ABSTRACT

The Ostracoda from nine sections of the Lower Fars Formation, Northern Iraq, Tel-Hajer well-1, Sheikh Ibrahim locality, Dohuk locality, Sheikhan locality, Bashiqa locality, Kirkuk well-208, Bai-Hassan well-33, Hamrin well-2 and the Naft Khana well-34, have been studied in detail.

One hundred and nine Ostracod species/subspecies belonging to 50 genera/ subgenera are described, of which one genus, one subgenus and 70 species are new. Five species are assigned to species previously described from western India. Five species are compared with other species from W. India, Iran, Turkey and France. Three species are regarded as having affinities with new species described in this thesis and 26 species are left under open nomenclature mainly because of lack of material or the impossibility of observing the internal details.

Biostratigraphically, the Lower Fars Formation in the Sinjar area is divided into three Assemblage Zones, these zones are applicable only to N. Iraq, but make a starting point for future work in the area. In the Kirkuk area, the saliferous beds proved completely barren, but the upper Red, Seepage and Transition beds yield Ostracods although the assemblages recognised are at present only regarded as tentative, because the samples are ditch cuttings.

Palaeoecology is discussed in terms of oxygenation, palaeoclimate, salinity and the trends in the depositional environment of the Lower Fars Formation.

The affinities of the present genera and species are discussed from a palaeogeographical view point in relation to the adjacent and related regions. Three Miocene Ostracods provinces are proposed, namely a western India province, a Zagros shelf province and a southeast Turkey province.

THE UNIVERSITY OF HULL

MIDDLE MIOCENE OSTRACODA FROM NORTHERN IRAQ

being a thesis submitted for the Degree of
Doctor of Philosophy
in the University of Hull.

by
Saleh K. Khalaf B.Sc. Mosul University Iraq.

May, 1984

CONTENTS

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION TO THE GEOLOGY OF NORTHERN IRAQ AND LOCATION OF THE AREA STUDIED

Northern Iraq occupies an interesting geological position in the Middle East and is situated between the Arabian shield to the southwest and Zagros geosyncline to the northeast.

The geological framework of the Middle East has been dealt with by Henson (1951). He subdivided the Middle East into various stratigraphic-tectonic zones in which the main tectonic provinces bounding Iraq can be recognised: They are;

1 - The Arabian shield in the southwest (stable region)

2 - Taurus mountains of Turkey in the north

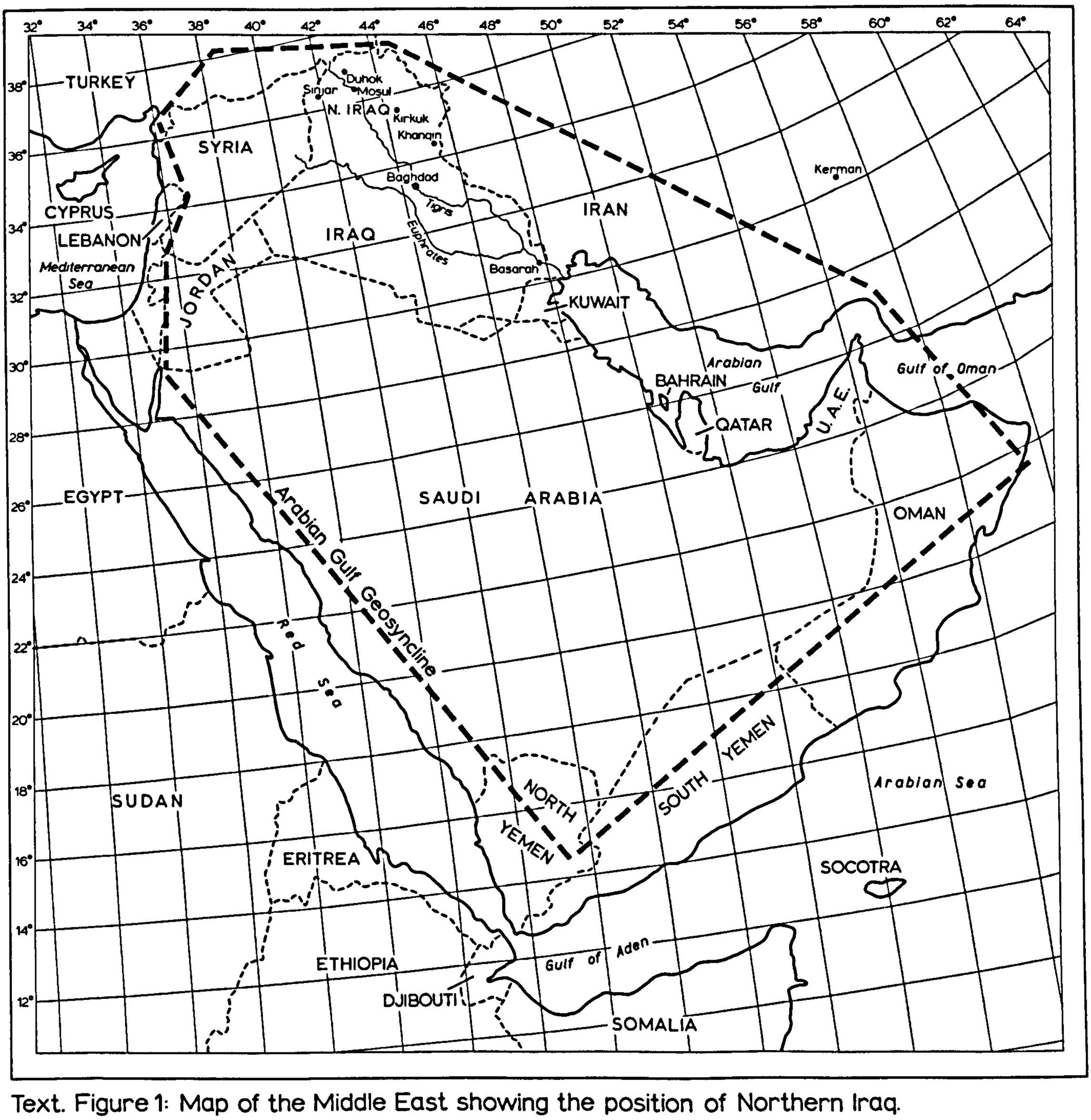
3 - Zagros mountains of Iran in the northeast-southeast

4 - Oman mountains continuing the line of the Zagros mountains to the south

5 - The mountains and highland of southern Arabia.

Northern Iraq is part of the Arabian Gulf geosyncline as defined by Morris (1978). According to him the Arabian Gulf geosyncline including the present area is bounded by the Arabian shield and the Dead Sea fault on the west, the southeastern overthrust and the belt of Turkey on the north, the Zagros thrust and the Oman line on the east and the hills of Southern Arabia to the south (Fig. 1).

So according to Morris's definition of the Arabian Gulf geosyncline and Henson's subdivision of the Middle East, northern Iraq is part of the unstable shelf area of the Middle East, which is a tectonically active area and includes the Taurus - Zagros - Oman mountain belt.

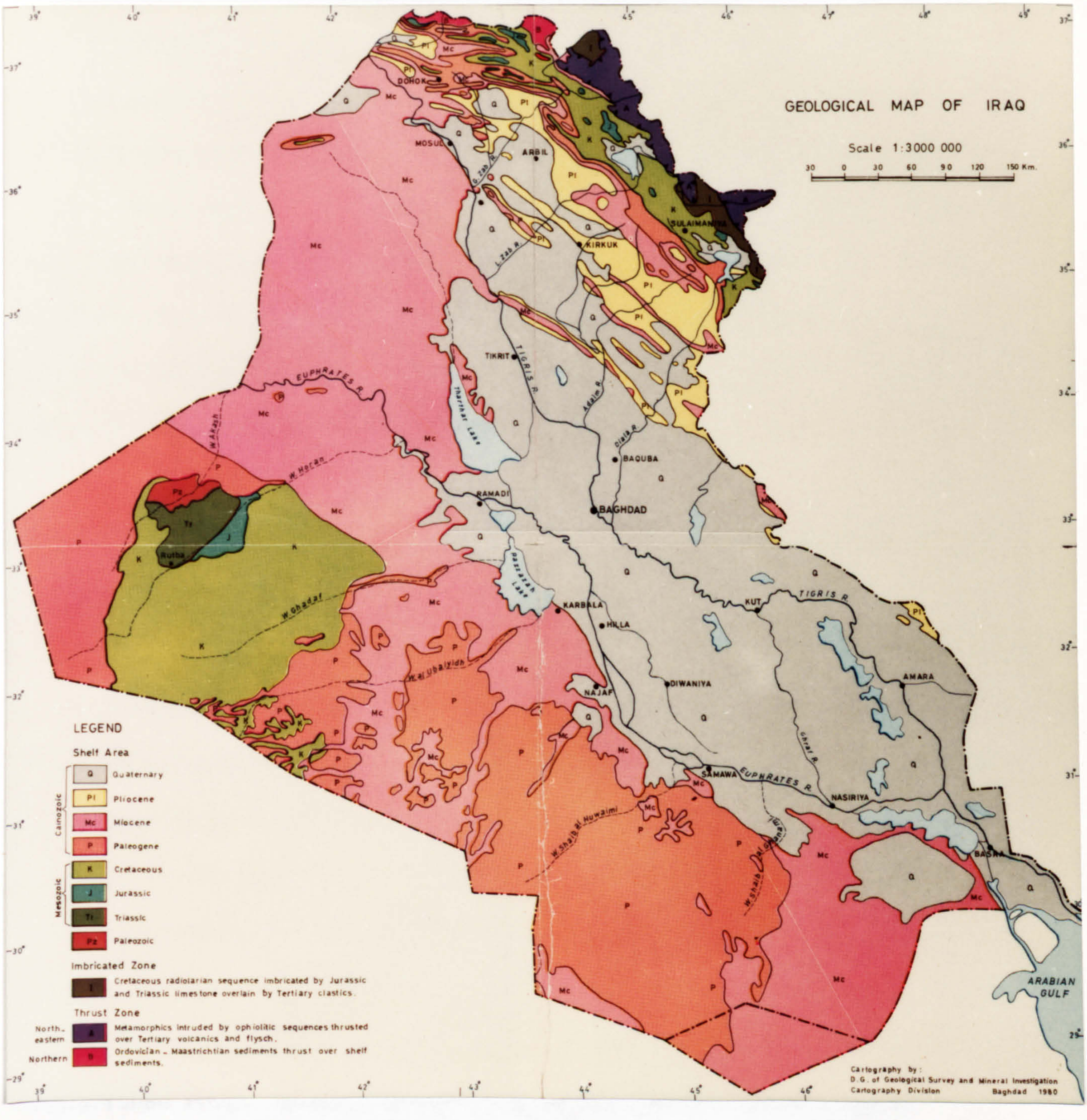


Text. Figure 1: Map of the Middle East showing the position of Northern Iraq.

Tectonically Iraq may be divided into two main parts consisting of stable shelf on the one hand and the unstable shelf on the other. The stable shelf comprises the west and southwest of Iraq and is characteristically unfolded with a reduced thickness of sedimentary cover.

The outcrops of the Arabo-Nubian massif or (shield) lie far to the south and southeast of the limits of the region considered.

The unstable shelf in Iraq is part of the Zagros folded belt and is covered with a thick sedimentary rock sequence. The intensity of the folding increases north-eastwards, perhaps due to the fact that the main force came from that direction. This unstable zone includes both folded and thrust zones and is characterised by thick sedimentary sequences and huge folds. The folds form long narrow N.W.-S.E. anticlines, following the Zagros mountains except for the Sinjar anticline which strikes E-W probably due to anticlockwise rotation associated with NE drift of the Afro-Arabian plate (Ibrahim 1979). These anticlines are separated by broad flat synclines to the northeast, where the innermost unit of the unstable shelf is characterised by intense folding and orogenic uplift, with tightly folded anticlines and synclines. The principal sediments cropping out in the folded zone are Cretaceous and Tertiary in age (Fig. 2). Some Palaeozoic formations are exposed in the northern part near the Turkish border. Further to the north and northeast, the unit can be considered as part of the Taurus and Zagros mountains in which the miogeosyncline consists of two units, the outer Rwanduz unit filled by Cretaceous up to Miocene deposits, the second unit is the northern thrust zone which is composed of sediments of the mio-geosyncline ridge thrust over the mio-geosyncline of northern Iraq (Kassab and Jassim 1980).



Text fig. 2. Geological Map of Iraq.

The eugeosyncline part of the Alpine area is called the thrust zone and consists essentially of two main parts. The first part consists of the lower and outer Tertiary units made up of the largely sedimentary lower Naopurden unit and the higher volcanic-sedimentary Walash unit. The second part is the higher Qandil unit which has a very complex structure and stratigraphy. The area studied lies in Northern Iraq in the central unit of the foothill zone, in which nine sections of the Lower Fars Formation were chosen across the basin extending from NW to the SE. Five of these sections are located in the Sinjar area, the others in the Kirkuk area. The position of the area relative to the remainder of the Middle East is shown in Fig. 1.

1.2 On the Tertiary Ostracoda from western Asia and some parts of Mediterranean region

In Iraq the Ostracods have received little attention from micropaleontologists. A literature survey shows that most of the work has been done on the foraminifers, due to a shortage of Ostracodologists in Iraq. As far as the author is aware there is no published work on Iraqi Ostracoda. In 1956 Al-Sayy͡b studied the Cretaceous Ostracoda around the Arabian Gulf and included southern Iraq, his work was submitted as a Ph.D. Thesis to the University of Iowa (U.S.A.); more recently Al-Sheikhly,1980 (Unpublished Ph.D. Thesis), University of Glasgow has investigated Maastrichtian Upper Eocene Ostracoda of the subfamily Trachyleberi͡dinae from Iraq, Jordan and Syria.

Information on the Ostracoda in areas adjacent to Iraq is limited. East of Iraq the most relevant work has been carried out in India and Pakistan.

M.H. Latham (1938) reported some Eocene Ostracoda from North-west India (now Pakistan) which was the first paper published on the India area. In the 1960s more work was carried out on the Indian Tertiary Ostracoda from India. Lyubimova, Guha and Mohan (1960) studied Ostracoda from Eocene and Miocene deposits in addition to Jurassic ones from the Kutch and Jaisalmar regions of western India. Bhatia and Mandwal (1960), Tewari and Tandon (1960), Guha (1961, 1965, 1967a, 1967b, 1968a, 1968b, 1968c, 1973, 1975), Rajagopalan (1962), Singh and Misra (1968), all investigated Tertiary Ostracoda from India and more related work has been done by Khosla (1968, 1972, 1973, 1976, 1978) Khosla and Haskins (1980), Khosla and Pant (1981), from western India. Sohn (1970) has investigated early Tertiary Ostracoda from West Pakistan. In the same area a more detailed study was made by Siddiqui (1971) on the Early Tertiary Ostracods of the family Trachyleberididae from West Pakistan which is most valuable in dealing with the taxonomy of some Iraqi Ostracoda. Bassiouni (1969 a and b) described some species from the Eocene of Jordan. More detailed work has been done by Al-Furaih 1980 on the Upper Cretaceous and Lower Tertiary Ostracoda (superfamily Cytheracea) from Saudi Arabia. The same author together with Siddiqui (1981) recorded a new trachyleberid genus from Saudi Arabia, Pakistan and India. Krstic 1979 reported some Ostracod species from the Miocene of the Kerman area, southwest Iran; further west M. Stancheva 1974 described a new genus from the Miocene of the Euxino-Caspian basin.

Concerning the related part of the Mediterranean, the information given here is confined to work relevant to Iraqi Ostracoda and the recent literature. Uliczny (1969) studied the Neogene Ostracoda from the eastern Mediterranean including the Hemicytheridae and Trachyleberididae, Gramann and Kockel (1969) reported Ostracods from Neogene and L. Quaternary

deposits of the so-called Strimon Basin in Greek Macedonia. Becker-Platen (1970) in describing oligocene to Lower Quaternary deposits of southeastern Anatolia (Turkey) recorded Ostracods from these strata. A more detailed study by Sissingh (1972) on the late Cenozoic Ostracods of Aegean islands Arc, gave a detailed account of the brackish and marine Ostracoda encountered in the Miocene, Pliocene and Pleistocene sediments of the south Aegean islands of Gavodos, Crete, Karpathos and Rhodes. From central Crete, Sissingh (1972) reported twenty six Miocene Ostracod species. The same author also studied the stratigraphic distribution of late Cenozoic Ostracoda in the central and eastern Mediterranean basin (Sissingh 1976). Neriman Doruk (1973, 1974, 1979) reported new genera and species from the Adana basin, southeastern Turkey. A more detailed study and investigation was carried out by Bassiouni 1979 in his monograph on the Oligocene and Neogene Cytherideinae, Hemicytherinae and Trachyleberidinae Ostracoda from Turkey, which looked further into the taxonomy, biostratigraphy and paleozoogeography. Thus at present our knowledge of Tertiary Ostracoda from Iraq and the adjacent areas, both to the east and to the west, is still very limited.

1.3 Aim of Research

The main aim of this study has been to supply systematic description of the Ostracoda from the Lower Fars Formation of northern Iraq. Thus different sections of the Lower Fars Formation across the basin from NW to SE were studied in order to accomplish this and to correlate the Ostracoda across the various Lower Fars sections in northern Iraq. On the basis of the Ostracoda faunas it was proposed to establish the environments in which the formation was deposited.

CHAPTER 2
METHODS OF STUDY

A. SAMPLING*

The sample localities for this study fall into two main groups. Surface samples and well samples, these localities chosen across the basin of the Lower Fars Formation (N. Iraq) to cover the area extending from NW (Syrian border) to the NE (Iranian border), Figure 3.

Surface samples from four localities were collected during field work in N. Iraq; subsurface samples (cuttings samples) were obtained from northern oil fields material released by the Ministry of Oil.

Surface localities:

Surface samples were collected from four localities northeast and northwest of Mosul City. These samples were taken at each variation in the lithology to cover the whole cyclic successions of the L. Fars Formation.

1. Bashiqa locality:

lat. 36^{o} 28' N, long. 43^{o} 28' E Thickness 47.80 m.

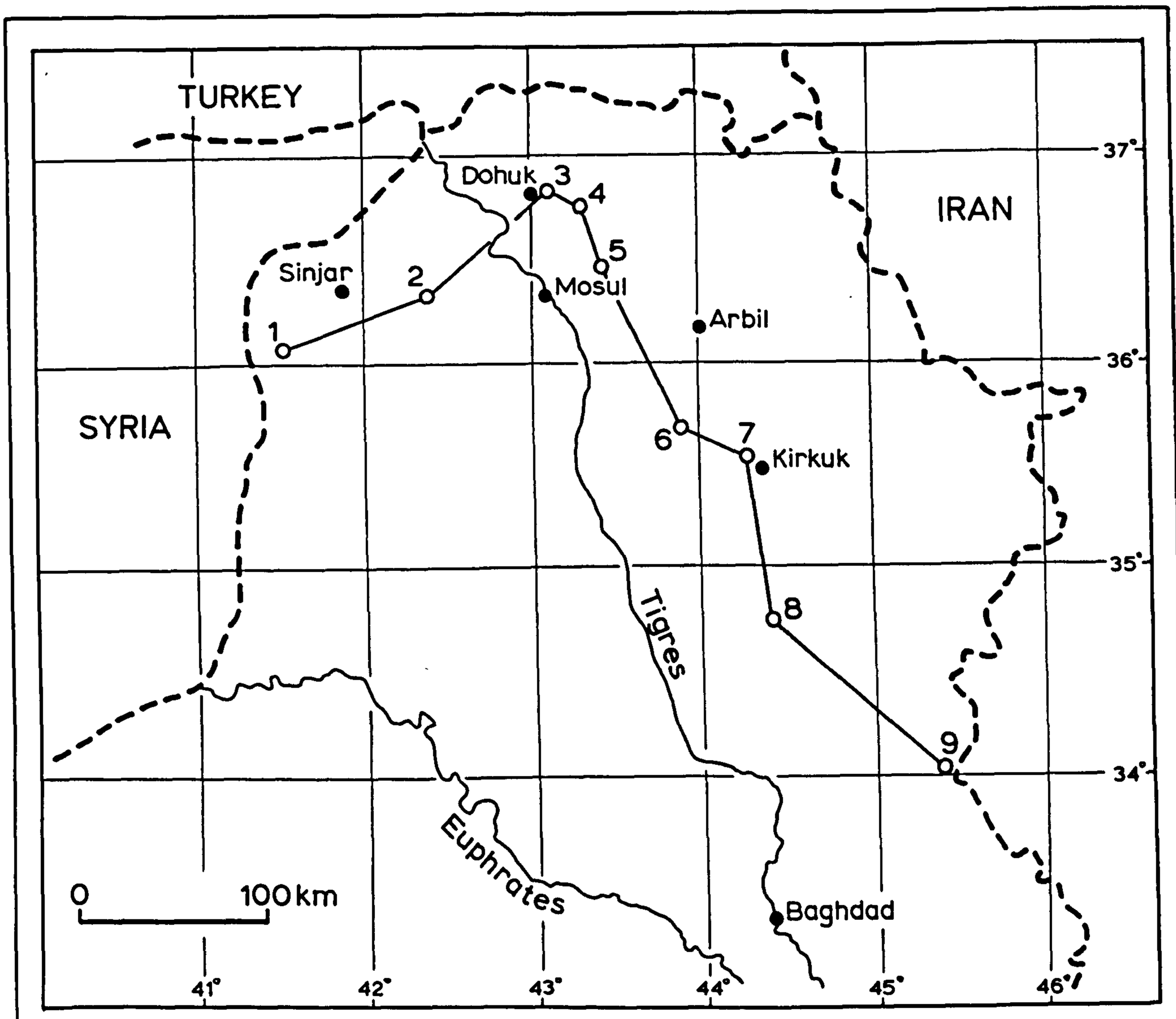
Seven samples of L. Fars Formation were collected from the southern limb of Bashiqa anticline which is situated about 28 km. northeast of Mosul City, it is a double plunging anticline with NW-SE trend, the Lower Fars Formation at this locality is represented by cyclic deposition of marl, marly limestone and limestone.

2. Sheikhan locality:

lat. 36^{o} 42' N long. 43^{o} 25' E Thickness 48.60 m.

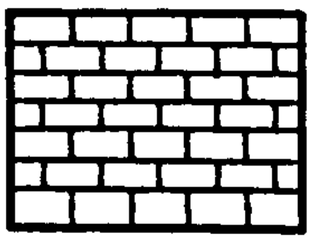
Twelve samples were collected from the northern limb of the Sheikhan anticline which is situated about 27 km NE of Mosul City and is a double plunging anticline striking northeast-southwest.

*The original units have been employed, no attempt has been made to convert metres to feet or vice versa.

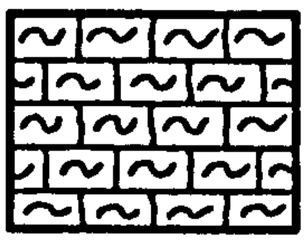


1. Tel-Hajer well 1.
2. Shek-Ibrahim section
3. Dohuk section
4. Shaikhan section
5. Bashiqa section
6. Bai Hassan well 33.
7. Kirkuk well 208.
8. Hamrin well 2.
9. Naft Khana well 34.

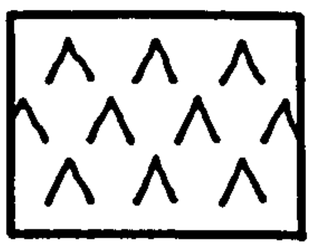
TEXT FIGURE 3. SHOWING LOCATIONS OF THE STUDIED SECTIONS



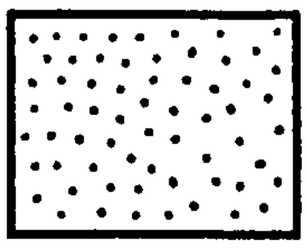
LIMESTONE



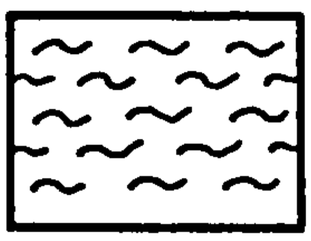
MARLY LIMESTONE



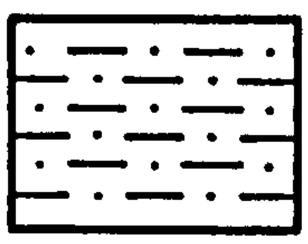
ANHYDRITE, GYPSUM, SALT



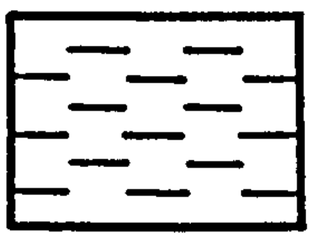
SANDSTONE



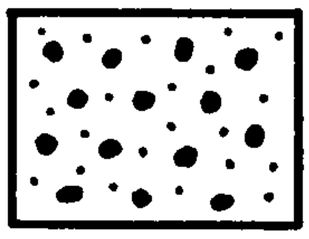
MARL



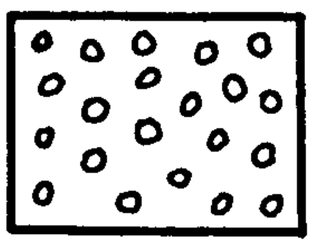
SILTSTONE



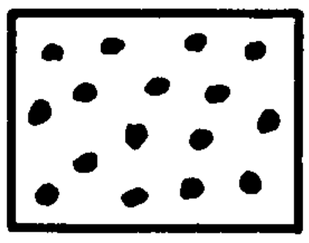
CLAY, SHALE



PEBBLY CEMENTED SAND



CONGLOMERATE



GRIT, PEBBLY SANDSTONE

MUDSTONE, OR NON-EXPOSED

BA. BASHIQA

SH. SHEIKHAN

DO. DOHUK

SHI. SHEIKH IBRAHIM

*. SAMPLES YIELDING OSTRACODS

At this locality the Lower Fars Formation, is completely devoid of gypsum.

3. Dohuk locality

lat. 36° 54′ N, long. 43° 01′ E Thickness 47.60 m.

Twenty samples were collected from the southern limb of the Dohuk anticline, 10 km NE of Dohuk City. The anticline represents a huge fold trending NW-SE from Dohuk City to Khabour village in the border area between Iraq, Syria and Turkey. At this locality the Lower Fars Formation is characterised by the appearance of gypsum beds.

4. Sheikh Ibrahim locality

lat. 36° 18′ N, long. 42° 29′ E Thickness 385.60 m.

Forty six samples were collected from the southern limb of the Sheikh Ibrahim anticline, 45 km west of Mosul, where a complete cyclic succession of limestone, marl and gypsum were present.

The Sheikh Ibrahim anticline follows the same direction as the Dohuk anticline which strikes NW-SE.

Subsurface localities

500 cuttings samples were obtained from five wells in N. Iraq, three of them situated in the Kirkuk area. The Naft Khana well - 34 is situated further to the east at the Iranian border and the Tel-Hajer well - 1 is situated in the Sinjar area at the western border with Syria. The geographical situation of these wells is:

5. Tel-Hajer Well - 1:

lat. 36° 4′ N, long. 41° 29′ E

This well lies at the western border with Syria, southwest of Sinjar town where the Lower Fars Formation is represented by a cyclic succession of reddish-brown siltstone and alternations of massive anhydrite with limestone and grey marl beds.

6. Bai-Hassan Well - 33

lat. 35° 37′ N, long. 43° 50′ E

The Lower Fars Formation at this well is a normal succession of siltstones, anhydrite and limestone beds, these are:

1 - Upper Red Beds: normal succession of siltstones, anhydrite and limestone. Thickness 370 ft.

2 - Seepage Beds: succession of anhydrite, siltstones, marls and thin limestones. Thickness 120.ft.

3 - Saliferous Beds: sequence of siltstone, anhydrite and thin beds of limestone. Thickness 542 ft.

4 - Transition Beds: A typical sequence of marls, anhydrite and limestone markers. Thickness 478 ft.

7. Kirkuk Well - 208

lat. 35° 3I′ N, long. 44° 17′ E

Here the Lower Fars Formation is well represented by the four members.

1 - Upper Red Beds: Typical interbedded brown siltstone, massive and white anhydrite with marly limestone. Thickness 31.2 m.

2 - Seepage Beds: A sequence of brown siltstones, massive anhydrite and thin beds of limestone. Thickness 143.7 m.

3 - Saliferous Beds: this interval consists of brown siltstone, anydrite with well developed S. limestone which is highly dolomitized and recrystallized. Thickness 12.8 m.

4 - Transition Beds: Consist of blue marl, anhydrite and grey brown limestone markers. Thickness 139 m.

8. Hamrin Well - 2

lat. 34^{o} 45′ N, long. 44^{o} 09′ E

This well is situated on the southeast plunge of the Hamrin structure.

The Lower Fars Formation subdivided into the usual four members:

1 - Upper Red Beds: This succession consists of white massive anhydrite, brown and blue siltstones, alternating with thin beds of limestone. Thickness 107.7 m.

2 - Seepage Beds: This is a normal sequence of thin grey limestones, blue siltstone and white anhydrite. Thickness 32.30 m.

3 - Saliferous Beds: The succession consists of thick rock salt beds, siltstones and dolomitic limestone of S_1, S_2 and S_3 (dolomitic limestone). Thickness 221.5 m.

4 - Transition Beds: This is a normal sequence of the marly limestone, hard, white, anhydrites and thin blue marls which underlies only some of the limestone markers. Thickness 126.2 m.

9. Naft-Khana Well - 34 Thickness 686 m.

lat. 34^{o} 01′ N, long. 45^{o} 21′ E

This well is situated on the southwest flank of the Naft Khana structure of NE of Iraq at the Iranian border.

The Lower Fars Formation is represented by anhydrite, marl, grey clay and thin beds of limestone.

B. TECHNIQUES

The methods used in extracting microfossils from sediments, as outlined by Sohn (1970) were followed in the present study. To extract Ostracods from the sediments, different methods were used depending on sediment type. The sample was first weighed and soft sediments boiled in water with two spoonfuls of sodium carbonate as a defloculent. Boiling and sieving was continued until a clean residue was obtained. Hard samples such as indurated shale or siltstone was obtained. Hard samples such as indurated shale or siltstone were heated on an electric iron plate, cooled and then soaked with kerosene. After half an hour the kerosene was filtered back into the container and the sample dried. Where the kerosene was again poured on to the sample the shale mostly broke down. If the sample did not break down sufficiently, after filtering the kerosene, two spoonfuls of sodium carbonate were added, and successive boilings and sievings carried out to get a residue.

For hard limestone, hydrogen peroxide (15% solution) was used. The dried sample was soaked in hydrogen peroxide overnight, then sodium carbonate and water added followed by boiling and sieving. This proved to be not very successful. Freezing and thawing by sodium acetate was also tried. After breaking the sample into fragments of about one cubic centimetre size, these were covered with sodium acetate, a few drops of water added and the sample was heated slowly. It was then removed from the heat and placed suddenly in a pan of cold water. This process was repeated many times. Most of these processes were of limited success, except the repeated boiling with sodium carbonate which gave comparatively better results. The boiled samples were washed

through 240, 16 mesh sieve and all the sieves were cleaned between washings of different samples. The filtered residues were dried and stored in plastic bags for picking.

Picking

The residue was spread on gridded, flat black trays, and the ostracods picked out with a moisted on sable brush at low magnification and transported to Frank slides.

Treatment of individual specimens

To observe internal and external shell structures, adherent matrix needed removal. Specimens were cleaned manually using fine electrolytically sharpened tungsten needles mounted in glass rods. If the valve was strongly calcified it was secured with a drop of gum tragacanth. This prevents the specimen popping out of the slide when touched with the needle after adding a drop of water to soften the matrix. An ultrasonic cleaner (Soniclean Generator) was used in some cases if there was a large number of specimens with strongly calcified shells. However, this method of cleaning is not entirely successful as specimens easily become broken. Malachite green was used to study the external features of the specimens under reflected light, but these were best studied in SEM stereo-photographs.

For internal details, the specimen was moistened with water and as it evaporated and dried, the desired results were obtained. Clove oil was also used on occasion when the period for soaking varied from a few minutes up to a few days.

Stereopair-photography

After cleaning; the specimens chosen for photography were mounted on stubs using either double-sided sellotape or kodaflat solution as mountant. The latter is the better, as it gives a good photographic background and it is easier to remove the specimen. The specimens were mounted with dorsal margin parallel to the edge of the stub which was then placed in a vacuum coating unit. A gold coating was found to give the best results. The specimens were examined and photographed using a Cambridge S 600 scanning electron microscope and Ilford F.p.4 film. Stereo-pairs were made of each photographed ostracod giving different views, plates were made up and rephotographed for final reproduction of A4. size.

Repository

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

CHAPTER 3
LOWER FARS FORMATION

3.1 Introduction

The Lower Fars Formation is one of the most important formations in Iraq. It has a principal role in petroleum geology since it has the ability to provide plastic cap rock seal of salt and anhydrite to retain oil in the underlying reservoir formation.

Pilgrim (1908) used the term Fars group for a series of sediments and evaporites in Iran, which also occurs widely in Iraq. Busk and Mayo (1918) replaced Pilgrim's term (Fars group) by Fars Formation and described its development in Iran, which forms the type locality. They also recognised Lower, Middle and Upper divisions of the Fars Formation. Pascoe (1922) described and mapped the Fars Formation from Iraq, in particular from 'Jabel Hemrin' and 'Jable Makhul'. He also mapped and described the Fars Formation from the exposures around the Kirkuk oil field, and introduced the term 'Hemrin stage' to include both Middle and Lower Fars and the Naseze zone of the conglomeratic part of the Upper Fars.

The early classification of the Lower Fars Formation in the Kirkuk area was originally introduced by Kitchen (1927) in an unpublished report. In 1951 Sugden divided the Lower Fars in the Kirkuk oil field on the basis of its limestone content and later Bellen (1959) gave a brief general description of the Lower Fars Formation in Iraq.

In Iran, James and Wynd (1965) subdivided the Gachsaran Formation into three members and showed that the formation ranged down into Lower Miocene. In Iraq, Owen and Nasr (1958) considered that the age of this formation ranged from early to M. Miocene. Al-Naqib (1967) similarly considered

the age of the Lower Fars Formation to be Lower to Middle Miocene, whilst Al-Sayyb and Kureshy(1967) assigned a Lower Miocene age to the Lower Fars Formation in Southern Iraq. I.I. Kassab and S.Z. Jassim (1980) stated that as defined in Iraq, the formation was undoubtedly Middle Miocene, as proved by the position of the formation above the Orbulina datum. From this, one is led to conclude that the Lower Fars Formation is probably a diachronous formation of Lower Miocene age in S.W. Iran and Middle Miocene age in Iraq, a situation due to a combination of tectonics and the pattern of deposition.

3.2 General distribution

The distribution of the Lower Fars Formation is affected by the structure of the surrounding area i.e. it is affected by the tectonics. In Iraq the formation is limited in its distribution by the Arabian Shield to the southwest and the Zagros range to the northeast which was already rising at the time of its deposition. Lees (1938) suggested that the Lower Fars salt and anhydrite deposits were laid down in an immense Gulf which stretched from the present Turkish frontier northwest of Mosul to the Arabian Gulf.

The Lower Fars Formation is not differentiated in Turkey although Altinli (1966) has described molasse which included age and facies equivalents of the Lower Fars Formation. In Syria, on the other hand, the formation concerned is widely distributed in the Al.Jezira area and extends towards the Syrian-Turkish border. In Saudia Arabia the formation has as its equivalent the Dam formation which has a marine fauna identical with that of the Lower Fars Formation (Powers et al. 1967). (Fig. 4)

EPOCH	N.E. SYRIA	IRAQ	IRAN	KUWAIT & S.E. IRAQ	SAUDI ARABIA
PLIOCENE	Bakhtairi	Bakhtairi	Bakhtairi	Dibdibba	Hofuf
	Upper Fars	Upper Fars	Agha Jari		
			Mishan		
MIOCENE	Lower Fars	Lower Fars	Gachsaran	Lower Fars	Dam
	Transition Zone				
	Jeribe	Jeribe	Asmari	Ghar	Hadrukh
	Dhiban	Dhiban / Euphrates	Kalhur		
OLIGOCENE					

Text Fig. 4. Correlation between the Miocene in N.E. Syria, Iraq, Iran, Kuwait & S.E. Iraq and Saudi Arabia. Modified after *G.A. James*, and *J.G. Wynd* 1965

The development of the Lower Fars Formation in Iraq, as indicated by the earlier workers (Lees 1938) shows that it is widely distributed, with the sediments spreading over the foothills zone and unfolded zones. The thickness of the formation thus shows great variation reaching more than 700 m at the centre of the basin in Iraq and about 600 m in the Kirkuk area (Bellen et al. 1959).

According to Owen and Nasr (1958), in southern Iraq the thickness of the formation is 335 m at Nahrumr. In the western desert, i.e. southwest of the River Euphrates, the formation occurs as a narrow strip only at the foot of the Rutba uplift. The formation also crops out in the area of the Qsar Sharqah,Al-Busayyah and Khashmat Ibn Halaf (Al-Naqib, 1967).

Extensive outcrops spread west of Najaf (middle Iraq). To the south in Kuwait, according to Owen and Nasr (1958), the Lower Fars Formation is recognizable in well Raudhatai No. 1 between drilled depths of 105 m and 215 m. Here it consists mainly of anhydrite, gypsum, clays, marls, and shallow water limestone containing Ostrea latimarginata and Quinqueloculina sp. (Al-Naqib, 1967). The unit which continues further to the south into the Zor escarpment consists of 38 m of fine grained sand, silt and clay containing Ostrea latimarginata. This unit is locally called the Zor formation.

3.3 Stratigraphy

The Lower Fars Formation is part of the Fars group in Iraq which also includes the Upper Fars Formation (Upper Miocene in age) composed mostly of alternations of claystone and fine to coarse-grained sandstones and

the Middle Fars (considered as a member in this work) which represents the transition zone between the underlying evaporitic sediments (Lower Fars Formation) and the overlying clastic rocks (Upper Fars Formation). Its environment of deposition is considered to have been both marine and terrestrial at various times.

The Lower Fars Formation represents the most widespread and stratigraphically important part of the Fars group in Iraq.

Kitchen (1927 unpublished report) introduced the first classification of the Lower Fars Formation of the Kirkuk area when he divided the formation into a number of informal units from bottom to top as follows: (Enclosure No. 1).

1. The Transition Beds: Composed mostly of anhydrite and siltstone, alternating with 14 limestone markers (T_1-T_5, Z, T_6-T_{13}). These beds rest on the basal Fars conglomerate.

2. The Saliferous Beds: These beds consist of rock salt and anhydrite with some siltstone and mudstone, with one marker bed of limestone designated 'S'. At some localities an additional limestone 'X' is also present. At the base of the beds there are two markers 'S_2' and 'S_3' which in some localities have been combined as marker band 'Y' (W. Sugden, 1951).

3. Seepage Beds: These consist of siltstone, anhydrite and mudstone, with four limestone marker beds (B_1 to B_4).

4. Upper Red Beds: These consist of reddish mudstone, fine sandstone and anhydrite alternating with the eight limestones (R_1 to R_8).

These beds are recognizable in the Kirkuk area of the Lower Fars basin but are not clearly distinguishable in the Sinjar basin and the southeastern area of Iraq.

Sugden (1951) divided the Lower Fars Formation (Kirkuk oil field) into three parts dependent on the desiccation rate as follows:

1. The lower part: According to Sugden, desiccation was not sufficient to produce salt and the maximum desiccation is represented by anhydrite. This part includes the whole of the Transition Beds, and the lower part of the Saliferous Beds up to the S_1 marker bed.

2. The middle part: Desiccation proceeded sufficiently to cause the deposition of salt. This part includes the whole of the Saliferous Beds above S_1 and contains very little limestone. This part probably represents an arid period in which evaporation exceeded precipitation and salinity became very high.

3. The upper part: Maximum desiccation here is represented by anhydrite and was insufficient to produce salt. This upper part includes both the Seepage Beds and the Upper Red Beds.

The Lower Fars Formation produces sulphur in the area around Mosul. On this basis Al-sawaf (1977) divided the sulphur bearing Lower Fars Formation into three lithological series from the bottom:

1: Productive Series

The lower member of this series contains sulphur deposits in the crest of some anticlines. It is characterised by mineralization producing secondary limestone, calcite, sulphur and some aragonite in the original gypsum and anhydrite beds.

2: Sulphate Series

Consists of gypsum and anhydrite with marl.

3: Carbonate Series

This forms the uppermost member of the Lower Fars Formation and consists of limestone, marl, sandstone and minor gypsum.

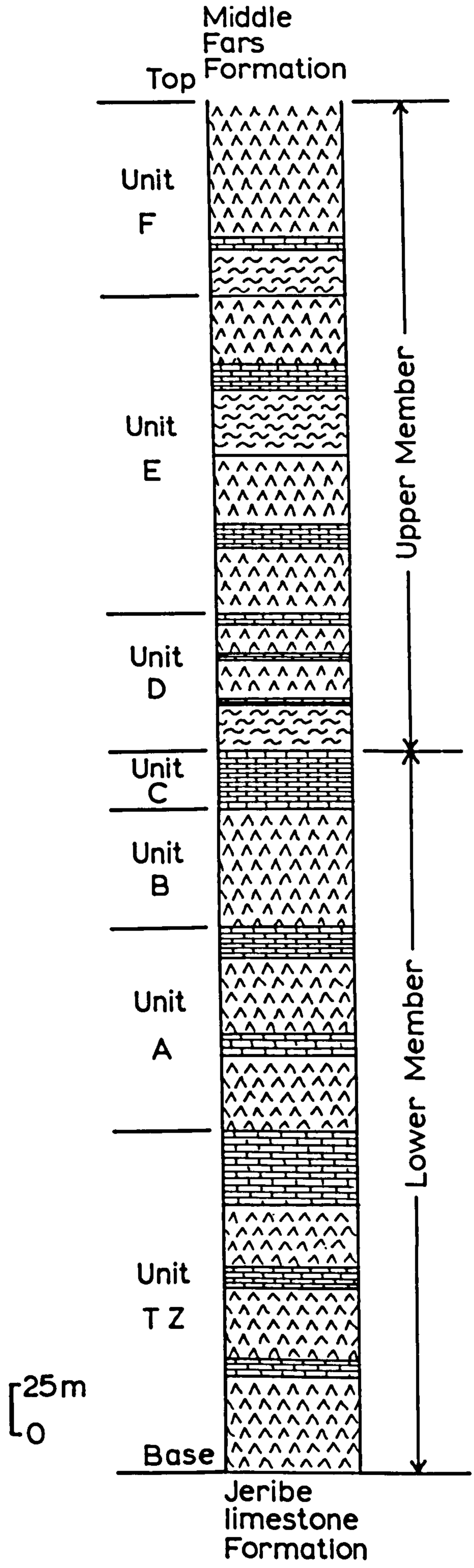
This classification was based on the Mishraq sulphur deposit, southern Mosul and some anticlines bearing sulphur around the Mosul area.

More recently Al- Mubarak (1978) in his study of the Al-Fatha-Mosul area, divided the Lower Fars Formation into two members based on lithological and faunal characters (Fig. 5).

I - Lower Members (LF_1)

This member is composed mainly of thick, massive gypsum, interbedded with thin horizons of limestone, occasionally with yellowish-green marl below or alternating with the limestone.

On the basis of lithological and physical properties the member is sub-



Text fig.5 Generalized stratigraphic columnar section of the Lower Fars Formation, Sinjar area modified after *Al-Mubarak* 1978.

divided into four rock units. These units from bottom to top are as follows:

1: Transition Zone (TZ) - consisting of two parts. The lower part is composed mainly of white massive gypsum, interbedded with two thin horizons of limestone. The upper part consists of intraclastic limestone which forms a massive middle part and is thin bedded above and below.

2: Gypsum-limestone unit (A) - this consists of gypsum and limestone. Two horizons of massive gypsum alternate with two horizons of brownish-grey limestone.

3: Gypsum unit (B) - white moderately hard gypsum. This is massive in the lower and upper parts and well-bedded in the middle part.

4: Limestone unit (C) - this represents the marker horizon which separates the two members of the Lower Fars Formation. It is composed of highly fossiliferous limestone with yellowish-green marl in between in some places.

II - <u>Upper Member</u> (LF_2)

This is represented by claystone, marl, limestone and gypsum in regular sequence. On the basis of lithological and physical properties the member is subdivided into three rock units from bottom to top as follows:-

1: Gypsum dominant unit (D): Gypsum is the dominant bed in this unit, but the cycle is built up of alternations of well bedded claystone, limestone and gypsum from bottom to top. The claystone beds are

purplish-red in the lower part, and dark green in the upper part. The limestone beds are composed of light-grey to whitish-grey, hard, highly-weathered, fossiliferous limestone which is occasionally marly to clayey. The gypsum beds are massive, moderately to highly weathered and white in colour.

2: Gypsum-claystone unit (E): This unit comprises two cycles, each cycle consisting of alternating well-bedded claystone, limestone and gypsum; the thickness of gypsum beds and claystone horizons is approximately the same.

3: Gypsum-dominant unit (F): This unit consist of 3-5 cycles of evaporite alternated with well bedded claystone, limestone.

The Lower Fars Formation is transgressive and the nature of the basal contact varies throughout the basin. At the margins the formation may rest on rocks of Lower Cretaceous age and its basal beds are conglomeritic (the Fars conglomerate).

In the centre of the basin, the sedimentation was vertically continuous, the Fars conglomerate does not occur, and the Jeribe limestone interdigitates with the limestone of Lower Fars Formation. The upper contact of the Lower Fars Formation in most parts of northern Iraq is with the Upper Fars Formation (Upper Miocene) which consists of claystone, siltstone and sandstone and is recognised in the field by the absence or decrease of gypsum and the appearance of sandstone.

CHAPTER 4
SYSTEMATIC DESCRIPTIONS

Subclass: Ostracoda Latreille, 1806

Order: PODOCOPIDA G.W. Muller, 1894

Suborder: PLATYCOPA Sars, 1886

Family: CYTHERELLIDAE Sars, 1866

Remarks:

Cytherella, Cytherelloidea and Platella are the most common taxa among Cytherellids, different views have arisen about the generic standing of these three taxa. Cytherella was erected by Jones (1849) with the sub-genus Cytherella for forms which were ovate to egg-shaped in lateral view with a smooth surface or variable number of pits.

The species placed in the genus Cytherella showed variable ornamentation from a smooth to slightly pitted surface and Morkhoven (1963) stated that varying punctation of the lateral surface of Cytherella occurs regularly. Some workers considered Cytherella as having the two subgenera Cytherella and Cytherelloidea e.g. Hartmann and Puri (1974) Sissingh (1972) and the American Treatise 1961 (p.382). Morkhoven (1963) on the other hand, regarded Cytherella and Cytherelloidea as distinct and separate genera as do many other workers Bate (1972), Neale (1975) and Keen (1978). This latter view is accepted here. Cytherelloidea was erected by Alexander (1929) to include the species sculptured with ridges, tubercles and pits.

It obviously differs from Cytherella in ornamentation and in outline the dorsal and ventral margins are straight rather than ovate. Therefore, it is considered as a distinct genus in this work.

Platella from the Miocene of Panama was erected by Coryell and Fields (1937)

as a distinct genus, but its generic status disputed. Morkhoven (1963) considered Platella as synonymous with Cytherella whereas Puri and Hartmann (1974)considered it to be a distinct genus. Bate (1972)stated that the species with strongly pitted shell surface belong in Platella which he considered a valid genus but he described species with a length of 450 um height 260 um and suggested that they might be juvenile instars. On the other hand the type species with dimensions, length 420 um and height 200 um may also be a juvenile.

Further study of the type species is required, and Platella could be considered as subgenus of Cytherella or abandoned.
abandoned

Genus CYTHERELLA Jones 1849

Type species: Cytherina ovata Roemer, 1840

Cytherella bashiqaensis sp. nov.

Pl. 1, figs. 1-6

Derivation of name: From Bashiqa village, which gave its name to the Bashiqa anticline, where the species was found.

Holotype: A carapace female HU. 275 T.3

Paratypes: Six specimens HU.275 T.4. 1-6

Type Horizon: M. Miocene, Lower Fars Formation, bed No.10. Sample BA.7.

Type locality: Bashiqa anticline, southern limb, 28 km NE of Mosul City, Northern Iraq.

Material: 40 specimens.

Diagnosis: Carapace ovate to subquadrate in lateral view, with maximum height at the posterior end. Lateral surface with numerous pits. Posterior end comparatively higher and more broadly rounded than the anterior.

Description: Carapace medium in size, subquadrate in side view, maximum thickness and height at the posterior end, greatest length at mid-height. Dorsal margin, in the left valve, strongly concave anterior to the middle, higher and gently sloping posteriorly, less high with a short sloping section anteriorly; in the right valve slightly concave anterior to the middle, higher with a slight convexity at the anterior and posterior parts of the carapace. Ventral margin nearly straight, running smoothly into the anterior and posterior ends. Anterior end regularly, narrowly rounded, with thin a marginal rim, more distinctive in the male. Posterior end comparatively broadly rounded, evenly rounded in the left valve, narrower at the middle in the right valve, higher and more inflated than the anterior end.

Lateral surface smooth with variable numbers of small rounded pits scattered over the carapace. Right valve larger and with prominent overlap along all the margins, so that the right valve forms the carapace outline inside view.

In dorsal view, the dorsal margin of the right valve is higher and overlaps the left valve; maximum width towards the posterior end. Anterior end narrowly tapered; posterior end inflated and gently rounded.

Internally, the right valve hinge consists of a simple groove; in the left simply a dorsal flange. The inner margin is clear at the posterior end. Muscle-scar situated dorsocentrally. Sexual dimorphism is pronounced. Presumed males more elongate and narrower compared with the females.

Dimensions of figured specimens:

Holotype HU.275 T.3 ♀ carapace pl. 1, fig. 1

L = 610 um

H = 390 um

W = 300 um

Paratype HU.275 T.4.1 ♂ carapace pl. 1, fig. 2

L = 620 um

H = 360 um

W = 290 um

Paratype HU.275 T.4.2 ♀ carapace pl. 1, fig. 3

L = 610 um

H = 350 um

Paratype HU.275 T.4.3 ♀ right valve pl. 1, fig. 4

L = 575 um

H = 306 um

Paratype HU.275 T.4.4 ♂ RV pl. 1, fig. 5

L = 620 um

H = 330 um

Paratype HU.275 T.4.5 ♀ carapace pl. 1, fig. 6

L = 610 um

H = 340 um

W = 250 um

Affinities and Differences:

C. bashiqaensis sp.nov. has some similarities to C. protuberantis Lyubimova and Guha 1960. However the Bashiqa species is more elongate and higher

than the Indian species, where as in C.protuberantis the anterior end is narrower. Lyubimova and Guha gave the wrong orientation to C. protuberantis and described the left valve as larger than the right. In the right valve the posterior end has smoothly rounded angle at mid-height in the Bashiqa species while it is evenly rounded in the Indian species. C. Palanaensis Khosla 1972 resembles the present species in the outline of the carapace, but it differs in other respects. The posterior end is narrower, dorsal and ventral margins are nearly straight, the lateral surface is ornamented with closely spaced concentric striations and there are small pustules in the posterior region. In dorsal view Khosla's species is wedge shaped and a narrower posterior end. C. pulchella Ruggieri 1967 shows some similarity to C. bashiqannsis sp. nov. but differs in being narrower and more elongate with well rounded anterior and posterior ends, a straight dorsal margin and a ventral margin which is concave in the middle.

Distribution:

This species has been found throughout the Lower Fars Formation sections of Dohuk, Bashiqa, Sheikhan and Kirkuk of Northern Iraq.

Cytherella sayybi sp. nov.

pl. 1, figs. 7-12

Derivation of Name: In the honour of Professor A. Al-Sayyb, Geology Department, Baghdad University.

Holotype: A female carapace HU.275 T.5

Paratypes: Five specimens HU.275 T.9. 1-5

Type horizon: M.Miocene, L.Fars Formation, bed no. 13, sample DO.12

Type locality: Dohuk anticline, southern limb 10 km NE Dohuk City.

Material: Twenty specimens.

Diagnosis: Sexual dimorphism pronounced. Subquadrate females are easily distinguished from the elongate, ovate males; lateral surface smooth and a shallow depression is present between the centre of the carapace and the dorsal margin.

Description: Relatively small-sized carapace. Females with subquadrate outline, males ovate, narrower and more elongate. Greatest height posteriorly, greatest length at 1/3 of the height above the ventral margin. Dorsal margin nearly straight, with slight median sinuation, with smoothly rounded angles joining the anterior and posterior ends. Ventral margin straight passing smoothly into the anterior and posterior margins.

Anterior margin broadly rounded, with faint marginal rim. In the female the posterior end is broadly and regularly rounded, in the right valve, and obliquely rounded with the dorsal part curving down in the left valve. In the male the posterior end is obliquely rounded with a gentle sloping of the upper part.

Posterior end inflated and higher than the anterior end. Lateral surface smooth, with slight depression in the dorso-central part of the carapace. Right valve overlaps the left all round. In internal view the valves deepest postero-ventrally reflecting the inflation of the carapace. Muscle scar pinnate in shape. Hinge in the left valve formed by the edge of the dorsal margin which fits into the right valve groove.

Sexual dimorphism is pronounced, the presumed males being more elongate and ovate than the presumed females. In addition the posterior end is more obliquely rounded in the males than in the females.

In dorsal view the carapace is straight and wedge-shaped with the maximum width posteriorly.

Dimensions of figured specimens:

Holotype HU.275 T.8 ♀ carapace pl.1, figs. 7,9
L = 525 um
H = 320 um

Paratype HU.275 T.9.1 ♂ carapace pl. 1, fig. 8
L = 540 um
H = 310 um

Paratype HU.275 T.9.2 ♀ carapace pl. 1, figs. 10, 12
L = 530 um
H = 330 um

Paratype HU.275 T.9.3 ♀ L. valve pl. fig. 11
L = 520 um
H = 300 um

Affinities and Differences

Cytherella sp. Guha 1965 from the Oligocene of western India differs from

the present species in being smaller, and having a narrower posterior end and convex ventral margin. Guha's species probably represents an immature specimen. C. tawaica Singh and Tewari 1966 shows some similarities to C. sayyhi sp. nov. but the Indian species is narrower and more elongate with regularly rounded anterior and posterior ends and its dorsal and ventral margin are concave in the middle.

The present species also shows affinites with Cytherella cf. C. lebanonensis Howe,1951 (Sohn 1970) from Pakistan, but the Iraqi species is more quadrate and wider than Sohn's material. C. vulgata Ruggieri 1962 differs from the present species in being more rounded in lateral view and higher with overlap only along the dorsal and ventral margins.

Distribution: Bashiqa, Dohuk, Sheikhan and Kirkuk of northern Iraq.

Cytherella dohukensis sp.nov.

pl.2, figs. 1-6

Derivation of name: From the type locality.

Holotype: A female carapace. HU.275 T.10

Paratypes: Three specimens HU.275 T.10. 1-3

Type horizon: M.Miocene, L.Fars Formation, bed no. 13, sample, DO. 12.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: 10 specimens.

Diagnosis: Carapace rounded rectangular in outline, greatest height at one quarter of the length. Dorsal margin sloping down, obliquely truncate in the dorso-posterior part. Lateral surface punctate, faint marginal rim

along the anterior end.

Description: In side view rectangular, greatest length at approximately mid-height. Anterior end broadly rounded with faint marginal rim, posterior end narrower and obliquely rounded. Dorsal margin nearly straight in the middle and anterior half, sloping down in the posterior half. Ventral margin straight in the left valve, slightly sinuate at the middle gradually curving upward to join the anterior and posterior ends in the right.

The lateral surface is covered with small punctuations which are stronger in the males than the females. Right valve overlapping the left along almost all the margins. Internal features not well seen. In dorsal view, the carapace is biconvex with the greatest width in the middle; posterior end truncate, anterior end rounded.

Sexual dimorphism is marked, the presumed females being higher and more rectangular in shape than the narrower males. The latter are also strongly punctate and have slightly convex dorsal margins and narrower truncate posterior end.

Dimensions of figured specimens:

Holotype HU.275 T.10 ♀ carapace pl.2. figs. 1, 4

L = 580 um

H = 300 um

Paratype HU.275 T.10.1 ♂ carapace pl. 2, figs. 2,3,5

L = 590 um

H = 290 um

Paratype HU.275 T.10.2 LV pl.2. fig. 6

L = 590 um

H = 280 um

Affinities and Differences:

Cytherella (Cytherella) vandenboldi Sissingh 1972 from the U. Miocene of the South Aegean has features comparable with the present species, but differs in its regularity and strongly pitted surface, narrower anterior and in having the postero-dorsal margin less oblique and truncate than that in the present species.

In addition to the above differences, the dorsal margin in Sissingh's species is nearly straight in both males and females whilst it is slightly convex in the male of the present species. In side view Sissingh's species is narrow and oblong in outline; the anterior end of C. dohukensis is more broadly rounded.

C. dohukensis sp.nov. has affinities with C. sordida Muller (1894) as figured by Bold 1966 from the U. Miocene of N' Tchengué Formation of Gabon (W. Africa), but the Gabon specimens are strongly punctate, with evenly rounded anterior and posterior ends. Sissingh 1972 recorded that the species figured by Bold 1966 from Gabon possessed raised anterior and posterior margins and that Mueller's species lacked these raised margins.

C. caelata Bold 1963 from the U. Miocene of Trinidad, shows some resemblance to the present species. The male of Bold's species differs in its sinuate ventral margin with its slight median concavity, and it lacks the overlap

along the anterior margin; the female is more roundly quadrangle with strong overlap along the dorsal margin.

Distribution: Rare specimens were found at Dohuk (Northern) Iraq, Naft Khana (NE) Iraq.

Genus CYTHERELLOIDEA Alexander, 1929

Type species: Cythere williamsoniana Jones, 1849

Cytherelloidea flexicostata sp. nov.

pl. 2, figs. 7-12

Derivation of name: From its flexuous ridge.

Holotype: A female carapace HU.275 T.11

Paratypes: Five specimens HU.275T 12. 1-5

Type horizon: M. Miocene L. Fars Formation, S. limb, bed no. 41, sample SHI.22.

Type locality: Sheikh Ibrahim anticline, 45 km NW of Mosul City.

Material: One hundred and twenty specimens

Diagnosis: A species of Cytherelloidea characterized by a sinuate ridge, two thickened knoblike processes postero-dorsally and posteroventrally, an extra ventral ridge commencing at the anteroventral corner of the main ridge and a smooth to ornamented lateral surface with indistinct reticulations.

Description: Carapace rounded quadrangular in outline in lateral view, in the right valve the height equal throughout, while in the left the maximum

height lies posteriorly. Dorsal margin straight to slightly sinuate in the right valve smoothly merging with the anterior and posterior ends. Dorsal margin in the left valve strongly concave anterior to the middle. Ventral margin nearly straight in the left, slightly concave in the middle in the right valve. Anterior end evenly rounded with very thin marginal rim. Posterior end comparatively broadly rounded and higher than the anterior end.

Surface ornamentation consists of a well-developed ridge running round the valve on the lateral surface, at about one quarter of the height below the dorsal margin and one quarter of the height above the ventral margin; the ridge is straight, at mid-length it curves slightly upwards dorsally, then curves ventrally and then finally upwards again to the point of junction between dorsal margin and anterior end, forming a (U) shape, running close to the anterior margin it forms a narrow loop, anteroventrally it curves up dorsally slightly and then continues on a straight course to end posteriorly in a thickened, knob-like structure which is joined to the similar postero-dorsal feature by a short vertical ridge. In the posterior half of the carapace the dorsal and the ventral parts of the ridge are parallel; in the anterior half the two parts approach each other and form a loop-like feature along the anterior end. Behind the anterior part of the ridge a short vertical ridge runs ventrally but ends before it reaches the ventral part of the ridge; dorsally it joins the sinuate part of the ridge. A faint ventral ridge commences from the antero-ventral part of the ridge, runs along the ventral margin and ends anterior to the posterior end at a very distinctive depression; it is joined the ventral part of the sinuate ridge with short vertical ridges. The rest of the surface is covered with indistinct reticulation which is best anteriorly where the reticulae are pentagonal in shape.

Right valve larger than the left, overlapping all round but more prominently along the dorsal and ventral margins. Internal features cannot be differentiated, apart from the hinge, which is typical of the genus.

Dimensions of figured specimens:

Holotype HU.275 T.11 ♀ carapace pl. 2, figs. 8,11
L = 620 um
H = 360 um
W = 250 um

Paratype HU.275 T.12.1 ♂ carapace pl. 2, figs, 7,10
L = 610 um
H = 320 um
W = 240 um

Paratype HU.275 T.12.2 ♀ RV pl.2, fig. 12
L = 660 um
H = 380 um

Paratype HU.275 T.12.3 RVI pl. 2, fig. 9
L = 600 um
H = 350 um

Affinities and Differences:

C. tewarii Bold 1963 from the U. Miocene of Trinidad has some similarities to the present species, but is more rounded in outline with the dorsal and ventral margin concave in the middle. The most obvious difference between the two species is in the ornamentation, in Bold's species the dorsal and ventral ridges are connected posteriorly by short vertical ridge with thickened knob-like protuberances at the junction which are more strongly developed in Bold's species than the present species. In addition the

dorsal part of the main ridge in the present species is strongly sinuate and forms a (U) shaped, narrow loop along the anterior margin whilst in Bold's species it is nearly straight with a wider loop along the anterior margin. The ventral ridge in Bold's species runs parallel to the ventral margin, ending before it reaches the anterior ridge, starts from the antero-ventral corner of the main ridge and ends before it reaches the posterior ridge. In dorsal view the posterior end of Bold's species is triangular in shape but is broadly rounded in the Iraqi species, and the latter is also covered with distinct reticulations.

C. flexicostata sp. nov. resembles C. guhai Khosla 1972 in general outline, but Khosla's species is characterised by its truncate posterior end and ornamented with two pronounced horizontal ridges with a third, discontinuous one, in the upper half. These two ridges are connected by a vertical marginal ridge at each end.

C. cambayensis Guha 1965 from western India is similar in outline to the present species but differs in its smaller size, its peripheral ridge and there is a circular depression in the middle part of the carapace.

Distribution: The species was found at Bashiqa,Dohuk, Sheikhan, Sheikh Ibrahim, Hamrin and Kirkuk areas of Northern Iraq.

Cytherelloidea hamrinensis sp. nov.

pl. 3; figs. 1-4

Derivation of name: From Hamrin anticline, northern Iraq, where the species was found.

Holotype: carapace HU.275 T.17

Paratypes: Two specimens HU.275 T.18. 1-2

Type horizon: M. Miocene, L. Fars Formation, at(326-328 m).

Type locality: Hamrin well. 2. Northern Iraq.

Material: Twenty four specimens including juveniles.

Diagnosis: A species of Cytherelloidea characterised by a peripheral ridge running all round the valve, a straight ventrolateral ridge which runs forward from the posterior end and terminated before it meets the anterior margin and a lateral surface covered with circular pits.

Description: Carapace elongate, rounded in the lateral view, with greatest height posteriorly, greatest length at mid-height. Anterior end evenly rounded with a faint marginal rim extending along the ventral margin, not seen along the dorsal margin, posterior end narrower and obliquely rounded. Dorsal margin slightly sinuate in the anterior third, ventral margin slightly concave in the middle.

Surface ornamentation consists of a marginal ridge all around the periphery. Dorsally it is about one quarter of the height below the dorsal margin, ventrally it lies just above and nearly parallel to the ventral margin starting postero-dorsally the ridge runs anteriorly and is straight on the posterior third of the valve; it then curves down to form a very distinctive, sinuate shape, and in the anterior third of the valve it curves up and runs along the anterior end forming a relatively wide loop. It runs, along the ventral margin posteriorly to join the dorsal part by means of a slightly raised, curved posterior ridge. A straight ventro-lateral ridge starts postero-ventrally and runs forward ending before it reaches the anterior margin.

A short curved postero-dorsal ridge joins the marginal ridge posteriorly. The lateral surface strongly covered with pits which are circular to ovate in shape. Right valve larger than the left overlapping along the dorsal and ventral margins and slightly along the anterior and posterior ends.

In dorsal view, the carapace is sub-triangular, tapering anteriorly and with the greatest width at the posterior end.

Sexual dimorphism is pronounced, the presumed males being more elongate and narrower than the presumed females.

Dimensions of the figured specimens:

Holotype	HU.275	T.17	carapace	pl.3, figs. 1, 3, 4
	L = 620 um			
	H = 350 um			
Paratype	HU.275	T.18.1	carapace	pl. 3, fig. 2
	L = 640 um			
	H = 320 um			

Affinities and Differences:

C. hamrinensis sp. nov. shows similarities to C. obliquecostata Bold 1963, from the U. Miocene of Trinidad, but Bold's species differs in ornamentation being characterised by three longitudinal ridges extending forward from the posterior ridge. The dorsal sinuation of the ridge in C. hamrinensis is not seen in Bold's species, the median ridge of the Bold species is sinuate while in the present species it is very straight. The lateral

surface in the present species is strongly punctate, not seen in Bold's species, and the latter is strongly concave in the middle of the ventral margin.

C. difficila Guha 1960 differs from the present species in its small size, the surface ornamented with one rib running parallel to margins and ends in the smooth, non-punctate surface. The present species differs from C. flexicostata sp. nov. in being less elongate, in the details of the ribbing and in its strongly punctate surface.

Distribution: Sheikhan, Bashiqa, Dohuk, Hamrin and Kirkuk localities of Northern Iraq.

Cytherelloidea crassinodosa sp. nov.

pl. 3, figs, 5-12

Derivation of name: From the two large nodes in each valve.

Holotype: A female carapace HU.275 T.19

Paratypes: Five specimens HU.275 T.20, 1-5

Type horizon: M. Miocene. L. Fars Formation, bed No..13 sample DO.12

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Thirty two specimens

Diagnosis: A strong, rectangular marginal ridge shows a very distinctive knob-like thickening postero-ventrally and postero-dorsally, the postero-dorsal one overreaching the dorsal margin. Sexual dimorphism is marked and distinct reticulation covers the lateral surface.

Description: Carapace rounded quadrangular in lateral view, the height almost equal throughout, greatest thickness posteriorly. Dorsal margin nearly straight in the right valve, slightly sinuated anterior to the middle in the left valve, ventral margin straight in the left, slightly convex in the right. Anterior evenly rounded, posterior end comparatively broadly rounded.

The lateral surface sculptured with a thick marginal ridge running along the entire margins. The dorsal part of the ridge curves downward and follows the rounded anterior end, ventrally the ridge is almost straight, and ends posteroventrally and posterodorsally in two thickened tubercles connected by a short, vertical ridge which curves forward slightly in its middle part.

The tubercles form the thickest part of the carapace and the posterior end is higher than the anterior.

In the male the ridge is thinner and closer to the anterior margin. The postero-dorsal knob obscures and overreaches the postero-dorsal part of the margin; the rest of the surface is covered pentagonal reticulation which varies from specimen to specimen.

The hinge in the right valve consists of a groove along the dorsal margin with a complementary flange along the dorsal margin in the left.

Sexual dimorphism is present, the presumed males being longer and more sub-rectangular shaped compared with the shorter, more quadrangular females in the lateral view.

In the dorsal view, the carapace is wedge-shaped, parallel sided in the

anterior half and sub-triangular in the posterior half. The greatest width occurs at the posterior end which is angulate dorsally and ventrally where the thickened posterior tubercles project.

The right valve is the higher and forms a distinctive ridge along the dorsal margin.

Dimensions of figured specimens:

Holotype HU.275 T.19 ♀ carapace pl. 3, figs, 7, 10
L = 610 um
H = 370 um

Paratype HU.275 T.20.1 ♀ carapace pl.3, figs, 5,6
L = 620 um
H = 370 um
W = 310 um

Paratype HU.275 T.20.2 ♂ carapace pl. 3, figs, 8, 11, 12
L = 640 um
H = 365 um
W = 290 um

Paratype HU.275 T.20.3 ♂ LV pl. 3, fig. 9
L = 610 um
H = 320 um

Affinities and Differences:

Cytherelloidea barkhanensis Tewari and Tondan 1960, differs from the present species in its oblong shape, depressed and wavy dorsal margin, smaller size, and less well developed marginal ridge.

C. crassinodosa sp. nov. is similar in outline to C. costatruncata Lyubimova and Mohan 1960 but it is quadrangular in outline while the Indian species ovate. In the Iraqi species the marginal ridge and tubercles are strongly developed whilst in the Indian species the anterior and posterior ends are narrower. Lyubimova and Guha described the left valve as larger than the right, and orientated the specimens wrongly since the right valve is larger than the left. Khosla 1978 recorded C. costatruncata Lyubimova and Mohan 1960 from the Lower Miocene of Gujarat probander districts, western India.

C. impages Bold 1966 differs from the present species in shape, particularly the outline of the dorsal and ventral margins in side view and in the lesser development of the posterior tubercles.

Distribution:

This species was found in the Lower Fars Formation at the localities of Bashiqa, Dohuk and Kirkuk localities of Northern Iraq.

Suborder PODOCOPA Sars 1866

Superfamily BAIRDIACEA Sars 1888

Family BAIRDIIDAE Sars 1888

Remarks: Bairdiid species from the Lower Fars Formation, Northern Iraq show affinities with species recorded from the Tertiary of W. India. Tewari and Tandon 1960, Khosla 1972, 1978, Sohn 1970 (Pakistan) placed the bairdiid species in the genera Bairdoppilata, and Neonesidea. Bairdoppilata was erected by H.W. Coryell, C.H. sample and P.H. Jennings, 1935 for species

similar to Bairdia in outline but differing in the hinge structure. The latter is the main diagnostic feature with a number of small denticles (RV) and sockets (LV) at the anterior and posterior marginal angles of the valves. In a different approach some workers have studied the succession of bairdiid species Sohn (1961, Palaeozoic), Kollmann (1963, Mesozoic) and Maddocks (1969 Recent), in attempts to elucidate the precise generic status of the various members of this family.

Morkhoven (1963) considered Bairdoppilata as synonymous with Bairdia, and that the hinge variation was acceptable within the confines of one genus. Bolz 1969 considered that the Bairdoppilata hinge is a structure belonging to free margin and not to the hinge proper and should not be used to separate systematic categories above the species level. Bold 1974 considered the variation in the hinge between Bairdia and Bairdoppilata to be due to mechanical rotation movement unlikely to be of diagnostic value. In considering the lateral outline, the species placed under the genus Bairdia from the Eocene of India shows very few similarities and slight differences to the present species. Meanwhile Bold 1974 has stated,"within the general 'bairdoid' shape, the outline is rather variable and obviously not a reliable criterium on the generic level".

Neonesidea was erected by Maddocks 1969 as a genus in her revision of some recent bairdiids. The species placed in this genus are closely similar to the species placed in Bairdia and Bairdoppilata. Comparing recent or the differences between recent and fossil species, Sohn 1960 points out that Palaeozoic Bairdia are smooth, have convex sides and never have serrated or spinose edges, whereas most modern species of Bairdia have such edges and many are punctate. Maddocks (1969) proposed her genus Neonesidea on the basis of convex sides, a smooth shell and denticulations only on the posterior

end of the left valve. In relation to denticulation, Bate 1972 stated "That some species exhibit denticulate margins does not appear to warrant a generic distinction and I am not convinced that the phyletic history of the genus would improve or made more accurate by erecting a new genus for these post-Palaeozoic forms". The presence of denticulations shows so much variation within a species that it is difficult to use as a differentiate criteria between two genera. Thus the ideas of Bold (1974) that Neonesidea and Bairdia are practically identical and that there is no reason to separate them are accepted here.

Bairdoppilata is also considered as synonymous with Bairdia. Other valid bairdiid genera are Triebelina which has distinct ridges and Paranesidea with strongly reticulation. Bairdiids are relatively rare in the Lower Fars samples.

Genus BAIRDIA McCoy, 1844

Type species: Bairdia curta McCoy, 1844

Synonyms: ?Nesidea Costa, 1849

Bairdoppilata Coryell, Sample and Jennings, 1935

Neonesidea Maddocks, 1969

Bairdia rafidainensis sp. nov.

pl. 4, figs. 1-6

Derivation of name: From rafidain the old name of Iraq.

Holotype: A carapace HU.275 T.21

Paratypes: One carapace and one valve HU.275 T.22. 1-2

Type horizon: M. Miocene Lower Fars Formation, bed no. 2, sample BA.2.

Type locality: Bashiqa anticline, southern limb, 28 km, NE Mosul City.

Material: Eighteen specimens.

Diagnosis: A species of Bairdia with the following characteristics: carapace subtrapezoidal, robust, tumid, in side view, greatest height just anterior to the middle. Dorsal margin in the right valve nearly straight centrally, long sloping posteriorly. Slightly concave in the anterior part, posterior end narrow, roundly pointed in the middle.

Description: Carapace subtrapezoidal in outline, with greatest height anterior to the middle. Dorsal margin tripartite. In the right valve, the central part is horizontal or slopes slightly backward, the anterior part slightly concave and the posterior part slopes gently. In the left valve, the dorsal margin is angled at the greatest height, the middle part sloping slightly backward, anterior part steeply sloping forward, posterior part curved downwards. Ventral margin concave centrally, merging smoothly into the anterior and posterior ends. Anterior end 'boat shaped' slightly angled in the upper part, obliquely rounded in the lower. Posterior end narrower, slightly convex in the upper part, roundly pointed in the middle, evenly oblique in the lower part. Left valve larger than the right, overlapping along the dorsal margin and mid ventrally.

Lateral surface smooth to finely pitted. In dorsal view carapace biconvex with maximum width at the middle, anterior and posterior ends narrowly pointed.

Internally, marginal area moderately broad, selvage well developed, marginal pore-canals moderately numerous, anterior and posterior vestibules are

present, wider anteriorly; Hinge simple as in the genus. Irregularly shaped muscle scars occur in circular group.

Dimensions of figured specimens:

Holotype HU.275 T.21 Carapace pl. 4, figs. 1, 2

L = 990 um

H = 750 um

W = 590 um

Paratype HU.275 T.22.1 Carapace pl. 4, figs, 3,4,6

L = 980 um

H = 660 um

Paratype HU.275 T.22.2 LV pl. 4, fig. 5

L = 1090 um

H = 750 um

Affinities and Differences:

The present species shows affinities with Bairdoppilata poddari Lyubimova and Mohan 1960, but the Indian species is deltoid in outline, its ventral margin forms a half circle with the anterior and posterior ends, and the dorsal margin forms two symmetrical sides whereas in the present species it consists of three distinct parts. The Iraqi species is also more elongate, and in dorsal view is narrower than the Indian species. Lyubimova and Mohan placed their species in Bairdoppilata without describing the hinge structure and as already noted Bairdoppilata is here considered synonymous with Bairdia. B. rafidainensis sp. nov. has some similarities with Bairdoppilata sp. A Khosla 1978 but differs from Khosla's species in the horizontal or posteriorly sloping middle part of the dorsal margin. Khosla's species is more angulate centrally, is narrower and more pointed

posteriorly and the posteroventral margin of left valve is fringed with 6-10 denticles which are not seen in the Iraqi species. Bairdia amygdaloides var. oblongate Bold 1946 (Brady 1866) differs from the present species in its narrower anterior end which forms a distinct angle where it joins the dorsal margin and its lesser height, whilst the ventral margin in the present species is broadly concave compared with Bold's form.

Distribution: Bashiqa and Dohuk localities of Northern Iraq.

Bairdia sp. aff. B.rafidainensis sp. nov.

pl. 4, figs. 7 - 10

aff. Bairdia rafidainensis sp. nov.

Figured specimens: HU.275 T.23.1-3

Horizon: M. Miocene. Lower Fars Formation, bed no. 13, sample DO.12.

Locality: Dohuk anticline, southern limb, 10 km NE of Dohuk City.

Material: Seven specimens.

Remarks: This species differs from B. rafidainensis sp. nov. in being more elongate, strongly angled at the greatest height, the right valve with two asymmetrical parts to the dorsal margin, and with the posterior end strongly concave in the upper part. Furthermore the left valve has a thick dorsal margin over-reaching the right valve and its ventral margin is straight whereas in B. rafidainensis sp. nov. it is concave.

Dimensions of figured specimens:

HU.275	T. 23.1	carapace	pl. 4, figs, 7,8

L = 1080 um

H = 680 um

HU.275 T.23.2 right valve pl. 4, fig. 10

L = 1010 um

H = 640 um

HU.275 T.23.3 carapace pl. 4, fig. 9

L = 1050 um

H = 680 um

Distribution: Rare specimens were found at Bashiqa and Dohuk in Northern Iraq.

Bairdia sp. A

pl.4, figs. 11,12

pl.5, figs. 1-3

Figured specimens: HU.275 T.24. 1-2

Horizon: M. Miocene, L. Fars Formation, bed no. 14, sample DO.12.

Locality: Dohuk anticline, southern limb, 10 km NE of Dohuk City.

Material: Five specimens.

Description: Carapace elongate ovate, greatest height in front of the middle. Anterior end rounded, obliquely below, slightly arched in the upper part.

Posterior margin narrowly rounded. Dorsal margin broadly arched, ventral margin slightly convex; left valve larger than the right, overlapping it along the dorsal and ventral margins but inconspicuously along the anterior

and posterior ends. In dorsal view the carapace is biconvex with narrower pointed anterior and posterior ends.

Dimensions of figured specimens:

HU.275 T.24, 1 carapace pl. 4, figs. 11, 12

L = 840 um

H = 530 um

HU.275 T.24, 2 carapace pl. 5, figs. 1-3

L = 840 um

H = 550 um

Affinities and Differences:

The present species resembles B. indica Tewari and Tandon 1960, but differs in its broadly arched dorsal margin and more elongate and higher, convex ventral margin. The Indian species is smaller, has different dorsal and ventral margin outlines in side view, and narrower anterior and posterior ends. Later Khosla (1972) renamed Tewari and Tandon's species because the name was pre-occupied by Nesidea (= Bairdia)indica (Douglas, 1931) from the Eocene of India. The present species shows some similarity to Neonesidea sp. Khosla 1978 but the latter is higher, has very distinctive overlap and a sharply pointed posterior end. Bairdia jonesi Bold 1946 is similar to the present species but differs in its posterior end which is angled below the middle and in its anterior end which is bluntly angled.

Distribution: Rare specimens were found in the Bashiqa and Dohuk areas of Northern Iraq.

Bairdia elliptica sp. nov.

pl. 5 figs. 4-7

Derivation of name: From its somewhat elliptical outline.

Holotype: A carapace HU.275 T.25

Paratypes: Two carapace HU.275 T.26.1-2

Type horizon: M. Miocene L. Fars Formation, bed no. 2, sample no. BA.2.

Type locality: Bashiqa anticline, S. limb, 10 km NE of Mosul City.

Material: Four specimens.

Diagnosis: A species of Bairdia with the following characteristics; broadly, evenly arched dorsal margin, subdeltoid in lateral view and a posterior end which is slightly pointed at the middle.

Description: Carapace subdeltoid in outline in lateral view, with greatest height at the middle, carapace with moderate convexity. Dorsal margin evenly arched sloping toward the anterior and posterior ends, ventral margin convex upward merging with the anterior and posterior margins. Anterior margin narrowly rounded in the middle, obliquely rounded below. Posterior end produced sub-ventrally, slightly pointed in the middle, convex in the upper part, curving down in the lower part.

Left valve larger than right, overlapping along the dorsal and mid-ventral margins, but not conspicuously along the anterior and posterior margins. The lateral surface is smooth. In dorsal view carapace biconvex with maximum width in front of the middle. Internal features were not visible.

Dimensions of figured specimens:

Holotype HU.275 T.25 pl. 5, figs. 4,5,6

L = 900 um

H = 590 um

W = 490 um

Paratype HU.275 T.26.1 carapace pl. 5, fig. 7

L = 1130 um

H = 740 um

Affinities and Differences:

Bairdoppilata? sp. Sohn 1970 shows some resemblance in outline but, Sohn's species is concave posterodorsally, relatively narrower and less high; also the dorsal margin in the present species is broadly arched. Khosla 1978 recorded a Bairdoppilata sp. from the Miocene of western India which shows similarities to the present species but Khosla's species differs in having a dorsal margin which is strongly arched in the middle, slopes down to the anterior and posterior ends and is higher than that in the present species.

Khosla species is also slightly concave posterodorsally and the ventral margin is nearly straight. Bairdia beraguaensis Singh and Tewari 1966 differs in being more elongate and strongly concave postero-dorsally.

Distribution: Rare specimens were found in the Bashiqa section, Northern Iraq.

Genus Paranesidea Maddocks 1969

Type-species: Paranesidea fracticorallicola Maddocks 1969

Paranesidea punctata sp.nov.

pl. 5 figs. 8-12

pl. 6 figs. 1-3

Derivation of name: From the punctate carapace.

Holotype: A male carapace HU.275 T.27

Paratypes: Two carapace HU.275 T.28. 1-2

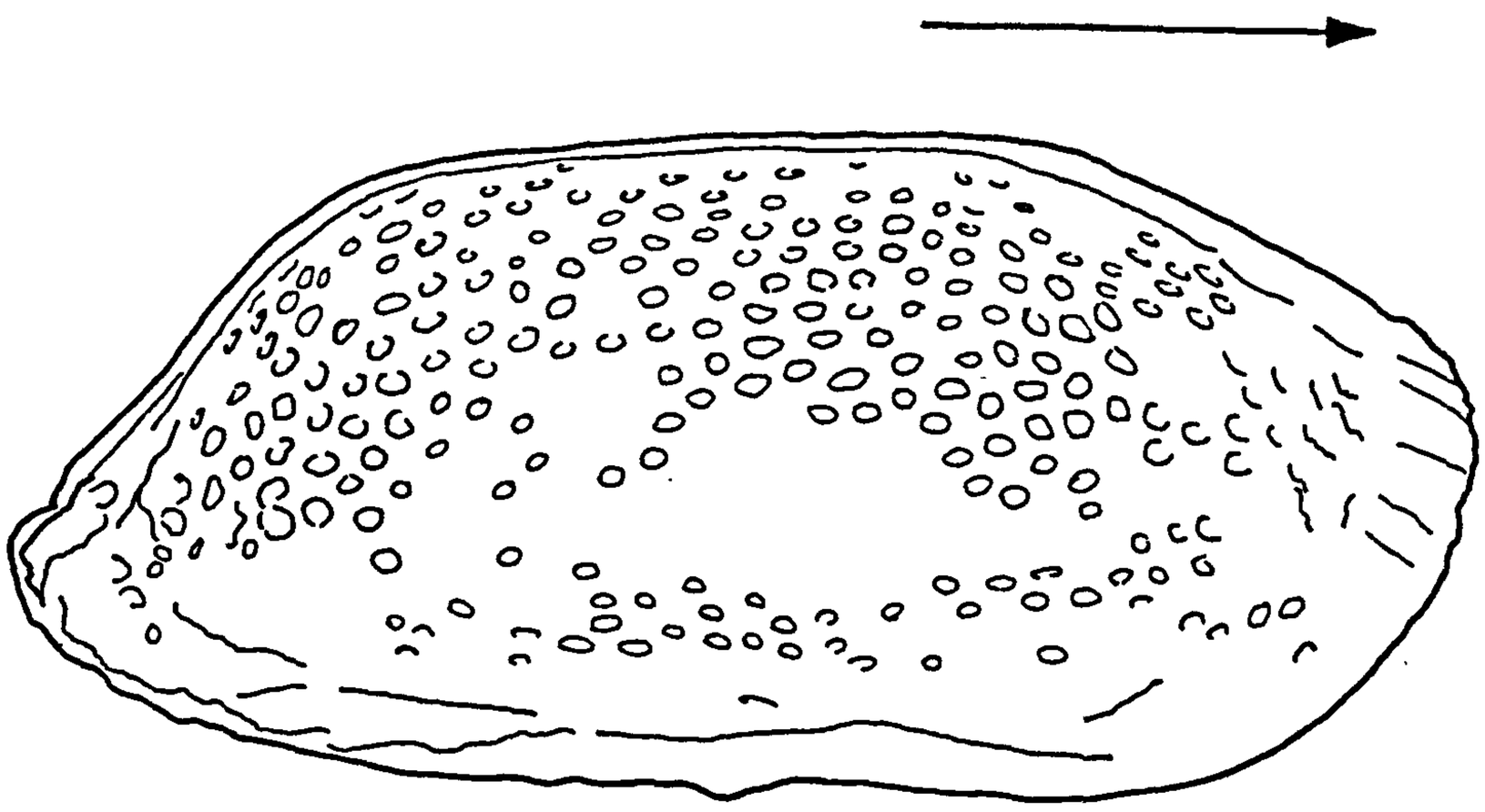
Type horizon: M. Miocene L. Fars Formation, bed no. 1, sample BA.1

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: Six specimens

Diagnosis: A species of Paranesidea with a straight dorsal margin with distinctive anterior and posterior cardinal angles, subrectangular outline with greatest height at the anterior cardinal angle and fine antero-ventral and postero-ventral denticulations.

