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BIOSTRATIGRAPHIC AND PALEOECOLOGIC ANALYSIS OF OSTRACODE ASSEMBLAGES FROM LATE PALEOCENE AND EARLY EOCENE SEDIMENTARY ROCKS, CORE UAK-5, GANJO TAKKAR INLIER, SINDH PROVINCE, PAKISTAN

by

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ABSTRACT

One hundred and forty-one species of ostracodes representing 45 genera were identified from upper Paleocene and lower Eocene sedimentary rocks in core UAK-5. The core was taken southwest of Ganjo Takkar, an inlier south of Hyderabad, southern Sindh Province. The 400 m core contains rocks from the upper part of the Bara Formation, the Lakhra Formation, the Sohnari Formation, and most of the Laki Formation (here including the Meting Limestone and Meting Shale Members). Five ostracode assemblage zones are recognized based on the stratigraphic ranges of the species. Major changes in the ostracode fauna are indicated near the top of the Lakhra, in the basal part of the Meting Limestone, and just above the base of the Meting Shale. The Meting Shale has the highest species diversity and abundance, and is interpreted to represent normal marine salinity and deeper inner to middle shelf water depths. The Meting Limestone has the next highest species diversity and abundance, and is interpreted to represent normal marine salinity and middle shelf water depths. The Lakhra and fossiliferous horizons in the upper part of the Bara show moderate species diversity and abundance, and are interpreted to represent normal marine salinity and inner shelf water depths.

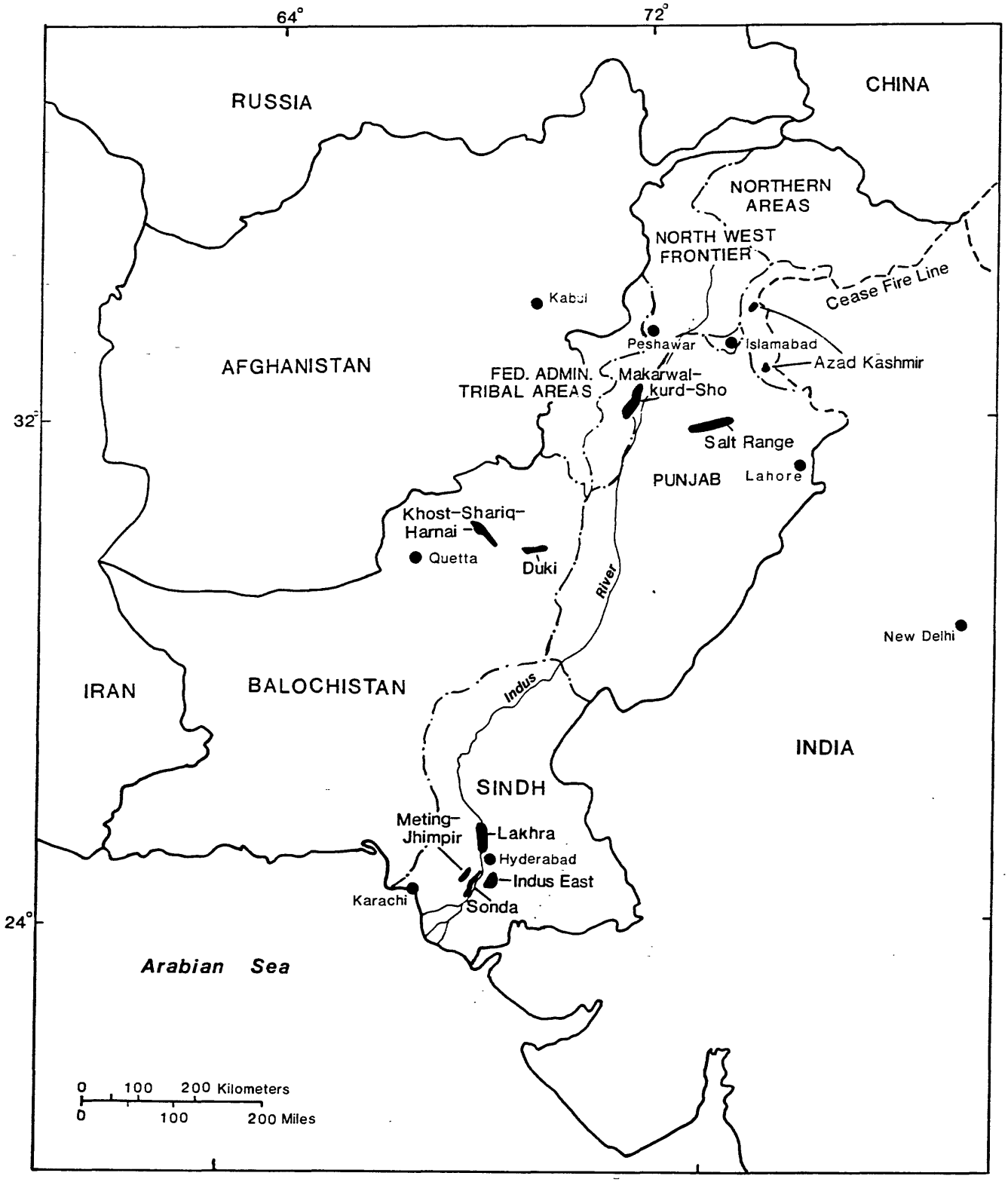
INTRODUCTION

During late February and early March of 1988, reconnaissance sampling was conducted to assess the utility of ostracodes in analyzing the age and paleoenvironments of Paleogene marine and marginal marine rocks of the Lakhra coal fields (fig. 1). Samples were taken from a long core and from six measured sections in the Ganjo Takkar and Saidpur Inliers (fig. 2). The Bara Formation, Lakhra Formation, Sohnari Formation, and Laki Formation (the latter consisting of the Meting Limestone, Meting Shale, and Laki Limestone Members) were sampled.

MATERIAL

This study is based on 28 samples taken from core UAK-5, collected from the southwest corner of Ganjo Takkar, an inlier of lower Tertiary sedimentary rocks south of Hyderabad and east of the Indus River. Drill hole UAK-5 was cored to a depth of 400 meters and recovered rocks from the Laki (the Meting Shale and Meting Limestone Members), Sohnari, Lakhra, and Bara formations (fig. 3).

Figure 1.--Map showing locations of coal fields in Pakistan.



Samples were processed and picked in the U.S. Geological Survey (USGS) laboratory in Denver, Colorado. Of the core and outcrop samples examined, the best recovery, in terms of preservation, species diversity, and abundance, is in the sample suite taken from the core. Ostracodes proved to be the most diverse and abundant microfossil in both the core and outcrop samples. All of the formations sampled contain ostracodes, most with moderate to high species diversity and good abundance. Samples from the core have the best preservation of the samples examined, and the recrystallized limestones of the Laki Limestone in outcrop had the poorest preservation.

LITHOSTRATIGRAPHIC UNITS

The Bara and Lakhra Formations comprise the Ranikot Group (fig. 4), which was first proposed by Blanford (1876) after Ranikot Fort, located in the northern part of the Laki Range. Blanford defined the Ranikot Group as consisting of the rocks between the Volcanic Trap rocks and the Kirthar or Lower Nummulitic Group. Blanford included strata later called the *Cardita beaumonti* beds in the Ranikot Group. In 1879 Blanford redefined the Ranikot Group and excluded the *Cardita beaumonti* beds and the Volcanic Trap Group. Shah (1977) defined the Ranikot Group according to Blanford's original concept, which therefore included rocks above the Volcanic Trap Group, including the *Cardita beaumonti* beds.

Vredenburg (1909) subdivided the Ranikot Group into the Lower Ranikot (primarily sandstone) and the Upper Ranikot (primarily limestone). Shah (1977) divided the Ranikot Group into the lowest Khadro Formation (the *Cardita beaumonti* beds), the middle Bara Formation (Lower Ranikot sandstone), and the upper Lakhra Formation (Upper Ranikot limestone).

The Khadro Formation was not examined in this report and will not be further considered. The term Bara was formally proposed by Shah (1977), after Bara Nai in the Laki Range. Strata herein called Bara Formation have been called the Gorge Beds (Eames, 1952), Ranikot Formation (Williams, 1959), and the Lower Ranikot Formation and lower part of the Jakkar Group, Thar, Rattaro, and Bad Kachu (Hunting Survey, 1961). The Bara consists predominantly of sandstone, with volcanic debris in the lower part. Shah (1977) reported no fossils from the Bara except for some oysters, reptilian remains, and carbonized leaf impressions in the lower part. The Bara overlies the early Paleocene (Danian) Khadro Formation and underlies the upper Paleocene Lakhra Formation, and has been inferred to be middle Paleocene in age. Palynologic studies indicate that the Bara is Paleocene, ranging from early to middle Paleocene (Frederiksen, 1990).

The Lakhra Formation was formally proposed by Shah (1977), who named the unit after Lakhra in the Laki Range. Strata herein called the Lakhra Formation have been called the Upper Ranikot Limestone (Vredenburg, 1906) and the upper Ranikot Formation and upper parts of the Bad Kachu, Rattaro and Thar Formations and lower part of the Jakkar Group (Hunting Survey, 1961). Sandstone is present in the lower part and interbedded sandstone and shale is present in the upper part. A diverse larger foraminifer assemblage, including *Nummulites, Assilina, Lepidocyclina*, and *Discocyclina*, indicate a late Paleocene age (Davies, 1927; Nuttall, 1931; Hunting Survey, 1961).

The term "Laki Series" was first proposed by Noetling (1903) for the lower part of Blanford's (1876) Kirthar Series. The Hunting Survey (1961) redefined the unit as the Laki Group. Shah (1977) first used the term Laki in a formational sense. The basal member of the Laki was termed the Sohnari Member (the Basal Laki Laterite of Nuttall, 1925), and the upper member was termed the Meting Limestone and Shale Member (the Meting shales and limestones of Vredenburg, 1906).

Figure 2.--Map showing surface geology of the Lakhra anticline and adjacent areas to the south. The location of the measured sections [indicated by SN- at Lakhra (after Siph Nala) and by numbers only at Ganjo Takkar] and core UAK-5 are indicated. Two cores adjacent to UAK-5 are also shown. Map adapted from Outerbridge (unpublished).

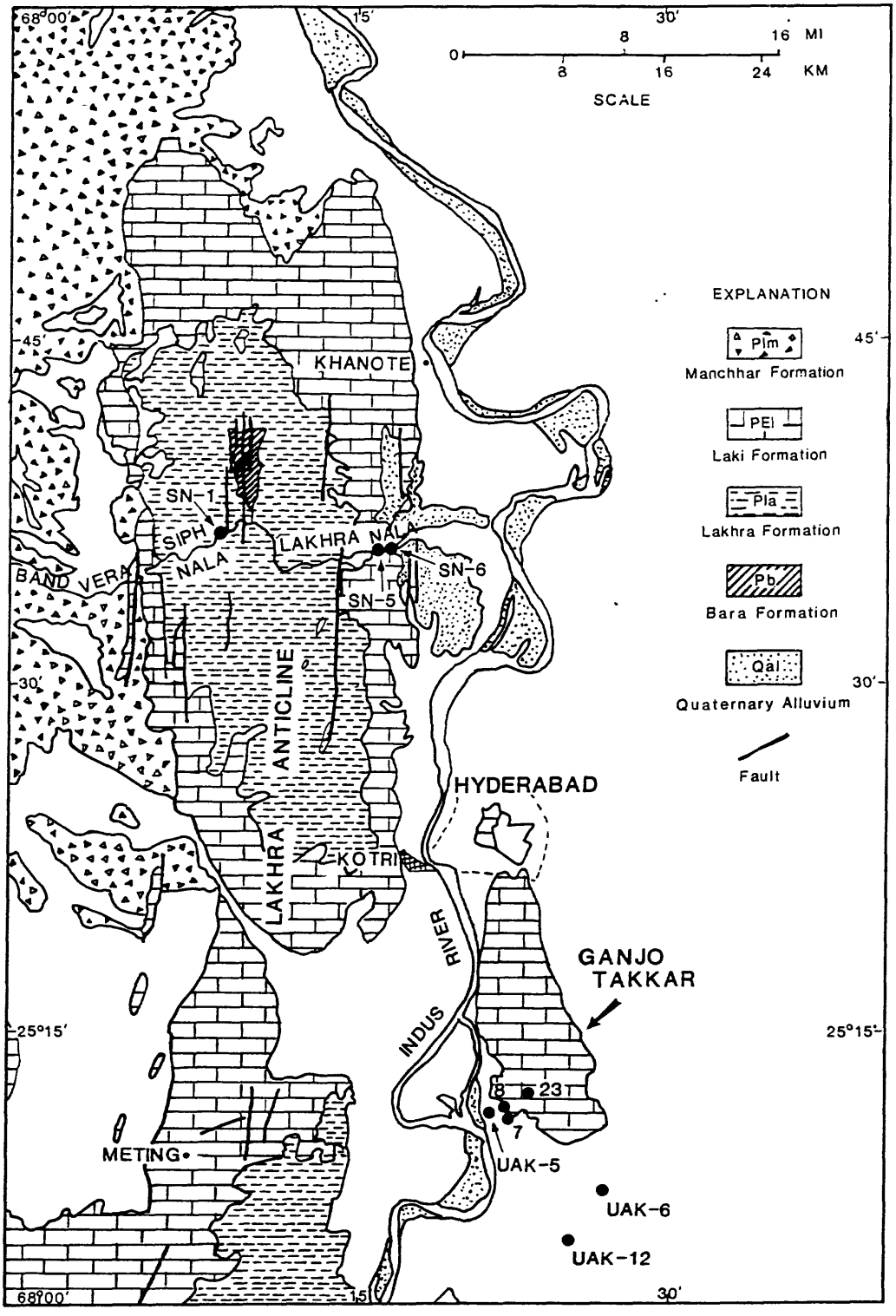


Figure 3.--Stratigraphic column of core UAK-5.

