatest height developed at the angulated point and the greatest length ventrally. The dorsal margin is characterised by three distinct parts. The mid-dorsal margin is slightly concave and slopes backwards. The postero-dorsal margin curves downwards and is rounded postero-ventrally, the antero-dorsal part slopes gently to merge into the anterior end at a rounded corner. The anterior half of the carapace is higher and wider than the posterior half. The ventral margin is slightly concave at mid-length in the right valve and nearly straight in the left. The anterior end is obliquely rounded and its upper part forms a rounded corner at the antero-dorsal margin. The left valve is larger than the right with prominent overlap along the anterior and ventral margins, but not conspicuously along the dorsal and posterior margins. Lateral surface smooth.

In dorsal view, the carapace is sublanceolate, its maximum width and thickness lies medially with a narrow posterior end forming a subtriangular shape. Internal structures were not seen.

Dimensions of figured specimens (μm):

		L	H	W
Holotype, carapace HU.203.T.14	(Pl. 11, figs. 1, 2)	730	330	283
Paratype, carapace HU.203.T.15	(Pl. 11, figs. 3, 4)	766	333	255
Paratype, carapace HU.203.T.16	(Pl. 11, figs. 5, 6)	800	347	280

Differences and affinities:

The specimens recorded in this study agree in all respects with the form illustrated by Esker (1968) from the Danian of Tunisia and designated as ***Paracypris*** sp. ***B.***

P. eskeri is similar in lateral view to ***Paracypris*** sp. ***2*** Foster ***et al.***, (1983) from the Late Palaeocene of Nigeria but differs in being more elongate and higher. In addition the Nigerian species is characterised by its bluntly pointed posterior end which is strongly extended below and its broadly convex dorsal margin. The outline ***P. eskeri*** is closely comparable to ***P. communis*** Van Den Bold (1946) from the Palaeocene and Lower Eocene of Guatemala, but the latter species differs in the left valve extending beyond the right valve and is also characterised by its straight dorsal margin, sloping steeply to the posterior end. ***Novocypris eocenanus*** Ducasse (1967) from the Middle Eocene of the Aquitaine Basin differs in its angled point occurring in the middle of the dorsal margin in left valve and in having a pointed posterior end. In addition the Libyan specimens are distinguished by their dorsal margin concavity in the middle of the dorsal area and in having a rounded posterior margin.

Paracypris eskeri bears close similarity to ***Paracypris?*** sp. Sohn (1970) from the Early Tertiary of West Pakistan. Sohn's species differs in being larger in size and the anterior and the posterior ends are more rounded.

Occurrence:

Known so far from the Middle Eocene of Well B1a-137, Well H1-NC41, Well L1-NC41, Well K1-NC41 and Well F1-NC41, and from the Danian of Tunisia.

Genus ***PONTOCYPRELLA*** Lyubimova, 1955

Type species: ***Bairdia harrisiana*** Jones, 1849

Remarks:

The genus ***Pontocyprella*** was proposed by Lyubimova, 1955, but since then its family assignment has been disputed. Moore (1961) placed it in the family Paracyprididae. Bate (1972) and Swain (1984) followed Moore. Other Ostracoda workers such as Neale (1962) and Donze ***et al.***, (1982) placed the genus in the family Pontocyprididae, whilst Hartmann & Puri (1974) indicated ***Pontocyprella*** as synonymous with ***Argilloecia*** in the family Pontocyprididae.

On the other hand, different views have been arisen about the assignment of this genus to Lyubimova or Mandelstam. Oertli (1956) attributed to Mandelstam 1956, Neale (1975) to Lyubimova 1955, Bate (1972) to Lyubimova 1955, Moore (1961) to Lyubimova, 1955, Howe & Laurencich (1958) to Mandelstam, 1956 and Donze ***et al.***, (1982) to Lyubimova, 1955. From the above remarks, Moore is followed.

Pontocyprella eocaenica sp. nov.

(Pl. 11, figs. 7-12)

Figured specimens:

Pl. 11, fig. 7, female carapace, paratype HU.203.T.17 , Pl. 11, fig. 8, male carapace, paratype HU.203.T.18, Pl. 11, fig. 9, female carapace, holotype HU.203.T.19, Pl. 11, fig. 10, male carapace, paratype HU.203.T.20, Pl. 11, fig. 11, female carapace, paratype HU.203.T.21 , Pl. 11 , fig. 12, female carapace, paratype HU.203.T.22. All specimens are from the same type locality and horizon except fig. 12 from depth 8250 ft.

Derivation of name:

From its occurrence in the Eocene.

Holotype:

Female carapace HU.203.T.19

Paratypes:

5 specimens HU.203.T.17, 18, 20-22

Type locality:

Well F1-NC41 section, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8260 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

75 specimens. In Well F1-NC41, 30 specimens were recorded, 16 from the Samdun Formation at drilling depths of 7870-8050 ft, and 14 specimens from the Harsha Formation at a depth of 8230 and 8260 ft. In Well C1-NC41, seven specimens were found, two from the Samdun Formation at a depth of 7400 ft., five specimens from the Harsha Formation at 7810 ft. In Well K1-NC41, 31 specimens were recorded, 14 specimens from the Samdun Formation at 8270-8450 ft., and 17 specimens from the Harsha Formation at drilling depths of 8740-8880 ft. In Well H1-NC41, three specimens were found. One specimen from the Samdun Formation at a drilling depth of 9700 and the other two specimens from the Harsha Formation at 10520-10540 ft. In Well L1-NC41, four specimens were found in the Harsha Formation at depths of 9120 and 9440 ft.

Diagnosis:

An elongate species of *Pontocyprella* with a broadly convex dorsal margin, with a smooth surface and rounded posterior end, terminating ventrally in a rounded point.

Description:

An elongate-oblong to subovate carapace in lateral view, greatest height about at the middle, greatest length ventrally. The dorsal margin is broadly convex, higher

in the anterior half and curving down posteriorly. Ventral margin is nearly straight in the left valve, slightly concave in front of the middle of the right valve. Anterior end is evenly rounded, slightly angular at its junction with dorsal margin and merging smoothly into the ventral margin. Posterior end is lower, produced ventrally and rounded. Lateral surface smooth to finely pitted. Left valve larger, overlapping along the entire margin, except mid-dorsally. Sexual dimorphism is pronounced, the presumed males are more elongate and slimmer than the presumed females.

In dorsal view, carapace is elliptical with its maximum width at the middle with a narrower anterior end and pointed posterior end. In dorsal view, the left valve is clearly seen to overlap the right valve ventrally. Only whole carapaces were found so internal features were not visible.

Dimensions of figured specimens(μm)***:***

		L	H	W
Paratype, ♀ carapace HU.203.T.17	(Pl. 11, fig. 7)	857	380	320
Paratype, ♂ carapace HU.203.T.18	(Pl. 11, fig. 8)	920	385	340
Holotype, ♀ carapace HU.203.T.19	(Pl. 11, fig. 9)	900	410	325
Paratype, ♂ carapace HU.203.T.20	(Pl. 11, fig. 10)	900	370	340
Paratype, ♀ carapace HU.203.T.21	(Pl. 11, fig. 11)	880	400	320
Paratype, ♀ carapace HU.203.T.22	(Pl. 11, fig. 12)	800	400	335

Differences and affinities:

This species differs from ***Pontocyprella acurica*** Deltel (1962) in having a straight ventral margin and the left valve overlaps the entire margin except mid-dorsally where in Deltel's species the left valve strongly overlaps the right valve dorsally. In addition ***P. eocaenica*** differs in its distinct dorsal outline. ***P. eocaenica*** resembles ***P. recurva*** Esker (1968), but differs from it in its sharply pointed posterior end and more arched dorsal margin. ***Bythocypris? mereirensis*** Cronin & Khalifa (1979) described from the Middle Eocene of Egypt shows some similarity to the present species, but the latter differs in its narrower posterior and anterior ends.

Occurrence:

Pontocyprella eocaenica is known so far from the Middle and Upper Eocene of Well K1-NC41, and from the Middle Eocene of Well H1-NC41, Well L1-NC41, Well C1-NC41 and Well F1-NC41.

Pontocyprella rara sp. nov.

(Pl. 13, figs. 1-2)

Figured specimens:

Pl. 13, fig. 1, carapace, holotype HU.203.T.23, Pl. 13, fig. 2, carapace, paratype HU.203.T.24. All specimens from the same type locality and horizon.

Derivation of name:

From its rare occurrence.

Holotype:

A carapace HU.203.T.23

Paratype:

A carapace HU.203.T.24

Type locality:

Well N1-NC41 section, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

Six specimens were found in Well N1-NC41 at drilling depths of 10160-10200 ft. All specimens from the Al Jurf Formation.

Diagnosis:

A species of *Pontocyprella* with the following characteristics; in lateral view, its length is more than twice the height , maximum height occurs medially and the valves are laterally flattened.

Description:

Medium-sized carapace, elongate to ovate in side view, greatest height lies in the middle and is equal to half the length. Its greatest length occurs at about one-sixth of the height above the ventral margin. The dorsal margin is strongly convex in the middle, curving and sloping gently posteriorly. Ventral margin is nearly straight in the left valve and slightly concave in the middle of the right valve. The anterior margin is obliquely rounded and merges smoothly into the ventral margin and is slightly angled dorsally. The posterior margin is lower and produced ventrally and is rounded. Left valve overlaps the right along its entire margin. Lateral surface is smooth. Sexual dimorphism was not observed. In dorsal view, the carapace is lanceolate with its maximum width and thickness medially. Posterior end forms a subtrianglar shape, which is narrow and rounded at the middle.

Internal features could not be seen as the material yielded only closed carapaces.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype, carapace HU.203.T.23	(Pl. 13, fig. 1)	1000	480	380
Paratype, carapace HU.203.T.24	(Pl. 13, fig. 2)	960	480	360

Differences and affinities:

Pontocyprella recurva Esker (1968) has some similarities with the present species, but differs in other respects. It is characterised by its almost straight dorsal margin which occurs along one-third of the length from the anterior end and in having a less pointed posterior end. In addition, the Libyan specimens have a strongly convex dorsal margin and the greatest height occurs medially.

Neale (1975) figured a single valve from the Upper Cretaceous of Australia which he placed tentatively in ***Pontocyprella*** this is closely comparable in general outline with the present new species. However, Neale's species differs in its less convex dorsal margin and in having more rounded posterior and anterior ends.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Pontocyprella recurva Esker, 1968

(Pl. 57, figs. 1-3)

1968 ***Pontocyprella recurva*** n. sp. Esker, p. 323, pl. 1, figs. 6-7, pl. 4, fig. 7.

1982 ***Pontocyprella recurva*** Esker; Donze ***et al.***, p. 281, pl. 2, figs. 1, 2.

1982a ***Pontocyprella recurva*** Esker; Boukhary ***et al.***, pl. 2

Figured specimens:

Pl. 57, fig. 1, carapace HU.203.T.25, Pl. 57, fig. 2, carapace HU.203.T.26, Pl. 57, fig. 3, carapace HU.203.T.27. All specimens are from the same locality and horizon.

Locality:

Well J1-NC41, NW offshore Libya.

Horizon:

Bu Isa Formation, Maastrichtian; depth 5190 ft.

Stratigraphic range:

Maastrichtian and Palaeocene.

Material:

Four specimens were found in Well J1-NC41 from the Bu Isa Formation at a drilling depth of 5190 ft.

Description:

An elongate carapace which is ovate in lateral view. Its anterior margin is broadly rounded ventrally and has a narrow rounded dorsal margin. Greatest length occurs above ventral margin, maximum height is anterior to the middle. The posterior margin is narrowly rounded. The dorsal margin is almost straight for the anterior one-third of its length. In the middle of the dorsal and posterior region it curves sharply

downwards towards a pointed posterior end. The ventral margin is concave in the middle and convex at the posterior and anterior ends. The lateral surface is smooth to finely pitted.

Left valve larger than the right, overreaching it all around, but more prominently along the dorsal and ventral margins. In dorsal view, the carapace is ovate with maximum width posterior to the middle.

Dimensions of figured specimens (μm)**:**

		L	H	W
Carapace HU.203.T.25	(Pl. 57, fig. 1)	836	580	315
Carapace HU.203.T.26	(Pl. 57, fig. 2)	610	295	232
Carapace HU.203.T.27	(Pl. 57, fig. 3)	782	383	290

Remarks:

This species was originally described from the Danian of Tunisia by Esker (1968). ***Pontocyprella recurva*** was also recorded from the Maastrichtian and Palaeocene of Tunisia by Donze *et al.*, (1982) and was also found in the Palaeocene of Egypt by Boukhary *et al.*, (1982). It occurs rarely in offshore NW Libya. The specimens recorded here agree well with Esker's species as far as can be ascertained on surface characters.

Occurrence:

This species is known from the Maastrichtian of Well N1-NC41, from the Danian, Palaeocene and Maastrichtian of Tunisia and from the Palaeocene of Egypt.

Family Pontocyprididae G. W. Müller, 1894

Genus ***Propontocypris*** Sylvester-Bradley, 1947

Type species: ***Pontocypris trigonella*** Sars, 1866

Propontocypris tarabulusensis sp. nov.

(Pl. 9, figs. 1-7)

Figured specimens :

Pl. 9, figs.1, 4, female carapace, paratype HU.203.T.28. From Well F1-NC41 at depth 8340 ft., Pl. 9, fig. 2, male carapace, holotype HU.203.T.29, Pl. 9, figs. 3, 5, female carapace, paratype HU.203.T.30. From Well F1-NC41 at depth 8080 ft., Pl. 9, figs. 6, 7, male carapace, HU.204.T.1. From Well B1a-137 at depth 6640 ft.

Derivation of name

From its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.203.T.29

Paratypes:

Three specimens HU.203.T.28, 30, HU.204.T.1

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8080 ft.

Stratigraphic range:

Middle Eocene.

Material:

13 specimens. In Well F1-NC41, 10 specimens were found, six in the Samdun Formation at depths of 6640-8080 ft. and four specimens from the Harsha Formation at drilling depths of 8330-8340 ft. In Well B1a-137, three specimens were recorded from the Dahman Formation at a drilling depth of 6640 ft.

Diagnosis:

Medium-sized carapace with the greatest height at mid-length. Dorsal margin is angled mid-dorsally and the posterior end is narrowly rounded and lower than the anterior.

Description:

In lateral view, the carapace is elongate-oval to subtriangular, greatest height at the middle, maximum length passes below the mid-point. The dorsal margin is broadly arched in the right valve and angled at the greatest height in the left valve, in which the antero-dorsal margin slopes gently anteriorly and posteriorly. The ventral margin is straight in the left valve and concave in the middle of the right valve. The anterior margin is evenly rounded at the middle, slightly angled dorsally. The posterior margin is lower, narrower and evenly rounded ventrally.

The lateral surface is smooth with fine pits scattered along the surface. The left valve is larger than the right valve, overlapping along the entire margin in the males . It is most distinct along the ventral margin in the females. Sexual dimorphism is pronounced, the presumed males are more elongate and higher than the presumed females. In dorsal view, carapace is lenticular with maximum width medially.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♀ carapace HU.203.T.28	(Pl. 9, figs. 1, 4)	592	369	315
Holotype, ♂ carapace HU.203.T.29	(Pl. 9, fig. 2)	900	420	330
Paratype, ♀ carapace HU.203.T.30	(Pl. 9, figs. 3, 5)	577	355	300
♂ carapace HU.204.T.1	(Pl. 9, figs.6,7)	950	470	360

Differences and affinities:

Bythocypris gohrbandti Esker (1968) is similar to the present species but the latter species differs in its strongly angled mid-dorsal margin. Esker's species also has higher posterior and anterior ends. The Indian species, ***Propontocypris eocaenica*** Neale & Singh (1985) shows some similarities to the present species, but differs in being smaller and characterised by its triangular outline. Also its greatest height occurs in the anterior third of the length, whilst in the Libyan specimens this occurs medially. ***P. tarabulusensis*** resembles ***Bythocypris? mereirensis*** Cronin & Khalifa (1979) in general outline. However, it differs in size and overlap, the present species

is larger in size and has a distinct overlap along the ventral margin and from the anterior to the posterior region.

Occurrence:

This species occurs in the Middle Eocene of Well F1-NC41, and from Well B1a-137.

Genus ***ARGILLOECIA*** Sars, 1866

Type species: ***Argilloecia cylindrica*** Brady, 1870

Argilloecia ghalilae sp. nov.

(Pl. 9, fig. 10, Pl. 10, figs. 1-5)

Figured specimens:

Pl. 9, fig. 10, female carapace, paratype HU.204.T.4, Pl. 10, fig. 1, female carapace, holotype HU.204.T.3, Pl. 10, fig. 2, female carapace, paratype HU.204.T.5, Pl. 10, fig. 3, male carapace, paratype HU.204.T.6, Pl. 10, fig. 4, male carapace, paratype HU.204.T.7, Pl. 10, fig. 5, female carapace, paratype HU.204.T.8. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Middle Eocene Ghalil Formation.

Holotype:

A female carapace HU.204.T.3

Paratypes:

Five specimens HU.204.T.4-8

Type locality:

Well B1-NC41 section, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7770 ft.

Stratigraphic range:

Middle Eocene.

Material:

223 specimens. In Well C1-NC41, 6 specimens were found, two specimens from the Samdun Formation at depths of 7400-7470 ft., and three from the Harsha Formation at 7810 ft. In Well K1-NC41, 40 specimens were found, 11 specimens from the Samdun Formation at depths of 8310-8430 ft, and 29 specimens from the Harsha Formation at 8660-9650 ft. In Well F1-NC41, 74 specimens were found, 19 specimens from the Samdun Formation at depths of 7970-8080 ft., and 55 specimens from the Harsha Formation at 8180-8480 ft. In Well B1a-137, 23 specimens were found, two specimens from the Dahman Formation at a depth of 6640 ft., and 21 specimens from the Harsha Formation at 6680-7300 ft. In Well B1-NC41, 53 specimens were found in the Ghalil Formation at drilling depths of 7510-7830 ft. In Well L1-NC41, 20 specimens were recorded in the Harsha Formation at depths of 9020-9620 ft. In Well D2-NC41, two specimens were found in the Ghalil Formation at a depths of 7880 ft. In Well H1-NC41, five specimens were found, two from the Samdun Formation at a drilling depth of 9660 ft., and the other three specimens from the Harsha Formation at depths of 10520-10610 ft.

Diagnosis

The new species is characterised by its smooth, elongate carapace, slightly convex dorsal margin, in being highest medially and by its very distinct sexual dimorphism.

Description:

The carapace is elongate to elongate-oblong with its greatest height at the middle; especially in the females. Maximum length occurs below the mid-point. The dorsal margin is slightly convex in the middle and slopes gently antero-dorsally. The ventral margin is straight in the left valve and is slightly concave mid-ventrally in the right valve, it curves upwards in its anterior half, merging smoothly with the posterior

margin. The anterior margin is obliquely rounded, whilst the posterior end is truncated, lower and situated close to the ventral margin.

The lateral surface is smooth. Left valve larger and overlaps the right along the ventral margin. Sexual dimorphism is very distinct, the presumed males are more elongate and less high than the presumed females. In dorsal view, the carapace has convex sides with maximum width and thickness in the middle. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♀ carapace HU.204.T.3	(Pl. 10, fig. 1)	980	421	365
Paratype, ♀ carapace HU.204.T.4	(Pl. 9, fig. 10)	990	410	370
Paratype, ♀ carapace HU.204.T.5	(Pl. 10, fig. 2)	950	365	340
Paratype, ♂ carapace HU.204.T.6	(Pl. 10, fig. 3)	1020	410	360
Paratype, ♂ carapace HU.204.T.7	(Pl. 10, fig. 4)	1010	400	365
Paratype, ♀ carapace HU.204.T.8	(Pl. 10, fig. 5)	920	370	340

Differences and affinities:

Unfortunately no single valves were obtained for this species so that it is impossible to see the internal features. However, the present species is placed in ***Argilloecia*** Sars (1866) rather than ***Aglaiocypris*** Sylvester-Bradley (1947) on the basis of the external shape and external characteristics. ***Argilloecia ghalilae*** shows some similarities to ***Argilloecia*** cf. ***fortia*** Bonnema (1941) as figured by Donze ***et al.***, (1982) in shape. However, Bonnema's species differs in having a more convex dorsal margin and pointed posterior end, whilst the Libyan species has a truncated posterior end. ***A. jeurrensis*** Keij (1957), differs from the new species in being more elongate and in having a slightly convex dorsal margin.

Occurrence:

The present species is recorded so far from the Middle Eocene of Well F1-NC41, Well B1a-137, Well H1-NC41, Well B1-NC41, Well C1-NC41, Well L1-NC41, Well K1-NC41 and Well D2-NC41.

Superfamily Cytheracea Baird, 1850

Family Cytheridae Baird, 1850

Subfamily Cytherinae Baird, 1850

Tribe Schizocytherini Mandelstam, 1960

Genus ***SCHIZOCYTHERE*** Triebel, 1950

Type species: ***Schizocythere hollandica*** Triebel, 1950

Schizocythere salahii sp. nov.

(Pl. 12, figs. 1-6)

1966 ***Schizocythere*** n. sp. ***1*** , Salahi, p. 20, pl. 3, figs. 22-24.

Figured specimens:

Pl. 12, figs. 1-3, carapace, holotype HU.204.T.9, Pl. 12, figs. 4-6, carapace, paratype HU.204.T.10. All specimens are from the same type locality and horizon.

Derivation of name:

In honour of Dr. Salahi who first illustrated this species.

Holotype:

A carapace HU.204.T.9

Paratypes:

A carapace HU.204.T.10

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Stratigraphic range:

Lower and Middle Eocene.

Material:

Six specimens were found in Well F1-NC41 from the Harsha Formation at drilling depths of 8180-8340 ft.

Diagnosis:

Schizocythere salahii is typified by deep rounded fossae and has a distinct eye tubercle, located just behind the anterior cardinal angle.

Description:

Carapace parallelogram in lateral view with greatest height at anterior cardinal angle, maximum length passes above the mid-height. The dorsal margin is almost straight, ventral margin convex. Anterior end is broadly obliquely rounded, posterior margin has a distinct caudal process situated nearly medially.

The left valve is larger than the right, overlapping it along the anterior and dorsal margins. A distinct eye tubercle is present, it is rounded and located just below the anterior cardinal angle. The lateral surface is coarsely reticulated with deep fossae. A weak rib starts from the eye tubercle and runs parallel to the anterior margin, curving at the antero-ventral corner and runs nearly parallel to the ventral margin. The caudal process is short and slightly above the middle of the posterior end.

In dorsal view, the carapace is biconvex with parallel sides and pointed posterior end. The outline is broken by deep fossae. Sexual dimorphism was not observed. Only closed carapaces were obtained therefore it was not possible to study the internal features.

Dimensions of figured specimens (μm)*:*

	L	H	W

Holotype, carapace HU.204.T.9	(Pl. 12, figs. 1-3)	389	252	223
Paratype, carapace HU.204.T.10	(Pl. 12, figs. 4-6)	380	228	208

Differences and affinities:

Salahi (1966) figured forms which are identical to ***Schizocythere salahii*** from the Lower Eocene of the Sirte Basin. It is close to ***S. deopanica*** Neale & Singh (1985) originally described from the Middle Eocene beds of Assam. The present species is closely similar in the ornamentation of the lateral surface, but the latter differs consistently in having a postero-dorsal tubercle and a narrower posterior end. ***S. prolata*** Siddiqui (1981), described from the Upper Palaeocene of Pakistan shows some similarities in general outline. However, these two species can easily be separated; Siddiqui's species is distinguished by an extension of the postero-ventral corner in each valve, and in having a well developed caudal process. ***S. prolata*** also has a more developed ventro-lateral ridge.

S. salahii differs from ***S. gujaratensis*** Guha (1968) as figured by Siddiqui (1981) from the Middle and Upper Eocene of the Zeo River section in the Sulaiman Range, Pakistan in lacking a postero-ventral tubercle, having a weak ventro-lateral ridge and the posterior margin is wider than Guha's species.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41 and from the Lower Eocene of the Sirte Basin, Libya.

Schizocythere distincta sp. nov.

(Pl. 12, figs. 8-12)

Figured specimens:

Pl. 12, figs. 8, 11, carapace, holotype HU.204.T.12. From depth 9450 ft., Pl. 12, fig. 9, carapace, paratype HU.204.T.13, Pl. 12, fig. 10, carapace, paratype HU.204.T.14, Pl. 12, fig. 12, carapace, paratype HU.204.T.15. From depth 9426 ft. All specimens are from Well K1-NC41.

Derivation of name:

L. *distinctus*.- separate, clear, distinct.

Holotype:

A carapace HU.204.T.12

Paratypes:

3 specimens HU.204.T.13-15

Type locality

Well K1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 9540 ft.

Stratigraphic range:

Middle Eocene.

Material:

11 specimens. In Well K1-NC41, 10 specimens were found in the Harsha Formation at drilling depths of 9000-9610 ft. In Well H1-NC41, only one specimen was found in the Harsha Formation at a depth of 10300 ft.

Diagnosis:

A species of ***Schizocythere*** characterised by its almost subrectangular carapace, whose ventral margin becomes convex mid-ventrally, and its distinct postero-dorsal tubercle.

Description:

Subrectangular carapace in lateral view, greatest length is at the posterior end, greatest height is located at the anterior cardinal angle. The anterior margin is obliquely rounded whilst the posterior is truncate at the middle with a small caudal process above the middle. It is also slightly concave in its upper part and also at the postero-ventral corner. The dorsal margin is straight and slightly convex in some specimens, sloping gently into the posterior end. Ventral margin is convex in front of the middle, merging smoothly into the posterior and anterior ends. Left valve larger

than the right, overlapping slightly along the anterior margin and more prominently along the ventral margin.

Lateral surface is sculptured with a thick marginal ridge that runs along the entire margin; the dorsal part of the ridge curves downwards and follows the rounded anterior end. Ventrally the ridge is almost straight and runs posteriorly to join the dorsal one. The rest of the surface is coarsely reticulate. Eye tubercle distinct.

In dorsal view, the carapace is biconvex with a pointed posterior and subrounded anterior end. Maximum width lies medially. Internal details were not seen as no single valves were obtained.

Dimensions of figured specimens(μm)***:***

		L	H	W
Holotype, carapace HU.204.T.12	(Pl. 12, figs. 8, 11)	443	264	190
Paratype, carapace HU.204.T.13	(Pl. 12, fig. 9)	390	222	170
Paratype, carapace HU.204.T.14	(Pl. 12, fig. 10)	420	245	185
Paratype, carapace HU.204.T.15	(Pl. 12, fig. 12)	380	228	180

Differences and affinities:

The present species differs from ***Schizocythere salahii*** in general outline and shape. It also resembles ***S. guijaratensis*** Guha (1968) in possessing a similar postero-ventral tubercle but Guha's species differs in that the marginal ridge is absent. There are also differences between these two species in the arrangement of the fossae and general shape.

This species easily is distinguished from ***Schizocythere*** sp. Helmdach & El Khoudary (1980) from the Late Eocene NE Libya by its general outline.

Occurrence:

This species is found so far from the Middle Eocene of Well H1-NC41, and from Well K1-NC41.

Schizocythere sp. ***A***

(Pl. 12, fig. 7)

Figured specimen

A carapace HU.204.T.11

Locality:

Well N1-NC41 , Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

Only one carapace was found in Well N1-NC41 from the Al Jurf Formation at a drilling depth of 10160 ft.

Description

Subquadrangular carapace in lateral view, its maximum height occurs at mid-length , the greatest length occurs at the mid-height. Dorsal margin is straight to slightly convex, ventral margin strongly convex mid-ventrally. Anterior margin end is broadly rounded but somewhat drawn out ventrally. The posterior end is narrower and has a slight upwards wing to the short caudal process. In the right valve, the dorsal part is concave.

The left valve is larger than the right and overreaches all margins, most conspicuously along the ventral margin. Lateral surface is characterised by being coarsely reticulate and ridged. In the ventral half there about three ridges; the two lower ridges run parallel to the ventral margin from the anterior marginal rim to the postero-ventral area. The dorsal ridge starts from around the eye tubercle and runs along the dorsal margin.

In dorsal view, the carapace is ovate with maximum width and thickness developed in the middle.

Dimensions of figured specimen (μm):

L	H	W

Carapace HU.204.T.11 (Pl. 12, fig. 7) 575 318 230

Remarks:

This species shows many affinities to ***Schizocythere tessellata*** (Bosquet) as figured by Keij (1957) in general outline. However, Bosquet's species differs in being larger, more elongate and in having more prominent ridges. In addition the Libyan specimens differ in lacking the postero-ventral extension. The present species is more closely related to ***Schizocythere*** cf. ***S. tessellata*** recorded from the Eocene of Egypt by Khalifa & Cronin (1979). It differs in having a more convex dorsal margin and is more inflated centrally. Apart from these features, the two species appear to be identical.

Occurrence:

This species is known so far from the Maastrichtian of Well N1-NC41.

Tribe Pectocytherini Hanai, 1957

Genus ***MUNSEYELLA*** Van Den Bold, 1957

Type species: ***Toulminia hyalokystis*** Munsey, 1953

Munseyella sp. *A*

(Pl. 38, figs. 4-5)

Figured specimen:

A carapace HU.204.T.16

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10270 ft.

Stratigraphic range:

Maastrichtian.

Material:

Only one carapace was found in Well N1-NC41 from the Al Jurf Formation at a depth of 10270 ft.

Description:

In lateral view, carapace subrectangular and robust, tapering posteriorly with straight dorsal margin in the right valve and slightly convex in the left valve, ventral margin is slightly concave in the middle and curving upwards towards the posterior end. The anterior end is well rounded with some infracurvature whilst the posterior end in somewhat narrowly rounded.

Greatest height occurs at the anterior cardinal angle and the greatest length is developed at the mid-height. The left valve is larger than the right overlapping it strongly along the ventral margin and postero-dorsal corner. Eye tubercle rounded and glassy and situated below the antero-dorsal margin. A well defined marginal rim runs along the anterior and ventral margins. Postero-dorsal tubercle is well developed and distinct in both valves. A thin eye rib runs vertically from the eye tubercle to end at the distinct subcentral tubercle. A thick ridge runs from the subcentral tubercle to the postero-dorsal tubercle. The rest of the surface is smooth with a few reticules at the anterior and posterior margins. Internal features were not seen.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.204.T.16	(Pl. 38, figs. 4, 5)	440	235	180

Differences and affinities:

Munseyella sp. ***A*** shows some similarities to ***M. tuberculata*** Neale (1975) from the Upper Cretaceous of Gingin, Western Australia in general outline and in shape and in having a postero-dorsal tubercle. However, the latter differs in the ornamentation of the lateral surface. Because only one specimen was found, it is left under open nomenclature.

Occurrence:

Known so far from the Maastrichtian of Well N1-NC41.

Family Cytherideidae Sars, 1925

Subfamily Cytherideinae Sars, 1925

Genus *Hemicyprideis* Malz & Triebel, 1970

Type species: *Hemicyprideis aucta* Malz & Triebel, 1970

Hemicyprideis sp. *A*

(Pl. 13, figs. 3-5)

Figured specimen:

Carapace HU.204.T.17

Locality:

Well H1-NC41, Tarabulus Basin, NW offshore, Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 10810 ft.

Stratigraphic range:

Middle Eocene

Material:

Only one carapace was found in Well H1-NC41 section from the Samdun Formation, at 10180 ft.

Description:

In side view, the carapace is subtrapezoidal with its greatest length occurring ventrally, maximum height occurs at the anterior cardinal angle. Dorsal margin is straight, sloping downwards posteriorly. There are distinct posterior and anterior angles, the former is well developed. Ventral margin is straight to slightly concave mid-ventrally, smoothly curved posteriorly and anteriorly. Anterior margin is obliquely rounded in the lower part, sloping downwards in the upper part. It is

decorated with fine denticulation. The posterior end is obliquely truncate with a rounded postero-ventral corner.

The lateral surface is punctate becoming finer along the dorsal margin. The punctae are arranged in concentric rows separated by longitudinal ridges along the anterior and ventral margins. The first of these starts from the anterior margin then runs parallel to the ventral margin, curving smoothly at the postero-ventral corner to stop nearly above the mid-height. The second one follows a similar route to the first. The left valve is the larger, overreaching the right all around but more distinctly along the ventral, posterior and the antero-dorsal margins. In dorsal view, the carapace is biconvex with a maximum width and thickness just at the anterior half.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.204.T.17	(Pl. 13, figs. 3-5)	820	440	310

Remarks:

Unfortunately only one carapace was found and also the occurrence of this specimen is probably due to contamination from overlying beds because ***Hemicyprideis*** is a common Neogene genus.

Family Krithidae Mandelstam, 1960

Subfamily Krithinae Mandelstam, 1960

Genus ***Krithe*** Brady, Crosskey and Robertson, 1874

Synonyms. ***Ilyobates*** Sars, 1866

Type species: ***Ilyobates praetexta*** Sars, 1866

Remarks:

Unfortunately all the material found in this study consisted of closed carapaces so it was not possible to ascertain the nature of the hinge and thus whether it should be placed in ***Krithe*** or ***Dentokrithe*** Khosla & Haskins (1980). However, a different view has arisen about the type species of ***Krithe***. Brady ***et al.*** (1874) regarded the type species of ***Ilyobates praetexta*** Sars (1866) as a junior synonym of ***Cythere (Cytherideis) bartonensis*** Jones (1857) which has been designated as the type species of ***Krithe***. Morkhoven (1963) thought that ***C. (C.) bartonensis*** and the type ***I. praetexta*** were not identical and that the type species of ***Krithe*** was ***I. praetexta.*** In (1970) Haskins studied the Tertiary ostracod fauna from the Isle of Wight, Barton and Hampshire, England and recorded the occurrence of a single tooth in ***Krithe*** "***Cythere (Cytherideis) bartonensis***" from its type locality and he also disagreed that the form designated as ***K. bartonensis*** by Brady, Crosskey and Robertson (1874) was conspecific with the type species. Khosla & Haskins (1980) erected a new genus of ***Dentokrithe*** on the basis of the hinge structure and dorsal outline to include the toothed forms.

The same authors also proposed ***C. (C.) bartonensis*** as the type species of ***Dentokrithe*** and regarded ***I. praetexta*** as the type species of ***Krithe*** as was also suggested by Morkhoven (1963) and others. This view is accepted here.

Dentokrithe is close and clearly related to ***Krithe*** in shape, marginal zone and central muscle scar pattern. All material discovered in this study is referred to ***Krithe*** until better and more well preserved material is obtained.

Krithe pseudorocana sp. nov.

(Pl. 13, figs. 6-8, 11)

Figured specimens:

Pl. 13, figs 6, 7, male carapace, holotype HU.204.T.18, Pl. 13, figs. 8, 11, female carapace, paratype HU.204.T.19. All the specimens from the type locality and horizon.

Derivation of name:

In reference to its similarity to Bertels Tertiary species from Argentina.

Holotype:

A male carapace HU.204.T.18

Paratype:

A female carapace HU.204.T.19

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Lower Eocene, depth 8160 ft.

Stratigraphic range:

Middle Eocene.

Material:

10 specimens. In Well D2-NC41, seven specimens were found in the Ghalil Formation at depths of 7960-8160 ft. In Well B1-NC41, three specimens were found in the Ghalil Formation at 7570 ft.

Diagnosis:

A species of *Krithe* characterised by its straight dorsal margin which is slightly concave in the anterior half, surface smooth to finely pitted.

Description:

In lateral view, the carapace elongate to subovate, greatest height occurs in the posterior half, with greatest length below the mid-height. Dorsal margin is slightly concave anteriorly and becomes higher and more broadly convex upwards to join the rounded postero-ventral corner. Ventral margin is straight to slightly concave mid-ventrally. the anterior end is evenly rounded whilst the posterior margin is truncated ventrally.

The lateral surface is smooth to finely pitted. The left valve is larger than the right, overlapping along all margins, except the antero-ventral corner. Sexual dimorphism is pronounced, the presumed males are more elongate than the presumed

females. In dorsal view, the carapace is biconvex with its maximum width and thickness occurring posteriorly, becoming narrower anteriorly with a slightly pointed anterior end and more broadly ovate posterior end. Internal features were not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.204.T.18	(Pl. 13, figs. 6, 7)	528	371	190
Paratype, ♀ carapace HU.204.T.19	(Pl. 13, figs. 8, 11)	500	341	175

Differences and affinities:

The Libyan material has affinities with ***Krithe rocana*** Bertels (1973) from the Tertiary of Argentina. Bertels's species differs in having a more truncated posterior end, also the anterior outline is less rounded. ***K. pseudorocana*** is also fairly similar to ***Dentokrithe bartonensis*** (Jones) as figured by Khosla & Haskins (1980) but the latter differs in its more elongate carapace and in having a convex dorsal margin and more truncate posterior end.

Occurrence:

This species is recorded so far from the Middle Eocene of Well D2-NC41 and Well B1-NC41.

Krithe ghalilae sp. nov..

(Pl. 13, figs. 9-10, 12)

Figured specimens:

Pl. 13, fig. 9, 12, male carapace, holotype HU.204.T.20, Pl. 13, Pl. 13, fig. 10, female carapace, paratype HU.204.T.21. All the specimens from the type locality and type horizon.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A male carapace HU.204.T.20

Paratype:

A female carapace HU.204.T.21

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 8060 ft.

Stratigraphic range:

Middle Eocene.

Material:

Nine specimens were found in Well D2-NC41 from the Ghalil Formation at drilling depths of 8000-8080 ft.

Diagnosis:

Sexual dimorphism is strongly pronounced, the carapace has parallel dorsal and ventral margins and the ventral part of the posterior margin is nearly vertical.

Description:

A medium-sized carapace, sub-ovate in lateral view with maximum height occurring medially. Dorsal margin is straight in the males and slightly convex in the females. Ventral margin is slightly concave in the middle and gradually merges with the anterior and posterior margins.. The anterior end is obliquely rounded, posterior end is strongly truncate. Lateral surface is smooth. The left valve is larger than the right, overlapping conspicuously along its entire margin, except at the dorsal margin and posterior end.

In dorsal view, the carapace is slightly pointed anteriorly and broadly rounded posteriorly. Maximum width occurs behind the middle. The sexes are easily distinguished, the males being more elongate, narrower and less high than the presumed females. Only a few closed carapaces were found, so the internal details could not be seen.

Dimensions of figured specimens (μm):

		L	H	W
Holotype, ♂ carapace HU.204.T.20	(Pl. 13, figs. 9, 12)	528	242	195
Paratype, ♀, carapace HU.204.T.21	(Pl. 13, fig. 10)	425	250	210

Differences and affinities:

The present species is easily distinguished by its distinctive shape. ***Krithe hiwanneensis*** Howe & Law (1936) as figured by Poag (1974) shows some similarities to ***Krithe ghalilae*** in general outline, especially in the females. It differs in its strongly truncated posterior end. In addition the dorsal margin is more convex in the posterior half.

This species shows some affinities to ***Krithe rocana*** Bertels (1973) but differs in being smaller and in having a higher posterior margin.

Occurrence:

This species is known so far from the Middle Eocene of Well D2-NC41.

Krithe fortidimorphica sp. nov.

(Pl. 14, figs. 3-8)

Figured specimens:

Pl. 14, fig. 3, male carapace, holotype HU.204.T.23, Pl. 14, fig. 4, male carapace, paratype HU.204.T.24, Pl. 14, fig. 5, male carapace, paratype HU.204.T.25, Pl. 14, fig. 6, female carapace, paratype HU.204.T.26, Pl. 14, fig. 7, female carapace, paratype HU.204.T.27, Pl. 8, male carapace, paratype HU.204.T.28. All specimens from the same type locality and horizon.

Derivation of name:

L. ***fortis*** - strong + ***dimorphica*** in reference to its strong sexual dimorphism

Holotype:

A male carapace HU.204.T.23

Paratypes:

Five specimens HU.204.T.24-28

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 8060 ft.

Stratigraphic range:

Maastrichtian, Palaeocene, Middle and Upper Eocene.

Material:

43 specimens were found only in Well D2-NC41, 20 specimens from the Ghalil Formation at drilling depths of 7860-8240 ft., and 16 specimens from the Al Jurf formation at 9500-9560 ft. In Well J1-NC41, seven specimens were found in the Bu Isa Formation at a drilling depth of 5190 ft.

Diagnosis:

A species of ***Krithe*** with marked sexual dimorphism, subparallel dorsal and ventral margins in the males and a broadly convex dorsal margin in the females.

Description:

Carapace subtrapezoidal in lateral view, with maximum height in the males in the posterior half, in the females just behind the middle. Greatest length occurs below the mid-height. Anterior end is obliquely rounded, posterior end is convex dorsally, more rounded ventrally and lower than the anterior end.

The dorsal and ventral margins are nearly subparallel in the males and there is a broadly convex dorsal margin and with slight concavity in front of the middle in the females. The left valve is larger than the right in the females, overreaching along its entire margin except the posterior end. In the males the left overlaps the right only at the ventral margin.

In dorsal view, the carapace is biconvex with a more rounded anterior end. The posterior end is more inflated and rounded, its greatest width lies at the middle. Sexual dimorphism is strongly marked, the presumed males are more elongate, and less high than the presumed females.

No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.204.T.23	(Pl. 14, fig. 3)	529	223	175
Paratype, ♂ carapace HU.204.T.24	(Pl. 14, fig. 4)	562	237	200
Paratype, ♂ carapace HU.204.T.25	(Pl. 14, fig. 5)	597	215	183
Paratype, ♀ carapace HU.204.T.26	(Pl. 14, fig. 6)	517	258	159
Paratype, ♀ carapace HU.204.T.27	(Pl. 14, fig. 7)	517	270	205
Paratype, ♂ carapace HU.204.T.28	(Pl. 14, fig. 8)	574	245	200

Differences and affinities:

In general shape and in outline the present species agree quite well with species described in the genus ***Krithe***. This species shows marked affinities to ***Krithe*** sp. as figured by Cronin & Khalifa (1979) from the Middle Eocene of the Qarara Formation, Egypt. However, the latter differs in having a more acutely truncated posterior end and in being more elongate. In addition the Libyan specimens can be distinguished by its outline. ***Krithe oryza*** Neale & Singh (1985) differs in having a more vaulted dorsal margin and in the somewhat narrower anterior part of the valve as seen in lateral view. It also differs in its more convex dorsal view. ***K. fortidimorphica*** is similar to ***Dentokrithe indica*** (Tewari & Tandon, 1960) as figured by Khosla & Haskins (1980) from the Eocene beds of Kutch and Rajasthan, western India, in general outline. It differs in being larger, in having a gently arched dorsal margin and overlap in the Indian species is more prominent all around the margins than in the present species.

Occurrence:

This species is known from the Middle and Upper Eocene and the Late Palaeocene of D2-NC41, and from the Maastrichtian of Well J1-NC41.

Krithe aljurfae sp. nov.

(Pl. 14, fig. 9-12)

Figured specimens:

Pl. 14, figs. 9, 10, male carapace, paratype HU.204.T.29. From depth 10300 ft., Pl. 14, fig. 11, female carapace, paratype HU.204.T.30, Pl. 14, fig. 12, female carapace, holotype HU.205.T.1. From depth 10160 ft. All specimens from Well N1-NC41.

Derivation of name:

In reference to its occurrence in the Al Jurf Formation.

Holotype:

A female carapace HU.205.T.1

Paratypes:

Two specimens HU.204.T.29, 30

Type locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

12 specimens were found in Well N1-NC41 from the Al Jurf Formation at drilling depths of 10110-10330 ft.

Diagnosis:

A species of *Krithe* characterised by its broadly convex dorsal margin, ventral margin which is strongly concave in front of the mid-length and posterior end convex to narrowly rounded with a postero-ventral angle.

Description:

Medium-sized, elongate carapace in lateral view, its maximum height posterior to the middle, greatest length just above the ventral margin. The dorsal margin is broadly convex sloping gently to the anterior and posterior ends. The ventral margin is nearly straight in the left valve and strongly concave in front of the mid-length in the right valve, with a rounded posterior angle in both valves. Anterior end fairly rounded and strongly curved ventrally, posterior end strongly convex in the upper part with a rounded postero-ventral corner. Lateral surface is smooth with fine pits. Left valve the larger, overreaching along all margins except at the posterior end, which is poorly developed. In dorsal view the carapace is ovate, and narrower anteriorly.

Sexual dimorphism is pronounced, the presumed males being less high and more elongate than the presumed females. Internal details were not seen.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♂ carapace HU.204.T.29	(Pl. 14, figs. 9, 10)	560	280	275
Paratype, ♀ carapace HU.204.T.30	(Pl. 14, fig. 11)	533	293	270
Holotype, ♀ carapace HU.205.T.1	(Pl. 14, fig. 12)	546	293	280

Differences and affinities:

Krithe aljurfae shows some similarities to ***K. montensis*** Deroo (1966) but the present species differs in having a strongly convex dorsal margin and concave ventral margin. ***K. vanveenae*** Deroo (1966) from the Upper Maastrichtian of Holland is similar to this species but Deroo's species is characterised by its broadly arched dorsal margin and straight ventral margin. ***Krithe*** cf. ***K. oryza*** Neale & Singh (1985) resembles the male of the present species but shows differences in size and in shape with a strongly convex dorsal margin. It has narrowly rounded anterior and posterior ends and the postero-dorsal area is also straighter.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Krithe sp. *A*

(Pl. 14, fig. 1-2)

Figured specimen:

A carapace HU.204.T.22

Locality:

Well J1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Bu Isa Formation, Maastrichtian, depth 5190 ft.

Stratigraphic range:

Maastrichtian.

Material:

One carapace was found in Well J1-NC41 from the Bu Isa Formation, depth 5190 ft.

Description:

A small-sized carapace, elliptical in lateral view, greatest length situated at the anterior margin, greatest height ventrally. Anterior end is rounded, posterior end is obliquely truncate and produced at the postero-ventral corner. Dorsal margin is slightly concave to almost straight. The ventral margin is nearly straight in the left valve with a slight concavity mid-ventrally. Lateral surface smooth. Left valve larger than the right, overlapping all around, but more prominently along the anterior and ventral margins. The truncated posterior area has the indentation typical of the genus.

In dorsal view, carapace elliptical and acuminate anteriorly and truncated posteriorly. Maximum width occurs nearly at the middle.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.204.T.22	(Pl. 14, figs. 1, 2)	482	223	195

Differences and affinities:

The present species shows some similarities to ***Krithe ghalilae*** but the latter species can be distinguished by its more strongly truncated posterior end. In the present species the posterior margin of the ventral area is nearly vertical and the indentation of the posterior end is well developed.

Occurrence:

Known from the Maastrichtian of Well J1-NC41.

Family Trachyleberididae Sylvester-Bradley, 1948

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Tribe TRACHYLEBERIDINI Sylvester-Bradley, 1948

Genus ***TRACHYLEBERIS*** Brady, 1898

Type species: ***Cythere scabrocuneata*** Brady, 1880

Trachyleberis africana sp. nov.

(Pl. 15, figs. 1-9)

Figured specimens:

Pl. 15, fig. 1, male carapace, holotype HU.205.T.2, Pl. 15, fig. 2, female carapace, paratype HU.205.T.3, Pl. 15, fig. 3, male carapace, paratype HU.205.T.4, Pl. 15, fig. 4, female carapace, paratype female HU.205.T.5, Pl. 15, fig. 5, male carapace, paratype HU.205.T.6, Pl. 15, fig. 6, female carapace, paratype HU.205.T.7. From depth 8280 ft., Pl. 15, fig. 7, female carapace, paratype HU.205.T.8, Pl. 15, fig. 8, female carapace, paratype HU.205.T.9, Pl. 15, fig. 9, male carapace, paratype HU.205.T.10. From depth 8310 ft. All specimens are from Well F1-NC41.

Derivation of name:

From its occurrence in Africa.

Holotype:

A male carapace HU.205.T.2

Paratypes:

Eight specimens HU.205.T.3-10

Type Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type Horizon:

Harsha Formation, Middle Eocene, depth 8280 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

25 specimens. In Well F1-NC41, 11 specimens were found, three specimens from the Samdun Formation at drilling depths of 7970-8080 ft. and eight specimens from the Harsha Formation at depths of 8180-8350 ft. In Well K1-NC41, 12 specimens were found, 9 specimens in the Samdun Formation at depths of 8220 and 8310 ft., and three specimens from the Dahman Formation at a depth of 8564 ft. In Well J1-NC41, two specimens were recorded from The Tellil Group equivalent at a depth of 4730 ft.

Diagnosis:

A species of ***Trachyleberis*** characterised by its obliquely rounded anterior margin, eye tubercle is very distinctive, round and located at the antero-dorsal corner. Sexual dimorphism well known.

Description:

The carapace is medium size and subrectangular in lateral view, greatest height at the anterior cardinal angle, maximum length occurs above the mid-height. The anterior margin is obliquely rounded whilst the posterior margin is subrounded, narrower, slightly concave in the upper part and rounded in the lower one. The dorsal margin is straight, obscured due to overreaching of the dorsal ridge, with distinctive anterior and posterior cardinal angles. The ventral margin is slightly concave and straight after concavity in the right valve, whilst it is straight and runs smoothly

towards the posterior in the left valve. Eye tubercle is very distinctive, rounded and located at the antero-dorsal corner. The left valve is larger than the right and overlaps the latter along the anterior, posterior and ventral margins. A subcentral tubercle is present but not very distinctive.

The lateral surface is strongly reticulate with two well developed ridges. The dorsal ridge, starts below the eye tubercle, runs posteriorly parallel to, and projecting over the dorsal margin and then curves down to terminate below the postero-dorsal angle. The diagnostic ridge originates from the eye tubercle and runs parallel to the anterior and ventral margins to end posteriorly in a slight ala above the ventral margin at about two-thirds of the length. There is a deep depression directly behind the diagnostic ridge. The rest of the surface consists of a combination of reticulation with superimposed tubercles. The reticulation is more developed in the centre of the carapace and in the posterior half, particularly in the males. The anterior margin has 8-10 denticles along its ventral half whilst the posterior margin has 4-6 coarse spines in its lower ventral part. Sexual dimorphism present, the presumed males are more elongate and higher than the presumed females.

In dorsal view, the carapace is convex with compressed anterior and posterior ends. Maximum width occurs in the middle. Only closed carapaces were found and it was not possible to see the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.205.T.2	(Pl. 15, fig. 1)	836	418	390
Paratype, ♀ carapace HU.205.T.3	(Pl. 15, fig. 2)	800	460	400
Paratype, ♂ carapace HU.205.T.4	(Pl. 15, fig. 3)	876	438	410
Paratype, ♀ carapace HU.205.T.5	(Pl. 15, fig. 4)	771	438	420
Paratype, ♂ carapace HU.205.T.6	(Pl. 15, fig. 5)	836	450	440
Paratype, ♀ carapace HU.205.T.7	(Pl. 15, fig. 6)	736	418	410
Paratype, ♀ carapace HU.205.T.8	(Pl. 15, fig. 7)	781	445	405
Paratype, ♀ carapace HU.205.T.9	(Pl. 15, fig. 8)	709	418	345

Paratype, ♂ carapace HU.205.T.10 (Pl. 15, fig. 9) 890 450 410

Differences and affinities:

The present species shows some similarities to the type species of this genus in the general outline. However, the latter differs in having a more pointed posterior ends, more developed spines on the surface and the anterior and posterior ends have more prominent spines. In addition, the Libyan material, differs in having a more reticulate surface with superimposed tubercles. This species also differs from all species described by Bassiouni (1969b) under this genus in the ornamentation of the lateral surface.

Occurrence:

This species is known so far from the Middle Eocene of Well F1-NC41, from Middle and Upper Eocene of Well K1-NC41, and from the Eocene of Well J1-NC41.

Trachyleberis tarabulusensis sp. nov.

(Pl. 20, figs. 9-11)

Figured specimens:

Pl. 20, fig. 9, female carapace, paratype HU.205.T.11, Pl. 20, fig. 10, female carapace, paratype HU.205.T.12. From depth 10180 ft, Pl. 20, fig. 11, male carapace, holotype HU.205.T.13. From depth 10140 ft. All specimens are from Well N1-NC41.

Derivation of name:

In reference to its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.205.T.13

Paratypes:

Two female carapaces HU.205.T.11-12

Type locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

Eleven specimens were found in Well N1-NC41 from the Al Jurf Formation, two specimens at a drilling depths of 10100 ft., two at 10140 ft., three specimens at 10180 ft. and four specimens at depths of 10260 and 10320 ft.

Diagnosis:

A species of *Trachyleberis* characterised by a subrectangular carapace in side view, a straight dorsal margin and an ornamentation of small spines. Surface covered by rounded tubercles. Sexual dimorphism strongly pronounced.

Description:

A subrectangular carapace in lateral view with the greatest height at the eye tubercle, greatest length at mid-height. Dorsal margin straight sloping gently towards the posterior end with well developed posterior cardinal angle and ornamented with short spines. Ventral margin is almost straight in the female, but in the males is strongly concave in the middle, curving smoothly anteriorly and posteriorly.

Anterior margin broad and slightly more narrowly rounded in the ventral half, posterior margin subtriangular, slightly pointed medially, concave in the upper part. Eye tubercle small, rounded but not prominent. Left valve larger than the right, overreaching strongly ventrally and only slightly at the antero-dorsal and postero-dorsal margins. The marginal rim is best developed around the anterior margin and is not clearly seen in the ventral and posterior margins.

There are about 8-12 small tubercles along the marginal rim which is more developed in its ventral half. Anterior margin is decorated with small denticles, posterior margin has 6-9 tubercles, those at the posterior being mostly in the ventral part of the margin. Lateral surface covered by spines distributed all over the surface and arranged concentrically in the centre of the carapace. In the ventral area the

spines are arranged in rows which are parallel to the ventral margin. A small narrow depression behind the anterior marginal rim can be seen in the females. The spines are less numerous on the anterior and posterior margins. Subcentral tubercle present but indistinct and covered with spines. Ventral margin ornamented with small denticles, more developed in the middle.

Sexual dimorphism is strongly pronounced, the presumed males more elongate, higher and narrower than the presumed females. In dorsal view, the carapace has convex sides with compressed anterior end and slightly pointed posterior. Maximum width nearly in the middle. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype ♀ carapace HU.205.T.11	(Pl. 20, fig. 9)	628	357	290
Paratype ♀ carapace HU.205.T.12	(Pl. 20, fig. 10)	628	342	305
Holotype ♂ carapace HU.205.T.13	(Pl. 20, fig. 11)	818	390	300

Differences and affinities:

The present species shows some similarities to ***Megommatocythere hariaensis*** Colin & Oertli (1982) in Donze ***et al.***, (1982) in shape but the latter differs in having a well developed eye tubercle standing out of the carapace, and the lateral surface is ornamented by a combination of reticules and spines. In addition the Libyan material lacks the postero-dorsal tubercle.

This species resembles ***Trachyleberidea tunisiensis*** Colin & Said (1982) in Donze ***et al.***, (1982) in general outline. The latter differs in its narrower and pointed posterior end, also its greatest length lies ventrally whilst in the present species it occurs at mid-height.

Occurrence:

This species is recorded so far from the Maastrichtian of Well N1-NC41.

Genus *ACANTHOCYTHEREIS* Howe, 1963

Type species: *Acanthocythereis araneosa* Howe, 1963

Acanthocythereis tarabulusensis sp. nov.

(Pl. 16, figs. 1-8)

Figured specimens:

Pl. 16, figs. 1-3, male carapace, holotype HU.205.T.14, Pl. 16, figs. 4-6, female carapace, paratype HU.205.T.15. From Well F1-NC41 at depth 8180 ft., Pl. 16, figs. 7, 8, male carapace, paratype HU.205.T.16. From Well F1-NC41 at depth 8030 ft.

Derivation of name:

In reference to its occurrence in Tarabulus Basin.

Holotype:

A male carapace HU.205.T.14

Paratypes:

Two specimens HU.205.T.15-16

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Material:

34 specimens. In Well B1a-137, two specimens were found in the Samdun Formation at a drilling depth of 6100 ft. In Well K1-NC41, one specimen was found in the Harsha Formation at a depth of 8740 ft. In Well C1-NC41, seven specimens were recorded from the Harsha Formation at depths of 7810 and 7970 ft. In Well F1-NC41, 11 specimens were found, five in the Samdun Formation at depths of 7990-8060 ft., six specimens in the Harsha Formation at 8180-8230 ft. In Well L1-NC41,

two specimens were found in the Harsha Formation at a drilling depth of 9120 ft. In Well B1-NC41, 11 specimens were found in the Ghalil Formation at depths of 7510-7960 ft.

Diagnosis:

A species of ***Acanthocythereis*** characterised by its very elongate shell and its distinct antero-marginal rim. Dorsal and ventral margins are straight and subparallel.

Description:

Thick-shelled, large-sized, subrectangular carapace in lateral view, greatest height occurs at the eye tubercle, greatest length passes through the middle of the carapace. Dorsal margin almost straight, ventral margin slightly concave anteriorly. Dorsal and ventral margins subparallel converging towards the posterior. Anterior margin obliquely rounded and extended below; posterior margin narrower and rounded medially. Posterior cardinal angle distinct, being better developed in the left valve. Eye tubercle very distinctive and rounded; situated at the antero-dorsal corner. Left valve larger than the right, overlapping the latter along the ventral margin.

Antero-marginal rim distinct, running from the eye tubercle round the anterior margin and terminating ventrally. The antero-marginal area is ornamented by two rows of spines, the outer row consists of about 12 small spines. The inner row lies on the marginal rim and consists of six rounded spines on the ventral part of the anterior rim. The posterior margin has 6-9 spines which are more developed in the lower part. The lateral surface consists of a combination of reticulation occasionally superimposed with small rounded spines. The reticulation varies from rounded, subrounded to subquadrate fossae. In the ventral half and along the anterior margin, the spines are more pronounced than on the rest of the surface.

In dorsal view, the carapace has parallel sides with compressed anterior and posterior ends. Maximum width occurs just behind the middle. In ventral view, the anterior spines are clearly visible. Sexual dimorphism is marked, the presumed females being shorter and less high than the presumed males. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm):

		L	H	W
Holotype, ♂ carapace HU.205.T.14	(Pl. 16, figs. 1-3)	1150	575	414
Paratype, ♀ carapace HU.205.T.15	(Pl. 16, figs. 4-6)	1000	533	444
Paratype, ♂ carapace HU.205.T.16	(Pl. 16, figs. 7, 8)	1071	525	315

Differences and affinities:

Acanthocythereis tarabulusensis is very similar to ***A. salahi*** Bassiouni (1969b) in general outline, but the latter differs in having a more spinose lateral surface and also has more rounded anterior and posterior margins. ***A. reticulata*** Esker (1968) as figured by Donze *et al.*, (1982) from the Palaeocene of Tunisia differs in its more pointed posterior, in having a postero-dorsal tubercle and a rounded tubercle on the dorsal margin. ***A. tarabulusensis*** is easily distinguished from ***A.? meslei*** Donze & Oertli (1982) in Donze *et al.*, (1982) in its more reticulate surface and in lacking the postero-dorsal tubercle.

The present species shows some similarities to ***A. conjuncta*** Al-Furaih (1980) from the Uppermost Cretaceous and Lower Palaeocene of Saudia Arabia in general outline, but differs in having a more rounded posterior margin, weakly developed anterior and posterior marginal spines, an indistinct subcentral tubercle and also differs in the details of the lateral surface ornamentation.

Occurrence:

This species is recorded so far from the Middle Eocene of Well B1a-137, Well K1-NC41, Well L1-NC41, Well F1-NC41, Well C1-NC41 and Well B1-NC41.

Acanthocythereis tellilae sp. nov.

(Pl. 16, figs. 9-12)

Figured specimens:

Pl. 16, figs. 9, 11-12, male carapace, holotype HU.205.T.17, Pl. 16, fig. 10, female carapace, paratype HU.205.T.18. All specimens are from the same type locality and horizon.

Derivation of name:

In reference to its occurrence in the Tellil Group.

Holotype:

A male carapace HU.205.T.17

Paratype:

A female carapace HU.205.T.18

Type locality:

Well J1-NC41, NW offshore Libya.

Type horizon:

Tellil Group, Eocene, depth 4730 ft.

Stratigraphic range:

Eocene.

Material:

Three specimens were found in Well J1-NC41 from the Tellil Group at a drilling depth of 4730 ft.

Diagnosis:

A species of ***Acanthocythereis*** with elongate, subquadrate carapace in lateral view, surface covered with a combination of reticulation and strong blunt spines. Sexual dimorphism well marked.

Description:

An elongate and subquadrate carapace in lateral view. Anterior margin broadly rounded with double rows of small tubercles of which the outer row consists of small nodes and fine denticles, the inner row consisted of eight nodes which are all regularly placed over the anterior marginal rim, posterior margin subtriangular, slightly pointed in the middle, smooth to finely denticulated in the upper part, decorated with small pointed spines in the lower part. Dorsal margin is almost

straight, tapering posteriorly with anterior and posterior cardinal angle, partially obscured by the projection of the dorsal spines, ventral margin straight. Dorsal and ventral margins are subparallel and converge slightly posteriorly. Left valve larger than the right, overlapping it along the ventral, postero-dorsal and antero-dorsal margins. Eye tubercle is very distinct glassy and rounded. Subcentral tubercle not seen. Greatest height lies at the anterior cardinal angle, greatest length passes below the mid-height. The lateral surface is characterised by the combination of reticulation and blunt spines, the pits vary in shape from elongate to ovate, subtriangular to subrectangular. Strong blunt spines some of which are bifid are superimposed on the reticulations. Fine scattered nodes occur on the surface. There is prominent row of reticules behind the anterior marginal rim, each of which connects anteriorly with the nodes of the inner row. Sexual dimorphism well marked, the presumed males more elongate, higher and narrower posteriorly than the presumed females.

In dorsal view the carapace has nearly parallel sides with a pointed posterior end. Maximum width occurs in the middle. The outline of both sides is broken by the lateral spines. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.205.T.17	(Pl. 16, figs. 9, 11-12)	836	390	370
Paratype, ♀ carapace HU.205.T.18	(Pl. 16, fig. 10)	741	383	375

Differences and affinities:

Acanthocythereis tellilae is easily distinguished from other ***Acanthocythereis*** species described in this study by its distinctive shape. In addition it has a coarsely reticulate surface. However, it shows some resemblance to ***A. projecta*** Bassiouni (1969b) from the Upper Eocene of Egypt, in general outline but differs in having sharper spines distributed all over the surface and narrower anterior and posterior ends.

Occurrence:

This species has been recorded from the Eocene of Well J1-NC41.

Acanthocythereis salahi Bassiouni , 1969b

(Pl. 17, figs. 1-8)

1966 *Acanthocythereis* n. sp. *1,* Salahi, p. 20, pl. 5, figs. 24-26.

1969b *Acanthocythereis salahi* Bassiouni, p. 389-391, pl. 25, figs. 1-2.

1981 *Acanthocythereis salahi* Bassiouni, Mechmeche; p. 48, pl. 2, figs. 5-10

Figured specimens:

Pl. 17, figs. 1-3, 7, 8, male carapace HU.205.T.19, Pl. 17, figs. 4-6, female carapace HU.205.T.20. All specimens are from the same locality and horizon.

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Samdun Formation, Middle Eocene, depth 8030 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

116 specimens. In Well B1-NC41, 49 specimens were found in the Ghalil Formation at 7290-7650 ft. In Well L1-NC41, one specimen was found in the Harsha Formation at a depth of 9440 ft. In Well C1-NC41, 15 specimens were found in the Samdun Formation at depths of 7170-7590 ft. In Well K1-NC41, six specimens were reported, three specimens from the Samdun Formation at depths of 8220 and 8370 ft, three specimens from the Harsha Formation at 8740 and 8780 ft. In Well F1-NC41, 45 specimens were found, 43 specimens from the Samdun Formation at depths of 7770-8080 ft., two specimens from the Harsha Formation at a drilling depth of 8180 ft.

Description:

A large species of *Acanthocythereis* with a subrectangular to subquadrate carapace in lateral view, greatest height at the anterior cardinal angle, maximum length occurs at the mid-height. Anterior margin rounded, posterior end slightly produced, concave in the upper part and rounded in the lower.

Dorsal margin straight, slightly obscured. The ventral margin is almost straight and subparallel to the dorsal margin. Eye tubercle prominent. Left valve is larger and overlaps the right at the antero-dorsal margin and along the ventral margin. A marginal anterior rim commences from the eye tubercle and runs parallel to the anterior margin, terminating ventrally. Anterior and posterior margins decorated with spines. Lateral surface ornamentation consists of a combination of reticulation and spines, the latter distributed all over the surface reticulation varies from small to large. A subcentral tubercle is very weak or absent.

Sexual dimorphism is present, the presumed males more elongate than the presumed females.

In dorsal view, the carapace is lenticular with nearly subparallel sides. Maximum width occurs medially in the males and posteriorly in the females. Also the males are slimmer than the females.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.205.T.19	(Pl. 17, figs. 1-3, 7, 8)	1071	571	300
♀ carapace HU.205.T.20	(Pl. 17, figs. 4-6)	866	511	345

Remarks:

This species was figured by Salahi (1966) as ***Acanthocythereis*** n. sp. ***1*** from the Oligocene of the Sirte Basin, Libya. Bassiouni (1969b) renamed it ***Acanthocythereis salahi*** from the Upper Eocene of Egypt. Also this species has been recorded from the Middle and Upper Eocene of Tunisia by Mechmeche (1981). The present specimens entirely agree with this species in overall size, shape and ornamentation especially with the specimens figured by Salahi (1966).

Occurrence:

Known so far from the Middle Eocene of Well C1-NC41, Well F1-NC41, and from the Middle and Upper Eocene of Well K1-NC41, Well L1-NC41 and Well B1-NC41, from the Oligocene of the Sirte Basin, Libya, from the Upper Eocene of Egypt, and from the Middle and Upper Eocene of Tunisia.

Acanthocythereis? sp. *A*

(Pl. 17, figs. 9-10)

Figured specimen:

A carapace HU.205.T.21

Locality:

Well B1a-137, Tarabulus Basin, NW offshore Libya.

Horizon:

Samdun Formation, Middle Eocene, depth 6100 ft.

Stratigraphic range:

Middle Eocene.

Material:

Two specimens were found in Well B1a-137 were found in the Samdun Formation at a depth of 6100 ft.

Description:

Medium-sized carapace tapering towards posterior. Anterior margin broad and obliquely rounded, posterior margin narrowly rounded and obtusely pointed in the middle, particularly in the left valve. Greatest height developed at the anterior cardinal angle, greatest length occurs at the mid-height. Dorsal and ventral margins are straight, subparallel or slightly converging to the posterior.

The eye tubercle is small but distinct located at the antero-dorsal corner. Subcentral tubercle is not very prominent, situated in the antero-central area. Left valve larger than the right, overlapping slightly at the anterior margin and more conspicuously at the postero-dorsal margin. The anterior margin has a marginal rim

which is well developed, the posterior marginal rim is indistinct. The antero-marginal area is ornamented with two rows of spines. The outer row consists of 8-10 short spines, strongest in the antero-ventral margin. The inner row lying upon the antero-marginal rim consists of 8 well developed spines, stronger and larger in its ventral half. The posterior margin is ornamented by 8 spines which are better developed in its lower part. Three of these spines are very coarse and located in the postero-ventral corner.

Lateral surface is mostly covered by spines or papillae with very weak reticulation between them, except for a small, smooth, poorly-spinose area in the posterior area. The surface of the dorsal margin has about 8 distinct spines. In the ventral area, the spines are arranged in rows parallel to the ventral margin.

This specimen seems to be a female rather than a male when compared with other species belonging to *Acanthocythereis*.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.205.T.21	(Pl. 17, figs. 9, 10)	781	436	355

Differences and affinities:

This species resembles ***Acanthocythereis*** in external appearance, general outline, shape and in the ornamentation of the lateral surface. However, because no internal characters have been observed, its assignment to ***Acanthocythereis*** must remain questionable.

The present species shows some similarities to ***Acanthocythereis salahi*** Bassiouni (1969b) but differs in having more developed blunt spines on the lateral surface and the dorsal margin has about 8 strong spines. These are less developed in Bassiouni's species. The present species also differs in having very weak reticulation between the spines. ***Acanthocythereis?*** sp. *A* differs from all ***Acanthocythereis*** species described in this study in its ornamentation. ***Acanthocythereis?*** sp. *A* resembles some species of the genus *Phalcocythere* Siddiqui (1971). The latter has a ventral ridge, distinct subcentral tubercle and postero-dorsal caudal process.

The present species is similar to ***Trachyleberis huantraicoensis*** Bertels (1969) from the Lower Tertiary (Lower Danian) of Roca Formation, Argentina but the latter differs in having a strongly concave antero-dorsal margin, narrower anterior end, posterior end produced subventrally and a more reticulate surface.

Occurrence:

The species is known from the Middle Eocene of Well B1a-137.

Acanthocythereis sp. *B*

(Pl. 17, figs. 11,12)

Figured specimen:

A carapace HU.205.T.22

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 8060 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

Nine specimens were found in Well D2-NC41 from Ghalil Formation at a depth of 7820-8060 ft.

Description:

In lateral view the carapace is elongate and subrectangular with an evenly rounded anterior end; the posterior end is subtriangular and pointed at the mid-height. Dorsal and ventral margins are straight, tapering towards the posterior and there is a well-marked posterior cardinal angle in the left valve. Greatest height occurs in the region of the eye tubercle, greatest length at about mid-height. Valves are almost equal. The lateral surface is reticulate with a few scattered spines.

The anterior margin is ornamented with a row of fine denticles. A distinct subcentral tubercle is present and is rounded in the right valve and less pronounced in the left valve.

Dimensions of figured specimens (μm)**:**

		L	H	W
Carapace HU.205.T.22	(Pl. 17, figs. 11, 12)	818	381	310

Differences and affinities:

The present species is closely related to ***Acanthocythereis prora*** Al-Furaih (1980) from the Lower Eocene of Saudia Arabia in general outline and in shape. However, the latter species differs in its more coarsely reticulated surface, in having a distinct subcentral tubercle in the left valve, more developed anterior and posterior marginal spines and in having a more prominent eye tubercle.

A. oxyderca Al-Furaih (1980) from the Middle and Upper Palaeocene of Saudia Arabia differs from this species in having marginal spines along the dorsal margin. The anterior and posterior margins are also more developed. A very thick antero-marginal rim is present and there is also a more distinct eye tubercle. In addition the Libyan specimens have a weak subcentral tubercle.

A. procapsus Siddiqui (1971) from the Upper Palaeocene of Pakistan shows some similarities to this species, but the Pakistan species differs in having a more pointed posterior end, weakly developed anterior and posterior spines and also possesses a less prominent eye tubercle. ***Acanthocythereis*** sp. ***B*** differs from all species described in this study in its posterior outline and ornamentation.

Occurrence:

This species occurs in the Middle and Upper Eocene of D2-NC41.

Tribe: COSTAINI Hartmann & Puri, 1974

Genus ***COSTA*** Neviani, 1928

Type species: ***Cytherina edwardsi*** Roemer, 1838

Costa oligocaenica sp. nov.

(Pl. 18, figs. 1-6)

1966 *Costa* n. sp. *3* Salahi, p. 23, pl. 5, figs. 1-3

Figured specimens:

Pl. 18, figs. 1-3, carapace, holotype HU.205.T.23. From depth 8180 ft., Pl. 18, figs. 4-6 carapace HU.205.T.24. From depth 8310 ft. All specimens are from Well F1-NC41.

Derivation of name:

From its first occurrences in the Oligocene deposits, Sirte Basin Libya.

Holotype:

A carapace HU.205.T.23

Paratype:

A carapace HU.205.T.24

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Stratigraphic range:

Middle Eocene and Oligocene.

Material:

Three specimens were found in Well F1-NC41 from the Harsha Formation at drilling depths of 8180 and 8310 ft.

Diagnosis:

A species of *Costa* characterised by a subrectangular carapace with well developed marginal ridge along the anterior, ventral and postero-ventral corner.

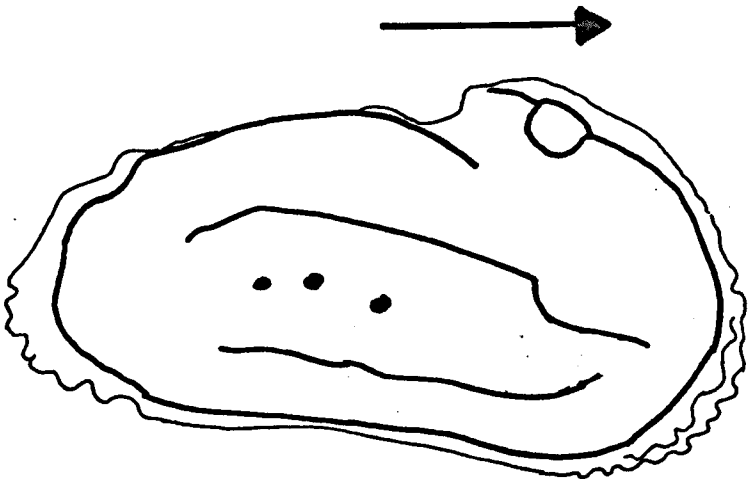

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Fig. 5.2 *Costa oligocaenica* sp. nov. Holotype HU.205.T.23, carapace from right, showing the surface ornamentation.

Description:

Carapace subrectangular in lateral view, greatest height at the anterior cardinal angle, greatest length passes through the mid-point. Anterior margin obliquely rounded, decorated with marginal denticulations; the marginal ridge commences at the antero-dorsal corner and continues along the anterior and ventral margins. Posterior margin truncate, narrowly rounded ventrally, slightly concave in the upper part and ornamented with 5-7 denticles in its lower half. Dorsal margin straight, sloping gently towards the posterior end. Anterior and posterior cardinal angles marked. Ventral margin straight to slightly concave in front of the middle, smoothly converging towards the anterior and the posterior margins.

Lateral surface ornamented by three longitudinal ridges. The medium one runs in an elegantly curved, convex upwards arc from the middle of the anterior margin. The ventral ridge starts from the antero-ventral corner and runs longitudinally above the central margin to the posterior end. The dorsal ridge, begins nearly behind the eye tubercle and runs straight to slightly convex backwards projecting above the dorsal margin to terminate posteriorly.

Eye tubercle pronounced with a shallow furrow behind it. Left valve larger than the right and overlapping it all round, more conspicuously along the ventral and anterior margins. The rest of the surface is smooth with three distinct small nodes in the middle between the ventral and the median ridges.

In dorsal view, carapace with parallel sides. Anterior and posterior ends are compressed laterally. In ventral view, the ventral ridge is very distinct and clearly seen. No single valves were obtained and hence no internal details could be seen.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, carapace HU.205.T.23	(Pl. 18, figs. 1-3)	676	369	284
Paratype, carapace HU.205.T.24	(Pl. 18, figs. 4-6)	613	331	266

Differences and affinities:

Salahi (1966) illustrated forms which he called ***Costa*** n. sp. ***3*** from the Oligocene of the Sirte Basin, Libya, which are identical with the present species. ***Costa oligocaenica*** shows some similarities to ***C. edwardsii*** (Roemer, 1838) as figured by Guillaume ***et al.***, (1985) in general outline and in having the same number of ridges but differs in the ornamentation of the lateral surface.

C. batii (Brady, 1866) as figured by Carbonel (1985) resembles this species but the latter differs by its more developed ridges and in having more convex dorsal margin and in having short spines.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41.

Costa libyaensis sp. nov.

(Pl. 18, figs. 7-12, Pl. 19, figs. 1,2)

Figured specimens:

Pl. 18, fig. 7, male carapace, holotype HU.205.T.25, Pl. 18, fig. 8, female carapace, paratype HU.205.T.26, Pl. 18, fig. 9, male carapace, paratype HU.205.T.27, Pl. 18, fig. 10, female carapace, paratype HU.205.T.28, Pl. 18, fig. 11, female carapace, paratype HU.205.T.29, Pl. 18, fig. 12, female carapace, paratype HU.205.T.30 from Well B1-NC41 at depth 7910, Pl. 19, fig. 1, male carapace HU.206.T.1, Pl. 19, fig. 2, male carapace HU.206.T.2 from Well F1-NC41 at depth 8330 ft.

Derivation of name:

From its occurrence in Libya.

Holotype:

A male carapace HU.205.T.25

Paratypes:

Five specimens HU.205.T.26-30

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7910 ft.

Stratigraphic range:

Middle Eocene.

Material:

55 specimens. In Well B1-NC41, 12 specimens were found in the Ghalil Formation at drilling depths between 7630 and 7910 ft. In Well C1-NC41, 12 specimens were found in the Harsha Formation at 7810 ft. In Well F1-NC41, 14 specimens were found in the Harsha Formation at depths of 8340-8480 ft. In Well L1-NC41, 12 specimens were found in the Harsha Formation at depths of 9520-9600

ft. In Well D2-NC41, three specimens were found in the Ghalil Formation at depths of 7940 and 8095 ft. In Well H1-NC41, two specimens were recorded from the Harsha Formation at a drilling depth of 10520 ft.

Diagnosis:

A species of ***Costa*** characterised by its strongly reticulate surface with three longitudinal ridges, highest at the eye tubercle. Sexual dimorphism well pronounced.

Description

Carapace elongate subrectangular, slender in the males, maximum height through the eye tubercle and the greatest length occurs at the mid-height. Dorsal margin is strongly modified by the dorsal ridge in lateral view; ventral margin straight to slightly concave mid-ventrally. Anterior end symmetrically rounded, posterior end subrounded to slightly pointed at the middle. Surface ornamented by reticules and prominent ridges. The dorsal ridge runs from nearly below the eye tubercle to just in front of the posterior margin where it curves downwards then disappears. The ventral ridge is nearly parallel to the median one. The median ridge starts just behind the anterior margin is stepped up a short distance further on then it runs parallel to the dorsal and ventral ridges and curves downwards posteriorly.

Antero-marginal rim distinct, running from the eye tubercle along the entire margin, this rim is very high and distinct along the anterior and posterior margins. Posterior margin has 5-8 small spines more developed along its ventral part. Eye tubercle present. The rest of the surface is coarsely reticulate, the shape of the pits varying from triangular to rectangular and subrounded. Left valve larger and overreaching the right along the entire margin, more developed at the anterior and ventral margins.

Sexual dimorphism present, the presumed females higher at the anterior margin and less elongate and easily distinguished from the more slender males.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♂ carapace HU.205.T.25	(Pl. 18, fig. 7)	819	438	340

Paratype, ♀ carapace HU.205.T.26	(Pl. 18, fig. 8)	809	476	420
Paratype, ♂ carapace HU.205.T.27	(Pl. 18, fig. 9)	847	438	375
Paratype, ♀ carapace HU.205.T.28	(Pl. 18, fig. 10)	863	505	420
Paratype, ♀ carapace HU.205.T.29	(Pl. 18, fig. 11)	747	434	360
Paratype, ♀ carapace HU.205.T.30	(Pl. 18, fig. 12)	782	434	350
♂ carapace HU.206.T.1	(Pl. 19, fig. 1)	977	488	390
♂ carapace HU.206.T.2	(Pl. 19, fig. 2)	926	463	370

Differences and affinities:

Costa libyaensis closely resembles ***Costa*** n. sp. ***1*** Salahi (1966) from the Lower Eocene of Libya but Salahi's species differs in having well developed ridges, and longer spines along the anterior and posterior margins. In addition the tubercle in these specimens is higher.

C. libyaensis is also similar to species described from the Eocene of Egypt by Bassiouni as ***Carinocythereis*** (***Reticulina***) ***heluanensis*** Bassiouni (1969b) but the latter species differs in its dorsal outline and it is much smaller. Furthermore, the present species has an antero-marginal rim running along the entire margin.

Occurrence:

This species is known from the Middle Eocene of Well D2-NC41, Well F1-NC41, Well L1-NC41, Well B1-NC41, Well C1-NC41 and Well H1-NC41.

Genus *PALEOCOSTA* Benson, 1977

Type species: ***Costa mokattamensis*** Bassiouni, 1969b

Paleocosta ghalilae sp. nov.

(Pl. 19, figs. 8-12)

Figured specimens:

Pl. 19, figs. 8-9, male carapace, holotype HU.206.T.6, Pl. 19, figs. 10-12, female carapace, Paratype HU.206.T.7. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A male carapace HU.206.T.6

Paratype:

A female carapace HU.206.T.7

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 8080 ft.

Stratigraphic range:

Middle Eocene.

Material:

11 specimens. In Well B1-NC41, three specimens were found in the Ghalil Formation at 7570 ft. In Well D2-NC41, eight specimens were found in the Ghalil Formation at depths of 7880-8190 ft.

Diagnosis:

A species of ***Paleocosta*** with well marked sexual dimorphism, surface ornamented with ridges and meshes, except for small area near the posterior end.

Description:

In lateral view, subrectangular carapace with greatest height at the anterior cardinal angle, maximum length developed below mid-height. Anterior end obliquely rounded, decorated with short denticles, posterior end rounded, slightly pointed medially and nearly forming a right angle; with smooth curved antero-dorsal margin. Dorsal margin nearly straight and obscured in the posterior half by the dorsal ridge, ventral margin slightly concave anteriorly, straight after concavity and curving

upwards to the posterior end. Left valve larger than the right and overlapping it along the entire margin, more developed in its ventral and posterior margins. Eye tubercle present but not very well developed.

The lateral surface is ornamented by five ridges. The dorsal ridge, originates below the eye tubercle and runs upwards over the dorsal margin, then curving downwards and ends posteriorly at about two-thirds of the height. The ventral ridge starts from the antero-ventral area and runs parallel to the ventral margin to disappear nearly at the postero-ventral corner. The median ridge begins from the reticulation pattern at about half of the height of the carapace then runs parallel to the ventral ridge and ends at about the same length as the ventral ridge. Another ridge is present between the ventral and median ridges and terminates posteriorly at one-fifth of the length from the posterior end.

A marginal rim extends from the eye tubercle along the anterior margin. A thick rib runs from the eye tubercle parallel to the anterior marginal rim to join the ventral marginal rim. The rest of the surface is covered with small, thin ribs forming meshes with the exception of the small area at the posterior end. At the anterior margin, the pits are rounded.

In dorsal view the carapace has parallel sides with pointed posterior end and compressed anterior end. Maximum width lies in the middle. Sexual dimorphism, the presumed males more elongate and higher than the presumed females. A few carapaces were found, it was not possible to study the internal features.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♂ carapace HU.206.T.6	(Pl. 19, figs. 8-9)	765	400	292
Paratype, ♀ carapace HU.206.T.7	(Pl. 19, figs. 10-12)	672	384	347

Differences and affinities:

Donze ***et al.***, (1982) figured forms as ***Paleocosta*** aff. ***P. libyaensis*** Benson (1977) from the middle and Upper Palaeocene of Tunisia which seems to be identical with the present species. ***Paleocosta ghalilae*** is similar to the ***P. libyaensis*** Benson

(1977) from the Middle Eocene of Libya in general outline and shape but the latter species differs in its coarser developed ridges, in having more developed spines along the anterior and posterior ends and lacks the anterior rib which is characteristic of the present species.

Costa retiolata Helmdach & El Khaudray (1980) from the Middle Eocene of the Northern Escarpment of Al Jabal Al Akhdar, Libya. resembles this species but differs in the ornamentation of the lateral surface.

Paleocosta kefensis Benson (1977) from the Middle Palaeocene of the Le Kef section of Tunisia differs in its more reticulate surface at the anterior and posterior margins and in having more developed denticles anteriorly and posteriorly.

Occurrence:

The present species is known so far from the Middle Eocene of Well B1-NC41 and Well D2-NC41.

Paleocosta bensoni Damotte & Donze, 1982

(Pl. 20, figs. 1-3, 8)

1966 ***Isobuntonia*** aff. ***harpa*** Apostolescu; Salahi, p. 11-12, , pl. 3, fig. 5.

1977 ***Paleocosta?*** sp. Benson, p. 37, pl. 3, fig. 5.

1982 ***Paleocosta bensoni*** Damotte & Donze; Donze ***et al.***, p. 285-286 , pl. 4, figs. 4-8.

Figured specimens:

Pl. 20, fig. 1, female carapace HU.206.T.8, Pl. 20, fig. 2, male carapace HU.205.T.9, Pl. 20, fig. 3, female carapace HU.206.T.10. From depth 9520 ft., Pl. 20, fig. 8, female carapace HU.206.T.11. From depth 9500 ft. All specimens are from Well D2-NC41.

Locality:

Le Kef Section, Tunisia.

Type horizon:

Middle Palaeocene.

Stratigraphic range:

Middle and Late Palaeocene.

Material:

Nine specimens were found in Well D2-NC41 from the Al Jurf Formation at drilling depths of 9440-9520 ft.

Diagnosis:

A species of ***Paleocosta*** which is rectangular to ovate in lateral view, greatest height at the anterior cardinal angle, greatest length at mid-height. Anterior margin broadly rounded, posterior margin subrounded, slightly pointed in the middle of the males, concave in the upper part and rounded below.

Dorsal margin straight and slightly obscured by the dorsal ridge, ventral margin straight in the males and slightly concave, curving upwards posteriorly and anteriorly in the females. Lateral surface ornamented with deep fossae and fine ridges. The fossae vary in shape from subtriangular, rounded to subrounded. Left valve larger than the right valve and overreaching it along the ventral and posterior margins. Eye tubercle rounded and distinct.

Sexual dimorphism well marked, the presumed males are less high and more elongate than the presumed females. Internal features were not seen.

Dimensions of figured specimens (μm)***:***

		L	H	W
♀ carapace HU.206.T.8	(Pl. 20, fig. 1)	600	357	260
♂ carapace HU.206.T.9	(Pl. 20, fig. 2)	736	352	310
♀ carapace HU.206.T.10	(Pl. 20, fig. 3)	593	344	220
♀ carapace HU.206.T.11	(Pl. 20, fig. 8)	587	343	265

Remarks:

Salahi (1966) illustrated forms from the Palaeocene of the Sirte Basin which he called ***Isobuntonia*** aff. ***harpa*** Apostolescu (1961). Later Benson (1977) figured one specimen from the Middle Palaeocene of the Le Kef section which he tentatively

placed in the genus ***Paleocosta***. Recently Damotte & Donze (1982) in Donze ***et al***, (1982) nominated this species as ***Paleocosta bensoni*** from the Middle Palaeocene of Le Kef section of Tunisia.

The specimens figured here are identical with this species. ***P. bensoni*** shows some affinities to ***P. libyaensis*** Benson (1977) in general outline but, differs in having well developed ridges. ***Paleocosta kefensis*** Benson (1977) is also much larger and differs in the style of ornamentation.

Occurrence:

This species occurs in the Late Palaeocene of Well D2-NC41 in the Middle and Late Palaeocene of Tunisia.

Paleocosta sp. *A*

(Pl. 19, figs. 3-7)

Figured specimens:

Pl. 19, figs. 3, 5, female carapace HU.206.T.3, Pl. 19, figs. 4, 7, female carapace HU.206.T.4 from depth 10300 ft., Pl. 19, fig. 6, male carapace HU.206.T.5. From depth 10160. All specimens are from Well N1-NC41.

Stratigraphic range:

Maastrichtian.

Material

11 specimen were found in Well N1-NC41 from the Al Jurf Formation, two specimens at 10140 ft., five specimens at 10160 ft. and the last four specimens from depths of 10200 and 10220 ft.

Description:

In lateral view, carapace suberctangular, medium sized. Dorsal margin straight, ventral margin almost straight, curving posteriorly. Both margins subparallel and converging towards the posterior end. Anterior margin smoothly rounded, posterior margin subtriangular, slightly concave in the upper part, straight in the lower

one. Maximum height occurs at the anterior cardinal angle, maximum length at the mid-height. Eye tubercle is distinct, rounded and located below the antero-dorsal corner of the carapace.

The left valve is larger than the right and conspicuously overlaps the latter at the antero-dorsal, ventral and postero-dorsal margins. The lateral surface is characterised by three longitudinal ridges (ventral ridge, median ridge and dorsal ridge). A well developed dorsal ridge begins from just below the eye tubercle, curving upwards and becoming parallel to the dorsal margin, the presence of pore cones on the dorsal margin gives some specimens a sinous appearance.

The ventral marginal ridge starts from the antero-ventral corner then runs parallel to the ventral margin and terminates posteriorly. The median ridge commences from the subcentral tubercle and runs nearly parallel to the ventral and dorsal margins towards the posterior end.

A very thick marginal rim starts from the eye tubercle and continues along the anterior and ventral margins to join the ventral ridge at the postero-ventral corner. Anteriorly 12-18 spines can be seen. The posterior margin has about 7 spines in its ventral half. The rest of the surface is reticulated between the longitudinal ridges. In some specimens the muri are strongly developed. The reticulation may be weak in some specimens.

Sexual dimorphism well marked, the presumed males less high than the presumed females. Internal features unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.206.T.3	(Pl. 19, figs. 3, 5)	579	331	290
♀ carapace HU.206.T.4	(Pl. 19, figs. 4, 7)	637	355	320
♂ carapace HU.206.T.5	(Pl. 19, fig. 6)	628	328	290

Differences and affinities (μm)**:**

This species is placed in the genus ***Paleocosta*** on its general outline shape and ornamentation. The present species is similar to ***Paleocosta mokattamensis***

(Bassiouni, 1969b) originally described from the Eocene of Egypt. This species was later transferred by Benson (1977) to his new genus *Paleocosta* as its type species. The Libyan material differs in its more reticulate surface and in having a very well developed anterior marginal rim which runs parallel to the anterior and ventral margins to join the ventral ridge at the postero-ventral corner.

This species also shows some similarities to *Paleocosta* aff. ***P. mokattamensis*** as figured by Donze ***et al.***, (1982) from the Palaeocene of Tunisia in general outline and shape but differs in the details of the lateral surface ornamentation

Occurrence:

Known so far from the Maastrichtian of Well N1-NC41.

Genus ***OBLITACYTHEREIS*** Benson, 1977

Subgenus *Paleoblitacythereis* Benson, 1977

Type species: ***Carinocythereis ruggierii*** Russo, 1964

Oblitacythereis (*P.*) *ruggierii* (Russo, 1964)

(Pl. 20, figs. 4-5)

Figured specimen:

A carapace HU.206.T.12

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Late Palaeocene, depth 9280 ft.

Material:

Only one carapace was found in Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Description:

Carapace elongate oval in shape with broadly rounded anterior end and decorated with 16-18 short denticles, posterior end truncate, slightly concave in the upper part with prominent spines in the dorsal and ventral corners. Dorsal margin straight and slightly obscured by the dorsal ridge at the posterior half, ventral margin gently concave in the middle.

Greatest height anteriorly, greatest length below the mid-height. Left valve larger than the right and overreaching it along the ventral and posterior margins. A marginal rim extends along the anterior margin and consists of row of 6 small denticles in its ventral part. The posterior marginal rim has 3-5 rounded denticles, particularly along its ventral half. The lateral surface is characterised by its three ridges. The ventral ridge, starts from the antero-ventral region then runs parallel to the ventral margin and ends posteriorly with a small node. The dorsal ridge, originates from below the antero-dorsal corner, curving upwards and becoming parallel to the dorsal margin in lateral view. The median ridge is usually longer than the others, begins nearly from a subcentral tubercle, curving upwards, then runs parallel to the former ridges and terminates posteriorly.

The rest of the surface appears to be coarsely reticulate around all margins with a small few nodes scattered over the surface.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.206.T.12	(Pl. 20, figs. 4, 5)	788	461	390

Remarks:

The occurrence of the this specimen is undoubtedly due to contamination from overlying beds because ***Oblitacythereis*** **(*P.*)** ***ruggierii*** (Russo, 1964) is a common Miocene species from Italy.

Genus ***RETICULINA*** Bassiouni, 1969b

Type species: ***Carinocythereis*** **(*Reticulina*)** ***heluanensis*** Bassiouni, 1969b

Reticulina elegans sp. nov.

(Pl. 38, figs. 1-3)

Figured specimens:

Pl. 38, fig. 1, carapace paratype HU.210.T.29, Pl. 38, fig. 2, carapace holotype HU.210.T.30, Pl. 38, fig. 3, carapace paratype HU.300.T.1. All specimens from the same type locality and horizon.

Derivation of name:

L. *elegans*: in reference to its elegant ornamentation.

Holotype:

A carapace HU.210.T.30

Paratypes:

Two specimens HU.210.T.29, HU.300.T.1

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Late Palaeocene, depth 9500 ft.

Stratigraphic range:

Late Palaeocene.

Material:

Nine specimens were found only in Well D2-NC41 from the Al Jurf Formation at depths of 9460, 9500 and 9540 ft.

Diagnosis:

A species of ***Reticulina*** characterised by its reticulate surface with a few superimposed small spines. In dorsal view, the greatest height occurs in the anterior half.

Description:

The carapace is subrectangular with rounded anterior margin, posterior margin obtusely pointed in the middle. Dorsal margin straight, sloping gently towards the

posterior end, ventral margin slightly concave medially in the right valve, straight to slightly convex in the left valve.

Greatest height lies at the anterior cardinal angle, maximum length passes through the mid-point. Left valve larger than the right valve and overlapping it along the ventral, antero-dorsal and postero-dorsal margins. The eye tubercle is small but distinct, located just below the antero-dorsal corner of the valve. Subcentral tubercle present but very weak.

There are some 14-16 denticles along the anterior margin and some 4-6 denticles along the ventral half of the posterior margin. The marginal rim is best developed around the anterior and posterior margins and is not clearly seen along the ventral margin. The surface ornamentation consists mainly of reticulation with few superimposed small rounded spines at the intersection of some of the muri. The reticulation varies from small to large, rounded-subrounded to subquadrate. Sexual dimorphism was not observed.

In dorsal view, carapace arrow-shaped with rounded anterior end and pointed posterior end. Maximum width occurs in the anterior half. Only a few closed carapace were found, it was not possible to study the internal characters.

Dimensions of figured specimens (μm)***:***

		L	H	W
Paratype, carapace HU.210.T.29	(Pl. 38, fig. 1)	836	436	410
Holotype, carapace HU.210.T.30	(Pl. 38, fig. 2)	817	443	365
Paratype, carapace HU.300.T.1	(Pl. 38, fig. 3)	772	454	375

Differences and affinities:

The present species shows some resemblance to species figured by Donze ***et al.***, (1982) from the Lower Eocene of Tunisia as ***Reticulina proteros*** (Bassiouni, 1969a) in general outline but the latter differs in having a well rounded posterior margin, a more developed reticules and the greatest length lies above the mid-height.

Occurrence:

Known so far from the Late Palaeocene of Well D2-NC41 of Well D2-NC41.

Reticulina? sp. *A*

(Pl. 38, fig. 6)

Figured specimen:

A carapace HU.300.T.2

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Late Palaeocene, depth 9520 ft.

Stratigraphic range:

Late Palaeocene.

Material:

Six specimens (including four broken carapace) were found in Well D2-NC41 from the Ghalil Formation at drilling depths of 9380-9520 ft.

Description:

A species of ***Reticulina*** with subquadrate outline; a well developed reticulate surface; anterior margin appears to be obliquely rounded and slightly extended below, posterior margin narrowly rounded and lower than the anterior. The anterior and posterior marginal rims are distinct and ornamented with some small denticles.

The entire surface is ornamented with well developed reticulation, relatively large fossae arranged in rows lying just behind the anterior marginal rim. The reticulation very poorly developed in the posterior margin. Smaller reticulation covers the dorsal area whilst the rest of the surface is covered by larger reticulation.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.300.T.2	(Pl. 38, fig. 6)	968	494	380

Differences and affinities:

The present species is tentatively placed in genus ***Reticulina*** on the basis of the external features, but until internal features are known, its exact generic designation must remain uncertain.

This species shows some similarities to ***Reticulina elegans*** in general outline, but differs in the details of the reticulation and in having more rounded posterior margin. The present species differs from all species described under the genus ***Reticulina*** in the ornamentation of the lateral surface and by the outline of the posterior margin.

This species appears to be new, but as only badly preserved carapaces have been found, no new taxon has been created.

Occurrence:

This species is recorded from the Late Palaeocene of Well D2-NC41.

Tribe PTERYGOCYTHEREIDINI Puri, 1957

Genus ***PTERYGOCYTHEREIS*** Blake, 1933

Type species: ***Cythere jonesii*** Baird, 1850

Pterygocythereis tarabulusensis sp. nov.