Description: Carapace stout subrectangular in lateral view, greatest height at the anterior cardinal angle, greatest length at one third of the height above the ventral margin. Dorsal margin in the male straight and joining the anterior and posterior ends with very distinctive angles; in the female apparently slightly arched but this may be due to the deformation in the figured specimen. Ventral margin concave in the middle, arching upward at the ends. Anterior margin angled above mid-height, dorsal part steeply sloping, the ventral part obliquely rounded, posterior margin pointed to form a pronounced caudal extension; dorsal part of the posterior margin slightly concave, ventral narrowly to obliquely rounded with marginal denticulations.



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Text fig. 6 Paranesidea punctata sp.nov.
HU.275 T.27 Carapace from right, lateral surface showing the ornamentation.

In the anterior margin, the marginal denticulations in the male more pronounced in the upper part, while in the female they are more pronounced in the lower part. The surface is strongly punctate. Left valve larger than the right, overlapping along the antero-dorsal, postero-dorsal, mid-ventral and mid-dorsal margins but not conspicuously along the antero-and postero-ventral margins.

The hinge is simple adont and a vestibule is present anteriorly and posteriorly. Other internal features are not visible. Sexual dimorphism present, the presumed males less high and narrower than the presumed females. In dorsal view, maximum width in the middle, anterior and posterior ends with pointed arrow-head shaped, left valve overlapping the right along the dorsal margin, both sides are slightly convex and subparallel.

Dimensions of the figured specimens:

Holotype HU.275 T.27 ♂ carapace pl. 5, figs. 8,11, Pl. 6, fig. 1

L = 570 um

H = 310 um

Paratype HU.275 T.28, 1 ♀ carapace pl. 5, figs. 9,12 pl. 6, fig. 2

L = 580 um

H = 350 um

Paratype HU.275 T.28,2 ♂ carapace pl. 5, fig. 10

L = 590 um

H = 300 um

Affinities and Differences:

Paranesidea nandanaensis Khosla 1978 shows some similarities to the present

species but is subtrapezoidal in lateral view and higher and shorter. The present species is more elongate with a straight dorsal margin and a more concave ventral margin.

Paranesidea punctata, shows some similarity to Triebelina boldi Key 1955 but the latter differs in having an upwardly curved ridge which runs above the ventral margin and a shallow depression above the anterior end of this ridge.

Triebelina reticulopunctata Benson 1959 has some similarities to the present species but differs in having short caudal process and straight ventral margin.

Distribution: This species was found at Bashiqa and Dohuk localities of Northern Iraq.

Family BYTHOCYPRIDIDAE Maddocks 1969

Genus BYTHOCYPRIS Brady 1880

Type-species: Bythocypris reniformis Brady 1880

Bythocypris pseudoreniformis sp. nov.

pl. 6 figs, 4-10, 12

Derivation of name: In reference to its similarity to B. reniformis Brady

Holotype: A female carapace HU.275 T.29

Paratypes: Six specimens HU.275 T.30, 1-7

Type horizon: M. Miocene L. Fars Formation, bed no. 45, sample SHI.25.

Type locality: Sheikh Ibrahim anticline, Northern limb, 27 km NW of Mosul City.

Material: Twenty five specimens

Diagnosis: A large species of Bythocypris, highest centrally and with tripartite dorsal margin slightly arched in the middle and sloping steeply antero-dorsally and postero-dorsally; the ventral part of the anterior margin is lower than the ventral margin.

Description: Carapace subreniform in lateral view, with greatest height centrally and greatest length ventrally. Dorsal margin tripartite, the middle one gently arched, the others sloping steeply anterodorsally, postero-dorsally. Ventral margin concave centrally merging smoothly postero-ventrally but with an angle anteroventrally. In the right valve the anterior margin is broadly rounded with a straight ventral part; in the left valve it is obliquely rounded and slightly angled dorsally, forming an oblique arc in the lateral view. Posterior end narrowly tapering; more rounded in the right valve, comparatively narrower in the left.

Left valve larger than the right, overlapping it along all margins except the anterior and with very strongly overlap at the ventral margin.

Internally a large anterior vestibule and a smaller posterior vestibule are present and the hinge is simple adont. Muscle scars as for the genus.

In dorsal view the carapace is lenticular with narrowly tapering pointed extremities and maximum width at the middle. Sexual dimorphism is probably present, the presumed males being more elongate, narrow and less in height

than the presumed females.

Dimensions of figured specimens:

Holotype HU.275. T.29 ♀ carapace pl. 6, figs, 4, 5

L = 920 um

H = 470 um

Paratype HU.275 T.30.1 ♂ carapace pl. 6, fig. 6

L = 980 um

H = 460 um

Paratype HU.275 T.30.2 ♀ carapace pl. 6, figs, 7,9,10

L = 960 um

H = 520 um

Paratype HU.275 T.30.3 ♂ carapace pl. 6, figs, 8, 12

L = 970 um

H = 490 um

Affinities and Differences:

This species shows similarities to B. reniformis Brady 1880 but is slightly more acuminate posteriorly.

In B. reniformis the dorsal margin is nearly symmetrically arched, where as it consists of three parts in the present species which also shows sexual dimorphism, the presumed males being more elongate than the females.

Distribution: The species was found at the Sheikh Ibrahim, Sheikhan and Hamrin localities of Northern Iraq.

Bythocypris elegantula sp. nov.

pl. 7, figs. 1-6

Derivation of name: A reference to its elegant and well preserved carapace.

Holotype: Carapace HU.275 T.31

Paratypes: Five specimens HU.275 T.32. 1-5

Type horizon: M. Miocene, L. Fars Formation, bed no. 45, sample SHI.25.

Type locality: Sheikh Ibrahim anticline. S. limb. 45 km NW of Mosul City.

Material: Forty specimens

Diagnosis: In lateral view, length more than twice the height, and greatest height anterior to the middle; dorsal margin slightly convex in the middle. Valves laterally flattened.

Description: Carapace elongate, reniform in side view, greatest height anterior to the middle, greatest length ventrally. Anterior end obliquely rounded. Dorsal margin slightly convex in the middle, gently sloping at posterodorsal and anterodorsal margins; ventral margin concave in the middle, convex in the posterior and anterior parts.

Lateral surface smooth to finely pitted. Left valve larger than right, overlapping it along the dorsal and ventral margins. Carapace in dorsal view lenticular in shape with convex sides, anterior end pointed and sub-triangular shaped, posterior end roundly pointed, maximum width and thickness

at the middle. Internal features as for the genus.

Dimensions of figured specimens:

Holotype HU.275 T.31 carapace pl. 7, fig. 1

L = 880 um

H = 400 um

Paratype HU.275 T.32. 1 carapace pl. 7, fig. 2

L = 860 um

H = 370 um

Paratype HU.275 T.32.2 carapace pl. 7, figs. 3, 4

L = 900 um

H = 350 um

Paratype HU.275 T.32.3 carapace pl. 7, figs. 5, 6

L = 920 um

H = 420 um

Affinities and Differences:

B. elongata Brady, 1880 has some similarities with the present species but differs in other respects and is characterised by its nearly straight dorso-median margin, steeply sloping posterodorsal margin, straight ventral margin and narrower anterior and posterior ends. In addition the Iraqi species is narrower and less high. B. prolata Maddocks 1969 differs in its small size, narrower extremities, gently arched dorsal margin and lesser height.

Distribution:

This species was found in the Sheikh Ibrahim section of the L. Fars Formation, Northwest Iraq.

Bythocypris sp. A

pl. 6, fig. 11 pl. 7, figs. 7,8,9

Figured specimens: A carapace HU.275 T.33. 1-2

Horizon: M. Miocene. L. Fars Formation, bed no. 45, sample no. SHI.25.

Locality: Sheikh Ibrahim anticline. S. limb. 45 km NW of Mosul city.

Material: Two specimens

Description: In lateral view relatively short. Thinly calcified sub-trapezoidal carapace, greatest height in the middle and nearly equal to half the length, maximum length ventrally. Anterior end compressed, subacute to obliquely rounded, posterior end truncate sloping gently in the upper part, narrowly rounded ventrally.

Dorsal margin rounded convex joining the anterior and posterior ends, ventral margin concave in the anterior part, curving upwardly posteriorly.

Lateral surface smooth to finely pitted. Left valve larger than right, overlapping distinctly along the dorsal margin. In dorsal view strongly compressed with subacute ends. Internally a large anterior vestibule and smaller posterior ones are present, other internal features were not seen.

Dimensions of the figured specimens:

Carapace HU.275 T.33.1 pl. 6, fig. 11, pl. 7, fig. 8

L = 690 um

H = 420 um

Carapace HU.275 T.33.2 pl. 7, figs. 7,9

L = 640 um

H = 360 um

Remarks: The present species differs from all described Bythocypris species in its distinctive shape, and the outline of the anterior and posterior ends. The figured specimens definitely represent a new species but it is left in open nomenclature due to the rarity of specimens.

Bythocypris sp. B

pl. 7, figs. 10,11

Figured specimens: A carapace HU.275 T.34, 1-2

Horizon: M. Miocene. Lower Fars Formation, bed no. 45, sample no. SHI.25

Locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Material: Five specimens.

Description: Carapace large, in side view elongate to subtrapezoidal, greatest height situated in the middle, and equal to half the length, greatest length at 1/6 of the height above the ventral margin. Anterior end obliquely rounded, swinging smoothly into the ventral margin, slightly

angled dorsally, posterior end narrowly rounded. Dorsal margin strongly arched in the middle, slightly concave antero-dorsally, curving and sloping gently posteriorly, ventral margin nearly straight in the left valve, slightly concave at the middle in the right valve. Carapace smooth, left valve larger than the right, overlapping all round except mid-anteriorly.

Dimensions of the figured specimens:

Carapace HU.275 T.34.1 pl. 7, fig. 10

L = 1040 um

H = 510 um

Carapace HU.275 T.34.2 pl. 7, fig. 11

L = 1040 um

H = 500 um

Remarks:

Specimens were rarely found and mostly closed carapaces in which no internal structures could be seen. The species placed in Bythocypris on the basis of the general shape and it is similar to previously described species of Bythocypris such as B. chapmani Neale 1975, which shows some similarities to the present species but differs in its narrowly rounded posterior end, lesser height and smaller size. The dorsal margin of the present species is broadly arched compared with Neale's species. Bairdia? kirtharensis Tewari and Tandon 1960 has some similarities to the Iraqi species but is more elongate and triangular in outline. The general shape of the Indian species is not typical of the genus Bairdia, and the generic placing is probably wrong.

Distribution: Rare specimens were found in the Dohuk and Sheikh Ibrahim sections of the L. Fars Formation of north-west Iraq.

Superfamily: CYPRIDACEA Baird, 1845

Family: PONTOCYPRIDIDAE G.W. Muller, 1894

Subfamily: PONTOCYPRIDINAE G.W. Muller, 1894

Genus: PROPONTOCYPRIS Sylvester-Bradley, 1947

Type species: Pontocypris trigonella Sars, 1866

Propontocypris miocaenica sp. nov.

pl. 8 figs. 5-10

Derivation of name: From its occurrence in the Miocene.

Holotype: Carapace HU.275 T.35

Paratypes: Three specimens HU.275 T.36, 1-3

Type horizon: M. Miocene. L. Fars Formation. bed no. 1, sample no. BA.1.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: Fifty specimens.

Diagnosis: A species of Propontocypris with the following characteristics: dorsal margin broadly arched in right valve, slightly angled in left, posterior end narrowly rounded lower than the anterior, surface smooth.

Description: Carapace elongate - oval to subtriangular in side view, maximum height nearly at the middle, greatest length passes below the mid-point. Anterior margin evenly rounded at the middle, slightly angled

dorsally, smooth junction with the ventral margin, posterior narrower and lower, evenly rounded ventrally. Dorsal margin broadly arched in the right valve, slightly angled at the greatest height in the left valve, in which the antero-dorsal margin slopes gently anteriorly and the postero-dorsal margin posteriorly, the carapace generally tapering posteriorly.

Ventral margin nearly straight in the left valve, slightly concave in the middle of right valve. Lateral surface smooth to finely pitted. Left valve larger than the right, overlapping most distinctly along the dorsal margin. Internally, inner margin and line of concrescence are separated forming anterior and posterior vestibules which are wider anteriorly and elongate ventrally. Hinge simple adont, the dorsal edge of the left valve fits into a shallow groove of the right valve. Muscle scar pattern consists of five individual subcircular scars, three anterior and two posterior. In dorsal view the carapace is lenticular with the greatest width at the middle and narrowly rounded ends.

Dimensions of figured specimens:

Holotype Carapace HU.275 T.35 pl. 8, figs. 5,6,10

L = 980 um

H = 460 um

Paratype Carapace HU.275 T.36.1 pl. 8, figs. 7,8

L = 1090 um

H = 450 um

Paratype LV HU.275 T.36.2 pl.8, fig. 9

L = 990 um

H = 520 um

Affinities and Differences:

P. miocaenica sp. nov. is similar in appearance to P. solitaria Carbonnel 1969, but the latter differs in having a clear cardinal angle and in the concavity of the antero-dorsal margin, whereas in the present species the dorsal margin is angled at the greatest height. The form described by Holden 1967 as Propontocypris simplex (originally described as Pontocypris simplex by(Brady 1880) has some resemblances but has a characteristic pointed posterior end, non-angulate margin, ventral margin concave in anterior half, convex in posterior half, and the larger right valve over-reaching the left valve everywhere except at the mid-dorsum where the left valve overlaps the right. In addition the present species is less high and more elongate.

P. miocaenica sp. nov. shows affinities with Pontocyprididae species described by Maddocks 1969 from the Indian Ocean area, but it is easily distinguished by its general shape.

Pontocypris micans Mandelstam is fairly similar to the present species but differs in its subtriangular shape, with strongly angulate mid-dorsal margin, narrower posterior end and sinuate ventral margin whilst the Iraqi species is more elongate.

Distribution: This species was found at Bashiqa, Dohuk and Sheikh Ibrahim localities of Northern Iraq.

P. (Propontocypris) sp.aff. P. solida Ruggieri 1962

pl. 7, fig. 12, pl. 8, figs, 1,2,3,4

aff. Propontocypris solida Ruggieri, 1952, p. 33-35, pl. 8. figs. 1-5

aff. Propontocypris solida Ruggieri in Carbonnel 1969, p.23, pl.10, figs. 5,6

Figured specimens: Two carapace HU.276 T.1-2

Horizon: M. Miocene. Lower Fars Formation, bed no. 12, sample no. DO.11.

Locality: Dohuk anticline, S. limb. 10 km NE of Dohuk City.

Material: Fifteen specimens.

Remarks: The present specimens resemble closely Propontocypris solida Ruggieri 1952, but the latter differs in having narrower anterior and posterior ends and in the present specimens the mid-dorsal margin of the left valve is slightly concave just behind the greatest height. In addition, the Iraqi specimens are more elongate and larger. The present species differs from Propontocypris miocaenica sp. nov. in which the dorsal margin consists of three indistinct parts.

Dimensions of figured specimens:

Carapace HU.276 T.1.1 pl. 7, fig. 12, pl.8, fig. 1

L = 1050 um

W = 470 um

Carapace HU.276 T.1.2 pl. 8, figs. 2,3,4

L = 1020 um

H = 450 um

Distribution: This species was found in the Sheikh Ibrahim, Dohuk and Bashiqa sections of the L. Fars Formation, Northern Iraq.

Propontocypris cuneiformis sp. nov.

pl.9 figs. 1,2,3

Derivation of name: From Cuneus L. a wedge in reference to its shape in side view.

Holotype: Carapace HU.276 T.2

Paratype: Two specimens HU.276 T.3,1-2

Material: Ten specimens

Type horizon: M. Miocene, L. Fars Formation, bed no. 89, sample no. SHI.46.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Diagnosis: Medium to small sized, high in front tapering behind; greatest height in front of the middle and equal to more than one third of the length.

Description: Carapace elongate to elongate-subelliptical in side view. Anterior end obliquely rounded, smoothly angled at the junction with the dorsal margin, gradually swinging in to the ventral margin, posterior end narrowly rounded; produced ventrally. Dorsal margin broadly arched, higher in front, sloping gently with slight curving backwards. Carapace tapering generally posteriorly, ventral margin straight to slightly concave in front of the middle, greatest length ventrally. Lateral surface smooth to finely pitted. Left valve larger than right, but without conspicuous overlap.

Only complete carapaces were found, but because of their thin shells some internal structures were visible as the specimen was drying after being moistened with water. Inner lamella moderately wide; muscle scar pattern consists of subcircular muscles grouped in a rosette.

In dorsal view carapace elongate with compressed anterior and posterior ends, maximum width at the middle.

Dimensions of figured specimen:

HU.276 T.3.1-2 carapace pl. 9, figs. 1,2,3

L = 710 um

H = 320 um

Remarks:

This species has similarities in outline to Pontocypris mytiloides Norman 1862 but the latter differs in having a slight angle at the greatest height, a strongly concave ventral margin, and in being less high and narrower.

Propontocypris (Schedopontocypris) bengalensis, Maddocks 1969 resembles the Iraqi species, but differs in the dorsal margin which slopes steeply backwards with a narrower posterior half whilst the present species has a broadly arched dorsal margin, and is more elongate and less high. The present species is placed in Propontocypris rather than Pontocypris on the basis of the general outline and the shape of the muscle scar pattern.

Distribution: The species was found in the Dohuk, Bashiqa and Sheikh Ibrahim sections, Northern Iraq.

Propontocypris sp. A

pl. 8, figs. 11-12

Figured specimen: A carapace HU.276 T.4

Horizon: M. Miocene. L. Fars Formation, bed no. 12, Sample no. DO.12.

Locality: Dohuk anticline, S. limb. 10 km NE of Dohuk City.

Material: Three specimens.

Description: In lateral view carapace elongate to subtriangular. Dorsal margin broadly convex, lower in the posterior half, higher in front with the greatest height anterior to the middle and equal to less than half the length.

Ventral margin nearly straight, slightly concave at the middle of the right valve.

Anterior end narrowly, obliquely rounded angled at the junction with the dorsal margin, posterior end truncated with distinct angle dorsally, obliquely rounded ventrally. Lateral surface smooth, valves semi-equal, left valve slightly higher than the right.

Dimensions of figured specimen:

HU.276 T.4 carapace pl. 8, figs. 11, 12

L = 760 um

H = 360 um

Remarks: Rare specimens were found in Dohuk section of L. Fars Formation, Northern Iraq. The present species differs from all the figured species in its different posterior shape and highly arched dorsal margin. On the basis of general outline the species agrees with characteristic features of P. (Schedopontocypris) Maddocks 1969, and it is fairly similar to P. (Schedopontocypris) sp. 4 Maddocks 1969 in general shape of the carapace, but it differs in its posterior margin which slopes gently ventrally but which is narrowly rounded in Maddocks species.

Maddocks used the muscle scar pattern as the diagnostic feature in

establishing the genus but the muscle scar pattern was not seen, and the present species is tentatively placed in Propontocypris Sylvester-Bradley 1947.

Propontocypris cuneiformis sp.nov. Variant A

pl. 9 figs. 4,5,6

Figured specimen: A carapace HU.276 T.5

Horizon: M. Miocene. L. Fars Formation, bed no. 1, sample no. BA.1.

Locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Remarks: This specimen represents a variant of Propontocypris cuneiformis sp. nov., which is more elongate, narrower and less high, the anterior and posterior ends narrowly rounded, dorsal margin lacking the angle at the greatest height.

The variant in dorsal view has slightly pointed anterior and posterior ends compared with Propontocypris cuneiformis sp. nov.

Dimensions of figured specimen:

HU.276	T.5	Carapace	pl. 9, figs. 4,5,6

L = 830 um

H = 340 um

Family: PARACYPRIDIDAE Sars, 1923

Genus: GHARDAGLAIA Hartmann, 1964

Type species: Ghardaglaia triebeli Hartmann 1964

Ghardaglaia nova sp. nov.

pl. 9, figs. 7-12, pl. 10, figs. 1,2

Derivation of name: Nova L - new.

Holotype: A male carapace HU.276 T.6.

Paratypes: Three specimens HU.276 T.7, 1-3.

Type horizon: M. Miocene, L. Fars Formation, bed no. 13, sample no. DO.12.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Fourteen specimens.

Diagnosis: Carapace elongate and smooth. Dorsal margin slightly convex, highest at first third of the length from anterior end, sexual dimorphism distinct.

Description: In side view carapace elongate to elongate-oblong-shaped, maximum length below mid-point. Dorsal margin slightly convex in the middle with sloping gently antero-dorsally, curving slightly postero-dorsally; ventral margin straight to slightly sinuate, curving upwards in its anterior half and merging smoothly with the posterior margin.

Anterior end obliquely rounded, posterior end truncated, lower than the anterior end situated close to the ventral margin with narrower obliquely rounded shape. Left valve hinge consists of a dorsal flange which fits into an elongate shallow groove in the right valve; Marginal area broad, anterior and posterior vestibules present of which the anterior is the wider, marginal pore canals short and less numerous posteriorly and ventrally. Adductor muscle scar pattern consists of five closely spaced scars, three

scars in a horizontal row with an ovate one below and a slightly elongate one above.

Sexual dimorphism conspicuous and distinct, the presumed males more elongate, narrower and less high than the presumed females.

In dorsal view carapace ovate with convex sides, rounded extremities, maximum width and thickness at the middle; sexual dimorphism very clear in dorsal view in which the male is slightly slimmer than the female.

Dimensions of figured specimens:

Holotype HU.276 T.6 ♂ carapace pl. 9, figs, 10,11,12

L = 980 um

H = 460 um

Paratype HU.276 T.7.1 ♀ carapace pl. 9, figs. 7,8,9

L = 940 um

H = 470 um

Paratype HU.276 T.7.2 ♂ L.V pl.10, fig.1

L = 945 um

H = 440 um

Paratype HU.276 T.7.3 ♀ RV. pl. 10, fig. 2.

L = 850 um

H = 390 um

Affinities and Differences:

The general outline of the present species shows similarities to the genus Aglaiocypris Sylvester-Bradley 1946, but it differs in the internal features the present species having a different hinge, wider marginal zone and more elongate marginal pore canals compared with Aglaiocypris. On the basis of the external shape and the internal features of Ghardaglaia Hartmann 1964, it is placed in this genus. The literature shows species only rarely described under this genus, the nearest related species being G. ambigua Neale 1979 but this differs in having a concave ventral margin anterior to the middle, steeply sloping antero-dorsal margin and in being higher and elongate subreniform shaped. Sohn 1970 tentatively recorded Aglaiocypris sp. in which the internal structures were not determined. It must be a species of Ghardaglaia and certainly shows affinities with the present species but is smaller in size with narrower anterior and posterior ends, nearly straight dorsal margin, and subequal valves.

Distribution: Specimens were found in the Sheikhan and Dohuk localities, L. Fars Formation of Northern Iraq.

Ghardaglaia sp. aff. G. kermani Krstic, 1979
pl. 10, figs. 3-8

aff. Ghardaglaia kermani Krstic, 1979, p.677-678, figs. 4-5.

Figured specimens: Two carapaces HU.276 T.8. 1-2

Horizon: M. Miocene. L. Fars Formation, at depth 3275-3289 ft.

Locality: Bai-Hassan, well 33, N. Iraq.

Material: Seven specimens.

Remarks: The Iraqi species is similar to Krstic's species in its general shape, but is noticeably different in the steeply sloping antero-dorsal margin of the right valve, its narrower anterior end and slightly convex dorsal margin. The Iranian species is more rectangular in shape, higher and more swollen in dorsal view. The present species differs from G. nova sp. nov., in its more rounded shape and in being comparatively higher. Due to lack of information of internal features, the present species is placed in affinity with G. kermani Krstic 1979.

Dimensions of figured specimens:

HU.276 T.8.1 carapace pl. 10, figs. 3,7,8

L = 1015 um

H = 520 um

HU.276 T.8.2 carapace pl.10, figs. 4,5,6

L = 1000 um

H = 520 um

Distribution: This species was found in the Sheikh Ibrahim, Kirkuk, Bai-Hassan areas of Northern Iraq.

Genus PONTOCYPRELLA Lyubimova, 1955

Type species: Bairdia harrisiana T.R. Jones, 1849

Remarks:

In 1849 T.R. Jones described a species from the Cretaceous deposits of England, and erroneously placed it in the genus Bairdia. According to Mandelstam it is a cyprid genus on the basis of the muscle scars. Neale 1962 figures Jones material and noted that the muscle scar pattern consists of three horizontally elongate scars each of them showing subdivisions. This pattern of muscle scar suggests that the species belongs more with the Cypridiidae than with the Bairdiidae.

The external morphology of Jones species more related to cyprids than to bairdiids, in which the carapace is reniform, elongate with unequal valves, the anterior end rounded, bow-shaped and higher than the narrowly rounded posterior end, with the dorsal margin curved, and the ventral margin concave.

There are different views about the family assignment of this genus. Moore (1961) placed the genus in the family Paracyprididae; Bate (1972) followed Moore. On the other hand Neale (1962) and Mandelstam and Schneider (1962) placed the genus in the family Pontocyprididae.

Hartmann and Puri 1974 considered it as synonymous with Argilloecia in the family Pontocyprididae and thus belonging in that family.

Some workers have attributed the genus to Lyubimova; others to Mandelstam. Malz (1959) attributed it to Lyubimova 1955, Oertli (1959) to Mandelstam 1955, Howe and Laurencich (1958) to Mandelstam 1956, Chernysheva (1960) to

Mandelstam and Schneider 1962, Bate (1972) to Lyubimova (1955), Neale (1975)to Mandelstam 1955 in Lyubimova and Moore 1961 to Lyubimova 1955. For convenience Moore is followed in this work.

Pontocyprella kirkukensis sp. nov.

pl. 10, figs. 9-12

Derivation of name: From the type locality of Kirkuk City.

Holotype: A male carapace HU.276 T.9.

Paratypes: Three specimens HU.276 T.10, 1-3.

Type horizon: M. Miocene. L. Fars Formation, at depth (650-655) m.

Type locality: Kirkuk well 208, N. Iraq.

Material: Thirteen specimens.

Diagnosis: A species of Pontocyprella Lyubimova 1955, which has gently arched dorsal margin, which is depressed anteriorly in the smaller right valve, posterior end rounded, terminating in a rounded point ventrally.

Description: Medium-sized, fairly thick shell which is elongate, oblong to subovate in side view, greatest height at the middle, greatest length ventrally. Anterior end obliquely rounded, slightly angular at the junction with dorsal margin, merging smoothly into the ventral margin. Posterior end lower, produced ventrally with truncated rounded shape. Dorsal margin gently arched, curving down to end in a rounded, truncated postero-ventral point; ventral margin nearly straight in the left valve, concave in front of the posterior end.

Left valve larger than the right overlapping along the dorsal margin and the middle of the ventral margin. Internal structures similar to that in the genus. Carapace in dorsal view lanceolate, with maximum width and thickness at the middle, anterior narrow, posterior end forming a sub-triangular shape narrowly rounded at the middle.

Sexual dimorphism marked, the presumed male more elongate than the presumed female.

Dimensions of figured specimens:

Holotype HU.276 T.9 ♂ carapace pl.10, fig. 10.

L = 1050 um

H = 510 um

W = 450 um

Paratype HU.276 T.10.1 ♀ carapace pl. 10, fig. 9.

L = 985 um

H = 470 um

W = 430 um

Paratype HU.276 T.10.2 ♂ carapace pl.10, fig. 11.

L = 1020 um

H = 500 um

Paratype HU.276 T.10.3 ♂ carapace pl.10, fig. 12.

L = 980 um

H = 450 um

Affinities and Differences:

Krithe cushmani Alexander 1929 is somewhat similar to the present species in outline, but differs in its subacute postero-ventral angle and lesser height. Khosla (1978) recorded a specimen as a variety of Paracypris meridionalis

Lyubimova and Mohan 1960, but Khosla's specimen differs in outline from Paracypris meridionalis. On external features the specimen agrees with Pontocyprella and in consequence shows affinities with the present species. The latter differs in having a nearly straight ventral margin, truncated posterior end, a lower antero-dorsal margin and in being higher than Khosla's specimen.

Distribution: The species was found in the Bashiqa and Kirkuk localities of Northern Iraq.

Pontocyprella sheikhanensis sp. nov.

pl. 11, figs. 1-8

Derivation of name: After the type locality of Sheikhan.

Holotype: Carapace HU.276 T.11.

Paratypes: Five specimens HU.276 T.12, 1-5.

Type horizon: M. Miocene, L. Fars Formation, bed no. 20, sample no. SH.11.

Type locality: Sheikhan anticline, Northern limb, 27 km NE of Mosul City.

Material: Sixty specimens.

Diagnosis: Dorsal margin angled at the greatest height, steeply sloping antero-dorsally; postero-ventral margin rounded.

Description: Carapace elongate, oblong to ovate in side view, greatest length ventrally.

Anterior end obliquely rounded, the upper part of the anterior end forming

a rounded corner at the antero-dorsal margin; posterior end produced and rounded postero-ventrally.

Dorsal margin consists of three indistinct parts, angled at the greatest height which is just in front of the centre of the carapace; the antero-dorsal part slopes steeply to merge into the anterior end at a rounded corner; the mid-dorsal margin is straight and slopes backwards, the postero-dorsal margin curving downwards and is rounded postero-ventrally.

The anterior half of the carapace is higher and wider than the posterior half. The ventral margin is slightly convex in the left, sinuate in the right valve. Left valve larger than the right overlapping along the entire margin except at the upper part of the anterior end and mid-dorsal margin. Lateral surface smooth. Sexual dimorphism marked, the presumed males more elongate than the presumed females.

Internally, anterior and posterior vestibules present, wider anteriorly, narrower and elongate ventrally, marginal zone narrow, marginal pore canals short and numerous. Muscle scars consist of three horizontally elongated anteriorly, two posteriorly and an elongate ovate dorsal one. Hinge is similar to that in the genus.

Dimensions of figured specimens:

Holotype HU.276 T.11 ♀ carapace pl. 11, figs. 1,2,3

L = 930 um

H = 460 um

Paratype HU.276 T.12.1 ♂ carapace pl.11, figs. 4,5,6

L = 950 um

H = 440 um

Paratype HU.276 T.12.2 RV pl. 11, fig. 7

L = 990 um

H = 450 um

Paratype HU.276 T.12.3 LV pl.11, fig. 8

L = 1020 um

H = 500 um

Affinities and Differences:

The present species is similar in lateral view to P. roundyi, Alexander 1929 but differs in being more elongate and higher. Alexender's species is characterized by its narrower anterior and posterior ends, the anterior end being connected with dorsal margin by a distinctive angle.

Neale (1975) figured a single right valve which he placed tentatively in Pontocyprella. Neale's species shows some similarities in outline to the present species but is higher with more rounded posterior end.

Pontocyprella? IREIS Grosdidier 1973 has some similarities but differs in having a convex dorsal margin, an obliquely rounded narrower posterior end, in being higher and in the strong overlap along the entire margins. The present species is more elongate and less high.

Pontocyprella aktagensis Mandelstam 1956, which was figured without description, differs in having narrowly rounded posterior end, being less high and in having obliquely arched dorsal margin.

Distribution: This species was found in the Naft Khana, Kirkuk, Hamrin, Sheikhan, Sheikh Ibrahim, Bashiqa, Dohuk, Bai - Hassan and Tel-Hajer localities of N. Iraq.

Pontocyprella bashiqaensis sp. nov.

pl.11, figs. 9-12, pl.12, figs. 1-2

Derivation of name: From the type locality.

Holotype: A carapace HU.276 T.13.

Paratypes: Two specimens HU.276 T.14, 1-2.

Type horizon: M. Miocene, L. Fars Formation, bed no. 1, sample no. BA.1.

Type locality: Bashiqa anticline. S. limb. 28 km NE of Mosul city.

Material: Eight specimens.

Diagnosis: A species of Pontocyprella with beak-like posterior end and elongate smooth carapace with broadly arched dorsal margin.

Description: Carapace elongate - oval in lateral view, highest about the middle, greatest length ventrally. Anterior end evenly rounded, posterior end produced ventrally forming a beak posteroventrally.

Dorsal margin broadly arched, higher at the anterior part, curving down posteriorly.

Left valve larger than the right valve, overlapping it dorsally and ventrally. Lateral surface smooth. Sexual dimorphism seen in some specimens, where the presumed males are more elongate and slimmer than the females.

In dorsal view carapace elliptical with narrower anterior end and pointed posterior end. Maximum thickness and width at the middle.

Duplicature fairly broad, elongate radial pore canals, numerous at anterior margin. Muscle scar pattern not seen.

In the right valve the dorsal margin forms a flange which fits into a groove along the dorsal margin of the left valve.

Dimensions of figured specimens:

Holotype HU.276 T.13 carapace pl.11, figs. 9,12

L = 1050 um

H = 460 um

Paratype HU.276 T.14.1 carapace pl.11, figs. 10,11. pl.12, fig. 1

L = 1120 um

H = 420 um

Paratype HU.276 T.14.2 LV pl.12, fig. 2.

L = 980 um

H = 440 um

Affinities and Differences:

From P. alexanderi Howe and Laurencich 1958, the new species can be distinguished by its more acuminate, beak-like posterior end whilst Howe and Laurencich's species is characterised by a more rounded posterior end, subtruncate anterior end, strongly concave ventral margin in the middle.

P. namitamboensis Bate 1968 has some similarities to the present species but differs in having a narrowly rounded posterior end, a gently sloping antero-dorsal margin and sub-truncate anterior end.

Distribution: The species was found in the Bashiqa, Dohuk sections of the L. Fars Formation of Northern Iraq.

Pontocyprella sp. A

pl. 12, figs. 4,5,6

Figured specimens: HU.276 T.15, 1-2

Horizon: M. Miocene. L. Fars Formation, bed no. 75, sample no. SHI.40.

Locality: Sheikh Ibrahim anticline. S. limb. 45 km NW of Mosul City.

Material: Five specimens.

Description: Carapace elongate, subovate to oblong in side view, greatest height anterior to the middle greatest length ventrally.

Dorsal margin broadly convex, forming a rounded angle with the anterior margin; ventral margin nearly straight.

Anterior and obliquely rounded, posterior end lower and obliquely truncated forming a smooth angle with the ventral margin. Left valve larger than the right, overlapping along the entire margin except at the anterior and posterior ends. Surface smooth.

The hinge in the left valve consists of a dorsal groove. Vestibules are

present anteriorly and posteriorly. Other internal features are not visible.

Dimensions of figured specimens:

HU.276 T.15.1 carapace pl.12, figs. 4,5

L = 970 um

H = 460 um

HU.276 T.15.2 LV pl.12, fig. 6

L = 930 um

H = 430 um

Remarks: In most respects this species is similar to Pontocyprella bashiqaensis sp. nov. but it differs in the posterior shape, which is obliquely truncated and forms a rounded corner with the ventral margin. Pontocyprella sp. A also differs in having a nearly straight ventral margin, rather than being concave in front of the posterior end.

Pontocyprella sp. aff. P? roundyi (Alexander) in Swain 1982 differs in having a steeply sloping antero-dorsal margin, truncated anterior end and narrower posterior end.

Distribution: Rare specimens were found in the Sheikh Ibrahim section of the L. Fars Formation, Northern Iraq.

Superfamily: CYTHERACEA Baird, 1850

Family: CYTHERIDAE Baird, 1850

Subfamily: CYTHERINAE Baird, 1850

Tribe: PAIJENBORCHELLINI Deroo, 1960

Genus: PAIJENBORCHELLA Kingman, 1948

Subgenus: EOPAIJENBORCHELLA Keij, 1960

Type-species: Paijenborchella iomata Triebel, 1949

P. (Eopaijenborchella) acuminata sp. nov.*

pl. 12, figs. 3,7,8

Derivation of name: From acuminatus L. - pointed.

Holotype: A female carapace HU.276 T.16.

Paratype: Four specimens HU.276 T.17, 1-4.

Type horizon: M. Miocene. L. Fars Formation, bed no.10, sample no. BA.7.

Type locality: Bashiqa anticline, S. limb. 28 km NE of Mosul City.

Material: Twenty five specimens.

Diagnosis: Distinctively shaped carapace with long tapering posterior end which is directed somewhat ventrally, concave ventral margin posteriorly, subcentral tubercle present.

Description: Carapace elongate, greatest height at anterior cardinal angle. Anterior end evenly rounded with distinctive marginal rim and higher than the posterior end which is strongly tapering and has a slightly concave postero-dorsal margin. Ventral margin straight, slightly concave postero-ventrally. If the carapace is orientated with the ventral margin horizontal, the greatest length will be below the ventral margin.

In dorsal view the carapace is elongate, widest just behind the middle,

* This is more related to Paijenborchellina or may represent new subgenus

anterior end rounded with pronounced thickened marginal rim.

Posterior end rather blunt, anterior to the middle the left valve overlaps the right valve along the dorsal margin.

Surface ornamentation consists of a strong marginal ridge which runs peripherally along the anterior margin. In front of the caudal process the carapace is inflated posteriorly and mid-ventrally with the development of two nodes or tubercles, one above the other posteriorly, and a marked inflated, subcentral tubercle about one third of the length from the anterior end. The rest of the surface is covered by elongated, oval reticules which form faint diagonal ribs on the dorsal part of the carapace.

The hinge in the left valve consists of a schizodont anterior socket, a bifid anteromedian tooth, posteromedian elongate crenulate bar and elongate socket; the line of concresence and inner margin coincide throughout and run parallel to outer margin, other internal features cannot be seen.

Sexual dimorphism present, the presumed males slimmer and less high than the presumed females.

Dimensions of figured specimens:

Holotype HU.276 T.16 ♀ carapace pl. 12, fig. 8

L = 610 um

H = 230 um

Paratype HU.276 T.17.1 ♀ carapace pl. 12, fig. 7

L = 620 um

H = 280 um

Paratype HU.276 T.17.2 ♂ carapace pl.12, fig. 3

L = 620 um

H = 230 um

Affinities and Differences:

This species is similar to Paijenborchella prona Lyubimova and Guha 1960 but the latter differs in some respects as in its greater height, very distinct anterior and posterior cardinal angles, medianly concave ventral margin and elongate, posterior end sloping strongly and inclined ventrally. The valves in the Indian species were symmetrical and without visible overlap.

The outline of this species is similar to that of P. (Eopaijenborchella) mohani Khosla 1972; but differs in several respects. The posterior end is more tapering and elongated and there is a marked concavity below the posterior cardinal angle.

The subcentral tubercle and the elongated reticulations are rather stronger in the present species. Khosla's species in dorsal view has a narrower anterior end, which is rounded but without minute spines in the Iraqi species.

The present species shows some similarity to P.(Paijenborchella) solitaria Ruggieri 1962 as figured by Sissingh (1972) but differs from it in details of outline and ornamentation.

Distribution: Bashiqa, Sheikhan, Kirkuk, Hamrin, and Bai-Hassan, sections of the L. Fars Formation, Northern Iraq.

P. (Eopaijenborchella) kausalis sp. nov.

pl.12, figs. 9-12

pl. 13, figs. 1-3

Derivation of name: kausalis Gr - a blister in reference to the blister-like inflation in the postero-ventral part of the carapace.

Holotype: A female carapace HU.276 T.18

Paratypes: Four specimens HU.276 T.19, 1-4.

Type horizon: M. Miocene. L. Fars Formation, bed no. 20, sample no. SH.11.

Type locality: Sheikhan anticline, N. limb. 27 km NE of Mosul City.

Material: Seventeen specimens.

Diagnosis: Carapace elongate to subquadrate in side view, a strong blister-like ridge is developed posteroventrally; posterior end drawn out with well developed long caudal process lower than the ventral margin.

Description: In lateral view carapace elongate to subquadrate, greatest height at the anterior cardinal angle. Anterior end obliquely rounded with distinct thick marginal rim, from which short ridges run towards the sub-central tubercle forming deep reticulations. Posterior end lower than the anterior, drawn out and ending in a rounded point.

Dorsal margin slightly convex with rounded anterior and posterior cardinal angles; ventral margin straight in the middle, curving posteriorly and smoothly merging into the anterior margin anteriorly.

Surface marked with a short ridge, blister-like postero-ventrally. There is a variation in the development of this ridge, which in some specimens continues along the ventral margin as a weak ridge; on other specimens it is very thick and crescent-shaped.

Above the short ridge at the posterodorsal corner a small rounded tubercle is seen. A flattened, subcentral tubercle is present. The rest of the surface is covered with quadrangular reticules along the anterior margin and elongate to ovate reticules parallel to the ventral margin. These reticules are separated by thick muri which in the dorsal half of some specimens give impression of forming diagonal ribs. A trace of an antero-dorsal sulcus is present in some specimens.

Left valve larger than the right, overreaching it along the entire margin except at the postero-dorsal corner. In dorsal view the carapace is compressed, the anterior end is pointed, maximum width is at the middle and the postero-dorsal tubercles project laterally.

Sexual dimorphism pronounced, the presumed males more elongate, narrow and less high than the presumed females. Most of the specimens have been found as closed carapaces so that the internal features have not been seen.

Dimensions of figured specimens:

Holotype HU.276 T.18 ♀ carapace pl.12, figs. 10,11

L = 630 um

H = 290 um

Paratype HU.276 T.19.1 ♂ carapace pl. 12, figs. 9,12

L = 620 um

H = 260 um

Paratype HU.276 T.19.2 ♀ carapace pl.13, figs. 1,2

L = 650 um

H = 300 um

Paratype HU.276 T.19.3 ♂ carapace pl.13, fig. 3

L = 660 um

H = 280 um

Affinities and Differences:

This species has some similarities with Paijenborchella boldi, Tewari and Tandon, particularly in outline but differs from it in details of ornamentation.

The Indian species is characterised by the development of two hump-like swellings near the posterior cardinal angle which are connected with each other; two swellings in front of the middle near the ventral margin, and an aloeform ridge starts from the junction of the posterior end and the caudal process, joining them to the anterior rim. The present species differs in having a reticulate surface, and short longitudinal ridges starting at the anterior marginal rim and running towards the subcentral tubercle.

P. (Eopaijenborchella) indica Khosla 1972 shows some similarity but differs in details of ornamentation.

Distribution: The species was found in the Bashiqa, Sheikhan, Sheikh Ibrahim, Kirkuk, Hamrin sections of the L. Fars Formation of Northern Iraq.

P. (Eopaijenborchella) aff. P. royi Khosla 1978

pl.13, figs. 4-6

Figured specimen: Carapace HU.276 T.20.

Horizon: M. Miocene. L. Fars Formation. bed no. 8, sample no. D0.7.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Three specimens.

Remarks:

The Iraqi specimen agrees with P. (Eopaijenborchella) royi Khosla 1978, but differs in lacking the development of reticulation meshes, and in having a sinuate dorsal margin, with smooth rounded anterior and posterior cardinal angles.

Khosla's species is less high and narrower with a relatively well-developed pointed caudal process. The Iraqi specimens lacks the anterior marginal rim, and is characterised by a faint antero-dorsal sulcus.

In dorsal view the Indian species is biconvex with narrower extremities compared with the Iraqi specimens.

Dimensions of the figured specimen:

HU.276 T.20 carapace pl.13, figs. 4,5,6

L = 750 um

H = 380 um

Distribution: Rare specimens were found at the Dohuk, Sheikh Ibrahim sections of the L. Fars Formation of Northern Iraq.

P. (Eopaijenborchella) sp.A

pl. 13; figs. 7,8

Figured specimen: Carapace HU.276. T.21.

Horizon: M. Miocene. L. Fars Formation, bed no. 14, sample no. DO.13.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: One carapace.

Description: Carapace elongate, wedge-shaped in side view, greatest height anteriorly. Anterior end obliquely rounded, with a thick marginal rim, a distinctive posterior shape, concave in the upper part, a short median, a process and the lower part forming a rounded angle with the ventral margin.

Dorsal margin straight, sloping down posteriorly, ventral margin nearly straight.

In front of the posterior end the lateral surface is marked by two small nodes one above the other; from the dorsal one faint ribs run forwards, from the ventral one a longitudinal ridge runs parallel to the ventral margin and terminates at the antero-ventral corner. The rest of the surface is smooth or covered with indistinct reticulations and ribs.

An inflated subcentral tubercle is present and short ridges are developed between this and the anterior margin.

Remarks:

The distinctive posterior shape distinguishes P.(Eop.) Sp.A from the other Paijenborchellinid genera. Only P. (Eopaijenborchella) mohani Khosla 1972 is closely similar in outline to the Iraqi species, but the latter differs in posterior shape and in details of ornamentation.

Distribution: Only one specimen was found in the Bashiqa section of L. Fars Formation, Northern Iraq.

Dimensions of figured specimen:

Carapace HU.276 T.21 pl.13, figs. 7,8

L = 510 um

H = 220 um

P. (Eopaijenborchella) spinosa sp.nov.

pl. 13, figs. 9,10,11,12

Derivation of name: spinosus L. - Thorny in reference to the well developed spines or tubercles.

Holotype: A female carapace HU.276 T.22.

Paratypes: Two specimens HU.276 T.23, 1-2.

Locality: Sheikhan anticline, Northern limb, 27 km NE of Mosul City.

Horizon: M. Miocene, L. Fars Formation, bed no. 14 , sample no. SH.5.

Material: Thirteen specimens.

Diagnosis: A species of P. (Eopaijenborchella) characterized by the straight dorsal margin with distinct postero-dorsal projection; left valve with well marked hinge ear. Two knob-like spines anteriorly and posteriorly situated above the ventral margins and separated by a shallow vertical sulcus.

Description: Carapace subquadrate to subrhomboidal shape in lateral view. Anterior margin rounded below, obliquely truncated above; posterior end

with well developed elongate caudal process, upper posterior margin concave. Dorsal margin straight with distinct anterior and posterior cardinal angles particularly in the left valve, greatest length passing just above the mid-height; ventral margin convex, curving upwards in the posterior direction.

The lateral surface is tra⌒versed vertically by a shallow sulcus, starting behind the pronounced eye tubercle and gradually dying out above the ventral margin. On either side of this sulcus two swellings are situated anteriorly and postero-dorsally, two or three knob-like spines are present postero-dorsally and the rest of the surface is covered with polygonal reticulations. There is a weak ventrolateral ridge. Left valve larger than the right with distinct overreach at the anterior and posterior cardinal angles.

Sexual dimorphism is pronounced, males are more elongate, narrower and lower than the females. In dorsal view, the carapace is somewhat arrow-shaped, the outline being broken by the vertical sulcus, the anterior end compressed and the posterior end elongate and pointed. Only closed carapaces were found, and so the internal features are unknown.

Dimensions of figured specimens:

Holotype HU.276 T.22 ♀ carapace pl. 13, figs, 10,12

L = 490 um

H = 255 um

Paratype HU.276 T.23.1 ♂ carapace pl.13, figs. 11,9

L = 530 um

H = 245 um

Remarks and Comparisons:

P. (Eopaijenborchella) moulina Sissingh 1972 as figured by N. Doruk 1973, is closely similar in outline to P. (Eopaijenborchella) spinosa sp.nov. but differs in other respects such as the dorsal margin which is somewhat inclined posteriorly, the lateral surface marked with a distinctive median carina and two ventrolateral ridges, the lower of which is well developed and may be blade-like ending in a short but sharp posterior spine, and the reticulate surface with polygonal fossae and punctate reticulum.

The above characters were not seen in the present species, the Iraqi species being distinguished by its two knob-like spines on either side of the vertical sulcus and the more elongate and round ended caudal process. Comparison with Neomonoceratina kutchensis Guha 1961 showed that the Indian species is smaller in size with a shorter caudal process and a dorsal margin sloping slightly posteriorly.

In addition there are no antero- and postero-dorsal projections and the reticules more developed in the present species.

The Iraqi species has been referred to P. (Eopaijenborchella) but it may be possible to set up a new subgenus on the basis of the two knob-like spines, postero-dorsal projection and the left valve with its well marked hinge-ear.

Unfortunately only a few specimens were obtained and no single valves were found so that it is not possible to ascertain the internal features of the shell.

Distribution: This species was found at the Sheikh Ibrahim, Sheikhan, Kirkuk, and Naft Khana localities of Northern Iraq.

P. (Eopaijenborchella) sp B.

pl.14, figs. 1,2

Figured specimen: Carapace HU.276 T.24

Horizon: M. Miocene. L. Fars Formation, at depth (314 - 315) m.

Locality: Hamrin well-2, N. Iraq.

Material: One carapace.

Description: Carapace small, subrhomboidal in side view, inflated ventrally and postero-dorsally, the ventral inflation caused by a ring-like ridge which curves upwards in the middle of the posterior part of the shell terminates in a thick, short spine.

Anterior end broadly rounded, below and obliquely truncated above; posterior end narrowly rounded, produced subdorsally, both with flange-like marginal rims.

Dorsal margin sinuous with prominent anterior and posterior cardinal angles; ventral margin short, straight forming the widest part of the shell.

Lateral surface transversed by a deep vertical sulcus originating behind the anterior cardinal angle, with vertical dorsal part and oblique ventral part, bounded ventrally by the ventrolateral ridge. The trace of an antero-dorsal ridge is present parallel to the anterior margin. The rest of the surface is covered by small quadrangular to oval reticules which form conspicuous muri particularly in the postero-dorsal area. Eye tubercle present; left valve slightly larger than the right, overreaching it conspicuously along the postero-dorsal margin. One carapace was found, and so no internal features could be seen.

Dimensions of figured specimen:

HU.276 T.24 carapace pl. 14, figs. 1,2

L = 370 um

H = 275 um

Remarks: The vertical sulcus, and the ornamentation place the present species in the Tribe Paijenborchellini Deroo, 1969, but the presence of a thick, ring-like, ventro-lateral ridge and the posterior shape make the present species easily distinguishable from other paijenborchellinid genera. Unfortunately only one carapace was found and if more material becomes available it may be useful to recognise this as a new genus or subgenus of paijenborchellini.

Genus Sulcostocythere Benson and Maddocks 1964

Type species: Sulcostocythere knysnaensis Benson and Maddocks, 1964

Sulcostocythere reticulata sp. nov.

pl.14, figs, 3-8

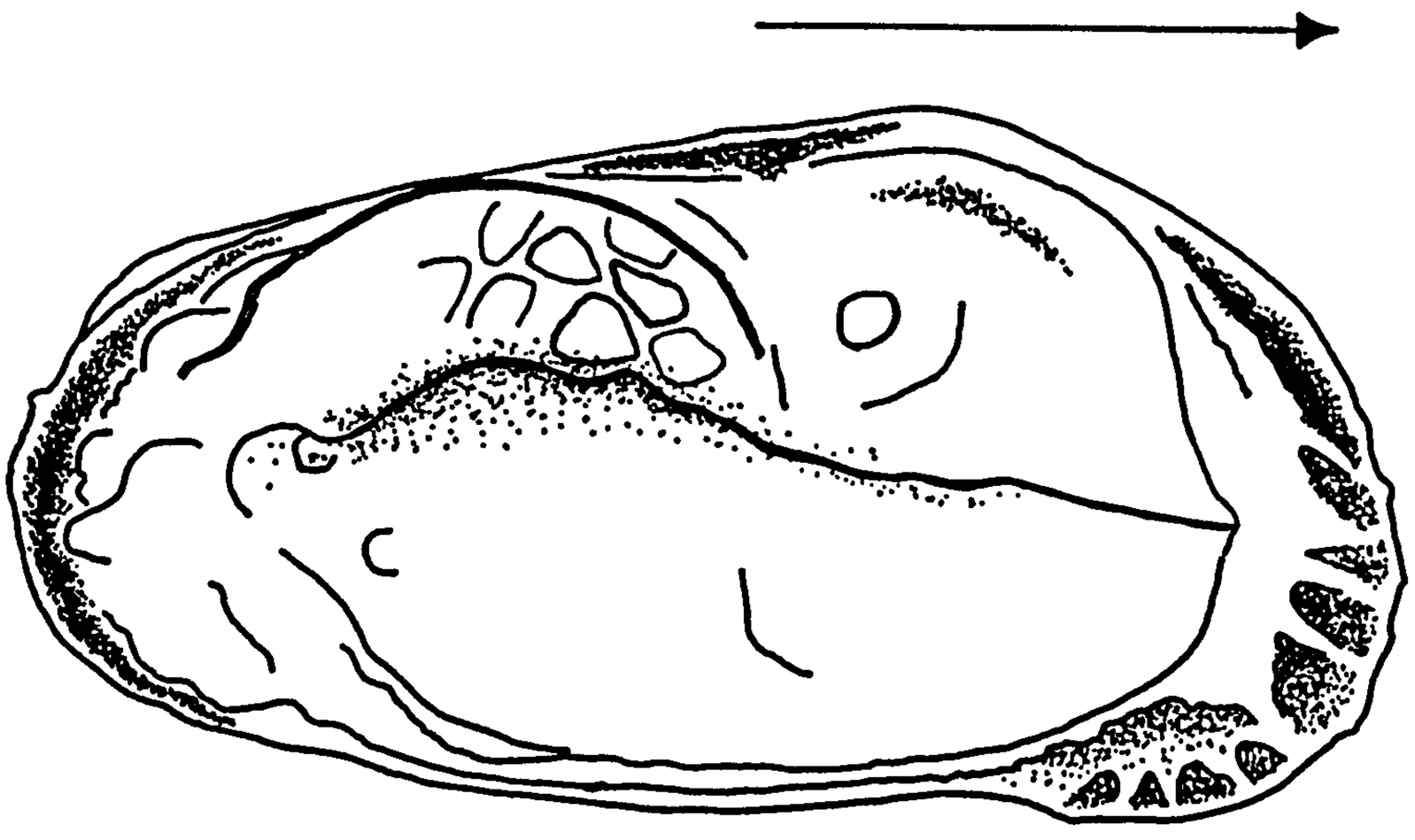
Derivation of name: Reticulatus L. netted or net-like in reference to the surface ornamentation.

Holotype: A female carapace HU.276 T.25.

Paratypes: Six specimens HU.276 T.26, 1-6.

Type horizon: M. Miocene, L. Fars Formation, bed no. 45, sample.SHI.25.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.



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Text fig. 7 Sulcostocythere reticulata sp.nov.
HU.276 T.25 Carapace from right lateral surface showing the longitudinal and diagonal ridges.

Material: Sixty specimens.

Diagnosis: A species of Sulcostocythere Benson and Maddocks 1964, with dorsal margin sloping posteriorly. Prominent anterior and posterior cardinal angles and a thick anterior rim which is compressed ventrally.

Description: Carapace subrectangular to subrhomboidal in lateral view, greatest height at the anterior cardinal angle, greatest length at one-third of the height above the ventral margin.

Dorsal margin straight, sloping steeply towards the posterior end; ventral margin flattened, sinuate, slightly concave at the antero-ventral corner, curving upwards posteriorly. Anterior end broadly and obliquely rounded below, compressed, directed ventrally; antero-dorsally truncate, steeply sloping and forming a thick rim. Ornamentation of longitudinal and diagonal ridges. Antero-dorsal ridge from the dorsal end of the sulcus passes through the ocular area and diverges to run parallel to the anterior end and join the median ridge at an acute angle.

Postero-dorsal ridge commences behind the sulcus at about one-third of the height below the dorsal margin, curves upwards over the postero-dorsal margin rising higher to obsucre the postero-dorsal margin in some specimens, and ends behind the posterior cardinal angle. A median ridge starts at the ventral end of the antero-dorsal margin, with a straight anterior part, arches in the posterior part of the valve to run parallel to the posterodorsal ridge and then curves down to a hook-shaped termination anterior to the posterior margin.

The ventrolateral ridge, parallel to the ventral margin is slightly alate posteriorly and joins the ventral rib anteriorly.

The ventral rib originates from the anterior end of the median ridge, curves down parallel to the anterior margin and then runs down parallel to the ventral margin ending at the postero-ventral corner.

The lateral surface has a vertical sulcus, originating behind the ocular area, which is wider dorsally and dies out above the ventrolateral ridge. The rest of the surface is covered with pentagonal reticulations, small knob-like nodes and undulate ribs are present in the posterior area, the dorsal part of the vertical sulcus and the upper part of the anterior area.

A rounded eye tubercle is present. Left valve larger than the right, dorsally overreaching it, especially at the posterior cardinal angle.

Carapace in dorsal view, ovate, compressed with tapering anterior end and narrowly rounded posterior end; maximum width at the middle, ridges prominent. Sexual dimorphism is pronounced, the presumed males more elongate than the presumed females.

Internal features as for the genus.

Dimensions of figured specimens:

Holotype HU.276 T.25 ♀ carapace pl.14, figs, 4-6

L = 565 um

H = 315 um

W = 260 um

Paratype HU.276 T.26.1 ♀ carapace pl. 14, fig. 7

L = 560 um

H = 320 um

W = 270 um

Paratype HU.276 T.26.2 ♂ carapace pl.14, fig. 8

L = 650 um

H = 320 um

W = 290 um

Paratype HU.276 T.26.3 ♂ carapace pl.14, fig. 3

L = 630 um

H = 330 um

W = 310 um

Affinities and Differences:

The species S. knysnaesis Benson and Maddocks 1964, is fairly similar in outline, but differs in details of ornamentation. The new species is characterised by its reticulate intermediate area, the absence of a posterior vertical ridge, the postero-dorsal ridge unconnected with the median ridge, and the anterodorsal ridge thin and weakly developed.

In dorsal view the outline of the present species is interrupted by the vertical sulcus and has a rounded posterior end; whilst the African species has convex sides, and a subtriangular posterior end.

In ventral view the outline of the present species is interrupted by the vertical sulcus, whilst the African species is sagittal-shaped the ventrolateral ridge forming a subdued wing, whilst the Iraqi species is elliptical-shaped with a broadly rounded posterior end.

Distribution: This species was found at the Sheikh Ibrahim, Dohuk, Kirkuk and Hamrin localities of Northern Iraq.

Sulcostocythere dimorphica sp. nov.

pl.14, figs. 9-12

pl.15, figs. 1,2

Derivation of name: In reference to the strong dimorphism evident in this species

Holotype: A male carapace HU.276 T.27.

Paratypes: Two specimens HU.276 T.28. 1-2.

Type horizon: L. Fars Formation, M. Miocene, at depth (220-255m).

Type locality: Kirkuk well 208, N. Iraq.

Material: Fourteen specimens.

Diagnosis: Sexual dimorphism strongly pronounced. Posterior end drawn-out and tending to produce a caudal process ventrally. Carapace outline with flange-like marginal area.

Description: Carapace elongate to elongate-subrectangular-subovoid in male, subtrapezoidal in the female, greatest height at the anterior cardinal angle, greatest length at one-third of the height above the ventral margin. Anterior margin obliquely rounded below, truncate above, posterior end truncate, steeply sloping in the upper part, drawn-out, obliquely rounded and tending to produce a caudal process ventrally.

Dorsal margin straight with distinct anterior and posterior cardinal angles; ventral margin straight, forming the widest part of the shell; carapace strongly inflated in the posterior half and ventrally.

A shallow, vertical, antero-dorsal sulcus originates behind the eye tubercle, runs across the shell and dies out ventrally; the rest of the surface is covered with indistinct longitudinal and diagonal ribs, and pentagonal

reticulations forming a fine pitted reticulum.

Left valve larger than the right, overreaching it distinctly along the cardinal angles.

Carapace elliptical in dorsal view with strong inflation and maximum width just behind the mid-length, tapering anteriorly.

Sexual dimorphism is strongly pronounced, the presumed males more elongate and less in height than the trapezoidal females.

Only complete carapaces were found, and it was not possible to observe the internal features.

Dimensions of figured specimens:

Holotype	HU.276 T.27 ♂	carapace	pl.14, figs. 9,10	
	L = 680 um		pl.15, fig. 1	
	H = 310 um			
	W = 320 um			
Paratype	HU.276 T.28.1 ♀	carapace	pl.14, figs, 11, 12	pl.15, fig. 2
	L = 600 um			
	H = 330 um			
	W = 270 um			

Remarks: The present species agrees with the diagnostic features of Sulcostocythere Benson and Maddocks, 1964, but it is easily distinguished from all described species by the shape of the posterior margin, the absence of longitudinal and diagonal ridges, the easily distinguished sexual dimorphism and the flange-like marginal area.

Distribution: This species was found at the Sheikh Ibrahim, Kirkuk and Bai - Hassan localities of Northern Iraq.

Sulcostocythere posterotruncata sp. nov.

pl. 15, figs. 7,8,10-12

Derivation of name: In reference to the straight posterior margin.

Holotype: A female carapace HU.276 T.29.

Paratypes: Two specimens HU.276 T.30. 1-2.

Type horizon: M. Miocene. L. Fars Formation at depth 3275-3280 ft.

Type locality: Bai-Hassan well 33, N. Iraq.

Material: Five specimens.

Diagnosis: A Sulcostocythere species, with elongate, oval male, subrhomboidal female carapace in side view, and whose lateral surface is covered with finely pitted reticules.

Description: Sexual dimorphism very distinct, the females are shorter and higher with subrhomboidal carapace in lateral view, while the males are more elongate-oval and lower than the females; greatest height at the ocular area, greatest length lies below mid-height. Anterior margin evenly rounded below, merging concavely into the ventral margin, obliquely truncate above. Dorsal margin straight with prominent anterior and posterior cardinal angles; ventral margin slightly convex, smoothly joined the posterior end; a marginal flange forms the outline of the carapace.

Surface ornamentation consists of longitudinal and diagonal ridges. An ocular ridge is well developed and runs parallel to the anterior margin; dorsal, median and ventrolateral ridges are weakly developed. A shallow, vertical sulcus originates behind the ocular swelling and dies out ventrally at about mid-height. The rest of the surface is covered with finely pitted reticules.

Left valve larger than the right, overreaching it more conspicuously along the postero-dorsal area.

In dorsal view the carapace is elliptical with the maximum width at the mid-length. The female carapace is narrower posteriorly with a slightly pointed posterior end.

Dimensions of figured specimens:

Holotype HU.276 T.29 ♀ carapace pl.15, figs. 7,8,12

L = 520 um

H = 310 um

Paratype HU.276 T.30.1 ♂ carapace pl.15, figs. 10,11

L = 620 um

H = 290 um

Affinities and Differences: So far, very few species of Sulcostocythere have been described.

S. posterotruncata sp.nov. can easily be distinguished from other species by its pitted reticules, anterior and posterior shape and strong sexual dimorphism.

Remarks: This species shows considerable variation in outline particularly between males and females, in the shape and size of the reticules and in the degree of development of the ridges.

Distribution: Rare specimens were found in the Kirkuk and Bai-Hassan localites, Northern Iraq.

Sulcostocythere posteronodosa sp. nov.

pl. 15, figs. 3-6, 9

Derivation of name: In reference to the postero-ventral node.

Holotype: A male carapace HU.276 T.32.

Paratypes: Two specimens HU.276 T.33, 1-2.

Type horizon: M. Miocene, L. Fars Formation at depth (326-327) m.

Type locality: Hamrin well No. 2, N. Iraq.

Material: Seven specimens.

Diagnosis: Well calcified, strongly inflated carapaces. In lateral view, posterodorsally concave with a ventral caudal process. Lateral surface strongly reticulate.

Description: Carapace elongate to elongate-subrectangular in males, sub-trapezoidal in the females, with greatest height at the anterior cardinal angle, greatest length at the one-third of the height above the ventral margin. Anterior margin obliquely rounded, posterior end truncate, concave

postero-dorsally and, tending to produce a caudal process ventrally.

Dorsal margin straight with rounded anterior and posterior cardinal angles, ventral margin straight, obscured by the ventrolateral ridge.

The sculpture consists of longitudinal and diagonal ridges. An antero-dorsal ridge originates from the ocular swelling and runs parallel to the anterior margin dying out before it joins the median ridge; the postero-dorsal ridge commences at the mid-part of the vertical sulcus, projects over the postero-dorsal margin and then curves down posteriorly to terminate in a small node anterior to the caudal process; a median ridge starts from the mid-anterior area, runs posteriorly with a straight anterior part which then curves upwards parallel to the postero-dorsal ridge; the ventrolateral ridge starts at the antero-ventral corner, runs horizontally to terminate posteriorly in a strong node; a ventral carina runs from the anterior end of the ventro-lateral ridge, parallel to the ventral margin and convex upwards, to end posteriorly in a small node.

A vertical sulcus behind the ocular swelling gradually dies out above the ventro-lateral ridge and divides the shell into two parts of which the anterior is the smaller.

The lateral surface is covered with well-developed polygonal reticules, the ocular swelling is well-developed and small nodes are present in the posterior half of the shell. Left valve larger than the right, overreaching more conspicuously along the dorsal margin.

In dorsal view, the ridges affect the outline of the carapace; anterior and

posterior ends compressed, maximum width in the posterior half, just behind the sulcus. In ventral view the ventro-lateral alae are distinct, and the ventral margin forms the widest part of the carapace.

Sexual dimorphism pronounced the presumed males more elongate than the presumed females. Internal features are unknown, but the anterior flange is very thin, and shows short and numerous marginal pore-canals.

Dimensions of figured specimens:

Holotype HU.276 T.32 ♂ carapace pl. 15, figs. 6, 9

L = 570 um

H = 270 um

W = 270 um

Paratype HU.276 T.33.1 ♀ carapace pl.15, fig. 4

L = 565 um

H = 265 um

W = 230 um

Paratype HU.276 T.33.2 ♂ carapace pl.15, fig. 5

L = 560 um

H = 260 um

Affinities and Differences:

The present species differs from the type species of Sulcostocythere, in having the posterior margin, produced into a caudal process ventrally.

From S. danakilensis Gramann 1971, the new species can be distinguished by its ventral caudal process, nearly straight ventral margin, and the

termination of the ventro-lateral ridge in a node, whilst Gramann's species has a subdued subdorsal caudal process and a convex ventral margin.

Distribution:

The species was found at the Sheikh Ibrahim and Hamrin localities of Northern Iraq.

Genus SCHNEIDERELLA Stancheva, 1974

Type species: Cythereis dromas Schneider, 1939

Remarks:

Schneider (1939, 1940) described the new species of Cythereis dromas. Later she described the same species but under the genus Trachyleberis whilst noting that because of the difference in the hinge structure its generic placement was questionable. In 1974 Stancheva decided that the ornamentation of the carapace and the hinge structure were sufficiently different from Trachyleberis and Cythereis to propose the new genus Schneiderella.

Schneiderella unispinata sp. nov.

pl. 16, figs. 1-6, 9

Derivation of name: In reference to the prominent single spine.

Holotype: A female carapace HU.276 T.34.

Paratypes: Six specimens HU.276. T.35, 1-6.

Type horizon: M. Miocene. L. Fars Formation, bed no. 20, sample no. SH.11.

Type locality: Sheikhan anticline. N. limb, 27 km NE of Mosul City.

Material: Over one hundred specimens.

Diagnosis: A species of Schneiderella, characterised by a carapace which is swollen posteriorly and has well developed ventrolateral alae and distinct anterior and posterior cardinal angles.

Description:

Carapace subrhomboidal in lateral view, with greatest height at anterior cardinal angle.

Anterior end broadly rounded below, obliquely truncated above, posterior end narrower, tending to produce a caudal process, rounded in the middle, obliquely below, concave above.

Dorsal margin straight with distinct anterior and posterior cardinal angles, ventral margin straight anteriorly, curving upwards towards posterior end where the shape becomes blade-like.

Lateral surface in each valve transversed by a vertical sulcus which starts behind the eye tubercle, and dies out ventrally just in front of the ventro-lateral alae. This divides each valve into two parts, the anterior of which is the smaller. The rest of the surface is covered with well developed pentagonal reticules, arranged in subparallel rows. Three distinctive ribs are developed. The anterodorsal one originates in the ocular area, runs parallel to the anterior margin and joins the median one at its anterior end; the median one is well developed anteriorly and dies out posteriorly; the

ventrolateral rib starts from the anteroventral corner, runs backwards parallel to the ventral margin and dies out posteriorly.

The carapace is inflated anteriorly and ventrally with two swellings posteriorly, the dorsal one slightly obscuring the dorsal margin in some specimens, the ventral one terminating in well developed alae. An elongate eye tubercle is present together with an ocular socket and a small node behind the eye tubercle.

Hinge in the right valve consists of an anterior lobed tooth and antero-median socket, separated from the weakly crenulate posterior tooth by an elongate crenulate groove. Narrower anterior and postero-ventral vestibules are present and the marginal pore-canals are short and straight but not numerous.

Muscle scars not seen due to ornamentation. In dorsal view the carapace outline is broken by the vertical sulcus and the pointed ventrolateral alae. Maximum width posteriorly, in ventral view, the ventrolateral alae pointing upward, both anterior and posterior ends are narrowly pointed, the ventral margin forming the widest part of the carapace. Left valve larger than the right overlapping along the entire margin except anteriorly.

Sexual dimorphism marked, the presumed males more elongate than the presumed females.

<u>Dimensions of figured specimens</u>:

Holotype ♀ carapace HU.276 T.34 pl.16, figs, 1,2

L = 560 um

H = 320 um

Paratype ♀ carapace HU.276 T.35.1 pl.16, fig. 3

L = 570 um

H = 310 um

Paratype ♂ carapace HU.276 T.35.2 pl.16, figs. 4,5

L = 670 um

H = 330 um

Paratype R.V.I. HU.276 T.35.3 pl.16, fig. 6

L = 560 um

H = 320 um

Paratype carapace HU.276 T.35.4 pl.16, fig. 9

L = 570 um

H = 320 um

Affinities and Differences:

Schneiderella unispinata sp.nov. is quite distinct from all the other Schneiderella species described so far, in its well developed pointed ventrolateral alae. In general shape S. unispinata sp.nov. resembles a number of species described under Neomonoceratina Kingma 1948, but the hinge structure and the posterior shape agree with Schneiderella Stancheva 1974 whose type species S. dromas differs in lacking ventrolateral alae and in a slight difference in the shape of reticules.

Distribution: The present species was found at the Bashiqa, Sheikhan,

Dohuk and Tel-Hajer localities of Northern Iraq.

Schneiderella vulgaris sp.nov.

pl.16, figs. 7,8,10-12

pl.17, figs. 1,2

Derivation of name: vulgaris L., a reference to its common occurrence at a number of localities.

Holotype: A male carapace HU.276 T.36.

Paratypes: Seven specimens HU.277 T.1, 1-7.

Type horizon: M. Miocene. L. Fars Formation at depth (324-225) m.

Type locality: Hamrin well 2, N. Iraq.

Material: Over one hundred specimens.

Diagnosis: A species with strong ventrolateral inflation, strongly reticulate surface, in which the merged reticular muri form subparallel costae.

Description:

Carapace elongate, subrectangular in lateral view, maximum thickness posteriorly.

Dorsal margin straight, with distinct anterior and posterior cardinal angles, ventral margin sinuate, curved upwards towards the posterior end. Anterior margin broadly, obliquely rounded below, obliquely truncated above, posterior end narrowly, obliquely rounded below, concave above.

Carapace slightly inflated anteriorly with longitudinal inflation ventrally. Two swellings occur in the posterior part, the dorsal one very strong and

projecting over the dorsal margin, the smaller ventral one is ridge-like and separated from the dorsal one by a shallow depression. An irregular vertical sulcus originating behind the eye tubercle divides the carapace into two unequal parts, of which the posterior is the bigger.

The anterodorsal, median and ventrolateral ribs are marked.

The rest of the valve surface is covered with well-developed, pentagonal to rectangular reticules, whose muri merge to form subparallel costae.

Eye tubercle elongate; two nodes are present along the anterior side of the vertical sulcus.

Left valve larger than the right, overreaching along the entire margin except the anterior one.

Marginal zone moderately wide anteriorly, narrow posteriorly. There is a narrow anterior vestibule. Marginal pore canals few, straight and widely spaced. Muscle scar pattern not seen.

Hinge in the right valve consists of a lobed anterior tooth, postjacent antero-median socket with two small pits inside, an elongate, narrow postero-median crenulate groove and a small lobed posterior tooth. Both socket and groove are separated from the interior by a well developed wall.

In the left valve the hinge consists of anterior and posterior sockets, sub-conical antero-median tooth elongate, crenulate, postero-median bar, both antero-median tooth and bar being separated from the dorsal margin by a

shallow groove.

In dorsal view carapace ovate with pointed anterior and posterior ends, a marked constriction due to the vertical sulcus, and with the maximum thickness and width posteriorly.

Sexual dimorphism pronounced, the presumed males more elongate than the presumed females.

Dimensions of figured specimens:

Holotype ♂ carapace HU.276 T.36 pl.16, figs. 7,10

L = 720 um

H = 350 um

Paratype ♀ carapace HU.277 T.1.1 pl.16, fig. 8

L = 710 um

H = 370 um

Paratype ♀ carapace HU.277 T.1.2 pl.16, fig. 11

L = 700 um

H = 360 um

Paratype ♂ carapace HU.277 T.1.3 pl.16, fig. 12

L = 730 um

H = 350 um

Paratype R.V.I HU.277 T.1.4 pl.17, fig. 1

L = 650 um

H = 350 um

Paratype L.V.I HU.277 T.1.5 pl.17, fig. 2.

L = 710 um

H = 350 um

Affinities and Differences:

Krstic (1979) figured two specimens which she placed in Schneiderella aff. oertlii (Guha), which was originally described by Guha 1967 as Neomonoceratina oertlii. The Iranian specimens are closely similar to the present species, but the latter differs in being more elongate and narrower.

Krstic's specimens have a broadly and obliquely rounded anterior margin, whilst the present species have a truncated anterior margin with distinct anterior cardinal angle and a slight difference in the posterior shape. In addition there is a difference in details of ornamentation. Guha's original material differs from S. vulgaris sp. nov. in its smaller size, narrower posterior end, and narrower obliquely rounded anterior margin.

The species closely resembles Neomonoceratina helvetica. Oertli in general shape and outline but differs in details of ornamentation and in internal features.

Distribution:

This species was found at the Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk, Hamrin, Bai Hassan, Naft Khana and Tel-Hajer localities of Northern Iraq.

Schneiderella sp.

pl.17, figs. 3-6

Figured specimens: HU.277 T.2.1-3

Horizon: M. Miocene. L. Fars Formation, bed no. 45, sample no.SHI.25.

Locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Material: Five specimens.

Description: A large carapace, subrectangular in lateral view, greatest height at anterior cardinal angle.

Anterior margin broad, obliquely rounded in the left valve; in the right valve gently sloping above, narrowly rounded below, posterior end broadly rounded. Dorsal margin straight, anterior and posterior cardinal angles present, ventral margin sinnate, curved upwards posteriorly; the carapace has a marginal rim, anterior and posterior margins narrower than the rest of the carapace.

An irregular vertical sulcus crosses each valve and is deep dorsally, becoming shallow and dying out ventrally, just above the ventral inflation.

This depression divides each valve into two parts. Two nodes occur along the anterior part of the sulcus. The strong ventral inflation terminates in a short ridge posteriorly. A strong swelling projects above the dorsal margin just behind the sulcus.

Lateral surface covered, with indistinct reticules and ribs.

An elongate eye tubercle is present.

Left valve larger than the right but the overlap is inconspicuous.

Remarks:

The present species differs from all described species, in its larger size, the distinctive shape of anterior and posterior ends, and the indistinct reticulations. Because few specimens were found the species is left under open nomenclature.

Dimensions of figured specimens:

Carapace HU.277 T.2.1 pl.17, fig. 3

L = 710 um

H = 360 um

Carapace HU.277 T.2.2 pl.17, fig. 4

L = 680 um

H = 340 um

Carapace HU.277 T.2.3 pl.17, figs. 5,6

L = 690 um

H = 350 um

Family: LEPTOCYTHERIDAE Hanai, 1957

Genus: LEPTOCYTHERE Sars, 1928

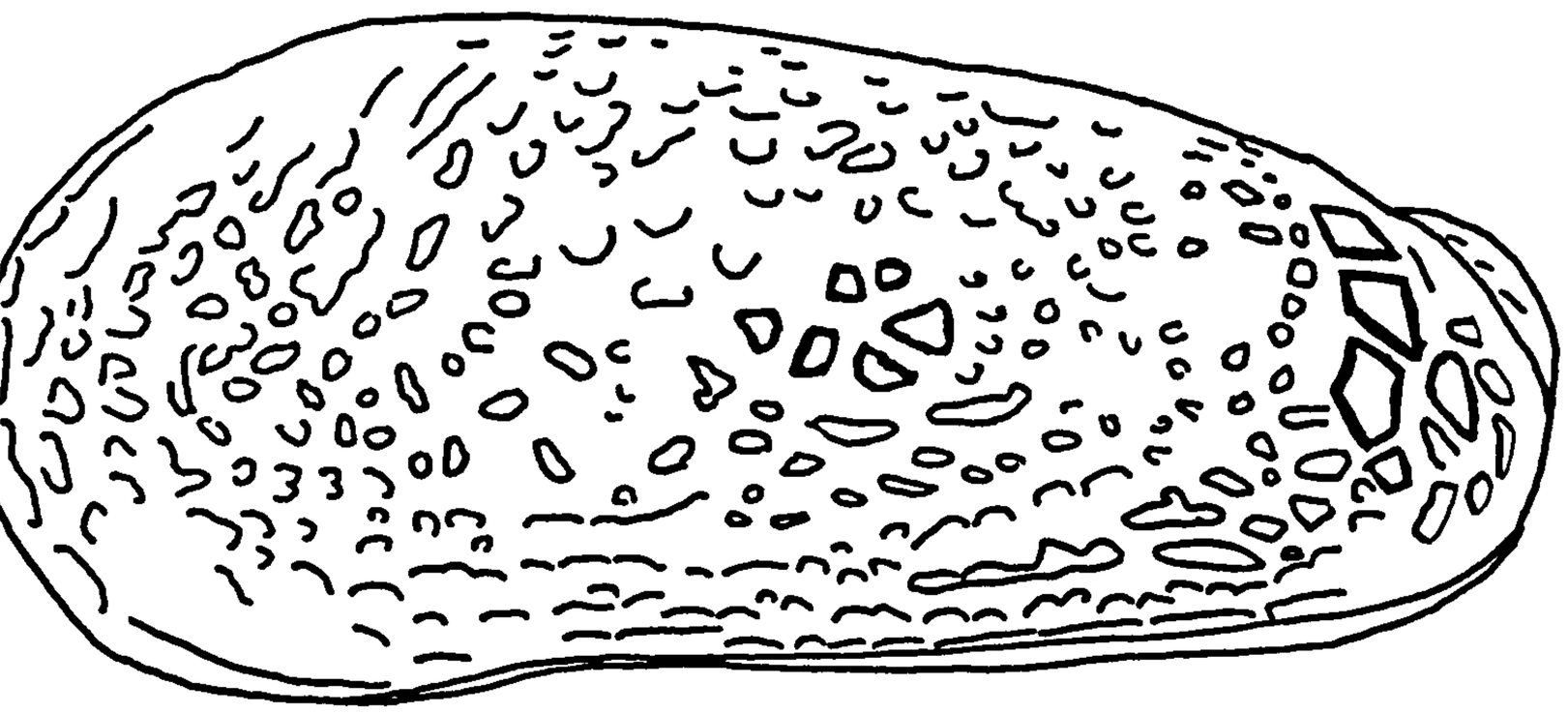
Subgenus: LEPTOCYTHERE Sars, 1928

Type species: Cythere pellucida Baird 1850

Leptocythere (Leptocythere) hajerensis sp.nov.

pl.17, figs. 7-12

Derivation of name: From the occurrence of the type specimens.



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Text fig. 8 L. (Leptocythere) hajerensis sp.nov.

HU.277 T.3 Carapace from left lateral surface showing the ornamentation.

Holotype: A male carapace HU.277 T.3.

Paratypes: Five specimens HU.277 T.4.1-5.

Type horizon: M. Miocene L. Fars Formation, at depth (274-279) m.

Type locality: Tel-Hajer Well 1, Northwest Iraq.

Material: Twenty specimens.

Diagnosis: A species of Leptocythere Sars, characterised by medium size, elongate, subelliptical in lateral view, coarsely pitted and slightly swollen postero-dorsally.

Description:

Medium in size, elongate, subelliptical tapering posteriorly, greatest height at the anterior cardinal angle. Anterior margin obliquely

rounded, marked with a weak marginal rim; posterior margin narrowly rounded with a lip-like cardinal angle.

Dorsal margin broadly arched, slightly concave in front of posterior cardinal angle, ventral margin straight, slightly concave at intersection of the greatest height.

Lateral surface coarsely pitted with numerous foveoles variable in shape and size; small and rounded along the dorsal margin, elongate and tending to produce subparallel rows along the ventral margin, variable in shape and size along the anterior half and forming thick muri in the antero-dorsal area. Centrally they become larger and triangular - ovate: towards the posterior end they become finer, and along the posterior margin they tend to be gathered into groups of five to six, some of them forming smooth polygonal reticules. Left valve slightly larger than the right, but with inconspicuous overlap.

In dorsal view the carapace is elliptical with the maximum width and thickness posteriorly, behind the anterior area, the valve margins form a shallow depression along the dorsal margin which dies out posteriorly. Sexual dimorphism marked, the presumed males more elongate and narrower posteriorly than the presumed females. Only one broken valve was found showing the internal features which agree with those of the genus.