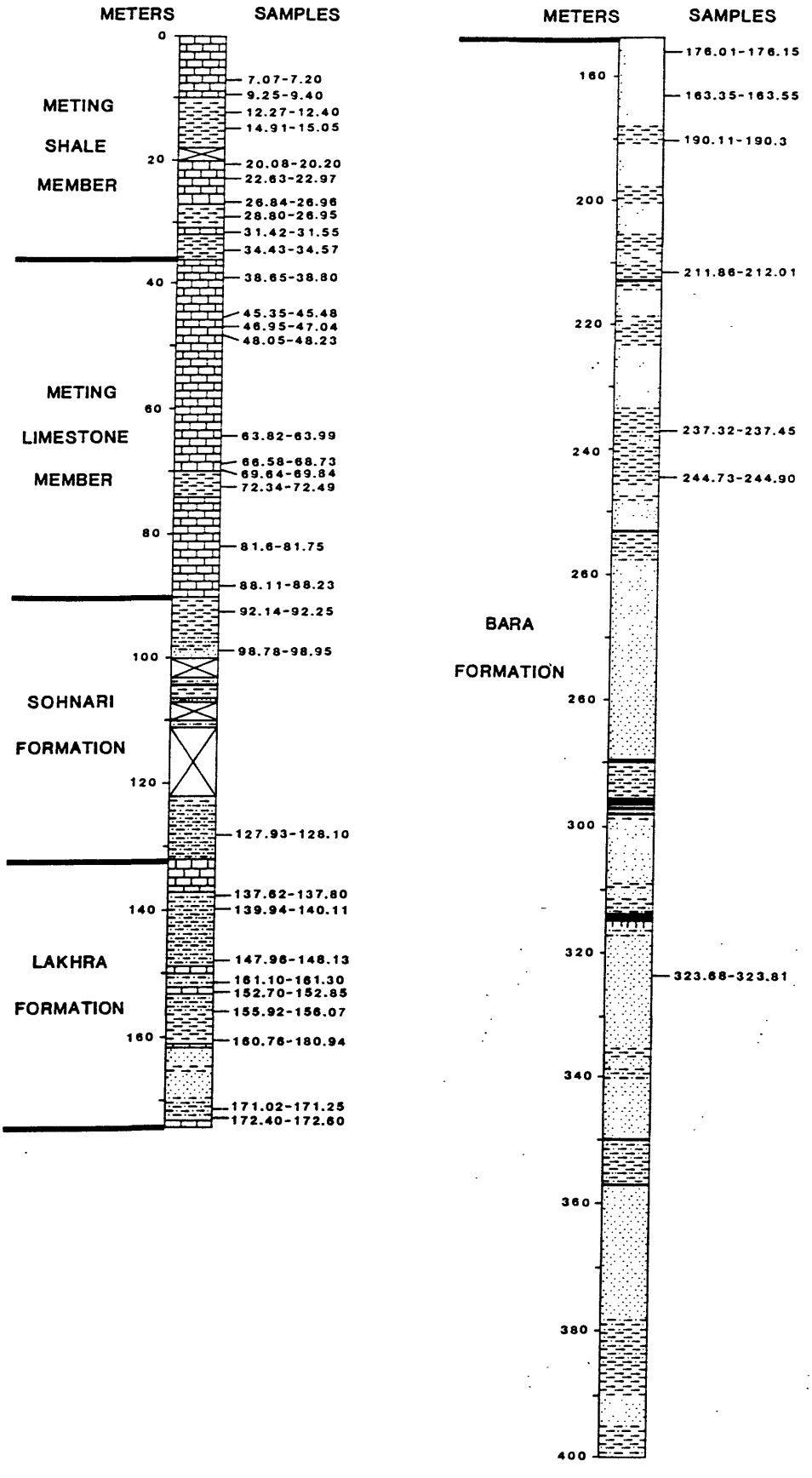
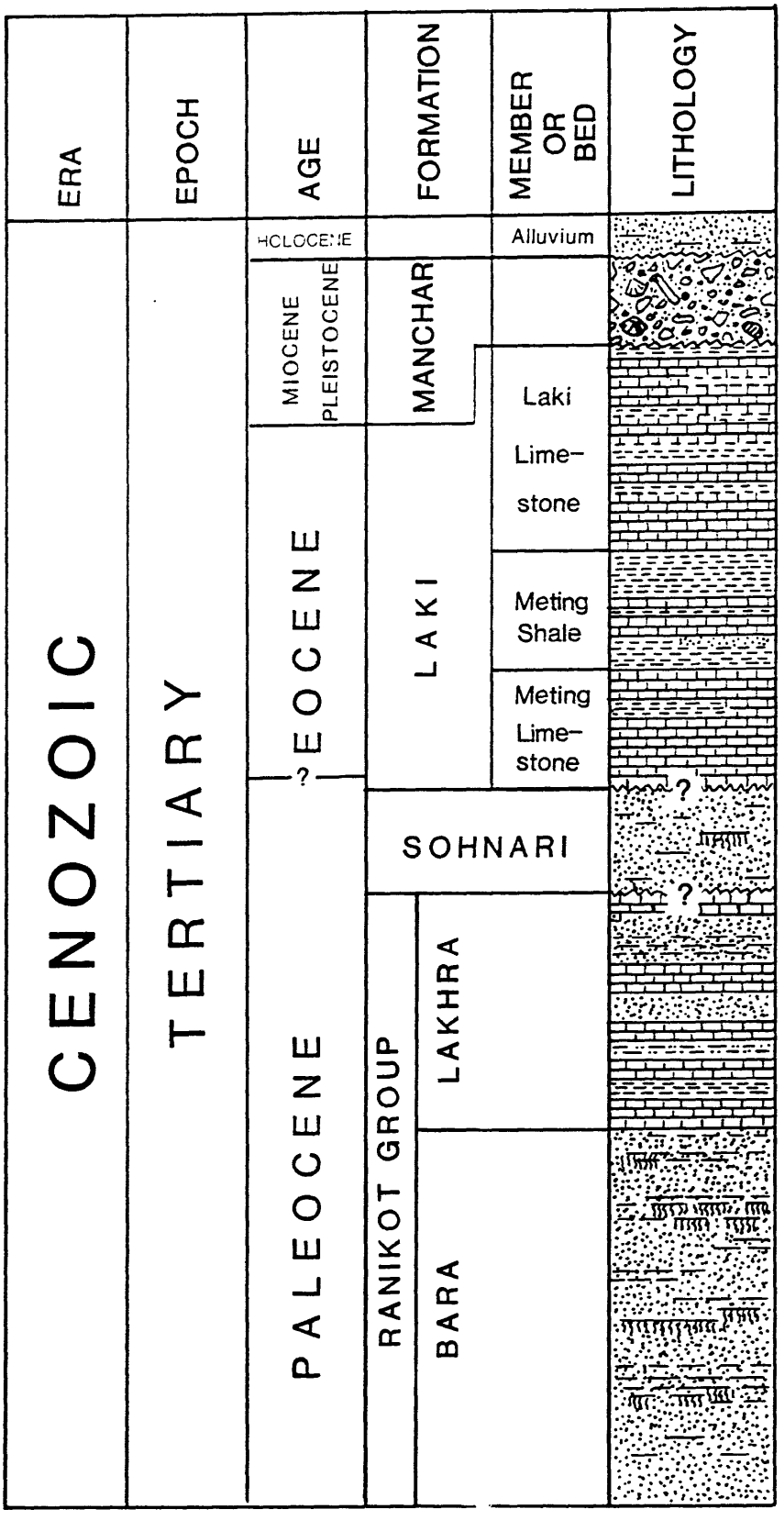


Figure 4.--Stratigraphic section of Tertiary sedimentary rocks in southern Sindh Province, Pakistan.



The Sohnari Formation consists of lateritic clay and shale (paleosols) and marginal marine and shallow marine facies (Outerbridge and others, 1991). The Meting Limestone and Meting Shale Members of the Laki Formation consist of nodular limestone in the lower part and interbedded shale and limestone in the upper part. The Laki contains a diverse fossil assemblage (Noetling, 1905; Davies, 1926; Haque, 1962; Hunting Survey, 1961; Iqbal, 1973). A number of species of the larger foraminifer genera *Assilina, Lockhartia*, and *Fasciolites* indicate an early Eocene age.

PREVIOUS OSTRACODE STUDIES

Sohn (1959) was the first to describe and monograph an assemblage of ostracodes from various formations in Pakistan, including the Eocene Ghazij Shale in the Sor Range, the Eocene Upper Chocolate Clay of Rakhi Nala, the Paleocene *Cardita beaumonti* beds (basal Bara Formation) of the Laki Range, and the Eocene Meting Limestone around Hyderabad. Sohn described 30 species from Pakistan and compared the fauna to ostracodes of the Paleocene Brightseat Formation of Maryland in the United States. This comparison is not particularly useful, as Paleocene Tethyan tropical taxa comprise a rather distinctive assemblage that does not extend to the Paleocene of the United States.

Siddiqui (1971) published a monograph on trachyleberid ostracode genera from Paleocene rocks in the Sor Range and from Paleocene and Eocene rocks of the Sulaiman Range. His is the most comprehensive survey of the Paleogene ostracodes in Pakistan. Siddiqui described four new genera and 54 new species. He noted a massive turnover at the species level between the late Paleocene and early Eocene. The range chart constructed for UAK-5 (fig. 5) does not show such a complete turnover at the species level, but there is a marked shift in the assemblage composition, and several genera do not range into the Eocene (eg., *"Veenia"*, New Genus C, *Brachycythere*).

Siddiqui and Al-Furaih (1981) described *Schizoptocythere*, a new genus from the early Tertiary of western Asia. The genus has a geologic record ranging from early Paleocene to middle Eocene in Saudi Arabia, Pakistan, and India; an unpublished occurrence in Cretaceous sediments of Jamaica is being described by Hazel (in press, 1992). The oldest described species of *Schizoptocythere* in Pakistan is found in the Eocene Ghazij Formation and Laki Formation. We have documented two species of *Schizoptocythere* from the Paleocene Lakhra Formation and two species from the early Eocene Meting Shale and Meting Limestone, which pushes the range of *Schizoptocythere* into the early Paleogene.

Siddiqui (1983) demonstrated the biostratigraphic significance of four genera that were originally described from Pakistan and are common components of the Paleogene Tethys zoogeographic province, particularly in strata of the Middle East and the Indian subcontinent. Siddiqui illustrated species of *Alocopocythere, Gyrocythere, Phalcocythere*, and *Stigmatocythere*. Species of these four genera are found in UAK-5 and throughout the Paleogene rocks of Pakistan. Siddiqui noted that no Paleocene species of *Gyrocythere* and *Stigmatocythere* had been found in Pakistan (although a Paleocene species of *Stigmatocythere* has been recovered from Nigeria). We have found a species of *Gyrocythere* in the Paleocene Lakhra Formation; *Stigmatocythere* occurs only in the Eocene Laki Formation.

PRELIMINARY BIOSTRATIGRAPHIC ZONATION

One hundred forty-one species of ostracodes representing 45 genera were identified in the 28 samples examined from core UAK-5; 88 species are used on the correlation chart and 138 species are included in the systematics section. To date, five previously described species are recognized with certainty; the remaining 133 species are left in open nomenclature for this report and will be formally treated in future taxonomic papers.

Five ostracode assemblage zones can be recognized, each marked by a significant number of first and last appearances (fig. 5). Because the zonation is preliminary in nature, being based on a single core, the assemblage zones are named, in ascending order, A through E in this report. After we have examined additional cores and better understand which species are responding to facies and which are time markers, we will propose formal assemblage zones and species range zones. We have examined several samples from the upper Bara Formation of core UAS-8, and several of the marker species in the lower part of Zone B and in Zone A are present. This suggests that, although some adjustment of zonal boundaries is probable, the overall stratigraphic distribution of the ostracode species is similar over the entire Lakhra coal field.

The large turnover of species and genera between Zones A-B-C and D-E parallels a turnover in palynomorphs (Frederiksen, 1990) and foraminifers. Several studies (Usmani, 1983; Usmani and Ahmed, 1986; Frederiksen, 1990) have placed the Paleocene/Eocene boundary above the top of the Sohnari and in the basal strata of the Meting Limestone. The turnover in the ostracode taxa is supportive of a temporal break at this stratigraphic position.

ZONE A

Zone A is the lowest zone described here, and is represented by a single sample at 211 m. The zone begins somewhere above 237 m (a barren sample) and ends somewhere between the samples taken at 211 m and 190 m. Zone A contains five species, all of which range into the overlying Zone B. The top of Zone A is marked by the first appearance of 10 species. Zone A occurs in the uppermost Bara Formation.

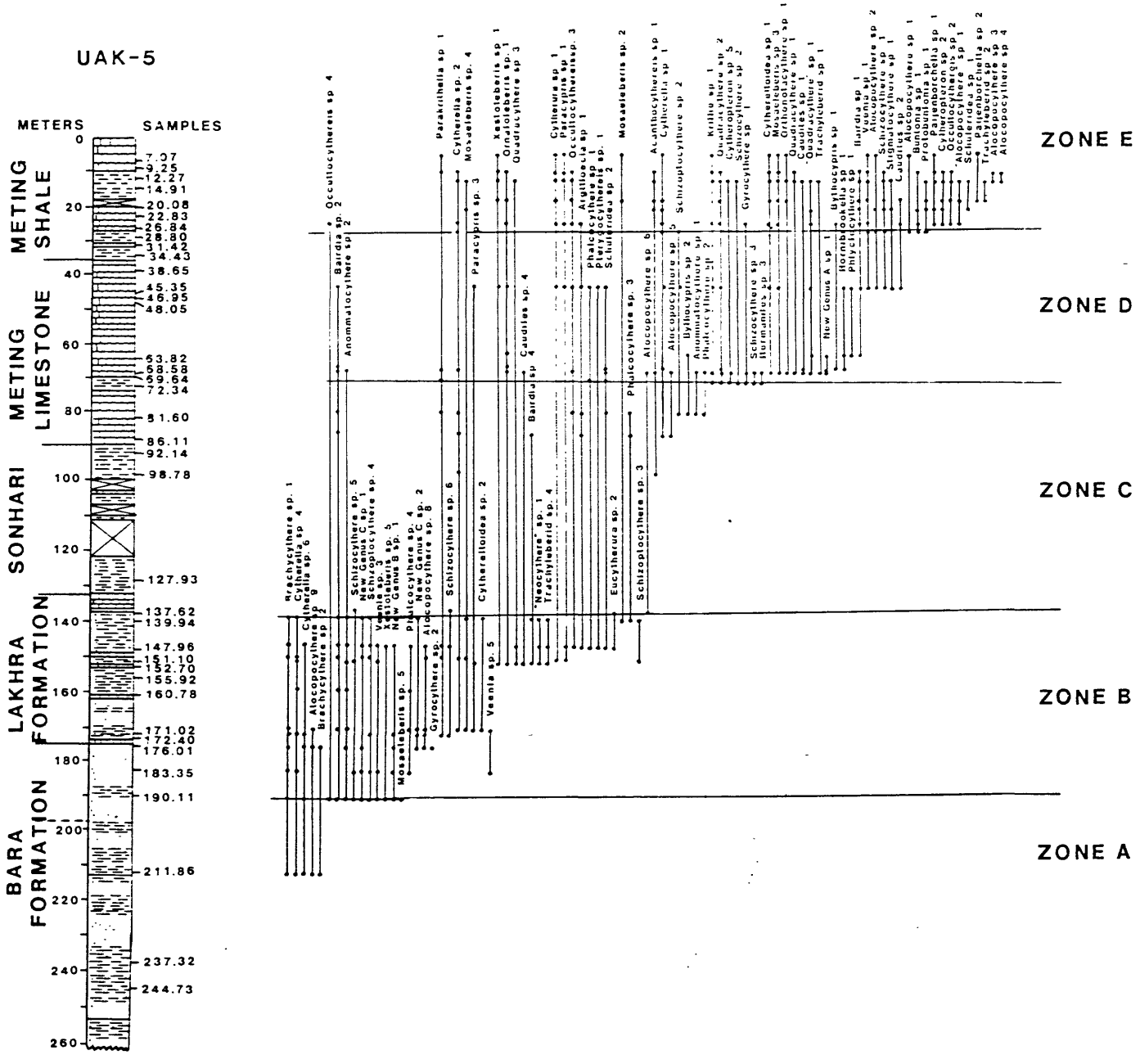
ZONE B

Zone B begins at about 190 m and ends at about 139 m. The base of the zone is defined by the first appearance of 10 species, including two very distinctive genera that are believed to represent new taxa. The top of the zone is marked by the last appearance of 12 species and the first appearance of three species. Sixteen species have their entire range within Zone B, and three of these species (*Schizoptocythere sp. 5, New Genus C sp. 1*, and *Schizoptocythere sp. 4*) have a first appearance datum (FAD) and last appearance (LAD) coincident with the lower and upper boundaries of the zone. Characteristic taxa of Zone B include *Brachycythere sp. 1, Schizocythere sp. 5, S. sp. 6, Veenia sp. 3, V. sp. 4, V. sp. 5, Cytherelloidea sp. 2, New Genus B, New Genus C, Alocopocythere sp. 8*, and *Gyrocythere sp. 2.* Zone B represents most of the Lakhra.

