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Late Miocene Ostracoda from NW Libya

AHMED. A. EL-WAER
Geology Department, Hull University, Cottingham Road, Hull HU6 7RX

ABSTRACT–Nine ostracod species from the Late Miocene Al Khums Formation (exposed 2 km north of Qabilat ash Shurfah, NW Libya) are described and illustrated in this paper. Of these, four species, namely *Cytherella libyaensis, Actinocythereis spinosa, Keijella africana* and *Neomonoceratina miocaenica*, are new; one was established by Doruk (1980), one by Moyes (1965) and the other three species are left under open nomenclature. These species support the macrofossil, foraminiferal and other ostracod (Innocenti & Pertusati, 1984 and El-Waer, in press) evidence in suggesting a Late Miocene age.

INTRODUCTION

The present study deals with Ostracoda from the Late Miocene Al Khums Formation exposed 2 km north of Qabilat ash Shurfah (see Fig. 1). The exposed section of the Formation measures approximately 14 m, and varies in composition between marlstone, calcaranitic limestone and calcareous clay. Four samples were collected from the section (see Fig. 2) in 1983 by Mr. K. Sherif of the Industrial Research Centre, Tripoli, Libya. These beds are overlain by fluvio-aeolian deposits. The Miocene samples yielded a fairly rich and well preserved ostracod fauna (El-Waer, in press), containing *Cytherella* sp., *Cytherella (Cytherella) vandenboldi* Sissingh, 1972, *Propontocypris* sp., *Loculicytheretta* aff. *miocaenica* Szczechura, 1978, *Mutilus carinatus* Doruk, 1973, *Loxoconcha* sp., *Loxoconcha (Palmoconcha)* sp., *Paracytheridea gharianensis* sp. nov., Paracytheridea sp., *Paijenborchellina punctata* sp. nov., *Neomonoceratina mouliana* Sissingh, 1972, *Neomonoceratina conulata* sp. nov., *Actinocythereis libyaensis* sp. nov., *Chrysocythere alkhumia* sp. nov., *Chrysocythere cataphracta muricata* subsp. nov., *Cistacythereis calamistrata* Doruk, 1973, *Cistacythereis qabilatshurafensis* sp. nov., *Falunia sicula* Aruta, 1966, *Ruggieria tetraptera tetraptera* (Seguenza, 1897), *Ruggieria miocaenica* sp. nov., *Keijella hodgii* (Brady, 1866), *Hermanites abundans* sp. nov. and one genus left under open nomenclature.

The present work covers a number of important species which were discovered in examining further material. These are *Cytherella* libyaensis sp. nov., *Propontocypris* sp., *Callistocythere* sp., *Actinocythereis spinosa* sp. nov., *Keijella africana* sp. nov., *Neomonoceratina miocaenica* sp. nov., *Loxoconcha* sp., *Paracytheridea inscita* Doruk, 1980, and *Carinovalva carinata* (Moyes, 1965) from the same sequence. The occurrence at this stratigraphical level of two previously described species provides additional evidence for a Late Miocene age.

All figured specimens are deposited in the collections of the Geology Department, University of Hull, England.

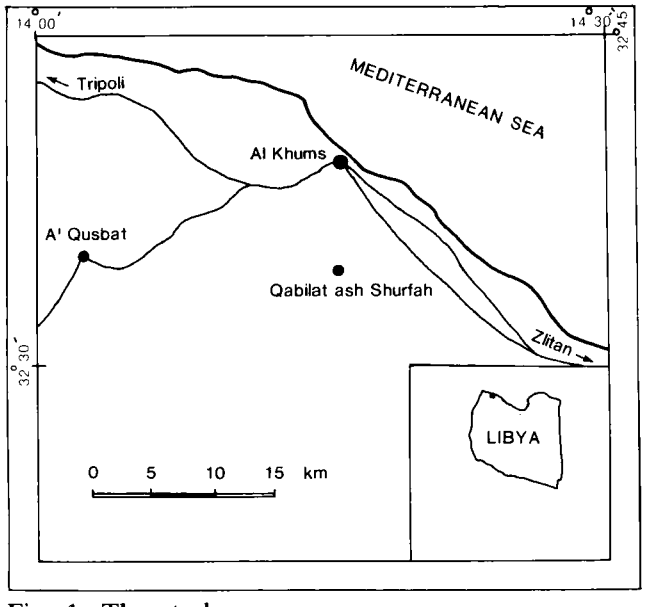


Fig. 1. The study area.

