

CRETACEOUS CYTHERELLIDAE FROM KUWAIT

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ABSTRACT

Cytherella species are the most abundant Ostracoda species in the Ahmadi Formation in Kuwait. Five out of the six *Cytherella* species found in this formation are new; these are *C. ahmadiensis*, *C. khalidrazzaki*, *C. iniquiorata*, *C. kuwaitensis*, and *C. arachoides*. Only one new species, *C. posterosulcata*, is found in the base of Gudair Formation above the Middle/Upper Unconformity in southeastern Kuwait. Six out of the seven *Cytherella* species are excellent zone markers.

Two new *Cytherelloidea* species, *C. pachycosmata* and *C. griphota*, are found in the Ahmadi and Mishrif Formations. The systematics of all *Cytherella* and *Cytherelloidea* species are discussed.

INTRODUCTION

The Cretaceous formations, in particular the Middle Cretaceous, bear Kuwait's major oil horizons, and hence their importance. Micropaleontological research is especially important in understanding the geology of Kuwait since the country's topography is featureless, the oldest outcrops being of Tertiary age. Therefore, all paleontologic work on strata older than that age must depend on rock samples from oil wells. Despite the importance of microfossils, the only works carried out on ostracodes from Kuwait are those of Al-Abdul-Razzaq (1979a, b, c). Other relevant studies, carried out on the Arabian Gulf coast areas, are those of Sayyab (1956) and Grosdidier (1973) (see Al-Abdul-Razzaq, 1979a).

Core samples were collected from seven wells in southeastern Kuwait; these are Magwa 8, Magwa 32, Ahmadi 3, Ahmadi 4, Burgan 342, Umm Gudair 1, and Minagish 11, and one well from the north, Sabria 20 (Fig. 1). The samples are from Ahmadi, Rumaila and Mishrif Formations of Cenomanian to ?Turonian age, and the base of Gudair Formation of Santonian age. The detailed work of Owen and Nasr (1958) on the stratigraphic sequence of southeastern Kuwait is adopted in this paper; however, the Ahmadi Formation is divided into two members (Al-Abdul-Razzaq, 1979a). The lower Ahmadi Limestone Member is early Cenomanian in age and the upper Ahmadi Shale Member is of late Cenomanian age. The stratigraphic ranges of *Cytherella* and *Cytherelloidea* species described below are shown in Fig. 2.

The type specimens described in this paper are deposited in the Museum of the Geology Department, Kuwait University, Kuwait.

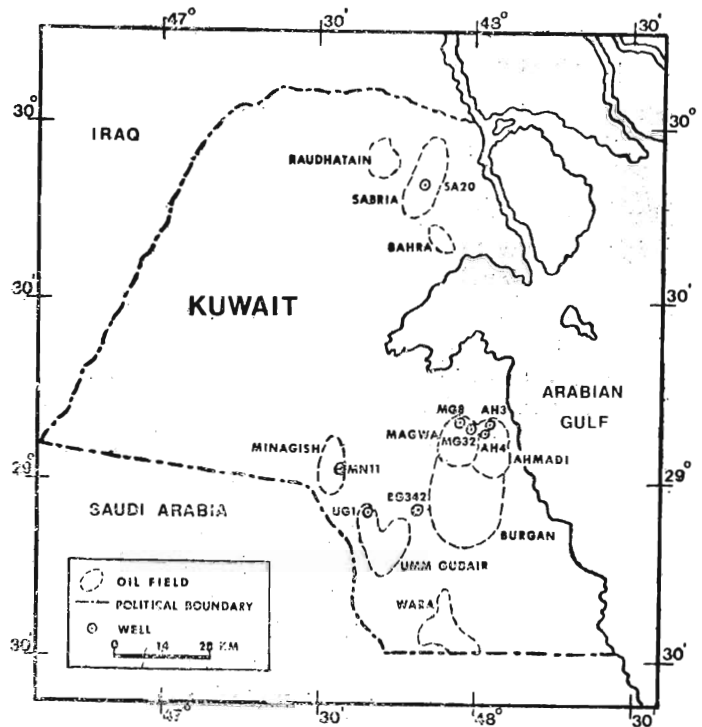


Fig. 1

SYSTEMATIC PALEONTOLOGY

Subclass	Ostracoda LATRIELLE, 1806
Order	Platycopa SARS, 1866
Family	Cytherellidae SARS, 1866
Genus	<i>Cytherella</i> JONES, 1849

Cytherella ahmadiensis sp. nov.

(Pl. I—1-6)

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AGE		FORMATION	<i>Cytherella posterosulcata</i>	<i>Cytherella khalidrazzaki</i>	<i>Cytherelloidea pachycosmata</i>	<i>Cytherelloidea griphota</i>	<i>Cytherella ahmadiensis</i>	<i>Cytherella iniquitata</i>	<i>Cytherella kuwaitensis</i>	<i>Cytherella sulcata</i> Rosenfeld	<i>Cytherella arachoides</i>
Upper Cret.	Santonian	Gudair	Abundant	Rare	Absent						
MIDDLE CRETACEOUS	Turonian	Mishrif									
	?	Rumaila									
	CENOMANIAN	AHMADI	Upper Shale Member								
			Lower Limestone Member								

Fig. 2

Origin of name : From the Ahmadi Formation, in which the species is abundant.

Holotype : An adult female carapace, No. A.1.

Paratypes : Three female carapaces and two valves, No. A.2-A.6 ; three male carapaces, No. A.7-A.9.

Diagnosis : A species of the genus *Cytherella* distinguished by having a very wide carapace in dorsal view (especially the female) ; dorsal border very strongly convex with a hump-like top.