ZONE C

Zone C begins at about 139 m and ends at about 72 m. The base of the zone is defined by the last appearance of 12 species and the first appearance of three species. The top of the zone is marked by the first appearance of seven species. An argument could be made to place the upper boundary of Zone C at 69 m, at the top of a claystone bed within the Meting Limestone, where eight species have their last appearance and eight species have their first appearance. Characteristic species of Zone C include *Alocopocythere sp. 5, A. sp. 6*, and *Anommatocythere sp. 1.* Zone C is considered to be the poorest defined zone, and the boundaries are expected to shift somewhat as data are added from other cores. Zone C represents the uppermost Lakhra, Sohnari, and the lower part of the Meting Limestone.

Figure 5.--Stratigraphic range chart of diagnostic ostracode species.



ZONE D

Zone D begins at about 72 m and ends at about 29 m. The base of the zone is defined by the last appearance of eight species and the first appearance of five species. A second group of eight species have their first appearance at about 70 m. The stepwise appearance is probably related to facies, as the sample at 72 m is a claystone and the sample at 70 m is a limestone. The top of the zone is marked by the last appearance of four species and the first appearance of seven species. Characteristic species of Zone D include *Schizoptocythere sp. 2, Gyrocythere sp. 1, New Genus A, Hornibrookella sp. 1*, and *Phlyctocythere sp. 1*. The FAD and LAD of *Gyrocythere sp. 1* is coincident with the lower and upper boundaries of Zone D. Zone D represents most of the Meting Limestone and the basal part of the Meting Shale.

ZONE E

Zone E begins at about 29 m and ranges to the top of the core. The base of the zone is defined by the last appearance of five species and the first appearance of seven species. Characteristic species of Zone E include *Alocopocythere sp. 1, A. sp. 3, A. sp. 4, Paijenborchella sp. 1, P. sp. 2, P. sp. 3, Buntonia sp. 1*, and *Protobuntonia sp. 1*. Zone E represents 29 m of the Meting Shale, from just above the base of the member to the top of the core.

PALEOECOLOGIC RECONSTRUCTIONS

Upper part of the Bara Formation and Lakhra Formation

The lowest sample of the Bara Formation in UAK-5 that contains ostracodes is at 244 m; the fauna consists of a single specimen of a cytherideid, probably a marginal marine form.

The first sample containing a marine assemblage is at 211 m; the fauna is characterized by low species diversity (about 8 species; fig. 6A) and low abundance (about 100 valves; fig. 7A). Species diversity increases upsection to about 12-15 species, and the abundance greatly increases to 500-1000 valves. In the uppermost part of the Bara, the ostracodes include about 18 species and over 1000 specimens. The uppermost Bara species indicate normal marine salinity, probably shallow nearshore conditions. The assemblage includes few delicate ornamented forms, being made up of heavy-shelled taxa.

In the lowest part of the Lakhra Formation, just above the basal limestone, species diversity is low (15 species; fig. 7B), but abundance is high (over 1000 valves; fig. 8B). Diversity and abundance drop in the siltstones of the middle Lakhra, to 5 species and 50 specimens, and the ostracode assemblage has its maximum diversity and abundance in the uppermost 5-7 m of siltstone (more than 20 species and 1000 specimens).

The lower part of the Lakhra shows moderate species diversity, consisting of heavy-shelled forms and very few delicate taxa. The lower Lakhra includes forms like *Veenia, Veenia*-like genera, and phytal (plant-dwelling) taxa. The assemblage indicates normal marine salinity and shallow nearshore conditions. The upper Lakhra has a much higher species diversity, and more delicately ornamented taxa appear (eg., *Phalcocythere, Schizoptocythere*). The ostracode assemblage indicates a trend upsection for increased water depths.

Figure 6A.--Plot of ostracode species diversity (number of species) in the Bara Formation, core UAK-5.

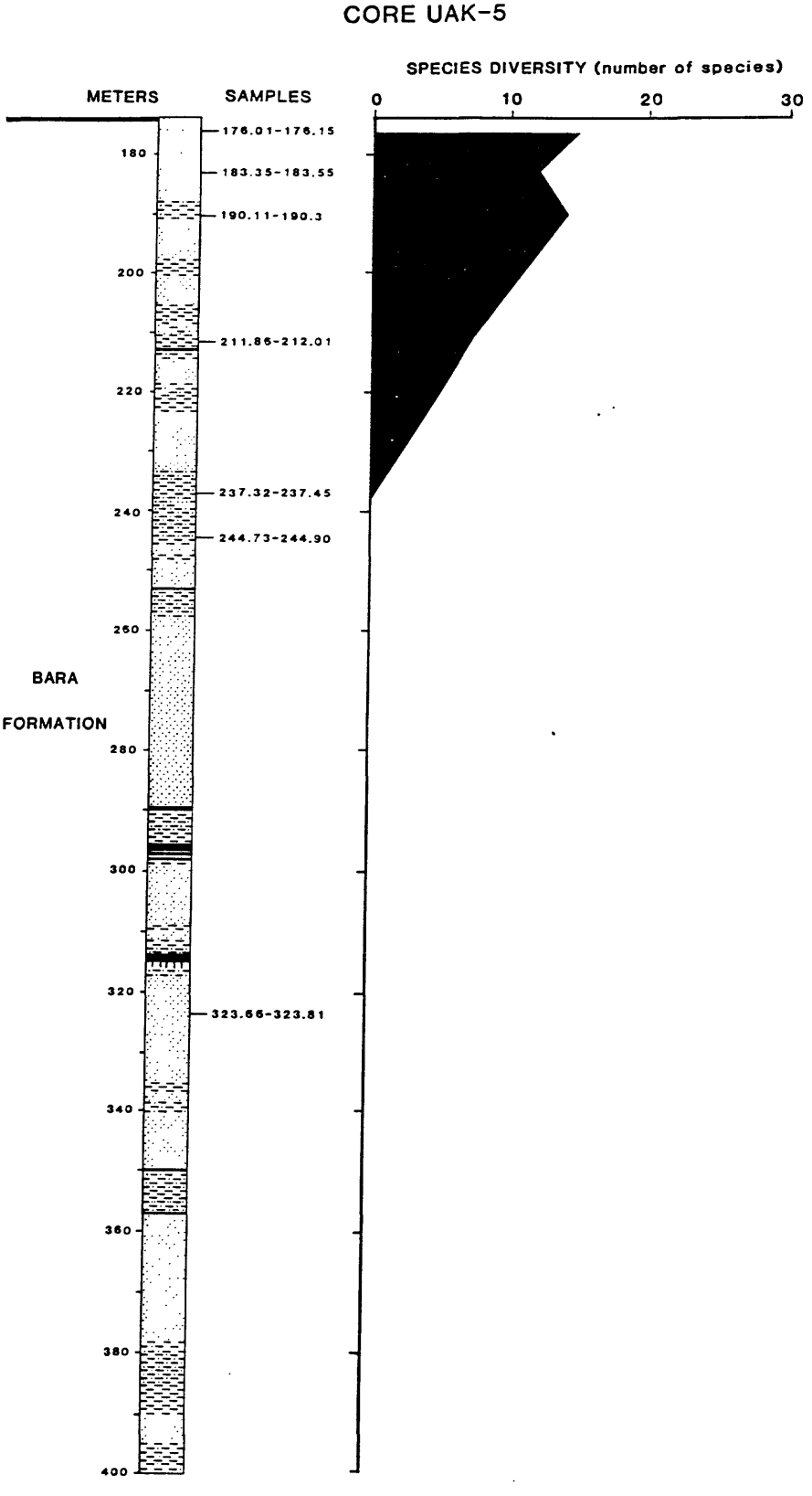
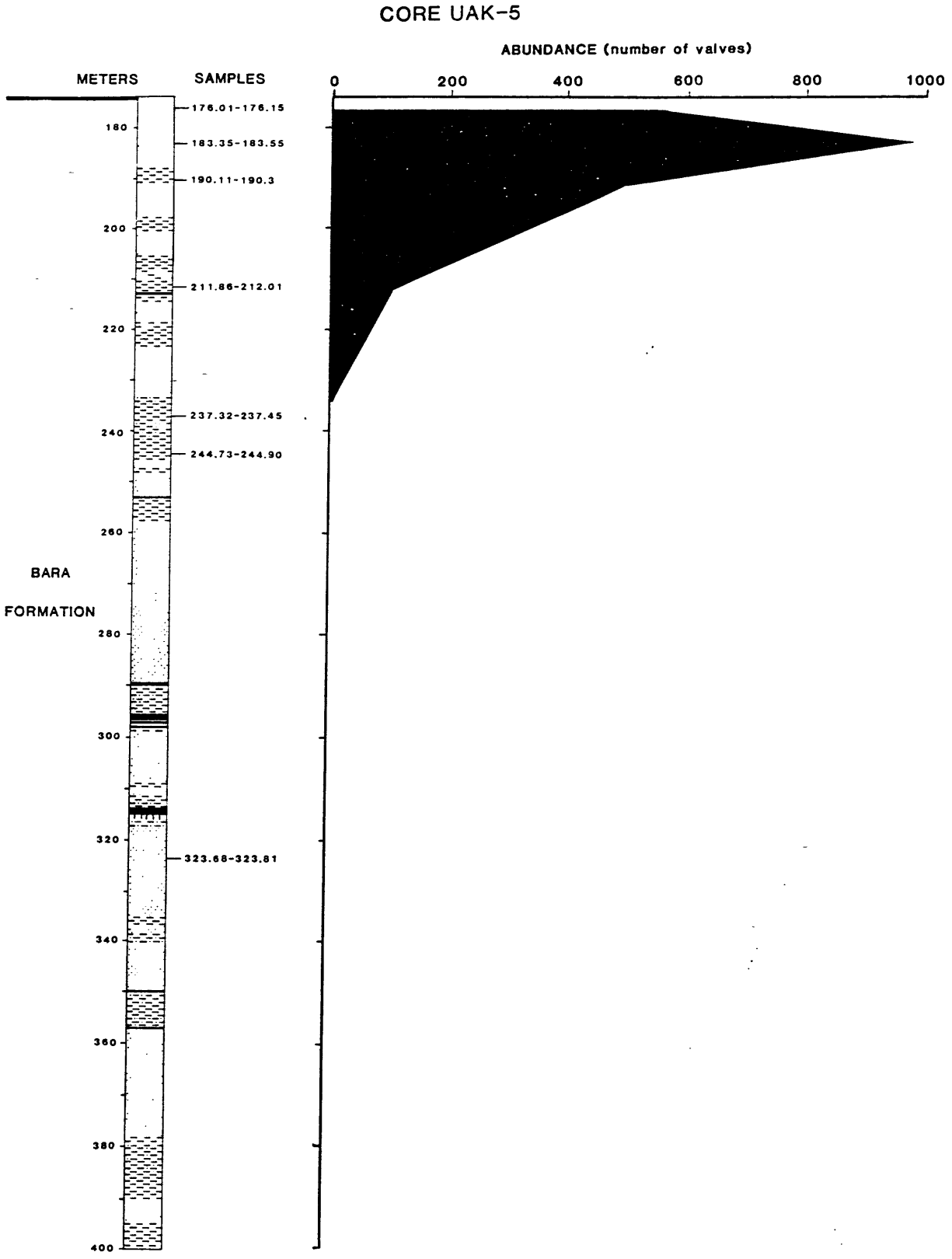


Figure 7A.--Plot of ostracode abundance (number of valves) in the Bara Formation, core UAK-5.



At the very top of the Lakhra, just below a limestone bed, the ostracodes show reduced species diversity and increased abundance. A large number of species and genera have their FAD and LAD at the top of the Lakhra, including taxa such as *Schizocythere* and *Eucytherura*.

Sohnari Formation

Only one sample from near the top of the Sohnari Formation in UAK-5 contains ostracodes, and only four specimens of three species were recovered. The species indicate normal marine salinity. The fauna is, however, too poor to make a definitive statement regarding water depth of other paleoenvironmental parameters. This sample may indicate the presence of a marine tongue in the Sohnari Formation.

Meting Limestone Member of Laki Formation

Species diversity is moderate (15 species) in the lower third of the Meting Limestone Member of the Laki Formation, with high abundances (over 600 specimens). A diversity peak occurs at the middle of the unit (30 species), accompanied by very high abundances (more than 1000 specimens). These peaks are followed by sharply reduced diversity, which is probably related to diagenesis and poor preservation (evidenced by crystal overgrowths and an abundance of sturdy carapaces, with few delicately ornamented forms). The upper part of the Meting Limestone shows a return to high species diversity (30 species) and abundance (over 1000 specimens).

The Meting Limestone assemblage consists of numerous ornamented forms, including delicate forms. The fauna is normal marine, probably middle shelf water depths. The lower part of the Meting Limestone appears to have had shallower water depths than the upper Meting Limestone, with an upsection trend toward increasing water depths.

Meting Shale Member of Laki Formation

Several peaks in species diversity can be seen in the Meting Shale Member of the Laki Formation. These are probably related to facies changes; species diversity is greater in the shales than in the limestones. Species diversity in the Meting Shale ranges from 10 to 40 species, and abundance ranges from 200 to over 1000 specimens.

The fauna indicates normal marine salinity. The assemblage includes many smaller species and a number of "streamlined" forms adapted to soft to semi-soft substrates. The assemblage includes a number of phytal forms. The fauna suggests deeper inner shelf water depths.

ACKNOWLEDGMENTS

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subsamples from UAK-5. John SanFilipo provided us with information on formational contacts and correlations between drillholes, as well as directing us to additional cores with fossiliferous sediments.

Figure 6B.--Plot of ostracode species diversity (number of species) in the Meting Shale and Meting Limestone Members of the Laki Formation, Sohnari Formation, and Lakhra Formation, core UAK-5.