(Pl. 21, figs. 7, 9-12)

1966 ***Pterygocythereis*** n. sp. ***1***, Salahi, p. 7-8, pl. 13, figs. 9-11

Figured specimens:

Pl. 21, fig. 7, female carapace, paratype HU.206.T.22 , Pl. 21, fig. 9, female carapace, paratype HU.206.T.23, Pl. 21, figs. 10, 12, male carapace, holotype HU.206.T.21, Pl. 21, fig. 11, male carapace, paratype HU.206.T.24. All specimens are from the same type locality and horizon.

Derivation of name:

From its occurrence in the Tarabulus Basin.

X 110

Fig. 5.3 *Pterygocythereis tarabulusensis* sp. nov. Paratype HU.206.T.23, female carapace from left, showing the surface ornamentation.

Holotype:

A male carapace HU.206.T.21

Paratypes:

3 specimens HU.206.T.22-24

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Formation, depth 7670 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

81 specimens. In Well L1-NC41, six (including two broken carapaces) specimens were found in the Harsha Formation at drilling depths of 9120- 9540 ft. In Well K1-NC41, three specimens were recorded in the Samdun Formation at 8220 ft. In Well C1-NC41, one specimen was found in the Samdun Formation at 7240 ft. In Well B1-NC41, 47 specimens were found in the Ghalil Formation at 7490-7790 ft. In Well D2-NC41, five specimens were found in the Ghalil Formation at 7820-8225 ft. In Well B1a-137, one broken carapace was found in the Samdun Formation at a drilling depth of 6600 ft. In Well F1-NC41, 18 specimens were found, 12 specimens from the Samdun Formation at depths of 7910-8060 ft., six specimens from the Harsha Formation at 8210-8400 ft.

Diagnosis:

A quadrate species of ***Pterygocythereis*** with a distinct, rounded eye tubercle, situated at the anterior cardinal corner, it also possesses a ventro-lateral ridge.

Description:

Carapace medium sized and thin shelled, subquadrate in lateral view, maximum height in front of the mid-height, maximum length occurs at the mid-height. Dorsal margin undulose due to the ornamentation, with rounded anterior and posterior cardinal angles, obscured by the marginal rib, especially in the left valve. Ventral margin slightly straight to almost convex mid-ventrally. Dorsal and ventral margins converging strongly towards the posterior. Anterior margin broadly and evenly rounded with a marginal rows of 10-13 fine denticles in the females, but more elongate and well pronounced in the males in the left valve. Posterior end is narrower and concave in the upper part, truncate and nearly straight in the middle, straight and sloping down in the lower part with a slight angle at the junction with the postero-ventral margin, subrounded in the left valve. Both valves finely denticulated in the

lower part of the posterior end with a strongly developed spine at the mid-height. A marginal rim runs along the entire margin.

Lateral surface smooth, strongly decorated with a row of spines along the dorsal margin. A well rounded tubercle at the postero-dorsal region, can be clearly seen in the males. A straight ventero-lateral ridge runs from the mid-length, curves slightly upwards and then curving down forms a semicircle. In some specimens this terminates as a knob-like structure. Left valve larger than the right, overlapping strongly along the anterior, ventral and posterior margins, where it is slightly seen in the dorsal margin. Eye tubercle very distinctive, glossy and rounded. Sexual dimorphism present, the presumed males are more elongate and higher than the presumed females.

In dorsal view carapace strongly arched in the posterior half. Maximum width at the heighest point. Eye tubercle clearly seen in dorsal view. Only carapaces were found, therefore it was not possible to study the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.206.T.21	(Pl. 21, figs. 10, 12)	686	382	340
Paratype, ♀ carapace HU.206.T.22	(Pl. 21, fig. 7)	550	335	300
Paratype, ♀ carapace HU.206.T.23	(Pl. 21, fig. 9)	557	342	295
Paratype, ♂ carapace HU.206.T.24	(Pl. 21, fig. 11)	574	365	277

Differences and affinities:

Salahi (1966) illustrated forms which he tentatively placed in ***Pterygocythereis*** from the Oligocene of the Sirte Basin, Libya, these are identical with the present species. This species has been referred to ***Pterygocythereis*** by Salahi (1966) with some doubt. However, it shows some affinities to this genus in its general outline, in having a well developed eye tubercle, but differs in the ornamentation of the lateral surface.

P. tarabulusensis shows some similarities to ***Diogmopteron*** Hill (1954) in general outline and shape, but Hill's genus differs in lacking the eye tubercle and in

having very strongly pointed alae. Unfortunately no single valves were found in this study. If better preserved material becomes available it may be possible to designate it as a new genus.

Occurrence:

This species is known so far from the Middle Eocene of Well B1-NC41, Well L1-NC41, Well C1-NC41, Well D2-NC41, Well B1a-137, Well F1-NC41, and from the Upper Eocene of Well K1-NC41, and from the Oligocene of the Sirte Basin, Libya.

Tribe BRACHYCYTHERINI Puri, 1954

Genus *BRACHYCYTHERE* Alexander, 1933

Type species: *Cythere sphenoides* Reuss, 1854

Brachycythere tarabulusensis sp. nov.

(Pl. 21, figs. 1-3)

Figured specimens:

Pl. 21, fig. 1, female carapace, paratype HU.206.T.16, Pl. 21, fig. 2, female carapace, paratype HU.206.T.17. From depth 10160 ft. Pl. 21, fig. 3, male carapace, holotype HU.206.T.18. From depth 10140 ft. All specimens are from Well N1-NC41.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.206.T.18

Paratypes:

2 specimens HU.206.T.16-17

Type locality;

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10140 ft.

Stratigraphic range:

Maastrichtian.

Material:

6 specimens were found in Well N1-NC41, from the Al Jurf Formation. One specimen at a depth of 10140 ft., four specimens at 10160 ft. and the last specimen at 10320 ft.

Diagnosis:

A species of ***Brachycythere*** with marked sexual dimorphism, surface finely pitted in the central part of the carapace which becomes smooth at the posterior and dorsal margins.

Description:

Large-sized, subrectangular to ovate carapace in lateral view, greatest length below mid-height, maximum height in front of the mid-height in the females and at the cardinal corner of the males. Anterior margin broadly and obliquely rounded, posterior end subtriangular with acute end. Dorsal margin straight, slightly arched at the anterior, sloping steeply to the posterior end, flattened along the hinge line. Ventral margin nearly straight to slightly convex, strongly converging with the dorsal margin into the compressed posterior end.

Lateral surface is finely pitted in the central part of the valves becoming smooth towards the posterior and dorsal margins. The anterior marginal area varies from smooth to finely pitted. A prominent ventro-lateral ridge, more developed in the right valve in both sexes. Left valve larger than the right and overlapping it all around, strongly along the anterior and dorsal margins, less pronounced at the posterior end. Eye tubercle distinct, located at the anterior cardinal corner of the carapace with a distinct sulcus behind it.

Sexual dimorphism is marked, the males being more elongate and drawn out posteriorly than the presumed females. Also distinguished by the posterior end which is pointed below the mid-height in the males.

In dorsal view, carapace ovate with swollen sides, maximum width and thickness occurs in front of the middle. Internal details were not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.206.T.18	(Pl. 21, fig. 3)	844	533	450
Paratype, ♀ carapace HU.206.T.16	(Pl. 21, fig. 1)	820	560	450
Paratype, ♀ carapace HU.206.T.17	(Pl. 21, fig. 2)	800	520	435

Differences and affinities:

Brachycythere armata Reyment (1960) from the Upper Maastrichtian of Nigeria is comparable in carapace outline. However, the Libyan material differs in not possessing an anterior marginal rim, also there are no anterior or posterior spines. Furthermore, Reyment's species has a well developed ventro-lateral ridge in each valve with two medial short, stout vertical riblets which are absent in the present species.

B. ekpo Reyment (1960) originally described from the Coniacian and Lower Santonian of Nigeria differs from ***B. tarabulusensis*** in having more a sharply pointed posterior end in both valves, an almost smooth surface, with some scattered fine pits, and also differs in its strongly drawn out posterior. In addition the present species is more inflated laterally.

B. tarabulusensis resembles ***B. oguni*** described from Nigeria by Reyment (1960) and is also found in Maastrichtian of the Lower Tar Member, Libya by Salaj & Nairn (1987) in general outline. However, the Libyan specimens differ in having pits along the ventral surface and also its posterior outline is somewhat different. In addition, ***B. oguni*** has coarser denticles at the anterior and posterior ends and a weak ventro-lateral ridge which is more developed in the present species.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Genus *OPIMOCYTHERE* Hazel, 1968

Type species: *Opimocythere bromni* Hazel, 1968

Opimocythere africana sp. nov.

(Pl. 21, fig. 4-6, 8)

Figured specimens:

Pl. 21, figs. 4, 6, male carapace, holotype HU.206.T.19. From Well D2-NC41 at depth 9250 ft., Pl. 21, figs. 5, 8, female carapace, HU.206.T.20. From Well C1-NC41 at depth 7240 ft.

Derivation of name:

From the occurrence of the species, and this is also the first description of the genus from Africa.

Holotype:

A male carapace HU.206.T.19

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Palaeocene, depth 9280 ft.

Stratigraphic range:

Palaeocene and Middle Eocene.

Material:

3 specimens. In Well D2-NC41, 2 specimens were found from the Al Jurf Formation at 9280 ft. One specimen from Well C1-NC41 section from Samdun Formation came from a depth of 7240 ft.

Diagnosis:

A species of *Opimocythere* with well developed ventero-lateral ridge, subtriangular posterior end and smooth areas around the anterior and posterior ends.

Description:

Carapace elongate in lateral view, maximum height lies at the anterior margin, greatest length located at the mid-height. Dorsal margin straight, sloping steeply to the posterior end, ventral margin straight to slightly convex mid-ventrally, curved posteriorly and anteriorly. Anterior end obliquely rounded in the upper part, smoothly rounded in the lower part with denticles along the anterior end. Posterior end subtriangular, concave in the upper part, also at its posterior end a few spines are present.

Lateral surface coarsely reticulate with smooth areas around the anterior and posterior ends. A marginal rim runs along the anterior margin, a thick ventral ridge is developed below the denticles and runs nearly parallel to the ventral margin dying out before it reaches the posterior flange. This small flange is developed below the mid-height of the posterior end and extends around the postero-ventral corner and below the ventral ridge.

Left valve is larger than the right, overreaching along the entire margin except at the lower anterior end which is less pronounced. Eye tubercle present. In dorsal view, carapace elliptical with compressed anterior and posterior ends, posterior spine well developed. Sexual dimorphism observed, males more elongate and less high the females.

Only closed carapaces were available for study, therefore it was not possible to see the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.206.T.19	(Pl. 21, figs. 4, 6)	836	400	380
♀ carapace HU.206.T.20	(Pl. 21, figs. 5, 8)	800	418	355

Differences and affinities:

Opimocythere africana is similar to ***O. browni*** and ***O. elonga*** both described by Hazel (1968) from the Danian of the Brightseat Formation, U.S.A. It can be distinguished by the absence of the anterior flange and in having less developed posterior spines. In addition Hazel's two species differ in being larger, more strongly

pitted and in having about four ribs in each valve that run below the ventral ridge which is clearly seen in ventral view.

Dingle (1976) figured a poorly preserved carapace which he tentatively placed in ***Brachycythere***. Dingle's species is very closely related in general outline and shape and in possessing the ventro-lateral ridge. However the Libyan species differs in its coarsely reticulate surface, more pointed posterior end, and in having small denticles developed at the anterior end. Dingle's form is certainly related to ***Opimocythere*** Hazel (1968).

Occurrence:

The present species is known so far the Middle Eocene of Well C1-NC41 and from the Late Palaeocene of Well D2-NC41.

Genus *DAHOMEYA* Apostolescu, 1961

Type species: *Dahomeya alata* Apostolescu, 1961

Dahomeya alata Apostolescu, 1961

(Pl. 22, figs. 1-7)

1961 ***Dahomeya alata*** Apostolescu, p. 769, pl. 2, figs. 23-25.

1963 ***Dahomeya alata*** Apostolescu; Reyment, p. 117-120, pl. 1, figs. 5 a-c.

1963 ***Dahomeya alata*** Apostolescu; Barsotti, p. 1524, pl. 1, fig. 3.

1981 ***Dahomeya alata*** Apostolescu; Reyment, p. 57, pl. 1, figs. 11, pl. 2, figs. 3 L, 3 R.

1982 ***Dahomeya alata*** Apostolescu; Donze ***et. al.***, p. 294, pl. 9, figs. 3-5.

1986 ***Dahomeya alata*** Apostolescu; Carbonnel, p. 81-82, pl. 5, figs. 4-6.

Figured specimens:

Pl. 22, figs. 1, 6, female carapace HU.206.T.25, Pl. 22, fig. 2, female carapace HU.206.T.26, Pl. 22, figs. 3, 4, male carapace HU.206.T.27, Pl. 22, fig. 5, female carapace HU.206.T.28, Pl. 22, fig. 7, male carapace HU.206.T.29. All specimens are from the same locality and horizon.

Locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 7770 ft.

Stratigraphic range:

Palaeocene, Lower and Middle Eocene.

Material:

49 specimens. In Well B1-NC41, 41 specimens (including 16 broken carapaces) were found in the Ghalil Formation at drilling depths of 7730-7930 ft. In Well D2-NC41, four specimens were recorded, two from the Ghalil Formation at 8240 ft., and the other two specimens from the Al Jurf Formation at drilling depths of 9360 and 9480 ft. In Well L1-NC41, four specimens were found in the Harsha Formation at depths of 9520-9540 ft.

Description:

Carapace subrectangular in lateral view with a rounded anterior margin decorated with small denticles along the lower part in some specimens and sharply rounded posteriorly. Maximum height at the middle, greatest length nearly at the mid-height. Dorsal margin straight, slightly convex, ventral margin convex mid-ventrally, curving posteriorly.

Lateral surface is covered by pits and a wing-like ventro-lateral process starts anteriorly at about one-quarter the length and terminates abruptly at the posterior margin. There is an anterior marginal rim, which is continuous along the dorsal margin and part of the ventral margin. A small depression can be seen behind the anterior margin. Left valve larger than the right valve, overlap occurs along the ventral margin. Eye tubercle distinct and rounded.

In dorsal view, the carapace is convex and widest medially.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.206.T.25	(Pl. 22, figs. 1, 6)	826	505	415
♀ carapace HU.205.T.26	(Pl. 22, fig. 2)	818	480	381
♂ carapace HU.205.T.27	(Pl. 22, figs. 3, 4)	884	494	390
♀ carapace HU.206.T.28	(Pl. 22, fig. 5)	781	460	418
♂ carapace HU.206.T.29	(Pl. 22, fig. 7)	888	511	420

Remarks:

The material found in this study agreed in all respects with specimens described by Apostolescu (1961) as *Dahomeya alata* from the Palaeocene of Ivory Coast and Senegal. This species has been described by Reyment (1963, 1981) from the Palaeocene and Lower Eocene of Nigeria, from the Palaeocene of the Sirte, Libya by Barsotti (1963), from the Palaeocene and Lower Eocene of Tunisia by Donze ***et al.***, (1982), and from the Middle Eocene of Senegal and Guinea Bissau by Carbonnel (1986).

Occurrence:

Known so far from the Middle Eocene of Well B1-NC41, Well L1-NC41 from the Late Palaeocene and Middle Eocene of Well D2-NC41, from Palaeocene and Lower Eocene of Nigeria, from the Palaeocene of Ivory Coast, from the Palaeocene and lower Eocene of Tunisia, from the Palaeocene of the Sirte Basin Libya, and from the Middle Eocene of Senegal and Guinea Bissau.

Dahomeya mediterranea sp. nov.

(Pl. 22, fig. 8-12)

Figured specimens:

Pl. 22, fig. 8, male carapace, paratype HU.206.T.30, Pl. 22, fig. 9, female carapace, paratype HU.207.T.1, Pl. 22, fig. 10, male carapace, paratype HU.207.T.2 ,

Pl. 22, fig. 11, female carapace, paratype HU.207.T.3, Pl. 22, fig. 12, male carapace, holotype HU.207.T.4. All specimens from the type locality and horizon.

Derivation of name:

From its occurrence below the Mediterranean Sea.

Holotype:

A male carapace HU.207.T.4

Paratypes:

Four specimens HU.206.T.30, HU.207.T.1-3

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 7970 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

338 specimens. In Well L1-NC41, 44 specimens were found in the Harsha Formation at 9060-9560 ft. In Well K1-NC41, 72 specimens were found, 31 specimens from the Samdun Formation at depths of 8220-8500 ft., five specimens from the Dahman Formation at 8564 ft., 36 specimens from the Harsha Formation at depths of 8600-9590 ft. In Well H1-NC41, 28 specimens (including 2 broken carapaces) were found, four specimens from the Samdun Formation at 9700 and 10020 ft., 24 specimens from the Harsha Formation at depths of 10300-10680 ft. In Well F1-NC41, 121 specimens were found, 39 specimens from the Samdun Formation at 7910-8080 ft., 82 specimens from the Harsha Formation at depths of 8180-8570 ft. In Well B1-NC41, 12 specimens were found in the Ghalil Formation at 7590-7770 ft. In Well B1a-137, 21 specimens were found, seven specimens from the Dahman Formation at 6640 ft, 14 specimens from the Harsha Formation at a depths of 6680-6900 ft. In Well C1-NC41, 40 specimens were recorded, nine specimens from

the Samdun Formation at 7270-7590 ft., and 31 specimens from the Harsha Formation at depths of 7680-7830 ft.

Diagnosis:

A species of ***Dahomeya*** Apostolescu, 1961 with medium-sized carapace, broadly rounded anterior margin and ornamented with a few small denticles along its ventral half.

Description:

In lateral view carapace subrectangular, maximum height in the anterior half, greatest length above mid-height. Dorsal margin straight, sloping gently to the posterior end. Ventral margin convex due to ventro-lateral swelling. Anterior margin broadly rounded, posterior end acutely subtriangular, pointed down from about the middle in the right valve. The anterior margin is ornamented with a few small denticles along the lower part.

The lateral surface is smooth with fine pits on the surface and which can be clearly seen on the central part of the carapace. A small weak ventral rib begins one-third of the length from the anterior margin and runs parallel to the ventral margin, terminating at two-thirds of the length. Left valve is larger and overlaps the right valve along its entire margin being least pronounced at the dorsal margin. Eye tubercle distinct.

In dorsal view, carapace oval with rounded anterior end, maximum width at the middle. In ventral view, the ventral ridge is clearly seen. Sexual dimorphism strongly marked, the presumed males more elongate than the presumed females. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)***:***

		L	H	W
Paratype, ♂ carapace HU.206.T.30	(Pl. 22, fig. 8)	681	380	311
Paratype, ♀ carapace HU.207.T.1	(Pl. 22, fig. 9)	634	382	300
Paratype, ♂ carapace HU.207.T.2	(Pl. 22, fig. 10)	695	373	325
Paratype, ♀ carapace HU.207.T.3	(Pl. 22, fig. 11)	622	375	356

Holotype, ♂ carapace HU.207.T.4 (Pl. 22, fig. 12) 637 340 260

Differences and affinities:

Dahomeya alata Apostolescu (1961) is similar to this species in general outline, but differs in being much larger, in having a well developed marginal rim along the dorsal margin and part of the ventral margin. It also differs in its more pitted surface and is also characterised by a well developed ventral ridge.

Digmocythere omarai Cronin & Khalifa (1979) from the late Eocene of Egypt resembles ***Dahomeya mediterranea*** but differs in having a more pointed posterior end and narrower anterior margin. In addition the lateral surface of the present species is pitted in the central region of the carapace.

D. mediterranea is similar to ***Brachycythere (Digmocythere) ismaila*** Bassiouni (1971) from the Eocene but Bassiouni's species differs in its more convex dorsal margin, is larger in size and possesses a more pronounced ventral ridge, which is drawn down at its middle. The left valve strongly overlaps the right along the entire margin.

Occurrence:

This species is recorded from the Middle Eocene of Well B1a-137, Well H1-NC41, Well L1-NC41, Well F1-NC41, Well C1-NC41 and Well B1-NC41, and from the Middle and Upper Eocene of Well K1-NC41.

Dahomeya sp. ***A***

(Pl. 23, fig. 1)

Figured specimen:

A carapace HU.207.T.5

Locality:

Well D2-NC41, Tarabulus Basin. NW offshore Libya.

Horizon:

Al Jurf Formation, Palaeocene, depth 9500 ft.

Stratigraphic range:

Palaeocene.

Material:

Only one carapace was found in Well D2-NC41 from the Al Jurf Formation at a drilling depth 9500 ft.

Description:

Carapace ovate in lateral outline with its maximum length passing slightly below mid-height, maximum height occurs nearly in the middle of the carapace. Anterior end broadly and obliquely rounded, posterior end narrower and subrounded, slightly concave in the upper part. Dorsal margin broadly convex, ventral margin concave mid-ventrally and curving upwards posteriorly. Externally, the well developed ventro-lateral ridge is almost parallel to the ventral margin and terminates posteriorly with a small spine. The surface of the carapace is ornamented with a fine to coarse dense punctation; the coarsest puncta occur in the median area, the ventral surface is smooth or possibly finely pitted.

A very narrow depressed area with puncta is present behind the anterior margin. Anterior margin bears a rim which is continuous along the entire margin. Left valve larger and overreaching the right strongly along the ventral and posterior margins. Eye tubercle present.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.207.T.5	(Pl. 23, fig. 1)	506	333	255

Differences and affinities:

Only one carapace was found in this study, it does appear to be quite distinctive and may be nominated as a new species but lack of material at this stage, prevents its designation. The present species is similar to ***Dahomeya alata*** Apostolescu (1961) but differs in its compressed ovate outline and in having a more broadly convex dorsal margin and differs in the posterior outline.

Dahomeya sp. Carbonnel (1986) from the Senegal and Guinea Bissau resembles this species in general outline but differs in details of the ornamentation, mainly in its smooth surface with spines along the anterior end. Its also lacks the anterior depression.

Occurrence:

This species occurs in the Late Palaeocene of well D2-NC41.

Tribe ECHINOCYTHEREIDINI Hazel, 1967

Genus ***HENRYHOWELLA*** Puri, 1957

Type species: ***Cythere evax*** Ulrich & Bassler, 1904

Henryhowella sp. ***A***

(Pl. 23, figs. 2-7)

Figured specimens:

Pl. 23, figs. 2-4, carapace HU.207.T.6. From Well C1-NC41 at depth 7010 ft., Pl. 23, figs. 5-7, carapace HU.207.T.7. From Well C1-NC41 at depth 7440 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

Only two specimens were found both in Well C1-NC41, one specimen from the Upper Eocene of Samdun Formation at drilling depth of 7010 ft., and the other specimen from the Middle Eocene of the Harsha Formation at a depth of 7440 ft.

Description:

Medium-sized, carapace which is subrectangular in lateral view, greatest height at the eye tubercle, greatest length occurs at the mid-height. Dorsal and ventral margins are straight and nearly subparallel. Anterior and posterior cardinal angles are present. Anterior end rounded with a distinct marginal rim, decorated with a row of

small tubercles. The posterior end is rounded, concave in the upper part, and lower than the anterior end.

Lateral surface reticulate with numerous blunt spines. A longitudinal protrusion occurs dorsally from almost below the eye tubercle to the posterior end. The median protrusion is divided into stronger tubercles. The ventral protrusion is nearly parallel to the ventral margin with superimposed tubercles. The reticulation is developed concentrically in the anterior area . The rest of the surface is covered with small nodes. Eye tubercle prominent. Left valve larger than the right and overlapping it along the ventral and posterior margins.

In dorsal view, the outline is broken by the median protrusion with a rounded anterior end and narrowly rounded posterior end. Maximum width lies in the anterior half. Internal structures were not seen as no single valves were obtained.

Dimensions of figured specimens(μm)***:***

		L	H	W
Carapace HU.207.T.6	(Pl. 23, figs. 2-4)	713	408	384
Carapace HU.207.T.7	(Pl. 23, figs. 5-7)	622	340	355

Differences and affinities:

The present species shows some similarities to the type species of ***Henryhowella*** Puri (1957) in general outline and shape but the latter differs in having a well developed marginal rim along the entire margin. Also the anterior area is ornamented by a series of small nodes, in the Libyan specimens this area is reticulated.

Occurrence:

Known so far from the Middle and Upper Eocene of Well C1-NC41.

Genus *ECHINOCYTHEREIS*, Puri, 1954

Type species: ***Cythereis garretti*** Howe & McGuirt, 1935

Echinocythereis harshae sp. nov.

(Pl. 24, figs. 1-6)

Figured specimens:

Pl. 24, fig. 1, male carapace, holotype HU.207.T.13, Pl. 24, fig. 2, male carapace, paratype HU.207.T.14, Pl. 24, fig. 3, female carapace, paratype HU.207.T.15, Pl. 24, fig. 4, female carapace, paratype HU.207.T.16, Pl. 24, fig. 5, male carapace, paratype HU.207.T.17, Pl. 24, fig. 6, female carapace paratype HU.207.T.18. All specimens from the same type locality and horizon except fig. 4 from depth 8180 ft.

Derivation of name:

From its occurrence in the Harsha Formation.

Holotype:

A male carapace HU.207.T.13

Paratypes:

Five specimens HU.207.T.14-18

Type Locality:

Well F1-NC41, Tarabulus basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8260 ft.

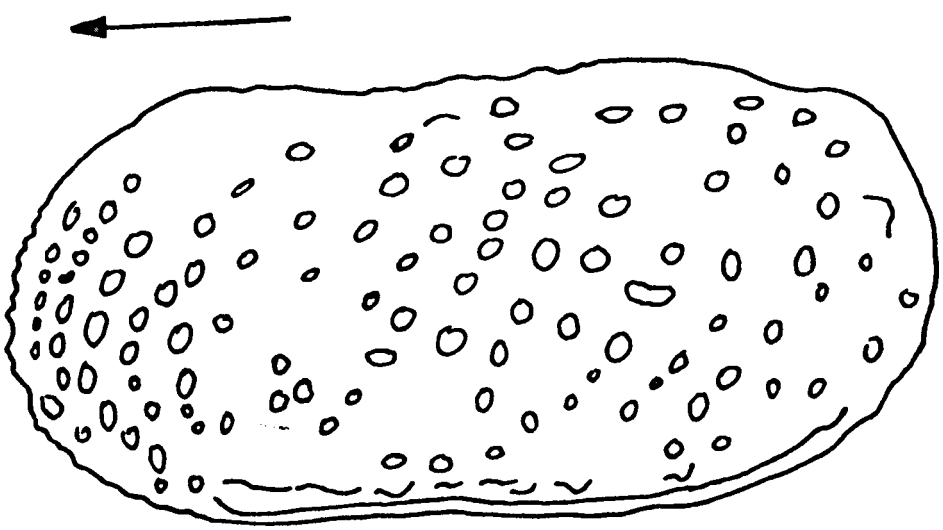
Stratigraphic range:

Middle and Upper Eocene.

Material:

1439 specimens. In Well C1-NC41, 532 specimens were found, 181 specimens in the Samdun Formation at drilling depths of 7960-7590 ft., and 351 specimens in the Harsha Formation at 7690-8060 ft. In Well F1-NC41, 68 specimens were recorded, 45 from the Samdun Formation at depths of 7800-8060 ft, and 23 specimens from the Harsha Formation at 8180-8480 ft. In Well B1-NC41, 57 specimens were found, 31 specimens in the Samdun Formation at drilling depths of

7330-7410 ft., whilst the other 26 specimens from the Harsha Formation at depths of 7470-7770 ft. In Well K1-NC41, 146 specimens were recovered, 35 in the Samdun Formation at 8020-8450 ft., 10 specimens in the Dahman Formation at a drilling depth of 8564 ft., and 101 specimens from the Harsha Formation at depths of 8600-9590 ft. In Well H1-NC41, 135 specimens were found, 25 in the Samdun Formation at 9720-10200 ft., and 110 specimens in the Harsha Formation at depths of 10300-10680 ft. In Well B1a-137, 102 specimens were found, 40 in the Samdun formation at drilling depths of 6000-6600 ft., 10 specimens in the Dahman Formation at a depth of 6640 ft., and 52 in the Harsha Formation at 6680-7120 ft.



X 140

Fig. 5.4 ***Echinocythereis harshae*** sp. nov., holotype HU.203.T.13, male carapace from left, showing the surface ornamentation.

In Well L1-NC41, 48 specimens were recorded in the Harsha Formation at drilling depths of 9020-9560 ft.

Diagnosis:

Echinocythereis species, characterised by its elongate carapace in which the posterior end forms an ear-shaped projection with the posterior margin.

Description:

In side view, carapace elongate and sub-triangular, with greatest height at the anterior cardinal angle, maximum length passes through mid-point. The dorsal margin is straight, slightly swollen near the dorsal margin, with well a developed anterior and posterior cardinal angle, decorated with about 8 small tubercles. The ventral margin is concave anteriorly to the middle, slightly convex curving upwards posteriorly. Anterior margin obliquely rounded with a marginal rim. Posterior margin narrowly truncate and rounded at the middle, forming an ear-shaped projection with the dorsal margin.

Lateral surface, ornamented by small nodes and ribs. In the dorsal margin from about the middle point in the posterior half, the ornamentation consists of small nodes. A small longitudinal rib runs parallel to the ventral margin. A maximum of five rows of small nodes also run parallel to the anterior margin.

The rest of the surface is covered by small nodes. Eye tubercle pronounced, well rounded and overreached by the anterior cardinal angle. Left valve larger than the right, overreaching the latter at the anterior, posterior and ventral margins.

In dorsal view the carapace is rounded anteriorly and posteriorly, with the greatest width and thickness nearly at the middle. Sexual dimorphism strongly pronounced, the presumed males are more elongate and higher than the presumed females.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♂ carapace HU.207.T.13	(Pl. 24, fig. 1)	814	424	400
Paratype, ♂ carapace HU.207.T.14	(Pl. 24, fig. 2)	833	430	425

Paratype, ♀ carapace HU.207.T.15	(Pl. 24, fig. 3)	634	365	340
Paratype, ♀ carapace HU.207.T.16	(Pl. 24, fig. 4)	655	395	335
Paratype, ♂ carapace HU.207.T.17	(Pl. 24, fig. 5)	785	390	375
Paratype, ♀ carapace HU.207.T.18	(Pl. 24, fig. 6)	685	390	343

Differences and affinities:

This species is one of the most abundant ostracoda in the study area and is distinct in its shape and ornamentation. ***Echinocythereis harshae*** shows some similarities to species described by Munster (1830) as figured by Ducasse ***et al.***, (1985) from the Upper Eocene of the Aquitaine basin, in general outline but the latter species differs in its more pointed posterior margin. In addition, in the Libyan specimens the dorsal margin is slightly concave in the middle and the posterior end forms an ear-shaped projection with the dorsal margin.

E. palanaensis Khosla (1972) from the Lower Eocene of Khuila Formation of India, resembles the present species but Khosla's species differs in the outline of the dorsal margin and also differs in its coarsely reticulate surface.

E. bassiouni described by Boukhary ***et al.***, (1982b) from the Middle Eocene of Egypt, somewhat resembles ***E. harshae*** in general outline and shape but differs in the ornamentation of the lateral surface.

Occurrence:

This species is recorded from the Middle Eocene of Well F1-NC41, Well L1-NC41, Well B1-NC41, Well H1-NC41, and from the Middle and Upper Eocene of Well C1-NC41, Well K1-NC41 and Well B1a-137.

Echinocythereis samdunae sp. nov.

(Pl. 24, figs. 7-12)

Figured specimens:

Pl. 24, fig. 7, female carapace, paratype HU.207.T.19, Pl. 24, fig. 8, female carapace, paratype HU.207.T.20, Pl. 24, fig. 9, female carapace, paratype

HU.207.T.21, Pl. 24, fig. 10, male carapace, paratype HU.207.T.22, Pl. 24, fig. 11, male carapace, holotype HU.207.T.23, Pl. 24, fig. 12, female carapace, paratype HU.207.T.24. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Samdun Formation.

Holotype:

A male carapace HU.207.T.23

Paratypes:

Five specimens HU.207.T.19-22, 24

Type locality:

Well C1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Samdun Formation, Upper Eocene, depth 7010 ft.

Stratigraphic range:

Middle and Upper Eocene

Material:

633 specimens. In Well H1-NC41, 19 specimens were found in the Samdun Formation at drilling depths of 9220-9740 ft. In Well B1-NC41, seven specimens were recorded from the Samdun Formation at 7210 and 7330 ft. In Well C1-NC41, 149 specimens were found in the Samdun Formation, the first three at a depth of 6830 ft., and 146 specimens at 7010-7590 ft. In Well F1-NC41, 373 specimens were found, 79 in the Samdun Formation at drilling depths of 7740-8080 ft., and 294 specimens in the Harsha Formation at 8180-8590 ft. In Well B1a-137, 70 specimens were recorded, 50 in the Samdun Formation at depths of between 6100-6600 ft., and 20 specimens from the Harsha Formation at drilling depths of 7060-7120 ft. In Well J1-NC41, 15 specimens were recovered from the Tellil Group at depths of 4660-4790 ft.

Diagnosis

A species of ***Echinocythereis*** with subrectangular to subquadrate lateral view and reticulate surface except for a smooth area posteriorly.

Description:

Medium sized, thick-shelled, carapace subrectangular to subquadrate in lateral view, greatest length passes below the middle, greatest height is developed at the anterior cardinal angle. Anterior margin gently sloping in the upper part, obliquely rounded below, decorated with fine denticles along the lower part. The posterior margin is obliquely rounded, sloping gently in its upper part and joining the dorsal margin at the ear-shaped cardinal angle. Dorsal margin humped due to the ornamentation, convex at the middle with distinct anterior and posterior cardinal angles. Ventral margin straight, curving upwards posteriorly in the left valve, concave anterior to the middle in the right valve. Left valve larger and overlaps the right, more conspicuously along the ventral, dorsal margins and at the antero-dorsal area. Subcentral tubercle present but not prominent. Eye tubercle rounded and overreached by the cardinal angle with a small depression behind it.

Lateral surface consists of tetragonal puncta with four rows of small nodes running parallel to the anterior margin. A short series of denticles runs from the central region to the lower part of the posterior end. In some specimens a small lateral spine is developed below the postero-dorsal corner. Sexual dimorphism strongly pronounced, the presumed males more elongate and higher than the presumed females. In dorsal view, carapace tumid in the posterior half with a rounded anterior end and narrowly rounded posterior end. Maximum width and thickness at the posterior half. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♂ carapace HU.207.T.23	(Pl. 24, fig. 11)	897	448	420
Paratype, ♀ carapace HU.207.T.19	(Pl. 24, fig. 7)	750	425	350
Paratype, ♀ carapace HU.207.T.20	(Pl. 24, fig. 8)	725	410	370
Paratype, ♀ carapace HU.207.T.21	(Pl. 24, fig. 9)	736	403	335

Paratype, ♂ carapace HU.207.T.22	(Pl. 24, fig. 10)	897	469	340
Paratype, ♀ carapace HU.207.T.24	(Pl. 24, fig. 12)	754	421	340

Differences and affinities:

There is a little in the literature with which this species can be compared; although it is somewhat similar to *Echinocythereis harshae* in general outline and shape but differs in details of the ornamentation of the lateral surface and by its more elongate carapace.

Leguminocythereis numidica Apostolescu and Magné (1956) from the Eocene of Algeria differs in general outline and ornamentation, being more strongly reticulate and lacking anterior and posterior nodes.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41, Well B1a-137, from the Middle and Upper Eocene of H1-NC41, Well C1-NC41, Well B1-NC41 and from the Eocene of Well J1-NC41.

Echinocythereis libyaensis sp. nov.

(Pl. 23, figs. 8-12)

Figured specimens:

Pl. 23, fig. 8, female carapace, paratype HU.207.T.8, Pl. 23, fig. 9, female carapace, paratype HU.207.T.9, Pl. 23, fig. 10, male carapace, holotype HU.207.T.10, Pl. 23, fig. 11, female carapace, paratype HU.207.T.11, Pl. 23, fig. 12, male carapace, paratype HU.207.T.12. All specimens from the type locality and horizon.

Derivation of name:

In reference to its geographical occurrence.

Holotype:

A male carapace HU.207.T.10

Paratypes:

Four specimens HU.207.T.8-9, 11-12

Type locality:

Well H1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 10810 ft.

Stratigraphic range:

Middle Eocene.

Material:

124 specimens. In Well H1-NC41, 20 specimens were found in the Harsha Formation at a drilling depth of 10810 ft. In Well C1-NC41, 65 specimens were recorded from the Harsha Formation at depths of 7890-8040 ft. In Well B1a-137, 15 specimens were found in the Harsha Formation at drilling depths of 7140-7455 ft. In Well L1-NC41, 24 specimens were recorded in the Harsha Formation at 9460 and 9540 ft.

Diagnosis:

E. libyaensis is characterised by a medium-sized carapace in which the dorsal margin undulates due to the ornamentation. Sexual dimorphism strongly pronounced.

Description:

In lateral view an elongate subrectangular carapace. Dorsal margin in lateral outline undulates because of ornamentation, ventral margin almost straight. Anterior end broadly rounded with marginal denticulation along the anterior margin, posterior end truncated, rounded at the middle, forming an ear-shaped projection with the dorsal margin, denticulate ventrally. Anterior and posterior cardinal angles well developed. Greatest height lies anteriorly, greatest length lies at the mid-height. Surface ornamentation consists of a combination of pentagonal puncta, small nodes and short ridges can be seen above the mid-height. In the posterior half, the ornamentation consists of well developed small nodes or papillae. On the ventral side, the surface is ornamented by pentagonal puncta and more pronounced nodes than in the dorsal half. Subcentral tubercle present. Eye tubercle pronounced and well

larger than the right and overlapping the latter along the ventral, posterior and antero-dorsal margins and is also less pronounced in the dorsal margin.

In dorsal view, the greatest width occurs almost medially with compressed anterior and posterior ends. Sexual dimorphism is present, females less elongate and narrower than the males. Internal characteristics unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.207.T.10	(Pl. 23, fig. 10)	890	440	410
Paratype, ♀ carapace HU.207.T.8	(Pl. 23, fig. 8)	666	410	366
Paratype, ♀ carapace HU.207.T.9	(Pl. 23, fig. 9)	691	410	400
Paratype, ♀ carapace HU.207.T.11	(Pl. 23, fig. 11)	650	383	330
Paratype, ♂ carapace HU.207.T.12	(Pl. 23, fig. 12)	836	420	420

Differences and affinities:

There are no published forms to which this species can be compared. However, it is closely related to ***Echinocythereis harshae***, and ***Echinocythereis samdunae*** as described in this study in shape and in general outline but differs in the ornamentation of the lateral surface.

Occurrence:

This species is recorded from the Middle Eocene of Well H1-NC41, Well C1-NC41, Well L1-NC41 and Well B1a-137.

Subfamily Buntoniinae Apostolescu, 1961

Genus *BUNTONIA* Howe, 1935

Type species: ***Buntonia shubutaensis*** Howe, 1935

Buntonia beninensis Reyment, 1960

(Pl. 25 , figs. 1-6)

1960 ***Buntonia (Buntonia) beninensis*** Reyment, p. 151-155, pl. XXIII, figs. 1, a-b, 2,

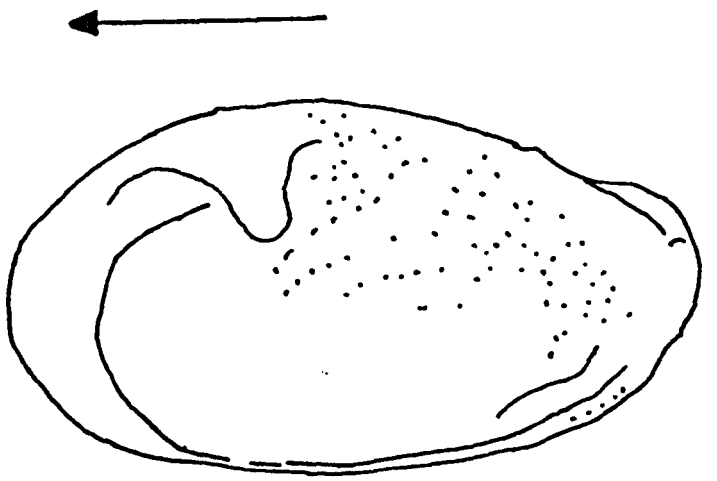
a-c.

1982 ***Buntonia*** sp. ***3*** Donze ***et al.***, p. 295, pl. figs. 9,10.

1988 ***Buntonia beninensis*** Reyment; Okosun, p. 654-656, 2 figs.

Material:

11 specimens were found only in Well D2-NC41 in the Al Jurf Formation. Four specimens at depth of 9400 ft., three specimens 9440 ft., three specimens at 9500 ft., and the last specimens from depth of 9520 ft.



X 140

Fig. 5.5 ***Buntonia beninensis*** Reyment, 1960. HU.207.T.25, male carapace from left, showing the surface ornamentation.

Figured specimens:

Pl. 25, fig. 1, male carapace, HU.207.T.25, Pl. 25, fig. 2, male carapace, HU.207.T.26. From depth 9400 ft. Pl. 25, fig. 3, male carapace, HU.207.T.27. From depth of 9440 ft., Pl. 25, fig. 4, female carapace, HU.207.T.28. From depth of 9400 ft., Pl. 25, fig. 5, female carapace, HU.207.T.29, Pl. 25, fig. 6, female carapace, HU.207.T.30. From depth of 9500 ft. All specimens are from Well D2-NC41.

Type locality:

The borehole at Araromi at a depth 317-370 ft., Nigeria.

Type horizon:

Late Palaeocene.

Stratigraphic range:

Late Palaeocene.

Description:

Medium to large, thick shelled, sub-rectangular carapace in lateral view, with greatest height developed at the anterior cardinal angle, maximum length at the middle. The dorsal margin is straight, except for a small concave part of the dorsal margin which can be seen in front of the posterior angle. The ventral margin is slightly convex in the left valve and straight, with a small concavity in the antero-ventral area of the right valve. The anterior margin is broadly and evenly rounded with the posterior margin truncate in the left valve, sub-rounded in the right valve. The lateral surface is smooth, except for a finely pitted area in the central and posterior areas of the valve especially in the males. A narrow, shallow sulcus borders the wide antero-marginal zone parallel to the margin. A small depression can be seen behind the eye tubercle. The left valve is larger than the right, with overlap antero-dorsally, postero-dorsally and postero-ventrally and also along the dorsal and ventral margins. The eye tubercle is weakly developed.

In dorsal view, the carapace is oval with slightly compressed ends. Greatest width occurs just behind the tubercle. Sexual dimorphism is strongly pronounced, the

presumed males are more elongate and wider than the females. Internal details were not seen.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.207.T.25	(Pl. 25, fig. 1)	642	342	270
♂ carapace HU.207.T.26	(Pl. 25, fig. 2)	550	345	250
♂ carapace HU.207.T.27	(Pl. 25, fig. 3)	657	371	290
♀ carapace HU.207.T.28	(Pl. 25, fig. 4)	533	320	270
♀ carapace HU.207.T.29	(Pl. 25, fig. 5)	550	335	237
♀ carapace HU.207.T.30	(Pl. 25, fig. 6)	585	357	280

Differences and affinities:

Donze ***et al.***, (1982) illustrated forms which were called ***Buntonia*** sp. ***3*** from the Late Palaeocene of Tunisia, which are identical with ***Buntonia beninensis.*** This species shows some similarities, in general outline to ***B. awadi*** Bassiouni (1969d) from the Middle Eocene of Jordan but the latter differs in having a coarsely pitted surface and more pointed posterior. ***B. beninensis*** is also closely comparable to species described by Bassiouni (1971) from the Upper Eocene of Egypt as ***B. faresi*** but the Libyan specimens differ in their truncated posterior margin and in having a small depression behind the eye tubercle. ***B. pulvinata*** Apostolescu (1961) from the Palaeocene of Togo also resembles the present species, but differs with the left valve strongly overlapping the right. In addition the Libyan material is characterised by its straight, dorsal margin and a small concavity in part of the dorsal margin in front of the posterior angle.

Occurrence:

Buntonia beninensis is known from the Late Palaeocene of Well D2-NC41, and was also found in the Palaeocene (Thanetian) of Tunisia, from the Late Palaeocene of Nigeria.

Buntonia sbetai sp. nov.

(Pl. 25 , figs. 7-12)

Figured specimens:

Pl. 25, fig. 7, female carapace, holotype HU.208.T.1, Pl. 25, fig. 12, female carapace, paratype HU.208.T.6. From depth 8000 ft., Pl. 25, fig. 8, female carapace, paratype HU.208.T.2, Pl. 25, fig. 9, male carapace, paratype HU.208.T.3, Pl. 25, fig. 10, female carapace, paratype HU.208.T.4. From depth 8060 ft., Pl. 25, fig. 11, male carapace, paratype HU.208.T.5. From depth 8080 ft. All specimens are from Well D2-NC41.

Derivation of name:

In honour of Dr. Ali Sbeta in recognition of his contribution to Libyan geology.

Holotype:

A female carapace HU.208.T.1

Paratypes:

Five specimens HU.208.T.2-6

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 8000 ft.

Stratigraphic range:

Middle Eocene.

Material:

13 specimens. were found in Well D2-NC41 section; five specimens at a drilling depth of 8000 ft., one specimen at depth of 8040 ft., three specimens at 8060 ft. and the last four specimens were found at a depth of 8080 ft. All specimens from the Ghalil Formation.

Diagnosis:

Buntonia sbetai is characterised by its smooth surface, except in the central area of the valve which is ornamented by longitudinal rows of puncta.

Description:

In lateral view, the carapace is pyriform and elongate with the greatest height at the anterior cardinal angle, and greatest length passes through the central point. The anterior margin is broadly rounded, whilst the posterior margin is narrower, truncated and less high. The dorsal margin is slightly sinous and slopes gently to the posterior end. The ventral margin is almost straight in the right valve and weakly concave in the left. Dorsal and ventral margin converge strongly posteriorly. The central lateral surface is ornamented by 4-6 longitudinal rows of puncta. Also a thin marginal rim is present along the anterior margin which continues along the ventral margin to the postero-ventral corner. The surface is swollen in the central area. The rest of the surface is smooth. The eye tubercle is weakly developed. The left valve is larger than the right.

In dorsal view, the sides of the carapace are convex with maximum width developed centrally. Sexual dimorphism is pronounced, the males being more elongate. No internal details were seen as no single valves were obtained.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♀ carapace HU.208.T.1	(Pl. 25, fig. 7)	483	270	220
Paratype, ♀ carapace HU.208.T.2	(Pl. 25, fig. 8)	477	260	211
Paratype, ♂ carapace HU.208.T.3	(Pl. 25, fig. 9)	537	287	225
Paratype, ♀ carapace HU.208.T.4	(Pl. 25, fig. 10)	466	255	230
Paratype, ♂ carapace HU.208.T.5	(Pl. 25, fig. 11)	541	270	215
Paratype, ♀ carapace HU.208.T.6	(Pl. 25, fig. 12)	477	277	220

Differences and affinities:

The species described by Apostolescu (1961) as ***Buntonia trichittensis*** from the Palaeocene of Sudan shows a close resemblance to ***B. sbetai*** in shape. The latter differs in having a broadly rounded anterior margin, straight ventral margin and the

swollen region is more pronounced. The species illustrated by Donze *et al.*, (1982) as *Buntonia* sp. *1* from Tunisia resembles *B. sbetai* in general outline, but differs in having an obliquely rounded anterior margin and also a rounded posterior end. In addition the Libyan specimens are characterised by higher anterior margins. *B. fares* Bassiouni (1971) from the Middle Eocene of Egypt is very similar to the present species in ornamentation, but differs in lateral outline, especially the posterior margin which is pointed and also the carapace is smaller in size.

B. sbetai shows some similarities to species described by Bassiouni (1969d) as *B. awadi* from the Middle Eocene of Jordan but the present species differs in its straight dorsal margin, truncated posterior margin and its smooth surface, except in the central area of the valve which is ornamented by longitudinal rows of puncta. The present species shows some affinity to *B. fortunata* Apostolescu (1961) from the Palaeocene of Benin and Nigeria, in general outline, but Apostolescu's species differs in having a coarsely pitted surface and pointed posterior.

B. sbetai is very similar to *Buntonia* (*Buntonia*) n. sp. *1* Salahi (1966) from the Palaeocene and lower Eocene of Libya, but the latter differs in its finely pitted surface, concave ventral margin and also the posterior margin is decorated by a pointed spine.

Occurrence:

This species has been recorded from the Middle Eocene of Well D2-NC41.

Buntonia aljurfae sp. nov.

(Pl. 26, figs. 1-6)

Figured specimens:

Pl. 26, figs. 1, 3, 5, male carapace holotype HU.208.T.7, Pl. 26, figs. 2, 4, 6, female carapace paratype HU.208.T.8. All from the same type locality and type horizon.

Derivation of name:

From its occurrence in the Al Jurf Formation.

Holotype:

A male carapace HU.208.T.7

Paratype:

A female carapace HU.208.T.8

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Late Palaeocene, depth 9360 ft.

Stratigraphic range:

Late Palaeocene.

Material:

Three specimens. In Well D2-NC41 section, only three specimens were found in the Al Jurf Formation at a drilling depth of 9360 ft.

Diagnosis:

A species of ***Buntonia*** characterised by its posteriorly pitted surface, with longitudinal ridges and a very narrow depressed anterior area behind and parallel to the anterior marginal area.

Description:

Carapace medium size, elongate pear-shaped in lateral view, with greatest length at the mid-point, greatest height at the anterior cardinal angle. The dorsal margin is straight, sloping steeply to the posterior end, ventral margin is nearly straight, slightly concave in the middle, turned upwards to the posterior end. The anterior margin is broadly and evenly rounded, the posterior margin is truncate in the left valve. Lateral surface consists of four longitudinal ridges. The dorsal ridge, begins behind a very small depression lying just below the dorsal end of the anterior-marginal rim and then curves upwards and runs along the dorsal margin to the postero-cardinal angle. The ventral ridge is slightly swollen, starting from the antero-

ventral area, and runs parallel to the ventral margin to the depressed posterior area about 3/4 of the length of the carapace. The median ridge is the shortest and is nearly straight, starting near the centre of the valve, running approximately parallel to the ventral and dorsal ridges and ending just before reaching the posterior depression. The fourth short ridge is present between the median and ventral ridges. A maximum of three thinner ribs can be seen near the ventral area, running parallel to the ventral margin. There is a marginal rim which extends around the anterior area, continuing along the ventral margin especially in the males. A very narrow depressed anterior area occurs behind and parallel to the anterior marginal rim. The rest of the surface is smooth, except a finely pitted area in the posterior half.

In dorsal view, the sides of the carapace are convex, with slightly compressed ends. Maximum width and thickness occurs in the middle of the dorsal margin. Sexual dimorphism is strongly pronounced, the presumed males are elongate and higher than the females.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.208.T.7	(Pl. 26, figs. 1, 3, 5)	635	350	270
Paratype, ♀ carapace HU.208.T.8	(Pl. 26, figs. 2, 4, 6)	475	312	242

Differences and affinities:

Buntonia aljurfae shows some similarities to species described by Apostolescu (1961) from the Lower Eocene of Togo and by Grekoff (1969) from the Lower Eocene of Algeria. This latter species differs in having well developed ridges, and also the presence of two ridges in the central area of the carapace, the lower of which curves upwards to join the upper ridge at its posterior end. The present species resembles ***B. ramosa*** as described by Bassiouni (1969d) from the Middle Eocene of Jordan but that species differs in having three very short ridges in the central area of the valve, a less truncated posterior end, and the males are shorter than the Libyan specimens.

B. aljurfae is closely comparable to *B. subtriangularis* (Sutton and Williams, 1939) as figured by Apostolescu (1961), but differs in its sub-rounded posterior margin and in having fewer longitudinal ridges.

Occurrence:

This species is known so far from the Late Palaeocene of Well D2-NC41.

Buntonia ghalilae sp nov.

(Pl. 26 , fig. 7-12)

Figured specimens:

Pl. 26, fig. 7, female carapace, holotype HU.208.T.9. From depth 8040 ft., Pl. 26, fig. 8, male carapace, paratype HU.208.T.10. From depth 7740 ft., Pl. 26, fig. 9, female carapace, paratype HU.208.T.11. From depth 8000 ft., Pl. 26, fig. 10, male carapace, paratype HU.208.T.12. From depth 7760 ft., Pl. 26, fig. 11, female carapace, paratype HU.208.T.13. From depth 7940 ft., Pl. 26, fig. 12, male carapace, paratype HU.208.T.14. From depth 8095 ft. All specimens are from Well D2-NC41.

Derivation of name:

From its occurrence in the Ghalil Formation, Tarabulus Basin, NW offshore Libya.

Holotype:

A female carapace HU.208.T.9

Paratypes:

Five specimens HU.208.T.10-14

Type Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7940 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

Seven specimens. This species was found only in Well D2-NC41 section, seven specimens were found in the Ghalil Formation at drilling depths of 7740-8095 ft.

Diagnosis:

This species is characterised by seven longitudinal ribs situated in the muscle scar area, and the surface covered by numerous pits, except where it becomes smooth in the anterior and posterior areas.

Description:

Carapace triangular in lateral view, with greatest height in front of the middle, greatest length below the mid-height. Dorsal margin straight to convex, only a small concave part of the dorsal margin is to be seen in front of the posterior angle. Ventral margin is convex, running continuously into the obliquely round anterior and truncate posterior margins. The surface is ornamented by ribs and pits. The upper rib begins at about half the height of the valves, the lower starts as the upper after 1/3 of the length of the valve and the median rib is as long as the upper and is situated at the 1/3 of the length. About four longitudinal ribs can be present near the ventral area, running parallel to the ventral margin. Some small weakly developed protrusions are often visible in the posterior third of the surface. A row of fine pits running along the anterior margin can be seen clearly in the left valve.

The rest of the surface is covered by numerous pits, except where it becomes smooth along the anterior and posterior margins. No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype, ♀ carapace HU.208.T.9	(Pl. 26, fig. 7)	482	305	250
Paratype, ♂ carapace HU.208.T.10	(Pl. 26, fig. 8)	500	312	230
Paratype, ♀ carapace HU.208.T.11	(Pl. 26, fig. 9)	500	277	255
Paratype, ♂ carapace HU.208.T.12	(Pl. 26, fig. 10)	461	277	230

Paratype, ♀ carapace HU.208.T.13	(Pl. 26, fig. 11)	422	266	240
Paratype, ♂ carapace HU.208.T.14	(Pl. 26, fig. 12)	500	294	250

Differences and affinities:

Buntonia ghalilae is closely comparable to ***B. hilalensis*** Helmdach & El Khoudary (1982) from the Middle Eocene of the Al Jabal Al Akhdar, NE Libya, but their species differs in having well developed ribs and a smooth surface. In addition ***B. ghalilae*** is covered by numerous pits except where it becomes smooth along the anterior and posterior margins.

B. ghalilae shows some similarities to ***B. attitogonesis*** Apostolescu (1961) from the Lower Eocene of Togo in general outline, but the latter species differs in having more longitudinal ribs distributed all over the surface, an unpitted surface and the greatest height of the Apostolescu's (1961) species occurs near the anterior margin whilst the greatest height of the new species is situated in the front of the mid-height.

Occurrence:

Buntonia ghalilae has been found in the Middle and Upper Eocene of Well D2-NC41.

Buntonia tellilae sp. nov.

(Pl. 28, figs. 1-8, 10)

Figured specimens:

Pl. 28, figs.1, 10, male carapace, holotype HU.208.T.22, Pl. 28, fig. 2, female carapace, paratype HU.208.T.23, Pl. 28, fig. 3, female carapace, paratype HU.208.T.24, Pl. 28, fig. 4, male carapace, paratype HU.208.T.25., Pl. 28, fig. 5, female carapace, paratype HU.208.T.26, Pl. 28, fig. 6, female carapace paratype HU.208.T.27, Pl. 28, fig. 7, male, carapace HU.208.T.28, Pl. 28, fig. 8, male carapace, paratype HU.208.T.29. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Tellil Group.

Holotype:

A male carapace HU.208.T.22

Paratypes:

Seven specimens HU.208.T.23-29

Type locality:

Well J1-NC41, NW offshore Libya.

Type horizon:

Tellil Group, Eocene, depth 4600 ft.

Stratigraphic range:

Eocene.

Material:

36 specimens were found only in Well J1-NC41 from the Tellil Group, 26 at a drilling depth of 4600 ft., three specimens at 4565 ft., four at a 4660 ft. and the last three specimens at 4730 ft.

Diagnosis:

A species of ***Buntonia*** characterised by its smooth area behind the eye tubercle and surface ornamented by several ridges.

Description:

Thin shelled, subrectangular to ovoid carapace in lateral view with the greatest height just behind the middle, maximum width below the mid-height. Anterior margin evenly rounded and decorated with about 8-12 spines, posterior margin truncate in the lower part and concave in the upper and ornamented with three spines in its ventral half. The dorsal margin is nearly straight in the males and slightly convex in the females forming an angle with the posterior cardinal angle. Lateral surface consists of several longitudinal ridges. The ventral ridge commences from the anterior area and runs posteriorly to end at the postero-ventral corner. The second one from the ventral margin starts nearly from the anterior marginal rim and runs parallel to the ventral ridge then dies out as the lower one does. The third and fourth ridges begin nearly

from the same area as the others and end posteriorly. The median ridge originates from the anterior marginal rim, runs upwards from just below to just above mid-height, then runs straight to terminate before it reaches the posterior end. The dorsal one starts from below the eye tubercle and runs backwards projecting over the dorsal margin posteriorly then curves down to end below the postero-dorsal angle. There are a few short ridges which can be seen in the dorsal half.

The rest of the surface is smooth. Left valve larger than the right and overlapping it along the anterior and ventral margins. Eye tubercle prominent. In dorsal view, carapace slightly compressed posteriorly with maximum width at the mid-length. Sexual dimorphism strongly pronounced, the presumed males are more elongate than the presumed females. Internal features unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.208.T.22	(Pl. 28, figs. 1, 10)	860	440	385
Paratype, ♀ carapace HU.208.T.23	(Pl. 28, fig. 2)	758	420	379
Paratype, ♀ carapace HU.208.T.24	(Pl. 28, fig. 3)	616	440	390
Paratype, ♂ carapace HU.208.T.25	(Pl. 28, fig. 4)	978	450	413
Paratype, ♀ carapace HU.208.T.26	(Pl. 28, fig. 5)	760	480	395
Paratype, ♀ carapace HU.208.T.27	(Pl. 28, fig. 6)	882	490	410
Paratype, ♂ carapace HU.208.T.28	(Pl. 28, fig. 7)	880	440	375
Paratype, ♂ carapace HU.208.T.29	(Pl. 28, fig. 8)	880	400	380

Differences and affinities :

This species shows some similarities to ***Buntonia attitogonensis*** Apostolescu (1961) from the Lower Eocene of Togo in general outline but differs in its more developed ridges. In addition the Apostolescu's species has a more prominent marginal rim and the ridges start nearly one-fourth of the length from the anterior margin. ***Buntonia*** (***Protobuntonia***) sp. aff. ***B.*** (***P.***) ***triangulata*** (Apostolescu) 1961 as figured by Foster ***et al.***, (1983) from the Palaeocene of Nigeria resembles the present species but differs in the outline of the dorsal margin.

Occurrence:

Buntonia tellilae is recorded from the Eocene of Well J1-NC41.

Buntonia sublatissima (Neviani, 1906)

(Pl. 28 , fig 9, 11-12.)

1985 ***Buntonia sublatissima sublatissima*** (Neviani, 1906); Carbonel, pl. 95, figs. 10, 11.

1988 ***Buntonia sublatissima*** (Neviani, 1906); Bonaduce ***et al.***, pl. 5, fig. 15.

Figured specimen:

Left valve HU.209.T.1

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, 7800 ft.

Material:

One left valve. In Well D2-NC41 section; only one left valve was found in the Ghalil Formation at a drilling depth of 7800 ft.

Description:

Carapace pear-shaped in lateral view, with greatest height somewhat in front of the middle of the carapace and more than half the length. The dorsal margin is strongly convex and in continuity with the anterior and posterior margins. The ventral margin is slightly convex. Anterior margin broadly rounded, posterior margin rounded and forming an angle with the posterior cardinal angle. The lateral surface is ornamented by somewhat sinuous longitudinal ridges, which do not reach the anterior and posterior extremities. The uppermost of these begins above half the height of the valve. The median one, starts at the same length as the uppermost one and is situated at 1/3 of the height. The third runs close to the median ridge and begins as the two

other ridges at 1/3 of the length. The ventral ridge, starts from the antero-ventral area and runs parallel to the ventral margin to a depressed area. There are about three small ribs running parallel to the ventral margin. The rest of the surface is pitted.

In dorsal view, carapace ovate, slightly acuminate at the posterior and anterior ends with greatest thickness at 1/3 of the length from the posterior end.

Dimensions of figured specimen (μm)**:**

		L	H	W
Right Valve HU.209.T.1	(Pl. 28, figs. 9, 11-12)	506	333	190

Remarks:

The present species is undoubtedly due to contamination from overlying rocks because this species is a common in the Recent of the Tunisia Shelf and in the Upper Miocene of France.

Buntonia harshae sp. nov.

(Pl. 27 , figs. 1-9, 11, Pl. 29, figs. 1, 2)

Figured specimens:

Pl. 27, figs. 1-3, male carapace, holotype HU.208.T.15. From depth 8260 ft., Pl. 27, figs. 4-6, female carapace, paratype HU.208.T.16. From depth 8370 ft., Pl. 27, figs. 7, 8, 9, 11, female carapace, paratype HU.208.T.17. From depth 8230 ft., Pl. 29, figs. 1, 2, female carapace, paratype HU.208.T.18. All figured specimens are from Well F1-NC41.

Derivation of name:

In reference to its occurrence in the Harsha Formation.

Holotype:

A male carapace HU.208.T.15

Paratypes:

Three specimens HU.208.T.16-18

Type Locality:

F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha formation, Middle Eocene, depth 8230 ft.

Stratigraphic range:

Middle Eocene.

Material:

Six specimens were found in the Harsha Formation of Well F1-NC41 at depths of 8230-8370 ft.

Diagnoses:

A species of ***Buntonia*** characterised by its dorsal margin half separated by two longitudinal groves. Greatest height occurs at the anterior cardinal angle.

Description:

Sub-rectangular carapace in lateral view with greatest height at the anterior cardinal angle, maximum length passes below the mid-height. Anterior margin fairly rounded, posterior margin sub-rounded. The dorsal margin is slightly convex in the middle of the dorsal margin and slopes straight to the posterior margin. The ventral margin is nearly straight, curving upwards posteriorly. Lateral surface is reticulate with well developed ridges separated by longitudinal costae. The ventral half of the lateral surface has six ridges running almost parallel to the ventral margin. The dorsal half, separated by two longitudinal grooves from the ventral half, has only two small ridges at an angle to the dorsal margin. There is a small rim running along the anterior margin.

The rest of the surface is covered by costae. No internal features were seen.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♂ carapace HU.208.T.15	(Pl. 27, figs. 1-3)	529	282	223
Paratype, ♀ carapace HU.208.T.16	(Pl. 27, figs. 4-6)	457	280	247
Paratype, ♀ carapace HU.208.T.17	(Pl. 27, figs. 7-9, 11)	444	246	230
Paratype, ♀ carapace HU.208.T.18	(Pl. 29, figs. 1, 2)	445	274	220

Differences and affinities:

The present species shows some similarities to ***Buntonia aljurfae*** in general outline, but differs in having costae between the ridges and is also characterised by its coarsely pitted surface. ***Buntonia*** sp. ***A*** of the present study is closely comparable to the present species, but differs in its higher and more finely pitted surface. This species is easily distinguished from others by its surface ornamentation.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41.

Buntonia sp. *A*

(Pl. 27, figs. 10, 12)

Figured specimens:

Pl. 27, fig. 10, carapace HU.208.T.20 from depth 8050 ft., Pl. 27, fig. 12, carapace HU.208.T.21 from depth 7920 ft. All specimens are from Well D2-NC41.

Stratigraphic range:

Middle Eocene.

Material:

Only two specimens were found both in Well D2-NC41, from the Middle Eocene of the Ghalil Formation , one specimen at a drilling depth of 7920 ft and the other specimen at 8050 ft.

Description:

The carapace is triangular in lateral view, greatest height somewhat in front of the middle, greatest length below mid-point. Dorsal margin straight, sloping steeply towards the posterior with a small concave area at the dorsal margin present in front of the posterior angle. Ventral margin widely rounded, running continuously towards the anterior and posterior ends. Anterior margin obliquely rounded with antero-dorsal margin gently sloping, posterior margin truncate and lower than the anterior margin. The lateral surface is ornamented with ridges and coarse pits. A row of pits extends

from the antero-dorsal corner and continues along the anterior margin. A slight ventro-lateral swelling can be seen. A few short ridges run above the ventral margin and end posteriorly. The upper ridge begins somewhat above half of the height of the valves; the lower one, which is as long as the upper ridge, is situated at one-third of the height.

The anterior marginal zone is smooth or poorly punctate whilst the rest of the surface is ornamented by a large and strongly developed punctation. Left valve larger than the right and overlapping it strongly along the ventral, antero-dorsal and posterior margins. In dorsal view the carapace is ovate. Maximum width in the middle.

Dimensions of figured specimens (μm)*:*

		L	H	W
Carapace HU.208.T.20	(Pl. 27, fig. 10)	390	260	215
Carapace HU.208.T.21	(Pl. 27, fig. 12)	433	266	240

Differences and affinities:

The present species appears to be related to ***Buntonia hilalensis*** Helmdach & El Khoudary (1982) from the Eocene of NW Libya but the latter differs in its completely smooth surface and in having more developed ridges. In addition, the present material has narrower anterior and posterior ends. ***B. fortunata*** Apostolescu (1961) from Dahomey is similar in general outline and shape but differs in details of the lateral surface ornamentation. ***Buntonia*** sp. ***1*** Dingle (1976) resembles this species in shape but differs in its more coarsely pitted surface and more developed ridges.

Because only two carapaces were found it is left under open nomenclature.

Occurrence:

Known so far from the Middle Eocene of Well D2-NC41.

Genus ***PROTOBUNTONIA*** Grekoff, 1954

Type species: ***Protobuntonia numidica*** Grekoff, 1954

Protobuntonia sp. *A*

(Pl. 29 , figs. 3, 4)

Figured specimen:

A carapace HU.209.T.2

Locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 7510 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one carapace was found In Well B1-NC41 section from the Ghalil Formation at a drilling depth of 7510 ft.

Diagnosis:

A species of ***Protobuntonia*** in which the carapace is coarsely pitted, except for a smooth small posterior area.

Description:

In lateral view, carapace small, elongate to sub-rectangular with greatest height in front of the middle and maximum length at about the middle. The anterior is broadly and obliquely rounded. The posterior margin is narrow with a pointed end. The dorsal margin is nearly straight and slopes gently to the posterior end. The ventral margin is slightly concave. Dorsal and ventral margins converge towards the acutely pointed posterior end. The lateral surface is coarsely pitted, except for a smooth area at the posterior margin. The pits are elongate and concentrically arranged and separated by longitudinal ribs in the ventral marginal area. The anterior and dorsal regions are covered by fine pits, while the rest of the surface is ornamented by a coarsely developed punctation. A narrow, shallow sulcus borders the wide antero-

marginal area parallel to the margin. A small depression lies just behind the eye tubercle.

In dorsal view, the carapace is ovate with slightly compressed ends, maximum width lies just in the middle of the carapace. The dorsal surface is smooth or poorly pitted along the hinge line in both valves. Internal details were not seen.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.209.T.2	(Pl. 29, figs.3, 4)	349	189	160

Differences and affinities:

Buntonia (***Protobuntonia***) n. sp ***1*** described by Salahi (1966) from the Palaeocene of Libya, is similar to this species but Salahi's species differs in having a more pointed posterior end, more distinct posterior cardinal angle and smooth surface. ***Buntonia*** (***Protobuntonia***) cf. ***Buntonia*** (***Protobuntonia***) ***numidica*** (Grekoff, 1954) as illustrated by Salahi (1966) shows some resemblance to ***Protobuntonia*** sp. ***A*** in general outline , but the latter species differs in having a short depression lying just behind the eye tubercle and in details of the ornamentation.

The present species also shows similarities to ***Buntonia tenuipunctata*** Apostolescu (1961) from the Palaeocene of Dahomey, but Apostolescu's species differs in its smooth surface, except for a coarsely pitted region in the muscle scar area and in having a less pointed posterior end. ***Protobuntonia nakkadi*** Bassiouni (1970) as figured by Donze ***et al.***, (1982) from Tunisia is similar to the present species, but differs in having a concave ventral margin, a finely pitted surface and also a more pointed posterior end.

Occurrence:

This species is recorded from the Middle Eocene of Well B1-NC41.

Genus *ISOBUNTONIA* Apostolescu, 1961

Type species: *Isobuntonia harpa* Apostolescu, 1961

Isobuntonia pseudotuberata (Apostolescu and Magné, 1956)

(Pl 29, figs. 5-12)

1956 *Cythereis pseudotuberata* Apostolescu & Magné, p. 342, pl. 1, figs. 16, 17.

1981 *Isobuntonia pseudotuberata* (Apostolescu & Magné); Mechmeche, p. 57, pl. 4, figs. 16-20.

Figured specimens:

Pl. 29, figs. 5, 6, male carapace HU.209.T.3, Pl. 29, figs. 7, 12, male carapace HU.209.T.4. From Well K1-NC41 at depth 9590 ft., Pl. 29, figs. 8, female carapace HU.209.T.5, Pl. 29, figs. 9, 11, female carapace HU.209.T.6. From Well K1-NC41 at depth 9610 ft., Pl. 29, fig. 10, female carapace HU.209.T.7. From Well B1-NC41 at depth 7950 ft.

Type Locality:

F 475, Algeria.

Type Horizon:

Upper Lutetian.

Stratigraphic range:

Lower and Middle Eocene.

Material:

9 specimens. In Well K1-NC41, three specimens were found in the Harsha Formation at drilling depths of 9590-9610 ft. In Well B1a-137, four specimens were found in the Harsha Formation at 7270 and 7330 ft. In well B1-NC41, two specimens were found in the Ghalil Formation at a drilling depth of 7950 ft.

Description:

Large-sized carapace, elongate, subrectangular in lateral view, greatest height through the anterior cardinal angle, greatest length at mid-height. Dorsal margin straight but appears to be convex due to the overlap of the dorsal ridge which is more

conspicuous in the left valve, gently sloping backwards in the posterior half with anterior and posterior cardinal angles. The latter is more prominent in some specimens. Ventral margin straight, slightly concave in the male, convex mid-ventrally, curving upwards posteriorly in the female. Anterior end, obliquely rounded, gently sloping in the upper part with a trace of denticles in the lower half, posterior end narrower, slightly concave in the upper part, curving down in the lower part and decorated with small spines. Lateral surface characterised by three ridges. A prominent marginal rim runs parallel to the anterior margin. The ventral ridge originates at the antero-ventral corner and runs longitudinally above the ventral margin to join the middle ridge at its posterior end. The dorsal ridge starts from behind the eye tubercle and runs above the dorsal margin to terminate posteriorly. The median ridge is elegantly curved, in a convex upwards arc from the middle of the anterior margin in the females and parallel to the ventral ridge in the male. The rest of the surface is covered with small rounded broken nodes in some places. Left valve larger than the right overlapping along the anterior margin but more conspicuously along the ventral margin. Eye tubercle present.

Sexual dimorphism is strongly pronounced, the males more elongate than the presumed females. In dorsal view, the male is slimmer than the female. Internal features were not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.209.T.3	(Pl. 29, figs. 5, 6)	900	460	421
♀ carapace HU.209.T.5	(Pl. 29, fig. 8)	830	490	450
♀ carapace HU.209.T.7	(Pl. 29, fig. 10)	820	480	450
♂ carapace HU.209.T.4	(Pl. 29, figs. 7, 12)	947	484	460
♀ carapace HU.209.T.6	(Pl. 29, figs. 9, 11)	830	457	420

Remarks:

This species was originally described as a new species of ***Cythereis*** by Apostolescu & Magné (1956) from the Middle Eocene of Algeria. Mechmeche

(1981) found this species in the Eocene of Tunisia and transferred it to ***Isobuntonia*** Apostolescu (1961). The Libyan specimens are identical in general character with this species and in particular with the specimens figured by Mechmeche (1981).

Occurrence:

This species occurs in the Middle Eocene of Well B1-NC41, Well B1a-137 and Well K1-NC41, from the Middle Eocene of Algeria and from the Lower Eocene of Tunisia.

Genus ***SOUDANELLA*** Apostolescu, 1961

Type species: ***Soudanella laciniosa laciniosa*** Apostolescu, 1961

Soudanella libyaensis sp. nov.

(Pl. 32, figs. 1-9, 11,12)

Figured specimens:

Pl. 32, fig. 1, female carapace, holotype HU.209.T.23, Pl. 32, fig. 2, female carapace, paratype HU.209.T.24, Pl. 32, fig. 3, male carapace, paratype HU.209.T.25, Pl. 32, fig. 4, male carapace, paratype HU.209.T.26, Pl. 32, fig. 5, male carapace, paratype HU.209.T.27, Pl. 32, fig. 6, female carapace, paratype HU.209.T.28, Pl. 32, fig. 7, female carapace, paratype HU.209.T.29, Pl. 32, fig. 8, female carapace, paratype HU.209.T.30 , Pl. 32, figs. 9, 12, male carapace, paratype HU.210.T.1 , Pl. 32, fig. 11, male carapace, paratype HU.210.T.2. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in Libya.

Holotype:

A female carapace HU.209.T.23

Paratypes:

Nine specimens HU.209.T.24-30, HU.210.T.1, 2

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore of Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7590 ft.

Stratigraphic range:

Middle Eocene.

Material:

447 specimens. In Well B1-NC41, 380 specimens were found in the Ghalil Formation at drilling depths of 7510-7930 ft. In Well D2-NC41, 54 specimens (including 2 broken carapaces) were reported from the Ghalil Formation at depths of 7880-8140 ft. In Well L1-NC41, 13 specimens were found in the Harsha Formation at depths of 9120-9600 ft.

Diagnosis:

A species of ***Soudanella*** Apostolescu 1961 with marked sexual dimorphism, carapace ovate in lateral view, surface ornamented with ridges.

Description

In lateral view, carapace elongate ovate, with its greatest height at the anterior cardinal angle, posterior end evenly and more narrowly rounded, slightly concave in the upper part. It is decorated with a few spines in the lower region. Anterior end strongly rounded and extended below sloping gently in the antero-dorsal corner with a trace of denticulation. Dorsal margin nearly straight sloping steeply towards the posterior. Ventral margin slightly concave anteriorly in the right valve, slightly convex in the left valve, curving smoothly towards the posterior end. Greatest length lies at the mid-height.

Lateral surface ornamented by longitudinal parallel ridges of different lengths. These converge towards the posterior end. The space between these ridges is coarsely pitted. A thick marginal rim runs along the anterior margin. Left valve larger than the right and overlapping the latter along the anterior and ventral margins.

In dorsal view the carapace is ovate, sloping more steeply towards the posterior end with a rounded anterior end and compressed posterior end. Maximum width in the posterior half. Sexual dimorphism strongly marked, the presumed males more elongate and narrower than the presumed females.

Only closed carapaceswere found in this study so the internal features were not seen.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♀ carapace HU.209.T.23	(Pl. 32, fig. 1)	623	361	295
Paratype, ♀ carapace HU.209.T.24	(Pl. 32, fig. 2)	625	320	305
Paratype, ♂ carapace HU.209.T.25	(Pl. 32, fig. 3)	608	324	260
Paratype, ♂ carapace HU.209.T.26	(Pl. 32, fig. 4)	671	330	298
Paratype, ♂ carapace HU.209.T.27	(Pl. 32, fig. 5)	616	328	235
Paratype, ♀ carapace HU.209.T.28	(Pl. 32, fig. 6)	676	328	320
Paratype, ♀ carapace HU.209.T.29	(Pl. 32, fig. 7)	615	369	290
Paratype, ♀ carapace HU.209.T.30	(Pl. 32, fig. 8)	630	353	295
Paratype, ♂ carapace HU.210.T.1	(Pl. 32, figs. 9, 12)	642	370	371
Paratype, ♂ carapace HU.210.T.2	(Pl. 32, fig. 11)	642	310	271

Differences and affinities:

Soudanella libyaensis is closely related to ***S. laciniosa laciniosa*** Apostolescu (1961) originally described from the Palaeocene of the Ivory coast. Recently this species was recorded from the Palaeocene of Nigeria by Foster ***et al.***, (1983). It differs in having less developed ridges and lacking the pits between them. It also has a very distinctive narrow furrow which runs parallel to the anterior margin from the antero-dorsal corner to the antero-ventral corner. ***S. nebulosa*** Apostolescu (1961) from Dahomey is easily distinguished from the present species by its more coarsely pitted surface in the anterior half and is also strongly pitted between the ridges.

The Libyan specimens differ from *S. laciniosa reticulata* Apostolescu (1961) from the Palaeocene of Dahomey in lacking the narrow furrow which runs parallel to the anterior margin, and they have a straighter dorsal margin.

Occurrence:

This species is known from the Middle Eocene of Well B1-NC41, Well D2-NC41 and Well L1-NC41.

Soudanella ghalilae sp. nov.

(Pl. 32, fig. 10, Pl. 33, figs. 1-7)

Figured specimens:

Pl. 32, fig. 10, female carapace, paratype HU.210.T.3, Pl. 33., fig. 1, female carapace, holotype HU.210.T.4, Pl. 33 , fig. 2, female carapace, paratype HU.210.T.5, Pl. 33, fig. 3, female carapace, paratype HU.210.T.6. From Well B1-NC41 at depth 7670 ft., Pl. 33, fig. 4, male carapace, paratype HU.210.T.7. From Well B1-NC41 at depth 7590 ft., Pl. 33, figs. 5, 6, male carapace, paratype HU.210.T.8 , Pl. 33, fig. 7, male carapace, paratype HU.210.T.9. From Well B1-NC41 at depth 7790 ft.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A female carapace HU.210.T.4

Paratypes:

Six specimens HU.210.T.3, 5-9

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7670 ft.

Stratigraphic range:

Middle Eocene.

Material:

43 specimens. In Well B1-NC41, 43 specimens were found from the Ghalil Formation at depths of 7490-7690 ft.

Diagnosis:

The present new species is characterised by medium size, dorsal and ventral margins are almost straight, lateral surface has 10-15 longitudinal ridges.

Description:

Carapace elongate, pyriform in lateral view. Anterior margin broadly rounded, gently curved at the antero-dorsal margin, posterior margin truncate. Dorsal margin almost straight, sloping gently to the posterior end, ventral margin concave anteriorly, slightly convex at the postero-ventral corner. Dorsal and ventral margins converge towards the posterior. A marginal rim is present along the anterior margin, continuing and finishing ventrally. Greatest height occurs at the anterior cardinal angle, greatest length passes through mid-point. Left valve slightly larger than the right, overreaching along the anterior, ventral and postero-dorsal margins. Sexual dimorphism present, the presumed females shorter and higher than the presumed males. Lateral surface has 10-15 longitudinal ridges, starting nearly from the muscle scar area and running backwards to the posterior end. The rest of the surface is smooth. A small depression occurs behind the cardinal angle. The anterior margin in its lower half has small denticles which are sometimes indistinct because of the thickening of the antero-marginal rim. The posterior margin bears 4-6 small denticles.

In dorsal view, the carapace is convex with maximum width at one-third of the length from the anterior end, dorsal margin sloping gently towards the posterior end. Anterior end compressed and the males are slimmer than the females. No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm):

		L	H	W
Paratype, ♀ carapace HU.210.T.3	(Pl. 32, fig. 10)	625	250	305
Holotype, ♀ carapace HU.210.T.4	(Pl. 33, fig. 1)	597	358	300

Paratype, ♀ carapace HU.210.T.5	(Pl. 33, fig. 2)	628	345	314
Paratype, ♀ carapace HU.210.T.6	(Pl. 33, fig. 3)	597	358	295
Paratype, ♂ carapace HU.210.T.7	(Pl. 33, fig. 4)	681	340	272
Paratype, ♂ carapace HU.210.T.8	(Pl. 33, figs. 5, 6)	671	382	260
Paratype, ♂ carapace HU.210.T.9	(Pl. 33, fig. 7)	611	298	245

Differences and affinities:

Soudanella ghalilae shows some similarities to ***S. libyaensis*** in general outline and shape but differs in the ornamentation of the lateral surface. This species is also similar to ***S. dolabrata*** Al-Furaih (1984) originally described from the Maastrichtian of the Aruma Formation, Saudi Arabia. Al-Furaih's species differs in having 5-6 longitudinal grooves between its narrow ribs. In each groove there is a row of pits in the central area of the carapace, it also has a more pointed posterior.

S. ghalilae resembles ***S. laciniosa triangulata*** described from Senegal by Apostolescu (1961) but the latter is distinguished in having less longitudinal ridges on the lateral surface, a more produced and pointed posterior end and the left valve strongly overlaps the right along the ventral margin. The Libyan specimens shows some similarities to ***Buntonia paucisulcata*** Al-Furaih 1980 from the Middle Palaeocene of Saudi Arabia. Recently (1984) the same author transferred it to ***Soudanella*** but the latter differs in its posterior outline and also has a shallow depression parallel to the anterior margin.

Occurrence:

Soudanella ghalilae occurs in the Middle Eocene of Well B1-NC41.

Soudanella tarabulusensis sp. nov.

(Pl. 33, figs. 8-12)

Figured specimen:

Pl. 33, fig. 8, female carapace, paratype HU.210.T.10, Pl. 33, fig. 9, female carapace, holotype HU.210.T.11. From Well B1-NC41 depth 7470 ft., Pl. 33, fig. 10,

female carapace, paratype HU.210.T.12. From Well B1-NC41 depth 7470 ft., Pl. 33, fig. 11, female carapace, paratype HU.210.T.13, Pl. 33, fig. 12, female carapace paratype HU.210.T.14. From Well B1-NC41 at depth 7470 ft. All specimens are from Well B1-NC41.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A female carapace HU.210.T.11

Paratypes:

Four specimens HU.210.T.10, 12-14

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7470 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

30 specimens. In Well B1-NC41, 29 specimens were found in the Ghalil Formation at depths of 7370-7530 ft. In Well D2-NC41, only one specimen was found in the Ghalil Formation at a depth of 7760 ft.

Diagnosis:

A species of ***Soudanella*** characterised by medium size, oval lateral view, both valves with a rounded anterior cardinal angle and a more distinct posterior one surface mostly smooth.

Description:

Carapace oval in lateral outline with the greatest height at the anterior cardinal angle, greatest length occurs at below mid-height. The anterior margin is obliquely rounded, but is slightly sharper in the dorsal half. Posterior margin truncate, its ventral part is broadly and regularly rounded with small denticles and is slightly concave in

the upper part. Dorsal margin almost straight with a rounded anterior cardinal angle and a more distinct posterior one. Ventral margin, strongly concave in front of the middle in the right valve and is nearly straight, curving upwards posteriorly in the left valve. Left valve larger than the right and overlaps along the entire margin with the exceptions of the lower anterior half and the middle of the posterior end. The overlap is most pronounced along the ventral margin.

The lateral surface is mostly smooth except in the posterior half which has very weak longitudinal ribs. Three rows of pits are arranged almost parallel to the ventral margin. A small depression lies below and behind the cardinal anterior angle. Antero-marginal rim runs along the anterior and ventral margins. Anterior margin is decorated with a few small denticles in the lower part. Eye tubercle present but weak. In dorsal view carapace compressed and ovoid with its maximum width in the posterior half.

Dimensions of figured specimens(μm)**:**

		L	H	W
Paratype, ♀ carapace HU.210.T.10	(Pl. 33, fig. 8)	584	320	246
Holotype, ♀ carapace HU.210.T.11	(Pl. 33, fig. 9)	606	363	280
Paratype, ♀ carapace HU.210.T.12	(Pl. 33, fig. 10)	594	350	297
Paratype, ♀ carapace HU.210.T.13	(Pl. 33, fig. 11)	600	428	285
Paratype, ♀ carapace HU.210.T.14	(Pl. 33, fig. 12)	604	365	270

Differences and affinities:

Soudanella tarabulusensis is similar to ***S. laciniosa triangulata*** Apostolescu (1961) in some respects but differs in having a truncated posterior margin and a more rounded end. Also the two species can be separated by the ornamentation of the lateral surface. This species differs from ***Soudanella ghalilae*** in the outline of the anterior and posterior ends and in its less ornamented surface.

Occurrence:

This species is known so far from the Middle Eocene of Well B1-NC41, and from the Upper Eocene of Well D2-NC41.

Genus *ASYMMETRICYTHERE* Bassiouni, 1971

Type species: ***Asymmetricythere hiltermanni*** Bassiouni, 1971

Asymmetricythere nova sp. nov.

(Pl. 30, fig. 1-12)

Figured specimens:

Pl. 30, figs. 2, 3, 7, 12, female carapace, holotype HU.209.T.9, Pl. 30, figs. 1, 5, female carapace, paratype HU.209.T.8. From Well F1-NC41 at depth 8180 ft., Pl. 30, figs. 4, 6, male carapace, paratype HU.209.T.10. From Well F1-NC41 at depth 8340 ft., Pl. 30 , figs. 8, 11, female carapace, paratype HU.209.T.11, Pl. 30, figs. 9, 10, male carapace, paratype HU.209.T.12. From Well F1-NC41 at depth 8260 ft.

Derivation of name:

L. ***nova***: new

Holotype:

A female carapace HU.209.T.9

Paratypes:

Four specimens HU.209.T.8, 10-12

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Stratigraphic range:

Middle Eocene.

Material:

23 specimens. In Well B1a-137, one specimen was found in the Dahman Formation at a drilling depth of 6440 ft. In Well F1-NC41, 12 specimens were recorded, seven specimens from the Samdun Formation at 7970 and 8060 ft., and five in the Harsha Formation at depths of 8180-8340 ft. In Well C1-NC41, one specimen

has been found in the Harsha Formation at a depth of 7810 ft. In Well K1-NC41, nine specimens were recovered, three in the Samdun Formation at depths of 8310 and 8370 ft., three specimens in the Dahman Formation at 8564 ft., and three specimens in the Harsha Formation at drilling depths of 8740-8760 ft.

Diagnosis:

Species of the genus ***Asymmetricythere*** Bassiouni, 1971 with subovate carapace in lateral view, surface consists of a combination of reticulation and ridges.

Description:

Carapace elongate and subovate in lateral view. Anterior end obliquely rounded with small denticles running along the ventral half, posterior end slightly concave dorsally with its angle at mid-height in the males and above mid-height in the females, decorated with four spines along its ventral half in both sexes. Dorsal margin almost straight, slightly obscured by inflated median area. Ventral margin concave anteriorly in the right valve, slightly convex, curving upwards posteriorly and anteriorly in the left valve. Greatest height at the anterior cardinal angle, greatest length occurs nearly at the mid-height in the females, slightly above in the males. Left valve larger than the right and overlapping the latter strongly along the ventral and antero-dorsal margins, less conspicuously along the posterior end. Sexual dimorphism is well pronounced, the presumed males more elongate and less high than the presumed females. Lateral surface strongly reticulate with a smooth area along the anterior and posterior margins in some specimens. In the ventral half there are four ridges that run straight and subparallel from nearly the antero-ventral area to the postero-ventral corner.

A median ridge starts almost at the anterior margin and runs straight to terminate posteriorly. In the dorsal half the surface is coarsely pitted. Two small ridges begin at above mid-height in the posterior half, then run parallel to each other and curve convexly towards the posterior end to join the other ridges mid-posteriorly. The space between all the ridges is coarsely pitted. Eye tubercle present.

In dorsal view, carapace sublanceolate in the males and subpyriform in the females. Maximum width in the anterior half. Internal features unknown.

Dimensions of figured specimens (μm)**:**

	L	H	W
Holotype, ♀ carapace HU.209.T.9 (Pl. 30, figs. 2, 3, 7, 12)	688	376	352
Paratype, ♀ carapace HU.209.T.8 (Pl. 30, figs. 1, 5)	700	366	350
Paratype, ♂ carapace HU.209.T.10 (Pl. 30, figs. 4, 6)	720	352	335
Paratype, ♀ carapace HU.209.T.11 (Pl. 30, figs. 8, 11)	700	400	375
Paratype, ♂ carapace HU.209.T.12 (Pl. 30, figs. 9, 10)	741	366	310

Differences and affinities:

Asymmetricythere nova is similar to ***A. valvulana*** Finger (1983) in general outline but the latter differs in having a more produced and pointed posterior end, more distinct cardinal angles and is also characterised by its poorly developed ridges that cross the median area. It shows some similarities to ***A. hiltermanni*** Bassiouni (1971) originally described from the Eocene of Egypt but Bassiouni's species differs in having more and longer ridges all over the surface and lacks a smooth area along the anterior and posterior margins. ***A. asymmetrella*** Bassiouni (1971) also differs in its distinctive posterior outline and is slightly different in its ornamentation.

Occurrence:

This species is found in the Middle Eocene of Well B1a-137, Well K1-NC41, Well C1-NC41 and Well F1-NC41.

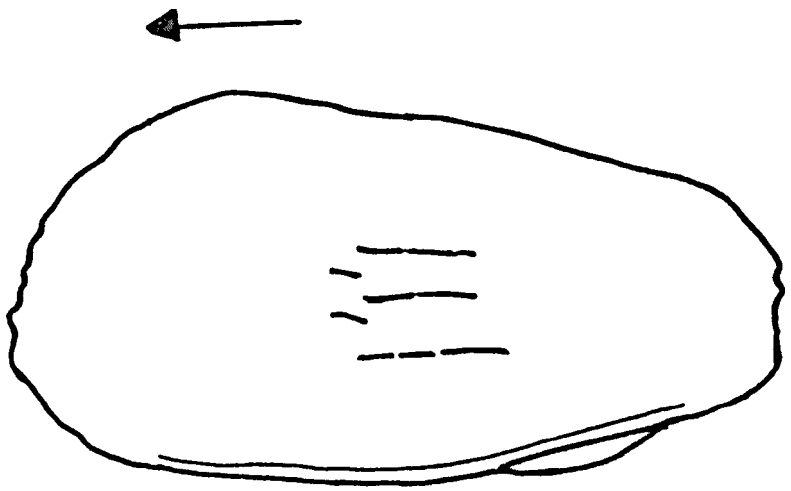
Asymmetricythere fossorum sp. nov.

(Pl. 31, figs. 1-6)

1981 ***Asymmetricythere yousefi*** Bassiouni, Mechmeche (1981) non Bassiouni (1971), p. 49, pl. 2, figs. 11-13.

Figured specimens:

Pl. 31, fig. 1, male carapace, holotype HU.209.T.13 , Pl. 31, figs. 2, 6, male carapace, paratype HU.209.T.14, Pl. 31, figs. 3, 5, male carapace, paratype HU.209.T.15, Pl. 31, fig. 4, female carapace, paratype HU.209.T.16. All specimens from Well F1-NC41 at depth 7970 ft. except fig. 4 from depth 8280 ft.



X 110

Fig. 5.6 *Asymmetricythere fossorum* sp. nov. Holotype HU.209.T.13, carapace from left, showing the surface ornamentation.

Derivation of name:

L. *fossa*: a ditch or trench in reference to the slit like ornamentation in the muscle scar area.

Holotype:

A male carapace HU.209.T.13

Paratypes:

Three specimens HU.210.T.14-16

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 7970 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

495 specimens. In Well B1-NC41, 121 specimens were found, 11 specimens in the Samdun Formation at drilling depths of 7210-7410 ft., and 110 specimens in the Ghalil Formation at 7430-7830 ft. In Well K1-NC41, 99 specimens were recorded, 46 from the Samdun Formation at depths of 8270-8450 ft., 10 specimens from the Dahman Formation at a drilling depth of 8564 ft., and 43 from the Harsha Formation at 8740-9450 ft. In Well H1-NC41, 20 specimens were found in the Samdun Formation at drilling depths of 9660-9980 ft. In Well F1-NC41, 195 specimens were recovered, 155 from the Samdun Formation at depths of 7870-8080 ft., and 80 specimens from the Harsha Formation at 8180-8350 ft. In Well C1-NC41, 53 specimens were found, 13 specimens in the Samdun Formation at drilling depths of 7400-7480 ft., and 40 specimens in the Harsha Formation at depths of 7690-7470 ft. In Well L1-NC41, seven specimens were found in the Harsha Formation at 9120 and 9460 ft.

Diagnosis:

A. fossorum is characterised by its very elongate shape and its surface ornamentation of three slit-like pits in the muscle scar area.

Description

Carapace elongate-subrectangular in lateral view with straight dorsal margin sloping gently towards the posterior end, ventral margin straight to slightly concave anteriorly, curving upwards at the postero-ventral margin. Anterior end symmetrically

rounded, decorated with small spines which all lie below two-thirds of its height, posterior end subtriangular, smooth in the upper part and decorated with three short tubercles in the lower part. Greatest height occurs just at the anterior cardinal angle, maximum length lies above mid-height. The lateral surface is ornamented by three slit-like pits which are distributed longitudinally in the muscle scar area. There are three longitudinal slits that run from the antero-dorsal corner to the postero-ventral corner. The rest of the surface is smooth with a very few pits scattered on the surface. Eye tubercle present with small subrounded sulcus situated behind it. Left valve larger than the right and overlapping it along the entire margin with the exception of the lower anterior half.

In dorsal view, carapace ovate with maximum width occurring just behind the middle. In ventral view, the denticles of the anterior margin and the ventral longitudinal slits are clearly seen. Only closed carapaces were found so it was not possible to see internal details. Sexual dimorphism present, the presumed females less elongate and narrow than the presumed males.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.209.T.13	(Pl. 31, fig. 1)	947	473	375
Paratype, ♂ carapace HU.209.T.14	(Pl. 31, figs. 2, 6)	900	420	460
Paratype, ♂ carapace HU.209.T.15	(Pl. 31, figs. 3, 5)	927	463	400
Paratype, ♀ carapace HU.209.T.16	(Pl. 31, fig. 4)	800	400	350

Differences and affinities:

The present species is closely related to ***Asymmetricythere elongata*** in general outline and shape but the two species can be easily separated by the ornamentation of the lateral surface. Mechmeche (1981) recorded specimens from the Eocene of Tunisia which she called ***A. yousefi*** Bassiouni (1971) which are identical with the present species. Her specimens are different from Bassiouni's species in the surface ornamentation, so therefore, her forms are considered as synonymous with ***A. fossorum.*** This species shows some similarities to ***Asymmetricythere*** sp. Carbonnel

(1986) from the Senegal and Guinea Bissau but Carbonnel's species is smaller, has a left valve that strongly overlaps the right all around and also differs in the outline in the dorsal view.

Occurrence:

Known so far from the Middle Eocene of Well H1-NC41, Well C1-NC41 and Well L1-NC41, Well F1-NC41, and from the Middle and Upper Eocene of Well B1-NC41, Well K1-NC41 and from the Middle and Upper Eocene of Tunisia.

Asymmetricythere elongata sp. nov.

(Pl. 31, figs. 7-12)

Figured specimens:

Pl. 31, fig. 7, female carapace, paratype HU.209.T.17, Pl. 31, fig. 8, male carapace, paratype HU.209.T.18, Pl. 31, fig. 9, male carapace, paratype HU.209.T.19, Pl. 31, fig. 10, male carapace, holotype HU.209.T.20, pl. 31, fig. 12, male carapace, paratype HU.209.T.22. From Well B1-NC41 at depth 7510 ft., Pl. 31, fig. 11, male carapace, paratype HU.209.T.21. From Well B1-NC41 at depth 7530 ft.

Derivation of name:

In reference to its elongate from its appearance in side view.

Holotype:

A male carapace HU.209.T.20

Paratypes:

Five specimens HU.209.T.17-19, 21-22

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore, Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7510 ft.

Stratigraphic range:

Middle Eocene.