<u>Dimensions of figured specimens</u>

Holotype ♂ carapace HU.277 T.3 pl.17, figs. 7, 8

L = 580 um

H = 270 um

W = 230 um

Paratype ? ♂ carapace HU.277 T.4.1 pl.17, fig. 9

L = 570 um

H = 275 um

Paratype ♀ carapace HU.277 T.4.2 pl.17, figs. 10a, 11

L = 570 um

H = 280 um

W = 250 um

Paratype ♀ carapace HU.277 T.4.3 pl.17, fig. 12

L = 580 um

H = 300 um

Paratype ♂ carapace HU.277 T.4.4 pl.17, fig. 10b

L = 610 um

H = 275 um

W = 230 um

Affinities and Differences

L. sanmarinensis Ruggieri, 1967 somewhat resembles the Iraqi species, but the latter differs in its narrower posterior end, coarser pits and diagonal muri behind the anterior cardinal angle.

L. hajerensis sp.nov. shows some similarities to L. pentagonalis Carbonnel 1969, but the median and anterior sulcus, convex dorsal margin, concave ventral margin, the difference in details of the ornamentation, and the short and wider carapace of L. pentagonalis, easily differentiate the two species.

Distribution: This species was found at the Sheikhan, Kirkuk, Dohuk and Tel-Hajer localities of Northern Iraq.

Genus CALLISTOCYTHERE Ruggieri, 1953

Type species: Cythere littoralis Muller, 1894

Callistocythere hipposideros sp.nov.

pl.18, figs. 1-6

Derivation of name: hipposideros Gr. horseshoe in reference to the two horseshoe shaped ridges in the posterior part of the carapace.

Holotype: A male holotype HU.277 T.5

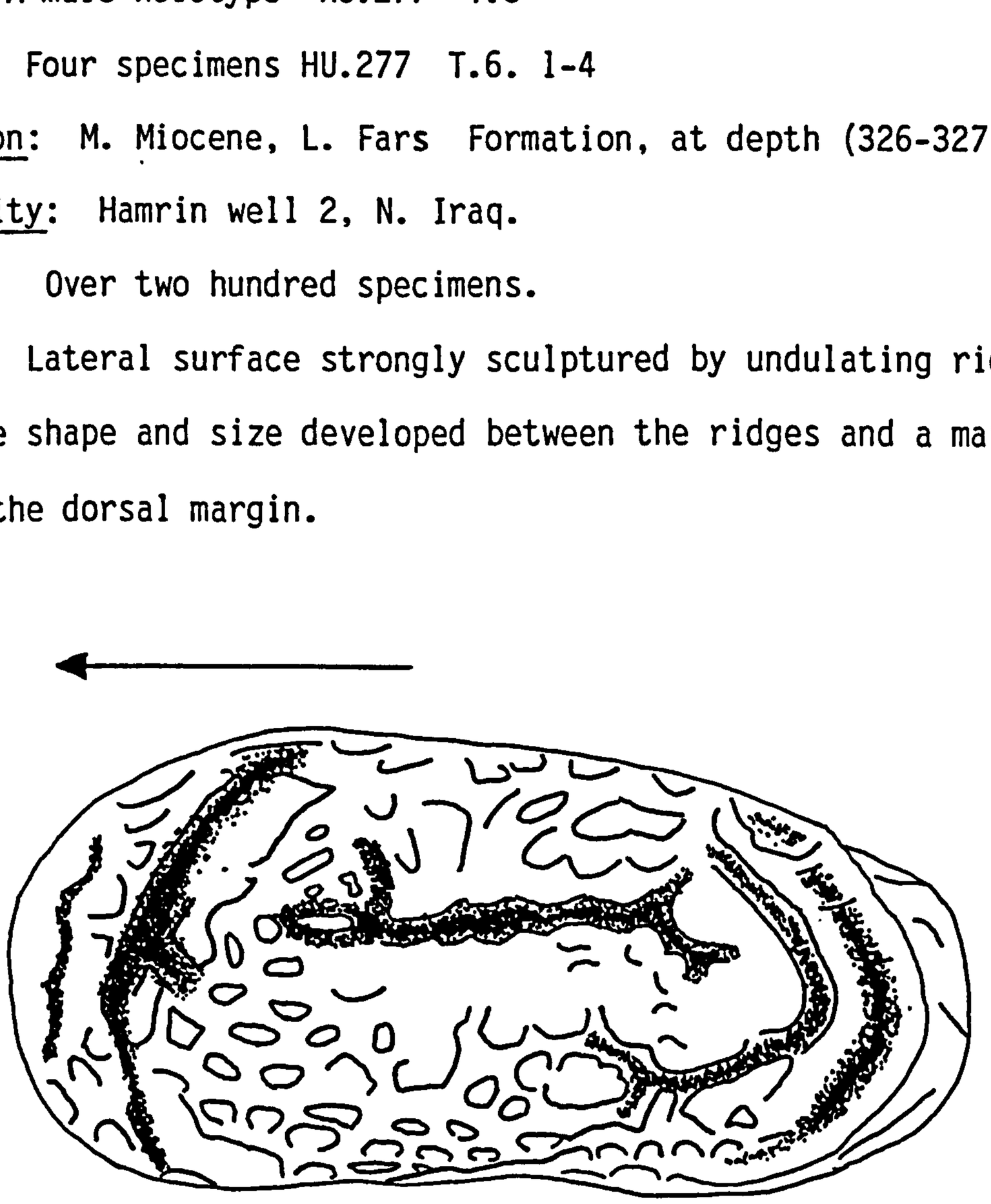
Paratypes: Four specimens HU.277 T.6. 1-4

Type horizon: M. Miocene, L. Fars Formation, at depth (326-327) m.

Type locality: Hamrin well 2, N. Iraq.

Material: Over two hundred specimens.

Diagnosis: Lateral surface strongly sculptured by undulating ridges, fossae of variable shape and size developed between the ridges and a marginal ridge modifying the dorsal margin.



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Text fig. 9. Callistocythere hipposideros. HU.277 T.6.1. Carapace from left, lateral surface showing the ornamentation.

Description:

Carapace moderate in size, elongate, subreniform in side view, greatest height at the anterior cardinal angle.

Anterior margin obliquely rounded, posterior margin obliquely rounded below, truncated above.

Dorsal margin slightly convex with distinct anterior and posterior cardinal angles, ventral margin sinuate, merging smoothly into the anterior and posterior ends. Surface ornamented by irregularly undulating ridges, a short ridge originating from the ocular area, runs diagonally forwards to terminate above the anteroventral area. Between this ridge and the anterior margin, a short undulate diagonal ridge is developed; a deep subparallel furrow runs behind.

A median ridge starts from a reticulate node just above the mid-height and runs backwards, bifurcating posteriorly where the ventral branch dies out above the ventrolateral ridge and the dorsal one joins the second posterior ridge.

In the posterior part there are two ridges. The first starts from the postero-ventral margin and joins the thin marginal ridge which modifies the dorsal margin; the second starts at the posterior end of the ventro-lateral ridge and runs parallel to the first one, curving up in the dorsal half to join the median ridge.

The posterior margin and first and second posterior ridges form a series of half circles, one above the other. A group of ventrolateral ridges running

parallel to the ventral margin dies out posteriorly at about one-third of the length from the posterior end.

At the middle of the carapace two horseshoe-shaped furrows occur along either side of the median ridge; the rest of the surface is covered with short undulating ridges and deep fossae of variable shape and size. These fossae may be rounded, triangular, elongate or ovate and fossae disappear in the posterior part. An eye tubercle is present.

Left valve slightly larger than the right, but overlap not conspicuous.

Sexual dimorphism present, males narrower posteriorly than the presumed females.

The line of concrescence and inner margin coincide along the entire margin, except anteriorly where there is a poorly developed vestibule. Hinge in the left valve consists of an anterior socket, followed by individual toothlets and a posterior socket, separated by a crenulate bar. Normal pore canals moderate in number.

In dorsal view carapace, arrow-head shaped, pointed anteriorly, nearly parallel sides at the middle and with the maximum thickness and width in the middle.

<u>Dimensions of figured specimens</u>:

Holotype ♂ carapace HU.277 T.5 pl.18, figs. 1,3

L = 460 um

H = 240 um

Paratype ♂ carapace HU.277 T.6.1 pl.18, fig. 2

L = 480 um

H = 210 um

Paratype ♀ carapace HU.277 T.6.2 pl.18, figs. 4,5,6

L = 460 um

H = 250 um

Affinities and Differences:

Callistocythere rotundata Ruggieri 1962, somewhat resembles the present species, but differs in having anterior marginal denticulations, a steeply sloping dorsal margin in being higher and less elongate and in having a different pattern of ridges.

Callistocythere littoralis (Müller) as figured by Athersuch and Whittaker 1980 has some similarities to C. hipposideros sp. nov. but the former differs in being less elongate, subquadrate in shape, comparatively finely pitted and lacking the development of the second posterior and anterior ridges, in addition to differences in the distribution of the undulating ridges.

From Callistocythere antoniettae Ruggieri 1967, the Iraqi species differs in its strongly suclptured surface, pattern of undulating ridges, coarse pitting and lesser height.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk, Hamrin, Naft Khana and Bai-Hassan localities of Northern Iraq.

Callistocythere sp.A.

p.18, figs. 7,10

Figured specimen: HU.276 T.7.

Horizon: M. Miocene, L. Fars Formation, at depth (69-70 m) below the surface.

Locality: Kirkuk well 208, N. Iraq.

Material: One carapace.

Description:

Carapace small, elongate, subreniform in side view. Anterior margin obliquely rounded below, truncated above, posterior end narrowly obliquely rounded. Dorsal margin straight, obscured posteriorly by a dorso-lateral ridge. Anterior and posterior cardinal angles present. Ventral margin runs smoothly into the posterior margin.

Lateral surface marked with thick undulating ridges. The anterior ridge originates from the ocular area and runs obliquely forwards to join the anterior margin at the middle, three deep fossae are developed between the anterior margin and the anterior ridge. Just above the mid-height is a thick rounded node from which three ridges originate; a short one which joins the anterior ridge, a ventral one which runs forwards to join the anterior margin above the antero-ventral area, and a median ridge which runs posteriorly and curves upwards to join the dorsal one in the last third of the length. From the antero-ventral corner a lateral ridge runs posteriorly and then bifurcates into two ridges, which unite and terminate in a thick node above postero-ventral corner. A dorsal ridge starts behind the eye tubercle, runs parallel to the dorsal margin, thickens up and runs parallel to the posterior margin forming the first posterior ridge, and dying out in the middle of ventral margin. The second posterior ridge forms a small arc parallel to the first one. Behind

the eye tubercle is a V-shaped ridge. The area between ridges is covered with small to large fossae and deep furrows. Eye tubercle present. Left valve slightly larger than the right.

Dimensions of figured specimen:

Carapace HU.277 T.7 pl.18, figs. 7,10

L = 415 um

H = 210 um

Remarks:

Callistocythere sp. A is fairly similar to C. ennensis Ruggieri 1962 but differs in being more elongate, with a straight dorsal margin and in having a different pattern of undulating ridges.

From Callistocythere hipposideros sp. nov. differs in being narrower and in details of ornamentation.

Callistocythere sp. B

pl.18, figs. 8, 11

Figured specimens: Hu.277 T.8. 1-2.

Horizon: M. Miocene, L. Fars Formation, bed no. 13, sample no. DO.12.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Four specimens.

Description:

Carapace elongate, subrectangular in side view, greatest height at anterior cardinal angle, greatest length at mid-height. Anterior margin broadly

obliquely rounded below, slightly concave above; the posterior margin curves upward to terminate in an ear-shaped projection dorsally.

Dorsal margin gently convex, strongly concave in front of postero-dorsal corner, ventral margin straight medianly with anterior infracurvature and running smoothly into the posterior margin.

External surface covered by longitudinal and diagonal ridges. Dorsal, median and posterior ridges are parallel to the margins; the antero-dorsal ridge originates from the eye tubercle runs obliquely forwards and then curves medianly to run diagonally and die out at the middle of the anterior margin. The rest of the surface is covered with small rounded fossae, along the dorsal, ventral, middle and posterior areas in the anterior part of the valves large deep, fossae and furrows are developed. Eye tubercle present.

Sexual dimorphism pronounced, the presumed males more elongate and less high than the presumed females.

<u>Dimensions of figured specimens:</u>

♂ carapace HU.277 T.8.1 pl.18 fig. 8

L = 430 um

H = 210 um

♀ carapace HU.277 T.8.2 pl.18, fig. 11

L = 410 um

H = 220 um

Remarks:

The present species is fairly similar to C. hipposideros sp. nov. but has slightly different ornamentation, in the fossae being small and rounded, the ridges reduced, the antero-dorsal ridge having a different course and the anterior margin being slightly concave dorsally.

Specimens were rare so the species is left under open nomenclature.

Genus SYLVESTRA Doruk 1973

Type species: Sylvestra posterobursa Doruk 1973

Sylvestra sp.

pl.18, figs. 9, 12

Figured specimen: Carapace HU.277 T.9

Horizon: M. Miocene. L. Fars Formation, bed no. 17, sample no. DO.16.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: One carapace.

Description: A species of Sylvestra Doruk, 1973, with subrectangular shape in lateral view.

Anterior margin obliquely rounded, with weak marginal rim, posterior margin obliquely rounded with distinct postero-dorsal lip.

Dorsal margin slightly convex, ventral margin straight, slightly concave anteriorly running smoothly into the posterior end. Lateral surface strongly sculptured by numerous small, rounded pits, which vary in shape and size. In the dorsal and central areas they are fine and rounded in shape. Towards the anterior they become finer until they disappear along the anterior margin; above the ventral margin they tend to be arranged in subparallel rows; towards the posterior margin 5-6 pits tend to be grouped together into a well developed fossa.

Longitudinal and diagonal ridges weakly developed. The anterior ridge

originates from the eye tubercle, runs parallel to the anterior margin, splitting into two branches which both die out above the antero-ventral corner; behind this ridge a subparallel shallow diagonal sulcus is present. An undulating marginal ridge starts mid-dorsally, curving down subparallel to the anterior ridge; above the antero-ventral corner it bifurcates, both branches running posteriorly, the ventral one also bifurcating. The two branches of the latter unite above the mid-ventral margin, curve upwards forming an inverse U-shaped and run parallel to the posterior margin, becoming thickened and blade-like above the posteroventral pouch and dying out at the postero-dorsal corner.

The smaller lateral ribs are distributed haphazardly and no particular pattern could be observed.

Left valve slightly larger than the right, overreaching it conspicuously along the postero-dorsal and antero-dorsal areas. The posterior end is higher than the anterior due to the development of a posteroventral pouch.

Dimensions of figured specimen:

Carapace HU.277 T.9 pl.18, figs. 9,12

L = 560 um

H = 290 um

Affinities and Differences:

On the outline, general shape and ornamentation, the present species is placed in the genus Sylvestra Doruk 1973.

Iraqi species has some similarities to S. posterobursa Doruk 1973, but differs

in its subrectangular shape, straight dorsal margin and comparatively finer fossae and ridges. The Turkish species is trapezoidal in shape, with an arched dorsal margin and the posteroventral pouch is also more prominent in Doruk's species.

Genus Dohukia n. gen.

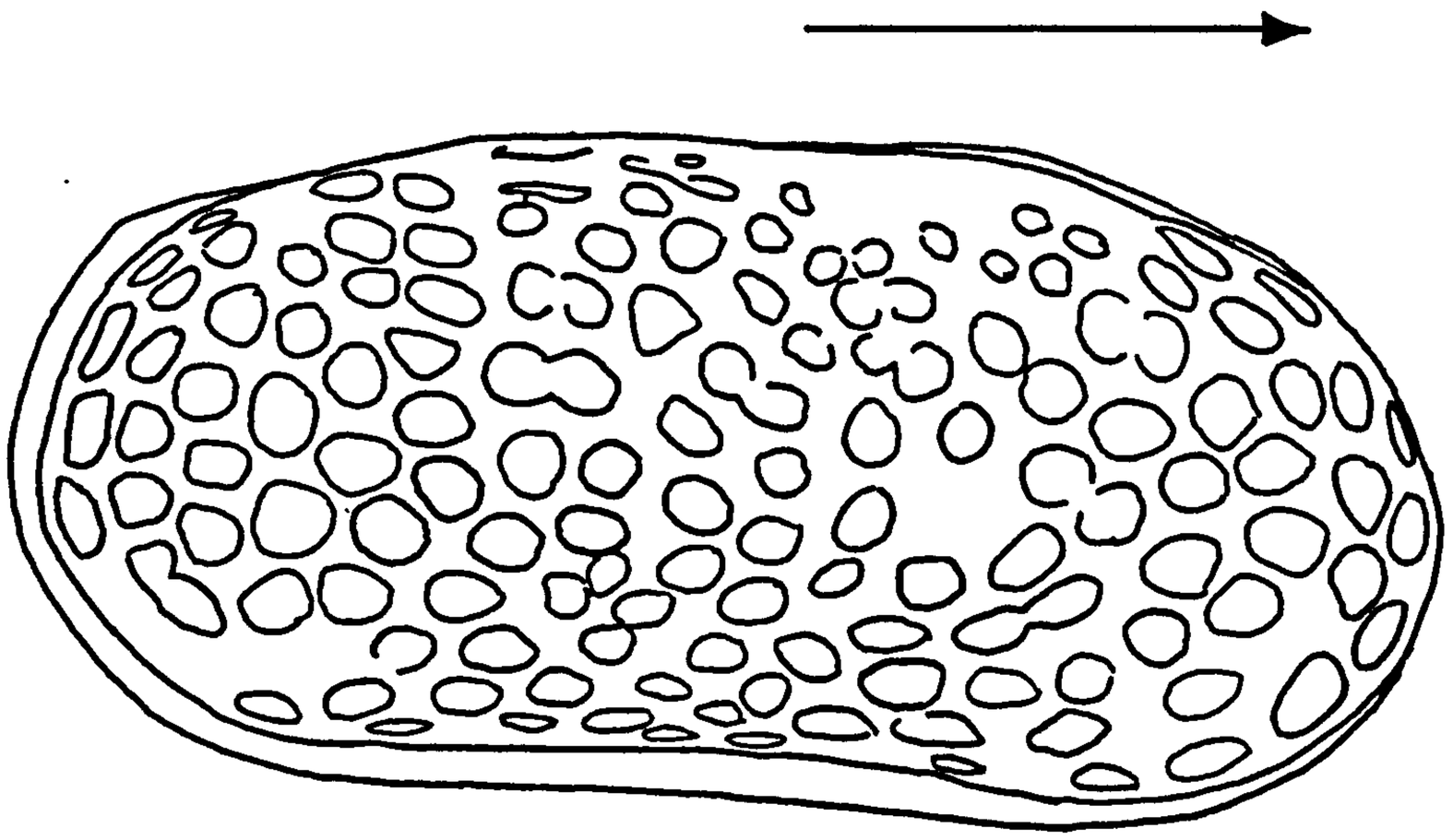
Etymology: After Dohuk city the type locality.

Type species: Dohukia fossulata. sp.nov.

Diagnosis: A genus of Leptocytherinae Hanai with thick-shelled, strongly calcified carapace, coarsely reticulate surface with deep fossae separated by thick muri. Hinge in the left valve consists of an anterior elongate groove and posterior quadriloculate socket, separated by a short median bar; in the right valve, the hinge consists of an anterior elongate bar, a small posterior tooth and a short median groove separated from the interior of the valve by an elongate bar.

Remarks: The subgenera Leptocythere (Leptocythere) Sars 1925, Leptocythere (Amnicythere) Devoto 1965, and the genera, Callistocythere Ruggieri 1953, Tanella Kingma 1948, Mesocythere Hartmann 1956, Arcacythere Hornibrook 1953, Sylvestra Doruk 1973, Rockallia Whatley, Frame and Whittaker 1978, show some similarities to the proposed genus.

From Leptocythere (Leptocythere) Sars 1925, the new genus can be distinguished by the difference in hinge structure, absence of vestibules, coarsely reticulate surface with deep fossae, inflated posterior area and branched



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Text fig. 10 Dohukia fossulata gen. et sp.nov.
HU.277 T.10 Carapace from right lateral surface showing the ornamentation.

marginal pore canals.

In external shape the new genus is somewhat similar to Leptocythere (Amnicythere) Devoto 1965, but differs in other respects, Amnicythere having a reticulate surface with polygonal meshes, simple marginal pore canals irregularly inserted between the irregular branching pore canals, a different hinge structure and the presence of a snap-knob and snap-pit ventrally.

Callistocythere Ruggieri 1953 differs in its strongly sculptured surface with undulating ridges which are absent in the new genus besides differences in the internal features.

Mesocythere Hartmann 1956; Van Morkhoven 1963 gave a reverse orientation of the original specimen making the posterior portion the anterior. If Van Morkhovan's orientation is correct, then the new genus is similar in shape to Mesocythere.

Tanella Kingma 1948, differs in outline, ornamentation and hinge structure.

The new genus is somewhat similar to Rockallia Whatley, Frame and Whittaker 1978 but differs in hinge structure and the absence of pore conuli.

The new genus is similar in ornamentation to Arcacythere Hornibrook 1953, but the latter differs in the oblong, box-like shell with its squarely truncate ends.

The hinge also differs and in the right valve consists of two terminal simple

or crenulate teeth and a straight faintly crenulate, median groove.

The posteroventral pouch, small size, different hinge structure, and different ornamentation distinguished Sylvestra Doruk 1973 from the new genus.

Dohukia fossulata gen. et sp.nov.

pl.19, figs. 1-8

Etymology: Fossulata L. pitted in reference to the ornamentation.

Holotype: A male carapace HU.277 T.10.

Paratypes: Six specimens HU.277 T.11, 1-7.

Type horizon: M. Miocene, L. Fars Formation, bed no. 13, sample no. DO.12.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Sixty specimens.

Diagnosis: Elongate, oblong-shaped, inflated posteriorly. Sexual dimorphism pronounced. Surface reticulate with deep rounded fossae.

Description: Medium to large sized, oblong in side view. Obliquely rounded anterior end, regularly rounded posterior end.

Dorsal margin nearly straight with rounded anterior and posterior cardinal angles, ventral margin slightly sinuate. Anterior half flattened, posterior half inflated with a slight median depression.

Surface strongly reticulate with relatively deep fossae separated by thick

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muri, tending to form subparallel rows along margin, a feature which is more distinct along the posterior margin.

Sexual dimorphism is marked; the presumed males narrower posteriorly than the presumed females.

The duplicature is moderately wide; line of concrescence and the inner margin coincide and there is no vestibule.

Marginal pore canals simple, numerous and arranged in bandles, selvage runs subparallel to the outer margin, the anterior flange and marginal denticulations well developed. Muscle scars not seen because of heavy reticulation.

Left valve larger than the right, overreaching it along the posterior margin and antero-dorsal margin. In dorsal view carapace pear-shaped, with sinuate sides, maximum thickness and width posteriorly, anterior end narrower than posterior end.

Dimensions of figured specimens:

Holotype ♂ carapace HU.277 T.10 pl.19, figs. 1,2

L = 720 um

H = 360 um

W = 350 um

Paratype ♀ carapace HU.277 T.11.1 pl.19, fig. 3

L = 680 um

H = 390 um

W = 370 um

Paratype ♂ carapace HU.277 T.11.2 pl.19. fig. 4

L = 710 um

H = 370 um

W = 330 um

Paratype ♂ carapace HU.277 T.11.3 pl.19, figs. 5,6,

L = 690 um

H = 350 um

Paratype LVI HU.277 T.11.4 pl.19, fig. 7

L - 740 um

H = 390 um

Paratype RVI HU.277 T.11.5 pl.19, fig. 8

L = 710 um

H = 340 um

Affinities and Differences:

Dohukia fossulata is similar to some species of Leptocythere in outline and general shape, but it is easily distinguished by its heavy reticulation and internal features.

Distribution: The species was found at the Bashiqa, Dohuk, Sheikh Ibrahim and Kirkuk, localities of Northern Iraq.

Family CYTHERIDEIDAE Sars, 1925

Subfamily CYTHERIDEINAE Sars, 1925

Genus CYPRIDEIS Jones, 1856

Type species: Candona torosa Jones 1850, p.27, pl.3, figs. 6a-e

Cyprideis sp.cf. C. (Cyprideis) sublittoralis adentata Bassiouni 1979 pl.40, fig. 12, pl.41, fig.1

cf. Cyprideis (Cyprideis) sublittoralis adentata

Bassiouni, 1979, pp.78-79, pl.9, figs. 5-13.

Figured specimen: Carapace HU.279 T.31.

Locality: Tel - Hajer well No. 1, N.W. Iraq.

Horizon: M. Miocene. L. Fars Formation at depth (274 - 279 m)

Material: One carapace.

Remarks: The present species from N. Iraq is closely comparable with Bassiouni's subspecies described from the Miocene of south Turkey. The Iraqi specimen differs in having a slightly different posterior end which is gently sloping in the upper part and roundly truncated ventrally whilst the Turkish species is characterised by a narrower, obliquely rounded posterior end.

Dimension of figured specimen:

Carapace HU.279 T.31 pl.40, fig. 12. pl.41, fig. 1.

L = 1100 um

H = 600 um

Genus MIOCYPRIDEIS Kollmann, 1960

Type species: Miocyprideis janoscheki Kollmann, 1960

Miocyprideis ovalis sp. nov.

pl.20, figs. 6-12

Derivation of name: In reference to its oval outline.

Holotype: A male carapace HU.277 T.13.

Paratypes: Six specimens HU.277 T.14, 1-6.

Type horizon: M. Miocene. L. Fars Formation. Bed no.20 sample SH.11.

Type locality: Sheikhan anticline, S. limb, 27 km NE of Mosul City.

Material: Two hundred specimens.

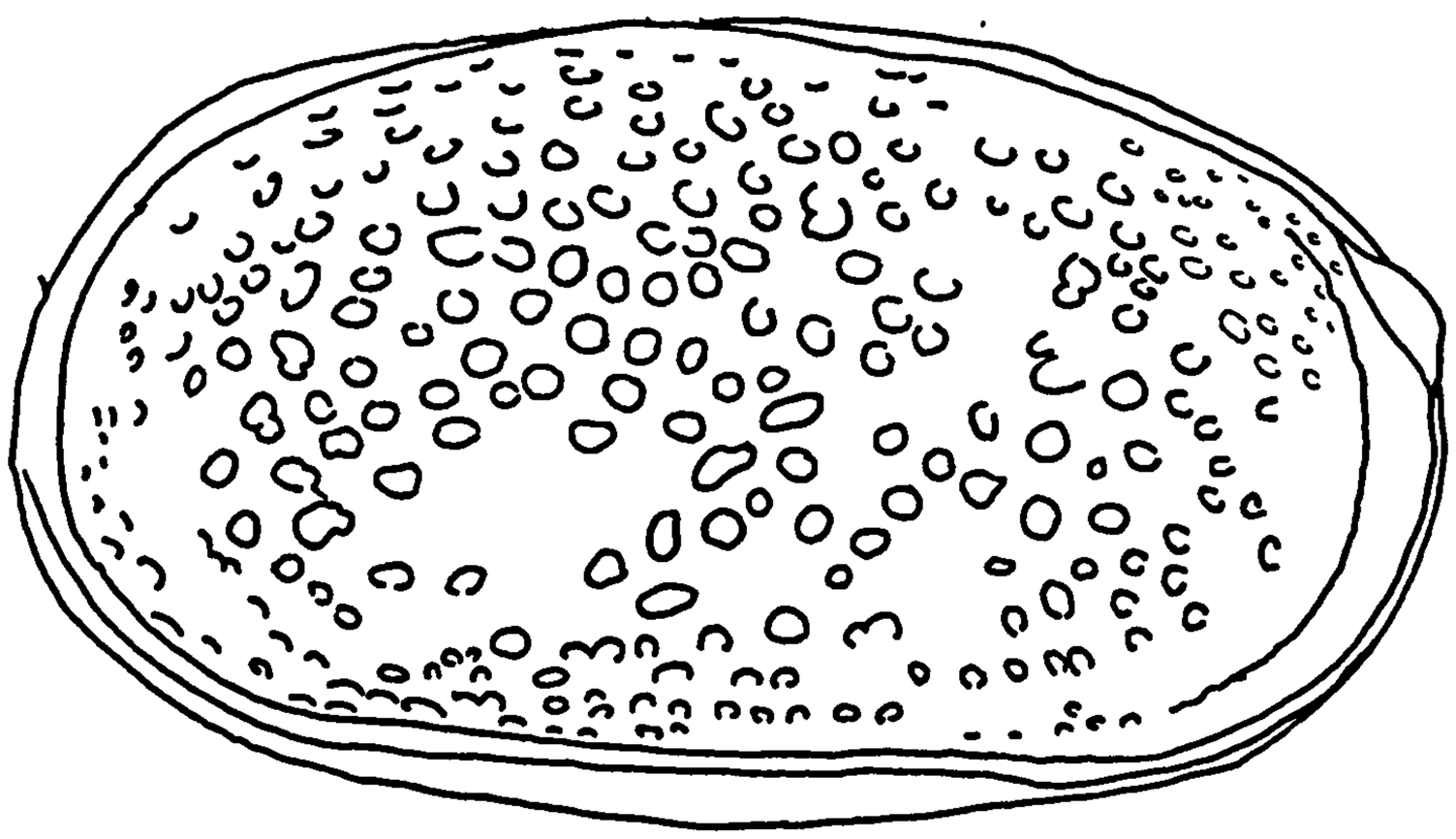
Diagnosis: A species of Miocyprideis with wide, flat anterior margin, lower than the rest of the body and forming a distinct furrow, a strongly pitted surface, the flat ventral margin is horizontal in the right and convex in the left.

Description:

Carapace elongate, ovate in lateral view, greatest height anterior to the middle, greatest length at the mid-height.

Anterior margin broadly, obliquely rounded, lower than the rest of the body and very distinct. Some specimens show a trace of marginal denticulation. Posterior margin obliquely truncated in the right valve, evenly rounded in the left.

Dorsal margin slightly convex with rounded anterior and posterior corners, ventral margin flat and horizontal in the right valve, sinuated in the left valve. Carapace inflated posteriorly and anteriorly, slightly lower at the middle.



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Text fig. 11 Miocyprideis ovalis sp.nov. HU.277 T.13
Carapace from right, lateral surface showing the ornamentation.

Lateral surface coarsely pitted, coarse and dense pits centrally, becoming finer and tending to arrange themselves in parallel rows along the ventral margin.

Left valve larger than the right, overlapping along the entire margin, except just behind the mid-dorsal margin when the two valves coincide.

Sexual dimorphism pronounced, the presumed males narrower and more elongate than the presumed females. Sexual dimorphism is more distinct in dorsal view. In dorsal view carapace pear-shaped, swollen and rounded posteriorly, narrower anteriorly; maximum thickness and width in the posterior half, the male slightly slimmer in dorsal view than the females.

Internally, line of concrescence and inner margin coincide and run parallel to the outer margin; marginal pore canals simple moderate in number. A distinctive flange and selvage run subperipherally. Muscle scars and hinge as for the genus; normal pore canals not numerous, scattered over the surface.

Dimensions of figured specimens:

Holotype ♂ carapace HU.277 T.13 pl.20, figs. 7,10.

L = 740 um

H = 440 um

Paratype ♂ carapace HU.277 T.14.1 pl.20, figs. 8, 11.

L = 730 um

H = 420 um

Paratype ♂ carapace HU.277 T.14.2 pl.20, fig. 6

L = 745 um

H = 440 um

W = 340 um

Paratype ♀ carapace HU.277 T.14.3 pl.20, fig. 9.

L = 710 um

H = 430 um

W = 380 um

Paratype LVI HU.277 T.14.4 pl.20, fig. 12.

L = 680 um

H = 370 um

Affinities and Differences:

This species has some resemblance to Miocyprideis iranica Krstic 1979, but the latter differs in being higher and having more rounded anterior and posterior ends and convex dorsal margin.

From Miocyprideis fortisensis Keij 1955, the present species differs in the absence of the small rounded depression and group of vertical furrows beneath the anterior cardinal angle.

M. ovalis sp. nov. shows some similarities to Miocyprideis cf. spinulosa Brady in Gramann 1971, but the latter differs in having narrower anterior and posterior ends, being less high and having slightly coarser pits covering the lateral surface.

Miocyprideis sp. Bold 1976 differs in having dense pits and in being narrower posteriorly and less high.

Distribution: The present species was found at the Sheikh Ibrahim, Dohuk, Sheikhan, Bashiqa, Hamrin, Bai-Hassan, Kirkuk and Naft Khana, localities of Northern Iraq.

Miocyprideis recta sp.nov.

pl.21, figs. 1-4

Derivation of name: In reference to its straight dorsal margin and somewhat rectangular appearance.

Holotype: A female carapace HU.277. T.15.

Paratypes: Four specimens HU.277 T.16, 1-4.

Type horizon: M. Miocene. L. Fars Formation, bed no. 8, sample no. DO.7.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: One hundred specimens.

Diagnosis: Prominent anterior cardinal angle, gently sloping antero-dorsal margin, denticulate anterior margin, smooth to pitted lateral surface.

Description:

Carapace elongate, subrectangular in side view, greatest height anteriorly, greatest length ventrally. Anterior margin obliquely rounded with fine marginal denticulations in the lower part, gently sloping in the upper, posterior margin, broadly truncated.

Dorsal margin nearly straight, with anterior and posterior cardinal angles; anterior more distinct, ventral margin straight to slightly convex, with rounded smooth connection with anterior and posterior ends. Lateral surface smooth to finely pitted in some specimens.

Left valve larger than the right, overlapping along all the margins, except mid-dorsally.

Inner lamella moderately wide anteriorly, narrower posteriorly, line of concrescence and inner margin coincide and run subperipherally to the outer

margin; selvage developed, but more prominent anteriorly, a distinctive flange along the anterior margin. Hinge and other internal structures as for the genus.

Sexual dimorphism present, presumed males less high than the presumed females. In dorsal view, carapace pear-shaped, narrower anteriorly, swollen posteriorly, maximum width and thickness in the posterior half.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.15 pl.21, figs. 1,3.

L = 780 um

H = 450 um

Paratype ♂ carapace HU.277 T.16.1 pl.21, fig. 2.

L = 710 um

H = 360 um

Paratype ♀ LVI HU.277 T.16.2 pl.21, fig. 4.

L = 680 um

H = 370 um

Affinities and Differences:

This species differs from Miocyprideis lyubimovae Khosla 1978 in being more elongate, narrower posteriorly and in having a gently sloping antero-dorsal margin and faint denticulations postero-ventrally. The new species has some similarities in outline to Cyprideis (Cyprideis) sp. Bassiouni 1979 but differs in internal structure.

From M. ovalis sp. nov. the present species differs in being narrower posteriorly and having a gently sloping antero-dorsal margin. In addition the lateral surface is smooth to finely pitted whereas it is coarsely pitted in M. ovalis sp. nov.

Distribution: This species was found at the Sheikhan, Dohuk, Sheikh Ibrahim, Naft Khana, Kirkuk and Hamrin localities of Northern Iraq.

Miocyprideis chaudhuryi (Lyubimova and Guha)1960

pl.21, figs. 5, 6.

Cyprideis chaudhuryi Lyubimova and Guha, in Lyubimova, Guha and Mohn, 1960, pp. 30-31, pl.11, fig. 9.

Miocyprideis chaudhuryi (Lyubimova and Guha). Guha 1961. p.2, text. figs. 3,19.

Haplocytheridea saurashtrensis Tewari and Tandon 1960. p.152, text fig. 6, figure 4a-e.

Cyprideis chaudhuryi Lyubimova and Guha. Guha 1967b, p.18, pl.1, figs. 2, 15.

Miocyprideis chaudhuryi (Lyubimova and Guha) - Guha 1967a, p.35.

Miocyprideis chaudhuryi (Lyubimova and Guha). Guha 1968a, p.212, pl. figs. 13,14.

Miocyprideis chaudhuryi (Lyubimova and Guha) Khosla 1978 p.273, pl.2, fig. 11, pl.6, fig. 8.

Figured specimens: HU.277 T.17, 1-2.

Horizon: M. Miocene. L. Fars Formation at depth (314-315 m)

Locality: Hamrin well 2, N. Iraq.

Material: Seven specimens.

Remarks: The Iraqi specimens agree with Miocyprideis chaudhuryi (Lyubimova and Guha 1960), but are comparatively larger and higher and slightly angled anterodorsally in the left valve;: the Indian specimens have more rounded extremities and a more broadly convex dorsal margin.

Dimensions of figured specimens:

Carapace HU.277 T.17.1 pl.21, fig. 5.

L = 730 um

H = 440 um

Carapace HU.277 T.17.2 pl.21, fig. 6.

L = 740 um

H = 480 um

Distribution: This species was found in the Sheikhan, Dohuk and Hamrin sections of the L. Fars Formation, Northern Iraq.

Miocyprideis sp. A

pl.21, figs. 7,8

Figured specimens: HU.277 T.18, 1-2.

Horizon: M. Miocene L. Fars Formation

Locality: Kirkuk well 208, N. Iraq. at depth (110-111 m)

Material: Seven valves.

Description: Carapace elongate, ovate in lateral view, greatest height just behind the middle, greatest length at mid-height.

Dorsal margin with a distinctive hump at greatest height, sloping steeply toward anterior margin, gently curving posteriorly.

Ventral margin straight, slightly angled at the junction with anterior and posterior ends.

Anterior margin obliquely rounded, with fine marginal denticulations, lower than the posterior. Posterior margin evenly rounded, slightly swollen higher than the anterior.

Lateral surface covered with scattered fine, rounded pits, which show variation in their intensity and distribution among different specimens. For internal features only fragile valves are found, so it is hard to describe these features, but the species agrees with the diagnostic features of Miocyprideis.

Sexual dimorphism marked, the presumed males more elongate, narrower anteriorly than the presumed females.

Dimension of figured specimens:

RVE HU.277 T.18.1 pl.21, fig. 8

L = 750 um

H = 430 um

RVE HU.277 T.18.2 pl.21, fig. 7.

L = 650 um

H = 350 um

Affinities and Differences:

This species is fairly similar to Miocyprideis konyaensis Bassiouni 1979, but differs in being slimmer, less high, and narrower at the anterior and posterior ends, and in the more sloping antero-dorsal margin.

Miocyprideis italiana Moos 1962 has some similarities to the Iraqi species, but Moos's species differs in being higher, with a convex dorsal margin, convergence posteriorly and a narrower posterior margin.

Distribution: The species was found at the Kirkuk and Bai-Hassan localities of Northern Iraq.

Miocyprideis sp. B

pl.21, fig. 9

Figured specimen: Carapace HU.277 T.19.

Horizon: M. Miocene. L. Fars Formation, bed no. 8, sample no. DO.7.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Four specimens.

Description: Carapace elongate, ovate in lateral view, maximum height at the middle, maximum length ventrally.

Anterior end evenly rounded, posterior end obliquely truncate, a distinctive flange forms the outer margin of the carapace.

Dorsal margin slightly convex, ventral margin straight forming the widest part of the carapace and smoothly joining the anterior and posterior ends. Lateral surface marked by a shallow dorso-median sulcus which dies out ventrally; valve surface covered with fine and minute pits.

Left valve larger than the right, but the overlap is not conspicuous.

Dimensions of figured specimens:

Carapace HU.277 T.19 pl.21, fig. 9

L = 680 um

H = 370 um

Remarks: The present species differs from a described species in its elongate shape, a marginal flange and the finely pitted surface.

Miocyprideis sp. aff. Miocyprideis ovalis sp. nov.

pl.21, fig. 10

aff. Miocyprideis ovalis sp. nov.

Figured specimen: Carapace HU.277 T.20.

Horizon: M. Miocene. L. Fars Formation. Bed no. 43, Sample no. SHI.24

Locality: Sheikh Ibrahim anticline, S. limb. 145 km NW of Mosul City.

Remarks: This species differs from M. ovalis sp. nov. in being higher, slightly angled at the greatest height and broader with an oblique anterior margin, narrowly truncate posterior end in the right valve and in being obliquely rounded, slightly angled dorsally in the left valve.

Lateral surface covered with fine pits, which are denser in M. ovalis sp. nov. Only rare specimens were found and no internal features could be ascertained, therefore this species is placed as aff. Miocyprideis ovalis sp. nov.

Dimensions of figured specimen:

carapace HU.277 T.20 pl.21, fig. 10

L = 630 um

H = 420 um

Genus NEOCYPRIDEIS Apostolescu, 1956

Type-species: Neocyprideis durocortoriensis Apostolescu, 1956

Neocyprideis ? sp.

pl. 21, figs. 11,12

Figured specimens: HU.277 T.21, 1-2.

Horizon: M. Miocene.L. Fars Formation at depth (3880 - 3885 ft)

Locality: Bai-Hassan well 33, Northern Iraq.

Material: Four specimens.

Description: Carapace subpentagonal in lateral view, greatest height at the middle; anterior margin obliquely rounded, with fine marginal denticulations, posterior end broadly rounded, dorsal margin strongly arched, slightly angled at junction with anterior and posterior margins,ventral margin straight.

Lateral surface smooth to finely pitted.

Inner lamella moderate, line of concrescence and inner margin coincide throughout and run subparallel to the outer margin, prominent subperipheral selvage, flange distinct along the anterior margin. Marginal pore canals straight and moderate in number, normal pore-canals simple, scattered over the surface, not numerous.

Hinge in the right valve consists of an elongate anterior tooth, divided into toothlets, a short deep median groove and an elongate posterior tooth. Muscle scars as for the genus.

Dimensions of figured specimens:

RV HU.277 T.21.1 pl.21, fig. 11

L = 780 um

H = 450 um

RVI HU.277 T.21.2 pl.21, fig. 12.

L = 720 um

H = 410 um

Remarks:

Rare specimens were found, and on the basis of the marginal pore-canals and normal pore canals, the species is tentatively placed in Neocyprideis Apostolescu, 1956.

This species has some similarities to Neocyprideis aquitanica Kollmann and Moyes (Yassini 1969) but it differs in being more elongate with broad anterior and posterior ends and a strongly arched dorsal margin.

The present species shows affinities with some described species of Miocyprideis, but it is placed tentatively in the Neocyprideis Apostolescu, 1956. Neocyprideis williamsoniana Bosquet 1852 differs in having a narrower anterior margin and wider posterior margin, with finely pitted surface.

Genus HEMICYPRIDEIS Malz and Triebel 1970

Type-species: Hemicyprideis aucta Malz and Triebel 1970

Hemicyprideis angulata angulata sp.nov. sub sp. nov.

pl. 22, figs. 1-6.

Derivation of name: In reference to the angular anterior cardinal angle in lateral view.

Holotype: A female carapace HU.277 T.22.

Paratypes: Five specimens HU.277 T.23, 1-5.

Type horizon: M. Miocene. L. Fars Formation. Bed No. 43, sample no.SHI.24.

Type locality: Sheikh Ibrahim anticline, S. limb. 45 km NW of Mosul City.

Material: Two hundred specimens.

Diagnosis: A species of Hemicyprideis with prominent higher point at the anterior cardinal angle behind which the dorsal margin slopes downwards; a prominent raised, sub-peripheral ridge is developed along the posterior margin and becomes thicker at the posteroventral corner.

Description:

Carapace subtrapezoidal in side view, greatest height at the anterior cardinal angle, greatest length ventrally.

Anterior end obliquely rounded in the lower part, sloping steeply downwards in the upper, with fine marginal denticulations in some specimens, posterior end obliquely truncated with rounded postero-ventral corner.

Dorsal margin straight, sloping downwards posteriorly, with distinct anterior and posterior cardinal angles, in which the anterior angle is the more distinct; ventral margin straight to slightly concave at its anterior junction, smoothly curved posteriorly.

Lateral surface strongly punctate, punctae coarser centrally, becoming finer along the margin, and tending to be arranged in concentric rows separated by longitudinal ridges along the anterior and ventral margins.

A curved ridge is developed along the posterior margin and becomes thicker

at the postero-ventral corner. This ridge starts from two-thirds of the length and curves down parallel to the posterior margin, projecting over the postero-ventral corner. It then runs longitudinally parallel to the ventral margin to merge into one of the anterior concentric ridges; the shape of this ridge varies between the male and female. In the female it appears as a subtriangular or undulating arc; in the male it is formed of a centrally pointed half-arc (hook-point).

There is a faint sulcus antero-dorsally below the anterior cardinal angle; the rest of the surface is uneven with weakly developed nodes along the valve surface. If Keen's system (1972) is used in numbering these nodes; node no. 7 is the most developed one, nodes 1 and 2 are represented in this species by the posterior ridge which in some specimens shows a tendency to split into two nodes, other nodes are weakly discernible on the valve surface.

In this species a shallow depression in front of the posterior ridge, runs forward particularly in the female specimen.

The nodes are more developed in juvenile specimens. Left valve larger than the right, overlapping along the entire margin and more distinctly along the posterior and ventral margins.

Internally the inner lamella is moderately wide anteriorly, narrower ventrally; line of concrescence and inner margin coincide and run parallel to the outer margin. There is a distinctive, well-developed flange, subperipheral selvage and numerous marginal pore canals with median swelling. The sieve-type normal pore canals are scattered over the surface. Muscle scars consist of a vertical row of four adductor-muscle scars, a V-shaped frontal scar,

and fulcral point inbetween.

Hinge in the left valve consists of an elongate, crenulate terminal socket (about nine loculi in each) separated by a crenulate median groove; hinge in the right valve complementary.

In dorsal view the carapace is biconvex, with the outline broken by the noded surface; maximum width and thickness just behind the middle, anterior end broadly pointed, posterior end wider, pointed laterally because of the posterior ridge.

Sexual dimorphism strongly marked, the presumed males narrower and less high than the presumed females. Sexual dimorphism is more distinctive in the dorsal view in which the male is narrower and slimmer than the female.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.22 pl.22, figs. 1,2.

L = 730 um

H = 400 um

W = 340 um

Paratype ♂ carapace HU.277 T.23.1 pl.22, fig. 4,5.

L = 700 um

H = 350 um

W = 290 um

Paratype ♂ carapace HU.277 T.23.2 pl.22, fig. 6.

L = 690 um

H = 360 um

Paratype LVI HU.277 T.23.3 pl.22, fig. 3

L = 640 um

H = 360 um

Affinities and Differences:

The new species is fairly similar to Hemicyprideis panti Khosla 1978, but the latter differs in the absence of the surface nodes and the posterior ridge.

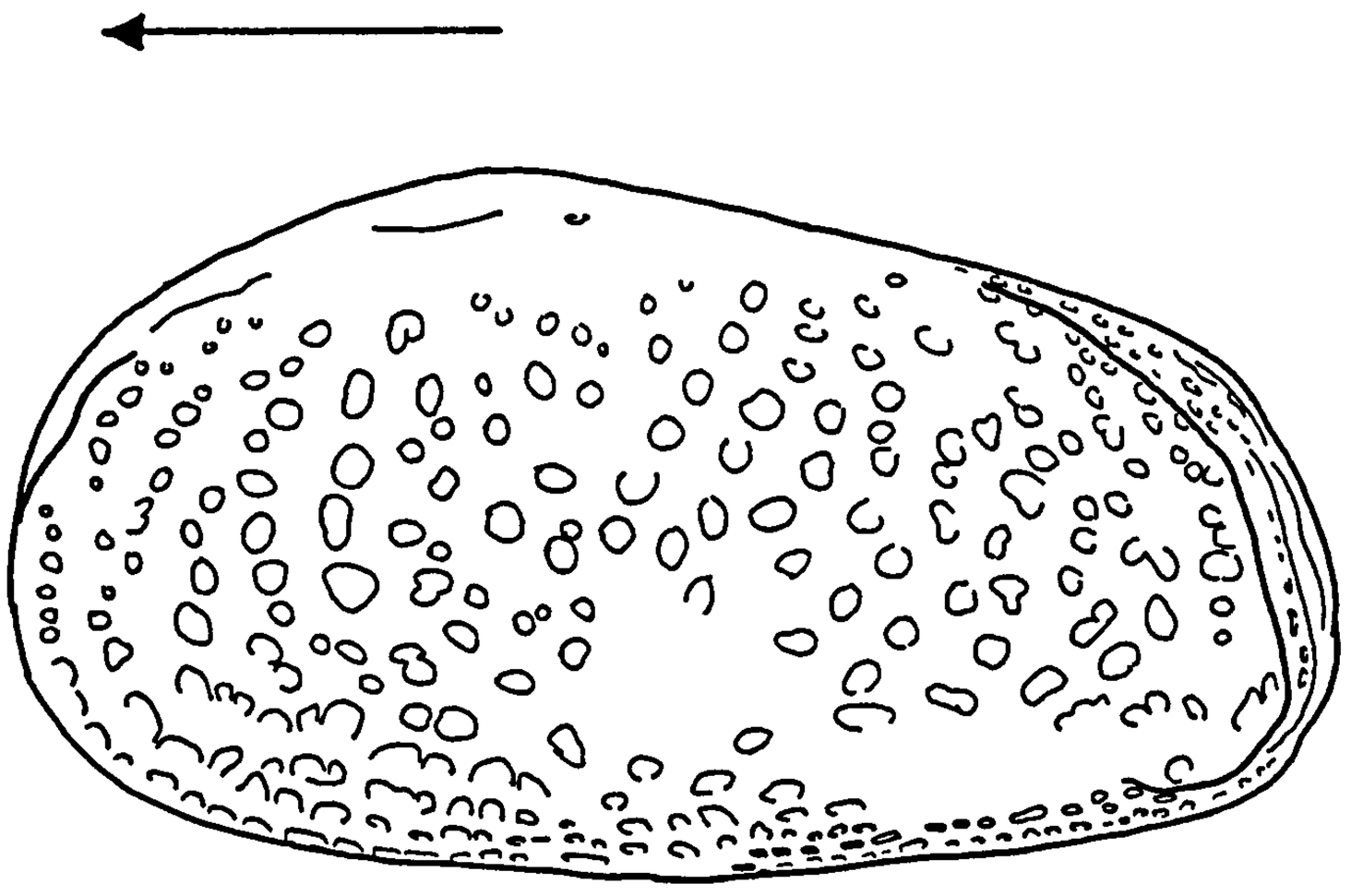
Hemicyprideis parvula Malz and Triebel 1970 has some similarities to the present species, but the latter differs in having a strongly pitted surface, well developed posterior ridge and lateral tubercles.

In addition H. parvula is narrower posteriorly. H. angulata angulata sp. nov. has some similarities to H. istanbulensis Bassiouni 1979, but the latter differs in being more quadrate in outline with strongly developed lateral nodes and in being finely pitted.

The present species also has some similarities to H. elongata Keen 1972, but the latter differs in its concave ventral margin posteriorly and the almost straight posterior margin, five low concentric ridges parallel to the anterior margin and indistinctly parallel to the ventral margin and seven tubercles on the surface of the carapace.

The Iraqi species is easily distinguished by its distinctive posterior ridge, and other differences in details of ornamentation.

Distribution: This species was found at the Sheikhan, Dohuk, Sheikh Ibrahim and Kirkuk localities of Northern Iraq.



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Text fig. 12 Hemicyprideis angulata angulata sp.nov. subsp. HU.277 T.23.3 Carapace from left lateral surface showing the ornamentation.

Hemic͡yprideis angulata decrementa n. ssp.

pl. 22, figs. 7-9, 12.

Derivation of name: decrementa L. diminution, lessening in reference to its posterior tapering in side view.

Holotype: A female carapace HU.277 T.24.

Paratype: Three specimens HU.277 T.25, 1-3.

Horizon: M. Miocene. L. Fars Formation at depth 314-315 metres.

Locality: Hamrin well 2, Northern Iraq.

Material: Eight specimens.

Description: Carapace elongate, subtrapezoidal in side view. Anterior margin obliquely rounded, gently sloping in the upper part, smoothly curved down in the lower part, posterior margin narrowly truncated, obliquely in the upper part, smoothly curved down in the lower part, posterior margin narrowly truncated, obliquely in the upper part, with smoothly curved postero-ventral corner. Dorsal margin straight with distinct anterior cardinal angle, rounded posterior cardinal angle, ventral margin straight to slightly convex.

Lateral surface covered with pits, coarser centrally but becoming finer and tending to be arranged in subparallel rows along the margin; two ribs occur anteriorly.

A posterior ridge starts behind the posterior margin becoming thickest in the middle and then curves parallel to the ventral margin.

In front of this ridge, a shallow depression runs forwards. The rest of the surface is uneven with lateral nodes or tubercles.

In the female left valve, the posterior ridge is arc-shaped and tends to divide into two nodes. It runs parallel to the posterior margin dying out below the posterior cardinal angle and runs parallel to the ventral margin to merge into the anterior marginal rib.

Left valve larger than the right, overlapping more distinctly along the posterior and ventral margins.

In dorsal view the carapace is biconvex; anterior end narrower than the posterior with the maximum width and thickness in the posterior half.

Sexual dimorphism marked, the presumed males more elongate and narrower than the presumed females. Internal features as those in the genus.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.24 pl.22, fig.7.

L = 670 um

H = 370 um

Paratype ♂ carapace HU.277 T.25.1 pl.22, fig. 8.

L = 710 um

H = 340 um

Paratype ♀ carapace HU.277 T.25.2 pl.22, fig. 9.

L = 660 um

H = 360 um

W = 330 um

Paratype ♂ carapace HU.277 T.25.3 pl.22, fig. 12.

L = 700 um

H = 390 um

Affinities and Differences;

The present sub-species is very similar to H. angulata angulata sp. nov. but differs in details of ornamentation, in which the posterior ridge of the male is subtriangular-shaped, while in H. angulata decrementa sp. nov. it is arc-shaped and pointed in the middle. In the left valve of the present sub-species the posterior ridge dies out behind the posterior cardinal angle and is short, thick and parallel to the posterior margin, while in H. angulata angulata sp.nov. the posterior ridge, runs upwards parallel to the dorsal margin. In addition the posterior margin of the present species is smoothly truncated.

From H. kachharai Khosla 1978, the present sub-species differs in being more elongate, less high and narrower posteriorly. Khosla's species is also characterised by the absence of the posterior ridge and lateral nodes.

Distribution: A few specimens were found at the Hamrin and Kirkuk locations of Northern Iraq.

Hemicyprideis miocaenica* sp. nov.

pl. 19, figs. 9-12

pl. 20, figs. 1-5

Derivation of name: From its occurrence in the Miocene of Iraq.

Holotype: A female carapace HU.277 T.11.

Paratypes: Ten specimens HU.277 T.12. 1-10.

Type horizon: M. Miocene. L. Fars Formation, bed no. 20, sample no. SH.11.

Type locality: Sheikhan anticline, S. limb, 27 km NE of Mosul City.

Material: Two hundred specimens.

Diagnosis: A species of Hemicyprideis, distinguished by well developed

* This is a homonym of Hemicyprideis miocaenica (LienenKlaus 1905) and is here renamed Hemicyprideis sheikhanensis

nodes in the posterior half, a shallow depression developed posteriorly and absence of postero-ventral spine and any anterior marginal denticulations.

Description:

Female: Carapace subquadrate in lateral view, anterior margin obliquely rounded, posterior margin narrowly truncate with distinct postero-ventral corner in the right valve.

Male: Elongate, subrectangular in lateral view, anterior margin obliquely rounded, posterior margin narrowly truncate with rounded postero-ventral corner. Dorsal margin slightly arched, sinuate anteriorly in the right valve, anterior and posterior cardinal angles marked, ventral margin straight, slightly concave anteriorly. In the male and female, greatest height at the anterior cardinal angle, greatest length about one third of the height above the ventral margin.

Surface: Lateral surface tuberculate, but the intensity of tuberculation is variable and the rest of the surface varies from smooth to pitted with fine rounded pits, which in some specimens form a row parallel to the anterior margin. Lateral nodes are well developed, in defining the position of nodes the system proposed by Sandberg 1964 is used.

Female right valve. The most frequent nodes are Nos. 1, 2, 6 and 7. Node No. 7 is strongly developed, thick with (combined) shape and forms the postero-ventral corner. Node No. 6 is flattened with subrounded shape, node No. 1 is represented by a thick elevation and No. 2 is elongate in shape. There is a faint indication of node No. 3 but no trace of nodes 4 and 5. Female left valve: comparatively nodes 1, 6 and 7 are more strongly developed in the right valve than in the left. There is a

variation in the shape of 6 and 7 which became narrower and elongate; node No. 1 is weakly developed, No. 2 is elongate and there is a trace of node No. 3.

Male right valve: Node No. 7 is strongly developed, thick, elevated, (combined) shaped and forms the postero-ventral corner. Node No. 6 is rounded and small with a small pit inside; No. 3 is represented by a small fine node. Posteriorly a longitudinal depression separates the nodes running forwards and dying out at the mid-length of the valve. The lateral surface is strongly ornamented with small rounded pits, there are short undulate ridges along the anterior half and the postero-dorsal half is higher than the postero-ventral half.

Male left valve: Along the lateral surface the most developed node is Nos. 7 which is rounded in shape. Node 6 is weakly developed and there is no trace of the other nodes. In comparison with the adult the juveniles are strongly noded and the lateral surface covered with small rounded pits. Left valve larger than the right, overreaching it more distinctly along the dorsal and ventral margins. Hinge in the left valve consisting of coarsely crenulate sockets, followed by finely crenulate median groove and an elongate crenulate posterior s͡ockets. Hinge in the right valve is positive and complementary. Inner lamella of moderate width, inner margin and line of concrescence coincide and run parallel to the outer margin; selvage subperipheral, and there is a well developed flange in both valves. Marginal pore canals numerous, some simple, others branching; normal pore canals numerous and of sieve type.

Muscle scars consist of a vertical row of four scars, V-shaped frontal scars, two elongate mandibular scars and a prominent fulcral scar.

Sexual dimorphism strongly pronounced. In dorsal view, the presumed males are more elongate, narrower and slimmer than the presumed females. Maximum width posteriorly; in the female the outline is broken by the lateral nodes.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.11 pl.19, figs. 10,11.
L = 720 um
H = 380 um
W = 300 um

Paratype ♂ carapace HU.277 T.12.1 pl.19, figs. 9, 12.
L = 730 um
H = 360 um
W = 290 um

Paratype ♀ carapace HU.277 T.12.2 pl.20, fig. 1, 4a.
L = 580 um
H = 380 um

Paratype ♀ carapace HU.277 T.12.3 pl.20, fig. 2.
L = 670 um
H = 360 um

Paratype ♀ LVI HU.277 T.12.4 pl.20, fig. 3.
L = 650 um
H = 350 um

Paratype ♂ carapace HU.277 T.12.5 pl.20, fig. 5.
L = 700 um
H = 350 um

Paratype LVI HU.277 T.12.6 pl.20, fig. 4b.
L = 615 um
H = 315 um

Affinities and Differences

From Hemicyprideis autonoma (Lyubimova and Guha) 1960 the new species differs in having well developed nodes 6 and 7 along the posterior margin and truncate posterior end, whilst the Indian species is strongly pitted and differs in outline.

Hemicyprideis cubensis chicoyensis Van den Bold 1946 shows some similarities to Hemicyprideis miocaenica sp. nov. but the latter differs in having well developed nodes distributed along the lateral surface and in being more elongate and narrower than Bold's species.

Family CUSHMANIDEIDAE Puri, 1973

Genus CUSHMANIDEA Blake, 1933

Type species: Cytheridea seminuda Cushman, 1906

Cushmanidea sp.

pl.22, figs. 10, 11

Figured specimen: A right valve. HU.277 T.26.

Horizon: M. Miocene, L. Fars Formation, bed no. 12, sample no. DO.11.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material; Four valves.

Description: Elongate, banana-shaped in lateral view. Anterior end obliquely rounded in the lower part, forming a rounded angle above, posterior end narrowly rounded. Dorsal margin straight, slightly convex posteriorly, ventral margin concave at the middle, smoothly joining the anterior and posterior ends. Greatest height at the middle, greatest length at the mid-height.

Inner lamella widest anteriorly, narrower posteriorly, other internal

structure cannot be seen, except for the hinge which in the right valve consists of an elongate flange anteriorly, a shallow elongate median groove separated from the interior of the valve by an elongate bar and a short, sharp flange posteriorly. Lateral surface smooth to finely pitted.

Dimensions of figured specimen:

RV HU.277 T.26 pl.22, figs. 10, 11

L = 850 um

H = 290 um

Remarks:

Rare fragile specimens were found, in which it is difficult to see the internal structure. The present species shows similarities to Pontocythere and Cushmanidea species, but on the basis of the hinge structure the species is more related to Cushmanidea and is therefore tentatively placed in Cushmanidea Blake 1933.

Family KRITHIDAE Mandelstam, 1960

Subfamily KRITHINAE Mandelstam, 1960

Remarks:

There are different opinions about the type species of Krithe. Brady, Crosskey and Robertson (1874), regarded the type species of Ilyobates (I. praetexta) Sars 1866, as a junior synonym of Cythere (Cythereideis) bartonensis Jones, 1857 which is designated as the type species of Krithe by Brady and Norman 1889.

Morkhoven 1963 stated that the two forms C.(C). bartonensis and I. praetexta are not identical and I. praetexta is the type species of Krithe. Recently Haskins (1970) recorded the occurrence of a single tooth in Krithe

[Cythere (Cytherideis) bartonensis Jones] from its type locality, he disagreed that the form designated as K. bartonensis by Brady, Crosskey and Robertson (1874) was conspecific with the type of the species. Haskins description of a single tooth in the Cythere (Cytherideis) bartonensis is a very useful contribution towards solving the dispute of Krithe type species.

On the basis of the hinge structure and dorsal outline, Haskins and Guha 1980 erected a new genus Dentokrithe to accommodate the toothed forms, they proposed C. (C) bartonensis as the type species of Dentokrithe and accepted 1. praetexta as the type species of Krithe, this designation is accepted in this work.

Genus KRITHE Brady, Crosskey and Robertson, 1874

Synonyms: Ilyobates Sars 1866

Type species: Ilyobates praetexta Sars 1866

Krithe sp.

pl.23, fig. 1

Figured specimen: HU.277 T.27.

Horizon: M. Miocene, L. Fars Formation, bed no. 1, sample no. BA.1.

Locality: Bushiqa anticline, S. limb, 28 km NE of Mosul City.

Material: Four specimens.

Description: Carapace elongate, wedge-shaped in side view. Anterior end, evenly rounded in the upper part, obliquely in the lower, strongly concave

at the junction with the ventral margin; posterior end, distinctive in shape, narrowly truncated, slightly concave dorsally, rounded ventrally.

Dorsal margin consists of two parts, the anterior one slightly convex, the posterior one starts at one quarter of the length from the posterior end and is slightly angled, sloping steeply downwards, with prominent posterior cardinal angle.

Ventral margin straight, slightly concave postero-ventrally.

Lateral surface smooth to finely pitted. Greatest height anteriorly, maximum length ventrally. Internal features agree with the genus Krithe.

Dimensions of figured specimen:

RV HU.277 T.27 pl.23, fig. 1.

L = 710 um

H = 310 um

Remarks:

Rare specimens were found and the present species is easily distinguished by its distinctive shape. Krithe dolichoderia Bold 1946 shows affinities with the figured specimen, but differs in having concave dorsal and ventral margins. The present species is also more elongate, with a ventral margin which is concave posteriorly, in addition to which it is wedge-shaped in side view.

Genus PARAKRITHE Van den Bold, 1958

Type species: Cytheridea (Dolocytheridea) vermunti Bold, 1946

Parakrithe? sp.

pl.23, figs. 2,3,5, 6

Figured specimens: Two carapace HU.277 T.28, 1-2.

Horizon: M. Miocene, L. Fars Formation at depth 326-327 metres.

Locality: Hamrin well 2, Northern Iraq.

Material: Ten specimens.

Description: Carapace elongate, subrectangular to sub-ovate in lateral view. Anterior margin evenly rounded. Posterior end truncated ventrally, convex in the upper part.

Dorsal margin broadly convex in the right valve, slightly angled at the middle in the left valve; ventral margin straight, concave at its junction with the anterior margin, rounded postero-ventrally.

Lateral surface smooth; left valve larger than the right overlapping more conspicuously along the dorsal and ventral margins.

Only a single valve was found in which the internal features were not well preserved showing just a small inner lamella with no vestibules and no other internal structure could be seen.

Dimensions of figured specimens:

Carapace HU.277 T.28.1 pl.23, figs. 2, 5

L = 610 um

H = 270 um

Carapace HU.277 T.28.2 pl.23, figs. 3, 6

L = 730 um

H = 380 um

Remarks:

The present species is tentatively placed in Parakrithe Bold 1958, because well preserved internal features are absent.

Parakrithe dactylomorpha Ruggeri 1962 is somewhat similar to this species but differs in being narrower posteriorly with concave ventral margin at the middle. Parakrithe sp. 2 Bold 1971b has some similarities, but differs in having a concave ventral margin at the middle, tapering posteriorly.

Parakrithe robusta Bold 1966 differs in having a strongly convex ventral margin and narrower posterior end. Krithe ariminensis Ruggeri 1967 shows some affinities but it is easily distinguished from the present species in being more elongate and slimmer.

Genus DENTOKRITHE Khosla and Haskins 1980

Type species: Cythere (Cythereideis) bartonensis Jones 1857

Dentokrithe comma sp. nov.

pl. 23, figs. 4,7,8,10,11

Derivation of name: In reference to its somewhat comma-like shape.

Holotype: A female carapace HU.277 T.29.

Paratypes: Five specimens HU.277 T.30, 1-5.

Type horizon: M. Miocene, L. Fars Formation, bed no. 1, sample no. BA.1.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: Three hundred specimens.

Diagnosis: A species of Dentokrithe with broadly arched dorsal margin, posterior end rather strongly convex to the narrowly rounded postero-ventral angle; ventral margin strongly concave in front of the anterior margin.

Description: Carapace elongate, tumid, maximum height anterior to the middle, greatest length just above the ventral margin.

Anterior margin regularly rounded, strongly curved ventrally, posterior end strongly convex in the upper part truncate to rounded postero-ventral corner. Dorsal margin broadly arched, ventral margin straight, rounded angle posteriorly, concave at the junction with the anterior margin.

Lateral surface smooth, with fine pites in some specimens. Internally the inner lamella wide anteriorly, moderate ventrally and narrower posteriorly.

The selvage runs subperipherally except along the posterior margin where it curves away from the outer margin to give an indented appearance. A shallow vestibule is present anteriorly. Marginal pore canals not numerous, simple. Muscle scars as those in the genus.

Hinge in the right valve represented by a dorsal margin with a distinct socket behind the middle; left complementary with distinct tooth along the dorsal groove.

Left valve larger than the right, overlapping more distinctly along the dorsal and ventral margins. In dorsal view carapace ovate-oblong narrower anteriorly.

Sexual dimorphism not pronounced, the presumed males narrower posteriorly and less high than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.29 pl.23, fig. 8.
L = 650 um
H = 300 um

Paratype RVI HU.277 T.30.3 pl.23, fig. 4
L = 800 um H = 370 um

Paratype ♂ carapace HU.277 T.30.1 pl.23, fig. 10
L = 670 um
H = 300 um

Paratype ♀ carapace HU.277 T.30.2 pl.23, fig. 11.
L = 650 um
H = 310 um

Paratype ♂ carapace lost Pl.23, fig. 7.

Affinities and Differences:

In outline and general shape the present species shows similarities to the species described in the genus Krithe but it differs in internal structures. From Krithe citae Oertli 1961 the present species can be distinguished by its strongly convex posterior margin in the upper part and even rounding ventrally. Oertli's species is concave in the middle of the ventral margin, while in the present species it is strongly concave at the junction with the anterior margin.

Dentokrithe comma sp. nov. shows more similarities to Krithe papillosa (Bosquet), in outline, but the present species differs in being narrower posteriorly, and in the formation of a slight angle with ventral margin, which is evenly rounded in Bosquet's species.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk and Naft Khana localities of Northern Iraq.

Dentokrithe aff. Dentokrithe indica Tewari and Tandon 1960
pl.23, figs. 9, 12

aff. Krithe indica Tewari and Tandon 1960, p.152, text. fig. 2, figs. 5a-b.
aff. Krithe indica (Tewari and Tandon) Khosla 1972, p.485, pl.1, fig. 21.
aff. Dentokrithe indica (Tewari and Tandon) Khosla and Haskins 1980, p.214, pl.1, figs. 14-19.

Figured specimens: HU.277 T.31.1-2.

Horizon: M. Miocene, L. Fars Formation, bed no. 12, sample DO.11.

Locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Six specimens.

Description: Carapace elongate to ovate in lateral view, with greatest height at the middle, greatest length ventrally.

Dorsal margin gently convex, curving down posteriorly; ventral margin slightly concave anteriorly.

Lateral surface smooth.

Left valve larger than the right, overlapping more distinctly along the dorsal margin.

Sexual dimorphism pronounced, males narrower and less high than the presumed females.

Dimensions of figured specimens:

♀ carapace HU .277 T. 31.1 pl.23, fig. 9.

L = 610 um

H = 330 um

♂ carapace HU.277 T.31.2 pl.23, fig. 12

L = 600 um

H = 280 um

Remarks:

Dentokrithe indica is very similar, but has a narrower truncated posterior end, with straight ventral margin.

The figured specimens are higher and wider than the Indian species.

Dentokrithe constricta sp. nov.

pl.24, figs. 3, 6, 7-10

Derivation of name: In reference to the pinching-in of the outline in lateral view at approximately one-third length.

Holotype: A female carapace HU.277 T.32.

Paratypes: Four specimens HU.277 T.33, 1-4.

Horizon: M. Miocene, L. Fars Formation at depth(314 - 315)m.

Type locality: Hamrin well 2, Northern Iraq.

Material: Fifty specimens.

Diagnosis: Carapace constricted at the first-third of the length from the anterior end, slightly inflated posteriorly, postero-ventral corner with a slight lip in the left valve.

Description:

Solid-shell, with elongate to sub-ovoid carapace in lateral view.

Dorsal margin slightly concave anteriorly, becomes higher and broadly convex, curving down posteriorly, ventral margin slightly concave anteriorly, convex upwards to join the rounded postero-ventral corner. Lateral surface smooth.

Left valve larger than the right, overlapping conspicuously along the entire margins, except at postero-ventral corner when the two valves coincide. Internal features are typical of the genus. The inner lamella was clearly observable in the only single valve which was found.

In dorsal view, carapace biconvex, becoming narrower anteriorly with slightly pointed anterior end and broadly ovate posterior end.

Maximum thickness and width posteriorly.

Sexual dimorphism pronounced, the presumed males slightly more elongate and narrower than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.277 T.32 pl.24, figs. 3, 6.

L = 710 um

H = 380 um

W = 300 um

Paratype ♀ carapace HU.277 T.33.1 pl.24, fig. 7.

L = 720 um

H = 370 um

W = 340 um

Paratype ♂ carapace HU.277 T.32.2 pl.24, fig. 8.

L = 740 um

H = 360 um

W = 315 um

Paratype ♀ carapace HU.277 T.33.3 pl.24, fig. 9

L = 710 um

H = 360 um

Paratype ♀ carapace HU.277 T.33.4 pl.24, fig. 10.

L = 690 um

H = 360 um

W = 320 um

Affinities and Differences:

The present species is fairly similar to D. autochthona (Lyubimova and Guha) 1960, but differs in being higher, inflated posteriorly, constricted anteriorly

and in having rounded posterior ventral corner.

D. constricta sp. nov. shows a little variation in outline among the different specimens and in particular in the posterior half of the shell.

Distribution:

This species was found at the Bai-Hassan, Naft Khana, Kirkuk and Hamrin localities of Northern Iraq.

Dentokrithe autochthona (Lyubimova and Guha) in Lyubimova, Guha, Mohn 1960 pl. 24, figs. 1-2, 4,5

Krithe autochthona Lyubimova and Guha, 1960, p.25, pl.11, fig. 4.

Krithe autochthona Lyubimova and Guha, Guha 1968, pp. 213-214, pl.2, fig. 2.

Krithe autochthona Lyubimova and Guha, Khosla, 1978, p.272, pl.2, figs. 18-20, pl.6, fig. 10.

Krithe indica var. kutchensis Tewari and Tandon, 1960, p.153, text. fig. 6, figs. 2a-b.

Dentokrithe autochtona (Lyubimova and Guha), Khosla and Haskins 1980, pp.212-214, pl.1, figs. 1-6.

Figured specimens: HU.277 T.34, 1-3.

Horizon: M. Miocene. L. Fars Formation, bed no. 19, sample no. SH.11.

Locality: Sheikhan anticline, 27 km NE of Mosul City.

Material: Fifty specimens.

Remarks: This species was originally described as new species of Krithe by Lyubimova and Guha 1960 from the Miocene of W. India.

Khosla and Haskins 1980, transferred the species to their new genus Dentokrithe.

The Iraqi specimens, entirely agree with Dentokrithe autochthona (Lyubimova and Guha) 1960, but there is slight variation, the Iraqi specimens being more thinner and slimmer with an absence of overlap along the anterior margin whilst in addition sexual dimorpism is quite pronounced in the Iraqi specimens.

Dimensions of figured specimens:

♂ carapace HU.277 T.34.1 pl.24, figs. 1,2.

L = 610 um

H = 280 um

♂ carapace HU.277 T.34.2 pl.24, fig. 4.

L = 640 um

H = 310 um

♀ carapace HU.277 T.34.3 pl.24, fig. 5.

L = 650 um

H = 330 um

Distribution: This species was found at the Bashiqa, Sheikhan, Sheikh Ibrahim, Kirkuk, and Dohuk localities of Northern Iraq.

Family TRACHYLEBERIDIDAE Sylvester-Bradley 1948

Subfamily TRACHYLEBERIDINAE Sylvester-Bradley 1948

Tribe TRACHYLEBERIDINI Sylvester-Bradley 1948

Genus ACTINOCYTHEREIS Puri 1953

Type species: Cythere exanthemata Ulrich and Bassler 1904

Actinocythereis iraqensis Khalaf 1982

pl. 24, figs. 11, 12

pl. 25, figs. 1-6

Actinocythereis iraqensis Khalaf 1982, 9 (9) 51-54.

Figured specimens: Holotype ♂ carapace HU.275 T.6

Paratypes: ♀ carapace HU.275 T.7, 1

♀ LV int. lat; HU.275 T.8

♂ carapace HU.275 T.7.2

♂ RV. int. lat. HU.275 T.7.3

Horizon: M. Miocene, L. Fars Formation, bed no. 50, sample no. SHI.28.

Locality: Sheikh Ibrahim anticline, S. limb, NW Iraq, 45 km west of Mosul City.

Material: Three hundred and fifty specimens.

Description: Thick-shelled, elongate carapace, subrectangular in lateral view with greatest height at the eye tubercle; greatest length nearly at mid-height.

Anterior end rounded, with distinct thick anterior marginal rim, decorated with double row of small nodes, posterior end subtriangular slightly pointed centrally, decorated with row of small nodes. Dorsal and ventral margins are straight and nearly subparallel, anterior and posterior cardinal angles

more distinct in the left valve.

Surface coarsely ornamented with different sized tubercles.

The median row runs obliquely anteroventrally to postero-dorsally and consists of five tubercles of which the postero-dorsal tubercles are smaller than the two anterior ones; the ventral row which lies below the median row is formed of four to five tubercles, the middle two of which are double; there is a curved dorsal row of eight tubercles, which anteriorly dips below the prominent eye tubercle, some of the posterior ones are doubled. The rows of tubercles form the elevated parts of the shell with shallow furrows inbetween.

There is a more distinct furrow behind the anterior marginal rim, which is bounded dorsally by a thick short ridge, which is connected with small node between the eye tubercle and sub-central tubercle. In dorsal view posterior end narrower than the broadly rounded anterior end, tubercles are prominent and break up the outline of the carapace and the maximum width and thickness is at the middle.

Internally deep valves; marginal zone moderately broad, marginal pore canals numerous, simple some clustered.

Line of concrescence and inner margin coincide and runs sub-peripherally and is not strongly developed, strong anterior flange in both valve, muscle scars cannot be seen due to thick shell.

Normal pore canals not numerous and of open type. Hinge in the left valve consists of an anterior deep rounded socket separated from the eye sinus by

a thick curved ridge, a strong postjacent outstanding antero-median tooth, separated from deep quadriloculate posterior socket, by a thick crenulate elongate bar which terminates with a slight node above the posterior socket. In the right valve a strong outstanding anterior tooth is followed by a deep postjacent socket, bounded by strong ridge emerging from the anterior tooth, a shallow crenulate postero-median groove and a strong subconical posterior tooth.

Left valve larger than the right valve, overlapping more distinctly along the posterior and ventral margins.

Sexual dimorphism marked, the presumed males more elongate and narrower than the presumed females. It is more distinct in dorsal view.

Dimensions of figured specimens:

Holotype ♂ carapace HU.275 T.6 pl.25, figs. 4,5.

L = 1092 um

H = 570 um

Paratype ♀ carapace HU.275 T.7.1 pl.24, fig. 12. pl.25, fig. 1.

L = 916 um

H = 530 um

Paratype ♀ Lv, int.lat. HU.275 T.8 pl.25, fig. 3.

L = 956 um

H = 550 um

Paratype ♀ carapace HU.275 T.7.2 pl.25, fig. 2.

L = 940 um

H = 555 um

Paratype ♂ RV, int. lat. HU.275 T.7.3 pl.25, fig. 6.

L = 1000 um

H = 510 um

Paratype ♂ carapace HU.275 T.7.4 pl.24, fig. 11.

L = 1040 um

H = 540 um

Affinities and Differences:

The present species shows affinities with Actinocythereis tumefacentis (Lyubimova and Guha) 1960 but differs in that the ventral margin of the latter species is strongly concave medially and the posterior end is more rounded than that of A. iraqensis.

This species differs from Trachyleberis (Actinocythereis) birmanica pyawbwe Gramann 1975 which is narrow posteriorly.

Distribution: A. iraqensis was found in the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Naft Khana Tel-Hajer, Kirkuk and Hamrin sections of Northern Iraq.

Actinocythereis costata sp. nov.

pl.25, figs. 7-12.

Derivation of name: In reference to the well developed ventral ridge in the lateral surface.

Holotype: A male carapace HU.277 T.35.

Paratypes: Four specimens HU.277 T.36, 1-4.

Type horizon: M. Miocene, L. Fars Formation at depth (655-660) m.

Type locality: Kirkuk well 208, Northern Iraq.

Material: Sixty specimens.

Diagnosis: A species of Actinocythereis Puri 1953, in which the dorsal margin is broken up by small tubercles with shallow furrows inbetween. Marginal flange starts from the anterior cardinal angle, runs parallel to the anterior margin and ventral margin to terminate posteriorly; a distinctive short ridge bounds the row of ventral tubercles, ventral margin straight in male, sinuate in the female.

Description:

Medium-sized carapace, elongate subrectangular in lateral view, greatest height through the anterior cardinal angle, greatest length at mid-height.

Anterior margin obliquely rounded, decorated with a double row of nodes, the inner one starting below the eye tubercle with small nodes which coincide in some specimens and form a thick anterior marginal rim which becomes thin along the ventral margin and terminates posteriorly with small node.

The outer one forms the marginal flange, with fine marginal denticulations along the anterior margin in some specimens. In the male left valve posterior margin subtriangular, smooth, slightly curved in the upper part, with marked posterior cardinal angle, sloping down decorated with 4-5 small nodes in the lower part, pointed in the middle; in the male right valve the posterior end is slightly concave in the upper part, curving down in the lower part.

In the female the posterior end is concave in the upper part sloping down

in the lower part and decorated with small nodes.

Dorsal margin straight, jagged with small nodes and shallow furrows inbetween, the distinctive one behind the eye tubercle, running diagonally, bounded ventrally with a fine ridge which springs from eye tubercle to join the subcentral tubercle. Anterior and posterior cardinal angles pronounced, ventral margin straight in male, concave anteriorly, curving upwards posteriorly in the female.

Lateral surface decorated with tubercles or nodes which are variable in size. The median row starts anteroventrally, runs obliquely postero-ventrally and consists of six nodes of which the anterior ones are larger, the four posterior ones are smaller. The ventral row consists of four to five small nodes of which the first anterior two are double, these nodes are bounded ventrally by a short distinctive ridge. The dorsal row consists of seven to eight small nodes with shallow furrows inbetween, which break up the dorsal margin outline. There is a rounded, prominent eye tubercle and prominent, ovate subcentral tubercle.

Left valve larger than the right valve overlapping it more distinctly along the posterior and ventral margins.

Inner lamella moderate, with distinct flange projecting anteriorly, line of concrescence and inner margin coincides and runs subperipherally to the outer margin. The selvage runs parallel to the anterior and posterior margin, not seen at mid-ventral margin.

Marginal pore canals are fairly numerous especially in the anterior portion.

The muscle scars are typical of the genus, normal pore canals are fairly numerous, small and open.

Hinge in the right valve consists of a strong outstanding anterior tooth, swinging ventrally with a short curved ridge to bound the deep, rounded postjacent socket, the postero-median element is represented by a shallow, strongly crenulate, elongate groove, followed by a strongly outstanding subovate, posterior tooth with flattened surface. Eye sinus, deep very pronounced, below the anterior tooth.

In dorsal view the carapace outline is broken up by rows of lateral tubercles, anterior end broadly rounded, posterior end narrower and strongly pointed centrally, maximum width and thickness at the middle. The left valve strongly overreaches the right at the posterior cardinal angle.

The sexes are easily distinguished, the males being more elongate, narrower and less high than the presumed females. This sexual dimorphism is well pronounced in dorsal view.

<u>Dimensions of figured specimens</u>:

Holotype ♂ carapace HU.277 T.35 pl.25, fig. 7.

L = 840 um

H = 480 um

Paratype ♀ carapace HU.277 T.36.1 pl.25, figs. 8, 9.

L = 815 um

H = 480 um

Paratype ♂ carapace HU.277 T.36.2 pl.25, fig. 10.

L = 825 um

H = 460 um

W = 450 um

Paratype ♀ carapace HU.277 T.36.3 pl.25, fig. 11.

L = 820 um

H = 500 um

W = 490 um

Paratype LVI ♀ HU.277 T.36.4 pl.25, fig. 12.

L = 790 um

H = 440 um

Affinities and Differences:

The Burmese subspecies Trachyleberis (Actinocythereis) birmanica kyankkokensis Gramann 1975 has some similarities to the present species, but differs in being smaller and characterised by a single large node in the postero-dorsal part of both valves, which is absent in the Iraqi species.

Gramann's species has a very narrow rounded posterior end, which is sub-triangular in the present species.

In dorsal view A. costata sp. nov. is thicker with a pointed posterior end.

This species is easily distinguished from other Actinocythereis species by its distinctive posterior shape and the distribution of the lateral nodes.

Distribution: This species was found in the Sheikhan, Dohuk, Bai-Hassan, Sheikh Ibrahim and Kirkuk sections of the L. Fars Formation, Northern Iraq.

Actinocythereis cornuocula cornuocula sp.nov. subsp.nov.

pl.26, figs. 1-6

Derivation of name: In reference to the horn-like nature of the eye tubercle - rocky.

Holotype: A female carapace HU.278 T.1.

Paratypes: Four specimens HU.278. T.2, 1-4.

Type horizon: M. Miocene, L. Fars Formation, bed no. 57, sample no. SHI.32.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Material: Forty specimens.

Diagnosis: A species of Actinocythereis with prominent eye tubercle (horn-shaped) standing out strongly from the surface, a distinct posterior cardinal angle and a second dorsal spine sharply pointed backwards, the sexes are easily distinguished with the males more elongate and narrower than the females.

Description:

Female carapace subquadrate in lateral view; male carapace elongate, sub-rectangular in side view; greatest height through the eye tubercle; greatest length below mid-height.