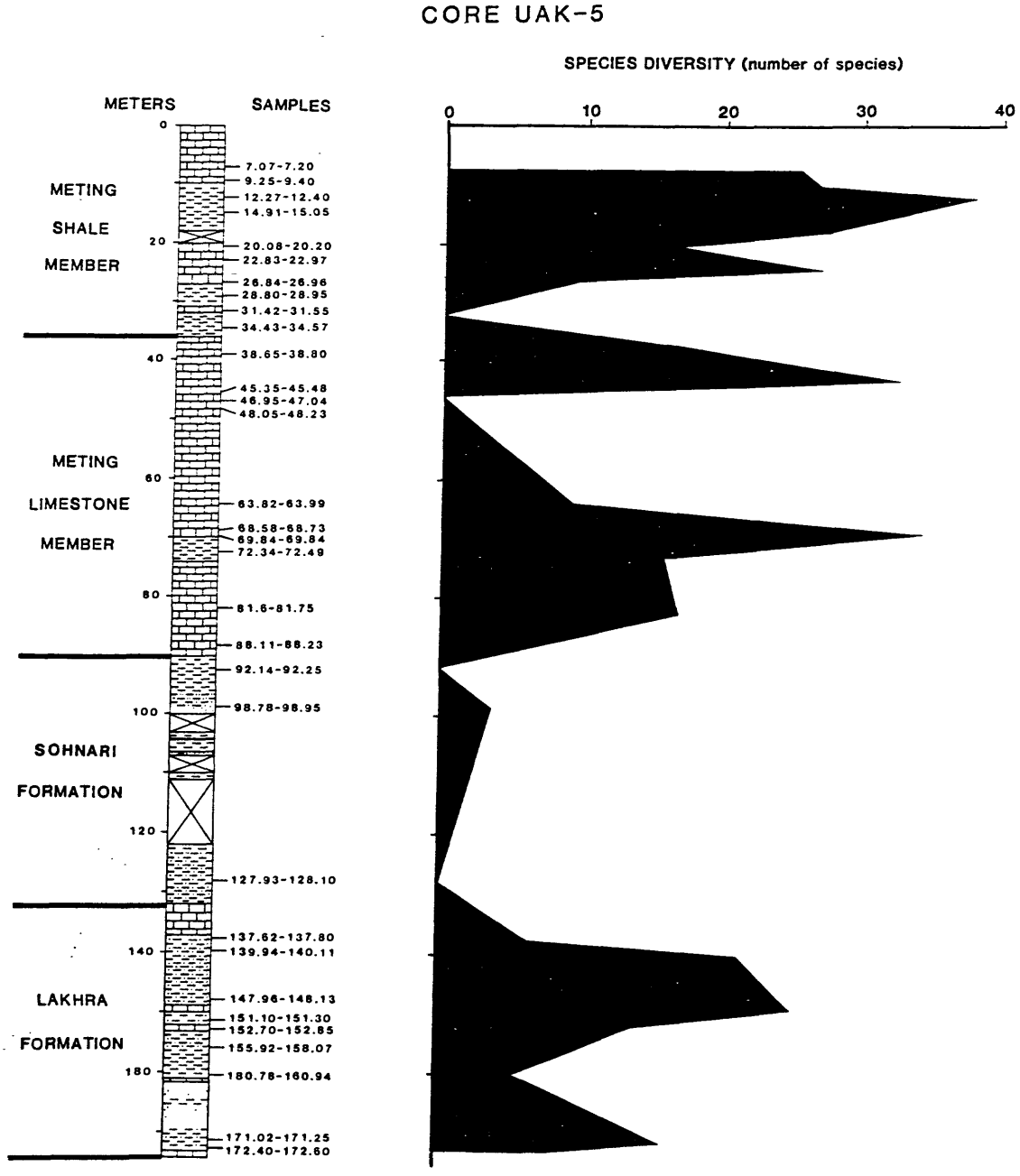
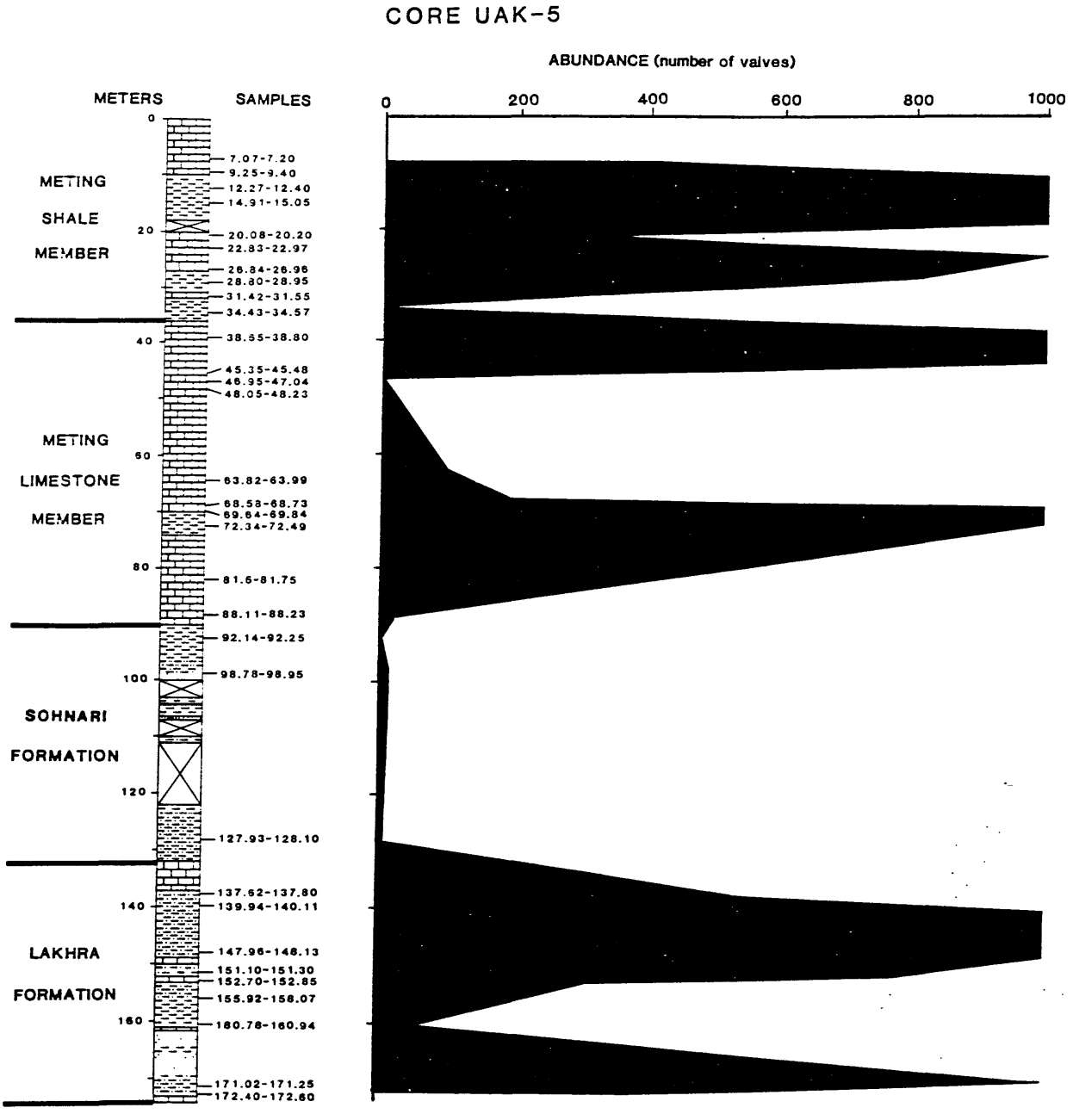


Figure 7B.--Plot of ostracode abundance (number of valves) in the Meting Shale and Meting Limestone Members of the Laki Formation, Sohnari Formation, and Lakhra Formation, core UAK-5.



SYSTEMATICS

Class OSTRACODA Latreille, 1806
Order PODOCOPIDA Mueller, 1864
Suborder PODOCOPINA Sars, 1866
Superfamily BARIDIACEA Sars, 1888
Family BAIRDIIDAE Sars, 1888
Genus BAIRDIA McCoy, 1844

Type species.--*Bairdia curtus* McCoy, 1844

Bairdia sp. 1
Plate 6, figure 12

Description.--In lateral view, left valve forms a rounded triangular shape; dorsal margin is distinctly arched; anterior margin is smoothly curved, drawn-out in middle of margin; ventral margin is broadly convex; posterior margin curves smoothly to posterodorsal region; small blunt caudal process located ventral of midline; posterodorsal margin smoothly and broadly curved. Greatest length is ventral of midline, through caudal process; greatest height is at midline of valve. Length 900 um, height 600 um.

No ornamentation. Small normal pores iregularly scattered over smooth surface of valve.

Occurrence.--12.27, 14.91, 20.08, 22.83, 26.84, 45.35, 63.82 m; Meting Shale, Meting Limestone.

Bairdia sp. 2
Plate 6, figures 11, 13

Bairdia cf. B. talukdari Guha. Baryar, Bhatti, and Ahmed, 1985, p. 99, figs. 7a, 7b.

Description.--In lateral view, left valve forms a rounded subtriangular shape. Dorsal margin highly arched; anterior margin smoothly and evenly curved; ventral margin broadly curved, nearly straight, curving up along posteroventral extent; posterior margin with a weak, broad, blunt caudal process located ventral of valve midline; posterodorsal part of margin curves up sharply and steeply toward dorsum. No cardinal angles. Greatest length through midline of valve; greatest height through midline. Length 909 um, height 600 um.

No ornamentation; valve surface is smooth. Numerous, very small normal pores distributed over surface, more numerous at anterior.

Occurrence.--45.35, 68.58, 69.64, 81.6, 88.11, 139.94, 147.96, 151.1, 160.78, 171.02, 190.11 m; Meting Limestone, Lakhra Formation.

Bairdia sp. 3

Occurrence.--81.6 m; Meting Limestone.

Bairdia sp. 4

Occurrence.--88.1, 139.94, 152.7 m; Meting Limestone, Lakhra Formation.

Bairdia sp. 5

Occurrence.--147.96, 152.7 m; Lakhra Formation.

Genus BYTHOCYPRIS Brady, 1880

Type species.--Bythocypris reniformis Brady, 1880

Bythocypris sp. 1
Plate 6, figure 9

Description.--In lateral view, dorsal margin is curved in an arched shape; anterior margin is rounded; ventral margin with a pronounced concavity; posterior margin is subrounded; posterodorsal margin nearly straight, curved broadly and obliquely toward dorsum. Greatest length is at midline of valve; greatest height is just anterior of midline. Length 1090 um, height 510 um.

No ornamentation is present; valve surface is smooth. Few scattered normal pores on surface.

Occurrence.--26.84, 68.58 m; Meting Shale, Meting Limestone.

Bythocypris sp. 2

Occurrence.--63.82, 81.6 m; Meting Limestone.

Superfamily CYPRIDACEA Baird, 1845
Family PONTOCYPRIDIDAE G.W. Mueller, 1894
Genus ARGILLOECIA Sars, 1866

Type species.--Argilloecia cylindrica G.W. Mueller, 1894

Argilloecia sp. 1
Plate 6, figure 14

Description.--In lateral view, right valve is elongate-cylindrical in outline. Dorsal margin broadly arched; anterior margin smoothly and evenly curved; ventral margin broadly arched, nearly straight; posterior margin truncated, consisting of a rounded right angle posteroventral corner, a straight middle portion, and a rounded obtuse posterodorsal corner. Greatest length through midline; greatest height through midline. Length 666 um, height 240 um.

Valve surface is smooth, no ornamentation. Few, small normal pores scattered over surface.

Occurrence.--26.84, 45.35. 81.6, 88.11, 147.96 m; Meting Shale, Meting Limestone, Lakhra Formation.

Argilloecia sp. 2

Occurrence.--20.08 m; Meting Shale.

Argilloecia sp. 3

Occurrence.--45.35 m; Meting Limestone.

"Argilloecia" sp. 1

Occurrence.--14.91 m; Meting Shale.

Family PARACYPRIDIDAE Sars, 1923
Genus PARACYPRIS Sars, 1866

Type species.--Paracypris polita Sars, 1866

Paracypris sapperi van den Bold, 1961
Plate 5, figure 13

Occurrence.--12.27 m; Meting Shale.

Paracypris sp. 1
Plate 5, figure 12

Description.--In lateral view, left valve forms an elongate ellipsoidal shale. Dorsal margin broadly arched; anterior margin smoothly and evenly curved; ventral margin broadly convex; posterior margin with a sharp posteroventral corner; posterodorsal margin segment slopes steeply to dorsal margin. Greatest length just ventral of midline; greatest height through midline. Length 1010 um, height 372 um.

Valve surface is smooth, no ornamentation. Numerous small normal pores scattered over surface.

Occurrence.-- 147.96, 151.1 m; Lakhra Formation.

Paracypris sp. 2

Occurrence.--81.6 m; Meting Limestone.

Paracypris sp. 3
Plate 5, figure 14

Description.--In lateral view, right valve forms an elongate triangular shape. Dorsal margin with a high central part forming an arch, from which the long, straight anterodorsal and posterodorsal sections proceed obliquely outward. Anterior margin drawn-out, subcylindrical in outline; anteroventral margin segment straight, sloping gently up toward anterior; remaining 2/3 of ventral margin toward posterior side is straight, very gently sloping up toward posterior; posterior margin drawn-out, with an elongate narrow caudal process. Convex portion at anteroventral margin. Left valve overlaps right valve at center of dorsal margin, less so along ventral margin. Greatest length ventral of midline, through caudal process; greatest height through valve midline. Length 666 um, height 253 um.

Valve surface smooth. No ornamentation.

Occurrence.--7.07, 12.27, 14.91, 26.84, 45.35, 152.7, 171.02 m; Meting Limestone, Lakhra Formation.

Superfamily CYTHERACEA Baird, 1845
Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948
Genus ALOCOPOCYTHERE Siddiqui, 1971

Type species.--Alocopocythere transcendens Siddiqui, 1971

Alocopocythere transcendens Siddiqui, 1971
Plate 1, figure 4

Alocopocythere transcendens Siddiqui, 1971, p. 14-15, pl. 1, figs. 4, 5, 8, 9; pl. 2, figs. 1-4, 6, 7

Measurements.--Length 633 um, height 406 um.

Occurrence.--69.64, 72.34, 88.11 m; Meting Limestone.

Alocopocythere sp. 1

Measurements.--Length 625 um, height 343 um.

Occurrence.--7.07, 28.8 m; Meting Shale.

Alocopocythere sp. 2

Occurrence.--7.07, 22.83, 28.8, 45.35 m; Meting Shale, Meting Limestone.

Alocopocythere sp. 3
Plate 1, figures 2, 3

Description.--In lateral view, left valve is elongate-ellipsoidal in outline. Dorsal margin is nearly straight; distinct, raised anterodorsal comer; anterior margin evenly curved; ventral margin very broadly curved, with a trace of a concavity; posterior margin truncated; posteroventral margin curves up sharply to mid-margin; posterodorsal corner forms a rounded right angle. Greatest extent of posterior margin is dorsal of midline. Greatest length is through midline; greatest height is through anterodorsal corner. Marked dimorphism: males are considerably longer and somewhat lower than females and have a posteroventral marginal spine. Length 678 um, height 357 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation forms ovoid, quadrate, and elongate pits; reticulation best developed in center of valve. Anterior, ventral and posterior margins with a broad, flat, weakly ornamented shelf. Reticulation pits are roughly arranged into several horizontally-arched rows dorsally, radially about the subcentral tubercle, and irregularly elsewhere. Anterior and ventral shelf areas with large quadrate pits arranged in a row parallel to the margin. Moderately developed, arcuate, low ventral ridge; strong dorsal ridge at middle of margin, overhangs dorsum and causes margin to appear irregular. Thin low marginal ridge at anterior and posterior. Large, smooth, ovoid eye spot. Distinctive V-shaped depression or sulcus at anterodorsal margin, just posterior of eye spot. Subtle subcentral tubercle, marked by slightly thickened reticulation ridges. Four small anteroventral marginal denticles. Small normal pores scattered over valve surface, occurring both on reticulation ridges and within pits. Normal pores at anterior margin have an elevated rim.

Occurrence.--12.27, 14.91 m; Meting Shale.

Alocopocythere sp. 4

Occurrence.--12.27, 14.91 m; Meting Shale.

Alocopocythere sp. 6

Occurrence.--69.64, 137.62 m; Meting Limestone, Lakhra Formation.