SYSTEMATIC DESCRIPTIONS

Subclass Ostracoda Latreille, 1806
Order Podocopida Muller, 1894
Suborder Platycopina Sars 1866
Family Cytherellidae Sars, 1866
Genus *Cytherella* Jones, 1849
Cytherella libyaensis sp. nov.
(Pl. 1, figs. 1–3)

Derivation of name. From its occurrence in Libya.
Diagnosis. A species of the genus *Cytherella* characterised by its coarsely pitted surface. The location of the

muscle scar area is indicated by a small, shallow depression.

Holotype. Male left valve, HU.317.T.3; Pl. 1, fig. 3.

Paratypes. Two specimens, HU.317.T.1,2; Pl. 1, figs. 1, 2 and two right valves and one left valve (HU.317.T.24).

Type locality and horizon. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Description. Carapace elongate to ovate in lateral view, with greatest height at the posterior margin. Dorsal margin straight, sloping gently to the anterior margin. Ventral margin slightly concave in the middle and curved upwards anteriorly. Posterior margin is rounded. The lateral surface is covered by coarse pits. The area of the muscle scar attachment is indicated by a small, shallow depression. The left valve is larger than the right. Sexual dimorphism is pronounced, the presumed males are more elongate and less high than the females. The internal features not visible.

Dimensions of figured specimens (in μm)

	Length	Height
Paratype, male right valve, HU.317.T.1.	650	358
Paratype, female right valve, HU.317.T.2.	613	373
Holotype, male left valve, HU.317.T.3.	653	360

Remarks. *Cytherella libyaensis* sp. nov. shows affinities with *Cytherella (Cytherella) vandenboldi* Sissingh, 1972, in its outline, but differs in having a straight, gently sloping dorsal margin, and a narrower anterior end.

Occurrence. Only at the type locality: sample 3 of the section 2 km north of Qabilat ash Shurfah.

Suborder Podocopina Sars, 1866
Superfamily Cypridacea Baird, 1845
Family Pontocyprididae Muller, 1894
Subfamily Pontocypridinae Muller, 1894
Genus *Propontocypris* Sylvester-Bradley, 1948
Propontocypris sp.
(Pl. 1, figs. 4–5)

Material. Three carapaces.

Description. In lateral view, carapace elongate to subtriangular, with greatest height nearly at the mid-length. Anterior margin obliquely rounded, posterior end narrowly rounded and lower than the anterior end. Dorsal margin is broadly arched, highest anteriorly, where the anterodorsal margin slopes gently anteriorly and the posterodorsal posteriorly. Ventral margin is straight to slightly concave in the left valve. Lateral surface smooth to finely pitted. In dorsal view the carapace is elongate, compressed anteriorly and posteriorly and with the maximum width at the mid-length.

Dimensions of figured specimens (in μm).

	Length	Height
Female, carapace, HU.317.T.4.	600	325
Male, carapace, HU.317.T.5.	625	310

Remarks: This species is very similar to *Propontocypris* sp. El-Waer (in press), but the latter species differs in having a less arched dorsal margin and a more pointed posterior end than the present one. This species is represented only by closed carapaces and it has not been possible to ascertain the finer morphological details. It is placed in *Propontocypris* on the basis of the general shape.

Occurrence. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Superfamily Cytheracea Baird, 1850
Family Leptocytheridae Hanai, 1957
Genus *Callistocythere* Ruggieri, 1953
Callistocythere sp.
(Pl. 1, fig. 6)

Material. One left valve.