Anterior margin obliquely rounded, with distinct marginal rim decorated with a double row of small nodes, of which the outer one consists of fine marginal denticulations; the inner one consists of small nodes in the upper part of the anterior margin and becoming sharp fringe along the lower part. Posterior margin truncated, sloping gently in the upper part, narrowly rounded in the lower. The upper part of the posterior margin is smooth, lower part decorated with a row of sharp spines; dorsal margin straight, sloping gently behind the eye tubercle, obscured in the posterior half by the dorsal spines.

Anterior and posterior cardinal angles distinct, the anterior coinciding with the eye tubercle. Ventral margin straight to slightly convex, decorated with small fringes.

Lateral surface strongly decorated with rows of prominent nodes and spines, the dorsal one consisting of three spines, sharply pointed upwards (particularly the middle one) and projecting over the dorsal margin; the median row runs obliquely from anteroventrally to posteroventrally and consists of five tubercles, the second of which is the largest and represents the subcentral tubercle; the ventral row consists of three nodes, the first two are small, the third one very large and prominent. Small nodes are scattered over the lateral surface.

Hinge in the left valve consists of a deep ovate anterior socket, a rounded postjacent anteromedian tooth - followed by a longitudinal bar and quadriloculate posterior sockets; the terminal hinge elements are bounded dorsally by the projection of the anterior and posterior cardinal angles. Hinge in the right valve complementary. Eye sinus present below the anteroventral margin of the anterior socket.

Line of concrescence and inner margin coincide and run throughout parallel to the outer margin, the selvage runs peripherally and a distinct marginal flange is present in each valve. Normal pore canals not numerous, open scattered over the valve surface. Other internal features are normal to the genus.

Left valve slightly larger than the right, overlapping more conspicuously along the posterior margin.

In dorsal view carapace biconvex, rounded anteriorly,narrow posteriorly, the

ventrolateral spine or node forms a very distinctive lateral extension. Maximum thickness and width behind the middle.

Sexual dimorphism strongly pronounced, the presumed males more elongate, less high than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.1 pl.26, fig. 1.
L = 730 um
H = 415 um

Paratype ♂ carapace HU.278 T.2.1 pl.26, figs. 2, 5.
L = 790 um
H = 405 um

Paratype ♀ carapace HU.278 T.2.2 pl.26, fig. 4.
L = 700 um
H = 410 um

Paratype ♂ carapace HU.278 T.2.3 pl.26, fig. 3.
L = 740 um
H = 390 um

Paratype ♀ carapace HU.278 T.2.4 pl.26, fig. 6.
L = 710 um
H = 410 um

Affinities and Differences:

The present species has some affinities to Trachyleberis (Actinocythereis) birmanica birmanica subsp. Gramann 1975, but differs in being higher anteriorly, and wider posteriorly, and having a more distinct posterior cardinal angle, a well developed median row of five tubercles, in the absence of a big postero-dorsal node and in the truncated posterior margin.

A. cornuocula s.s. is closely related to Actinocythereis levinsoni Bhatia and Mandwal 1960, but the latter differs in being narrower, in the ventral margin fringed by eight flattened, coalescent spines, in the rounded anterior and posterior ends and the ventral row consisting of four individual tubercles. In addition the present species differs in its horn-like eye tubercle and prominent, ventrolateral node.

Distribution: A. cornuocula cornuocula was found at the Bashiqa, Dohuk, Sheikhan, Sheikh Ibrahim, and Hamrin localities of Northern Iraq.

Actinocythereis cornuocula spinosa n. ssp.

pl.26, figs. 11, 12.

Derivation of name: In reference to the well developed spines with bifid terminations.

Holotype: A female carapace HU.278 T.5.

Paratypes: Four specimens HU.278, T.6.4.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Type horizon: M. Miocene, L. Fars Formation, bed no. 12, sample no. DO.11.

Material: Twenty specimens.

Diagnosis: Lateral surface ornamented with three distinct rows of vertically tapering spines, of which the median and ventral spines are bifid.

Description:

Carapace elongate subrectangular in side view, greatest height at the anterior

cardinal angle, greatest length passing through mid height. Anterior margin obliquely rounded, decorated with a double row of spines and denticles, the first one consists of about thirty five marginal denticulations, the second one consists of seven small tubercles over the anterior marginal rim. Posterior margin, subtriangular slightly rounded at the middle, smooth in the upper part, decorated with a double row of fine pointed spines in the lower part.

Dorsal margin straight, jagged with upward pointing tubercles; anterior and posterior cardinal angles prominent, the anterior one with a distinct eye tubercle; ventral margin straight at the middle, converging anteriorly and posteriorly.

Lateral surface marked by three rows of tubercles and spines. The dorsal row consists of five backward-pointing spines which project above the dorsal margin; the median row consists of five, vertically pointing, spines running obliquely from anteroventrally to posteroventrally, of which the biggest is the subcentral one; the ventral row consist of three spines, the first two are very small, the ventrolateral one is very prominent with a bifid head.

Left valve larger than the right, overlapping conspicuously along the ventral and posterior margins. Inner lamella moderately wide with a distinct flange; selvage developed peripherally to the outer margin. Hinge in the right valve consists of a strong outstanding anterior tooth, forming a distinct arc ventrally, bounding a deep rounded socket, a flattened, outstanding posterior tooth, separated from the anteromedian element by a shallow, longitudinal, crenulate groove.

There is a marked eye sinus behind the anteroventral margin of the anterior

tooth. Marginal pore canals numerous, some are thickened in the middle. Muscle scars indistinct.

Sexual dimorphism marked, the presumed males more elongate and narrower than the presumed females, and easily distinguished in dorsal view.

In dorsal view both sides are jagged due to the upward-pointing tubercles and spines, anterior end rounded, posteriorly narrowly rounded with the maximum width and thickness behind the middle.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.5. pl.26, fig. 11.

L = 730 um

H = 390 um

Paratype RVI HU.278 T.6.1 pl.26, fig. 12.

L = 720 um

H = 390 um

Affinities and Differences:

The present species resembles Actinocythereis khariensis Khosla and Pant 1982 in some respects, but differs in having a broad anterior margin, straight ventral margin, and differs in details of ornamentation of which the ventral row has two small nodes and a large ventrolateral one instead of the four small nodes of Actinocythereis khariensis. In addition the posterior margin of the Indian species is narrower than that in the Iraqi species.

Actinocythereis kutchensis has some similarities to the present species, but differs in the shape of the tubercles, which are mostly rounded in shape, with a distinctive tubercle over the posteroventral corner which is not seen in the

Iraqi species.

Distribution: This species was found in the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim and Kirkuk sections of L. Fars Formation of Northern Iraq.

Actinocythereis dextraspina sp.nov.

pl.26. figs. 7-10.

Derivation of name: In reference to the postero-ventral spine which is developed in the right valve.

Holotype: A female carapace HU.278, T.3.

Paratypes: Three specimens HU.278 T.4, 1-3.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed no. 1, sample no. BA.1.

Material: Twenty specimens.

Diagnosis: A distinctive spine developed posteroventrally in the right valve only, antero-ventral tubercle flattened, decorated with small nodes.

Description:

Carapace elongate, subrectangular in side view, greatest height through the anterior cardinal angle.

Dorsal margin straight, broken by the row of small nodes, ventral margin slightly convex, merging evenly into the anterior margin; joining the posterior margin with a postero-ventral spine.

Anterior margin obliquely rounded, decorated with a double row of small nodes and denticles. Anterior marginal rim distinct, posterior margin subtriangular to slightly rounded at the middle, decorated with fine spines, more conspicuous ventrally.

Lateral surface oranmented with spines and nodes which are not well developed, the biggest one being the anteroventral tubercle, the spines more distinct posteriorly.

Eye tubercle small and rounded, subcentral tubercle marked.

Marginal area moderately broad, line of concrescence and inner margin coincide, selvage well developed, running peripherally to the outer margin. Marginal pore canals moderate in number and elongate; some of them are paired in the antero-dorsal part. Posterior marginal area narrower with fewer marginal pore canals.

Sexual dimorphism pronounced, the presumed males more elongate and narrower than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.3 pl.26, fig. 7.

L = 785 um

H = 460 um

Paratype ♂ carapace HU.278 T.4.1 pl.26, fig. 8.

L = 830 um

H = 430 um

Paratype ♂ carapace HU.278 T.4.2 pl.26, fig. 9.

L = 810 um

H = 460 um

Paratype ♂ RVI HU.278 T.4.3 pl.26, fig. 10.

L = 800 um

H = 440 um

Affinities and Differences:

The present species differs from A. cornuocula sp. nov. in having a distinctive posteroventral spine developed in the right valve only, and in the tubercles being comparatively weakly developed compared with other Actinocythereis species.

The present species shows some similarities to Actinocythereis spinellosa var. valdiyai Singh and Misra 1968, but the latter differs in being narrower, with well developed tubercles and spines coupled with the absence of a postero-ventral spine, which is diagnostic in the present species.

Distribution: This species was found at the Bashiqa and Dohuk localities of Northern Iraq.

Genus ACANTHOCYTHEREIS Howe 1963

Type species: Acanthocythereis araneosa Howe 1963

Acanthocythereis dohukensis Khalaf 1982

pl. 27, figs. 1-6

Acanthocythereis dohukensis Khalaf 1982 4 (8) 47-50.

Figured specimens: Holotype HU.275 T.1 ♂ car.

Paratypes HU.275 T.2, 1-5 ♀ car.

Horizon: M. Miocene. Lower Fars Formation, bed No. 12, Sample DO.11.

Type locality: Dohuk anticline, southern limb, 10 km NE of Dohuk City, N. Iraq, L. Fars Formation, bed no. 12.

Material: Fifteen specimens.

Description: Carapace elongate, subrectangular in side view, with greatest height at the anterior cardinal angle. Anterior margin broadly rounded with double rows of small tubercles of which the inner one consists of eleven nodes of which the first seven are regularly spaced over the anterior marginal rim and connected by a fine thread, the last four are minute in size and continue above the ventral margin; the outer row consists of a combination of small nodes and fine denticles which continue along the ventral margin and form the fringing row.

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 straight with distinct anterior and posterior cardinal angles, partially obscured by the projection of the dorsal spines, ventral margin straight; both converging slightly posteriorly.

X 135

Text fig. 13 Acanthocythereis dohukensis Khalaf 1982
HU.275 T.1 Carapace from right, lateral surface showing the ornamentation.

Lateral surface covered with a combination of reticulations and strong blunt spines, the reticules show variation in shape from subtriangular to subrectangular, elongate to ovate. There is a distinctive row of reticules behind the anterior marginal rim, of which the individual reticules are subrectangular to subtriangular in shape, separated longitudinally by fine muri, each of which connects anteriorly with the nodes of the inner row; posteriorly every two are connected with a fine node. Strong, blunt, some of which are bifid, are superimposed on the reticulations, the dorsal ones point backwards; fine nodes occur scattered over the surface, some of them tending to form a longitudinal row over the ventral margin.

Eye tubercle distinct with flattened surface standing out from the carapace; subcentral tubercle prominent with ovate shape.

Left valve larger than the right, overlapping more conspicuously along the posterior margin.

Rare, fragile single valves were found, which show that the hinge is holamphidont, the marginal area moderately wide and the marginal pore canals simple and numerous.

In dorsal view, the anterior and posterior ends are pointed, the outline in both sides is broken by the lateral spines; greatest thickness and width just behind the middle.

Sexual dimorphism is quite marked, the presumed males more elongate, less high and narrower posteriorly than the presumed females.

Dimensions of figured specimens:

Holotype ♂ carapace HU.275 T.1 pl.27, figs. 1,2,3.

L = 836 um

H = 425 um

Paratype ♀ carapace HU.275 T.2 pl.27, figs. 4,5,6.

L = 788 um

H = 440 um

Affinities and Differences:

Acanthocythereis hystrix Reuss differs in having much blunter spines and the posterior margin is more subtriangular.

Trachyleberis (Acanthocythereis)procapsus Siddiqui 1971 is narrower and less high, has a slightly concave ventral margin anteroventrally and differs in detail of reticulation.

This species shows some resemblance to Acanthocythereis alacer Al-Furaih 1980, but differs in being more elongate, less high, narrower posteriorly and with more, well-developed, blunt spines.

Acanthocythereis sp. Salahi 1966 differs in being higher with a pointed posterior end ventrally.

Acanthocythereis projecta Bassiouni 1969 is comparatively more elongate and is narrower posteriorly with much blunter spines along the entire margins and strongly outstanding eye tubercle.

Distribution: This species has been found in the L. Fars Formation of the Bashiqa and Dohuk sections.

Acanthocythereis sp.

pl. 27, figs. 7, 8

Figured specimen: A carapace HU.278 T.7

Type locality: Bashiqa anticline, S. limb. 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed no. 1, sample no. BA.1.

Material: One carapace.

Description: Carapace elongate, subrectangular in side view, greatest height through the anterior cardinal angle, greatest length passes through mid-height. Anterior margin obliquely rounded and directed ventrally, decorated with a double row of small nodes; the inner one consists of about five small nodes; the outer marginal denticulations, some of which are doubled, is more developed antero-ventrally. Posterior margin subtriangular, slightly concave in the upper part, curving down in the lower, decorated with fine spines.

Dorsal margin straight with distinct anterior and posterior cardinal angles. In the right valve a distinctive spine projects over the posterior cardinal angle. Ventral margin slightly convex upwards at the middle because of ventral inflation, concave in the anterior and posterior portions, decorated with a fine fringe. Surface ornamentation consists of vertically pointed spines, some of them bifid, superimposed on well developed reticules; a distinctive rib which carries small regularly spaced nodes springs from the eye tubercle, runs parallel to the anterior margin then curves down parallel to the ventral margin; small spines are scattered over the lateral surface.

There is a pronounced rounded eye tubercle with eye sinus below. The marked

subcentral tubercle is ovate.

Left valve slightly larger than the right, overreaching more conspicuously at the upper part of the posterior margin.

Internal features unknown.

Dimensions of figured specimen:

Carapace HU.278 T.7 pl.27, figs. 7,8.

L = 740 um

H = 390 um

Affinities and Differences:

Because only one specimen was found it is left under open nomenclature although there is little doubt that it represents a new species. The present specimen shows some affinity with Trachyleberis (Acanthocythereis) podigaster Siddiqui 1971, but is less high with the anterior margin directed ventrally and a more spiny surface compared with Siddiqui's species.

Acanthocythereis sp. has some resemblance to Acanthocythereis oxyderca Al-Furaih 1980 but the latter differs in being narrower posteriorly,in having a more pronounced eye tubercle and a reticulate surface with irregular-shaped fossae.

Tribe COSTAINI Hartmann and Puri 1974

Genus CHRYSOCYTHERE Ruggieri 1961

Type species: Chrysocythere cataphracta Ruggieri 1961

Chrysocythere naqibi Khalaf 1982

pl.27 figs. 9-12

Chrysocythere naqibi Khalaf 1982, 9 (10) 55-58.

Figured specimens: Holotype ♀ carapace HU.275 T.13 Paratype ♂ carapace HU.275 T.14.

Horizon: M. Miocene.

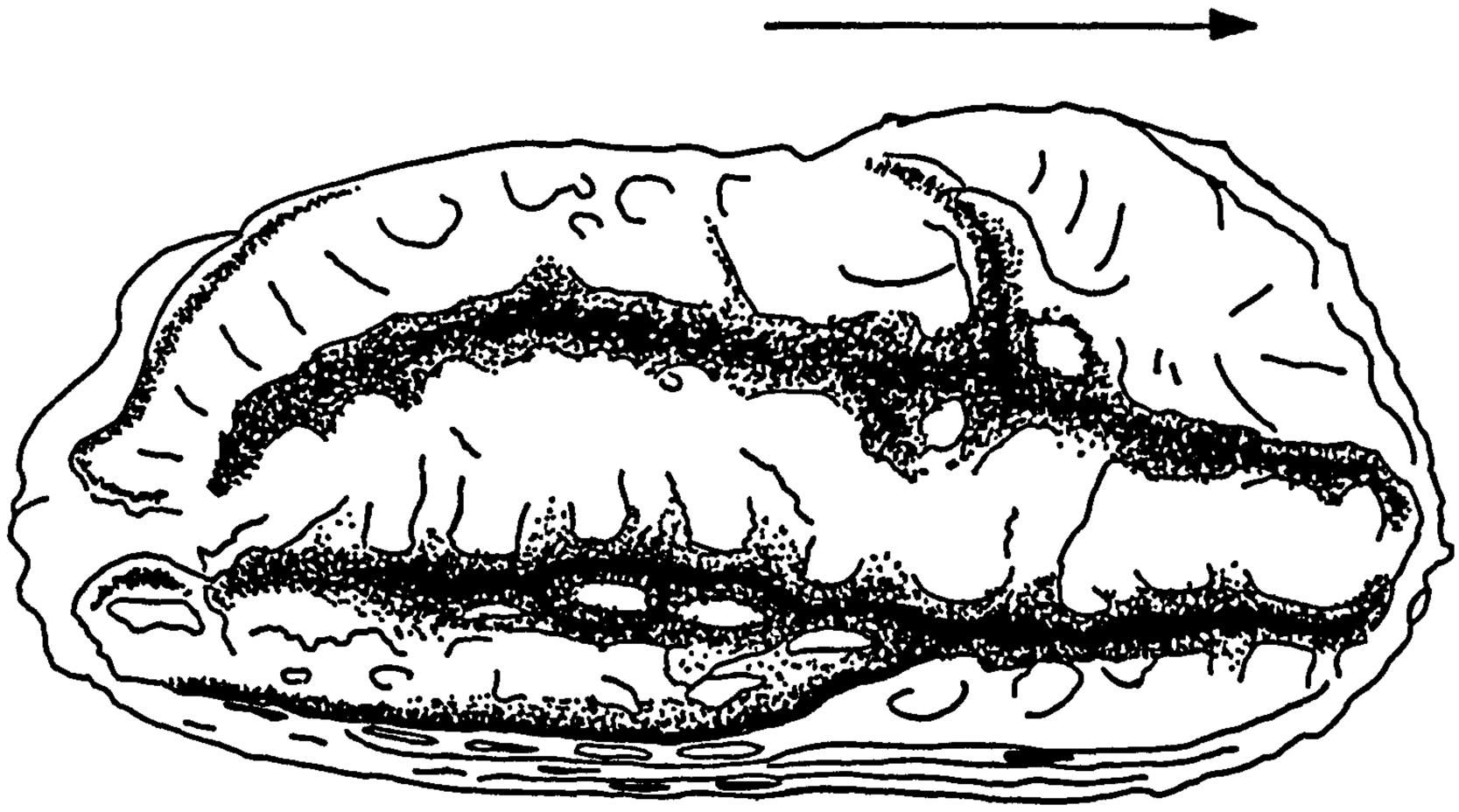
Locality: Sheikh Ibrahim anticline, southern limb, NW Iraq, 45 km west of Mosul City, L. Fars Formation, bed no. 50; M. Miocene: lat 36° 18′ N, long 42° 39⁻ E.

Material: Two specimens.

Description: Carapace subrectangular in lateral view, greatest height at the anterior cardinal angle, greatest length passing through mid-height.

Anterior margin obliquely rounded, decorated with marginal denticulations and marginal ridge, commencing at the antero-dorsal corner and continuing along the anterior margin, to join the ventral ridge at the antero-ventral corner. Posterior margin truncate, narrowly rounded ventrally, slightly concave in the upper part.

Dorsal margin modified by the dorsal ridge, anterior and posterior cardinal angles marked. Ventral margin straight, smoothly converging towards anterior and posterior margins. Lateral surface ornamented with three longitudinal ridges. The dorsal and median are connected by a short curved transverse



X 131

Text fig. 14 Chrysocythere naqibi Khalaf 1982
HU.275 T.13 Carapace from right, lateral surface showing the ornamentation.

ridge at about one third the length from the anterior end, the dorsal one projecting over the dorsal margin, curving down to terminate anterior to the middle of the posterior margin.

The median ridge runs in an elegantly curved, convex upward arc from the middle of the anterior margin towards the middle of the posterior end. The ventral ridge starts from the anteroventral corner and runs longitudinally above the ventral margin to join the median ridge at its posterior end, the rest of the surface is characterised by a typical ornamentation of thick transverse ridges which connect the median and ventral ridges forming distinctive reticulae; two rounded reticulae alternate in the anterior part of the median ridge; a distinctive additional longitudinal ridge is developed below the ventral ridge which is joined to the latter and follows a curved path in the posterior two-thirds of the shell.

Eye tubercle pronounced, with a shallow furrow behind. Left valve larger than the right, but overlapping is conspicuous.

Sexual dimorphism is very marked, the presumed male being longer and narrower than the female.

In dorsal view the carapace is biconvex, slightly tumid posteriorly in the female, slimmer in the male, anterior margin rounded, posterior end narrowly rounded, slightly pointed at the middle, maximum width and thickness posteriorly.

<u>Dimensions of figured specimens</u>:

Holotype ♀ carapace HU.275 T.13 pl.27 figs. 10,12.

L = 904 um

H = 480 um

Paratype ♂ carapace HU.275 T.14 pl.27, figs. 9,11.

L = 992 um

H = 470 um

Affinities and Differences:

The present species differs from Chrysocythere paradisus Doruk 1973, which is more elongate and differs in details of reticulum.

C. naqibi is more elongate than C. cataphracta Ruggieri 1962, and differs in details of the reticulation.

The new subspecies of C. cataphracta described from the M. Miocene of Mersin of Turkey by Bassiouni, 1979 shows some similarity in ornamentation but the present species differs in the development of an additional longitudinal ridge below the ventral ridge which is joined to the latter and follows a curved path in the posterior two-thirds of the shell.

Distribution: C. naqibi occurs in the M. Miocene sections of the Sheikh Ibrahim anticline, NW Iraq.

Genus GYROCYTHERE Siddiqui 1971

Type species: Gyrocythere exaggerata Siddiqui 1971

Gyrocythere siddiquii Khosla 1978

pl.28; fig. 1

Gyrocythere siddiquii Khosla 1978, p.269, pl. 4, fig. 5.

Figured specimen: A carapace HU.278 T.8.

Horizon: M. Miocene, L. Fars Formation, bed no.10, sample no. BA.7.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: One carapace.

Remarks: The figured specimen agrees well in shape and type of ornamentation with Khosla's species, but there are some differences such as the reticulation which in the Iraqi specimen is coarser and well developed, the anterior margin which is broadly and obliquely rounded and the smooth posterior-ventral margin which is denticulate in the Indian specimen.

Dimensions of figured specimen:

Carapace HU.278 T.8 pl.28, fig. 1.

L = 730 um

H = 400 um

Gyrocythere grossipunctata sp.nov.

pl.28, figs. 2-4

Derivation of name: In reference to the coarsely punctate ornamentation.

Holotype: Holotype carapace HU.278, T.9

Paratypes: Two specimens HU.278 T.10, 1-2.

Type horizon: M. Miocene, L. Fars Formation, bed no. 2, sample no. BA.2.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: Four specimens.

Diagnosis: A species of Gyrocythere Siddiqui 1971 with four ridges, the dorsal one of which is convex upwards forming a posterodorsal shoulder; posterior margin subrounded, slightly concave in the upper part and ventral margin almost concealed in lateral outline by the ventrolateral ridge.

Description:

Carapace subrectangular in lateral view, greatest height passing through the eye tubercle, greatest length at mid-height.

Anterior margin broadly and obliquely rounded, posterior margin subrounded, produced at the middle, slightly concave dorsally, curved down posteriorly. Dorsal margin slightly concave anteriorly obscured posteriorly by the projection of the dorsal ridge, which forms the postero-dorsal shoulder; anterior and posterior cardinal angles marked but not prominent. Ventral margin concave anterior to the middle, convex upwards posteriorly.

Subcentral tubercle marked but not prominent particularly in the left valve, eye tubercle rounded and distinct. Lateral surface strongly reticulate with longitudinal ridges. The dorsal ridge starts anteriorly below the

eye tubercle and curves upwards posteriorly over the dorsal margin forming the postero-dorsal shoulder. The second ridge commences anteriorly between the eye and subcentral tubercles, curves convexly upwards, then downwards posteriorly to terminate anterior to the middle of posterior end. The mid-ridge is ill-defined, being more distinct in the right valve than the left and passes through the subcentral tubercle; its anterior part is indistinct. The fourth or ventral ridge commences anteriorly above the anteroventral corner and runs backwards to terminate in a slight node or thickening in the posterior third above the ventral margin. Between the ventral margin and the ventral ridge, a ventro-lateral ridge is developed which is more conspicuous in the right valve and almost concealed in lateral outline, this ridge terminates in a slight alar expansion at the posteroventral corner. The rest of the surface is covered with strong reticulation of deep meshes which vary in shape from elongate to rounded ovate and which are arranged in rows parallel to the anterior and ventral margins.

Left valve larger than the right, overlapping more conspicuously along the dorsal and posterior margins. In dorsal view the carapace is ovate, with rounded anterior and posterior ends; maximum width and thickness posteriorly.

Sexual dimorphism present but not pronounced, the presumed males being more elongate, less high than the presumed females.

Internal features not seen.

<u>Dimensions of figured specimens</u>:

Holotype carapace HU.278 T.9 pl.28, figs. 2,3.

L = 820 um

H = 440 um

Paratype carapace HU.278 T.10.1 pl.28, fig. 4.

L = 790 um

H = 430 um

Affinities and Differences:

Gyrocythere grossipunctata sp.nov. has some similarities to Gyrocythere perfecta Siddiqui 1971, but differs in having coarser ornamentation with deep meshes separated by thick muri; the third ridge in Siddiqui's species is convex downwards in its anterior half and slopes obliquely upwards towards the posterior, while in the present species it is nearly straight, and the median third ridge is well developed in G. perfecta Siddiqui 1971 but is ill-defined in the present species.

On the other hand the present species is larger with comparatively broad anterior and posterior margins. In addition to which G. grossipunctata sp.nov. is somewhat similar to G. mitigata Siddiqui 1971 but the latter differs in its rounded posterior end, straight ventral margin, reticulate surface with three longitudinal ridges, distinct marginal rim and denticulate anterior and posterior-ventral margins, besides which the present species is higher and wider.

Distribution: Rare specimens were found at Bashiqa and Kirkuk localities of Northern Iraq.

Gyrocythere sheikhibrahamensis sp.nov.

pl.28 figs. 5,6,9

Derivation of name: From the type locality.

Holotype: A male carapace HU.278 T.11.

Paratypes: Two specimens HU.279 T.12, 1-2.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed no. 43, sample no. SHI.24.

Material: Three specimens.

Diagnosis: A species of Gyrocythere with a distinct postero-ventral spine, weakly ornamented surface and strongly pronounced sexual dimorphism.

Description:

Carapace elongate subrectangular in lateral outline, greatest height at the anterior cardinal angle, greatest length just above the ventral margin.

Anterior margin obliquely rounded, finely denticulate; denticulations more conspicuous ventrally, posterior margin slightly subangular, rounded at the middle, slightly concave above, denticulate ventrally; in the female left valve the upper part of the posterior end curves down slightly, the gently sloping lower part is finely denticulate.

Dorsal margin nearly straight, slightly obsucred posteriorly with distinct anterior and posterior cardinal angles, particularly in the left valve; ventral margin concave anterior to the middle, curving upwards posteriorly.

Lateral surface weakly ornamented reflecting the state of preservation, but traces of longitudinal ridges can be seen and more conspicuous reticulations

along the anterior margin; above the ventral margin is a longitudinal rib which ends posteriorly in a small node or spine.

Subcentral tubercle present but not prominent; eye tubercle rounded and distinct with a short groove in front.

Line of concrescence and inner margin coincide throughout and parallel to the outer margin, selvage well developed anteriorly.

Marginal pore canals simple but not numerous. Hinge holamphidont, in the left valve consisting of deep anterior socket, antero-median projecting tooth, crenulate postero-median bar and quadriloculate posterior socket.

Left valve larger than the right, overlapping it more conspicuously along the dorsal margin. In dorsal view carapace with rounded anterior and posterior ends, maximum width and thickness behind the middle.

Sexual dimorphism strongly pronounced, the presumed male more narrowly elongate, less high and wide than the presumed females.

<u>Dimensions of figured specimens</u>:

Holotype ♂ carapace HU.278 T.11 pl.28, figs. 6, 9.

L = 660 um

H = 330 um

Paratype ♀ carapace lost

Affinities and Differences:

The present species agrees with the genus Gyrocythere siddiqui 1971 but differs in being more elongate and in that the sexes are very easily distinguished with oblong males while in Siddiqui's genus they are slightly subquadrate.

The most closely related species is Gyrocythere perfecta Siddiqui 1971 but this differs in having a strongly and deeply reticulate surface on which the ridges are more distinctive and a convex dorsal margin compared with the straight one in the present species. It is easily distinguished from other species by its strong dimorphism, its relatively primitive hinge and its narrower marginal zone.

Distribution: Rare specimens were found in the Sheikh Ibrahim section, northwest of Iraq.

Genus FALUNIA Grekoff and Moyes 1956

Subgenus HILTERMANNICYTHERE Bassiouni 1970

Type species: Cythereis turbida Müller 1894

Falunia (Hiltermannicythere) miocaenica sp.nov.

pl.29, figs. 2, 3, 5, 6, 7.

Derivation of name: In reference to its occurrence in the Miocene.

Holotype: A male carapace HU.278 T.15.

Paratypes: Two specimens HU.278 T.16, 1-3.

Type locality: M. Miocene, L. Fars Formation, bed No. 8, sample No. DO.7.

Horizon: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Thirteen specimens.

Diagnosis: Carapace elongate with prominent anterior marginal rim and undulating vertical ridge posteriorly. Dorsal margin forms the outer marginal flange of the carapace; surface strongly pitted.

Description:

Carapace elongate, subrectangular in outline, greatest height at the anterior cardinal angle, greatest length just below the middle.

Anterior margin broadly, obliquely with prominent anterior marginal rim which starts from the eye tubercle and then curves down parallel to the anterior margin, with well developed subrectangular reticules in front. Posterior margin truncate, produced at the middle, concave above and below.

Dorsal margin straight to slightly convex posteriorly due to the projection of the dorsal flange, ventral margin slightly concave at antero-ventral corner, gently curving upwards posteriorly, both margins converge posteriorly. Lateral surface marked with median and ventral ridges originating from the anterior marginal rim.

The median one starts below the mid-point of the anterior marginal rim, its slightly convex downwards anterior part then curves upwards and runs posteriorly close to the dorsal margin until below the posterior cardinal angle it curves down to terminate above the postero-ventral corner. Just below this postero-dorsal corner in the right valve the median ridge splits into two branches, the upper one short and attached to the posterior cardinal angle, the lower one curving downwards to join the posterior ventral corner. In some specimens an undulating ridge joins the lower

posterior part of the median ridge to form a distinctive circular ridge in the posterior third of the shell. The ventral ridge originates at the antero-ventral corner and runs posteriorly to join the median ridge with a short undulating vertical ridge. Two ventro-lateral ridges occur between the ventral ridge and the ventral margin and are more conspicuous in the right valve.

There is a trace of the anterior part of the dorsal ridge seen in the right valve between the eye tubercle and the median ridge, the posterior part coincides with the dorsal margin and forms the marginal flange.

Eye tubercle elongate in shape; subcentral tubercle indistinct.

Left valve larger than the right and overlapping more conspicuously posteriorly.

In dorsal view carapace with narrowly rounded anterior end and slightly pointed posterior end; maximum width and thickness at the middle.

Sexual dimorphism strongly pronounced,the presumed males more elongate, narrower and less high than the presumed females.

Internal features not seen.

Dimensions of figured specimens:

Holotype ♂ carapace HU.278 T.15 pl.29, figs. 2, 5.

L = 800 um

H = 380 um

Paratype ♀ carapace HU.278 T.16.1 pl.29, fig. 6.

L = 750 um

H = 410 um

Paratype ♂ carapace HU.278 T.16.2 pl.29, fig. 3.

L = 810 um

H = 365 um

Affinities and Differences:

Bassiouni 1970 erected the new subgenus of Falunia (Hiltermannicythere) with Cythereis quadridentata Baird 1850 as a type species and C. turbida Muller 1894 (1912) as synonym.

Sissingh 1972 claimed that the specimens figured as F. (H.) quadridentata (Baird) by Bassiouni 1970 do not belong to this species because longitudinal slits in the lateral surface are lacking. He suggested that the individuals could belong to Cythereis turbida Muller 1894, therefore F. turbida is not a junior synonym of F. quadridentata (Baird) as suggested by Bassiouni and the true C. quadridentata has been placed in the genus Celitha.

The present species is placed in the subgenus Hiltermannicythere Bassiouni 1970, on the basis of the external features, which agrees with the diagnostic features of Hiltermannicythere Bassiouni 1970. Hiltermannicythere emaciata Brady 1866 as figured by Bassiouni (1979) differs in being narrower and with different posterior shape, the interspaces in the present species are strongly reticulate.

Distribution: This species was found at the Bashiqa, Sheikh Ibrahim, and Dohuk localities of Northern Iraq.

Genus STIGMATOCYTHERE Siddiqui 1971

Type species: Stigmatocythere obliqua Siddiqui 1971

Stigmatocythere nodosa sp. nov.

pl. 29, figs. 8-12

Derivation of name: In reference to the nodose surface.

Holotype: A female carapace HU.278 T.17.

Paratypes: Five specimens HU.278 T.18, 1-5.

Type horizon: M. Miocene, L. Fars Formation, bed No.14, sample SH.11

Type locality: Sheikhan anticline, S. limb, 27 km NE of Mosul City.

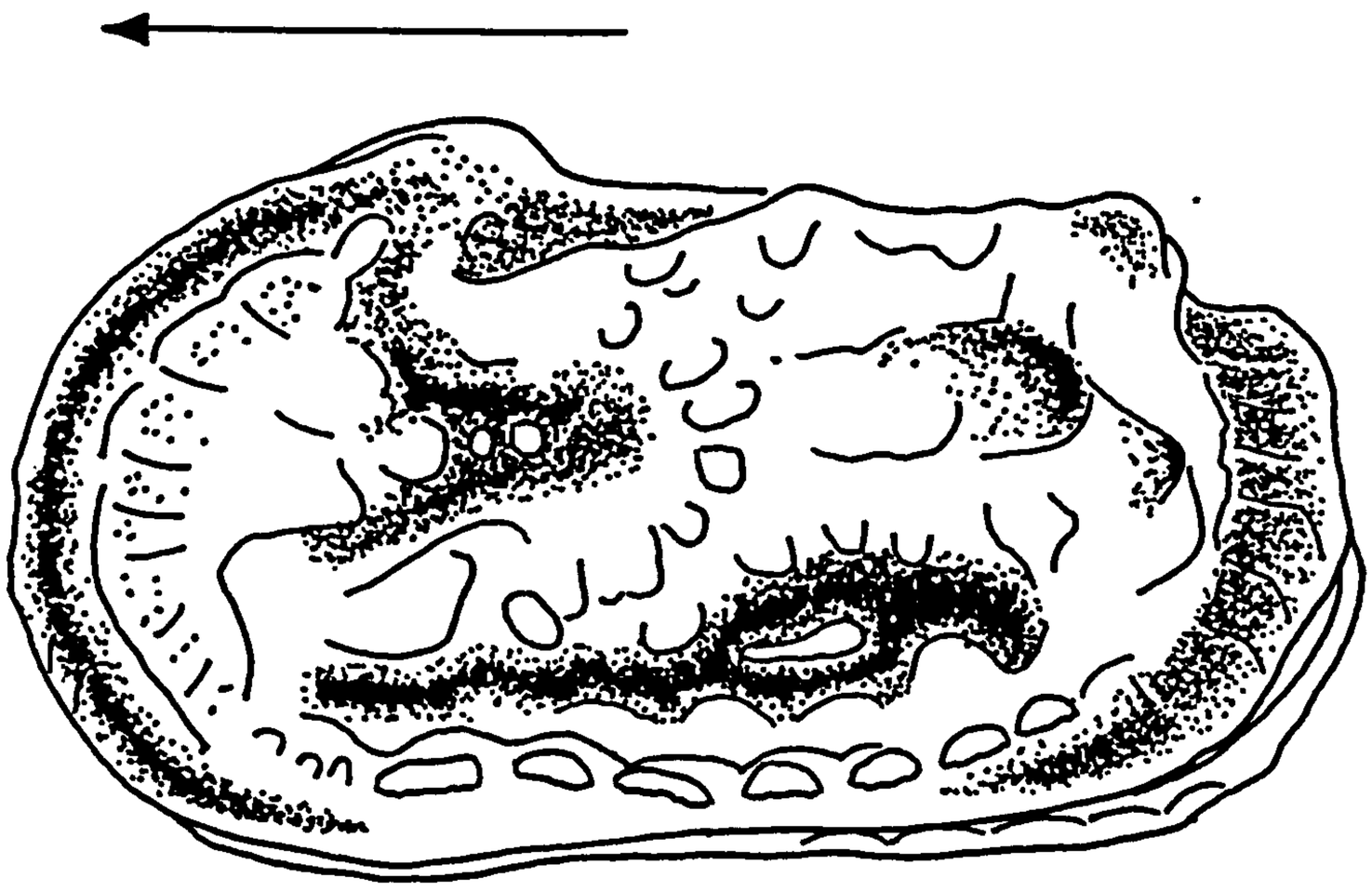
Material: Twenty five specimens.

Diagnosis: A small species of the genus Stigmatocythere, with three longitudinal ridges in addition to the diagnostic curved ridge, a vertical line of nodes connecting the longitudinal ridges posteriorly.

Description:

Carapace subrectangular in lateral view, greatest height passing through the eye tubercle, greatest length below mid-point.

Anterior margin obliquely rounded with high, well-developed marginal rim starting from the eye tubercle, its continuation along the ventral posterior margin less evident; posterior margin narrowly, obliquely truncate.



X 218

Text fig. 15 Stigmatocythere nodosa sp.nov.
HU.278 T.17 Carapace from left lateral surface showing the ornamentation.

Dorsal margin nearly straight, slightly inclined backwards posteriorly with distinct anterior and posterior cardinal angles of which the latter is the more distinctive particularly in the right valve.

Ventral margin slightly concave anterior to the middle curving upwards posteriorly.

Lateral surface strongly reticulate with four longitudinal ridges. The diagnostic curved ridge starts at the eye tubercle curves sharply to form a U-shape over the subcentral tubercle, the ventral side running forward to die out below the mid point of the anterior margin. The undulating ridge starts below the eye tubercle and runs posteriorly, overreaching the dorsal margin and ending anterior to the posterior-dorsal corner with a distinctive node.

The median ridge or line, commences behind the subcentral tubercle, ill defined to start with it curves slightly downward to form a line of two thick nodes and dies out above the postero-ventral corner. A ventral ridge begins 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 posterior third of the ventral ridge and curves down slightly posteriorly to end above the postero-ventral corner. The valve surface between these ridges is strongly pitted. Valves almost equal in size with the left valve slightly larger than the right.

Eye tubercle round, with a distinctive longitudinal furrow below; subcentral tubercle present but not conspicuous. Internal features: duplicature moderately wide, selvage subperipheral, hinge in the left valve consists

of anterior projecting tooth with postjacent deep socket, followed by locellate groove and pessular posterior tooth. In dorsal view rounded anterior and posterior ends, the outline broken posteriorly by the postero-dorsal nodes or alae; maximum width and thickness behind the middle.

Sexual dimorphism strongly pronounced, the presumed males more elongate, less high and width than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.17 pl.29 figs. 10, 11

L = 500 um

H = 320 um

Paratype ♂ carapace HU.278 T.18.1 pl.29, fig. 8

L = 580 um

H = 315 um

Paratype ♂ carapace HU.278 T.18.2 pl.29, fig. 9

L = 550 um

H = 310 um

Paratype ♂ carapace HU.278 T.18.3 pl.29, fig. 12

L = 550 um

H = 305 um

Affinities and Differences:

This species is similar to Stigmatocythere obliqua Siddiqui 1971 in outline but its easily distinguished due to its characteristic surface ornamentation particularly the U-shaped ridge above the subcentral tubercle, and the vertical posterior line of nodes, only a trace of anterior denticulation

is present in this species while this feature is strongly developed in Siddiqui's species.

Stigmatocythere nodosa sp.nov. differs from Stigmatocythere reversa Khosla 1976, in having a well-developed vertical line of nodes connecting the three longitudinal ridges, and a short ridge developed between ventral ridge and median ridges. Khosla's species has reverse overlap in which the right valve slightly overreaches the left at the anterodorsal and posterodorsal margins, and is also characterised by a reversed hinge structure and anterior and posterior margins fringed with short spines.

S. latebrosa (Lyubimova and Guha) 1960 shows some similarities to the present species, but the latter is easily distinguished by the distribution pattern of the undulate ridges.

Distribution: S. nodosa sp. nov. was found at the Bashiqa, Dohuk, Sheikh Ibrahim and Kirkuk localities of Northern Iraq.

Stigmatocythere cellulosa sp. nov.

pl.30, figs. 1, 2, 4, 5.

Derivation of name: In reference to the strong pitting which occurs over the surface of the carapace.

Holotype: A female carapace HU.278 T.19.

Paratypes: Two specimens HU.278 T.20, 1-2.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Horizon: M. Miocene, L. Fars Formation, bed No.12, sample No. DO.11.

Material: Eight specimens.

Diagnosis: A species of Stigmatocythere with longitudinal ridges, and strongly pitted surface, posterior third decorated with well developed undulating ridges.

Description:

Carapace small, subrectangular in side view, greatest height at anterior cardinal angle, greatest length below mid-point.

Anterior margin obliquely rounded, slightly denticulate ventrally; posterior margin narrowly truncate, slightly concave in the upper part, rounded in the middle.

Dorsal margin straight, obscured due to overreaching of the dorsal ridge, with distinctive anterior and posterior cardinal angles, particularly in the right valve; ventral margin slightly concave anterior to the middle, curving upwards posteriorly.

Lateral surface strongly ornamented with four longitudinal ridges. The dorsal one which commences below the eye tubercle, runs backwards, projecting over the dorsal margin, then curves down to terminate below the postero-dorsal angle. The diagnostic curved ridge is ill defined. The two median ridges originating in the antero-ventral part, run parallel convexly upwards above the subcentral tubercle; both are joined by a short vertical ridge, and continue posteriorly, the upper one to terminate with undulate end at one quarter of the length from the posterior margin, the lower curving down to join the ventral margin in its posterior third. Another

well-developed ridge occurs between the lower median ridge and the ventrolateral ridge. Starting above the antero-ventral corner, it runs posteriorly and curves down at mid-point to joint the ventro-lateral ridge. The ventro-lateral ridge starts from the antero-ventral corner and runs posteriorly, curving down to join the ventral margin anterior to the posterior end of the lower median ridge. Between the eye tubercle and the anterior part of the upper median ridge is a short, convex-upwards ridge.

The posterior third of the carapace is decorated with small nodes and undulate ridges. Surface between the ribs with parallel rows of well developed pits.

Eye tubercle present but not prominent; subcentral complex marked.

Left valve slightly larger than the right, overreaching it most conspicuously along the antero-dorsal and posterior margins.

Sexual dimorphism strongly pronounced, the presumed males more elongate, less high and wide than the presumed females.

In dorsal view carapace compressed, with rounded anterior and posterior margins, maximum width and thickness behind the mid-point.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.19 pl.30, figs, 4, 5

L = 480 um

H = 250 um

Paratype ♂ carapace HU.278 T.20.1 pl.30, fig. 1

L = 510 um

H = 240 um

Paratype ♀ carapace HU.278 T.20.2 pl.30, fig. 2

L = 450 um

H = 250 um

Affinities and Differences:

This species has some similarities to Stigmatocythere latebrosa Lyubimova and Guha 1960, but it is easy to distinguish S. cellulosa sp.nov. from all described species of Stigmatocythere due to its characteristic surface ornamentation, particularly the two median parallel ridges and ill-defined nature of the curved ridge.

Distribution: Stigmatocythere cellulosa sp.nov. was found at Dohuk locality of Northern Iraq.

Tribe ECHINOCYTHEREIDINI Hazel 1967

Genus ECHINOCYTHEREIS Puri, 1954

Subgenus SCELIDOCYTHEREIS Siddiqui, 1971

Type species: Echinocythereis (Scelidocythereis) multibullata Siddiqui, 1971

Echinocythereis (Scelidocythereis) asiatica sp.nov.

pl.31, figs. 1-6

Derivation of name: In the occurrence of the species and the first description of the subgenus in Asia.

Holotype: A male carapace HU.278 T.23.

Paratypes: Five specimens HU.278 T.24, 1-5.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 45, sample No. SHI.25.

Material: Twenty specimens.

Diagnosis: An elongate species of the subgenus Scelidocythereis in which the posterior end forms an ear-shaped projection with the dorsal margin; surface ornamented with nodes or tubercles and longitudinal ridges above the ventral margin.

Description:

Carapace elongate, subrectangular in side view, greatest height at the anterior cardinal angle, greatest length passes through mid-point.

Anterior end obliquely rounded with primitive marginal rim; posterior end narrowly truncated, rounded at the middle, forming an ear-shaped projection with the dorsal margin and joining the ventral margin at a marked node.

Dorsal margin straight, undulating posteriorly due to the ornamentation, with well developed anterior and posterior cardinal angles; ventral margin concave anterior to the middle, convex upwards posteriorly. Surface ornamentation a combination of papillae or small nodes and short undulating ridges superimposed on distinct reticulations in some specimens.

Dorsally above the mid-point and in the posterior half, the ornamentation consists of well developed small nodes or papillae. There is a round subcentral tubercle and above the ventral margin in the anterior half short undulate ridges cover the surface, the more prominent being two longitudinal

ridges running above the ventral margin from the anteroventral corner to terminate posteriorly anterior to the posteroventral corner. Eye tubercle, pronounced and well rounded, overreached by the anterior cardinal angle; subcentral tubercle marked but not prominent, covered with undulate ridges. Left valve larger than the right, overreaching the latter at the anterior and posterior cardinal angles. Only one valve was found, and the internal features are as those in the subgenus described by Siddiqui 1971.

In dorsal view the carapace is rounded anteriorly and narrower posteriorly with maximum width and thickness at the middle. The outline is broken up by the nodes and lateral ridges and the postero-dorsal ear-shaped projection is very distinctive along the dorsal margin.

Sexual dimorphism very pronounced, the presumed females are higher and wider than the elongate, narrower, presumed males.

Dimensions of figured specimens:

Holotype ♂ carapace HU.278 T.23 pl.31, figs. 1, 4

L = 590 um

H = 300 um

Paratype ♀ carapace HU.278 T.24.1 pl.31, figs, 3, 6

L = 550 um

H = 310 um

Paratype ♀ carapace HU.278 T.24.2 pl.31, fig. 2

L = 570 um

H = 300 um

Paratype ♂ carapace HU.278 T.24.3 pl.31, fig. 5

L = 540 um

H = 310 um

Affinities and Differences:

Echinocythereis (Scelidocythereis) asiatica sp. nov. differs from E. (Scelidocythereis) multibulleta Siddiqui 1971, in having comparatively narrower, and slimmer presumed males, a distinctive hinge ear-shaped postero-dorsal angle and a marked node at the postero-ventral corner. The Iraqi species is characterised by well developed undulating ridges along the anterior and ventral areas and by the absence of the marginal denticles. In addition the present species is characterised by the truncated posterior end which is rounded in Siddiqui's species.

Distribution: This species was found at the Hamrin, Kirkuk, Dohuk and Sheikh Ibrahim localities of Northern Iraq.

Genus ALOCOPOCYTHERE Siddiqui, 1971

Type species: Alocopocythere transcendens Siddiqui, 1971

Alocopocythere fossularis (Lyubimova and Guha) 1960

pl. 31, figs. 7 - 12

pl. 32, figs. 1, 4

Trachyleberis fossularis Lyubimova and Guha, in Lyubimova, Guha and Mohan, 1960, pp. 40-41, pl.3, fig. 7.

Cytheretta charopadiensis Tewari and Tandon, 1960, pp. 159-160, text, fig. 5, figs. 4a-b.

?Cytheromorpha sp. indet. Bhatia and Mondwal, 1960, p.282, pl. 41, fig. 10.

Echinocythereis fossularis (Lyubimova and Guha), Guha 1961, p.4, figs. 5, 9.

Guha et al. 1965, p.13, pl.3., fig. 12.

Quadracythere fossularis (Lyubimova and Guha), Guha 1968a, pp. 215-216, pl.2, fig. 20.

Alocopocythere fossularis (Lyubimova and Guha) 1960, Guha 1975, p.18.

Alocopocythere fossularis (Lyubimova and Guha) Siddiqui 1971, p. 14, 15.

Alocopocythere fossularis (Lyubimova and Guha) Khosla 1978, pp. 266-267, pl. 4, fig. 2.

Figured specimens: HU.278 T.25, 1-6.

Horizon: M. Miocene, L. Fars Formation, bed No.19, sample No. SH.11.

Locality: Sheikhan anticline, N. limb, 28 km NE of Mosul City.

Material: One hundred and fifty specimens.

Description: Carapace subrectangular to subquadrate in lateral view, greatest height at the anterior cardinal angle, greatest length passes below the middle. Anterior margin gently sloping in the upper part, obliquely rounded below; anterior marginal rim which is well-developed and prominent anteriorly is less well-developed in its continuation along the ventral margin; posterior margin curving down obliquely, sloping slightly in its upper part and joining the dorsal margin at the ear-shaped cardinal angle.

Lateral surface strongly ornamented with tetragonal or pentagonal reticules.

Dorsal margin humped due to the ornamentation with distinct anterior and posterior cardinal angles, more prominent in the left valve, ventral margin slightly concave anterior to the middle, curving upwards posteriorly;

subcentral tubercle present but not pronounced.

Eye tubercle large, rounded and overreached by the anterior cardinal angle, the diagnostic ridge and furrow well developed. In some specimens a short lateral spine is developed above the postero-ventral corner, at one eighth of the length from the posterior end. In dorsal view carapace slightly tumid in the posterior half, maximum thickness and width just behind the middle; rounded anterior end, narrowly rounded posterior end.

Internally the valves are deep with a moderately wide duplicature anteriorly; line of concrescence and inner margin coincide throughout. Selvage prominent in both valves, sub-peripheral in the left and running sub-parallel to the outer margin of the right valve; marginal pore canals simple and numerous. Hinge holamphidont, the right valve with a relatively high anterior tooth, deep rounded socket opening into posteromedian groove and high reniform posterior tooth. In the left valve the deep, rounded anterior socket is bounded on all sides and followed by a postjacent antero-median tooth, separated from the elongate, posterior socket by a well-developed longitudinal postero-median bar. Sexual dimorphism well marked the presumed females higher, wider and more quadrate than the presumed males.

<u>Dimensions of figured specimens</u>:

Carapace ♂ HU.278 T.25.1 pl.31, fig. 7

L = 780 um

H = 455 um

Carapace ♂ HU.278 T.25.2 pl.31, figs. 8, 9

L = 850 um

H = 440 um

Carapace ♀ HU.278 T.25.3 pl.31, fig. 10

L = 850 um

H = 470 um

Carapace ♀ HU.278 T.25.4 pl.31, fig. 11

L = 790 um

H = 440 um

Carapace ♀ HU.278 T.25.5 pl.31, fig. 12

L = 790 um

H = 470 um

♂ RVI HU.278 T.25.6 pl.32, fig.1

L = 750 um

H = 360 um

♂ LVI HU.278 T.25.7 pl.32, fig. 4.

L = 770 um

H = 410 um

Remarks:

Lyubimova and Guha 1960, described Trachyleberis fossularis 1960 from the M. Miocene of Kutch, Western India, but later the species was transferred to Alocopocythere by Siddiqui, 1971. In overall shape, size and external appearance, the Iraqi form agrees well with their original description, although there is a slight difference in reticulation which is deeper in the Indian specimen. There are also slight differences in posterior shape and a shallow furrow is developed in front of the eye tubercle in the Iraqi form.

Distribution: This species was found at Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk, Hamrin and Bai Hassan.

Alocopocythere sheikhibrahimensis sp. nov.

pl.32, figs. 2, 3, 5, 6

Derivation of name: From the type locality.

Holotype: A female carapace HU.278 T.26.

Paratypes: Five specimens HU.278 T.27, 1-5.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 69, sample No. SHI.38.

Material: Forty specimens.

Diagnosis: A species of Alocopocythere strongly ornamented with relatively deep fossae with superimposed lineations which are more prominent posteriorly.

Description:

Carapace subrectangular in side view, greatest height at the anterior cardinal angle. Anterior margin obliquely rounded with higher marginal rim which becomes lower and less distinct along the ventral margin, posterior margin slightly rounded at the middle, curving down ventrally.

Dorsal margin humped due to the ornamentation with anterior and posterior cardinal angles, which are more prominent in the left valve; ventral margin slightly concave anterior to the middle, curving upwards posteriorly.

Lateral surface strongly ornamented with deep fossae, separated by thick muri forming parallel rows along the posterior half. A short, vertical ridge originates at the eye tubercle and has a well-developed furrow behind it and a distinct spine above the postero-ventral corner is seen in some specimens.

Left valve larger than the right, overreaching the latter along the anterior and posterior cardinal angles.

Eye tubercle ovate and well developed.

Internally the valves are deep with moderately wide duplicature, and the line of concrescence and inner margin coincide throughout.

The well-developed selvage runs subperipherally and is bounded by the anterior flange grooves; marginal pore canals, simple, elongate, numerous anteriorly. Other internal details unknown.

In dorsal view maximum width and thickness behind the middle.

Sexual dimorphism marked, the presumed males less high and narrower than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.26 pl.32, fig. 3

L = 640 um

H = 390 um

Paratype ♀ carapace HU.278 T.27.1 pl.32, fig. 6

L = 610 um

H = 405 um

Paratype ♂ carapace HU.278 T.27.2 pl.32, fig.2

L = 600 um

H = 380 um

Paratype ♀ carapace HU.278 T.27.3 pl.32, fig. 5

L = 690 um

H = 370 um

Affinities and Differences:

Alocopocythere sheikhibrahimensis sp. nov. is fairly similar to Alocopocythere gujaratensis Khosla 1978, but differs from the latter in having deep fossae separated by thick muri, which tend to form parallel rows, convex upwards in the posterior half.

The present species shows some similarities to Alocopocythere radiata in outline but the latter differs in its coarser reticulate surface with superimposed ridges and the ventral inflation culminates in a marked ventral ridge almost parallel to the ventral margin which is not seen in the present species. Siddiqui's species also has a narrower and slightly pointed posterior end at the mid-height.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim and Naft Khana localities of Northern Iraq.

Alocopocythere sp.

pl. 32, figs. 7,8

Figured specimens: HU.278 T.28, 1-2

Horizon: M. Miocene, L. Fars Formation at depth (315-316) m.

Locality: Kirkuk Well 208. Northern Iraq.

Material: Six specimens.

Description: Small, subrectangular to subquadrate carapace in side view, greatest height at the anterior cardinal angle.

Anterior margin obliquely, broadly rounded, posterior end narrowly obliquely rounded.

Dorsal margin nearly straight with prominent anterior and posterior cardinal angles and gently sloping backwards in the anterior half, ventral margin slightly concave in the anterior half, curving upwards posteriorly.

Lateral surface finely ornamented with pentagonal or tetragonal reticules; two fine ridges originate at the eye tubercle, one short vertical ridge bounded posteriorly by a shallow furrow, the other running over the anterior margin and continuing along the ventral and posterior as a less developed ridge. The ventral inflation tends to form a ridge parallel to the ventral margin and terminates in a small spine above the postero-ventral corner.

Eye tubercle small, high and distinct, bounded posteriorly by a longitudinal furrow. The marked subcentral tubercle has a rounded flattened surface.

Internal characters not known.

Dimensions of figured specimens:

Carapace ♀ HU. 278, T.28.1 pl.32, fig. 7

L = 500 um

H = 330 um

Carapace ♂ HU.278 T.28.2 pl.32, fig. 8

L = 550 um

H = 330 um

Remarks: Rare specimens were found in the L. Fars Formation (M. Miocene) of Northern Iraq. The present species is easily distinguished from all described species of Aiocopocythere by its finely reticulate surface and narrower, rounded posterior end.

Aiocopocythere coarctata Siddiqui 1971 is somewhat similar to the present species but differs in being short, less high and narrower, with sinuous dorsal margin and faint longitudinal ridges superimposed on the reticulations.

Subfamily BUNTONIINAE Apostolescu 1961

Genus BUNTONIA Howe, 1935

Type species: Buntonia shubutaensis Howe 1935 (= young of ? Cythereis israelskyi Howe and Pyeatt 1935)

Buntonia sheikhanensis sp.nov.

pl.32, figs. 9-12

Derivation of name: From the type locality.

Holotype: A female carapace HU.278 T.29

Paratypes: Two specimens HU.278 T.30, 1-2

Type locality: Sheikhan anticline, N. limb, 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 20, sample No. SH.11.

Material: Twelve specimens.

Diagnosis: A species of the genus Buntonia Howe 1935 characterised by 5 - 6 shallow longitudinal grooves, separated by longitudinal ribs in the lower part of the posterior half. Sexes easily distinguished.

Description:

Elongate carapace, oval to pear-shaped in lateral view, greatest height at the anterior cardinal angle, maximum length at one quarter of the length above the ventral margin. Anterior margin obliquely rounded, with faint costa forming the outer rim and running along the ventral margin to terminate in a small node or spine at the posteroventral corner. Posterior end narrowly, obliquely rounded, slightly concave in the upper part of the left valve.

Dorsal margin straight, sloping gently backwards toward the posterior end, with rounded anterior and posterior cardinal angles; ventral margin concave anterior to the middle, slightly convex posteriorly, with gentle slope in the posterior third.

Lateral surface oranmented with 5 - 6 shallow longitudinal grooves, separated by longitudinal costae in the lower part of the posterior half, originating just anterior to the middle and running backwards posteriorly as do the grooves. There is a faint rib which passes through the posterior ends of all longitudinal costae and continues above the ventral margin in some specimens. The rest of the surface is covered with numerous pits. These are large posteriorly with a deep anterior part and shallow posterior part and fine along the dorsal and anterior margins.

Eye tubercle not well developed.

Left valve larger than the right, overreaching the latter at the anterior and posterior margins. Sexual dimorphism strongly pronounced, the presumed males more elongate, narrower, less high and wide than the presumed females.

Internal details not known.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.29 pl.32, fig. 10, 12

L = 510 um

H = 290 um

Paratype ♂ carapace HU.278 T.30.1 pl.32, fig. 9, 11

L = 550 um

H = 235 um

Affinities and Differences:

Buntonia sheikhanensis sp. nov. most closely resembles Buntonia secedens (Lyubimova and Guha 1960), but the latter differs in having a symmetrical, regularly rounded anterior end and differently shaped posterior end. The lateral surface of the Indian species is covered with elongated and frequent costae which become indistinct in the anterior part, while in the present species the costae are thicker and originate just anterior to the middle running backwards in the lower part of the posterior half. The marked overlap of the present species is not seen in Lyubimova and Guha species.

Buntonia paucisulcata Al-Furaih 1980 differs from the Iraqi species in its

carapace which has compressed anterior and posterior ends with tumid central portion and a row of small pits in each groove, while the present species has a flattened carapace and no pits are seen along the longitudinal grooves.

Distribution: This species was found at the Sheikhan, Dohuk, Hamrin and Naft Khana localities of Northern Iraq.

Genus ISOBUNTONIA Apostolescu 1961

Type species: Isobuntonia harpa Apostolescu 1961

Isobuntonia pulchra sp. nov.

pl.28, figs. 7,8,10-12

pl.29, figs. 1,4

Derivation of name: In reference to its handsome ornamentation.

Holotype: A male carapace HU.278 T.13.

Paratypes: Six specimens HU.278 T.14. 1-6.

Type horizon: M. Miocene, L. Fars Formation, bed no.10, sample no. BA.7.

Type locality: Bashiqa anticline, S. limb. 10 km NE of Mosul City.

Material: Twenty five specimens.

Diagnosis: Sexual dimorphism strongly pronounced, the males are longer, narrower and less high than the presumed females; the first anterior ridge terminates in two pointed spines posteriorly above the postero-ventral corner; prominent anterior and posterior cardinal angle particularly in the right valve.

Description: Carapace elongate, subrectangular in lateral outline, greatest height passing through the eye tubercle, greatest length just above the

mid-height. Anterior margin, obliquely rounded with traces of denticles ventrally; posterior margin subtriangular, pointed in the middle, denticulate ventrally. Dorsal margin straight but appears to be convex due to the overreaching of the dorsal ridge, more conspicuous in the left valve; anterior and posterior cardinal angles well marked, the posterior one the more distinct. Ventral margin concave anterior to the middle, slightly convex posteriorly. Lateral surface with strong ornamentation of longitudinal and diagonal ridges; four to five ridges running backwards posteriorly. The dorsal one starts behind the eye tubercle curves upwards posteriorly, overreaching the dorsal margin and forming an outer convex flange; the second starts at the same point bending down sharply mid-dorsally to terminate in a small node anterior to the middle of the posterior end; the third, fourth and fifth (which is less prounounced in some specimens) originate from the subcentral tubercle, run convexly upwards and then bend down to end in a small node anterior to the middle of the lower part of the posterior margin. In the first third of the anterior part, three ridges spring from the eye tubercle, run parallel to the anterior margin and then bend down to run backwards parallel to the ventral margin. The first of these forms a flange above the ventral margin and merges into the posterior end; the second continues above the ventral margin and is less pronounced; the third is very distinctive, lies above the ventral margin and terminates above the postero-ventral corner in two, well-developed, upward pointing spines. These ridges show a degree of variation in their development in the various specimens. The rest of the surface is strongly reticulate with deep fossae separated by thick muri which tend to be parallel in the marginal areas, concentric around the subcentral tubercle and form parallel rows in the posterior half of the shell.

Eye tubercle rounded and distinct; subcentral tubercle well marked, flattened and elongate in shape. Left valve larger than the right overlapping almost along the entire margins but more conspicuously along the dorsal margin.

Inner margin and line of concrescence coincide throughout, duplicature of moderate width with distinctive anterior flange, selvage well-developed, parallel to the outer margin, more distinctive at the anterior margin.

Normal pore canals simple and numerous; radial pore canals straight, some paired and denser at anteroventral corner.

Hinge holamphidont; in the left valve consisting of a deep anterior socket, a rounded, outstanding anterio-median tooth which continues anteriorly in a small ridge separating the anterior socket from the eye-sinus, a postero-median element represented by an elongate bar, and a quadriloculate posterior socket.

Muscle scar pattern consists of four adductor scars, in a vertical row and U-shaped frontal scar. In dorsal view carapace biconvex, with narrowly, rounded anterior end, pointed posterior end; maximum width and thickness at the middle. Sexual dimorphism strongly pronounced, the presumed males more elongate and less high than the presumed females; in dorsal view the male is slimmer than the female.

Dimensions of figured specimens

Holotype ♂ carapace HU.278 T.13 pl.28, figs. 7, 10

L = 790 um
H = 350 um
W = 400 um

Paratype ♀ carapace HU.278 T.14.1 pl.28, figs. 8, 11

L = 760 um

H = 410 um

W = 420 um

Paratype ♂ carapace HU.278 T.14.2 pl.29, fig. 4

L = 810 um

H = 400 um

Paratype ♀ carapace HU.278 T.14.3 pl.29, fig. 1

L = 760 um

H = 405 um W = 420 um

Paratype ♂ LVI HU.278 T.14.4 pl.28, fig. 12

L = 765 um

H = 410 um

Affinities and Differences

This species is fairly similar to Isobuntonia harpa Apostolescu 1961, but it is distinguished by the well developed longitudinal reticules parallel to the ridges, and the anterior ridge terminates in two pointed spines posteriorly above the postero-ventral corner. In addition the present species more elongate and less high than Apostolescu's species.

Distribution: This species was found in the Bashiqa, Dohuk and Sheikh Ibrahim sections of the L. Fars Formation in Northern Iraq.

Isobuntonia cuspidata sp.nov.

pl.33, figs. 1-3

Derivation of name: In reference to the pointed posterior end.

Holotype: A male right valve HU.278 T.31

Paratypes: Two valves HU.278 T.32.1-2

Type locality: Hamrin well-2, N. Iraq.

Horizon: M. Miocene, L. Fars Formation at depth (314-315 m)

Material: Six specimens

Diagnosis: A species of the genus Isobuntonia Apostolescu 1961 with a median pointed posterior end, and deep rounded pits arranged in longitudinal rows between the ridges.

Description: Small to medium sized carapace elongate subrectangular to subtriangular in lateral view, greatest height at the beginning of the anterior third, maximum length at mid height.

Anterior margin obliquely rounded, gently sloping in the upper half, posterior margin narrower, pointed at the middle.

Dorsal margin slightly convex, gently sloping backwards in the posterior half, with anterior and posterior cardinal angles, of which the latter is more prominent in some specimens. Ventral margin slightly concave anterior to the middle, convex at the middle, curving upwards posteriorly to join the posterior margin.

Lateral surface is reticulate. Five longitudinal ridges are developed in the posterior half, the first one below the dorsal margin commences

anterior to the subcentral tubercle and runs upwards diagonally forming an acute angle anterior to the mid-dorsal margin; it then curves convexly towards the posterior end, and joins other ridges at the mid-posterior third; its anterior end is joined to the anterior ridge in some specimens. The second, third and fourth ridges start from the posterior half of the subcentral tubercle, and run posteriorly where they all join together form a half circle anterior to the posterior end. The fifth (ventral) ridge starts above the antero-ventral corner, runs backwards overhanging the ventral margin and joins the fourth ridge anterior to the posterior end. The two anterior ridges run parallel to the anterior margin; the outer one is well-developed and joins the eye tubercle, their development showing variation among different specimens. The interspaces between the ridges are strongly pitted, rounded pits following the pattern of the longitudinal and diagonal ridges.

Eye tubercle rounded with glassy appearance; eye sinus present with a furrow behind it.

The duplicature is moderately wide along the anterior and posterior margins, there is a well-developed sub-peripheral selvage anteriorly and a well-developed anterior flange. Hinge in the right valve consists of inflated anterior tooth followed by a deep antero-median socket which is bounded ventrally to the continuation of the anterior tooth and opens into a shallow, crenulate, postero-median groove; there is a well-developed reniform posterior tooth. The left valve hinge is complementary, other internal features as those in the genus.

Sexual dimorphism present, the presumed females are higher anteriorly and

slightly wider than the presumed males.

Dimensions of figured specimens:

Holotype ♀ RV HU.278 T.31 pl.33, figs. 2, 3

L = 670 um

H = 350 um

Paratype ♂ RV HU.278 T.32.1 pl.33, fig. 1

L = 685 um

H = 335 um

Affinities and Differences:

This species is fairly similar to Isobuntonia pulchra sp.nov. but differs in being narrower and smaller in size, the anterior ridges are less developed in this species, and the dorsal ridge forms an acute angle below the eye tubercle, the pits are deep and rounded in shape, while more elongate in I. pulchra sp. nov. In addition the subcentral tubercle is situated closer to the anterior and ventral margin in the present species.

Distribution: Rare specimens were found at the Dohuk locality of the L. Fars Formation, Norther Iraq.

Genus ASYMMETRICYTHERE Bassiouni 1971

Type species: Asymmetricythere hiltermanni Bassiouni 1971

Asymmetricythere reticulata sp.nov.

pl. 33, figs. 4-10

Derivation of name: In reference to its reticulate ornamentation.

Holotype: A male carapace HU.278 T.33

Paratypes: Six specimens HU.278 T.34, 1-6

Type horizon: M. Miocene, L. Fars Formation, bed No. 20, sample No. SH.11

Type locality: Sheikhan anticline, N. limb, 28 km NE of Mosul City.

Material: Two hundred specimens.

Diagnosis: A species of Asymmetricythere with a carapace strongly inflated ventrally, posterior end strongly concave in the upper third, lateral surface strongly reticulate.

Description: Medium to large size with greatest width in the posterior half. Carapace subrectangular in side view, greatest height at mid-dorsal margin, greatest length at mid-height.

Anterior margin obliquely rounded, denticulate ventrally, posterior end narrower, concave in the upper third, 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 to slightly convex at the middle with prominent anterior and posterior cardinal angles, ventral margin modified by ventral swelling, slightly concave anterior to the middle in some specimens, convex at the middle, curving upwards posteriorly.

The lateral surface is strongly reticulate; three longitudinal ribs run along the ventrolateral swelling, continue along the anterior margin and follow its general infracurvature to end below the eye tubercle, the upper two are connected by a short rib above the antero-ventral corner, both of

them terminate in a small node at the beginning of the posterior third of the valve. From the mid-dorsal margin, ribs radiate towards the anterior and posterior halves; at the middle the ribs are nearly straight. The pits, which are coarser centrally, are deep, rounded and elongate forming parallel rows along the ventral side, and following the anterior and dorsal ribs in their patterns.

Eye tubercle rounded and well-developed.

Left valve larger than the right, overreaching it more conspicuously along the posterior and ventral margins.

Line of concrescence and inner margin slightly separated anteriorly forming a narrow vestibule. The duplicature is moderately wide, the selvage is well-developed antero-ventrally and there is a well developed anterior flange.

Because of strong calcification and heavy reticulation muscle scars cannot be seen; marginal pore canals are straight and simple.

Hinge in the left valve, consists of fairly deep anterior socket, bounded dorsally and separated from the ocular socket by a curved partition, which is thickened at the middle; the anteromedian tooth is represented by slightly swollen anterior end of the thick, median longitudinal bar, which is followed by a quadriloculate posterior socket. In the right valve the sharp anterior tooth with postjacent socket, opens into a crenulate postero-median groove and a thick, posterior tooth projects on a platform.

Sexual dimorphism pronounced, the presumed males less high and wide than the presumed females; in dorsal view the latter are more swollen than the presumed males, maximum thickness and width in the posterior half.

Dimensions of figured specimens:

Holotype ♂ carapace HU.278 T.33 pl.33, figs. 5, 8
L = 720 um
H = 410 um
W = 420 um

Paratype ♀ carapace HU.278 T.34.1 pl.33, figs. 4,7
L = 710 um
H = 415 um
W = 450 um

Paratype ♂ carapace HU.278 T.34.2 pl.33, fig. 6
L = 710 um
H = 400 um

Paratype ♀ carapace HU.278 T.34.3 pl.33, fig. 9
L = 720 um
H = 425 um

Paratype ♀ LV HU.278 T.34.4 pl.33. fig. 10
L = 610 um
H = 390 um

Affinities and Differences:

From Leguminocythereis lunejensis Guha 1968, the present species differs in being more elongate with the carapace swollen ventrally, strong reticulation with coarser and better developed pits and well developed ribs along the dorsal, anterior and ventral margins. Guha's species is

characterised by its less-developed ribs and reticulation, besides being more quadrate with a narrower posterior end.

L. obesa Stchepinsky 1960 differs in being more quadrate, strongly inflated ventrally and in the ribs forming a concentric pattern above the ventral margin and anterior to the distinct subcentral tubercle which is indistinct in the present species.

From Asymmetricythere yousefi Bassiouni 1971, the present species differs in having well developed ribs and coarse reticulation, while Bassiouni's species has narrower posterior end and the carapace becomes narrower posteriorly.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk and Hamrin localities of Northern Iraq.

Tribe LEGUMINOCYTHERINI Howe 1963

Genus RUGGIERIA Keij 1957

Subgenus RUGGIERIA Keij 1957

Type species: Cythere michelinia Bosquet 1852

Ruggieria (Ruggieria) nova sp. nov.

pl.33, figs. 11, 12

pl.34, figs. 1-4

Derivation of name: L. novus - new

Holotype: A female carapace HU.278 T.35

Paratypes: Three specimens HU.278 T.36, 1-3

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 1, sample No. BA.1.

Material: Twenty specimens

Diagnosis: A species of the subgenus Ruggieria characterised by three longitudinal ridges and slightly compressed posterior end, lower than the anterior end.

Description:

Carapace elongate, subovate to oblong in lateral view, greatest height anteriorly, maximum length at below mid-height.

Anterior margin gently sloping in the upper part, broadly, obliquely rounded in the lower part and with a marginal row of 12-15 fine denticles; posterior end slightly compressed and lower than the anterior, sub-triangular shape, slightly concave in the upper part, gently convex in the posterior half, joining the posterior end with an obtuse angle; anterior cardinal angle high and smoothly curved, ventral margin nearly straight, smoothly joining the anterior and posterior ends.

The lateral surface has three longitudinal ridges, the ill-defined dorsal one forms the thickest dorsal margin in some specimens and in others bends down posteriorly; the median ridge starts at the posterior end of the subcentral tubercle and runs backwards to end at two-thirds of the length with slight ala in some specimens; a strongly developed ventral ridge starts from the ventral third of the anterior end and runs posteriorly, overhanging the ventral margin, forming an ala of the posterior end above the postero-ventral corner. Between the ventral ridge and the ventral margin, there is a weak ventrolateral rib which ends posteriorly below the

posterior end of the ventral ridge; the anterior continuation dies out in the weakly developed submarginal anterior ridge. The rest of the surface is smooth.

Eye tubercle present but not prominent, overreached by the anterior cardinal angle; subcentral tubercle marked and forms the anterior end of the median ridge. Left valve larger than the right, overreaching the latter along the posterior and antero-dorsal margins.

Sexes easily distinguished, males more elongated and narrower than the presumed females.

Only one fragile valve was obtained, and it is very difficult to see all the internal features, but the available ones conform with the diagnostic features of the subgenus.

In dorsal view the carapace is sagittate or arrow-head shaped with rounded anterior end and pointed posterior end, the lateral alae are very prominent; maximum width and thickness in the posterior half.

Dimensions of figured specimens:

Holotype	♀	carapace	HU.278 T.35	pl.33, fig. 11 pl.34, figs. 1, 4a
		L = 800 um		
		H = 390 um		
Paratype	♂	carapace	HU.278 T.36.1	pl.33, fig. 12 pl.34, figs. 2, 3
		L = 720 um		
		H = 380 um		

Affinities and Differences:

Ruggieria (Ruggieria) nova sp. nov. is fairly similar to Ruggieria tetraptera tetraptera (Sequenza 1879) as figured by Bassiouni 1979 from the Neogene of Turkey, but the Iraqi species differs in being higher with comparatively broad anterior and posterior margins, whilst the median ridge swells slightly anteriorly to form the subcentral tubercle which is not seen in the Turkish material.

In addition R. (R.) tetraptera tetraptera has a distinctive concave postero-ventral corner. The present species shows some similarities to Ruggieria dictyon Bold 1966 but the latter differs in its subrectangular shape and strong reticulation with deep rectangular, square and hexagonal pits.

Distribution: This species was found at the Bashiqa and Dohuk localities of Northern Iraq.

Family HEMICYTHEREIDAE Puri 1953

Subfamily HEMICYTHERINAE Puri 1953

Tribe AURILINI Puri 1973

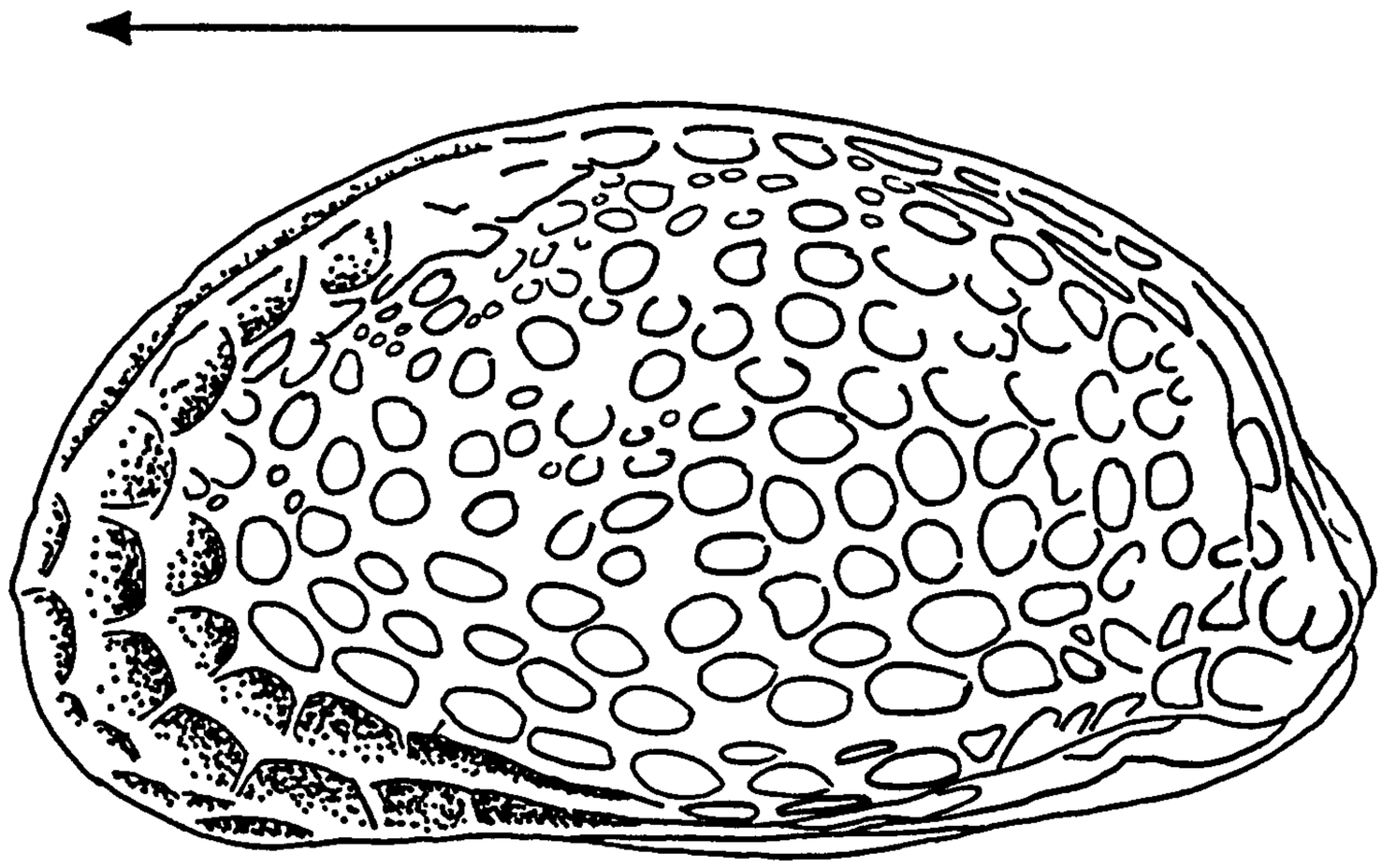
Genus MUTILUS Neviani 1928

Type species: Mutilus retiformis (Terquem) by G. Ruggieri and P.C. Sylvester-Bradley, Stereo-Atlas of Ostracod shells, pt. 2, 1973.

Mutilus fortireticulata sp.nov.

pl.34 figs. 4b, 5-9, 12

Derivation of name: In reference to its strong reticulation.



X 127

Text fig. 16 Mutilus fortireticulata sp.nov.
HU.279 T.1 Carapace from left, lateral surface showing the ornamentation.

Holotype: A female carapace HU.279 T.1.

Paratypes: Four specimens HU.279, T.2 , 1-4.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 75, sample No. SHI.40.

Material: Eleven specimens

Diagnosis: A species of the genus Mutilus characterised by a massive carapace with four concentric ridges in the anterior third of which the last two project over the ventro-lateral inflation.

Description:

A strongly calcified carapace with semicircular outline in side view with the greatest height just behind the eye tubercle; carapace inflated ventrally with ventro-lateral prolongation.

Anterior margin forms a subcircular arc and joins the dorsal margin in a rounded angle; posterior margin narrower, concave in the upper part and ending posteroventrally in a short truncate caudal process.

Dorsal margin, in the left valve slightly convex when seen from outside and nearly straight when seen from inside, in the right valve dorsal margin slightly convex in the anterior half and gently sloping backwards in the posterior half; anterior and posterior cardinal angles present, more prominent in the right valve.

Surface ornamentation consists of thick muri some of them are fairly pitted, enclosing relatively deep rounded fossae which are arranged concentrically at the middle; along the anterior third there are four concentric ridges originating from the eye tubercle area, running parallel to the anterior

margin and forming parallel rows of rectangular or polygonal meshes anteriorly and along the ventral margin. The first ridge dies out in the ventral margin at the anteroventral corner, the second and third are connected together above the mid-ventral margin whilst the fourth one forms the lateral prolongation of the ventrolateral inflation and ends with slight alar extension in front of the caudal process, a weak prolongation is developed in some specimens at the postero-dorsal margin.

Eye tubercle small, glassy and rounded. Left valve larger than the right, overreaching more conspicuously along the dorsal, posterodorsal and antero-dorsal margins.

Duplicature moderately wide. The line of concrescence and the inner margin coincide throughout, selvage well developed and parallel to the outer margin. The marginal pore canals are straight, mostly simple, closely spaced anteriorly, less so in the posterior area. The hinge is holamphidont, in the left valve the relatively deep anterior socket is bounded ventrally by the continuation of the postero-median bar which joins the reniform posterior socket; there is a well developed knob-like antero-median tooth. Central muscle scar consists of three frontal scars and four adductor scars, some of which are divided.

In dorsal view the carapace has regularly convex sides with slightly pointed anterior and posterior ends; maximum width and thickness at the middle. Sexual dimorphism marked the presumed females a little higher and wider posteriorly than the presumed males.

Dimensions of figured specimens:

Holotype ♀ carapace HU.279 T.1 pl.34, figs. 5, 6

L = 860 um

H = 520 um

Holotype Ornamentation pl.34, fig. 4b

Paratype ♂ carapace HU.279 T.2.1 pl. 34, fig. 9

L = 830 um

H = 505 um

Paratype ♀ carapace HU.279 T.2.2 pl.34, fig. 8

L = 810 um

H = 510 um

W = 460 um

Paratype ♀ LV HU.279 T.2.3 pl.34, fig. 7

L = 760 um

H = 480 um

Paratype ♂ carapace HU.279 T.2.4 pl.34, fig. 12

L = 870 um

H = 490 um
W = 455 µm

Affinities and Differences:

Mutilus freudenthali described originally as Aurila freudenthali by Sissingh 1972 then transferred to Mutilus by N. Doruk 1973 resembles Mutilus fortireticulata sp. nov. in some respects, but differs in being larger in size, having a convex dorsal margin in both valves and a short nearly straight posterior margin, while the Iraqi species is characterised by relatively coarser fossae separated by thick pitted muri which form three concentric rows of rectangular or pentagonal shaped pits in the anterior

third and above the ventral margin, while Sissingh's species is ornamented with fossae which are variable in shape with excavate muri and with rows of angular pits along the margin. The Iraqi species also has a prominent ventrolateral ridge which forms the ventrolateral prolongation.

Aurila pigadiana Sissingh 1972 has some similarities to the present species, but the latter differs in having a strongly ornamented surface, in being more elongate with a conave ventral margin in the anterior third and a comparatively broader anterior margin. Sissingh's species may belong to Mutilus rather than Aurila but it needs further examination.

Mutilus keiji Ruggieri 1962 differs in having coarser, deep fossae and a narrower and pointed posterior end ventrally.