Alocopocythere sp. 7
Plate 1, figure 5

Description.--In lateral view, male left valve forms a trapezoidal shape. Dorsal margin is straight, angling down toward posterior end; dorsal margin appears irregular in lateral view due to overhanging dorsal ridge; anterodorsal corner pronounced due to large anterior hinge element; anterior margin smoothly curved; ventral margin with slight concavity, converges toward posterior; posterior margin drawn-out, weak caudal process. Greatest length through midline; greatest height through anterior hinge element. Length 707 m, height 461 um.

Ornamentation consists of reticulation, ridges, and denticles. Recticulation forms ovoid to quadrate pits; reticulation best developed in center of valve. Anterior and posterior margins with a broad, flat, weakly ornamented shelf. Reticulation pits are roughly arranged into several horizontal rows posteriorly and radially at the anterior. Large, irregular, subcentral tubercle, marked by slightly thickened reticulation ridges. Anterior and posterior shelf areas with quadrate pits arranged in a row parallel to the margin.

Moderately developed, arcuate ventral ridge; strong, short dorsal ridge at middle of margin, overhangs dorsum and causes margin to appear irregular. Large, smooth, ovoid eye spot. Distinctive V-shaped depression or sulcus at anterodorsal margin, just posterior of eye spot. Numerous small anterior marginal denticles; 10 posterior marginal denticles. Normal pores scattered over valve surface, occurring both on reticulation ridges and as celate pores with apophysis.

Occurrence.--139.94 m; Lakhra Formation.

Alocopocythere sp. 8
Plate 1, figure 6

Description.--In lateral view, male left valve forms an elongate subquadrate shape. Dorsal margin sinuous, with convex posterior part and concave anterior part; obtuse anterodorsal cardinal angle; evenly curved anterior margin; posteror margin with slight concavity; posteroventral margin converges toward posterior; posterior margin drawn-out. Greatest length through midline; greatest height through anterior hinge element.

Ornamentation consists of reticulation and denticles. Reticulation forms ovoid, triangular, and elongate-elliposid pits; reticulation best developed in posterior half of valve. Anterior, ventral, and posterior margins with a broad shelf; shelf ornamented with large quadrate pits at anterior, elongate ellipsoidal pits along the venter, and small ovoid pits at the posterior. Reticulation pits chaotically arranged. Subtle irregular tubercle formed by curved and slightly thickened reticulation ridges. Anterior with a thin raised marginal rim. Large, smooth, ovoid eye spot. Distinctive V-shaped depression or sulcus at anterodorsal margin, just posterior of eye spot. Numerous small anterior marginal denticles; four short posterior marginal denticles. Normal pores scattered over valve surface, occurring on reticulation ridges.

Occurrence.--147.96, 151.1, 171.02, 172.4, 176.01 m; Lakhra Formation.

Alocopocythere sp. 9
Plate 1, figure 7

Description.--In lateral view, male left valve forms an elongate quadrate shape. Dorsal margin scalloped, generally straight; distinct, obtuse posterodorsal cardinal angle; raised obtuse anterodorsal cardinal angle; evenly curved anterior margin; straight ventral margin, parallel to the dorsal margin; truncated posterior margin. Greatest length through midline; greatest height through anterior hinge element.

Ornamentation consists of reticulation and denticles. Reticulation forms ovoid, quadrate, and elongate-ellipsoid pits. Reticulation most strongly developed on posterior two-thirds of valve. Anterior and posterior margins flattened, with single row of quadrate pits arranged parallel to the margin. Reticulation pits chaotically arranged over valve. Subcentral tubercle formed by thickened C-shaped reticulation ridge. Anterior and posterior margins with raised, thin rim. Moderately sized, ovoid, smooth eye spot. Distinctive V-shaped depression or sulcus at anterodorsal margin, just posterior of eye spot. Numerous small anterior marginal denticles; six small posterior marginal denticles and one larger, blunt posteroventral denticle. Normal pores scattered over valve surface, occurring both on reticulation ridges and as celate pores with apophysis.

Occurrence.--171.02, 176.01, 211.86 m; Lakhra Formation, Bara Formation.

Alocopocythere sp. 10

Occurrence.--183.35 m; Lakhra Formation.

"Alocopocythere" sp. 1
Plate 1, figure 1

Description.--In lateral view, adult left valve is elongate-ellipsoidal in outline. Dorsal margin is nearly straight; strong, raised, obtuse anterodorsal cardinal angle; anterior margin is evenly curved; ventral margin is nearly straight, with subtle concavity; posteroventral margin angles up sharply; rounded, small caudal process located dorsal of midline. Greatest length through valve midline; greatest height through anterior hinge element.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation forms ovoid and elongate pits; reticulation best developed in center of valve. Anterior and posterior margins with a broad, flat, smooth shelf. Thin, low marginal rim along anterior and posterior. Reticulation pits are roughly arranged into several horizontal rows. Moderately developed, arcuate ventral ridge; strong, short dorsal ridge at middle of margin, overhangs dorsum and causes margin to appear irregular. Large, smooth, ovoid eye spot. Distinctive V-shaped depression or sulcus at anterodorsal margin, just posterior of eye spot. Six small anteroventral marginal denticles. Small normal pores scattered over valve surface, occurring at edge of ornamentation pits on reticulation ridges.

Occurrence.--14.91, 20.08, 22.83, 26.84 m; Meting Shale.

Genus ANOMMATOCYTHERE Sohn, 1959

Type species.--Anommatocythere microreticulata Sohn, 1959

Anommatocythere sp. 1
Plate 2, figure 1

Description.--In lateral view, left valve elongate-ovoid in outline. Dorsal margin broadly arched, nearly straight, inclined downward toward posterior; anterior margin evenly curved; ventral margin broadly concave; posterior margin with a large, broad caudal process, located just ventral of valve midline. No cardinal angles. Greatest length ventral of midline, through caudal process; greatest height through anterodorsal corner. length 850 um, height 475 um.

Ornamentation consists of a reticulation pattern that defines ovoid pits. Reticulation ridges are low and fairly narrow. Subtle subcentral muscle tubercle, highlighted by a heavier development of the reticulation. Reticulation does not form a distinct pattem--pits are arranged roughly concentrically. Caudal process is smooth. Flattened region along anterior margin, marked by radially-arranged reticulation ridges. Rounded ridge overhangs ventral margin, forms an inflated area along the ventral part of the valve. Numerous large normal pores, sieve-type, located within reticulation pits.

Occurrence.--68.58, 69.64, 81.6 m; Meting Limestone.

Anommatocythere sp. 2

Occurrence.--139.94, 147.96, 152.7, 160.78, 171.02, 176.01, 190.11 m; Meting Limestone, Lakhra Formation.

Anommatocythere sp. 3

Occurrence.--160.78 m; Lakhra Formation.

Genus BUNTONIA Howe, 1935

Type species.--Buntonia shubataensis Howe, 1935

Buntonia sp. 1
Plate 1, figure 8

Description.--In lateral view, left valve is almost ellipsoidal in shape. Dorsal margin broadly arched, posterodorsal part slightly concave, anterodorsal part curved; anterior margin is rounded; ventral margin forms a broad curve converging upward toward posterior; posterior margin is crescentic. Greatest length is at the midline of the valve; greatest height is at anterior of midline. Length 510 um, height 280 um

Ornamentation consists of ovoid, subrounded, and elongated pits. One broad elongate sulcus ranges from the center of the dorsal margin to the center of the valve. A second elongate sulcus, which is comparatively smaller, trends from the center of the valve toward the ventral margin. Pits become smaller toward the anterior and posterior margins. A weak swelling is located parallel to the anterior margin; a broad depression originates from the anterodorsal region, following the trend of the anterior margin and pinching out at the anteroventral region.

Occurrence.--12.27, 22.83, 26.84, 28.8 m; Meting Shale.

Buntoniid sp. 1
Plate 1, figure 10

Description.--In lateral view, left valve is subtrapezoidal in shape. Dorsal margin is sinuous, inclined steeply to posterior; anterior margin broadly rounded, forming crescentic shape; ventral margin forms broad convex curve; posteroventral margin straight, inclined acutely posterodorsally; broad, rounded caudal process located just dorsal of midline. Greatest length is dorsal of midline, through caudal process; greatest height is anterior of midline, through anterodorsal corner. Length 573 um, height 352 um.

Ornamentation consists of pitting, ridges, and spines. Subrounded pits trend roughly concentrically in rows, parallel to anterior and ventral margins. Pits become smaller at anterior and posterior margins. One ridge evolves from anterodorsal region, follows the anterior margin, and ends at the posteroventral corner. A second weak ridge originates at the anteroventral region and trends parallel to the ventral margin, terminating at the posterior. Anterior margin and caudal process with broad, flattened, smooth regions. Valve is inflated ventrally. Few normal pores are present on the valve surface. Six denticles at the anterior and anteroventral margins; three small denticles at posterior margin. Subrounded eye tubercle.

Occurrence.--28.8 m; Meting Shale.

Genus PROTOBUNTONIA Grekoff, 1954

Type species.--*Protobuntonia numida* Grekoff, 1954

Protobuntonia sp. 1
Plate 1, figure 9

Description.--In lateral view, left valve is elongate-subtriangular in shape. Dorsal margin nearly straight, with slight convexity at center of margin; distinct raised anterodorsal corner; anterior margin evenly curved; ventral margin very broadly curved; posterior margin is truncated; posterodorsal margin forms rounded right angle. Greatest length at midline; greatest height anterior of midline, through anterodorsal corner. Length 443 um, height 265 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation pits are rectangular, subrounded, and ellipsoidal in shape. Reticulation irregularly distributed over center of valve. Reticulation shifts to fine pitting at periphery. Weak reticulation ridges trend lngitudinally across valve. A triangular V-shaped depression at anterodorsal region. Fifteen small denticles at anterior margin. Subtle, flattened, elongate eye spot. Anterior, ventral, and posterior margins rimmed by a broad, flattened smooth region. Narrow ridge parallels anterior margin.

Occurrence.--14.91, 20.08, 22.83, 28.8 m; Meting Shale.

Genus GYROCYTHERE Siddiqui, 1971

Type species.--*Gyrocythere exaggerata* Siddiqui, 1971

Gyrocythere sp. 1
Plate 2, figure 2

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is sinuous in course at the posterior half; anterior margin forms a rounded crescentic shape; ventral margin is slightly concave in the middle and somewhat convex at the anterior and posterior; posterior margin is truncated and forms a smooth curve; obtuse posterodorsal corner; distinct, rounded anterodorsal corner. Greatest length is through midline of valve; greatest height is anterior of midline, through anterodorsal corner. Length 1050 um, height 570 um.

Ornamentation consists of reticulation, ridges, spines, and denticles. Reticulation forms rectangular, triangular, subrounded, and oval pits. Pits are concentric around the subcentral tubercle, becoming progressively more parallel to the margins toward the edge of the valve. Two ridges occur near the ventral margin. One ridge originates at the anteroventer, obliquely following the ventral margin, and ending toward the valve midline. The second ridge originates at the center of the ventral margin, follows the posterior margin, and terminates at the posterodorsum. Four short, small spines occur along the posterior margin; about 24 moderate denticles along the anterior and anteroventral margins. Normal pores evenly distributed over the surface. Smooth, prominent, subrounded eye tubercle.

Occurrence.--26.84, 69.64, 72.34 m; Meting Shale, Meting Limestone.

Gyrocythere sp. 2

Occurrence.--176.01 m; Lakhra Formation.

Genus HERMANITES Puri, 1955

Type species.--*Hermania reticulata* Puri, 1954

Hermanites sp. 2
Plate 2, figure 14

Description.--In lateral view, left valve is subquadrate to subrectangular in outline. Dorsal margin irregular, follows an overall horizontal trace; anterodorsal corner rounded, obtuse, raised above margin; anterior margin smoothly and evenly curved; ventral margin broadly concave, inclined upward at posterior end; posterior margin somewhat truncated, with blunt, wide caudal process located ventral of midline; posterodorsal margin concave, sloping steeply to dorsum; posterodorsal cardinal angle a right angle. Greatest length ventral of midline, through caudal process; greatest height through anterodorsal cardinal angle. Length 666 um, height 400 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation pits are ovoid, quadrate, and irregular in shape. Reticulation is arranged concentrically, parallel to the anterior margin up to the subcentral tubercle; reticulation is more chaotically arranged along dorsal, posterior, and ventral parts. Large, smooth, raised subcentral tubercle. Large triangular region along posterior margin is fairly flat and unornamented. Reticulation ridges become thicker, more calcified at posterior side. A pronounced ridge originates at the posterodorsal corner and proceeds slightly obliquely to the ventral margin, where it meets with a hroizontal-trending ventral ridge that parallels the margin. The intersection of the ridges is marked by a sharp tubercle. Posteroventral margin with four short, broad denticles; anterior margin with about 18 small sharp denticles. Elongate-ovoid, smooth eye spot. Normal pores located within ornament pits.

Occurrence.--45.35 m; Meting Limestone.

Hermanites sp. 3
Plate 2, figure 15

Description.--In lateral view, left valve is trapezoid in shape. Dorsal margin inclines toward posterior, forms a scalloped shape because of ornament overhang; anterior margin is smoothly rounded, with greatest extent vetnral of midline; ventral margin has a weak, shallow concavity, converges toward posterior; sharp, short caudal process is ventral of midline; posterodorsal margin is truncated, nearly vertical. Rounded, obtuse anterodorsal cardinal angle; posterodorsal cardinal angle forms a right angle. Greatest length ventral of midline, through caudal process; greatest height through anterior hinge element. Length 515 um, height 310 um.

Ornamentation consists of reticulation, ridges, tubercles, and denticles. Primary ornament is reticulation, which forms large ovoid to subquadrate pits. Reticulation is arranged concentrically, subparallel to the valve margins. Broad, flat anterior marginal rim; irregular, scalloped dorsal ridge. An irregular, strong ridge originates at the posterodorsal corner and proceeds to the ventral margin; a short arm of the ridge trends horizontally to a large, smooth subcentral tubercle. Arcuate, strong, wide ventral ridge partly overhangs the margin and terminates at the posterior as a large tubercle. Posterior margin with a broad, weakly ornamented shelf that is triangular in shape. Subtle, smooth elongate eye spot. Anterior margin

with numerous small denticles; posterior with six marginal denticles. Sieve-type normal pores located in ornament pits; pores have surrounding rim.

Occurrence.--69.64, 72.34 m; Meting Limestone.

Hermanites sp. 4

Occurrence.--69.64, 81.6 m; Meting Limestone.

Hermanites sp. 5

Occurrence.--152.7 m; Lakhra Formation.

Genus OCCULTOCYTHEREIS Howe, 1951

Type species.--*Occultocythereis delumbata* Howe, 1951

Occultocythereis sp. 1

Occurrence.--7.70 m; Meting Shale.

Occultocythereis sp. 2
Plate 3, figure 8

Description.--In lateral view, left valve is elongate, quadrate in outline. Dorsal margin is slightly sinuous, converges weakly toward posterior; oblique, rounded, protruding anterodorsal and posterodorsal cardinal angles; anterior margin evenly curved; anteroventral comer extends down well beyond margin; ventral margin sinuous, with pronounced concavity; posterior margin truncated. Greatest length through midline; greatest height through anterior hinge element. Length 420 um, height 208 um.