Description : Carapace thick-shelled, large, subovate in lateral view, with smooth surface. Dorsal border strongly arched, bluntly pointed at the top (hump-like), with the posterior slope steeper than the anterior ; anterior slope straight to very gently concave in the right valve, slightly concave in the left valve ; posterior slope gently convex in the female, flattened in the right valve of the male, extending from the dorsal (hump-like) top to the bluntly pointed posterior end. Ventral border strongly convex in the right valve, broad and gently arched in the left valve. Anterior end broad, even and well rounded in both valves ; posterior end narrower and obliquely rounded in the right valve, the margin projecting beyond the left valve, obtusely angled at about mid-height, the border convex in the lower half and flatter in the upper half ; posterior end in the left valve broad and well rounded. Greatest height of carapace at or just behind mid-length and approximately equal to two-thirds of the length ; in dorsal view the carapace very wide and sub-

oval, strongly inflated in the posterior half, especially in the female, slightly compressed along the posterior marginal area in the male. Greatest width at about two-thirds of the length postero-centrally. Right valve much larger than the left, conspicuously extending over the entire margin, strongest overlap along the middle of the dorsal, posterior, and ventral margins. Hinge simple, consisting of a groove along the edge of the contact margin of the larger right valve, almost paralleling the border of the valve except along the mid-dorsal hump-like top ; left valve hinging complementing that of the right, consisting of a ridge along the margin. Internal area of the valves divided into two subequal cavities, the anterior one very much shallower and slightly longer, with the feather-shaped muscle scars at the posterior end of it and just above mid-height ; most specimens showing an oblong raised surface instead of the muscle scars.

<i>Dimensions (in mm) :</i>	Length	Height
Male	0.84 - 0.88	0.58 - 0.61
Female	0.90 - 0.95	0.63 - 0.67

Sexual dimorphism : Female carapace larger and higher than male, much wider and very strongly inflated, especially posteriorly.

Remarks : Even though *Cytherella ahmadiensis* is one of the most common species in the Ahmadi Formation and is found in great numbers in the samples from the Greater Burgan Field, and also from the Sabria Field (Well : SA No. 20) in northern Kuwait, Sayyab (1956) did not record the existence of this species in his samples from the Middle or Upper Cretaceous of the Arabian Gulf coast. This species is not found in the Mishrif or Gudair Formations of ? Turonian and Santonian age respectively.

Type locality : Ahmadi Field, southeastern Kuwait, Ahmadi 3 well.

Type stratum : Ahmadi Formation, depth 1329 m (4360 ft.).

Stratigraphic range : Cenomanian.

Cytherella khalidrazzaki sp. nov.

(Pl. II—1-6)

Origin of name : In honour of my father, Khalid Al-Abdul Razzak, for his love, devotion, and encouragement.

Holotype : An adult female carapace, No. A.10.

Paratypes : Three female carapaces and three valves, No. A.11-A.16 ; two male carapaces, No. A.17, A.18.

Diagnosis : A *Cytherella* species characterized by having the dorsal half of the posterior margin of right valve thicker and more projected than that of left valve, forming an edge-like projection.

Description : Carapace large, elongate suboval in lateral view, surface smooth. Dorsal border arched and angular at about the middle, especially in the right valve, with a straight anterior and posterior slope; the latter slightly longer and steeper; the angular point of the left valve lower than that of the right valve and behind it. Ventral border moderately arched in the right valve, broad and gently arched in the left valve. Anterior end broad, well and evenly rounded; posterior end narrower and obliquely rounded, sharply curved at its dorsal half, flatter ventrally; dorsal half of posterior margin of right valve thicker and more projected than that of left valve, forming an edge-like projection better seen in posterior view (this feature more pronounced in male carapaces). Greatest height at about mid-length at the angulated area of the dorsal margin; in dorsal view, valves convex, the greatest width at about the middle of the carapace, tapering towards the ends with the anterior end more compressed than the posterior. Right valve larger and projecting over the left around the periphery. Hinge primitive, the right valve with a narrow groove running along the inner margin and almost parallel to it; left valve with corresponding thin and rounded ridge. Central muscle scars typical of the genus, feather-shaped, situated on a slightly elevated area, suboval in outline, just in front of mid-length and subdorsal; scars consisting of two curved rows with six elements in the front row and five in the back one.

<i>Dimensions (in mm)</i> :	Length	Height
Male	0.85 - 0.89	0.54 - 0.58
Female	0.86 - 0.90	0.56 - 0.60

Sexual dimorphism : Females wider than males.

Remarks : Forms of *Cytherella khalidrazzaki* are found associated with *Cytherella ahmadiensis* in the Ahmadi Formation of Cenomanian age, and is one of the most common species in the formation, especially in the lower Ahmadi Limestone Member. It is also found in the upper Tuba Limestone in the Ahmadi Formation in the Sabria Field (Well : SA No. 20) in northern Kuwait. Unlike *C. ahmadiensis*, it occurs in the Mishrif Formation of ? Turonian age, but not as abundantly as in the Ahmadi Formation.

Type locality : Ahmadi Field, southeastern Kuwait, Ahmadi 3 well.

Type stratum : Ahmadi Formation, depth 1329 m (4360 ft.).

Stratigraphic range : Cenomanian—? Turonian.

Cytherella sulcata ROSENFELD 1974
(Pl. II—7)

1959 Ostracode U-10; Glintzboeckel and Magné, Pl. 3, fig. 31.

1968 *Cytherella* ? U-10 (Glintzboeckel and Magné) Grekoff, p. 223, Pl. 1, fig. 6.

1973 *Cytherella* U-10 Glintzboeckel and Magné Grosdidier, Pl. 1, figs 2a-c.