Material:

35 specimens. In Well C1-NC41, 14 specimens were found in the Harsha Formation at drilling depths of 7810-8000 ft. In Well B1-NC41, 19 specimens were recorded in the Ghalil Formation at depths of 7470-7670 ft. In Well B1a-137, two specimens were found in the Dahman Formation at a drilling depth of 6440 ft.

Diagnosis:

A species of ***Asymmetricythere*** characterised by its easily distinguished sexual dimorphism and 6-8 shallow longitudinal grooves separated by longitudinal ribs.

Description:

A large sized, carapace subrectangular to subquadrate in lateral view, greatest height at the anterior cardinal angle, maximum length above mid-point. Dorsal margin straight sloping backwards towards the posterior end, with rounded anterior and posterior cardinal angles. Ventral margin concave anterior to the middle, slightly convex posteriorly. Anterior end obliquely rounded with a thin marginal rim running along the anterior and ventral margins terminating at the postero-ventral corner. Posterior end narrowly rounded, slightly concave in the upper part of the right valve in the females and rounded and produced subdorsally in the males.

Left valve larger than the right and overlapping it along the anterior and ventral margins. Lateral surface ornamented with 6-8 shallow longitudinal grooves separated by longitudinal costae in the posterior half. These originate anteriorly to the middle and run posteriorly, terminating at one-third of the length from the posterior end. There are three ribs that run parallel to the ventral margin. Anterior and posterior ends are decorated with small denticles; the rest of the surface is smooth. Eye tubercle distinct with a shallow depression behind it. Sexual dimorphism present, the presumed males more elongate and less high than the presumed females.

In dorsal view, carapace lenticular in shape. Maximum width at the middle with compressed anterior and posterior ends. Internal details were not seen as no single valves were obtained.

Dimensions of figured specimens (μm):

		L	H	W
Paratype, ♀ carapace HU.209.T.17	(Pl. 31, fig. 7)	926	515	400
Paratype, ♂ carapace HU.209.T.18	(Pl. 31, fig. 8)	968	465	421
Paratype, ♂ carapace HU.209.T.19	(Pl. 31, fig. 9)	989	489	420
Holotype, ♂ carapace HU.209.T.20	(Pl. 31, fig. 10)	857	419	425
Paratype, ♂ carapace HU.209.T.21	(Pl. 31, fig. 11)	968	465	431
Paratype, ♂ carapace HU.209.T.22	(Pl. 31, fig. 12)	978	473	400

Differences and affinities:

Asymmetricythere elongata closely resembles ***A. yousefi*** Bassiouni (1971) from the Eocene of Egypt in general outline. The latter has better developed ridges, is narrower in the posterior region and the anterior and posterior margins are decorated with long spines. Bassiouni's species is also much smaller than ***A. elongata***, and the lateral surface ornamentation is also different.

Occurrence:

This species is recorded from the Middle Eocene of Well C1-NC41, Well B1-NC41 and Well B1a-137.

Subfamily Campylocytherinae Puri, 1960

Tribe LEGUMINOCYTHERINI Howe, 1961

Genus ***LEGUMINOCYTHEREIS*** Howe 1936

Type species: ***Leguminocythereis scarbaeus*** Howe & Law 1936

Leguminocythereis lokossaensis Apostolescu, 1961

(Pl. 34, figs. 1-4)

1961 ***Leguminocythereis lokossaensis*** Apostolescu, p. 823-824, pl. X, figs. 184-186.

1963 ***Leguminocythereis lokossaensis*** Apostolescu; Barsotti, p. 1527, pl. 2, fig. 16.

1966 ***Leguminocythereis lokossaensis*** Apostolescu; Salahi, p. 16-17, pl. 4, figs. 15-

17.

1966 ***Leguminocythereis*** n. sp. ***2*** Salahi, p. 17, pl. 4, figs. 11-13.

1986 ***Leguminocythereis lokossaensis*** Apostolescu, Carbonnel; p. 87-88, pl. 3, figs. 1-3

Figured specimens:

Pl. 34, fig. 1, female carapace HU.210.T.15, Pl. 34, fig. 2, female carapace HU.210.T.16, Pl. 34, fig. 3, female carapace HU.210.T.17, Pl. 34, fig. 4, male carapace HU.210.T.18. All specimens are from the same locality and horizon.

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Late Palaeocene, depth 9380 ft.

Stratigraphic range:

Palaeocene and Lower Eocene.

Material:

11 specimens (including six broken valves) were found in Well D2-NC41 from the Al Jurf Formation at depths of 9280-9540 ft.

Description:

Medium sized, ovate carapace in lateral view, greatest height in the middle, greatest length lies at the mid-height. Anterior margin with infracurvature, posterior margin truncate and slightly produced into a caudal process, slightly concave at the postero-dorsal margin. The dorsal margin is straight in the males and slightly convex in the females. The ventral margin is strongly modified by the ventral swelling and appears convex in side view. Lateral surface is reticulate with a few longitudinal ridges. The longitudinal ridges run along the anterior and follow its general infracurvature. The rest of the surface is ornamented by rounded pits, more prominent centrally. In dorsal view, carapace ovate with maximum width at the middle.

Sexual dimorphism present, the presumed males more elongate, higher and comparatively less swollen in the ventral area. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ Carapace HU.210.T.15	(Pl. 34, fig. 1)	676	384	385
♀ Carapace HU.210.T.16	(Pl. 34, fig. 2)	723	405	384
♀ Carapace HU.210.T.17	(Pl. 34, fig. 3)	646	376	375
♂ Carapace HU.210.T.18	(Pl. 34, fig. 4)	707	384	400

Remarks:

This species was originally described by Apostolescu (1961) as ***Leguminocythereis lokossaensis*** from the Palaeocene of Togo. Barsotti (1963) found this species in the Palaeocene beds of the Sirte Basin, Libya and Salahi (1966) recorded it from the Lower Eocene of Libya. ***Leguminocythereis*** n. sp. ***2*** Salahi (1966) from the Lower and Middle Eocene of Sirte Basin, Libya is identical with this species and his species is assigned to the synonymy of ***Leguminocythereis lokossaensis***. In overall shape, size and external appearance, the material figured here agrees well with their original descriptions.

Occurrence:

This species occurs in the Late Palaeocene of Well D2-NC41, from the Palaeocene of Ivory Coast, from the Palaeocene Togo and Libya and from the Palaeocene of Senegal.

Leguminocythereis lagaghiroboensis Apostolescu, 1961

(Pl. 34, figs. 5, 6)

1961 ***Leguminocythereis lagaghiroboensis*** Apostolescu, p. 823, pl. 9, figs. 180-183.

1963 ***Leguminocythereis lagaghiroboensis*** Apostolescu; Reyment, p. 139-151, pl. III, figs.1, a-c, pl. XIII, figs. 5-10.

1963 ***Leguminocythereis lagaghiroboensis*** Apostolescu, Barsotti, p. 1527, pl. 1, figs. 11.

Figured specimen:

A carapace HU.210.T.19

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Farwah Group, Late Palaeocene, depth 9280 ft.

Stratigraphic range:

Late Palaeocene.

Material:

Only one specimen was found in Well D2-NC41 from the Farwah Group at a drilling depth of 9280 ft.

Description:

A species of ***Leguminocythereis*** with the left valve larger than the right and overlapping it along the antero-dorsal margin, along the postero-dorsal part of the margin and less developed along the ventral margin. Dorsal margin slightly convex anteriorly, sloping steeply towards the posterior end, ventral margin straight to slightly convex, curving smoothly posteriorly. The anterior margin is obliquely rounded, slopes gently at the antero-dorsal corner; the posterior margin is irregularly pointed or alternatively drawn out into a caudal process. Dorsal and ventral margins converge towards the posterior. Greatest height at one-third of the length from the anterior margin, greatest length occurs below mid-height. Lateral surface consists of irregular reticulations and concentric pits at the anterior and posterior margins.

Eye tubercle prominent. The anterior margin has traces of denticles along its ventral half. A small depression behind the eye tubercle can be seen.

Dimensions of figured specimen (μm)***:***

L	H	W

Carapace HU.210.T.19 (Pl. 34, figs. 5, 6) 893 510 470

Remarks:

This species has been recognised for a long time in Africa. ***Leguminocythereis lagaghiroboensis*** Apostolescu (1961) was originally described from the Palaeocene of the Ivory Coast. Reyment (1963) found this species in the Palaeocene of Nigeria and also mentioned that this species occurs in Libya. Barsotti (1963) recorded this species from the Palaeocene of the Sirte Basin, Libya. The material here described agrees in all respects with the original description.

Occurrence:

Known from the Late Palaeocene of Well D2-NC41, from the Palaeocene of Libya, Nigeria and Ivory Coast.

Leguminocythereis libyaensis sp. nov.

(Pl. 34, figs. 7-12)

Figured specimens:

Pl. 34, fig. 7, female, carapace HU.210.T.20, Pl. 34, fig. 9, female, carapace HU.210.T.22 From depth 8110 ft., Pl. 34, fig. 8, female, carapace HU.210.T.21. From depth 8040 ft., Pl. 34, fig. 11, female, carapace HU.210.T.24. From depth 8000 ft. All above specimens from Well D2-NC41. Pl. 34, fig. 10, male carapace, holotype HU.210.T.23, Pl. 34, fig. 12, male carapace, paratype HU.210.T.25. From Well B1-NC41 at depth 7890 ft.

Derivation of name:

In reference to its occurrence in Libya.

Holotype:

A male carapace HU.210.T.23

Paratype:

One specimen HU.210.T.25

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7890 ft.

Stratigraphic range:

Middle Eocene.

Material:

106 specimens. In Well B1-NC41, 55 specimens were found in the Ghalil Formation at a drilling depths of 7570-7910 ft. In Well D2-NC41, 10 specimens were recorded from the Ghalil Formation at 8060-8225 ft. In Well C1-NC41, 12 specimens were found in the Harsha Formation at depths of 7810-7970 ft. In Well L1-NC41, 29 specimens were found in the Harsha Formation at drilling depths of 9120-9540 ft.

Diagnosis:

A species of ***Leguminocythereis*** with the carapace strongly inflated ventrally, posterior end strongly concave in the upper part.

Description:

Medium to large size, subrectangular carapace in side view with the greatest height medially in the males and at the antero-dorsal corner in the females, greatest length occurs in the middle. Anterior margin obliquely rounded and strongly extended below, denticulate ventrally, posterior margin narrower, strongly concave in the upper part, truncated and nearly straight in the middle, straight and sloping down in the lower part with slight angle at the junction with the postero-ventral margin. Dorsal margin straight, sloping steeply towards the posterior end in the right valve. Dorsal margin in the left valve is convex with prominent anterior and posterior cardinal angles. Ventral margin convex at the middle, modified by the swelling and curving smoothly upwards posteriorly. The lateral surface is characterised by ribs and coarse pits. In the male, four longitudinal ribs run along the ventero-lateral swelling from the antero-ventral corner to the postero-ventral corner. From the dorsal margin, ribs radiate towards the anterior and posterior halves, at the middle of the carapace the ribs are straight.

In the female, the lateral surface is ornamented by ventral ridges. These ridges originate about one-third of the way from the anterior end and run parallel to the ventral margin and terminate nearly at the postero-ventral area. The rest of the surface is coarsely pitted except for small areas at the anterior and posterior margins, the pits are coarse centrally, elongate and rounded forming rows along the ventral ridges. Left valve larger than the right, overreaching it along the entire margin, more conspicuously along the anterior, ventral margins and the lower part of the posterior margin. Eye tubercle distinct with a small depression behind it. Sexual dimorphism is well marked, the presumed males are more elongate and higher than the presumed females. In dorsal view, the carapace has swollen sides. Maximum width and thickness lies in the middle.

Only closed carapaces were available as no single valves were obtained, it was not possible to study the internal details.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.210.T.20	(Pl. 34, fig. 7)	880	484	460
♀ carapace HU.210.T.21	(Pl. 34, fig. 8)	838	457	420
♀ carapace HU.210.T.22	(Pl. 34, fig. 9)	809	436	390
Holotype, ♂ carapace HU.210.T.23	(Pl. 34, fig. 10)	876	457	440
♀ carapace HU.210.T.24	(Pl. 34, fig. 11)	800	457	420
Paratype, ♂ carapace HU.210.T.25	(Pl. 34, fig. 12)	876	457	435

Differences and affinities:

In general outline and shape, ***Leguminocythereis libyaensis*** is closely related to ***L. sadeki*** Bassiouni (1969c) originally described from the Upper Eocene of Egypt. However, the latter differs in its more reticulate surface and also lacks the smooth areas around the anterior and posterior margins. ***L. libyaensis*** shows some similarities to ***L. lokossaensis*** Apostolescu (1961) but the latter differs in its ovate shape in lateral view, in having a more produced posterior end, more swelling ventral margin and different lateral surface ornamentation.

Occurrence:

This species is known from the Middle Eocene of Well B1-NC41, Well L1-NC41, Well D2-NC41 and Well C1-NC41.

Leguminocythereis tellilae sp. nov.

(Pl. 35, figs. 1-4)

Figured specimens:

Pl. 35 , figs.1, 3, male carapace, holotype HU.210.T.26, Pl. 35, fig. 2, female carapace, paratype HU.210.T.27, Pl. 35, fig. 4, female carapace, paratype HU.210.T.28 From Well J1-NC41 at depth 4730 ft.

Derivation of name:

From its occurrence in the Tellil Group.

Holotype:

A male carapace HU.210.T.26

Paratypes:

Two specimens HU.210.T.27, 28

Type locality:

Well J1-NC41, NW offshore Libya.

Type horizon:

Tellil Group, Eocene, depth 4730.

Stratigraphic range:

Eocene.

Material:

570 specimens. In Well B1a-137, 189 specimens were found, 23 in the Samdun Formation at depths of 6040-6320 ft., nine specimens in the Dahman Formation at a drilling depth of 6440 ft., and 157 specimens from the Harsha Formation at 6480-7330 ft. In Well F1-NC41, 232 specimens were recorded, 109 specimens from the Samdun Formation at depths of 7870-8080 ft., and 123 specimens

from the Harsha Formation at drilling depths of 8180-8570 ft. In Well C1-NC41, 109 specimens were found, 43 in the Samdun Formation at 6960-7480 ft., and 66 specimens in the Harsha Formation at drilling depths of 7690-8020 ft. In Well H1-NC41, 32 specimens were recorded, 24 from the Samdun Formation at drilling depths of 9640-10080 ft., and eight specimens from the Harsha Formation at 10420-10660 ft. In J1-NC41, eight specimens were found in the Tellil Group at drilling depths of 4730-4790 ft.

Diagnosis:

Leguminocythereis tellilae is characterised by its medium size, slightly convex dorsal margin medially, distinct eye tubercle located below the antero-dorsal margin, and marked sexual dimorphism.

Description:

In lateral view, carapace subrectangular, thick shelled, medium sized. Dorsal margin to slightly convex at the middle with well developed anterior and posterior cardinal angles. Ventral margin concave anteriorly, convex at the middle. Anterior end broadly and obliquely rounded, posterior end truncate medially, slightly concave in the upper part, curving smoothly at the postero-ventral corner.

Greatest height lies in the middle of the dorsal margin, greatest length developed at mid-height. Surface coarsely reticulate. The ventral ribs run along the ventero-lateral swelling, continue along the anterior margin and follow its general infracurvature to end below the eye tubercle. In the middle of the dorsal margin, ribs radiate towards the anterior and posterior margins. In the centre of the valves, the pits are coarser and deep, rounded and elongate forming parallel rows along the ventral area and following the anterior and dorsal ribs in their pattern.

Left valve larger than the right and overlapping the latter along the ventral, postero-dorsal and antero-dorsal margins. Eye tubercle distinct, located below the antero-dorsal corner. In dorsal view, carapace convex with maximum width medially. Sexual dimorphism strongly pronounced, the presumed females being shorter and

higher than the presumed males. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm):

		L	H	W
Holotype, ♂ carapace HU.210.T.26	(Pl. 35, figs. 1, 3)	692	353	330
Paratype, ♀ carapace HU.210.T.27	(Pl. 35, fig. 2)	676	384	365
Paratype, ♀ carapace HU.210.T.28	(Pl. 35, fig. 4)	692	384	355

Differences and affinities:

Leguminocythereis tellilae differs from all described ***Leguminocythereis*** species in its general outline and shape. It is closest to ***L. lokossaensis*** Apostolsecu (1961) but the latter differs in having coarse ridges, more produced posterior margin and is also smaller in size. In addition, the present species has a different dorsal outline.

Occurrence:

This species is found in the Middle Eocene of Well F1-NC41 and Well H1-NC41, from the Middle and Upper Eocene of Well B1a-137, Well C1-NC41, and from the Eocene of Well J1-NC41.

Family Hemicytheridae Puri, 1953

Subfamily Hemicytherinae Puri, 1953

Tribe HEMICYTHERINI Puri, 1953

Genus ***UROMUELLERINA*** Bassiouni, 1969c

Type species: ***Uromuellerina saidi*** Bassiouni, 1969c

Uromuellerina saidi Bassiouni, 1969c

(Pl. 37, Figs. 1-6, 8,9)

1969c ***Uromuellerina saidi*** n sp. Bassiouni, p. 208-210, pl. 20, figs. 1-3.

1980 ***Uromuellerina saidi*** Bassiouni; Helmdach & El Khoudary, p. 263, pl. 1 , fig. 20

Figured specimens:

Pl. 37, figs. 1, 3, female carapace HU.300.T.3, Pl. 37, figs.. 2, 4-6, 8, female carapace HU.300.T.4, Pl. 37, fig. 9, female carapace HU.300.T.5. All figured specimens are from the same locality and horizon.

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8220 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

Three specimens were found in Well F1-NC41 from the Harsha Formation at a drilling depth of 8220 ft.

Description:

In lateral view, carapace subrectangular with greatest height passing through the eye tubercle whilst the greatest length developed at below mid-height. Anterior margin broadly and obliquely rounded with well developed marginal rim which starts from the eye tubercle and runs parallel to the anterior margin. The posterior margin is obliquely truncate. The dorsal margin is nearly straight, obscured due to overreaching of the dorsal ridge with distinct anterior and posterior cardinal angles. The ventral margin is slightly concave in front of the middle.

Lateral surface strongly reticulate with about four longitudinal ridges. The dorsal ridge which starts below the eye tubercle, runs backwards projecting over the dorsal margin posteriorly, then curves down to terminate below the postero-dorsal angle. The median ridge, begins behind the subcentral tubercle, running upwards to reach the posterior marginal rim. A ventral ridge, commences above the antero-ventral corner and runs posteriorly to terminate above the ventral margin at the beginning of the posterior third. A short ridge, starts above the ventral ridge and runs

parallel to the median one and dies out before reaching the posterior marginal rim. Eye tubercle is distinct and rounded. The rest of the surface between these ridges is strongly pitted. The left valve is slightly larger than the right valve and overlaps the latter along the entire margin with the exception of the posterior end. Eye tubercle present. Sub-central tubercle present but not well developed.

In dorsal view, the carapace has rounded anterior and posterior ends, with greatest width and thickness behind the middle. No internal features were seen as no single valves were obtained.

Dimension of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.300.T.3	(Pl. 37, figs. 1, 3)	836	436	380
♀ carapace HU.300.T.4	(Pl. 37, figs. 2, 4-6, 8)	750	425	395
♀ carapace HU.300.T.5	(Pl. 37, fig. 9)	621	370	320

Remarks:

Uromuellerina saidi was described by Bassiouni (1969c) from the Upper Eocene of Egypt and also from the Upper Eocene of Al Jabal al Akhdar NE Libya, Helmdach ***et. al.***, (1980) The present material agreed well with the Bassiouni' species in overall external morphology.

Occurrence:

This species is recorded from the Middle Eocene of Well F1-NC41, from the Upper Eocene of Egypt and NE Libya.

Uromuellerina sp. ***A***

(Pl. 37, figs.. 7, 10-12)

Figured specimen:

A carapace HU.300.T.6

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8280 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one specimen was found in Well F1-NC41, from the Harsha Formation at a drilling depth of 8280 ft..

Description:

Carapace medium-sized, subrectangular in side view, maximum height at the anterior cardinal angle, greatest length below the mid-point. Anterior margin, fairly rounded, posterior margin narrowly rounded and lower than the anterior end. Dorsal margin straight, sloping gently to the posterior end; the ventral margin is slightly concave anterior to the middle, curving upwards posteriorly. The lateral surface is weakly ornamented by ridges. The ventral ridge starts from the antero-ventral corner and runs parallel to the ventral margin. The dorsal ridge, which commences below the eye tubercle, curves upwards over the dorsal margin and then slopes gently to the posterior end. A marginal rim begins at the eye tubercle and curves down parallel to the anterior margin. The eye tubercle is present but not well preserved.

The rest of the surface is coarsely pitted In dorsal view, carapace compressed with rounded anterior and posterior margins, maximum width behind the mid-point.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.300.T.6	(Pl. 37, figs. 7, 10-12)	700	378	307

Remarks:

Only one specimen was found in this study and is easily distinguished from ***Uromuellerina saidi*** Bassiouni (1969c) by its weakly developed ridges, finely reticulate surface and narrower, rounded posterior end.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41.

Tribe AURILINI Puri, 1974

Genus *POKORNYELLA* Oertli, 1956

Type species: *Cythere limbata* Bosquet, 1852

Pokornyella harshae sp. nov.

(Pl. 39, figs. 1-6)

Figured specimens:

Pl. 39, figs. 1, 4, carapace holotype HU.300.T.7, Pl. 39, figs. 2, 3, carapace paratype HU.300.T.8, Pl. 39, figs. 5, 6, carapace paratype HU.300.T.9. All specimens from the same type locality and horizon.

Derivation of name:

In reference to its occurrence in the Harsha Formation.

Holotype:

A carapace HU.300.T.7

Paratypes:

Two specimens HU.300.T.8-9

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8300 ft.

Stratigraphic range:

Middle Eocene.

Material:

Six specimens were found in Well F1-NC41 at drilling depths of 8230-8350 ft. All specimens from the Harsha Formation.

Diagnosis:

A species of ***Pokornyella*** characterised by its coarsely pitted surface, the pits being elongate and concentrically arranged; posterior end produced into a caudal process.

Description:

Medium sized carapace with semicircular outline in side view with greatest length passing through mid-height and greatest height occurring just behind the middle. Carapace inflated ventrally. Anterior margin is almost continuous with the dorsal margin and forms a subcircular arc, posterior margin narrower, concave in the upper part, produced into a caudal process in the middle and joining the ventral margin obliquely. Dorsal margin in the right valve straight, sloping gently towards the posterior end, in the left valve dorsal margin slightly convex mid-dorsally. Anterior and posterior cardinal angle present, more prominent in the left valve.

Surface coarsely pitted, the pits being elongate and concentrically arranged, separated by longitudinal ribs in the ventral area. There is a small smooth area along the anterior and posterior end. A weak prolongation is developed in some specimens at the postero-ventral margin. Left valve larger than the right and overlapping it, more conspicuously at the antero-dorsal, postero-dorsal and ventral margins. Eye tubercle small and rounded.

In dorsal view the carapace is convex with compressed anterior end and slightly pointed posterior end. Maximum width and thickness lies the middle. Sexual dimorphism was not observed.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, carapace HU.300.T.7	(Pl. 39, figs. 1, 4)	766	391	380
Paratype, carapace HU.300.T.8	(Pl. 39, figs. 2, 3)	625	375	369
Paratype, carapace HU.300.T.9	(Pl. 39, figs. 5, 6)	666	375	368

Differences and affinities:

This species shows some similarities to ***Pokornyella ventricosa*** (Bosquet, 1852) as figured by Ducasse ***et al.***, (1985) but the latter differs in having a more

convex dorsal margin in the left valve whilst it is straight in the Libyan material. In addition, ***P. harshae*** has a less reticulate surface with a smooth narrow zone around the anterior margin. ***P. harshae*** is similar to ***Pokornyella*** cf. ***ventricosa*** (Bosquet, 1852) as figured by Ducasse *et al.*, (1985), but the latter has a more produced posterior margin and lacks the smooth area around the anterior margin.

Occurrence:

This species is recorded so far from the Middle Eocene of Well F1-NC41.

Genus *MARTINICYTHERE* Bassiouni, 1969c

Type species: ***Martinicythere samalutensis*** Bassiouni, 1969c

Martinicythere samalutensis samalutensis Bassiouni, 1969c

(Pl. 35, figs. 5-7)

1969c ***Martinicythere samalutensis samalutensis*** Bassiouni, p. 217, pl. 18, figs. 8-11, pl. 19, fig. 8-10.

1979 ***Martinicythere samalutensis*** Bassiouni, Cronin & Khalifa; p. 404, pl. 1, figs. 11-12.

Figured specimen:

A carapace HU.300.T.10

Locality:

Well F1-NC41, Tarabulus, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8180 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

One carapace was found in Well F1-NC41 from the Harsha Formation at a drilling depth 8180 ft.

Description:

The carapace is elongate and subrectangular in lateral view, with greatest height at a fifth of the length adjacent to the eye tubercle. Greatest length passes through the mid-height. The anterior margin is symmetrically rounded, decorated with two rows of small spines and denticles. The first row consists of about 15 marginal denticulations, the second row consists of 9 small tubercles occurring over the anterior marginal rim. The posterior margin is sub-triangular, slightly rounded in the middle and smooth in the upper part, decorated with a row of fine denticles in the lower part. The dorsal margin is straight with pointed spines running along it. The ventral margin is nearly straight but curves upwards gently to the posterior area. Postero-dorsal tubercle present particularly in the left valve. Left valve slightly larger than the right and overlapping the latter along its ventral margin The lateral surface is strongly ornamented with rows of prominent tubercles. The dorsal row consists of about 6 backwards pointing spines which project above the dorsal margin. The ventral row consists of 4 spines connected by a ridge, the first three spines are very small, the most posterior spine is very prominent. The eye tubercle is rounded and distinct. The rest of the surface is ornamented by small tubercles.

In dorsal view, both sides are jagged due to the upward pointing tubercles and spines. Internal details not seen.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.300.T.10	(Pl. 35, figs. 5-7)	525	300	240

Remarks:

Martinicythere samalutensis samalutensis Bassiouni was recorded from the Upper Eocene of Egypt by Bassiouni (1969c) and this species has also been found in the Middle Eocene Qarara Formation of Egypt by Cronin & Khalifa (1979). In this

study, the present specimen agrees well the Bassiouni's species and it has been found in the Middle Eocene of the Harsha Formation of the Tarabulus basin.

Occurrence:

This species is found in the Middle Eocene of Well F1-NC41, and in the Middle and Upper Eocene of Egypt.

Subfamily Thaerocytherinae Hazel, 1967

Tribe THAEROCYTHERINI Hazel, 1967

Genus *HERMANITES* Puri, 1955

Type species: ***Hermania reticulata*** Puri, 1954

Hermanites libyaensis sp. nov.

(Pl. 35, figs. 8-12)

Figured specimens:

Pl. 35, fig. 9, male carapace, paratype HU.300.T.12. From Well L1-NC41 at depth 9020 ft., Pl. 35, fig. 8, male carapace, paratype HU.300.T.11, Pl. 35, fig. 10, female carapace, paratype HU.300.T.13, Pl. 35, fig. 11, female carapace, paratype HU.300.T.14, Pl. 35, fig. 12, female carapace, holotype HU.300.T.15. From Well L1-NC41 at depth 9060 ft. All specimens from Well L1-NC41.

Derivation of name:

From its occurrence in Libya.

Holotype:

A male carapace HU.300.T.12

Paratypes:

Four specimens HU.300.T.11, 13-15

Type locality:

Well L1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 9020 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

337 specimens. In Well H1-NC41, three specimens were found in the Samdun Formation at a drilling depth of 9980 ft. In Well K1-NC41, 19 specimens were recorded, 17 in the Samdun Formation at 8020-8450 ft., and two specimens in the Harsha Formation at a depth of 8740 ft. In Well C1-NC41, 13 specimens were found, two specimens in the Samdun Formation at 7400 and 7470 ft., and 11 specimens in the Harsha Formation at drilling depths of 7690 and 7810 ft. In Well F1-NC41, 239 specimens were recorded, 126 from the Samdun Formation at depths of 7770-8080 ft., and 113 specimens from the Harsha Formation at 8180-8570 ft. In Well B1a-137, six specimens were found in the Harsha Formation at drilling depths of 6860-6890 ft. In Well L1-NC41, 57 specimens were found in the Harsha Formation at depths between 9020-9600 ft.

Diagnosis:

A species of ***Hermanites*** with well developed dorsal and ventral ridges, the latter with a small posterior node; lateral surface reticulate with medium subrectangular puncta anteriorly.

Description:

A subquadrate to subrectangular carapace in lateral view with the greatest height at the eye tubercle, greatest length in the middle. Dorsal margin straight in the left valve and slightly humped in the right valve due to the projection of the dorsal ridge. Ventral margin slightly concave anteriorly, straight after concavity. Anterior margin evenly rounded, posterior margin truncate. A distinct marginal rim extends from the eye tubercle and runs parallel to the anterior margin, continuing along the ventral and posterior margin. The posterior margin is ornamented with about four denticles along its ventral half, the anterior margin has fine denticulations.

Left valve larger than the right and overlapping the latter at the antero-dorsal and postero-dorsal margins. The lateral surface is ornamented with two ridges. The ventral one is well-developed, straight, starting from the antero-ventral area and ending in a small node towards the posterior end. The dorsal ridge is strongly developed, commencing below the eye tubercle, curving upwards over the dorsal margin and ending posteriorly. Eye tubercle present, glossy and rounded. Subcentral tubercle is well developed. The entire surface is reticulate, medium and subrectangular puncta lie parallel to the anterior margin. The rest of the surface is covered by rounded and square puncta. In some specimens the muri of the reticulation in the antero-marginal area are very prominent and appear as a thin ridges extending from the anterior margin towards the subcentral tubercle. Sexual dimorphism pronounced, the presumed males more elongate and higher than the presumed females.

In dorsal view, the anterior and posterior ends are compressed laterally. Maximum width occurs in the anterior half in the females and in the middle in the males. The dorsal surface along the hinge line in both valves is smooth or poorly punctate. Internal details were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♂ carapace HU.300.T.12	(Pl. 35, fig. 9)	1034	534	-
Paratype, ♂ carapace HU.300.T.11	(Pl. 35, fig. 8)	947	452	-
Paratype, ♀ carapace HU.300.T.13	(Pl. 35, fig. 10)	844	511	-
Paratype, ♀ carapace HU.300.T.14	(Pl. 35, fig. 11)	860	530	440
Holotype, ♀ carapace HU.300.T.15	(Pl. 35, fig. 12)	888	533	460

Differences and affinities:

This species is similar to ***Hermanites*** n. sp. ***2*** Salahi (1966) from the Oligocene of the Sirte Basin, Libya in general outline and in shape but the latter species differs in having more a strongly reticulate surface, more developed and sharper dorsal and ventral ridges and is also characterised by its coarse spines along

the anterior and posterior ends. ***Hermanites libyaensis*** shows some similarities to ***Hermanites*** aff. ***tschoppi*** Van Den Bold (1946) as figured by Carbonnel (1986) but the latter differs in its coarsely reticulate surface, more developed subcentral tubercle and in having four blunt spines in the lower posterior part. The present species differs from ***Hermanites sagitta*** Bate (1972) in the dorsal and posterior outlines. In addition Bate's species has almost three tubercles along the dorsal margin which are absent in this species and lateral surface ornamentation is also different.

Hermanites n. sp. ***1*** Salahi (1966) from the Oligocene of the Sirte Basin, Libya differs in its more pointed and narrower posterior margin and its different reticulation pattern.

Occurrence:

Known so far from the Middle Eocene of Well H1-NC41, Well L1-NC41, Well C1-NC41, Well L1-NC41, Well F1-NC41 and Well B1a-137, and from the Middle and Upper Eocene of Well K1-NC41.

Hermanites sp. *A*

(Pl. 36, fig. 6)

Figured specimen:

A carapace HU.300.T.16

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10180 ft.

Stratigraphic range:

Maastrichtian.

Description:

An elongate subrectangular carapace in lateral view with rounded anterior margin, posterior end slightly pointed and produced subventrally, decorated with

short spines. Ventral margin strongly concave just behind the anterior margin and nearly straight after the concavity, dorsal margin straight, projected by the dorsal ridge with prominent anterior and posterior cardinal angles. Greatest height at the anterior cardinal angle, maximum length occurs below the mid-point. Surface with two longitudinal ridges. The dorsal ridge originates below the eye tubercle, running convexly backwards and projecting over the dorsal margin. It joins with a short vertical transverse ridge. The ventral ridge begins at the antero-ventral corner, running diagonally backwards to end above the ventral margin at the beginning of the posterior fourth of the length. A well developed marginal ridge from the eye tubercle runs parallel to the anterior margin and continues along the ventral and posterior margins. Anterior margin decorated with fine denticulation along its ventral half.

The rest of the surface is strongly covered with puncta of different shapes. A few small nodes scattered over the lateral surface. Eye tubercle present but not well developed. Subcentral tubercle prominent. Internal features were not seen.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.300.T.16	(Pl. 36, fig. 6)	765	400	340

Differences and affinities:

The present species is resembles ***Hermanites*** n. sp. ***2*** Salahi (1966) in shape but differs in the nature of its ventral ridge and lateral surface ornamentation. This species shows some similarity to ***Hermanites paijenborchiana*** Keij (1957) from the Middle Eocene of Belgium in general outline but differs in its strongly reticulate surface, more developed ridges, distinct subcentral tubercle and in having more developed spines along the anterior and the posterior margins.

Hermanites sp. ***A*** is similar to ***Hermanites*** aff. ***alatus*** Ducasse (1963) as figured by Ducasse ***et al.***, (1985) but differs in the ornamentation of the lateral surface and in its strongly concave postero-dorsal margin.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Tribe BRADLEYINI Benson, 1972

Genus *QUADRACYTHERE* Hornibrook, 1952

Quadracythere cretacea sp. nov.

(Pl. 36, figs. 1-2)

Figured specimens:

Pl. 36, fig. 1, male carapace, holotype HU.300.T.17 , Pl. 36, fig. 2, female carapace, paratype HU.300.T.18. All from the same type locality and horizon.

Derivation of name:

From its occurrence in the Upper Cretaceous.

Holotype:

A male carapace HU.300.T.17

Paratype:

A female carapace HU.300.T.18

Type Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

Six specimens were found in the Al Jurf Formation of Well N1-NC41 at a drilling depth of 10160 ft.

Diagnosis:

A subrectangular species of *Quadracythere* with the greatest height at the anterior cardinal angle; dorsal margin straight and slightly modified by the dorsal ridge; marginal denticulations are present along the anterior margin.

Description:

Carapace subrectangular in outline in lateral view, highest at the anterior cardinal angle, greatest length ventrally. Anterior margin symmetrically rounded, posterior margin truncate in the ventral half, concave in the upper half. The dorsal margin is straight and slightly modified by the dorsal ridge. The ventral margin is almost straight. The lateral surface is reticulate. Thin marginal rim runs along the entire margin. The surface is characterised by two ridges. The dorsal ridge originates from almost behind the eye tubercle and runs along the dorsal margin, sloping gently to the posterior end and is joined posteriorly by a short vertical ridge. The ventral ridge is more developed than the dorsal one and runs parallel to the ventral margin from the antero-ventral corner to the postero-ventral corner. Eye tubercle present and rounded. The subcentral tubercle is well developed. Marginal denticulation is present along the anterior margin. Posterior margin has three well developed spines along its ventral half.

Left valve larger than the right and overreaching it along the anterior and dorsal margins. Sexual dimorphism well pronounced, the presumed males more elongate and less high than the presumed females. Internal details were not seen because only closed carapaces were found in this study.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.300.T.17	(Pl. 36, fig. 1)	750	333	380
Paratype, ♀ carapace HU.300.T.18	(Pl. 36, fig. 2)	725	391	370

Differences and affinities:

This species is similar to ***Quadracythere lagaghiroboensis*** (Apostolescu, 1961) from the Palaeocene of the West Africa and this species was also recorded from the Palaeocene of Nigeria by Reyment (1963) who mentioned that this species also occurs in Libya. However, the West African species differs in having a more developed and elongate ventral ridge, the reticulation is coarser and there is a more distinct and rounded eye tubercle than in the present species.

Occurrence:

This species is known so far from the Maastrichtian of Well N1-NC41.

Quadracythere sp. *A*

(Pl. 36, fig. 3)

Figured specimen:

A carapace HU.300.T.19

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10180 ft.

Stratigraphic range:

Maastrichtian.

Material:

Only one specimen has been found in Well N1-NC41 from the Al Jurf Formation at a drilling depth 10180 ft.

Description:

Subquadrate carapace in lateral view with obliquely rounded anterior end, posterior end produced ventrally with a short caudal process. Greatest height occurs at the antero-dorsal corner, greatest length ventrally. Dorsal margin is nearly straight, obscured by the dorsal ridge posteriorly, ventral margin straight. Both margins parallel and converging posteriorly. The lateral surface is reticulate, except for a smooth area along the posterior margin. The anterior marginal rim is finely denticulate and extends from the eye tubercle parallel to the anterior margin and posterior margins, being less distinct ventrally and is very distinctive and thick at the posterior and anterior margins. There is a trace of small denticles along the ventral part of the posterior end.

The surface is characterised by two ridges. The dorsal ridge starts below the eye tubercle, curving upwards and becoming parallel to the dorsal margin in lateral

view ends posteriorly at a small postero-dorsal process. The ventral ridge is strongly developed, straight, starting from the antero-ventral corner and ends in a small node towards the posterior. Subcentral tubercle is very distinct. Eye tubercle present but not prominent. Internal features were not seen.

Dimensions of figured specimen **(μm):**

		L	H	W
Carapace HU.300.T.19	(Pl. 36, fig. 3)	629	340	290

Differences and affinities:

Only one carapace was found in this study and despite the lack of knowledge of the internal features, I believe that this species can be placed in the genus ***Quadracythere*** on the basis of the outline, shape, in the number of ridges and in having a subcentral tubercle, although this cannot be done with complete certainty.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Quadracythere sp. ***B***

(Pl. 36, figs. 4, 5)

Figured specimen:

A carapace HU.300.T.20

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8310 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one carapace was found in Well F1-NC41 from the Harsha Formation at a drilling depth of 8310 ft.

Description:

Medium sized carapace with the greatest height at the anterior cardinal angle, maximum length subventrally. Dorsal margin is nearly straight, ventral margin is almost straight curving upwards to the posterior end. Anterior margin smoothly rounded with infracurvature, posterior margin with subventral caudal process, strongly concave in the upper part. Left valve larger than the right and strongly overreaching the latter along its antero-dorsal, postero-dorsal and dorsal margins. Postero-dorsally the carapace is alate particularly in the left valve. The lateral surface is coarsely pitted, except for a smooth area around the posterior end. A weakly developed subcentral tubercle can be seen. Eye tubercle is present but not prominent.

A ventral ridge runs from the antero-ventral area parallel to the ventral ridge to terminate posteriorly in a small node like-structure. No details of internal features are known.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.300.T.20	(Pl. 36, figs. 4, 5)	533	320	320

Differences and affinities:

Quadracythere sp. ***B*** appears to be a new species, but as only one carapace has been found no new taxon has been created. The present species shows some similarities to ***Quadracythere*** sp. ***A*** in general outline and in shape but the latter differs in having a more prominent subcentral tubercle, well developed ventral ridge, anterior marginal denticulation and in details of the ornamentation. The present species resembles ***Quadracythere*** sp. Carbonnel (1986) but Carbonnel's species differs in its more reticulate surface, more distinct subcentral tubercle and in having anterior and posterior marginal denticulations.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41.

Subfamily Urocythereidinae Hartmann & Puri, 1974

Genus *UROCYTHEREIS* Ruggieri, 1950

Type species: ***Cytherina favosa*** Roemer, 1838

Urocythereis elongata sp. nov.

(Pl. 36, figs. 7-12)

Figured specimens:

Pl. 36, figs. 7, 9, male carapace, holotype HU.300.T.21, Pl. 36, figs. 8, 12, female carapace, paratype HU.300.T.22, Pl. 36, figs. 10, 11, female carapace, paratype HU.300.T.23. All specimens are from the same type locality and horizon.

Derivation of name:

In reference to its elongate shape in lateral view.

Holotype:

A male carapace HU.300.T.21.

Paratypes:

Two carapaces HU.300.T.22-23

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8330 ft.

Stratigraphic range:

Middle Eocene.

Material:

36 specimens. In Well F1-NC41, 33 specimens were found in the Harsha Formation at drilling depths of 8180-8400 ft. In Well K1-NC41, three specimens were recorded from the Dahman Formation at a depth of 8564 ft.

Diagnosis:

An elongate species with strongly reticulate surface and characteristic dorsal ridge.

Description:

The carapace is elongate and subrectangular in lateral view with the greatest height at the antero-dorsal corner, greatest length lies below the mid-height. The dorsal margin is straight, whilst the ventral margin is straight in the left valve and slightly concave in the right valve, straight after the concavity. The anterior margin is symmetrically rounded with gentle antero-dorsal slope, posterior margin rounded in the lower half and strongly concave in the upper half. The left valve is slightly larger than the right valve and overlaps it along the ventral and posterior margins and also at the antero-dorsal margin. Eye tubercle is distinct, rounded and located below the antero-dorsal corner. The lateral surface is strongly reticulate with a distinct dorsal ridge. The prominent dorsal ridge originates below the eye tubercle, runs parallel to the dorsal margin and disappears at mid-height at the posterior end. A maximum of two ribs run from the subcentral tubercle parallel to each other to terminate posteriorly. The reticulation varies in shape. The anterior margin has 10-15 denticles along its ventral half whilst the posterior margin has three well developed spines in the lower part of the ventral margin. Sexual dimorphism is present, the presumed males being more elongate than the presumed females.

In dorsal view, the carapace has convex sides and tapers towards the posterior end. Maximum width developed in the posterior half. Posterior end slightly pointed. Only complete carapaces were found, it was not possible to see the internal features.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype, ♂ carapace HU.300.T.21	(Pl. 36, figs. 7, 9)	666	325	295
Paratype, ♀ carapace HU.300.T.22	(Pl. 36, figs. 8, 12)	642	328	290
Paratype, ♀ carapace HU.300.T.23	(Pl. 36, figs. 10, 11)	637	340	300

Differences and affinities:

The present species is easily distinguished from the other ***Urocythereis*** by its distinctive ornamentation. However, ***Urocythereis elongata*** shows similarities to ***U. favosa*** (Roemer, 1838) as figured by Bassiouni (1965), in shape but the latter differs

in the ornamentation of the lateral surface. There is little in the literature with which this taxon can be compared.

Occurrence:

This species is recorded from the Middle Eocene of Well F1-NC41 and Well K1-NC41.

Subfamily Orioninininae Puri, 1974

Genus *ORIONINA* Puri, 1954

Type species: ***Cythere vaughani***, Ulrich & Bassler, 1904

Orionina sp. *A*

(Pl. 15, figs. 10-12)

Figured specimen:

A carapace HU.206.T.13

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Upper Eocene, depth 7940 ft.

Stratigraphic range:

Middle Eocene.

Material :

Only one carapace has been found in Well F1-NC41 from the Samdun Formation at a drilling depth of 7940 ft.

Description:

Carapace rectangular in lateral view, narrowing slightly towards posterior end. Greatest length passes below mid-height, maximum height occurs at the anterior cardinal angle. Dorsal margin straight, sloping gently towards the posterior end, ventral margin concave mid-ventrally, curving smoothly anteriorly and posteriorly.

Anterior end symmetrically rounded with trace of denticles, posterior end subtriangular, slightly concave in the upper part. Left valve larger than the right and overreaching it all around the margins. Anterior and posterior cardinal angles present of which the latter is the more prominent. Eye tubercle small, rounded and located slightly below the antero-dorsal angle. Subcentral tubercle present. A thick marginal rim is present along the entire margin, being better developed at the anterior, posterior and dorsal margins.

Lateral surface consists of ridges and weak reticulation except for a small area in the posterior margin. The dorsal ridge originates from nearly below the eye tubercle, runs parallel to the dorsal margin then slopes down posteriorly to disappear in the postero-ventral corner. The ventral ridge begins from the antero-ventral corner then runs parallel to the ventral margin, curves upwards to join the dorsal ridge in the postero-dorsal area. A small ridge runs from the subcentral tubercle to join the ventral ridge at the mid-height of the posterior margin. A small shallow depression is present behind the posterior marginal rim. In dorsal view, the carapace has parallel sides with compressed anterior end. Maximum width occurs in the middle. Internal features were not seen because only one carapace was found.

Dimensions of figured specimens (μm)**:**

		L	H	W
Carapace HU.206.T.13	(Pl. 15, figs. 10-12)	486	254	160

Differences and affinities:

This species shows some similarities to ***Orionina vaughani*** (Ulrich & Bassler, 1904) as figured by Van Den Bold (1963) in general outline and in shape but differs in details of the lateral surface and also differs in the posterior outline.

Occurrence:

Known so far from the Middle Eocene of Well F1-NC41.

Genus ***OCCULTOCYTHEREIS*** Howe, 1951

Type species: ***Occultocythereis delumbata*** Howe, 1951

Occultocythereis sp. *A*

(Pl. 20, figs. 6, 7)

Figured specimen:

A carapace HU.206.T.14

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10220 ft.

Stratigraphic range:

Maastrichtian.

Material:

Two specimens were found in Well N1-NC41 from the Al Jurf Formation, one specimen at 10180 ft. and the other at 10220 ft.

Description:

Carapace elongate, subrectangular in lateral view, greatest height anteriorly, greatest length below the mid-height. Dorsal margin straight, hidden posteriorly by the dorsal ridge; ventral margin straight to slightly concave mid-ventrally. Dorsal and ventral margins converge towards the posterior end. Anterior end evenly rounded decorated with short fine spines; posterior end subangular, pointed at the mid-height and postero-ventral margin ornamented with some 5 spines.

Lateral surface is ornamented by ridges. The dorsal ridge is well developed, slightly convex upwards, starts behind the eye tubercle, runs parallel to the dorsal margin and terminates posteriorly in a well developed postero-dorsal process. The postero-dorsal process is confluent with a short vertical rib which extends downwards to die out at above mid-height. A short ventro-lateral ridge runs obliquely from about one-third of the length from the anterior end and one-sixth of the height. A median ridge runs obliquely through the antero-median swelling towards the antero-ventral

corner, especially in the left valve. A prominent marginal rim extends along the margins except for the dorsal margin, and is best developed along the anterior and ventral margins. Eye tubercle pronounced.

Left valve larger than the right valve and overlaps it along all the margins, most conspicuously along the lower part of the anterior and ventral margins. In dorsal view the carapace has parallel sides and compressed ends, the antero-median swelling and the dorsal ridge are clearly seen. Only two carapaces were obtained and it was not possible to see the internal features.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.206.T.14	(Pl. 20, figs. 6, 7)	486	237	150

Differences and affinities:

The present species shows some similarities to ***Occultocythereis arabica*** Al-Furaih (1980) originally described from the Lower Palaeocene of Saudi Arabia but Al-Furaih's species differs in being compressed anteriorly, and in having a reticulate surface and a less developed ventro-lateral ridge. In addition ***Occultocythereis*** sp. ***A*** is less high and more elongate.

Occurrence:

This species is found in the Maastrichtian of Well N1-NC41.

Genus ***CRISTAELEBERIS*** Bassiouni, 1970

Type species: ***Cristaeleberis reticulata*** Bassiouni, 1970

Cristaeleberis sp. ***A***

(Pl. 20, fig. 12)

Figured specimen:

A carapace HU.206.T.15

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

One carapace was found in Well N1-NC41 from the Al Jurf Formation at a drilling depth of 10180 ft.

Description:

An elongate subrectangular carapace in lateral view with the greatest height at the eye tubercle, greatest length developed at the mid-height. Anterior end broadly rounded, posterior end narrowly rounded with concave postero-dorsal margin. Dorsal margin slightly sinuous anteriorly, straight after sinuosity, ventral margin is almost straight. Dorsal and ventral margins are subparallel, converging towards the posterior. Eye tubercle is medium in size, well rounded and distinct, situated at the antero-dorsal corner of the valve. A high rounded and prominent subcentral tubercle located slightly anterior to the centre. A marginal rim extends along the anterior and posterior margins and is distinct. The posterior margin ornamented with a strong spine at the postero-ventral corner.

Lateral surface is reticulate, the reticulation varies in size, the reticulation of the anterior area arranged in rows of square puncta, the posterior area is less reticulate. The median region of the valve is strongly reticulate. A ventero-lateral ridge runs from near the antero-ventral corner parallel to the ventral margin and ends at two-thirds of the length from the anterior end in a well developed node. Small rounded tubercles occur at the postero-dorsal margin. Only one carapace was found so that it is not possible to describe the internal details.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.206.T.15	(Pl. 20, fig. 12)	990	500	550

Differences and affinities:

This species seems to be male rather than female when compared with the other species belonging to genus the ***Cristaeleberis***. There is no difficulty in distinguishing ***Cristaeleberis thomasi*** Donze & Said (1982) in Donze ***et al.***, (1982) from the present species, since it has more developed and longer spines along the anterior and posterior ends and a few spines scattered over the surface, particularly in the dorsal and ventral areas. In addition, the Libyan specimen is much larger. Unfortunately only one carapace was found and if more material becomes available, it may be useful to recognise this as new species.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41.

Family Cytherettidae Triebel, 1952

Genus ***CYTHERETTA*** Müller, 1894

Type species: ***Cytheretta rubra*** Müller, 1894

Cytheretta tellilae sp. nov.

(Pl. 39, figs. 7-10)

Figured specimens:

Pl. 39, figs. 7, 10 female carapace, holotype HU.300.T.24, Pl. 39, fig. 8, female, carapace, paratype HU.300.T.25, Pl. 39, fig. 9, male carapace, paratype HU.300.T.26. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Tellil Group.

Holotype:

A male carapace HU.300.T.24

Paratypes:

Two specimens HU.300.T.25-26

Type locality:

Well J1-NC41, NW offshore Libya.

Type horizon:

Tellil Group, Eocene, depth 4600 ft.

Stratigraphic range:

Eocene.

Material:

26 specimens were found in Well J1-NC41 from the Tellil Group at a drilling depths of 4600-4780 ft.

Diagnosis:

A species of *Cytheretta* characterised by its 4-6 longitudinal grooves separated by costa; the anterior margin has about 12 spines along its ventral half. Sexual dimorphism strongly pronounced.

Description:

Carapace elongate, ovate in lateral view. Anterior margin obliquely rounded, slightly extended below, posterior margin truncated, smooth in the upper part and decorated with 4 spines in the lower part. Dorsal margin straight, sloping gently backwards towards the posterior end with rounded anterior and posterior angles of which the latter is the more developed, particularly in the left valve; ventral margin in the right valve concave anteriorly and in the left valve, the ventral margin is slightly convex, running upwards posteriorly. The lateral surface is ornamented by about 4-6 longitudinal grooves separated by costa, originating from the mid-anterior part of the valves and running posteriorly like the grooves. The ventro-lateral groove starts from the antero-dorsal corner and runs parallel to the ventral margin to terminate almost at the postero-ventral corner. The anterior margin has nearly 12 spines which all lie in its ventral half and are more developed in the females. The rest of the surface is smooth with very fine pits scattered over it. Left valve larger than the right and overreaching the latter along the anterior and ventral margins. Sexual dimorphism strongly pronounced, the presumed males more elongate, narrower and less high than the presumed females.

In ventral view, the carapace has regularly convex sides with compressed anterior and posterior ends. Maximum width just behind the middle. Also the longitudinal groove and the anterior and the posterior spines are clearly seen. Internal features were not seen as no single valve were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♀ carapace HU.300.T.24	(Pl. 39, figs. 7, 10)	765	417	385
Paratype, ♀ carapace HU.300.T.25	(Pl. 39, fig. 8)	926	470	442
Paratype, ♂ carapace HU.300.T.26	(Pl. 39, fig. 9)	900	440	385

Differences and affinities:

Cytheretta tellilae most closely resembles ***Cytheretta*** n. sp. ***1*** Salahi (1966) from the Oligocene of Libya but the latter species differs in having less longitudinal grooves, a higher posterior end and in being more inflated ventrally. The present species shows some similarities to ***Cytheretta*** n. sp. ***2*** Salahi (1966) in shape but differs in the ornamentation of the lateral surface.

Occurrence:

This species is known so far from the Eocene of Well J1-NC41.

Cytheretta n. sp. *1* Salahi 1966

(Pl. 39, fig. 11)

Figured specimen:

A carapace HU.300.T.27

Locality:

Well J1-NC41, NW offshore Libya.

Horizon:

Tellil Group, Eocene, depth 4600 ft.

Stratigraphic range:

Oligocene and Eocene.

Material:

Two carapaces were found in Well J1-NC41 from Tellil Group at a drilling depth of 4600 ft.

Description:

In lateral view, carapace ovate with the greatest height mid-ventrally, greatest length occurs above mid-height. Anterior margin fairly rounded, decorated with nearly 10 spines along its ventral half, posterior margin subtriangular smooth in the upper part and decorated with three more developed spines in the lower part. Dorsal margin fairly straight except for a small concave part of the dorsal margin to be seen in front of the posterior angle, ventral margin strongly concave anteriorly and convex mid-ventrally, curving smoothly towards the posterior end.

Surface ornamented by slit-like pits which are distributed longitudinally in the muscle scar area. The upper two slits are shorter. The ventral groove runs from nearly one-third of the length from the anterior end and runs parallel to the ventral margin to terminate posteriorly. The rest of the surface is smooth with a few fine pits scattered on the surface. Left valve larger and overlapping the right along its ventral margin and at the postero-dorsal margin. Carapace inflated mid-ventrally. In dorsal view, carapace biconvex with maximum width and thickness lying just behind the middle. In ventral view, the longitudinal groove and the slits are clearly seen.

Only two carapaces were found in this study so it was not possible to see the internal details.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.300.T.27	(Pl. 39, fig. 11)	773	434	360

Remarks:

This species was originally described from the Oligocene of the Sirte Basin, Libya by Salahi (1966). It occurs rarely in offshore NW Libya. The specimens recorded here agree well with *Cytheretta* n. sp. *1* as far as can be ascertained on

surface characters although Salahi's species does have a short ventral longitudinal groove.

Occurrence:

This species is recorded from the Eocene of Well J1-NC41, and from the Oligocene of the Sirte Basin.

Genus ***FLEXUS*** Neviani, 1928

Type species: ***Cythere plicata*** Munster, 1830

Flexus quadricostata sp. nov.

(Pl. 40, figs. 1-6)

Figured specimens:

Pl. 40, figs. 1, 3, 5, male carapace holotype HU.300.T.28, Pl. 2, 4, 6, female carapace paratype HU.206.T.29. All specimens from the same type locality and horizon.

Derivation of name:

L. ***quadricostata***: four ribbed in reference to its characteristic feature.

Holotype:

A male carapace HU.300.T.28

Paratype:

A female carapace HU.300.T.29

Type locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 8300 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

21 specimens. In Well K1-NC41, 11 specimens were found. Five specimens from the Samdun Formation at drilling depths of 8220-8340 ft., two from the Dahman Formation at 8564 ft., and four from the Harsha Formation at 8760-9000 ft. In Well F1-NC41, 10 specimens were found, three specimens from the Samdun Formation at a depths of 7920-8080 ft., and seven from the Harsha Formation at drilling depths of 8280-8330 ft.

Diagnosis:

A species of ***Flexus*** with marked sexual dimorphism, greatest height at the cardinal angle and characterised by four ridges.

Description:

Carapace elongate in lateral view with greatest length at below the mid-height, greatest height lies at the anterior cardinal angle. The dorsal margin is almost straight, sloping down to the posterior end; ventral margin slightly concave mid-ventrally, curving smoothly towards the posterior end. Anterior margin obliquely rounded, decorated with marginal denticulation along its ventral half and a marginal ridge runs from the antero-dorsal corner, continues along the anterior margin and then runs parallel to the ventral margin to join the ventral ridge posteriorly. Posterior end truncate. The lateral surface is ornamented by three longitudinal ridges. The dorsal ridge starts from the eye tubercle and runs backwards projecting above the dorsal margin, it then curves down to the posterior region. In the anterior area the ventral ridge joins the median one and runs straight to disappear before reaching the posterior margin. The median ridge is nearly parallel to the ventral ridge and dies out where the ventral one does. The rest of the surface is smooth with the exception of coarse pits which run along the median ridge. Sexual dimorphism strongly marked, the presumed males more elongate and less high than the presumed females.

In dorsal view the carapace has convex sides with maximum width in the centre. The males are slimmer than the females.

Dimensions of figured specimens (μm)*:*

	L	H	W

Holotype, ♂ carapace HU.300.T.28	(Pl. 40, figs. 1, 3, 5)	529	270	211
Paratype, ♀ carapace HU.300.T.29	(Pl. 40, figs. 2, 4, 6)	468	285	237

Differences and affinities:

Flexus quadricostata closely resembles ***F. coarctata*** Al-Furaih (1980) originally described from the Middle Eocene of Saudi Arabia in general outline, shape and in the number of ridges but differs in being smaller and in having punctation along its median ridge and some puncta in the anterior area whilst Al-Furaih's species is completely smooth. He mentioned that his species was referred to ***Flexus*** with some doubt as it has four ridges whereas the type species has only three ridges.

In this study only closed carapaces were available and it was not possible to see the internal features. If more material becomes available it may be useful to recognise this as a new genus of *Cytherettidae*.

Occurrence:

This species is known from the Middle Eocene of Well F1-NC41, and from the Middle and Upper Eocene of Well K1-NC41.

Flexus africana sp. nov.

(Pl. 40, figs. 7-12)

Figured specimens:

Pl. 40, fig. 7, male carapace, paratype HU.300.T.30 from depth 9400 ft., Pl. 40, fig. 8, female carapace, paratype HU.301.T.1. From depth 9450 ft, Pl. 40, fig. 9, female carapace, holotype HU.301.T.2, Pl. 40, fig. 10, female carapace, paratype HU.301.T.3. From depth 9400 ft., Pl. 40, fig. 11, female carapace, paratype HU.301.T.4 from depth 8564 ft., Pl. 40, fig. 12, male carapace HU.301.T.5. From depth 9400 ft. All specimens from the Well K1-NC41.

Derivation of name:

From its occurrence in Africa.

Holotype:

A female carapace HU.301.T.2

Paratypes:

Five specimens HU.300.T.30, HU.301.T.1, 3-5.

Type locality:

Well K1-NC41, Tarabulus Basin, NW offshore Libya.

Type Horizon:

Harsha Formation, Middle Eocene, depth 9400 ft.

Stratigraphic range:

Middle Eocene.

Material:

30 specimens. In Well F1-NC41, two specimens were found in the Harsha Formation at depths of 8280 and 8310 ft. In Well K1-NC41, 27 specimens were recorded, one from the Dahman Formation at a drilling depth of 8564 ft., and 26 specimens from the Harsha Formation, one at 8740 ft., four at a depth of 9000 ft., and 21 specimens at drilling depths of 9130-9690 ft. In Well B1a-137, one specimen were found in the Harsha Formation at a depth of 7490 ft.

Diagnosis:

This new species is characterised by its coarsely pitted surface, subrectangular carapace in lateral view with marginal denticulation along the anterior margin.

Description:

A medium sized, subrectangular carapace in lateral view. Anterior margin obliquely rounded, posterior end subtriangular, slightly curved in the upper part with well marked posterior cardinal angle, sloping down with a small node in its lower part in the males. The posterior end in the females is concave in the upper part sloping down below and decorated with small spines. Dorsal margin is straight, obscured due to overreaching of the dorsal ridge with well marked anterior and posterior cardinal angles. Ventral margin is straight to slightly concave anterior to the middle, curving upwards posteriorly. Greatest height through the anterior cardinal angle and greatest

length occurs above the middle. The anterior margin is decorated with fine denticulations in the males.

Lateral surface is coarsely pitted with four longitudinal ridges. The dorsal ridge which commences below the eye tubercle and runs backwards, projecting over the dorsal margin then curves down to terminate below the postero-dorsal angle. The anterior ridge starts from the eye tubercle and then runs parallel to the anterior margin to continue along the ventral margin to end at the postero-ventral corner and join the ventral ridge. The median one begins from the anterior margin of the subcentral tubercle and runs posteriorly to disappear at one-fifth of the length from the posterior end. The ventral ridge starts from the ventral third of the anterior end and runs parallel to the ventral margin to terminate posteriorly. The rest of the surface is coarsely pitted. Eye tubercle pronounced.

Left valve larger than the right valve and overlapping along the ventral margin. Sexual dimorphism present, females less elongate and higher than the males. In dorsal view, compressed with maximum width in the posterior half. Internal details unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♂ carapace HU.300.T.30	(Pl. 40, fig. 7)	644	333	230
Paratype, ♀ carapace HU.301.T.1	(Pl. 40, fig. 8)	491	310	240
Holotype, ♀ carapace HU.301.T.2	(Pl. 40, fig. 9)	509	303	230
Paratype, ♀ carapace HU.301.T.3	(Pl. 40, fig. 10)	516	309	250
Paratype, ♀ carapace HU.301.T.4	(Pl. 40, fig. 11)	464	258	225
Paratype, ♂ carapace HU.301.T.5	(Pl. 40, fig. 12)	551	266	220

Differences and affinities:

Flexus africana resembles ***F. quadricostata*** in shape, and in the number of ridges but differs from it in its coarsely pitted surface and the posterior outline. The present species differs from ***F. coarctata*** Al-Furaih (1980) in the ornamentation of the lateral surface. No other closely comparable forms are figured in the literature.

Occurrence:

This species is found so far from the Middle Eocene of Well F1-NC41, Well K1-NC41 and Well B1a-137.

Tribe LOCULICYTHERETTINI Gründel, 1976

Genus ***HEPTALOCULITES*** Ruggieri, 1963

Type species: ***Heptaloculites gortanii*** Ruggieri, 1963

Remarks.

The genus ***Loculicytheretta*** was erected by Ruggieri (1954) for ***Cythere pavonia*** Brady 1866, originally described from a sponge sand from Levant. It has attracted the attention of ostracod workers more than most, not only as a result of its morphological peculiarities but also because of its phylogentic and biostratigraphic importance. Species possess postero-ventral loculi in the female valves; this feature is common in Palaeozoic ostracods but among the post-Palaeozoic Ostracoda only occurs in the genera ***Loculicytheretta*** and ***Heptaloculites***. The true function of these loculi is as yet poorly understood, and various hypotheses have been proposed (McKenzie 1971, Athersuch & Bonaduce 1976).

Van Morkhoven's (1963) extensive review of post-Palaeozoic Ostracoda gave abundant illustrations of ***L. pavonia***, the only species known at that time, adding that he had observed in sub-recent deposits of West Africa, a related species which differed from it in having six loculi instead of three in the female.

Ruggieri (1963) investigated Eocene deposits in Sicily and described a species with seven loculi, which resembled ***Loculicytheretta*** in its general features but differed in its smooth surface. Since he considered the difference in the ornamentation to be of generic value, he proposed a new genus ***Heptaloculites***, for the species ***H. gortanii.*** Ruggieri also indicated that ***Loxoconcha? cavernosa*** Apostolescu & Magne,

1956 and a species with six loculi and reticulate surface from the Upper Eocene of Saudi Arabia (Ruggieri, p. 2, 1963) might also belong to ***Heptaloculites***.

In (1973a,b,c), Oertli published on several species of ***Loculicytheretta***, and regarded the Eocene genus ***Heptaloculites*** as a subgenus of ***Loculicytheretta***, differing essentially in the configuration of the marginal zone , although the hinge and central muscle scar field are comparable with those of ***L (L.) pavonia*** Brady (1866). He mentioned seven species, three of which were left in open nomenclature.

Bismuth ***et al.***, (1978) described several species of ***Loculicytheretta***, treating ***Heptaloculites*** as a junior synonym of ***Loculicytheretta***. They make no subgeneric distinction between the Eocene species in Oertli (1973a,b,c) with vestibulum and about thirty anterior marginal pore canals called ***Loculicytheretta (Heptaloculites)***, and the post-Oligocene species without vestibulum and about twenty anterior marginal pore canals.

Bismuth ***et al.***, (1978) mentioned that the preservation of the material did not allow a close examination of Eocene species on the configuration of the anterior marginal zone. Also, as no Oligocene species have been found, they considered ***Heptaloculites*** as synonymous with ***Loculicytheretta***.

Carbonel & Colin (1982) studied in detail the morphology of loculate ostracods from the Palaeogene and Neogene to Recent demonstrating that the loculi appear to form as a result of two different morphogenetic processes thereby giving rise to two separate phylogenetic lineages. This hypothesis is supported by the Palaeogene stocks possibly derived from ***Leguminocythereis*** (Oertli, 1976); whilst ***Loculicytheretta pavonia*** shows certain anatomical affinities with the genus ***Cytheretta*** (Athersuch & Bonaduce, 1976).

Furthermore the Palaeogene taxa with vestibulum possess more marginal pore canals (about 30) than the Neogene species without vestibulum (about 20). None of the Palaeogene species have a ventral carina, whilst the Neogene and Recent taxa especially in the males have ventral, laterally reticulate, excavate carinae. Also no

species with loculi have been recorded from the Oligocene. This represents an interval of about 15 million years.

For the Palaeogene species, Carbonel & Colin (1982) proposed to retain the genus ***Heptaloculites*** Ruggieri, 1963 , whereas the Neogene to Recent taxa were to be allocated to ***Loculicytheretta*** Ruggieri, 1954. Therefore, as a result of their work, ***Heptaloculites*** is considered as a distinct genus in this study.

Heptaloculites tunetana (Oertli, 1978)

(Pl. 41, figs. 1-6, 8))

1973c ***Loculicytheretta (Heptaloculites)*** Oertli, unnamed species, p. 43-44, 14 figs.

1978 ***Loculicytheretta tunetana*** Oertli, in Bismuth ***et al.***; p. 237-238, pl. 4, figs. 59-63.

1981 ***Loculicytheretta tunetana*** Oertli, Mechmeche; p. 63, pl. 6, figs. 13-14.

1982 ***Loculicytheretta tunetana*** Oertli, Carbonel & Colin; pl. 4, figs. 5,7.

Figured specimens:

Pl. 41, fig. 2, female carapace HU.301.T.7, Pl. 41, fig. 3, male carapace HU.301.T.8, Pl. 41, fig. 4, female carapace HU.301.T.9, pl. 41, figs 5, 6, female carapace HU.301.T.10. From Well B1a-137 at depth 6440 ft., Pl. 41, fig. 1, female carapace HU.301.T.6, Pl. 41, fig. 8, male carapace HU.301.T.11. From Well C1-NC41 at depth 7440 ft.

Type Locality:

Northwestern slope of the Djebil, 15 Km NW of Haffouz, Tunisia.

Type horizon:

Upper Lutetian.

Stratigraphic range:

Middle and Upper Eocene.

Material:

385 specimens. In Well B1a-137 section, 79 specimens have been found, 75 specimens were recovered from the Samdun Formation at drilling depths between 6100 and 6560 ft., and four from the Dahman Formation at 6440 ft. In Well C1-NC41 section, 48 specimens have been found; 38 specimens were recorded from the Samdun Formation at depths between 7170 and 7540 ft., and 11 specimens from the Harsha Formation at depths between 7730 and 8060 ft. Forty-nine specimens were found in the Well F1-NC41 section, 16 specimens from the Samdun Formation at depths between 7800 and 8080 ft., and 33 specimens from the Harsha Formation at depths between 8180 and 8610 ft. In Well K1-NC41 section, 169 specimens have been found, 41 specimens from the Samdun Formation at drilling depths between 8310 and 8500 ft., and 15 specimens were found in a single sample from the Dahman Formation at a depth of 8564 ft., and 113 specimens were recovered from eighteen samples of the Harsha Formation at drilling depths between 8740 and 9590 ft. In Well H1-NC41 section, 37 specimens have been reported; 27 specimens from fourteen samples of the middle part of the Samdun Formation at drilling depths between 9660 and 10180 ft., and the other 10 specimens were recovered from the Harsha Formation at depths between 10300 and 10760 ft. North of the study area, in Well B1-NC41 section, 2 specimens were found in the Samdun Formation at a drilling depth of 7730 ft.

Description:

This species of the genus ***Heptaloculites*** Ruggieri, 1963 is characterised by a medium-sized carapace, with four well developed loculi, the males have a more elongate carapace especially in the anterior part forming a straight dorsal outline. The lateral surface is ellipsoidal and evenly rounded throughout in the females, the anterior margin is slightly straight in the upper part and rounded in the lower part. The ventral margin, especially in the females is straight and slightly curved upwards to the antero-ventral area. The surface is smooth. The left valve is larger than the right and overlapping it along the dorsal and ventral margins.

In dorsal view the carapace has biconvex sides with maximum width occurring in the anterior half. Internal features could not be seen as the material yielded only closed carapaces.

In ventral view, the loculi are well developed being situated along the length of the ventrum.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.301.T.6	(Pl. 41, fig. 1)	681	400	246
♀ carapace HU.301.T.7	(Pl. 41, fig. 2)	731	428	250
♂ carapace HU.301.T.8	(Pl. 41, fig. 3)	755	405	260
♀ carapace HU.301.T.9	(Pl. 41, fig. 4)	646	369	215
♀ carapace HU.301.T.10	(Pl. 41, figs. 5, 6)	684	410	284
♂ carapace HU.301.T.11	(Pl. 41, fig. 8)	766	420	266

Remarks:

This species was illustrated by Oertli (1973c) and designated as an unnamed ***Loculicytheretta (Heptaloculites)*** from a well offshore in the Gulf of Gabes, Tunisia. Oertli (1978), in Bismuth ***et al.***, (1978) renamed and transferred it to the genus ***Loculicytheretta.*** This species is easily distinguished from the other species by its distinct four loculi and also by its smooth surface and elongate shape. ***Heptaloculites tunetana*** resembles the Middle Miocene species ***L. libyca*** Szczechura (1978), from Libya in Bismuth ***et al.***, (1978); this latter species differs mainly in the outline of the valves which are less elongate and in the possession of more distinct, circular loculi. ***H. tunetana*** shows some similarity to ***Heptaloculites quinqueloculita*** (Bismuth, 1978) in Bismuth ***et al.***, (1978), but this later species differs in having five not so distinct loculi above which are developed weak, undulate costulae. The present species is also similar to ***Loculicytheretta moyes*** Oertli (1978) in Bismuth ***et al.***, (1978) which differs in having a coarsely reticulate surface.

Occurrence:

Heptaloculites tunetana is known so far from the Middle Eocene of Well B1-NC41, Well C1-NC41, Well H1-NC41, Well F1-NC41 and Well B1a-137, from the Middle and Upper Eocene of Well K1-NC41, from the Middle Eocene (upper part of the Lutetian) and Upper Eocene (base of Priabonian) of Tunisia, from the Middle Eocene of Algeria, from the Middle Eocene of Ivory Coast.

Heptaloculites aff. *H. gortanii* (Ruggieri, 1963)

(Pl. 41, figs. 7, 9-12)

1963 *Heptaloculites gortanii* n. sp. Ruggieri, p. 3-5, pl. 1, 3 figs.

1978 *Loculicytheretta* aff. *gortanii* (Ruggieri, 1963), Bismuth *et al.*; p. 237, pl. 3, figs. 49-58.

1981 *Loculicytheretta* aff. *gortanii* (Ruggieri, 1963), Mechmeche; p. 60, pl. 5, figs. 13-14.

Figured specimens:

Pl. 41, figs. 7, 9, 11, 12, female carapace HU.301.T.12. From Well C1-NC41 at depth 7090 ft., Pl. 41, fig. 10, female carapace HU.301.T.13. From Well B1a-137 at depth 6140 ft.

Locality:

Well C1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Samdun Formation, Middle Eocene, depth 7090 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

36 specimens. In Well C1-NC41 section, seven specimens have been found from the upper part of the Tellil Group (Samdun Formation), the first specimen at a depth of 6960 ft., five specimens from 7090 ft., while the other specimen came from a

depth of 7130 ft. In well B1a-137 section six specimens have also been found in the Samdun Formation, one specimen from a depth of 6040 ft., one specimen at 6060 ft., three specimens at 6100 ft., and the last specimen at 6140 ft. In well H1-NC41, five specimens were recovered from the Samdun Formation at drilling depths between 9440 and 9880 ft. In Well K1-NC41 section, 17 specimens were found at depths between 8020 and 9130 ft. In Well B1-NC41, one specimen was found in the Samdun Formation at a drilling depth of 7290 ft.

Description:

The present species is characterised by a subrectangular carapace and by seven well developed loculi distributed along the ventral margin. The dorsal margin slopes gently to the posterior margin; the ventral margin is characterised by the loculi which run anteriorly to posteriorly. The surface is smooth, but occasionally there is a very weak pitted ornamentation restricted to the middle of the surface.

Sexual dimorphism present, the males are typically more elongate and larger than the females. Only closed carapaces were found in this study and it was not possible to study the internal features.

Dimensions of figured specimens (μm)***:***

		L	H	W
♀ carapace HU.301.T.12	(Pl. 41, figs. 7, 9, 11, 12)	641	350	290
♀ carapace HU.301.T.13	(Pl. 41, fig. 10)	688	385	320

Remarks.

This species shows some affinities with the older species ***Heptaloculites gortanii*** (Ruggieri, 1963), from the Eocene of Italy in possessing the same number of loculi, but the latter differs in having a more pointed posterior, the females are smaller, their posterior outline is less pointed, and the last loculus reaches the mid-posterior margin. Furthermore ***Heptaloculites*** aff. ***H. gortanii*** also shows some similarity to ***Heptaloculites semirugosa*** (Apostolescu & Magné, 1956), but the latter species differs in its reticulate surface developed in the postero-ventral margin and has six less well developed loculi.

Occurrence:

This species is recorded from the Middle and Upper Eocene of Well B1a-137, Well H1-NC41 and Well K1-NC41, from the Upper Eocene of Well C1-NC41, Well B1-NC41, and from the Upper Eocene to the top of the Middle Eocene of Tunisia and from the Upper Eocene of Senegal.

Heptaloculites minuta (Oertli, 1978)

(Pl. 42, figs. 1-6)

1973c *Loculicytheretta* (*Heptaloculites*) sp. *B* Oertli, p. 40.

1978 *Loculicytheretta minuta* Oertli, in Bismuth *et al.*; p. 240, pl. 4, figs. 66-71.

1981 *Loculicytheretta minuta* Oertli, Mechmeche; p. 61, pl. 5, figs. 18-20.

Figured specimens:

Pl. 42, fig. 1, female carapace HU.301.T.14, Pl. 42, fig. 3, female carapace HU.301.T.16, Pl. 42, fig. 4, male carapace HU.301.T.17. From Well F1-NC41 at depth 8260 ft., Pl. 42, fig. 2, female carapace HU.302.T.15, Pl. 42, fig. 5, female carapace HU.301.T.18, Pl. 42, fig. 6, male carapace HU.301.T.19. From Well B1a-137 at depth 6680 ft.

Type locality:

Djebel Cherahil, 5 km SSW Side Naser' Allah, 50 km. SSW of Kairrouan, Tunisia.

Type horizon:

Middle Lutetian.

Stratigraphic range:

Middle Eocene.

Material:

70 specimens. In Well B1a-137 section, 16 specimens were found in the Harsha Formation at depths of 6680-6840 ft. In Well F1-NC41 section, 38 specimens were recorded from fifteen samples of the Harsha Formation at drilling depths of

between 8180 and 8610 ft. In Well H1-NC41 section, five specimens were found in the lower part of the Tellil Group (Harsha Formation), four specimens were reported from a depths of 10340 ft., 10380 ft., and 10420 ft., and the last specimen was found 10620 ft. In Well K1-NC41 section, 11 specimens were found in the Harsha Formation, one of them at depth 8910 ft., eight at 9010-9130 ft., whilst the last two specimens were recovered from depths of between 9400 and 9690 ft.

Description:

Small to medium in size, sub-rectangular carapace in lateral view with its greatest height at the anterior margin and greatest width at the mid-length. The dorsal margin is almost straight and parallel to the ventral margin. The ventral margin in females is flat, becoming narrower towards the anterior extremity; the anterior margin is rounded. The lateral surface is characterised by a regular reticulation and a tendency to develop fine, longitudinal riblets especially in the area of the posterior margin. The dorsal marginal area is sometimes smooth. There a distinct but flat post-ocular depression. The females of this species are probably characterised by four, poorly developed loculi.

In dorsal view, the sides are sub-parallel with acuminate extremities except, in the females, where the posterior extremity forms a right angle with the sides. Males are easily distinguished by being more elongate and less high than the females.

Dimensions of figured specimens (μm)*:*

		L	H	W
♀ carapace HU.301.T.14	(Pl. 42, fig. 1)	535	307	240
♀ carapace HU.301.T.15	(Pl. 42, fig. 2)	531	340	230
♀ carapace HU.301.T.16	(Pl. 42, fig. 3)	491	295	205
♂ carapace HU.301.T.17	(Pl. 42, fig. 4)	575	286	210
♀ carapace HU.301.T.18	(Pl. 42, fig. 5)	564	335	220
♂ carapace HU.301.T.19	(Pl. 42, fig. 6)	627	320	240

Remarks:

The present species was originally described by Oertli (1978) in Bismuth *et al.*, (1978) from the Middle Eocene of Tunisia. ***Heptaloculites prima*** (Bismuth & Oertli, 1978) is very similar to ***H. minuta*** (Oertli, 1978), but the latter species is smaller and has four poorly developed loculi while the species defined by Bismuth & Oertli is characterised by six, weakly developed loculi. Furthermore, ***H. prima*** (Bismuth & Oertli) in Bismuth ***et al.***, (1978) is covered by parallel meshes arranged along the anterior and posterior margins except in some specimens, the middle part of this surface is smooth. The present species is also distinguished from ***Heptaloculites*** aff. ***H. prima*** (Bismuth & Oertli, 1978) in Bismuth ***et al.***, (1978) which lacks ornamentation near the anterior margin, has a smooth, flattened surface above the loculi of the females, and also differs in having coarser reticulation.

Occurrence:

This species is found in the Middle Eocene of Well B1a-137, Well F1-NC41, Well K1-NC41, Well H1-NC41, and from the Middle Eocene of Tunisia.

Heptaloculites semirugosa (Apostolescu & Magné, 1956)

(Pl. 42, figs. 7-12)

1956 ***Loxoconcha semirugosa*** n.sp Apostolescu & Magné, p. 34, pl. 1, figs. 14, 15.

1973b ***Loculicytheretta (Heptaloculites) semirugosa*** (Apostolescu & Magné); Oertli, p. 40-42, 15 figs.

1978 ***Loculicytheretta semirugosa*** (Apostolescu & Magné); Bismuth ***et al.***, p. 240-241, pl. 5, figs. 83-88

1981 ***Loculicytheretta semirugosa*** (Apostolescu & Magné); Mechmeche; p. 63, pl. 6, figs. 13-14.

Figured specimens:

Pl. 42, fig. 7, female carapace HU.301.T.20, Pl. 42, fig. 8, male carapace HU.301.T.21, Pl. 42, fig. 9, female carapace HU.301.T.22, Pl. 42, fig. 12, female

carapace HU.301.T.24. From Well B1a-137 at depth 7020 ft., Pl. 42, figs. 10,11, female carapace HU.301.T.23. From Well C1-NC41 at depth 7970 ft.

Type locality:

A 5327 (Algeria)

Type horizon:

Lutetian

Stratigraphic range:

Middle Eocene.

Material:

1007 specimens. In Well C1-NC41 section, 304 specimens were found in thirteen samples of the Harsha Formation at depths of 7810-8070 ft. In Well B1a-137 section, 490 specimens were recorded in the Harsha Formation at depths of between 6760 and 7490 ft. In Well K1-NC41 section, 38 specimens were recovered from sixteen samples of the Harsha Formation between 8950 and 9590 ft. In Well F1-NC41 section, only seven specimens were found in the Harsha Formation, one specimen at 8230 ft., four specimens from three samples at depths between 8350 and 8370 ft., one specimen at 8430 ft., and the last specimen at a depth of 8590 ft. In Well H1-NC41 section, 168 specimens were reported from twenty-three samples of the Harsha Formation at drilling depths of between 10460 and 10950 ft.

Description:

A species of ***Heptaloculites*** which is characterised by six, weakly developed loculi; medium sized carapace, is sub-rectangular in lateral view with its greatest height developed at the anterior margin. The anterior margin is nearly rounded. The left valve is slightly larger than the right valve. The dorsal and ventral margins are almost straight, especially in the males. The lateral surface is coarsely pitted on the postero-ventral area. Sexual dimorphism is present, males are more elongate and higher than the females.

Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)***:***

		L	H	W
♀ carapace HU.301.T.20	(Pl. 42, fig. 7)	757	450	360
♂ carapace HU.301.T.21	(Pl. 42, fig. 8)	874	465	375
♀ carapace HU.301.T.22	(Pl. 42, fig. 9)	766	450	355
♀ carapace HU.301.T.23	(Pl. 42, figs. 10, 11)	738	425	341
♀ carapace HU.301.T.24	(Pl. 42, fig. 12)	750	440	285

Remarks:

This species was originally described by Apostolescu & Magné (1956) as a new species of ***Loxoconcha?*** from Algeria. In 1973b, Oertli transferred the species to ***Loculicytheretta*** (***Heptaloculites***). Bismuth ***et al.***, (1978) also transferred this species to the genus ***Loculicytheretta***. In this study, the species belongs to the genus ***Heptaloculites*** as defined by Ruggieri (1963) and the Libyan specimens are identical with this species.

The present species also shows some similarity to ***Heptaloculites cavernosa*** (Apostolescu & Magné, 1956) but the latter species differs in having a smoother surface and being larger in size. ***H. semirugosa*** is also similar to ***H.*** aff. ***H. gortanii*** (Ruggieri, 1963), but is characterised by six weakly defined loculi occurring along the ventral margin.

Occurrence:

This species occurs in the Middle Eocene of Well C1-NC41, Well B1a-137, Well K1-NC41, Well F1-NC41 and Well H1-NC41, and from the Middle Eocene of Algeria and Tunisia.

Heptaloculites prima (Bismuth & Oertli, 1978)

(Pl. 43, figs. 8-12, Pl. 44, figs. 1, 2)

1973c ***Loculicytheretta*** (***Heptaloculites***) sp. ***C*** Oertli, p. 40.

1978 ***Loculicytheretta prima*** Bismuth & Oertli; in Bismuth ***et al.***, p. 241-242, pl. 7, figs. 109-121.

Figured specimens:

Pl. 43, fig. 11, male carapace HU.302.T.8, Pl. 43, fig. 9, 12, female carapace HU.302.T.9, Pl. 43, fig.10, female carapace HU.302.T.10, Pl. 43, fig. 8, Pl. 44, fig. 1, male carapace HU.302.T.11., Pl. 44, fig. 2, female carapace HU.302.T.12. All specimens from Well K1-NC41 at a depth of 9690 ft.

Type locality:

2 km WNW of the station of Kalaa Djerda, sample Thala 101, Tunisia.

Type horizon:

Lower Lutetian.

Stratigraphic range:

Middle Eocene.

Material:

37 specimens. This species has only been recorded from the two Wells. In Well K1-NC41 section, 35 specimens came from the Harsha Formation, two specimens came from 9480 ft., seven were found at 9590 ft., 10 specimens from depths of 9610 and 9650 ft., and the last 16 specimens were recovered from a depth of 9690 ft. In Well B1a-137 section, two specimens were recovered from the Harsha Formation at a drilling depth of 7425 ft.

Description:

Thick shelled, medium-sized sub-rectangular carapace, with greatest height anteriorly, greatest length developed nearly at the mid-height. The dorsal margin is slightly convex in the middle part of the dorsal area, anterior margin obliquely rounded. The lateral surface is characterised by a regular reticulation, the meshes forming a parallel arrangement from the posterior to the anterior margins. Moreover, the central part of the surface sometimes shows less ornamentation and may even be smooth. In some specimens the anterior and the posterior margins are decorated with small marginal spines. The females have six, poorly developed loculi, the first pair

being situated in the front of the middle, whilst the last pair is situated at above half the height.

In dorsal view, the male carapaces are characterised by being slightly swollen in the posterior area. The female carapaces, in dorsal view, are narrower with almost parallel sides and are truncated posteriorly. Sexual dimorphism is pronounced, the males being more elongate than the females.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.302.T.8	(Pl. 43, fig. 11)	767	410	300
♀ carapace HU.302.T.9	(Pl. 43, figs. 9, 12)	630	369	290
♀ carapace HU.302.T.10	(Pl. 43, fig. 10)	625	384	285
♂ carapace HU.302.T.11	(Pl. 43, fig. 8, Pl. 44, fig. 1)	773	406	340
♀ carapace HU.302.T.12	(Pl. 44, fig. 2)	628	360	309

Remarks:

Heptaloculites prima was first described from the Middle Eocene of Tunisia by Bismuth & Oertli (1978) in Bismuth ***et al.***, (1978) and the present species is very similar to ***Heptaloculites*** aff. ***H. gortanii*** (Ruggieri, 1963), which differs in the lack of ornamentation near the anterior margin and also has a smooth flattened surface just above the loculi. ***H. prima*** shows some affinities with ***H. minuta*** (Oertli, 1978) in Bismuth ***et al.***, (1978), but the latter species differs in having four, poorly developed loculi and also in that the area behind the anterior and dorsal margin is smooth. Furthermore, the present species shows some similarity to ***Loculicytheretta miocaenica*** Szczechura (1978) in Bismuth ***et al.***, (1978) described from the northern part of the Sirte basin, but differs in having six well developed loculi and about ten longitudinal costulae and fine reticulation.

Occurrence:

Known so far from the Middle Eocene of Well B1a-137, Well K1-NC41, and from the Middle Eocene of Tunisia.

Heptaloculites cavernosa (Apostolescu & Magné, 1956)

(Pl. 43, figs. 1-7)

1956 ***Loxoconcha? cavernosa*** n. sp. Apostolescu & Magné; p. 340, pl. 1, figs. 7-9.

1956 ***Loxoconcha polita*** n. sp. Apostolescu & Magné; p. 341, pl. 1, figs. 12, 13.

1963 ***Loxoconcha? cavernosa*** Apostolescu & Magné, Ruggieri; p. 2, 3-4.

1973a ***Loculicytheretta (Heptaloculites) cavernosa*** (Apostolescu & Magné); Oertli; p. 35-40, 23 figs.

1978 ***Loculicytheretta cavernosa*** (Apostolescu & Magné); Bismuth ***et al.***; p. 238, pl. 4, figs. 64-68.

1981 ***Loculicytheretta cavernosa*** (Apostolescu & Magné), Mechmeche; p. 60, pl. 5, figs. 15, 17.

Figured specimens:

Pl. 43, fig. 1, female carapace HU.301.T.26, Pl. 43, fig. 2, female carapace HU.301.T.27, Pl. 43, fig. 3, female carapace HU.301.T.28, Pl. 43, fig. 4, female carapace HU.301.T.29, Pl. 43, fig. 5, male carapace HU.301.T.30, Pl. 43, fig. 6, male carapace HU.302.T.1, Pl. 43, fig. 7, female carapace HU.301.T.2. All specimens from Well B1a-137 at a depth of 6140 ft..

Type locality:

A 488 (Algeria)

Type horizon:

Upper Lutetian

Stratigraphic range:

Middle Eocene.

Material:

2526 specimens. In Well F1-NC41 section, 17 specimens have been found, 14 specimens in the Samdun Formation at depths of 7740-8080 ft. and three specimen was reported from the Harsha Formation at a depth of 8180 ft and 8210 ft. In Well

B1-NC41 section, 49 specimens were found only from the Samdun Formation. The first specimen was recovered at a drilling depth of 7310 ft., 12 specimens were found at 7310 ft., 36 specimens reported from depths ranging between 7330 and 7410 ft. In Well K1-NC41 section, 11 specimens were found, in the Samdun Formation, three specimens at 8310 ft., 2 specimens found at 8370 ft., one specimen at a depth of 8450 ft., and five specimens in the Harsha Formation at drilling depths of 8910-9000 ft. In Well B1a-137 section, 1202 specimens have been reported, 1017 of which were found in the Samdun Formation at depths of 6100-6600 ft.. Only seven specimens were recovered from the Dahman Formation at a drilling depth of 6640. In 12 samples of the Harsha Formation, 178 specimens were found at depths between 6680 and 7060 ft. In Well H1-NC41 section, 268 specimens were recorded. Of these 92 specimens came from the Samdun Formation at depths between 9520 and 10200 ft., 176 specimens from the Harsha Formation at depths ranging between 10300 and 10510 ft. In Well C1-NC41, 979 specimens were found, 396 specimens from the Samdun formation at depths between 7130 and 7950 ft. In the Harsha formation, 583 specimens so far were found at depths between 7680 and 8070 ft.

Description:

Thick shelled, sub-rectangular carapace in lateral view, with its greatest height at the anterior, cardinal angle. This species is also characterised by six, well-developed loculi. The lateral surface is smooth, sometimes being ornamented by fine pitting on the postero-ventral area. Left valve is larger than the right and overlapping it along the ventral and antero-dorsal margins. Sexual dimorphism is present, the males are more elongate than the females and mostly smooth, or with a finely pitted surface; the males are also marked by the convexity in the ventral margin area.

In dorsal view the carapace is biconvex with maximum width developed at the anterior half. Internal features were not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.301.T.26	(Pl. 43, fig. 1)	722	425	255

♀ carapace HU.301.T.27	(Pl. 43, fig. 2)	725	430	274
♀ carapace HU.301.T.28	(Pl. 43, fig. 3)	703	462	200
♀ carapace HU.301.T.29	(Pl. 43, fig. 4)	709	420	241
♂ carapace HU.301.T.30	(Pl. 43, fig. 5)	860	480	340
♂ carapace HU.302.T.1	(Pl. 43, fig. 6)	830	485	280
♀ carapace HU.302.T.2	(Pl. 43, fig. 7)	727	450	225

Remarks:

This species was originally described from Algeria as ***Loxoconcha? cavernosa*** by Apostolescu & Magné (1956) who also described ***Loxoconcha polita*** as a distinct species. Bismuth ***et al.***,(1978) concluded that ***Loxoconcha polita*** is the male of ***H cavernosa***. Ruggieri (1963) mentioned on his paper of the Eocene species from Sicily, that the above species possibly belongs to the newly defined genus ***Heptaloculites.*** In 1973a, Oertli transferred this species to ***Loculicytheretta*** (***Heptaloculites***) ***cavernosa*** and finally Bismuth ***et al.***, (1978) transferred it to ***Loculicytheretta cavernosa.*** This view is not accepted in the present study. The present species is very similar to ***H. semirugosa*** (Apostolescu & Magné, 1956) but differs from it, in having a smoother surface and well developed loculi.

Occurrence:

H. cavernosa is known so far from the Middle Eocene of Well B1a-137, Well B1-NC41, Well C1-NC41, Well K1-NC41, Well H1-NC41, Well F1-NC41, from the Middle Eocene of Algeria and from the Middle Eocene of Tunisia.

Heptaloculites semipunctata (Apostolescu & Magné, 1956)

(Pl. 44, figs. 3-6)

1956 ***Loxoconcha? semipunctata*** n.sp. Apostolescu & Magné, p. 342, pl. 1, figs. 10-11.

1978 ***Loculicytheretta semipunctata*** (Apostolescu & Magné), Bismuth ***et al.***, p. 241, pl. 5, figs. 89-93.

1981 *Loculicytheretta semipunctata* (Apostolescu & Magné), Mechmeche; p. 62, pl. 6, figs. 7-9.

Figured specimens:

Pl. 44, fig. 3, female carapace HU.302.T.13, Pl. 44, fig. 4, female carapace HU.302.T.14, Pl. 44, fig. 5, female carapace HU.302.T.15, Pl. 44, fig. 6, female carapace HU.302.T.16. All specimens from Well B1a-137 at a depth of 7425 ft.

Type locality:

F 475, Algeria.

Type horizon:

Upper Lutetian

Stratigraphic range:

Top most part of the Lower Eocene and Middle Eocene.

Material:

17 specimens were found In Well B1a-137 section, from the Harsha Formation at drilling depths of 7330-7490 ft.

Description:

In lateral view, sub-rectangular carapace of medium size, with its greatest height anteriorly. The dorsal and ventral margins are almost parallel. This species is also characterised by five or six weakly developed loculi, running along the ventral margin. The surface is smooth, except in the posterior area with a narrow zone of reticulate pits along the anterior margin.

Internal details were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.302.T.13	(Pl. 44, fig. 3)	640	416	280
♀ carapace HU.302.T.14	(Pl. 44, fig. 4)	643	434	250
♀ carapace HU.302.T.15	(Pl. 44, fig. 5)	624	384	285
♀ carapace HU.302.T.16	(Pl. 44, fig. 6)	628	410	300

Remarks:

This species shows some similarity to ***Heptaloculites quinqueloculita*** (Bismuth, 1978) in Bismuth ***et al.***, (1978), but the latter species differs in having a completely smooth surface. The present species is easily distinguished from the others by its characteristic ornamentation.

Occurrence:

This species is recorded so far from the Middle Eocene of Well B1a-137, from the Middle Eocene of Algeria and from the top most lower Eocene and Middle Eocene of Tunisia.

Heptaloculites quinqueloculita (Bismuth, 1978)

(Pl. 44, figs. 7-12)

1978 ***Loculicytheretta quinqueloculita*** Bismuth; in Bismuth ***et al.***, p. 243, pl. 6, figs. 100-108.

Figured specimens:

Pl. 44, fig. 7, female carapace HU.302.T.17, Pl. 44, fig. 8, female right valve HU.302.T.18, Pl. 44, fig. 9, female carapace HU.302.T.19, Pl. 44, fig. 10, female carapace HU.302.T.20, Pl. 44, fig. 11, female carapace HU.302.T.21, Pl. 44, fig. 12, female carapace HU.302.T.22. All specimens from Well K1-NC41 at a depth of 9690 ft.

Type locality:

2 km WNW of the station of Kalaa Djerda, sample 105, Tunisia.

Type horizon:

Lower Lutetian:

Stratigraphic range:

Middle Eocene.

Material:

This species has only been found In K1-NC41, 137 specimens were found in the Harsha Formation, four specimens were found at 9400 ft., three specimens at 9426 ft., eight specimens at 9450 ft., four specimens at 9480 ft., 15 specimens found at 9590 ft., and 103 specimens were reported from depths between 9610 and 9690 ft.

Diagnosis:

The carapace is sub-rectangular in lateral view with its greatest height at the cardinal angle. The anterior margin is nearly rounded. The dorsal margin is almost straight, the ventral margin is nearly straight having an upward trend in the posterior third. The lateral surface is smooth, but there are small riblets running above the loculi. Five, poorly developed loculi are situated along the ventral margin, running from the antero-ventral area to the posterior extremity.

Sexual dimorphism present, the males are more elongate than the females.

Dimensions of figured specimens (μm)*:*

		L	H	W
♀ carapace HU.302.T.17	(Pl. 44, fig. 7)	666	383	220
♀ right valve HU.302.T.18	(Pl. 44, fig. 8)	633	383	165
♀ carapace HU.302.T.19	(Pl. 44, fig. 9)	642	300	250
♀ carapace HU.302.T.20	(Pl. 44, fig. 10)	680	390	260
♀ carapace HU.302.T.21	(Pl. 44, fig. 11)	700	395	265
♀ carapace HU.302.T.22	(Pl. 44, fig. 12)	678	391	295

Remarks:

The present species was first described from the Middle Eocene of Tunisia by Bismuth (1978) in Bismuth ***et al.***, (1978). Its resembles ***Heptaloculites eocaenica*** sp. nov., but the latter differs in being larger, and also in having very poorly developed loculi.

Occurrence:

Known so far from the Middle Eocene of Well K1-NC41, and from the Middle Eocene of Tunisia.

Heptaloculites harshae sp. nov.

(Pl. 45, figs. 9-12)

1978 *Heptaloculites* aff. ***prima*** (Bismuth & Oertli), Bismuth ***et al.***, p. 242, pl. 6, figs. 94-99.

1981 ***Loculicytheretta*** aff. ***prima*** (Bismuth & Oertli), Mechmeche; p. 62, pl. 6, figs. 10-12.