Distribution: This species was found at the Dohuk, Bashiqa and Sheikh Ibrahim localities of Northern Iraq.

Mutilus parcafossata sp.nov.

pl.35, figs. 1-8

Derivation of name: In reference to the small pits covering the surface.

Holotype: A female carapace HU.279 T.3.

Paratypes: Seven specimens HU.279 T.4, 1-7

Type locality: Sheik Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 45, sample No. SHI.25.

Material: Twenty specimens.

Diagnosis: A species with dense, finely pitted surface, which in some specimens develops muri forming groups of fossae each one consisting of 8 - 10 fine pits; carapace slightly swollen above the ventral margin.

Description:

Carapace almond to subtriangular shape in lateral view, greatest height just anterior to the middle, maximum length passes through the first quarter of the height above the ventral margin.

Anterior margin obliquely rounded forming a continuous curve with the dorsal margin, posterior margin narrower, short, slightly concave in the upper part and tending to produce a rounded beak ventrally.

Dorsal margin slightly convex and curving down with rounded anterior and posterior cardinal angles which are more prominent in the right valve; ventral margin straight smoothly joining the anterior and posterior angles and partially obscured by the overhanging swelling. Lateral surface densely covered with very fine pits, muri developing in some specimens to form groups of fossae each of which consists of 8 - 10 pits. Some specimens show traces of a concentric ridge along the anterior and ventral margins.

Eye tubercle present but not prominent with traces of a shallow furrow below it.

Left valve larger than the right, overreaching the latter along the dorsal, anterodorsal and posterodorsal margins.

Internally the valves are moderately deep; inner lamella of moderate width,

narrower posteriorly. Line of concrescence and inner margin coincide throughout; anterior flange distinctive in both valves and forming the outer anterior margin; subperipheral selvage well developed.

Hinge in the left valve consists of a deep anterior socket bounded dorsally and ventrally and followed by the low elongate anteromedian tooth; the postero-median bar is narrower in the middle and wider at the anterior and posterior ends, and is followed posteriorly by an elongate posterior socket which is toothled in the middle to receive the incised posterior tooth of the opposite valve. In the right valve the hinge consists of a strong, outstanding anterior tooth, a relatively deep postjacent socket opening into a shallow elongate postero-median groove, which is bounded dorsally and ventrally, the posterior element is an elongate reniform tooth which is notched in the middle; eye sinus seen at the antero-ventral end of the anterior element.

Marginal pore canals numerous simple and straight, normal pore canals moderate in number, rounded in outline and of sieve type. Only the adductor scars were seen and consists of five undivided scars. Carapace in dorsal view biconvex with narrowly rounded anterior and posterior ends, maximum width and thickness at the middle.

Sexual dimorphism pronounced the presumed males narrower, less high and wide than the presumed females.

<u>Dimensions of figured specimens:</u>

Holotype ♀ carapace HU.279 T.3 pl.35, figs. 1, 3

L = 790 um

H = 485 um

Paratype ♀ carapace HU.279 T.4.1 pl.35, fig. 2

L = 760 um

H = 450 um

Paratype ♂ carapace HU.279 T.4.2 pl.35, fig. 5

L = 750 um

H = 380 um

Paratype ♂ Hu.279 T.4.3 pl.35, figs. 4, 6

L = 770 um

H = 450 um W = 390 um

Paratype ♂ RV HU.279 T.4.4 pl.25, fig. 7

L = 740 um

H = 400 um

Paratype ♀ LV HU.279 T.4.5 pl.35, fig. 8

L = 760 um

H = 450 um

Affinities and Differences:

Mutilus parcafossata sp. nov. is easily distinguished from other species by its diagnostic characters, but it shows some similarities to Mutilus albicans Ruggieri as figured by Doruk (1973). However, the latter differs in being more tumid, higher and wider with concave ventral margin anteriorly and coarsely pitted surface, whereas the Iraqi species is finely pitted, narrower and less high.

Distribution: This species was found at the Sheikh Ibrahim locality of Northern Iraq.

Mutilus sp.

pl.34, figs.10, 11

Figured specimens: HU.279 T.5, 1-2

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 2, sample No. BA.2.

Material: Four specimens.

Description: Carapace small sized and auriform in lateral view, with the greatest height anterior to the middle. Anterior margin obliquely rounded, posterior margin subtriangular in the left valve, concave in the upper part, short and produced postero-ventrally in the right valve.

Dorsal margin broadly convex with rounded anterior and posterior cardinal angles, ventral margin sinuate, slightly angled with posterior margin.

Lateral surface finely pitted, the pits becoming coarser in the mid-dorsal area. There are traces of three concentric ribs in the anterior half with rectangular or pentagonal meshes, the first one passing through the eye tubercle and dying out at the mid-dorsal margin.

Eye tubercle present but not pronounced.

Left valve larger than the right valve, overreaching the latter along the dorsal margin and the upper part of the posterior margin.

Internal details as for the genus.

Dimensions of figured specimens:

Carapace HU.279 T.5.1 pl.34, fig. 10

L = 750 um

H = 440 um

Carapace HU.279 T.5.2 pl.34, fig. 11

L = 620 um

H = 340 um

Remarks:

The present species is fairly similar to M. fortireticulata sp. nov. but differs in its smaller size and finer ornamentation, the muri being connected in the upper half of the valves and the pits becoming coarser. However, because this species is smaller than M. fortireticulata sp. nov. and juveniles of the latter were not available for study, the present species is left under open nomenclature.

Mutilus speyeri Brady 1868 as figured by Doruk (1973) differs in being higher with coarser ornamentation and a strongly concave postero-dorsal margin.

Subfamily THAEROCYTHERINAE Hazel 1967

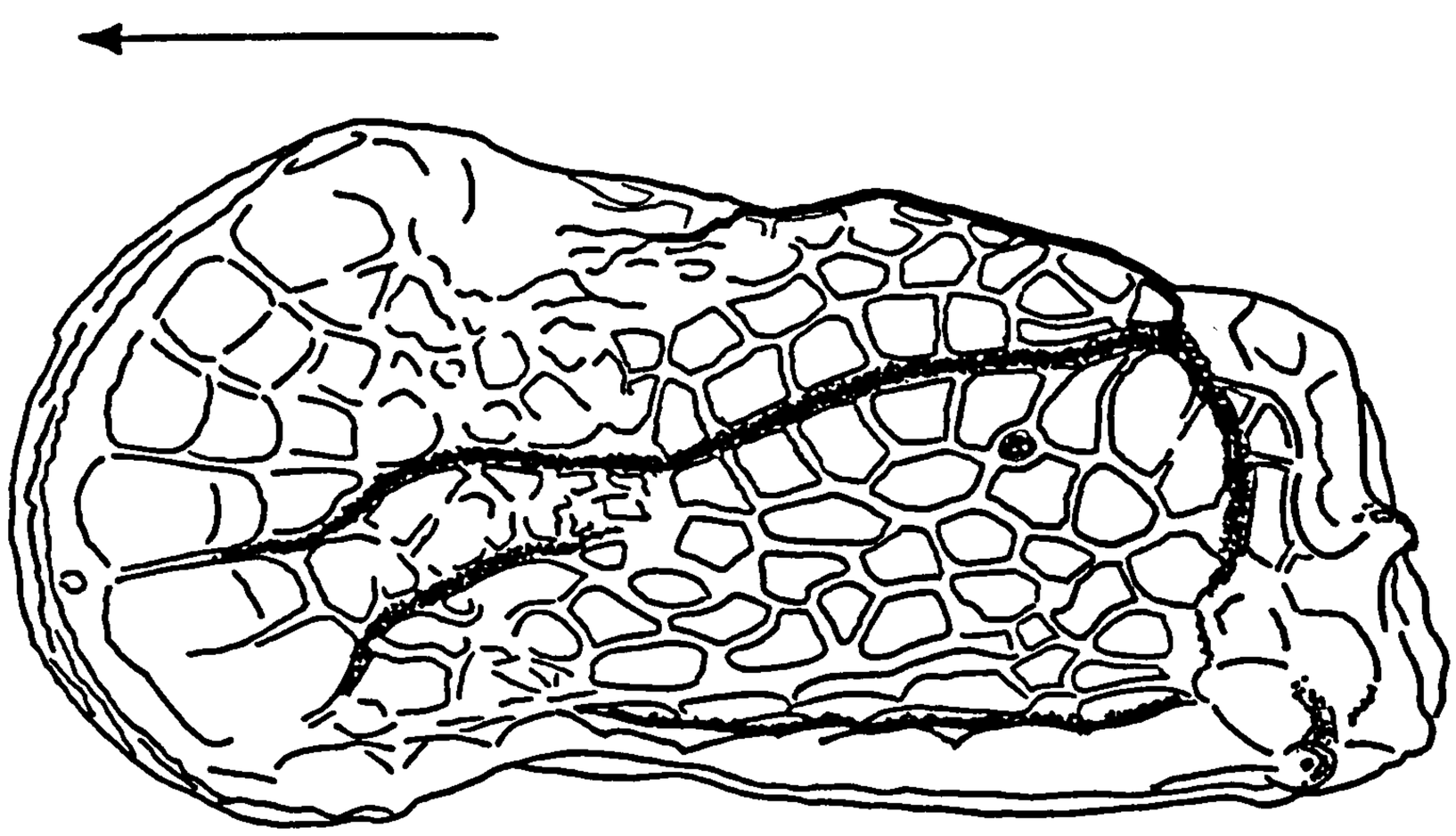
Tribe THAEROCYTHERINI Hazel 1967

Genus HERMANITES Puri 1955

Type species: Hermania reticulata Puri 1953

Hermanites transversicostata Khalaf 1982

pl. 36, figs. 1-8



X 116

Text fig. 17 Hermanites transversicostata Khalaf 1982
HU.275 T.15 Carapace from left, lateral surface showing ornamentation.

Hermanites transversicostata Khalaf, 1982. 9 (11) 59-62.

Figured specimens: Holotype ♂ carapace, HU.275, T.15.

Paratype ♀ car. HU.275, T.16.1-3

Horizon: M. Miocene.

Locality: Sheikhan anticline, Northern limb, 27 km NE of Mosul City, Northern Iraq, Lower Fars Formation, bed No. 10; M. Miocene, lat. 36° 42′ N, long. 43° 25′ E.

Material: Two hundred and fifty specimens.

Description: Carapace elongate, subrectangular in side view, greatest height passing through the anterior cardinal angle, maximum length just above the ventral margin. Anterior margin obliquely rounded, with moderate high anterior margin rim, its continuation along the ventral margin forms a marginal flange and terminated posteriorly with small node above the postero-ventral corner, posterior margin steeply inclined, narrowly rounded and produced ventrally, decorated with short spines.

Dorsal margin humped, due to the projection of the dorsal margin, with prominent anterior and posterior cardinal angles, ventral margin strongly concave just behind the anterior margin, and nearly straight after the concavity. Lateral surface marked by well developed longitudinal ridges, the dorsal one originates below the eye tubercle, running convexly backwards with projection over the dorsal margin, joined posteriorly with a short, vertical transverse ridge which terminates with small node above the ventral margin at one eighth of the length from posterior end, the ventral ridge commenced from the antero-ventral area running diagonally backwards to ends with small node above the ventral margin at the beginning of the posterior third, its anterior end joined the subcentral tubercle

by a short curved ridge, from the postero-dorsal end of the subcentral tubercle, a short curved ridge with straight course in its first third then curves down in the second third and joins the anterior margin with straight third, behind the subcentral tubercle a short ridge running diagonally towards dorsal margin to join the transverse vertical ridge at its beginning, the rest of the surface is strongly covered with reticules of different shapes, at the anterior third the subrectangular reticulae with the ridge gave a palmate appearance, small nodes scattered over the lateral surface.

Eye tubercle rounded, glassy and well developed, subcentral tubercle prominent.

Left valve larger than the right valve, overreaching along the anterior and posterior cardinal angles. Inner lamella moderately wide, line of concrescence and inner margin coincide throughout, anterior flange peripheral and well developed in both valves.

Marginal pore canals simple numerous anteriorly less along the ventral and posterior margins, selvage is well developed and runs subperipherally to the outer margin, but curves in the antero-ventral region to follow the anterior concavity in the ventral margin.

Hinge holamphidont: left valve hinge consists of two terminal sockets, antero-median element represented by subconical tooth followed by a postero-median elongate bar, in the right valve the hinge is complementary, other internal features cannot be seen. Eye sinus present at the antero-ventral end of the anterior element.

In dorsal view the sides are broken by the lateral ridge, rounded anterior end, narrowly elongate posterior end, maximum width and thickness posteriorly.

Sexual dimorphism pronounced, the presumed males more elongate, narrower, less high than the presumed females.

Dimensions of figured specimens:

Holotype carapace ♂ HU.275 T.15 pl.36, figs. 1-3

L = 992 um

H = 520 um

W = 380 um

Paratype carapace ♀ HU.275 T.16.1 pl.36, figs. 4-6

L = 824 um

H = 480 um

W = 410 um

Paratype ♂ LV HU.275 T.16.2 pl.36, fig.7

L = 950 um

H = 520 um

Paratype ♂ RV HU.275 T.16.3 pl.36, fig. 8

L = 795 um

H = 425 um

Affinities and Differences:

Hermanites transversicostata shows affinities with Hermanites cracens Siddiqui 1971 but, in the present species, the dorsal margin is humped and the ventral margin strongly concave just behind the anterior margin. Furthermore, the posterior margin has the steeply inclined, short posteriorly transverse ridge not seen in Siddiqui's species.

H. transversicostata differs from H. sp. cf. H. paijenborchianus Keij figured by Khosla (1978) in the shape of the posterior margin which is slightly concave posterodorsally and more rounded posteroventrally; the present species is also much longer.

Distribution: This species is found in the M. Miocene of the Tel Hajer, Sheikh Ibrahim, Sheikhan, Dohuk, Bashiqa, Kirkuk and Hamrin sections of Northern Iraq.

Hermanites compressa sp. nov.

pl.35 figs. 9-12

Derivation of name: In reference to the compressed carapace and compressed marginal rim.

Holotype: A male carapace HU.279 T.6.

Paratypes: Two specimens HU.279 T.7. 1-2

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 12, sample No. DO.11.

Material: Ten specimens

Diagnosis: A relatively stout, compressed carapace, with sponge-like reticulation and two alate ridges posteriorly.

Description: Carapace elongate, subrectangular in side view with greatest height at the anterior cardinal angle and maximum length one-third the height above the ventral margin. Anterior margin obliquely rounded with well-developed marginal rim ending dorsally in the eye tubercle.

Posterior margin, narrowly compressed, concave dorsally and slightly convex ventrally with well-marked marginal rim. Dorsal margin nearly straight, sloping gently backwards and partially obscured by the dorsal ridge and with distinct anterior and posterior cardinal angles; ventral margin straight.

Lateral surface densely covered with deep reticulation of spongy type with variable shape which becomes larger and subrectangular in the anterior half.

Well-developed dorsal and ventral ridges, the former starting mid-dorsally above the subcentral tubercle and ending in front of the posterior cardinal angle in a well-marked ala. The ventral ridge starts at the antero-ventral corner and runs diagonally backwards to end in an ala at a quarter the height above the ventral margin at two-thirds length.

Subcentral tubercle rounded and well developed.

Eye tubercle small, glassy and rounded.

Left valve larger than the right, overreaching it more conspicuously along the anterior and posterior cardinal angles.

In dorsal view carapace with rounded anterior end, and slightly pointed posterior end, maximum width and thickness posteriorly.

Internal details not observed.

Sexual dimorphism well pronounced, the presumed females higher, wider and

more subquadrate than the presumed males.

Dimensions of figured specimens:

Holotype ♂ carapace HU.279 T.6 pl.35, figs. 9, 10

L = 670 um

H = 330 um

Paratype ♀ carapace HU.279 T.7.1 pl.35, figs. 11,12

L = 620 um

H = 340 um

Affinities and Differences:

This species somewhat resembles Hermanites goeli Khosla 1972 in general appearance, but differs in being more elongate and slightly narrower with dorsal and ventral ridges alate posteriorly. Hermanites ulrichi Bold 1961 differs in being relatively higher and having larger and irregular meshes in the posterior portion which become smaller anteriorly and a median ridge is also present in Bold's species. From Hermanites purii Tewari and Tandon 1960 the present species can be distinguished by its type of ornamentation and straight dorsal and ventral margins which are wavy and undulate in the Indian species.

Distribution: A few specimens were found in the Dohuk section of the L. Fars Formation, M. Miocene, Northern Iraq.

Tribe BRADLEYINI Benson 1972

Genus QUADRACYTHERE Hornibrook 1952

Subgenus Mosulia nov.

Etymology from the type locality Mosual area.

Type species: Quadracythere (Mosulia) pulchra sp.nov.

Diagnosis: Subovate, ventrally inflated carapace with prominent wing-like lateral expansion and two longitudinal ridges which dies out posteriorly: pronounced postero-ventral caudal process, pitted surface, eye tubercle low and faint with diagonal furrow behind.

Remarks: Van Morkhoven 1962 has suggested that it is desirable to split up Quadracythere into several subgenera because of variability in type of ornamentation and outline. Later Moos 1965 erected Hornibrookella as a new subgenus of Quadracythere, on the basis of the division of the uppermost adductor muscle scar. Al-Furaih 1977 raised Hornibrookella to full generic status on the basis that Hornibrookella does not develop the median longitudinal ridge. Al Furaih found that the division of adductor muscle scar of Hornibrookella varies within a single species.

The new subgenus is erected to accommodate all the species of short, subovate shape with convex dorsal margin, prominent wing-like lateral expansion, and covered with small rounded pits.

The new subgenus differs from Brachycythere in having wing-like lateral expansion and lobed posterior tooth, whilst the latter is characterised by conspicuous ventrolateral swelling and elongate/crenulate posterior tooth. Anommatocythere Sohn 1971 differs in having a reticulate surface and in the reticulae being arranged in lines separated by longitudinal ribs. Sohn's genus also lacks the prominent ventral wing which is more prominent in the new subgenus.

From the above discussion, it is proposed that Quadracythere split into three subgenera.

1. Quadracythere Hornibrook 1952 to include species with subquadrate carapace in lateral view. Lateral surface reticulate with ventral and dorsolateral keels. Posterior margin produced a distinct caudal process. Hinge holamphidont.

2. Hornibrookella Moos 1965, because the characters used by Al-Furaih 1977, are of subgeneric level rather than generic status, therefore Hornibrookella a subgenus of Quadracythere to include species with more elongate shape and characterised by the absence of the median longitudinal ridge .

3. Mosulia nov. see diagnosis.

Quadracythere (Mosulia) pulchra sp.nov.

pl. 30, figs. 3, 6, 7-12

Derivation of name: In reference to its elegant shape and ornamentation.

Holotype: A female carapace HU.278 T.21.

Paratypes: Seven specimens HU.278 T.22, 1-7

Type horizon: M. Miocene, L. Fars Formation, bed No. 7 , sample No. BA.5.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Material: One hundred and twenty specimens.

Diagnosis: Ventrally inflated carapace with prominent wing-like lateral expansion and two longitudinal ridges which die out posteriorly; pronounced posteroventral caudal termination.

Description: Subrectangular to subovate carapace in side view, greatest height just behind the eye tubercle, greatest length about one-third of the height above the ventral margin.

Anterior end broadly, obliquely rounded, slightly compressed ventrally; posterior end narrowly acuminate, tending to produce a caudal process at the middle, upper half concave, lower half curving down.

Dorsal margin broadly convex in the left valve, gently sloping backwards posteriorly in the right valve with prominent anterior and posterior cardinal angles. Ventral margin straight and forming the widest part of the shell, a distinct ventrolateral wing with two longitudinal ridges overhangs the ventral margin. Surface ornamented with rounded pits which are more prominent centrally, almost smooth near the dorsal and posterior margins.

A longitudinal furrow is developed behind the pronounced eye tubercle.

Left valve larger than the right, overlapping along the entire periphery with the strongest overlap along the dorsal and posterior margins.

Internally line of concrescence and inner margin coincide; marginal pore canals are numerous, simple and straight, the selvage is prominent and subperipheral to the outer margin and there is a distinctive flange anteriorly.

Hinge in the right valve consists of a strong knob-like anterior tooth, postjacent deep socket, followed by a longitudinal groove and lobed posterior

tooth, left valve complementary but with a prominent accommodation groove. Muscle scar as in the genus. In dorsal view, the tumid carapace forms an arrow-head shape with compressed anterior end and pointed posterior one, maximum width and thickness at the middle.

Sexual dimorphism marked, the presumed males narrower, less high and wide than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.278 T.21 pl.30, figs. 7, 8
L = 682 um
H = 420 um

Paratype ♂ carapace HU.278 T.22.1 pl.30, figs. 10, 11
L = 700 um
H = 400 um

Paratype ♂ carapace HU.278 T.22.2 pl.30, fig.3
L = 510 um
H = 245 um

Paratype ♀ carapace HU.278 T.22.3 pl.30, fig.6
L = 450 um
H = 250 um

Paratype ♀ carapace HU.278 T.22.4 pl.30, fig. 9
L = 690 um
H = 430 um

Paratype RVI HU.278 T.22.5 pl.30, fig. 12
L = 600 um
H = 340 um

Affinities and Differences:

This species differs from Brachycythere? harmoniensis Bold 1960, in having strong ventrolateral wing-like expansions above the ventral margin, and a different shape posteriorly with a tendency to produce a caudal process. It also has a well-developed longitudinal furrow behind the eye tubercle and anterior denticulations are absent.

The present species shows similarities to the Quadracythere nandanaensis Khosla 1978; but the latter differs in having straight dorsal margin, strongly reticulate surface with distinct postero-ventral and prolongation, Khosla's species more related to the new subegenus rather than to the Quadracythere.

The present species shows similarities to Anommatocythere microreticulata Sohn 1970 in outline, but Sohn erected the genus Anommatocythere on the basis that there is no ventral swelling or wing, subcentral node or eye tubercle while the present species is characterised by a strong ventrolateral wing expansion and longitudinal furrow anteriorly, and the presence of an eye tubercle although this is not prominent.

Hemicythere sahuni Tewari and Tandon 1960 is similar in outline to the present species but differs in the hinge structure and the absence of the longitudinal furrow behind the eye tubercle.

Q. (Hornibrookella) kurdistanensis sp. nov.

pl. 37, figs. 1-6

Derivation of name: From the type area.

Holotype: A male carapace HU.279 T.8.

Paratypes: Two specimens HU.279 T.9.1-2.

Type horizon: M. Miocene, L. Fars Formation, bed No. 17, sample No. DO.16.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Nine specimens.

Diagnosis: Surface strongly reticulate, with superimposed longitudinal lineations clearly seen in the posterior half. A diagnostic ridge originates from the eye tubercle, runs parallel to the anterior and ventral margins and ends in a slight ala posteriorly.

Description: Greatest height occurs at the anterior cardinal angle, greatest length at one-third of the height above the ventral margin.

Anterior margin obliquely rounded, with upraised, zig-zag marginal rim which continues along the ventral and posterior margins. Its continuation along the ventral margin is less evident, but it becomes more prominent at the postero-ventral margin. Posterior end subangular, concave in the upper part, convex posteroventrally with trace of denticulations. Dorsal margin undulate due to the ornamentation, with rounded and protruding anterior cardinal angle and posterior cardinal angle obscured by the postero-dorsal ridge. Ventral margin concave anterior to the middle, slightly convex upwards posteriorly.

Lateral surface strongly ornamented with coarse reticulations with super-

imposed longitudinal lineations which are more conspicuous in the posterior half. The deep fossae become large and rectangular in shape and form rows parallel to the anterior and ventral margins; they are arranged in a concentric pattern around the subcentral tubercle. The diagnostic ridge originates from the eye tubercle and runs parallel to the anterior and ventral margins to terminate posteriorly in a slight ala above the ventral margin at two-thirds the length. A short postero-dorsal ridge commences mid-dorsally and ends in a horn-like ala above the posterior cardinal angle, a sharp edge originates from the eye tubercle, slopes backwards and dies out in the dorsal margin at the anterior end of the postero-dorsal ridge. There is a short, ventrolateral ridge which starts below the subcentral tubercle and joins the diagnostic ridge at its posterior end. A row of eight small nodes runs obliquely antero-dorsally to postero-ventrally; other small nodes occur scattered over the lateral surface.

The eye tubercle is rounded and prominent and a subcentral tubercle is present.

Left valve larger than right, overreaching the latter along the anterior and posterior cardinal angles. Only two valves were obtained, one of them very fragile, the other centrally filled with shell which obscured the muscle scars.

The internal features observed were:

A left valve hinge consisting of a deep rounded socket, followed by highly projecting antero-median tooth, separated from the reniform posterior socket by a strongly projecting postero-median longitudinal

bar; the right valve hinge is complementary. Duplicature moderately wide, selvage subperipheral and bordered by the anterior flange. Marginal pore canals numerous and simple.

In dorsal view the maximum width and thickness lies posteriorly. Sexual dimorphism moderately marked, the presumed females slightly higher and wider than the presumed males.

Dimensions of figured specimens:

Holotype ♂ carapace HU.279 T.8 pl.37, figs. 1-3

L = 710 um

H = 420 um

Paratype ♀ carapace HU.279 T.9.1-2 pl.37, figs. 4-6

L = 665 um

H = 390 um

Affinities and Differences:

From Hornibrookella episcelis Al-Furaih 1977, the present species differs in being higher, wider and more quadrate. It also differs in details of ornamentation, the present species having a diagnostic ridge starting at the eye tubercle and an oblique row of small nodes running anteroventrally to postero-ventrally. Al-Furaih's species shows a difference in its distinct caudal process.

This species is fairly similar to Q. (Hornibrookella) subquadra Siddiqui 1971 but has a longitudinal lineation superimposed on the strongly reticulate surface, diagnostic sub-parallel ridge and an oblique row of small nodes; the fossae in the present species are coarser and more

rectangular in the posterior half. The Iraqi species is also higher and wider than the Pakistani species.

Hornibrookella cf. macropora (Bosquet 1852) in Bassiouni 1969 shows similarities to the present species but the latter differs in being higher and more elongate with strongly reticulate lateral surface.

Distribution: This species was found at the Bashiqa and Dohuk localities of Northern Iraq.

Q. (Hornibrookella) sp.

pl.36, figs. 9-12

Figured specimens: HU.279 T.10. 1-2

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Horizon: M. Miocene, L. Farms Formation, bed no.10, sample no. BA.7.

Material: Two specimens.

Remarks: This species is fairly close to Q. (H). kurdistanensis sp.nov. in outline, general shape and ornamentation, but differs principally in posterior shape; the posterior margin is lower than the anterior, postero-dorsal and postero-ventral margins and is compressed giving a plate-like

appearance.

This species is slightly more elongate than Q. (H). kurdistanensis sp. nov. There are some similarities to H. posterisella Al-Furaih 1977 but differences in details of ornamentation.

Dimensions of figured specimens:

Carapce HU.279 T.10.1 pl.36, figs. 9,12

L = 620 um

H = 390 um

Carapace HU.279 T.10.2 pl.36, figs. 10,11

L = 600 um

H = 360 um

Family CYTHERETTIDAE Triebel 1952

Genus Flexus Neviani 1928

Synonyms: Eucytheretta Puri 1958, p.188

Type species: Cythere plicuta Von Munster

Flexus trifurcata (Lyubimova and Guha) 1960

pl.37, figs. 7-9

Cytheretta trifurcata Lyubimova and Guha in Lyubimova, Guha and Mohn, 1960, pp. 45-46, pl.4, fig. 3.

?Cytherelloidea sp. indet. Bhatia and Mandwal, 1960, p.283, pl.41, fig. 13.

Cytherelloidea kathrawarensis Tewari and Tandon, 1960, p.160, text, fig. 5

Cytheretta (Flexus) trifurcata Lyubimova and Guha in Khosla 1978, p.271, plate 3, figs. 3-4.

Figured specimens: HU.279 T.11, 1-3.

Horizon: M. Miocene, L. Fars Formation at depth (660-665m).

Locality: Kirkuk well 208, N. Iraq.

Material: Forty specimens.

Remarks: Originally described from the lower Miocene beds of Kutch, W. India. The Iraqi specimens are identical in general character with this species and in particular with the specimens figured by Khosla 1978 from the L. Miocene of W. India. The Iraqi specimens show slight variations in the development of the longitudinal ridges and the indistinct reticules and short ridges developed between the ventral ridge and the ventral margin. The internal details of the Iraqi specimens are these of the Juveniles.

Dimensions of figured specimens:

Carapace ♂ HU.279 T.11.1 pl.37, fig. 7

L = 580 um

H = 320 um

Carapace ♀ ? HU.279 T.11.2 pl.37, fig. 8

L = 560 um

H = 340 um

Carapace ♂ HU.279 T.11.3 pl.37, fig. 9

L = 560 um

H = 310 um

Distribution: The species was found at the Bashiqa, Dohuk, Kirkuk, Sheikh Ibrahim and Hamrin localities of N. Iraq.

Family LOXOCONCHIDAE Sars 1925

Subfamily LOXOCONCHINAE Sars 1926

Genus LOXOCONCHA Sars 1866

Subgenus LOXOCONCHA Sars 1866

Remarks: Van Morkhoven (1963) thought that the genus needed thorough revision which would probably result in a division into several subgenera but this requires study of different species of Loxoconcha throughout the Cretaceous and Tertiary to investigate their distribution and range. But in the present study few species were found.

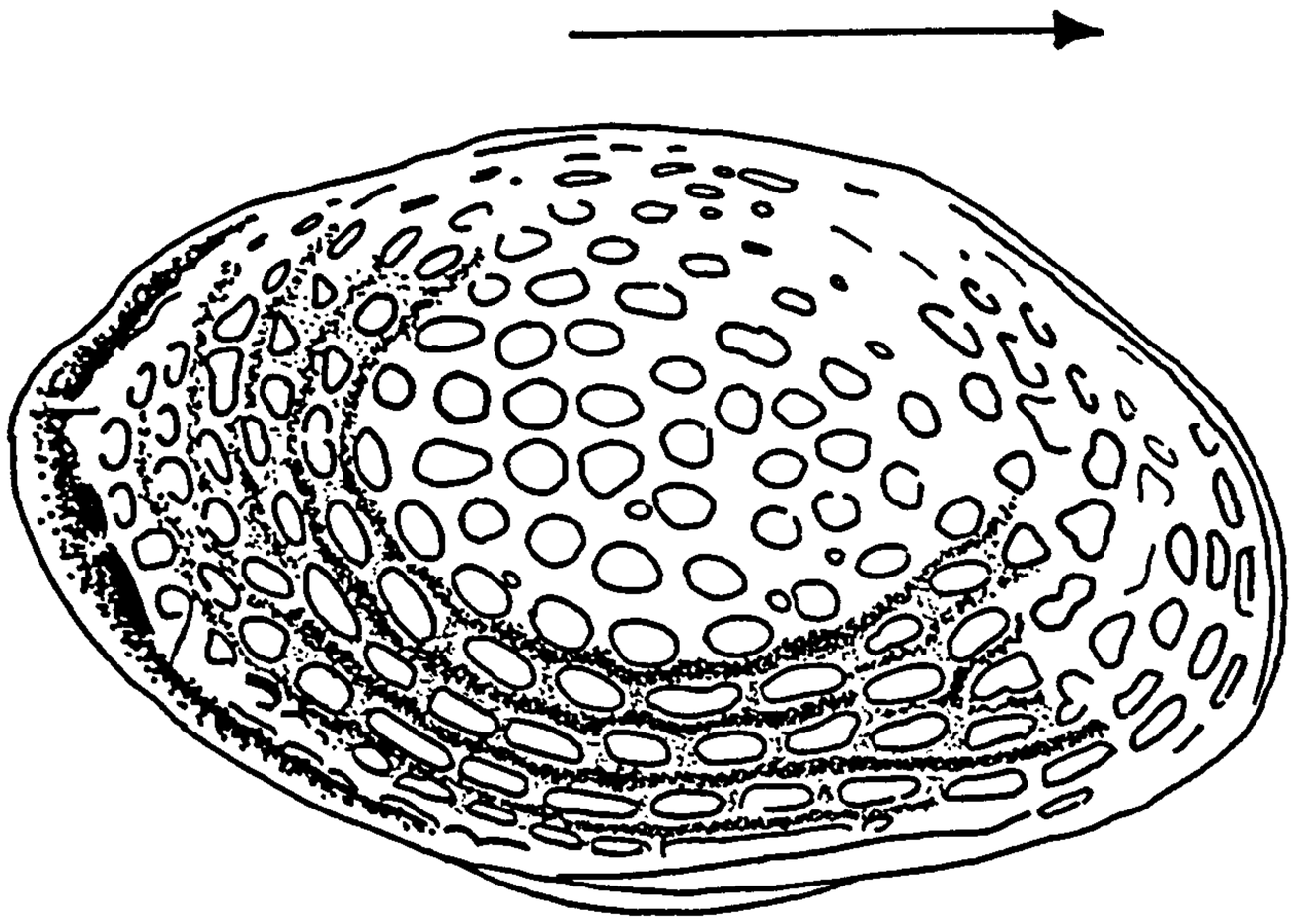
Finger's idea (1983) in considering Palmoconcha Swain & Gilby(1974)as a subgenus of Loxoconcha is accepted on the basis of including all coarsely reticulate species with a flange-like terminal area, and inflated ventral surface. The genus Loxoconcha is thus split into two subgenera.

1. Subgenus (Loxoconcha): to include all loxoconcha species with fine to pitted surfaces.
2. Subgenus Palmoconcha. (Swain and Gilby 1974)

Loxoconcha (Loxoconcha) hamrinensis sp.nov.

pl. 37, figs. 10-12

pl. 38, figs. 1-2, 4-5



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Text fig. 18 Loxoconcha (Loxoconcha) hamrinensis sp.nov. HU.279 T.12 Carapace from right, lateral surface showing the ornamentation.

Derivation of name: After the type locality.

Holotype: A female HU.279 T.12.

Paratypes: Four specimens HU.279 T.13, 1-4.

Type locality: Hamrin well 2, Northern Iraq.

Type horizon: M. Miocene, L. Fars Formation at depth (314-315 m)

Material: Two hundred specimens.

Diagnosis: Ovate to subrhomboidal with greatest height just in front of the middle. Surface ornamented with concentrically arranged pits.

Description: Carapace ovate to subrhomboidal in lateral view, tumid in the ventral part, the swollen portion bordered on the lower side by a convex ridge.

Anterior end obliquely rounded, continuing smoothly into the ventral margin, gently sloping in the upper part with rounded angle at its junction with the dorsal margin, posterior end narrower with concave postero-dorsal margin and convex postero-ventral margin.

In the female, dorsal margin slightly sinuate with a distinct posterior cardinal angle; in the male nearly straight with rounded anterior cardinal angle and more distinct posterior one; ventral margin sinuate with slight concavity anterior to the middle, convex upwards posteriorly. Lateral surface pitted, the pits being elongate and concentrically arranged separated by longitudinal ribs; coarse and rounded in the middle, becoming finer at posterior and dorsal margins.

Internal features are characteristic of the genus. Left valve larger than the right, overlapping it more conspicuously along the dorsal and anterior

margins. In dorsal view carapace is lenticular with the maximum thickness and width behind the middle; anterior and posterior ends are compressed.

Sexual dimorphism is present but not very prominent, the presumed males more elongate and less high than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.279 T.12 pl.37, fig. 10
pl.38, figs, 1,2

L = 535 um

H = 365 um

W = 330 um

Paratype ♂ carapace HU.279 T.13.1 pl.37, figs. 11, 12

L = 540 um

H = 340 um

W = 310 um

Paratype ♂ carapace HU.279 T.13.2 pl.38, figs. 4, 5

L = 560 um

H = 350 um

W = 310 um

Affinities and Differences:

This species has some similarities to L. dertoberis Ruggieri 1967 but it differs in having a narrower posterior end with a subdorsal caudal process. Loxoconcha bairdi Muller 1912 in Breman (1976) differs in having longitudinal ribs along the anterior margin and reticules along the posterior margin which is smooth in the present species.

Loxoconcha confinis Lyubimova and Guha 1960 differs in its symmetrical

convex dorsal margin and small subdorsal caudal process with narrower anterior margin.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim and Kirkuk localities of N. Iraq.

Loxoconcha (*Loxoconcha*) *pseudohamrinensis* sp. nov.

pl. 38, fig. 12

pl. 39, figs. 1, 2

Derivation of name: From its similarity to the previous species.

Holotype: Carapace HU.279 T.14.

Paratype: Two specimens HU.279 T.15, 1-2.

Type horizon: M. Miocene, L. Fars Formation, bed No. 17, sample No. DO.16.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Forty specimens.

Diagnosis: Carapace with pronounced ventrolateral swelling and finely pitted surface.

Description: Carapace strongly calcified, rhomboidal in lateral view, with greatest height at one-third the length. Anterior margin obliquely rounded with gentle anterodorsal slope; posterior end narrower and slightly obliquely rounded. Dorsal margin nearly straight with distinct posterior cardinal angle, anterior one less prominent. Ventral margin concave anterior to the middle, swinging upwards posteriorly; carapace strongly swollen ventrolaterally.

Lateral surface finely pitted, these pits being finer and arranged almost parallel to the anteromargin, centrally they become slightly coarser. Eye tubercle present but not distinctive.

Left valve larger than the right, overreaching it more conspicuously along the dorsal margin. Only carapaces were obtained so the internal features could not be seen.

Dimensions of figured specimens:

Carapace HU.279 T.14 pl.39, fig. 1

L = 570 um

H = 380 um

Carapace HU.279 T.15.1 pl. 39, fig. 2

L = 560 um

H = 330 um

Details of ornamentation on the surface of carapace.
HU.279 T.15.1 pl.38 fig.12

Affinities and Differences:

By comparison Loxoconcha agilis Ruggieri 1967 is more rhomboidal in shape with the upturned posterior end tending to form a sub-dorsal caudal process. Loxoconcha rhomboidea (Fischer) as figured by Carbonnel (1969) differs in being more elongate, having a narrower posterior end and finer pits. Loxoconcha punctatella Reuss as figured by Keij (1955) differs in its narrower subtriangular posterior end and its distinctive rounded eye tubercle.

Distribution: This species was found at the Dohuk and Sheikh Ibrahim localities of Northern Iraq.

Loxoconcha (Palmoconcha) miocaenica sp.nov.

pl. 38, figs, 3,6,7-11

Derivation of name: From its occurrence in the Miocene of Iraq.

Holotype: A female carapace HU.279 T.16.

Paratypes: Four specimens HU.279 T.17, 1-4.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Horizon: M. Miocene, L. Fars Formation, bed No. 1, sample No. BA.1.

Materials: Thirty specimens.

Diagnosis: Distinguished by its thick shell, oranmented with coarse elongate pits arranged concentrically around the margins. Carapace inflated ventrally.

Description: Carapace thick, inflated ventrally, elongate to subovate in lateral view, greatest height anterior to the middle. Anterior margin flattened and obliquely rounded, posterior margin narrower, obliquely rounded, and continuing into the posterior marginal flange.

Surface covered with elongate pits arranged in a concentric pattern around the margins and becoming rounded to oval shaped in the middle of the valve.

Eye tubercle present but not very distinctive, more conspicuous in the right valve.

Left valve larger than the right, overlapping more conspicuously along the dorsal margin.

Hinge typical of the subgenus; marginal area relatively broad; selvage

well developed subperipherally and with a well-developed anterior flange. Muscle scars and radial pore canals not very clear but in conformity with the subgenus.

Sexual dimorphism present, the presumed males being slightly narrower posteriorly than the presumed females.

In dorsal view, carapace lenticular in shape, maximum width and thickness at the middle, the presumed males slightly narrower at the middle than the presumed females.

Dimensions of figured specimens:

Holotype ♀ carapace HU.279 T.16 pl.38, figs. 7, 10

L = 650 um

H = 400 um

Paratype ♂ carapace HU.279 T.17.1, pl.38, fig. 8

L = 680 um

H = 390 um

Paratype RVI HU.279 T.17.2 pl.38, fig. 9

L = 530 um

H = 320 um

Paratype ♀ carapace HU.279 T.17.3 pl.38, fig. 3
L = 650 um H = 360 um

Affinities and Differences:

This species is fairly similar in outline to Loxoconcha lilljborchi (Brady) (recte lilljeborgii) as figured by Guha (1968) but it differs in being more elongate, less high and more coarsely ornamented.

Loxoconcha alata (Brady) as figured by Breman (1976) differs in having a

narrower posterior end slightly pointed at the middle, a slightly truncated anterior end, and in the lateral surface being comparatively finely pitted with a very distinctive eye tubercle in the left valve.

Distribution: This species was found at the Bashiqa, Sheikh Ibrahim and Dohuk localities of N. Iraq.

Genus HIRSCHMANNIA Elofson 1941

Type species: Cythere viridis O.F. Muller 1785

Hirschmannia ? rara sp. nov.

pl. 39, figs. 3, 5, 6

Derivation of name: A reference to its rarity of occurrence.

Holotype: A female carapace HU.279 T.18.

Paratypes: Two specimens HU.279 T.19, 1-2.

Type locality: Hamrin well 2, N. Iraq.

Horizon: M. Miocene, L. Fars Formation, at depth (314-315 m)

Material: Ten specimens.

Diagnosis: Carapace plump ventrally, finely pitted. Sexual dimorphism very pronounced.

Description: Female carapace subrhomboidal in lateral view; male elongate to subovate in lateral view, greatest height at one-third the length; swollen carapace overhanging the ventral margin. Anterior end obliquely rounded below, gently curving down in the upper part, posterior end narrowly rounded forming a distinct angle with the dorsal margin.

Dorsal margin slightly convex in the anterior part, sloping gently backwards in the posterior half; ventral margin concave, anterior to the middle, curving upwards posteriorly.

Surface smooth to finely pitted.

Sexual dimorphism very pronounced, the presumed male more elongate and less high than the presumed females.

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

Dimensions of figured specimens:

Carapace ♀ HU.279 T.18 pl.39, figs. 3, 6

L = 530 um

H = 340 um

Carapace ♂ HU.279 T.19.1 pl.39, fig. 5

L = 560 um

H = 330 um

Affinities and Differences:

This species differs from Hirschmannia viridis (Muller) as figured by Wagner 1957 in having narrower anterior and posterior ends.

Loxoconcha elliptica Brady shows affinities to the present species but the latter differs in the inflation above the ventral margin and in the slightly narrower anterior and posterior ends.

The present species is placed in the genus Hirschmannia on the basis of

external features.

Distribution: Rare specimens were found at Sheikh Ibrahim, Kirkuk and Hamrin localities of N. Iraq.

Genus PHLYCTOCYTHERE Keij

Type species: Phlyctocythere eocaenica Keij 1958

Phlyctocythere sp.

pl.39, fig. 4

Figured specimen: HU.279 T.20.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Horizon: M. Miocene, L. Fars Formation, bed No. 15, sample No. DO.14.

Material: Three specimens.

Description: Small to medium sized, somewhat subrhomboidal in lateral view with the greatest height anterior to the middle.

Anterior margin obliquely rounded, narrow at the middle, posterior end narrower and produced into a caudal process subdorsally. Dorsal margin convex anteriorly, becoming lower and sloping backwards posteriorly. There is no eye tubercle and the lateral surface is smooth. Left valve larger than the right with overlap not very conspicuous.

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

Dimensions:

Carapace HU.279 T.20 pl.39, fig. 4

L = 490 um

H = 320 um

Affinities and Differences:

The present species shows similarities to Phylctocythere pellucida G.W. Muller, 1894, but differs in being higher and narrower posteriorly with a nearly straight ventral margin.

Family PARACYTHERIDEIDAE Puri 1957

Genus PARACYTHERIDEA G.W. Muller 1894

Type species: Paracytheridea depressa G.W. Muller 1894

Paracytheridea splendida sp. nov.

pl. 39, figs. 7-9

Derivation of name: In reference to its excellent preservation and elegant ornamentation.

Holotype: A right valve female HU.279 T.21.

Paratypes: Three specimens HU.279 T.22, 1-3.

Type locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 41, sample No. SHI.22.

Material: Fifteen specimens.

Diagnosis: A species of Paracytheridea with postero-dorsal swelling in the females which is much reduced in the males; a well developed ala points backwards.

Description: Carapace elongate, subrectangular in lateral view, with

greatest height at one-third the length and maximum length at mid-height.

Anterior margin regularly rounded, posterior end lower, narrow, sub-triangular, produced into a pointed median caudal process. Dorsal margin nearly straight, slightly sinuated centrally due to the ornamentation and with distinct anterior and posterior cardinal angles; ventral margin nearly straight, slightly sinuate centrally due to the ornamentation. The lateral surface is nearly smooth anterodorsally and posteriorly, but other areas are covered by indistinct reticules and rib pattern. A distinct subcentral swelling extends towards the ventral margin to join the ventro-lateral ridge, which begins anteroventrally and runs posteriorly to terminate above the posteroventral corner with a well-developed, backward pointing, ala posteriorly. Other swelling developed in the postero-dorsal area but much reduced in the male carapace. A somewhat stronger rib runs from the mid-anterior margin towards the posterodorsal area then curves down posteriorly to die out anterior to the mid-posterior caudal process. A number of smaller ribs run above the ventrolateral wing. An irregular vertical sulcus starts behind the rounded eye tubercle and runs across the valve to the ventrolateral wing. Inner lamella moderately wide anteriorly, line of concrescence and inner margin coincide throughout, anterior flange well-developed.

Hinge in the right valve consists of anterior tooth (not well developed), followed by small socket and elongate, narrow, crenulate groove ending in the incised posterior tooth. Other internal features cannot be seen, because only a few fragile valves were found which were easily broken if further cleaning had been done.

Sexual dimorphism is pronounced, the presumed male narrow, less in height

than the presumed females.

Dimensions of figured specimens:

Holotype RV ♀ HU.279 T.21 pl.39, figs, 7, 8

L = 690 um

H = 320 um

Paratype LV ♂ HU.279 T.22.1 pl.39, fig. 9

L = 630 um

H = 300 um

Remarks: This species is very similar in outline to P. perspicua Lyubimova and Guha 1960 but the latter differs in having stronger pointed alae; the ornamentation in Lyubimova and Guha's species is not very clear from the figured specimen. They also say nothing about sexual dimorphism which is pronounced in the present species. The present species also differs in possessing an eye tubercle and in its posterodorsal swelling. The species is similar also to P. misrai Tewari and Tandon 1960, but differs in having a shallow vertical sulcus originating behind the eye tubercle. Tewari and Tandon's species is considered synonymous with Guha's species by Khosla 1978.

Distribution: This species was found at the Bashiqa, Dohuk and Sheikh Ibrahim localities of N. Iraq.

Family CYTHERURIDAE G.W. Muller 1894

Subfamily CYTHERURINAE G.W. Muller 1894

Genus SEMICYTHERURA Wagner 1957

Type species: Cythere nigrescens Baird, 1838

Semicytherura matiaensis sp. nov.

pl. 39, figs. 10, 11

Derivation of name: From the Diar Matia (church) on the axis of the anticline close to the type section.

Holotype: A female carapace HU.279 T.23.

Paratypes: Three specimens HU.279 T.24.1-3.

Type locality: Bashiqa anticline, S. limb, 28 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No. 1, sample No. BA.1.

Material: Fifteen specimens.

Diagnosis: A species of Semicytherura with short ridge above the ventral margin, a shallow vertical sulcus cross the valve to this ridge.

Description: Carapace subrectangular to subrounded in lateral view, with greatest height anteriorly.

Anterior margin symmetrically rounded, posterior end medially produced into a truncate caudal process. Dorsal margin nearly straight with rounded anterior and posterior cardinal angles, ventral margin concave at the middle and forming the widest part of the body, merging smoothly into the anteroventral margin and forming a distinctive marginal keel posteriorly.

External surface pitted to reticulate. In the female the raised surface of the muri form parallel costae in the posterior half. The posterior continuation of lateral ridge above the ventral margin is less well developed and curves upwards above the postero-ventral corner to join the parallel costae in the posterior half of the valve.

A shallow vertical sulcus starts behind the eye tubercle and dies out above the ventrolateral ridge. The lateral surface is covered with reticules separated by well-developed muri in the anterior half and forming parallel costae in the posterior half.

Eye tubercle small and rounded.

Sexual dimorphism is present. The presumed females are shorter and higher than the elongate, narrower males. Internally, the features are conspecific with the genus.

Dimensions of figured specimens:

Holotype ♀ carapace HU.279 T.23 pl.39, fig. 10

L = 450 um

H = 230 um

Paratype ♂ carapace HU.279 T.24.1 pl.39, fig. 11

L = 470 um

H = 220 um

Affinities and Differences:

C. interposita Lyubimova and Guha 1960 agrees in general shape with new species but the shallow vertical sulcus and the lateral ridge above the ventral margin are absent in the Indian species. On the basis of outline Lyubimova and Guha's species agree more with Semicytherura than Cytherura.

Distribution: A few specimens were found at the Bashiqa and Dohuk localities of N. Iraq.

Semicytherura sp.

pl.39, fig. 12

Figured specimen: HU.279, T.25.

Type locality: Kirkuk well-208, N. Iraq.

Type Horizon: M. Miocene, L. Fars Formation, at depth (655 - 660) m.

Material: One carapace.

Description: Carapace oblong in lateral view, greatest height at the eye tubercle, greatest length above mid-height.

Anterior end rounded with well-developed marginal rim, posterior end produced into a subdorsal process with steeply down-curved postero-ventral margin. Dorsal margin nearly straight, ventral margin slightly sinuate, forming a convex postero-ventral corner. On the lateral surface two ridges start from the anterior marginal rim; the median one from the mid-anterior marginal rim runs backwards to terminate in the mid-third of the posterior part, the ventral ridge starts from the anteroventral corner, running backwards above the ventral margin, curving upwards posteriorly to die out above the mid-posteroventral margin; the rest of the surface is covered with indistinct reticules and longitudinal ribs, a trace of a shallow sulcus is present.

Dimensions of figured specimen:

Carapace HU.279 T.25 pl.39, fig. 12

L = 450 um

H = 210 um

Remarks: This species is similar to Semicytherura sanmarinensis Ruggieri

1967 but the latter differs in having well-developed reticules, three longitudinal ridges and three short longitudinal ridges in the postero-ventral area.

Family XESTOLEBERIDIDAE Sars 1928

Genus XESTOLEBERIS Sars 1866

Type species: Cythere aurantia Baird 1838

Xestoleberis orientalis sp. nov.

pl.40, figs. 1-5

Derivation of name: A reference to its occurrence in the Middle East.

Holotype: A male carapace HU.279 T.26.

Paratypes: Four specimens HU.279 T.27, 1-4.

Type locality: Sheikhan anticline, 27 km NE of Mosul City.

Type horizon: M. Miocene, L. Fars Formation, bed No.20, sample No. SH.11.

Material: Eighty specimens.

Diagnosis: A species of Xestoleberis with egg-shaped, low and slightly drawn out anteriorly, distinctive postero-dorsal angle.

Description: Carapace egg-shaped in side view, greatest height just behind the middle, greatest length at one-eigth of the height above the ventral margin. Anterior end narrowly rounded and produced ventrally, posterior end higher, obliquely convex upwards with distinct postero-dorsal angle.

Dorsal margin broadly convex, low and sloping down anteriorly, angled at the greatest height, ventral margin concave anteriorly, and forming a rounded postero-ventral corner.

Lateral surface smooth to finely pitted.

Left valve larger than the right, overreaching more conspicuously at the anterior and posterior margins. Internally deep valves, narrow marginal zone, vestibula seen along the anterior margin, marginal pore canals short, simple. Muscle scars consist of a vertical row of four adductor scars, two mandibular scars and one heart-shaped frontal scar. Hinge not clearly seen but apparently the same as that in the genus.

Sexual dimorphism present, the presumed males smaller and narrower at anterior and posterior ends than the presumed females.

In dorsal view carapace ovate with maximum width and thickness posteriorly; pointed anterior end, ovate posterior end.

Dimensions of figured specimens:

Holotype ♂ carapace HU.279 T.26, pl. 40, fig. 1

L = 620 um

H = 400 um

Paratype ♀ carapace HU.279 T.27.1 pl.40, fig. 2

L = 590 um

H = 385 um

Paratype LVI HU.279 T.27.2 pl.40, fig. 3

L = 580 um

H = 420 um

Paratype ♂ carapace HU.279 T.27.3 pl.40, fig. 4

L = 570 um

H = 370 um

Paratype ♀ carapace HU.279 T.27.4 pl.40, fig. 5

L = 600 um

H = 405 um

Affinities and Differences:

X. orientalis sp. nov. shows some similarities to X. subglobosa (Bosquet) as figured by Khosla (1972) but the latter differs in having a narrow posterior margin and straight ventral margin. X. variegata (Brady) in Khosla (1978) is similar to the present species, but differs in having a regularly rounded posterior end, and in the absence of a postero-dorsal angle, with strong angulation at the mid-dorsal margin.

X. cypria Athersuch 1976 differs in being higher and relatively more elongate,,with a broad posterior margin.

X. reymenti Ruggieri 1967 differs in having a higher and broader posterior margin.

Distribution: This species was found at the Bashiqa, Sheikhan, Dohuk, Sheikh Ibrahim, Kirkuk and Hamrin localities of N. Iraq.

Xestoleberis sp.

pl.40, fig. 6

Figured specimen: Carapace HU.279, T.28.1-2.

Horizon: M. Miocene, L. Fars Formation, bed No.75, sample No. SHI.40.

Locality: Sheikh Ibrahim anticline, S. limb, 45 km NW of Mosul City.

Material: Two specimens.

Description: Carapace ovate in lateral view. Anterior end low and narrowly rounded, posterior end higher, obliquely rounded.

Dorsal margin convex sloping down posteriorly, ventral margin convex upwards, smoothly joining the anterior and posterior ends.

Greatest height at the middle, maximum length below the centre point.

Left valve larger than right, overlapping more conspicuously along the posterior and ventral margins. Lateral surface smooth to finely pitted.

Dimensions of figured specimen:

Carapace HU.279 T.28.I pl.40, fig. 6

L = 590 um

H = 420 um

Remarks: This species is fairly similar to X. orientalis sp. nov. but differs in having more rounded shape with convex dorsal and ventral margin. It may perhaps represent the female of that species. Few specimens were found, however, and since it has not been possible to link it unequivocally with X. orientalis it is here left under open nomenclature.

Family BYTHOCYTHERIDAE Sars 1866

Genus PSEUDOCERATINA Bold 1965

Type Species: Pseudoceratina droogeri Bold 1965

Pseudoceratina? nova sp. nov.

pl.40, figs. 7-11

Derivation of name: L. novus - new.

Holotype: A male carapace HU.279 T.29.

Paratypes: Three specimens HU.279 T.30, 1-3.

Type horizon: M. Miocene, L. Fars Formation, bed No. 14, sample No. DO.13.

Type locality: Dohuk anticline, S. limb, 10 km NE of Dohuk City.

Material: Fourteen specimens.

Diagnosis: Carapace compressed anteriorly and posteriorly with blade-like shape, forming the ventral margin.

Description: Carapace elongate, parallelogram-shaped in lateral view, height nearly equal along the valves, maximum length subdorsally.

Anterior end compressed, regularly rounded, posterior end flattened compressed, subtriangular, produced into a short caudal process subdorsally.

Dorsal margin straight with rounded anterior and posterior cardinal angles, ventral margin slightly convex, curving upwards posteriorly.

Lateral surface smooth to finely pitted or covered with indistinct puncta; a shallow sulcus starts mid-dorsally, crossing the valves vertically, up to the ventro-lateral wing. Ventrolaterally there is a prominent wing, with thin and narrower anterior end which becomes thick and terminates in a slight lateral alar projection posteriorly. Short ribs run along this ventrolateral wing. A longitudinal costa commences at the beginning of the anterior third and runs along the dorsal margin. It then curves down

posteriorly to die out in front of the posterior end. In dorsal view the carapace is arrow-shaped, with pointed anterior and posterior ends, maximum width and thickness behind the middle. In ventral view, the ventral blade-like shape is very distinctive.

Sexual dimorphism present, the presumed males more elongate, narrower and less high than the presumed females.

Dimensions of figured specimens:

Holotype ♂ carapace HU.279 T.29 pl.40, fig. 8

L = 600 um

H = 270 um

Paratype ♀ carapace HU.279 T.30.1 pl.40, fig. 7

L = 600 um

H = 300 um

Paratype ♂ carapace HU.279 T.30.2 pl.40, figs. 9, 11

L = 630 um

H = 260 um

Paratype ♀ carapace HU.279 T30.3 pl.40, fig. 10

L = 600 um

H = 300 um

Remarks:

The present species is somewhat similar to the Monoceratina Roth 1928 in some respects, but differs in having the lateral wing or ridge above the ventral margin, whilst in Monoceratina the ventral spine is at the ventral margin, and the caudal process is produced dorsally whereas in the present species it is subdorsal.

However, Monoceratina was originally described from palaeozoic strata and the finer details of the carapace of the type species are not known according to Morkhoven (1962) and it remains problematical whether or not the post-palaeozoic forms referred to the genus are really congeneric with type species. Later Bold (1965) erected Pseudoceratina from the Miocene of the Caribbean characterised by two hollow lateral spines, separated by a subvertical median sulcus, and a hinge with terminal teeth and sockets in both valves. The present species is fairly similar to the Bold species particularly in its posterior shape, and the short ventro-lateral ridge constricted in the middle and showing a tendency to form two hollow spines, but due to the lack of internal features, the present species is only tentatively placed in the Bold's genus.

Genus A. sp.

pl. 41, figs. 2, 3

Figured specimens: HU.279 T.32.1-2.

Horizon: M. Miocene, L. Fars Formation at depth (220-225 m)

Locality: Kirkuk well 208, N. Iraq.

Material: Twenty five fragile valves.

Diagnosis: Sexes easily distinguished, the presumed males more elongate, tapering posteriorly than the presumed females.

Description: Carapace elongate, subrectangular to subtriangular in lateral view, with greatest height anteriorly. Anterior margin obliquely rounded, posterior margin also rounded but relatively narrower, angled at the middle

in the female specimens.

Dorsal margin undulate with prominent anterior and posterior cardinal angles, ventral margin nearly straight in the female, slightly concave in the postero-ventral area; in the male ventral margin undulate, both converging posteriorly.

Lateral surface marked by rectangular and pentagonal reticules; prominent anterior ribs spring from the eye tubercle and run parallel to the anterior margin, subcentral tubercle marked with shallow sulcus immediately behind it, and a deep depression directly above the dorsal part of the subcentral tubercle.

Eye tubercle glassy and rounded.

Both anterior and posterior margins decorated with fine denticules which are more prominent in the female.

Left valve larger than the right, overlapping it more conspicuously along the posterior margin.

Internal features were not observed, just the fragile valves showing that the hinge is similar to the Archicythereis type.

Dimensions of figured specimens:

♀ carapace HU.279 T.32.1 pl.41, fig. 2

L = 620 um

H = 370 um

♂ LVE HU.279 T.32.2 pl.41, fig. 3

L = 650 um

H = 350 um

Remarks: Genus A sp. whilst trachyleberine is more related to Archicythereis Howe 1936, but that genus was based on juvenile molt, and because the internal features of the present species are not well known, it is here left under nomenclature.

Genus B. sp.

pl. 41, fig. 4, 5

Figured specimens: Two valves HU.279 T.33, 1-2

Horizon: M. Miocene, L. Fars Formation at depth (220-225 m)

Locality: Kirkuk well 208, N. Iraq.

Material: Four specimens.

Diagnosis: Two shallow sulcus traverse each valve centrally and posteriorly, ventrolateral ridge developed above the ventral margin.

Description: Elongate, subrectangular in lateral view, with greatest height at the anterior cardinal angle. Anterior margin regularly rounded, with short, gentle slope below the eye tubercle, posterior margin, narrower, concave dorsally, curving down ventrally.

Dorsal margin straight with prominent anterior and posterior cardinal angles, ventral margin concave at the middle, curving up smoothly to join the

anterior and posterior ends.

Lateral surface traversed by two shallow, vertical sulci. The anterior one, starts at the mid-dorsal margin, has a wide upper part and becomes narrower below, dying out at the anterior end of the ventro-lateral ridge; a small node is present at anterior upper part of this sulcus. The second sulcus starts at a fifth of the length from the posterior end, and dies out above the posterior end of the ventro-lateral ridge. Valves strongly inflated ventrally, forming a prominent ventro-lateral ridge above the ventral margin. The anterior end of this ridge dies out at 1/6 the height above the ventral margin; its posterior end is more prominent and terminates above the postero-ventral corner. A short vertical ridge is present anterior to the posterior cardinal angle. The rest of the surface is covered with small rounded pits.

No eye tubercle and subcentral tubercle were seen.

Dimensions of figured specimens:

LV HU.279 T.33.1 pl.41, fig. 4

L = 430 um

H = 270 um

LV HU.279, T.33.2 pl.41, fig. 5

L = 470 um

H = 260 um

Remarks: Genus B sp. is more related to Limnocythere Brady, 1868, but the present species differs in having two shallow sulcus, and due to the absence of internal features, the present species left under indeterminable genus.

CHAPTER 5
BIOSTRATIGRAPHY

BIOSTRATIGRAPHY

Ostracoda from nine sections of the Lower Fars Formation in Northern Iraq have been studied. In some of these sections only a few samples yielded ostracoda, but a fairly complete picture of the faunal content of the Lower Fars Formation could be obtained. Several faunal assemblages can be recognized and although the boundaries between these assemblages are not always sharp, they do have stratigraphic significance.

A range of ostracod species in the four surface sections and Kirkuk well 208 are given in figs (19-23). The ostracod species obtained from the various sections make it possible to subdivide the Lower Fars Formation into three Assemblage Zones. The zonation is based mainly on the occurrence of ostracoda species of regional significance in these sections. The ostracod zones suggested here are Assemblage Zones as defined in the International Stratigraphic Guide of Hedberg (1976). At present these assemblage zones are applicable only to the Iraq part of the Lower Fars Formation basin, but it is hoped that future work in the area will help to establish more zones on a wider basis in adjacent countries.

The Sheikh Ibrahim section which contains the whole cyclic successions of the Lower Fars Formation in N. Iraq is used as the standard and the other studied sections correlated with it. The Lower Fars Formation in N. Iraq is divided here into three Assemblage zones, according to the stratigraphic range, appearance and disappearance of ostracod species (Text, fig. 19). The zones are named after characteristic species but are not dependent on these, being recognized by the whole assemblage.

MIDDLE MIOCENE

LOWER FARS

ASSEMBLAGE ZONES

ZONE A | ZONE B | ZONE C

SUB ZONE A1 | SUB ZONE A2 | S.Z. B1 | SUB ZONE B2 | S.Z. B3 | MAZS

BASE SCALE 0 4m SAMPLES TOP

SHI.1 SHI.2 SHI.3 SHI.4 SHI.6 SHI.9 SHI.13 SHI.15 SHI.16 SHI.18 SHI.19 SHI.22 SHI.24 SHI.26 SHI.27 SHI.28 SHI.30 SHI.32 SHI.37 SHI.38 SHI.39 SHI.44 SHI.45 SHI.46

AGE

FORMATION

SPECIES

Echinocythereis (Scelidocythereis) asiatica sp.nov.
Bythocypris sp.B
Schneiderella unispinata sp.nov.
Miocyprideis recta sp.nov.
Sulcostocythere reticulata sp.nov.
Miocyprideis ovalis sp.nov.
Hemicyprideis angulata angulata sp.nov. subsp.nov.
Asymmetricythere reticulata sp.nov.
Actinocythereis cornuocula cornuocula sp.nov. subsp.nov.
Schneiderella vulgaris sp.nov.
Falunia (Hiltermannicythere) miocaenica sp.nov.
Paijenborchella (Eopaijenborchella) spinosa sp.nov.
Sulcostocythere dimorphica sp.nov.
Sulcostocythere posteronodosa sp.nov.
Xestoleberis orientalis sp.nov.
Hirschmannia ? rara sp.nov.
Alocopocythere sp
Xestoleberis sp.
Loxoconcha (Palmoconcha) miocaenica sp.nov.
Loxoconcha (Loxoconcha) hamrinensis sp.nov.
Hermanites transversicostata sp.nov.
Mutilus paracafossata sp.nov.
Mutilus fortireticulata sp.nov.
Actinocythereis iraqensis Khalaf 1982
Callistocythere hipposideros sp.nov.
Paijenborchella (Eopaijenborchella) kausalis sp.nov.
Pontocyprella sheikhanensis sp.nov.
Ghardaglaia sp. aff. G. kermani Krstic 1979
Cytherelloidea flexicostata sp.nov.
Paracytheridea splendida sp.nov.
Alocopocythere fossularis (Lyubimova and Guha) 1960
Loxoconcha (Loxoconcha) pseudohamrinensis sp.nov.
Flexus trifurcata (Lyubimova and Guha) 1960
Gyrocythere sheikhibrahimensis sp.nov.
Miocyprideis sp. aff. Miocyprideis ovalis sp.nov.
Paijenborchella (Eopaijenborchella) aff. p. (Eop.) royi Khosla 1978
Propontocypris miocaenica sp.nov.
Bythocypris sp.A
Bythocypris elegantula sp.nov.
Bythocypris pseudoreniformis sp.nov.
Schneiderella sp.
Chrysocythere naqibi Khalaf 1982
Dentokrithe comma sp.nov.
Dohukia fossulata gen. et sp.nov.
Pontocyprella sp.A
Propontocypris sp. aff. Propontocypris solida Ruggieri 1962
Alocopocythere sheikhibrahimensis sp.nov.
Cytherelloidea hamrinensis sp.nov.
Cytherelloidea crassinodosa sp.nov.
Quadracythere (Mosulia) pulchra sp.nov.
Actinocythereis costata sp.nov.
Dentokrithe autochthona (Lyubimova and Guha)1960
Propontocypris cuneiformis sp.nov.
Cytherella sayybi sp.nov.
Stigmatocythere nodosa sp.nov.

TEXT FIG. 19 ASSEMBLAGE ZONES OF OSTRACOD SPECIES OF THE LOWER FARS FORMATION IN SHEIKH IBRAHIM LOCALITY, N.W. IRAQ

The following is a brief discussion of these Lower Fars Assemblage zones from lowest to highest.

1. Assemblage Zone A — [Asymmetricythere reticulata sp.nov.; Miocyprideis ovalis sp.nov.

Assemblage Zone A is characterized by the first appearance of the above common species and is named after them. At the middle of this zone the following species appear

Hemicyprideis angualata angulata sp. nov.subsp.

Actinocythereis cornuocula cornuocula sp.nov. subsp.

Schneiderella vulgaris sp.nov.

This zone can be divided into two subzones:

Subzone A.1 — [Miocyprideis recta sp.nov.; Sulcostocythere reticulata sp.nov.

Subzone A.2 — [Sulcostocythere dimorphica sp.nov.; Sulcostocythere posteronodosa sp.nov.

The subzone A.1 is characterised by Miocyprideis recta sp.nov. and Sulcostocythere reticulata sp.nov. These species continue through the subzone A.2 which is recognised by the appearance of new species rather than the disappearance of old ones.

Subzone A.2: This subzone is characterised by the following species:

P. (Eopaijenborchella) spinosa sp.nov.

Sulcostocythere dimorphica sp.nov.

Sulcostocythere posteronodosa sp.nov.

The last two species are confined to this subzone and are characterised by

a short vertical stratigraphical range which suggests that these beds may perhaps be regarded as a transition bed between the lower and upper members of Lower Fars Formation.

2. Assemblage Zone B. This zone is named after

Hermanites transversicostata Khalaf 1982

Mutilus fortireticulata sp.nov.

The lower limit of this zone is defined by the appearance of the above species. This zone can be divided into four assemblage sub-zones.

Subzone B1: This subzone is characterised by the following common species:

L. (Palmoconcha) miocaenica sp.nov.

L. (Loxoconcha) hamerinensis sp.nov.

H. transversicostata Khalaf 1982

M. fortireticulata sp.nov.

The other species found in this subzone are:

Alocopocythere sp. Actinocythereis iraqensis Khalaf 1982 Xestoleberis sp. Callistocythere hipposideros sp.nov., Hirschmannia? rara sp.nov., P. (Eopaijenborchella) kausalis sp.nov., Pontocyprella sheikhanensis sp.nov., Xestoleberis orientalis sp.nov., Mutilus paracafossata sp.nov., Cytherelloidea flexicostata sp.nov., Paracytheridea splendida sp.nov., Alocopocythere fossularis (Lyubimova and Guha) 1960. Most of these species continue into the B.3 and B.4 subzones.

The upper limit of this subzone is defined by the appearance of Ghardaglaia sp. aff. G. kermani Krstic 1979, and other species which appear in the subzone B.2.

Subzone B.2: This subzone is named after

Flexus trifurcata Lyubimova and Guha 1960

Gyrocythere sheikhibrahimensis sp.nov.

This subzone is based on the presence of the following species for the first time.

L. (Loxoconcha)pseudohamerinensis sp.nov.

Bythocypris elongantula sp.nov.

Bythocypris pseudoreniformis sp.nov.

Miocyprideis sp.aff. Miocyprideis ovalis sp.nov.

Bythocypris sp.B.

P. (Eopaijenborchella) aff. P. (Eop.) royi Khosla 1978

Propontocypris miocaenica sp.nov.

Bythocypris sp.A Schneiderella sp.

Chrysocythere naqibi Khalaf 1982

These species have a characteristically short stratigraphical range, and disappear before the top of the sub-zone, the overlying sub-zone B3 being marked by the incoming of the new species mentioned below.

Subzone B.3.: This subzone is named after

Alocopocythere sheikhibrahimensis sp.nov.

Pontocyprella sp. A

The other species found in this subzone are:

Dohukia fossulata sp.nov., Dentokrithe comma sp.nov., Propontocypris sp.aff. P. solida Ruggieri 1962.

This subzone is characterised by the presence of the new genus Dohukia.

The upper limit is marked by the appearance of the species belonging to the subzone B.4.

Subzone B.4: is named after Q. (Mosulia) pulchra sp.nov.

Dentokrithe autochthona (Lyubimova and Guha) 1960

This subzone is characterised by the presence of the new subgenus Quadracythere (Mosulia). The other species found in this subzone are: Actinocythereis costata sp.nov., Cytherelloidea hamrinensis sp.nov., Cytherelloidea crassinodosa sp.nov.

The upper limit of this subzone is defined by the disappearance of the above species.

3. Assemblage Zone C is named after Cytherella sayybi sp.nov. which has a short vertical stratigraphic range and is confined to this zone. In this zone a large number of species disappear as shown in the text figures, and the zone is characterised by other species with short stratigraphical range such as Stigmatocythere nodosa sp.nov. and Propontocypris cuneiformis sp.nov. with a vertical continuation of some species from other zones. The range of ostracod species in the Kirkuk area is shown in Text fig. 23, which shows the approximate distribution of species in Lower Fars marker beds in Kirkuk well 208. The specimens came from ditch cuttings so that whilst the top occurrence of each species is accurately placed in the section, caution is needed when interpreting the lower limit of species as in any well sample. Here, biostratigraphic correlation must be based on first appearance from the top down rather than the bottom up, and a tentative correlation with the work on the surface sections outlined above is given below.

1. Upper Red Beds Ostracod assemblage

*L. (Loxoconcha) hamerinensis sp.nov., *Hermanites transversicostata Khalaf 1982, *Alocopocythere fossularis (Lyubimova and Guha) 1960, *Alocopocythere sheikhibrahimensis sp.nov., *Asymmetricythere reticulata sp.nov., Miocyprideis ovalis sp.nov. *Parakrithe? sp., *Actinocythereis iraqensis Khalaf 1982, *Miocyprideis recta sp.nov., *Callistocythere hipposideros sp.nov., *Pontocyprella kirkukensis sp.nov., *Schneiderella vulgaris sp.nov., *Buntonia sheikhanensis sp.nov., *Isobuntonia pulchra sp.nov., *Stigmatocythere nodosa sp.nov., *Flexus trifurcata (Lyubimova and Guha) 1960, *P. (Eop.) acuminata sp.nov., *Leptocythere (leptocythere) hajerensis sp.nov., Cytherelloidea flexicostata sp.nov., Callistocythere sp. A, Neocyprideis? sp. Cushmanidea sp.,, *Dentokrithe constricta sp.nov., Pontocyprella acuminata sp.nov., Sulcostocythere reticulata sp.nov., Sulcostocythere dimorphica sp.nov., Sulcostocythere posterotruncata sp.nov., Dentokrithe autochthona (Lyubimova and Guha). All species marked with * are found in seepage and transition beds. The bed Nos. R2 and R8 are proved completely barren.

2. Seepage Beds Ostracod assemblage

Cytherelloidea flexicostata sp.nov., Dentokrithe comma sp.nov., Pontocyprella acuminata sp.nov., Dohukia fossulata sp.nov., Hemicyprideis angulata angulata sp.nov., subsp.nov., Hemicyprideis angulata decrementa n.ssp., E. (Scelidocythereis) asiatica sp.nov., Cytherelloidea hamrinensis sp.nov., Ghardaglaia sp.aff. G. kermani Krstic 1979, Actinocythereis cornuocula cornuocula sp.nov. subsp.nov. Genus B, Ghardaglaia nova sp.nov., Pontocyprella sheikhanensis sp.nov., Hemicyprideis miocaenica sp.nov., Cytherella sayybi sp.nov.

The bed no. B.4 proved to be completely barren.

3. The Saliferous Beds are completely barren.

4. The Transition Beds Ostracod assemblage

Beds T1, T5, T8, T10 and T13 are completely barren. The following species are found in the Transition Beds, in addition to the species which are found in Transition, Seepage and Upper Red Beds.

Quadracythere (Mosulia) pulchra sp.nov.. Actinocythereis costata sp.nov., P. (Eop.) kausalis sp.nov., Miocyprideis sp. B, Cytherelloidea crassinodosa sp.nov., Alocopocythere sp. Dentokrithe comma sp.nov., Miocyprideis ovalis sp.nov., Semicytherura sp.

Discussion of the individual sections

Dohuk section

The distribution of ostracod species in the Dohuk section shows some variation from the Sheikh Ibrahim section, the absence of Assemblage Zone A indicates that the Dohuk section represents the upper member of Lower Fars Formation. The subzones B.1 and B.2 are missing and this may be due to lithological variation. The subzone B.3 is marked with the characteristic species

Alocopocythere sheikhibrahimensis sp.nov.

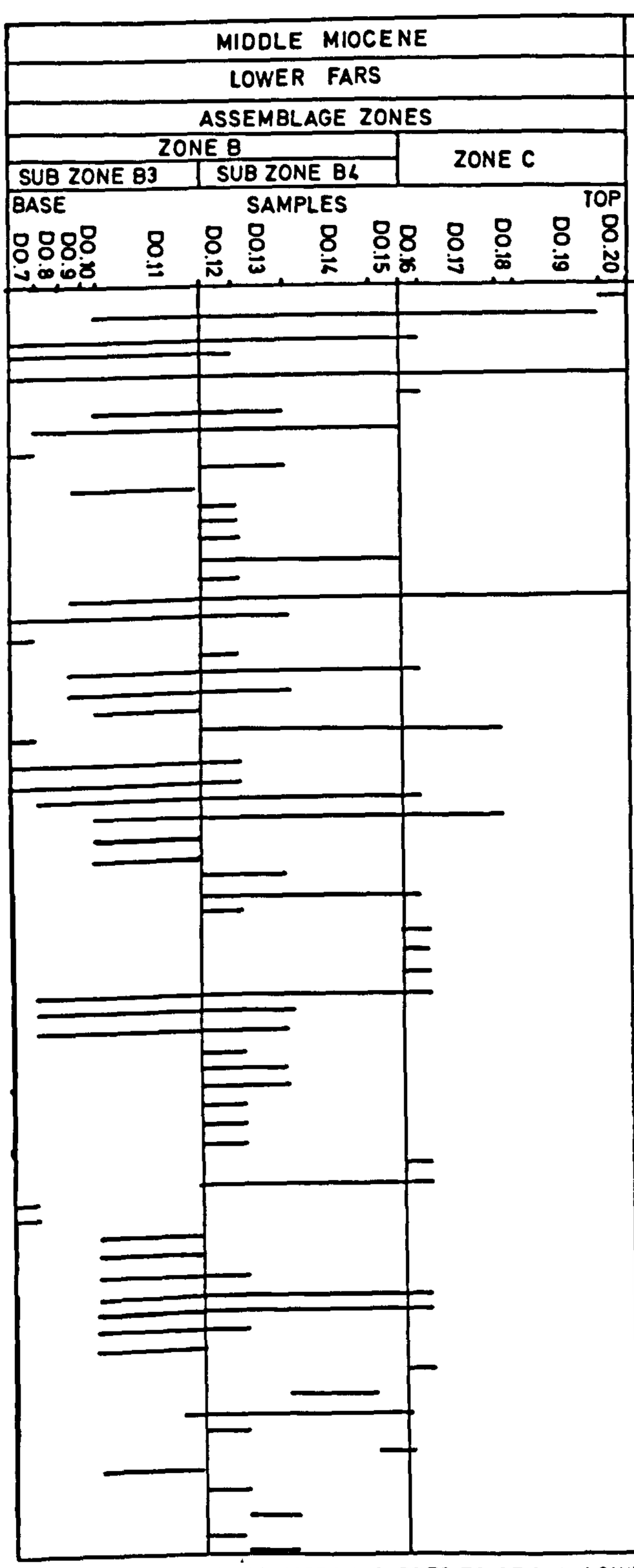
Pontocyprella sp. A

Propontocypris sp.aff. Propontocypris solida Ruggieri 1962

The subzone B.4 is characterised by the absence of Q. (Mosulia) pulchra sp.nov., but with the presence of other characteristic subzone species:

Actinocythereis costata sp.nov.

Cytherelloidea hamrinensis sp.nov.



AGE

FORMATION

SPECIES

Echinocytereis (Scelidocythereis) asiatica sp.nov.
Schneiderella unispinata sp.nov.
Miocyprideis recta sp.nov.
Sulcostocythere reticulata sp.nov.
Miocyprideis ovalis sp.nov.
Hemicyprideis angulata angulata sp.nov. sub sp.nov.
Asymmetricythere reticulata sp.nov.
Schneiderella vulgaris sp.nov.
Falunia (Hiltermannicythere) miocaenica sp.nov.
Xestoleberis orientalis sp.nov.
Alocopocythere sheikhibrahimensis sp.nov.
Xestoleberis sp.
Loxoconcha (Palmoconcha) miocaenica sp.nov.
Loxoconcha (Loxoconcha) hamrinensis sp.nov.
Hermanites transversicostata Khalaf 1982
Mutilus fortireticulata sp.nov.
Actinocythereis iraqensis Khalaf 1982
Callistocythere hipposideros sp.nov.
Paijenborchella (Eopaijenborchella) Kausalis sp.nov.
Pontocyprella sheikhanensis sp.nov.
Cytherelloidea flexicostata sp.nov.
Paracytheridea splendida sp.nov.
Alocopocythere fossularis (Lyubimova and Guha) 1960
Loxoconcha (Loxoconcha) pseudohamrinensis sp.nov.
Flexus trifurcata (Lyubimova and Guha) 1960
Paijenborchella (Eopaijenborchella) sp. aff. P. (Eop.) royi Khosla 1978
Propontocypris miocaenica sp.nov.
Dentokrithe comma sp.nov.
Dohukia fossulata gen. et. sp.nov.
Pontocyprella sp.A
Propontocypris sp. aff. Propontocypris solida Ruggieri 1962
Cytherelloidea hamrinensis sp.nov.
Cytherelloidea crassinodosa sp.nov.
Actinocythereis costata sp.nov.
Propontocypris cuneiformis sp.nov.
Cytherella sayybi sp.nov.
Stigmatocythere nodosa sp.nov.
Cytherella bashiqaensis sp.nov.
Cytherella dohukensis sp.nov.
Bairdia rafidainensis sp.nov.
Bairdia sp. aff. B.rafidainensis sp.nov.
Bairdia sp.A
Paranesidea punctata sp.nov.
Propontocypris sp.
Ghardaglaia nova sp.nov.
Callistocythere sp.B
Sylvestra sp.
Hemicyprideis miocaenica sp.nov.
Miocyprideis chaudhuryi (Lyubimova and Guha) 1960
Miocyprideis sp.B
Cushmanidea sp.
Dentokrithe aff. Dentokrithe indica Tewari and Tandon 1960
Actinocythereis dextraspina sp.nov.
Acanthocythereis dohukensis Khalaf 1982
Actinocythereis cornuocula spinosa sub sp. n.ssp.
Ruggieria nova sp.nov.
Hermanites compressa sp.nov.
Quadracythere (Hornibrookella) Kurdistanensis sp.nov.
Phlyctocythere sp.
Semicytherura matiaensis sp.nov.
Pseudoceratina nova sp.nov.
Isobuntonia pulchra sp.nov.
Stigmatocythere cellulosa sp.nov.
Buntonia sheikhanensis sp.nov.
Pontocyprella bashiqaensis sp.nov.
P.(Eopaijenborchella) sp.A
Dentokrithe autochthona (Lyubimova and Guha)1960

TEXT FIG.20 RANGE OF OSTRACOD SPECIES OF THE LOWER FARS FORMATION IN THE DOHUK LOCALITY N. IRAQ

Cytherelloidea crassinodosa sp.nov.

Both subzones B.3 and B.4 characterised by the first appearance of the following species: Cytherella dohukensis sp.nov., B. rafidainensis sp.nov., Miocyprideis chaudhuryi (Lyubimova and Guha) 1960, Actinocythereis dextraspina sp.nov., Acanthocythereis dohukensis Khalaf 1982, Ruggieria nova sp.nov., Semicytherara matensis sp.nov., Hermanites compressa sp.nov., Stigmatocythere cellulosa sp.nov., Paranesidea punctata sp.nov., Ghardaglaia nova sp.nov., Pseudoceratina?nova sp.nov., Buntonia sheikhanensis sp.nov.

The Assemblage Zone C is characterised by appearance of Sylvestra sp. and Quadracythere (Hornibrookella) kurdistanensis sp.nov.