Description. Carapace elongate, subrectangular in laterial view, greatest height at the anterior cardinal angle. Anterior margin rounded, posterior margin obliquely rounded and lower than the anterior end. Dorsal margin slightly convex and sloping gently to anterior and posterior cardinal angles. Ventral margin straight. Ornamentation consists of a complex pattern of ridges and intervening fossae. Behind the sub-central tubercle

Explanation of Plate 1

Figs. 1–3. *Cytherella libyaensis* sp. nov.: fig. 1, paratype, male right valve, HU.317.T.1 (×61); fig. 2, paratype, female internal view, right valve, HU.317.T.2 (×61); fig. 3, holotype, male left valve, HU.317.T.3 (×57).

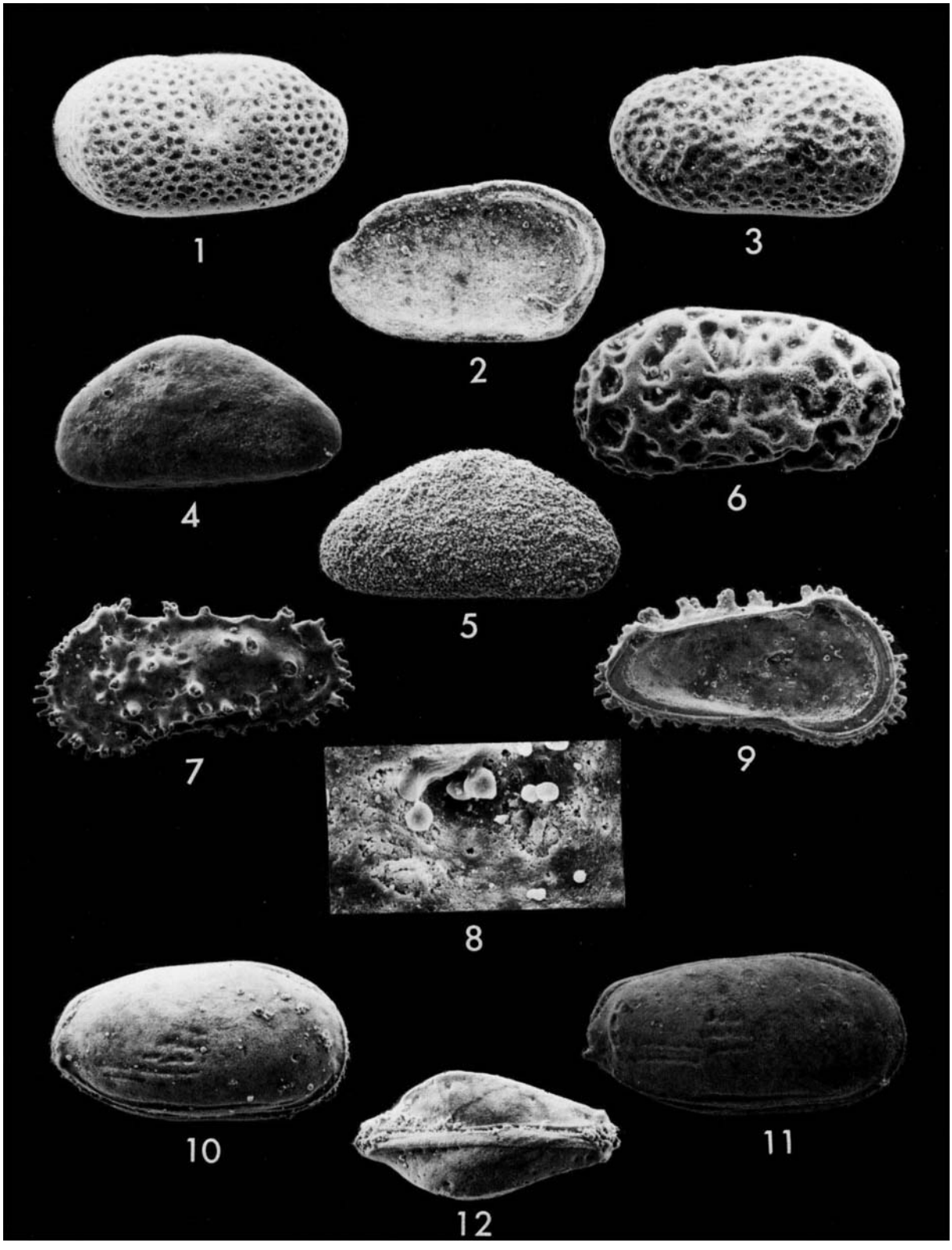
Figs. 4, 5. *Propontocypris* sp.: fig. 4, female carapace from left, HU.317.T.4 (×75); fig. 5, male carapace from right, HU.317.T.5 (×75).