Figured specimens:

Pl. 45, fig. 9, female carapace, holotype HU.302.T.28. From depth 7270 ft., Pl. 45, fig. 10, female carapace, paratype HU.302.T.29, Pl. 45, fig. 11, female, carapace paratype HU.302.T.30. From depth 7330 ft., Pl. 45, fig. 12, male carapace HU.303.T.1. From depth 8000 ft. All specimens from Well B1a-137 except fig. 12 from Well C1-NC41.

Derivation of name:

From its occurrence in the Harsha Formation.

Holotype:

A female carapace HU.302.T.28

Paratype:

Two carapaces HU.302.T.29-30

Type locality:

Well B1a-137, Tarabulus Basin, NW offshore Libya.

Type horizon:

Harsha Formation, Middle Eocene, depth 7270 ft.

Stratigraphic range:

Middle Eocene.

Material:

21 specimens. In well C1-NC41, 12 specimens came from the Harsha Formation, 11 specimens were found at depths of 8000-8070 ft. In Well B1a-137 section, 8 eight

specimens were found in the Harsha Formation at drilling depths of 7240-7425 ft. In Well H1-NC41, one specimen was found in the Harsha Formation at a drilling depth of 10810 ft.

Diagnosis:

A species of ***Heptaloculites*** characterised by its strongly pronounced sexual dimorphism and coarsely pitted surface with distinct reticulation.

Description:

The carapace is elongate and subrectangular in lateral view, with the greatest height anteriorly. The dorsal margin is almost straight, the ventral margin, decorated with four loculi, is fairly straight, curving upwards at the posterior end. The anterior margin is fairly rounded. The lateral surface is coarsely pitted with distinct reticulation except in the anterior area. Left valve is larger and overlaps the left along its entire margin.

Sexual dimorphism is strongly pronounced with the males being more elongate and less high than the females. Only closed carapaces were available and it was not possible to observe the internal features.

Dimensions of figured specimens (μm)***:***

		L	H	W
Holotype, ♀ carapace HU.302.T.28	(Pl. 44, fig. 9)	750	400	330
Paratype, ♀ carapace HU.302.T.29	(Pl. 44, fig. 10)	741	420	344
Paratype, ♀ carapace HU.302.T.30	(Pl. 44, fig. 11)	816	469	400
♂ carapace HU.303.T.1	(Pl. 44, fig. 12)	860	440	370

Differences and affinities :

Heptaloculites harshae is very similar to ***H. prima*** (Bismuth & Oertli, 1978) in Bismuth ***et al.***, (1978), but differs in lacking ornamentation close to the anterior area and in the females having a smooth, flattened surface just above the loculi. ***H. minuta*** shows some similarity to this species but differs in its small size and regular reticulation pattern with a tendency to develop fine longitudinal riblets and also in its less developed loculi. Furthermore, ***H. semirugosa*** (Apostolescu & Magné, 1956)

shows some affinities to the present species but the Apostolescu & Magné species differs in having pits developed at the postero-ventral margin whilst ***H. harshae*** is covered by a coarse meshed reticulation, except in the anterior marginal area.

Occurrence:

This species is known from the Middle Eocene of Well B1a-137, C1-NC41, Well H1-NC41, and from the Middle Eocene of Tunisia.

Heptaloculites eocaenica sp. nov.

(Pl. 45, figs. 1-8)

1981 ***Loculicytheretta*** sp. ***1***, Mechmeche; p. 64, pl. 6, figs. 5, 6.

Figured specimens:

Pl. 45, fig. 1, female carapace holotype HU.302.T.23, Pl. 45, figs. 3-4, female carapace paratype HU.302.T.25. From depth 7400 ft., Pl. 45, figs. 2, 7, female carapace paratype HU.302.T.24, Pl. 45, figs. 5-6, female carapace paratype HU.302.T.26, Pl. 45, fig. 8, female carapace paratype HU.302.T.27. From depth 7770 ft. All figured specimens from Well C1-NC41.

Derivation of name:

From its stratigraphical occurrence in the Eocene of the Tarabulus basin, offshore, Libya.

Holotype:

A female carapace HU.302.T.23

Paratypes:

Four female carapaces HU.302.T.24-27

Type locality:

Well C1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Samdun Formation, Middle Eocene, depth 7400 ft.

Stratigraphic range:

Lower and Middle Eocene.

Material:

316 specimens. In Well C1-NC41 section, 166 specimens were found, 49 in the Samdun Formation at depths between 7360 and 7590, and 117 specimens in the Harsha Formation at 7680-8070 ft. In Well B1a-137, 113 specimens have been recorded; 30 specimens from the Samdun Formation at depths between 6400 ft., 35 specimens from the Dahman Formation at a drilling depth of 6640 ft., and 48 specimens from the Harsha Formation at depths 6680-7270 ft. In Well H1-NC41 section, 35 specimens were reported, five specimens from the Samdun Formation at depths between 9680 and 10060 ft., and 30 specimens from the Harsha Formation at depths ranging from 10340 to 10680 ft. In Well F1-NC41, two specimens were found in the Samdun Formation at a drilling depth of 7740 ft.

Diagnosis:

This new species of the genus ***Heptaloculites*** Ruggieri, 1963 is characterised in lateral view by its large, thick shelled, sub-rectangular carapace and its smooth surface, with very poorly developed loculi.

Description:

In lateral view, large, thick shelled, subrectangular carapace with the greatest height at the anterior margin and the greatest width at the middle . The dorsal margin is straight, sloping gently to the posterior margin. The ventral margin is straight, rising slightly posteriorly. Anterior margin is broadly rounded, posterior margin is smooth in the upper part and decorated by weakly developed loculi and is also less high than the anterior margin. The surface is smooth. In dorsal view, the carapace is rather narrow, with almost parallel sides.

Sexual dimorphism was not observed in the present material. No internal details were seen as no single valves were obtained.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype ♀ carapace HU.302.T.23	(Pl. 45, fig. 1)	952	547	350
Paratype ♀ carapace HU.302.T.24	(Pl. 45, figs. 2, 7)	780	404	391
Paratype ♀ carapace HU.302.T.25	(Pl. 45, figs. 3, 4)	863	522	335
Paratype ♀ carapace HU.302.T.26	(Pl. 45, figs. 5, 6)	854	500	375
Paratype ♀ carapace HU.302.T.27	(Pl. 45, fig. 8)	790	470	345

Differences and affinities :

Mechmeche (1981) illustrated forms which she called ***Loculicytheretta*** sp. ***1*** from the Lower and Middle Eocene of Tunisia which are identical with ***Heptaloculites eocaenica.*** ***Heptaloculites eocaenica*** shows some similarity to ***H. cavernosa*** (Apostolescu & Magne, 1956) but the Libyan species differs in having a smooth surface, very poorly developed loculi and also differs in its greater size. ***H. eocaenica*** resembles closely ***H. quinqueloculita*** (Bismuth, 1978), but the latter species differs in having a less pointed carapace and in its weak, undulate costulae above the loculi; moreover the latter species has five loculi which are more developed than in the new species. ***H. eocaenica*** easily distinguished from the other ***Heptaloculites*** species by its larger size and its very weakly developed loculi.

Occurrence:

This species in found so far in the Middle Eocene of Well B1a-137, Well H1-NC41, Well C1-NC41 and Well F1-NC41, and from the Lower and Middle Eocene of Tunisia.

Family Loxoconchidae Sars, 1925

Subfamily Loxoconchinae Sars, 1925

Genus ***LOXOCONCHA*** Sars, 1925

Loxoconcha tarabulusensis sp. nov.

(Pl. 46, figs. 1-8, 10, 11)

Figured specimens:

Pl. 46, fig. 1, male carapace, holotype HU.303.T.2, Pl. 46, fig. 2, male carapace, paratype HU.303.T.3, Pl. 46, fig. 3, male carapace paratype HU.303.T.4, Pl. 46, fig. 4, female carapace, paratype HU.303.T.5, Pl. 46, fig. 5, female carapace, paratype HU.303.T.6, Pl. 46, figs.6, 10 female carapace, paratype HU.303.T.7, Pl. 46, fig. 7, male carapace, paratype HU.303.T.8, Pl. 46, fig. 8, male carapace, paratype HU.303.T.9, Pl. 46, fig. 11, male carapace, paratype HU.303.T.10. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.303.T.2

Paratypes:

Eight specimens HU.303.T.3-10

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7670 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

3591 specimens. In Well K1-NC41, 561 specimens were found, 134 in the Samdun Formation at drilling depths of 8020-8500 ft., 36 specimens in the Dahman Formation at a depth of 8564 ft., and 391 specimens in the Harsha Formation at 8660-9590 ft. In Well F1-NC41, 1024 specimens were recorded, 471 from the Samdun Formation at depths of 7740-8080 ft., and 553 specimens from the Harsha Formation at drilling depths of 8180-8590 ft. In Well C1-NC41, 368 specimens were found, 149 in the Samdun Formation at 7040-7570 ft., and 219 specimens in the Harsha Formation at drilling depths of 7690-8020 ft. In Well H1-NC41, 639 specimens were recovered, 195 in the Samdun Formation at 9640-10200 ft., and 444 specimens in the

Harsha Formation at drilling depths of 10300-10930 ft. In Well B1-NC41, 757 specimens were found, 51 in the Samdun Formation at depths of 7250-7410 ft., and 706 specimens in the Ghalil Formation at depths of 7490-7950 ft. In Well D2-NC41, four specimens were found in the Ghalil formation at depths of 8040 and 8060 ft. In Well B1a-137, 150 specimens were recorded, 50 specimens from the Samdun Formation at 6040-6600 ft., 12 from the Dahman Formation at a drilling depth of 6640 ft., and 88 specimens from the Harsha Formation at depths of 6680-7390 ft. In Well L1-NC41, 88 specimens were found in the Harsha Formation at drilling depths of 9440-9600 ft.

Diagnosis:

A species of ***Loxoconcha*** characterised by its finely pitted surface, smooth posterior and well marked sexual dimorphism.

Description:

Carapace rhomboidal in lateral view, inflated ventrally with the greatest height anterior to the middle. Anterior margin obliquely rounded, gently curving down in the upper part, posterior margin narrower, obliquely rounded, forming a distinct angle with the dorsal margin and continuing into posterior marginal flange. Dorsal margin almost straight, ventral margin concave anteriorly, convex upwards posteriorly. Eye tubercle present but not very distinctive, more conspicuous in the left valve. Left valve larger than the right and overreaching it, being more developed along the anterior and the ventral margins. The lateral surface is finely pitted, except for a smooth area at the posterior end, the pits being very fine and arranged almost parallel to the ventral margin. Greatest length occurs above the mid-height. In dorsal view, the carapace is lenticular with inflated sides. Posterior and anterior ends are compressed. Maximum width just behind the middle. Eye tubercle is clearly seen in the dorsal view. Sexual dimorphism is well pronounced, the presumed males more elongate and less high than the presumed females.

Only carapaces were obtained and as no valves were available for study it was not possible to describe the internal features.

Dimensions of figured specimens (μm):

		L	H	W
Holotype, ♂ carapace HU.303.T.2	(Pl. 46, fig. 1)	650	400	325
Paratype, ♂ carapace HU.303.T.3	(Pl. 46, fig. 2)	600	375	320
Paratype, ♂ carapace HU.303.T.4	(Pl. 46, fig. 3)	616	383	330
Paratype, ♀ carapace HU.303.T.5	(Pl. 46, fig. 4)	608	416	340
Paratype, ♀ carapace HU.303.T.6	(Pl. 46, fig. 5)	608	400	362
Paratype, ♀ carapace HU.303.T.7	(Pl. 46, fig. 6, 10)	600	416	340
Paratype, ♂ carapace HU.303.T.8	(Pl. 46, fig. 7)	621	380	324
Paratype, ♂ carapace HU.303.T.9	(Pl. 46, fig. 8)	608	390	333
Paratype, ♂ carapace HU.303.T.10	(Pl. 46, fig. 11)	640	370	335

Differences and affinities:

Loxoconcha gounodensis Apostolescu & Magné (1956) from the Middle Eocene of Algeria differs in having narrower anterior and posterior ends and is less high. The present species resembles ***L. lagosensis*** Reyment (1960) from the Eocene of Nigeria in general outline and shape but the latter differs in being much smaller, its lateral surface is coarsely pitted and it has a strong keel-like structure on the ventral margin. ***L. tarabulusensis*** shows some similarities to ***Loxoconcha*** sp. El-Waer (1988) from the Late Miocene of the Al Khums Formation, Libya but the latter species has a straight dorsal margin and the left valve is larger and strongly overlaps the right. ***Loxoconcha*** sp. ***2*** Mechmeche (1981) from the Eocene of Tunisia is similar to ***L. tarabulusensis*** but the two can easily be distinguished by the outline of the dorsal margin and also Mechmeche's specimens are more inflated ventrally.

Occurrence:

This species occurs in the Middle Eocene of Well H1-NC41, Well F1-NC41, Well L1-NC41, Well D2-NC41, from the Middle and Upper Eocene of Well C1-NC41, Well K1-NC41, Well B1a-137 and Well B1-NC41.

Loxoconcha mataiensis Khalifa & Cronin, 1979

(Pl. 46, figs. 9, 12, Pl. 47, figs. 1-6)

1979 *Loxoconcha mataiensis* Khalifa & Cronin, p. 179, pl. 1, figs. 21, 22

Figured specimens:

Pl. 46, fig. 9, male carapace HU.303.T.11, Pl. 46, fig. 12, Pl. 47, fig. 4, female carapace HU.303.T.12, Pl. 47, fig. 1, male carapace HU.303.T.13, Pl. 47, fig. 2, female carapace HU.303.T.14, Pl. 47, fig. 3, female carapace HU.303.T.15, Pl. 47, fig. 5, male carapace HU.303.T.16, Pl. 47, fig. 6, female carapace HU.303.T.17. All specimens from Well B1-NC41 at a depth of 7670 ft.

Type Locality:

El Sheikh Fald section, East of beni Mazar, upper Egypt.

Type horizon:

Middle Eocene.

Stratigraphic range:

Middle Eocene.

Material:

53 specimens were found in Well B1-NC41, all specimens from the Ghalil Formation at drilling depths of 7570-7850 ft.

Description:

A species of ***Loxoconcha*** characterised by its ovate to subrhomboidal carapace in lateral view, anterior end rounded below, sloping smoothly in the upper part. Posterior end narrowly rounded with a postero-dorsal caudal process. Dorsal margin straight to slightly convex medially, ventral margin convex mid-ventrally, curving smoothly to the posterior and anterior ends. Surface concentrically reticulate centrally, becoming less pitted towards the margins. A few fine longitudinal ribs may be developed ventrally or dorsally. A weak eye tubercle is almost obscured by the ornamentation. The posterior marginal area is almost smooth.

In dorsal view, carapace elliptical with compressed ends. Maximum width lies anteriorly in the females and in the middle in the males. Internal structures unknown.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.303.T.11	(Pl. 46, fig. 9)	382	228	195
♀ carapace HU.303.T.12	(Pl. 46, fig. 12, Pl. 47, fig. 4)	350	250	200
♂ carapace HU.303.T.13	(Pl. 47, fig. 1)	371	228	185
♀ carapace HU.303.T.14	(Pl. 47, fig. 2)	325	230	191
♀ carapace HU.303.T.15	(Pl. 47, fig. 3)	345	235	200
♂ carapace HU.303.T.16	(Pl. 47, fig. 5)	382	230	200
♀ carapace HU.303.T.17	(Pl. 47, fig. 6)	330	240	210

Remarks:

This species was originally described from the Eocene of Egypt by Khalifa & Cronin (1979). The Libyan specimens are slightly smaller, but in other morphological features and in age, these specimens agree well with ***Loxoconcha mataiensis*** Khalifa & Cronin.

Occurrence:

Known so far from the Middle Eocene of Well B1-NC41, and from the Middle Eocene of Egypt.

Loxoconcha ghalilae sp. nov.

(Pl. 47, figs. 7-12)

Figured specimens:

Pl. 47, fig. 7, female carapace, paratype HU.303.T.18, Pl. 47, fig. 8, female carapace, paratype HU.303.T.19, Pl. 47, fig. 9, male carapace, holotype HU.303.T.20, Pl. 47, fig. 10, female carapace, paratype HU.303.T.21, Pl. 47, fig. 11, female carapace, paratype HU.303.T.22, Pl. 47, fig. 12, female carapace, paratype HU.303.T.23. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A male carapace HU.303.T.20

Paratypes:

Five specimens HU.303.T.18, 19, 21-23

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7450 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

670 specimens. In Well B1-NC41, 344 specimens were found in the Ghalil Formation at drilling depths of 7430-7950 ft. In Well H1-NC41, 28 specimens were recorded from the Harsha Formation at 10560-10930 ft. In Well C1-NC41, 144 specimens were found, 70 in the Samdun Formation, four at depth of 7040 ft, and 66 specimens at 7170-7570 ft. Seventy four specimens were also found in the Harsha Formation at drilling depths of 7690-7890 ft. In Well D2-NC41, 32 specimens were found in the Ghalil Formation at depths of 7800-8180 ft. In Well F1-NC41, 67 specimens were recorded, 14 from the Samdun Formation at depths of 7940-8010 ft., and 53 specimens from the Harsha Formation at 8300-8579 ft. In Well K1-NC41, three specimens were found in the Harsha Formation at 8910 and 8950 ft. In Well B1a-137, 52 specimens were found in the Harsha Formation at drilling depths of 7060-7455 ft.

Diagnosis:

A coarsely reticulate species of ***Loxoconcha*** which is subovate to rhomboidal in lateral view, males more elongate and higher than the females.

Description:

In lateral view, carapace subovate to rhomdoidal with the greatest length passing above mid-height, greatest height at the middle of the carapace. Anterior end somewhat broadly and obliquely rounded, posterior end narrower, rounded and lower than the anterior end. Dorsal margin straight, sloping backwards posteriorly, ventral margin slightly convex caused by the swelling of the valve and slightly concave anteriorly. Lateral surface has elongate and concentrically arranged pits, separated by the longitudinal ribs in the ventral area; pits coarse and rounded in the middle, becoming finer towards the margins. There are small smooth areas at the posterior and anterior ends. Left valve larger and overlapping the right all around except along the dorsal margin. In dorsal view, carapace ovate with slightly convex sides. Maximum width at the middle. In ventral view, longitudinal ribs in each valve are very distinctive. Sexual dimorphism present, the presumed females being slightly narrower posteriorly and less elongate than the presumed males.

Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Paratype, ♀ carapace HU.303.T.18	(Pl. 47, fig. 7)	523	353	305
Paratype, ♀ carapace HU.303.T.19	(Pl. 47, fig. 8)	537	350	280
Holotype, ♂ carapace HU.303.T.20	(Pl. 47, fig. 9)	646	384	330
Paratype, ♀ carapace HU.303.T.21	(Pl. 47, fig. 10)	530	369	315
Paratype, ♀ carapace HU.303.T.22	(Pl. 47, fig. 11)	550	360	300
Paratype, ♀ carapace HU.303.T.23	(Pl. 47, fig. 12)	538	369	310

Differences and affinities:

Loxoconcha ghalilae is similar to ***L. tarabulusensis*** in general outline and in shape, but differs in the ornamentation of the lateral surface. ***Loxoconcha*** sp. ***1*** Mechmeche (1981) is smaller and has a convex dorsal margin in the left valve. In ***L. ghalilae*** this is straight and the surface is also less coarsely pitted. ***L. pseudopunctatella*** Cronin & Khalifa (1979) from the Late Eocene of the Egyptian El

Mereir Formation resembles the present species but is smaller (L = 0.338 μm, H = 290 μm), and has a more reticulate surface and more produced posterior margin.

Occurrence:

This species is known so far from the Middle Eocene of Well B1-NC41, Well H1-NC41, Well F1-NC41, Well K1-NC41 and Well B1a-137, and from the Middle and Upper Eocene of Well C1-NC41 and Well D2-NC41.

Loxoconcha palaeocaenica sp. nov.

(Pl. 48, figs. 1-6)

Figured specimens:

Pl. 48, fig. 1, female carapace, paratype HU.303.T.24, Pl. 48, fig. 2, female carapace, paratype HU.303.T.25 , Pl. 48, fig. 3, female carapace, holotype HU.303.T.26, Pl. 48, fig. 4, male carapace, paratype HU.303.T.27, Pl. 48, fig. 5, male carapace, paratype HU.303.T.28, Pl. 48, fig. 6, male carapace, paratype HU.303.T.29. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Palaeocene beds.

Holotype:

A female carapace HU.303.T.26

Paratypes:

Five specimens HU.303.T.24-25, 27-29

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Late Palaeocene, depth 9520

Stratigraphic range;

Late Palaeocene.

Material:

14 specimens were found in Well D2-NC41 at drilling depths of 9380-9520 ft. All specimens are from the Al Jurf Formation.

Diagnosis:

A species of ***Loxoconcha*** characterised by its medium-sized carapace and its posterior end has an upward swing and short rounded subdorsal caudal process.

Description:

The carapace is medium sized and subrectangular in lateral view. Anterior end broadly and obliquely rounded, gently sloping in the antero-dorsal corner, strongly extended below, posterior end has an upward swing and short rounded subdorsal caudal process. Greatest height located at one-third of the length from the posterior end, greatest length passes through about mid-height. In the left valve, dorsal margin is almost straight, slightly obscured in the middle and slopes gently to the posterior end. Dorsal margin in the right valve, slightly concave anteriorly, convex in the posterior half. Ventral margin concave anteriorly, convex mid-ventrally, curving smoothly towards the posterior end. Anterior and posterior marginal areas are fairly broad and smooth. Anterior and posterior cardinal angles present. Lateral surface coarsely reticulate. Two ventral ridges run from the antero-ventral margin parallel to the ventral, posterior and half of the dorsal margin then turn downward and gradually disappear above the middle of the anterior half. A set of parallel ridges are present in the antero-dorsal region. Anterior marginal rim runs along the anterior margin to join the lower ventral ridge medially.

In dorsal view, carapace lenticular with maximum width just behind the middle. In ventral view ventral ridges are clearly seen. Left valve slightly larger than the right valve. Sexual dimorphism present, the presumed males more elongate and slimmer than the presumed females.

Dimensions of figured specimens (μm):

		L	H	W
Paratype, ♀ carapace HU.303.T.24	(Pl. 48, fig. 1)	470	250	270
Paratype, ♀ carapace HU.303.T.25	(Pl. 48, fig. 2)	438	220	190

Holotype, ♀ carapace HU.303.T.26	(Pl. 48, fig. 3)	484	252	180
Paratype, ♂ carapace HU.303.T.27	(Pl. 48, fig. 4)	505	221	200
Paratype, ♂ carapace HU.303.T.28	(Pl. 48, fig. 5)	470	215	200
Paratype, ♂ carapace HU.303.T.29	(Pl. 48 , fig. 6)	489	221	205

Differences and affinities:

The present species shows some similarities to ***Loxoconcha pseudopunctatella*** Cronin & Khalifa (1979) but the latter differs in having less developed ridges, postero-dorsally finely pitted, in having straight dorsal margin in the left valve and also distinguished by its smaller size.

Occurrence:

Known so far from the Late Palaeocene of Well D2-NC41.

Loxoconcha aljurfae sp. nov.

(Pl. 48, figs. 7-12)

Figured specimens:

Pl. 48, fig. 7, female carapace, paratype HU.303.T.30, Pl. 48, fig. 8, female carapace, paratype HU.304.T.1 , Pl. 48, figs. 9, 11, male carapace, paratype HU.304.T.2, Pl. 48, figs. 10, 12, male carapace, holotype HU.304.T.3. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Al Jurf Formation.

Holotype:

A carapace HU.304.T.3

Paratypes:

Three specimens HU.303.T.30, HU.304.T.1, 2

Type locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Palaeocene, depth 9520.

Stratigraphic range:

Late Palaeocene.

Material:

77 specimens were found in Well D2-NC41 at drilling depths of 9380-9520 ft. All specimens are from the Al Jurf Formation.

Diagnosis:

This species is characterised by its small size and distinctive anterior and posterior margins.

Description:

Carapace subrectangular in lateral view with greatest length at mid-height, greatest height at the anterior margin. Anterior margin compressed, slightly extended below with sharp antero-dorsal slope, posterior margin narrower, obliquely rounded, continuing into posterior flange, concave at the postero-dorsal margin and convex at the postero-ventral corner. The dorsal margin is nearly straight with a distinct anterior and posterior cardinal angle, ventral margin straight. Well developed marginal flange in the posterior half of the ventral margin. A few longitudinal ribs developed ventrally. The rest of the surface is concentrically reticulate, the fossae tending to be rather irregularly shaped. A weak eye tubercle is almost obscured by the ornamentation. Left valve larger than the right and overreaching it along the entire margin except for the posterior end, more prominent at the anterior, dorsal and ventral margins. In some specimens the right valve is seen to overlap the left along the posterior end. Sexual dimorphism is present.

In dorsal view, carapace elliptical with laterally compressed marginal areas with maximum width in the posterior half. Only carapaces were found so no internal features were seen.

Dimensions of figured specimens (μm)*:*

		L	H	W
Paratype, ♀ carapace HU.303.T.30	(Pl. 48, fig. 7)	419	247	215
Paratype, ♀ carapace HU.304.T.1	(Pl. 48, fig. 8)	447	228	220

Paratype, ♂ carapace HU.304.T.2	(Pl. 48, figs. 9, 11)	400	208	210
Holotype, ♂ carapace HU.304.T.3	(Pl. 48, figs.10,12)	408	226	200

Differences and affinities:

Palaeocene ***Loxoconcha*** are very rarely described from Africa and there is nothing which this species can be compared. The present species is so distinctive and so well preserved that it is unlikely to be confused with any other taxon and it is therefore named. This species is easily separated by its posterior and anterior margins.

Occurrence:

This species is recorded so far from the late Palaeocene of Well D2-NC41.

Loxoconcha sirtaensis sp. nov.

(Pl. 49, figs. 8-10)

1966 ***Loxoconcha aff. L. marionensis*** Puri, Salahi, p. 19, pl. 2, fig. 21.

Figured specimens:

Pl. 49, fig. 8, carapace, paratype HU.304.T.7, Pl. 49, fig. 9, carapace, holotype HU.304.T.8, Pl. 49, fig. 10, carapace, paratype HU.304.T.9. All specimens from the same type locality and horizon.

Derivation of name:

From its first occurrence in the Sirte Basin, Libya.

Holotype:

A carapace HU.304.T.8

Paratypes:

Two specimens HU.304.T.7, 9

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7630 ft.

Stratigraphic range:

Middle Eocene.

Material:

15 specimens were found in the Ghalil Formation, three at a depth 7630 ft., and 12 specimens at 7730 ft. All specimens are from Well B1-NC41.

Diagnosis:

Subovate carapace with greatest height in the posterior half, surface ornamented with concentrically arranged pits.

Description:

Thick-shelled, sub-ovate carapace in lateral view. Anterior end rounded, posterior end produced with a concave postero-dorsal margin and convex postero-ventral margin. Dorsal margin more or less straight, ventral margin convex mid-ventrally, curving upwards posteriorly. Greatest height in the posterior half, greatest length occurs at mid-point. Left valve slightly larger than the right. The posterior marginal area is broad and smooth, the rest of the surface is ornamented with a sculpture which varies from moderately coarse pits in the middle of the carapace with fine ribs parallel to ventral margin, to weakly defined pits in the anterior half where no ribs are developed.

In dorsal view the carapace is arrow-shaped. Maximum width just behind the middle. Internal features were not observed. Sexual dimorphism was not seen.

Dimensions of figured specimens (μm)*:*

		L	H	W
Paratype carapace HU.304.T.7	(Pl. 49, fig. 8)	334	220	184
Holotype carapace HU.304.T.8	(Pl. 49, fig. 9)	371	238	220
Paratype carapace HU.304.T.9	(Pl. 49, fig. 10)	363	222	200

Differences and affinities:

Salahi (1966) illustrated one figured specimen from the Middle Eocene of the Wadi Thamit Formation, Sirte Basin, Libya which is identical with the present species and named it as ***Loxoconcha*** aff. ***L. marionensis*** Puri. The present species is easily

distinguished from any other ***Loxoconcha*** species by its distinctive posterior outline and by its smaller size.

Occurrence:

This species is Known from the Middle Eocene of Well B1-NC41, and from the Middle Eocene of the Sirte basin.

Loxoconcha sp. ***A***

(Pl. 49, figs. 1-4)

Figured specimens:

Pl. 49, figs. 1, 2, carapace HU.304.T.4, Pl. 49, figs. 3, 4, carapace HU.304.T.5. All figured specimens are from the same locality and horizon.

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 8120 ft.

Stratigraphic range:

Middle Eocene.

Material:

Two specimens were found in the Ghalil Formation of Well D2-NC41 at a drilling depth of 8120 ft.

Description:

Small sized, subrhomboidal carapace in lateral view, highest mid-ventrally, greatest length lies above mid-height. Anterior margin obliquely rounded and extended below with gentle antero-dorsal slope, posterior margin slightly produced, concave in the upper part and convex below. Dorsal margin nearly straight with a distinct posterior cardinal angle, ventral margin concave anteriorly, convex mid-ventrally, curving smoothly towards the posterior end. Carapace more inflated at the postero-ventral margin. Left valve overlaps the right along the ventral margin and the

right overlaps the left strongly along the posterior margin. The surface is ornamented by coarse, rounded pits in the middle part of the carapace, becoming finer towards the posterior and dorsal margins. Eye tubercle present but not distinct.

In dorsal view, carapace ovate with maximum width and thickness just behind the middle.

Dimensions of figured specimens (μm)**:**

		L	H	W
Carapace HU.304.T.4	(Pl. 49, figs. 1, 2)	416	238	205
Carapace HU.304.T.5	(Pl. 49, figs. 3, 4)	418	244	210

Differences and affinities:

This species differs from ***Loxoconcha ghalilae*** in its anterior margin which is strongly extended below, its coarse and rounded pits in the ventral half and its more produced posterior end. ***Loxoconcha*** sp. ***A*** is similar to ***Loxoconcha lagosensis*** Reyment (1963) in general outline and shape but the latter species differs in its coarser pits in the middle of the valve, its strong keel-like structure and its narrow smooth zone along the margins.

Occurrence:

Known so far from the Middle Eocene of Well D2-NC41.

Loxoconcha sp. ***B***

(Pl. 49, fig. 5-7)

Figured specimens:

Pl. 49, figs. 5-7, carapace HU.304.T.6

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 7940 ft.

Stratigraphic range:

Middle Eocene.

Material:

A single specimen has been found in the Harsha Formation of Well F1-NC41 at a depth of 7940 ft.

Description:

Carapace rectangular in lateral view, dorsal margin almost straight merging into the semi-circular anterior margin. The ventral margin is parallel to the dorsal margin, merging gradually into posterior and anterior ends. Posterior end short, rounded with a subdorsal caudal process. Greatest height in the anterior half, maximum length passes through mid-height. Surface strongly reticulate with longitudinal ridges. In the ventral half and the posterior margin three ridges can be seen. The ridges which run on the ventral side are initially parallel to the ventral margin, and then turn upwards in the postero-ventral area continuing posteriorly and extending horizontally in the anterior direction. Eye tubercle weak. Left valve larger than the right. The rest of the surface is coarsely reticulate with deep fossae.

In dorsal view the carapace has nearly parallel sides and the posterior ridges are clearly seen. Maximum width in the middle.

Dimensions of figured specimen (μm)*:*

		L	H	W
Carapace HU.304.T.6	(Pl. 49, figs. 5-7)	368	201	152

Differences and affinities:

Only one carapace was found so it was not possible to see the internal features. However the present species resembles ***Loxoconcha delemontensis*** Oertli (1956) in general outline but differs in its more reticulate surface and the eye tubercle in Oertli's species is more distinct. ***L. nystiana*** (Bosquet) as figured by Keij (1957) shows some similarities to this species but differs in being much larger, its anterior and posterior marginal areas are smooth and the ventral margin more concave.

Occurrence:

This species is known from the Middle Eocene of Well F1-NC41.

Genus *CYTHEROMORPHA* Hirschmann, 1909

Cytheromorpha? sp. *A*

(Pl. 49, figs. 11,12)

Figured specimen:

A carapace HU.304.T.10

Locality:

Well D2-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 8120 ft.

Material:

Only one carapace was found in Well D2-NC41 from the Ghalil Formation at a drilling depth of 8120 ft.

Stratigraphic range:

Middle Eocene.

Description:

Carapace elongate and reniform in side view, highest anteriorly. Anterior end evenly rounded, posterior end angled at the middle, subrounded below, narrower obliquely than the anterior end. Dorsal margin straight to slightly concave anteriorly, sloping steeply towards the posterior, ventral margin sinuate in the middle. Valves about equal size, no distinct overlap can be seen.

Surface smooth in the central part of the carapace, coarsely pitted along the anterior and posterior ends. Internal features were not seen.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.304.T.10	(Pl. 49, figs. 11, 12)	462	233	165

Differences and affinities:

Information on this badly preserved single specimen is limited to the general outline and shape. It is tentatively placed in the genus ***Cytheromorpha*** on the basis of the external features although it almost certainly does not belong there. Because only one carapace was found it is left under open nomenclature.

Occurrence:

Known so far from the Middle Eocene of Well D2-NC41.

Family Cytheruridae Müller, 1894

Subfamily Cytheropterinae Hanai, 1957

Genus ***CYTHEROPTERON*** Sars, 1866

Type species: ***Cythere latissima*** Norman, 1865

Cytheropteron lekefense Esker, 1968

(Pl. 39, fig. 12)

1968 ***Cytheropteron lekefense*** Esker, p. 332, pl. 2, figs. 3-5.

1982 ***Cytheropteron lekefense*** Esker; Donze ***et al.***, p. 297, pl. 12, fig. 11.

Figured specimen:

A carapace HU.305.T.2

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10180 ft.

Stratigraphic range:

Maastrichtian and Palaeocene.

Material:

Only one specimen was found in Well N1-NC41 from the Al Jurf Formation at a drilling depth of 10180 ft.

Description:

A species of ***Cytheropteron*** with carapace subrhomboidal in lateral view. Anterior end evenly rounded, posterior end angular with a short caudal process about one-fifth of the height down from the dorsal margin. Dorsal margin strongly convex, sloping rather sharply to the anterior and posterior ends. Ventral margin slightly convex in front of the middle, running smoothly to the posterior end. Greatest height along the middle, greatest length passes through mid-height. Left valve overlaps the right except for part of the caudal process. Lateral surface ornamented with fine pits posteriorly and coarse pits above the ala. Ala in each valve has a small sulcus that extends out towards the margin and is usually deepest towards the margin of the alae. Valves more inflated centrally.

In dorsal view, carapace alate subovate with compressed anterior and posterior ends. Alae nearly straight across their posterior margin and sharply rounded towards the anterior. Maximum width occurs in the middle.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.305.T.2	(Pl. 39, fig. 12)	360	230	200

Remarks:

Cytheropteron lekefense Esker (1968) was originally described from the Danian of Tunisia. The Libyan specimen is identical in general character with this species and in particular with a specimen figured by Donze ***et al.***, (1982) from the Danian of the El Kef section, Tunisia. However, this specimen has a slightly pointed posterior and a higher anterior end.

Occurrence:

This species occurs in the Maastrichtian of Well N1-NC41, and also in the Maastrichtian and Palaeocene of Tunisia.

Cytheropteron elongata sp. nov.

(Pl. 52, figs. 7-12)

Figured specimens:

Pl. 52, fig. 7, female carapace, paratype HU.305.T.3, Pl. 52, figs. 8, 12, male carapace, holotype HU.305.T.4. From Well B1-NC41 at depth 7830 ft., Pl. 52, fig. 9, female carapace HU.305.T.5. From Well D2-NC41 at depth 9460 ft., Pl. 52, fig. 10, female carapace HU.305.T.6. From Well D2-NC41 at depth 9500 ft., Pl. 52, fig. 11, female carapace HU.305.T.7. From Well D2-NC41 at depth 9460 ft.

Derivation of name:

L. *Elongatus*: elongate from its shape in side view.

Holotype:

A male carapace HU.305.T.4

Paratype:

A female HU.305.T.3

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7830 ft.

Stratigraphic range:

Late Palaeocene and Middle Eocene.

Material:

46 specimens. In Well B1-NC41, 42 specimens were found in the Ghalil Formation at drilling depths of 7570-7870 ft. In Well D2-NC41, 14 specimens were recorded, five in the Ghalil Formation at 7980-8095 ft., and nine specimens from the Al Jurf Formation at depths of 9400-9500 ft.

Diagnosis:

A medium, thick-shelled, moderately inflated species of *Cytheropteron* with broad and strongly developed alae. Posterior pointed, surface smooth except for a coarsely pitted area above the alae.

Description:

Medium, thick-shelled and moderately inflated, carapace subtriangular to subrhomboidal in lateral view, greatest length lies above the mid-height, maximum height lies in the anterior half in the males and just behind the middle in the females. Anterior end obliquely rounded below, gently curving down in the upper part, posterior end caudate, dorso-caudal slope concave, ventro-caudal slope straight. Dorsal margin gently arched in the females, straight, sloping gently to the posterior end in the males, ventral margin biconvex, running smoothly towards the posterior and anterior ends. The lateral surface is ornamented with a strong and broad ala, with a distinct curve (convex downwards). Ornamentation consists of coarse pits above the alae. Three to four very small ribs can be seen below the alae. The rest of the surface is smooth. Left valve larger than the right and overlaps the latter slightly along its entire margin. Sexual dimorphism is present, the presumed males more elongate and slimmer than the presumed females.

In dorsal view, carapace sagittal, with pointed posterior end and rounded anterior end. Maximum width and thickness in the anterior half. Internal details were not observed.

Dimensions of figured specimens (μm)**:**

		L	H
Holotype, ♂ carapace HU.305.T.4	(Pl. 52, figs. 8, 12)	505	282
Paratype, ♀ carapace HU.305.T.3	(Pl. 52, fig. 7)	437	287
♀ carapace HU.305.T.5	(Pl. 52, fig. 9)	361	233
♀ carapace HU.305.T.6	(Pl. 52, fig. 10)	320	200
♀ carapace HU.305.T.7	(Pl. 52, fig. 11)	421	257

Differences and affinities:

This new species differs from ***Cytheropteron tarabulusensis*** in its more elongate carapace, its smooth lateral surface except above the alae where it is coarsely pitted and its very broad alae with a distinct curve.

Occurrence:

The present species is recorded from the Middle Eocene of Well B1-NC41, and from the Late Palaeocene and Middle Eocene of Well D2-NC41.

Cytheropteron tarabulusensis sp. nov.

(Pl. 53, figs. 1-12)

Figured specimens:

Pl. 53, figs. 1, 9, carapace, holotype HU.305.T.8, Pl. 53, fig. 2, carapace, paratype HU.305.T.9, Pl. 53, figs. 3, 11, carapace, paratype HU.305.T.10, Pl. 53, figs. 4, 12, carapace, paratype HU.305.T.11, Pl. 53, fig. 5, carapace, paratype HU.305.T.12. From Well B1-NC41 at depth 7770 ft., Pl. 53, fig. 6, carapace HU.305.T.13, Pl. 53, fig. 7, carapace HU.305.T.14, Pl. 53, fig. 8, carapace HU.305.T.15, Pl. 53, fig. 10, carapace HU.305.T.16. From Well F1-NC41 at depth 8330 ft.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A carapace HU.305.T.8

Paratypes:

Four specimens HU.305.T.9-12

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7770 ft.

Stratigraphic range:

Middle Eocene.

Material:

121 specimens. In Well B1-NC41, 71 specimens were found in the Ghalil Formation at drilling depths of 7470-7930 ft. In Well H1-NC41, 18 specimens were

recorded from the Harsha Formation at 10300-10700 ft. In Well C1-NC41, 13 specimens were found in the Harsha Formation at 7770-7890 ft. In Well F1-NC41, five specimen has been found in the Harsha Formation at a drilling depth of 8280 ft. In Well B1a-137, three specimens were recorded from the Harsha Formation at a depth of 6870 ft. In Well L1-NC41, 11 specimens were found in the Harsha Formation at 9440-9580 ft.

Diagnosis:

A species of ***Cytheropteron*** with ovate carapace in lateral view, anterior end rounded with infracurvature, a few ribs run between the alae and the ventral margin. In dorsal view, carapace subhastate with pointed posterior end.

Description:

Carapace ovate in lateral view with its greatest height slightly in front of the middle, greatest length occurs just above mid-height. The dorsal margin is arched in the anterior half, gently sloping in the middle and steep towards the posterior end in the right valve, and almost straight in the left valve. Ventral margin strongly convex, particularly in the middle, also slightly concave anteriorly. Anterior end rounded with infracurvature, posterior end slightly acuminate. Surface coarsely pitted above the alae, the pits cover all the surface except a small area at the posterior end. Left valve larger and overreaching the right. Alae process large and distinctive. A few ribs run between the alae and the ventral margin.

In dorsal view, carapace sub-hastate with a pointed posterior end. Maximum width at the mid-length. Only carapaces were obtained in this study so it was not possible to study the internal features.

Dimensions of figured specimens (μm)*:*

		L	H	W
Holotype, carapace HU.305.T.8	(Pl. 53, figs.1, 9)	474	312	285
Paratype, carapace HU.305.T.9	(Pl. 53, fig. 2)	466	285	255
Paratype, carapace HU.305.T.10	(Pl. 53, figs.3, 11)	475	300	285
Paratype, carapace HU.305.T.11	(Pl. 53, figs.4, 12)	511	266	280

Paratype, carapace HU.305.T.12	(Pl. 53, fig. 5)	381	265	209
Carapace HU.305.T.13	(Pl. 53, fig. 6)	468	300	250
Carapace HU.305.T.14	(Pl. 53, fig. 7)	435	294	245
Carapace HU.305.T.15	(Pl. 53, fig. 8)	420	270	240
Carapace HU.305.T.16	(Pl. 53, fig. 10)	462	300	250

Differences and affinities:

Cytheropteron lekefense Esker (1968) shows some similarities to ***C. tarabulusensis*** but is easily separated from it by its more pointed posterior end and more convex dorsal margin which slopes steeply down to an evenly rounded anterior end in the left valve. These specimens have a straight dorsal margin. The present species also differs in its more coarsely pitted surface and is its more pointed alae. ***C. tarabulusensis*** resembles ***C. oba*** Reyment (1963) originally described from the Palaeocene of Nigeria but differs in having a more pointed posterior with two or three blunt, indefinite subdenticles, more elongate alae and faint riblets superimposed on the surface. ***C. tarabulusensis*** is similar to ***C. boukaryi*** Khalifa & Cronin (1979) from the Middle Eocene of Egypt but differs in the outline of the dorsal margin and in its more rounded and higher posterior margin.

Occurrence:

This species is found in the Middle Eocene of Well B1-NC41, Well L1-NC41, Well H1-NC41, Well C1-NC41, Well F1-NC41 and Well B1a-137.

Subfamily Cytherurinae Müller, 1894

Genus ***SEMICYTHERURA*** Wagner, 1957

Type species: ***Cythere nigrescens*** Baird, 1838

Semicytherura aljurfae sp. nov.

(Pl. 50, figs. 1-6)

Figured specimens:

Pl. 50, figs. 1, 4, carapace holotype HU.304.T.11, Pl. 50, figs. 2, 5, carapace paratype HU.304.T.12, Pl. 50, figs. 3, 6, carapace paratype HU.304.T.13. All figured specimens are from the same type locality and horizon.

Derivation of name:

From its occurrence in the Al Jurf Formation.

Holotype:

A carapace HU.304.11

Paratypes:

Two carapaces HU.304.T.12, 13

Type locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10270 ft.

Stratigraphic range:

Maastrichtian.

Material:

12 specimens were found in Al Jurf Formation of Well N1-NC41 at drilling depths of 10180-10320 ft.

Diagnosis:

This species is characterised by its small-sized carapace with a marginal rim that runs along the entire margin except a small area at the posterior end.

Description:

The carapace is small-sized and ovate in lateral view, greatest height occurs in the middle and the greatest length developed at mid-height. The dorsal margin is strongly arched in both valves whilst the ventral margin is straight to slightly convex. The anterior margin shows strong infracurvature, posterior end has a clear caudal process. The left valve is slightly larger than the right and overlaps around all the margins.

The lateral surface is coarsely pitted with superimposed ribs, with the exception for a small smooth area at the posterior end. The ribs run from the anterior marginal rim to the posterior margin and are clearly seen in the ventral half. A small depression runs behind and parallel to the anterior margin. A well developed marginal rim runs along the anterior margin except at the posterior. In dorsal view the carapace has convex sides with a compressed anterior end and sharply pointed posterior end, maximum width in the middle. In ventral view the ventral ribs are visible.

Only closed carapaces were found as no single valves were obtained, it was not possible to see the internal features. Sexual dimorphism was not observed.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype carapace HU.304.T.11	(Pl. 50, figs. 1, 4)	369	217	190
Paratype carapace HU.304.T.12	(Pl. 50, figs. 2, 5)	380	238	191
Paratype carapace HU.304.T.13	(Pl. 50, figs. 3, 6)	360	217	160

Difference and affinities:

Semicytherura aljurfae shows some similarities to ***S. africana*** of the present study in shape but differs in the ornamentation of the lateral surface. ***S. aljurfae*** is similar to ***S. inversa*** (Seguenza) as figured by Puri (1974) but the latter species differs in the ornamentation of the lateral surface. No other species found in the literature can be compared with this species.

Occurrence:

This species is recorded so far from the Maastrichtian of Well N1-NC41.

Semicytherura tarabulusensis sp. nov.

(Pl. 50, figs. 7-12, Pl. 51, figs. 1-4)

Figured specimens:

Pl. 50, figs. 7, 9, male carapace, holotype HU.304.T.14, Pl. 50, fig. 8, Pl. 51, fig. 1, female carapace paratype HU.304.T.15, Pl. 50, figs. 10, 12, female carapace, paratype HU.304.T.16. From a depth of 10270 ft., Pl. 50, fig. 11, Pl. 51, fig. 2, female carapace, paratype HU.304.T.17. From a depth of 10300 ft., Pl. 51, figs. 3, 4, male carapace paratype HU.304.T.18. From depth 10140 ft. All specimens were from Well N1-NC41.

Derivation of name:

From its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.304.T.14

Paratypes:

Four carapaces HU.304.T.15-18

Type locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Al Jurf Formation, Maastrichtian, depth 10270 ft.

Stratigraphic range:

Maastrichtian.

Material:

11 specimens were found in the Al Jurf Formation of Well N1-NC41 at drilling depths of 10140-10320 ft.

Diagnosis:

This species characterised by its strongly reticulate surface and pronounced sexual dimorphism.

Description:

Shape typical of ***Semicytherura*** with greatest length developed at or above mid-height whilst the greatest height occurs at the anterior half. In lateral view the postero-dorsal margin is convex in the left valve and concave in the right valve. The dorsal margin is straight in the male and slightly convex in the female. The ventral

margin is straight to slightly sinuate centrally due to the ornamentation. The anterior margin is regularly rounded, posterior end is lower, narrow and is produced into a pointed median caudal process.

The lateral surface is covered by distinct reticules and ribs. The marginal rim is best developed around anterior, dorsal and posterior margins but is not clearly seen along the ventral margin. The ventro-lateral ridge runs from the antero-ventral area parallel to the ventral margin and ends at the postero-ventral corner. A distinct shallow vertical sulucs starts behind the eye tubercle and dies out above the ventro-lateral ridge. A somewhat stronger rib runs from the mid-anterior marginal rim towards the postero-dorsal area, then curves down to die out at the posterior end. Another small depression can be seen at the postero-ventral area. The rest of the surface consists of a combination of reticules and ribs. The left valve is slightly larger than the right valve and overlaps it along the ventral and posterior margins. Sexual dimorphism is present. The presumed females are shorter and higher than the elongate and narrower males.

In dorsal view the carapace has convex sides with compressed anterior and posterior ends. Maximum width occurs medially.

Few carapaces were obtained and as no single valves were available for study it was not possible to describe the internal features.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♂ carapace HU.304.T.14	(Pl. 50, figs. 7, 9)	383	183	140
Paratype, ♀ carapace HU.304.T.15	(Pl. 50, fig. 8, Pl. 51, fig. 1)	320	184	160
Paratype, ♀ carapace HU.304.T.16	(Pl. 50, figs. 10, 12)	323	184	170
Paratype, ♀ carapace HU.304.T.17	(Pl. 50, fig. 11, Pl. 51, fig. 2)	350	184	169
Paratype, ♂ carapace HU.304.T.18	(Pl. 51, figs. 3, 4)	375	183	180

Differences and affinities:

Semicytherura tarabulusensis is unlikely to be confused with any other species and there is little that is comparable figured in the literature; although ***S.***

angulata Neale (1975) is close but differs in having well developed ridges and also differs in details of the ornamentation. The present species shows some similarities to *S. cretae* Neale (1975) in general shape but differs in the ornamentation of the lateral surface.

Occurrence

S. tarabulusensis is known so far from the Maastrichtian of Well N1-NC41.

Semicytherura africana sp. nov.

(Pl. 51, figs. 5-12)

Figured specimens:

Pl. 51, figs. 6, 8, 10, 11, female carapace, holotype HU.304.T.20. From Well F1-NC41 at a depth of 7940 ft., Pl. 51, figs. 5, 7, 9, male carapace HU.304.T.19. From Well B1a-137 at a depth of 6640 ft., Pl. 51, fig. 12, female carapace HU.304.T.21. From Well K1-NC41 at a depth of 8950 ft.

Derivation of name:

From its occurrence in North Africa.

Holotype:

A female carapace HU.304.T.20

Type horizon:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Type locality:

Harsha Formation, Middle Eocene, depth 7940 ft.

Stratigraphic range:

Middle Eocene.

Diagnosis:

A species of *Semicytherura* Wagner, 1957 characterised by its coarsely pitted surface, arched dorsal margin and strongly developed sexual dimorphism.

Description:

In lateral view the carapace is elongate and sub-elliptical with greatest height in the middle of the carapace, maximum length passes below the mid-height. Dorsal margin arched and slopes gently to the posterior and the anterior margins. Ventral margin is nearly straight, curving upwards into the posterior end. Anterior margin is somewhat bluntly rounded, posterior margin produced into a caudal process.

The lateral surface is coarsely pitted except in the central area of the valve, whilst in the dorsal and anterior margins the pits become fine and are arranged parallel. A few ribs run parallel to the ventral and anterior margins. The rest of the surface is finely pitted except for a smooth area around the posterior end.

In dorsal view the carapace is elongate, sub-ovate and is compressed posteriorly, maximum width occurs in the mid-length, anterior end rounded and posterior end pointed. In ventral view the ventral ribs are clearly seen.

Sexual dimorphism is strongly pronounced, males being markedly more elongate and inflated posteriorly than females. No internal features were seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, ♀ carapace HU.304.T.20.	(Pl. 51, figs. 6, 8, 10, 11)	454	250	247
♂ carapace HU.304.T.19.	(Pl. 51, figs. 5, 7, 9)	495	266	215
♀ carapace HU.304.T.21.	(Pl. 51, fig. 12)	340	221	

Differences and affinities:

Semicytherura africana shows some similarities to ***S. indica*** Neale & Singh (1985) from the Middle Eocene of Assam in general outline, but the Libyan species differs in having a more convex dorsal margin and also by its coarsely pitted surface. The present species also resembles ***S. rameshi*** (Singh & Misra, 1968) as figured by Khosla (1972) from the Eocene beds of Rajasthan, but the Indian species has a more pointed posterior end and convex ventral margin and a more coarsely pitted surface.

S. africana is very similar to *Cytherura* n. sp. *1* Salahi (1966) from the Palaeocene of the Sirte Basin in general outline and shape but differs in the ornamentation of the lateral surface. Salahi's species is characterised by a more produced posterior end.

Occurrence:

This species occurs in the Middle Eocene of Well B1a-137, Well F1-NC41 and Well K1-NC41.

Semicytherura sp. aff. *S. gracilis* (Lienenklaus, 1895)

(Pl. 52, figs. 4-6)

1988 *Semicytherura* sp. cf. *gracilis* (Lienenklaus, 1895); Guernet, pp. 222-223, pl. 4, fig. 4

Figured specimen:

A carapace HU.304.T.23

Locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 7690 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one specimen was recorded from the Ghalil Formation of Well B1-NC41 at a drilling depth 7690 ft.

Description:

A subtriangular species of *Semicytherura*, characterised by its anterior margin which is obliquely rounded and a posterior margin produced into a caudal process. The dorsal margin is convex whilst the ventral margin is over-hung by the valve tumidity.

The lateral surface is ornamented by longitudinal ribs and by a small depression in the anterior half. The longitudinal ribs run parallel to the ventral margin, especially in the ventral half, except where the ornamentation is smooth in the dorsal and ventral areas. The rest of the surface is finely pitted.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.304.T.23	(Pl. 52, figs. 4-6)	473	263	220

Remarks.

Guernet (1988) illustrated ***Semicytherura*** sp. cf. ***gracilis*** from the Eocene of Italy which is identical to the Libyan specimen. The only difference is in the present species which possesses a small depression absent in Guernet's species.

Occurrence:

This species is known so far from the Middle Eocene of Well B1-NC41.

Semicytherura sp. ***A***

(Pl. 52, figs. 1-3)

Figured specimen:

A carapace HU.304.T.22

Locality:

Well B1a-137, Tarabulus Basin, NW offshore Libya.

Horizon:

Samdun Formation, Middle Eocene, depth 6320 ft.

Stratigraphic range:

Middle Eocene.

Material:

One specimen was found in the Samdun Formation of Well B1a-137 at a drilling depth of 6320 ft.

Description:

Carapace rectangular to subrounded in side view, greatest height lies in the middle, maximum length just in front of the posterior end. The dorsal margin is straight and slightly concave in the middle. The ventral margin is slightly concave medially and convex in the posterior half. The anterior margin is obliquely rounded whilst the posterior margin is medially produced.

The lateral surface is ornamented by pits and ridges. The ventral half of the surface has about four ridges running almost parallel to the ventral margin. In dorsal view the carapace is lens-shaped with maximum width in the middle. In ventral view the ventral ridges can be seen clearly. No internal features were seen.

Dimensions of figured specimen (μm)**:**

		L	H	W
Carapace HU.304.T.22	(Pl. 52, figs. 1-3)	409	195	161

Remarks:

Cytherura porcina Keen (1972) agrees in general outline with the present species but differs in having a gently convex dorsal margin, concave ventral margin and prominent ridges. This species is left under open nomenclature because only one carapace was found.

Occurrence:

This species is recorded so far from the Middle Eocene of Well B1a-137.

Genus ***MEHESELLA*** Reyment, 1960

Type species: ***Mehesella paleobifrensis*** Reyment, 1960

Mehesella africana sp. nov.

(Pl. 54, figs. 1-12)

Figured specimens:

Pl. 54, fig. 1-3, male carapace HU.304.T.24, Pl. 54, figs. 4-6, female carapace, HU.304.T.25. From Well L1-NC41 at depth 9600 ft., Pl. 54, fig. 7, female carapace,

paratype HU.304.T.26. From Well B1-NC41 at a depth of 7910 ft., Pl. 54, fig. 8, female carapace, paratype HU.304.T.27. From Well B1-NC41 at a depth of 7950 ft., Pl. 54, fig. 9, male carapace, holotype HU.304.T.28. From Well B1-NC41 at a depth of 7890 ft., Pl. 54, fig. 10, female carapace, paratype HU.304.T.29. From Well B1-NC41 at a depth of 7910 ft., Pl. 54, fig. 11, female carapace, paratype HU.304.T.30. From Well B1-NC41 at a depth of 7950 ft., Pl. 54, fig. 12, male carapace, paratype HU.305.T.1. From Well B1-NC41 at depth of 7890 ft.

Derivation of name:

From its occurrence in Africa.

Holotype:

A male carapace HU.304.T.28

Paratypes:

Five specimens HU.304.T.26, 27, 29-30, HU.305.T.1

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7890 ft.

Stratigraphic range:

Middle Eocene.

Material:

17 specimens. In Well B1-NC41, 14 specimens were found in the Ghalil Formation at drilling depths of 7910-7950 ft. In Well L1-NC41, three specimens were found in the Harsha Formation at a drilling depth of 9600 ft..

Diagnosis:

A species of ***Mehesella*** Reyment, 1960 with marked sexual dimorphism, surface strongly reticulate in the central part of the carapace becoming smooth round the anterior, dorsal and posterior margins.

Description:

Thick-shelled, elongate, subovate carapace in lateral view, greatest height lies in the middle, greatest length occurs at the mid-height. Anterior margin evenly but comparatively narrowly rounded with small denticles along the lower part, posterior margin narrower and rounded and drawn out into an inflated blunt caudal process , slightly concave in the upper part with a trace of small denticles in the lower. Dorsal margin straight, sloping gently towards the posterior and anterior ends, ventral margin is strongly convex posteriorly, slightly concave anteriorly. Lateral surface coarsely ornamented with symmetrically arranged pits in the central part of the carapace. There are four oblique longitudinal riblets in each valve. These start from the antero-ventral corner and run parallel to the ventral margin terminating before the postero-ventral corner. The rest of the surface is smooth. Left valve larger than the right and overreaching it slightly along the dorsal margin and less pronounced at the posterior end. Eye tubercle present but flat. In dorsal view, carapace egg-shaped to ovate with maximum width and thickness just behind the middle.

Sexual dimorphism strongly pronounced, the presumed males more elongate and wider than the presumed females. Internal features were not seen.

Dimensions of figured specimens (μm)**:**

		L	H	W
♂ carapace HU.304.T.24	(Pl. 54, figs. 1-3)	977	522	488
♀ carapace HU.304.T.25	(Pl. 54, figs. 4-6)	905	505	419
Paratype, ♀ carapace HU.304.T.26	(Pl. 54, fig. 7)	819	466	455
Paratype, ♀ carapace HU.304.T.27	(Pl. 54, fig. 8)	840	480	440
Holotype , ♂ carapace HU.304.T.28	(Pl. 54, fig. 9)	947	484	465
Paratype, ♀ carapace HU.304.T.29	(Pl. 54, fig. 10)	860	480	440
Paratype, ♀ carapace HU.304.T.30	(Pl. 54, fig. 11)	828	466	440
Paratype, ♂ carapace HU.305.T.1	(Pl. 54, fig. 12)	877	484	470

Differences and affinities:

Mehesella africana shows some similarity in general outline to ***M. biafrensis*** Reyment (1960) from the Eocene of Nigeria but the latter differs in its convex dorsal

margin and its more coarsely reticulate surface. In addition, the present species is much larger. *M. africana* also resembles *M. paleobiafrensis* Reyment (1960) from the Upper Maastrichtian of Nigeria but Reyment's species differs in its much smaller size, swollen ventral margin and is easily distinguished from the present species by the outline of the dorsal margin.

Occurrence:

Known so far from the Middle Eocene of Well B1-NC41 and Well L1-NC41.

Family Xestoleberididae Sars, 1928

Genus *XESTOLEBERIS* Sars, 1866

Xestoleberis ghalilae sp. nov.

(Pl. 55, figs. 1-6)

Figured specimens:

Pl. 55, fig. 1, carapace, paratype HU.305.T.17, Pl. 55, fig. 2, carapace, paratype HU.305.T.18, Pl. 55, fig. 3, carapace, holotype HU.305.T.19, Pl. 55, fig. 4, carapace, paratype HU.305.T.20, Pl. 55, fig. 5, carapace Paratype HU.305.T.21, Pl. 55, fig. 6, carapace, paratype HU.305.T.22. All specimens from the same type locality and horizon.

Derivation of name:

From its occurrence in the Ghalil Formation.

Holotype:

A carapace HU.305.T.19

Paratypes:

Five specimens HU.305.T.17-18, 20-22

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle Eocene, depth 7510 ft.

Stratigraphic range:

Middle Eocene.

Material:

193 specimens. In Well B1-NC41, 60 specimens were found in the Ghalil Formation at drilling depths of 7470-7870 ft. In Well K1-NC41, 20 specimens were recorded, six in the Samdun Formation at 8450 and 8500 ft, one specimen in the Dahman Formation at a drilling depth of 8564 ft., and 13 specimens in the at depths of 9000-9450 ft. In Well F1-NC41, two specimens were found in the Samdun Formation at 7970 ft. In Well D2-NC41, 11 specimens were recovered from the Ghalil Formation at drilling depths of 7840-8180 ft. In Well H1-NC41, 55 specimens were found, 21 in the Samdun Formation at depths of 9680-9960 ft., and 34 in the Harsha Formation at 10600-10780 ft. In Well C1-NC41, one specimen was found in the Harsha Formation at a depth of 7890 ft. In Well B1a-137, 45 specimens were recorded, 22 in the Samdun Formation at depths of 6140-6600 ft., eight specimens from the Dahman Formation at a drilling depths of 6640 ft., and 15 specimens from the Harsha Formation at 6680-7150 ft.

Diagnosis:

A species of ***Xestoleberis*** characterised by its very small carapace, dorsal margin angled at mid-height and smooth surface.

Description:

In lateral view carapace very small in size and ovate, greatest height just at the angled point of the dorsal margin, greatest length ventrally. Dorsal margin arched, angled at the greatest height sloping down posteriorly and anteriorly, ventral margin concave, anteriorly and forming a rounded postero-ventral corner. Anterior end low and narrowly rounded, whilst the posterior end is higher and obliquely rounded.

Left valve larger than the right and overreaching more conspicuously along the entire margins with the exception of the lower posterior margin. The lateral surface is smooth to finely pitted. In dorsal view, carapace ovate with strongly convex sides. Maximum width and thickness occurs in the posterior half, pointed anteriorly,

ovate posterior end. In dorsal view also, the left valve is clearly seen overlapping the right along the ventral margin. Sexual dimorphism was not observed. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Holotype, carapace HU.305.T.19	(Pl. 55, fig. 3)	385	238	210
Paratype, carapace HU.305.T.17	(Pl. 55, fig. 1)	371	238	215
Paratype, carapace HU.305.T.18	(Pl. 55, fig. 2)	386	225	213
Paratype, carapace HU.305.T.20	(Pl. 55, fig. 4)	405	252	230
Paratype, carapace HU.305.T.21	(Pl. 55, fig. 5)	369	225	208
Paratype, carapace HU.305.T.22	(Pl. 55, fig. 6)	372	236	205

Differences and affinities:

Xestoleberis ghalilae shows some similarities to ***X. tarabulusensis*** but differs in its angled dorsal margin, higher anterior end and in having a less concave ventral margin. ***X. reymenti*** Ruggieri (1967) differs in its higher posterior margin and in the dorsal outline. ***X. subglobosa*** (Bosquet, 1852) as figured by Khosla (1972) from the Eocene beds of Rajasthan, India resembles the present species but differs in having a straight ventral margin and narrower posterior end. ***X. muelleriana*** Lienenklaus, as figured by Keij (1957), is similar to this species but differs in its more angled dorsal margin. ***X. ghalilae*** is closely related to specimens figured from the Eocene of Libya by Helmdach & El Khoudray (1980) particularly (fig. 26, pl. 1) which should be placed in this new species.

Occurrence:

This species is recorded from the Middle Eocene of Well B1-NC41, Well H1-NC41, Well F1-NC41, Well K1-NC41, Well B1a-137, Well D2-NC41 and Well C1-NC41.

Xestoleberis tarabulusensis sp. nov.

(Pl. 55, fig. 7-12)

Figured specimens:

Pl. 55, fig. 7, male carapace, paratype HU.305.T.23. From depth 7830, Pl. 55, fig. 8, female carapace, paratype HU.305.T.24, Pl. 55, fig. 9, female carapace, holotype HU.305.T.25, Pl. 55, fig. 10, female carapace, paratype HU.305.T.26, Pl. 55, fig. 11, female carapace, paratype HU.305.T.27, Pl. 55, fig. 12, male carapace paratype HU.305.T.28. All specimens from the same type locality and horizon.

Derivation of name:

In reference to its occurrence in the Tarabulus Basin.

Holotype:

A male carapace HU.305.T.25

Paratypes:

Five specimens HU.305.T.23, 24, 26-28

Type locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Type horizon:

Ghalil Formation, Middle, Eocene, depth 7830 ft.

Stratigraphic range:

Middle and Upper Eocene.

Material:

927 specimens. In Well B1-NC41, 454 specimens were found, nine in the Samdun Formation at drilling depths of 7290-7390 ft., and 445 specimens in the Ghalil Formation at 7430-7950 ft. In Well C1-NC41, 133 specimens were recorded,, 47 from the Samdun Formation at depths of 7170-7520 ft., and 86 specimens from the Harsha Formation at drilling depths of 7690-8040 ft. In Well F1-NC41, 38 specimens were recovered, 28 in the Samdun Formation at depths of 7970-8060 ft., and 10 specimens from the Harsha Formation at 8180-8300 ft. In Well H1-NC41, 177

specimens were found, 42 in the Samdun Formation at depths of 9640-10200 ft., and 135 specimens in the Harsha Formation at 10300-10810 ft. In Well K1-NC41, 92 specimens were recorded, 12 from the Samdun Formation at depths of 8220-8500 ft., one specimen from the Dahman Formation at a drilling depth of 8564 ft., and 79 specimens from the Harsha Formation at 8740-9480 ft. In Well B1a-137, three specimens were found in the Samdun Formation at a drilling depth of 6320 ft. In Well L1-NC41, 30 specimens were recorded in the Harsha Formation at depths of 9360-9620 ft.

Diagnosis:

A species of ***Xestoleberis*** with egg-shaped carapace in lateral view, strongly convex dorsal margin and well marked sexual dimorphism.

Description:

The carapace is medium-sized, egg-shaped in lateral view, greatest height just in the posterior half, maximum length at one-fifth of the height. Anterior end narrowly rounded and produced ventrally, posterior end broadly, obliquely rounded and higher than the anterior end, convex upwards with a distinct postero-dorsal angle. Dorsal margin strongly convex, sloping gently anteriorly and forming a rounded postero-ventral corner. Left valve larger than the right, overlapping it all around the margins, but more developed at the anterior and ventral margins. Surface smooth with very few, fine pits. In dorsal view, the carapace is ovate with broadly rounded posterior end and narrower anterior end. In ventral view, the left valve is clearly seen strongly overlapping the right. Sexual dimorphism well marked, the presumed males less high than the presumed females.

Dimensions of figured specimens (μm)*:*

		L	H	W
Paratype, ♂ carapace HU.305.T.23	(Pl. 55, fig. 7)	551	331	330
Paratype, ♀ carapace HU.305.T.24	(Pl. 55, fig. 8)	537	330	344
Holotype, ♀ carapace HU.305.T.25	(Pl. 55, fig. 9)	510	331	320
Paratype, ♀ carapace HU.305.T.26	(Pl. 55, fig. 10)	537	331	340

Paratype, ♀ carapace HU.305.T.27	(Pl. 55, fig. 11)	503	310	309
Paratype, ♂ carapace HU.305.T.28	(Pl. 55, fig. 12)	509	303	285

Differences and affinities:

Xestoleberis tarabulusensis is similar to ***X. tunisiensis*** Esker (1968) from the Danian of Tunisia. Esker's species is less elongate, higher and has its greatest height at the middle, the ventral margin is slightly convex. ***Xestoleberis*** cf. ***X. dumblei*** as figured by Helmdach & El Khoudary (1980) from Libya (especially fig. 27, pl. 1) resembles this species in general outline but the latter species differs in having a more convex dorsal margin and less produced postero-ventral corner.

Occurrence:

This species is known so far from the Middle Eocene of Well H1-NC41, Well L1-NC41, Well F1-NC41 and Well B1a-137, and from the Middle Eocene and Upper Eocene of Well B1-NC41 and Well K1-NC41.

Genus ***UROLEBERIS*** Triebel, 1958

Type species: ***Eocytheropteron parnensis*** Apostolescu, 1955

Uroleberis sp. ***A***

(Pl. 56, figs. 1, 2)

Figured specimen:

A carapace HU.305.T.29

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8080 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one carapace was found in Well F1-NC41 from the Harsha Formation at a drilling depth of 8080 ft.

Description:

In lateral view, carapace is ovate to elongate with greatest height at the mid-length. The dorsal margin is convex and slopes gently to the anterior and posterior ends. The posterior margin has a short and distinct caudal process below the mid-height. Anterior margin has strong infracurvature. The ventral margin is almost straight. The lateral surface is finely pitted. In dorsal view, the carapace is elliptical with the greatest width attained at mid-length. No internal features were seen as no single valves were obtained.

Dimensions of figured specimen (μm)***:***

		L	H	W
Carapace HU.305.T.29	(Pl. 56, fig. 1, 2)	440	247	230

Differences and affinities:

This single specimen is distinctive and well preserved and is unlikely to be confused with other species. However, the present species resembles ***Uroleberis armeniaca*** as described by Neale & Singh (1985) from the Middle Eocene of Assam which differs in having a strongly convex dorsal margin and a coarsely pitted surface. ***U. glabella*** was described by Apostolescu (1961) from the Palaeocene of Sudan and from Libya (Barsotti 1963). It differs from the present species in its more elongate carapace and larger size, in addition the present species has a less arched dorsal margin. ***Uroleberis*** n. sp. ***2*** Salahi (1966) from the Middle Eocene of the Wadi Thamit Formation, Libya, shows some similarities to ***Uroleberis*** sp. ***A***, but differs in possessing a finely pitted surface and the dorsal margin slopes gently to the anterior and posterior ends. The present species shows some similarity to ***Uroleberis striatopunctata*** Ducasse (1967) from the same age, but the species under investigation differs in having an almost straight ventral margin. Also Ducasse's species is characterised by its more convex dorsal margin and more coarsely pitted surface.

Occurrence:

Only one carapace has been found so far from the Middle Eocene of Well F1-NC41.

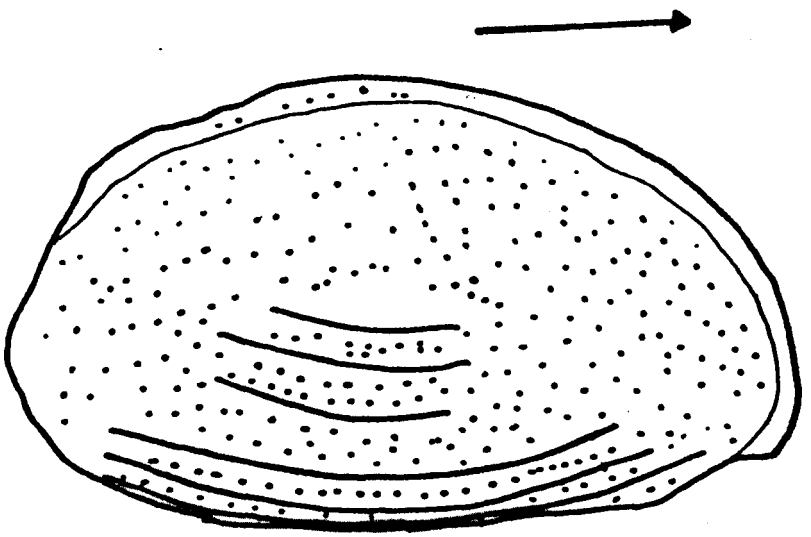
Uncertain family

Genus *A* sp. *a*

(Pl. 38, figs. 7-12)

Figured specimens:

Pl. 38, figs. 7, 11, carapace HU.305.T.30, from depth 10180 ft., Pl. 38, fig. 8, carapace HU.306.T.1, Pl. 38, fig. 9, carapace HU.306.T.2 , Pl. 38, fig. 12, carapace HU.306.T.4. From depth 10140 ft., Pl. 38, fig. 10 , carapace HU.306.T.3. From depth 10180. All specimens from the Well N1-NC41.



X 275

Fig. 5.7 Genus *A* sp. *a* HU.305.T.30, carapace from right, showing the surface ornamentation.

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Al Jurf Formation, Maastrichtian, depth 10180 ft.

Stratigraphic range:

Maastrichtian.

Material:

Seven specimens were found in Well N1-NC41 from the Al Jurf Formation at depths of 10140 and 10180 ft.

Diagnosis:

The present genus is characterised by its six longitudinal ridges located in the ventral half.

Description:

Small-sized, ovate carapace in lateral view, with broadly convex dorsal margin in the left valve. The dorsal margin in the right valve is straight to slightly convex, slopes gently into the anterior and posterior ends. Ventral margin is convex due to the projection of the ventral ridges. Anterior end obliquely rounded and strongly extended below, posterior end rounded and higher than the anterior end. Greatest height occurs in the antero-dorsal corner in the right valve and in the middle of the left valve, greatest length lies nearly at the mid-height. Left valve larger than the right and overlaps it along its entire margin except at the postero-dorsal corner, more developed along the anterior, dorsal and postero-dorsal margins and less pronounced along the ventral margin. Lateral surface is ornamented with well developed ridges. The first, second and the third from the ventral margin are very elongate, originate close to the antero-ventral area and run parallel to the ventral margin to end at the postero-ventral corner. The upper three ridges are very short. The rest of the surface is finely pitted.

In dorsal view, the carapace has strong convex sides with maximum width in the middle. In ventral view, the ventral ridges are clearly observed. Sexual dimorphism was not observed. Internal features were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
Carapace HU.305.T.30	(Pl. 38, figs. 7, 11)	390	218	–
Carapace HU.306.T.1	(Pl. 38, fig. 8)	328	000	196
Carapace HU.306.T.2	(Pl. 38, fig. 9)	336	196	–
Carapace HU.306.T.3	(Pl. 38, fig. 10)	400	233	–
Carapace HU.306.T.4	(Pl. 38, fig. 12)	380	238	–

Differences and affinities:

Genus ***A*** sp. ***a*** seems related to ***Cytheropteron*** Sars, 1866, but the present species differs in the ornamentation of the lateral surface and due to the absence of internal features, it is left as an indeterminable genus.

Occurrence:

The present species is recorded so far from the Maastrichtian of Well N1-NC41.

Genus ***B*** sp. ***a***

(Pl. 56, figs. 8-12)

Figured specimens:

Pl. 56, figs. 8, 11, female carapace HU.306.T.9, Pl. 56, fig. 9, male carapace HU.306.T.10 , Pl. 56, fig. 10, female carapace HU.306.T.11, Pl. 56, fig. 12, male carapace HU.306.T.12. All specimens are from Well B1-NC41.

Locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 7590 ft.

Stratigraphic range:

Middle Eocene.

Material:

442 specimens. In Well C1-NC41, 61 specimens were found in the Harsha Formation, five at depths of 7770 ft. and 56 at 7810 and 7820 ft. In Well F1-NC41, 30 specimens were recorded, 9 from the Samdun Formation at a drilling depths of 7810-7970 ft., and 21 specimens from the Harsha Formation at 8220-8370 ft. In Well H1-NC41, 63 specimens were found, one specimen in the Samdun Formation at a drilling depth of 9860 ft., and 62 specimens in the Harsha Formation at depths of 10300-10660 ft. In Well B1a-137, six specimens were recovered from the Samdun Formation at 6480 and 6520 ft. In Well B1-NC41, 255 specimens were found in the Ghalil Formation at depths of 7490-7930 ft. In Well L1-NC41, 27 specimens were recorded in the Harsha Formation at drilling depths of 9360-9620 ft.

Diagnosis:

A species of this new genus characterised by its finely pitted surface, males more elongate and less high than the females.

Description:

An elongate and subovate carapace in lateral view with the greatest height at the middle and greatest length at mid-height. Anterior end obliquely rounded, posterior end truncate in the females and slightly pointed in the males. Dorsal margin straight, slightly tapered towards the posterior end in the right valve, dorsal margin slightly convex in the left valve. Ventral margin straight to slightly convex in the postero-ventral region. Left valve larger than the right and overreaching it along the ventral and posterior margins. Surface is finely pitted except for a small area around the entire margin. Sexual dimorphism is pronounced, the presumed males more elongate and less high than the presumed females.

In dorsal view the carapace has convex sides with laterally compressed ends and maximum width at mid-length. Internal details were not seen as no single valves were obtained.

Dimensions of figured specimens (μm)**:**

		L	H	W
♀ carapace HU.306.T.9	(Pl. 56, fig. 8, 11)	455	288	-
♂ carapace HU.306.T.10	(Pl. 56, fig. 9)	500	000	188
♀ carapace HU.306.T.11	(Pl. 56, fig. 10)	477	277	–
♂ carapace HU.306.T.12	(Pl. 56, fig. 12)	494	242	–

Differences and affinities:

This species shows some similarities to Genus ***B*** sp. ***b*** in general outline and shape but differs in the ornamentation of the lateral surface. The present species resembles ***Boldella deldenensis*** Keij (1957) but the latter differs in the shape, ornamentation and in the outline of the posterior end.

Occurrence:

This species is found so far in the Middle Eocene of Well B1a-137, Well L1-NC41, Well F1-NC41, Well B1-NC41, Well H1-NC41 and Well C1-NC41.

Genus ***B*** sp. ***b***

(Pl. 56, figs. 3-7)

Figured specimens:

Pl. 56, figs. 3, 6, female carapace HU.306.T.5, Pl. 56, fig. 4, female carapace HU.306.T.6 , Pl. 56, fig. 5, male carapace HU.306.T.7, Pl. 56, fig. 7, male carapace HU.305.T.8. All specimens are from the same locality and horizon.

Locality:

Well B1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Ghalil Formation, Middle Eocene, depth 7790 ft.

Stratigraphic range:

Middle Eocene.

Material:

87 specimens were found in Well B1-NC41 at drilling depths of 7730-7930 ft. All figured specimens are from the Ghalil Formation.

Diagnosis:

A new species characterised by a thick, subovate with subparallel dorsal and ventral margins; anterior margin obliquely rounded.

Description:

Medium sized, thick-shelled, subovate carapace, the larger left valve overlapping the right along the ventral margin and less conspicuously at the postero-dorsal margin. Obliquely rounded anterior and posterior margins. The anterior margin is slightly extended below, posterior margin slightly pointed and drawn out to a caudal process just below the mid-height. Dorsal margin straight, sloping gently towards the posterior end, ventral margin nearly straight and slightly concave anteriorly. Dorsal and ventral margins are subparallel. The lateral surface is ornamented with very thin ribs and coarse pitting. The ribs are mostly located in the lower middle part of the carapace with the space between the ribs coarsely pitted. The upper part of the surface is pitted with or without any trace of the ribs. The rest of the surface is smooth. In dorsal view, the carapace is elliptical with maximum width at mid-height. Sexual dimorphism is present, the presumed females being shorter and higher than the presumed males.

Only carapaces were available so that it was not possible to study the internal features.

Dimensions of figured specimens (μm)*:*

		L	H	W
♀ carapace HU.306.T.5	(Pl. 56, figs. 3, 6)	475	248	-
♀ carapace HU.306.T.6	(Pl. 56, fig. 4)	423	238	-
♂ carapace HU.306.T.7	(Pl. 56. fig. 5)	485	-	180

♂ carapace HU.306.T.8 (Pl. 56, fig. 7) 468 226

Differences and affinities:

The present species has some similarities to genus ***Boldella*** Keij (1957) from the Upper Eocene of Netherlands in general outline, but the latter differs its upturned posterior end with an obtuse angle postero-dorsally, compressed posterior end and different ventral outline. ***Jonesia*** Brady 1866 resembles this species but Brady's genus differs in its strongly concave ventral margin, sharply acuminate posterior end, flange like termination in the postero-ventral area and carapace outline.

Occurrence:

This species is recorded from the Middle Eocene of Well B1-NC41.

Genus *C* sp. *a*

(Pl. 57, figs. 4-10)

Figured specimens:

Pl. 57, figs. 4, 9, female carapace HU.306.T.13. From depth 10180 ft., Pl. 57, fig. 5, female carapace HU.306.T.14. From depth 10140 ft., Pl. 57, fig. 6, male carapace HU.306.T.15, Pl. 57, fig. 7, female carapace HU.306.T.16, Pl. 57, fig. 8, female carapace HU.306.T.17, Pl. 57, fig. 10, female carapace HU.306.T.18. From depth 10160 ft. All specimens from Well N1-NC41.

Locality:

Well N1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

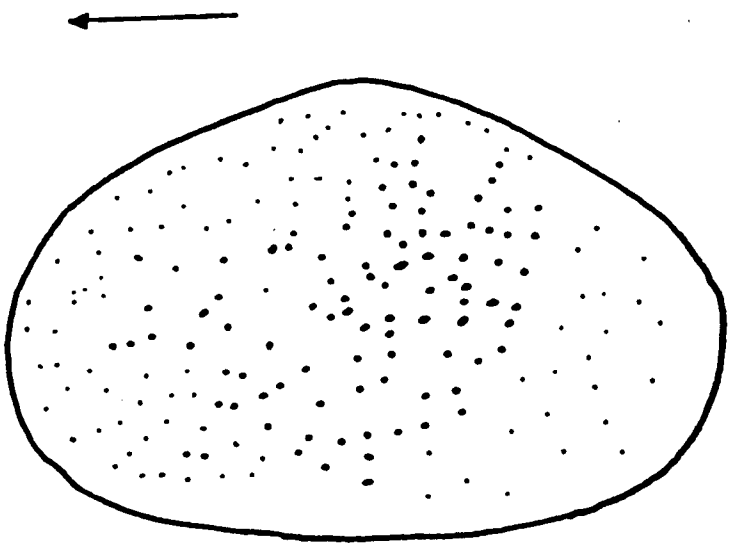
Al Jurf Formation, Maastrichtian, depth 10160 ft.

Stratigraphic range:

Maastrichtian.

Material:

Eight specimens were found in the Al Jurf Formation of Well N1-NC41 at depths of 10140-10180 ft.



X 120

Fig. 5.8 Genus *C* sp. *a* HU.306.T.13, female carapace from left, showing the surface ornamentation.

Diagnosis:

Surface finely pitted, dorsal margin strongly arched, obtusely angled in the middle. Strong sexual dimorphism, presumed males more elongate and tapering posteriorly than the presumed females.

Description:

A subovate, thick-shelled carapace in lateral view, greatest height at the angled point, greatest length occurs below the mid-height. The dorsal margin is strongly arched, obtusely angled in the middle with the posterior slope steeper than the anterior, ventral margin concave anteriorly, straight after concavity, merging smoothly with the anterior and posterior ends in the right valve. In the left valve, the ventral margin is slightly convex. Anterior end obliquely rounded and strongly extended below, posterior end also rounded and relatively narrower. Left valve larger than the right and overlapping the latter along the entire margin, more developed along the ventral and anterior margins. The lateral surface is finely pitted, apart from smooth or poorly pitted areas along the entire margin. Sexual dimorphism strongly pronounced, the presumed males more elongate and tapering posteriorly more than the presumed females.

In dorsal view the carapace has convex sides with rounded posterior end, anterior narrowly rounded. Maximum width lies anterior to the middle. Few carapaces were obtained and as no single valves were available for study, it was not possible to describe the internal features.

Dimensions of figured specimens (μm)**:**

		L	H
♀ carapace HU.306.T.13	(Pl. 57, figs. 4, 9)	790	500
♀ carapace HU.306.T.14	(Pl. 57, fig. 5)	800	491
♂ carapace HU.306.T.15	(Pl. 57, fig. 6)	819	485
♀ carapace HU.306.T.16	(Pl. 57, fig. 7)	752	457
♀ carapace HU.306.T.17	(Pl. 57, fig. 8)	765	417
♀ carapace HU.306.T.18	(Pl. 57, fig. 10)	760	490

Differences and affinities:

There is little in the literature to which this species could be compared. At the generic level ***Cophinia*** Apostolescu (1961) resembles this new genus in the ornamentation but Apostolescu's genus differs in the details of overlap, the left valve strongly overlapping the right valve along the entire margin and its posterior end

being pointed towards the venter in the left valve whereas in the present genus it is rounded. In addition, the dorsal margin is strongly arched and obtusely angled in the middle. This new genus is somewhat similar similarities to ***Dactylia*** Apostolescu (1961) from the Maastrichtian of Dahomey but the latter differs in its strongly concave ventral margin, well developed overlap and in details of the dorsal margin.

Occurrence:

Known so far from the Maastrichtian of Well N1-NC41.

Genus *D* sp. *a*

(Pl. 57, figs. 11,12)

Figured specimen:

A carapace HU.306.T.19

Locality:

Well F1-NC41, Tarabulus Basin, NW offshore Libya.

Horizon:

Harsha Formation, Middle Eocene, depth 8330 ft.

Stratigraphic range:

Middle Eocene.

Material:

Only one carapace was found in Well F1-NC41, from the Harsha Formation at a drilling depth of 8330 ft.

Description:

A subrectangular carapace in lateral view with the greatest height anteriorly and the greatest length ventrally. Dorsal margin straight, sloping gently towards the posterior end, ventral margin concave. Anterior margin smoothly and obliquely rounded, posterior margin truncated ventrally with short caudal process, smoothly curving in the upper part. Left valve larger than the right and overlapping the latter at

the antero-dorsal corner and posterior end. Eye tubercle present but not very prominent. A thick marginal rim runs parallel to the anterior and posterior ends, more distinct in the posterior end. The lateral surface is covered with elongate pits arranged parallel along the ventral and dorsal margins and becoming rounded to oval in the middle of the carapace. The area behind the posterior marginal rim appears to be depressed and in the anterior portion of the rim is accentuated by a row of parallel fossae.

Internal features were not seen as no single valves were obtained.

Dimensions of figured specimen (μm)***:***

		L	H
Carapace HU.306.T.19	(Pl. 57, figs. 11, 12)	684	330

Differences and affinities:

It is not possible to place this genus in a family with any certainty and it is here thought best to leave the genus and species in open nomenclature. This genus shows some similarities to ***Urocythereis*** Ruggieri (1950), but differs from it in the outline of the posterior and dorsal margins and also in the ornamentation of the lateral surface.

Occurrence:

This species is found in the Middle Eocene of Well F1-NC41.

CHAPTER 6

BIOSTRATIGRAPHY

6.1 OSTRACOD BIOZONES.

In the present study all specimens came from ditch cuttings so that the problem of caving in borehole samples and contamination could not always be overcome. However, this has been taken into account and displaced specimens were removed from samples. This was only possible where there were obvious preservational differences and also by considering the general distribution of species in each well and by comparison of its stratigraphic range in surrounding areas. However, the top occurrence of each species can be regarded as correct, in that, it will fall within the actual age of the species. Bottom occurrences may be incorrect owing to caving which produces an artificial range. Some caution is, therefore, needed when interpreting the lower limit of species from well samples.

The ranges of ostracod species in the ten wells are given in figs. (1-10). The Ostracoda species obtained from various sections of the Tellil Group (Harsha, Dahman and Samdun Formations) make it possible to subdivide the Tellil Group into five zones. These zones are applicable in the present study only in the Tellil Group in NW offshore Libya, but this zonation scheme does apply to the deposits of similar age in Tunisia. However, it is not applicable in different facies of the northern part of the Tarabulus Basin which represents deeper water environments of the Ghalil Formation.

Well B1a-137 section (Fig. 6.1) contains the five zones used as the standard to which the other studied sections are correlated.

These five zones are based on the first appearance of Ostracoda down-hole within the Middle and Upper Eocene and as such represent extinction events.

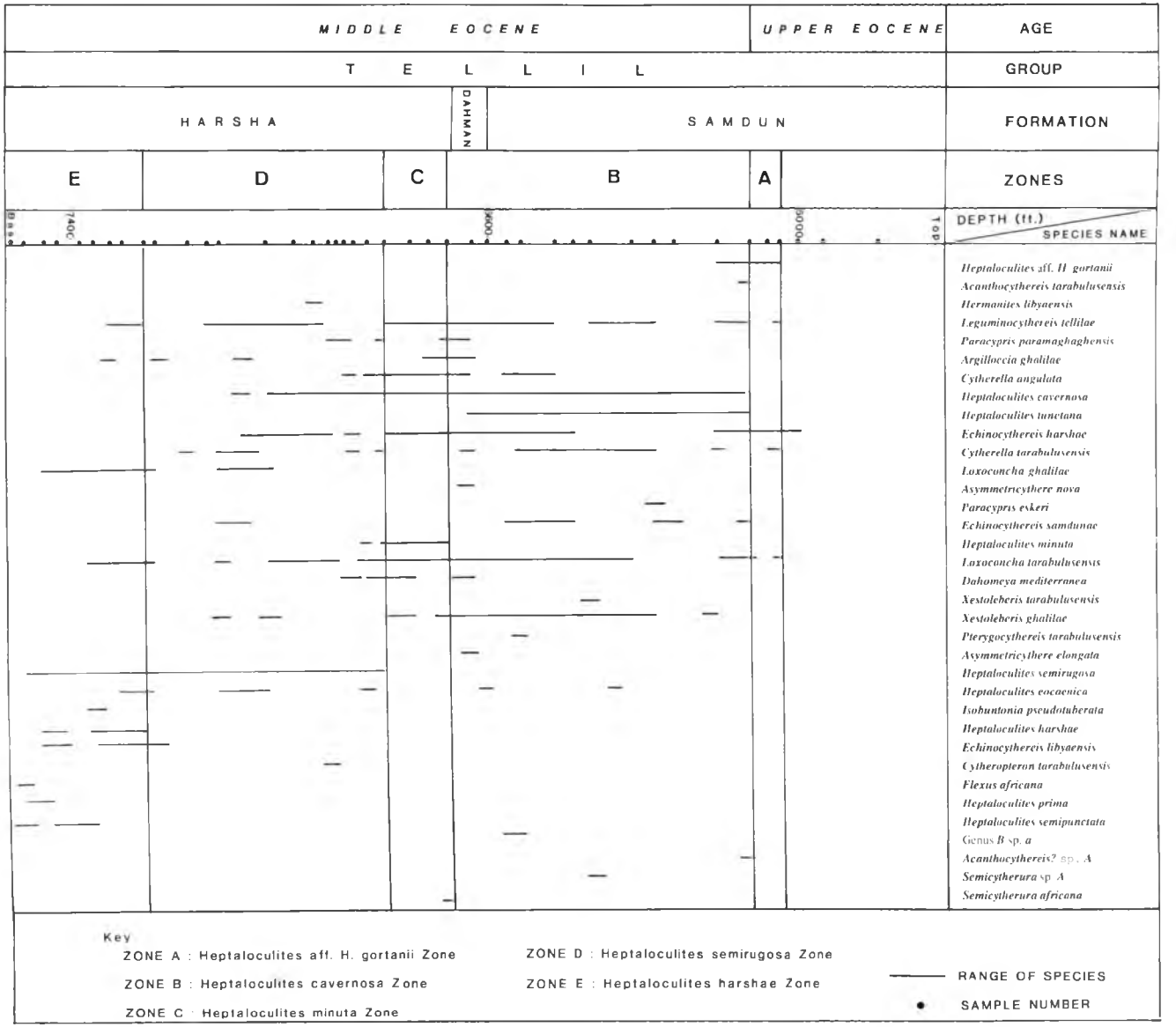


FIG. 6.1 RANGES OF OSTRACOD SPECIES OF THE TELLIL GROUP IN WELL B1a-137, NW OFFSHORE LIBYA.

They are described from the youngest to oldest and their bases are defined by the first appearance (extinction) of the following index species. The ages of these zones are determined by the ranges of ostracod species found elsewhere.

6.1.1 *Heptaloculites* aff. *H. gortanii* Zone. A

This zone is characterised by ***Heptaloculites*** aff. ***H. gortanii*** which has been found as a rare species near the top of the Samdun Formation. The top of this zone is based on its first appearance, down borehole which at present is at 6040 ft. The base of this zone is defined by the first appearance of ***Heptaloculites cavernosa.***

No species were found to be restricted to this zone. Indeed several taxa ranged into adjacent zones, such as:

Echinocythereis samdunae
Loxoconcha tarabulusensis
Cytherella tarabulusensis
Leguminocythereis tellilae

An Upper Eocene age is proposed for this zone on the basis of the range of ***Heptaloculites*** aff. ***H. gortanii*** which was also recorded from the Upper Eocene (Priabonian) and the top of the Middle Eocene (Upper Lutetian) by Bismuth ***et al.***, (1978). This species was also found in the Upper Eocene ranging to the top of the upper part of the Lutetian by Oertli (1976). This zone was defined in the Upper Eocene of Tunisia by the occurrence of ***Heptaloculites*** aff. ***H. gortanii*** by Oertli (1976) and Mechmeche (1981). An Upper Eocene age was indicated in Senegal by Carbonnel (1986) for the ***Heptaloculites*** aff. ***H. gortanii*** and ***Asymmetricythere*** sp. Zone

6.1.2 *Heptaloculites cavernosa* Zone. B

In this study, this zone is recognized by the first appearance, down-hole, of ***Heptaloculites cavernosa*** which is distinct and abundant in this particular zone. This

species also extends into other lower zones. The base of this zone is defined by the first appearance of ***Heptaloculites minuta.*** Furthermore, a large number of species also first appear within this zone and are restricted to it, such as:

Heptaloculites tunetana
Asymmetricythere elongata
Paracypris eskeri
Xestoleberis tarabulusensis
Pterygocythereis tarabulusensis
Asymmetricythere nova
Genus ***B*** sp. ***a***
Acanthocythereis? sp. ***A***
Acanthocythereis tarabulusensis
Semicytherura sp. ***A.***

The following species also first appear in this zone although they have been found in the underlying zones, including:

Heptaloculites eocaenica
Cytherella angulata
Paracypris paramaghaghensis
Echinocythereis samdunae
Dahomeya mediterranea
Argilloecia ghalilae
Xestoleberis ghalilae

Other ostracod species were found in this zone which also occur in the underlying and/or overlying zones:

Cytherella tarabulusensis
Echinocythereis harshae
Loxoconcha tarabulusensis
Leguminocythereis tellilae

A Middle Eocene age is proposed for this zone on the basis of the range of ***Heptaloculites cavernosa***, which was also recorded from the Middle Eocene (Middle

Lutetian) of Tunisia by Bismuth *et al.*, (1978). This zone was established by Oertli (1976) for the Middle Eocene of Tunisia and also was defined in Tunisia by Mechmeche (1981). Furthermore, ***Heptaloculites cavernosa*** was found in the Middle Eocene (Lutetian) of Algeria by Apostolescu and Magne (1956). ***Heptaloculites tunetana*** was reported from the Middle and Upper Eocene of Tunisia by Bismuth *et al.*, (1978). This species was also found in the Tunisian mainland by Mechmeche (1981) from the Upper Eocene (Priabonian) and Middle Eocene (Lutetian).

6.1.3 *Heptaloculites minuta* Zone. C

This zone is characterised by ***Heptaloculites minuta***, its top defined by the first appearance. This species also extends into the ***Heptaloculites semirugosa*** Zone. The base of this zone is defined by the first appearance of ***Heptaloculites semirugosa.*** ***Heptaloculites minuta*** was found in the Middle Eocene of Tunisia as defined Mechmeche (1981) and this zone was also established by Oertli (1976) in the Middle Eocene (Middle Lutetian) of Tunisia. A large number of species were found in this zone but were not restricted to it:

Paracypris paramaghaghensis
Argilloecia ghalilae
Cytherella angulata
Echinocythereis harshae
Xestoleberis ghalilae
Dahomeya mediterranea
Loxoconcha tarabulusensis

Only one species, ***Semicytherura africana*** was found to be restricted to this zone.

6.1.4 *Heptaloculites semirugosa* Zone. D

The top of this zone is marked by the first appearance of ***Heptaloculites semirugosa***, although this species extends into the ***Heptaloculites harshae*** Zone. The

base of this zone is defined by the first appearance of ***Heptaloculites harshae.*** The following species are found in this zone but not restricted to it:

Heptaloculites eocaenica
Echinocythereis harshae
Dahomeya mediterranea
Leguminocythereis tellilae
Cytherella tarabulusensis
Echinocythereis samdunae
Echinocythereis libyaensis
Cytherella angulata
Argilloecia ghalilae
Loxoconcha samdunae
Xestoleberis ghalilae
Loxoconcha tarabulusensis
Argilloecia ghalilae
Paracypris paramaghaghensis

The following species are restricted to this zone:

Hermanites libyaensis
Cytheropteron tarabulusensis

A few species make their first appearance within this zone although they range into the underlying zones:

Echinocythereis libyaensis
Loxoconcha samdunae

Heptaloculites semirugosa was reported from the Middle Eocene (Lutetian) of Algeria by Apostolescu and Magné (1956). This species also occurs in the Middle Eocene (Lower-Middle Lutetian) of Tunisia as recorded by Bismuth ***et al.***, (1978). Noticeably, this species has never been found in the Upper Lutetian of Tunisia and NW offshore Libya. This zone was also reported in Tunisia by Oertli (1976) and was dated as Middle Eocene (Lower Lutetian).