Ornamentation consists of reticulation, spines, tubercles, and denticles. Primary ornament is a weak reticulation, with low broad ridges that form shallow ovoid pits. Reticulation is developed in the valve center and terminates as radiating ridges toward the anterior and posterior. Anterior, posterior, and ventral margins with a broad sulcus subparallel to the valve outline. Anterior and posterior with a wide, smooth marginal rim. Large, smooth, ovoid eye tubercle. Large, rounded subcentral tubercle. Two large spines at posterodorsal corner. Posterior margin with three large spines at midmargin and nine large denticles along the venter. Anterior marginal rim with a row of short, rounded spines that increase in size ventrally. Anterior margin with numerous large denticles in dorsal half and overlapping clavate spines in ventral half. Few, large sieve-type normal pores occur in reticulation pits.

Occurrence.--12.27, 14.91, 20.08, 26.84 m; Meting Shale.

Occultocythereis sp. 3
Plate 3, figure 9

Description.--In lateral view, left valve elongate-rectangular in outline. Dorsal margin is straight, inclined toward posterior; anterior margin evenly rounded; ventral margin with pronounced concavity; posterior margin somewhat truncated; posteroventral portion has an oblique corner and angles up to middle of margin; posterodorsal part slopes steeply up to dorsum; distinct, rounded, obtuse posterodorsal and posteroventral corners. Greatest length through midline of valve; greatest height through anterodorsal corner.

Ornamentation consists of reticulation, spines, and denticles. Most of valve covered by a low reticulation network, arranged roughly in a concentric-radial pattern. Wide, flat, crescentic areas adjacent to the anterior and posterior margins are free of ornamentation. Reticulation network covered with small, short spines. The spines are simple or have an expanded terminus that is bifurcate or trifurcate. The appearance in lateral view is of a pustule-covered surface that is nearly interconnected. The valves are laterally compressed. Anterior with a row of numerous short spines along the entire margin. Smaller spines form a continuous row along the ventral margin. Seven larger spines extend vertically along the margin. All of the margins have numerous marginal denticles or short spines; posterior margin has the largest spines. Rounded, smooth hemispherical eye spot.

Occurrence.--12.27, 14.91, 20.08, 26.84, 45.35, 69.64, 81.6, 139.94, 147.96 m; Meting Shale, Meting Limestone, Lakhra Formation.

Occultocythereis sp. 4

Occurrence.--26.8, 190.11 m; Meting Shale, Lakhra Formation.

Occultocythereis sp. 5

Occurrence.--69.64 m; Meting Limestone.

Genus PHALCOCYTHERE Siddiqui, 1971

Type species.--*Cythere horrescens* Bosquet, 1852

Phalcocythere sp. 1
Plate 3, figure 10

Description.--In lateral view, adult left valve is subquadrate to ellipsoidal in shape. Dorsal margin is sinuous, mostly convex; rounded, obtuse, protruding anterodorsal cardinal angle; evenly curved anterior margin; ventral margin with shallow, slight concavity; posteroventral margin curves obliquely up; posterodrsal margin truncated, nearly vertical; obtuse, rounded posterodorsal cardinal angle. Greatest length is slightly dorsal of midline; greatest height through anterior hinge element. Length 500 um, height 325 um.

Ornamentation consists of reticulation and denticles. The reticulation ridges are low and broad, forming shallow ovoid pits. The pits are arranged roughly concentric to the subcentral tubercle and the

valve margins. Ornament pits become smaller at antero- and posterodorsal regions. A short dorsal ridge overhangs the margin. Irregularly-shaped smooth subcentral tubercle. Arcuate, weak ridges occur along the ventral margin. Large, rounded, smooth eye spot. Numerous anterior marginal denticles; few small denticles along venter; seven posterior marginal denticles. Small normal pores scattered over valve surface; pores are located on reticulation ridges.

Occurrence.--45.35, 72.34, 137.62, 139.94, 147.96 m; Meting Limestone, Lakhra Formation.

Phalcocythere sp. 2
Plate 3, figures 11, 12

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is broadly arched; rounded anterior margin, with greatest extent ventral of midline; ventral margin with pronounced concavity; posterior margin truncated, with weak caudal process; posteroventral margin convex; posterodorsal margin concave; subtle, obtuse, rounded posterodorsal corner. Greatest length at midline of valve; greatest height anterior of midline, through anterodorsal corner. Length 715 um, height 392 um.

Ornamentation consists of reticulation, ridges, and spines. Reticulation pits are subrounded in shape and distributed irregularly over the valve surface. Reticulation ridges are narrow but relatively high and visible. Reticulation ridge intersections are marked by short blunt spines, located all over the valve surface. A weak ventral ridge forms a straight line above the middle of the ventral margin. A second weak, low ridge parallels the posterior margin. The dorsal margin is irregular in outline due to overhanging blunt spines, especially at the posterodorsal. Posteroventral margin with small spines.

Occurrence.--68.58, 69.64, 81.6 m; Meting Limestone.

Phalcocythere sp. 3

Measurements.--Length 714 um, height 428 um.

Occurrence.--81.6, 88.11, 139.94 m; Meting Limestone, Lakhra Formation.

Phalcocythere sp. 4

Occurrence.--147.96, 160.78, 171.02, 183.35 m; Lakhra Formation.

Phalcocythere sp. 5

Occurrence.--190.11 m; Lakhra Formation.

Genus HORNIBROOKELLA Moos, 1965

Type species.--Cythere anna Lienenklaus, 1894

Hornibrookella sp. 1

Occurrence.--45.35, 63.82, 68.58 m; Meting Limestone.

Hornibrookella sp. 2

Occurrence.--68.58 m; Meting Limestone.

Genus QUADRACYTHERE Hornlbrook, 1952

Type species.--Cythere truncula Brady, 1898

Quadracythere directa Siddiqui, 1971
Plate 2, figure 13

Quadracythere (Hornibrookella) directa Siddiqui, 1971, p. 66-67, pl. 33, figs. 16, 17; pl. 34, figs. 1, 2.

Occurrence.--12.27 m; Meting Shale; Green and Nodular Shales, Rakhi Nala.

Quadracythere reticulospinosa Sohn, 1959
Plate 2, figure 9

Quadracythere reticulospinosa Sohn, 1959, p. 64, pl. 2, figs. 29-33.

Occurrence.--81.6 m; Meting Limestone. Meting Limestone, about 4 mi. south of Meting Railway Station, Hyderabad District.

Quadracythere sp. 1
Plate 2, figures 7, 10

Description.--In lateral view, adult left valve is subquadrate in shape. Dorsal margin is slightly sinuous, nearly straight; obtuse, rounded anterodorsal cardinal angle; anterior margin is evenly curved; ventral margin is convex; posterior margin is truncated, angles obliquely along posteroventer and posterodorsum. Greatest length through midline; greatest height through anterior hinge element. Length 680 um, height 366 um.

Ornamentation consists of reticulation and denticles. Reticulation ridges form ovoid- to subquadrate-shaped pits. Reticulation is arranged roughly in a concentric pattern, subparallel to the tubercle; reticulation pattern is more chaotic and compressed at the posterior end. Muscle scar tubercle is formed by thickening of reticulation ridges, forming an open circle with several small radiate ridges.

Anterior and ventral margins with a single row of large, subquadrate pits; posterior margin nearly smooth, with weak development of ornament. Weak, arcuate ventral ridge; moderately developed, overhanging dorsal ridge. Large, smooth eye spot. Anterior with numerous small marginal denticles; posterior margin with five denticles. Few, small normal pores scattered over valve surface, occurring at intersection of reticulation ridges.

Occurrence.--12.27, 14.91, 69.64 m; Meting Shale, Meting Limestone.

Quadracythere sp. 2
Plate 2, figures 8, 12

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is irregular, inclined slightly to the posterior; distinct, raised, anterodorsal corner; anterior margin forms a rounded arcuate shape; ventral margin very slightly concave, nearly straight; posterior margin truncated. Dorsal and ventral margins slightly converge toward the posterior. Greatest length is at the midline of the valve; greatest height is just anterior of valve midline. Length 833 um, height 466 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation forms subrounded, oval, subrectangular, and irregular pits. One row of pits is parallel to the ventral margin; a second row of ornament pits is parallel to the anterior margin. Subcentral tubercle is highlighted by C-shaped ornamentation. A strong ridge is parallel to the ventral margin, forming a right angle turn at the posteroventer and ending at the posterodorsal margin. A second ridge originates at the anterodorsal region and extends to the anteroventral portion. The ridges seem to be superimposed on the reticulation pattern. Strong anterior marginal rim; low posterior marginal rim. Fine anteroventral marginal denticles; about six short blunt denticles along the posterior margin. Posterior margin with a broad, flattened region that has a weak reticulation pattern. Large rounded eye spot. Normal pores are distributed over the valve surface, occurring both in the ornament pits and on the ridges.

Occurrence.--12.27, 14.91, 20.08, 26.8, 45.35, 68.58, 69.64, 72.34 m; Meting Shale, Meting Limestone.

Quadracythere sp. 3

Occurrence.--14.91, 147.96, 152.7 m; Meting Shale, Lakhra Formation.

Quadracythere sp. 4

Occurrence.--14.91 m; Meting Shale.

Quadracythere sp. 5

Occurrence.--26.83 m; Meting Shale.

"Quadracythere" sp. 1
Plate 2, figure 6

Description.--In lateral view, left valve is almost rectangular in shape. Dorsal margin is straight and inclines slightly towards posterior. Distinctly raised anterodorsal corner. Anterior margin is rounded, semicrescentic in shape; ventral margin is straight but slightly oblique towards posterior; posterior margin is truncated; obtuse posterodorsal margin. Greatest length is through midline of valve; greatest height is anterior of midline, through anterodorsal corner. Length 500 um, height 285 um.

Ornamentation consists of reticulation and ridges. Reticulation forms subrounded and rectangular pits. Ornament pits are arranged irregularly all over the valve. One prominent ridge originates from the anterodorsal region, runs along the anterior margin, and passes parallel to the ventral margin after a right angle turn at the anteroventral margin. A second ridge originates from the posteroventrum, parallels the posterior, and ends at the posterodorsum. Smooth region at posterior end. Moderate posterior marginal ridge. Hemispherical subcentral tubercle. Clusters of pustules form tubercle-like structures that occur irregularly all over valve surface. Small denticles throughout the ventral margin; eight spines are from the mid-posterior to posteroventrum. Sieve pores common in the middle and posterior of the valve. Pustules common all over the valve surface.

Occurrence.--12.27, 14.91, 22.83, 26.83, 45.35, 63.82, 69.64m; Meting Shale, Meting Limestone.

Genus STIGMATOCYTHERE Siddiqui, 1971

Type species.--*Stigmatocythere obliqua* Siddiqui, 1971

Stigmatocythere sp. 1
Plate 2, figure 3

Description.--In lateral view, adult left valve is subquadrate and rounded in shape. Dorsal margin is straight, inclined slightly toward posterior; strong, protruding anterodorsal cardinal angle; anterior margin evenly curved; ventral margin nearly straight, inclined obliquely toward posterior end; posteroventral margin angles up sharply; posterodorsal margin truncated; posterodorsal cardinal angle nearly a right angle. Greatest length through midline; greatest height through anterior hinge element.

Ornamentation consists of tubercles, ridges, spines, and denticles. Valve surface is largely smooth, especially at anterior. Large, smooth, ovoid subcentral tubercle. Six smaller tubercles or blunt spines line up in a crescentic pattern along the ventral and posterior margins; the curve is paralleled by a scalloped narrow ridge along the ventral margin. Dorsal margin with four blunt spines that extend beyond the valve edge. Large, smooth eye tubercle. Anterior and posterior margins with a broad, smooth, flattened platform. Five thick denticles occur in the middle of the posterior margin; numerous denticles occur along the anterior and ventral margins.

Occurrence.--14.91, 22.83, 45.35 m; Meting Shale, Meting Limestone.

Genus ACANTHOCYTHEREIS Howe, 1963

Type species.--*Acanthocythereis araneosa* Howe, 1963

Acanthocythereis sp. 1
Plate 2, figures 4, 5

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is nearly straight, inclined slightly toward posterior; distinct raised anterodorsal cardinal angle; anterior margin rounded, forms an arcuate shape; ventral margin slightly concave; posterior margin truncated, forms an uneven curve; posterodorsal corner forms a right angle. Ventral margin converges toward posterior. Greatest length is through midline of valve; greatest height is anterior of midline, through anterodorsal corner. Length 807 um, height 415 um; length 664 um, height 430 um.

Ornamentation consists of reticulation, ridges, and spines. Reticulation forms rectangular, subrounded, and oval pits. Ornament pits are arranged in concentric form. Rows of pits are parallel to the anteiror, ventral, and posterior margins. Blunt spines occur all over the surface of the valve, at intersections of reticulation ridges. Two ridges originate at the anterodorsal corner and proceed parallel to the anterior margin, terminating close to the center of the ventral margin. Double row of blunt marginal spines at anterior; fewer, larger spines along posteroventer; mix of larger blunt spines and smaller denticles forming multiple rows at posterior. Large, smooth, raised eye tubercle.

Occurrence.--12.27, 14.91, 20.08, 22.83, 69.64, 72.34, 98.78 m; Meting Shale, Meting Limestone, Sohnari Formation.

Genus SCHIZOPTOCYTHERE Siddiqui and Al-Furaih, 1981

Type species.--*Schizoptocythere circumspinosa* Siddiqui and Al-Furaih, 1981

Schizoptocythere sp. 1

Occurrence.--20.08 m; Meting Shale.

Schizoptocythere sp. 2

Occurrence.--28.8, 45.35, 81.6 m; Meting Shale, Meting Limestone.

Schizoptocythere sp. 3
Plate 1, figures 14, 15

Description.--In lateral view, left valve is triangular in shape, forming an isosceles triangle. The dorsal margin is uneven, inclined steeply toward the posterior; anterodorsal corner is slightly raised above the margin; anterior margin is subrounded; ventral margin has a concavity, inclines obliquely to the posterior; posterodorsal margin is nearly straight, inclined obliquely toward dorsum; obtuse posterodorsal corner. The dorsal and ventral margins converge toward the posterior end. Weak caudal process. Greatest length is ventral of midline, through caudal process; greatest height is anterior of midline, through anterodorsal corner.

Ornamentation consists of reticulation, ridges, spines, and denticles. The reticulation forms subrounded, ovoid, and ellipsoidal pits. Three distinct spines are located on the subcentral muscle tubercle. Four spines are located along the middle part of the ventral margin. Few, large normal pores occur on the

valve surface between pits. Ten moderate sized spines occur along the anterior, ventral, and posteroventral margins. Five large blunt spines project well beyond the dorsal margin. Two sets of marginal denticles: one group occurs along the anteroventral margin, and a second set of six blunt denticles have fused to form a flange at the middle of the ventral margin that extends beyond the edge of the valve. Rounded, raised, distinct eye tubercle. Rounded ventral ridge is expressed as a swelling along the ventral half of the valve. Broad, flattened, smooth regions are adjacent to the posterior and anterior margins.

Occurrence.--139.94, 151.1 m; Lakhra Formation.

Schizoptocythere sp. 4
Plate 1, figure 13

Description.--In lateral view, left valve forms an isosceles triangle in outline. Dorsal margin is straight, steeply inclined toward posterior; anterior margin subrounded; ventral margin has concavity and inclines toward posterior; posterior margin is truncated; posterodorsal corner is obtuse. Dorsal and ventral margins converge to posterior. Greatest length is at middle of valve; greatest height is anterior of midline, through anterodorsal corner. Length 576 um, height 277 um.