Fig. 6. *Callistocythere* sp., left valve, HU.317.T.6 (×57).

Figs. 7–9. *Actinocythereis spinosa* sp. nov.: fig. 7, holotype, left valve, HU.317.T.7 (×60); fig. 8, paratype, muscle scar pattern, HU.317.T.8; fig. 9, paratype, internal view, left valve, HU.317.T.8 (×61).

Figs. 10, 11. *Keijella africana* sp. nov.: fig. 10, paratype, female carapace from right, HU.317.T.9 (×70); fig 11, holotype, male carapace from right, HU.317.T.10 (×68).

Fig. 12. *Carinovalva carinata* (Moyes, 1965), carapace, dorsal view, HU.317.T.11 (×82).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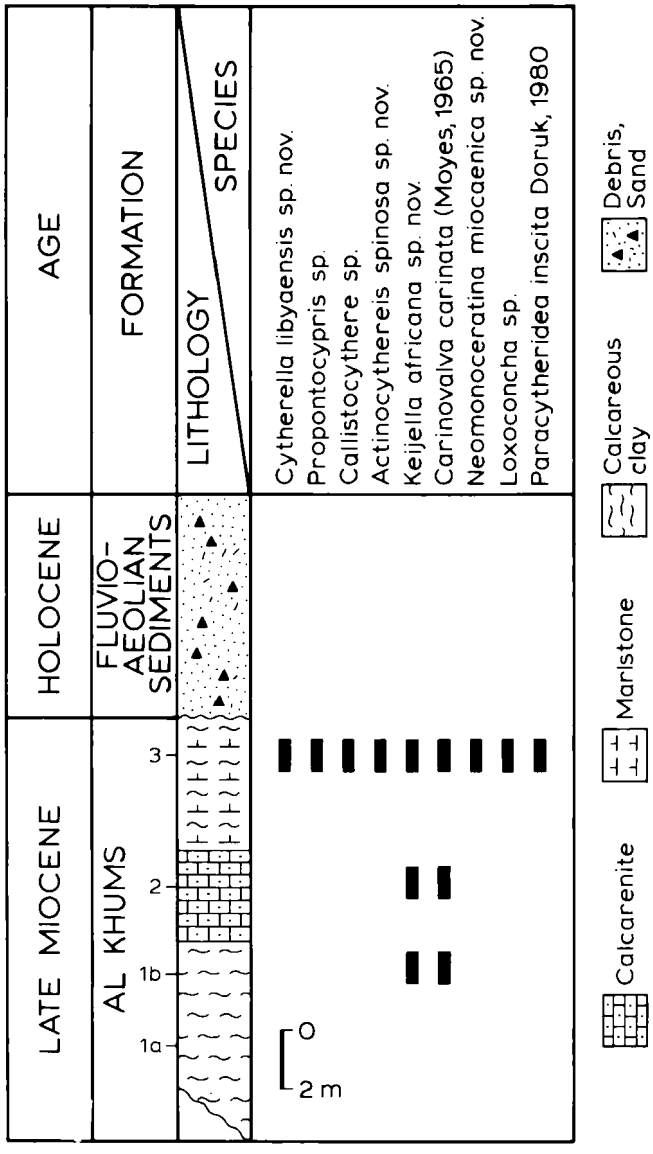


Fig. 2. The exposed section of the Al Khums Formation.