6.1.5 *Heptaloculites harshae* Zone. E

This zone is named after ***Heptaloculites harshae*** which has a short vertical stratigraphical range and is confined to this zone. In this zone a large number of species disappear as shown in fig. (1), the zone is characterised by other species with similarly short stratigraphical ranges such as ***Heptaloculites prima*** and ***Heptaloculites semipunctata*** with a vertical continuation of some species from other zones. The following species are recorded from this zone although they have been found in the overlying zones:

Echinocythereis libyaensis
Heptaloculites eocaenica
Argilloecia ghalilae
Loxoconcha tarabulusensis
Loxoconcha samdunae
Leguminocythereis tellilae

Two species were found to be restricted to it:

Isobuntonia pseudotuberata
Flexus africana

This zone is correlated to the ***Loculicytheretta*** aff. ***L. prima*** Zone in the Middle Eocene (Lower Lutetian) of Tunisia as nominated by Oertli (1976). ***Heptaloculites harshae*** was also found in the Middle Eocene (Lower Lutetian) by Bismuth ***et al.***, (1978) who recorded it as ***Loculicytheretta*** aff. ***L. prima***. The latter species was also reported from the Middle Eocene (Lutetian) of Tunisia by Mechmeche (1981). ***Heptaloculites semipunctata*** was reported by Bismuth ***et al.***, (1978) from the Middle Eocene (Lower Lutetian) of Tunisia and was also found in the Middle Eocene (Lower Lutetian) of Algeria by Apostolescu and Magne (1956)

6.2 OSTRACOD BIOZONES IN THE OTHER WELLS:

6.2.1 WELL C1-NC41: (Fig. 6.2)

Four zones were recognised in this well, the *Heptaloculites* aff. *H. gortanii* Zone, the *Heptaloculites cavernosa* Zone, the *Heptaloculites semirugosa* Zone and the *Heptaloculites harshae* Zone

6.2.1.1 *Heptaloculites* aff. *H. gortanii* Zone. A

In this well the zone is easily recognised by the first appearance downhole of *Heptaloculites* aff. *H. gortanii* with the base defined by the first appearance downhole of *Heptaloculites cavernosa.* The following species were found in this zone, although they extended into underlying zones:

Leguminocythereis tellilae
Cytherella tarabulusensis
Echinocythereis harshae
Loxoconcha samdunae
Loxoconcha tarabulusensis

Henryhowella sp. *A.* was found to be restricted to this zone.

6.2.1.2 *Heptaloculites cavernosa* Zone. B

The top of this zone is marked by the zonal species, although it extends into the older zones. The base of this zone is defined by the first appearance downhole of *Heptaloculites semirugosa.* A large number of species first appear within this zone and were not restricted to it:

Heptaloculites eocaenica
Acanthocythereis salahi
Asymmetricythere fossorum
Pontocyprella eocaenica
Paracypris paramaghaghensis
Leguminocythereis libyaensis,

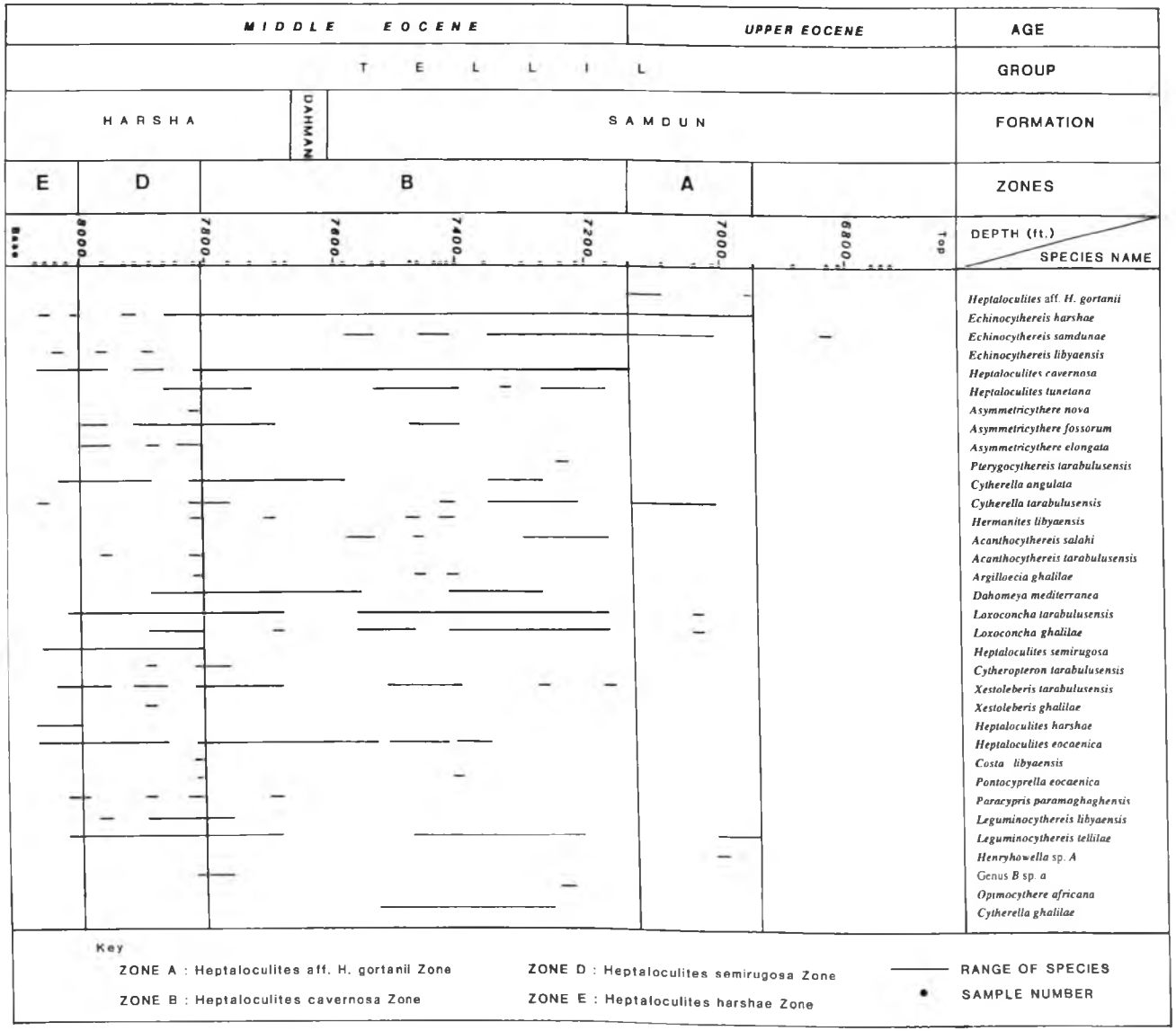


FIG. 6.2 RANGES OF OSTRACOD SPECIES OF THE TELLIL GROUP IN WELL C1-NC41, NW OFFSHORE LIBYA.

Cytherella angulata
Cytherella tarabulusensis
Loxoconcha ghalilae
Cytheropteron tarabulusensis
Xestoleberis tarabulusensis
Hermanites libyaensis
Argilloecia ghalilae
Dahomeya mediterranea
Heptaloculites tunetana
Genus *B* sp. *a*

These species first appear within this zone and are restricted to it:
Opimocythere africana
Cytherella ghalilae
Pterygocythereis tarabulusensis.

The following species were recorded from this zone although they also occur in the overlying and/or underlying zones:

Echinocythereis samdunae
Loxoconcha tarabulusensis,
Leguminocythereis tellilae
Cytherella tarabulusensis,
Echinocythereis harshae
Loxoconcha samdunae.

6.2.1.3 *Heptaloculites semirugosa* Zone. D

This zone is characterised by ***Heptaloculites semirugosa*** with the top defined by its first appearance, whilst the base is marked by the first appearance downhole of the ***Heptaloculites harshae.*** Five species were found to be restricted to this zone:

Costa libyaensis
Acanthocythereis tarabulusensis
Asymmetricythere nova
Asymmetricythere elongata

Xestoleberis ghalilae

Other ostracod species which occur in this zone but are not restricted to it, being also recorded from the underling and/or overlying zones:

Heptaloculites eocaenica
Cytherella tarabulusensis
Cytherella angulata
Leguminocythereis libyaensis
Leguminocythereis tellilae
Paracypris paramaghaghensis
Pontocyprella eocaenica
Asymmetricythere fossorum
Acanthocythereis tarabulusensis
Cytherella tarabulusensis
Hermanites libyaensis
Argilloecia ghalilae
Dahomeya mediterranea
Loxoconcha tarabulusensis
Cytheropteron tarabulusensis
Xestoleberis tarabulusensis
Echinocythereis harshae
Heptaloculites tunetana
Loxoconcha samdunae
Genus *B* sp. *a*

The following species make their first appearance within this zone and extend their ranges into the ***Heptaloculites harshae*** zone:

Xestoleberis ghalilae

Echinocythereis libyaensis.

6.2.1.4 *Heptaloculites harshae* Zone. E

In this well, the zone is marked by the total range of ***Heptaloculites harshae.*** The following species were found in this zone, but were not restricted to it:

Heptaloculites eocaenica
Paracypris paramaghaghensis
Leguminocythereis tellilae
Cytherella angulata
Cytherella tarabulusensis
Xestoleberis tarabulusensis
Loxoconcha tarabulusensis
Echinocythereis libyaensis
Echinocythereis harshae

6.2.2 WELL K1-NC41: (Fig. 6.3)

Five zones were found in this well, the *Heptaloculites* aff. *H. gortanii* Zone, the *Heptaloculites cavernosa* Zone, the *Heptaloculites minuta* Zone, the *Heptaloculites semirugosa* Zone and the *Heptaloculites harshae* Zone.

6.2.2.1 *Heptaloculites* aff. *H. gortanii* Zone. A

This zone is characterised by the first appearance downhole of this species at 8020 ft., however, no samples were obtained from the upper part of this section. Therefore, the upper limit must be regarded as provisional and may need to be revised upwards in the light of further evidence. The base of this zone is defined by the first appearance of the next zonal marker.

Several species make their first appearance in this zone but are not restricted to it, and they have been found in the underlying zones:

Asymmetricythere fossorum
Cytherella tarabulusensis
Pontocyprella eocaenica
Flexus quadricostata
Xestoleberis tarabulusensis
Paracypris paramaghaghensis
Heptaloculites tunetana
Dahomeya mediterranea
Echinocythereis harshae

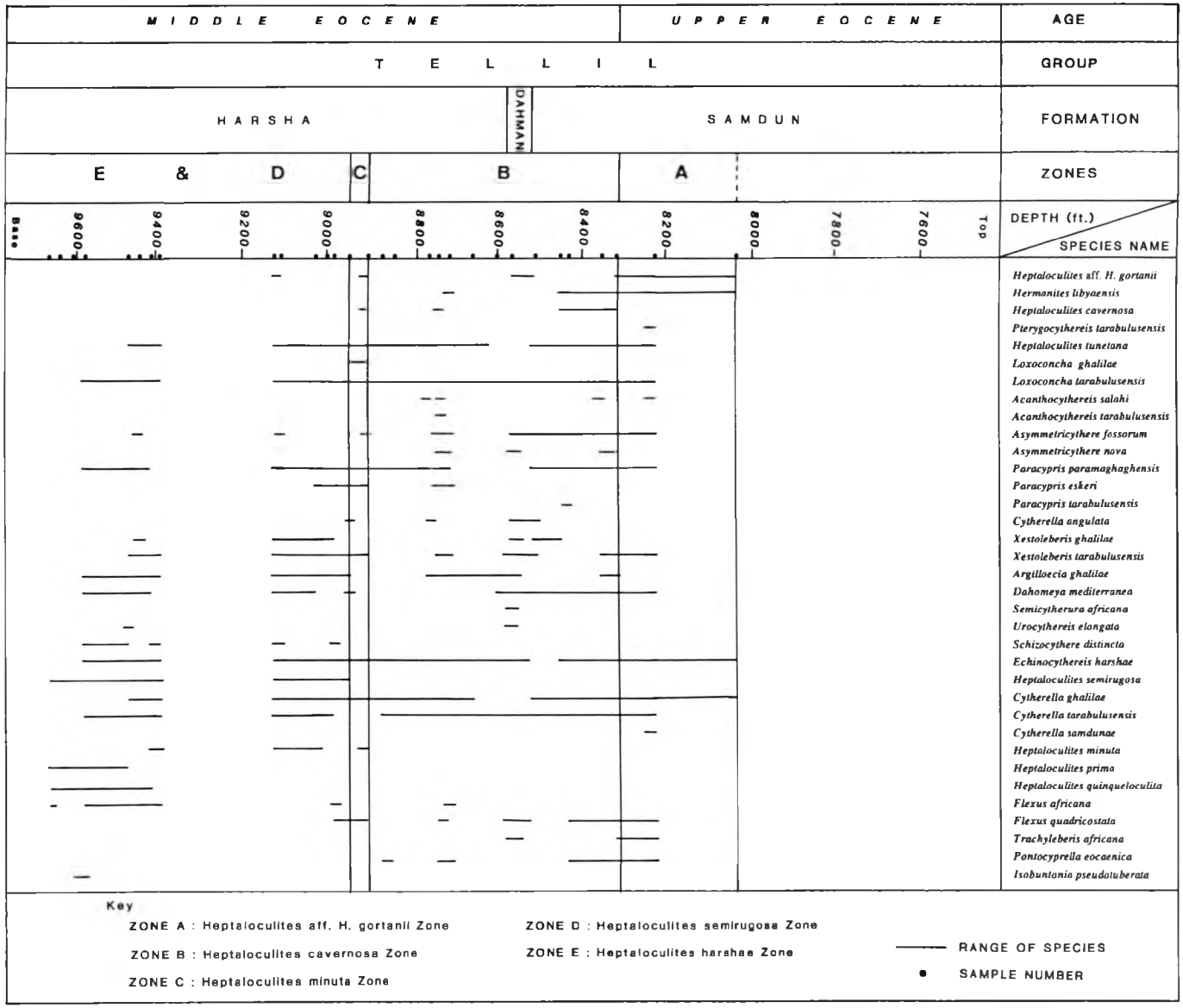


FIG. 6.3 RANGES OF OSTRACOD SPECIES OF THE TELLIL GROUP IN WELL K1-NC41, NW OFFSHORE LIBYA.

Trachyleberis africana
Hermanites libyaensis
Cytherella ghalilae
Loxoconcha tarabulusensis
Acanthocythereis salahi

Cytherella samdunae and *Pterygocythereis tarabulusensis* were found to be restricted in this zone.

6.2.2.2 *Heptaloculites cavernosa* Zone. B

The upper limit of this zone is characterised by the first appearance downhole of *Heptaloculites cavernosa* and the lower limit is recognised by the first appearance downhole by the next zonal marker. Species that first appear within this zone and are restricted to it are;

Acanthocythereis tarabulusensis
Asymmetricythere nova
Semicytherura africana
Paracypris tarabulusensis
Urocythereis elongata

A large number of species first appear in this zone although they have been found in the underlying zones. These are:

Flexus africana
Paracypris eskeri
Acanthocythereis salahi
Cytherella angulata
Xestoleberis ghalilae
Argilloecia ghalilae

Other ostracod species which occur in this zone but were also recorded from the higher and lower zones are:

Loxoconcha tarabulusensis
Hermanites libyaensis
Pontocyprella eocaenica
Xestoleberis tarabulusensis
Trachyleberis africana
Cytherella ghalilae
Cytherella tarabulusensis
Echinocythereis harshae
Asymmetricythere fossorum
Flexus quadricostata
Paracypris paramaghaghensis
Heptaloculites tunetana
Dahomeya mediterranea
Acanthocythereis salahi

6.2.2.3 *Heptaloculites minuta* Zone. C

The top of this zone is marked by the first appearance downhole of this species whilst the base is defined by the appearance of ***Heptaloculites semirugosa,*** although this species extends into the older zones. The following species were found in this zone although they were found in other zones:

Cytherella ghalilae
Xestoleberis tarabulusensis
Loxoconcha tarabulusensis
Asymmetricythere fossorum
Flexus quadricostata
Paracypris paramaghaghensis
Paracypris eskeri
Heptaloculites tunetana
Dahomeya mediterranea
Echinocythereis harshae

Only ***Loxoconcha ghalilae*** makes its first appearance in this zone and is restricted to it.

6.2.2.4 *Heptaloculites semirugosa* Zone. D and *Heptaloculites harshae* Zone. E

The upper limit of the ***Heptaloculites semirugosa*** Zone is well recognised in this well by the first appearance downhole of the zonal marker. However, the boundary between the ***Heptaloculites semirugosa*** Zone and the ***Heptaloculites harshae*** Zone is not clear due to the lack of samples. The first appearance downhole of ***Heptaloculites prima*** is considered to indicate the presence of the ***Heptaloculites harshae*** Zone. ***Heptaloculites quinqueloculita*** also first appears in the ***Heptaloculites semirugosa*** Zone and extends to the ***Heptaloculites harshae*** zone. ***Isobuntonia pseudotuberata*** was found in the lower part of the ***Heptaloculites harshae*** zone. Other species found in this zone but not restricted to it, ranging into higher zones are:

Echinocythereis harshae
Cytherella tarabulusensis
Cytherella ghalilae
Flexus quadricostata
Paracypris eskeri
Xestoleberis tarabulusensis
Loxoconcha tarabulusensis
Flexus africana
Paracypris paramaghaghensis
Cytherella angulata
Argilloecia ghalilae
Dahomeya mediterranea

Asymmetricythere fossorum was present, but is considered here to be caved contaminant material.

6.2.3 WELL H1-NC41: (Fig. 6.4)

Five zones were recognised in this well, the ***Heptaloculites*** aff. ***H. gortanii*** Zone, the ***Heptaloculites cavernosa*** Zone, the ***Heptaloculites minuta*** Zone, the ***Heptaloculites semirugosa*** Zone and the ***Heptaloculites harshae*** Zone.

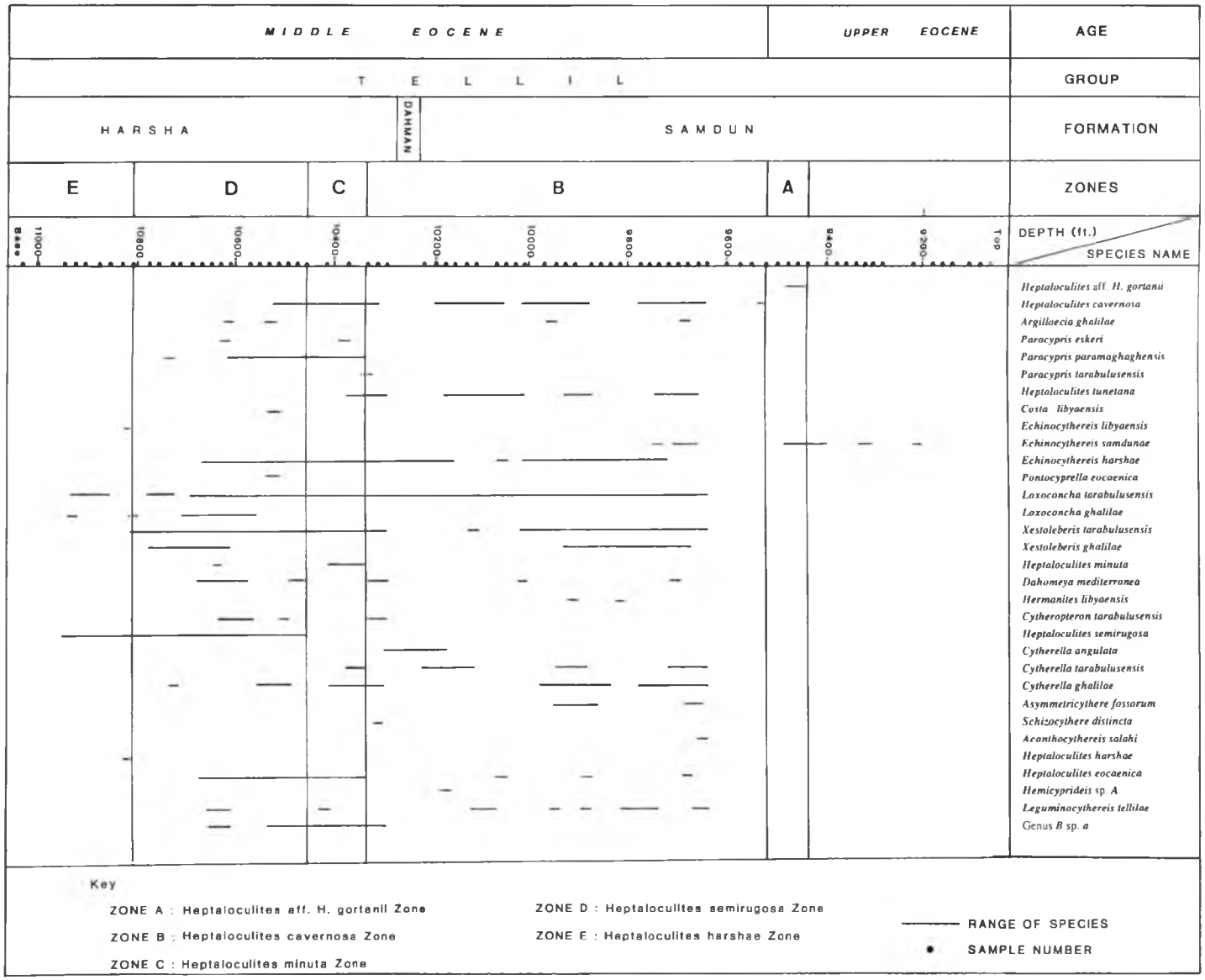


FIG. 6.4 RANGES OF OSTRACOD SPECIES OF THE TELLIL GROUP IN WELL H1-NC41, NW OFFSHORE LIBYA.

6.2.3.1 *Heptaloculites* aff. *H. gortanii* Zone. A

The base of this zone is defined by the first appearance downhole of *Heptaloculites cavernosa.* Besides the zonal species the only other species was *Echinocythereis samdunae* which was not restricted to this zone

6.2.3.2 *Heptaloculites cavernosa* Zone. B

This zone is easily distinguished by the first appearance of the zonal species and the lower limit is defined by the first appearance downhole of *Heptaloculites minuta.* Several species first appear downhole within this zone and are restricted to it:

Henryhowella sp. *A*
Hermanites libyaensis
Asymmetricythere fossorum
Acanthocythereis salahi
Schizocythere distincta
Cytherella angulata.

The following species first appear in this zone, although they were found in the underlying zones:

Cytheropteron tarabulusensis
Argilloecia ghalilae
Xestoleberis ghalilae
Xestoleberis tarabulusensis
Leguminocythereis tellilae
Echinocythereis harshae
Heptaloculites tunetana
Dahomeya mediterranea
Cytherella ghalilae
Heptaloculites eocaenica
Cytherella tarabulusensis
Loxoconcha tarabulusensis

6.2.3.3 *Heptaloculites minuta* Zone. C

The upper limit of this zone is marked by the first appearance of ***Heptaloculites minuta***, with the base defined by the first appearance downhole of ***Heptaloculites semirugosa***. The following species were also found in this zone but were not restricted to it:

Loxoconcha tarabulusensis
Cytheropteron tarabulusensis
Echinocythereis harshae
Cytherella tarabulusensis
Dahomeya mediterranea
Xestoleberis tarabulusensis
Paracypris tarabulusensis
Cytherella ghalilae
Heptaloculites eocaenica
Heptaloculites tunetana
Leguminocythereis tellilae
Genus ***B*** sp. ***a***

In this zone ***Paracypris eskeri*** makes its first appearance although it has been found in the ***Heptaloculites semirugosa*** Zone.

6.2.3.4 *Heptaloculites semirugosa* Zone. D

The zone is recognised by the first appearance of ***Heptaloculites semirugosa*** and the base of this zone is marked by the first appearance downhole of ***Heptaloculites harshae***. The following species were restricted to this zone:

Costa libyaensis

Pontocyprella eocaenica.

Other ostracod species recorded, but which were but not restricted, ranging into higher and/or lower zones:

Leguminocythereis tellilae
Paracypris eskeri
Argilloecia ghalilae
Cytheropteron tarabulusensis
Loxoconcha tarabulusensis
Dahomeya mediterranea
Paracypris paramaghaghensis
Xestoleberis ghalilae
Loxoconcha ghalilae
Cytherella ghalilae
Echinocythereis harshae
Heptaloculites eocaenica
Genus ***B*** sp. ***a***
Xestoleberis tarabulusensis

6.2.3.5 *Heptaloculites harshae* Zone. E

In this well this zone is characterised by the first appearance of ***Heptaloculites harshae***. It was difficult to determine the base of this zone, because of the rarity of ***Heptaloculites harshae.***

Two species found in this zone were also recovered in the overlying zones:

Loxoconcha tarabulusensis

Loxoconcha ghalilae.

Only one, ***Echinocythereis libyaensis*** was restricted to this zone.

6.2.4 WELL F1-NC41: (Fig. 6.5)

Three zones were found in this well, the ***Heptaloculites cavernosa*** Zone, the ***Heptaloculites minuta*** Zone and the ***Heptaloculites semirugosa*** Zone.

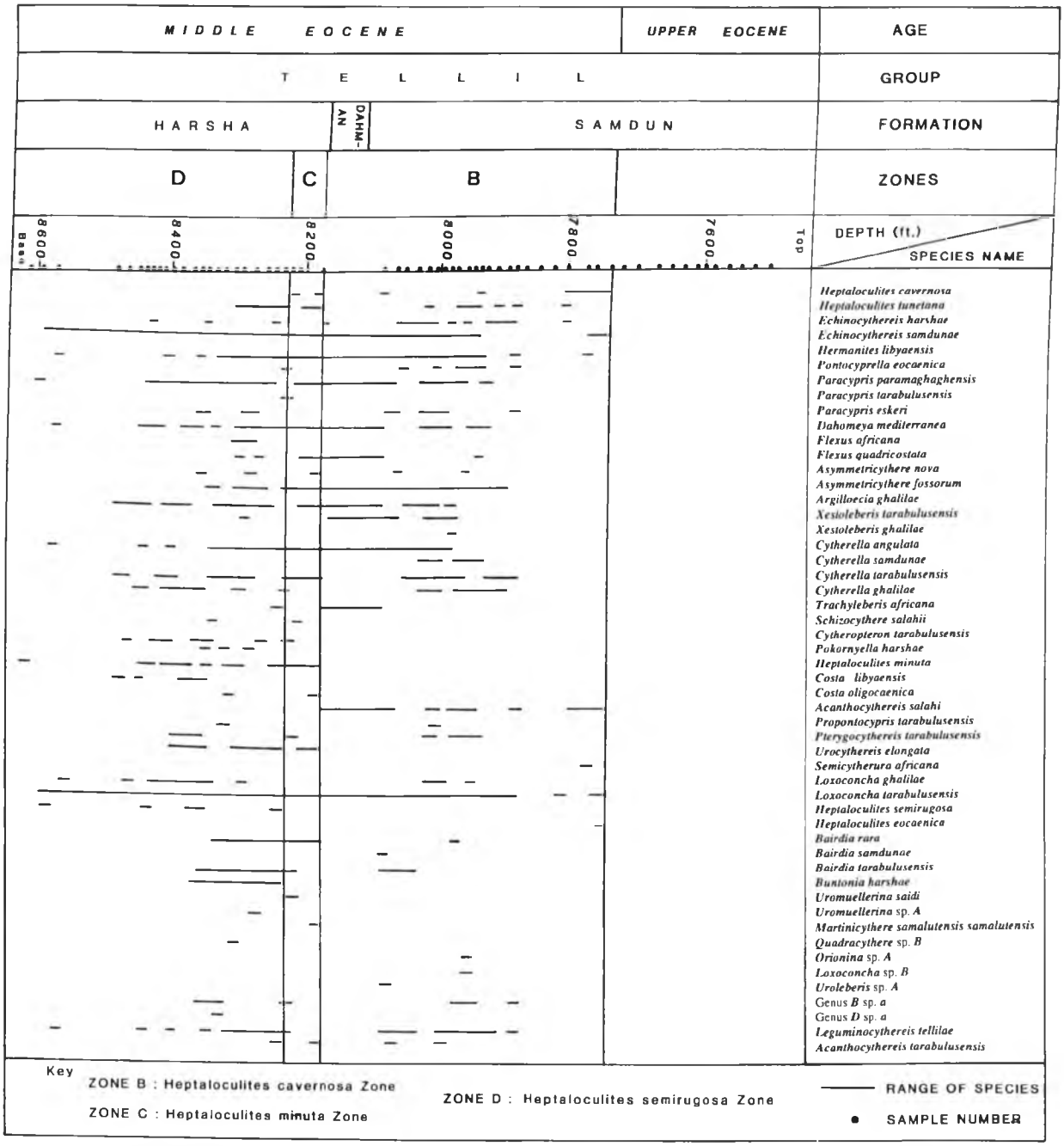


FIG. 6.5 RANGES OF OSTRACOD SPECIES OF THE TELLIL GROUP IN WELL F1-NC41, NW OFFSHORE LIBYA.

6.2.4.1 *Heptaloculites cavernosa* Zone. B

The upper limit of this zone is defined by the first appearance downhole of ***Heptaloculites cavernosa,*** and the lower limit defined by the first appearance downhole of ***Heptaloculites minuta.*** The following species first appear in this zone although they were found in the underlying zones:

Heptaloculites tunetana
Paracypris eskeri
Genus ***B*** sp. ***a***
Echinocythereis harshae
Leguminocythereis tellilae
Hermanites libyaensis
Pontocyprella eocaenica
Paracypris paramaghaghensis
Dahomeya mediterranea
Flexus quadricostata
Xestoleberis tarabulusensis
Argilloecia ghalilae
Cytherella angulata
Trachyleberis africana
Cytherella tarabulusensis
Pterygocythereis tarabulusensis
Echinocythereis samdunae
Loxoconcha tarabulusensis
Asymmetricythere fossorum
Cytherella ghalilae
Loxoconcha ghalilae
Bairdia rara
Bairdia tarabulusensis
Asymmetricythere nova
Acanthocythereis tarabulusensis

Other species that first appear within this zone and were restricted to it include:

Bairdia samdunae

Xestoleberis tarabulusensis
Cytherella samdunae
Xestoleberis ghalilae
Orionina sp. *A*
Loxoconcha sp. *B*
Uroleberis sp. *A*
Semicytherura africana
Heptaloculites eocaenica

Acanthocythereis salahi Bassiouni, 1969b. The latter species was also recorded the Upper Eocene of Egypt, from the Oligocene of Libya by Salahi (1966) and from the Middle and Upper Eocene of Tunisia by Mechmeche (1981).

6.2.4.2 *Heptaloculites minuta* Zone. C

This zone is defined by the first appearance downhole of ***Heptaloculites minuta***, with the base marked by the first appearance downhole of the next index species. Five species that make their first appearance downhole in this zone but are not restricted to it, extending into the ***Heptaloculites semirugosa*** Zone are:

Paracypris tarabulusensis
Costa oligocaenica
Urocythereis elongata
Cytheropteron tarabulusensis
Schizocythere salahi

Two species restricted to this zone were; ***Uromuellerina saidi*** Bassiouni (1969c) which was originally described from the Eocene of Egypt and also found in the Eocene of Al Jabal al Akhadr, Libya by Helmdach and El Khoudary (1980) and ***Martinicythere samalutensis samalutensis*** Bassiouni (1969c) from the Middle and Upper Eocene of Egypt.

The following species were found in this zone but also occur in the underlying and overlying zones:

Echinocythereis harshae
Argilloecia ghalilae
Xestoleberis tarabulusensis
Flexus quadricostata
Asymmetricythere fossorum
Loxoconcha tarabulusensis
Echinocythereis samdunae
Urocythereis elongata
Pterygocythereis tarabulusensis
Dahomeya mediterranea
Paracypris paramaghaghensis
Hermanites libyaensis
Leguminocythereis tellilae
Cytherella angulata
Trachyleberis africana
Cytherella tarabulusensis
Acanthocythereis salahi
Heptaloculites eocaenica
Cytherella ghalilae
Loxoconcha tarabulusensis
Bairdia rara
Bairdia tarabulusensis
Genus *B* sp. *a*
Leguminocythereis tellilae
Acanthocythereis tarabulusensis

6.2.4.3 *Heptaloculites semirugosa* Zone. D

In this well the zone is defined by the first appearance downhole of *Heptaloculites semirugosa.* Several species that first appear within this zone and were also restricted to it were:

Pokorynella harshae
Flexus africana
Costa libyaensis
Uromuellerina sp. *A*
Quadracythere sp. *A*

Buntonia harshae
Genus *D* sp. *a*

The following species were also found in this zone and in the younger zones:

Loxoconcha ghalilae
Cytherella ghalilae
Loxoconcha tarabulusensis
Echinocythereis harshae
Asymmetricythere fossorum
Urocythereis elongata
Pterygocythereis tarabulusensis
Propontocypris tarabulusensis
Cytherella tarabulusensis
Schizocythere distincta
Trachyleberis africana
Cytherella angulata
Argilloecia ghalilae
Paracypris eskeri
Xestoleberis tarabulusensis
Flexus quadricostata
Dahomeya mediterranea
Paracypris paramaghaghensis
Pontocyprella eocaenica
Hermanites libyaensis
Leguminocythereis tellilae
Bairdia rara
Cytheropteron tarabulusensis
Genus *B* sp. *a*
Asymmetricythere nova
Acanthocythereis tarabulusensis

6.2.5 WELL B1-NC41: (Fig. 6.6)

Two zones can be recognized in this well, the *Heptaloculites* aff. *H. gortanii* Zone

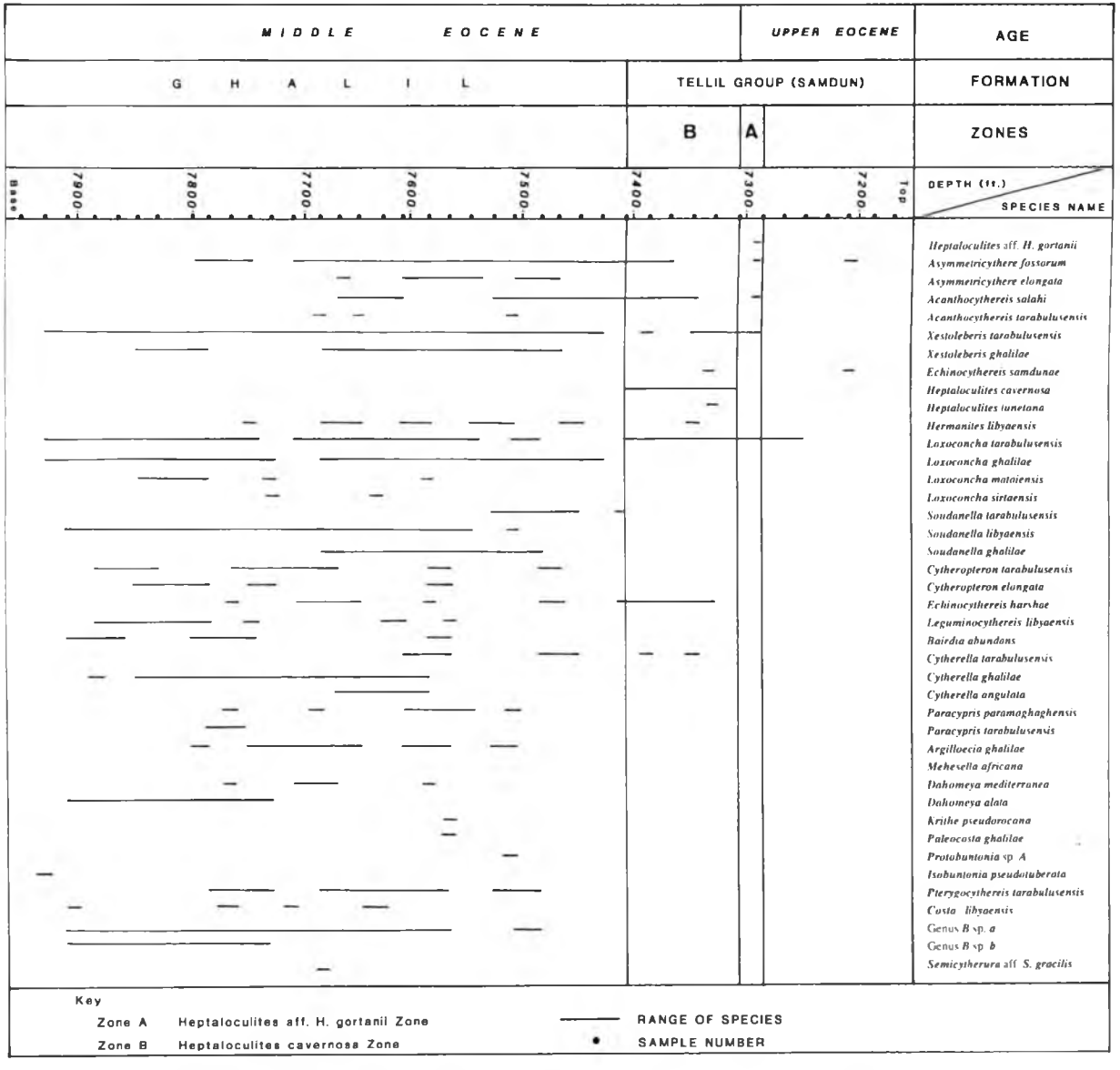


FIG. 6.6 RANGES OF OSTRACOD SPECIES OF THE GHALIL AND SAMDUN FORMATIONS IN WELL B1-NC41, NW OFFSHORE LIBYA.

and the ***Heptaloculites cavernosa*** Zone found in the shallower facies Tellil Group. It is not possible to recognise any of the lower ***Heptaloculites*** zones in the deeper water Ghalil Formation.

6.2.5.1 *Heptaloculites* aff. *H. gortanii* Zone. A

This zone is defined by the first appearance downhole of ***Heptaloculites*** aff. ***H. gortanii*** whilst the base of this zone is marked by the first appearance of ***Heptaloculites cavernosa.***

The following species make their first appearance within this zone although they have been also found in the underlying and/or overlying beds and in the Ghalil Formation:

Xestoleberis tarabulusensis
Acanthocythereis salahi
Loxoconcha tarabulusensis

Asymmetricythere fossorum is also found in this zone but not restricted to it. No species were found to be restricted to this level.

6.2.5.2 *Heptaloculites cavernosa* Zone. B

In this well the zone is characterised by the total range of ***Heptaloculites cavernosa. Heptaloculites tunetana*** also first appears in this zone and is restricted to it. Three species make their first appearance within this zone but their ranges extend to the Ghalil Formation:

Hermanites libyaensis
Echinocythereis harshae
Cytherella tarabulusensis

The following species were recorded from this zone and also occur in the overlying ***Heptaloculites*** aff. ***H. gortanii*** Zone and underlying the Ghalil Formation:

Asymmetricythere fossorum
Loxoconcha tarabulusensis
Echinocythereis samdunae.

Fig. 6.6 shows the ranges of the ostracod species recovered from the Ghalil Formation in Well B1-NC41. The following species which were found in the Tellil Group in the present study also occur in the Ghalil Formation: ***Xestoleberis ghalilae***, ***Asymmetricythere elongata***, ***Acanthocythereis tarabulusensis***, ***Cytheropteron tarabulusensis***, ***Leguminocythereis libyaensis***, ***Cytherella angulata***, ***Paracypris tarabulusensis***, ***Argilloecia ghalilae***, ***Costa libyaensis***, Genus ***B*** sp. ***a*** and Genus ***B*** sp. ***b***.

The ranges of these species are confined to the Middle Eocene. ***Loxoconcha mataiensis*** Cronin and Khalifa (1979) was originally described from the Middle Eocene of Egypt and also occurs in the Ghalil formation.

The following new species were recorded from this section for the first time: ***Loxoconcha sirtaensis***, ***Soudanella tarabulusensis***, ***Soudanella libyaensis***, ***Soudanella ghalilae***, ***Cytheropteron elongata***, ***Bairdia abundans***, ***Mehesella africana***, ***Krithe pseudorocana***, ***Paleocosta ghalilae*** and ***Protobuntonia*** sp. ***A***. The ranges of these species are unknown.

Isobuntonia pseudotuberata (Apostolescu & Magné, 1956) was described from the Middle Eocene of Algeria, the Lower Eocene of Tunisia by Mechmeche (1981) and it was found in the Middle Eocene of the Tellil Group.

Dahomeya alata Apostolescu (1961) was also found in the Ghalil Formation. The range of this species is Palaeocene to Middle Eocene. ***Semicytherura*** aff. ***S. gracilis*** (Lienenklaus, 1895) was recorded from the Middle Eocene by Carbonnel (1988).

Other ostracod species recorded in this section which have also been found in the overlying zones of the Samdun Formation include: ***Asymmetricythere fossorum***,

Acanthocythereis salahi Bassiouni (1969b), *Xestoleberis tarabulusensis*, *Echinocythereis samdunae*, *Hermanites libyaensis*, *Dahomeya mediterranea*, *Pterygocythereis tarabulusensis*, *Paracypris paramaghaghensis*, *Echinocythereis harshae* and *Cytherella tarabulusensis*. These species range from the Middle to the Upper Eocene in the other wells of the Tellil Group.

The above mentioned ostracod species indicate a Middle Eocene age for the Ghalil Formation in Well B1-NC41.

6.3 OCCURRENCES OF THE ZONES AND THE AGE OF THE FORMATIONS ACCORDING TO THE OSTRACODA SPECIES.

6.3.1 Occurrences of the zones:

6.3.1.1 *Heptaloculites* aff. *H. gortanii* Zone. A

This zone occurs in the middle of the Samdun Formation throughout the studied area in wells B1a-137, B1-NC41, H1-NC41, K1-NC41 and C1-NC41. This zone cannot be recognised in Well F1-NC41.

6.3.1.2 *Heptaloculites cavernosa* Zone. B

This zone occurs in the Samdun, Dahman Formations and in the top most part of the Harsha Formation in Well B1a-137; in the Dahman, Samdun and in the upper part of the Harsha Formation in Well C1-NC41. This zone is also found in the lower part of the Samdun Formation, in the Dahman Formation and in the upper part of the Harsha Formation in Well K1-NC41. This zone also occurs in the Samdun, Dahman Formations and in the top most part of the Harsha Formation in Well H1-NC41. In Well F1-NC41, this zone is recognised in the Samdun, Dahman and in the upper most part of the Harsha Formation and in the lower part of the Samdun Formation in Well B1-NC41.

6.3.1.3 *Heptaloculites minuta* Zone. C

The zone was found in the upper part of the Harsha Formation in Well B1a-137; it cannot be recognized in Well C1-NC41 or B1-NC41. It is also found in the Harsha Formation in Wells K1-NC41, H1-NC41 and F1-NC41.

6.3.1.4 *Heptaloculites semirugosa* Zone. D

This zone is well established in the Harsha Formation of Wells B1a-137, C1-NC41, H1-NC41 and F1-NC41. The zone cannot be separated from the underlying ***Heptaloculites harshae*** Zone in Well K1-NC41 and is not seen in Well B1-NC41.

6.3.1.5 *Heptaloculites harshae* Zone. E

The zone occurs in the lower part of the Harsha Formation in Well B1a-137, C1-NC41. This zone cannot be recognised in Well F1-NC41 and B1-NC41 and in Well K1-NC41, this zone is difficult to separate from the overlying zone.

6.3.2 Age of the Formations:

6.3.2.1 Samdun Formation:

An Upper Eocene age is assigned to the rocks on the basis of the ***Heptaloculites*** aff. ***H. gortanii*** Zone and on its stratigraphic position. The lower part of this Formation is defined by the occurrence of ***Heptaloculites cavernosa*** and is regarded as Middle Eocene. The Samdun Formation was indicated by Hammuda ***et al.***, (1985) as Middle and Upper Eocene from its relative stratigraphic position.

6.3.2.2 Dahman Formation:

The formation is only recognised in five wells in the present study, B1a-137, C1-NC41, H1-NC41, K1-NC41 and F1-NC41. The whole formation in these wells lies within the ***Heptaloculites cavernosa*** Zone giving a Middle Eocene age to this

Formation. Hammuda *et al.*, (1985) favoured a Middle Eocene age for the Dahman Formation according to its stratigraphic position.

6.3.2.3 Harsha Formation:

This formation includes four zones, the ***Heptaloculites cavernosa*** zone, the ***Heptaloculites minuta*** zone, the ***Heptaloculites semirugosa*** zone and the ***Heptaloculites harshae*** zone. A Middle Eocene age is proposed for these rocks on the basis of the above mentioned zones. The Harsha Formation was dated as Middle Eocene by Hammuda *et al.*, (1985) again on its relative stratigraphical position.

6.4 THE OCCURRENCES AND DISTRIBUTION OF THE OSTRACOD SPECIES IN THE FOLLOWING WELLS:

6.4.1 WELL D2-NC41:

Fig. 6.7 shows the ranges of the ostracod species recorded from the Ghalil and Al Jurf Formations and from the lower part of the Farwah Group in well D2-NC41. At sample depth 7880 ft., the following species were found; ***Argilloecia ghalilae***, ***Paleocosta ghalilae*** and ***Soudanella libyaensis***. These are indicative of a Middle Eocene age. Other species also recorded in the other samples; ***Krithe pseudorocana***, ***Costa libyaensis***, ***Xestoleberis ghalilae***, ***Leguminocythereis libyaensis*** were also recorded from the Middle Eocene in the other wells in the present study. ***Cytheropteron elongata*** found in this section ranges from the Late Palaeocene to the Middle Eocene in this study. The occurrence of the Recent species of ***Buntonia sublatissima*** at sample depth 7800 ft., is due to contamination. ***Asymmetricythere fossorum***, ***Loxoconcha samdunae*** and ***Cytherella ghalilae*** range from the Middle to the Upper Eocene in the other wells. The following species make their first appearance in this section and were not recorded from other wells: ***Krithe ghalilae***, ***Buntonia*** sp. ***A***, ***Loxoconcha*** sp. ***A***, ***Cytheromorpha?*** sp. ***A***, ***Acanthocythereis*** sp. ***B***, ***Buntonia ghalilae***, ***Buntonia sbetai***. The ranges of these species are unknown.

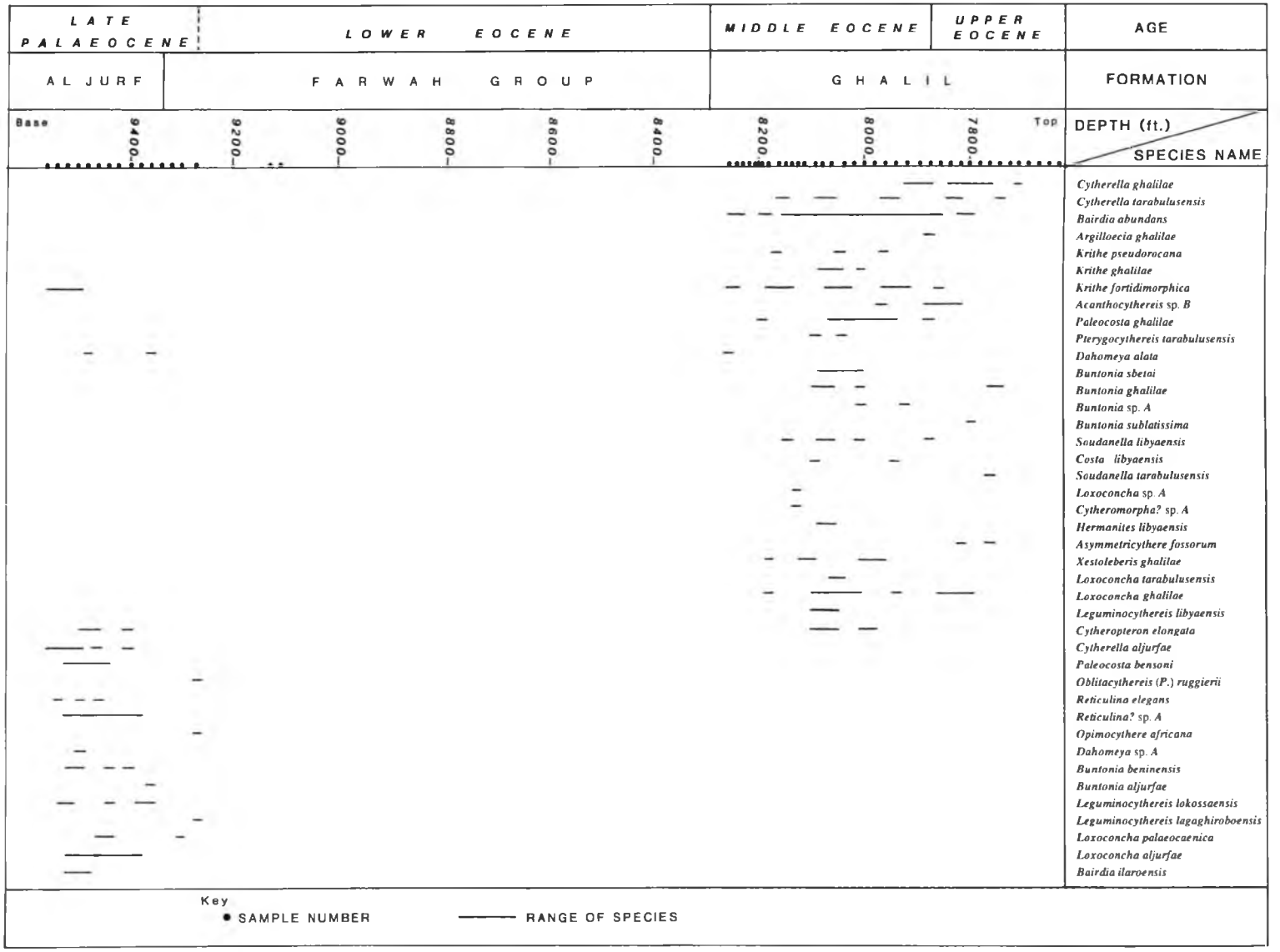


FIG. 6.7 RANGES OF OSTRACOD SPECIES OF THE GHALIL AND AL JRUF FORMATIONS IN WELL D2-NC41, NW OFFSHORE LIBYA.

Bairdia abundans and *Krithe pseudorocana* were recorded from the Middle Eocene of the Ghalil Formation in Well B1-NC41.

On the basis of the above species the following ages were assigned to this section of Well D2-NC41. 7618-7880 ft.: Upper Eocene, 7880-8284 ft: Middle Eocene.

Several samples were obtained from the lower part of the Farwah Group and from the Al Jurf Formation. At sample depth 9280 ft., ***Leguminocythereis lagaghiroboensis*** and ***Opimocythere africana*** were first recorded. ***Leguminocythereis lagaghiroboensis*** is indicative of a Late Palaeocene age and ***Opimocythere africana*** was recorded from the Middle Eocene of the Tellil Group. The occurrence of ***Oblitacythereis (P.) rugierii*** (Russo) in this sample is considered to be contamination from overlying beds as it is a common Miocene species from Italy. At sample depth 9360 ft., ***Buntonia aljurfae*** was first found but the range of this species is unknown. ***Leguminocythereis lokossaensis*** Apostolescu (1961) was also found in this sample, a species which ranges from the Late Palaeocene to the Early Eocene. ***Dahomeya alata*** (1961) was also recorded in this sample and ranges from the Late Palaeocene to the Middle Eocene.

At sample depth 9380 ft., the following species, whose total range are unknown make their first appearances: ***Loxoconcha palaeocaenica*** and ***Reticulina?*** sp. *A*. Also in this sample ***Leguminocythereis lokossaensis*** was found. At sample depth 9400 ft., ***Buntonia beninensis*** Reyment, ***Cytheropteron elongata, Cytherella aljurfae*** and ***Reticulina?*** sp. *A* were recorded. ***Buntonia beninensis*** was originally described from the Late Palaeocene of Nigeria and was also recorded from the Palaeocene of Libya. The range of ***Cytherella aljurfae*** is unknown. At sample depth 9440 ft., ***Paleocosta bensoni*** makes its first appearance, this species was found only in the Late Palaeocene of Tunisia by Donze ***et al.***, (1982)

The following species were also recorded in this sample: ***Leguminocythereis lokossaensis, Reticulina?*** sp. ***A, Buntonia beninensis, Cytherella aljurfae*** and ***Loxoconcha palaeocaenica.*** In the sample from 9460 ft., ***Bairdia ilaroensis, Reticulina elegans, Paleocosta bensoni, Reticulina?*** sp. ***A*** and ***Dahomeya alata*** were recovered. The range of ***Bairdia ilaroensis*** is Maastrichtian to Palaeocene. In the sample from 9500 ft., ***Buntonia - beninensis, Cytherella aljurfae, Krithe fortidimorphica, Leguminocythereis lokossaensis, Paleocosta bensoni, Reticulina?*** sp. ***A, and Cytheropteron elongata*** were found. ***Dahomeya*** sp. ***A.*** makes its first appearance in this sample, but its range is unknown. At sample depth 9520 ft., six species were recorded: ***Bairdia ilaroensis, Krithe fortidimorphica, Reticulina?*** sp. ***A, Buntonia beninensis, Paleocosta bensoni*** and ***Cytherella aljurfae.*** At 9540 ft., three species were recorded: ***Leguminocythereis lokossaensis, Krithe fortidimorphica*** and ***Reticulina elegans.*** At sample depth 9560 ft., only two species were found: ***Cytherella aljurfae*** and ***Krithe fortidimorphica.***

On the basis of the evidence given by the ranges of the ostracod species above the age of the lower part of the Farwah Group and Al Jurf Formation in D2-NC41 is Late Palaeocene (sample depth 9280-9600 ft.). However, as no samples were obtained from the middle and upper part of the Farwah Group the upper limit of the Late Palaeocene must be regarded as provisional and may need to be revised upwards in the light of further evidence.

6.4.2 WELL N1-NC41:

Fig. 6.8 shows the ranges of the ostracod species recorded from the Al Jurf Formation in Well N1-NC41. At sample depth 10090 ft., ***Bairdia ilaroensis*** was first recorded. This species ranges from the Maastrichtian to Late Palaeocene, but is usually more associated with Late Palaeocene. At sample depth 10100 ft., two species were recorded, ***Trachyleberis tarabulusensis*** and ***Bairdia ilaroensis.***

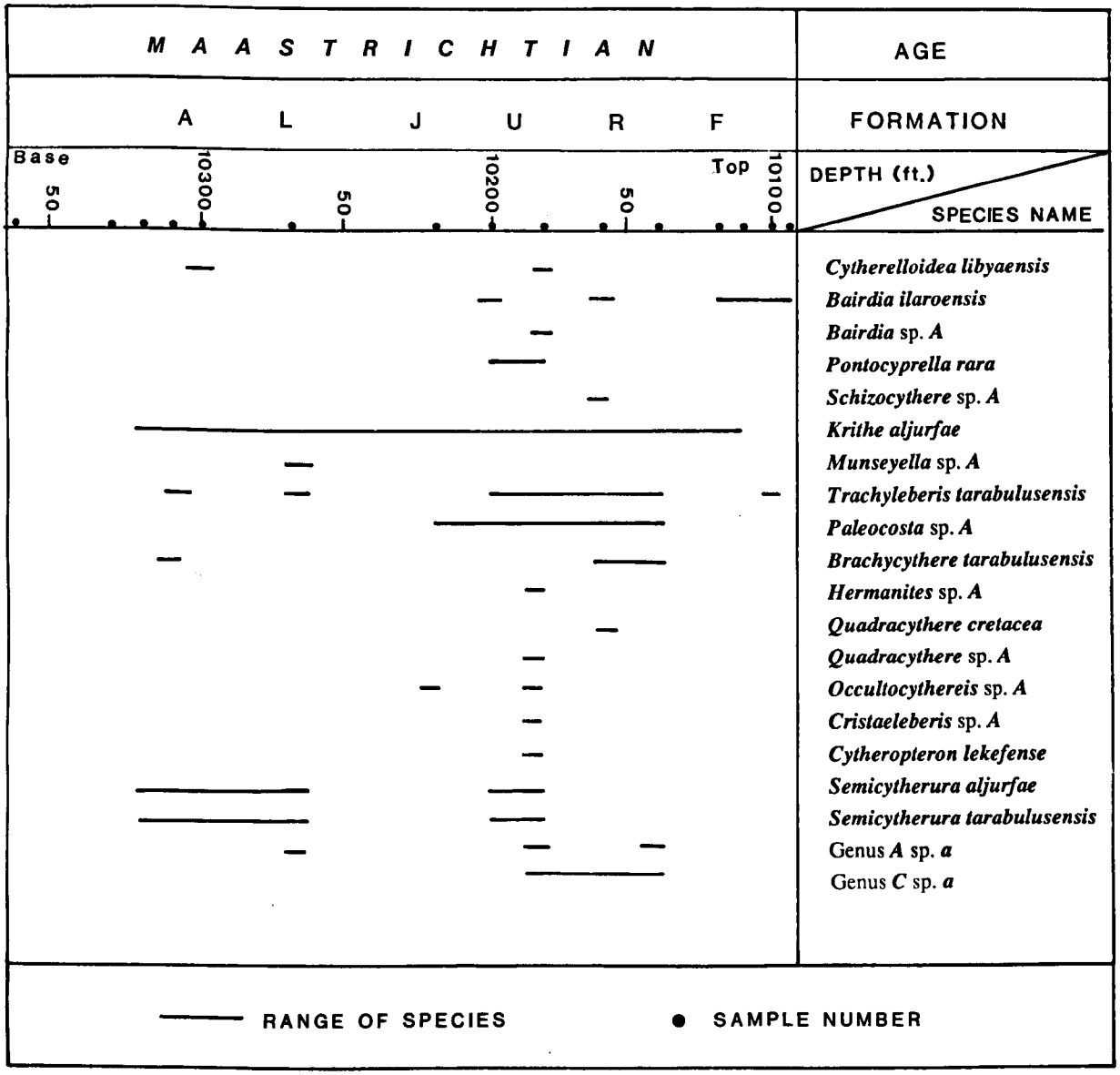


FIG. 6.8 RANGES OF OSTRACOD SPECIES OF THE AL JURF FORMATION IN WELL N1-NC41, NW OFFSHORE LIBYA.

At sample depth 10110 ft., ***Krithe aljurfae*** was first found. the range of this species is unknown. Also in this sample ***Bairdia ilaroensis*** was found. At sample depth 10120 ft., the above mentioned two species were also found. At sample depth 10140 ft., the following species were recorded for the first time, ***Paleocosta*** sp. ***A***, ***Brachycythere tarabulusensis***, Genus ***A*** sp. ***a***, ***Semicytherura tarabulusensis***, Genus ***C*** sp. ***a***. ***Krithe aljurfae*** and ***Trachyleberis tarabulusensis***.

At sample depth 10160 ft., ***Schizocythere*** sp. ***A***, ***Pontocyprella rara*** and ***Quadracythere*** sp. ***A*** were first recorded. Also in this sample the following species were found, ***Bairdia ilaroensis***, ***Krithe aljurfae***, ***Paleocosta*** sp. ***A***, ***Trachyleberis tarabulusensis***, ***Brachycythere tarabulusensis*** and Genus ***C*** sp. ***a***. At sample depth 10180 ft., the following species made their first appearance, ***Cytherelloidea libyaensis***, ***Bairdia*** sp. ***A***, ***Semicytherura aljurfae***, ***Hermanites*** sp. ***A***, ***Quadracythere*** sp. ***A*** and ***Occultocythereis*** ap. ***A***. The ranges of these species are unknown.

Cytheropteron lekefense was also found in this sample. The range of this species is Maastrichtian to Palaeocene. Other species also recorded in this sample were ***Krithe aljurfae***, ***Pontocyprella rara***, ***Paleocosta*** sp. ***A***, Genus ***A*** sp. ***a*** and Genus ***C*** sp. ***a***. At sample 10200 ft., six species were found, ***Trachyleberis tarabulusensis***, ***Krithe aljurfae***, ***Semicytherura aljurfae***, ***Pontocyprella rara***, ***Paleocosta*** sp. ***A*** and ***Bairdia ilaroensis***. At sample depth 10220 ft, three species were recorded, ***Occultocythereis*** sp. ***A***, ***Krithe aljurfae*** and ***Paleocosta*** sp. ***A***.

At sample 10270 ft., the following species make its first appearance, ***Munseyella*** sp. ***A***. Also in this sample, ***Semicytherura aljurfae***, ***Semicytherura tarabulusensis***, ***Krithe aljurfae*** and ***Trachyleberis tarabulusensis*** were found. At sample depth 10300 ft., ***Krithe aljurfae*** and ***Semicytherura tarabulusensis*** were found. At sample depth 10310 ft and 10320 ft., ***Krithe aljurfae***, ***Semicytherura aljurfae*** and ***Trachyleberis tarabulusensis*** were found. No ostracod species were recorded from sample depths 10330 ft. and 10365 ft.

The Maastrichtian age of this formation is proposed on the basis of the planktonic foramininferid ***Globotruncata stuarti*** Zone which was recognised in this

formation by the palaeontologists of the Agip Oil Company. Other Foraminifera species were ***Globotruncana rugosa*** and ***Globotruncana gansseri***. Furthermore, also in Well N1-NC41, the formation is equivalent lithological and stratigraphically to the Al Haria A Formation in Tunisia which is also regarded as Maastrichtian in age.

6.4.3 WELL J1-NC41:

The ranges of the ostracod species from the Tellil Group Equivalent, Al Jurf and Bu Isa Formations in Well J1-NC41 are shown in Fig. 9. On information from the Libyan National Oil Corporation the interval from 4548 to 5114 ft., was assigned as Eocene in age.

Nine samples were obtained from the upper part of the group. At sample depth 4540 ft., no ostracod species were recorded. At sample depth 4565 ft., ***Buntonia tellilae*** was first recorded. The range of this species is unknown. At sample depth 4600 ft., the following species made their first appearance: ***Cytherella tellilae***, ***Cytheretta tellilae*** and ***Cytheretta*** n. sp. ***1*** Salahi. The ranges of the first two species are unknown. The last species was originally described from the Oligocene beds of the Sirte Basin. In this sample ***Buntonia tellilae*** was also found. At sample depth 4660 ft., ***Echinocythereis samdunae*** was first recorded and was found in the Middle and Upper Eocene in the Tellil Group in the studied area. ***Cytherella tellilae***, ***Cytheretta tellilae*** and ***Buntonia tellilae*** also were found in this sample.

At sample depth 4730 ft., ***Trachyleberis africana***, and ***Leguminocythereis tellilae*** were recorded; the range of these two species is Middle to Upper Eocene according to their occurrence in the other wells of the Tellil Group. In this sample, ***Bairdia buisa***e and ***Acanthocythereis tellilae*** were also recorded, the ranges of these species are unknown. The following ostracod species were also found in this sample: ***Cytheretta tellilae***, ***Buntonia tellilae*** and ***Cytherella tellilae***.

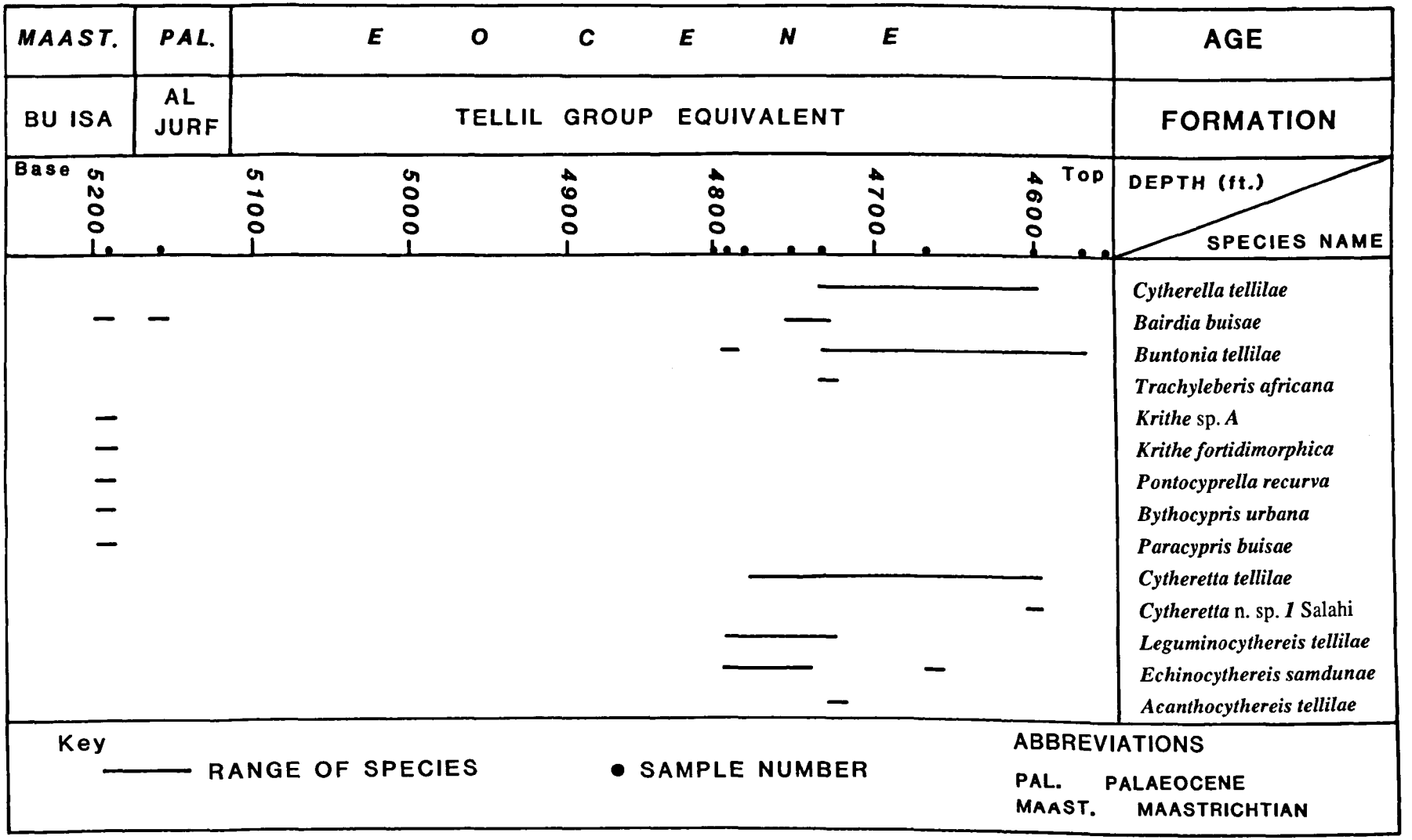


FIG. 6.9 RANGES OF OSTRACOD SPECIES OF THE BU ISA, AL JURF FORMATIONS AND TELLIL GROUP EQUIVALENT IN WELL J1-NC41, NW OFFSHORE LIBYA.

At sample depth 4750 ft., the following species were reported: ***Echinocythereis samdunae***, ***Leguminocythereis tellilae***, ***Bairdia buisae*** and ***Cytheretta tellilae***. At sample depth 4780 ft, ***Cytherella tellilae***, ***Echinocythereis samdunae*** and ***Leguminocythereis tellilae*** were found. At sample depth 4790 ft, three species were recorded, ***Buntonia tellilae***, ***Echinocythereis samdunae*** and ***Leguminocythereis tellilae***. No ostracod species were found at sample depth 4800 ft.

Only one sample was obtained from the Al Jurf Formation (sample depth 5160 ft.) which contained only ***Bairdia buisae***. It was not possible to determine the age of this formation by the ostracod. The lithology composition and the stratigraphical position is equivalent to the Al Haria B Formation in Tunisia which is Palaeocene in age. However, Eliagoubi (1986) studied the sediments of the Al Jurf Formation in this well and assigned it to the Palaeocene on the basis of the planktonic Foraminifera ***Morozovella trinidadensis*** and ***Morozovella uncinata***.

One sample at depth 5190 ft., was available in this study from the Bu Isa Formation and the following species were recorded: ***Krithe fortidimorphica***, ***Krithe*** sp. ***a***, ***Bythocypris urbana***, ***Pontocyprella recurva***, ***Paracypris buisae***. The range of ***Pontocyprella recurva*** is Maastrichtian to Palaeocene, but this species is more commonly associated with the Maastrichtian. On the basis of this species this sample is assigned to the Maastrichtian.

Eliagoubi (1986) also studied the upper part of this formation and regarded its age as Maastrichtian on the basis of the planktonic Foraminifera which indicate the presence of the ***Globotruncana fornicata*** Zone and the lower part of the ***Globortuncana gansseri*** subzone.

6.4.4 WELL L1-NC41:

Fig. 6.10 shows the ranges of the ostracod species found in the Harsha Formation of the Tellil Group in Well L1-NC41.

The following ostracod species recorded in this formation which have been found in the other sections of the present study include: ***Asymmetricythere fossorum***, ***Acanthocythereis salahi***, ***Xestoleberis tarabulusensis***, ***Echinocythereis samdunae***, ***Hermanites libyaensis***, ***Dahomeya mediterranea***, ***Pterygocythereis tarabulusensis***, ***Paracypris paramaghaghensis***, ***Echinocythereis harshae***, ***Cytherella tarabulusensis***, ***Cytherella ghalilae***, ***Bairdia abundans*** and ***Pontocyprella eocaenica.*** These species range from the Middle to the Upper Eocene.

Dahomeya alata Apostolescu, 1961 was also found in this section. The range of this species is Palaeocene to Eocene.

Other ostracod species recorded in this formation which were found in the other sections of the present study also occur in this section: ***Acanthocythereis tarabulusensis***, ***Cytheropteron tarabulusensis***, ***Leguminocythereis libyaensis***, ***Paracypris tarabulusensis***, ***Echinocythereis libyaensis***, ***Mehesella africana***, ***Soudanella libyaensis***, ***Argilloecia ghalilae***, ***Paracypris eskeri***, ***Costa libyaensis*** and Genus ***B*** sp. ***a***. The range of these species are confined to the Middle Eocene.

The above mentioned ostracod species indicative a Middle Eocene age for this section.

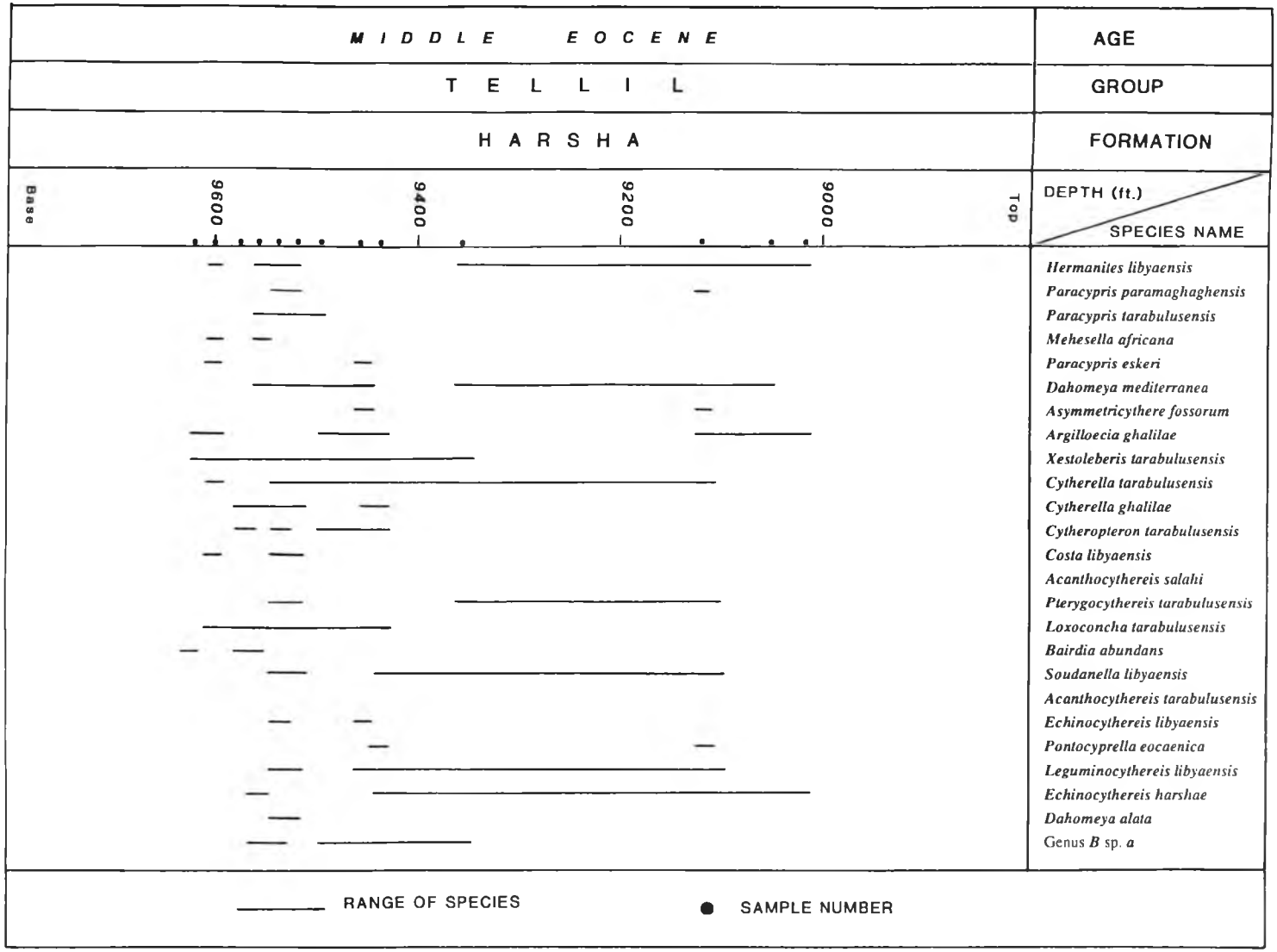


FIG. 6.10 RANGES OF OSTRACOD SPECIES OF THE HARSHA FORMATION IN WELL L1-NC41, NW OFFSHORE LIBYA.

CHAPTER 7

FAUNAL RELATIONSHIPS

As far as the author is aware there is a lack of specific published previous work on NW offshore Libya. A comparison on a broader scale is, however, interesting and so in this chapter, NW offshore Libya Ostracoda are compared with those of other areas largely in northern and western Africa. For convenience, this comparison is essentially with Upper Cretaceous (Maastrichtian), Palaeocene and Eocene Ostracoda from adjacent areas.

7.1 UPPER CRETACEOUS (MAASTRICHTIAN):

The only study of the Maastrichtian in Libya was carried out in the Sirte Basin by Salahi (1966) who recorded two species, ***Buntonia*** **(*P.*)** cf. **(*P.*)** ***numidica*** (Grekoff, 1954) and ***Leguminocythereis exigue*** (Apostolescu, 1961). Neither were found in the present study. More recent work by Salaj & Nairn (1987) concerned the Lower Tar Memeber of the Zimam Formation of the Al Hamada Al Hamra Basin. The following genera were found in the Maastrichtian of NW offshore Libya: ***Cytherelloidea, Bairdia, Brachycythere, Schizocythere, Cristaeleberis.***

For the distribution of ostracods species occurring in Libya and West Africa see Table 7.1.

Comparison is made by geographical location.

7.1.1 Tunisia

Ostracoda from the Maastrichtian sediments in the Kef section, northwestern Tunisia were studied by Donze ***et al.***,(1982). Thirty species were reported. Of these

Table (1): Distribution chart for ostracods occurring in Libya and West Africa during the Upper Cretaceous (Maastrichtian).

Species name	Nigeria	Senegal	Libya	Ghana	Algeria	Tunisia	Dahomey & Togo
Brachycythere armata Reyment	*	*	*				*
Brachycythere oguni Reyment	*	*	*	*	*	*	
Cytherella kunradensis Van Veen	*		*				
Cytherella posteropunctata Reyment	*		*				
Bairdia decumana Van Veen	*		*				
Cytherelloidea cytherelloides Reyment	*		*				
C. araromiensis Reyment	*		*				
Ovocytheridea apiformis Reyment	*		*	*			*
Veenia grekoffi Reyment	*		*				
Veenia warriensis Reyment	*		*	*			
Veenia? ughelli Reyment	*		*	*			
Veenia? occidentalis Reyment	*		*				
Schizocythere treibeli Reyment	*		*				
Mehesella paleobiafrensis Reyment	*		*	*			
Cythereis deltaensis Reyment	*		*	*			

* present

Cytherelloidea melleguensis Damotte & Said, 1982 (in Donze *et al.*, 1982) was similar to Libyan species. Two other species also occur in NW offshore Libya, namely *Pontocyprella recurva* Esker, 1968 and *Cytheropteron lekefense* Esker, 1968. Other taxa from Tunisia also show considerable similarities to the Libyan species. *Paleocosta* sp. *A* from the study area strongly resembles *Paleocosta* aff. *P. mokattamensis* (Bassiouni, 1969b) as recorded by Donze *et al.*, (1982) from the Palaeocene beds of the Kef section. Also *Trachyleberis tarbulusensis* sp. nov. shows some similarities to the newly described genus *Megonatocythere* Colin & Oertli, 1982 (in Donze *et al.*, 1982) and the Libyan species also resembles *Trachyleberidea tunisiensis* Colin & Said, 1982 (in Donze *et al.*, 1982). Furthermore, the following genera recorded from the Maastrichtian of Tunisia were also found in this study: *Cytherelloidea, Bairdia, Paracypris, Cytheropteron, Schizocythere, Bythocypris* and *Cristaeleberis.*

Salaj & Nairn (1987) found three species which also occur in the Tunisian area; *Cristaeleberis thomasi* Donze & Said, 1982 (in Donze *et al.*, 1982), *Acanthocythereis meslei* Donze & Oertli, 1982 (in Donze *et al.*, 1982) and *Acanthocythereis reticulata* Esker, 1968. They also recorded the following genera which occur in the Lower Tar Member of the Zimam Formation in the Al Hamada Al Hamra Basin: *Cytherella, Bairdia, Acanthocythere, Cytherelloidea* and *Schizocythere* A further faunal relationship with West Africa (including Nigeria) is indicated by the presence of *Brachycythere oguni* Reyment, 1960 as recorded by Ben Abdessalem (1978) which shows some similarities to the NW offshore Libyan taxa.

7.1.2 Algeria

Grekoff (1969) studied the Cretaceous-Lower Tertiary ostracod fauna from Algeria, figuring a few species from the Maastrichtian interval such as *Brachycythere oguni* Reyment, 1960, *Cytherella* sp. and *Soudanella laciniosa triangulata* Apostolescu, 1961. The latter species is not known to occur below the Tertiary in Libya. However, *Brachycythere oguni* Reyment, 1960 was originally described from

the Maastrichtian and Palaeocene of Nigeria, and also occurs in Al Hamada Al Hamra Basin of Libya, Tunisia, Senegal and Ghana.

7.1.3 Egypt

Van den Bold (1964) described some Cretaceous Ostracoda from the Abu-Rawash area west of Cairo. The following genera were also found in this study: ***Bairdia***, ***Paracypris***, ***Hermanites*** and ***Brachycythere***. However, ***Cytherella***, ***Darwinula***, ***Eucythere***, ***Ovocytheridea***, ***Fabanella***, ***Hutsonia***, ***Neocythere***, ***Protobuntonia***, ***Cythereis***, ***Anticythereis***, ***Metacytheropteron*** and ***Xestoleberis*** were not found in the present study.

Comparison with the Maastrichtian ostracod fauna from Jordan described by Bassiouni (1970) shows that there is no direct link at a specific level between NW offshore Libyan and the Jordan species. Several specimens of ***Cristaeleberis*** from Libya may have some affinities with species of the same genus as described by Bassiouni (1970). There are no other genera common to both areas. Maastrichtian species from these two areas still await study and may well correspond to those from Libya.

7.1.4 Nigeria

Two publications by Reyment (1960) and (1963) describe a Late Cretaceous Ostracoda fauna. No species were found in common with the NW offshore Libya, except ***Bairdia ilaroensis*** Reyment & Reyment, 1959 which occurs commonly in the study area but which is absent from the Maastrichtian of Nigeria. ***Brachycythere tarabulusensis*** sp. nov. of the present study shows some similarities to ***B. oguni*** Reyment, 1960. In addition ***Paleocosta*** sp. ***A*** of the present study may have some affinities with ***Veenia warriensis*** Reyment, 1960. The genera common to both NW offshore Libya and Nigeria include ***Brachycythere***, ***Cytherelloidea***, ***Paracypris***, ***Bairdia***, ***Schizocythere*** and ***Bythocypris***. A large proportion of the Nigerian fauna differs at generic level. ***Cytherella***, ***Mehesella*** , ***Cythereis*** and ***Veenia*** occur in

Nigeria whilst ***Pontocyprella***, ***Munseyella***, ***Krithe***, ***Trachyleberis***, ***Hermanites***, ***Quadracythere***, ***Occultocythereis***, ***Cristaeleberis***, ***Cytheropteron***, ***Semicytherura*** and the two unnamed genera Genus ***A*** sp. ***a***, and Genus ***C*** sp. ***a*** occur in the present study. The similar genera confirm that there was no isolation of the NW offshore area at the generic level. Moreover, there is almost no correspondence at the specific level.

On the other hand, one of the most striking findings has been that several species recorded by Salaj & Nairn (1987) from the Maastrichtian sediments of the Al Hamada Al Hamra Basin also occur in Nigeria (Reyment, 1960) such as ***Brachycythere armata*** Reyment, 1960, ***B. contracta*** Reyment, 1960, ***B. oguni*** Reyment, 1960, ***Cytherella kunradensis*** Van Veen, 1932, ***Cytherella posteropunctata*** Reyment, 1960, ***Ovocytheridea apformis*** Reyment, 1960, ***Veenis? ughelli*** Reyment, 1960, ***V. warriensis*** Reyment, 1960, ***V. grekoffi*** Reyment, 1960, ***V.? occidentalis*** Reyment, 1960, ***Bairdia decumana*** Van Veen, 1934, ***Cytherelloidea cytherelloides*** Reyment, 1960, ***C. araromiensis*** Reyment, 1960, ***Schizocythere triebeli*** Reyment, 1960, ***Cythereis deltaensis*** Reyment, 1960 and ***Cytherura pagana*** Reyment, 1960.

7.1.5 West Africa

A number of authors have studied Late Cretaceous sediments in West Africa. Papers of principal importance used in this study are those covering the Ivory Coast, Senegal, Dahomeya and Togo by Apostolescu (1961) and Senegal by Apostolescu (1963). There are apparently few similarities between the faunas of NW offshore Libya and West Africa at the specific level. However Genus ***C*** sp. ***a*** of the present study shows some strong affinities with ***Cophinia*** Apostolescu, 1961. Several genera are common to both areas: ***Bairdia***, ***Brachycythere***, ***Schizocythere***, and ***Cytheropteron***, whilst ***Mehesella***, ***Leguminocythereis***, ***Buntonia***, ***Soudanella*** (not found in this study until Palaeogene times) ***Cytherura***, ***Veenia***, ***Nannocythere***, ***Anticythereis***, ***Dactylia*** and ***Clithrocytheridea*** were not found from NW offshore Libya.

On the other hand the ostracod fauna recorded from onshore sediments in the Al Hamada Al Hamra Basin shows strong links with West African Ostracoda faunas. Salaj & Nairn (1987) found many typical West African species in the Al Hamada Al Hamra Basin (see table 1 for ostracods occurring both in the Libya and West Africa Basins). This fauna could have been spread northwards by the Trans-Saharan epicontinental route (fig. 7.1).

7.1.6 Saudi Arabia:

Al Furaih (1980, 1984, 1985) described Maastrichtian ostracod species from Saudi Arabia. Species of the genera ***Brachycythere***, ***Occultocythereis*** and ***Hermanites*** recorded by Al Furaih show some similarity to species described from the Tarabulus Basin, NW offshore Libya.

From the above discussion, comparison at specific level is not possible because most of the species under investigation are new. As regards generic composition, the ostracod fauna is close to those from North and West Africa and the fauna suggests a lesser link with Saudi Arabia. However, the presence of sixteen ostracod species in the Al Hamada Al Hamra Basin (Salaj & Nairn, 1987) originally described from Nigeria, suggests a much greater connection with West Africa (including Nigeria) at a specific level and there might have been some kind of ecological barrier which has prevented the spread of this fauna into NW offshore Libya.

7.2 PALAEOCENE:

The following Palaeocene species were found to be common to the Tarabulus Basin, NW offshore Libya and other areas.

Dahomeya alata Apostolescu, 1961 (Tunisia, Sirte Basin, Libya, West Africa)

Cytheropteron lekefense Esker, 1968 (Tunisia)

Paleocosta bensoni Damotte & Donze, 1982 (Tunisia)

Buntonia beninensis Reyment, 1960 (Nigeria)

Bairdia ilaroensis Reyment & Reyment, 1959 (Nigeria)

Leguminocythereis lagaghiroboensis Apostolescu, 1961 (Sirte Basin, Libya and West Africa)

Leguminocythereis lokossaensis Apostolescu, 1961 (Sirte Basin, Libya and West Africa)

However, there are also a number of genera, but not species, that are common between the study area and North and West Africa.

For the distribution of the ostracods occurring in Libya and other parts of Africa see Table 7.2.

7.2.1 Tunisia

Esker (1968), Said (1978) and Donze *et al.*, (1982) described a diverse Palaeocene ostracod fauna from Tunisia. *Dahomeya alata* Apostolescu, 1961, *Pontocyprella recurva* Esker, 1968 and *Paleocosta bensoni* Damotte & Donze, 1982 (in Donze *et al.*, 1982) occur in the Tarabulus Basin of NW offshore Libya. Species of *Paleocosta* from the present study area show some similarities with specimens figured by Donze *et al.*, (op. cit.) as *Paleocosta* aff. *P. mokattamensis* (Bassiouni, 1969b) and the Libyan species also shows affinities to *Costa? warriensis* (Reyment, 1960). In addition, *Reticulina elegans* sp. nov. found in this study resembles superficially some *Reticulina* species recorded in Tunisia by Donze *et al.*, (1982). *Buntonia beninensis* Reyment, 1960 from the Tarabulus Basin corresponds to the form reported as *Buntonia* sp. *3* by Donze *et al.*, (1982). Several genera recorded from Tunisia are similar to the Libyan genera, some of which were also reported from West Africa. These include *Cytherelloidea, Bairdia, Buntonia, Leguminocythereis,* also some species of *Bradleya* placed by Donze *et al.*, (op. cit.) as *Martinicythere, Dahomeya, Loxoconcha* and *Xestoleberis.*

Tunisian ostracod faunas show great similarities at specific level to West Africa (including Nigeria) faunas.

Table (2): Distribution chart for ostracods occurring in Libya and West Africa during the Palaeocene.

Species name	Libya	Nigeria	Tunisia	Senegal	Togo	Ivory Coast	Mali	Niger	Ghana
Cytherella sylvesterbradleyi Reyment	*	*		*					
Bairdia ilaroensis[1] Reyment &Reyment	*	*							
Leguminocythereis lokossaensis[1] Apostolescu	*	*		*	*	*			
L. lagaghiroboensis[1] Apostolescu	*	*				*			*
Dahomeya alata[1] Apostolescu	*	*	*	*	*	*			
Paracypris nigeriensis Reymnet	*	*							
Hornibrookella lagaghiroboensis (Apostolescu)	*	*		*		*	*	*	
Iorubaella ologuni Reyment	*	*							
Anticythereis bopaensis Apostolescu	*	*	*	*					
Protobuntonia punctata Reyment	*	*							
P. ioruba Reyment	*	*					*		
Bradleya praecrassa Apostolescu	*	*					*		
Ambocythere tatteuliensis Apostolescu	*	*					*		
Buntonia beninensis[1] Reyment	*	*							
B. cf. ***B. tichittensis*** Apostolescu	*	*			*				
Soudanella laciniosa Apostolescu	*	*	*	*		*	*		
Veenia warriensis Reyment	*	*						*	
Cythereis teiskotensis (Apostolescu)	*	*					*		
Buntonia pulvinata Apostolescu	*	*			*				
Acanthocythereis teiskotensis (Apostolescu)	*	*				*	*	*	

* present

1 = indicates that the species found in the present study.

Several species were found to be common to both areas such as ***Veenia warriensis*** Reyment (1960) from the Maastrichtian and Palaeocene of Nigeria. This species was also reported from Tunisia by Esker (1968) as ***Costa? warriensis*** and also was found in the Al Hamada Al Hamra Basin Libya by Salaji & Nairn (1987) and in Sirte Basin by Reyment (1966).

Leguminocythereis aff. ***L. exigue*** (Apostolescu, 1961) was recovered by Donze ***et al.***, (op. cit), and also occurs in the Sirte Basin (Salahi, 1966), and the Ivory Coast, Togo and Senegal (Apostolescu 1961). It was also reported to occur in the Sirte Basin by Barsotti (1963) as ***Anticythere bopaensis*** Apostolescu, 1961. In addition, ***Soudanella laciniosa laciniosa*** Apostolescu, 1961 which also occurs in different parts of Africa, was found in Libya by Barsotti (1963) and in West Africa (excluding Nigeria) by Apostolescu (1961), Dipo ***et al.***, (1982) and Carbonnel (1986). ***Dahomeya alata*** Apostolescu, 1961 is a typical West African species and was also found in Tunisia by Donze ***et al.***, (1982). The following genera are common to Tunisia and West Africa: ***Ovocytheridea, Buntonia, Bradleya, Veenia, Dahomeya, Pontocyprella, Bairdia, Leguminocythereis, Loxoconcha, Protobasslerites, Protobuntonia*** and ***Xestoleberis.***

It is clear there are faunal similarities between North Africa and West Africa.

7.2.2 Nigeria

A large Nigerian Palaeocene ostracod fauna has been described by Reyment (1960, 1966, 1981) and in more recent work by Foster ***et al.***, (1983). At specific level, there are several common species between Nigeria and the present study: ***Bairdia ilaroensis*** Reyment & Reyment, 1959, ***Leguminocythereis lagaghiroboensis*** Apostolescu, 1961 and ***Buntonia beninensis*** Reyment, 1960. In addition ***Bairdia*** sp. ***A*** of this study is similar to ***B. ilaroensis*** Reyment & Reyment, 1959 and ***Dahomeya*** sp. ***A*** also found in the present study has similarities to ***Dahomeya alata*** Apostolescu, 1961. The genera common between NW offshore Libya and Nigeria are ***Cytherella,***

Buntonia, Dahomeya, Leguminocythereis and ***Loxoconcha.*** The presence of this faunal comparison between NW offshore Libya and Nigeria suggests a much greater link than has been indicated previously during Maastrichtian time.

On the Libyan mainland more work was carried out by Barsotti (1963), Reyment (1966), Reyment & Reyment (1980), and Salahi (1966). They found many species common between the Sirte Basin and Nigeria such as ***Dahomeya alata*** Apostolescu, 1961, ***Leguminocythereis bopaensis*** (Apostolescu, 1961), ***Buntonia pulvinata*** Apostolescu, 1961, ***Quadracythere lagaghiroboensis*** (Apostolescu, 1961), ***Trachyleberis teiskotensis*** (Apostolescu, 1961), ***Cythereis teiskotensis*** (Apostolescu, 1961), ***Paracypris nigeriensis*** Reyment, 1960, ***Veenia warriensis*** Reyment, 1960, ***Xestoleberis kekere*** Reyment, 1963, ***Iorubaella ologuni*** Reyment, 1963 and ***Protobuntonia ioruba*** Reyment, 1960. Also several species have been reported in common between Nigeria and other West African basins.

7.2.3 West Africa

Several authors have studied the Palaeogene ostracod fauna. Ostracods have been described by Apostolescu (1961) from Senegal, the Ivory Coast, Dahomey, Togo and Mali. Diop ***et al.***, (1982) studied the Palaeocene ostracods from Senegal and more recent work was carried out by Carbonnel (1986) on material from Senegal and Guinea Bissau. Only a few species were found in common between NW offshore Libya, the Sirte Basin and West Africa including ***Leguminocythereis lokossaensis*** Apostolescu, 1961. This species has been described from Togo by Apostolescu (1961) and it was also found in the Ivory Coast and Senegal by Carbonnel (1986). ***Leguminocythereis lagaghiroboensis*** Apostolescu, 1961 was recorded from the Ivory Coast and Iullemeden Basin and this species was also found in the Sirte Basin by Barsotti (1963). The following distinctive genera were found to be common between West Africa and NW offshore Libya: ***Buntonia, Dahomeya, Leguminocythereis.***

Barsotti (1963) working in Libya was the first to publish accounts of the great number of species common to both the Sirte Basin and West Africa including

Buntonia virgulata Apostolescu, 1961, *Bradleya cultrata* Apostolescu, 1961, *Isohabrocythere teiskotensis* Apostolescu, 1961, *Soudanella laciniosa triangulata* Apostolescu, 1961, *Dahomeya alata* Apostolescu, 1961, *Leguminocythereis teiskotensis* Apostolescu, 1961 and others. Carbonnel (1986) recorded many species from Senegal and Guinea Bissau which showed some similarities to the NW offshore Libyan fauna. He also found *Buntonia* sp. *1* Salahi, 1966 which occurs in the Sirte Basin. Diop *et al.*, (1982) reported *Cytherella sylvesterbradleyi* Reyment, 1963 which occurs in both Nigeria and Libya (Reyment, 1980). This large number of similar species in common between West Africa and Libya, indicates a strong migratory connection between them.

7.2.4 Saudi Arabia

From the Palaeocene of Saudi Arabia, Al Furaih (1980) described a large Palaeocene ostracod fauna. At specific level, there is no comparison between NW offshore Libya and Saudi Arabia and the same is true at generic level where only one genus is seen in both areas.

7.2.5 Mauritania

Carbonnel (1988) studied the Palaeocene sediments from Mauritania. The genera *Loxoconcha* and *Buntonia* recorded by Carbonnel are also found in NW offshore Libya. On the other hand he found *Anticythere* aff. *A. bopaensis* Apostolescu, 1961 which also occurs in the Sirte Basin Barsotti (1963). These genera are also recorded from the Palaeocene of West Africa.

7.2.6 Jordan

Bassiouni (1970) recorded a few ostracod genera from the Palaeocene of Jordan. Of the genera described, *Paleocosta*, *Cristaeleberis* and *Reticulina* are common to both Jordan and Libya.

7.3 EOCENE:

The following species found in the Tarabulus Basin NW offshore Libya, are common to Libya and other areas, others are tentatively referred to species from other areas.

Acanthocythere salahi Bassiouni, 1969b (Tunisia, Egypt)

Dahomeya alata Apostolescu, 1961 (West Africa, Tunisia)

Isobuntonia pseudotuberata (Apostolescu & Magné), 1956 (Algeria, Tunisia)

Uromuellerina saidi Bassiouni, 1969c (Egypt, NE Libya.)

Cytherella sp. *1* Mechmeche, 1981 = *Cytherella tellilae* sp. nov. (Tunisia)

Martinicythere samalutensis samalutensis Bassiouni, 1969c (Egypt)

Bairdia sp. Mechmeche, 1981 = *Bairdia abundans* sp. nov. (Tunisia and Egypt)

Heptaloculites tunetana (Oertli), 1978 (Tunisia)

H. aff. *H. gortanii* (Ruggieri), 1963 (Tunisia and Senegal & Guinea Bissau)

H. minuta (Oertli), 1978 (Tunisia & Mauritania)

H. semirugosa (Apostolescu & Magné), 1956 (Tunisia and Algeria)

H. prima (Oertli), 1978 (Tunisia)

H. cavernosa (Apostolescu & Magné), 1956 (Tunisia and Algeria)

H. semipunctata (Apostolescu & Magné), 1956 (Tunisia and Algeria)

H. quinqueloculita (Bismuth), 1978 (Tunisia)

H. aff. *H. prima* (Oertli) 1978 = *H. harshae* sp. nov. (Tunisia)

H. sp. Mechmeche, 1981 = *H. eocaenica* sp. nov. (Tunisia)

Paracypris sp. *B* Esker, 1968 = *Paracypris eskeri* sp. nov. (Tunisia)

Schizocythere n. sp. *1* Salahi, 1966 = *Schizocythere salahii* sp. nov. (Sirte Basin, Libya).