1974 *Cytherella sulcata* Rosenfeld, in Rosenfeld and Raab, p. 5, Pl.1, figs. 6-8; Pl. 4, figs. 1,2

1979 *Cytherella sulcata* Rosenfeld, Al-Abdul-Razzaq, p. 243, Pl. 1, figs. 1-7.

Illustrated specimens : One female carapace, No. M. 19.

Remarks : *Cytherella sulcata* Rosenfeld is an excellent zone marker in the Arabian Gulf area. This species has a wide geographic distribution (see Al-Abdul-Razzaq, 1979c) and secures the age determination as Cenomanian to the lower part of the Ahmadi Formation. Sayyab (1956) found this species in his samples from the eastern coast of the Arabian Gulf.

Locality : Magwa Field, southeastern Kuwait, Magwa 8 well.

Stratum : Ahmadi Formation, depth 1285 m (4215 ft.).

Stratigraphic range : Lower Cenomanian.

Cytherella posterosulcata sp. nov.
(Pl. III—1-4)

Origin of name : From the Latin *posterior* ("rear") and *sulcus*, m. ("furrow"), referring to the horizontal depression in the postero-central area of the valves.

Holotype : An adult female carapace, No. B. 28.

Paratypes : Three female carapaces and two valves, No. B.29-B.33; two male carapaces, No. B.34, B.35.

Diagnosis : A *Cytherella* species distinguished by its postero-central sulcus and small rounded depression just below the middle of the dorsal margin on the right valve.

Description : Shell thick-walled, carapace medium to large, surface smooth. In lateral view, left valve with an elongate oval outline, the right valve subovate. Greatest height just behind mid-length in the female, at about the middle in the male. Dorsal border arched in the right valve, obtusely angular at the point where the nearly straight anterior and posterior slopes meet; this angular point just behind the mid-length in the female carapace, at about the middle in the male. Dorsal border of left valve slightly sinuate, gently concave in the anterior half (stronger in the female), slightly convex in the posterior half in the female (flatter in the male); ventral border moderately arched in the right valve of the female, broader in the male; almost straight in the left valve in both sexes. Anterior and posterior ends well and evenly rounded, subequal in the left valve, the posterior border in the right valve slightly truncated ventrally and produced into a very bluntly pointing angle at about mid-height. In dorsal view, the greatest width in the posterior half, postero-central; left valve differing markedly from the right, the right valve outline almost straight but the left inflated in the posterior half of the female, less so in the male valve. In lateral view of right valve, a longi-

tudinal shallow median sulcus running in the postero-central area, deeper posteriorly; and a small rounded depressed area just under the obtusely angular point of the dorsal margin. Right valve larger and strongly overlapping the left along the entire margin especially along the middle of the dorsal and the ventral margins in both sexes, and also along the posterior margin in the female. Internal feature typical of those of the genus.

Dimensions (in mm) :	Length	Height
Male	0.69 - 0.74	0.40 - 0.44
Female	0.68 - 0.74	0.45 - 0.49

Sexual dimorphism : The female is higher and much wider than the male; the posterior half of the female left valve inflated, whereas that of the male gently convex, widest at the middle. Ventral border of the female right valve more arched than that of the male.

Remarks : *Cytherella posterosulcata* is the only *Cytherella* species that occurs at the base of the Upper Cretaceous in the Greater Burgan Field, with no trace of it in the Mishrif and Ahmadi Formations of ? Turonian and Cenomanian age respectively.

Cytherella posterosulcata differs markedly from the other species of the genus described above except for *C. sulcata* Rosenfeld (1974). These two species resemble each other in general outline and the presence of a median sulcus. However, they can be easily distinguished: the posterior end of *C. sulcata* is much more truncated ventrally and dorsally than is *C. posterosulcata*, and it is produced into a subdorsal point. The median sulcus in the right valve is stronger in Rosenfeld's species than in *C. posterosulcata*, the latter species has a small rounded depressed area just under the angular point of the dorsal border, which is lacking in *C. sulcata*. Moreover, the margins of *C. sulcata* are wider and much more angular.

The hinge of *Cytherella posterosulcata* does not have the tooth-like projection on the dorsal part of the left valve ridge or the corresponding socket-like depression in the groove of the right valve, such as is present in *C. sulcata*.

Type locality : Burgan Field, southeastern Kuwait, Burgan 342 well.

Type stratum : Gudair Formation, depth 1326 m (4350 ft.).

Stratigraphic range : Santonian.

Cytherella kuwaitensis sp. nov.

(Pl. IV—1-6)

Origin of name : Named for the country of Kuwait in which the species was discovered.

Holotype : An adult female carapace, No. A. 36.

Paratypes : Three female carapaces and two valves, No. A.37-A.41; three male carapaces and one valve, No. A.42-A.45.

Diagnosis : A species of *Cytherella* with the following

characteristics: the posterior margin of the right valve wide and strongly projecting, it also has a sharp edge, vertical in lateral view.

Description : Carapace medium in size, surface smooth, elongate-suboval in lateral view. Greatest height at about mid-length. Dorsal and ventral borders arched in the right valve with the dorsal border angular at about the middle (angle higher and stronger in the female), posterior slope steeper than the anterior; the subdorsal marginal area just in front of the middle depressed in both valves; ventral border broadly and evenly arched (more or less straight in the male); however, dorsal and ventral borders subparallel in the left valve, with the former slightly concave anteriorly, gently convex posteriorly, and the latter straight. Anterior end even and well rounded in both valves, the posterior end narrower and truncated ventrally, bluntly pointed at a subdorsal angle; posterior margin of the right valve wide and projecting strongly, posteriorly forming a sharp edge (best seen in posterior view), the edge vertical in lateral view. In dorsal view, carapace elongate-subrectangular, with greatest width slightly behind the middle of the carapace but not very much greater than the average width of the carapace, width subequal throughout the length. Right valve larger than left and overlapping it around the entire margin, greatest overlap along the dorsal angulation and the middle of the ventral margin. Hinge in the right valve consisting of a groove along the inner margin almost parallel to the border; left valve with a complementary rounded ridge. Central muscle scars clearly observed in few left valves typical of the genus.