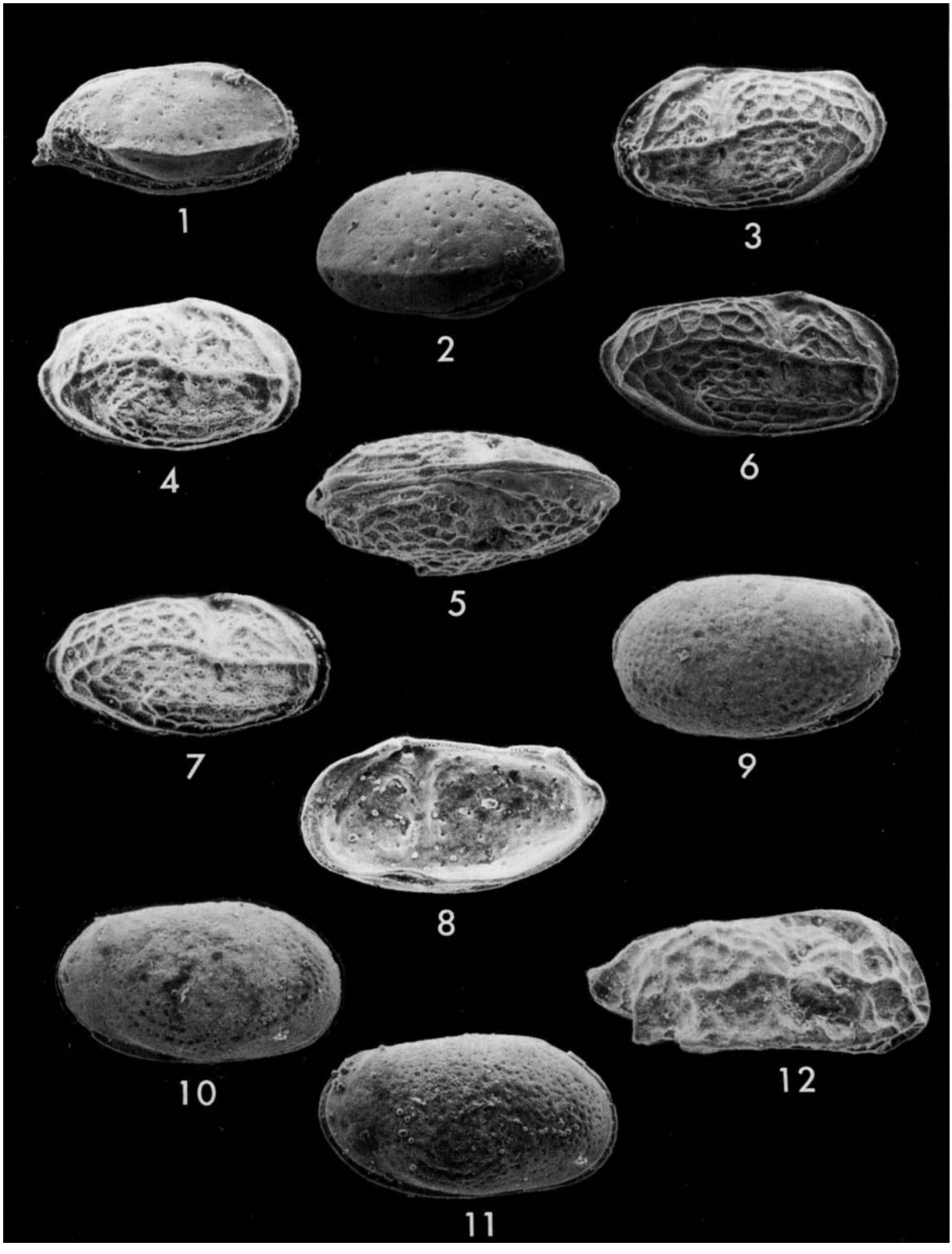
Explanation of Plate 2

Figs 1, 2 *Carinovalva carinata* (Moyes, 1965); fig. 1, male carapace from right, HU.317.T.12 (×79); fig. 2, female carapace from left, HU.317.T.13 (×78).