In addition, certain genera are found to be common to the study area and other areas including *Paleocosta, Asymmetricythere, Soudanella, Protobuntonia,*

Table (3): Distribution chart for ostracods occurring in Libya and other parts of Africa during the Eocene.

Species name	Libya	Tunisia	Egypt	Algeria	Ivory Coast	Senegal	Muritania
Acanthocythereis salahi Bassiouni	*	*	*				
Isobuntonia pseudotuberata (Apostolescu & Magné)	*	*		*			
Uromuellerina saidi[1] Bassiouni	*		*				
Martinicythere samalutensis Bassiouni	*		*				
Dahomeya alata Apostolescu	*					*	
Bairdia abundans sp. nov.	*	*	*				
Cytherella tellilae sp. nov.	*	*					
Heptaloculites tunetana (Oertli)	*	*			*		
H. aff. ***H. gortanii*** (Ruggieri)	*	*				*	
H. minuta (Oertli)	*	*					*
H. semirugosa (Apostolescu & Magné)	*	*		*			
H. prima (Bismuth & Oertli)	*	*					
H. cavernosa (Apostolescu & Magné)	*	*		*			
H. semipunctata (Apostolescu & Magné)	*	*		*			
H. quinqueloculita (Bismuth)	*	*					
H. harshae sp. nov.	*	*					
H. eocaenica sp. nov.	*	*					

* present

1 = indicates that the species also recorded by Helmdach & El Khoudray (1980) from NE Libya.

Buntonia and many more cosmopolitan genera. For the distribution of the ostracods occurring in Libya and other parts of Africa see Table 7.3.

7.3.1 Tunisia

A number of authors have studied the Eocene ostracod fauna in Tunisia. Important papers used in this study are those of Donze *et al.*, (1982), Bismuth *et al.*, (1978) and Mechmeche (1978). Bismuth *et al.*, (1978) studied *Heptaloculites* from the Middle and Upper Eocene of Tunisia, and recorded ten species, such as *H. tunetana* (Oertli, 1978) in Bismuth *et al.*, (1978), *H.* aff. *H. gortanii* (Ruggieri, 1963), *H. minuta* (Oertli, 1978) in Bismuth *et al.*, (1978), *H. semirugosa* (Apostolescu & Magné, 1956), *H. prima* (Bismuth & Oertli, 1978) in Bismuth *et al.*, (1978), *H. cavernosa* (Apostolescu & Magné, 1956), *H. semipunctata* (Apostolescu & Magné, 1956), *H. quinqueloculita* (Bismuth, 1978) in Bismuth *et al.* (1978) and *H.* aff. *H. prima* (Bismuth & Oertli, 1978) in Bismuth *et al.*, (1978). This latter species is designated in the present study as *H. harshae* sp. nov.. All of the above mentioned species also occur in the Tarabulus Basin NW offshore Libya. Mechmeche (1978) described the Eocene ostracod fauna which included *Acanthocythereis salahi* Bassiouni, 1969b and *Isobuntonia pseudotuberata* (Apostolescu & Magné, 1956). All these were found in the present study. Also illustrated was *Cytherella* sp. *1* from the Middle Eocene, a species here designated as *Cytherella tellilae* sp. nov. She also recorded most of the *Heptaloculites* species except *H. quinqueloculita* (Bismuth) in Bismuth *et al.*, (1978) and *H. prima* (Oertli, 1978) in Bismuth *et al.*, (1978) which also occur in the present study. *H. eocaenica* sp. nov. is identical to a species reported by her as *Heptaloculites* sp. *1*. *Bairdia abundans* sp. nov. was also recorded in Tunisia by Mechmeche (1981) as *Bairdia* sp. Furthermore, *Loxoconcha* sp. *2* shows some similarities to *Loxoconcha tarabulusensis* sp. nov.

At generic level many genera were found to be common to both areas, including *Buntonia*, *Asymmetricythere*, *Martinicythere*, *Cytheropteron*, *Leguminocythereis*, *Soudanella*, *Paleocosta* and *Xestoleberis*.

7.3.2 Algeria

Apostolescu & Magne (1956) recorded many new ostracod species from Algeria. At specific level there are many species in common between the study area and Algeria: ***Heptaloculites cavernosa*** (Apostolescu & Magné, 1956), ***H. semirugosa*** (Apostolescu & Magne, 1956), ***H. semipunctata*** (Apostolescu & Magné, 1956) and ***Isobuntonia pseudotuberata*** (Apostolescu & Magné, 1956). In addition, ***Loxoconcha goundensis*** Apostolescu & Magne, 1956 from the Middle Eocene of Algeria is very similar to ***Loxoconcha tarabulusensis*** sp. nov. and ***Echinocythereis libyaensis*** sp. nov. resembles ***Leguminocythereis numidica*** Apostolescu & Magné, 1956. Grekoff (1969) recorded a few ostracod species from the Lower Eocene which were not found in the Tarabulus Basin of NW offshore Libya.

7.3.3 Egypt

A large Egyptian Eocene ostracod fauna was described by Bassiouni (1969a,b,c,d and 1971), Khalifa & Cronin (1979) and by Cronin & Khalifa (1979). Five species found in Egypt, namely ***Acanthocythereis salahi*** Bassiouni, 1969b, ***Uromuellerina saidi*** Bassiouni, 1969c, ***Loxoconcha mataiensis*** Khalifa & Cronin, 1979, ***Martinicythere samalutensis samalutensis*** Bassiouni, 1969c and ***Bairdia*** sp. Cronin & Khalifa, 1979 also occur in the present study.

Other species from Egypt also show considerable similarities to the Libyan species. ***Cytherella ghalilae*** sp. nov. of this study shows obvious resemblances to ***Cytherella*** sp. *1*. ***Bythocypris? mereinensis*** Cronin & Khalifa, 1979 described from the Middle Eocene also shows similarities to ***Pontocyprella eocaenica*** sp. nov. Furthermore, ***Acanthocythereis tarabulusensis*** sp. nov. is very similar to ***Acanthocythereis salahi*** Bassiouni, 1969b. Other species from the Eocene of Egypt are similar to the Libyan fauna, and some of these such as ***Acanthocythereis projecta*** Bassiouni, 1969b were previously recorded from Tunisia. ***Reticulina heluanesis*** Bassiouni, 1969b appears to be more related to ***Costa*** than ***Reticulina***, and is similar

to ***Costa libyaensis*** sp. nov. ***Digmocythere omarai*** Cronin & Khalifa, 1979 may belong to ***Dahomeya*** Apostolescu, 1961 rather than ***Digmocythere*** on the basis of the external characters and shows some similarities to ***Dahomeya mediterranea*** sp. nov. of the present study. ***Buntonia fares*** Bassiouni, 1971, ***B. awadi*** and ***B. ramosa*** were all described by Bassiouni, 1969d. ***Protobuntonia nakkadi*** Bassiouni, 1970 ***Leguminocythereis sadeki*** Bassiouni, 1969c, ***Loxoconcha pseudopunctata*** Cronin & Khalifa, 1979 and ***Cytheropteron boukaryi*** Khalifa & Cronin, 1979 show similarities to the Libyan species. Furthermore, the following genera recorded from the Eocene of Egypt were also found in this study: ***Asymmetricythere***, ***Pterygocythereis***, ***Pokornyella***, ***Hermanites***, ***Paleocosta*** and ***Trachyleberis***.

7.3.4 Mauritania

Carbonnel (1988) described Palaeogene and Neogene ostracod species from Mauritania. Altogether eleven species were reported from the Eocene interval. Only one species was common between NW offshore Libya and Mauritania, namely, ***Heptaloculites minuta*** (Oertli, 1978) in Bismuth ***et al.***, (1978). ***Loxoconcha*** sp. ***A*** of the present study shows some similarities to ***Loxoconcha lagosensis*** Reyment, 1963 recorded by Carbonnel from the same area. At generic level, the following genera recorded from the Eocene of Mauritania are also found in the present study: ***Asymmetricythere***, ***Cytherella***, ***Hermanites***, ***Paleocosta*** and ***Isobuntonia***.

7.3.5 Senegal & Guinea Bissau

Extensive work was carried out by Carbonnel (1986) on the Palaeogene ostracod fauna from Senegal and Guinea Bissau. At specific level, there are only two species recorded that occur in both areas, namely ***Heptaloculites*** aff. ***gortanii*** (Ruggieri, 1963) and ***Dahomeya alata*** Apostolescu, 1961. In addition, a new species of ***Asymmetricythere*** found here shows some similarities to ***Asymmetricythere*** sp. Carbonnel, 1986 from Senegal and Guinea Bissau. Several genera recorded by Carbonnel are similar to the Libyan genera, of which some were also reported from

North and West Africa, such as ***Soudanella***, ***Buntonia***, ***Protobuntonia***, ***Leguminocythereis***, ***Paleocosta***, ***Loxoconcha***, ***Isobuntonia***, ***Bairdia***, ***Propontocypris*** and ***Trachyleberis***. A number of species were found to be common to Senegal, Guinea Bissau, Tunisia and Egypt including ***Reticulina sangalkamensis*** (Apostolescu, 1961) and ***Reticulina scitula proteros*** Bassiouni, 1969a. Apostolescu (1961) recorded several species from Senegal which were not found in this study. However, at a generic level there were many genera which also occurred in the NW offshore Libyan Basin.

7.3.6 West Africa

Reyment (1963) was the first one to describe Eocene Ostracoda from Nigeria. At a specific level, there are no species in common between Nigeria and NW offshore Libya. Only two genera recorded by him occur in the present study, ***Buntonia*** and ***Loxoconcha***. Working in Togo and Dahomeya, Apostolescu (1961) and Kogbe & Mehes (1986) studied the Eocene ostracods. Only one species occurs in both the study area and Togo and Dahomeya, ***Dahomeya alata*** Apostolescu, 1961. Genera common in the Eocene of both areas are, ***Costa***, ***Trachyleberis***, ***Cytherella***, ***Buntonia***, ***Isobuntonia*** and ***Leguminocythereis***. Kogbe & Mehes (1986) mentioned two genera that occur in Ghana which were also found in the present study. In the Ivory Coast, Apostolescu (1961) and Kogbe & Mehes (1986) also recorded ***Dahomeya alata*** Apostolescu, 1961 from the Lower Eocene. This species is found from in offshore Libya in the Palaeocene and Middle Eocene. They also reported ***Leguminocythereis lokossaensis*** Apostolescu, 1961 which also occurs in the Palaeocene sediments of NW offshore Libya.

7.3.7 Jordan

Bassiouni (1969d, 1970) studied the Eocene sediments from Jordan. The genera ***Buntonia***, ***Soudanella*** and ***Paleocosta*** recorded by Bassiouni are also found in NW offshore Libya.

7.3.8 Pakistan & India

Extensive work on the Tertiary (especially Eocene) ostracods of India has been published by Guha (1965, 1968,), Khosla (1972), Khosla & Pant (1981), Neale and Singh (1985) and from Pakistan, Sohn (1970) and Siddiqui (1971, 1981). The following genera recorded from the Eocene of India and Pakistan were also found in the present study: ***Buntonia***, ***Schizocythere***, ***Semicytherura***, ***Hermanites***, ***Acanthocythereis***, ***Loxoconcha***, ***Cytherella***, ***Bairdia***, ***Xestoleberis***, ***Krithe***, ***Leguminocythereis***, ***Paracypris***, ***Echinocythereis*** and ***Cytheropteron***. The majority of these taxa were found in the West and other parts of North Africa.

7.3.9 Saudi Arabia

Al Furaih (1980) recorded a few ostracod genera from the Eocene of Saudi Arabia. ***Flexus coarctata*** Al-Furaih, 1980 is similar to ***F. quadricosta*** sp. nov. and ***F. africana*** sp. nov. of the present study. There is one more genus in common between both areas, whilst ***Phacorhabdotus*** has not been found in the present study. Al-Furaih (1984) studied the Palaeocene and Lower Eocene ostracods from the Umm er Radhuma Formation of Saudi Arabia and recorded six genera. Only one genus was common to Saudi Arabia and NW offshore Libya.

7.3.10 Mediterranean

From the Eocene of Sicily, Ruggieri (1963) described the genus ***Heptaloculites*** which also occurs in the present study. Working also on the northern side of the Tethys Ducasse (1967), Deltel (1962), Swain (1984) and others recorded some genera similar to forms found in NW offshore Libya.

From these considerations it is clear that at the specific level, the Eocene ostracod fauna is more closely related to those from North Africa and some parts of West Africa. Generically, the ostracod fauna is closely similar to those of West

Africa, India, Pakistan and Jordan, but not so similar to Saudi Arabian and European faunas. However, the question of affinities at generic level must be approached with caution, because both collection failure and ecological factors may effect the picture considerably.

7.4 PALAEOGEOGRAPHICAL CONSIDERATIONS:

A major transgression of the sea occurred during the Upper Cretaceous when the Mediterranean Sea was linked with southern Nigeria through a zone extending between the Hogger and the Tibesti (Furon, 1934). He indicates that this same link was re-established at the beginning of the Eocene. This latter transgression corresponds to the large Palaeocene transgression in Libya as recorded by Haynes (1962). The Tethys Sea extended to its maximum distance from the North of Africa reaching the northern foot of the Tibesti. The Maastrichtian transgression in Nigeria was quite important and during its climax must have stretched northwestwards across the country to link with the south trending transgression of the Tethys (Reyment, 1965, Adegoke, 1969, Kogbe, 1972, 1979 and others). However, the dating of the Maastrichtian transgression in Nigeria has been based on correlating species of the ammonite genus ***Libycoceras*** which occurred in different basins. Kogbe (1980) discovered ***L. afikpoensis*** (Reyment) from northwestern Nigeria which occurred at the same time as another form, ***L. ismaeli*** (Zittel), recorded in the Maastrichtian sediments of Niger to which it appeared to have close affinities.

Kogbe's (1980) conclusions that the connection between the Tethys and the Gulf of Guinea could only have crossed the Sahara were based on the complete absence of the ammonite genus ***Libycoceras*** along the Atlantic coastline of West Africa (Senegal, Mauritania and Morocco). Also the presence of marine fossils in the Maastrichtian of the Niger Basin may suggest that the Maastrichtian transgression from the Gulf of Guinea linked up with that from the Tethys through the mid-Niger basin, Sokoto, Niger and Mali.

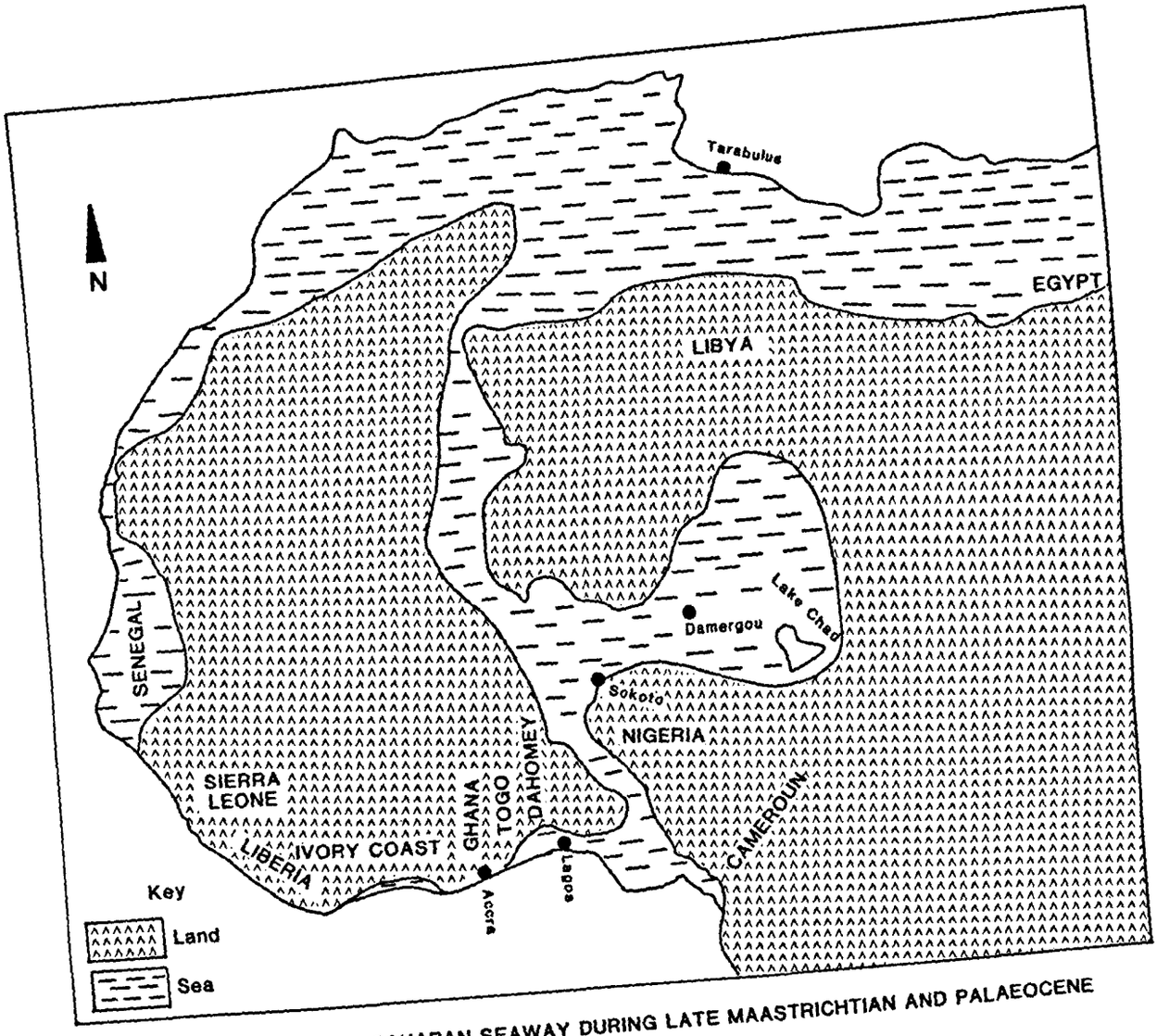


FIG. 7.1 TRANS-SAHARAN SEAWAY DURING LATE MAASTRICHTIAN AND PALAEOCENE
(AFTER KOGBE 1980)

Petters (1977, 1978) has argued that a connection did not exist between the Saharan Seaway and the Gulf of Guinea. His argument was based the distinctive foraminiferal assemblages occurring during the Maastrichtian and Palaeocene times. Kogbe (1980) countered that the presence of the ammonite ***Libycoceras*** is a more reliable biostratigraphical indicator. Differences in foraminifera tend to be indicative of, and controlled by, environmental variation. Reyment (1966), Reyment & Reyment (1980) based their conclusions on the similarities of ostracods, ammonites and molluscan fauna between North Africa and West Africa during the Upper Cretaceous and Palaeocene. Reyment (1982) described several species of ostracods from the Upper Cretaceous of Morocco and concluded that the link with West Africa was slight, with a notable absence of ***Ovocytheridea*** typical of the Nigerian, Cameroun and Gabon regions (Reyment 1966). This genus, however, does occur in Algeria (Bellion ***et al.***, 1973) from Libya and Egypt (Reyment, 1980) from Libya (Salaj and Nairn, 1987) and from Tunisia (Ben Abdessalem, 1978). It could have been spread northwards to those areas through the Trans-Saharan seaway.

More than sixteen species are common between North and West Africa. Most of these species were not found during Maastrichtian time (see Table 7.1) along the Atlantic coastline of West Africa. A higher number of the species recorded in Libya also occur in Nigeria. This seems to indicate that North Africa was involved in colonization by a migration mainly coming from the south to the north during the Maastrichtian via the Trans-Saharan seaway. Furthermore, the presence of ***Brachycythere*** and ***Mehesella*** which are typical West African genera appears to confirm this migration from the south through the Trans-Saharan seaway.

During the Palaeocene, Barsotti (1963) pointed out that 23 species were present in the Sirte Basin; of these 20 commonly occur in West Africa. He concluded that the majority of the species probably migrated to Libya from the south. Reyment (1963, 1966) studied the ostracod associations of the Nigerian Coastal Basin and noticed a large number of common forms between Libya, Nigeria, Mali and Niger. Kogbe ***et al.***, (1976) and Kogbe (1980) added a few more species to those recorded by

Reyment (1966) for the Sokoto embayment of the Iullemenden Basin of northwestern Nigeria which also occur in Libya. Reyment & Reyment (1980) found several species from the Palaeocene of the Sirte Basin which also occurred in the West Africa Basins. They believed that most, but not all, of these species were identical with those found in Libya and that they arrived in the Sirte Basin via the Trans-Saharan epicontinental sea.

The present study of the Palaeocene sediments of the Tarabulus Basin NW offshore Libya shows that many of the species found are identical with the Palaeocene ostracod fauna of West Africa (including Nigeria). Some of the species found in this study were also recovered from the Sirte Basin and Tunisia. ***Bairdia ilaroensis*** Reyment & Reyment, 1959, ***Buntonia beninensis*** Reyment, 1960 which were originally described and found only in Nigeria, have now been recovered from the Tarabulus Basin of NW offshore Libya. Furthermore some species common to the two areas have been recorded by other workers such as ***Protobuntonia punctata*** Reyment, 1963, ***Ambocythere tatteuliensis*** Apostolescu, 1961 and ***Bradleya praecrassa*** Apostolescu, 1961. It is important to note the complete absence of these species along the Atlantic Coast of West Africa. The Palaeocene connection between the Tethys and Gulf of Guinea could therefore only have occurred across the Sahara. The distinctive fauna mentioned above supports this view that migration to Libya took place via the Trans-Saharan epicontinental sea. On the other hand some ostracods found in North Africa may have possibly migrated around the coast of Africa and through the Straits of Gibraltar. Migration around the coast of Africa may be visualised in connection with the appearance of many species, of which ***Dahomeya alata*** Apostolescu, 1961 is an example, found in Nigeria, Ivory Coast, Senegal and North Africa. A similar mode of migration might explain the occurrence of ***Reticulina sangalkamensis*** (Apostolescu, 1961) in the Palaeocene of Senegal and Tunisia. However, far more ostracod species were common to Libya and West Africa see (Table 7.2.2). In this respect, the present work provides support for the results of Barsotti (1963), Reyment (1963, 1966), Reyment & Reyment (1980) and Kogbe

(1980) that some of the species common to North and West Africa migrated through the Trans-Saharan epicontinental sea. (fig. 7.1)

The Eocene ostracod species found in the present study suggest that there was no direct marine connection with West Africa via the Sahara as no species were found in common with Niger, Mali and Nigeria. This view supports Barsotti, (1963) and Adegoke (1969) in their views that the Trans-Saharan epicontinental sea probably existed throughout the entire Palaeocene and separation took place in the Lower Eocene due to uplifting tectonic phases.

CHAPTER 8

Hammuda *et al.*, (1985) suggested that the Ghalil Formation was deposited mainly in deep shelf environments based on the of abundance of the planktonic foraminifera such as ***Morozovella, Truncorotalia, Globorotalia, Truncorotaloides*** and sediment type.

In Well B1-NC41 the deeper basinal facies were temporarily interrupted and shallow water deposition probably took place as indicted by the presence of shallow water ostracod species.

Thus in general one can concluded from the ostracod fauna, the large number of individual specimens of each species, with sediment type (shale, claystone with sparse limestone), the environment is indicative of deep water environment, possibly mid to outer shelf.

8.2 Al Jurf Formation:

The occurrence of ***Krithe, Bairdia, Paleocosta, Reticulina, Cristaleberis*** and ***Buntonia,*** the diversity of ostracod fauna and the sediment type (black shale, claystone with levels of limestone) indicate a deep water marine environment.

In general many workers have suggested such a similar environment. For example, Eliagoubi (1986) suggested a deep shelf environment for the lower Al Jurf Formation, followed by deeper water deposition which was interrupted by a localised shallower period of deposition. This was indicated the type of sediment and the abundant planktonic foraminifera; ***Heterohelix globulosa, Planoglobulina carseyae carseyae, Globotruncana arca, Morozovella acuta*** and many others.

Hammuda *et al.*, (1985) stated that the environment of deposition of this formation was a deep platform based on the predominance of planktonic foraminifera and the lithological composition.

Abdullah (1987) indicated that the Al Jurf Formation is characterised by a relative abundance of planktonic and benthonic foraminifera typical of deep marine conditions (mid to outer shelf).

To the west of Tarabulus Basin, the El Haria Formation which is equivalent to the Al Jurf Formation in this basin, was deposited in a deep water environment Aubert & Berggren (1976).

From the evidence presented above the Al Jurf Formation was deposited in a deep water environment, indicated by characteristic ostracod genera, planktonic foraminifera and the lithological composition.

8.3 Bu Isa Formation:

The ostracod fauna of this formation is low in abundance and diversity. The presence of ***Krithe***, ***Bairdia***, ***Bythocypris***, ***Pontocyprella*** and ***Paracypris***, all of which have an absence of strongly or ornamented lateral surfaces with developed eye tubercle and the sediments types indicate a deep marine environment in the upper part of the Bu Isa Formation.

The genus ***Pontocyprella*** is restricted to open sea, basinal environments as indicated by Babinot (1973) and Colin ***et al.***, (1982). The majority of ***Paracypris*** taxa live in normal sea waters (Morkhoven, 1963) but most common in sublittoral regions (Puri ***et al.***, 1969)

Eliagoubi (1986) suggested a shoaling environment for the deposition for the upper part of the Bu Isa Formation.

A deep water environment for the deposition of this formation is also proposed on the basis of the presence Planktonic Foraminifera recognised by the palaeontologists of the Agip Oil Company.

The ostracods present in these beds appear to have indicated a deeper water marine environment.

8.4 Harsha Formation:

A shallow water, inner neritic environment for the Harsha Formation is indicated by the presence of strongly reticulate ostracods, some having ornamented

lateral surfaces with well developed eye tubercles such as; ***Asymmetricythere***, ***Hermanites***, ***Heptaloculites***, ***Isobuntonia***, ***Leguminocythereis***, ***Schizocythere***, ***Pokornyella***, ***Urocythereis***, ***Cytheropteron*** (thick shelled), ***Flexus*** and ***Loxoconcha***.

The presence of ***Cytherella*** which forms an important element in the fauna range over a wide range of depth at the present from shallow, even brackish environments to bathyal and even abyssal depths. In the latter habitats this genus is usually represented by large and smooth species. Here the high incidence of punctate forms is more in accord with an inner shelf environment. This habitat is supported by the high diversity and abundance of the genus ***Heptaloculites***, represented by nine species in the present study. The latter genus dominates in inner neritic environment (Bismuth ***et al.***, 1978).

However, the presence of smooth and thin shelled ostracod such as; ***Paracypris***, ***Pontocyprella*** and ***Argilleocia***, suggests contact with the open sea. The occurrence of the same taxa, with similarly preserved fauna in the studied wells suggests a similar environment deposition.

In Well L1-NC41 only the lower part of this formation was sampled. The sediments (marl, locally grading to shale with some levels of limestone) with Ostracoda dominated by ostracod genus ***Soudanella***, ***Mehesella*** and others with the absence of the genus ***Heptaloculites*** suggests deeper water conditions for this section. This also confirmed by the presence of the relatively abundant Planktonic Foraminifera.

Thus the general aspect of the fauna suggests that the Harsha Formation was deposited mainly in a shallow water inner neritic environment.

8.5 Samdun Formation:

The occurrence of ***Leguminocythereis***, ***Heptaloculites***, ***Asymmetricythere***, ***Hermanites***, ***Loxoconcha***, ***Urocythereis***, with the high diversity of the ostracod fauna indicates a shallow water, inner neritic environment.

The presence of ***Pontocyprella***, ***Paracypris*** and ***Argilloecia*** indicates partial connection with open sea environments.

The poor diversity or absence of ostracod species in the top part of the Samdun Formation may be due either to an unfavourable habitat or more likely, due to lack of preservation; or possibly combination of both factors.

CHAPTER 9

CONCLUSIONS

The Upper Cretaceous, Palaeocène and Eocene ostracod from ten boreholes in NW offshore Libya have been studied in detail, consisting one hundred and thirty-three species and subspecies belonging to fifty-five genera and subgenera. Of these seventy-seven species are new, twenty-three are related to taxa previously described from the adjacent areas. Two species have affinities with species described elsewhere. It was impossible to name thirty-one species and four new genera, therefore, left under open nomenclature due to lack of material or the impossibility of observing the internal features.

Biostratigraphically, the Middle and Upper Eocene of the Tellil Group (Harsha, Dahman and Samdun Formations) has been divided into five zones based on the Genus ***Heptaloculites*** Ruggieri, 1963. The order of which presented below from youngest to oldest:

1. ***Heptaloculites*** aff. ***H. gortanii*** Zone. **A**
2. ***Heptaloculites cavernosa*** Zone. **B**
3. ***Heptaloculites minuta*** Zone. **C**
4. ***Heptaloculites semirugosa*** Zone. **D**
5. ***Heptaloculites harshae*** Zone. **E**

A Middle Eocene age is assigned to Zone **B**, Zone **C**, Zone **D** and Zone **E** whilst an Upper Eocene age is proposed for Zone **A**. The Samdun Formation of the Tellil group and the Ghalil Formation contact is placed at the base of the ***Heptaloculites cavernosa*** Zone in Well B1-NC41. The Samdun Formation of the Tellil Group is regarded as Middle and Upper Eocene. The Dahman Formation of the Tellil Group is considered to be Middle Eocene in age. The Harsha Formation of the Tellil Group is dated as Middle Eocene. The age of the Al Jurf Formation in Well

N1-NC41 is considered to be Maastrichtian on the base of its stratigraphic position and by planktonic Foraminifera. The age of the upper part of the Al Jurf Formation in Well D2-NC41 is regarded as Late Palaeocene. The age of the Al Jurf Formation in Well J1-NC41 is considered to be Palaeocene. The age of the Ghalil Formation in Well D2-NC41 is regarded as Middle to Upper Eocene and in Well B1-NC41, it is considered to be Middle Eocene. The age of the Bu Isa Formation is regarded as Maastrichtian age.

The comparison of the Maastrichtian species, regards generic composition of the fauna as close to that of from North and West Africa and this fauna suggests a lesser link with the Middle East (Saudi Arabia) whilst comparison at specific level is impossible because most of the ostracod species recovered in the present study are new. However, the presence of sixteen species in the Al Hamada Al Hamra (Ghadames) Basin originally described from West Africa suggest a much greater connection with West Africa at specific level. The Palaeocene fauna is very similar in its specific level and is closely related at generic composition to those described from the West and North Africa. For example, ***Dahomeya alata***, ***Buntonia beninensis***, ***Leguminocythereis lokossaensis***, ***Leguminocythereis lagaghiroboensis***, ***Paleocosta bensoni***, ***Bairdia ilaroensis*** and ***Cytheropteron lekense*** were found in the Palaeocene of NW offshore Libya. During the Eocene time, the fauna was closely related to North Africa and with lesser links with West Africa (see faunal relationship Chapter 7). The fauna also shows some affinities with the Tertiary of India, Pakistan and Europe; however, it is somewhat different to the Middle East faunas.

The above faunal relationships of the Maastrichtian and Palaeocene ostracods from the study area led to the conclusion that some common species of North and West Africa migrated through the Trans-Saharan Epicontinental Sea. In the Eocene, there were no common species between Libya and Nigeria, Mali and Niger, which suggest that there was no direct marine link with West Africa via the Sahara.

The studied environment of deposition of the formations has been determined as follows: The Harsha Formation was deposited in a shallow water inner neritic environment. However, the presence of open sea species indicated a partial connection with the open sea environments. In Well L1-NC41 the presence of ***Soudanella, Mehesella*** and others with the absence of ***Heptaloculites*** suggests deeper water conditions. The ostracod present in the upper part of the Bu Isa Formation appears to have indication of deeper water environment.

The Samdun Formation was also deposited in shallow water inner neritic environment. The occurrence of the same taxa with similarity in preservation of fauna in the studied area suggests a similar environment of deposition. The presence of open sea species suggests a contact with the open sea environments. The upper part of this formation is distinguished by the poor diversity or absence of ostracod species, which may be either due to an unfavourable habitat or more likely due to lack of preservation or possibly may be due to the combination of both factors. The Ghalil Formation was mainly deposited in a deep water environment, possibly mid-outer shelf.

In Well B1-NC41 the deeper facies were temporarily interrupted and shallow water probably entered which is indicated by the presence of shallow water ostracod species. The occurrence of the ostracod fauna and sediment type in the Al Jurf Formation suggests a deeper water environment.

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PLATES

(1-57)

EXPLANATION OF PLATE 1

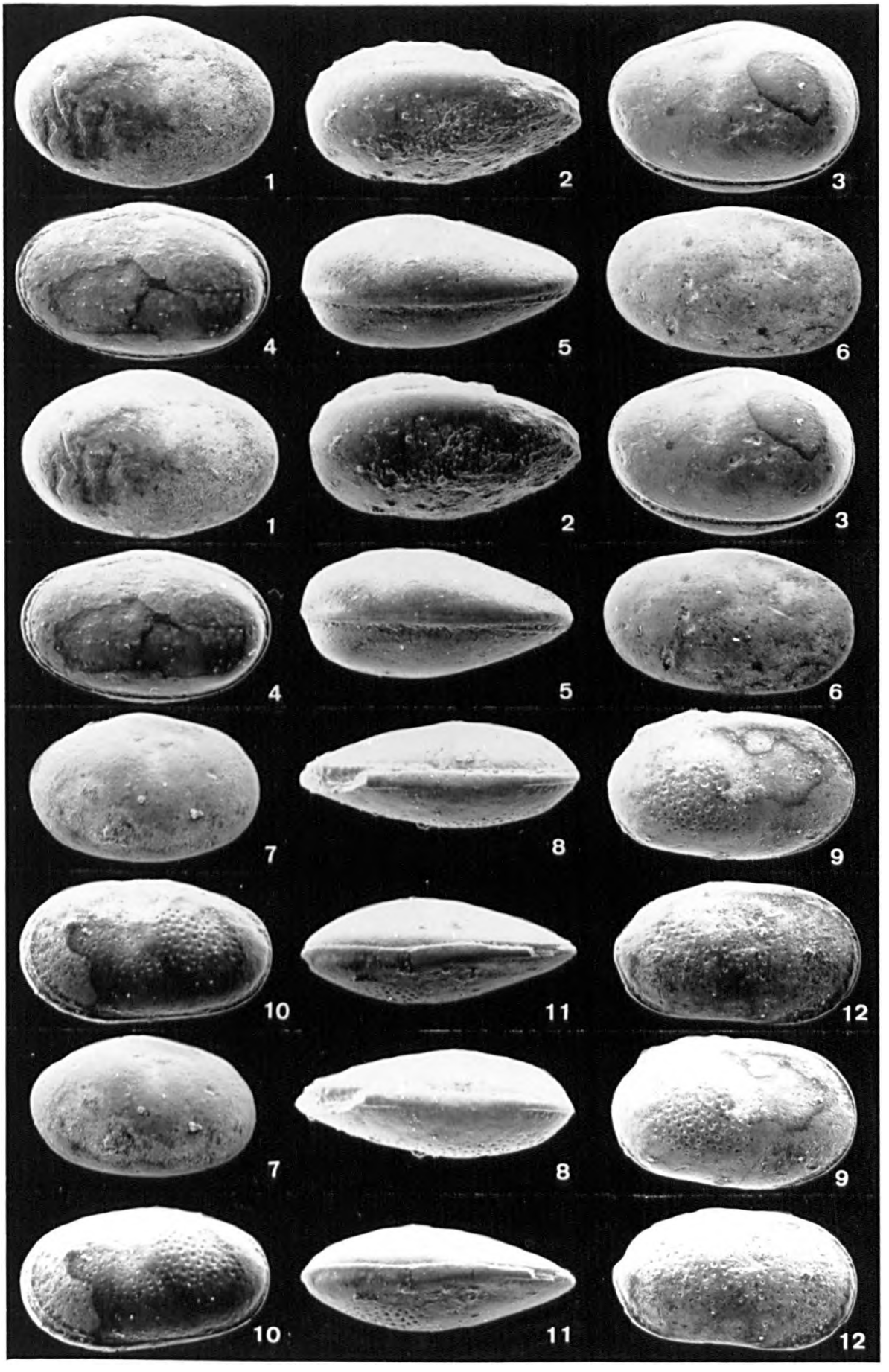
Figs. 1-7 ***Cytherella angulata*** sp. nov. p. 45

1. Female carapace from right HU.201.T.1 X 60
2. Paratype, female carapace, dorsal view HU.201.T.2 X 65
3. Holotype, female carapace from left HU.201.T.3 X 60
4. Paratype, male carapace from left HU.201.T.4 X 60
5. Female, carapace ventral view HU.201.T.5 X 65
6. Paratype, male carapace from right HU.201.T.6 X 65
7. Paratype, female carapace from right HU.201.T.7 X 65

Figs. 8-12 ***Cytherella ghalilae*** sp. nov. p. 48

8. Paratype, male carapace, ventral view HU.201.T.8 X 75
9. Paratype, female carapace from right HU.201.T.9 X 70
10. Holotype, male carapace from left HU.201.T.10 X 70
11. Paratype, female carapace, dorsal view HU.201.T.11 X 85
12. Paratype, male carapace from right HU.201.T.12 X 70

PLATE 1



EXPLANATION OF PLATE 2

Fig. 1 ***Cytherella ghalilae*** sp. nov. p. 48

1. Paratype, female carapace from left HU.201.T.13 X 70

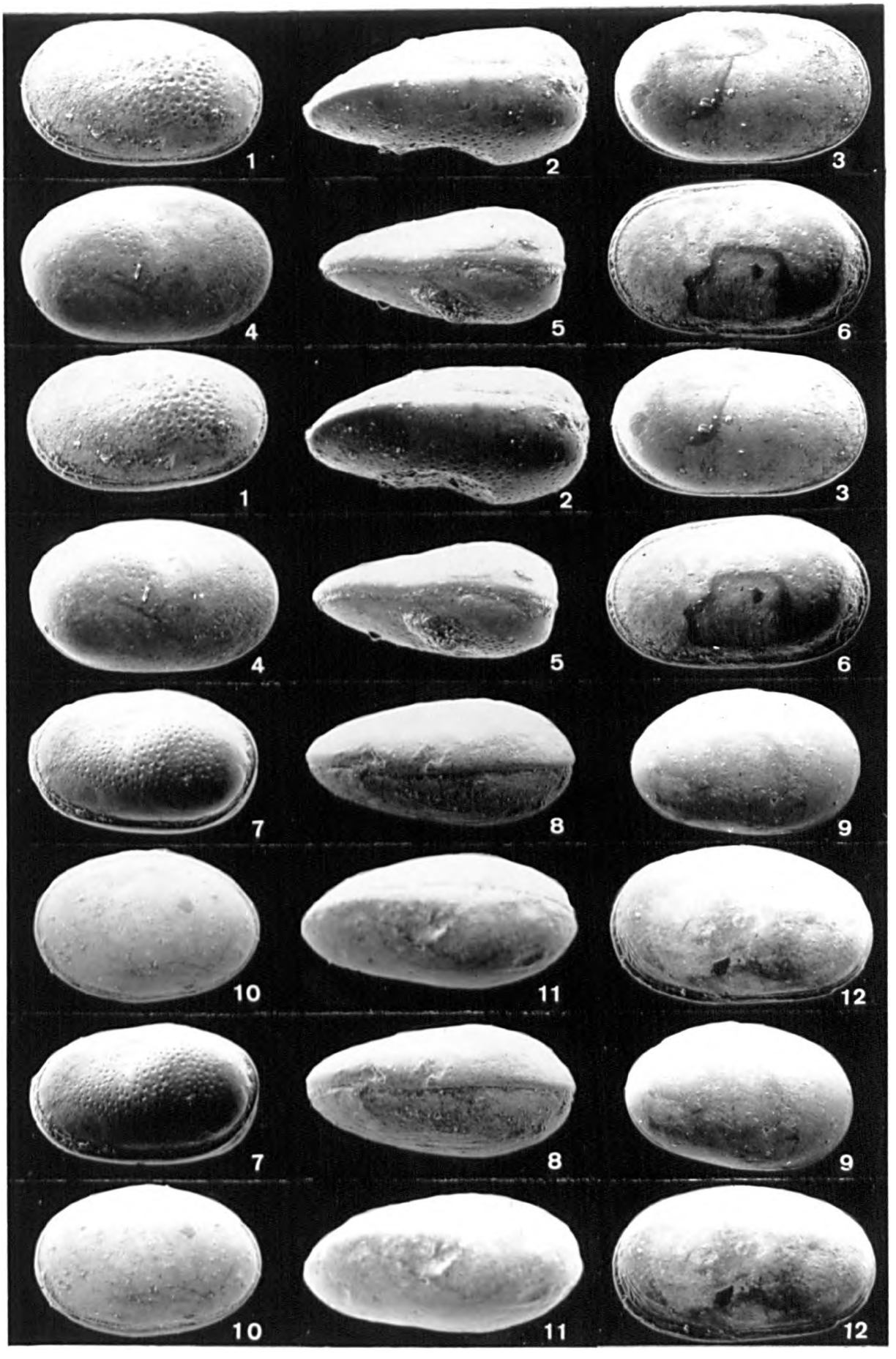
Figs. 2-7 ***Cytherella tarabulusensis*** sp. nov. p. 51

2. Paratype, carapace ventral view HU.201.T.14 X 70
3. Paratype, carapace from right HU.201.T.15 X 70
4. Holotype, carapace from right HU.201.T.16 X 60
5. Paratype, carapace dorsal view HU.201.T.17 X 60
6. Paratype, carapace from left HU.201.T.18 X 70
7. Paratype, carapace from left HU.201.T.19 X 60

Figs. 8-12 ***Cytherella aljurfae*** sp. nov. p. 54

8. Paratype, male carapace, dorsal view HU.201.T.20 X 60
9. Holotype, female carapace from right HU.201.T.21 X 60
10. Paratype, female carapace from left HU.201.T.22 X 55
11. Paratype, female carapace, ventral view HU.201.T.23 X 80
12. Paratype, male carapace from right HU.201.T.24 X 60

PLATE 2



EXPLANATION OF PLATE 3

Figs. 1-6 ***Cytherella tellilae*** sp. nov. **p. 56**

1. Holotype, carapace from right HU.201.T.25 **X 47**
2. Holotype, carapace dorsal view HU.201.T.25 **X 57**
3. Holotype, carapace from left HU.201.T.25 **X 45**
4. Paratype, carapace from left HU.201.T.26 **X 50**
5. Paratype, carapace ventral view HU.201.T.26 **X 45**
6. Paratype, carapace from right HU.201.T.26 **X 45**

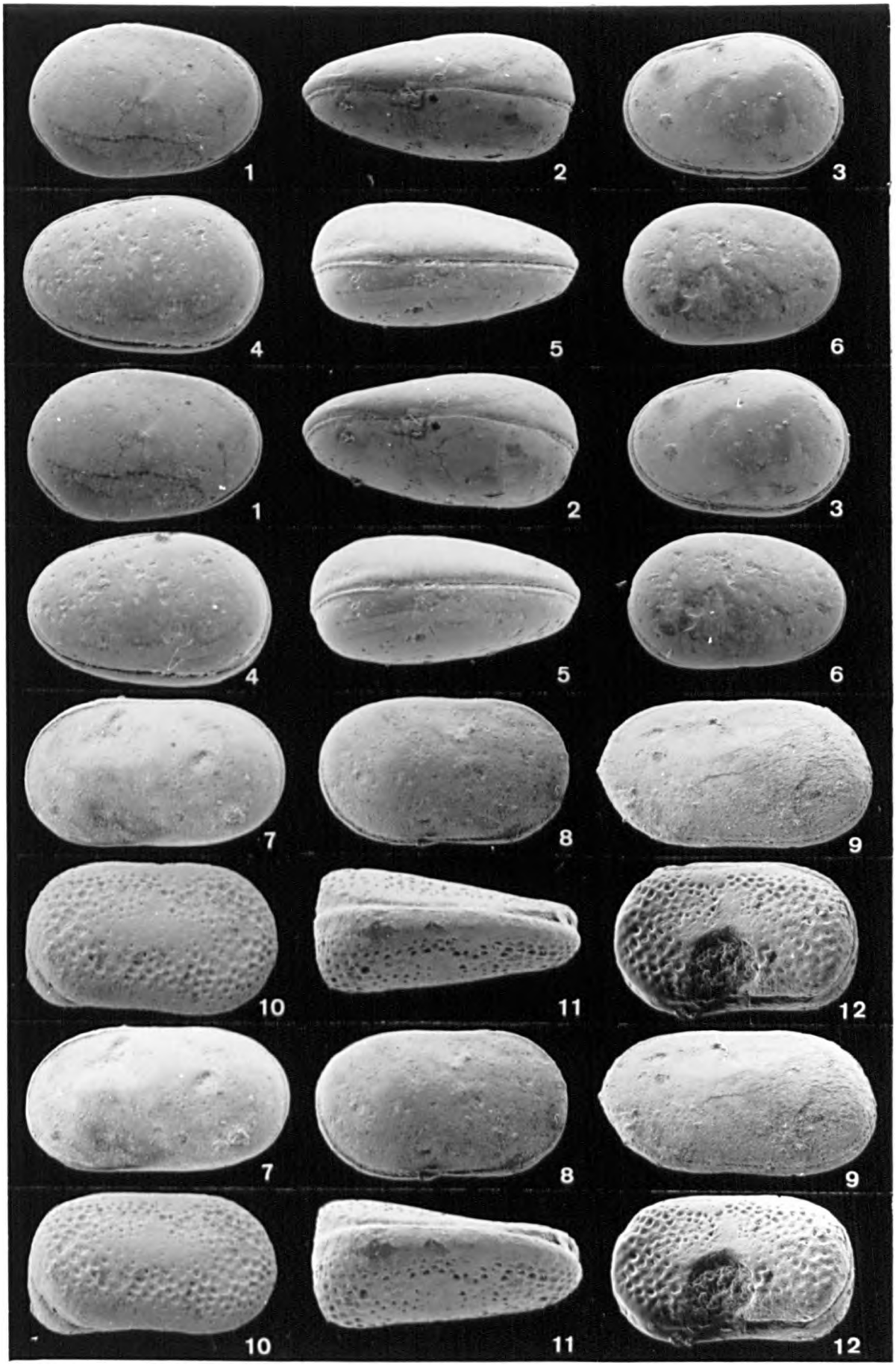
Figs. 7-9 ***Cytherella samdunae*** sp. nov. **p. 58**

7. Holotype, male carapace from left HU.201.T.27 **X 72**
8. Paratype, female carapace from left HU.201.T.28 **X 67**
9. Paratype, male carapace from left HU.201.T.29 **X 77**

Figs. 10-12 ***Cytherella*** sp. ***A*** **p. 60**

10. Carapace from right HU.201.T.30 **X 67**
11. Carapace dorsal view HU.201.T.30 **X 70**
12. Carapace from left HU.201.T.30 **X 65**

PLATE 3



EXPLANATION OF PLATE 4

Figs. 1-3 ***Cytherelloidea libyaensis*** sp. nov. p. 61

1. Holotype, carapace from right HU.202.T.1 X 72
2. Paratype, carapace dorsal view HU.202.T.2 X 77
3. Paratype, carapace from right HU.202.T.2 X 77

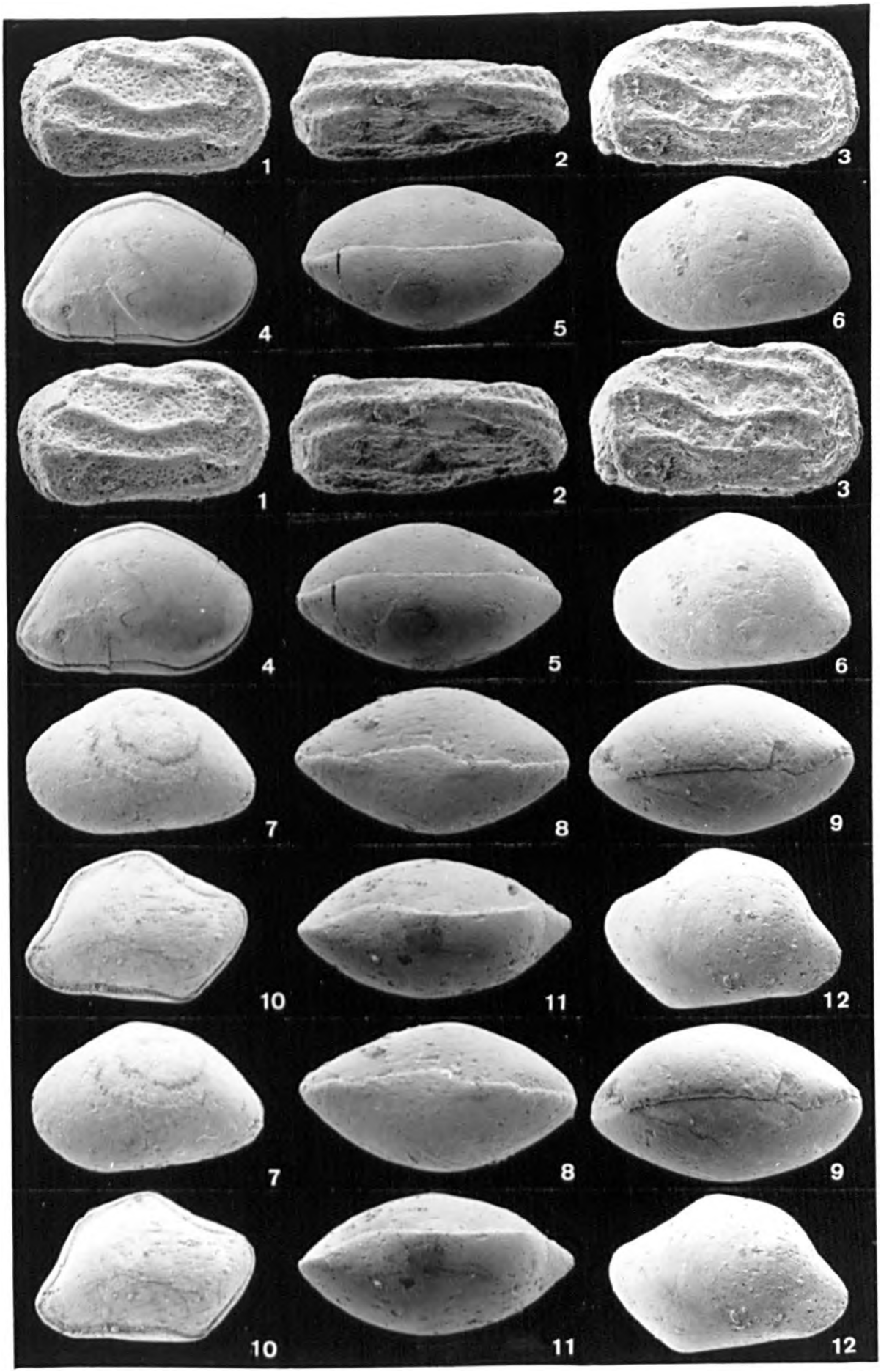
Figs. 4-9 ***Bairdia ilaroensis*** Reyment & Reyment (1959) p. 64

4. Carapace from right HU.202.T.3 X 45
5. Carapace dorsal view HU.202.T.3 X 50
6. Carapace from left HU.202.T.4 X 52
7. Carapace from left HU.202.T.5 X 52
8. Carapace ventral view HU.202.T.4 X 60
9. Carapace dorsal view HU.202.T.6 X 57

Figs. 10-12 ***Bairdia*** sp. ***A*** p. 78

10. Carapace from right HU.202.T.7 X 55
11. Carapace dorsal view HU.202.T.7 X 67
12. Carapace from left HU.202.T.7 X 57

PLATE 4



EXPLANATION OF PLATE 5

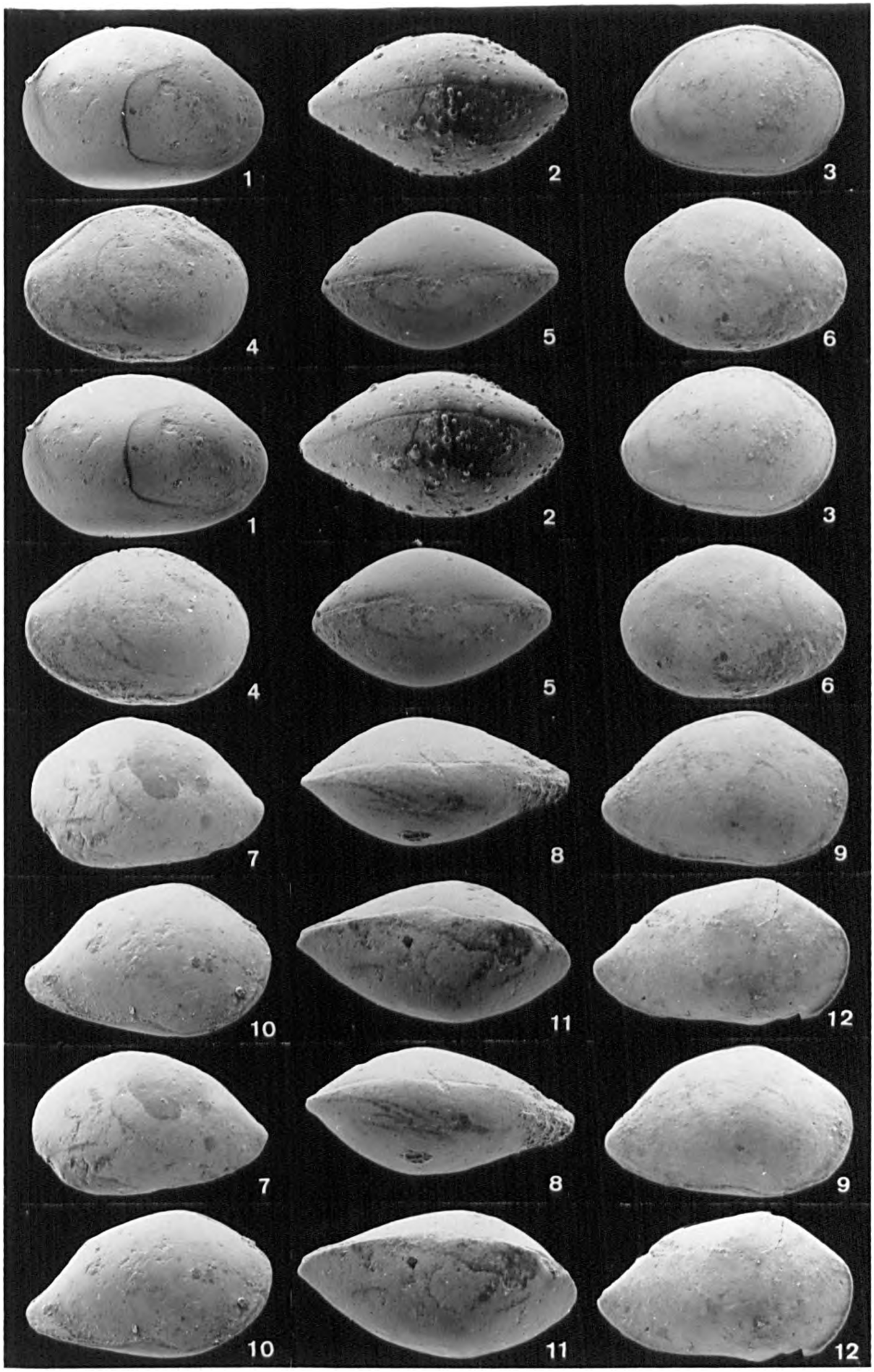
Figs. 1-6 ***Bairdia abundans*** sp. nov. p. 66

1. Holotype, carapace from left HU.202.T.8 X 45
2. Paratype, carapace dorsal view HU.202.T.9 X 52
3. Paratype, carapace from right HU.202.T.10 X 47
4. Paratype, carapace from right HU.202.T.11 X 52
5. Paratype, carapace ventral view HU.202.T.12 X 55
6. Paratype, carapace from left HU.202.T11 X 50

Figs. 7-12 ***Bairdia buisae*** sp. nov. p. 68

7. Paratype, carapace from left HU.202.T.13 X 60
8. Paratype, carapace dorsal view HU.202.T.14 X 62
9. Paratype, carapace from right HU.202.T.14 X 67
10. Paratype, carapace from right HU.202.T.15 X 74
11. Paratype, carapace ventral view HU.202.T.13 X 67
12. Holotype, right valve external view HU.202.T.16 X 45

PLATE 5

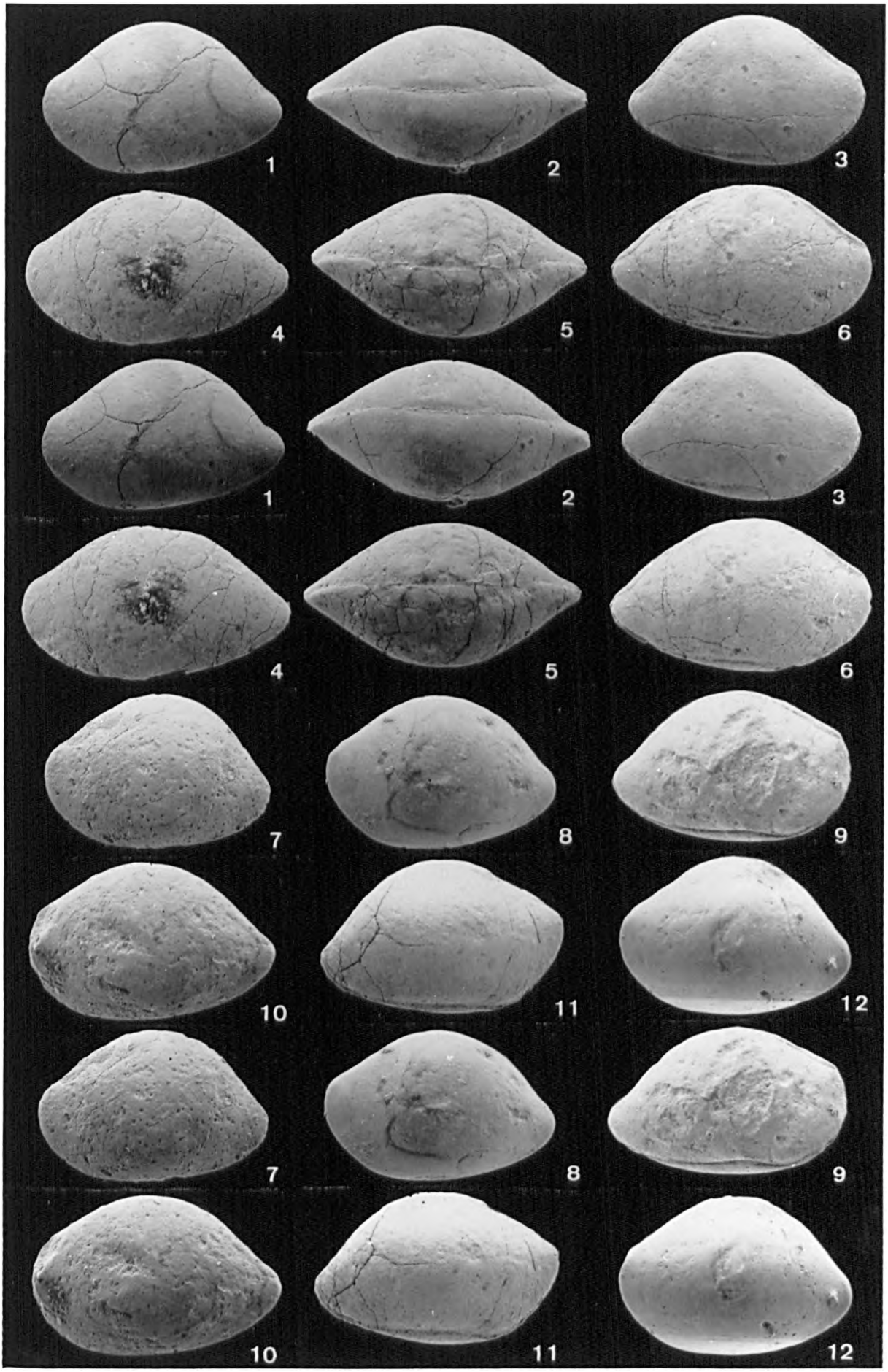


EXPLANATION OF PLATE 6

figs. 1-12 ***Bairdia tarabulusensis*** sp. nov. p. 71

1. Holotype, female carapace from left HU.202.T.17 X 40
2. Holotype, female carapace, dorsal view HU.202.T.17 X 45
3. Holotype, female carapace from right HU.202.T.17 X 37
4. Paratype, male carapace from left HU.202.T.18 X 42
5. Paratype, male carapace, dorsal view HU.202.T.18 X 45
6. Paratype, male carapace from right HU.202.T.18 X 42
7. Paratype, female carapace from left HU.202.T.20 X 37
8. Paratype, female carapace from left HU.202.T.21 X 37
9. Paratype, female carapace from right HU.202.T.19 X 47
10. Paratype, female carapace from left HU.202.T.19 X 47
11. Paratype, male carapace from right HU.202.T.23 X 42
12. Paratype, female carapace from left HU.202.T.22 X 42

PLATE 6



EXPLANATION OF PLATE 7

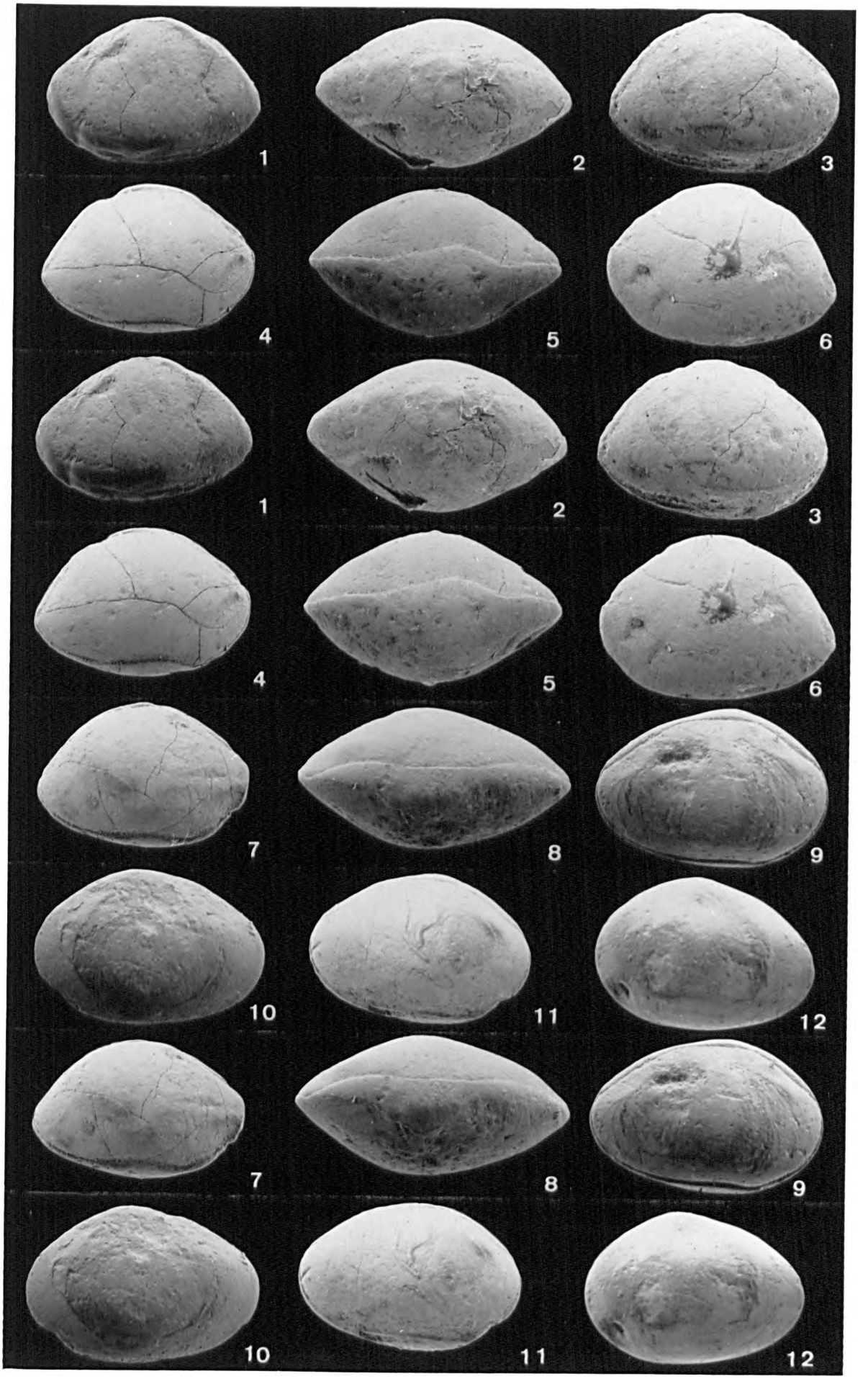
Figs. 1-7 ***Bairdia samdunae*** sp. nov. p. 74

1. Holotype, carapace from left HU.202.T.24 X 32
2. Holotype, carapace dorsal view HU.202.T.24 X 38
3. Holotype, carapace from right HU.202.T.24 X 35
4. Paratype, carapace from right HU.202.T.25 X 32
5. Paratype, carapace ventral view HU.202.T.25 X 38
6. Paratype, carapace from left HU.202.T.25 X 35
7. Paratype, carapace from right HU.202.T.26 X 35

Figs. 8-12 ***Bairdia rara*** sp. nov. p. 76

8. Paratype, carapace dorsal view HU.202.T.28 X 38
9. Holotype, carapace from right HU.202.T.27 X 32
10. Paratype, carapace from left HU.202.T.28 X 32
11. Paratype, carapace from right HU.202.T.28 X 32
12. Holotype, carapace from left HU.202.T.27 X 32

PLATE 7



EXPLANATION OF PLATE 8

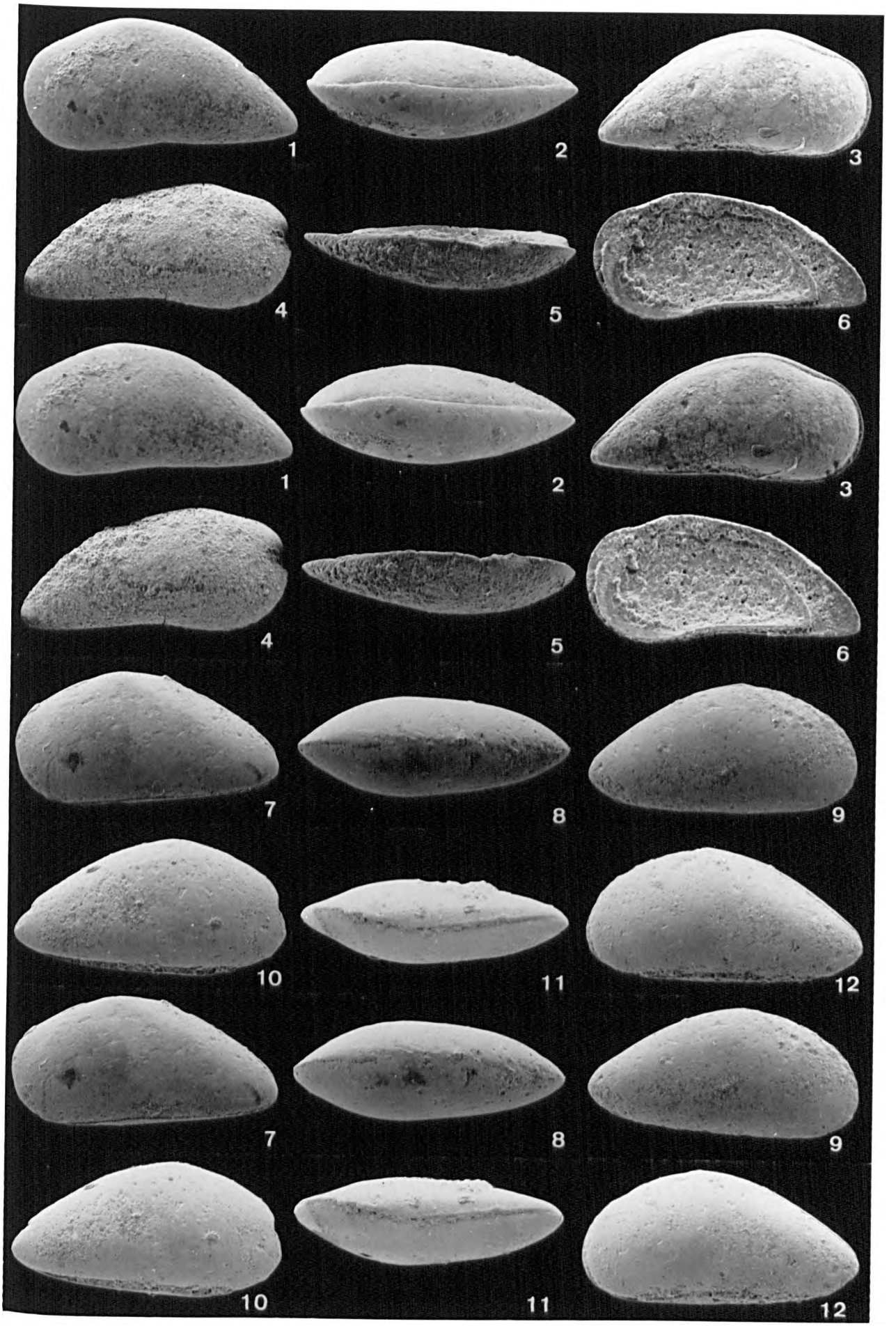
Figs. 1-6 ***Paracypris buisae*** sp. nov. p. 82

1. Holotype, carapace from left HU.203.T.3 X 65
2. Holotype, carapace dorsal view HU.203.T.3 X 65
3. Holotype, carapace from right HU.202.T.3 X 62
4. Paratype, right valve, external view HU.203.T.4 X 87
5. Paratype, right valve, dorsal view HU.203.T.4 X 87
6. Paratype, right valve, internal view HU.203.T.4 X 85

Figs. 7-12 ***Paracypris tarabulusensis*** sp. nov. p. 84

7. Holotype, carapace from left HU.203.T.5 X 87
8. Holotype, carapace dorsal view HU.203.T.5 X 92
9. Paratype, carapace from right HU.203.T.7 X 75
10. Paratype, carapace from right HU.203.T.6 X 77
11. Paratype, carapace ventral view HU.203.T.6 X 75
12. Paratype, carapace from left HU.203.T.7 X 80

PLATE 8



EXPLANATION OF PLATE 9

Figs. 1-7 ***Propontocypris tarabulusensis*** sp. nov. p. 98

1. Paratype, female carapace from left HU.203.T.28 X 65
2. Holotype, male carapace from left HU.203.T.29 X 50
3. Paratype, female carapace from left HU.203.T.30 X 67
4. Paratype, female carapace from right HU.203.T.28 X 65
5. Paratype, female carapace from right HU.203.T.30 X 67
6. Paratype, male carapace from right HU.204.T.1 X 50
7. Paratype, male carapace from left HU.204.T.1 X 47

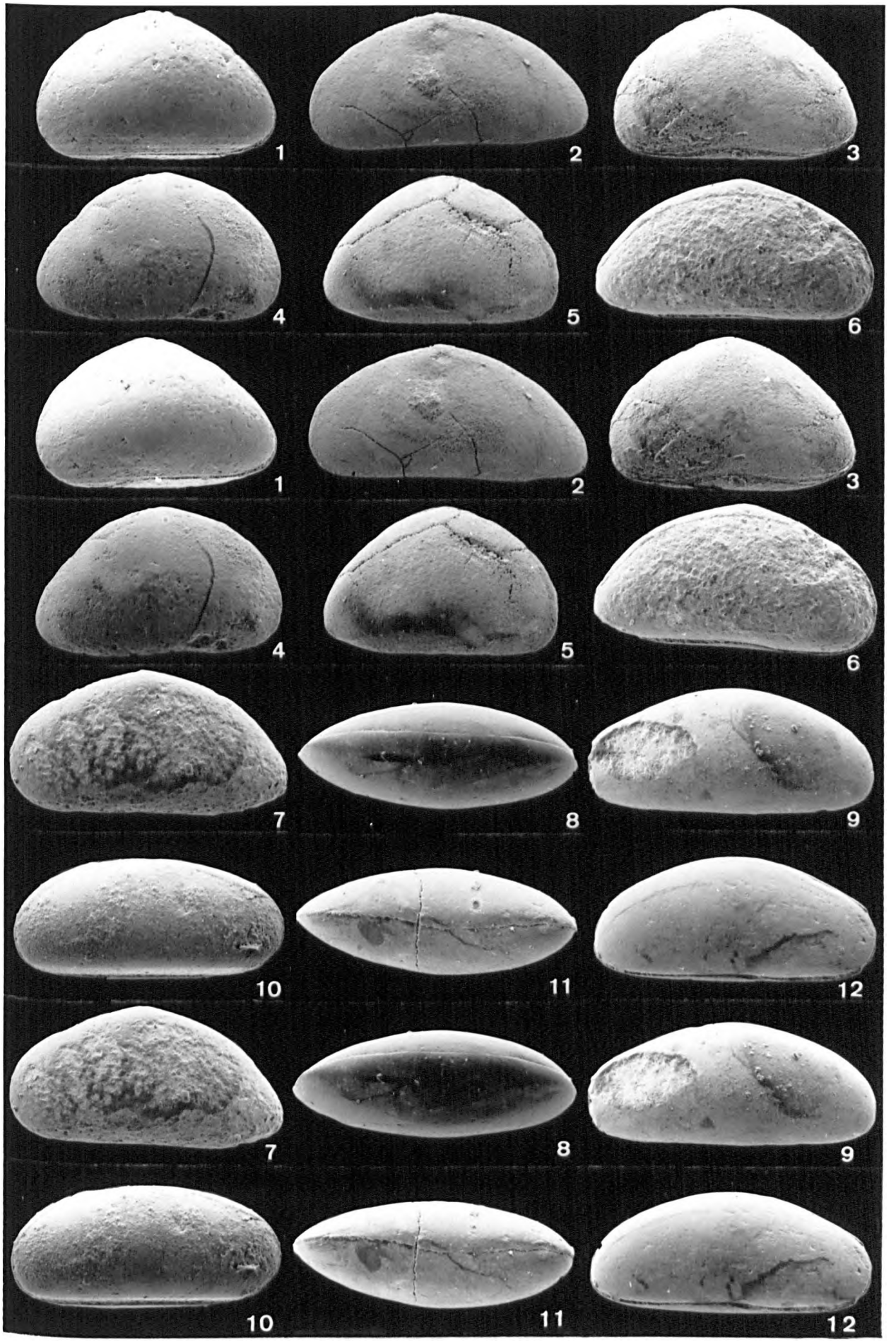
Figs. 8-9, 11-12 ***Bythocypris urbana*** sp. nov. p. 80

8. Paratype, carapace dorsal view HU.202.T.29 X 87
9. Paratype, carapace from left HU.202.T.30 X 67
11. Paratype, carapace ventral view HU.203.T.1 X 100
12. Holotype, carapace from right HU.203.T.2 X 70

Fig. 10 ***Argilloecia ghalilae*** sp. nov. p. 101

10. Paratype, female carapace from right HU.204.T.4 X 47

PLATE 9



EXPLANATION OF PLATE 10

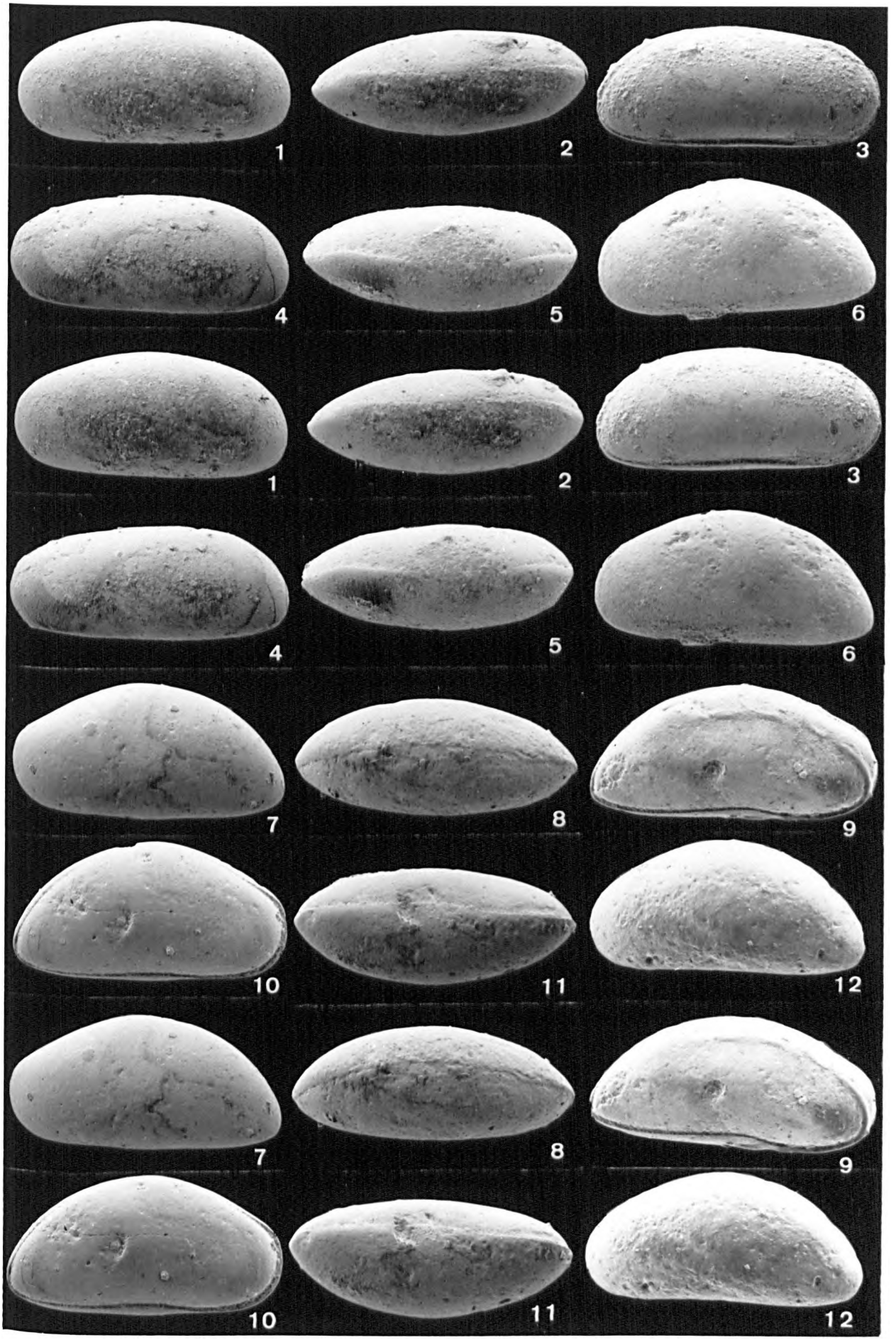
Figs. 1-5 ***Argilloecia ghalilae*** sp. nov. p. 101

1. Holotype, female carapace from left HU.204.T.3 X 47
2. Paratype, female carapace, dorsal view HU.204.T.5 X 50
3. Paratype, male carapace from right HU.204.T.6 X 47
4. Paratype, male carapace from left HU.204.T.7 X 47
5. Paratype, female carapace, dorsal view HU.204.T.8 X 50

Figs. 6-12 ***Paracypris paramagahaensis*** sp. nov. p. 86

6. Paratype, male carapace from left HU.203.T.8 X 50
7. Holotype, female carapace from left HU.203.T.9 X 50
8. Paratype, female carapace, dorsal view HU.203.T.10 X 55
9. Paratype, male carapace from right HU.203.T.11 X 50
10. Holotype, female carapace from right HU.203.T.9 X 50
11. Paratype, female carapace, ventral view HU.203.T.12 X 55
12. Paratype, female carapace from left HU.203.T.13 X 50

PLATE 10



EXPLANATION OF PLATE 11

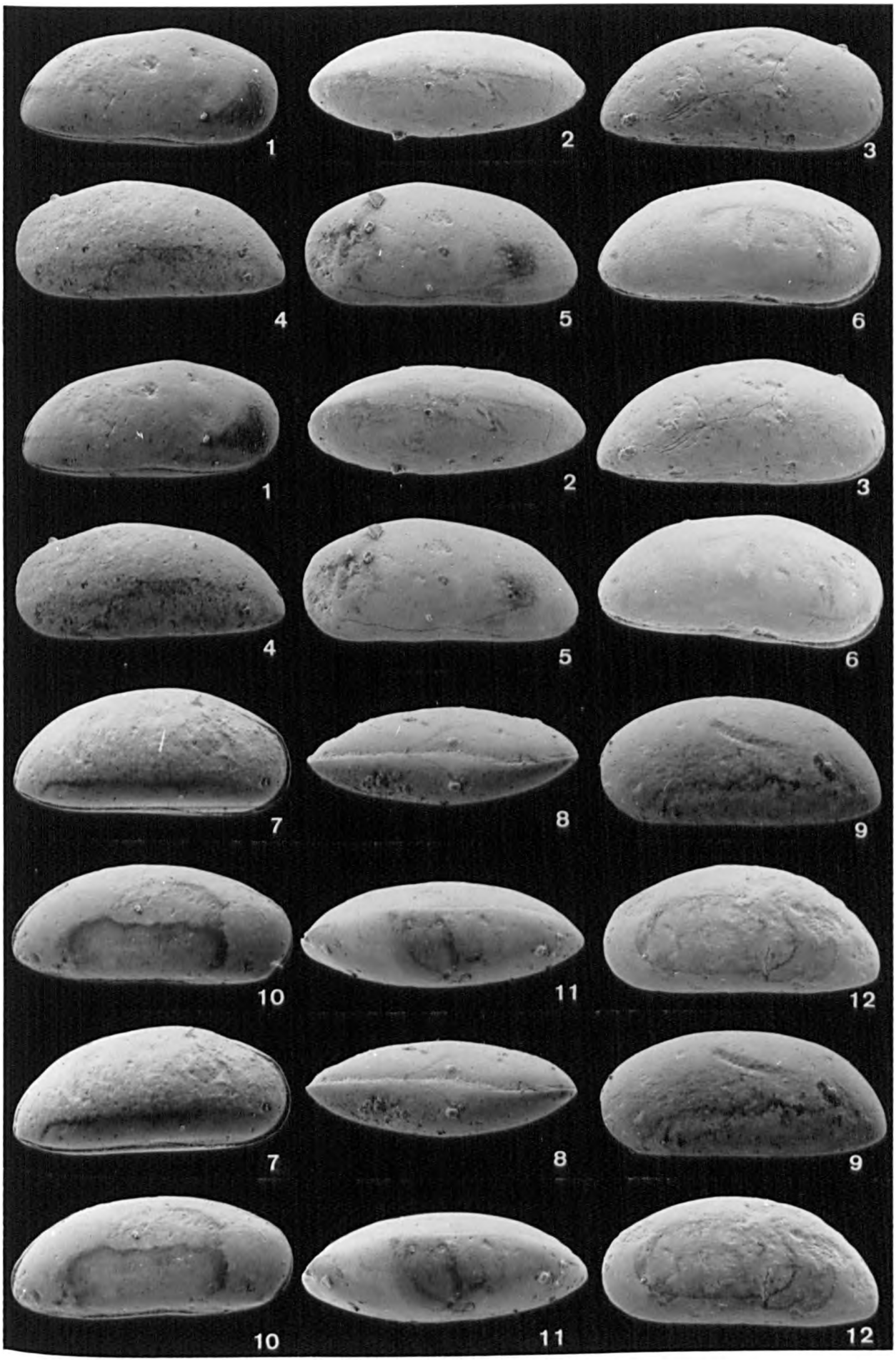
Figs. 1-6 ***Paracypris eskeri*** sp. nov. p. 89

1. Holotype, carapace from right HU.203.T.14 X 57
2. Holotype, carapace dorsal view HU.203.T.14 X 60
3. Paratype, carapace from right HU.203.T.15 X 60
4. Paratype, carapace from left HU.203.T.15 X 60
5. Paratype, carapace from left HU.203.T.16 X 55
6. Paratype, carapace from right HU.203.T.16 X 57

Figs. 7-12 ***Pontocyprella eocaenica*** sp. nov. p. 92

7. Paratype, female carapace from right HU.203.T.17 X 52
8. Paratype, male carapace, ventral view HU.203.T.18 X 50
9. Holotype, female carapace from left HU.203.T.19 X 50
10. Paratype, male carapace from right HU.203.T.20 X 50
11. Paratype, female carapace, dorsal view HU.203.T.21 X 50
12. Paratype, female carapace from left HU.203.T.22 X 5

PLATE 11



EXPLANATION OF PLATE 12

Figs. 1-6 ***Schizocythere salahii*** sp. nov. p. 104

1. Holotype, carapace from left HU.204.T.9 X 95
2. Holotype, carapace dorsal view HU.204.T.9 X 105
3. Holotype, carapace from right HU.204.T.9 X 90
4. Paratype, carapace from left HU.204.T.10 X 105
5. Paratype, carapace ventral view HU.204.T.10 X 115
6. Paratype, carapace from right HU.204.T.10 X 110

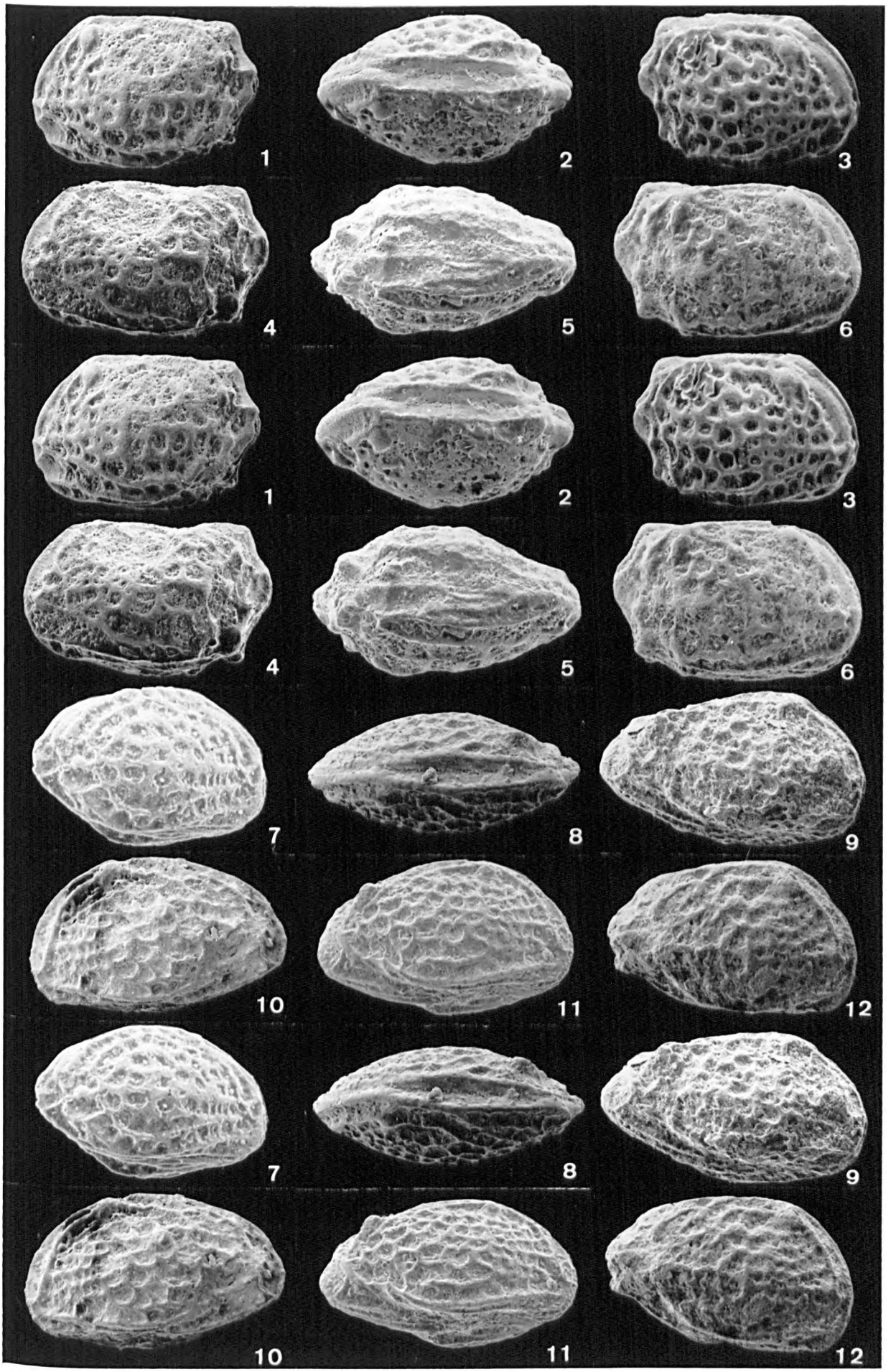
Fig. 7 ***Schizocythere*** sp. ***A*** p. 108

7. Carapace from right HU.204.T.11 X 80

Figs. 8-12 ***Schizocythere distincta*** sp. nov. p. 106

8. Holotype, carapace dorsal view HU.204.T.12 X 100
9. Paratype, carapace from right HU.204.T.13 X 110
10. Paratype, carapace from left HU.204.T.14 X 100
11. Holotype, carapace from right HU.204.T.12 X 92
12. Paratype, carapace from right HU.204.T.15 X 105

PLATE 12



EXPLANATION OF PLATE 13

Figs. 1-2 ***Pontocyprella rara*** sp. nov. p. 95

1. Holotype, carapace from left HU.203.T.23 X 50
2. Paratype, carapace from right HU.203.T.24 X 50

Figs. 3-5 ***Hemicyprideis*** sp. ***A*** p. 112

3. Carapace from left HU.204.T.17 X 60
4. Carapace from right HU.204.T.17 X 55
5. Carapace dorsal view HU.204.T.17 X 55

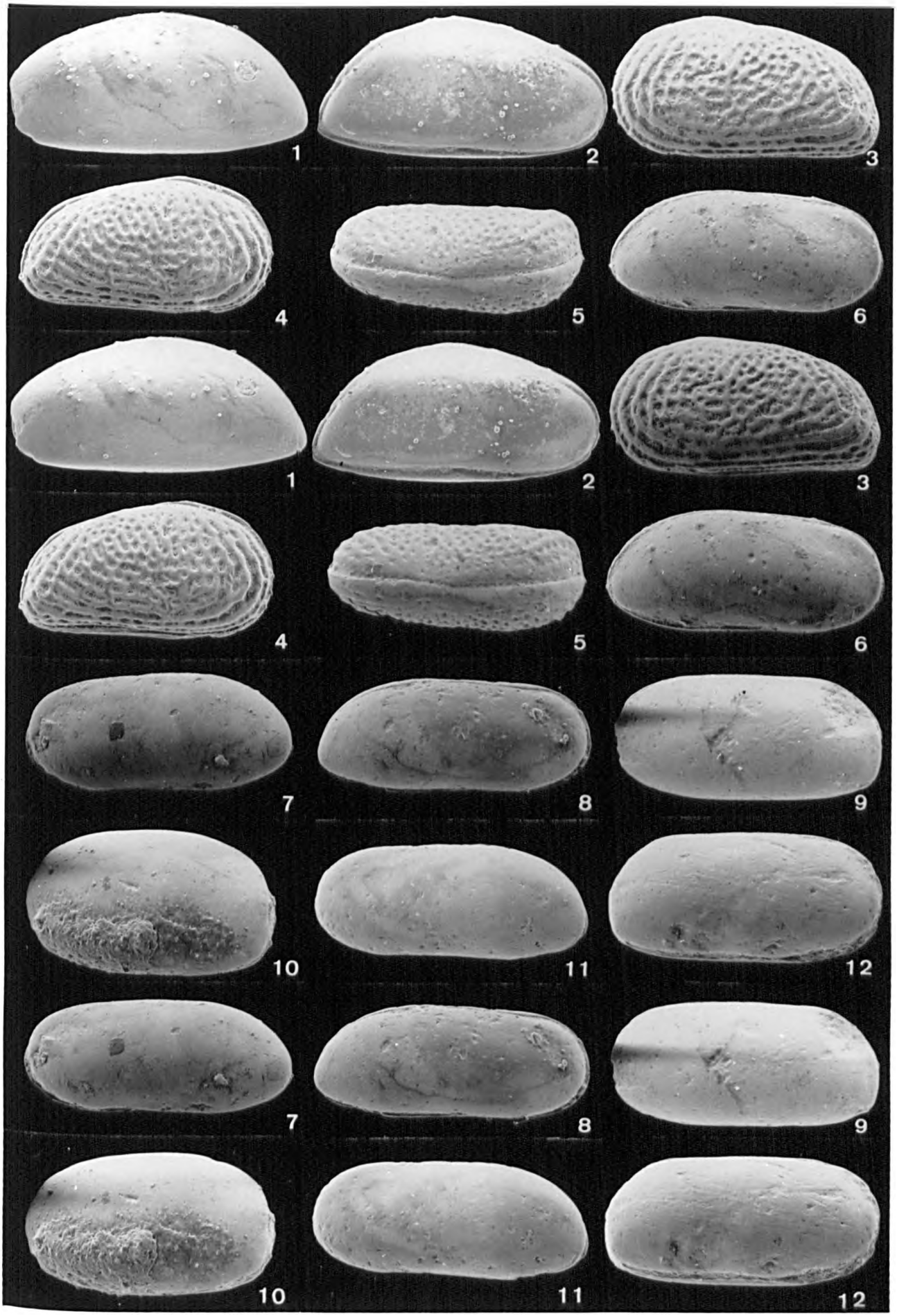
Figs. 6-8, 11 ***Krithe pseudorocana*** sp. nov. p. 114

6. Holotype, male carapace from right HU.204.T.18 X 85
7. Holotype, male carapace from left HU.204.T.18 X 82
8. Paratype, female carapace from right HU.204.T.19 X 90
11. Paratype, female carapace from left HU.204.T.19 X 92

Figs. 9-10, 12 ***Krithe ghalilae*** sp. nov. p. 116

9. Holotype, male carapace from left HU.204.T.20 X 90
10. Paratype, female carapace from left HU.204.T.21 X 97
12. Holotype, male carapace from right HU.204.T.20 X 92