Sheikhan Section

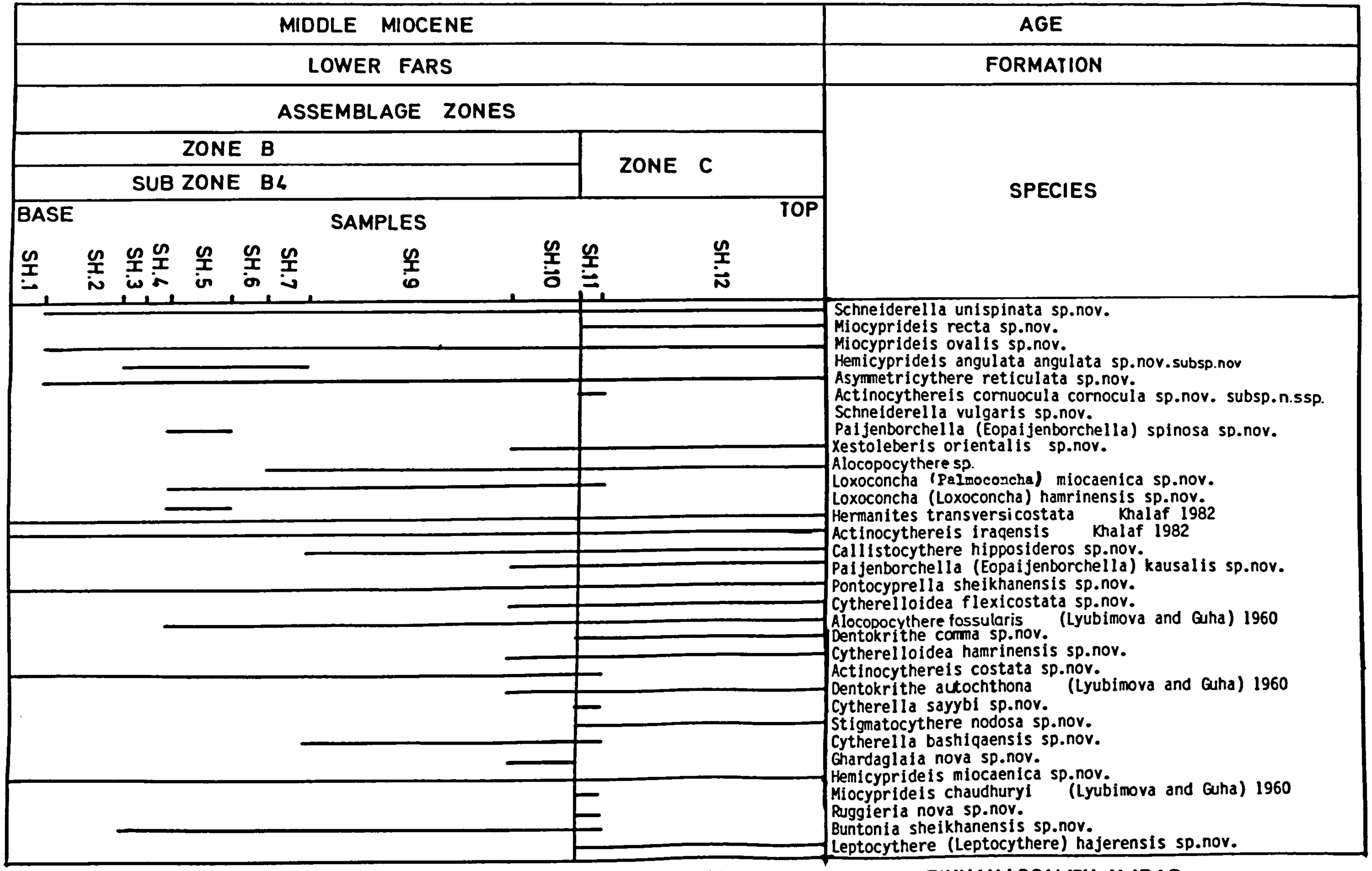
In this section Assemblage Zone A is absent and Assemblage Zone B is indicated by the presence of subzone B.4., leading to the conclusion that the Sheikhan section represents the upper member of the Lower Fars Formation. Subzone B.4 is characterised by the following species:

Actinocythereis costata sp.nov.

Cytherelloidea hamrinensis sp.nov.

Dentokrithe autochthona (Lyubimova and Guha) 1960

The presence of Ghardaġlaia nova sp.nov., Hemicyprideis miocaenica sp.nov., and Buntonia sheikhaensis sp.nov. which also appear in subzone B.4 in the Dohuk section confirm the presence of subzone B.4 in the Sheikhan section.



TEXT FIG. 21 RANGE OF OSTRACOD SPECIES OF THE LOWER FARS FORMATION IN THE SHEIKHAN LOCALITY, N. IRAQ

The Assemblage Zone C is present with characteristic species:

Cytherella sayybi sp.nov.

Stigmatocythere nodosa sp.nov.

and the presence of Leptocythere (leptocythere) hajerensis sp.nov. for the first time.

Bashiqa section

This section is characterised by the disappearance of some species and the appearance of others. The presence of the characteristic species of B.3 and B.4 subzones indicates that the Bashiqa section represents the upper member of the Lower Fars Formation.

Subzone B.3 is characterised by:

Propontocypris sp. aff. propontocypris solida Ruggieri 1962

Alocopocythere sheikhibrahimensis sp.nov.

and presence of Dohukia fossulata sp.nov.

Dentokrithe comma sp.nov.

Subzone B.4 is characterised by the following species:

Quadra cythere (Mosulia) pulchra sp.nov.

Dentokrithe autochthona (Lyubimova and Guha) 1960

Cytherelloidea crassinodosa sp.nov.

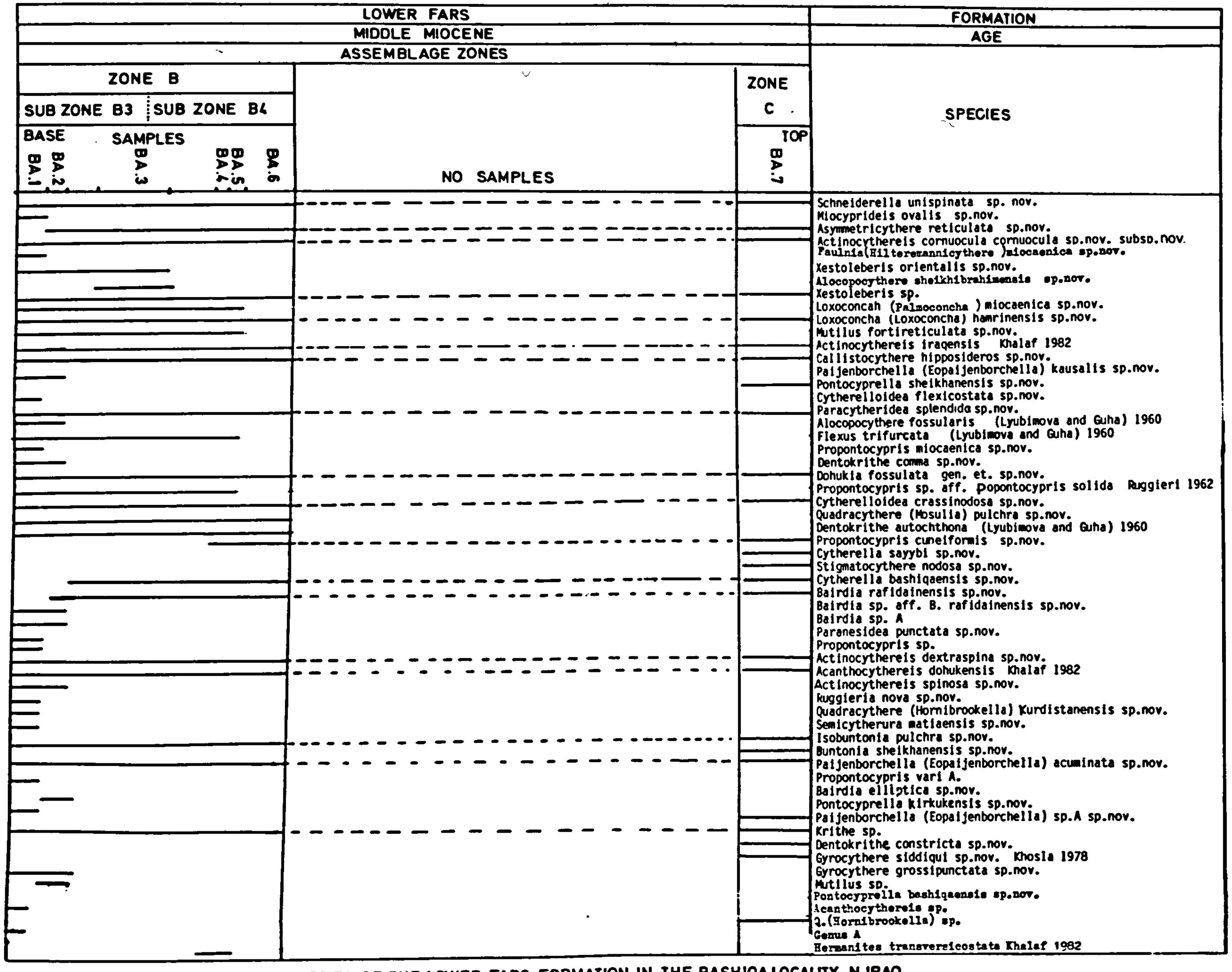
Assemblage Zone C.

This zone at the Bashiqa locality is characterised by the common ostracod species as shown in the Text fig. 22 and the following species, for the first time.

Gyrocythere Siddiquil Khosla 1978

Paijenborchella (Eopaijenborchella) sp. A.

Quadracythere (Hornibrookella) sp.



TEXT FIG.22 RANGE OF OSTRACOD SPECIES OF THE LOWER FARS FORMATION IN THE BASHIQA LOCALITY N.IRAQ

The following species were found in Hamrin well 2.

Actinocythereis iraqensis Khalaf 1982, Xestoleberis orientalis sp.nov. Actinocythereis cornuocula cornuocula sp.nov. subsp.nov. Alocopocythere sheikhibrahimensis sp.nov., Sulcostocythere posteronodosa sp.nov., Miocyprideis ovalis sp.nov., Buntonia sheikhanensis sp.nov., Miocyprideis recta sp.nov., Miocyprideis chauduryi Lyubimova and Guha 1960 Callistocythere hipposideros sp.nov., Parakrithe? sp. Schneiderella vulgaris sp.nov., Cytherelloidea hamrinensis sp.nov., Loxoconcha (Loxoconcha) hamrinensis sp.nov., P. (Eopaijenborchella) acuminata sp.nov., P. (Eop.) kausalis sp.nov., Asymmetricythere reticulata sp.nov., Isobuntonia cuspidata sp.nov., Alocopocythere fossularis (Lyubimova and Guha) 1960, Hirschmannia? rara sp.nov., Hemicyprideis angulata decrementa n.ssp. Dentokrithe constricta sp.nov., Echinocythereis (Scelidocythereis) asiatica sp.nov., Hermanites transversicostata Khalaf 1982.

The following species were found in Bai-Hassan well-33

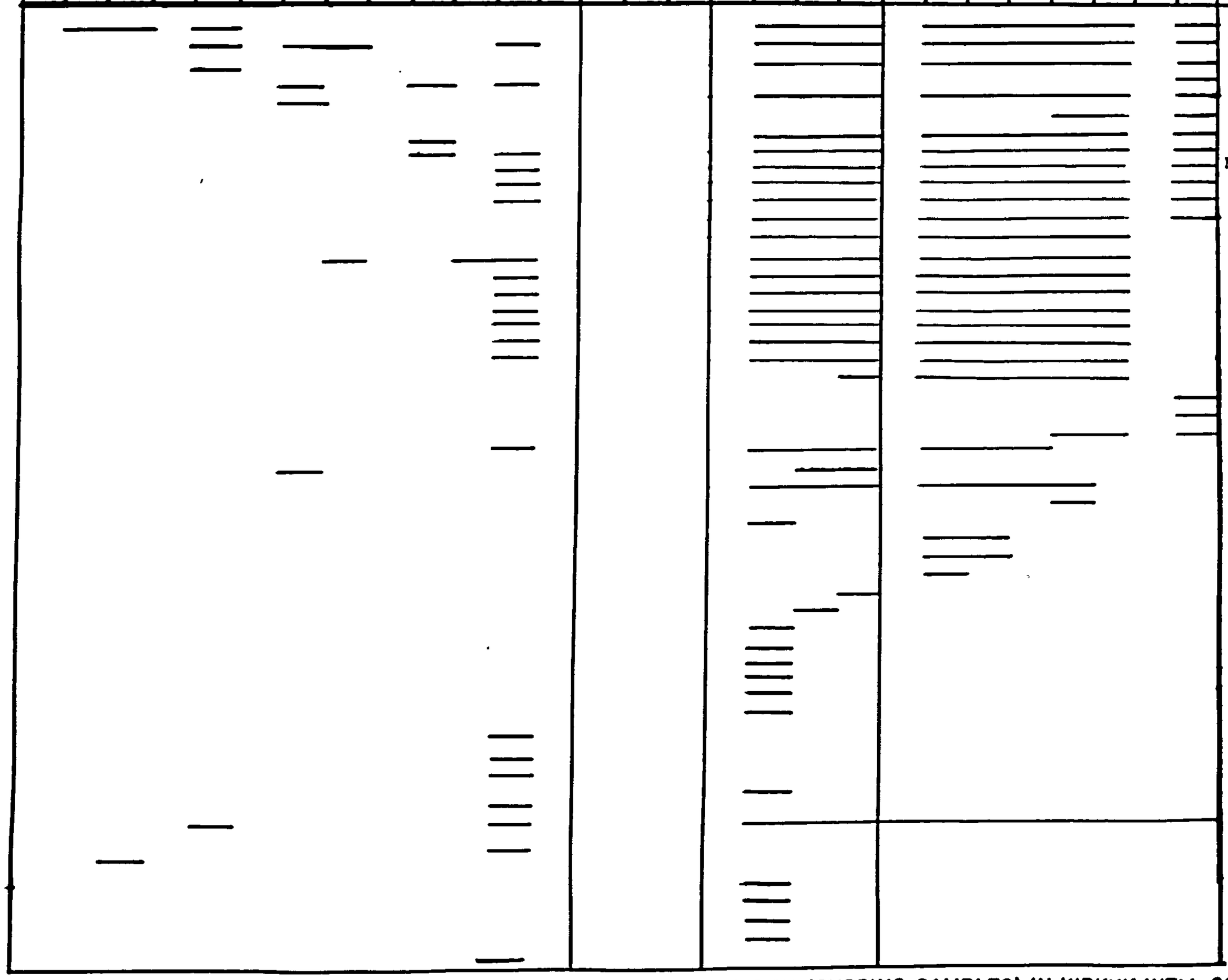
Schneiderella vulgaris sp.nov., Hemicyprideis angulata angulata sp.nov., Miocyprideis ovalis sp.nov., Asymmetricythere reticulata sp.nov., Genus B, Hermanites transversicostata Khalaf 1982, Miocyprideis recta sp.nov. Dentokrithe autochthona (Lyubimova and Guha) 1960, Pontocyprella kirkukensis sp.nov., Leptocythere hajerensis sp.nov., Xestoleberis orientalis sp.nov., Ghardaglaia sp.aff. G. kermani Krstic 1979, Alocopocythere sp., Buntonia sheikhanensis sp.nov., Callistocythere hipposideros sp.nov., Flexus trifurcata Lyubimova and Guha 1960. P. (Eop.) acuminata sp.nov., Sulcostocythere posterotruncata sp.nov., Hirschmannia? rara sp.nov., Neocyprideis? sp., Dentokrithe constricta sp.nov., Actinocythereis costata sp.nov., Alocopocythere fossularis (Lyubimova and

MIDDLE MIOCENE

LOWER FARS

BASE — TRANSITION BEDS OSTRACOD ASSEMBLAGE — SALIFEROUS BEDS (BARREN) — SEEPAGE BEDS OSTRACOD ASSEMBLAGE — UPPER RED BEDS OSTRACOD ASSEMBLAGE — TOP

T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1	S3	S2	S1	B4	B3	B2	B1	R8	R7	R6	R5	R4	R3	R2	R1



AGE

FORMATION

SPECIES

Loxoconcha(Loxoconcha)hamrinensis sp.nov
Hermanites transversicostata Khalaf 1982
Alocopocythere fossularis (Lyubimova and Guha)1960
Alocopocythe e sheikhibrahimensis sp.nov.
Asymmetricythere reticulata sp.nov.
Miocyprideis ovalis sp.nov.
Parakrithe? sp.
Actinocythereis iraqensis Khalaf 1982
Miocypridies recta sp.nov.
Callistocythere hipposideros sp.nov.
Pontocyprella kirkukensis sp.nov.
Schneiderella unispinosa sp.nov.
Paijenborchella(Eopaijenborchella)spinosa sp.nov.
Schneiderella vulgaris sp.nov.
Buntonia sheikhanensis sp.nov.
Isobuntonia pulchra sp.nov.
Stigmatocythere nodosa sp.nov.
Flexus trifurcata (Lyubimova and Guha)1960
Paijenborchella(Eopaijenborchella)acuminata sp.nov.
Leptocythere(Leptocythere)hajerensis sp.nov.
Cytherelloidea flexicostata sp.nov.
Callistocythere sp.A
Neocyprideis? sp.
Cushmanidea sp.
Dentokrithe constricta sp.nov.
Dentokrithe comma sp.nov.
Pontocyprella acuminata sp.nov.
Sulcostocythere reticulata sp.nov.
Dohukia fossulata sp.nov.
Sulcostocythere dimorphica sp.nov.
Sulcostocythere posterotruncata sp.nov.
Dentokrithe autochthona (Lyubimova and Guha)1960
Hemicyprideis angulata angulata sp.nov. sub.sp nov.
Hemicyprideis angulata decrementa n.ssp
Echinocythereis(Scelidocythereis)asiatica sp.nov.
Cytherelliodea hamrinensis sp.nov.
Ghardaglaia sp.aff.G.Kermani Krstic 1979
Actinocythereis cornuocula cornuocula sp.nov.subsp.
Actinocythereis cornuocula spinosa subsp.
Genus B
Alocopocythere sp.
Cytherelloidea crassinodosa sp.nov.
Miocyprideis sp.A
Genus A
Paijenborchella(Eopaijenborchella)kausalis sp.nov.
Xestoleberis orientalis sp.nov.
Actinocythereis costata sp.nov.
Quadracythere (Mosulia)pulchra sp.nov.
Ghardaglaia nova sp.nov.
Pontocyprella sheikhanensis sp.nov.
Hemicyprideis miocaenica sp.nov.
Cytherella sayybi sp.nov.
Semicythura sp.

TEXT FIG. 23 RANGE OF OSTRACOD SPECIES OF THE LOWER FARS FORMATION (CUTTING SAMPLES) IN KIRKUK WELL 208, N. IRAQ

Guha) 1960.

The following species are found in Naft Khana 34

Schneiderella vulgaris sp.nov., Asymmetricythere reticulata sp.nov., Miocyprideis ovalis sp.nov., Leptocythere hajerensis sp.nov., Actinocythereis iraqensis Khalaf 1982, Callistocythere hipposideros sp.nov. Flexus trifurcata Lyubimova and Guha 1960, Genus A. Alocopocythere sheikhibrahimensis sp.nov., P. (Eop.) acuminata sp.nov., Buntonia sheikhanensis sp.nov.

The following species were found in Tel-Hajer well 1

Hermanites transversicostata Khalaf 1983, Pontocyprella sheikhanensis sp.nov., Q. (Mosulia) pulchra sp.nov., Flexus trifurcata Lyubimova and Guah 1960. Actinocythereis iraqensis Khalaf 1982, Stigmatocythere nodosa sp.nov., Actinocythereis cornuocula cornuocula sp.nov., subsp.nov., Pseudoceratina ? nova sp.nov., Asymmetricythere reticulata sp.nov., Callistocythere hipposideros sp.nov., Loxoconcha (Loxoconcha) hamrinensis sp.nov., Miocyprideis ovalis sp.nov., Alocopocythere sheikhibrahimensis sp.nov., Genus B, Leptocythere hajerensis sp.nov., Xestoleberis orientalis sp.nov., Cytherella bashiqensis sp.nov., Cyprideis sp.cf. C. (Cyprideis) sublittoralis adentata Bassiouni 1979.

CHAPTER 6
PALAEOECOLOGY

PALAEOECOLOGY

Information on recent and fossil Ostracoda from Iraq is scarce and thus it is not possible to say anything meaningful about ecology at the species level. The Palaeoecological interpretation is based on comparison with data from other sources such as indicator genera combined with stratigraphical and sedimentological observations. Interpretation by means of indicator genera has a limited value, but comparison on the basis of the predominance of one group of indicator genera can be used to give a general impression of the palaeoecology.

The main object and scope of this palaeoecological interpretation is to use all the criteria and the associated ostracoda to give a rough outline in general terms of oxygen, palaeoclimate, salinity, temperature, and trends in the development of the depositional environment of the Lower Fars Formation.

Oxygenation:

Generally the colour of the Ostracod test coming from a normally oxygenated environment varies from white to light brown, but sometimes it is dark brown or black. Most species of Ostracoda from subsurface samples are characterised by a dark test, and those from surface samples vary from white to light brown. However, a common feature in the Lower Fars Formation residues of the present study was pyrite, whose presence in this Formation had previously been noted by Sugden (1966). Three types of occurrence are present:-

1. well-developed, separate crystals of pyrite from the washed residues
2. pyrite covering the whole carapace of some Ostracod species, which

gives the fauna a black colour and 3. pyrite as elongated stick-like developments on the Ostracod carapace.

Oertli (1971) explained that the black colour of some ostracods was due to pyritization. Normally, close to the sediment surface there is a phase of aerobic decay during which bacteria utilize dissolved oxygen for the oxidation of organic matter. However, after death some individuals escape destruction until they are buried at a depth to which dissolved oxygen does not penetrate at which point the remaining organic matter suffers a phase of anaerobic bacterial decay. The decomposition of proteins sets free considerable amounts of hydrogen-sulphide formed by anaerobic decay and this reacts with iron oxides to form iron-sulphides, the so-formed pyrite replacing part of the calcite (Michal 1968). This reaction could well explain the black colour of the Ostracod tests found in the Lower Fars Formation. This is further supported by the discovery of the aneorobic bacterium Desulphoribrio desulpharicana in the Lower Fars Formation by Al-Sawaf (1977). On the other hand some specimens coming from surface samples are characterised by a dark brown colour of the test. This can be explained by oxidation during which the bacteria utilize dissolved oxygen to produce hydrogen sulphide which reacts with the iron to form hydrotroilite. This is unstable in an oxidizing environment and is converted to limonite which gives the dark brown colour to the Ostracod test. Limonite is well known in the Lower Fars Formation.

From the above discussion one concludes that the dark-red colour of some Ostracod tests and the presence of limonite on the one hand, and the black colour of other Ostracod tests and the presence of pyrite on the

other hand, indicates that there is primary oxidation after burial which changes to reduction at the beginning of pyrite formation, and that the rarity of single valves coupled with the predominance of carapaces indicates rapid sedimentation. Oertli (1971) noted that this phenomenon is most likely to occur in the deeper or axial parts of basins where maximum thicknesses of sediment accumulate and K.L. Finger (1983) suggested that carapaces infilled with pyrite indicate rapid burial in a slightly basic and reducing environment which seems applicable in the case of the Lower Fars Formation.

Palaeoclimate:

In northern Iraq variation in sedimentation between the Lower, Middle and Upper Fars, where the Lower Fars is characterised by evaporite deposition, the Middle Fars by an absence of evaporites and the Upper Fars by the predominance of clastic sediments indicates that sedimentation was partly controlled by varying climatic conditions. Generally deposition of gypsum-anhydrite indicates the existence of an arid climate during the Miocene in the Middle East.

Variation in the ornamentation and in the development of nodes of some ostracods found in the Lower Fars Formation, could be caused by climatic changes and this will be discussed later in this chapter.

Salinity and morphological variation:

As the Lower Fars Formation is characterised by the deposition of gypsum, salinity is obviously an important factor in the environment of deposition, and salinity has always been regarded as a primary factor affecting ostracod distribution (Neale 1964). Keen (1971, 1972, 1977) has also

discussed the effects of salinity changes on valve morphology.

The ostracod species described from the Lower Fars Formation show variation in valve morphology such as the development of nodes or hollow tubercles and ornamentation. Many workers have studied the relationship between nodes and salinity. Scheifer (1953) quoted 5‰ as being the critical level, below which noded forms occur. Vesper (1972) recorded occasional noded adults in salinities up to 14‰ but between 6‰ and 2‰ they increased to form 85% of the population. Kilenyi (1972) concluded that the proportion of noded specimens increases with decreasing salinity but that there is no simple linear relationship, and he sought an explanation in balanced polymorphism. Hemicyprideis miocaenica sp.nov., Hemicyprideis angulata angulata sp.nov.subsp. and Hemicyprideis angulata decrementa nssp. described from the Lower Fars Formation are characterised by nodes or hollow tubercles, but there is variation in the development of these nodes. Hemicyprideis miocaenica sp. nov. characterised by well developed nodes which are relatively large is dominant at the Bashiqa, Sheikhan and, to some extent, Dohuk localities, the first two localities being characterised by a complete absence of gypsum beds. H. miocaenica sp. nov. is absent or very rare in the lower member of the Lower Fars Formation at the Sheikh Ibrahim locality which is characterised by the dominant beds of gypsum. The same locality provides rare small Hemicyprideis angulata angulata sp.nov.subsp. with weakly developed nodes compared with H. miocaenica sp. nov. from the upper member of the Lower Fars Formation at the Bashiqa, Sheikhan and Dohuk localities. H. angulata angulata increases in number of individuals and becomes common with relatively well developed nodes in the u. member of the Lower Fars Formation at the Sheikh Ibrahim locality.

H. angulata angulata sp. nov. is rare in the Kirkuk area whereas H. decrementa subsp. is found in the Kirkuk area but characterised by weakly developed nodes. All these variations are most probably related to salinity changes. Keen (1971) studied the palaeoecology of H. montosa from a gypseous environment and concluded that maximum nodosity was probably attained in the mesohaline range. Bate (1971) described smooth Cyprideis species from the hyper-saline environment of Abu-Dhabi lagoon and Bassiouni (1979) recorded smooth Cyprideis species of M. Miocene age from S.E. Turkey indicating at least temporary hypersaline conditions.

If Malz's (1971) suggestion that the recent Cyprideis is an ecological substitute for Tertiary Hemicyprideis applies here, the description of smooth Cyprideis from a hypersaline environment indicates that there is an inverse relation between salinity and the development of nodes. Bassiouni (1979) concluded that the rarity or complete absence of noded Cyprideis may prove at least temporary dry climatic conditions which lead to meso-pliohaline water salinity, and the dominance of the noded Cyprideis morphotype in the brackish sediments indicates oligo-to miohaline conditions. The other morphologigal feature observed in these ostracod species from the Lower Fars Formation is the variation in ornamentation from strongly pitted to completely smooth within the same species, and variation in the development of reticulation all of which may be due to salinity changes. Keen's (1977) explanation of short-term fluctuations occurring because of periods of drought which produce higher salinity, and periods of high rainfall and floods giving lower salinities, could be applied here. This compares with Bassiouni's conclusion that the presence of smooth Cyprideis together with large noded morphotypes indicated seasonal climatic conditions with rainy periods causing freshening of

the water and dry seasons causing increased salinity. The variation in ornamentation of Miocyprideis, Sulcostocythere, Asymmetricythere, and Hemicyprideis can be explained following the idea of Sandberg (1964) that during deposition there was a periodic fluctuation in salinity, or that it altered over a period of time from lower to higher salinity or vice versa.

Another phenomenon shown by the Lower Fars Formation ostracods is variation in size. Many workers have studied the relationship between size and salinity. Baker (1963) showed a decrease in size with decrease in salinity in Leptocythere and Loxoconcha, but this could not be explained by Kilenyi (1971). Keen (1971) found in Hemicyprideis montosa that the largest specimens come from freshwater, the smallest from polyhaline waters with intermediate sizes from other salinities. He also suggested that food supply and population density, might also affect size. Van Harten (1975) recorded larger carapaces of Cyprideis torosa from lower salinities. The ostracod species described from the Lower Fars Formation show variation in size with the larger specimens coming from lower salinities and the smaller from higher salinities and this variation appears to follow the same behaviour in the development of nodes.

From the above discussion one concludes that salinity during the deposition of the Lower Fars Formation was under periodic or seasonal fluctuations and that this is shown by variation in the development of nodes in Hemicyprideis and the presence of smooth Cyprideis sp. cf. C. (Cyprideis) sublittoralis adentata Bassiouni 1979, and the variation in ornamentation and size of other species. Salinity in the Lower Fars Formation varied from brackish, normal to hypersaline, where gypsum was predominant and

where some samples, characterised by gypsum nodules proved completely barren.

Trends in the development of the depositional environment of the Lower Fars Formation

Most workers agree that a strongly reticulate or ornamented lateral surface with well-developed eye tubercle indicate an ostracod which inhabits shallow water. In the Lower Fars Formation assemblages such genera are Actinocythereis, Asymmetricythere, Sulcostocythere, Schneiderella, F. (Hiltermannicythere), Callistocythere, Gyrocythere, Chrysocythere, Alocopocythere, Stigmatocythere, Hermanites, Mutilus Ruggieria, Isobuntonia, Dohukia, Quadracythere (Mosulia). The above genera and others show morphological variation in their distribution across the Lower Fars Formation basin, and this reflects the variation in the development of the depositional environment. At the Sheikh Ibrahim locality where the cyclic depositions of the Lower Fars Formation is well represented, Assemblage Al indicates shallow marine, but somewhat deeper conditions, than other localities. The presence of E. (Scelidocythereis), Schneiderella, Sulcostocythere, Miocyprideis and Bythocypris, in the lower part of the lower member of Lower Fars Formation, probably represents a transgression phase combined with deposition of marl. Later the appearance of rare Hemicyprideis with weakly developed nodes, combined with the deposition of thick gypsum beds and thin limestone beds indurated with gypsum, indicates that there is a hypersaline lagoon developed during some part of the lower member of Lower Fars Formation. At the top of the lower member the two well-known species of Sulcostocythere, combined with the deposition of marly limestone, indicate a change in salinity towards normal marine, for Sulcostocythere was originally recorded from

a salinity range of 30‰ - 31‰ (Benson and Maddocks 1964).

At the beginning of the upper member, new genera appeared with an increase in the number of species in Assemblage B. These genera are Hiltermannicythere, Xestoleberis, Alocopocythere, L. (Palmoconcha). L. (Loxoconcha), Hermanites, Mutilus, Actinocythereis, Callistocythere, Pontocyprella. In the middle part of the upper member the increase in Hemicyprideis with well-developed nodes combined with the presence of Loxoconcha, Paracytheridea and Xestoleberis indicates a mixed environment (brackish environment). In some part of the upper member the presence of Bythocypris; may be explained according to Sylvester-Bradley and Benson 1971 who stated that Bythocypris or Krithe and other deep genera are also found in the warmer or at least shallow water. The upper part of Assemblage Zone B.4 and Assemblage Zone C indicate a very shallow, near shore environment for Propontocypris which Maddocks (1964) suggested is characteristic of shallow water, near-shore environments and is tolerant of higher salinities and temperature fluctuations.

At the Dohuk locality the Lower Fars Formation is thinner and characterised by the appearance of Paranesidea, Semicytherura and Bairdia. Maddocks (1964) described Paranesidea as characteristic of very shallow water (tropical fauna). Kornicker (1961) found that in the tropics the genus Bairdia was common up to depths of 15-25 metres. The bulk of the ostracod assemblage indicates shallower water than at the Sheikh Ibrahim locality.

At the Sheikhan and Bashiqa localities the common genera indicate a very shallow environment with brackish conditions characterised by Hemicyprideis (well developed nodes), Xestoleberis, Miocyprideis, L. (Loxoconcha). This,

together with the presence of clastic sediments, indicates that the Sheikhan and Bashiqa localities represent the marginal facies of the basin.

In the Kirkuk area the Lower Fars Formation is divided into four informal units which are not recognised in the Sinjar area. The deposition pattern represents desiccation and dilution phases. The ostracod assemblage in the Transition Beds indicates restricted, shallow marine conditions which show fluctuations in salinity which sometimes represents brackish or mixed phases with the presence of Hemicyprideis and Neocyprideis. Desiccation is sufficient to cause the deposition of salt to indicate hypersaline lagoons including saliferous beds, which proved completely barren. The Seepage and Upper Red Beds ostracod assemblage indicates a very shallow water environment and this is supported by the presence of clastic sediments, indicating the margin of the L. Fars basin in the Kirkuk area. The ostracod genera are similar to those found at the Bashiqa and Sheikhan localities.

CHAPTER 7
FAUNAL RELATIONSHIPS

FAUNAL RELATIONSHIPS

There is a paucity of previous work on N. Iraq and as far as the author is aware there are no published records from the area, making comparison on a broader scale interesting. In this chapter the Ostracod genera found in the Lower Fars Formation are compared with those of other areas, largely in Western Asia and the Mediterranean. This comparison is essentially with Miocene Ostracoda from adjacent areas, but, where appropriate, records of some genera in the U. Cretaceous and Lower Tertiary of other areas are given in order to show the affinities of Miocene Ostracoda from Iraq and to draw attention to their palaeoecological significance. The only study of U. Cretaceous-Eocene Ostracoda from N. Iraq is by Al-Sheikhly 1980 (unpublished Ph.D. thesis), who recorded the following genera, which are also found in the Miocene in the present study. Acanthocythereis, Bairdia, Cytherella, Cytherelloidea, Hermanites, Paracytheridea, Pontocyprella, Semicytherura?, Xestoleberis, Krithe, Quadracythere, Buntonia, Leptocythere, Loxoconcha, Alocopocythere, Propontocypris.

For convenience the faunal relationships are discussed on a geographical basis.

IRAN

Ostracoda from the L. Miocene sediments in the area between Shams and Rahniz, SW Iran were studied by Krstic (1979). Altogether fifteen species were reported. The dominant species is Miocyprideis iranica Krstic 1979 which is fairly similar to the Iraqi species. Two other species also occur in the Lower Fars Formation, N. Iraq namely

Alocopocythere fossularis (Lyubimova and Guha) placed by Krstic as Echinocythereis cf. fossularis (Lyubimova and Guha) and Flexus trifurcata (Lyubimova and Guha) found in the Lower Fars Formation and reported by Krstic as Flexus sp. Juv. cf. Flexus trifurcata. She gives the dimensions of the latter as L = 0.622 mm, H = 0.325 mm whereas the holotype dimensions are L = 0.59 mm, H = 0.31 mm. Thus Krstic's specimen is not a juvenile. Other species from Iran also show considerable similarities to the Iraqi species. Ghardaglaia sp. aff. Ghardaglaia kermani Krstic 1979 from the Lower Fars Formation shows obvious resemblances to Ghardaglaia kermani Krstic 1979. Other species recorded from the L. Miocene of Iran are similar to Iraqi species and some of them were previously recorded from western India such as Cytherelloidea aff. costatruncata Lyubimova and Guha, Macrocypris? cf. M. meridionalis Lyubimova and Guha (although the Iranian species is more related to Pontocyprella than Macrocypris and is similar to Pontocyprella bashiqaensis sp. nov.). Actinocythereis tumefacentis (Lyubimova and Guha) 1960, Loxoconcha cf. L. subovata (Münster), Xestoleberis sp., Schneiderella aff. oertlii Guha, Paijenborchella (Eopaijenborchella) berggreni Krstic 1979 and Paracytheridea sp. Hemicyprideis autonoma (Lyubimova and Guha) 1960.

INDIA

Extensive work on the Tertiary (particularly Miocene) Ostracods of Western India has been published by Lyubimova, Guha and Mohn 1960, Guha, 1961, 1967, 1968, Guha et al 1965, Khosla 1976, 1978. The following genera recorded from the Miocene of India are also found in the Lower Fars Formation in N. Iraq. Actinocythereis, Loxoconcha, Alocopocythere, Flexus, Cytherelloidea, Cytherella, Stigmatocythere, Schneiderella, Bairdia, Cushmanidea, Pontocyprella, Paracytheridea, Paijenborchella, Miocyprideis,

the fauna closely resembled that of the type Tortonian. Most of the genera also occur in N. Iraq and include similar species of Bairdia, Cytherella, Callistocythere, Acanthocythereis, Buntonia, Chrysocythere, Ruggieria, Loxoconcha, Paracytheridea.

ETHIOPIA

Gramann (1971) described Neogene Ostracods from Ethiopia including Callistocythere, Echinocythereis? afraensis (a species of Alocopocythere rather Echinocythereis), Chrysocythere, Ruggieria, Cyprideis, Miocyprideis, Sulcostocythere and Loxoconcha.

GABON

Ostracod genera described from the Neogene of Gabon by Bold 1966 are similar to Neogene Ostracoda from the Mediterranean and include Cytherella (U.Miocene), Propontocypris (M-U.Miocene), Bairdia (M.-U.Miocene, Krithe (M. Miocene), Parakrithe (M. Miocene), Chrysocythere (M. Miocene), Hermanites (M. Miocene), Buntonia (M. Miocene), Ruggieria (U. Miocene), Mutilus (U. Miocene), Loxoconcha (U. Miocene), Paijenborchella (M.-U. Miocene), Xestoleberis, Cyprideis (U. Miocene). Most of the described species show similarities to the species described from N. Iraq.

TURKEY

Bassiouni (1979) studied Cytherideinae, Hemicytherinae, and Trachyleberidinae from the Oligocene, Neogene and Pleistocene of Turkey. The following genera recorded by Bassiouni are found in the Lower Fars Formation of N. Iraq. Miocyprideis (Oligocene-Miocene), Cyprideis sp. cf. C. (Cyprideis) sublittoralis adentata Bassiouni 1979, Neocyprideis (U. Oligocene), Acanthocythereis (M. Miocene), Hemicyprideis (Oligocene-Miocene),

Do Not FILM

Ruggieria (Oligocene-U. Miocene), Chrysocythere (M. Miocene), Hiltermannicythere (Pliocene) and Mutilus (Pliocene). Also working in Turkey, Doruk (1973, 1979) studied the Neogene and Quaternary Ostracoda of the Adana and Antakya basins. Genera common to the M. Miocene of both Turkey and Iraq are:- Bairdia, Cytherella, Hermanites, Krithe, Acanthocythereis, Buntonia, Ruggieria, Callistocythere, Cytherelloidea, Loxoconcha, Mutilus, Paijenborchella (Eopaijenborchella), Quadracythere, Xestoleberis, Cyprideis, Cushmanidea, Semicytherura, Bythocypris, Parakrithe, Paracytheridea, Leptocythere and Chrysocythere.

MEDITERRANEAN

From the M. Miocene of Enna, Sicily, Ruggieri (1962) recorded the following genera whose species shows similarities to the species described from N. Iraq. Parakrithe, Bairdia, Cytherella, Acanthocythereis, Hermanites, Chrysocythere, Falunia, Mutilus, Ruggieria, Loxoconcha and Xestoleberis.

The other genera recorded by Ruggieri 1967 from the M.-U.Miocene of the North Apennines are found in N. Iraq too. Cytherella, Krithe, Falunia, Ruggieria, Leptocythere, Callistocythere, Semicytherura, Loxoconcha and Xestoleberis. The Late Cenozoic Ostracoda from the South Aegean Islands by Sissingh 1972 are similar to the Ostracoda from N. Iraq with the following genera found in both areas. Cytherella, Cytherelloidea, Bairdia, Bythocypris, Krithe, Xestoleberis, Parakrithe, Leptocythere, Callistocythere, Buntonia, Falunia (Hiltermannicythere), Mutilus, Loxoconcha, Paracytheridea, Semicytherura, Paijenborchella (Eopaijenborchella).

Study of Recent Ostracoda from Cyprus by Athersuch (1976, 1979) recorded

the following genera which is found also in Iraq. Cyprideis, Callistocythere, Xestoleberis, Loxoconcha and Hiltermannicythere. The Ostracod genera and some species show affinites with the Miocene Ostracoda described from the Caribbean, extensively studied by Van den Bold, for example the record of the genus Pseudoceratina from Miocene of Iraq and Dominica, other Caribbean Ostracods assemblages are similar in composition and environment. Some genera in the N. Iraq Miocene occur also in the U. Cretaceous and early Tertiary of Saudi Arabia covered by Al_ Furaih (1980) and in the early Tertiary of Pakistan (Sohn 1970; Siddiqui 1971). Oligocene and Miocene species from these two areas still await study and may well correspond to those from Iraq.

In these considerations it is clear that as regards generic composition the Ostracod faunas represents a shallow water environment, are close to those of India and Turkey, and not quite so close to those of Africa and other areas. However, this question of affinities at the generic level must be approached with caution because both collection failure and ecological considerations may affect the picture considerably. Nevertheless general considerations have led to the idea of Miocene Ostracod provinces outlined below.

Miocene Ostracod Provinces

Generically Lower Fars Formation Ostracoda of Northern Iraq are similar to those of similar age found in Western Asia and the east Mediterranean and Caribbean. However, comparison at the specific composition is not possible because most of the species under investigation are new. From the above review at the generic level and on the basis of described taxa in the present study, three related Miocene Ostracod provinces are proposed.

1. Western India Province:

This province covering western India and particularly the Kutch area, is characterised by rich Ostracod assemblages, common genera being Actinocythereis, Alocopocythere and Stigmatocythere, with Cytherellidae, Bairdidae, Trachyleberidàdae, Hemicytheridae and other Ostracod genera recorded earlier in this chapter also present.

2. Zagros Shelf Province (N. Iraq and NW-SW Iran):

This province is proposed on the basis of the present study, and Krstic's work on Iran (1979). The common genera in this province are Actinocythereis, Schneiderella, Alocopocythere, Miocyprideis, Dentokrithe and Pontocyprella.

3. Southeast Turkey Province:

This province is proposed on the basis of Doruk's work (1979) on the Adana and Antakya basins and Bassiouni (1979). It is characterised by the common genera Hemicyprideis, Cyprideis, Miocyprideis, Mutilus, Ruggieria, Chrysocythere and Hiltermannicythere. These three provinces are related to each other, the following species are common to Western India, N. Iraq and NW-SW Iran:- Alocopocythere fossularis (Lyubimova and Guha) 1960, Dentokrithe autochthona (Lyubimova and Guha) 1960, Dentokrithe aff. Dentokrithe indica Tewari and Tandon 1960. Miocyprideis chaudhuryi (Lyubimova and Guha) 1960, Gyrocythere siddiquii Khosla 1978 and Hemicyprideis autonoma (Lyubimova and Guha) 1960 recorded by Krstic (1979) as Cytheridea cf. C. autonoma. Other genera recorded from N. Iraq and SW Iran but not recorded from SE Turkey are Stigmatocythere, Gyrocythere, Paranesidea and Pontocyprella. The genus Ghardaglaia originally described from the Red Sea, has been found in N. Iraq and SW Iran but

not so far recorded from SE Turkey and Western India. In N. Iraq the genus Sulcostocythere is described for the first time in the area. The southeast Turkey province shows more similarity in ostracod composition to N. Iraq and SW Iran than to W. India with Hemicyprideis and Miocyprideis as common genera. The two genera Chrysocythere, Sylvestra and Cyprideis sp.cf. C. (Cyprideis) sublittoralis adentata Bassiouni 1979, are recorded from N. Iraq and SE Turkey but not recorded from Western India.

Palaeogeographical Considerations

Similar palaeogeographical conditions occurred in SE Turkey on the one hand and NW-SW Iran, Northern Iraq on the other representing two of the proposed Miocene Ostracod provinces noted above. The last transgression of the sea in the Zagros trough occurred in the late Oligocene (Kashfi 1980). The Zagros geosyncline, by this time had developed into a large shallow trough in which the advancing sea produced the Asmari Limestone. Thus the area was covered by a widespread shallow sea as late as early Miocene time. During the deposition of the Lower Fars, the rising Zagros trough had developed into local lagoonal and evaporite basins, leading to the deposition of the diachronous Lower Fars Formation. This is of Lower Miocene age in SW Iran becoming younger towards the NW where in N. Iraq it is of M. Miocene age.

The Miocene in Iraq is characterised by a quiet tectonic regime, slight subsidence and wide transgression with the development of a relatively broad, shallow basin which is filled in with sediments that can be divided into a lower and upper cycle. The transgression started in the Lower Miocene with the deposition of the Serikagni Formation. In the Kirkuk area because of the U. Oligocene uplift the Avana limestone was uplifted

and erosion took place which produced a conglomerate followed by the deposition of the lagoonal Euphrates limestone. Deposition during the L. Miocene is in accordance with movements which caused the deposition of the Dhiban anhydrite in which the basin became partially or wholly enclosed. After a break in sedimentation the M. Miocene cycle started with the deposition of a shallow lagoonal limestone (Jeribe) and ended with regression caused by the movements indicated by the basal Fars conglomerate. The following transgression led to the deposition of Lower Fars Formation.

In southeast Turkey, at the end of Oligocene, there were some movements in the Taurus orogenic zone, and the present foothills structure began to rise. A relatively narrow foredeep developed immediately to the south of the orogenic zone (Ala and Moos 1979). In the NE Syria, it is clear that the Miocene sediments closely resemble those deposited in northwest Iraq and southwest Iran. Indeed the individual formations continue from northwest Iraq into northeast Syria.

Thus SE Turkey and NE Syria as suggested by (Ala and Moos) occupy the NW corner of the Zagros basin which includes N. Iraq and SW Iran.

CHAPTER 8
CONCLUSIONS

CONCLUSIONS

Information derived from the detailed study of the Ostracoda from the Lower Fars Formation of N. Iraq has led to the following conclusions. The Miocene Ostracoda from N. Iraq show affinities with the Mediterranean and Indopacific Bioprovinces, indicating that N. Iraq, NW-SW Iran represent an intermediate zone between Tethyan Mediterranean and Tethyan Indopacific.

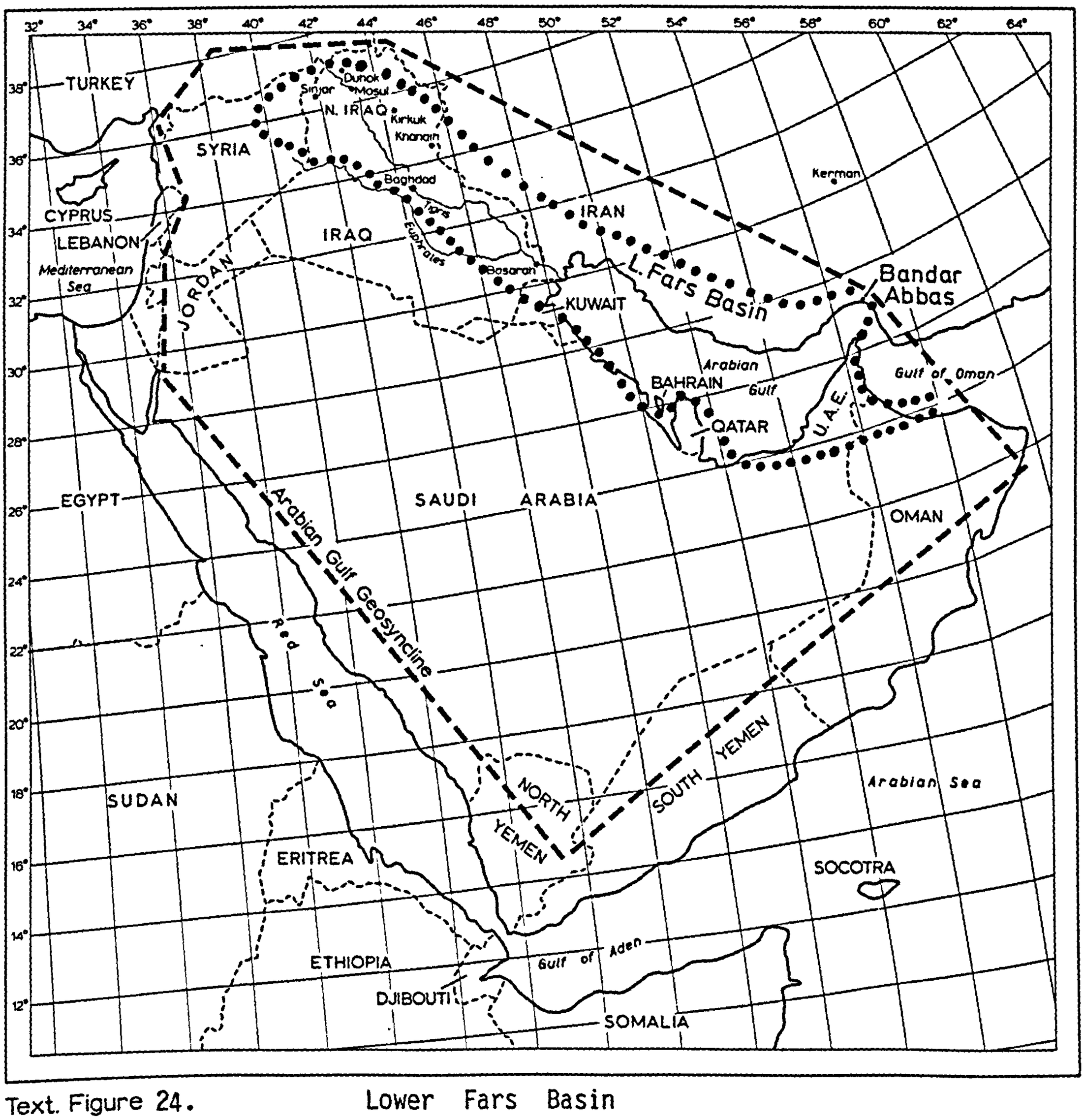
With the Mediterranean the fauna is closely related in its similar generic composition and some species are very close to these described from the Antakya,Adana and Mersin regions of southeast Turkey. For example, the Turkish species Chrysocythere paradisus Doruk 1973, Chrysocythere cataphracta Bassiouni 1979, Mutilus albicans Ruggeri 1973 and Ruggieria tetraptera tetraptera sequenza are similar to the Iraqi species Ruggieria nova sp.nov., Chrysocythere naqibi Khalaf 1982 and Mutilus fortireticulata sp. nov. Other species are fairly similar and related to species described from Sicily, Italy and Crete.

The Iraqi fauna also shows links with the Western Indopacific fauna in the presence of some common species and particularly some of these from India (see faunal relationships). The fauna also shows affinities with the Tertiary of Burma in the presence of Alocopocythere fossularis (Lyubimova and Guha) 1960 and the other species described by Gramann are fairly similar to the Iraqi species. With Africa the Lower Fars fauna has some affinities with those described from Libya and Algeria and the fauna also show a similar generic composition to those of Gabon and Ethiopia.

The above faunal relationships of Miocene Ostracoda from N. Iraq led to the conclusion that the Lower Fars basin in N. Iraq was part of a broad shallow, trough developed in front of the Zagros chain striking northwest-southeast and extending from Bandar Abbas in the extreme southeast more than 2,000 km to connect with the extreme eastern extension of the Mediterranean trough possibly in Syria or Turkey, (fig.24). For Syria there is no study on Miocene Ostracoda but sedimentological observations add confirmation. The southern connection possibly lies in the Arabian Gulf area of the Indian Ocean. The presence of the same species in India, Iran and Iraq support this view, and the tremendous evaporite deposits can only be explained by regional communication with the open sea (Stocklin 1968).

However, the presence of Miocyprideis in Turkey, Iraq, Iran and further east in India indicate (as suggested by McKenzie 1967) that the genus arrived in India before the disruption of Tethys. The same conclusions can be applied to the genera Hemicyprideis and Chrysocythere. This led to the conclusion that the Lower Fars basin in Iran, Iraq and Syria may represent the final remnant of western Tethys.

Palaeoecologically, too, the Lower Fars fauna is closely related to the adjacent areas, and is similar to that described by Bassiouni (1979) from the brackish and temporal hypersaline environment in the Neogene of Turkey. From India all the related species indicate shallow shelf conditions. Ostracod species described from the M. Miocene Al-Jaghbub Formation of N. Libya, which are fairly similar to the present species, lived in very shallow, warm water and the Lower Fars environment was very similar. The frequent occurrence of Loxoconcha with Borealis melo



Text. Figure 24. Lower Fars Basin

indicates this as suggested by Ruggieri (1964). This is confirmed if one accepts Mackenzie's (1974) suggestion that Cytherelloidea indicates 20-25^{o}C for the temperature and Sohn's (1964) that it indicates not less than 10^{o}C. Meanwhile the presence of Paranesidea also indicates a tropical fauna. The variations in the development of nodosity and ornamentation indicate fluctuations in salinity, which varied from brackish through normal to hypersaline. These show that as a result of movement in the M. Miocene the shallow trough was broken up into evaporitic basins leading to the deposition of the Lower Fars Formation. The basin in N. Iraq was divided into the evaporitic basins of Kirkuk and Sinjar in which a lagoonal environment is indicated by the gypsiferous series, these lagoons having a slight connection with the sea.

Biostratigraphically, the Lower Fars Formation is divided into three Assemblage Zones. Assemblage Zone A covers the Lower member and the transition beds, assemblage zones B and C cover the lower, middle and top part of the upper member of the Lower Fars Formation.

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APPENDIX

Lithological Descriptions

Bashiqa Section (Enclosure 5)

Bed No./Sample No.	Lithology
*1/BA.1 (Bottom)	Marl, yellowish-grey in colour, with black patches, highly fossiliferous
*2/BA.2	Limestone, pale-yellow, somewhat hard, fossiliferous
*4/BA.3	Marl, greyish-green in colour, fine grained, powdery with conchoidal shape
*6/BA.4	Limestone, greyish-white, argillaceous, fairly hard
*7/BA.5	Limestone, yellowish to white, somewhat hard, with black patches
8/BA.6	Marl,highly weathered
*10/BA.7	Limestone, grey to greenish in colour, fairly hard, highly fossiliferous, marly in some parts

Sheikhan Section (Enclosure 4)

*2/SH_1 (Bottom)	Marl fairly hard, pale green to grey with pale yellow patches internally which may be an indication of some iron oxides
*6/SH_2	Marl, fractured, light green with pale brown patches of iron oxide (limonite is present)
*10/SH_3	Marl, pale green to blue in colour, soft and easily disintegrated
13/SH_4	Grey, hard recrystallized arenaceous limestone.
*14/SH_5	Pale olive colour, marl highly calcareous with conchoidal fracture and pale yellow patches in side

Sheikhan Section (continued)

Bed No./Sample No.	Lithology
*15/SH_6	Light grey, fairly hard, microcrystalline limestone with some dolomite
16/SH_7	White to light grey, somewhat hard limestone
17/SH_8	Red marl, silty and sandy
*18/SH_9	Grey to pale green, soft and friable with iron oxides
*19/SH_{10}	Yellowish hard argillaceous limestone, well bedded and jointed
*20/SH_{11}	Marly limestone fairly hard
*21/SH_{12}	Grey to pale green, soft marl

Dohuk Section (Enclosure 3)

Bed No. / sample No.	Lithology
2/Do.1	Light green marl, sandy appearance fine grained, conchoidal fracture, very rich in the nodular iron oxides
3/Do.2	Mudstone, friable, soft
4/Do.3	Red, fairly hard siltstone, well-bedded
5/Do.4	Alternation of red clay and silt with green nodules
6/Do.5	Brownish to pale yellow, fairly hard siltstone
7/Do.6	Mudstone pale brown, very soft with green nodules in parts
*8/Do.7	Light grey marl, fine grained, friable
*9/Do.8	Light grey with black patches somewhat hard, very thin bedded

Dohuk Section (continued)

Bed No./Sample No.	Lithology
10/Do.9	Mudstone, red in colour highly friable with green patches inside
*11/Do.10	Pale grey in colour, fairly hard limestone
*12/Do.11	Pale green marl with yellow bands colour when fractured, fairly soft with black patches inside
*13/Do.12	Limestone white-buff somewhat hard. Argillaceous limestone with yellow patches of iron oxides
*14/Do.13	Light grey marl, fairly soft with yellow patches of iron oxides
15/Do.14	Mudstone, red colour, fairly soft and friable
*16/Do.15	Marl, pale grey soft and friable
*17/Do.16	Pale grey to white, Argillaceous limestone
18/Do.17	Red and green mudstone
19/-	Gypsum
20/Do.18	Red clay and alternations of siltstone
*21/Do.19	Yellowish-green, clay and marl
22/-	Gypsum
*23/Do.20	Limestone white to grey in colour, fairly hard and massive

Sheikh Ibrahim Section (Enclosure 2)

Bed No./Sample No.	Lithology
3/SHI.1	Green marl, friable, silty with gypsum nodules
*5/SHI.2	Alternation of marl and marly limestone with iron oxides

Sheikh Ibrahim Section (continued)

Bed No./Sample No.	Lithology
*7/SHI.3	Marl and marly limestone, friable, highly weathered, greenish colour
*8/SHI.4	Pale yellow limestone, somewhat marly
9/SHI.5	Light green marl, friable, thin bedded with some clusters of gypsum
*11/SHI.6	White to grey, thin bedded limestone with some nodules of iron oxides
13/SHI.7	Marl and marly limestone with some gypsum crystals
15/SHI.8	Bioclastic limestone, detrital, very thin bedded with nodules of gypsum
*17/SHI.9	Bioclastic, marly limestone, lenticular, fossiliferous
19/SHI.10	Bioclastic, detrital limestone, with some nodules of marl and a high ratio of gypsum
*21/SHI.11	Thin bedded, bioclastic detrital limestone
23/SHI.12	Pale yellow, fairly hard, marly limestone
*24/SHI.13	Grey to white bioclastic limestone
26/SHI.14	Pale green to yellow, marly limestone
*28/SHI.15	Pale grey, hard limestone with fine grains
*30/SHI.16	Alternation of marl and marly limestone, grey to pale green in colour
32/SHI.17	Hard, white to grey limestone
*34/SHI.18	Grey to green, marl, fairly hard with alternation of marly limestone
*37/SHI.19	Light grey, fairly hard limestone
38/SHI.20	White to greyish, fairly hard limestone

Sheikh Ibrahim Section (continued)

Bed No./Sample No.	Lithology
40/SHI.21	Marl friable, grey to pale green in colour
*41/SHI.22	Green marl, friable and soft
42/SHI.23	Light grey, shaley organic limestone
*43/SHI.24	Pale grey marl with conchoidal fracture
*45/SHI.25	Pale yellow, shaley limestone
*46/SHI.26	Green marl, friable, intensively weathered
*49/SHI.27	Marl, greenish-grey in colour, soft and friable
*50/SHI.28	Alternations of limestone and marly limestone, very thin bedded
*53/SHI.29	Soft and friable highly weathered, grey marl
*54/SHI.30	Organic limestone with some nodules of marl
*56/SHI.31	Greenish to grey, soft and friable marl
*57/SHI.32	Limestone, yellowish brown, fine grained
*59/SHI.33	Alteration of grey to white - grey marl and marly limestone
60/SHI.34	White-grey marly limestone, strongly weathered
*62/SHI.35	Limestone, greenish to grey in colour, somewhat marly
64/SHI.36	Highly weathered soft marl
*66/SHI.37	Green marl, friable, somewhat marly limestone in the upper part
69/SHI.38	Grey marl, strongly weathered
70/SHI.39	Limestone, yellowish to brown in colour, fairly hard
*75/SHI.40	Grey to greenish, friable marl
76/SHI.41	Limestone, argillaceous and gypsiferous

Sheikh Ibrahim Section (continued)

Bed No./Sample No.	Lithology
78/SHI.42	Red, friable clay
79/SHI.43	Alternation of clay and marl, soft and friable
*80/SHI.44	Light grey, fossiliferous limestone with black patches
*85/SHI.45	Pale grey to yellow, shaley limestone, highly fossiliferous
*89/SHI.46	Pale-yellow, shaley limestone, highly fossiliferous

Cuttings samples from Kirkuk 208, Bai-Hassan 33 and Hamrin 2 came from the Lower Fars Formation. The marker beds and the lithology of these beds are nearly the same throughout the Kirkuk area.

The following descriptions are of individual Lower Fars marker beds from which the cutting samples were taken.

Top 1 - Upper Red Beds:

These beds are a succession of anhydrite, brown to blue marly siltstones and eight limestone markers (R_1 - R_8).

*R_1 - marker: fine-grained limestone, with scattered dark markings of pyrite with little or no fauna.

R_2 - marker: This marker is silty, sandy, marly limestone with black pyrite staining.

*R_3 - marker: Light grey bed, limestone composed mainly of shell debris with black pyritic markings.

*R_4 - marker: Dark grey limestone with heavy pyrite staining.

*R_5 - marker: Marly, shelly limestone, silty in part, pyrite markings are often common.

*R_6 - marker: fine grained, silty and marly limestone with pyritic blotches.

*R_7 - marker: Pale grey limestone, made up mainly of shell fragments and characterised by the absence of pyrite.

R_8 - marker: Grey to bluish grey, fine grained limestone, silty and marly.

2. Seepage Beds Markers:

Composed of reddish mudstones and siltstones, with relatively frequent, four limestone markers (B_1 - B_4)

*B_1 - marker: Grey to bluish grey, silty and marly limestone, coloured by black pyritic markings.

*B_2 - marker: Grey to yellowish grey limestone, no pyritic shell debris.

*B_3 - marker: Grey, a finely crystalline, compact, pseudo-oolite, with some pyritic markings.

B_4 - marker: This bed is divided into two parts, the upper part is dark grey marly limestone with well graded sand, the lower part is dark blue-grey, marly limestone.

3. Saliferous Bed Markers:

Composed of rock salt and anhydrite with some siltstones, mudstones, and with less frequent limestone intercalations.

X - marker: Grey to grey-brown limestone, silty and dolomitic.

S - marker: Grey to grey-brown limestone, coarsely recrystallised.

Y - marker: Grey limestone varies from silty to marly with embedded shell fragments.

4. Transition Beds Markers:

Composed mostly of anhydrite separated by frequent, but relatively thin limestones (T_1 - T_{13}).

T_1 - marker: White to cream limestone, in some places this marker is a very thin, featureless mudstone.

*T_2 - marker: White to cream limestone, sometimes with fine-grained calcite.

*T_3 - marker: Blue-grey, silty, marly limestone.

*T_4 - marker: Blue-grey marly limestone, with pyritic markings.

T_5 - marker: Cream to light brown dolomitic limestone.

*T_6 - marker: Consists of two parts, the upper one is light to dark brown, and the lower is grey limestone.

*T_7 - marker: Grey to grey-brown, dolomitic limestone.

T_8 - marker: Grey to dark brown anhydritic and dolomitic limestone

*T_9 - marker: Dark brown to grey in colour, the upper part dolomitic limestone, the lower part grey limestone.

T_{10} - marker: Grey to light grown, marly limestone.

*T_{11} - marker: Grey, silty to marly limestone.

*T_{12} - marker: Light grey limestone.

T_{13} - marker: Grey to dark brown limestone.

PLATES

EXPLANATION OF PLATE 1

Figs. 1-6 Cytherella bashiqaensis sp.nov. p.22

		mg
1.	Holotype, female carapace from left, HU.275 T.3	x 83
2.	Paratype, male carapce from left, HU.275 T.4.1.	x 82
3.	Paratype, female carapace from right, HU.275 T.4.2	x 83
4.	Paratype, female right valve, internal, lateral view, HU.275 T.4.3	x 90
5.	Paratype, male left valve, internal lateral view, HU.275 T.4.4	x 82
6.	Paratype, female carapace dorsal view, HU.275 T.4.5	x 83

Figs. 7-12 Cytherella sayybi sp.nov. p.25

7.	Holotype, female carapace from left, HU.275 T.5	x 84
8.	Paratype, male carapace from left, HU.275 T.9.1	x 92
9.	Holotype, female carapace from right, HU.275 T.5	x 84
10.	Paratype, male carapace from left, HU.275 T.9.2	x 84
11.	Paratype, female left valve, internal lateral view, HU.275 T.9.3	x 92
12.	Paratype, male carapace dorsal view, HU.275 T.9.2	x 84

PLATE I

EXPLANATION OF PLATE 2

figs. 1-6 Cytherella dohukensis sp.nov. p.28

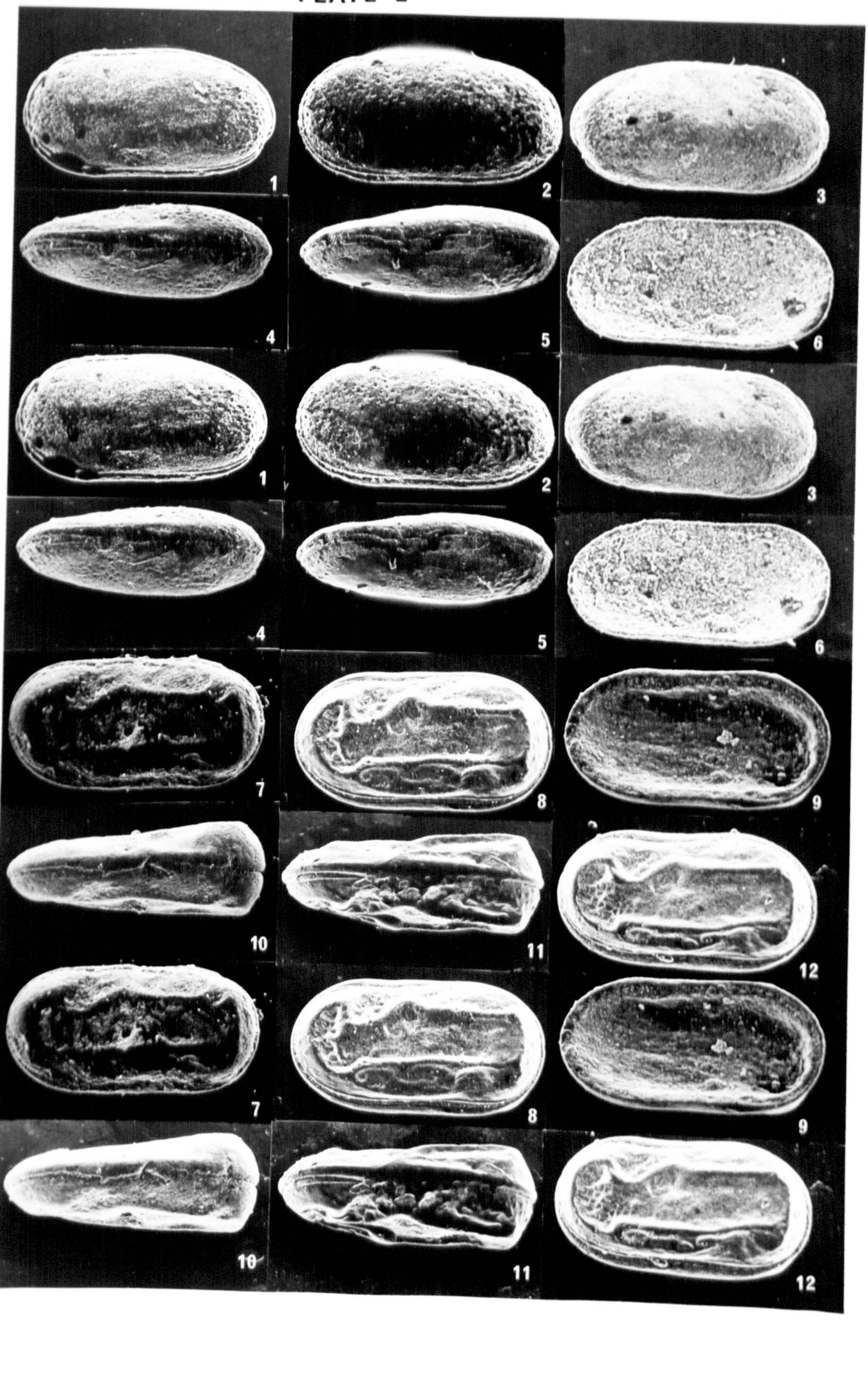
mg

1. Holotype, female carapace from right, HU.275, T.10 x 84
2. Paratype, male carapace from right, HU.275 T.10.1 x 86
3. Paratype, male carapace from left, HU.275 T.10.1 x 86
4. Holotype, female carapace dorsal view, HU.275 T.10 x 84
5. Paratype, male carapace dorsal view, HU.275 T.10.1 x 86
6. Paratype, left valve internal view, HU.275 T.10.2 x 88

figs. 7-12 Cytherelloidea flexicostata sp.nov. p.31

7. Paratype, male carapace from left, HU.275 T.12.1 x 81
8. Holotype, female carapace from left, HU.275 T.11 x 80
9. Paratype, right valve internal view, HU.275 T.12.3 x 86
10. Paratype, male carapace, dorsal view, HU.275 T.12.1 x 81
11. Holotype, female carapace, dorsal view, HU.275 T.11 x 80
12. Paratype, female carapace from left., HU.275 T.12.2 x 85

PLATE 2



EXPLANATION OF PLATE 3

Figs. 1-4 Cytherelloidea hamrinensis sp.nov. p.34

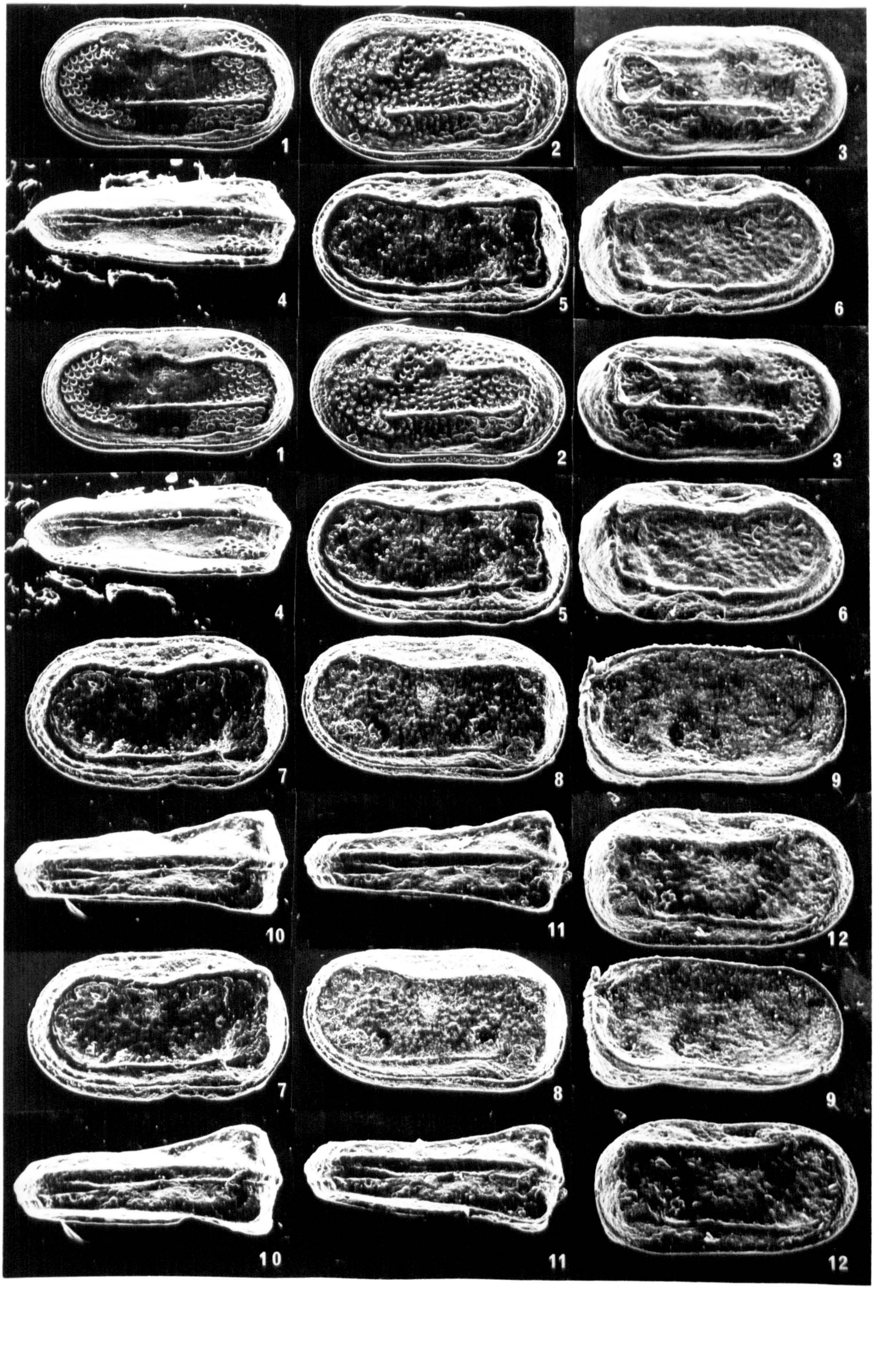
mg

1. Holotype, carapace from left, HU.275, T.17 x 76
2. Paratype, carapace from left, HU.275 T.18.1 x 77
3. Holotype, carapace from right, HU.275 T.17 x 76
4. Holotype, carapace dorsal view, HU.275 T.17 x 76

Figs. 5-12 Cytherelloidea crassinodosa sp.nov. p.37

5. Paratype, female carapace from left, HU.275 T.20.1 x 77
6. Paratype, female carapace from right, HU.275 T.20.1 x 77
7. Holotype, female carapace from right, HU.275 T.19 x 80
8. Paratype, male carapace from left, HU.275 T.20.2 x 76
9. Paratype, male left valve, internal view, HU.275 T.20.3 x 81
10. Holotype, female carapace, dorsal view, HU.275 T.19 x 80
11. Paratype, male carapace dorsal view, HU.275 T.20.2 x 76
12. Paratype, male carapace, from right valve HU.275 T.20.2 x 76

PLATE 3



EXPLANATION OF PLATE 4

Figs. 1-6 Bairdia rafidainensis sp.nov. p.42

mg

1. Holotype, carapace from right, HU.275 T.21 x 47
2. Holotype, carapace from left, HU.275 T.21 x 47
3. Paratype, carapace from left, HU.275 T.22.1 x 48
4. Paratype, carapace dorsal view, HU.275 T.22.1 x 48
5. Paratype, left valve internal view, HU.275 T.22.2 x 39
6. Paratype, carapace from right, HU.275 T.22.1 x 48

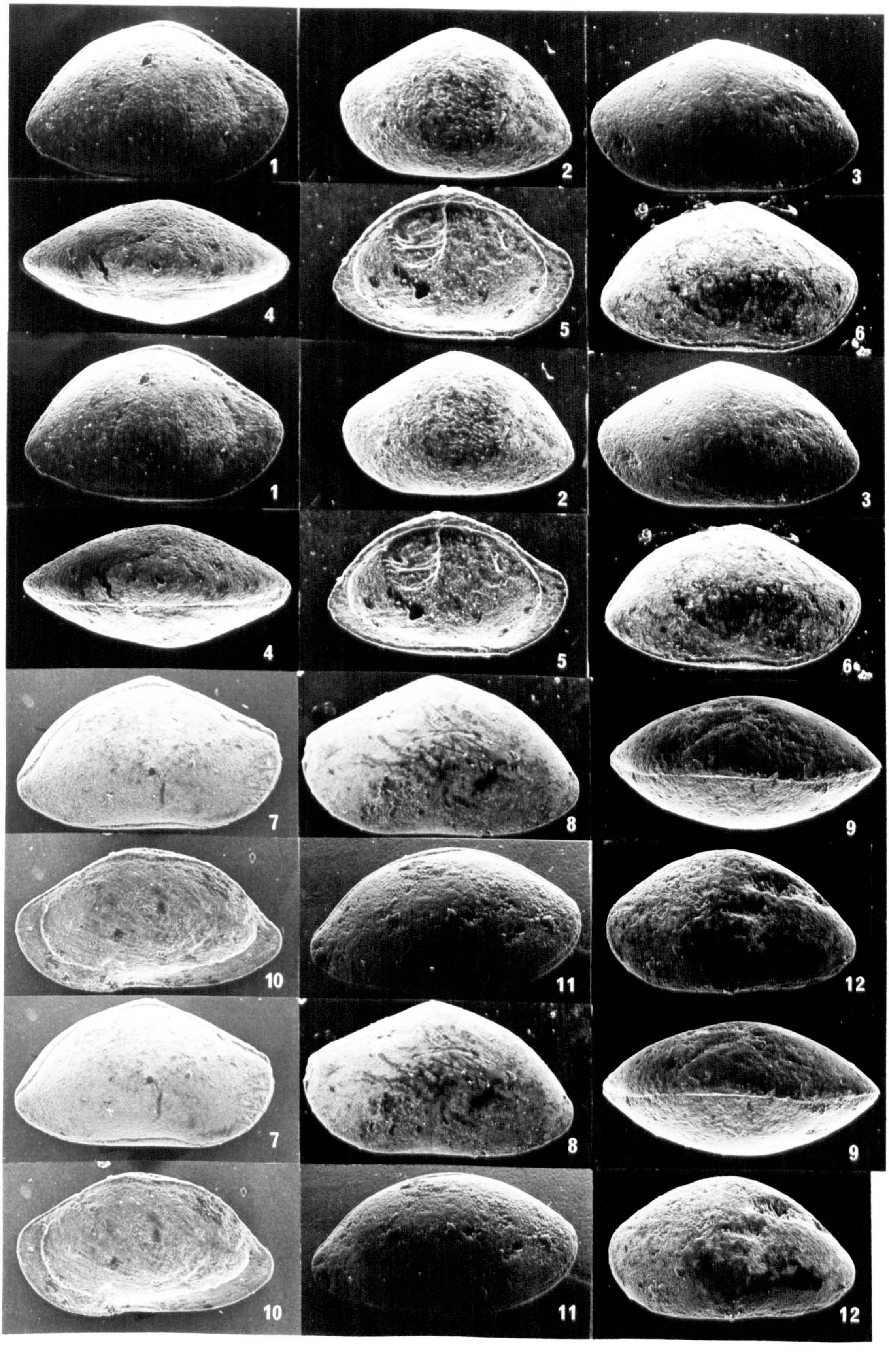
Figs. 7-10 Bairdia sp.aff. B. rafidainensis sp.nov. p.45

7. Carapace from right, external view, HU.275, T.23.1 x 43
8. Carapace from left, external view, HU.275, T.23.1 x 43
9. Carapace, dorsal view, HU.275, T.23.3 x 45
10. Right valve, internal lateral view, HU.275, T.23.2 x 47

Figs. 11-12 Bairdia sp.A p.46

11. Carapace from right, external view, HU.275, T.24.1 x 54
12. Carapace from left, external view, HU.275, T.24.1 x 54

PLATE 4



EXPLANATION OF PLATE 5

Figs. 1-3 Bairdia sp. A — p.46

mg

1. Carapace, from left, external view, HU.275, T.24.2 — x 52
2. Carapace, dorsal view, HU.275, T.24.2 — x 52
3. Carapace, ventral view, HU.275, T.24.2 — x 52

Figs. 4-7 Bairdia elliptica sp.nov. — p.48

4. Holotype, carapace from right, HU.275, T.25 — x 49
5. Holotype, carapace from left, HU.275, T.25 — x 49
6. Holotype, carapace dorsal view, HU.275, T.25 — x 49
7. Paratype, carapace from right, HU.275, T.26.1-2 — x 37

Figs. 8-12 Paranesidea punctata sp.nov. — p.50

8. Holotype, male, carapace from right, HU.275, T.27 — x 92
9. Paratype, female, carapace from right, HU.275, T.28.1 — x 82
10. Paratype, male carapace from left, HU.275, T.28.2 — x 86
11. Holotype, male carapace from left, HU.275, T.27 — x 92
12. Paratype, female carapace from left, HU.275, T.28.1 — x 82

PLATE 5

EXPLANATION OF PLATE 6

Figs. 1-3 Paranesidea punctata sp.nov. p.50

mg

1. Holotype, male carapace dorsal view, HU.275, T.27 x 92
2. Paratype, female carapace dorsal view, HU.275, T.28.1 x 82
3. Details of ornamentation on the surface of the carapace HU.275, T.27 x180

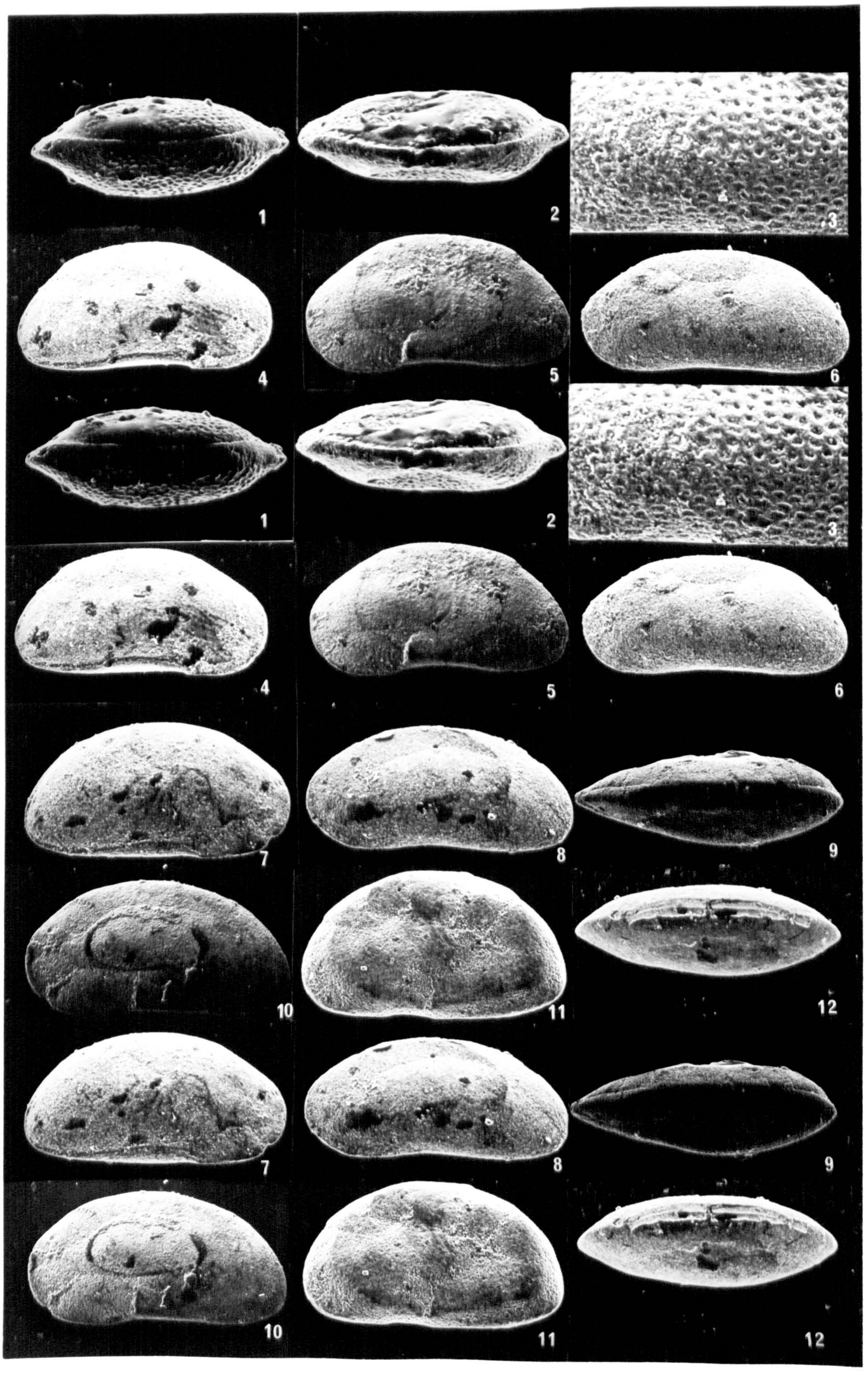
Figs. 4-10, 12 Bythocypris pseudoreniformis sp.nov. p.53

4. Holotype, female carapace from right, HU.275, T.29 x 51
5. Holotype, female carapace from left, HU.275, T.29 x 51
6. Paratype, male carapace from left, HU.275, T.30.1 x 48
7. Paratype, female carapace from right, HU.275, T.30.2 x 50
8. Paratype, male carapace from left, HU.275, T.30.3 x 49
9. Paratype, female carapace dorsal view, HU.275, T.30.2 x 50
10. Paratype, female carapace from left, HU.275, T.30.2 x 50
12. Paratype, male carapace, dorsal view, HU.275, T.30.3 x 49