Dimensions (in mm) :	Length	Height
Male	0.62 - 0.64	0.34 - 0.37
Female	0.64 - 0.68	0.41 - 0.43

Sexual dimorphism : Female carapace slightly higher and wider than that of the male, dorsal border of female angular at about the middle and the posterior marginal projection more pronounced in the female.

Remarks : *Cytherella kuwaitensis* differs from known *Cytherella* species in its peculiar projected posterior margin in the right valve. Even though Grosdidier (1973, Pl. 1, figs. 3a-d, 4a-c, 5a-b), illustrated a few species from the coastal Fars Province of Iran with this character, ranging in age from Albion to Santonian, none of them is the same as this species. In lateral view, the posterior margin is very strongly projecting into a bluntly pointing angle in Grosdidier's species, whereas the posterior edge is vertical in *Cytherella kuwaitensis*.

This species occurs in the lower Ahmadi Limestone Member but neither in the upper Ahmadi Shale Member nor in the Mishrif Formation. Sayyab (1956) found identical forms in the Middle Cretaceous of the Arabian Gulf coast. Although this species was found in large

numbers, it is still less abundant than *Cytherella ahmadiensis* and *C. khalidrazzaki*.

Type locality : Ahmadi Field, southeastern Kuwait, Ahmadi 3 well.

Type stratum : Ahmadi Formation, depth 1329 m (4350 ft.).

Stratigraphic range : Lower Cenomanian.

Cytherella iniquiorata sp. nov.

(Pl. IV—7-10)

Origin of name : From the Latin *iniquus* ("unequally") and *ora*, f. ("border, rim"), referring to the unequal bordering by a rim on the margin of the valves.

Holotype : An adult carapace, No. M. 46.

Paratypes : Five adult carapaces, No. M.47-M.51.

Diagnosis : A *Cytherella* species with a rim running along the anterior margin of the left valve ; a shallow longitudinal depression situated in the central area just below the dorsal margin of each valve.

Description : Carapace small, surface smooth, elongate-oval-subrectangular in lateral view, greatest length at about the middle of the valves and greatest height subequal throughout the length. Carapace wedge-shaped in dorsal and ventral views, greatest width near the posterior margin, tapering anteriorly ; a shallow longitudinal depression situated just below the central part of the dorsal margin of each valve, best seen in dorsal view. Dorsal and ventral borders sub-parallel ; the former straight in the right valve, very gently sinuate in the left valve with the anterior portion slightly concave and the posterior portion slightly convex ; ventral border very, very gently concave in both valves. Anterior and posterior ends subequal, broad and evenly rounded in both valves except for a slightly oblique truncation at the ventral part of the posterior end of the left valve. Left valve rimmed along its anterior margin. Right valve larger and overlapping the left around the entire periphery with slightly stronger overlap at the anterior half of the dorsal border and along the ventral border. Internal features typical of the genus.

<i>Dimensions (in mm) :</i>	Length	Height
	0.51 - 0.54	0.26 - 0.28

Sexual dimorphism : None observed.

Remarks : *Cytherella iniquiorata* resembles *C. lebanonensis* Howe (1951, p. 3, Pl. 1, figs. 11, 12) from the Middle Eocene of Florida, U.S.A., and also reported from the Early Eocene of West Pakistan by Sohn (1959, p. 59, Pl. 1, figs. 10-12). However, this species differs from Howe's in having a shallow and narrow longitudinal depression paralleling the dorsal margin.

Cytherella iniquiorata is rare in the Ahmadi Formation of Cenomanian age.

Type locality : Magwa Field, southeastern Kuwait, Magwa 8 well.

Type stratum : Ahmadi Formation, depth 1278 m (4195 ft.).

Stratigraphic range : Cenomanian.

Cytherella arachoides sp. nov.

(Pl. III—5-10)

Origin of name : From the Greek *arachos*, m. (*Arachis*, the genus of the peanut) and *-oides* ("like"), referring to the peanut-shaped outline of the carapace in dorsal and ventral views.

Holotype : An adult carapace, No. A.52.

Paratypes : Three carapaces and two valves, No. A.53-A.57.

Diagnosis : A *Cytherella* species characterized by shallow and very broad depression in the central dorsal and central ventral areas, giving the carapace a bilobate (peanut-shaped) aspect in dorsal view.

Description : Shell thick-walled, carapace medium in size, its surface smooth to finely punctate. In lateral view, carapace oval, with greatest height behind the middle and greatest length above mid-height. Dorsal border very broadly arched in right valve, truncated posteriorly ; convex in the posterior half of the left valve and more or less straight in the anterior half ; ventral border nearly straight. Anterior end broad, well and evenly rounded ; posterior end broadly rounded in the left valve and slightly truncated ; truncation much stronger in the right valve, both in the dorsal and ventral portions of the posterior end, with an obtusely pointed termination above mid-height. Central dorsal and central ventral areas marked with a shallow and very broad depression, giving the carapace a bilobate (peanut-shaped) aspect in dorsal and ventral views ; greatest width through the central part of the posterior half. Right valve overlapping the left, conspicuously along the dorsal, ventral, and dorsal parts of the posterior margins. Hinge simple, consisting of a strong and thick ridge running parallel to the margin in the left valve ; right valve hinge consisting of a groove complementing the ridge of the opposite valve. Muscle scars not observed.