Figs. 3–8 *Neomonoceratina miocaenica* sp. nov.: fig. 3, holotype, female left valve, HU.317.T.14 (×60); fig. 4, paratype, female right valve, HU.317.T.15 (×66); fig. 5, paratype, male carapace, dorsal view (specimen lost), HU.317.T.16 (×67); fig 6, paratype, male right valve, HU.317.T.17 (×65); fig. 7, paratype, male right valve, HU.317.T.18 (×65); fig. 8, paratype, male right valve, internal view, HU.317.T.19 (×65).

Figs. 9–11. *Loxoconcha* sp.: fig. 9, female, carapace from left, HU.317.T.20 (×70); fig. 10, female, carapace from right, HU.317.T.21 (×68); fig. 11, male, carapace from right, HU.317.T.22 (×69).

Fig. 12. *Paracytheridea inscita* Doruk, 1980, male right valve, HU.317.T.23 (×87).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is a strong straight, horizontal median ridge which ends about one-fifth length from the posterior end. A strong ridge runs from the eye tubercle parallel to the anterior margin and about midway between the anterior and the sub-central tubercle. This rib curves round into an irregular ventral-lateral rib which ends in a rhombic tubercle again ends almost one-fifth length from the posterior marginal thickening, a rather irregular rib which runs near the anterior and roughly parallel to it and an oblique rib parallel to the posterodorsal margin and midway between that margin and the posterior termination of the median rib. The ornamentation is completed by a series of transverse ribs and intervening fossae of variable shape and size.

Dimensions of figured specimen (in μm).

	Length	Height
Left valve, HU.317.T.6.	933	466

Remarks. *Callistocythere* sp. shows some similarities to *Callistocythere mediterranea* (Muller, 1894) figured by Doruk (1980), but the latter differs in having marginal denticulations and different surface ornamentation.

Occurrence. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Family Trachyleberididae Sylvester-Bradley, 1948
Subfamily Trachyleberidinae Sylvester-Bradley, 1948
Genus *Actinocythereis* Puri, 1953
Actinocythereis spinosa sp. nov.
(Pl. 1, figs. 7–9)

Derivation of name. From its marked spines.

Diagnosis. This new species of genus *Actinocythereis* is characterised by its surface ornamentation of blunt spines and by reticulation in the area behind the anterior margin and in the muscle scar area.

Holotype. Left valve, HU.317.T.7; Pl. 1, fig. 7.

Paratype. Left valve, HU.317.T.8; Pl. 1, figs. 8, 9 and one other left valve and one broken right valve (HU.317.T.25.)

Type locality and horizon. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Description. Carapace elongate, subrectangular in lateral view with greatest height at the anterior cardinal angle. Dorsal margin straight, partially obscured by the projecting tubercles. Ventral margin straight, rising slightly posteriorly. Anterior margin broadly rounded with double row of small spines of which the inner series consists of about fourteen tubercles regularly spaced over the anterior marginal rim. The outer series consists of a combination of small nodes and fine denticles which continues along the ventral margin. The posterior margin is subtriangular, slightly pointed in the middle and decorated with small spines. The lateral surface is covered by strong blunt spines and by reticulation in the area behind the anterior margin and in the muscle scar area. Fine nodes occur scattered over the surface, some of them tending to form a longitudinal row over the ventral margin. Eye tubercle is very marked. The muscle scar pattern is clear and consists of vertical row of four adductor scars with U-shaped frontal scar in a pit. The hinge is typical of the genus. Sexual dimorphism was not observed.

Dimensions of figured specimens (in μm).