Fig. 11 Bythocypris sp. A p.59

11. Carapace, from left, external view, HU.275, T.33.1 x 71

PLATE 6



EXPLANATION OF PLATE 7

Figs. 1-6 Bythocypris elegantula sp.nov. p.57

mg

1. Holotype, male carapace from left, HU.275, T.31 x 55
2. Paratype, female carapace from left, HU.275, T.32.1 x 58
3. Paratype, male carapace dorsal view, HU.275, T.32.2 x 56
4. Paratype, male carapace from right, HU.275, T.32.2 x 56
5. Paratype, male carapace from right, HU.275, T.32.3 x 55
6. Paratype, male carapace dorsal view, HU.275, T.32.3 x 55

Figs. 7-9 Bythocypris sp.A p.59

7. Carapace, from left, external view, HU.275, T.33.2 x 75
8. Carapace, from left, external view, HU.275, T.33.1 x 71
9. Carapace, from right, external view, HU.275, T.33.2 x 75

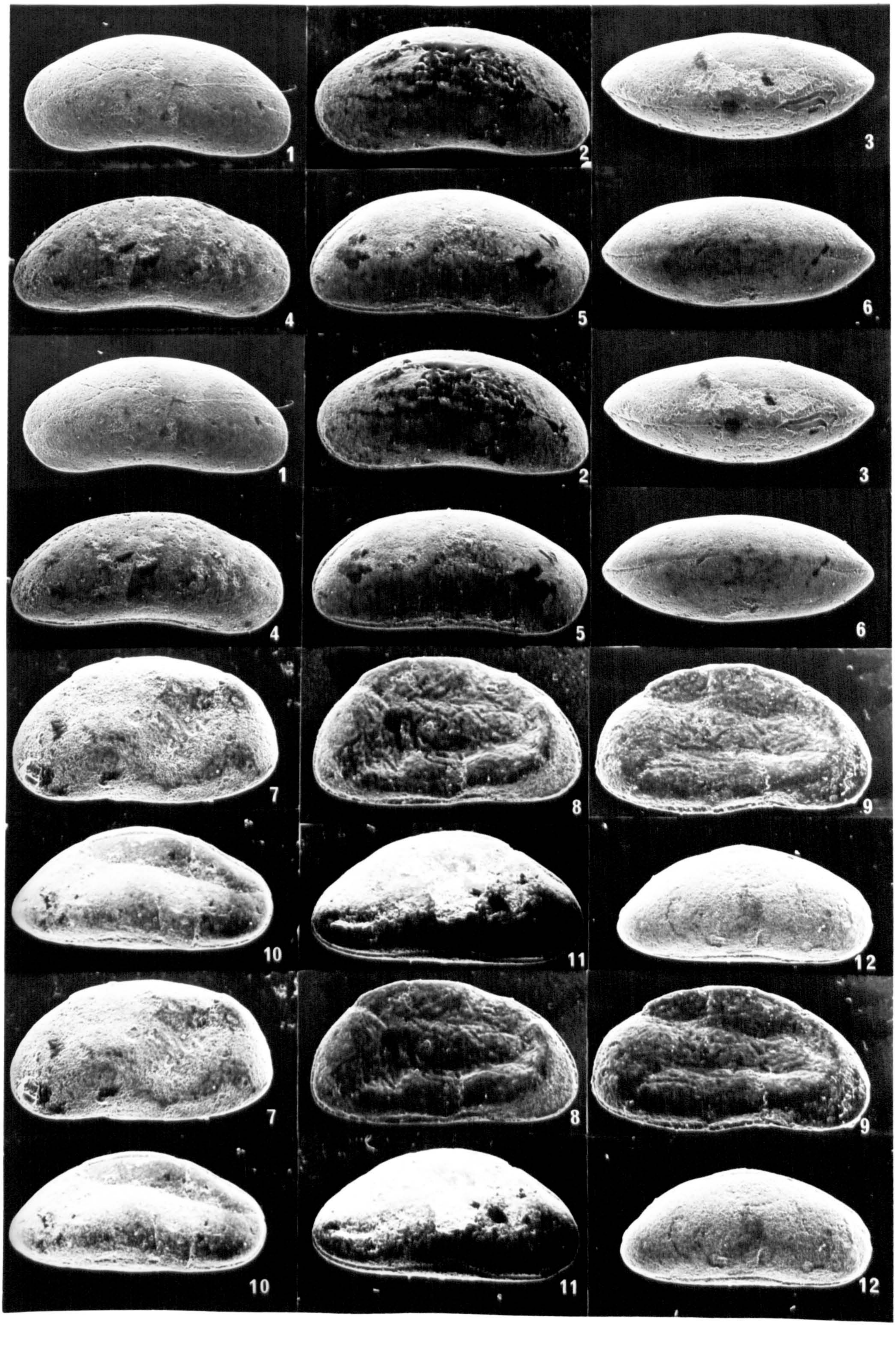
Figs.10-11 Bythocypris sp.B p.60

10. Carapace, from right, external view, HU.275, T.34.1 x 45
11. Carapace, from right, external view, HU.275, T.34.2 x 47

Fig. 12 P.(Propontocypris) sp.aff. P.solida Ruggieri 1962 p.65

12. Carapace, from right, external view, HU.276, T.1.1 x 45

PLATE 7



EXPLANATION OF PLATE 8

figs. 1-4 P. (Propontocypris) sp.aff. P. solida Ruggieri 1962 p.65

mg

1. Carapace, from left, external view, HU.276, T.1.1 x 45
2. Carapace, from right, external view, HU.276, T.1.2 x 48
3. Carapace, from left, external view, HU.276, T.1.2 x 48
4. Carapace, dorsal view, HU.276, T.1.2 x 48

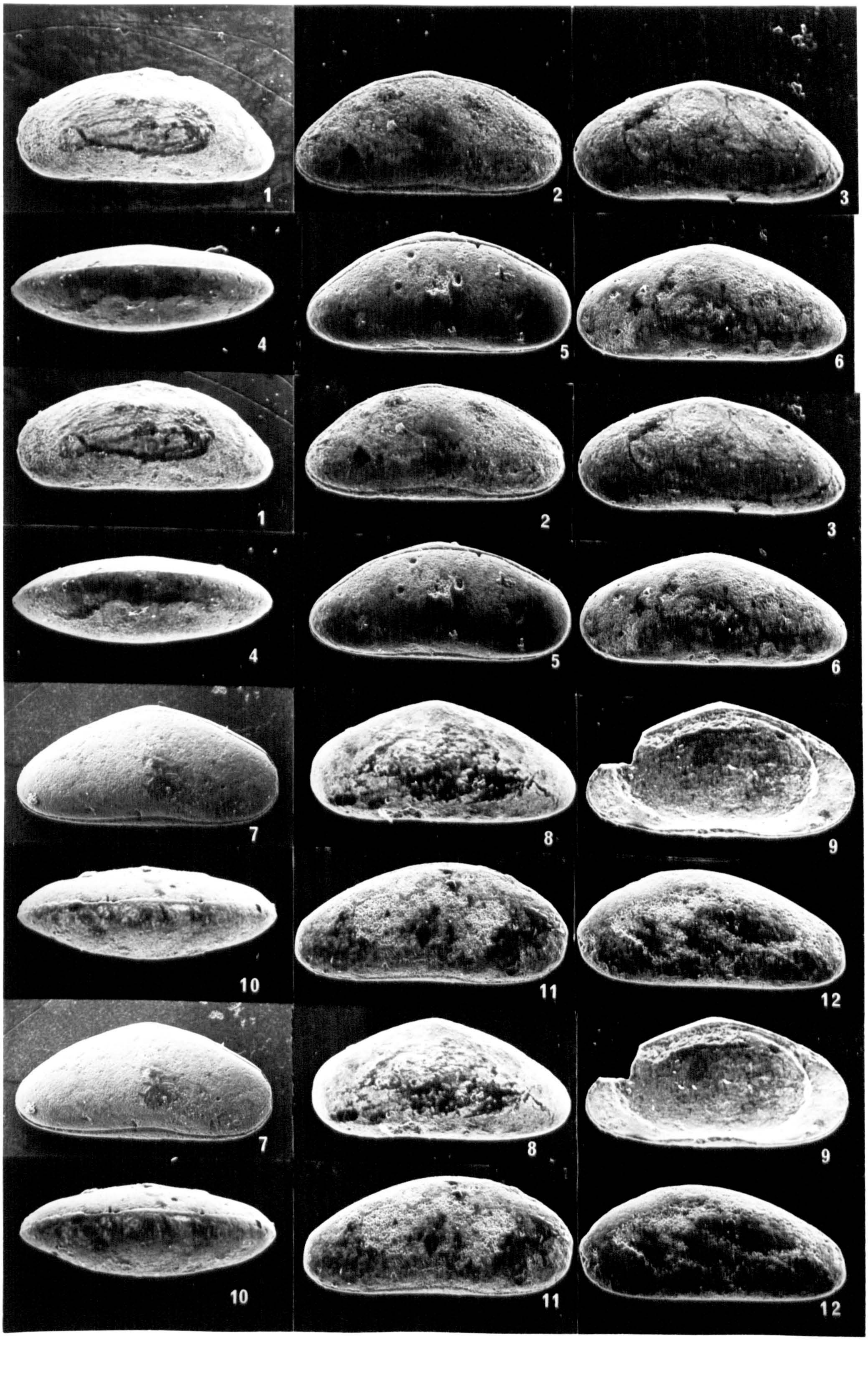
figs. 5-10 Propontocypris miocaenica sp.nov. p.62

5. Holotype, carapace from right, external view, HU.275, T.35 x 50
6. Holotype, carapace from left, external view, HU.275, T.35 x 50
7. Paratype, carapace from right, external view, HU.275, T.36.1 x 45
8. Paratype, carapace from left, external view, HU.275, T.36.1 x 45
9. Paratype, left valve, internal view, HU.275, T.36.2 x 50
10. Holotype, carapace, dorsal view, HU.275, T.35 x 50

figs. 11-12 Propontocypris sp.A p.67

11. Carapace, right valve, external view, HU.276, T.4 x 65
12. Carapace, left valve, external view, HU.276, T.4 x 65

PLATE 8



EXPLANATION OF PLATE 9

figs. 1-3 Propontocypris cuneiformis sp.nov. p.66

mg

1. Carapace, left valve, external view, HU.276, T.2 x 71
2. Carapace, right valve, external view, HU.276, T.2 x 71
3. Carapace, dorsal view, HU1.276, T.2 x 71

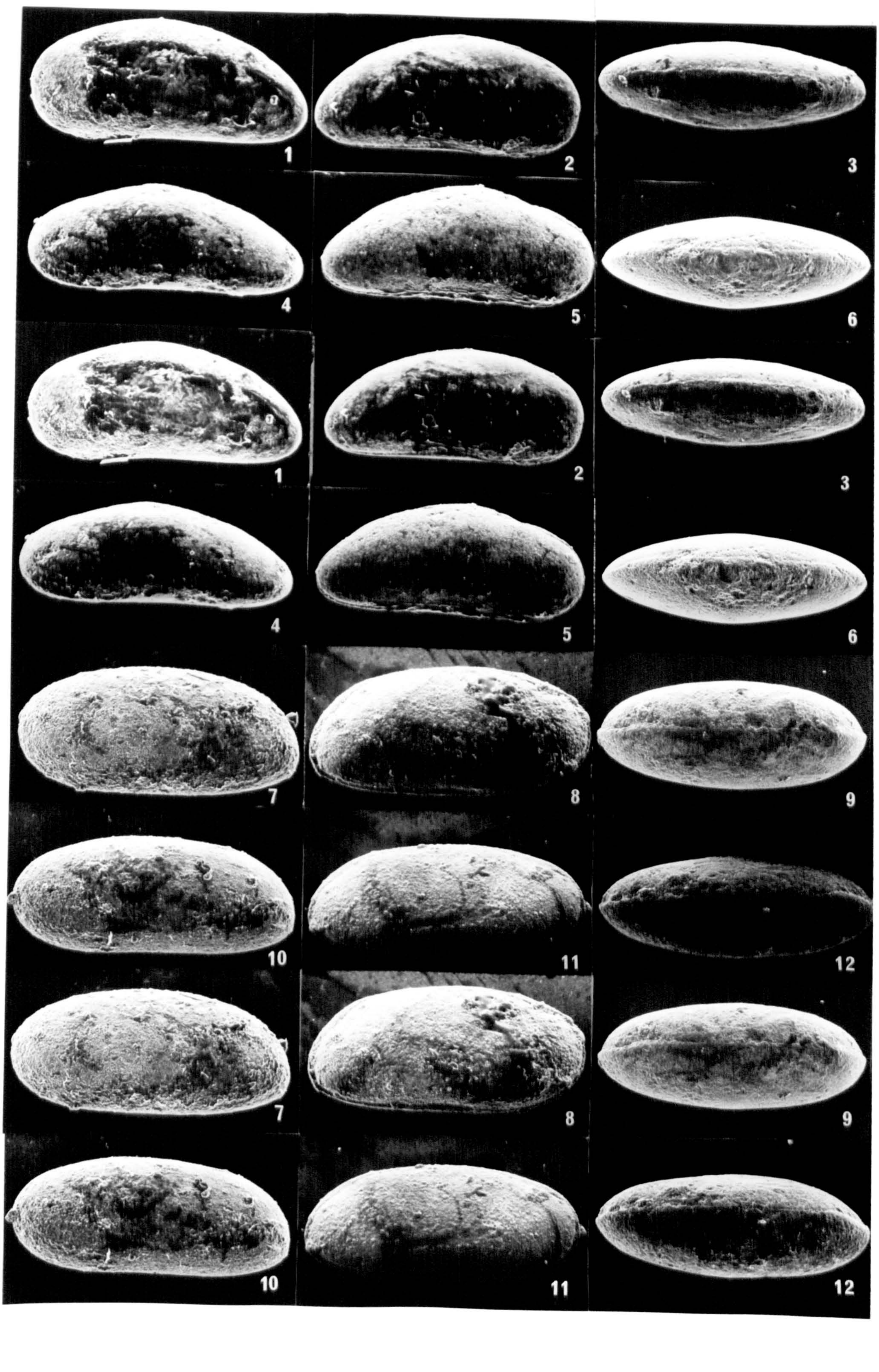
figs. 4-6 Propontocypris cuneiformis variant A p.69

4. Carapace, left valve, external view, HU.276, T.5 x 61
5. Carapace, right valve, external view, HU.276, T.5 x 61
6. Carapace, dorsal view, HU.276. T.5 x 61

figs. 7-12 Ghardaglaia nova sp.nov. p.70

7. Paratype, female carapace from left, HU.276, T.7.1 x 54
8. Paratype, female carapace from right, HU.276, T.7.1 x 54
9. Paratype, female carapace, dorsal view, HU.276, T.7.1 x 54
10. Holotype, male carapace, from left, HU.276,T.6 x 52
11. Holotype, male carapace from right, HU.276, T.6 x 52
12. Holotype, male carapace dorsal view, HU.276, T.6 x 52

PLATE 9



EXPLANATION OF PLATE 10

figs. 1-2 Ghardaglaia nova sp.nov. p.70

mg

1. Paratype, male left valve, internal lateral view, HU.276, T.7.2 x 52
2. Paratype, female right, internal lateral view, HU.276, T.7.3 x 60

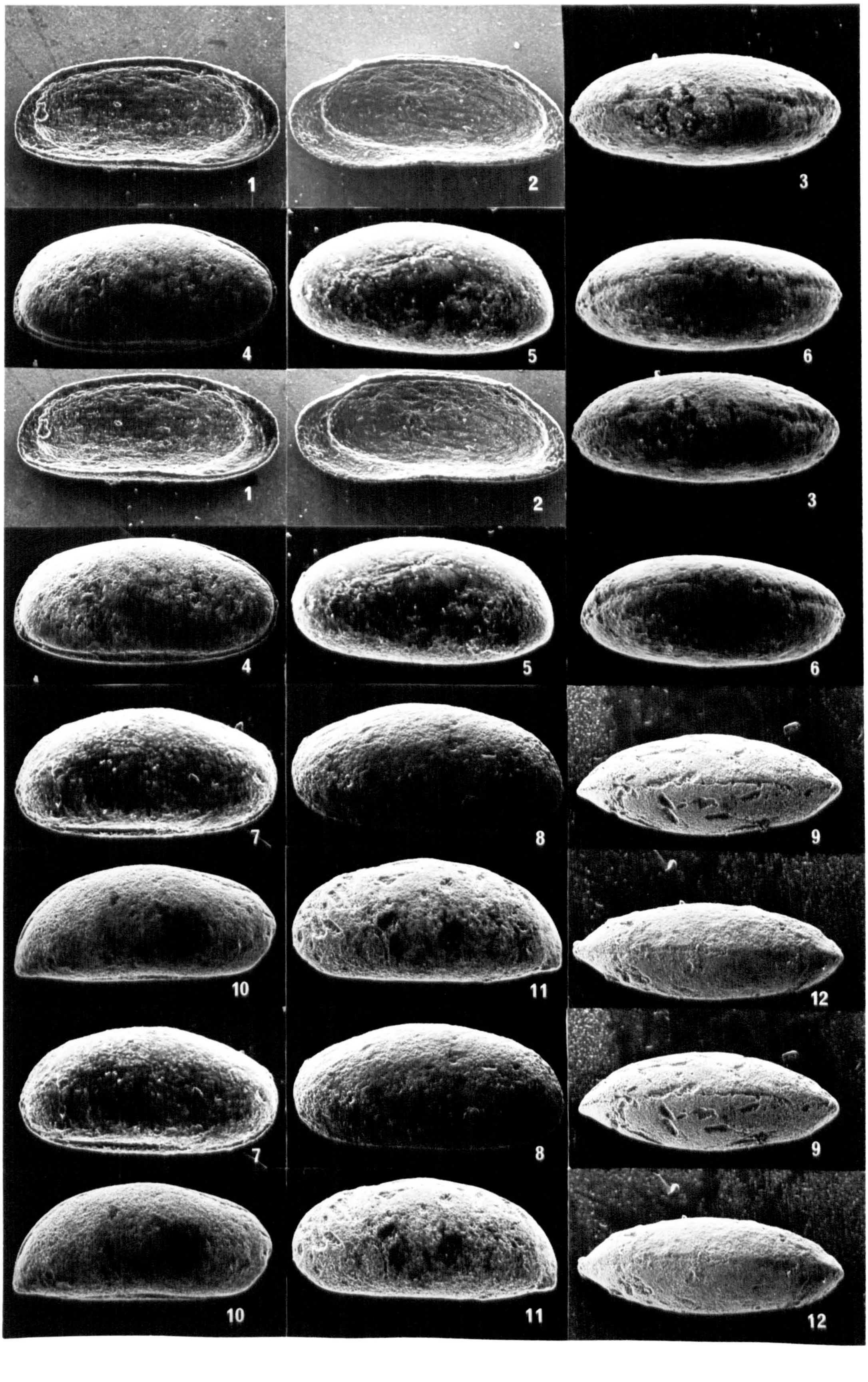
figs. 3-8 Ghardaglaia sp.aff. G. Kermani Krstic, 1979 p.72

3. Carapace, dorsal view, HU.276, T.8.1 x 49
4. Carapace, right valve,external view, HU.276. T.8.2 x 50
5. Carapace, left valve, external lateral view, HU.276, T.8.2 x 50
6. Carapace, dorsal view, HU.276, T.8.2 x 50
7. Carapace, right valve, external, HU.276, T.8.1 x 49
8. Carapace, left valve, external, HU.276, T.8.1 x 49

figs. 9-12 Pontocyprella kirkukensis sp.nov. p.75

9. Paratype, female carapace, dorsal view, HU.276, T.10.1 x 48
10. Holotype, male carapace, from right, HU.276, T.9 x 44
11. Paratype, male carapace, from left, HU.276, T.10.2 x 47
12. Paratype, male carapace, dorsal view, HU.276, T.10.3 x 49

PLATE 10



EXPLANATION OF PLATE 11

figs. 1-8 Pontocyprella sheikhanensis sp.nov. p.77

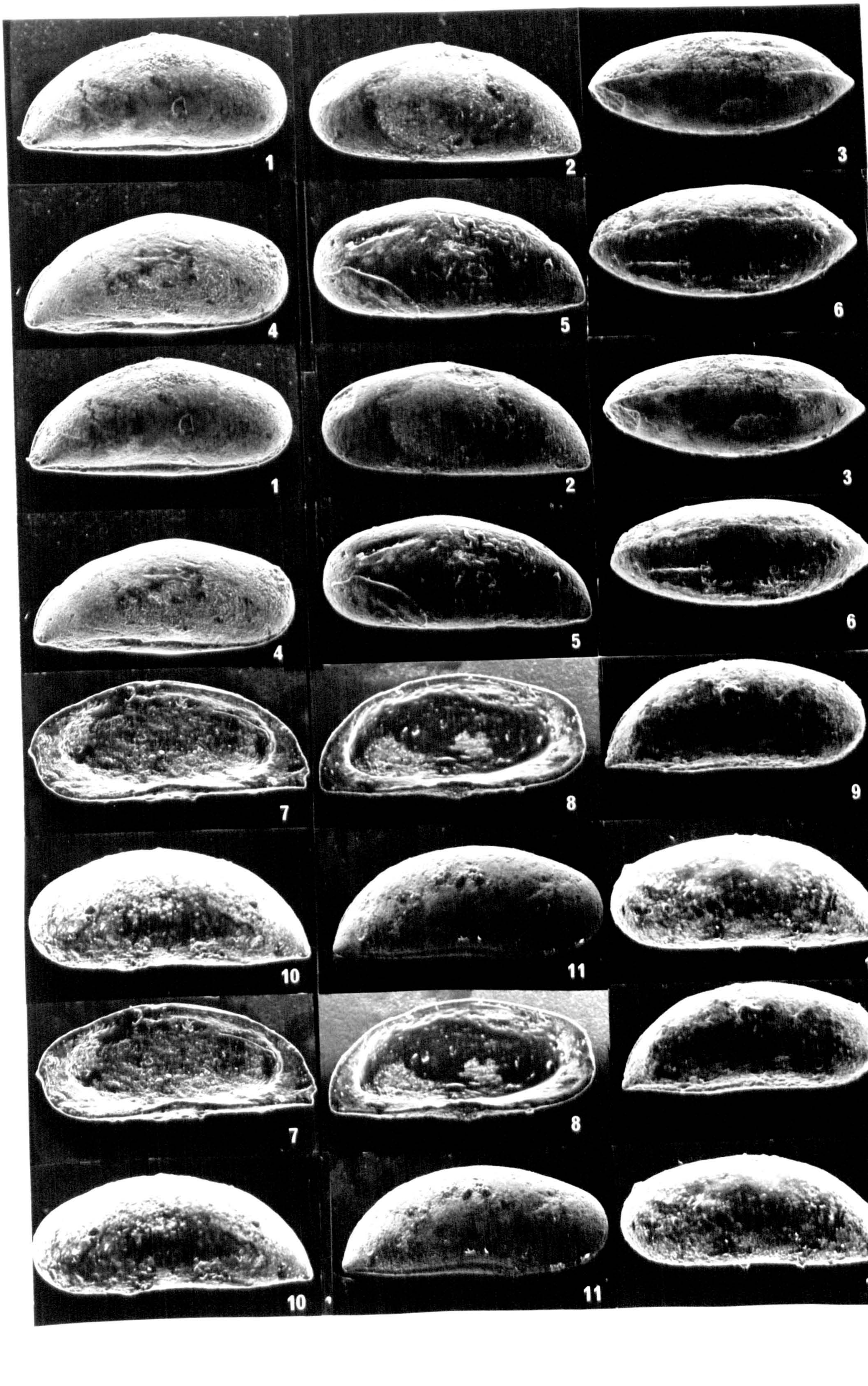
mg

1. Holotype, female carapace from right, HU.276, T.11 x 50
2. Holotype, female carapace from left, HU.276, T.11 x 50
3. Holotype, female carapace, dorsal view, HU.276, T.11 x 50
4. Paratype, male carapace from right, HU.276, T.12.1 x 50
5. Paratype,male carapace from left, HU.276, T.12.1 x 50
6. Paratype, male dorsal view, HU.276, T.12.1 x 50
7. Paratype, female right valve, internal view, HU.276, T.12.2 x 52
8. Paratype, left valve, internal view, HU.276, T.12.3 x 47

figs. 9-12 Pontocyprella bashiqaensis sp.nov. p.80

9. Holotype, carapace from right, HU.276, T.13 x 46
10. Paratype, carapace from left, HU.276, T.14.1 x 44
11. Paratype, carapace from right, HU.276, T.14.1 x 44
12. Holotype, carapace from left, HU.276, T.13 x 46

PLATE 11



EXPLANATION OF PLATE 12

Figs. 1-2 Pontocyprella bashiqaensis sp.nov. p.80

mg

1. Holotype, carapace dorsal view, HU.276, T.13 x 46
2. Paratype, left valve, internal view, HU.276, T.14.2 x 50

figs. 4-6 Pontocyprella sp. A p.82

4. Carapace from left, external view, HU.276, T.15.1 x 53
5. Carapace from right, external view, HU.276, T.15.1 x 53
6. Left valve, internal view, HU.276, T.15.2 x 54

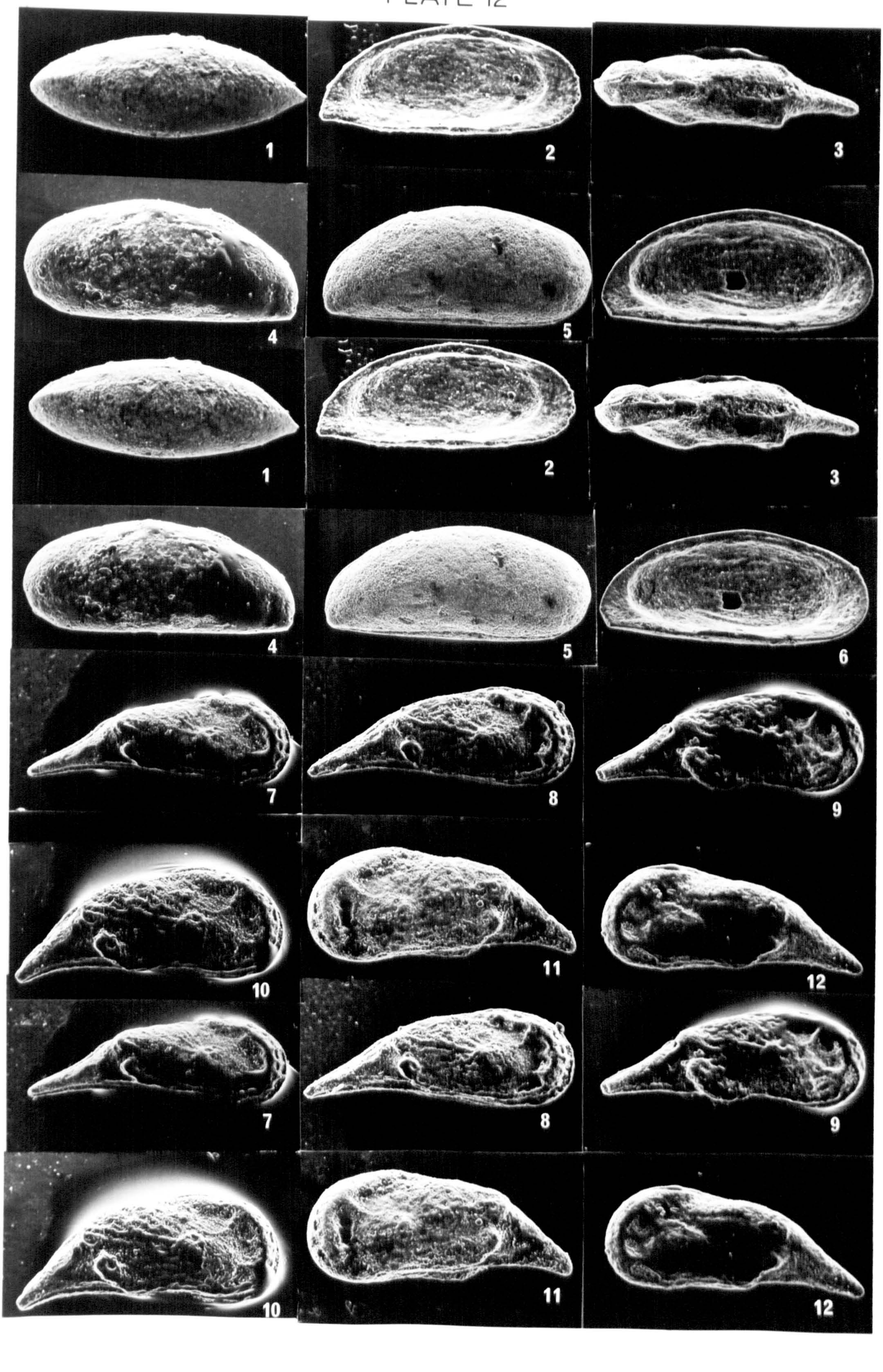
figs. 3,7,8 P. (Eopaijenborchella) acuminata sp.nov. p.84

3. Paratype, carapace dorsal view, HU.276, T.17.2 x 77
7. Paratype, carapace, from right, HU.276, T.17.1 x 74
8. Holotype, carapace from right, HU.276, T.16 x 79

figs. 9-12 P. (Eopaijenborchella) kausalis sp.nov. p.87

9. Paratype, male carapace from right, Hu.276, T.19.1 x 76
10. Holotype, female carapace from right, HU.276, T.18 x 70
11. Holotype, female carapace from left, HU.276, T.18 x 70
12. Paratype, male carapace from left, HU.276, T.19.1 x 76

PLATE 12



EXPLANATION OF PLATE 13

figs. 1-3 *P.* (*Eopaijenborchella*) *kausalis* sp.nov. p.87

1. Paratype, female carapace from left, HU.276, T.19.2 x 71
2. Paratype, female carapace dorsal view, HU.276, T.19.2 x 71
3. Paratype, male carapace dorsal view, HU.276, T.19.3 x 74

figs. 4-6 *P.* (*Eopaijenborchella*) aff. *P. royi* Khosla 1978 p.90

4. Carapace, from right, external view, HU.276, T.20 x 68
5. Carapace, from right, external view, HU.276, T.20 x 68
6. Carapace, dorsal view, HU.276, T.20 x 68

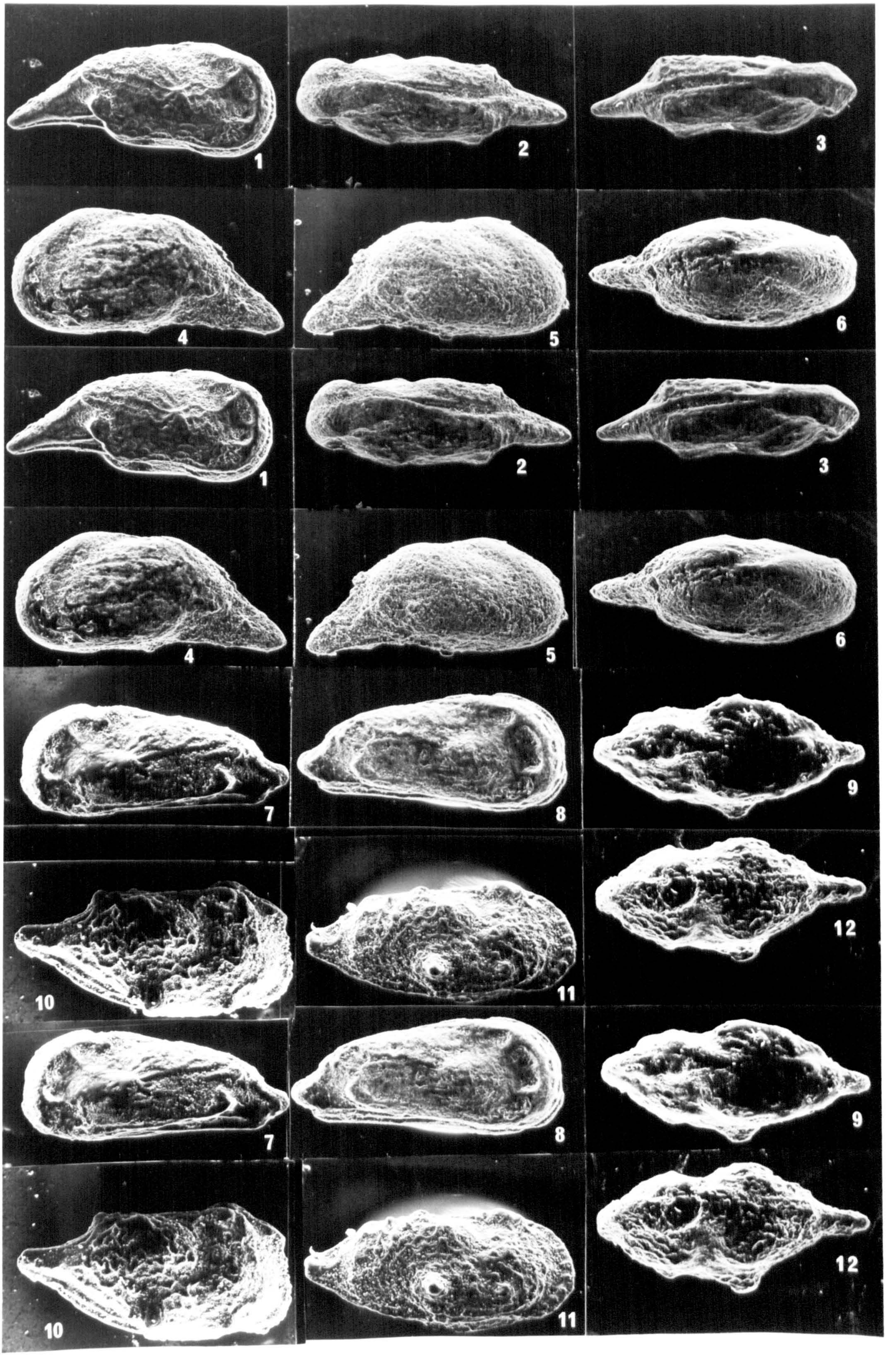
figs. 7-8 *P.* (*Eopaijenborchella*) sp. A p.91

7. Carapace, from left, HU.276, T.21 x 98
8. Carapace, from right, HU.276, T.21 x 98

figs. 9-12 *P.* (*Eopaijenborchella*) *spinosa* sp.nov. p.92

9. Paratype, male carapace dorsal view, HU.276, T.23.1 x 92
10. Holotype, female carapace from right, HU.276, T.22 x 102
11. Paratype, male carapace from right, HU.276, T.23.1 x 92
12. Holotype, female carapace dorsal view, HU.276, T.22 x 102

PLATE 13



EXPLANATION OF PLATE 14

figs. 1-2 P. (Eopaijenborchella) sp. B — p.95

mg

1. Carapace, right valve, external view, HU.276, T.24 — x 108
2. Carapace, left valve, external view, HU.276, T.24 — x 108

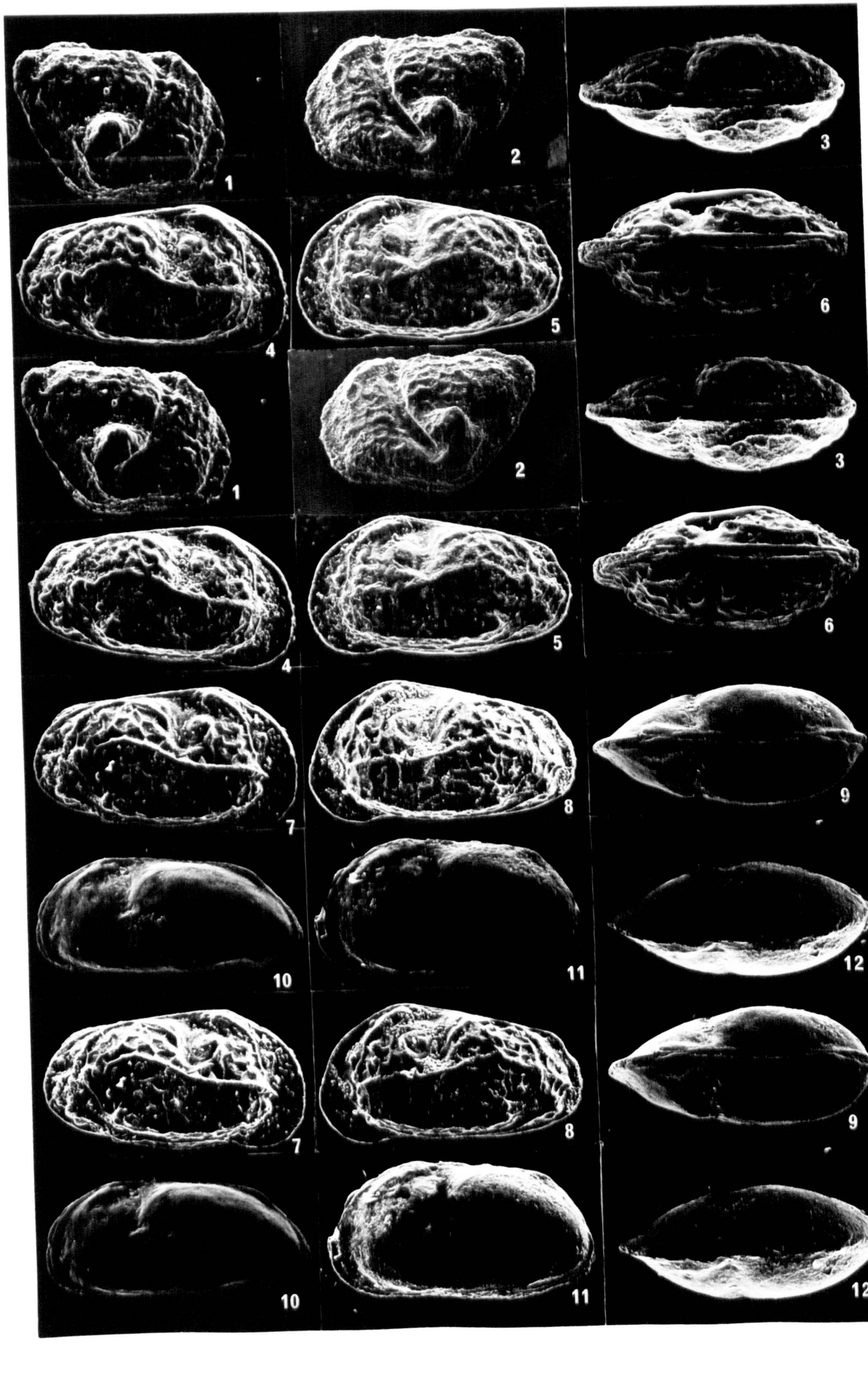
figs. 3-8 Sulcostocythere reticulata sp.nov. — p.96

3. Paratype, male, carapace dorsal view, HU.276, T.26.3 — x 81
4. Holotype, female carapace from right, HU.276, T.25 — x 88
5. Holotype, female carapace from left, HU.276, T.25 — x 88
6. Holotype, female carapace, dorsal view, HU.276, T.25 — x 88
7. Paratype, female carapace, from right, HU.276, T.26.1 — x 89
8. Paratype, male carapace, from left, HU.276, T.26.2 — x 78

figs. 9-12 Sulcostocythere dimorphica sp.nov. — p.101

9. Holotype, male carapace, dorsal view, HU.276, T.27 — x 75
10. Holotype, male carapace, from left, HU.276, T.27 — x 75
11. Paratype, female carapace from left, HU.276, T.28.1 — x 85
12. Paratype, female carapace dorsal view, HU.276, T.28.1 — x 85

PLATE 14



EXPLANATION OF PLATE 15

figs. 1-2 Sulcostocythere dimorphica sp.nov. p.101

mg

1. Holotype, male carapace, from left, Hu.276, T.27 x 75
2. Paratype, female carapace from left, HU.276, T.28.1 x 85

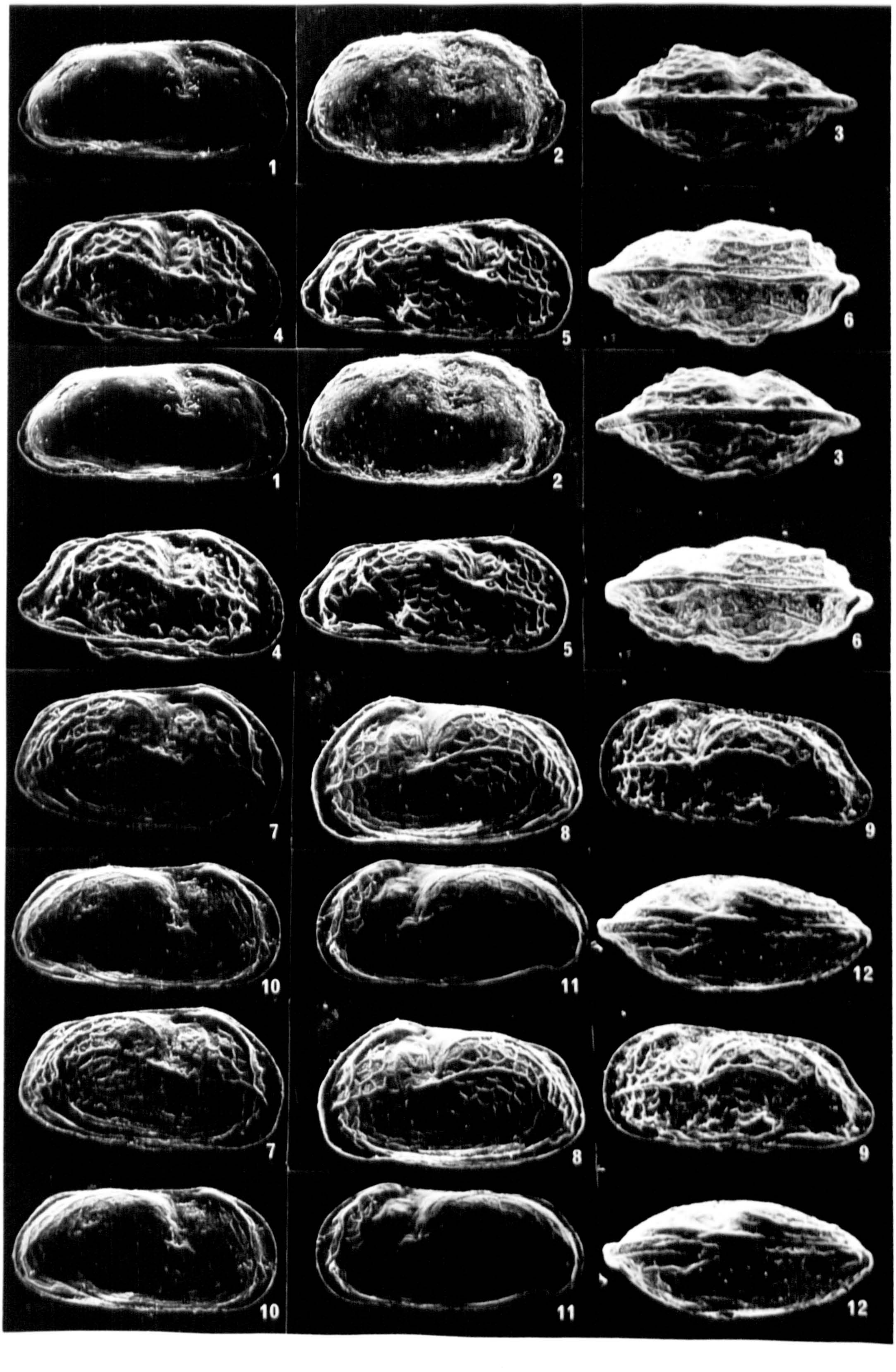
figs. 7,8,10-12 Sulcostocythere posterotruncata sp.nov. p.103

7. Holotype, female carapace from right, HU.276, T.29 x 95
8. Holotype, female carapace from left, HU.276, T.29 x 95
10. Paratype, male carapace from right, HU.276, T.30.1 x 80
11. Paratype, male carapace from left, HU.276, T.30.1 x 80
12. Holotype, female carapace dorsal view, HU.276, T.29 x 98

figs. 3-6, 9 Sulcostocythere posteronodosa sp.nov. p.105

3. Paratype, female carapace dorsal view, HU.276, T.33.1 x 93
4. Paratype, female carapace from right, HU.276, T.33.1 x 93
5. Paratype, female carapace from right, HU.276, T.33.2 x 91
6. Holotype, male carapace, dorsal view, HU.276, T.32 x 87
9. Holotype, male carapace, from left, HU.276, T.32 x 87

PLATE 15



EXPLANATION OF PLATE 16

figs. 1-6, 9 Schneiderella unispinata sp.nov. p.108

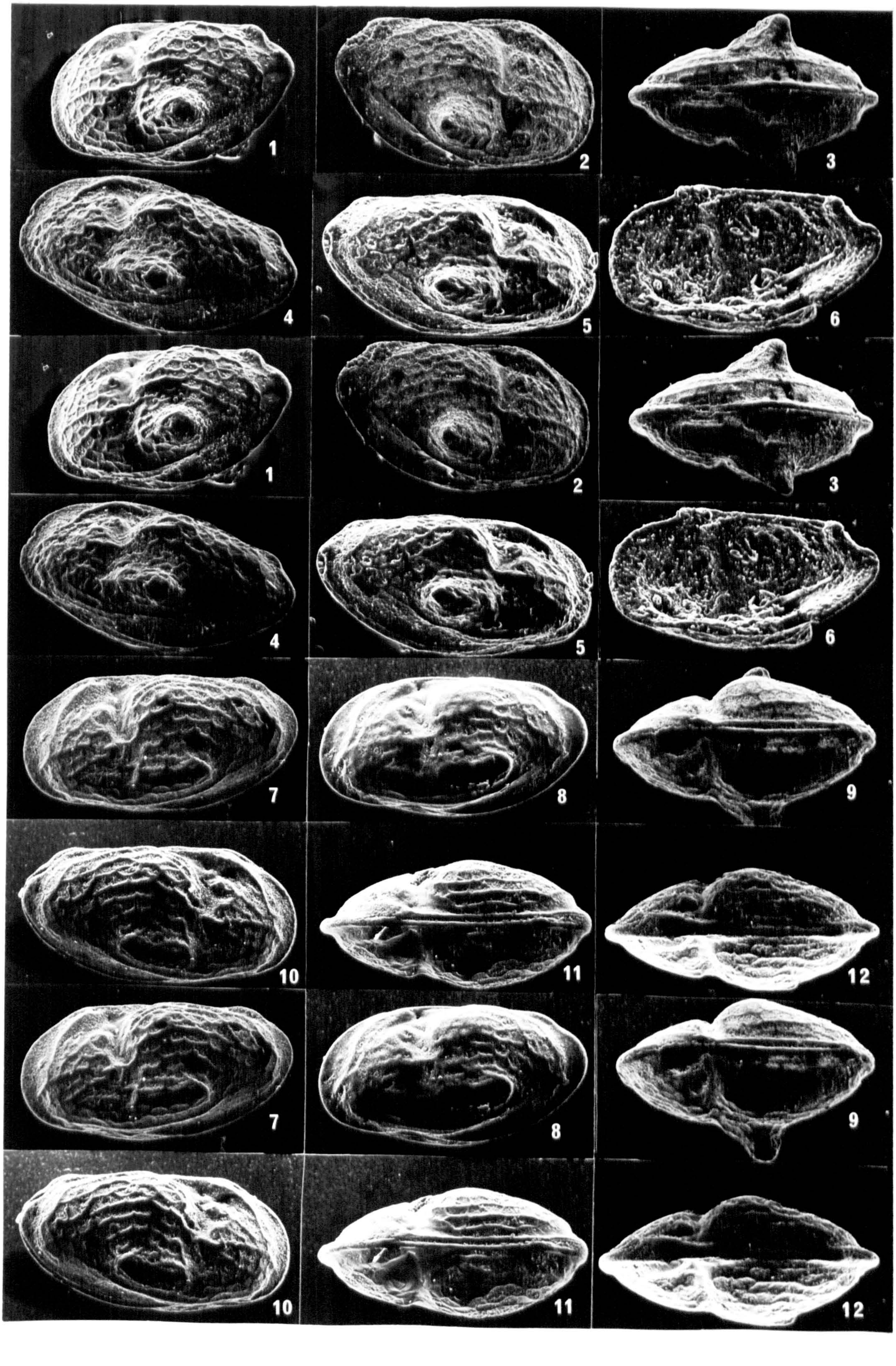
mg

1. Holotype, female carapace, from left, HU.276, T.34 x 80
2. Holotype, female carapace, from right, HU.276, T.34 x 80
3. Paratype, female carapace, ventral view, HU.276, T.35.1 x 81
4. Paratype, male carapace from left, HU.276, T.35.2 x 76
5. Paratype, male carapace from right, HU.276, T.35.2 x 76
6. Paratype, right valve, internal view, HU.276, T.35.3 x 91
9. Paratype, carapace dorsal view, HU.276, T.35.4 x 86

figs. 7,8,10-12 Schneiderella vulgaris sp.nov. p.112

7. Holotype, male carapace from left, HU.276, T.36 x 70
8. Paratype, female carapace from left, HU.277, T.1.1 x 68
10. Holotype, male carapace from right, HU.276, T.36 x 70
11. Paratype, female carapace dorsal view, HU.277, T.1.2 x 71
12. Paratype, male carapace dorsal view, HU.277, T.1.3 x 70

PLATE 16



EXPLANATION OF PLATE 17

figs. 1-2 Schneiderella vulgaris sp.nov. p.112

mg

1. Paratype, right valve, internal view, HU.277, T.1.4 x 80

2. Paratype, left valve, internal view, HU.277, T.1.5 x 74

figs. 3-6 Schneiderella sp. p.116

3. Carapace from left, HU.277, T.2.1 x 72

4. Carapace, from left, HU.277, T.2.2 x 78

5. Carapace from left, HU.277, T.2.3 x 74

6. Carapace from right, HU.277, T.2.3 x 74

figs. 7-12 Leptocythere (Leptocythere) hajerensis sp.nov. p.117

7. Holotype, male carapace from right, HU.277, T.3 x 89

8. Holotype, male carapace from left, HU.277, T.3 x 89

9. Paratype, male carapace dorsal view, HU.277, T.4.1 x 89

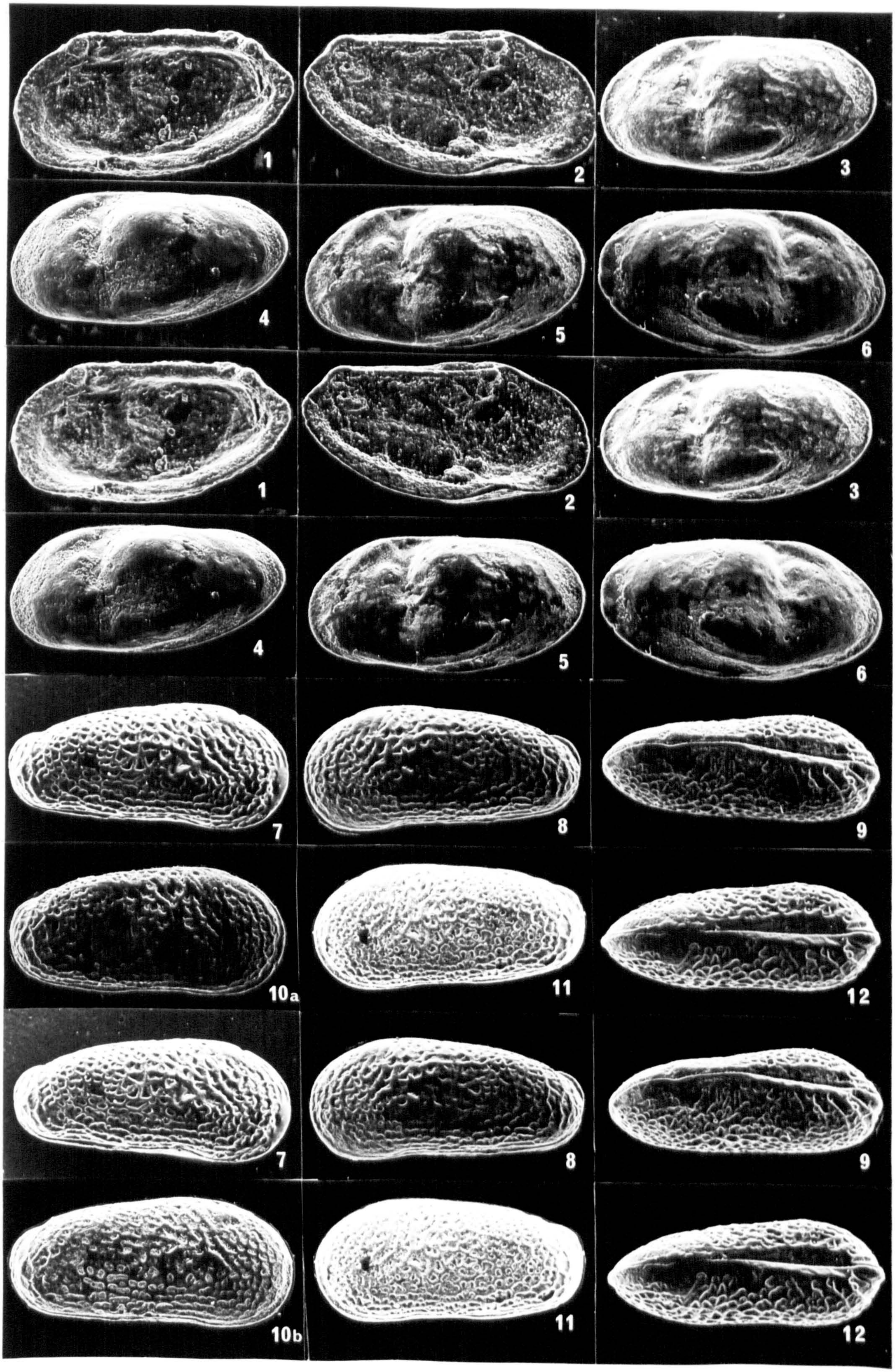
10a Paratype, female carapace from right, HU.277, T.4.2 x 89

10b Paratype, male carapace from right, HU.277, T.4.4 x 86

11. Paratype, female carapace from left, HU.277, T.4.2 x 89

12. Paratype, female carapace dorsal view, HU.277, T.4.3 x 86

PLATE 17



EXPLANATION OF PLATE 18

figs. 1-6 Callistocythere hipposideros sp.nov. p.121

mg

1. Holotype, male carapace from right, HU.277, T.5 x 110
2. Paratype, male carapace from left, HU.277, T.6.1 x 106
3. Holotype, dorsal view, HU.277, T.5 x 110
4. Paratype, female carapace, from right, HU.277, T.6.2 x 110

figs. 7,10 Callistocythere sp. A p.125

7. Carapace, left valve, external view, HU.277, T.7 x 120
10. Carapace, right valve, external view, HU.277, T.7 x 120

figs. 8, 11 Callistocythere sp. B p.126

8. Carapace, male from left, HU.277, T.8.1 x 123
11. Carapace, female from left, HU.277, T.8.2 x 129

figs. 9, 12 Sylvestra sp. p.128

9. Carapace, from left, HU.277, T.9 x 92
12. Carapace, from right, HU.277, T.9 x 92

PLATE 18

EXPLANATION OF PLATE 19.

figs. 1-8 Dohukia fossulata gen.et. sp.nov. p.133

mg

1. Holotype, male carapace from right, HU.277, T.10 x 70
2. Holotype, male carapace from left, HU.277, T.10 x 70
3. Paratype, male carapace, dorsal view, HU.277, T.11.1 x 76
4. Paratype, male carapace from right, HU.277, T.11.2 x 74
5. Paratype, male carapace from left, HU.277, T.11.3 x 73
6. Paratype, male carapace dorsal view, HU.277, T.11.3 x 73
7. Paratype, left valve, internal view, HU.277, T.11.4 x 70
8. Paratype, right valve, internal view, HU.277, T.11.5 x 72

figs. 9-12 Hemicyprideis miocaenica sp.nov. p.158

9. Paratype, male carapace, from right, HU.277, T.12.1 x 70
10. Holotype, female carapace, from right, HU.277, T.11 x 71
11. Holotype, female carapace, from left, HU.277, T.11 x 71
12. Paratype, male carapace, from left, HU.277, T.12.1 x 70

PLATE 19

EXPLANATION OF PLATE 20

figs. 1-5 Hemicyprideis miocaenica sp.nov. p.158

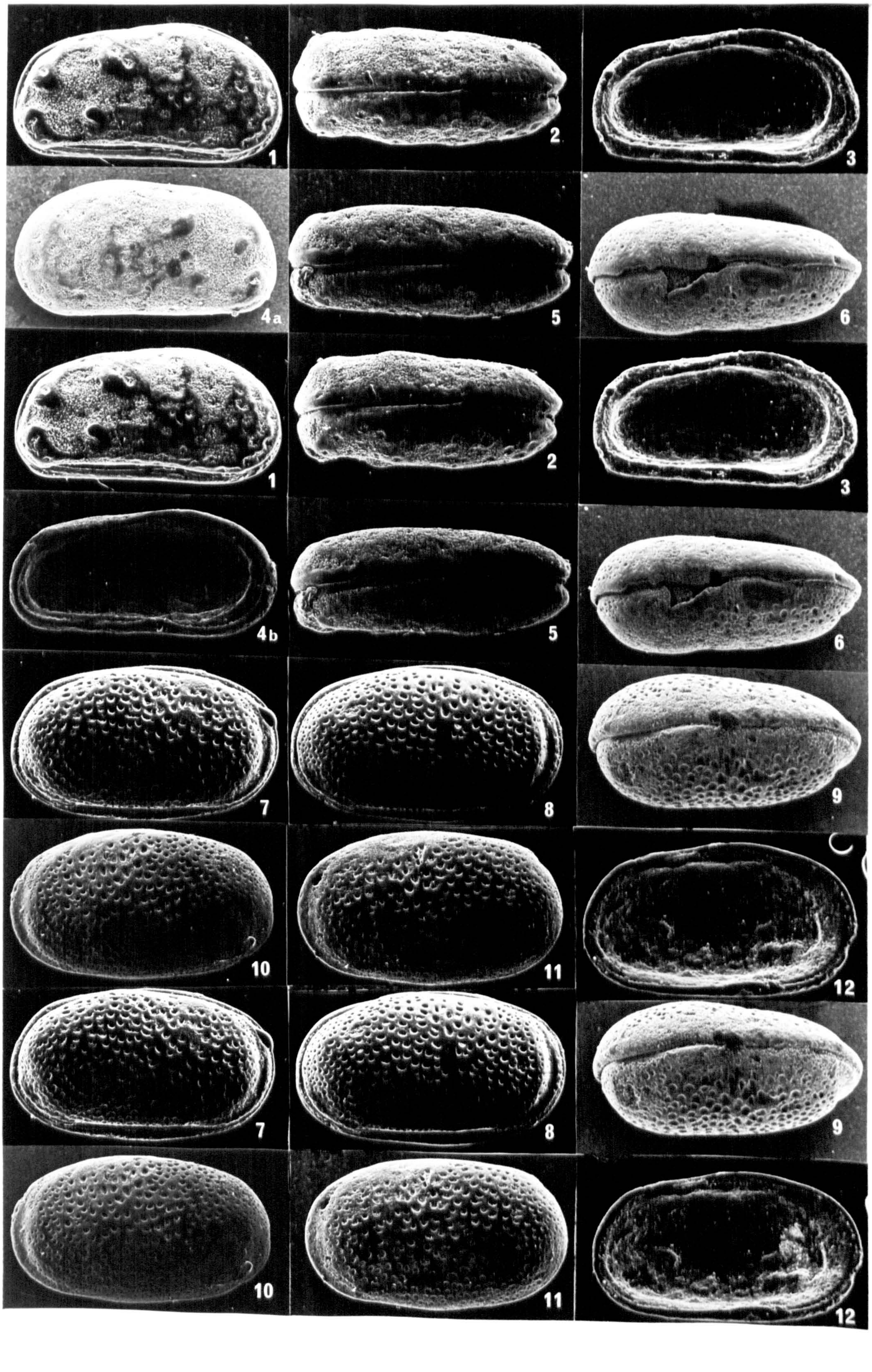
mg

1. Paratype, female carapace, from right, HU.277, T.12.2 x 88
2. Paratype, female carapace, dorsal view, HU.277, T.12.3 x 77
3. Paratype, LV internal view, HU.277, T.12.4 x 78
4a Paratype, female carapace from left, HU.277, T.12.2 x 88
4b Paratype, male left valve internal view, HU.277, T.12.6 x 83
5. Paratype, male carapace, dorsal view, HU.277, T.12.5 x 74

figs. 6-12 Miocyprideis ovalis sp.nov. p.138

6. Paratype, male carapace, dorsal view, HU.277, T.14.2 x 68
7. Holotype, male carapace from right, HU.277, T.13 x 69
8. Paratype, male carapace from right, HU.277, T.14.1 x 70
9. Paratype, female carapace dorsal view, HU.277, T.14.3 x 72
10. Holotype, male carapace from left, HU.277, T.13 x 69
11. Paratype, male carapace fromleft, HU.277, T.14.1 x 70
12. Paratype, left valve, internal view, HU.277, T.14.14 x 73

PLATE 20



EXPLANATION OF PLATE 21

figs. 1-4 Miocyprideis recta sp.nov. p.142

mg

1. Holotype, female carapace from left, HU.277, T.15 x 68
2. Paratype, male carapace from left, HU.277, T.16.1 x 72
3. Holotype, female, dorsal view, HU.277, T.15 x 68
4. Paratype, female, left valve, internal view, HU.277, T.16.2 x 76

figs.5-6 Miocyprideis chaudhuryi (Lyubimova and Guha) 1960 p.144

5. Carapace, from right, HU.277, T.17.1 x 67
6. Carapace, from left, HU.277, T.17.2 x 63

figs. 7-8 Miocyprideis sp. A p.145

7. Right valve external, HU.277, T.18.1 x 81
8. Right valve external, HU.277, T.18.2 x 69

fig. 9 Miocyprideis sp. B p.147

9. Carapace, from left, external view, HU.277, T.19 x 78

fig. 10 Miocyprideis sp.aff. Miocyprideis ovalis sp.nov. p.148

10. Carapace, from right, external view, HU.277, T.20 x 77

figs. 11, 12 Neocyprideis? sp. p.149

11. Right valve, external view, HU.277, T.21.1 x 68
12. Right valve, internal view, HU.277, T.21.2 x 69

PLATE 21

EXPLANATION OF PLATE 22

figs.1-6 Hemicyprideis angulata angulata sp.nov.subsp.nov. p.150

mg

1. Holotype, female carapace, from left, HU.277, T.22 x 73
2. Holotype, female carapace, from right, HU.277, T.22 x 73
3. Paratype, left valve, internal view, HU.277, T.23.3 x 82
4. Paratype, male carapace, from left, HU.277, T.23.1 x 72
5. Paratype, male carapace, from right, HU.277, T.23.1 x 72
6. Paratype, male carapace, dorsal view, HU.277, T.23.2 x 73

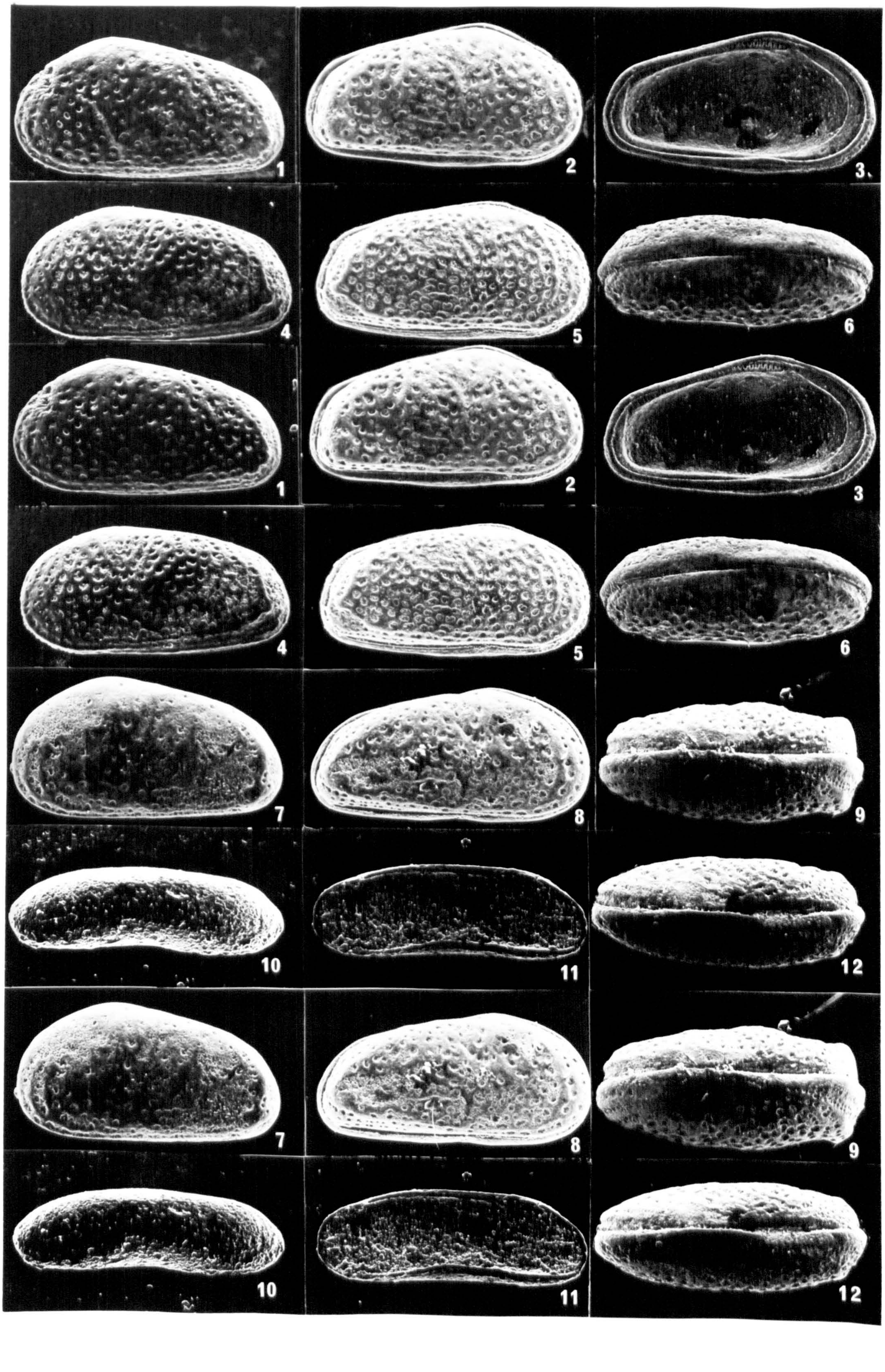
figs. 7-9,12 Hemicyprideis angulata decrementa n.ssp. p.156

7. Paratype, male carapace from left, HU.277, T.25.1 x 72
8. Holotype, female carapace from right, HU.277, T.24 x 79
9. Paratype, female carapace, dorsal view, HU.277, T.25.2 x 75
12. Paratype, male carapace, dorsal view, HU.277, T.25.3 x 74

figs. 10,11 Cushmanidea sp. p.162

10. Right valve, external view, HU.277, T.26 x 61
11. Right valve, internal view, HU.277, T.26 x 61

PLATE 22



EXPLANATION OF PLATE 23

fig. 1 *Krithe* sp. p.164

mg

1. Right valve, external view, HU.277, T.27 x 73

figs. 2,3,5,6 *Parakrithe*? sp. p.166

2. Carapace, from right, external view, HU.277, T.28.1 x 85
3. Carapace, from right, external view, HU.277, T.28.2 x 70
5. Carapace, from left external view, HU.277, T.28.1 x 85
6. Carapace, from left external view, HU.277, T.28.2 x 70

figs. 4, 7,8,10,11 *Dentokrithe comma* sp.nov. p.167

4. Paratype, right valve, internal view, HU.277, T.30.4 x 79
7. Paratype, male from left Lost
8. Holotype, female carapace from right, HU.277, T.29 x 78
10. Paratype, male carapace, from left, HU.277, T.30.1 x 79
11. Paratype, female carapace from left, HU.277, T.30.2 x 77

figs. 9,12 *Dentokrithe* aff. *Dentokrithe indica* Tewari and Tandon 1960 p.170

9. Carapace, female from right, HU.277, T.31.1 x 80
12. Carapace, male from right, HU.277, T.31.2 x 83

PLATE 23

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EXPLANATION OF PLATE 24

figs, 3,6,7-10 Dentokrithe constricta sp.nov. p.172

mg

3. Holotype, female carapace from left, HU.277, T.32 x 70
6. Holotype, female carapace from right, HU.277, T.32 x 70
7. Paratype, female? carapace from left, HU.277, T.33.1 x 69
8. Paratype, male, carapace from left, HU.277, T.33.2 x 67
9. Paratype, female carapace dorsal view, HU.277, T.33.3 x 70
10. Paratype, female carapace from right, HU.277, T.33.4 x 71

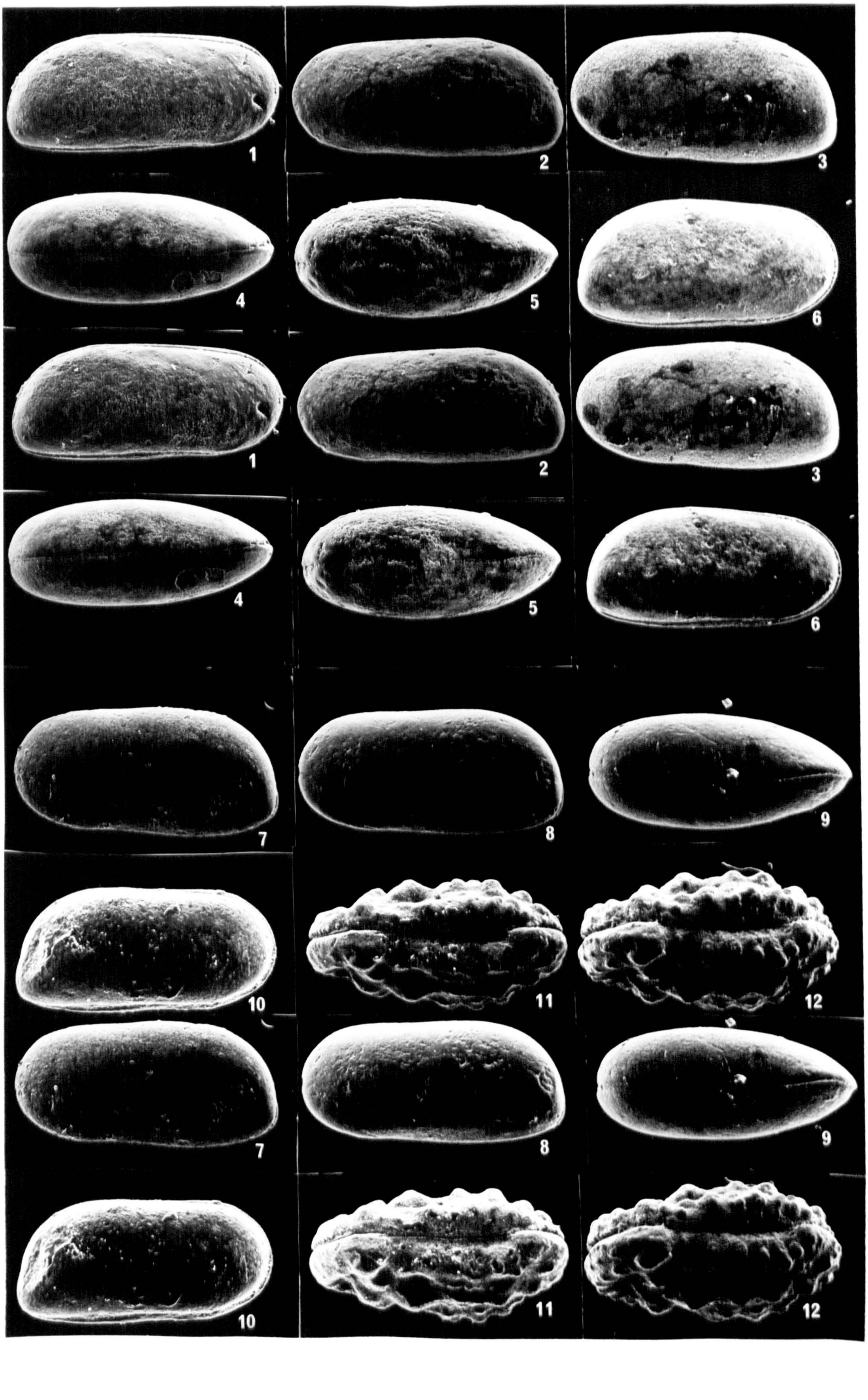
figs. 1,2,4,5 Dentokrithe authochthona (Lyubimova and Guha) 1960 p.174

1. Carapace, male from right, HU.277, T.34.1 x 85
2. Carapace, male from left, HU.277, T.34.1 x 85
4. Carapace, male, dorsal view, HU.277, T.34.2 x 79
5. Carapace, female, dorsal view, HU.277, T.34.3 x 77

figs. 11,12 Actinocythereis iraqensis Khalaf 1982 p.176

11. Paratype, male carapace, dorsal view, HU.275, T.7.4 x 48
12. Paratype, female carapace, dorsal view, HU.275, T.7.1 x 53

PLATE 24



EXPLANATION OF PLATE 25

figs. 1-6 Actinocythereis iraqensis Khalaf 1982 p.176

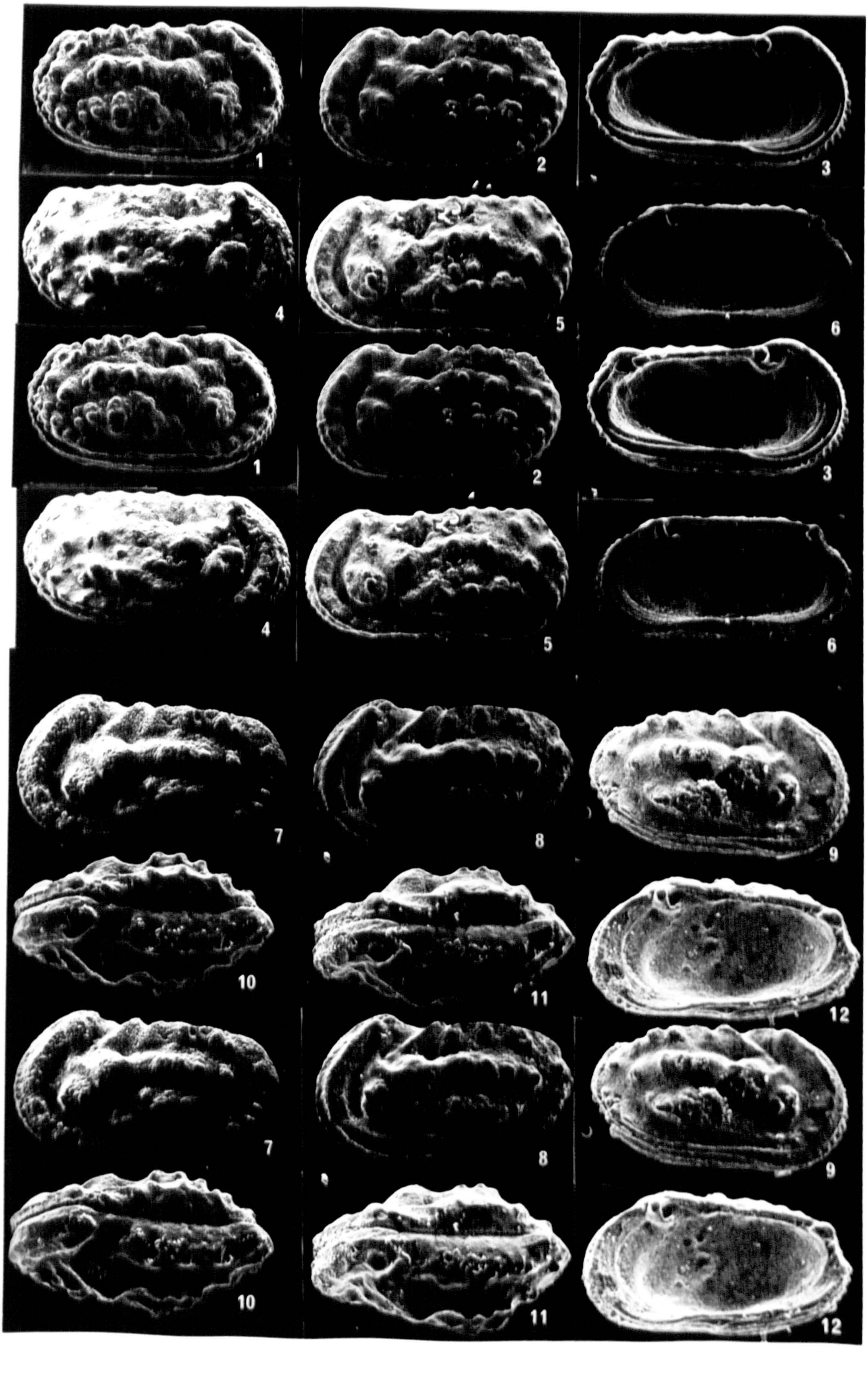
mg

1. Paratype, female carapace, from right, HU.275, T.7.1 x 53
2. Paratype, female carapace from left, HU.275, T.7.2 x 49
3. Paratype, female, left valve, internal view, HU.275, T.8 x 52
4. Holotype, male carapace from right, HU.275, T.6 x 47
5. Holotype, male carapace from left, HU.275, T.6 x 47
6. Paratype, male right valve, internal view, HU.275, T.7.3 x 50

figs. 7-12 Actinocythereis costata sp.nov. p.179

7. Holotype, male carapace from left, HU.277, T.35 x 62
8. Paratype, female carapace from left, HU.277, T.36.1 x 59
9. Paratype, female carapace from right, HU.277, T.36.1 x 59
10. Paratype, male carapace, dorsal view, HU.277, T.36.2 x 61
11. Paratype, female carapace, dorsal view, HU.277, T.36.3 x 61
12. Paratype, left valve, internal view, HU.277, T.36.4 x 64

PLATE 25



EXPLANATION OF PLATE 26

figs.1-6 Actinocythereis cornuocula cornuocula sp.nov. subsp.nov. p.184

1. Holotype, female carapace from left, HU.278, T.1 x 70
2. Paratype, female carapace from left, HU.278, T.2.1 x 63
3. Paratype, male carapace dorsal view, HU.278, T.2.3 x 67
4. Paratype, female carapace from right, HU.278, T.2.2 x 71
5. Paratype, male carapace from right, HU.278, T.2.1 x 63
6. Paratype, female carapace dorsal view, HU.278, T.2.4 x 67

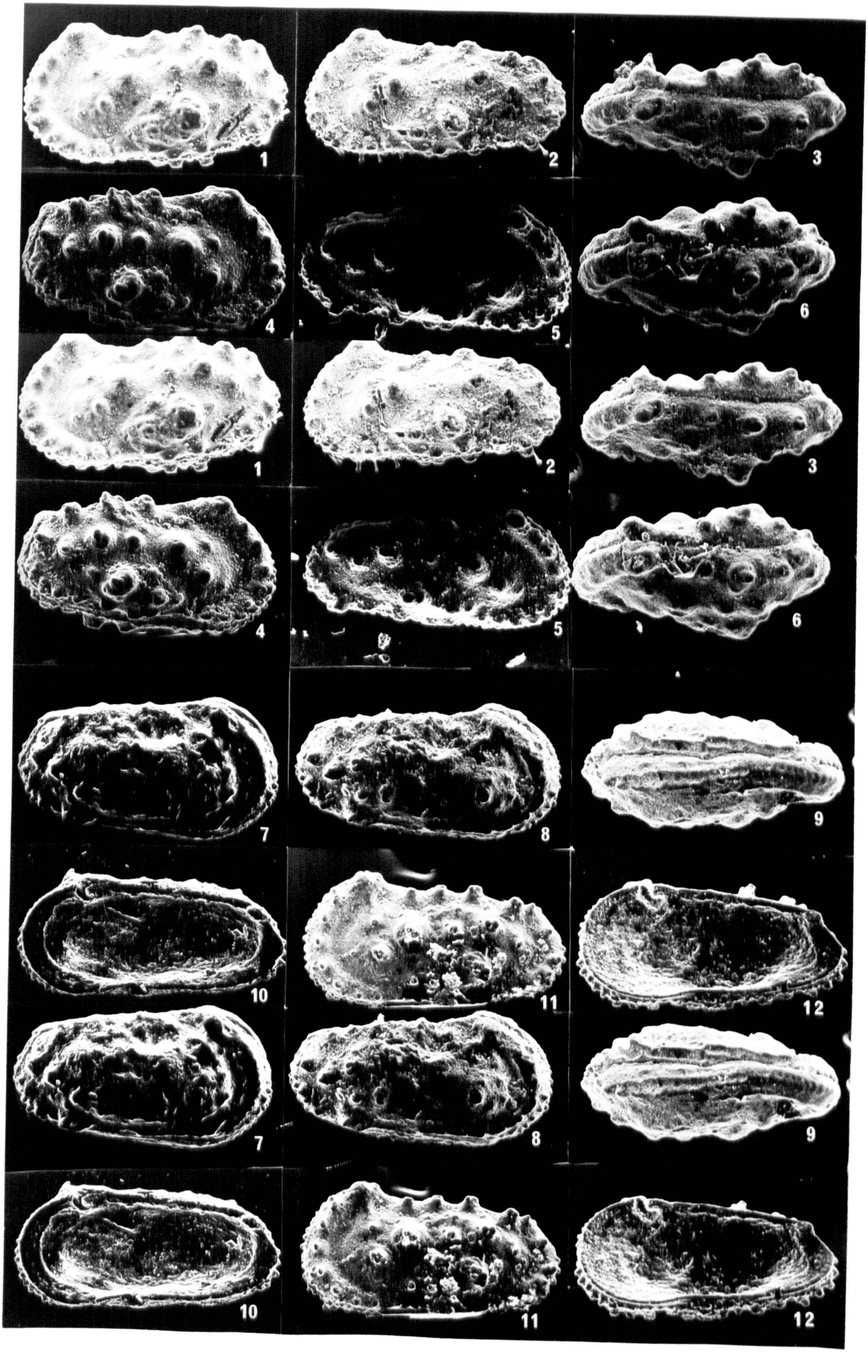
figs. 7-10 Actinocythereis dextraspina sp.nov. p.190

7. Holotype, female carapace from right, HU.278, T.3 x 63
8. Paratype, male carapace from right, HU.278, T.4.1 x 61
9. Paratype, male carapace ventral view, HU.278, T.4.2 x 62
10. Paratype, male right valve internal, HU.278, T.4.3 x 64

figs. 11,12 Actinocythereis cornuocula spinosa n.ssp. p.187

11. Holotype, female carapace, from left, HU.278, T.5 x 68
12. Paratype, right valve internal view, HU.278, T.6.1 x 71

PLATE 26



EXPLANATION OF PLATE 27

figs. 1-6 Acanthocythereis dohukensis Khalaf 1982 p.193

mg

1. Holotype, male carapace from right, HU.275, T.1 x 63
2. Holotype, male carapace from left, HU.275, T.1 x 63
3. Holotype, male carapace dorsal view, HU.275, T.1 x 63
4. Paratype, female carapace right valve, HU.275, T.2 x 63
5. Paratype, female carapace left valve, HU.275, T.2 x 63
6. Paratype, female carapace dorsal view, HU.275, T.2 x 63