<i>Dimensions (in mm) :</i>	Length	Height
	0.65 - 0.69	0.39 - 0.42

Sexual dimorphism : Female carapace wider than that of male.

Remarks : High magnification of the shell surface shows that the wall is composed of two very porous layers (Pl. 3, fig. 10, magnified $\times 10,000$). Unlike other *Cytherella* species described above, *Cytherella arachoides* occurs in the upper Ahmadi Shale Member only. No trace of the species is found in either the lower Ahmadi Limestone Member or the Mishrif Formation,

Type locality : Ahmadi Field, southeastern Kuwait, Ahmadi 4 well.

Type stratum : Ahmadi Formation, depth 1170 m (3840 ft.).

Stratigraphic range : Upper Cenomanian.

Cytherelloidea pachycosmata sp. nov.
(Pl. V—1-5)

Origin of name : From the Greek *pachys* ("heavy, stout, thick") and *kosmos*, m. ("ornamentation"), referring to the heavy ornamentation of ridges and reticulations.

Holotype : An adult male carapace, No. M. 58.

Paratypes : Three male carapaces, No. M.59-M.61 ; three female carapaces, No. M.62-M.64.

Diagnosis : A species of the genus *Cytherelloidea* distinguished by a sub-marginal ridge running along the free margin but subdorsal, a subdorsal depression.

Description : Carapace subrectangular (curved corners) in lateral view. Posterior and anterior ends broadly rounded, subequal in the female, but the posterior narrower in the male. Anterior end evenly and well rounded, the posterior end truncated ventrally. Dorsal and ventral margins parallel in the female, but subparallel in the male ; dorsal margin almost straight, slightly sloping posteriorly ; ventral margin straight in the female, concave in the male (concave in the middle and convex at both ends). Greatest height sub-equal throughout the length in the female, anterior in the male. Valves not inflated, the greatest width posterior in both sexes, but females wider than males. Right valve larger, extending over the left around the entire margin, strongest overlap along dorsal and ventral margins. Right valve rimmed around the entire margin, the left only anteriorly.

Ornamentation consisting of a network of fine to medium reticulations covering the entire surface of the carapace (with no particular pattern) except for the ridges and the subcentral depression. The depression smooth, low, and lying in the dorsocentral area. Submarginal ridge consisting of four ridges connected to one another, three running along the free margin and the fourth extending below the dorsal margin (subdorsal). The antero-marginal ridge extending from the anterodorsal corner paralleling the anterior margin, broad at the base and narrower at the crest, joining the ventral ridge running along the ventral border (narrower than the former ridge), curving upward and connected to the posterior ridge. In the female, two knobs in the posterior area (one posterodorsal, the other posteroventral), separated but linked to each other by the posterior ridge (which fades away posterodorsally). In the male, the posterior ridge a little higher and stronger than the other ridges, paralleling the border and reaching the posterodorsal corner, bending nearly at right angle and connected to

a narrower subdorsal ridge ; the latter extending almost parallel to the dorsal margin and below it, curving around and above the subdorsal depression and ending anteriorly without reaching the anteromarginal ridge ; in the female, the subdorsal ridge connected to the postero-dorsal knob. A subventral ridge, convex, lying above the ventral ridge and connected to the posteroventral knob in the female, not connected to the posterior ridge in the male. A short curved ridgelet lying between the subventral ridge and the subdorsal depression ; a branching ridgelet extending obliquely in the central anterior area, connected anteriorly to the subdorsal ridge in some specimens.

Only one right valve of a male (broken posteriorly) studied ; the hinge primitive, consisting of a narrow and shallow groove around the periphery, stronger on the dorsal margin. No muscle scars seen.

<i>Dimensions (in mm)</i> :	Length	Height
Male	0.46 - 0.52	0.22 - 0.27
Female	0.51 - 0.55	0.26 - 0.29

Sexual dimorphism : Very prominent, the female slightly larger than the male and possessing two knobs posteriorly (brood pouches, one posterodorsal and the other posteroventral) ; the posterior end narrower in the male.

Remarks : *Cytherelloidea* IRD₂₆ illustrated by Grosdidier (1973, Pl. 2, figs. 9a-c) from the Lower Aptian of the coastal Fars Province of Iran looks similar to the females of *Cytherelloidea pachycosmata*. Also *Cytherelloidea* sp. 1 found by Rosenfeld and Raab (1974, p. 5, Pl. 1, figs. 11, 12) in the Upper Cenomanian of Palestine seems to resemble the males of this species. However, surfaces of both of the species of Grosdidier and Rosenfeld and Raab are not reticulated as in the new species.

Cytherelloidea pachycosmata resembles *C. btaterensis* Bischoff (1964, p. 17, Pl. 2, figs. 16, 17 ; Pl. 3, figs. 18, 19) found in Lebanon, ranging from Upper Aptian to Middle Albian. Bischoff's species is larger and differs in having about twenty irregularly dispersed and unequal little nodes, the sub-ventral ridge not connected to the posteroventral knob in the female, no ridgelets in the inner field but a ridgelet-like structure formed by three small nodes, and reticulations covering the inner field ridges and the base of the marginal ridges. This species seems related to both *C. retiuclata* Alexander (1929, p. 59, Pl. 2, fig. 11) of the Lower Cretaceous of Texas and *C. vimali* Jain (1975, p. 200, Figs. 1E-H, 3C-D) from the Upper Cretaceous of South India. These two species differ from *C. pachycosmata* mainly in having a dorsal ridge along the border ; moreover, Jain's species lack a posterior ridge.

This species is rare in the Ahmadi Formation and Mishrif Formation of Cenomanian and ? Turonian age

respectively. It is also present in Well : SA No. 20 in the Sabria Field in northern Kuwait.