	Length	Height
Holotype, left valve, HU.317.T.7.	830	384
Paratype, left valve, HU.317.T.8.	825	380

Remarks. This new species of *Actinocythereis* compares closely with *Actinocythereis libyaensis* El-Waer (in press). *A. spinosa* differs in having strong blunt spines on the lateral surface and the area behind the anterior margin covered by reticulations. In addition, it has some similarities to *Actinocythereis ramaniaensis* Khosla & Pant (1981), but the latter species differs in lacking ventral marginal spines and is not reticulate in the area behind the anterior margin.

Occurrence. Only at the type locality: sample 3 of the section 2 km north of Qabilat ash Shurfah.

Genus *Keijella* Ruggieri, 1967
Keijella africana sp. nov.
(Pl. 1, figs. 10–11)

Derivation of name. From its occurrence in north Africa.

Diagnosis. The lateral surface is ornamented by slit-like pits which are distributed longitudinally in the muscle area.

Holotype. Male carapace, HU.317.T.10; Pl. 1, fig. 11.

Paratype. Female carapace, HU.317.T.9; Pl. 1, fig. 10.

Other material. Three carapaces (HU.317.T.26.) from samples 1b and 2.

Type locality and horizon. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Description. Carapace ovate in lateral view, with greatest height at the anterior cardinal angle. Ventral margin straight, curving upwards at the posterior end. Dorsal margin straight but sloping gently posteriorly in the posterior third of its length. Anterior margin symmetrically rounded, decorated by 12 denticles which all lie below two-thirds height. Posterior margin subtriangular, smooth in the upper part and decorated with one pointed spine in the lower part. The lateral surface is ornamented by slit-like pits which are distributed longitudinally in the muscle scar area. The ventral longitudinal slits run from the posterior margin backwards in the posteroventral area. Another series run in a single line just behind the posterior margin. Sexual dimorphism is pronounced, the males being elongate and narrower than the females. No internal details were seen as no single valves were obtained.

Dimensions of figured specimens (in μm).

	Length	Height
Paratype, female carapace, HU.317.T.9.	706	373
Holotype, male carapace, HU.317.T.10.	733	346

Remarks. The present species has some similarities to *Keijella hodgii* (Brady, 1866) as figured by Ruggieri (1967), Doruk (1973) and El-Waer (in press), but the latter differs in that the anterior series of pits run in a single line just behind the anterior margin and the males are less high. *K. africana* is also somewhat similar to *Keijella clauda* Doruk, 1973, but the latter differs in lacking the pits on the lateral surface and the sloping dorsal margin.

Occurrence. In samples 1b, 2 and 3 of the section 2 km north of Qabilat ash Shurfah.

Genus *Carinovalva* Sissingh, 1973
Carinovalva carinata (Moyes, 1965)
(Pl. 1, fig. 12; Pl. 2, figs. 1–2)

1965 *Ruggieria carinata* n. sp. Moyes; 91–93, pl. XI, figs. 10–12.
1969 *Ruggieria (Keija) carinata carinata* (Moyes); Carbonnel; 128–129, pl. 16, figs. 5–8.
1985 *Carinovalva carinata* (Moyes); Carbonel; pl. 95, figs. 6, 7.

Material. Five carapaces.

Dimensions of figured specimens (in μm).

	Length	Height
Male carapace, HU.317.T.11.	511	244
Male carapace, HU.317.T.12.	517	250
Female carapace, HU.317.T.13.	482	282

Remarks. *Carinovalva carinata* (Moyes, 1965) was originally described from the Upper Miocene of the Bay of Biscay and recorded by Carbonnel (1969) from the Rhone Basin. The species is recorded also from the Upper Miocene (Tortonian) of Portugal by Nascimento (1983).

Occurrence. 2 km north of Qabilat ash Shurfah, Late Miocene, samples 1b and 3.

Family Cytheridae Baird, 1850
Subfamily Cytherinae Baird, 1850
Tribe: *Paijenborchellini* Deroo, 1960
Genus *Neomonceratina* Kingma, 1948
Neomonoceratina miocaenica sp. nov.
(Pl. 2, figs. 3–8)

Derivation of name. From its stratigraphic occurrence in the Miocene.