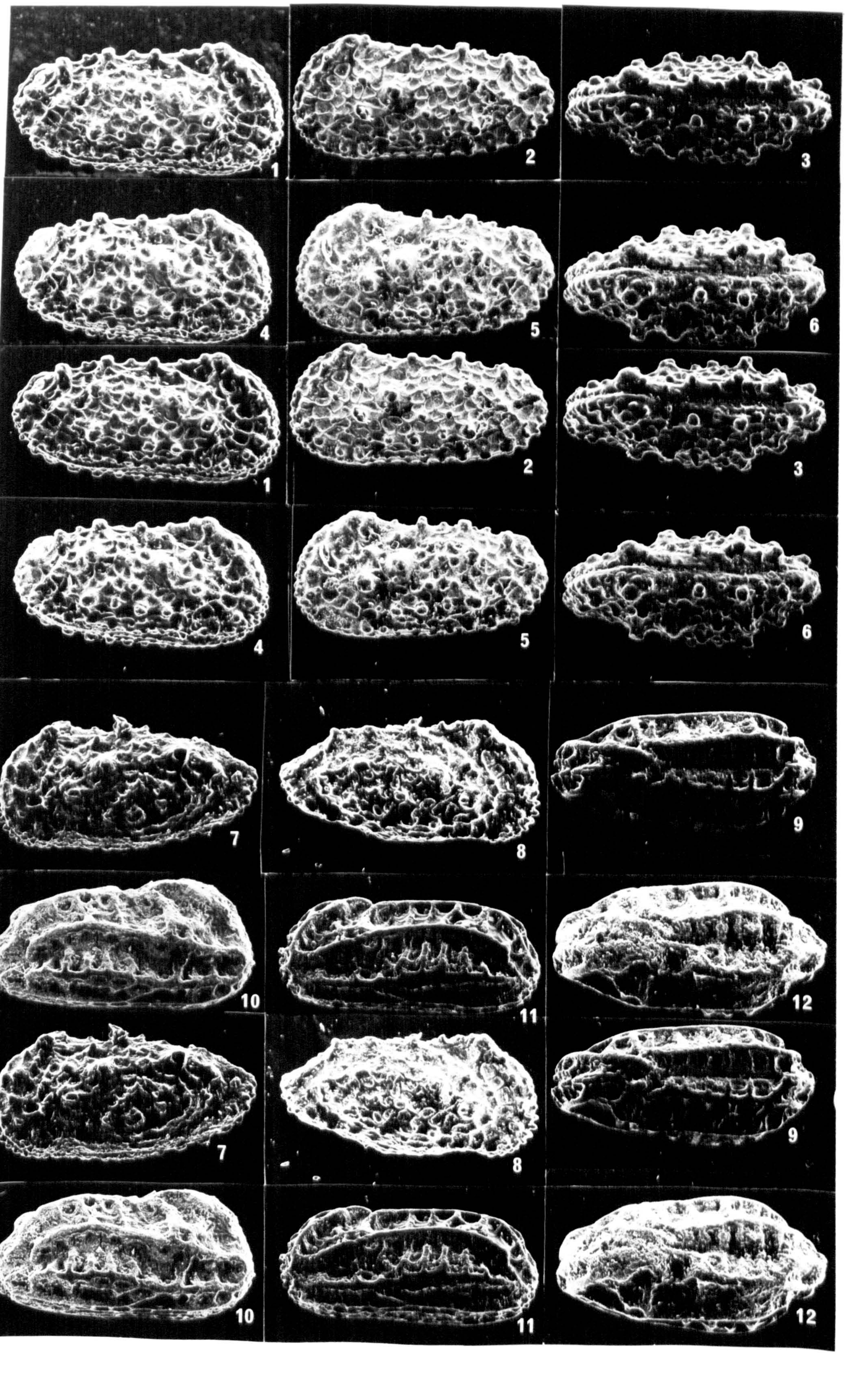
figs. 7-8 Acanthocythereis sp. p.197

7. Carapace, left valve, external view, HU.278, T.7 x 66
8. Carapace, right valve, external view, HU.278, T.7 x 66

figs. 9-12 Chrysocythere naqibi Khalaf 1982 p.199

9. Paratype, male, carapace, dorsal view, HU.275, T.14 x 50
10. Holotype, female carapace from right, HU.275, T.13 x 56
11. Paratype, male carapace from left, HU.275, T.14 x 50
12. Holotype, female carapace dorsal view, HU.275, T.13 x 56

PLATE 27



EXPLANATION OF PLATE 28

fig. 1 Gyrocythere siddiquii Khosla 1978 — p.203

mg

1. Carapace, left valve, external view, HU.278, T.8 — x 69

figs. 2-4 Gyrocythere grossipunctata sp.nov. — p.204

2. Holotype, carapace from left, HU.278, T.9 — x 61
3. Holotype, carapace from right, HU.278, T.9 — x 61
4. Paratype, carapace dorsal view, HU.278, T.10.1 — x 63

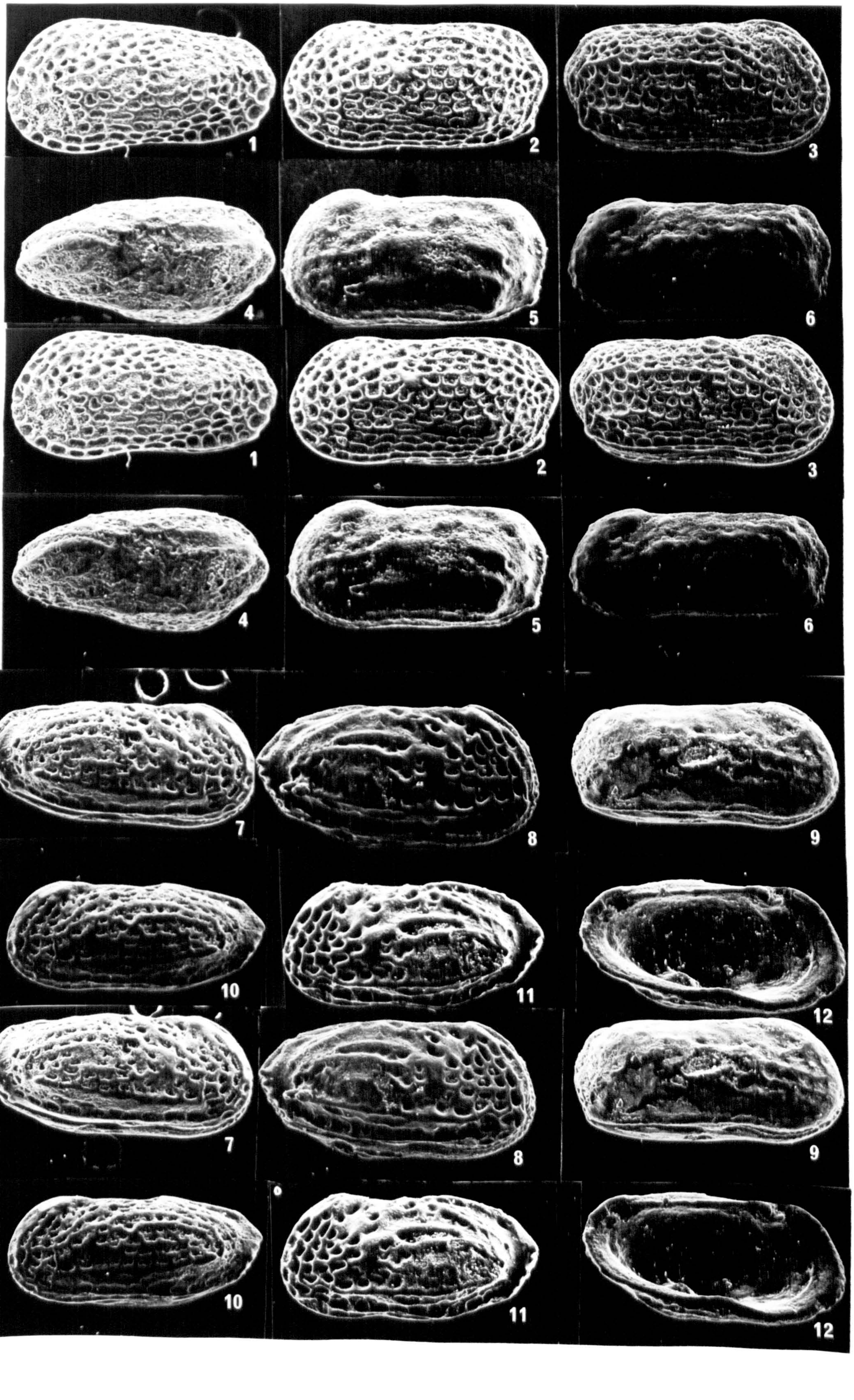
figs. 5,6,9 Gyrocythere sheikhibrahamensis sp.nov. — p.207

5. Paratype, female carapace — Lost
6. Holotype, male carapace from left, HU.278, T.11 — x 76
9. Holotype, male carapace from right, HU.278, T.11 — x 76

figs.7,8,10-12 Isobuntonia pulchra sp.nov. — p.234

7. Holotype, male carapace from right, HU.278, T.13 — x 65
8. Paratype, female carapace from right, HU.278, T.14.1 — x 69
10. Holotype, male carapace from left, HU.278, T.13 — x 65
11. Paratype, female carapace from left, HU.278, T.14.1 — x 69
12. Paratype, left valve, internal view, HU.278, T.14.4 — x 61

PLATE 28



EXPLANATION OF PLATE 29

fig. 1,4 Isobuntonia pulchra sp.nov. p.234

mg

1. Paratype, female carapace, dorsal view, HU.278, T.14.3 x 60

4. Paratype, male carapace, dorsal view, HU.278, T.14.2 x 65

figs. 2,3,5-7 Falunia (Hiltermannicythere) miocaenica sp.nov. p.209

2. Holotype, male carapace from right, HU.278, T.15 x 62

3. Paratype, male carapace dorsal view, HU.278, T.16.2 x 61

5. Holotype, male carapace from left, HU.278, T.15 x 62

6. Paratype, female carapace dorsal view, HU.278, T.16.1 x 66

figs. 8-12 Stigmatocythere nodosa sp.nov. p.213

8. Paratype, male carapace from left, HU.278, T.18.1 x 84

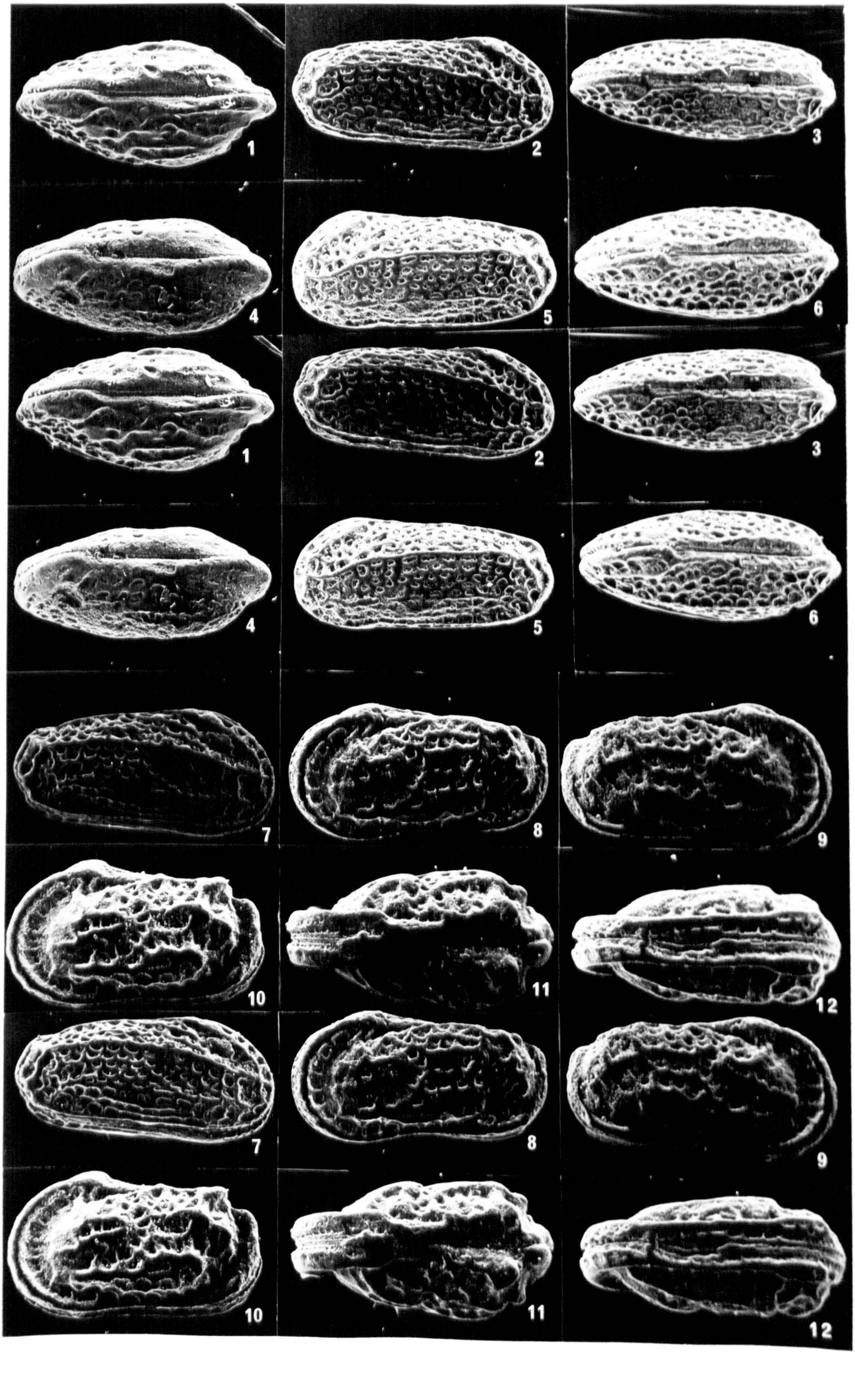
9. Paratype, male carapace from right, HU.278, T.18.2 x 92

10. Holotype, female carapace from left, HU.278, T.17 x 98

11. Holotype, dorsal view, HU.278, T.17 x 98

12. Paratype, male, ventral view, HU.278, T.18.3 x 91

PLATE 29



EXPLANATION OF PLATE 30

figs. 1,2,4,5 Stigmatocythere cellulosa sp.nov. p.217

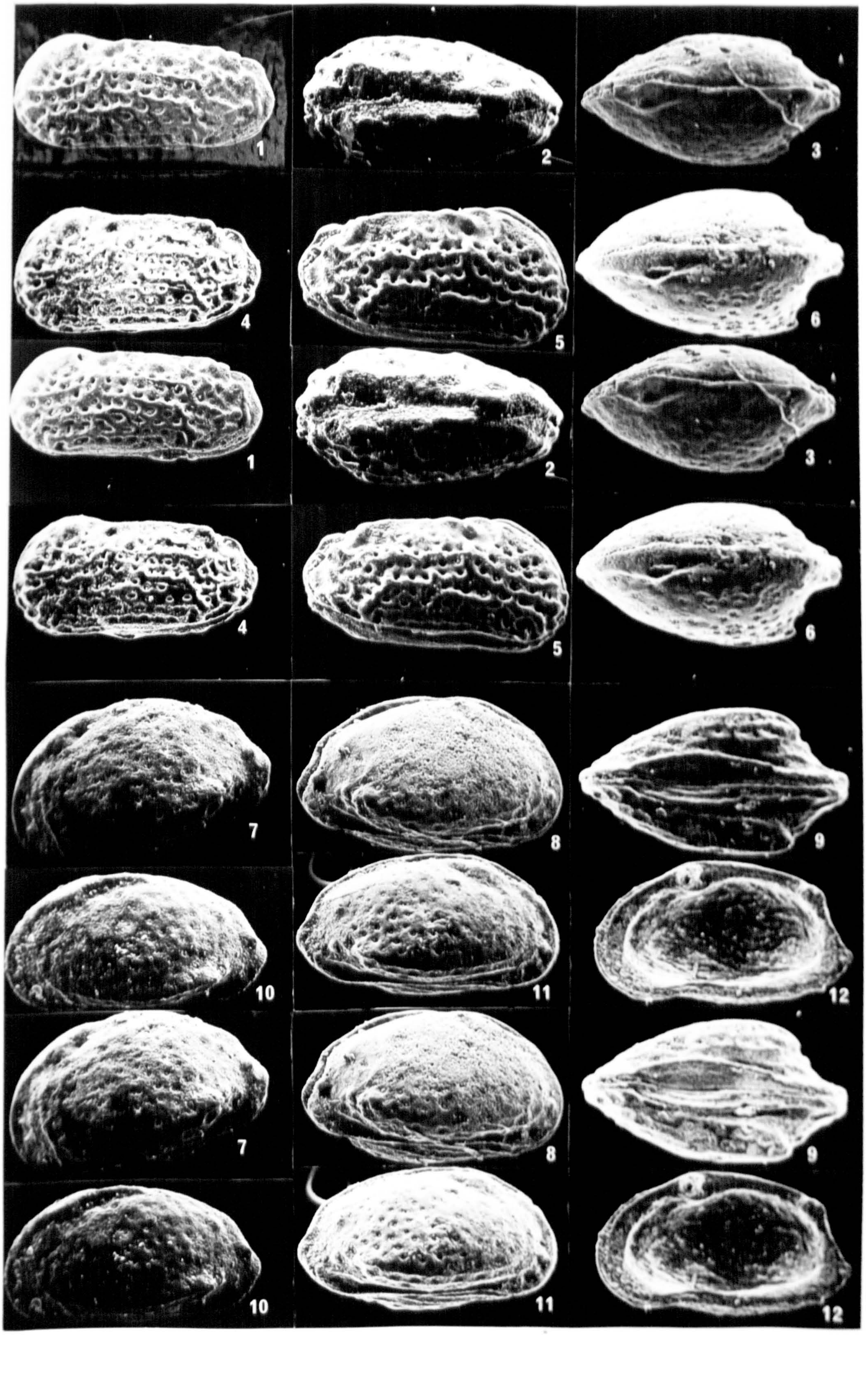
mg

1. Paratype carapace, male from left, HU.278, T.20.1 x 98
2. Paratype carapace, female dorsal view, HU.278, T.20.2 x 108
4. Holotype carapace,female from right, HU.278, T.19 x 100
5. Holotype carapace female from left, HU.278, T.19 x 100

figs. 3,6,7-12 Quadracythere (Mosulia) pulchra sp.nov. p.266

3. Paratype, male carapace, dorsal view, HU.278, T.22.2 x 96
6. Paratype, female carapace dorsal view, HU.278, T.22.7 x 113
7. Holotype, female carapace from left, HU.278, T.21 x 70
8. Holotype, female carapace from right, HU.278, T.21 x 70
9. Paratype, female carapace, ventral view, HU.278, T.22.4 x 74
10. Paratype, male carapace from left, HU.278, T.22.1 x 71
11. Paratype, male carapace from right, HU.278, T.22.1 x 71
12. Paratype, right valve internal view, HU.278, T.22.5 x 80

PLATE 30



EXPLANATION OF PLATE 31

figs. 1-6 Echinocythereis (Scelidocythereis) asiatica sp.nov. p.220

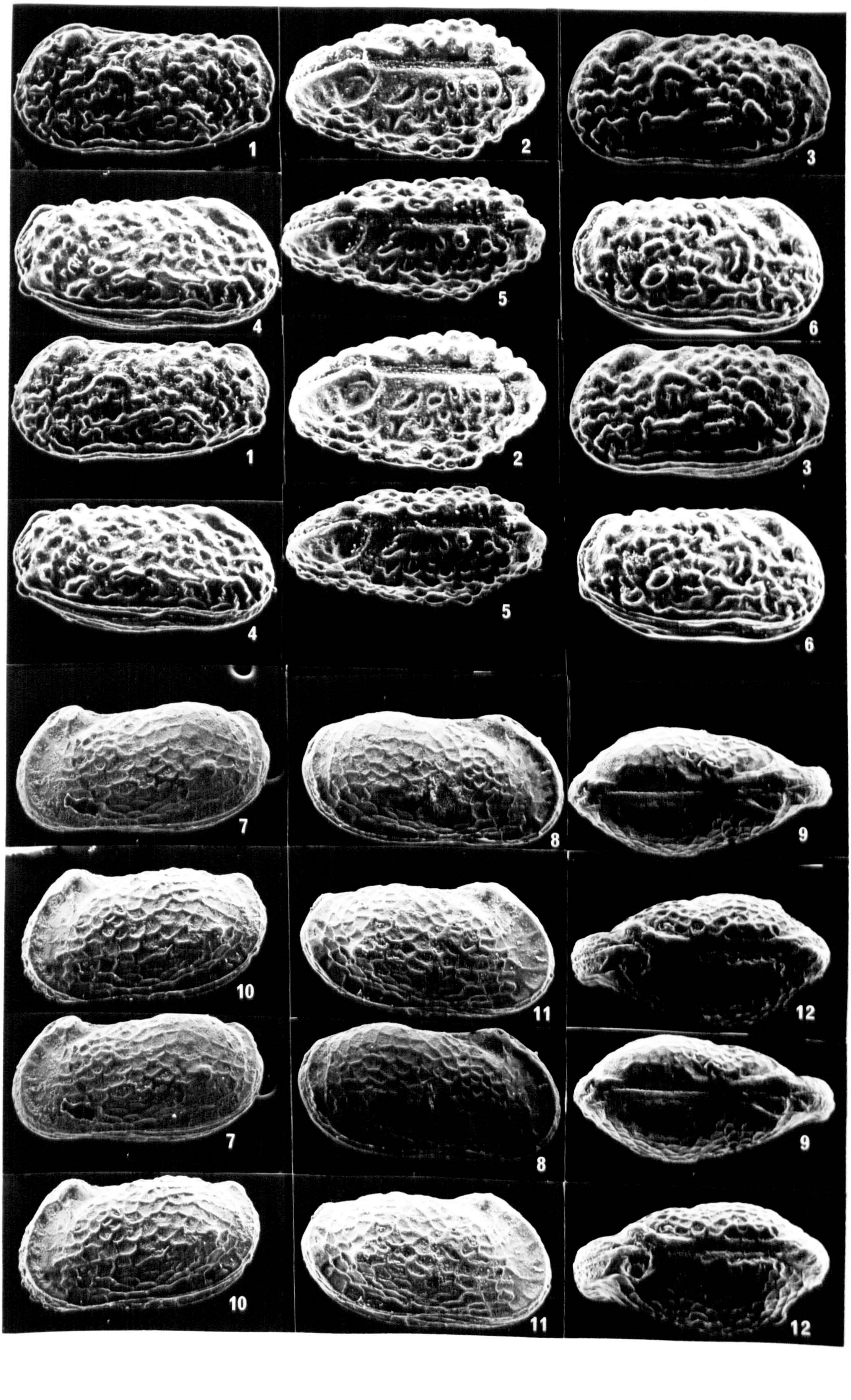
mg

1. Holotype, male carapace from left, HU.278, T.23 x 84
2. Paratype, female carapace, dorsal view, HU.278, T.24.2 x 86
3. Paratype, female carapace from left, HU.278, T.24.1 x 82
4. Holotype, male carapace from right, HU.278, T.23 x 84
5. Paratype, male carapace dorsal view, HU.278, T.24.3 x 94
6. Paratype, female carapace from right valve, HU.278, T.24.1 x 89

figs. 7-12 Alocopocythere fossularis (Lyubimova and Guha) 1960 p.223

7. Carapace, male, left valve, HU.278, T.25.1 x 63
8. Carapace, male right valve, HU.278, T.25.2 x 57
9. Carapace, male dorsal view, HU.278, T.25.2 x 57
10. Carapace, female right valve, HU.278, T.25.3 x 52
11. Carapace, female right valve, HU.278, T.25.4 x 58
12. Carapace, female dorsal view, HU.278, T.25.5 x 61

PLATE 31



EXPLANATION OF PLATE 32

figs. 1,4 Alocopocythere fossularis (Lyubimova & Guah) 1960 — p.223

mg

1. Right valve, male, internal view, HU.278, T.25.6 — x 66

4. Left valve, male, internal view, HU.278, T.25.7 — x 61

figs. 2,3,5,6 Alocopocythere sheikhibrahimensis sp.nov. — p.227

2. Paratype, female carapace from right, HU.278, T.27.2 — x 78

3. Holotype, female carapace from right, HU.278, T.26 — x 73

5. Paratype, female right valve internal, HU.278, T.27.3 — x 72

6. Paratype, female carapace dorsal view, HU.278, T.27.2 — x 77

figs. 7,8 Alocopocythere sp. — p.279

7. Carapace, female, from right, HU.278, T.28.1 — x 98

8. Carapace, male from left, HU.278, T.28.2 — x 91

figs. 9,12 Buntonia sheikhanensis sp.nov. — p.231

9. Paratype, male carapace from right, HU.278, T.30.1 — x 90

10. Holotype, female carapace from left, HU.278, T.29 — x 98

11. Paratype, male carapace from left, HU.278, T.30.1 — x 90

12. Holotype, female carapace from right, HU.278, T.29 — x 96

PLATE 32

EXPLANATION OF PLATE 33

figs. 1-3 Isobuntonia cuspidata sp.nov. p.238

mg

1. Paratype, male right valve, external view, HU.278, T.32.1 x 67
2. Holotype, female right valve, external view, HU.278, T.31 x 84
3. Holotype, male right valve internal view, HU.278, T.31 x 67

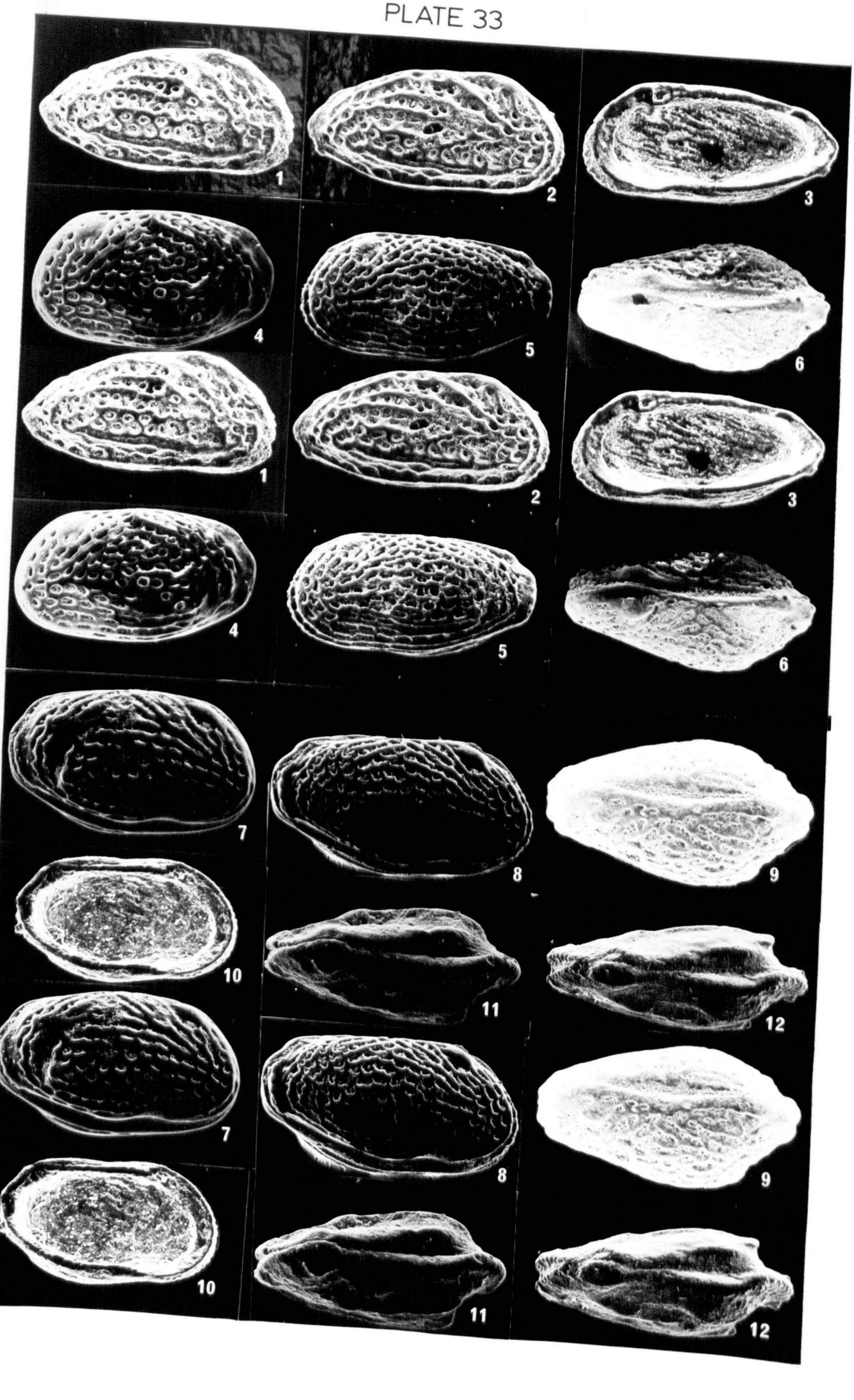
figs. 4-10 Asymmetricythere reticulata sp.nov. p.240

4. Paratype, female carapace from left, HU.278, T.34.1 x 67
5. Holotype, male carapace from left, HU.278, T.33 x 68
6. Paratype, male carapace dorsal view, HU.278, T.34.2 x 67
7. Paratype, female carapace from right, HU.278, T.34.1 x 67
8. Holotype, male carapace from right, HU.278, T.33 x 68
9. Paratype, female carapace dorsal view, HU.278, T.34.3 x 71
10. Paratype, female left valve, internal view, HU.278, T.34.4 x 70

figs. 11-12 Ruggieria (Ruggieria) nova sp.nov. p.244

11. Holotype, female carapace dorsal view, HU.278, T.35 x 61
12. Paratype, male carapace dorsal view, HU.278, T.36.1 x 68

PLATE 33



EXPLANATION OF PLATE 34

figs. 1,2,3,4a *Ruggieria* (*Ruggieria*) *nova* sp.nov. p.244

mg

1. Holotype, female carapace from left, HU.278, T.35 x 61

2. Paratype, male carapace from left, HU.278, T.36.1 x 68

3. Paratype, male carapace from right, HU.278, T.36.1 x 68

4a Holotype, female carapace from right, HU.278, T.35 x 61

figs. 4b,5-9,12 *Mutilus fortireticulata* sp.nov. p.247

4b Details of ornamentation on the surface of holotype carapace HU.279, T.1 x 95

5. Holotype, female carapace from left, HU.279, T.1 x 56

6. Holotype, female carapace from right, HU.279, T.1 x 56

7. Paratype, female left valve internal view, HU.279, T.2.3 x 60

8. Paratype, female carapace dorsal view, HU.279, T.2.2 x 64

9. Paratype, male carapace from right, HU.279, T.2.1 x 57

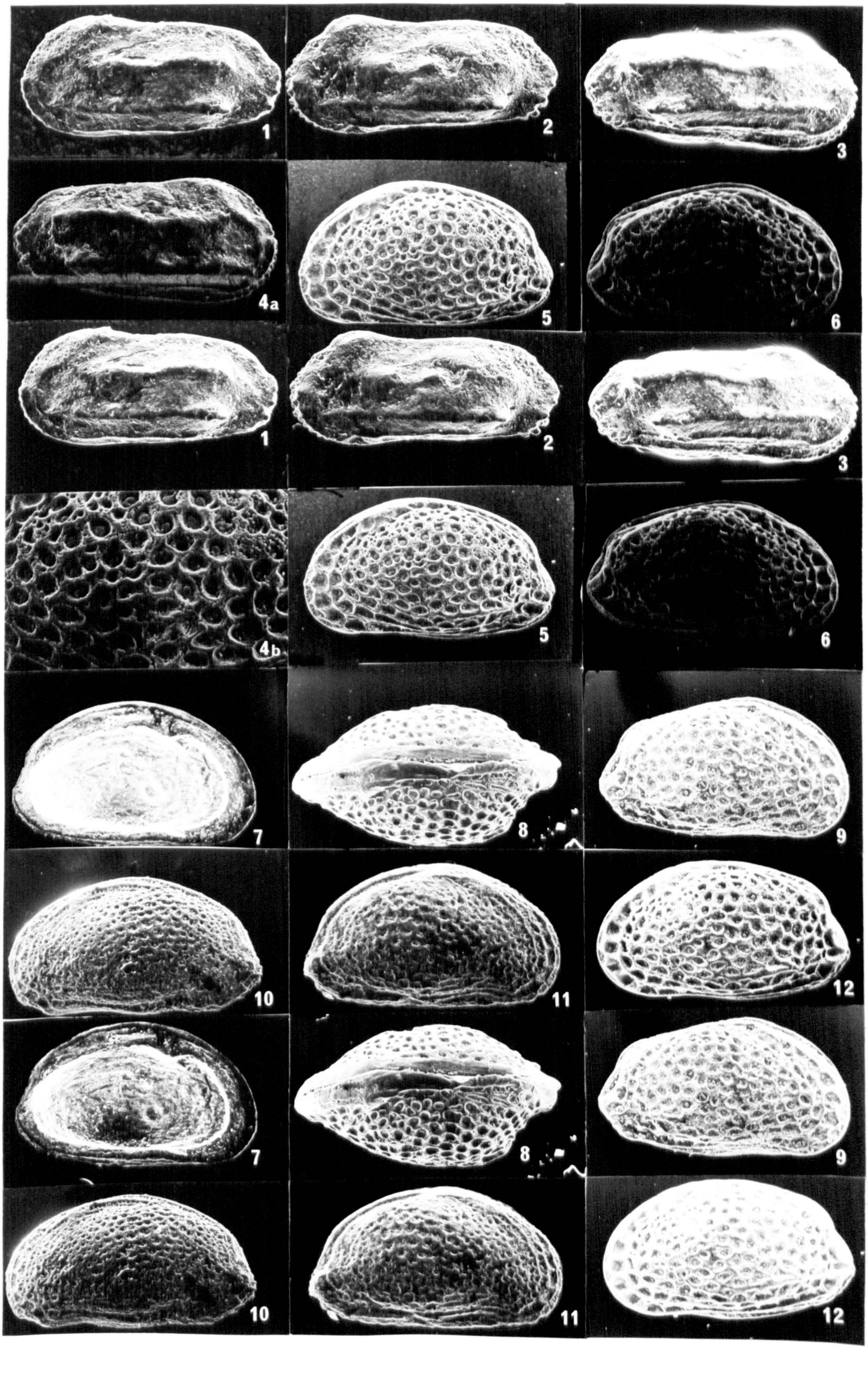
12. Paratype, male carapace from left, HU.279, T.2.4 x 55

figs.10-11 *Mutilus* sp. p.256

10. Carapace, from left external view, HU.279, T.5.1 x 64

11. Carapace, from right external view, HU.279, T.5.2 x 77

PLATE 34



EXPLANATION OF PLATE 35

figs. 1-8 Mutilus paracafossata sp.nov. p.252

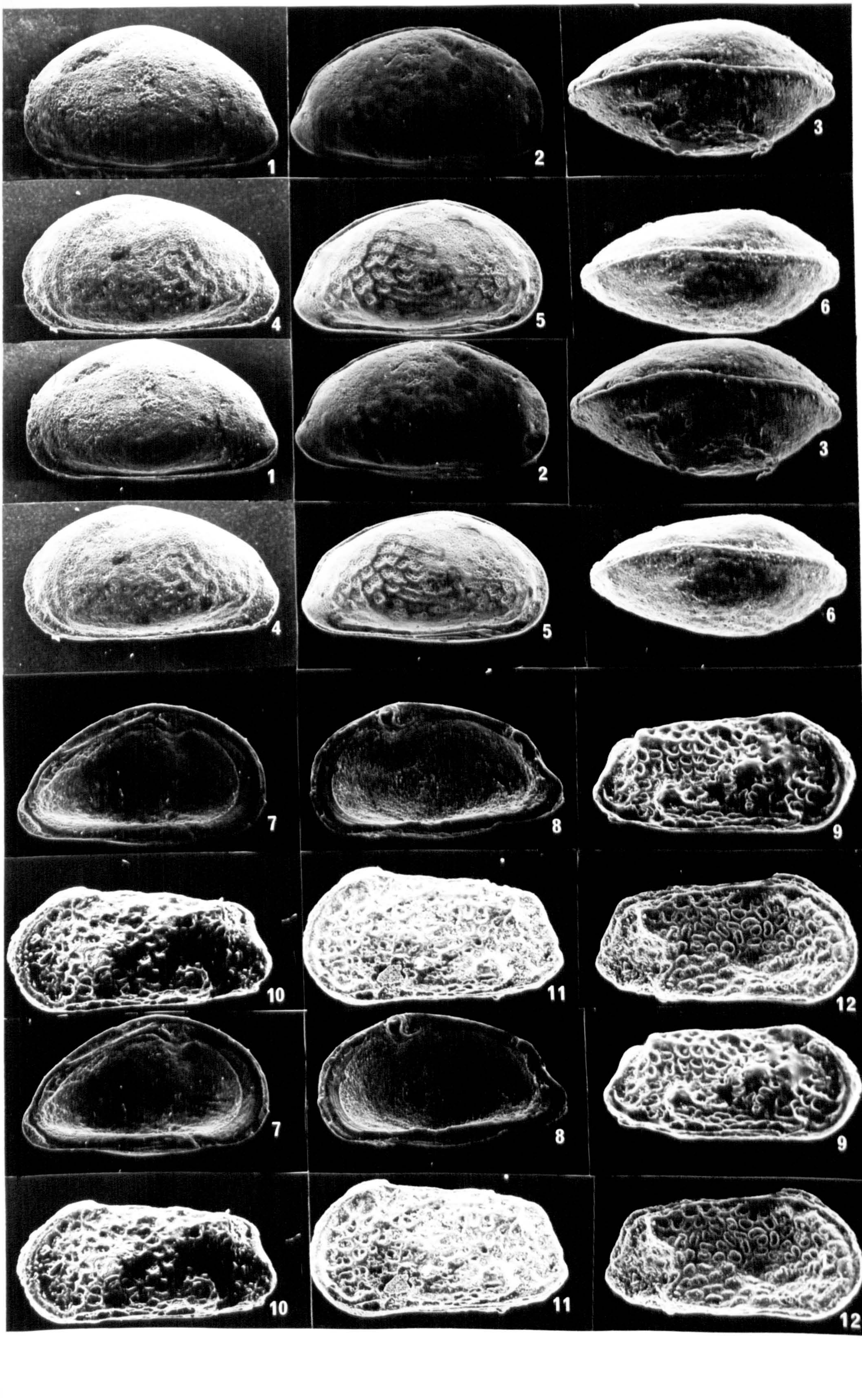
mg

1. Holotype, female carapace from left, HU.279, T.3 x 62
2. Paratype, female carapace from right, HU.279, T.4.1 x 63
3. Holotype, female carapace dorsal view, HU.279, T.3 x 62
4. Paratype, male carapace from left, HU.279, T.4.3 x 65
5. Paratype, male carapace from right, HU.279, T.4.2 x 65
6. Paratype, male carapace dorsal view, HU.279, T.4.3 x 65
7. Paratype, male, left valve internal view, HU.279, T.4.4 x 69
8. Paratype, female right valve internal view, HU.279, T.4.5 x 64

figs. 9-12 Hermanites compressa sp.nov. p.262

9. Holotype, male carapace from right, HU.279, T.6 x 73
10. Holotype, male carapace from left, HU.279, T.6 x 73
11. Paratype, female carapace from left, HU.279, T.7.1 x 79
12. Paratype, female carapace from right, HU.279, T.7.1 x 79

PLATE 35



EXPLANATION OF PLATE 36

figs. 1-8 Hermanites transversicostata Khalaf 1982 p.257

		mg
1.	Holotype, male carapace from left, HU.275, T.15	x 51
2.	Holotype, male carapace from right, HU.275, T.15	x 51
3.	Holotype, male carapace dorsal view, HU.275, T.15	x 51
4.	Paratype, female carapace from left, HU.275, T.16.1	x 60
5.	Paratype, female carapace from right, HU.275, T.16.1	x 60
6.	Paratype, female carapace dorsal view, HU.275, T.16.1	x 60
7.	Paratype, male left valve internal view, HU.275, T.16.2	x 53
8.	Paratype, male right valve internal view, HU.275, T.16.3	x 64

figs. 9-12 Quadracythere (Hornibrookella) sp. p.273

9.	Carapace, from left, HU.279, T.10.1	x 75
10.	Carapace, from left, HU.279, T.10.2	x 70
11.	Carapace, from right, HU.279, T.10.2	x 70
12.	Carapace, from left, HU.279, T.10.1	x 75

PLATE 36

EXPLANATION OF PLATE 37

figs.1-6 Quadracythere (Hornibrookella) kurdistanensis sp.nov. p.270

mg

1. Holotype, male carapace from left, HU.279, T.8 x 65
2. Holotype, male carapace from right, HU.279, T.8 x 65
3. Holotype, male carapace dorsal view, HU.279, T.8 x 65
4. Paratype, female carapace from left, HU.279, T.9.1 x 69
5. Paratype, female carapace from right, HU.279, T.9.1 x 69
6. Paratype, female carapace dorsal view, HU.279, T.9.1 x 69

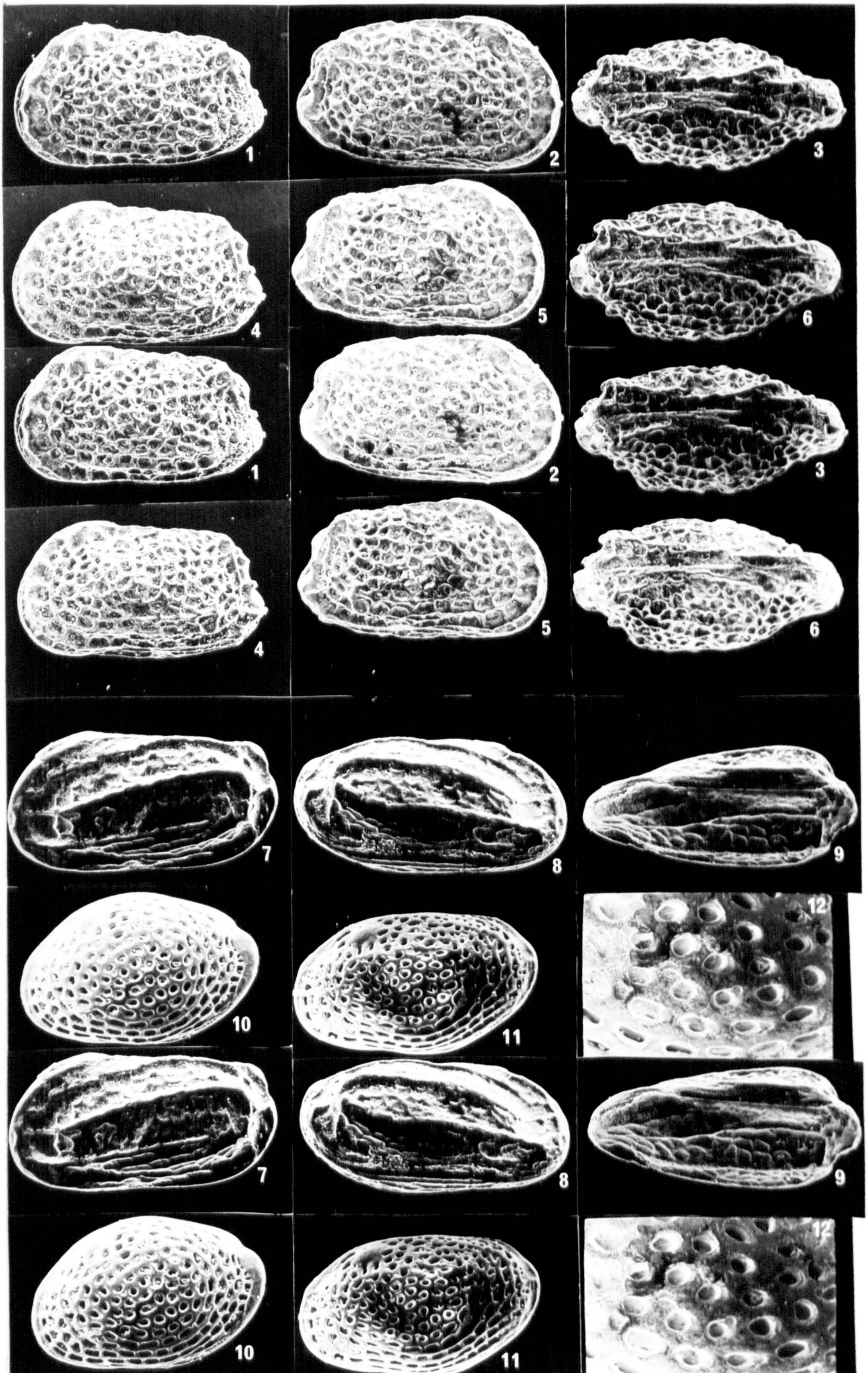
figs. 7-9, Flexus trifurcata (Lyubimova and Guha) 1960 p.274

7. Carapace, male from left, HU.279, T.11.1 x 86
8. Carapace, female from right, HU.279, T.11.2 x 89
9. Carapace, male dorsal view, HU.279, T.11.3 x 89

figs.10-12 Loxoconcha (Loxoconcha) hamrinensis sp.nov. p.276

10. Holotype, female carapace, from left, HU.279, T.12 x 82
11. Paratype, male carapace from left, HU.279, T.13.1 x 83
12. Details of ornamentation on the surface of the carapace HU.279, T.13.1 x 180

PLATE 37



EXPLANATION OF PLATE 38

figs. 1,2,4,5 Loxoconcha (Loxoconcha) hamrinensis sp.nov. p. 276

mg

1. Holotype, female carapace from right, HU.279, T.12 x 82
2. Holotype, female carapace dorsal view, HU.279, T.12 x 82
4. Paratype, male carapace from right, HU.279, T.13.2 x 87
5. Paratype, male carapace dorsal view, HU.279, T.13.2 x 87

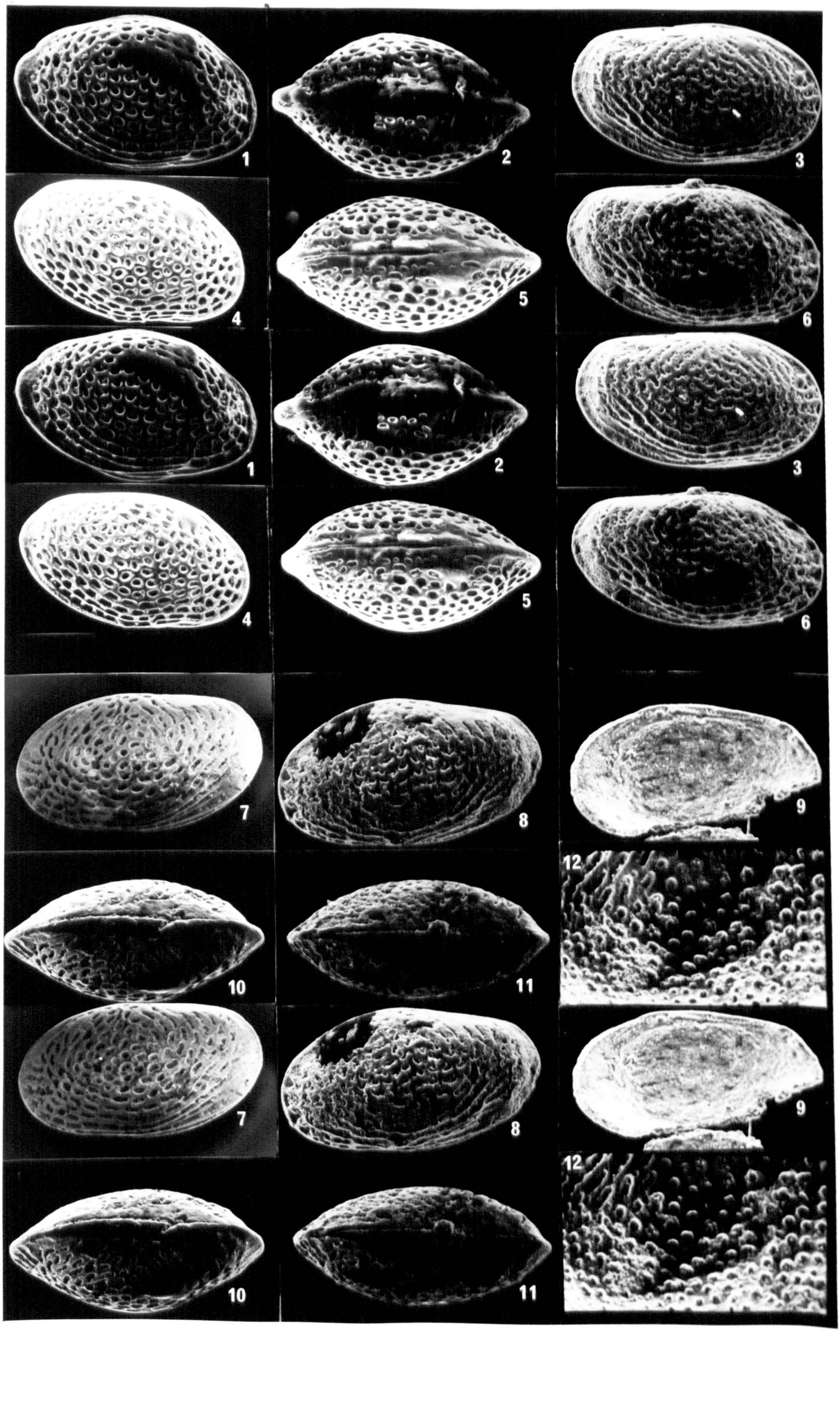
figs.3,6,7-11 Loxoconcha (Palmoconcha) miocaenica sp.nov. p.282

3. Paratype, female carapace from right, HU.279, T.17.3 x 71
6. Paratype, male carapace from right, HU.279, T.17.4 Lost
7. Holotype, female carapace from left, HU.279, T.16 x 74
8. Paratype, male carapace from left, HU.279, T.17.1 x 75
9. Paratype, right valve internal, HU.279, T.17.2 x 92
10. Holotype, female carapace dorsal view, HU.279, T.16 x 74
11. Paratype, male carapace dorsal view, HU.279, T.17.4 lost

fig. 12 Loxoconcha (Loxoconcha) pseudohamrinensis sp.nov. p.280

12. Details of ornamentation on the surface of carapace HU.279, T.15.1 x 140

PLATE 38



EXPLANATION OF PLATE 39

figs. 1, 2 Loxoconcha (Loxoconcha) pseudohamrinensis sp.nov. p.280

mg

1. Holotype, carapace from right, HU.279, T.14 x 77
2. Paratype, carapace from left, HU.279, T.15.1 x 76

figs. 3,5,6 Hirschmannia? rara sp.nov. p.284

3. Holotype, female carapace from left, HU.279, T.18 x 86
5. Paratype, male carapace from right, HU.279, T.19.1 x 85
6. Holotype, female carapace from right, HU.279, T.18 x 86

fig. 4 Phlyctocythere sp. p.286

4. Carapace, from right, external view, HU.279, T.20 x 93

figs. 7-9 Paracytheridea splendida sp.nov. p.287

7. Holotype, female right valve, internal view, HU.279, T.21 x 74
8. Holotype, female right valve, external view, HU.279, T.21 x 74
9. Paratype, male left valve external view, HU.279, T.22.1 x 79

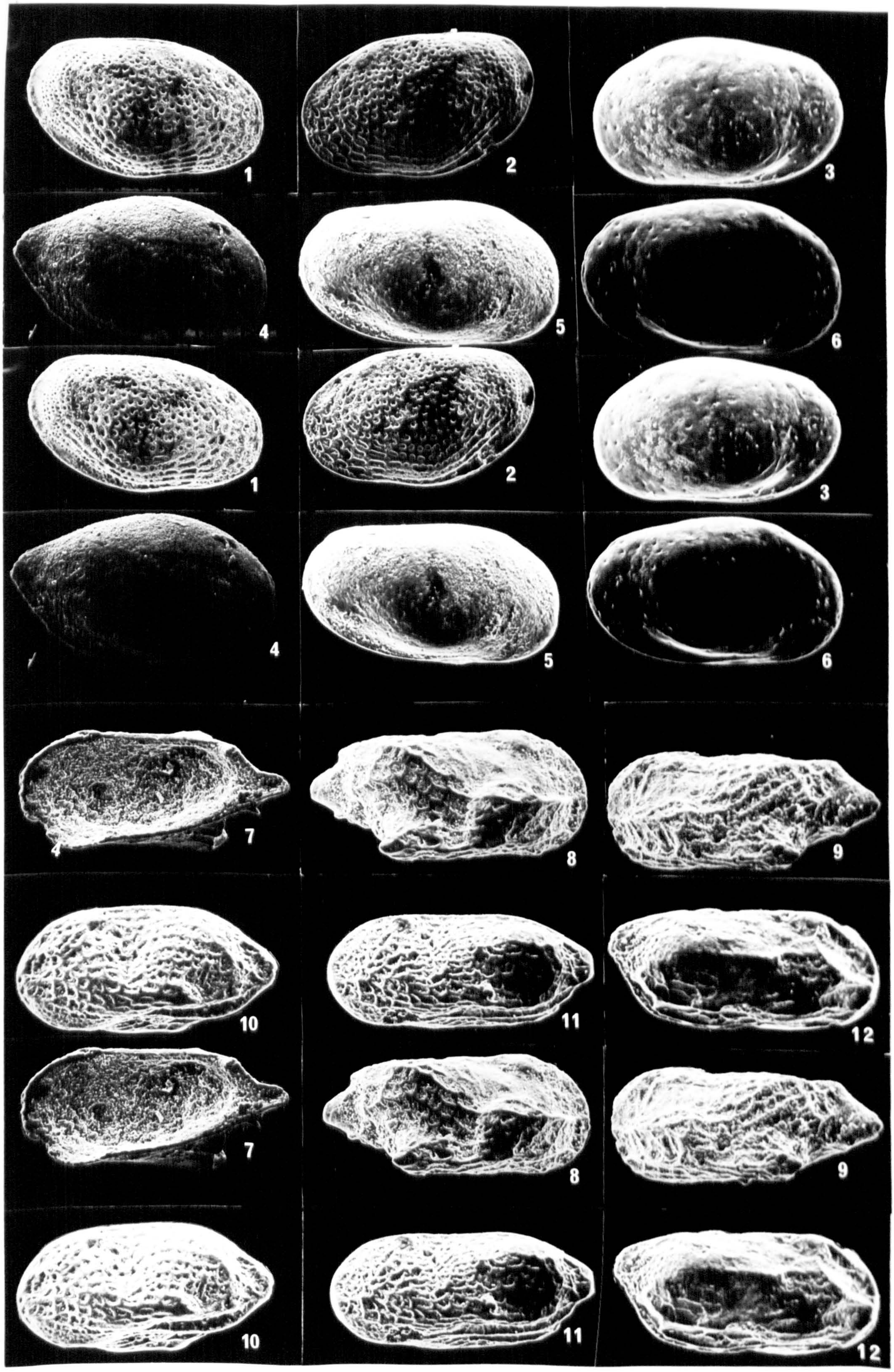
figs.10,11 Semicytherura matiaensis sp.nov. p.290

10. Holotype, female carapace from left, HU.279, T.23 x 108
11. Paratype, male carapace from left, HU.279, T.24.1 x 106

fig.12 Semicytherura sp. p.292

12. Carapace, from right, HU.279, T.25 x 111

PLATE 39



EXPLANATION OF PLATE 40

figs. 1-5 Xestoleberis orientalis sp.nov. p.293

mg

1. Holotype, male carapace from right, HU.279, T.26 x 74
2. Paratype, female carapace from left, HU.279, T.27.1 x 81
3. Paratype, left valve, internal view, HU.279, T.27.2 x 74
4. Paratype, male carapace, dorsal view, HU.279, T.27.3 x 85
5. Paratype, female carapace, dorsal view, HU.279, T.27.4 x 85

fig.6 Xestoleberis sp. p.295

6. Carapace, from right, HU.279, T.28.1 x 74

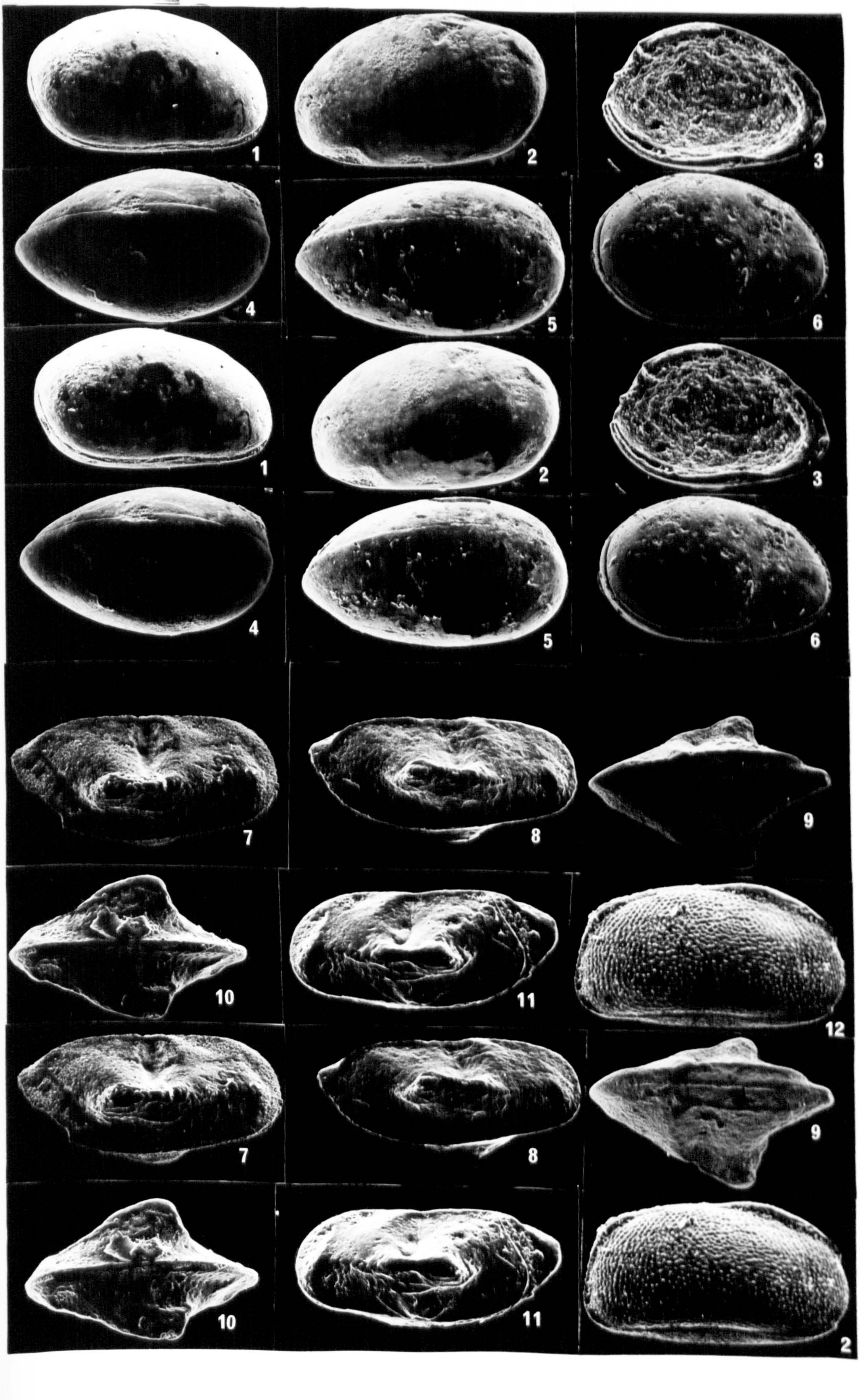
figs. 7-11 Pseudoceratina? nova sp.nov. p.297

7. Paratype, female carapace from right, HU.279, T.30.1 x 85
8. Holotype, male carapace from right, HU.279, T.29 x 85
9. Paratype, male carapace dorsal view, HU.279, T.30.2 x 73
10. Paratype, female carapace, ventral view, HU.279, T.30.3 x 76
11. Paratype, male carapace from left, HU.279, T.30.2 x 73

fig. 12 Cyprideis sp.aff. C. (Cyprideis) sublittoralis adentata Bassiouni 1979 p.238

12. Carapace, from right external view, HU.279, T.31 x 46

PLATE 40



EXPLANATION OF PLATE 41

1 Cyprideis sp.aff. C. (Cyprideis) sublittoralis adentata Bassiouni p.238

mg

1. Carapace, from left, external view, HU.279, T.31 x 46

figs. 2,3 Genus A sp. p.300

2. Carapace, female from right external view, HU.279, T.32.1 x 79

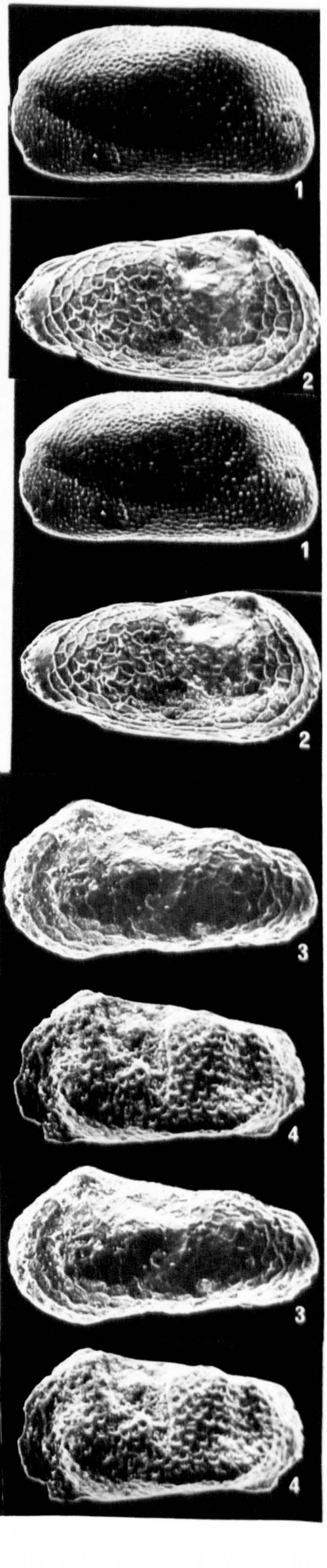
3. Male, left valve external view, HU.279, T.32.2 x 78

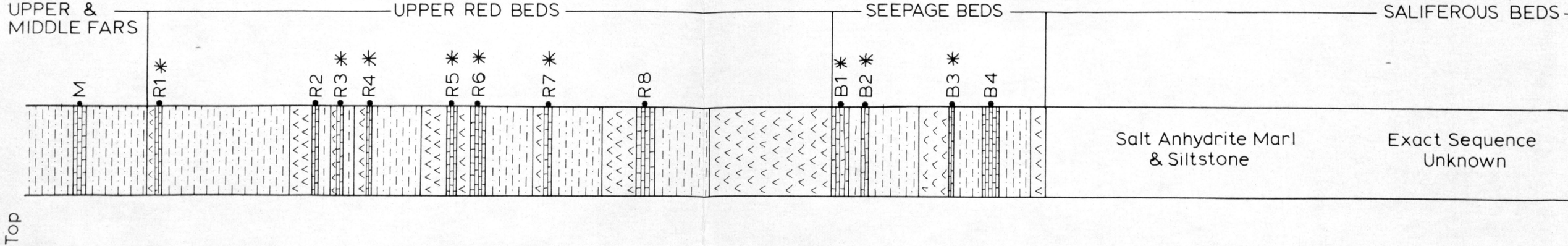
figs. 4,5 Genus B sp. p.302

4. Left valve external view, HU.279, T.33.1 x 109

5. Left valve external view, HU.279, T.33.2 x 104

PLATE 41




UPPER &
MIDDLE FARS
UPPER RED BEDS
SEEPAGE BEDS
SALIFEROUS BEDS
M
R1
R2
R3
R4
R5
R6
R7
R8
B1
B2
B3
B4
Salt Anhydrite Marl
& Siltstone
Exact Sequence
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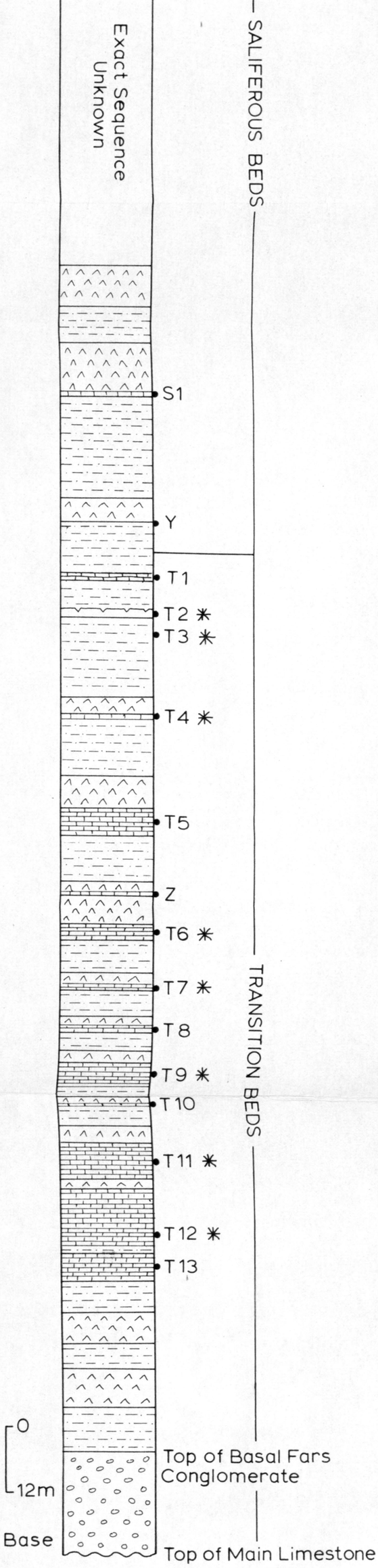
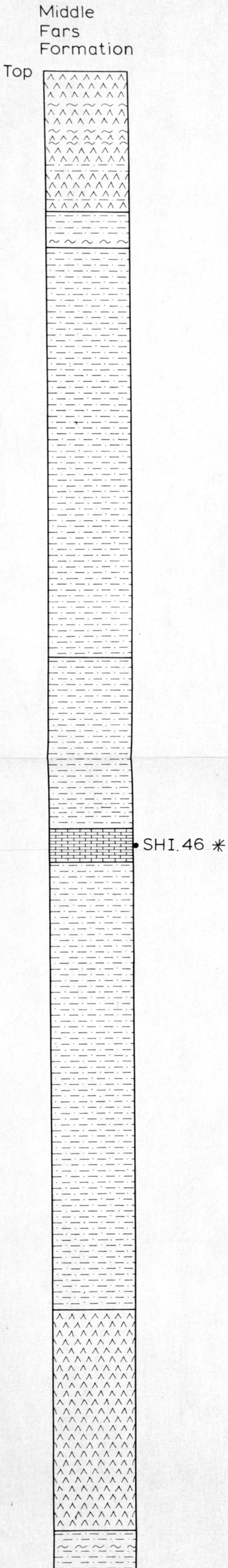
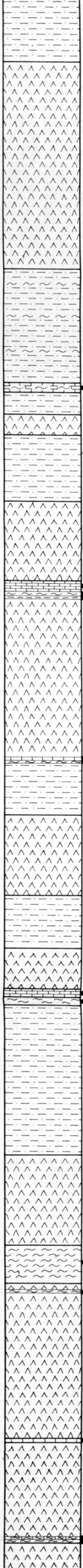


Enclosure 1.
Generalised Columnar Section of the Lower Fars Formation, Kirkuk oil-field
Modified after W. Sugden (1951) and H.V. Dunnington (1956)


Middle
Fars
Formation
Top
SHI. 46 *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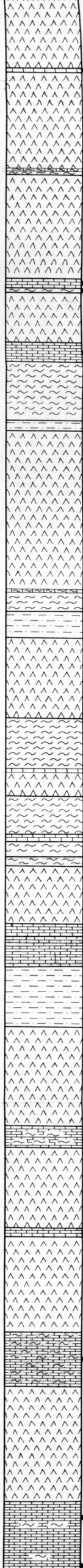
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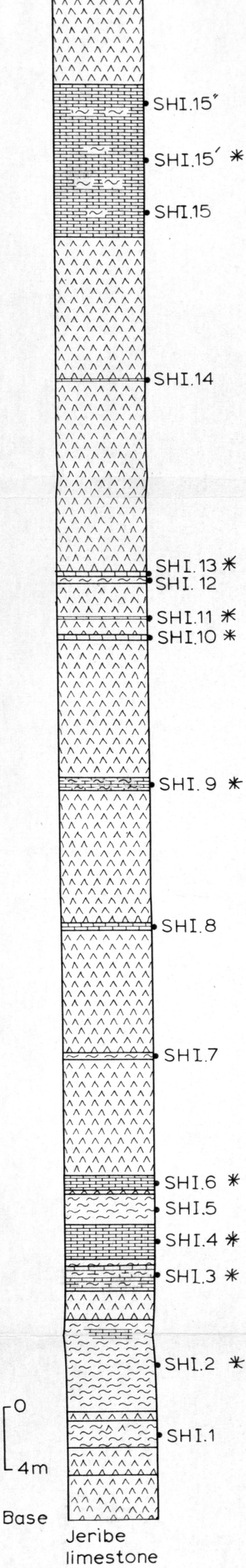
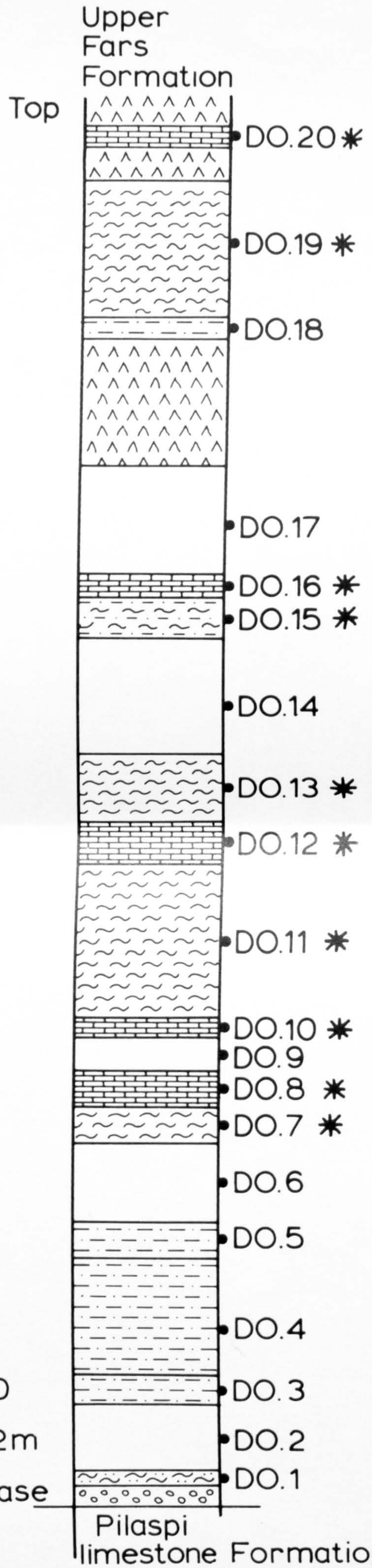
SHI.21
SHI.20
SHI.19 ✳
SHI.18 ✳
SHI.17
SHI.16 ✳
SHI.15'
SHI.15' ✳

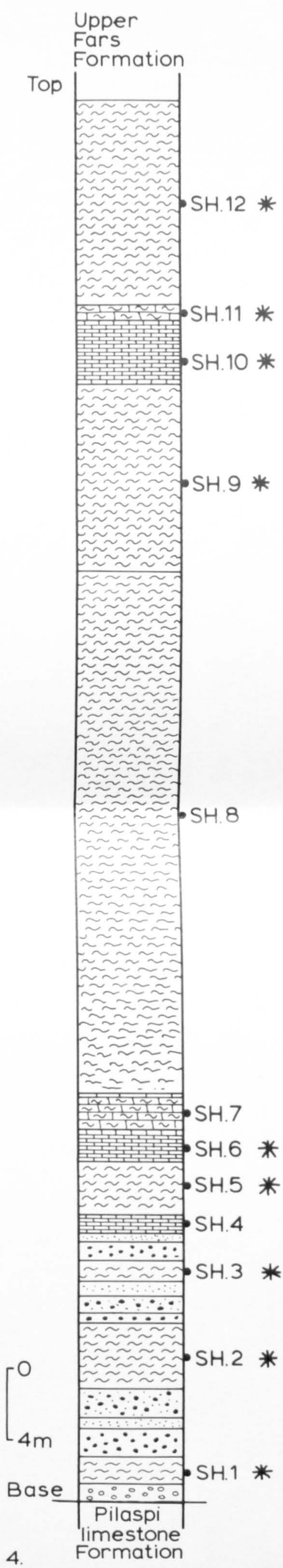


Enclosure 2.

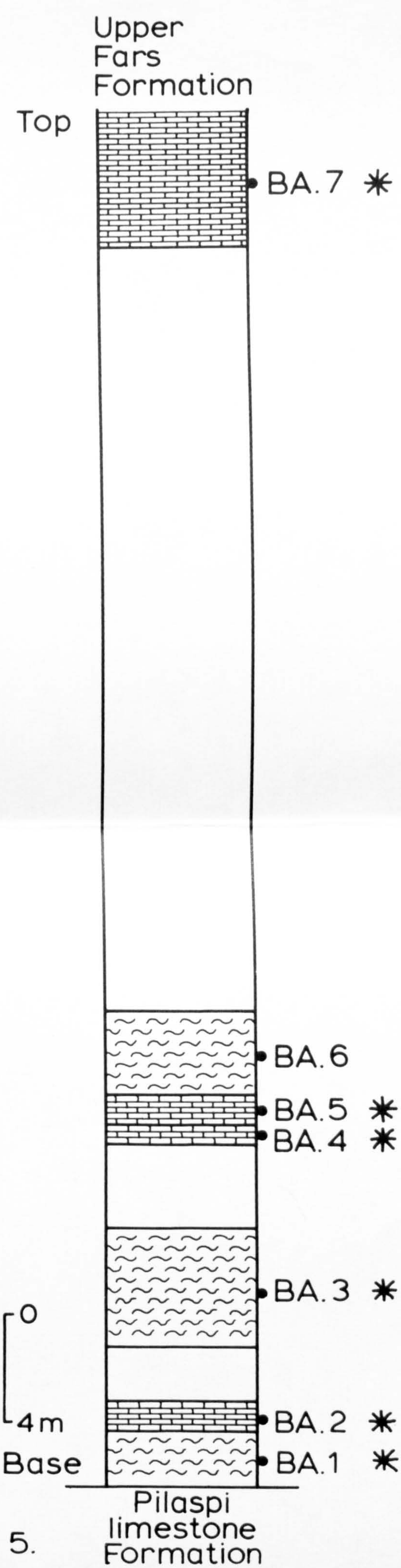
Lithological section in the Lower Fars Formation Sheikh Ibrahim locality.



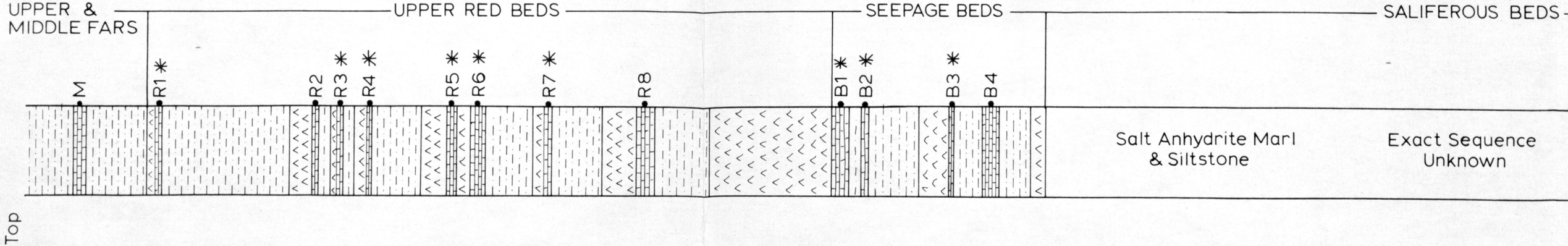
Enclosure 3.
Lithological section of the Lower Fars Formation of Dohuk locality Northern Iraq

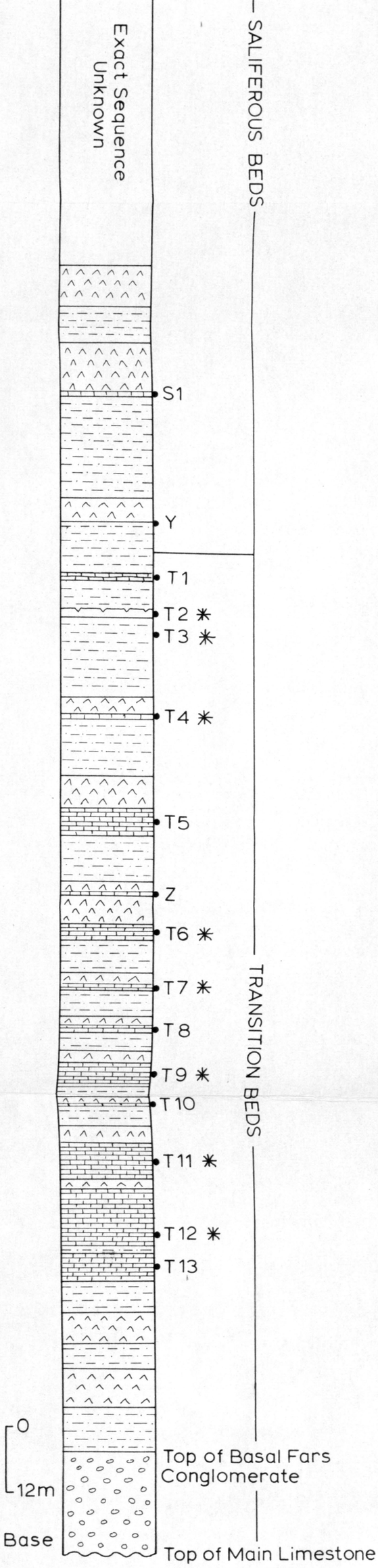


Enclosure 4.
Lithological section of the lower Fars Formation
Sheikhan locality N. Iraq.

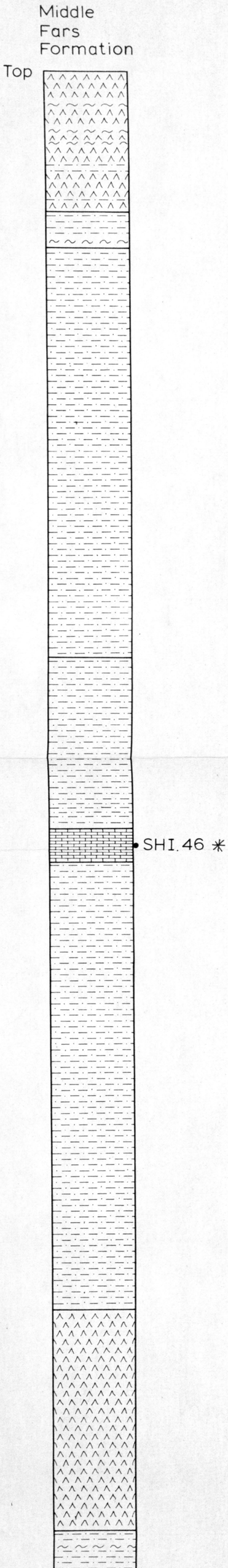


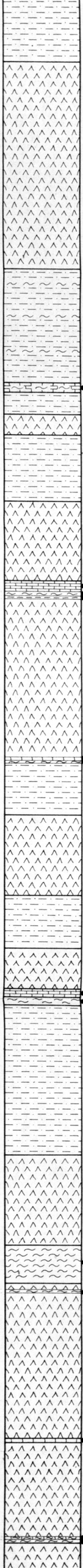
Enclosure 5.
Lithological section in the Lower Formation, Bashiqa locality.

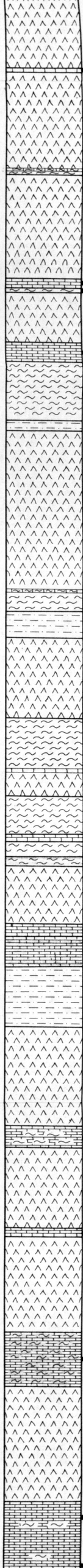

UPPER &
MIDDLE FARS
UPPER RED BEDS
SEEPAGE BEDS
SALIFEROUS BEDS
M
R1
R2
R3
R4
R5
R6
R7
R8
B1
B2
B3
B4
Salt Anhydrite Marl
& Siltstone
Exact Sequence
Unknown
Top

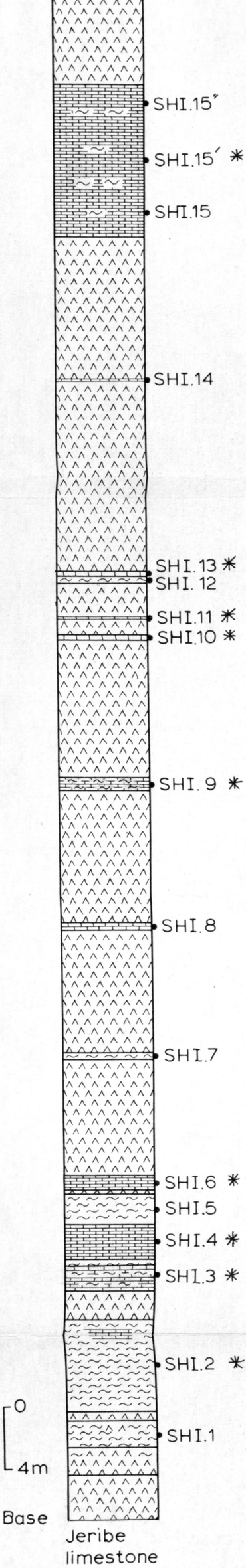


Enclosure 1.
Generalised Columnar Section of the Lower Fars Formation, Kirkuk oil-field
Modified after W. Sugden (1951) and H.V. Dunnington (1956)


Middle
Fars
Formation
Top
SHI. 46 *


SHI.45 ✳
SHI.44 ✳
SHI.43
SHI.42
SHI.41
SHI.40 ✳
SHI.39
SHI.38
SHI.37 ✳
SHI.36
SHI.35 ✳
SHI.34
SHI.33 ✳


SHI.35 ✳
SHI.34
SHI.33 ✳
SHI.32 ✳
SHI.31 ✳
SHI.30 ✳
SHI.29 ✳
SHI.28 ✳
SHI.27 ✳
SHI.26 ✳
SHI.25 ✳
SHI.24 ✳
SHI.23
SHI.22 ✳
SHI.21
SHI.20
SHI.19 ✳
SHI.18 ✳
SHI.17
SHI.16 ✳
SHI.15'
SHI.15' ✳



Enclosure 2.

Lithological section in the Lower Fars Formation Sheikh Ibrahim locality.