PLATE 13



EXPLANATION OF PLATE 14

Figs. 1-2 ***Krithe*** sp. ***A*** p. 123

1. Carapace from right HU.204.T.22 X 92
2. Carapace from left HU.204.T.22 X 97

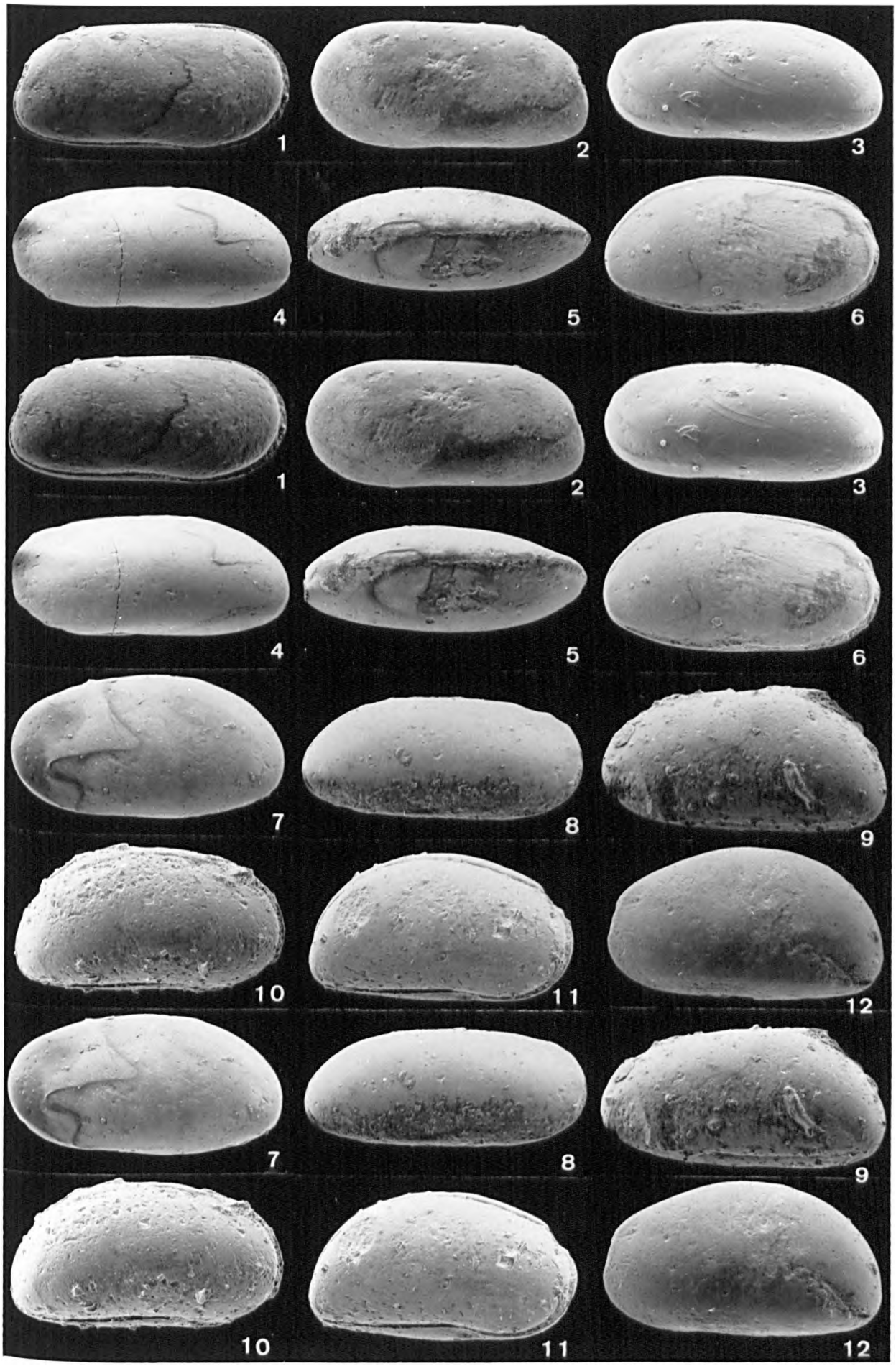
Figs. 3-8 ***Krithe fortidimorphica*** sp. nov. p. 118

3. Holotype, male carapace from left HU.204.T.23 X 85
4. Paratype, male carapace from left HU.204.T.24 X 80
5. Paratype, male carapace, dorsal view HU.204.T.25 X 92
6. Paratype, female carapace from right HU.204.T.26 X 85
7. Paratype, female carapace from left HU.204.T.27 X 85
8. Paratype, male carapace from right HU.204.T.28 X 80

Figs. 9-12 ***Krithe aljurfae*** sp. nov. p. 121

9. Paratype, male carapace from left HU.204.T.29 X 82
10. Paratype, male carapace from right HU.204.T.29 X 80
11. Paratype, female carapace from right HU.204.T.30 X 80
12. Holotype, female carapace from left HU.205.T.1 X 77

PLATE 14



EXPLANATION OF PLATE 15

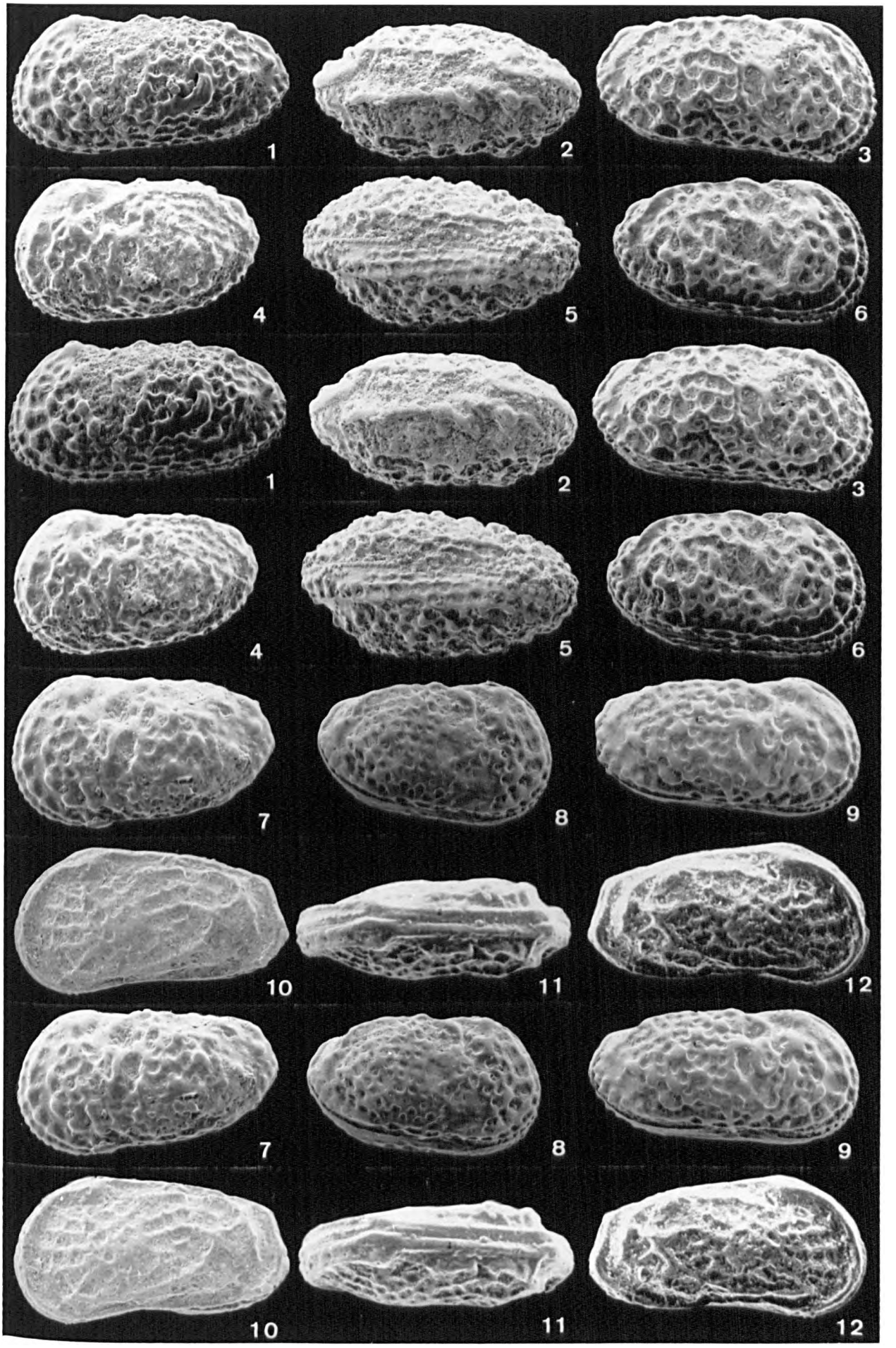
Figs. 1-9 ***Trachyleberis africana*** sp. nov. p. 124

1. Holotype, male carapace from left HU.205.T.2 X 55
2. Paratype, female carapace, dorsal view HU.205.T.3 X 55
3. Paratype, male carapace from right HU.205.T.4 X 52
4. Paratype, female carapace from left HU.205.T.5 X 52
5. Paratype, male carapace, ventral view HU.205.T.6 X 55
6. Paratype, female carapace from right HU.205.T.7 X 55
7. Paratype, female carapace from left HU.205.T.8 X 55
8. Paratype, female carapace from right HU.205.T.9 X 55
9. Paratype, male carapace from right HU.205.T.10 X 50

Figs. 10-12 ***Orionina*** sp. ***A*** p. 252

10. Carapace from left HU.206.T.13 X 92
11. Carapace dorsal view HU.206.T.13 X 100
12. Carapace from right HU.206.T.13 X 100

PLATE 15



EXPLANATION OF PLATE 16

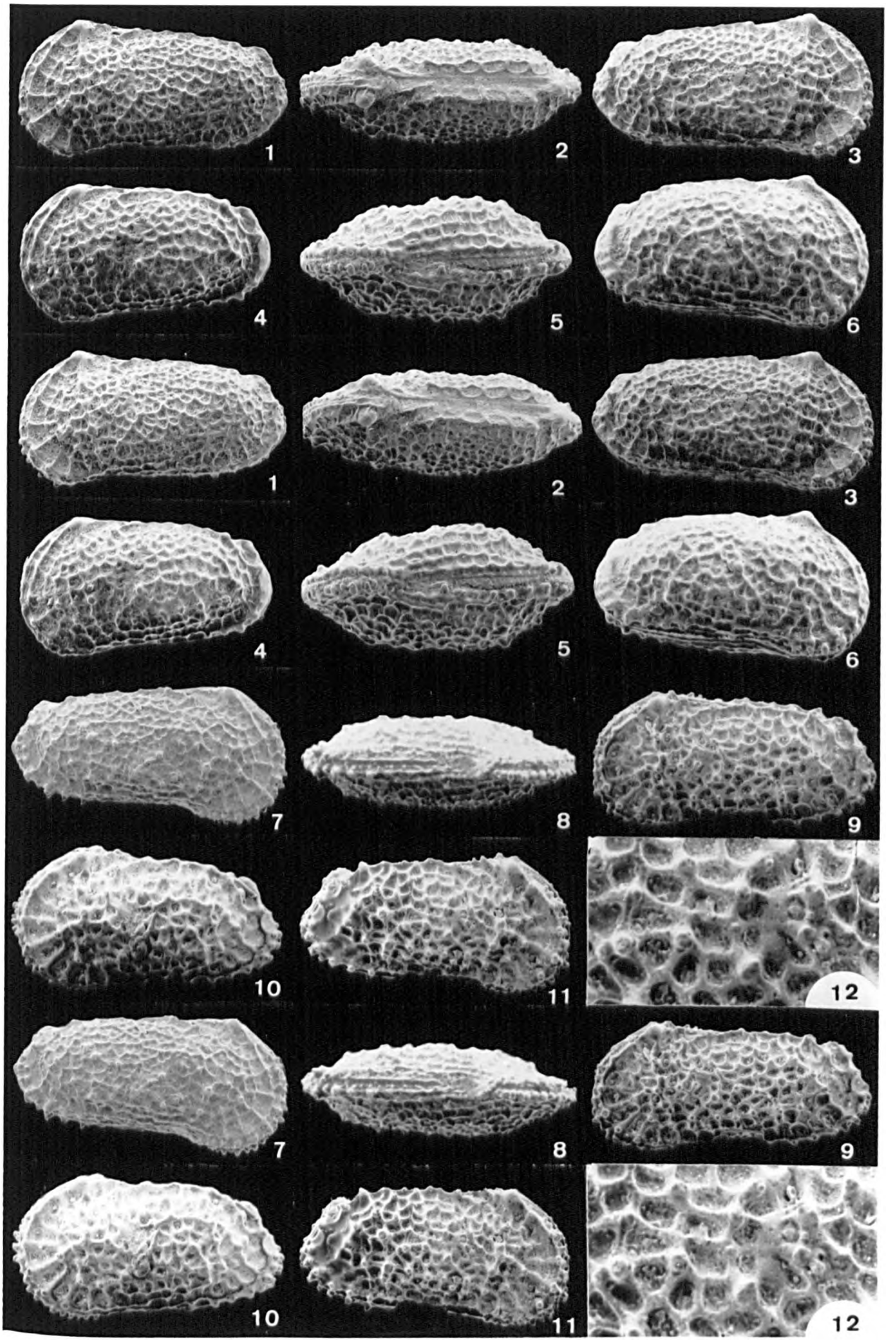
Figs. 1-8 *Acanthocythereis tarabulusensis* sp. nov. p. 130

1. Holotype, male carapace from left HU.205.T.14 X 39
2. Holotype, male carapace, dorsal view HU.205.T.14 X 41
3. Holotype, male carapace from right HU.205.T.14 X 42
4. Paratype, female carapace from left HU.205.T.15 X 42
5. Paratype, female carapace, ventral view HU.205.T.15 X 45
6. Paratype, female carapace from right HU.205.T.15 X 47
7. Paratype, male carapace from right HU.206.T.16 X 42
8. Paratype, male carapace, ventral view HU.206.T.16 X 50

Figs. 9-12 *Acanthocythereis tellilae* sp. nov. p. 132

9. Holotype, male carapace from left HU.205.T.17 X 55
10. Paratype, male carapace from left HU.205.T.18 X 60
11. Holotype, male carapace from right HU.205.T.17 X 46
12. Details of the ornamentation of male holotype HU.205.T.17 X 140

PLATE 16



EXPLANATION OF PLATE 17

Figs. 1-8 ***Acanthocythereis salahi*** Bassiouni, 1969b — p. 135

1. Male, carapace from left HU.205.T.19 — X 41
2. Male, carapace dorsal view HU.205.T.19 — X 45
3. Male, carapace from right HU.205.T.19 — X 42
4. Female, carapace from left HU.205.T.20 — X 45
5. Female, carapace dorsal view HU.205.T.20 — X 60
6. Female, carapace from right HU.205.T.20 — X 45
7. Details of the ornamentation HU.205.T.19 — X 100
8. Male, carapace from left HU.205.T.19 — X 47

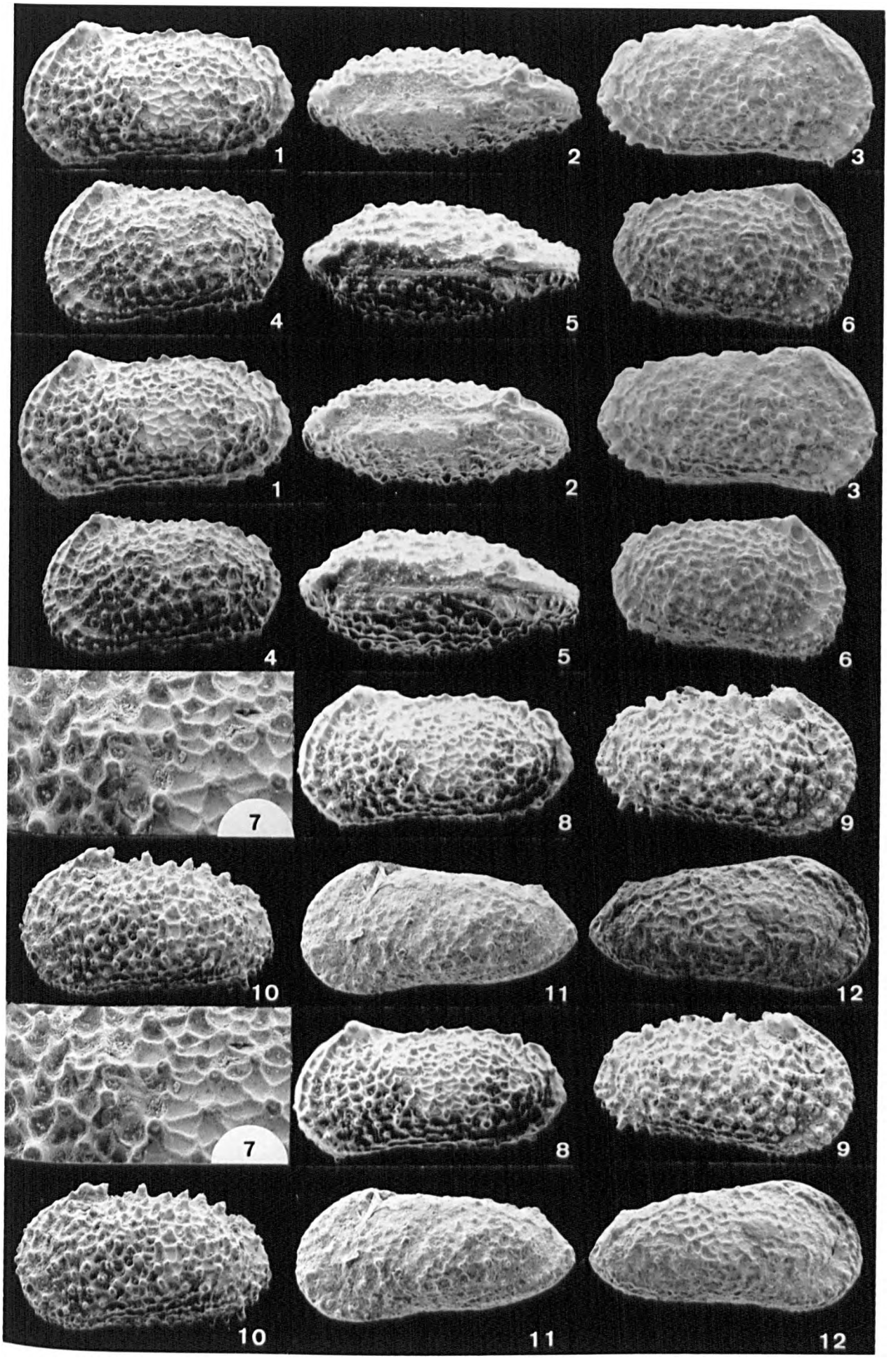
Figs. 9-10 ***Acanthocythereis?*** sp. ***A*** — p. 137

9. Carapace from right HU.205.T.21 — X 55
10. Carapace from left HU.205.T.21 — X 52

Figs. 11-12 ***Acanthocythereis*** sp. ***B*** — p. 139

11. Carapace from left HU.205.T.22 — X 55
12. Carapace from right HU.205.T.22 — X 55

PLATE 17



EXPLANATION OF PLATE 18

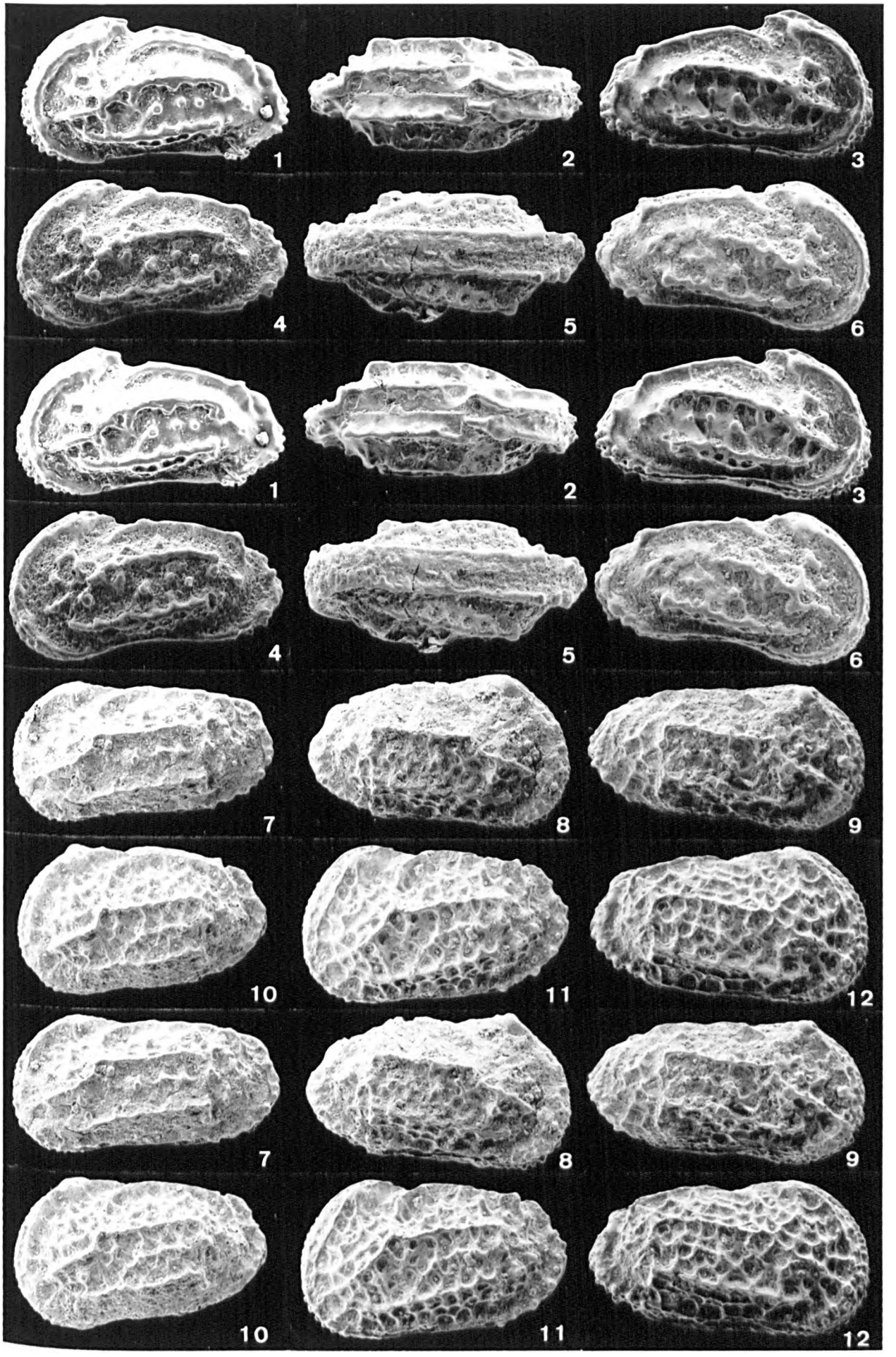
Figs. 1-6 ***Costa oligocaenica*** sp. nov. p. 141

1. Holotype, carapace from left HU.205.T.23 X 65
2. Holotype, carapace dorsal view HU.205.T.23 X 65
3. Holotype, carapace from right HU.205.T.23 X 67
4. Paratype, carapace from left HU.205.T.24 X 72
5. Paratype, carapace ventral view HU.205.T.24 X 75
6. Paratype, carapace from right HU.205.T.24 X 72

Figs. 7-12 ***Costa libyaensis*** sp. nov. p. 144

7. Holotype, male carapace from left HU.205.T.25 X 52
8. Paratype, female carapace from right HU.205.T.26 X 52
9. Paratype, male carapace from right HU.205.T.27 X 52
10. Paratype, female carapace from left HU.205.T.28 X 47
11. Paratype, female carapace from left HU.205.T.29 X 57
12. Paratype, female carapace from right HU.205.T.30 X 57

PLATE 18



EXPLANATION OF PLATE 19

Figs. 1-2 ***Costa libyaensis*** sp. nov. p. 144

1. Male, carapace from left HU.206.T.1 X 45
2. Male, carapace from right HU.206.T.2 X 47

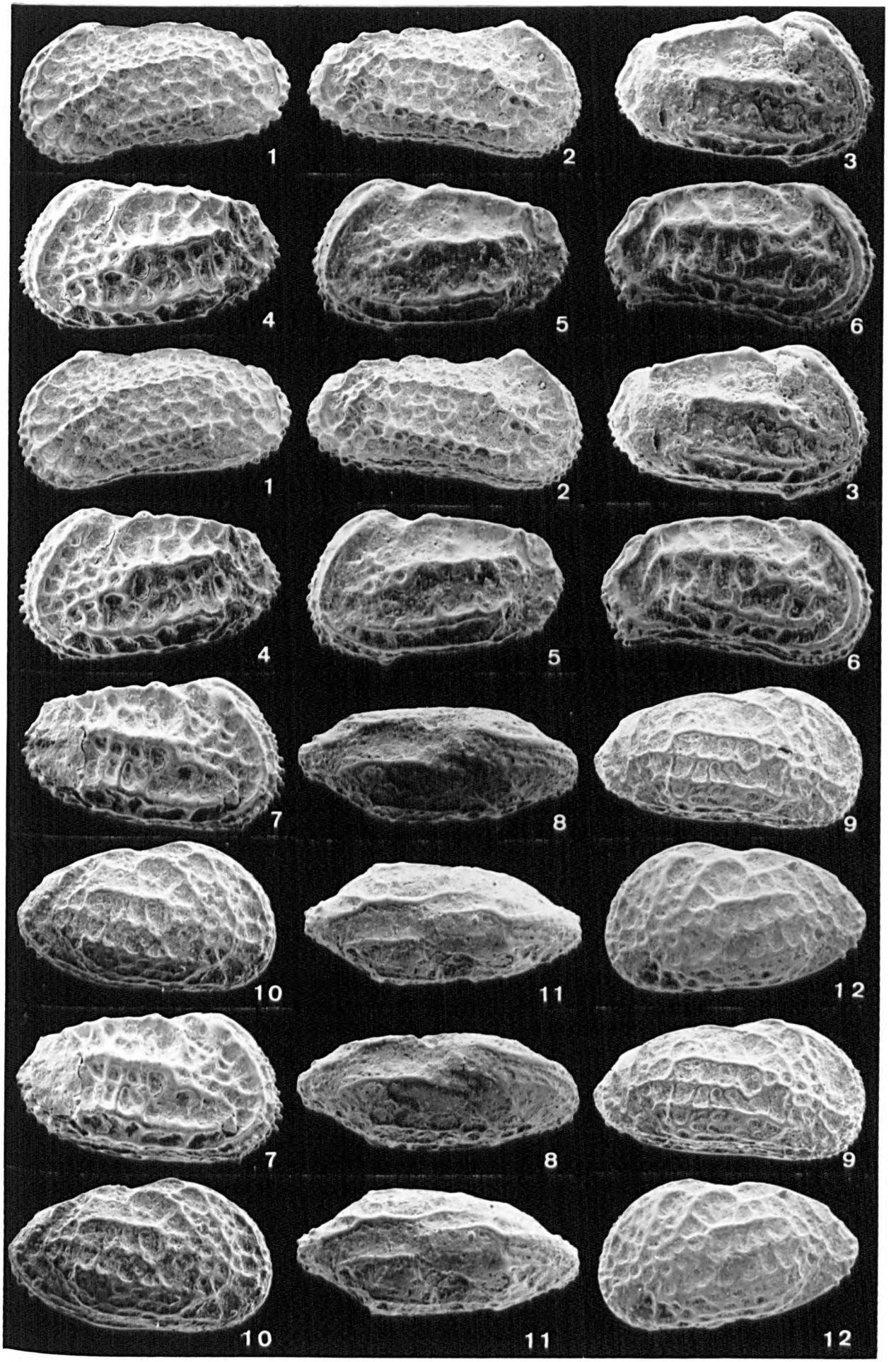
Figs. 3-7 ***Paleocosta*** sp. ***A*** p. 151

3. Female, carapace from right HU.206.T.3 X 75
4. Female, carapace from left HU.206.T.4 X 67
5. Female, carapace from left HU.206.T.3 X 72
6. Male, carapace from right HU.206.T.5 X 70
7. Female, carapace from right HU.206.T.4 X 67

Figs. 8-12 ***Paleocosta ghalilae*** sp. nov. p. 146

8. Holotype, male carapace, dorsal view HU.206.T.6 X 65
9. Holotype, male carapace from right HU.206.T.6 X 57
10. Paratype, female carapace from right HU.206.T.7 X 62
11. Paratype, female carapace, dorsal view HU.206.T.7 X 57
12. Paratype, female carapace from left HU.206.T.7 X 61

PLATE 19



EXPLANATION OF PLATE 20

Figs. 1-3, 8 ***Paleocosta bensoni*** Damotte & Donze, 1982 — p. 149

1. Female, carapace from left HU.206.T.8 — X 70
2. Male, carapace from left HU.206.T.9 — X 62
3. Female, carapace from right HU.206.T.10 — X 72
8. Female, carapace from left HU.206.T.11 — X 80

Figs. 4-5 ***Oblitacythereis (P.) ruggierii*** (Russo, 1964) — p. 153

4. Carapace from left HU.206.T.12 — X 52
5. Carapace from right HU.206.T.12 — X 55

Figs. 6-7 ***Occultocythereis*** sp. ***A***

6. Carapace from right HU.206.T.14 — X 95
7. Carapace from left HU.206.T.14 — X 92

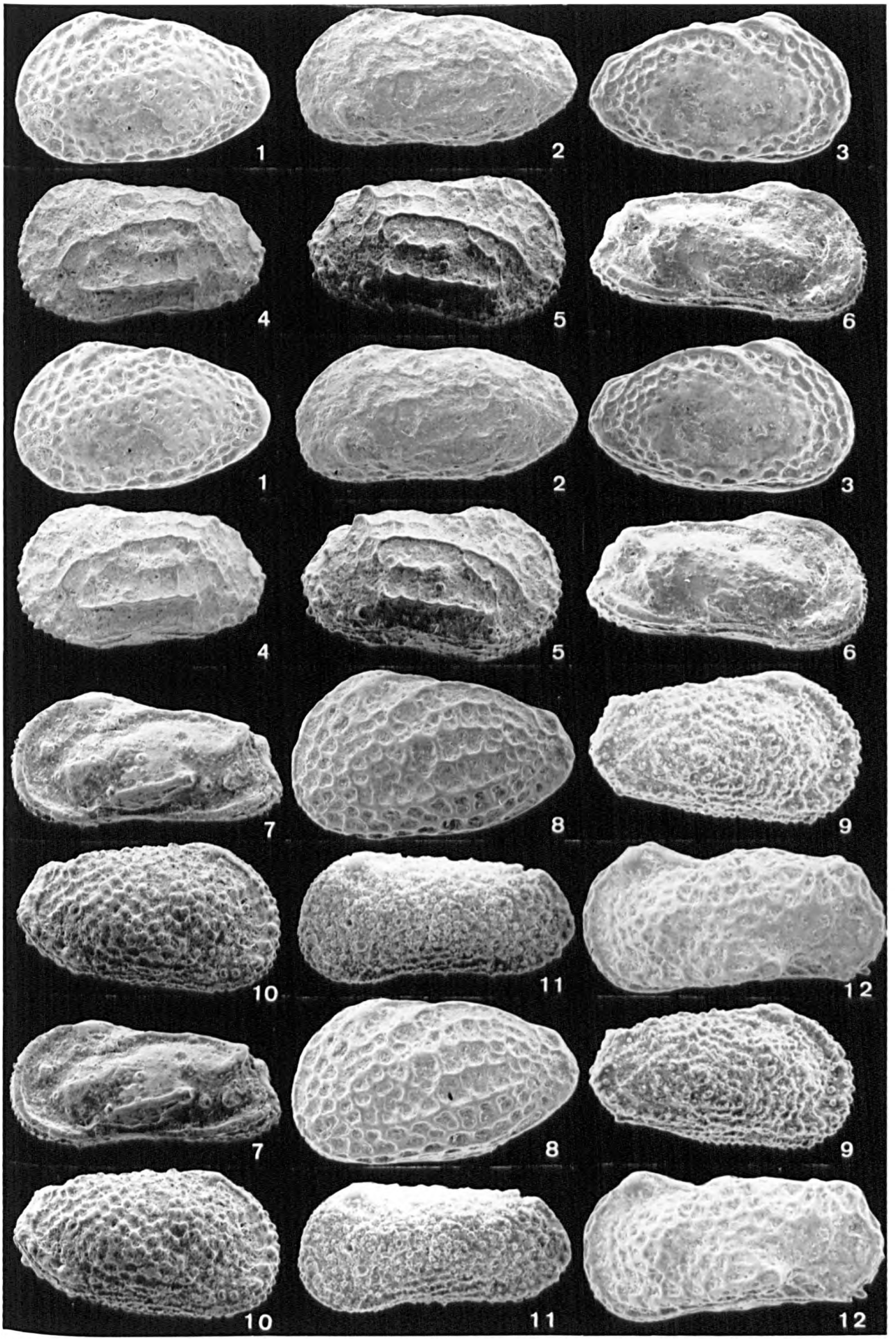
Figs. 9-11 ***Trachyleberis tarabulusensis*** sp. nov. — p. 127

9. Paratype, female carapace from right HU.205.T.11 — X 70
10. Paratype, female carapace from right HU.205.T.12 — X 70
11. Holotype, male carapace from left HU.205.T.13 — X 55

Fig. 12 ***Cristaeleberis*** sp. ***A*** — p. 255

12. Male, carapace from left HU.206.T.15 — X 50

PLATE 20



EXPLANATION OF PLATE 21

Figs. 1-3 ***Brachycythere tarabulusensis*** sp. nov. p. 162

1. Paratype, female carapace from right HU.206.T.16 X 50
2. Paratype, female carapace from left HU.206.T.17 X 50
3. Holotype, male carapace from right HU.206.T.18 X 45

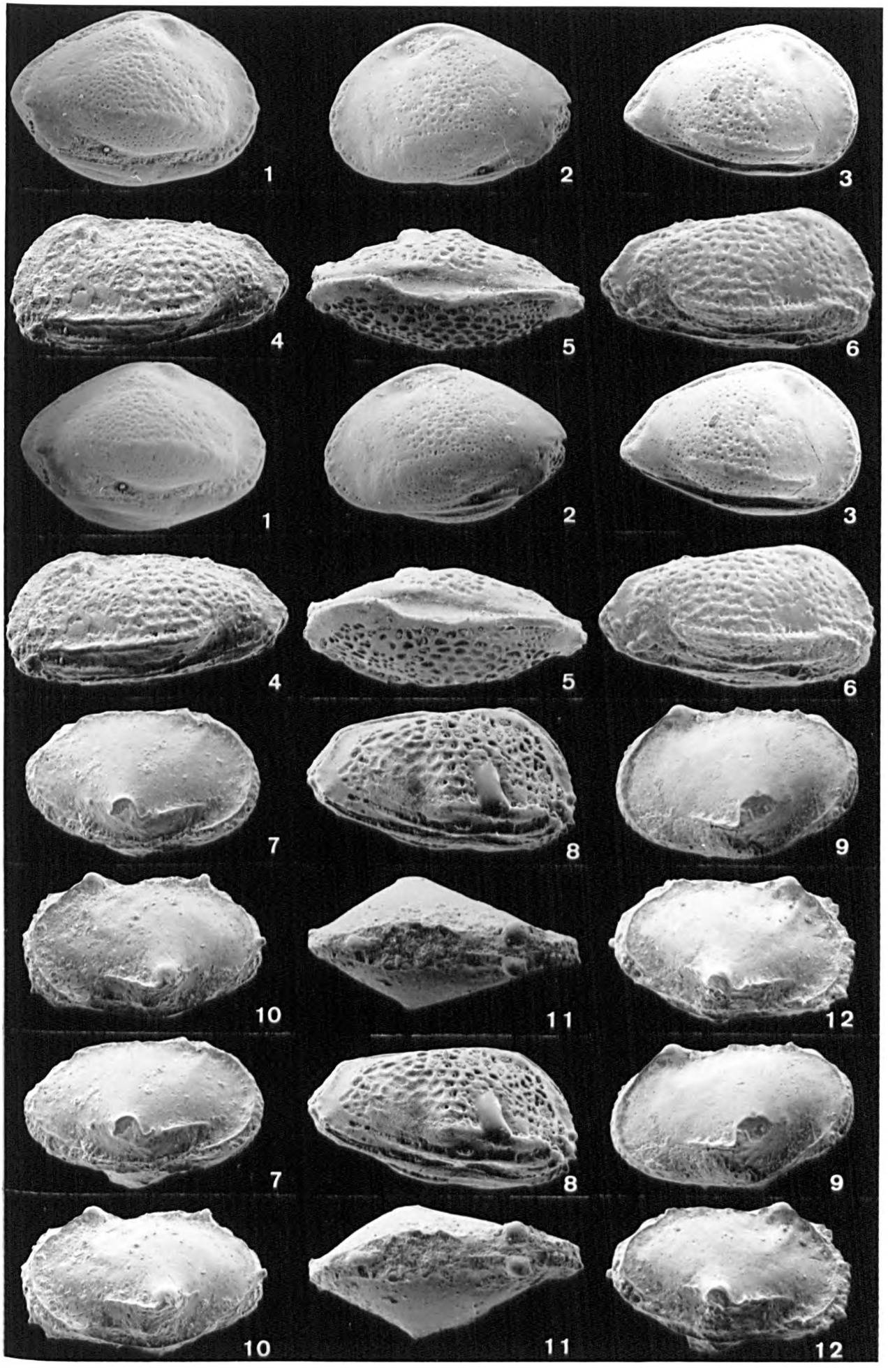
Figs. 4-6, 8 ***Opimocythere africana*** sp. nov. p. 165

4. Holotype, male carapace from left HU.206.T.19 X 55
5. Holotype, female carapace, dorsal view HU.206.T.20 X 52
6. Holotype, male carapace from right HU.206.T.19 X 55
8. female,carapace from right HU.206.T.20 X 55

Figs. 7, 9-12 ***Pterygocythereis tarabulusensis*** sp. nov. p. 158

7. Paratype, female carapace from right HU.206.T.22 X 70
9. Paratype, female carapace from left HU.206.T.23 X 70
10. Holotype, male carapace from left HU.206.T.21 X 57
11. Paratype, male carapace, dorsal view HU.206.T.24 X 77
12. Holotype, male carapace from right HU.206.T.21 X 60

PLATE 21



EXPLANATION OF PLATE 22

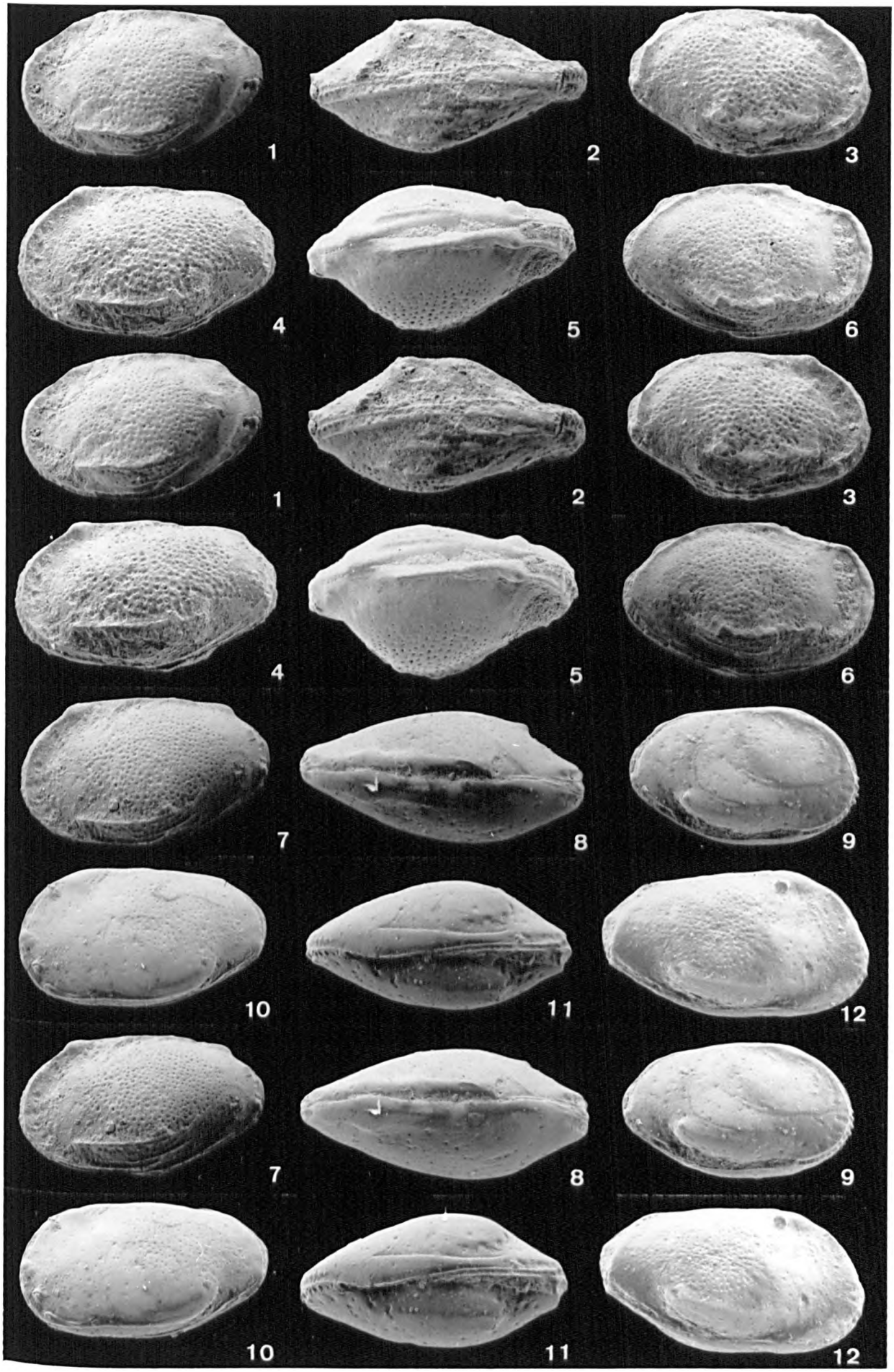
Figs. 1-7 ***Dahomeya alata*** Apostolescu, 1961 p. 167

1. Female, carapace from left HU.206.T.25 X 45
2. Female, carapace ventral view HU.206.T.26 X 55
3. Male, carapace from right HU.206.T.27 X 45
4. Male, carapace from left HU.206.T.27 X 47
5. Female, carapace dorsal view HU.206.T.28 X 55
6. Female, carapace from right HU.206.T.25 X 47
7. Male, carapace from left HU.206.T.29 X 47

Figs. 8-12 ***Dahomeya mediterranea*** sp. nov. p. 169

8. Paratype, male carapace, dorsal view HU.206.T.30 X 67
9. Paratype, female carapace from right HU.207.T.1 X 57
10. Paratype, male carapace from left HU.207.T.2 X 57
11. Paratype, female carapace, ventral view HU.207.T.3 X 67
12. Holotype, male carapace from right HU.207.T.4 X 67

PLATE 22



EXPLANATION OF PLATE 23

Fig. 1 ***Dahomeya*** sp. ***A*** p. 172

1. Carapace from right HU.207.T.5 X 75

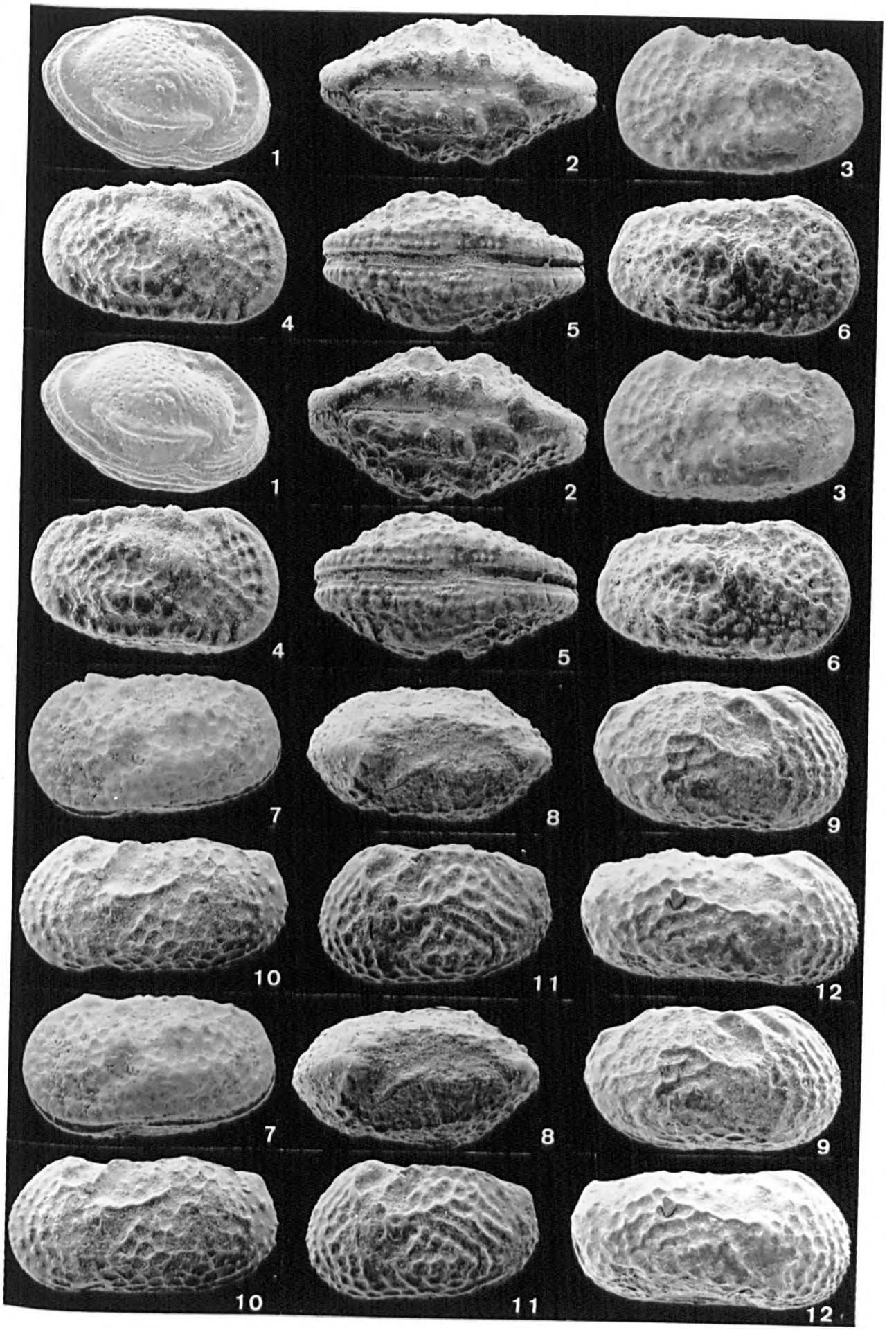
Figs. 2-7 ***Henryhowella*** sp. A p. 175

2. Carapace dorsal view HU.207.T.6 X 62
3. Carapace from left HU.207.T.6 X 57
4. Carapace from right HU.207.T.6 X 57
5. Carapace ventral view HU.207.T.7 X 67
6. Carapace from right HU.207.T.7 X 67
7. Carapace from left HU.207.T.7 X 67

Figs. 8-12 ***Echinocythereis libyaensis*** sp. nov. p. 182

8. Paratype, female carapace, dorsal view HU.207.T.8 X 60
9. Paratype, female carapace from right HU.207.T.9 X 60
10. Holotype, male carapace from left HU.207.T.10 X 50
11. Paratype, female carapace from left HU.207.T.11 X 60
12. Paratype, male carapace from right HU.207.T.12 X 55

PLATE 23



EXPLANATION OF PLATE 24

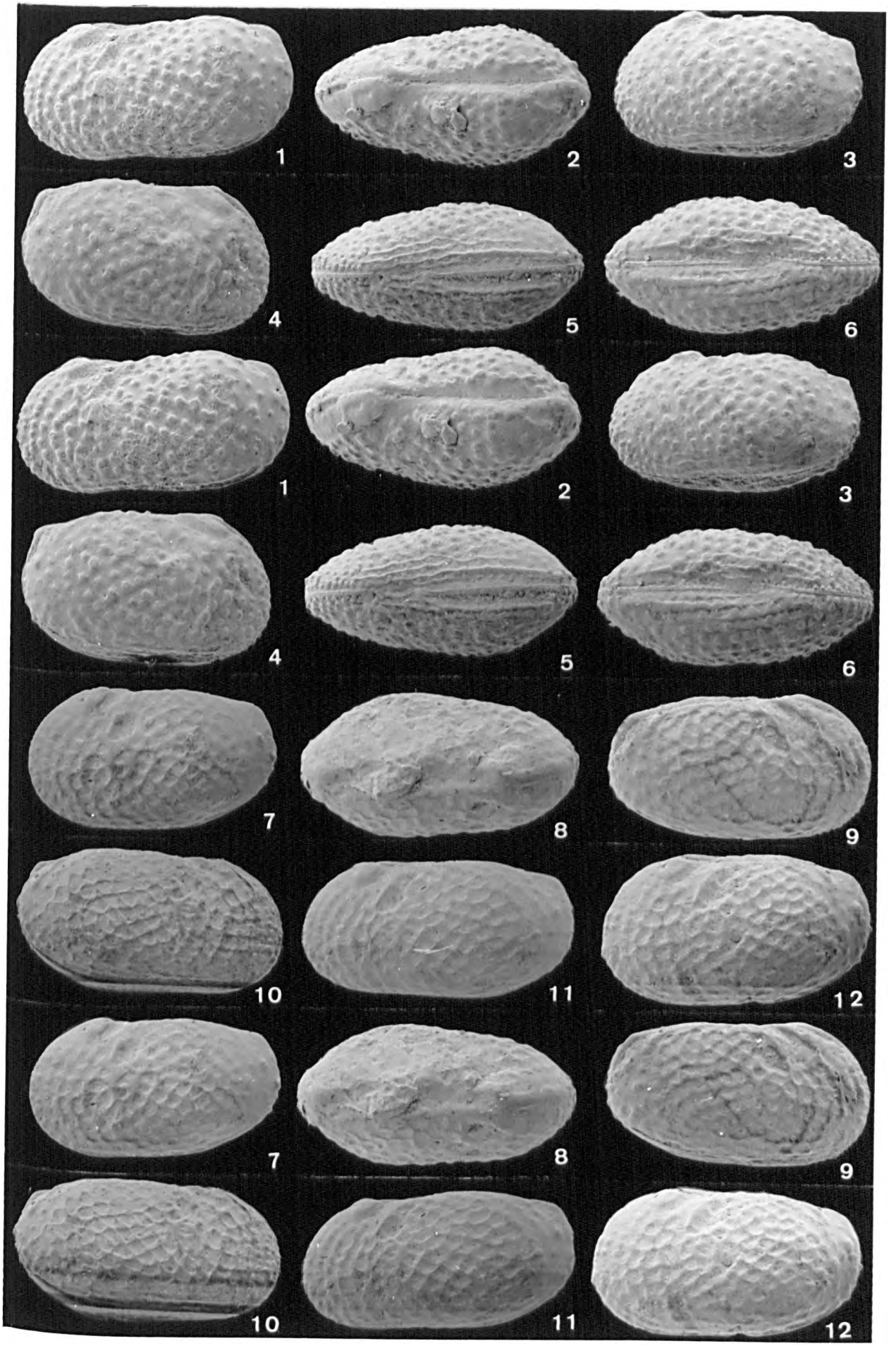
1-6 ***Echinocythereis harshae*** sp. nov. p. 176

1. Holotype, male carapace from left HU.207.T.13 X 54
2. Paratype, male carapace, dorsal view HU.207.T.14 X 54
3. Paratype, female carapace from left HU.207.T.15 X 63
4. Paratype, female carapace from right HU.207.T.16 X 61
5. Paratype, male carapace, ventral view HU.207.T.17 X 56
6. Paratype, female carapace ventral view HU.207.T.18 X 64

Figs. 7-12 ***Echinocythereis samdunae*** sp. nov. p. 172

7. Paratype, female carapace from left HU.207.T.19 X 54
8. Paratype, female carapace, dorsal view HU.207.T.20 X 62
9. Paratype, female carapace from right HU.207.T.21 X 57
10. Paratype, male carapace from right HU.207.T.22 X 49
11. Holotype, male carapace from left HU.207.T.23 X 49
12. Paratype, female carapace from left HU.207.T.24 X 57

PLATE 24



EXPLANATION OF PLATE 25

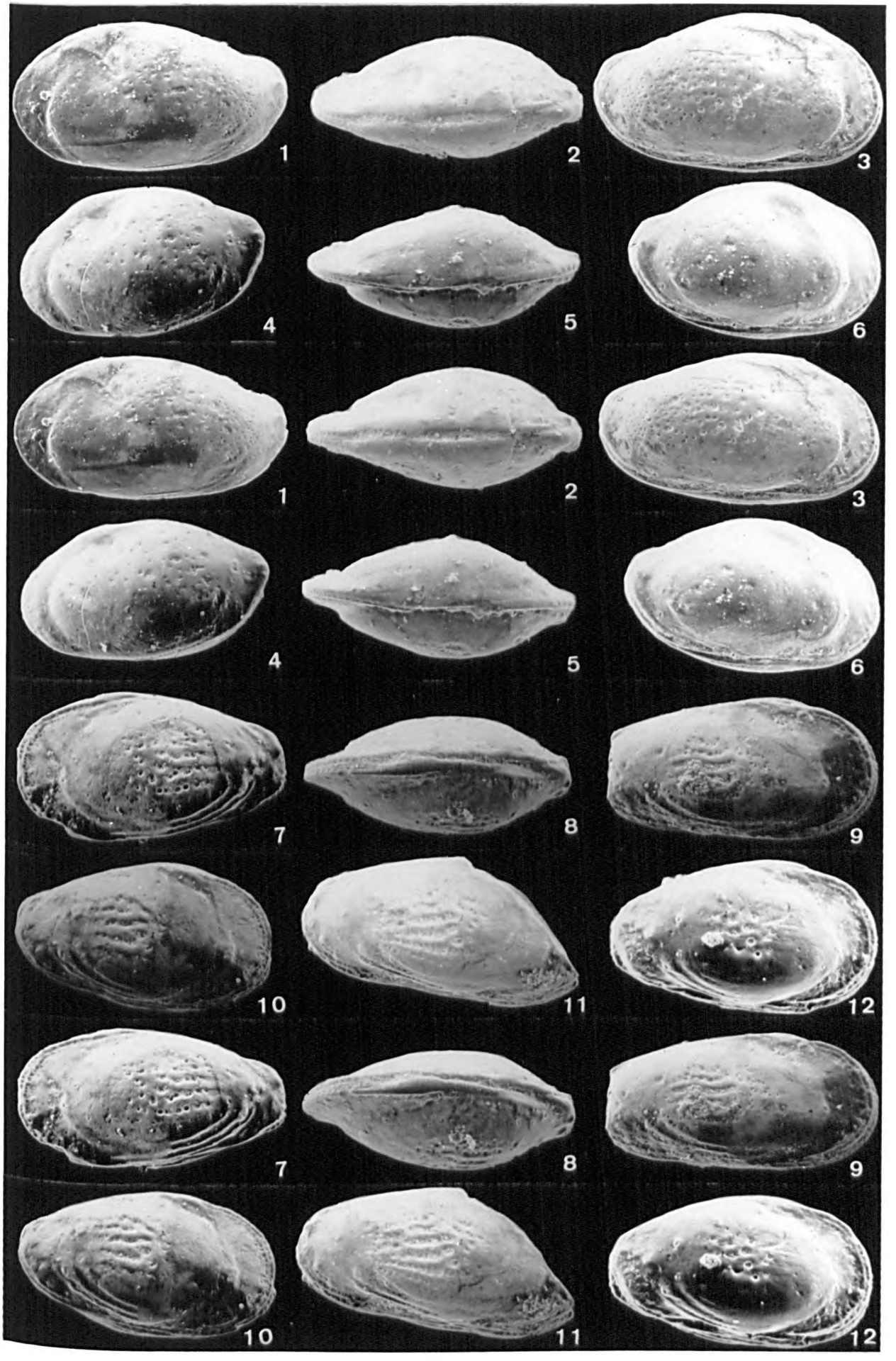
Figs. 1-6 ***Buntonia beninensis*** Reyment, 1960 p. 184

1. Male, carapace from left HU.207.T.25 X 70
2. Male, carapace dorsal view HU.207.T.26 X 80
3. Male, carapace from right HU.207.T.27 X 70
4. Female, carapace from left HU.207.T.28 X 75
5. Female, carapace ventral view HU.207.T.29 X 80
6. Female, carapace from right HU.207.T.30 X 70

Figs. 7-12 ***Buntonia sbetai*** sp. nov. p. 187

7. Holotype, female carapace from left HU.208.T.1 X 90
8. Paratype, female carapace, dorsal view HU.208.T.2 X 90
9. Paratype, male carapace from right HU.208.T.3 X 80
10. Paratype, female carapace from right HU.208.T.4 X 90
11. Paratype, broken male carapace from right HU.208.T.5 X 85
12. Paratype, female carapace from right HU.208.T.6 X 90

PLATE 25



EXPLANATION OF PLATE 26

Figs. 1-6 ***Buntonia aljurfae*** sp. nov. p. 190

1. Holotype, male carapace from left HU.208.T.7 X 77
2. Paratype, female carapace, dorsal view HU.208.T.8 X 82
3. Holotype, male carapace from right HU.208.T.7 X 70
4. Paratype, female carapace from left HU.208.T.8 X 80
5. Holotype, male carapace, dorsal view HU.208.T.7 X 77
6. Paratype, female carapace from right HU.208.T.8 X 75

Figs. 7-12 ***Buntonia ghalilae*** sp. nov. p. 193

7. Holotype, female carapace from left HU.208.T.9 X 85
8. Paratype, male carapace from left HU.208.T.10 X 90
9. Paratype, female carapace from left HU.208.T.11 X 90
10. Paratype, male carapace from right HU.208.T.12 X 90
11. Paratype, female carapace from left HU.208.T.13 X 90
12. Paratype, male carapace from right HU.208.T.14 X 85

PLATE 26

EXPLANATION OF PLATE 27

Figs. 1-9, 11 ***Buntonia harshae*** sp. nov. p. 199

1. Holotype, male carapace from left HU.208.T.15 X 85
2. Holotype, male carapace, dorsal view HU.208.T.15 X 87
3. Holotype, male carapace from right HU.208.T.15 X 85
4. Paratype, female carapace from left HU.208.T.16 X 87
5. Paratype, female carapace, dorsal view HU.208.T.16 X 90
6. Paratype, female carapace from right HU.208.T.16 X 87
7. Paratype, female carapace from left HU.208.T.17 X 90
8. Paratype, female carapace, dorsal view HU.208.T.17 X 97
9. Paratype, female carapace from right HU.208.T.17 X 95
11. Paratype, female carapace, ventral view HU.208.T.17 X 110

Figs. 10, 12 ***Buntonia*** sp. ***A*** p. 201

10. Carapace from right HU.208.T.20 X 100
12. Carapace from left HU.208.T.21 X 90

PLATE 27

EXPLANATION OF PLATE 28

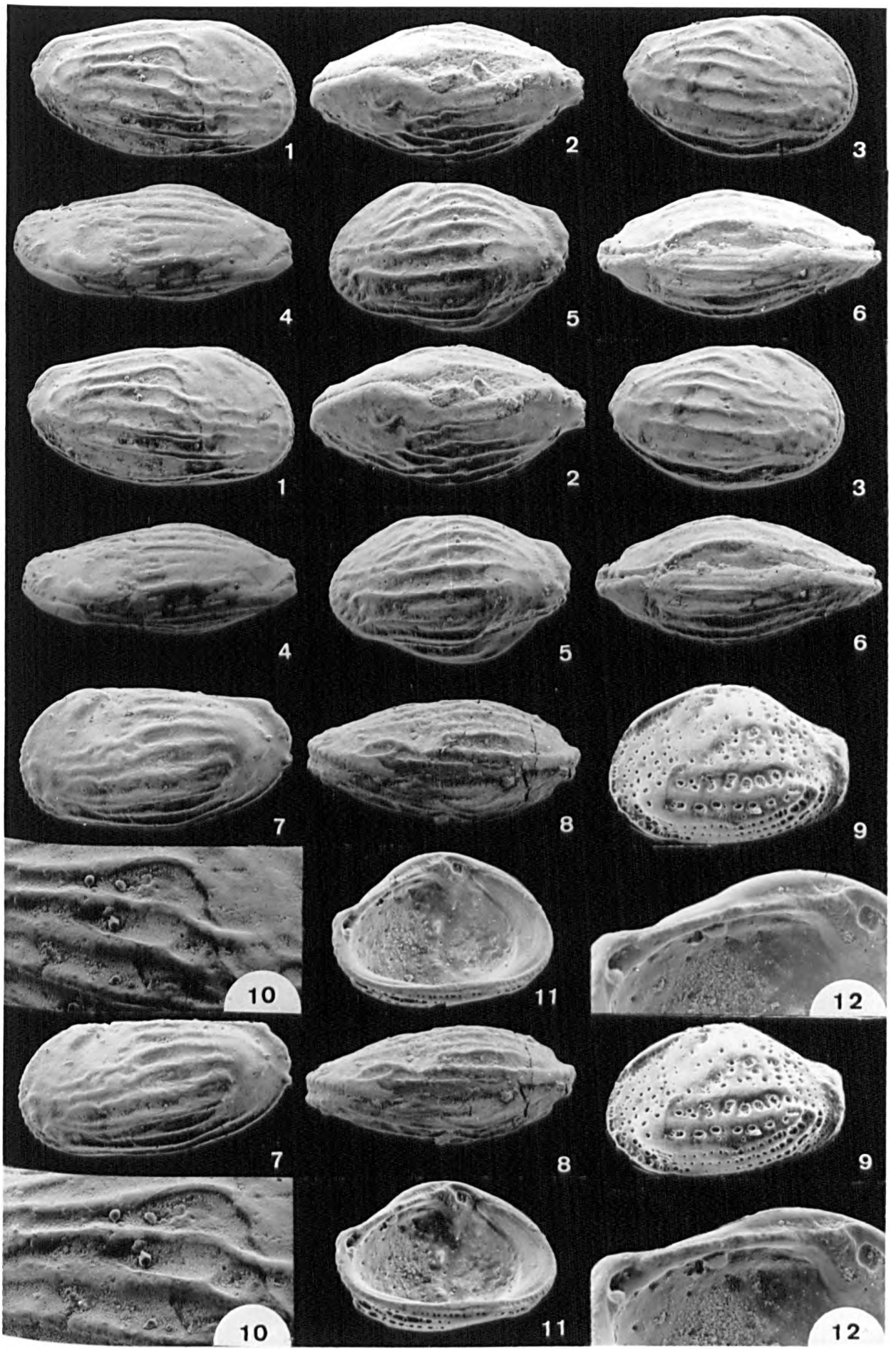
Figs. 1-8, 10 ***Buntonia tellilae*** sp. nov. p. 195

1. Holotype, male carapace from right HU.208.T.22 X 50
2. Paratype, female carapace, dorsal view HU.208.T.23 X 58
3. Paratype, female carapace from right HU.208.T.24 X 66
4. Paratype, male carapace, dorsal view HU.208.T.25 X 46
5. Paratype, female carapace from left HU.208.T.26 X 50
6. Paratype, female carapace, ventral view HU.208.T.27 X 51
7. Paratype, male carapace from left HU.208.T.28 X 50
8. Paratype, male carapace, ventral view HU.208.T.29 X 50
10. Details of the ornamentation of the male HU.208.T.22 X 110

Figs. 9, 11-12 ***Buntonia sublatissima*** (Neviani, 1906) p. 198

9. Left valve, external view HU.209.T.1 X 75
11. Left valve, internal view HU.209.T.1 X 72
12. Hinge view HU.209.T.1 X 150

PLATE 28



EXPLANATION OF PLATE 29

Figs. 1-2 ***Buntonia harshae*** sp. nov. p. 199

1. Paratype, female carapace from left HU.208.T.18 X 87
2. Paratype, female carapace from right HU.208.T.18 X 87

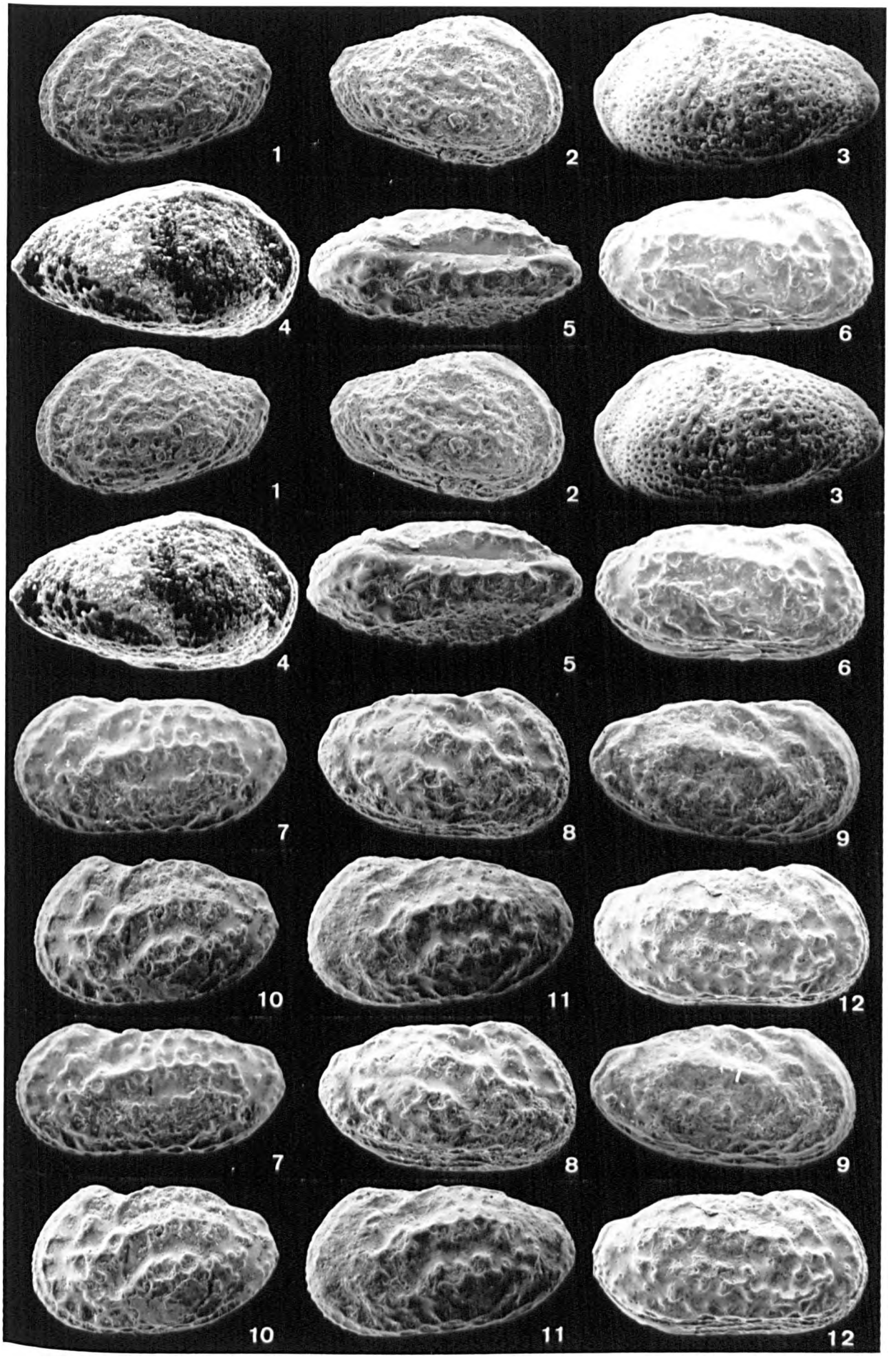
Figs. 3-4 ***Protobuntonia*** sp. ***A*** p. 203

3. Carapace from left HU.209.T.2 X 137
4. Carapace from right HU.209.T.2 X 137

Figs. 5-12 ***Isobuntonia pseudotuberata*** (Apostolescu & Magne, 1956) p. 205

5. Male, carapace dorsal view HU.209.T.3 X 47
6. Male, carapace from right HU.209.T.3 X 47
7. Male, carapace from left HU.209.T.4 X 52
8. Female, carapace from right HU.209.T.5 X 50
9. Female, carapace from right HU.209.T.6 X 60
10. Female, carapace from left HU.209.T.7 X 50
11. Female, carapace from left HU.209.T.6 X 52
12. Male, carapace from right HU.209.T.4 X 47

PLATE 29

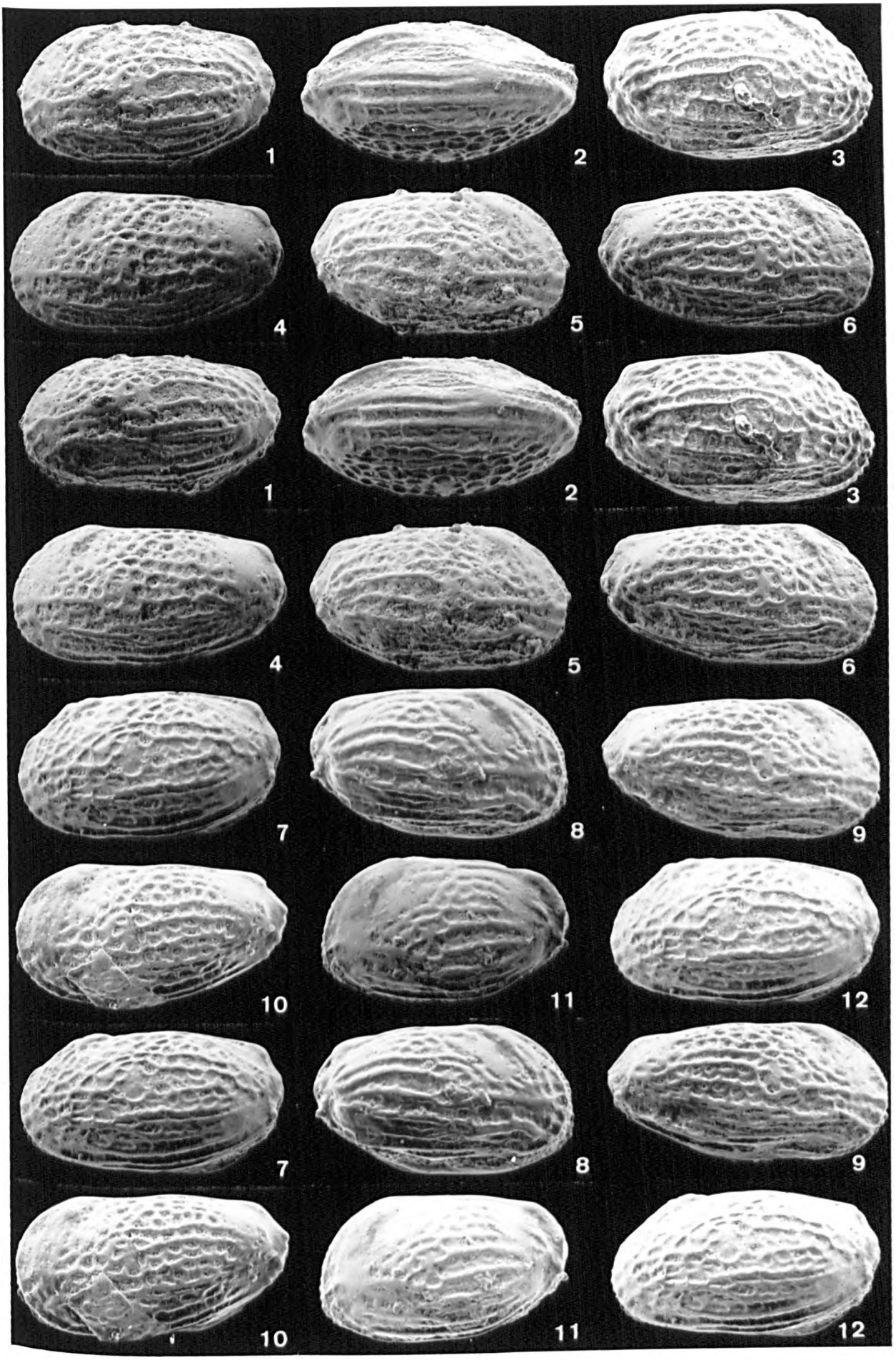


EXPLANATION OF PLATE 30

Figs. 1-12 ***Asymmetricythere nova*** sp. nov. p. 215

1. Paratype, female carapace from left HU.209.T.8 X 60
2. Holotype, female carapace, ventral view HU.209.T.9 X 62
3. Holotype, female carapace from right HU.209.T.9 X 60
4. Paratype, male carapace from left HU.209.T.10 X 62
5. Paratype, female carapace from right HU.209.T.8 X 62
6. Paratype, male carapace from right HU.209.T.10 X 62
7. Holotype, female carapace from left HU.209.T.9 X 62
8. Paratype, female carapace from right HU.209.T.11 X 60
9. Paratype, male carapace from right HU.209.T.12 X 60
10. Paratype, male carapace from left HU.209.T.12 X 60
11. Paratype, female carapace from left HU.209.T.11 X 57
12. Holotype, female carapace from left HU.209.T.9 X 62

PLATE 30



EXPLANATION OF PLATE 31

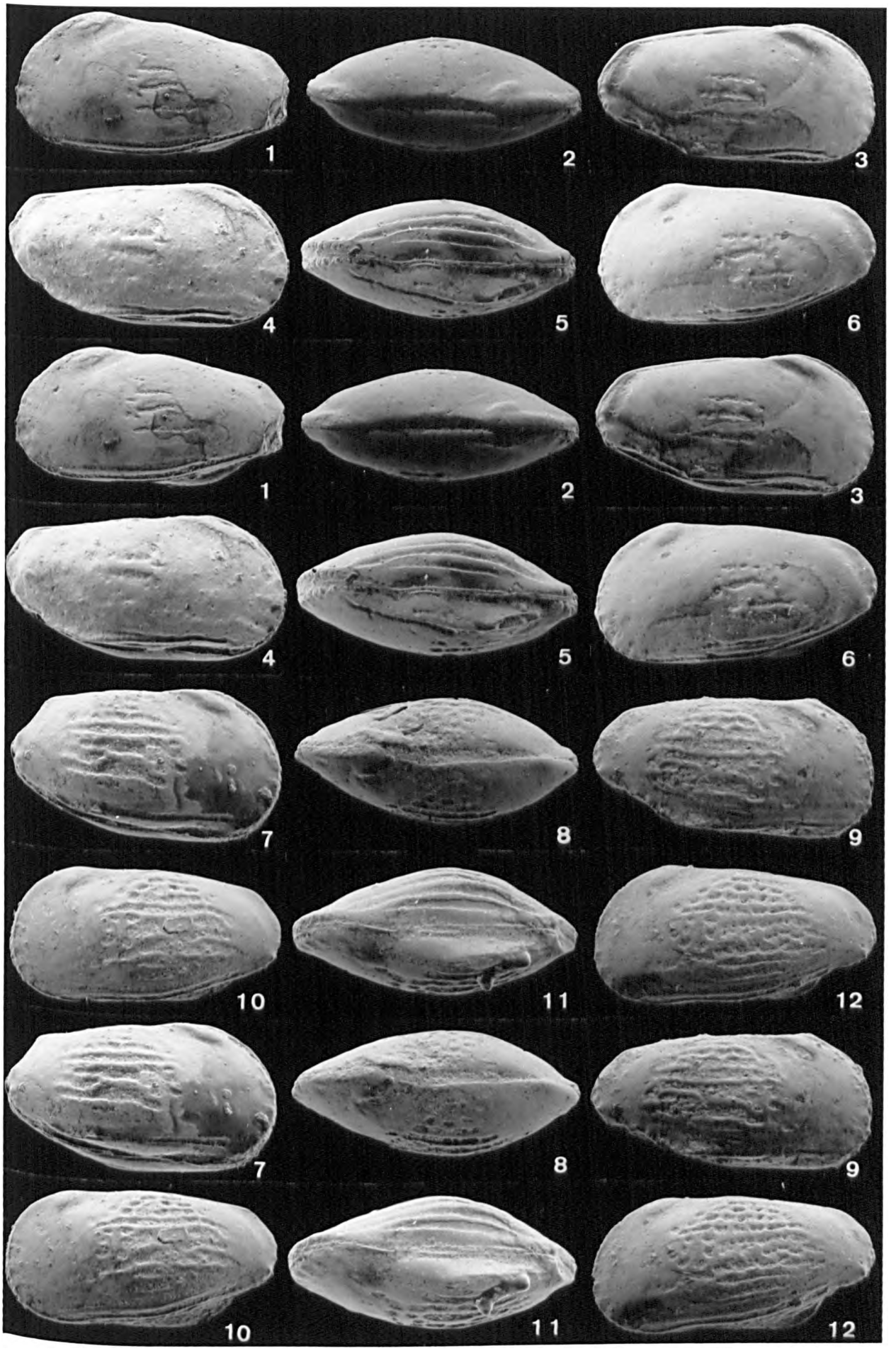
Figs. 1-6 ***Asymmetricythere fossorum*** sp. nov. p. 217

1. Holotype, male carapace from left HU.209.T.13 X 47
2. Paratype, male carapace, dorsal view HU.209.T.14 X 50
3. Paratype, male carapace from right HU.209.T.15 X 48
4. Paratype, female carapace from right HU.209.T.16 X 57
5. Paratype, male carapace, ventral view HU.209.T.15 X 48
6. Paratype, male carapace from left HU.209.T.14 X 52

Figs. 7-12 ***Asymmetricythere elongata*** sp. nov. p. 221

7. Paratype, female carapace from right HU.209.T.17 X 47
8. Paratype, male carapace, dorsal view HU.209.T.18 X 47
9. Paratype, male carapace from right HU.209.T.19 X 46
10. Holotype, male carapace from left HU.209.T.20 X 52
11. Paratype, male carapace, ventral view HU.209.T.21 X 47
12. Paratype, male carapace from left HU.209.T.22 X 46

PLATE 31



EXPLANATION OF PLATE 32

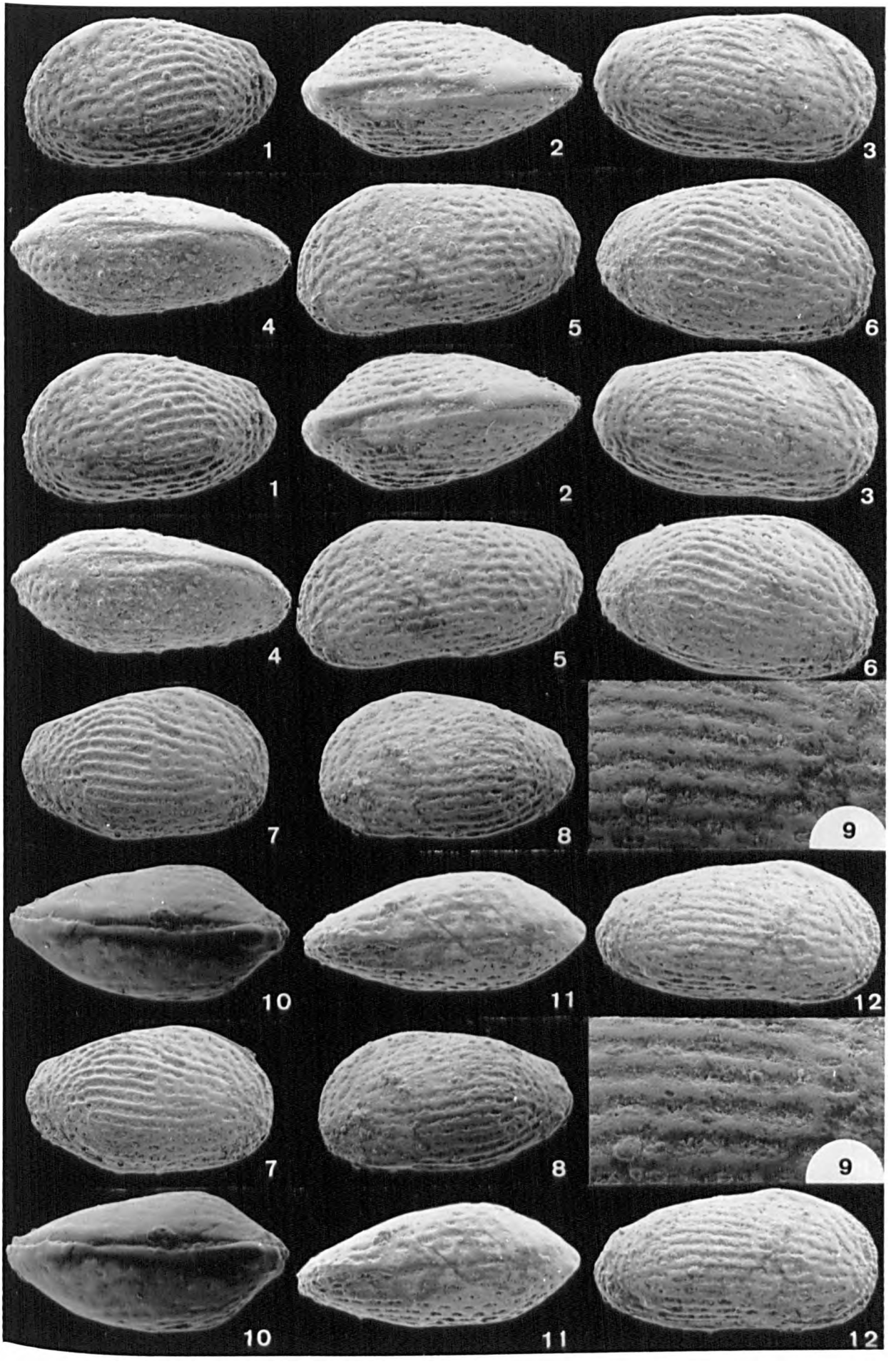
Figs. 1-9, 11, 12 ***Soudanella libyaensis*** sp. nov. p. 207

1. Holotype, female carapace from left HU.209.T.23 X 65
2. Paratype, female carapace, dorsal view HU.209.T.24 X 72
3. Paratype, male carapace from right HU.209.T.25 X 74
4. Paratype, male carapace, dorsal view HU.209.T.26 X 67
5. Paratype, male carapace from left HU.209.T.27 X 73
6. Paratype, female carapace from right HU.209.T.28 X 65
7. Paratype, female carapace from right HU.209.T.29 X 65
8. Paratype, female carapace from left HU.209.T.30 X 65
9. Details of the ornamentation HU.210.T.1 X 170
11. Paratype, male carapace, ventral view HU.210.T.2 X 70
12. Paratype, male carapace from right HU.210.T.1 X 70

Fig. 10 ***Soudanella ghalilae*** sp. nov. p. 210

10. Paratype, female carapace, dorsal view HU.210.T.3 X 72

PLATE 32



EXPLANATION OF PLATE 33

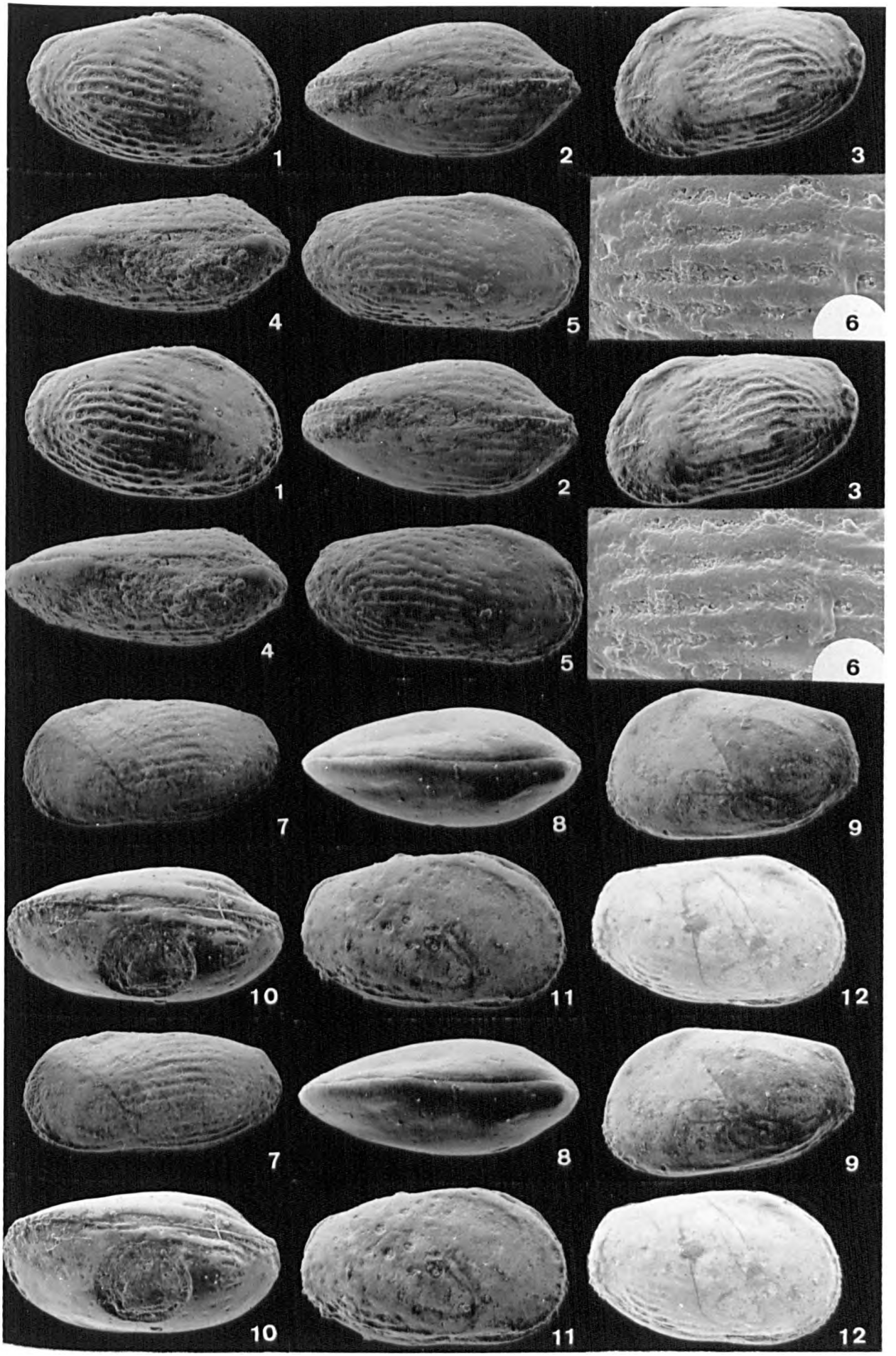
Figs. 1-7 ***Soudanella ghalilae*** sp. nov. p. 210

1. Holotype, female carapace from right HU.210.T.4 X 67
2. Paratype, female carapace, ventral view HU.210.T.5 X 70
3. Paratype, female carapace from left HU.210.T.6 X 67
4. Paratype, male carapace, dorsal view HU.210.T.7 X 66
5. Paratype, male carapace from right HU.210.T.8 X 67
6. Details of the ornamentation of male HU.210.T.8 X 210
7. Paratype, male carapace from left HU.210.T.9 X 67

Figs. 8-12 ***Soudanella tarabulusensis*** sp. nov. p. 212

8. Paratype, female carapace, dorsal view HU.210.T.10 X 77
9. Holotype, female carapace from left HU.210.T.11 X 66
10. Paratype, female carapace, ventral view HU.210.T.12 X 74
11. Paratype, female carapace from right HU.210.T.13 X 70
12. Paratype, female carapace from right HU.210.T.14 X 67

PLATE 33



EXPLANATION OF PLATE 34

Figs. 1-4 ***Leguminocythereis lokossaensis*** Apostolescu, 1961 p. 223

1. Female, carapace from right HU.210.T.15 X 65
2. Female, carapace dorsal view HU.210.T.16 X 65
3. Female, carapace from left HU.210.T.17 X 65
4. Male, carapace from left HU.210.T.18 X 65

Figs. 5-6 ***Leguminocythereis lagaghiroboensis*** Apostolescu, 1961 p. 225

5. Carapace from left HU.210.T.19 X 47
6. Carapace from right HU.210.T.19 X 47

Figs. 7-12 ***Leguminocythereis libyaensis*** sp. nov. p. 227

7. Female, carapace from left HU.210.T.20 X 47
8. Female carapace from right HU.210.T.21 X 52
9. Female carapace from right HU.210.T.22 X 55
10. Holotype, male carapace from left HU.210.T.23 X 52
11. Female carapace from right HU.210.T.24 X 52
12. Paratype, male carapace from right HU.210.T.25 X 52

PLATE 34

EXPLANATION OF PLATE 35

Figs. 1-4 ***Leguminocythereis tellilae*** sp. nov. p. 230

1. Holotype, male carapace from left HU.210.T.26 X 65
2. Paratype, female carapace from right HU.210.T.27 X 65
3. Holotype, male carapace from right HU.210.T.26 X 70
4. Paratype, female carapace from left HU.210.T.28 X 65

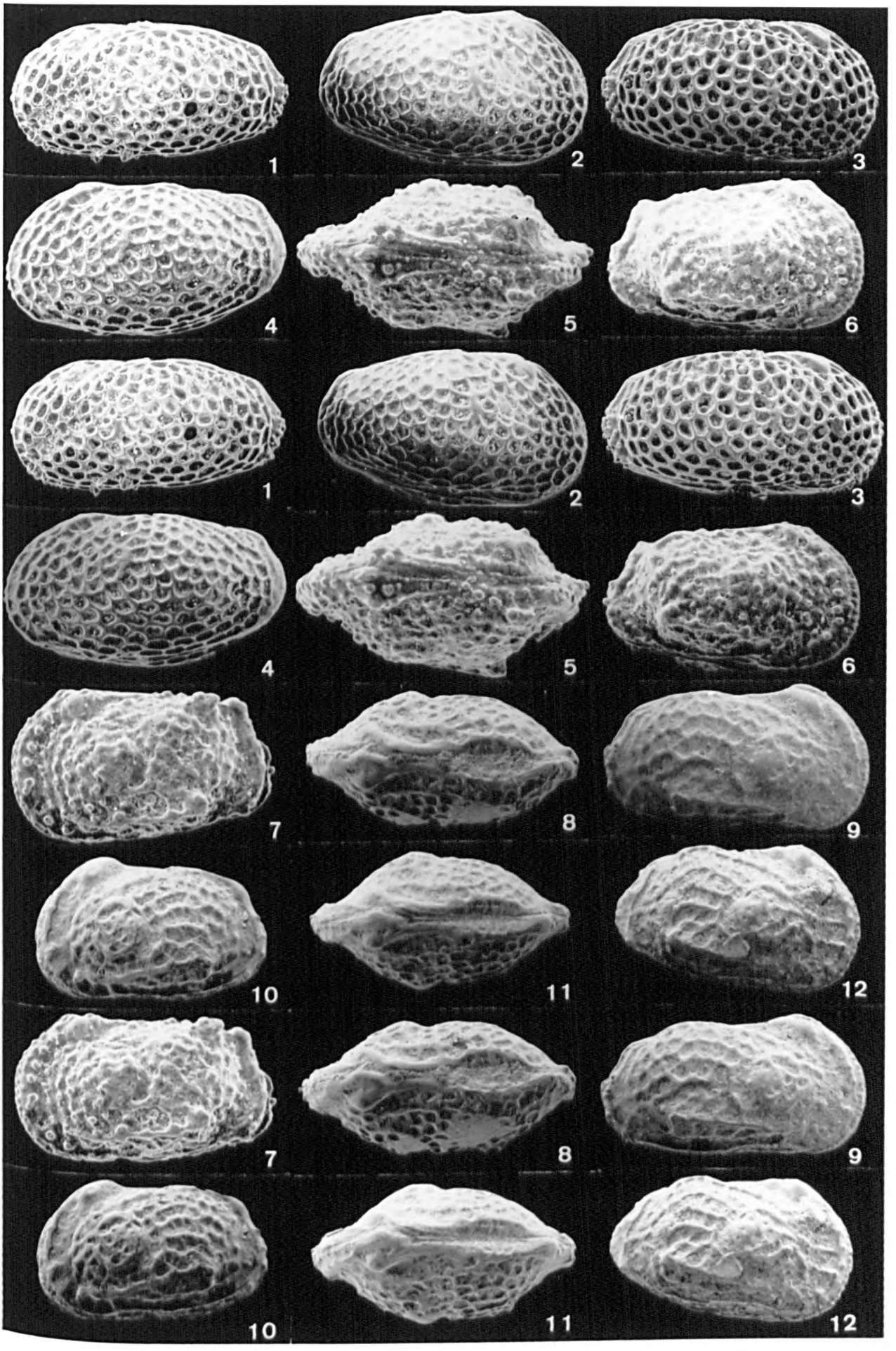
Figs. 5-7 ***Martinicythere samalutensis samalutensis*** Bassiouni, 1969c p. 238

5. Carapace dorsal view HU.300.T.10 X 80
6. Carapace from right HU.300.T.10 X 100
7. Carapace from left HU.300.T.10 X 80

Figs. 8-12 ***Hermanites libyaensis*** sp. nov. p. 240

8. Paratype, male carapace, dorsal view HU.300.T.11 X 47
9. Paratype, male carapace from right HU.300.T.12 X 43
10. Paratype, female carapace from left HU.300.T.13 X 45
11. Paratype, female carapace, dorsal view HU.300.T.14 X 50
12. Holotype, female carapace from right HU.300.T.15 X 45

PLATE 35



EXPLANATION OF PLATE 36

Figs. 1-2 ***Quadracythere cretacea*** sp. nov. p. 245

1. Holotype, male carapace from right HU.300.T.17 X 60
2. Paratype, female carapace from right HU.300.T.18 X 60

Fig. 3 ***Quadracythere*** sp. ***A*** p. 247

3. Carapace from left HU.300.T.19 X 67

Figs. 4-5 ***Quadracythere*** sp. ***B*** p. 248

4. Carapace from left HU.300.T.20 X 75
5. Carapace from right HU.300.T.20 X 72

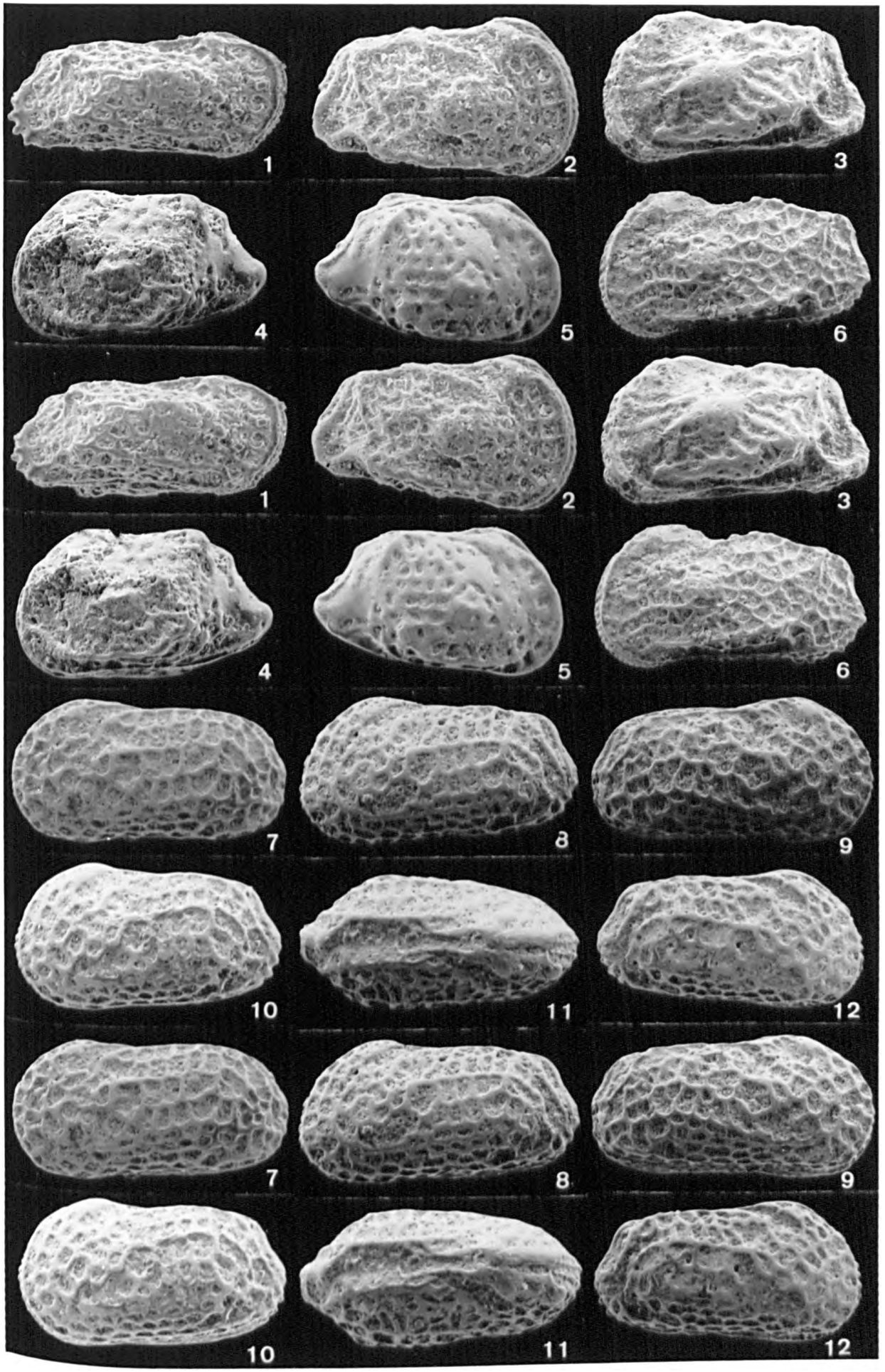
Fig. 6 ***Hermanites*** sp. ***A*** p. 243