Diagnosis. A species of *Neomonoceratina* characterised by its coarsely punctate to reticulate surface and deep, subcentral vertical sulcus.

Holotype. Female left valve, HU.317.T.14; Pl. 2, fig. 3.

Paratypes. Five specimens, HU.317.T.15–19; Pl. 2, figs. 4–8 and 11 right valves, 12 left valves and five carapaces (HU.317.T.27).

Type locality and horizon. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Description. Carapace subrectangular to subrhomboidal in lateral view, with greatest height at the anterior cardinal angle. Anterior margin broadly and obliquely rounded. Ventral margin fairly straight, slightly convex in the middle, curving upwards posteriorly. Lateral surface with a vertical sulcus which is widest dorsally and dies out above the ventral lateral ridge. The lateral surface is characterised by ridges. The ventrolateral ridge runs parallel to the ventral margin, is slightly alate posteriorly and joins the ventral rib anteriorly. The posterodorsal ridge commences behind the sulcus at above one-third height below the dorsal margin, curves upwards posterodorsally and ends behind the posterior cardinal angle. The median ridge starts from the middle of the ridge parallel to the anterior margin, runs across the median sulcus, and continues to join the inner posterodorsal rib posteriorly. The ventral rib originates from the anterior end of the median ridge, curves down parallel to the ventral margin to the posteroventral corner where it runs into the posterior rib. A small eye tubercle is present. The muscle scar pattern and the hinge are typical of the genus. Sexual dimorphism is marked, the presumed males being more elongate and narrower than the females.

Dimensions of figured specimens (in μm).

	Length	Height
Holotype, female left valve, HU.317.T.14.	650	370
Paratype, female right valve, HU.317.T.15.	570	335
Paratype, male carapace, HU.317.T.16.	680	300
Paratype, male right valve, HU.317.T.17.	660	300
Paratype, male right valve, HU.317.T.18.	700	350
Paratype, male, HU.317.T.19.	660	320

Remarks. The new species is closely comparable with *Neomonoceratina delicata* Ishizaki & Kato, 1976, but the latter has a more smoothly rounded anterior margin and posteroventral spines. *N. miocaenica* is also distinguished from *N. delicata* by its more reticulate surface.

Occurrence. Only at the type locality: sample 3 of the section 2 km north of Qabilat ash Shurfah.

Family Loxoconchidae Sars, 1925
Genus *Loxoconcha* Sars, 1866
Loxoconcha sp.
(Pl. 2, figs. 9–11)

Material. Five carapaces.

Description. Carapace elongate to subovate in lateral view with greatest height at one-third the length. Anterior margin obliquely rounded, posterior margin more narrowly slightly rounded. Dorsal margin nearly straight, sloping gently backwards posteriorly. Ventral margin straight, curved upwards posteriorly. The lateral surface is finely pitted, the pits being arranged in a

concentric pattern around the margins. Sexual dimorphism present, the presumed males being more elongate than the females. No internal details were seen as no single valves were obtained.

Dimensions of figured specimens (in μm)

	Length	Height
Female carapace, HU.317.T.20.	586	333
Female carapace, HU.317.T.21.	600	333
Male carapace, HU.317.T.22.	625	326

Remarks. The present species is compared with *Loxoconcha punctatella* (Reuss, 1850) as figured by Oertli (1956) and El-Waer (in press); the latter differs in having the ventral margin slightly concave in the middle and narrower posterior end.

Occurrence. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

Family Paracytherideidea Puri, 1957
Genus *Paracytheridea* Muller, 1894
Paracytheridea inscita Doruk, 1980
(Pl. 2, fig. 12)

1980 *Paracytheridea inscita* Doruk: 7(25), 143–146.

Material. One right valve.

Dimensions of figured specimens (in μm).

	Length	Height
Male right valve, HU.317.T.23.	536	273

Remarks. *Paracytheridea inscita* Doruk was originally described from the Upper Miocene, Antakya region of Turkey.

Occurrence. 2 km north of Qabilat ash Shurfah, Late Miocene, sample 3.

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