Ornamentation consists of spines. Valve surface is essentially smooth; no reticulation or pitting. Slight swelling of valve along middle of ventral margin. Six large spines with expanded ends occur along anterodorsal margin; three large spines with expanded ends in middle of anterior margin. Eight blunt denticles or small spines occur along anteroventral margin; four large spines with expanded ends are along the ventral margin; three small, blunt spines along the posterior margin. A broad depressed area extends from the posteroventer, follows the posterior margin, and ends at the posterodorsal margin. Subtle, ovoid, smooth eye spot.

Occurrence.--139.94, 151.1, 172.4, 183.35, 190.11 m; Lakhra Formation.

Schizoptocythere sp. 5

Occurrence.--147.96 m; Lakhra Formation.

Genus VEENIA Butler and Jones, 1957

Type species.--*Cythereis ozanana* Israelsky, 1929

Veenia sp. 1
Plate 3, figures 1, 2

Description.--In lateral view, left valve is elongate-rectangular to subtrapezoidal in outline. Dorsal margin is somewhat sinuous, angling slightly down toward the posterior; oblique, curved posterodorsal cardinal angle; large, broad raised anterodorsal corner; evenly curved anterior margin; straight ventral margin, trends obliquely up toward posterior; posteroventral comer an oblique angle, defining a caudal process; most of posterior margin is straight, angling sharply up anterodorsally. Greatest length ventral of midline, through caudal process formed by posteroventral corner; greatest height anterior of midline, through

anterodorsal corner. Length 666 um, height 380 um.

Ornamentation consists of tubercles, ridges, nodes, spines, and denticles. Most of valve surface is smooth. Valve is dominated by a large, smooth, rounded subcentral tubercle. Five elongate node-like ridges radiate from the tuberce along its posterior side. An arcuate ridge forms a swelled area above the ventral margin. Distinct, smooth, raised rim along anterior and posterior margins. Two long spines project from the posteroventral corner. A series of denticles occur along the anterior margin. Large, smooth, hemispherical eye tubercle. Normal pores evenly distributed over valve surface.

Occurrence.--7.07, 12.27, 14.91, 20.08, 26.84, 28.8, 45.35 m; Meting Shale, Meting Limestone.

Veenia sp. 2

Occurrence.--45.35 m; Meting Limestone.

Veenia sp. 3
Plate 3, figure 3

Description.--In lateral view, adult left valve is elongate and quadrate in shape. Dorsal margin is nearly straight, converges slightly obliquely toward posterior; anterior margin is smoothly curved, with greatest extent ventral of midline; ventral margin is sinuous, with shallow, broad concavity; posterior margin is drawn-out, with weak caudal process located ventral of midline. Rounded, obscured cardinal angles. Greatest height through anterior hinge element; greatest length through caudal process.

Ornamentation consists of reticulation, ridges, spines, and denticles. Large, smooth, rounded subcentral tubercle. The reticulation pattern, consisting of narrow ridges and ovoid pits, occurs along the anterior, ventral, and posterior marginal regions of the valve. Oblique ridge occurs subparallel to the ventral margin. Four narrow ridges proceed horizontally from the tubercle towards the posterior end; the ridges become progressively longer dorsally. Ventral and posterior margins with broad, flattened shelf covered with weakly developed reticulation. Thin marginal ridge at anterior and posterior. Smooth ovoid eye spot. Anterior margin with numerous denticles or short spines and two longer spines; posterior margin with five blunt denticles and two larger spines. Few normal pores scattered over valve surface, occurring on ridges.

Occurrence.--147.96, 151.1, 152.7, 183.35, 190.11 m; Lakhra Formation.

Veenia sp. 4

Occurrence.--160.78 m; Lakhra Formation.

Veenia sp. 5
Plate 3, figure 4

Description.--In lateral view, adult right valve is elongate, triangular in shape. Dorsal margin sinuous, converges toward posterior; anterior margin evenly rounded; ventral margin convex, converges toward posterior; posterior with acute caudal process located ventral of midline. Greatest length through caudal process; greatest height through anterior hinge element.

Ornamentation consists of reticulation, ridges, tubercles, and denticles. Large, rounded, smooth subcentral tubercle dominates valve. Reticulation is weakly developed, primarily at anterior end. Anterior margin with a single row of elongate ornament pits oriented radially from the tubercle. Arcuate, thickened ventral ridge. Posterior side of tubercle with elongate, horizontally-oriented ridges. Large, smooth, ovoid eye spot. Anterior and posterior with marginal rim. Posterior and ventral margins with wide, flattened shelf. Secondary papillate ornament adjacent to tubercle. Sieve-type normal pores, some located in ornament pits and some occurring within blunt spines. Anterior with 12 marginal denticles; posterior with nine marginal denticles and spines.

Occurrence.--171.02 m; Lakhra Formation.

New Genus A

New Genus A sp. 1
Plate 4, figure 13

Description.--In lateral view, left valve is quadrate in shape. Dorsal margin is concave; anterior margin is evenly curved; ventral margin is broadly concave; posterior margin is irregular, with hint of caudal process located ventral of midvalve. Dorsal and ventral marginds are subparallel. Greatest length is slightly ventral of midline; greatest height is through anterior hinge element. Juvenile: length 564 um, height 294 um; adult: length 1060 um, height 620 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation is weak, ridges are narrow and weak; reticulation forms quadrate, ovoid, and crescentic shaped pits. Reticulation is developed as a single row along the anterior margin, as several rows along the ventral margin, and covering about one-third of the valve at the posterior end. Strong, smooth ridge parallels the anterior margin. Most of the valve surface is smooth, with scattered, large normal pores. Posterior margin scalloped, with two overlapping rows of blunt marginal denticles.

Occurrence.--68.58, 69.64 m; Meting Limestone.

New Genus A sp. 2
Plate 4, figure 14

Description.--In lateral view, left valve is elongate-quadrate in shape. Dorsal margin broadly convex, nearly straight; anterior margin smoothly curved; ventral margin is broadly concave; posterior margin with a blunt caudal process located ventral of midline; posterodorsal margin nearly vertical. Greatest length slightly ventral of midline; greatest height through anterior hinge element.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation developed as single row of small pits along anterior margin. Posterior margin with scalloped reticulation occurring just inside of margin. Ventral margin with weak sinuous ridge. Posteroventral margin with two rows of overlapping blunt denticles. Numerous large normal pores scattered over valve surface.

Occurrence.--68.58 m; Meting Limestone.

New Genus B

New Genus B sp. 1
Plate 1, figures 11, 12

Description.--In lateral view, left valve is ellipsoidal in shape. Dorsal margin is highly arched, with greatest height just anterior of midline of valve; posterodorsal portion is straight, angling down toward posterior; anterior margin is evenly curved; ventral margin is slightly concave, nearly straight; posterior margin has a weak caudal process located slightly ventral of valve midline. Dorsal and ventral margins converge toward posterior. Greatest length is ventral of midline, through caudal process; greatest height is just anterior of valve midline. Length 588 um, height 364 um.

Ornamentation consists of longitudinal ridges. Ridges converge at anterior and posterior margins. Ridges are wide, flat, and nearly equal in size. Ridges die out toward dorsal margin. Elongate oval pits occur in the medial dorsal region and extend in a narrow band to middle of valve. Smooth flattened regions occur adjacent to anterior and posterior margins. Arcuate depression along anterodorsal margin. Approximately eight small denticles at middle of anterior margin. At least 82 normal pores are evenly distributed over valve surface, occurring both on and between ridges.

Inner margin of equal width throughout. Four adductor muscle scars form vertical row. Scars are elongate in shape. Large ovoid frontal muscle scar. Rounded fulcral point. Few elongate dorsal muscle scars, most just below hinge.

Hinge in right valve consists of anterior rounded tooth, smooth anteromedian bar, crenulate posteromedian groove, and an elongate posterior tooth followed by a bipartite posterior tooth.

Occurrence.--139.94, 147.96, 172.4, 176.01, 183.35, 190.11 m; Lakhra Formation.

New Genus C

New Genus C sp. 1
Plate 3, figures 5, 6

Description.--In lateral view, left valve is elongate-subtriangular in outline. Dorsal margin forms a distinct obtuse curve, converging toward posteroventer; anterodorsal margin with a small notch; large, raised, rounded, obtuse anterodorsal corner; anterior margin smoothly curved, with greatest width ventral of midline; anteroventral margin convex, posteroventral margin concave; ventral margin sinuous in course; posterior margin forms a caudal process, broad and drawn-out, directed posteroventrally, so that posterior end appears to "droop". Greatest length through midline; greatest height anterior of midline, through anterodorsal corner. Length 526 um, height 294 um.

Ornamentation consists of ridges and spines. Most of valve surface is smooth. Entire valve with a low, rounded marginal ridge. Four ridges trend longitudinally in the median valve region. The dorsal-most ridge is arched; the dorsomedian ridge is nearly straight; the ventromedian ridge is arched; and the ventral-most ridge forms an elongate S-shape. Anterodorsal corner with a narrow, elongate, oblique depression. Rounded, smooth eye spot. Anterior margin with four long narrow spines; posteroventral margin with a prominent, elongate spine directed posteroventrally.

Occurrence.--139.94, 147.96, 151.1, 176.01, 183.35, 190.11 m; Lakhra Formation.

New Genus C sp. 2
Plate 3, figure 7

Description.--In lateral view, left valve is subtriangular, elongate in shape. Dorsal margin nearly straight, inclined down toward posterior; anterior margin is smoothly curved; ventral margin is sinuous, with a convex anterior half and concave posterior half; posterior margin protracted, with a strong caudal process that occurs well ventral of midline. Greatest length is ventral of midline; greatest height through anterior hinge element.

Ornamentation consists of reticulation, tubercles, and denticles. Reticulation ridges are wide and low. Reticulation covers a crescentic region posteriorly, with the two arms extending dorsal and ventral of subcentral tubercle. Reticulation pits are small, shallow, and ovoid. Reticulation consists of a single rwo along the anterior margin, forming large quadrate pits. A crescentic raised area at the posteromedian valve area highlights the reticulation. Anterior and posterior margins with a smooth, strong ridge. Large, rounded, smooth subcentral tubercle with a trailing ridge that extends toward the anterior. Posterior with a smooth, depressed arcuate region along the margin. Posteroventral corner with a distinctive elongate marginal spine, directed posteroventrally. Anteroventral margin with three short denticles. Numerous normal pores are scattered over valve surface, occurring mainly on reticulation ridges, with few in the pits. Secondary reticulate ornament developed on floor of primary reticulation pits, especially in median valve region surrounding subcentral tubercle.

Occurrence.--139.94, 171.02, 172.4, 176.01 m; Lakhra Formation.

Trachyleberid sp. 1

Occurrence.--14.91, 69.64 m; Meting Shale, Meting Limestone.

Trachyleberid sp. 2
Plate 3, figure 15

Description.--In lateral view, left valve is subtrapezoid in shape. Dorsal margin is straight; anterior margin is evenly curved; ventral margin is sinuous, with a slight concavity; posteroventral margin scalloped, with a strong, protruding caudal process; posterodorsal margin slopes obliquely toward anterodorsum. Rounded, obtuse antero- and posterodorsal cardinal angles. Greatest length ventral of midline, through caudal process; greatest height through anterior hinge element.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation consists of low, broad ridges that form irregyular polygonal shapes. Reticulation pattern is fairly chaotic. Subtle subcentral tubercle. Ventral margin with sinuous, overhanging ridge. A vertical ridge originates at the posterodorsal corner and terminates ventrally as an irregular tubercle. Anterior and posterior margins with a low, smooth rim. Prominent ovoid eye tubercle. Anterior with numerous, very small marginal denticles; posterior with seven blunt, strong marginal denticles. Few, scattered, small normal pores occur on reticulation ridges. Length 750 um, height 428 um.

Occurrence.--20.08 m; Meting Shale.

Trachyleberid sp. 3

Occurrence.--139.94 m; Lakhra Formation.

Trachyleberid sp. 4
Plate 3, figures 13, 14

Description.--In lateral view, left valve is subrectangular in shape. Dorsal margin is nearly straight and inclines slightly toward posterior; anterior margin forms a semi-rounded shape; ventral margin is almost straight and slightly inclined toward posterior; posterior margin is truncated; posterodorsal corner forms obtuse angle. Greatest length is slightly ventral of midline; greatest height is anterior of valve midline, through anterodorsal corner.

Ornamentation consists of reticulation, ridges, and spines. Reticulation forms rectangular, elongated rectangular, triangular, subrounded, oval, and irregular pits. Ornament pits are arranged in a spiral pattern around the subcentral tubercle in the center of the valve, in a concentric pattern at the anterior, and in a broad curve parallel to the ventral-posterior ridge. One prominent arcuate ridge originates from the anteroventrum and ends at posterodorsum. A second weaker ridge originates from posteroventer and follows the posterior margin up to the posterodorsum. Strong, broad anterior marginal rim; low, broad posterior marginal rim. Elongated bar-like depression from posterodorsum to posteroventer, parallel to posterior margin. A second depression is semi-triangular in shape, located at dorsal margin close to the eye tubercle. Prominent, smooth, subrounded eye spot. Medium-size denticles located at anterior and small denticles at anteroventral margin; six blunt spines along mid-posterior and posteroventral margin. Pores are located all over valve, comparatively less in the anterior.

Occurrence.--139.94, 147.96, 152.7 m; Lakhra Formation.

Trachyleberid sp. 5

Occurrence.--211.86 m; Bara Formation.

Family HEMICYTHERIDAE Puri, 1953
Genus CAUDITES Coryell and Fields, 1937

Type species.--Caudites medialis Coryell and Fields, 1937

Caudites sp. 1
Plate 4, figure 10

Description.--In lateral view, left valve is elongate, subtriangular in shape. Dorsal margin is straight, inclined obliquely toward posteroventer; obtuse, rounded anterodorsal cardinal angle; anterior margin evenly curved; ventral margin is nearly straight, with very subtle concavity; ventral margin inclined toward posterior; posteroventral margin with pronounced, acute, drawn-out caudal process; posterodorsal margin concave, nearly vertical; posterodorsal corner forms a right angle. Dorsal and ventral margins converge toward posterior. Greatest length ventral of midline, through caudal process; greatest height through anterior hinge element. Length 572 um, height 294 um.

Ornamentation is spartan, with most of valve surface being smooth. Anterior with broad, smooth marginal rim. A prominent ridge that trends vertically from the dorsal margin to the ventral margin forms a zig-zag shape. Weak, small eye spot. Few small normal pores scattered over valve surface. Few, very small anterior marginal denticles. Posterior margin with four small denticles along the ventral side of the caudal process and eight short triangle-shaped denticles along the posterodorsal margin.

Occurrence.--14.91, 20.08, 68.58, 69.64 m; Meting Shale, Meting Limestone.

Caudites sp. 2
Plate 4, figures 11, 12

Description.--In lateral view, left valve is subrectangular to subtrapezoidal in shape. Dorsal margin is uneven, concave overall, inclined slightly toward posterior. Distinctly raised anterodorsal corner; subrounded anterior margin; slightly uneven ventral margin tapering toward posterior; posterior margin having prominent caudal process located ventral of valve midline; posterodorsal corner is obtuse and raised. Greatest length is slightly ventral of midline, through caudal process; greatest height is anterior of midline, through anterodorsal corner. Length 700 um, height 366 um.