6. Carapace from left HU.300.T.16 X 57

Figs. 7-12 ***Urocythereis elongata*** sp. nov. p. 250

7. Holotype, male carapace from left HU.300.T.21 X 67
8. Paratype, female carapace from left HU.300.T.22 X 70
9. Holotype, male carapace from right HU.300.T.21 X 67
10. Paratype, female carapace from left HU.300.T.23 X 67
11. Paratype, female carapace, dorsal view HU.300.T.23 X 70
12. Paratype, female carapace from right HU.300.T.22 X 67

PLATE 36



EXPLANATION OF PLATE 37

Figs. 1-6, 8, 9 ***Uromuellerina saidi*** Bassiouni, 1969c p. 232

1. Female, carapace from left HU.300.T.3 X 55
2. Female, carapace dorsal view HU.300.T.4 X 80
3. Female, carapace from right HU.300.T.3 X 55
4. Female, carapace from right HU.300.T.4 X 55
5. Female, carapace ventral view HU.300.T.4 X 65
6. Female, carapace from left HU.300.T.4 X 60
8. Female, carapace from right HU.300.T.4 X 55
9. Female, carapace from right HU.300.T.5 X 70

Figs. 7, 10-12 ***Uromuellerina*** sp. ***A*** p. 234

7. Carapace from right HU.300.T.6 X 60
10. Carapace from left HU.300.T.6 X 70
11. Carapace dorsal view HU.300.T.6 X 65
12. Carapace from right HU.300.T.6 X 60

PLATE 37

EXPLANATION OF PLATE 38

Figs. 1-3 ***Reticulina elegans*** sp. nov. p. 155

1. Paratype, carapace from left HU.210.T.29 X 55
2. Holotype, carapace from right HU.210.T.30 X 57
3. Paratype, carapace from left HU.300.T.1 X 55

Figs. 4-5 ***Munseyella*** sp. ***A*** p. 110

4. Carapace from left HU.204.T.16 X 100
5. Carapace from right HU.204.T.16 X 97

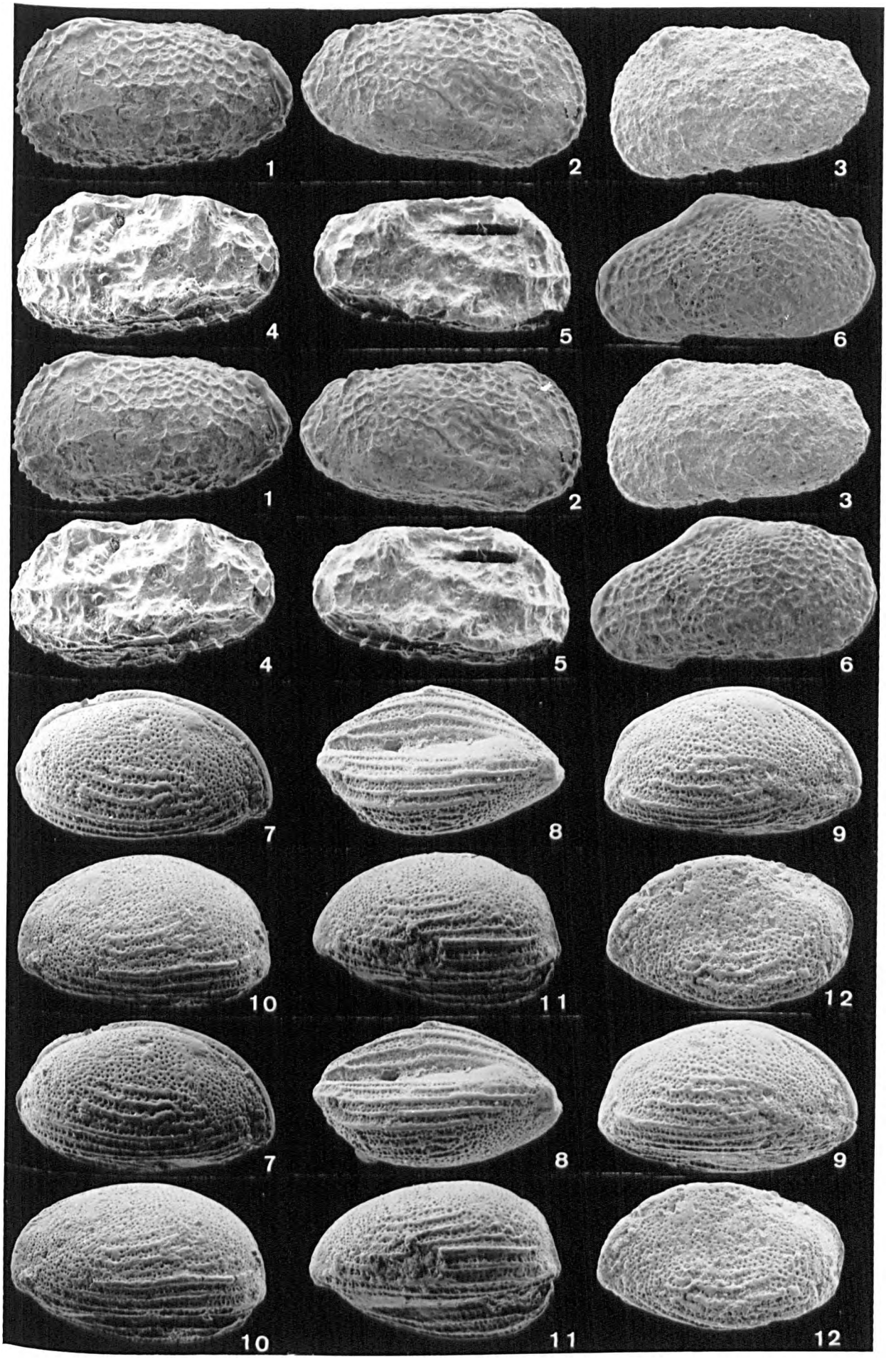
Fig. 6 ***Reticulina?*** sp. ***A*** p. 157

6. Carapace from left HU.300.T.2 X 47

Figs. 7-12 Genus ***A*** sp. ***a*** p. 333

7. Carapace from right HU.305.T.30 X 110
8. Carapace, ventral view HU.306.T.1 X 130
9. Carapace from right HU.306.T.2 X 125
10. Carapace from left HU.306.T.3 X 105
11. Carapace from left HU.305.T.30 X 110
12. Carapace from left HU.306.T.4 X 110

PLATE 38



EXPLANATION OF PLATE 39

Figs. 1-6 ***Pokornyella harshae*** sp. nov. p. 236

1. Holotype, carapace from left HU.300.T.7 X 60
2. Paratype, carapace dorsal view HU.300.T.8 X 65
3. Paratype, carapace from right HU.300.T.8 X 60
4. Holotype, carapace from right HU.300.T.7 X 60
5. Paratype, carapace ventral view HU.300.T.9 X 62
6. Paratype, carapace from right HU.300.T.9 X 60

Figs. 7-10 ***Cytheretta tellilae*** sp. nov. p. 257

7. Holotype, female carapace from left HU.300.T.24 X 57
8. Paratype, female carapace, ventral view HU.300.T.25 X 47
9. Paratype, male carapace from right HU.300.T.26 X 50
10. Holotype, female carapace from right HU.300.T.24 X 60

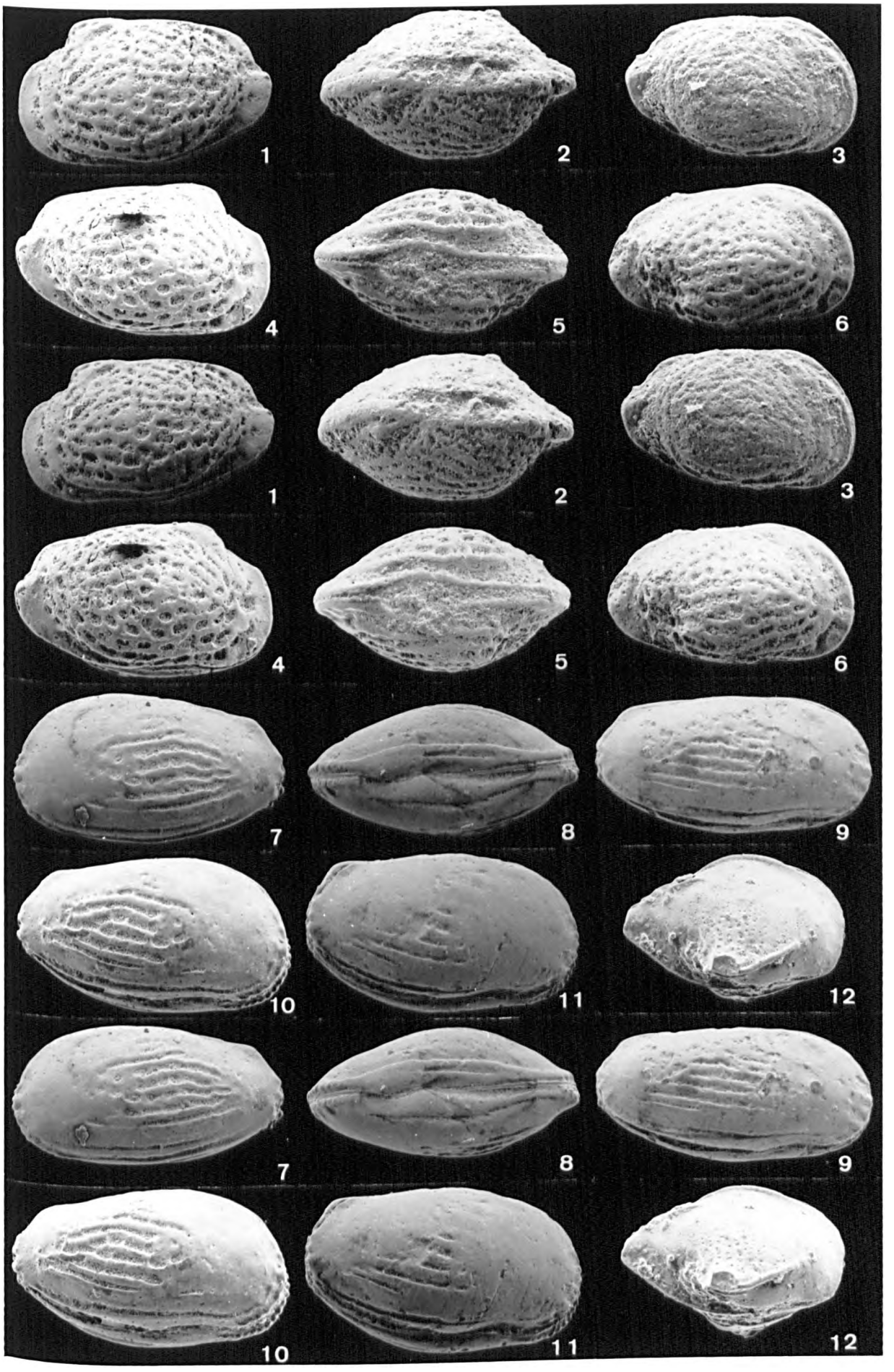
Fig. 11 ***Cytheretta*** n. sp. ***1*** Salahi, 1966 p. 259

11. Carapace from right HU.300.T.27 X 57

Fig. 12 ***Cytheropteron lekefense*** Esker, 1968 p. 308

12. Carapace from right HU.305.T.2 X 100

PLATE 39



EXPLANATION OF PLATE 40

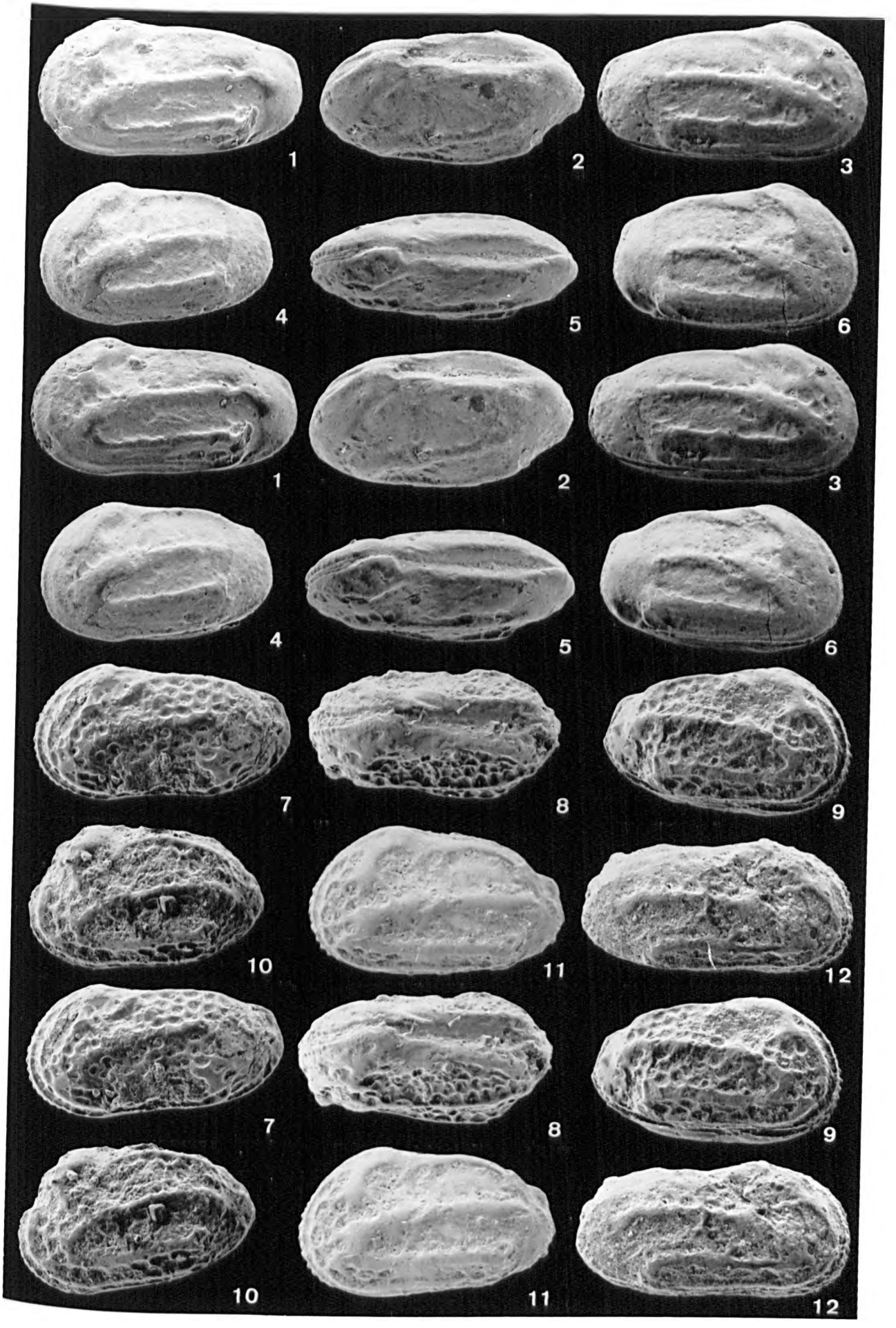
Figs 1-6 ***Flexus quadricostata*** sp. nov. p. 261

1. Holotype, male carapace from left HU.300.T.28 X 85
2. Paratype, female carapace, dorsal view HU.300.T.29 X 92
3. Holotype, male carapace from right HU.300.T.28 X 87
4. Paratype, female carapace from left HU.300.T.29 X 82
5. Holotype, male carapace, dorsal view HU.300.T.28 X 85
6. Paratype, female carapace from right HU.300.T.29 X 87

Figs. 7-12 ***Flexus africana*** sp. nov. p. 263

7. Paratype, male carapace from left HU.300.T.30 X 67
8. Paratype, female carapace, dorsal view HU.301.T.1 X 87
9. Holotype, female carapace from right HU.301.T.2 X 82
10. Paratype, female carapace from left HU.301.T.3 X 77
11. Paratype, female carapace from left HU.301.T.4 X 92
12. Paratype, male carapace from right HU.301.T.5 X 82

PLATE 40



EXPLANATION OF PLATE 41

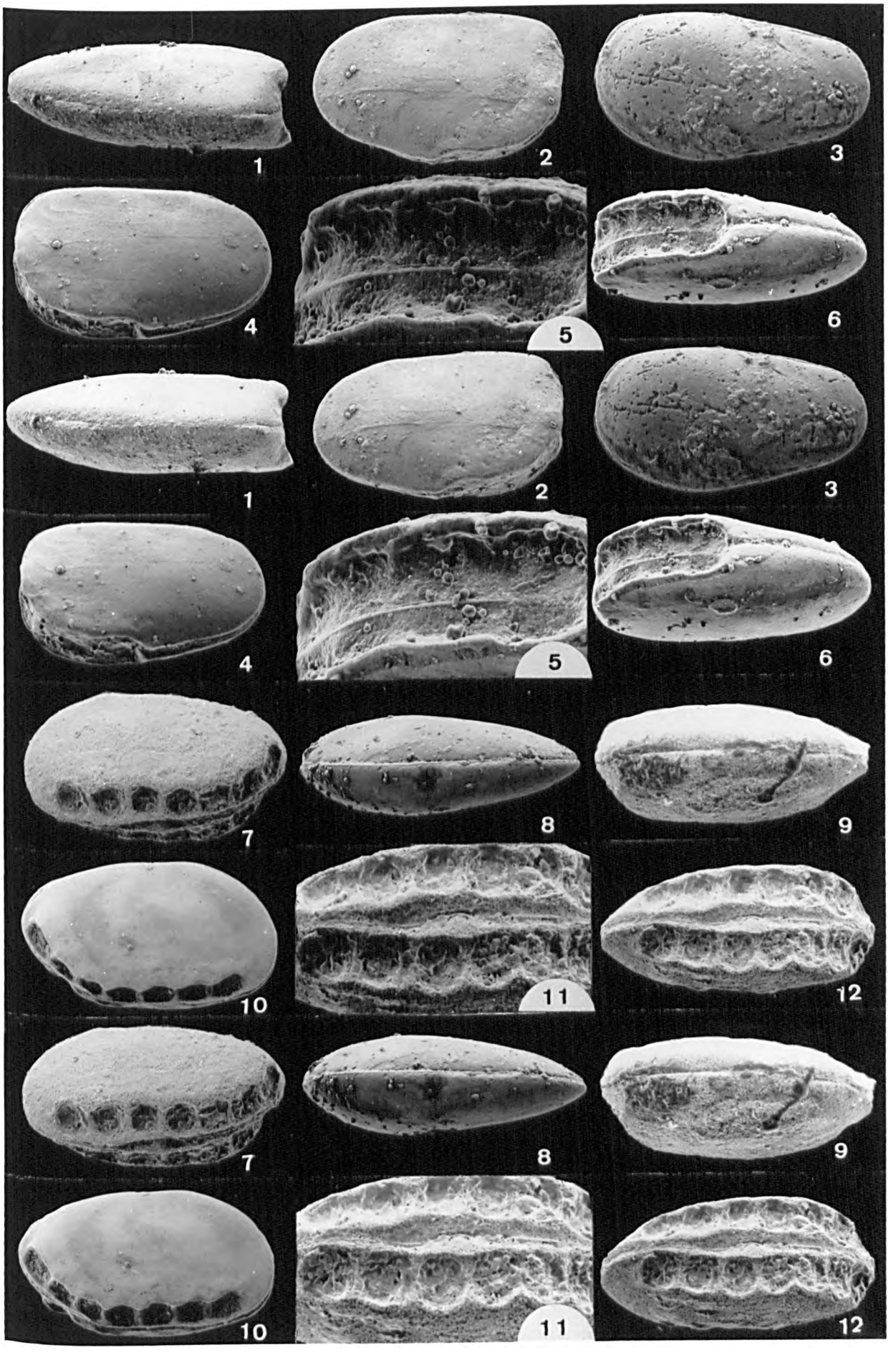
Figs. 1-6, 8 ***Heptaloculites tunetana*** (Oertli, 1978) p. 268

1. Female, carapace dorsal view HU.301.T.6 X 69
2. Female, carapace from left HU.301.T.7 X 65
3. Male, carapace from right HU.301.T.8 X 58
4. Female, carapace from right HU.301.T.9 X 65
5. Details of female loculi HU.301.T.10 X 150
6. Female, carapace ventral view HU.301.T.10 X 65
8. Male, carapace dorsal view HU.301.T.11 X 60

Figs. 7, 9-12 ***Heptaloculites*** aff. ***H. gortanii*** (Ruggieri, 1963) p. 271

7. Female, carapace from left HU.301.T.12 X 67
9. Female, carapace dorsal view HU.301.T.12 X 75
10. Female, carapace from right HU.301.T.13 X 61
11. Details of female loculi HU.301.T.12 X 100
12. Female, carapace ventral view HU.301.T.12 X 68

PLATE 41



EXPLANATION OF PLATE 42

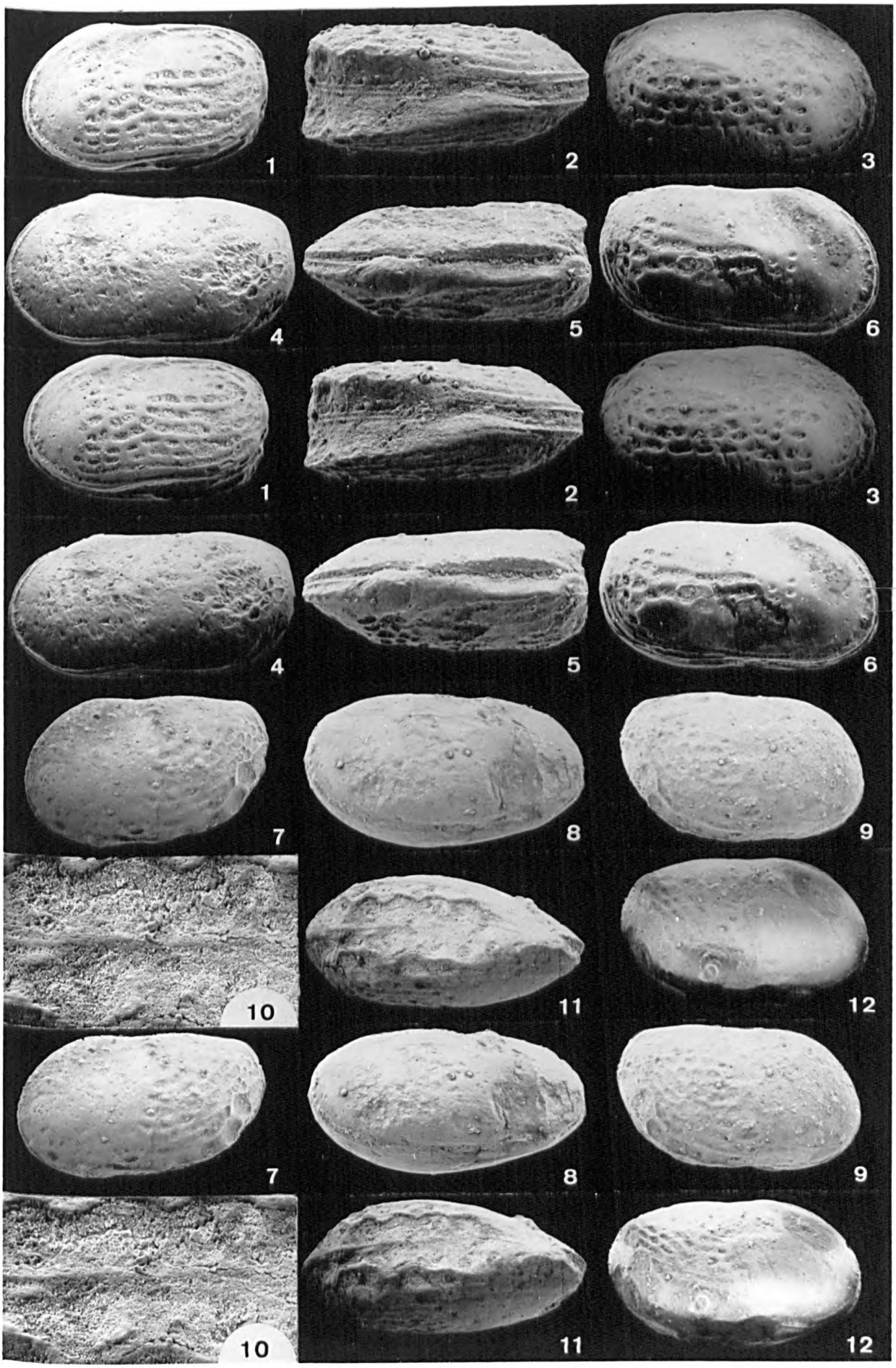
Figs. 1-6 ***Heptaloculites minuta*** (Oertli, 1978) p. 273

1. Female, carapace from left HU.301.T.14 X 73
2. Female, carapace ventral view HU.301.T.15 X 85
3. Female, carapace from right HU.301.T.16 X 87
4. Male, carapace from left HU.301.T.17 X 80
5. Female, carapace dorsal view HU.301.T.18 X 81
6. Male, carapace from right HU.301.T.19 X 70

Figs. 7-12 ***Heptaloculites semirugosa*** (Apostolescu & Magne, 1956) p. 275

7. Female, carapace from left HU.301.T.20 X 51
8. Male, carapace from right HU.301.T.21 X 51
9. Female, carapace from right HU.301.T.22 X 50
10. Female, ornamentation of loculi HU.301.T.23 X 184
11. Female, carapace ventral view HU.301.T.23 X 61
12. Female, carapace from right HU.301.T.24 X

PLATE 42



EXPLANATION OF PLATE 43

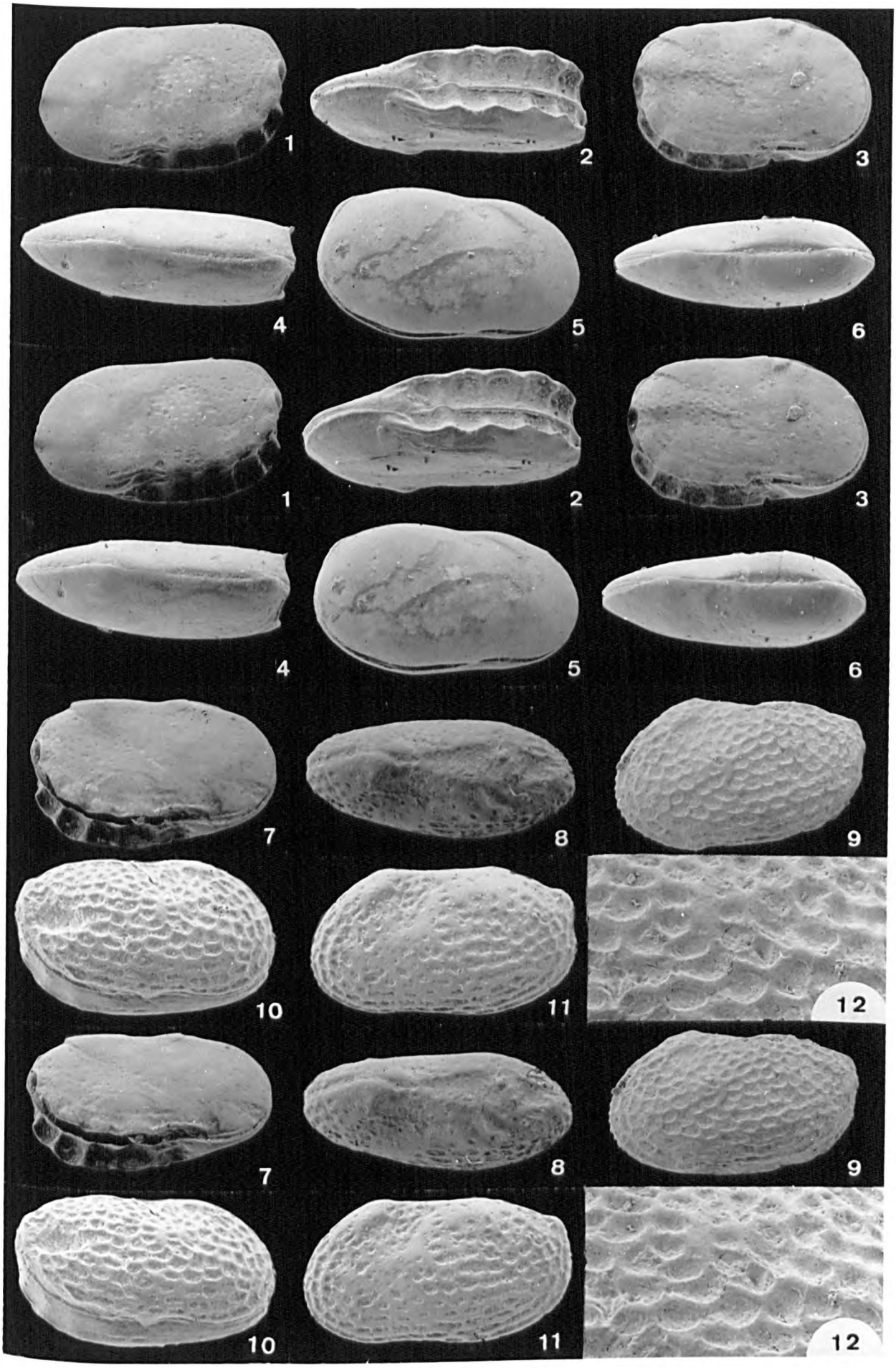
Figs. 1-7 ***Heptaloculites cavernosa*** (Apostolescu & Magne, 1956) p. 280

1. Female, carapace from left HU.301.T.26 X 54
2. Female, carapace ventral view HU.301.T.27 X 62
3. Female, carapace from right HU.301.T.28 X 54
4. Female, carapace dorsal view HU.301.T.29 X 62
5. Male, carapace from right HU.301.T.30 X 50
6. Male, carapace dorsal view HU.302.T.1 X 50
7. Female, carapace from right HU.302.T.2 X 55

Figs. 8-12 ***Heptaloculites prima*** (Bismuth & Oertli, 1978) p. 277

8. Male, carapace dorsal view HU.302.T.11 X 55
9. Female, carapace from left HU.302.T.9 X 67
10. Female, carapace from right HU.302.T.10 X 66
11. Male, carapace from left HU.302.T.8 X 56
12. Female, ornamentation of the left valve HU.302.T.9 X 110

PLATE 43



EXPLANATION OF PLATE 44

Figs. 1, 2 ***Heptaloculites prima*** (Bismuth & Oertli, 1978) p. 277

1. Male, carapace from right HU.302.T.11 X 56
2. Female, carapace ventral view HU.302.T.12 X 72

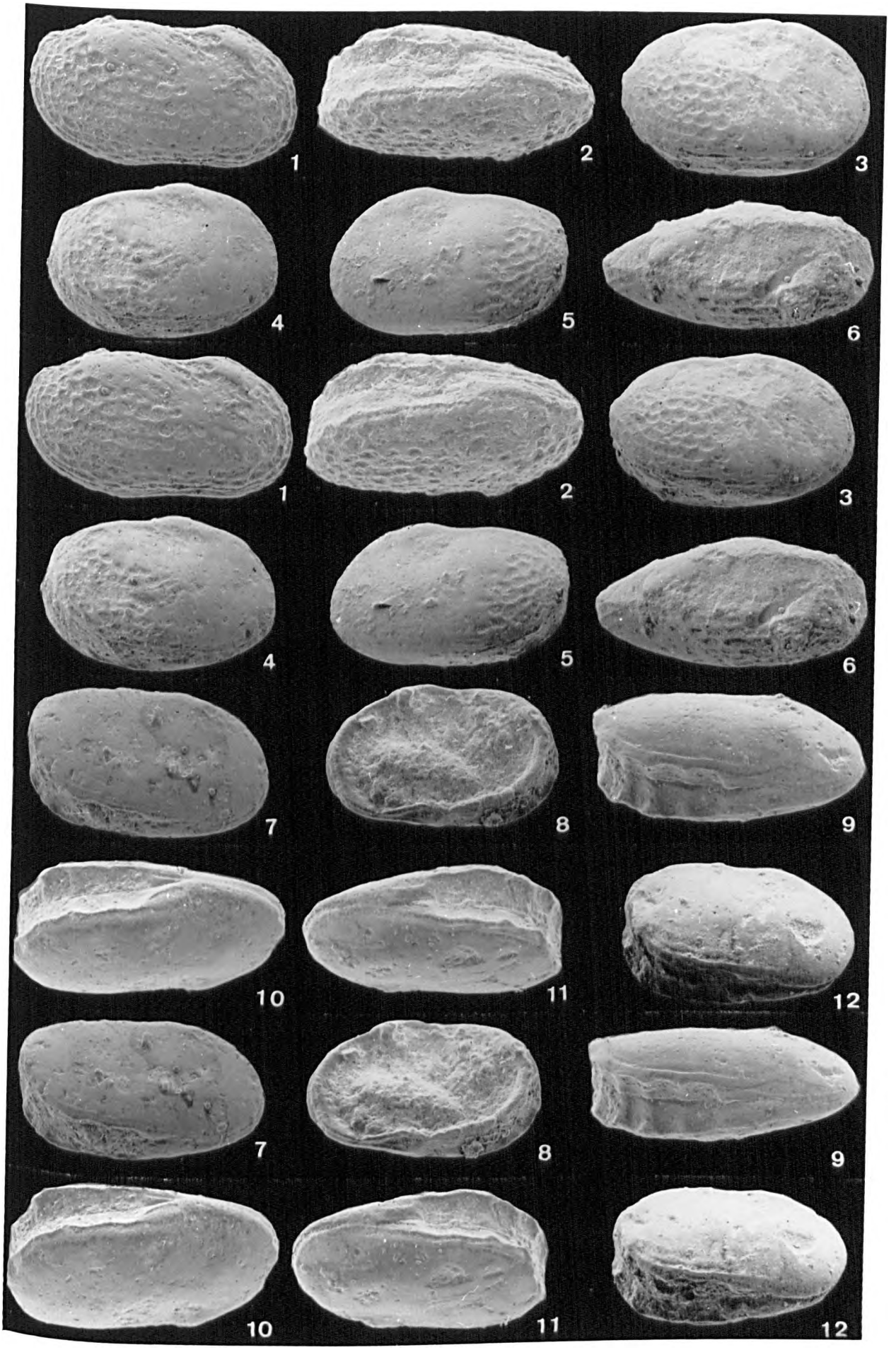
Figs. 3-6 ***Heptaloculites semipunctata*** (Apostolescu & Magne, 1956) p. 282

3. Female, carapace from right HU.302.T.13 X 62
4. Female, carapace from right HU.302.T.14 X 57
5. Female, carapace from left HU.302.T.15 X 62
6. Female, carapace ventral view HU.302.T.16 X 70

Figs. 7-12 ***Heptaloculites quinqueloculita*** (Bismuth, 1978) p. 284

7. Female, carapace from right HU.302.T.17 X 60
8. Female, right valve internal view HU.302.T.18 X 60
9. Female, carapace oblique ventral view HU.302.T.19 X 70
10. Female, carapace oblique ventral view HU.302.T.20 X 65
11. Female, carapace oblique ventral view HU.302.T.21 X 65
12. Female, carapace from right HU.302.T.22 X 56

PLATE 44



EXPLANATION OF PLATE 45

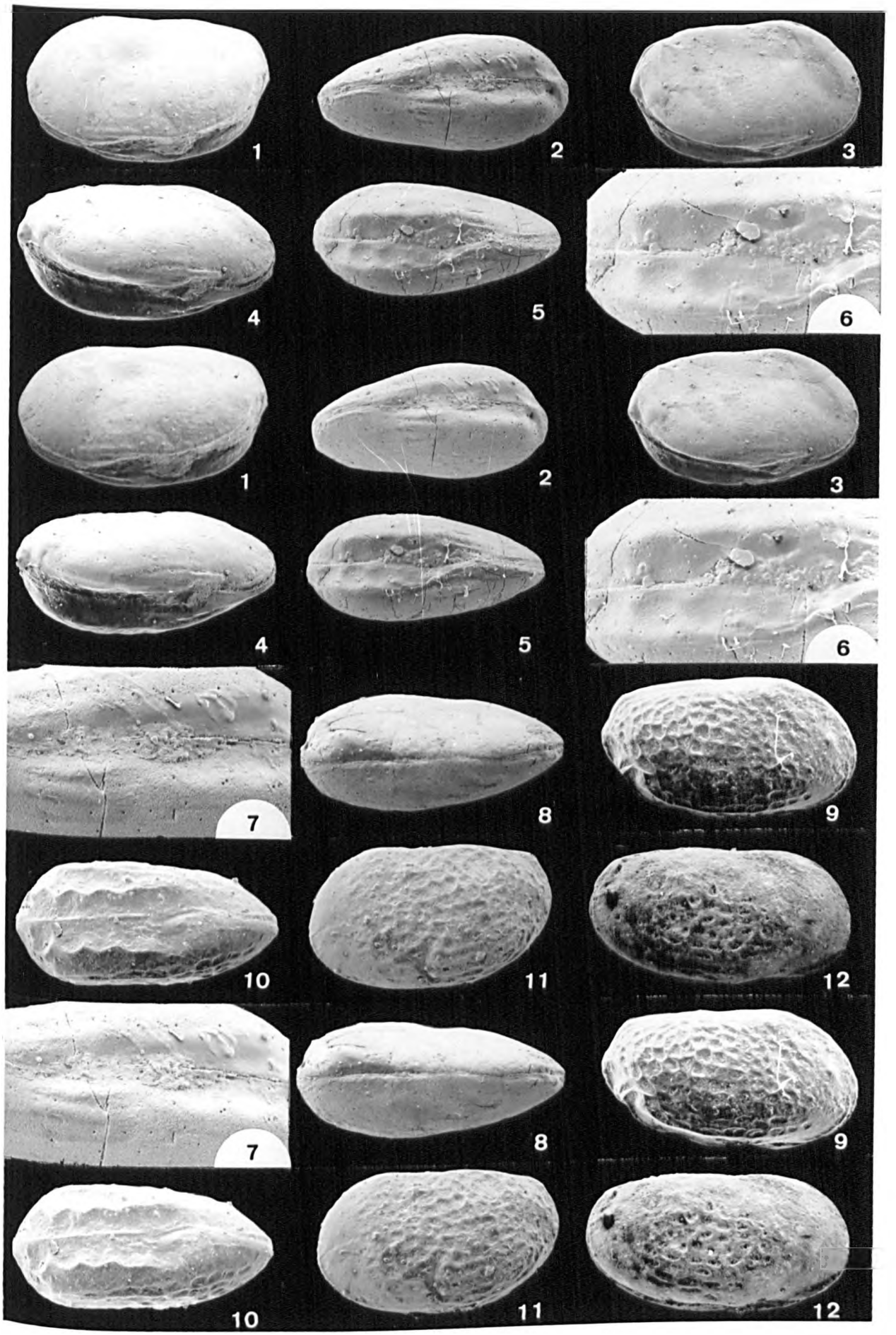
Figs. 1-8 ***Heptaloculites eocaenica*** sp. nov. p. 288

1. Holotype, female carapace from left HU.302.T.23 X 42
2. Paratype, female carapace, ventral view HU.302.T.24 X 52
3. Paratype, female carapace from right HU.302.T.25 X 44
4. Paratype, female carapace from right HU.302.T.25 X 50
5. Paratype, female carapace, ventral view HU.302.T.26 X 48
6. Details of the paratype female loculi HU.302.T.26 X 95
7. Details of the paratype female loculi HU.302.T.24 X 95
8. Paratype, female carapace, dorsal view HU.302.T.27 X 55

Figs. 9-12 ***Heptaloculites harshae*** sp. nov. p. 286

9. Holotype, female carapace from right HU.302.T.28 X 54
10. Paratype, female carapace, ventral view HU.302.T.29 X 58
11. Paratype, female carapace from left HU.302.T.30 X 49
12. Male, carapace from right HU.303.T.1 X 45

PLATE 45



EXPLANATION OF PLATE 46

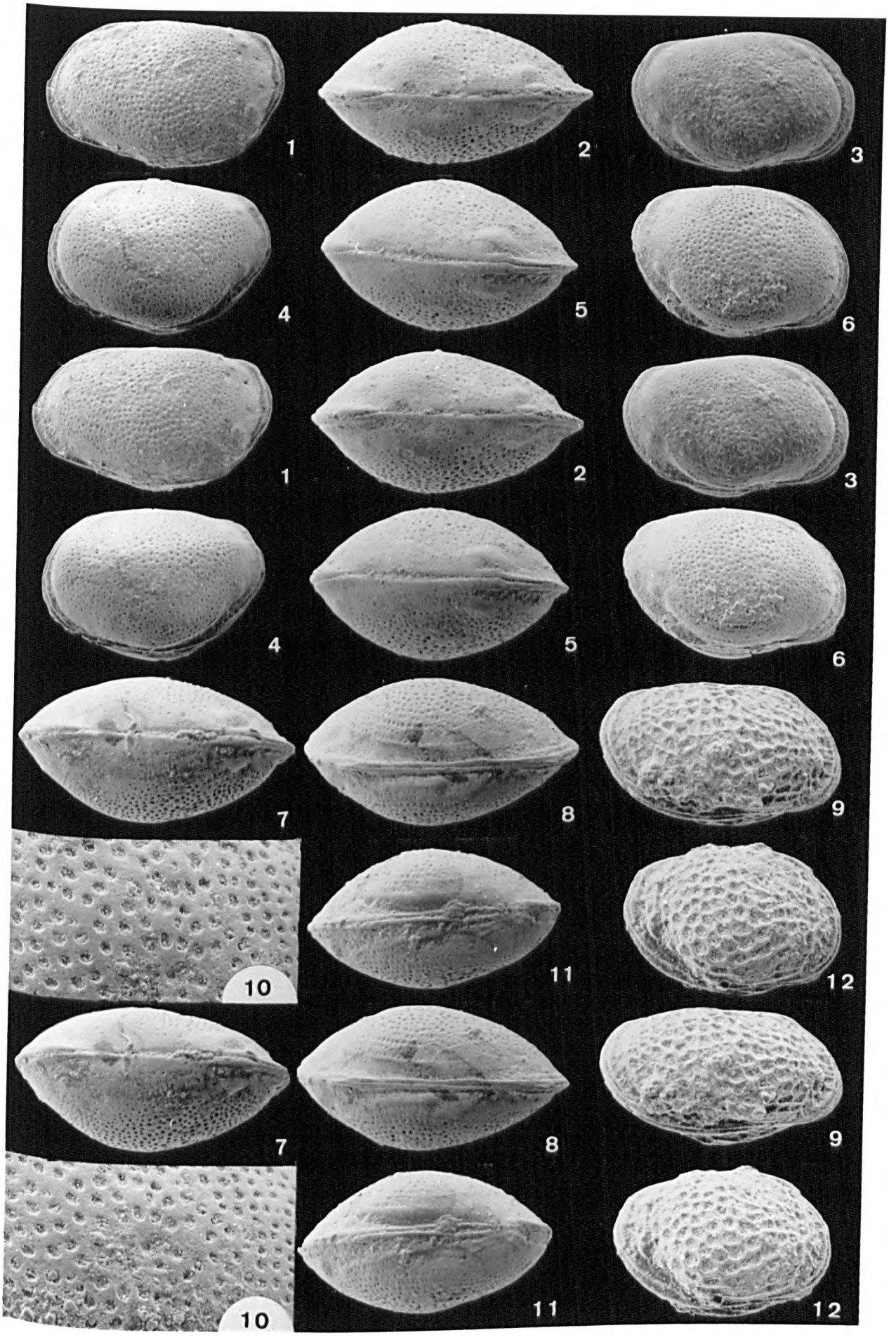
Figs. 1-8, 10-11 ***Loxoconcha tarabulusensis*** sp. nov. p. 290

1. Holotype, male carapace from left HU.303.T.2 X 60
2. Paratype, male carapace, dorsal view HU.303.T.3 X 75
3. Paratype, male carapace from right HU.303.T.4 X 60
4. Paratype, female carapace from left HU.303.T.5 X 60
5. Paratype, female carapace, dorsal view HU.303.T.6 X 69
6. Paratype, female carapace from right HU.303.T.7 X 60
7. Paratype, male carapace, dorsal view HU.303.T.8 X 74
8. Paratype, male carapace, ventral view HU.303.T.9 X 74
10. Details of the ornamentation of the female HU.303.T.7 X 200
11. Paratype, male carapace, ventral view HU.303.T.10 X 69

Figs. 9, 12 ***Loxoconcha mataiensis*** Khalifa & Cronin, 1979 p. 294

9. Male, carapace from right HU.303.T.11 X 105
12. Female, carapace from right HU.303.T.12 X 100

PLATE 46



EXPLANATION OF PLATE 47

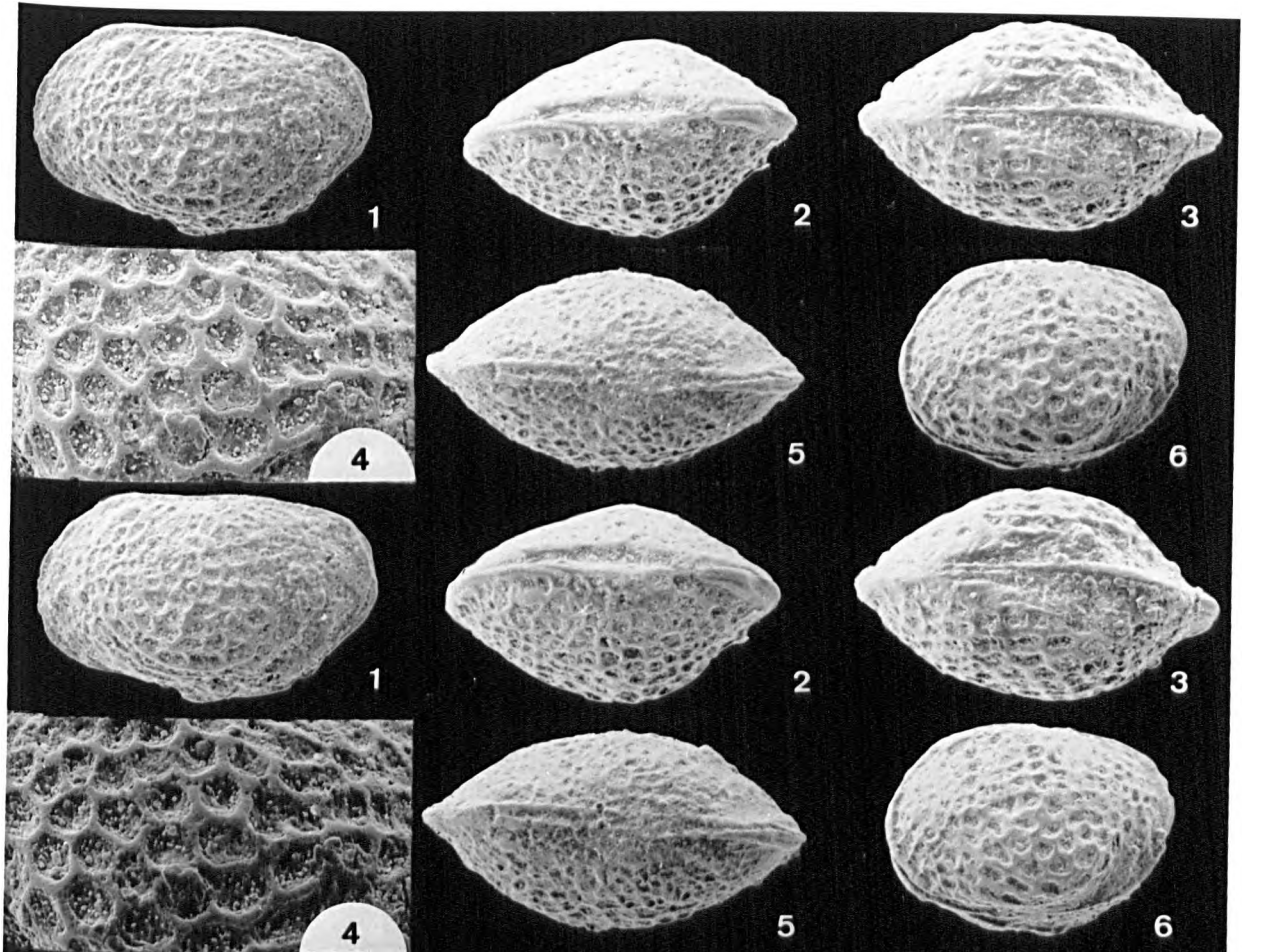
Figs. 1-6 ***Loxoconcha mataiensis*** Khalifa & Cronin, 1979 p. 294

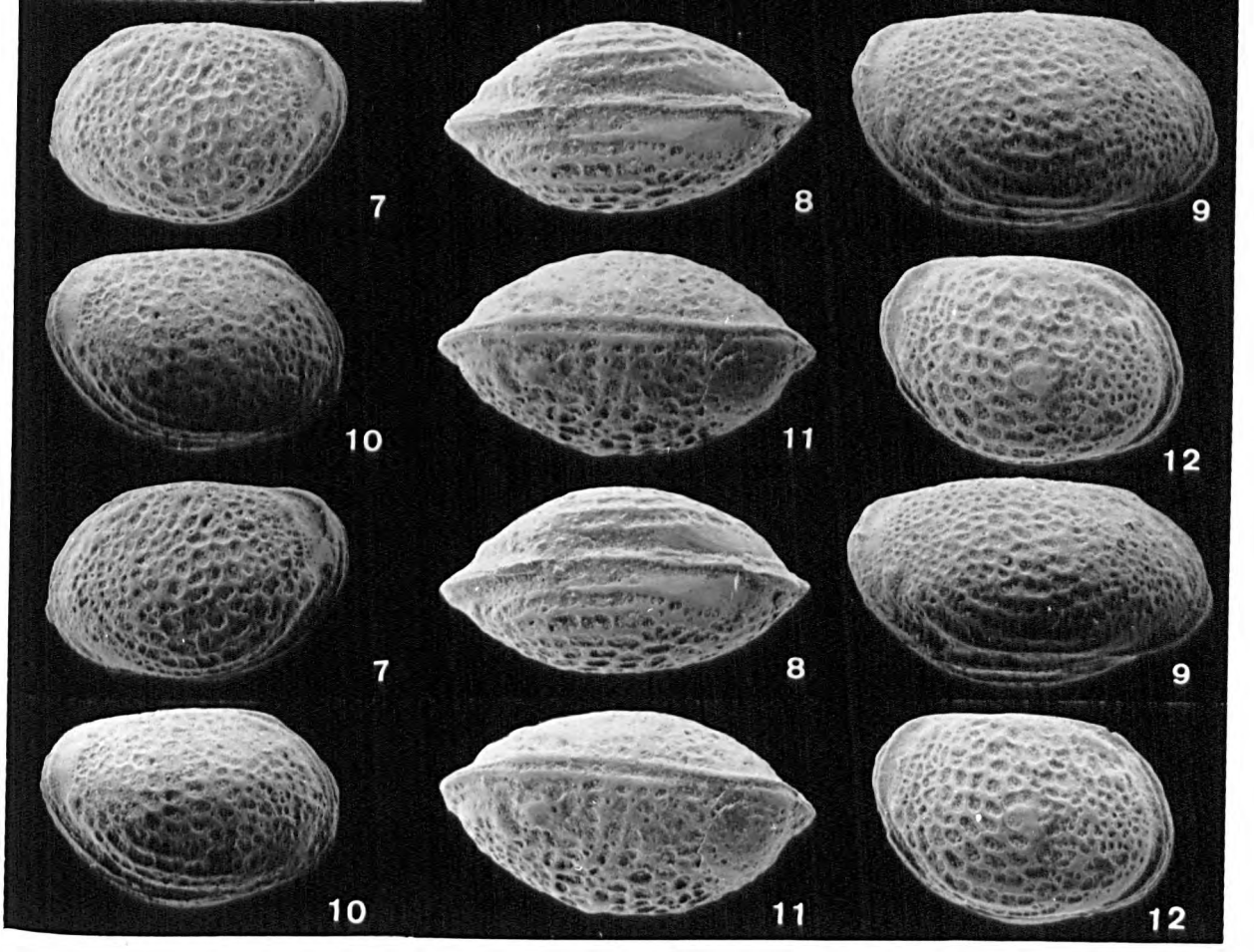
1. Male, carapace from left HU.303.T.13 X 105
2. Female, carapace dorsal view HU.303.T.14 X 120
3. Female, carapace ventral view HU.303.T.15 X 120
4. Details, of the ornamentation of female HU.303.T.12 X 220
5. Male, carapace dorsal view HU.303.T.16 X 115
6. Female, carapace from left HU.303.T.17 X 100

Figs. 7-12 ***Loxoconcha ghalilae*** sp. nov. p. 295

7. Paratype, female carapace from left HU.303.T.18 X 65
8. Paratype, female carapace, ventral view HU.303.T.19 X 80
9. Holotype, male carapace from right HU.303.T.20 X 65
10. Paratype, female carapace from right HU.303.T.21 X 65
11. Paratype, female carapace, ventral view HU.303.T.22 X 80
12. Paratype, female carapace from right HU.303.T.23 X 65

PLATE 47

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EXPLANATION OF PLATE 48

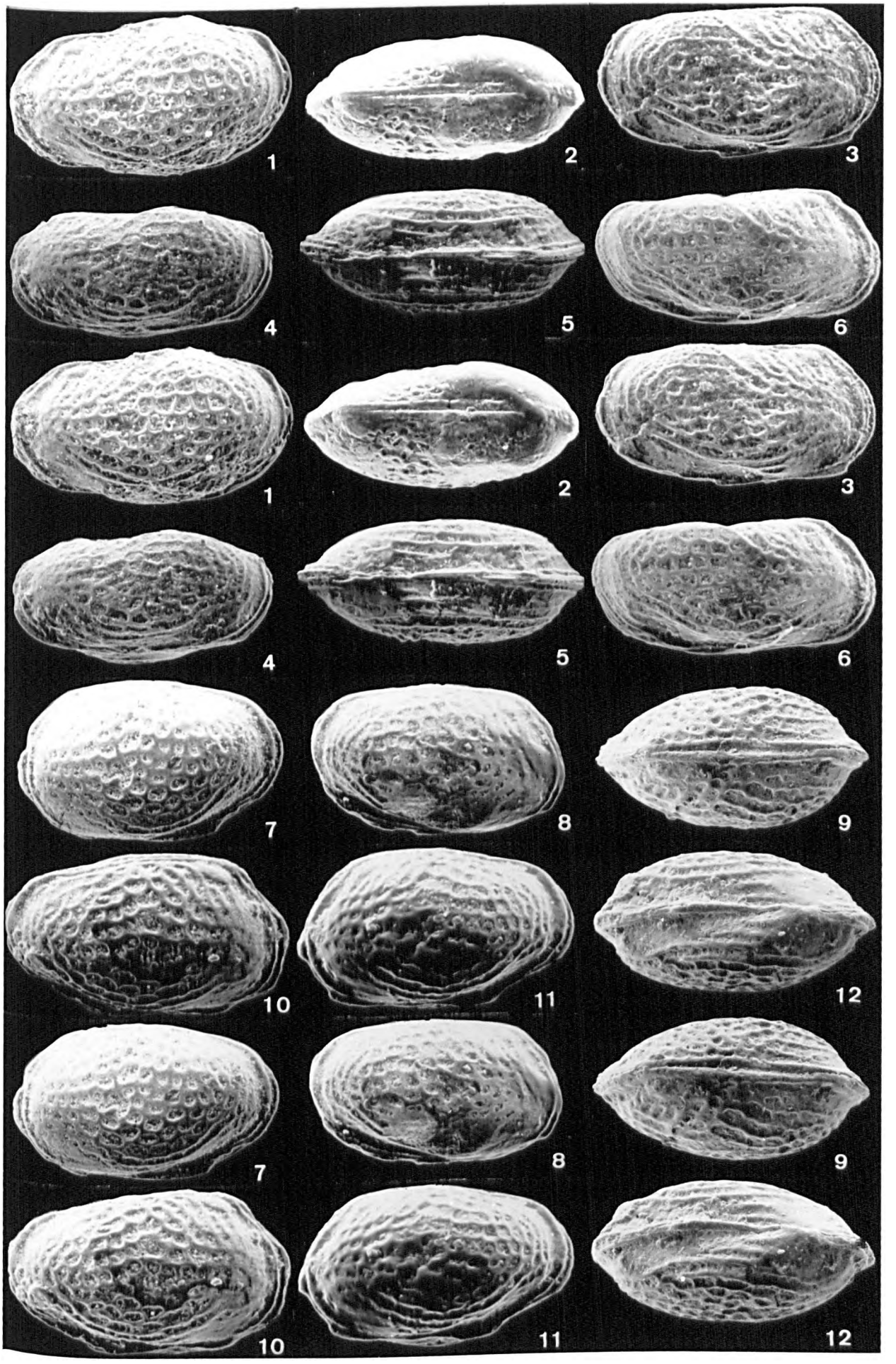
Figs. 1-6 ***Loxoconcha palaeocaenica*** sp. nov. p. 298

1. Paratype, female carapace from left HU.303.T.24 X 100
2. Paratype, female carapace, dorsal view HU.303.T.25 X 105
3. Holotype, female carapace from right HU.303.T.26 X 95
4. Paratype, male carapace from left HU.303.T.27 X 95
5. Paratype, male carapace, ventral view HU.303.T.28 X 100
6. Paratype, male carapace from right HU.303.T.29 X 95

Figs. 7-12 ***Loxoconcha aljurfae*** sp. nov. p. 300

7. Paratype, female carapace from left HU.303.T.30 X 105
8. Paratype, female carapace from right HU.304.T.1 X 105
9. Paratype, male carapace, dorsal view HU.304.T.2 X 110
10. Holotype, male carapace from right HU.304.T.3 X 115
11. Paratype, male carapace from left HU.304.T.2 X 115
12. Holotype, male carapace, ventral view HU.304.T.3 X 110

PLATE 48



EXPLANATION OF PLATE 49

Figs. 1-4 ***Loxoconcha*** sp. ***A*** p. 304

1. Carapace from right HU.304.T.4 X 100
2. Carapace from left HU.304.T.4 X 95
3. Carapace from right HU.304.T.5 X 100
4. Carapace from left HU.304.T.5 X 95

Figs. 5-7 ***Loxoconcha*** sp. ***B*** p. 305

5. Carapace dorsal view HU.304.T.6 X 137
6. Carapace from left HU.304.T.6 X 90
7. Carapace from right HU.304.T.6 X 80

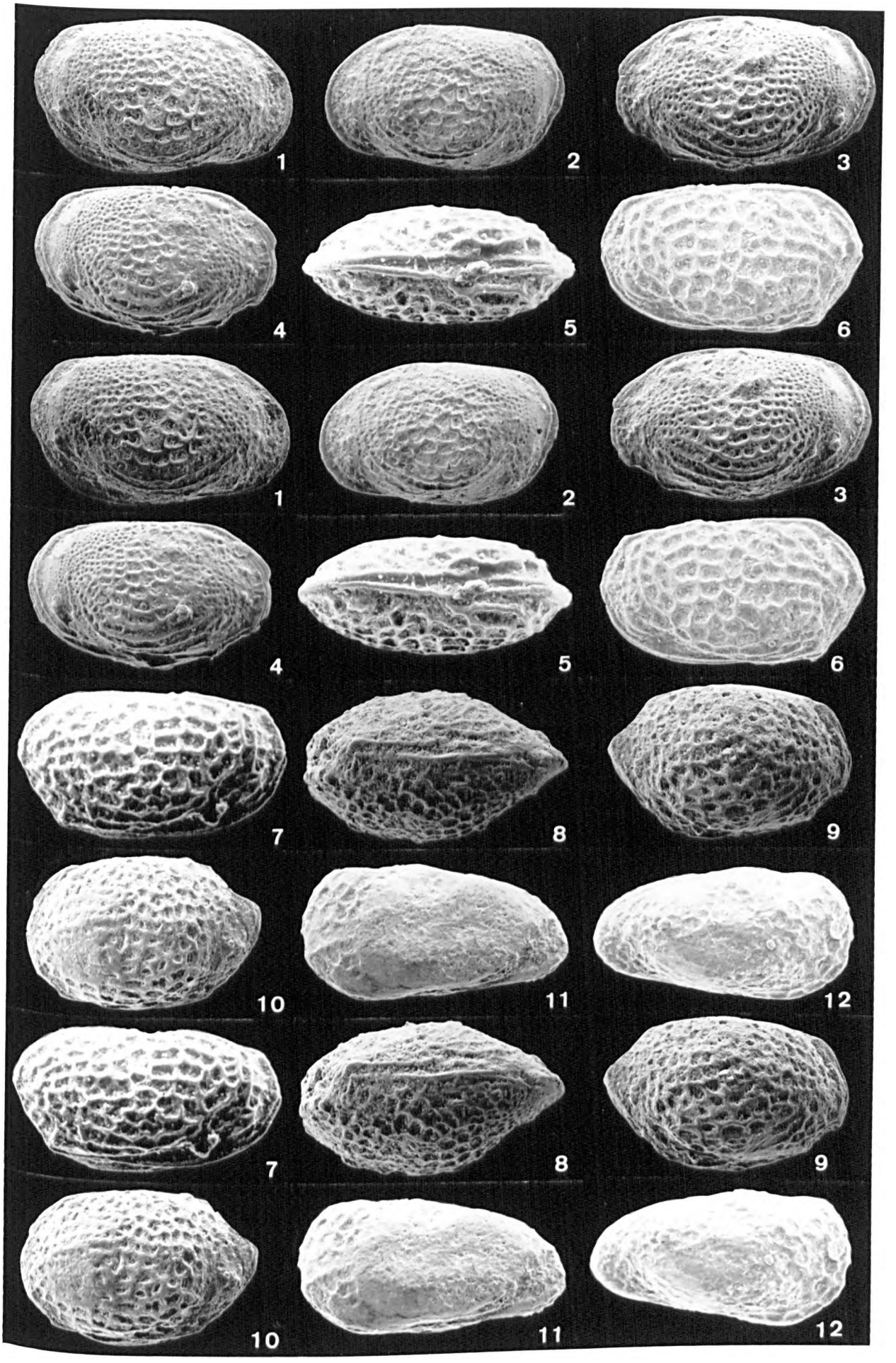
Figs. 8-10 ***Loxoconcha sirtaensis*** sp. nov. p. 302

8. Paratype, carapace dorsal view HU.304.T.7 X 130
9. Holotype, carapace from right HU.304.T.8 X 110
10. Paratype, carapace from left HU.304.T.9 X 105

Figs. 11-12 ***Cytheromorpha?*** sp. ***A*** p. 307

11. Carapace from left HU.304.T.10 X 92
12. Carapace from right HU.304.T.10 X 90

PLATE 49



EXPLANATION OF PLATE 50

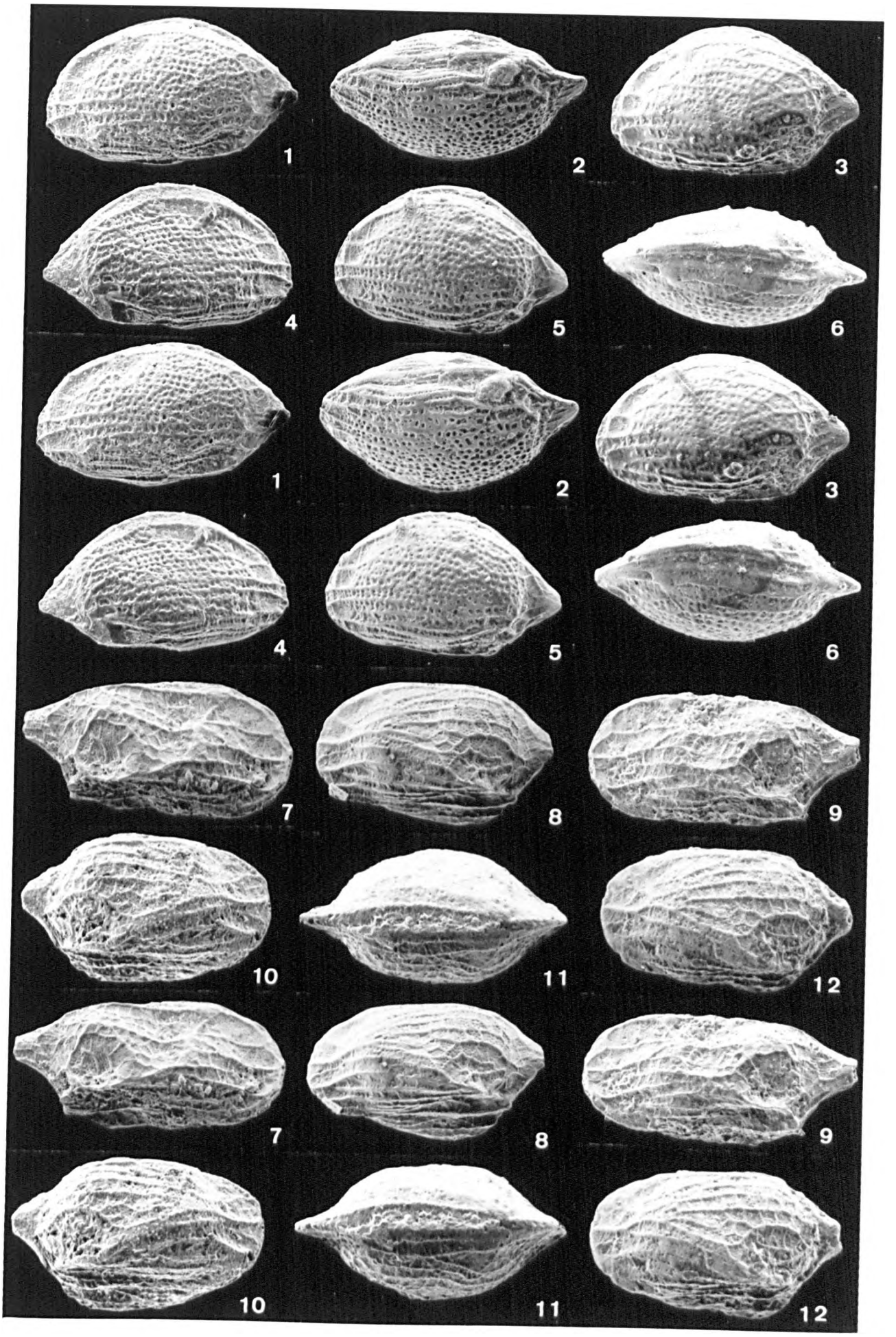
Figs. 1-6 ***Semicytherura aljurfae*** sp. nov.. p. 314

1. Holotype, carapace from left HU.304.T.11 X 115
2. Paratype, carapace, ventral view HU.304.T.12 X 115
3. Paratype, carapace from left HU.304.T.13 X 115
4. Holotype, carapace from right HU.304.T.11 X 110
5. Paratype, carapace from left HU.304.T.12 X 105
6. Paratype, carapace, dorsal view HU.304.T.13 X 125

Figs. 7-12 ***Semicytherura tarabulusensis*** sp. nov. p. 316

7. Holotype, male carapace from right HU.304.T.14 X 125
8. Paratype, female carapace from left HU.304.T.15 X 125
9. Holotype, male carapace from left HU.304.T.14 X 125
10. Paratype, female carapace from right HU.304.T.16 X 130
11. Paratype, female carapace, dorsal view HU.304.T.17 X 130
12. Paratype, female carapace from left HU.304.T.16 X 125

PLATE 50



EXPLANATION OF PLATE 51

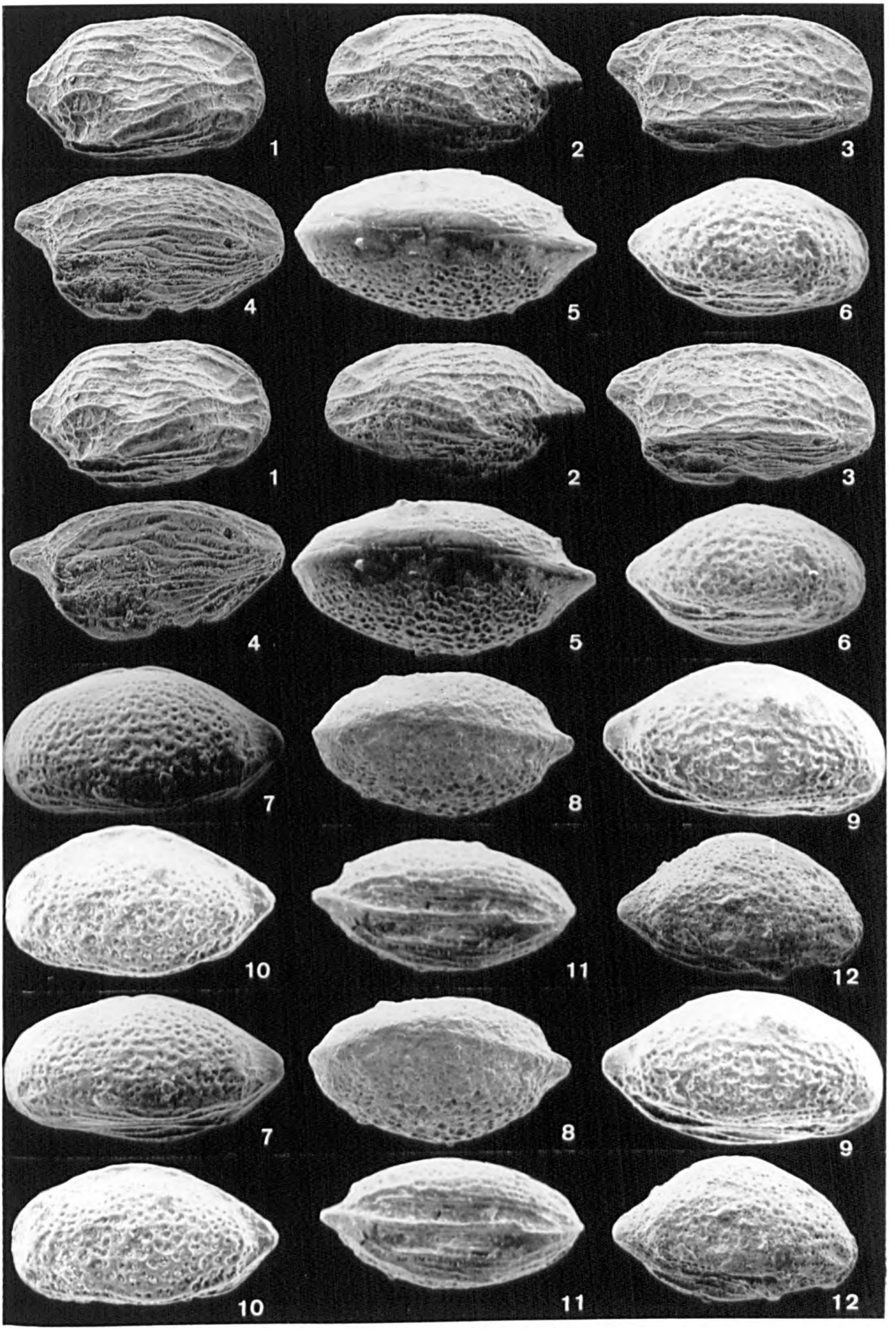
Figs. 1-4 ***Semicytherura tarabulusensis*** sp. nov. p. 316

1. Paratype, female carapace from right HU.304.T.15 X 120
2. Paratype, female carapace from left HU.304.T.17 X 125
3. Paratype, male carapace from right HU.304.T.18 X 120
4. Paratype, male carapace oblique, external view HU.304.T.18 X 125

Figs. 5-12 ***Semicytherura africana*** sp. nov. p. 319

5. Male,carapace dorsal view HU.304.T.19 X 130
6. Holotype, female carapace from right HU.304.T.20 X 100
7. Male,carapace from left HU.304.T.19 X 110
8. Holotype, female carapace, dorsal view HU.304.T.20 X 105
9. Male,carapace from right HU.304.T.19 X 105
10. Holotype, female carapace from left HU.304.T.20 X 110
11. Holotype, female carapace, ventral view HU.304.T.20 X 115
12. Female, carapace from right HU.304.T.21 X 120

PLATE 51



EXPLANATION OF PLATE 52

Figs. 1-3 ***Semicytherura*** sp. ***A*** p. 322

1. Carapace from left HU.304.T.22 X 110
2. Carapace ventral view HU.304.T.22 X 130
3. Carapace from right HU.304.T.22 X 110

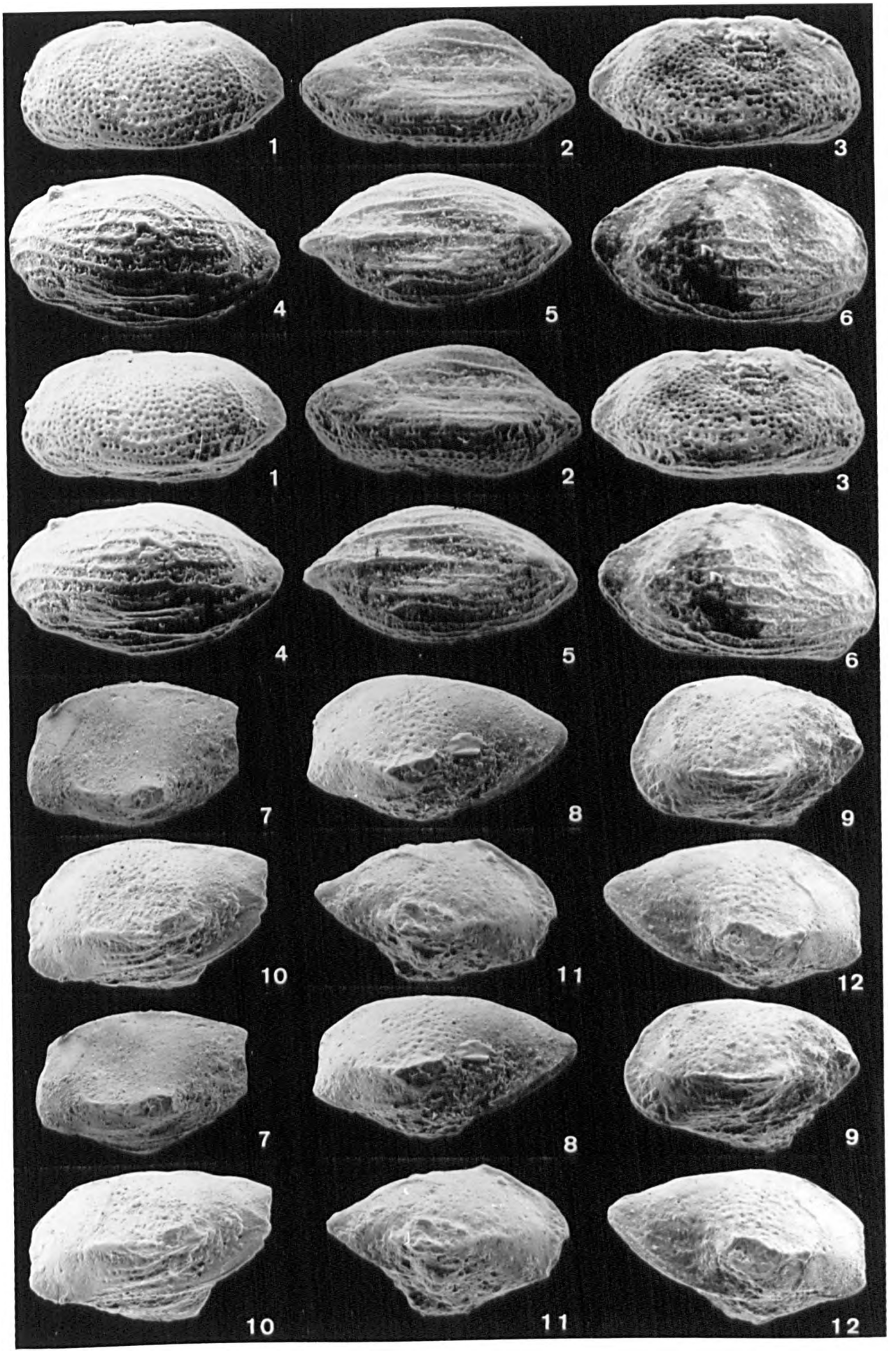
Figs. 4-6 ***Semicytherura*** aff. ***S. gracilis*** (Lienenklaus, 1895) p. 321

4. Carapace from left HU.304.T.23 X 95
5. Carapace ventral view HU.304.T.23 X 100
6. Carapace from right HU.304.T.23 X 95

Figs. 7-12 ***Cytheropteron elongata*** sp. nov. p. 309

7. Paratype, female carapace from left HU.305.T.3 X 80
8. Holotype, male carapace from left HU.305.T.4 X 87
9. Female, carapace from left HU.305.T.5 X 105
10. Female, carapace from left HU.305.T.6 X 125
11. Female, carapace from right HU.305.T.7 X 95
12. Holotype, male carapace from right HU.305.T.4 X 85

PLATE 52

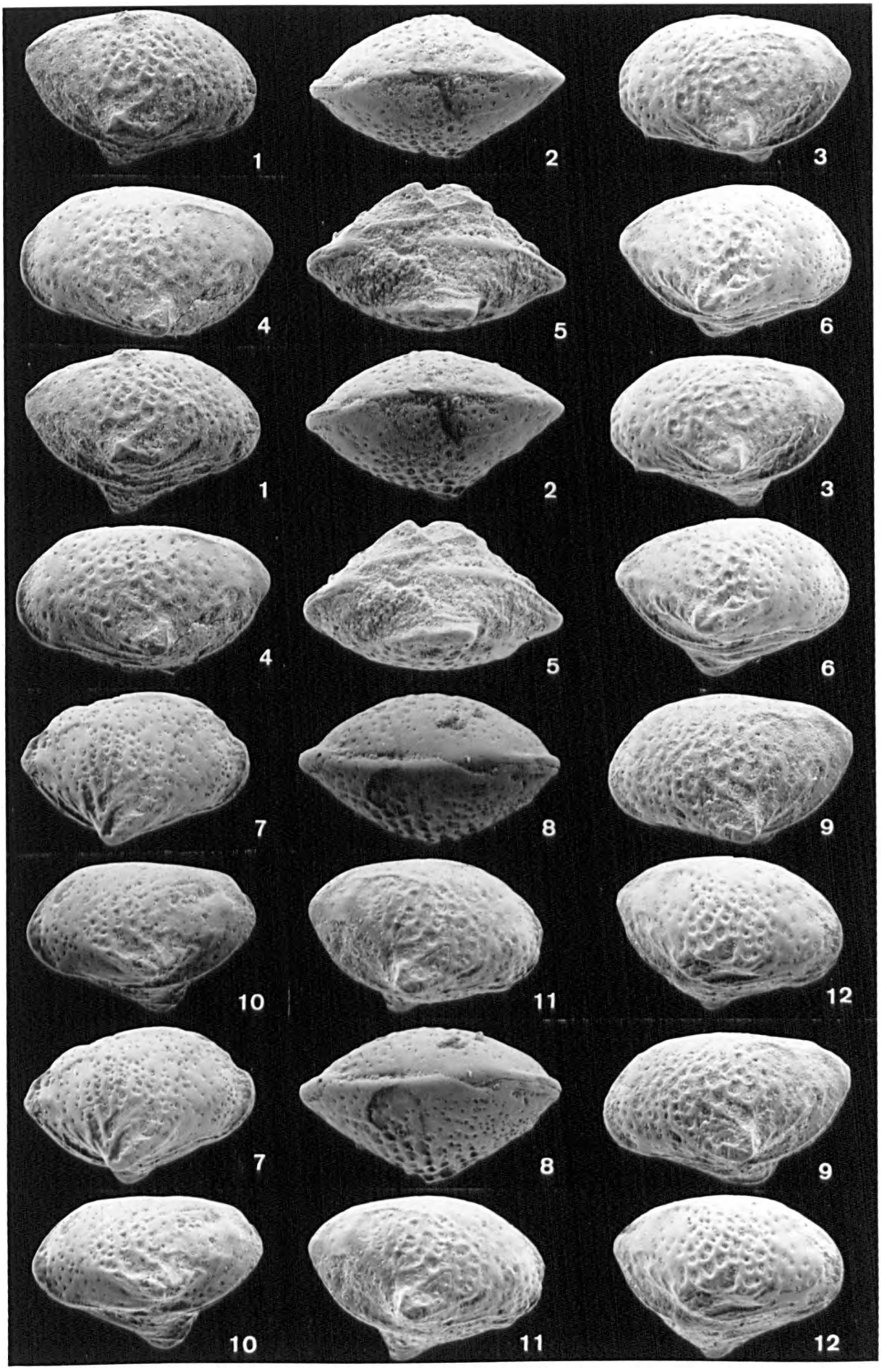


EXPLANATION OF PLATE 53

Figs. 1-12 ***Cytheropteron tarabulusensis*** sp. nov. p. 312

1. Holotype, carapace from right HU.305.T.8 X 80
2. Paratype, carapace dorsal view HU.305.T.9 X 90
3. Paratype, carapace from left HU.305.T.10 X 80
4. Paratype, carapace from left HU.305.T.11 X 90
5. Paratype, carapace ventral view HU.305.T.12 X 110
6. Carapace from right HU.305.T.13 X 80
7. Carapace from right HU.305.T.14 X 85
8. Carapace dorsal view HU.305.T.15 X 100
9. Holotype, carapace from left HU.305.T.8 X 82
10. Carapace from left HU.305.T.16 X 80
11. Paratype, carapace from right HU.305.T.10 X 82
12. Paratype, carapace from right HU.305.T.11 X 82

PLATE 53

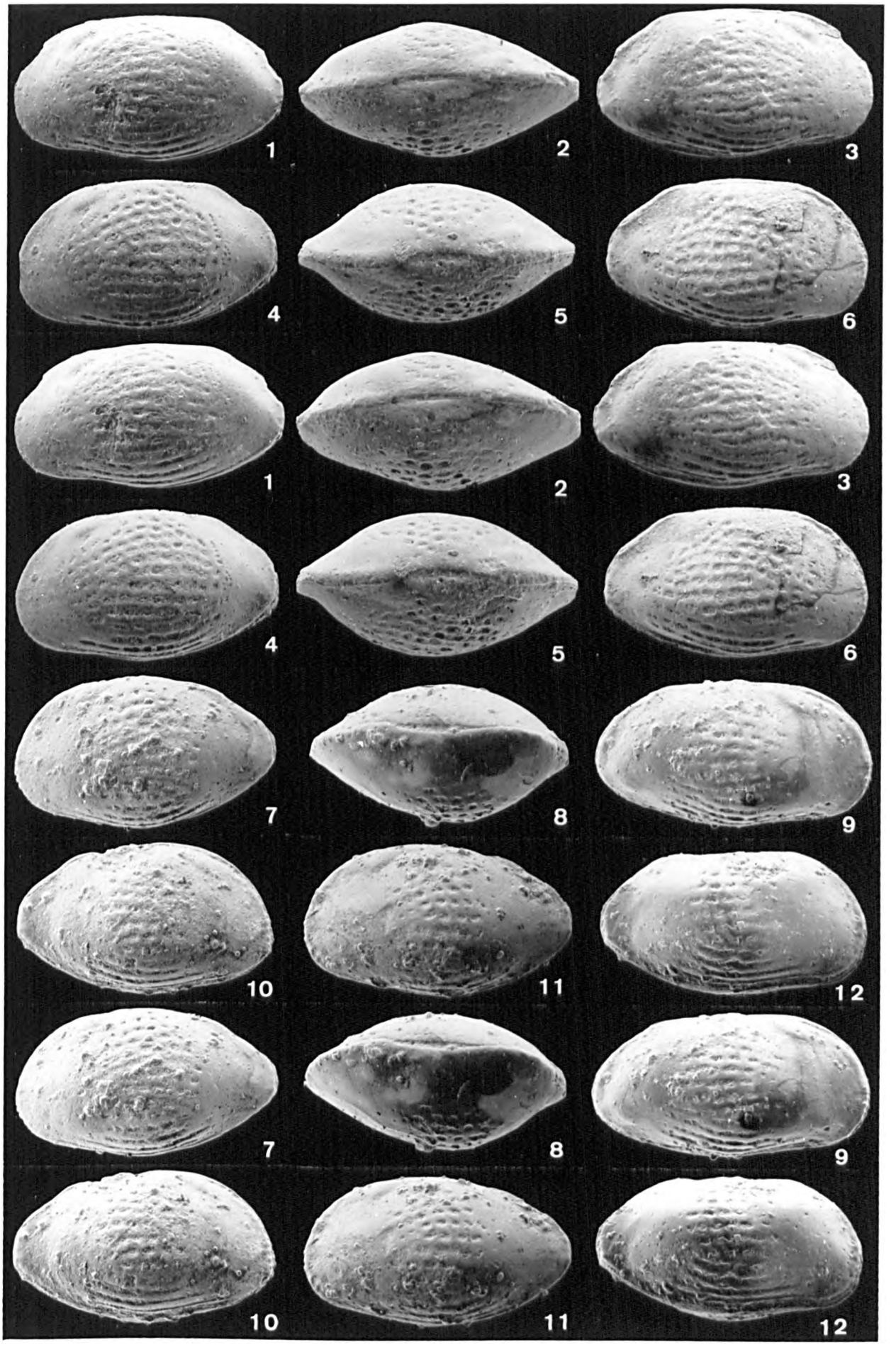


EXPLANATION OF PLATE 54

Figs. 1-12 ***Mehesella africana*** sp. nov. p. 323

1. Male, carapace from left HU.304.T.24 X 45
2. Male, carapace dorsal view HU.304.T.24 X 45
3. Male, carapace from right HU.304.T.24 X 45
4. Female, carapace from left HU.304.T.25 X 47
5. Female, carapace dorsal view HU.304.T.25 X 52
6. Female, carapace from right HU.304.T.25 X 47
7. Paratype, female carapace from left HU.304.T.26 X 52
8. Paratype, female carapace, dorsal view HU.304.T.27 X 50
9. Holotype, male carapace from right HU.304.T.28 X 47
10. Paratype, female carapace from right HU.304.T.29 X 50
11. Paratype, female carapace from left HU.304.T.30 X 52
12. Paratype, male carapace from right HU.305.T.1 X 47

PLATE 54



EXPLANATION OF PLATE 55

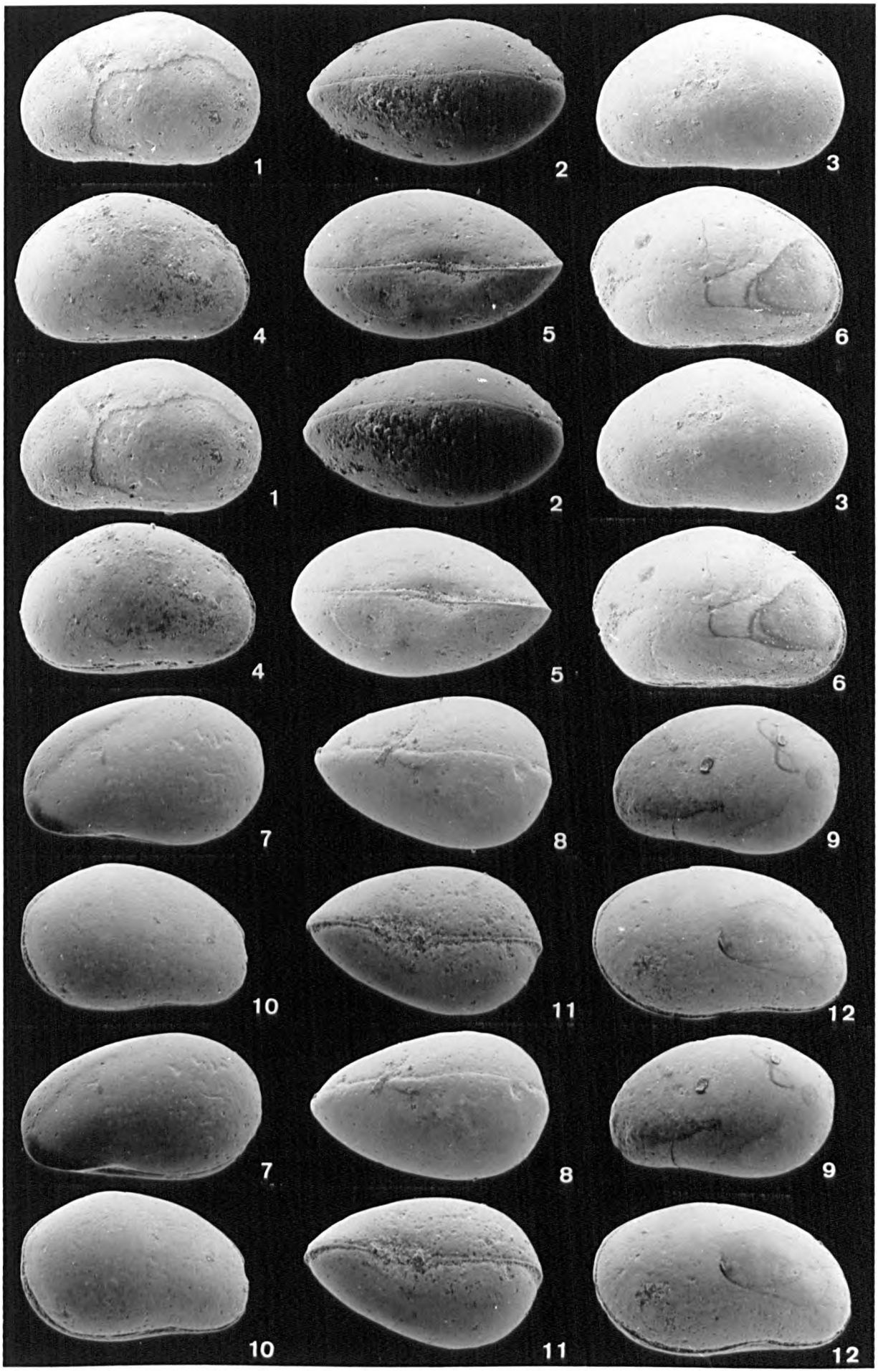
Figs. 1-6 ***Xestoleberis ghalilae*** sp. nov. p. 326

1. Paratype, carapace from left HU.305.T.17 X 105
2. Paratype, carapace dorsal view HU.305.T.18 X 110
3. Holotype, carapace from left HU.305.T.19 X 105
4. Paratype, carapace from right HU.305.T.20 X 95
5. Paratype, carapace ventral view HU.305.T.21 X 115
6. Paratype, carapace from right HU.305.T.22 X 110

Figs. 7-12 ***Xestoleberis tarabulusensis*** sp. nov. p. 329

7. Paratype, male carapace from left HU.305.T.23 X 72
8. Paratype, female carapace, dorsal view HU.305.T.24 X 72
9. Holotype, female carapace from left HU.305.T.25 X 72
10. Paratype, female carapace from right HU.305.T.26 X 72
11. Paratype, female carapace, ventral view HU.305.T.27 X 77
12. Paratype, male carapace from right HU.305.T.28 X 82

PLATE 55



EXPLANATION OF PLATE 56

Figs. 1-2 ***Uroleberis*** sp. ***A*** p. 331

1. Carapace from left HU.305.T.29 X 97
2. Carapace dorsal view HU.305.T.29 X 100

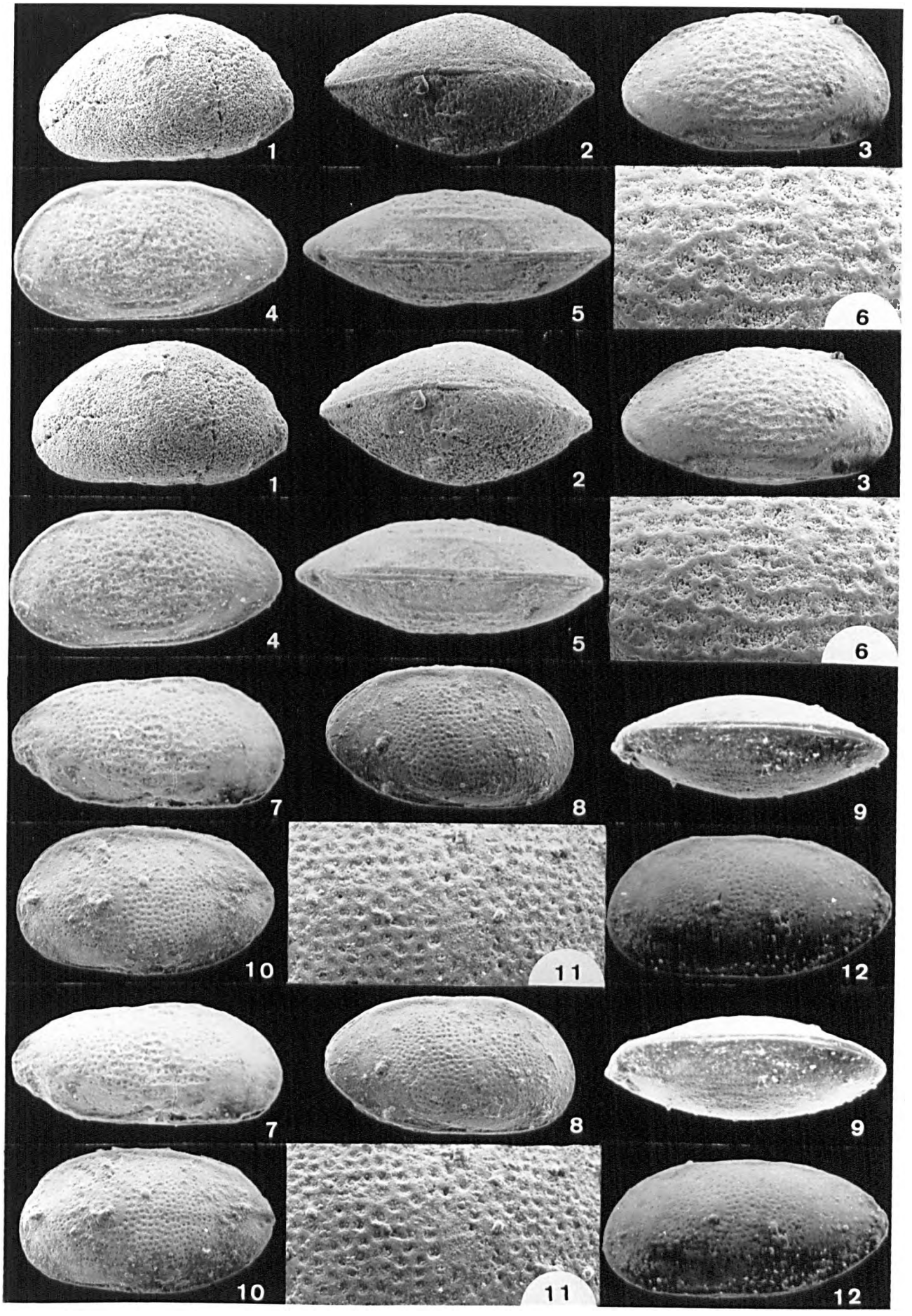
Figs. 3-7 Genus ***B*** sp. ***b*** p. 337

3. Female, carapace from right HU.306.T.5 X 92
4. Female, carapace from left HU.306.T.6 X 105
5. Male, carapace ventral view HU.306.T.7 X 105
6. Details of the female ornamentation HU.305.T.5 X 230
7. Male, carapace from right HU.305.T.8 X 95

Figs. 8-12 Genus ***B*** sp. ***a*** p. 335

8. Female, carapace from right HU.306.T.9 X 90
9. Male, carapace dorsal view HU.306.T.10 X 90
10. Female, carapace from left HU.306.T.11 X 90
11. Details of the female ornamentation HU.306.T.9 X 230
12. Male, carapace from left HU.306.T.12 X 95

PLATE 56



EXPLANATION OF PLATE 57

Figs. 1-3 ***Pontocyprella recurva*** Esker, 1968 p. 97

1. Carapace from right HU.203.T.25 X 57
2. Carapace dorsal view HU.203.T.26 X 77
3. Carapace from left HU.203.T.27 X 62

Figs. 4-10 Genus ***C*** sp. ***a*** p. 339

4. Female, carapace from right HU.306.T.13 X 50
5. Female, carapace ventral view HU.306.T.14 X 55
6. Male, carapace from right HU.306.T.15 X 52
7. Female, carapace from left HU.306.T.16 X 52
8. Female, carapace dorsal view HU.306.T.17 X 57
9. Female, carapace from left HU.306.T.13 X 50
10. Female, carapace from right HU.306.T.18 X 50

Figs. 11-12 Genus ***D*** sp. ***a*** p. 342

11. Carapace from left HU.306.T.19 X 62
12. Carapace from right HU.306.T.19 X 65

PLATE 57