Type locality : Magwa Field, southeastern Kuwait, Magwa 8 well.

Type stratum : Ahmadi Formation, depth 1282 m (4205 ft.).

Stratigraphic range : Cenomanian—? Turonian.

Cytherelloidea griphota sp. nov.

(Pl. V—6-10)

Origin of name : From the Greek *griphos*, m. ("a woven fishing basket, a network"), referring to the ornamentation.

Holotype : An adult female carapace, No. A.68.

Paratypes : One female carapace, No. A.69 ; three male carapaces, No. A.65-A.67.

Diagnosis : A species of *Cytherelloidea* distinguished by a network of coarse reticulations covering the surface of the carapace except the subdorsal depression, which in dorsal view appears to subdivide the carapace into two subequal parts.

Description : Carapace elongate subovate to subrectangular in lateral view. Right valve larger and overlapping the left around the entire margin ; right valve, but not the left, with a rim around the periphery. Greatest height anterior in the male but subequal throughout the length in the female. Dorsal and ventral margins subparallel ; dorsal margin in male straight to slightly arched in the anterior half, sloping posteriorly, but in the female straight but truncated posteriorly ; ventral margin slightly concave in the middle but gently convex at the ends, curving into the anterior and posterior ends. Anterior and posterior ends broadly rounded, the latter narrower in the male, subequal in the female, with the dorsal portion of the posterior end truncated. Surface of carapace, except the subdorsal depression, covered with a network of coarse reticulations with thick elements forming the meshes ; reticulations stronger in some specimens than others and even differing in strength in the same carapace. The smooth subdorsal depression very distinct and lying just above mid-height in the central area of the valve. In the female, two separated large rounded knobs (brood pouches) occupying the posterior area, one posterodorsal and the other posteroventral. In dorsal view, carapace laterally compressed at both anterior and posterior ends in the male, but only at the anterior end in the female. Subdorsal depression subdividing the carapace into two distinct halves ; greatest width through the posterocentral area in the male but at the posterior end in the female. Internal features not observed.

<i>Dimensions (in mm) :</i>	Length	Height
Male	0.49 - 0.51	0.24 - 0.26
Female	0.50 - 0.53	0.25 - 0.28

Sexual dimorphism : Distinct, females with two posterior knobs (brood pouches, one posterodorsal, the other posteroventral) occupying the whole posterior area ; males with narrower posterior end.

Remarks : *Cytherelloidea griphota* resembles *C. besrineensis* Bischoff (1964, p. 15, Pl. 3, figs. 21, 22) from the Lower Cretaceous of Lebanon. However, this species has a subcentral depression which is more distinct in both lateral and dorsal views, and in the dorsal view the depression appears to subdivide the carapace into two parts. In addition, the surface of this species is covered with coarse reticulations, irregularly arranged, the network composed of thick elements forming the meshes, while Bischoff's species had ridgelet reticulations paralleling the free border but not the dorsal border and the meshes range from polygonal to elongate.

This species is present in the Ahmadi and Mishrif Formations of Cenomanian and ? Turonian age respectively.

Type locality : Ahmadi Field, southeastern Kuwait, Ahmadi 3 well.

Type stratum : Ahmadi Formation, depth 1329 m (4360 ft.).

Stratigraphic range : Cenomanian- ? Turonian.

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EXPLANATION OF PLATES

(All figures are scanning electron micrographs)

PLATE I

- 1-6 *Cytherella ahmadiensis* sp. nov. 1, right lateral view of female carapace, paratype No. A.2, $\times 100$; 2, left lateral view of female carapace, holotype No. A.1, $\times 100$; 3, interior view of female left valve, paratype No. A.5, $\times 100$; 4, interior view of female right valve, paratype No. A.6, $\times 100$; 5, dorsal view of female carapace, paratype No. A.3., $\times 100$; 6, left lateral view of male carapace, paratype No. A.7, $\times 100$.

PLATE II

- 1-6 *Cytherella khalidrazzaki* sp. nov. 1, right lateral view of female carapace, paratype No. A.11, $\times 100$; 2, left lateral view of female carapace, holotype No. A.10, $\times 100$; 3, interior view of female left valve, paratype No. A.13, $\times 100$; 4, central muscle scars in female left valve, paratype No. A.13, $\times 300$; 5, interior view of female right valve, paratype No. A.14, $\times 100$; 6, dorsal view of male carapace, paratype No. A.17, $\times 100$.
- 7 *Cytherella sulcata* Rosenfeld, left lateral view of female carapace, No. M.19, $\times 150$.

PLATE III

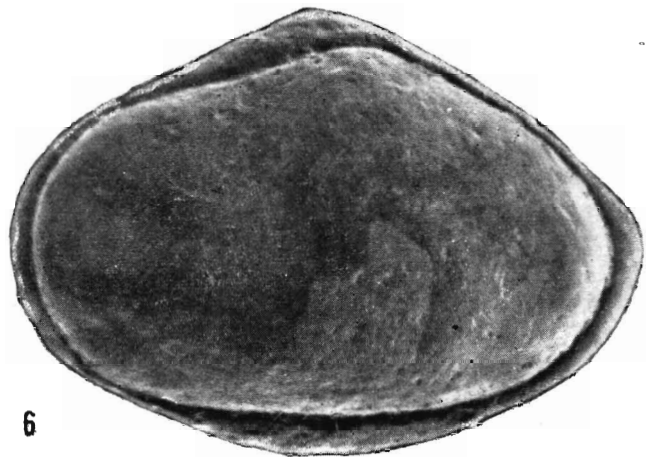
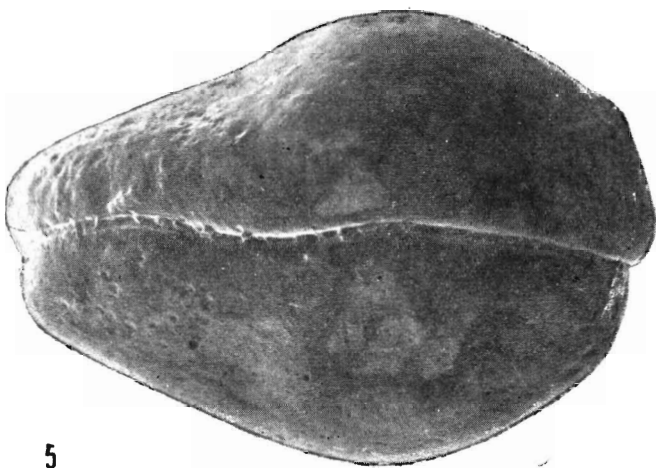
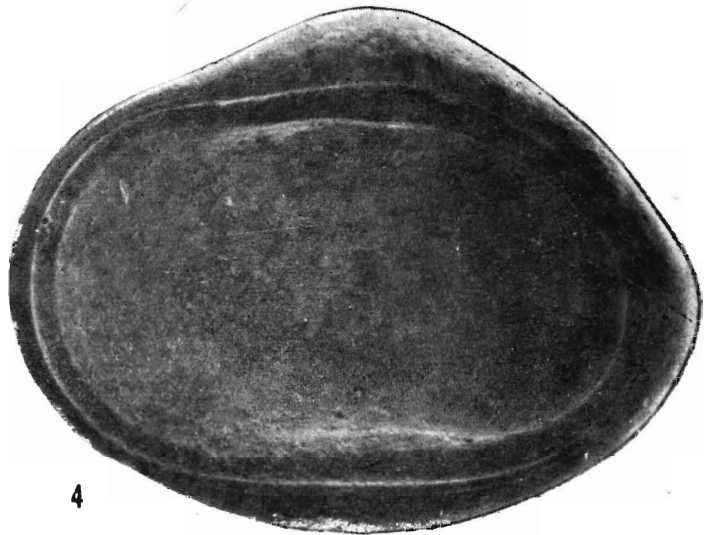
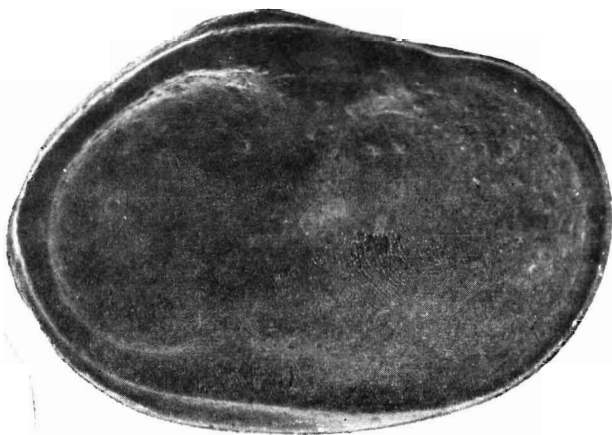
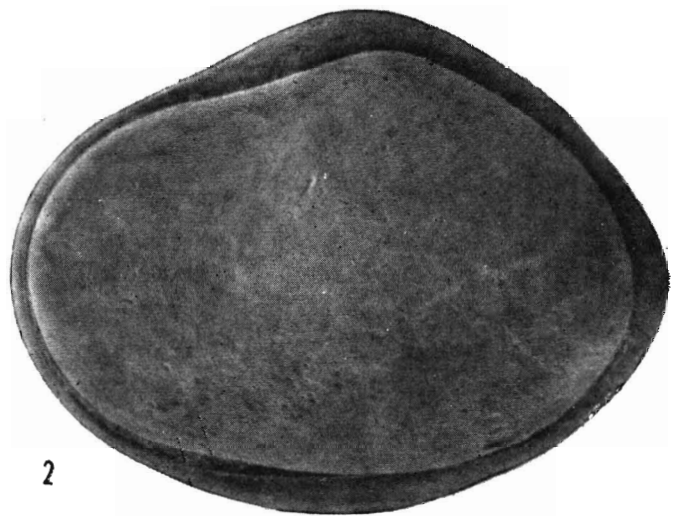
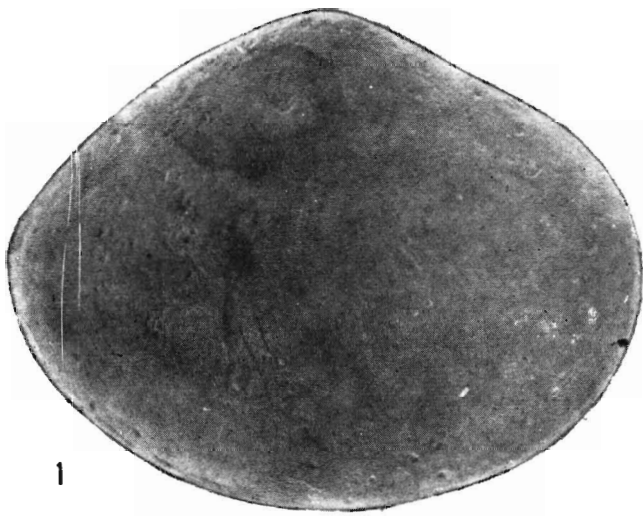
- 1-4 *Cytherella posterosulcata* sp. nov. 1, right lateral view of female carapace, paratype No. B.29, $\times 120$; 2, left lateral view of female carapace, holotype No. B.28 $\times 120$; 3, ventral view of female carapace, paratype No. B.31, $\times 120$; 4, dorsal view of female carapace, paratype No. B.30, $\times 120$.
- 5-10 *Cytherella arachoides* sp. nov., 5, right lateral view of female carapace, paratype No. A.53, $\times 100$; 6, left lateral view of female carapace, holotype No. A.52, $\times 100$; 7, interior view of female right valve, paratype No. A.56, $\times 100$; 8, dorsal view of male carapace, paratype No. A.55, $\times 100$; 9, interior view of female left valve, paratype No. A.57, $\times 100$; 10, exterior shell surface showing wall composed of two porous layers, paratype No. A.57, $\times 10,000$.

PLATE IV

- 1-6 *Cytherella kuwaitensis* sp. nov., 1, right lateral view of female carapace, paratype No. A.37, $\times 120$; 2, left lateral view of female carapace, holotype No. A.36, $\times 120$; 3, left lateral view of male carapace, paratype No. A.43, $\times 120$; 4, ventral view of female carapace, paratype No. A.39, $\times 120$; 5, interior view of female left valve, paratype No. A.40, $\times 120$; 6, interior view of female right valve, paratype No. A.41, $\times 120$.
- 7-10 *Cytherella iniquiorata* sp., nov. 7, right lateral view of adult carapace, paratype No. A.47, $\times 120$; 8, left lateral view of adult carapace, holotype No. M.46, $\times 120$; 9, ventral view of adult carapace, paratype No. M.49, $\times 120$; 10, dorsal view of adult carapace, paratype No. M.48, $\times 120$.

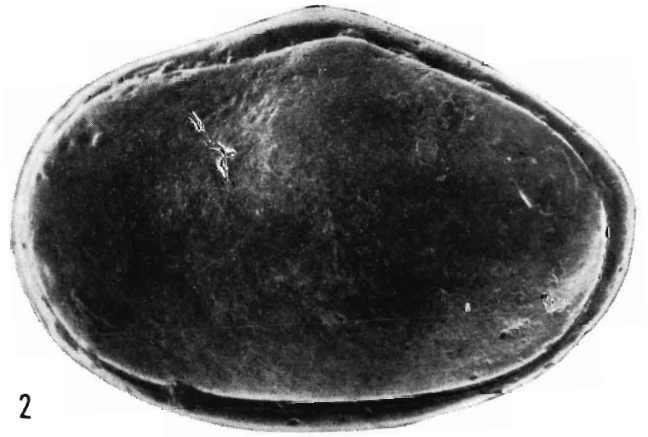
PLATE V

- 1-5 *Cytherelloidea pachycosmata* sp. nov. 1, left lateral view of male carapace, holotype no. M. 58, $\times 160$; 2, left lateral view of female carapace, paratype No. M. 63, $\times 160$; 3, right lateral view of male carapace, paratype no. M.59, $\times 160$; 4, ventral view of female carapace, paratype No. M.64 $\times 160$; 5, ventral view of male carapace, paratype No. M.61, $\times 160$.
- 6-10 *Cytherelloidea griphota* sp. nov. 6, right lateral view of male carapace, paratype No. A.67, $\times 160$; 7, left lateral view of male carapace, paratype No. A.65, $\times 160$; 8, dorsal view of male carapace, paratype no. A.66 $\times 160$; 9, dorsal view of female carapace, paratype No. A.69, $\times 160$; 10, left lateral view of female carapace, holotype No. A.68, $\times 160$.

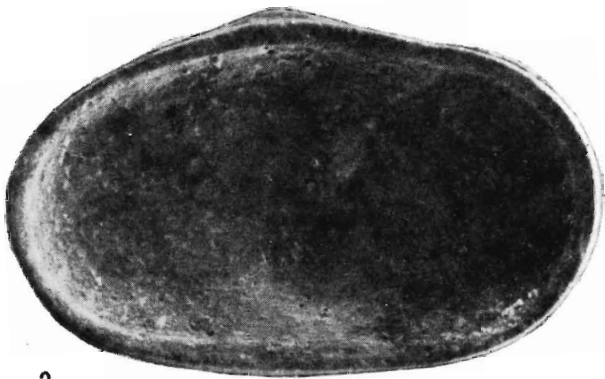




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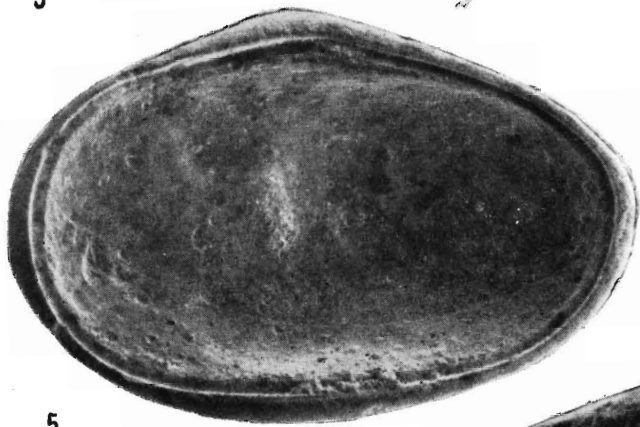
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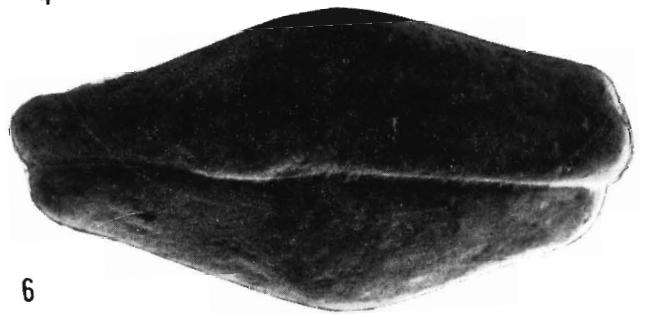
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