Ornamentation consists of reticulation, ridges, denticles, and spines. Reticulation forms rectangular, triangular, and subrounded pits. One row of pits is concentric about the rounded subcentral tubercle and forms a circular shape. A second row of pits is parallel to the first and follows the concentric trend. A third row of pits roughly follows the concentric pattern, occurring close to and parallel with the anterodorsal, anterior, and anteroventral margins. One row of pits follows the posteroventral, posterior, and posterodorsal margins. A prominent ridge originates at the posterodorsal comer, proceeds somwehat obliquely to the ventral margin, where it forms a tubercle-like structure, then proceeds parallel to the ventral margin and terminates at the anteroventral margin. A marginal ridge originates at the anterodorsum and parallels the anterior margin. Flattened triangular region along posterior margin, with only a trace of the reticulation. Two spines at the posteroventral margin; 12 small denticles at the anterior and anteroventral margin. Smooth ovoid eye spot. Few normal pores, occurring in ornament pits, mostly at edge of pits.

Occurrence.--26.84, 45.35 m; Meting Shale, Meting Limestone.

Caudites sp. 3
Plate 4, figure 9

Description.--In lateral view, right valve forms an elongate triangular shape. Dorsal margin is nearly straight, inclines obliquely toward posterior; anterior margin irregularly curved; ventral margin sinuous, angles up obliquely toward posterior; posterior margin with a very attenuated, narrow, sharp caudal process, located ventral of midline; posterodorsal margin angles obliquely toward anterodorsum; oblique posterodorsal cardinal angle. Dorsal and ventral margins converge sharply toward posterior. Greatest length ventral of midline, through caudal process; greatest height through anterior hinge element.

Ornamentation consists of reticulation and ridges. Reticulation covers most of valve surface, forming a radial pattern. Reticulation ridges are low and narrow, forming small ovoid pits. Two stronger reticulation ridges radiate from the median region toward the posterior; four stronger reticulation ridges radiate to the anterior margin. These stronger ridges terminate marginally as short spines or tubercles. A straight ridge occurs along the ventral margin.

Occurrence.--69.64 m; Meting Limestone.

Caudites sp. 4

Occurrence.--69.64, 152.7 m; Meting Limestone, Lakhra Formation.

Family BRACHYCYTHERIDAE Puri, 1954
Genus BRACHYCYTHERE Alexander, 1933

Type species.--Cythere sphenoides Reuss, 1854

Brachycythere sp. 1
Plate 6, figures 7, 8, 10

Description.--In lateral view, right valve is triangular in shape. Dorsal margin is broadly arched, angling obliquely toward posterior; slight concave portion at anterodorsal region; anterior margin is broadly rounded with a sharp end; anteroventral margin forms a high pronounced concavity followed by a broad convex portion in the middle of the ventral margin; posterior margin is rounded, drawn-out. Greatest length is at the midline of the valve; greatest height is anterior of midline of valve, through anterodorsal corner. Length 735 um, height 428 um.

Ornamentation consists of reticulation, ridges, spines, and denticles. Reticulation pits are rectangular and subrounded, of different sizes, and distributed in rows. Pitting becomes progressively finer toward valve margins. Ridges are low, fairly narrow, trending parallel to each other in the shape of a triangle, following the valve outline. Subtle subcentral tubercle. Normal pores are small, scattered over the surface. One spine at posteroventral margin; seven denticles along anterior margin. Eye tubercle is subtle, forms a broad elongate smooth shape.

Occurrence.--139.94, 147.96, 151.1, 171.02, 172.4, 176.01, 183.35, 190.11, 211.86 m; Lakhra Formation,

Bara Formation.

Genus PTERYGOCYTHEREIS Blake, 1933

Type species.--*Cythereis jonesii* Baird, 1850

Pterygocythereis sp. 1

Occurrence.--45.35, 147.96 m; Meting Limestone, Lakhra Formation.

Family LOXOCONCHIDAE Sars, 1925
Genus PHLYCTOCYTHERE Kalj, 1958

Type species.--*Phlyctocythere eocaenica* Kaij, 1958

Phlyctocythere sp. 1
Plate 5, figure 8

Description.--In lateral view, right valve is ovoid to subcircular in outline. Dorsal margin very broadly arched, nearly straight; anterodorsal margin steeply curved; anterior margin smoothly curved, with maximum curvature slightly ventral of midline; ventral margin very broadly concave; posteroventral margin inclined sharply toward dorsal; blunt, wide, pronounced caudal process; posterodorsal margin nearly straight, proceeds at 45^0 anterodorsally. No cardinal angles. Greatest length nearly midvalve; greatest height at midline.

Ornamentation consists of weak reticulation along dorsal and anteroventral margins. Reticulation forms small, ovoid pits. Most of valve surface is smooth. Valve is inflated at center, flat along margins, forming a disc-shape in profile. Wide, smooth, flat marginal flange along anterior, venter, and posterior.

Occurrence.--45.35, 68.58 m; Meting Limestone.

Family SCHIZOCYTHERIDAE Howe, 1961
Genus SCHIZOCYTHERE Triebel, 1950

Type species.--*Schizocythere hollandica* Triebel, 1950

Schizocythere sp. 1
Plate 4, figure 2

Description.--In lateral view, left valve is ovoid in outline. Dorsal margin very broadly arched, nearly straight; anterior margin smoothly curved, with greatest width ventral of midline; ventral margin obscured by ridge, appears broadly concave; posterior margin smoothly curved, with blunt, wide caudal process. Greatest length at midline of valve, through caudal process; greatest height through midline. Length 400 um, height 256 um.

Ornamentation consists of reticulation and tubercles. Few, thickened reticulation ridges form large polygonal pits with rounded shapes. A thickened ridge at dorsum dominates and overhangs the margin.

Anterior and posterior margins with narrow, flat, smooth regions. Strong arcuate ventral ridge overhangs margin and terminates posteroventrally as a tubercle. Large, subtriangular, smooth eye spot. Sieve-type normal pores occur within ornament pits. Four small anteroventral marginal denticles.

Occurrence.--12.27, 14.91, 20.08, 22.83, 26.84, 45.35 m; Meting Shale, Meting Limestone.

Schizocythere sp. 2

Occurrence.--14.91, 72.34 m; Meting Shale, Meting Limestone.

Schizocythere sp. 3
Plate 4, figure 5

Description.--In lateral view, left valve is ovoid in shape. Dorsal margin is nearly straight, inclined slightly toward posterior; anterior margin is evenly curved; ventral margin is convex, with a slight concavity; posterior margin with a broad, truncated caudal process. Obtuse, rounded posterodorsal cardinal angle. Greatest length through valve midline; greatest height through anterior hinge element. Length 537 um, height 352 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation forms ovoid pits of various sizes; reticulation pattern is fairly chaotic. Anterior and posterior margins with a flattened, smooth region. Large, smooth eye tubercle. A thickened reticulation ridge originates at the eye tubercle and trends to the middle of the ventral margin, forming an arcuate shape; the ridge terminates as a sharp point. A connecting reticulation ridge trends along a straight line to the caudal process. Large, sieve-type normal pores occur in the reticulation pits. Very small, numerous denticles along antero- and posteroventral margins.

Occurrence.--68.58, 69.64, 72.34 m; Meting Limestone.

Schizocythere sp. 4

Occurrence.--69.64 m; Meting Limestone.

Schizocythere sp. 5
Plate 4, figures 3, 6

Description.--In lateral view, left valve forms a shortened quadrate shape. Dorsal margin is convex, inclined toward posterior; anterior margin is smoothly curved, with greatest extent ventral of midline; ventral margin is sinuous, with a pronounced concavity; posterior margin forms a distinct truncated caudal process located dorsal of midline. Obtuse, rounded posterodorsal cardinal angle. Greatest length through caudal process; greatest height through anterior hinge element. Length 466 um, height 295 um.

Ornamentation consists of reticulation, tubercles, and denticles. Reticulation is coarse, with wide, high ridges that form a chaotic pattern of large ovoid to quadrate pits. Large, elongate, raised eye tubercle. Sinuous, irregular ventral ridge overhangs margin and terminates at posteroventer as a large tubercle that protrudes beyond valve margin. Large, protruding tubercle at posterodorsal corner. Anterior and posterior

margins with a broad, flattened region. Very small anteroventral marginal denticles.

Occurrence.--137.62, 139.94, 152.7, 183.35, 190.11 m; Lakhra Formation.

Schizocythere sorensis Siddiqui, 1981
Plate 4, figures 1, 4

Schizocythere sorensis Siddiqui, 1981, p. 234, pl. 18, figs. 8-11.

Measurements.--Length 500 um, height 289 um.

Occurrence.--137.62, 139.94, 147.96, 172.4, 176.01 m; Lakhra Formation.

Genus PAIJENBORCHELLA Kingma, 1948

Type species.--*Paijenborchella aurantia* Baird, 1838

Paijenborchella sp. 1
Plate 4, figure 7

Description.--In lateral view, right valve forms an elongate subtriangular shape. Dorsal margin is very broadly arched, nearly straight; anterior margin is smoothly curved, with the maximum width ventral of midline; ventral margin curves obliquely up toward posterior; posterior margin with an exaggerated caudal process that curves downward; posteroventral margin shows a highly arched, concave shape. No cardinal angles. Greatest length significantly ventral of midline, through caudal process; greatest height anterior of midline. Length 486 um, height 226 um.

Ornamentation consists of reticulation and denticles. Reticulation trends roughly parallel to the anterior margin in the anterior third, parallel to the posterodorsal, posterior, and ventral margins immediately adjacent to the valve edge, and irregularly in the posteromedian region. Surface of caudal process is smooth. Anterior margin with flattened region, nearly smooth, with weak radial ridges from the reticulation. Subtle, weakly developed, rounded ventral ridge. Wide, shallow, subtle sulcus trends from dorsal margin to center of valve. Few, small normal pores occur on reticulation ridges. Four small, evenly spaced anterior marginal denticles.

Occurrence.--7.07, 12.27, 14.91, 22.83, 26.84 m; Meting Shale.

Paijenborchella sp. 2
Plate 4, figure 8

Description.--In lateral view, left valve is elongate, subtriangular to subquadrate in shape. Dorsal margin very broadly convex, inclined slightly to posterior; anterior margin smoothly curved, with greatest extent ventral of midline; ventral margin sinuous, with pronounced, deep concavity; posterior margin with a narrow, protruding spine-like caudal process at the posteroventral corner; posterodorsal margin curves obliquely toward anterodorsum. Greatest length through caudal process; greatest height through anterior hinge element. Length 510 um, height 255 um.

Ornamentation consists of pitting. Small ovoid pits cover the valve surface, becoming larger toward valve periphery. Pits follow a reticulate pattern at anterior end. Smooth, ovoid eye tubercle. Crescentic sulcus occurs from the middle of the dorsal margin to mid-valve. Anterior and ventral margins with broad, smooth, flattened region with superimposed ridges extending radially from pitted ornament to valve edge.

Occurrence.--7.07, 14.91, 20.08 m; Meting Shale.

Paijenborchella sp. 4

Occurrence.--45.35 m; Meting Limestone.

Family XESTOLEBERIDIDAE Sars, 1928
Genus XESTOLEBERIS Sars, 1928

Type species.--Cythere aurantia Baird, 1838

Xestoleberis sp. 1

Occurrence.--7.07, 12.27, 14.91, 20.08, 45.35, 81.6, 152.7 m; Meting Shale, Meting Limestone, Lakhra Formation.

Xestoleberis sp. 2

Occurrence.--12.27, 26.84, 68.58 m; Meting Shale.

Xestoleberis sp. 3

Occurrence.--63.82, 68.58 m; Meting Limestone.

Xestoleberis sp. 4

Occurrence.--69.64 m; Meting Limestone.

Xestoleberis sp. 5

Occurrence.--147.96, 190.11 m; Lakhra Formation.

Genus ORNATOLEBERIS Kaij, 1975

Type species.--Ornatoleberis morkhoveni Kaij, 1975

Ornatoleberis sp. 1
Plate 4, figure 15

Description.--In lateral view, left valve is ovoid in shape. Dorsal margin rounded, highly arched; anterior margin evenly curved, with maximum curvature just ventral of midline; ventral margin sinuous with concavity; posterior margin smoothly curved, with small blunt caudal process located about midline. No cardinal angles. Valve is highly inflated. Greatest length at midline through caudal process; greatest height at midline. Length 500 um, height 310 um.

Ornamentation consists of pitting and weak ridges. Valve surface is covered with small ovoid pits. Pits are largest at center of valve, becoming progressively smaller toward the outside. Caudal process and anterior margin nearly free of pitting. Large, rounded, inflated ridge overhangs ventral margin and forms a broad, flattened ventral surface. Several rows of fine ridges form a concentric pattern, proceeding from the anterodorsal comer, along the anterior margin, and along the ventral ridge to the base of the caudal process. Slightly thickened, smooth, crescentic region marks the xestoleberid spot. Scattered, small normal pores evenly distributed over the valve surface, occurring on the surface between the pits.

Occurrence.--12.27, 20.08, 26.84, 45.35, 63.82, 68.58, 69.64, 152.7 m; Meting Shale, Meting Limestone, Lakhra Formation.

Family LEPTOCYTHERIDAE Hanai, 1957
Genus TANELLA Kingma, 1957

Type species.--Tanella gracilis Kingma, 1957

"Tanella" sp. 1

Occurrence.--176.01 m; Lakhra Formation.

Genus MOSALEBERIS Deroo, 1966

Type species.--Mosaleberis interrupta (Crane, 1965)

Mosaleberis sp. 1

Occurrence.--7.07 m; Meting Shale.

Mosaleberis sp. 2
Plate 7, figure 2

Description.--In lateral view, left valve is quadrate, truncated in shape. Dorsal margin is sinuous, inclined obliquely toward posterior; anterior margin is evenly rounded; ventral margin is convex, curving up toward

posterior; slight concavity; posterior margin is slightly drawn-out, with obliquely inclined posterodorsal and posteroventral parts and vertical median part. Greatest length through midline; greatest height through anterior hinge element. Length 452 um, height 285 um.

Ornamentation consists of reticulation, ridges, and denticles. Reticulation is in middle of valve, comprised of thick, wide ridges and small ovoid pits. Reticulation arranged in horizontal rows; at posterior end, reticulation ridges are stronger, seen as several horizontal ridges. Strong, crescentic ventral ridge. Anterior and posterior ends with weak reticulation, more pitting. Anterior margin with smooth ridge; posterior margin with broad, smooth, flattened region. Strong L-shaped ridge originates at large, smooth, ovoid eye tubercle and extends to middle of valve. Oblique, short sulcus trends anteroventrally from middle of dorsal margin. Anterior with numerous sharp marginal denticles; posteroventral corner with pronounced spine.

Occurrence.--7.07, 20.08, 45.35, 139.94 m; Meting Shale, Meting Limestone, Lakhra Formation.

Mosaleberis sp. 3
Plate 7, figures 1, 3

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is nearly straight, inclined slightly toward posterior; distinct, raised anterodorsal corner; anterior margin forms a rounded crescentic shape; ventral margin slightly concave; posterior margin is truncated, forms a smooth flat curve; obtuse posterodorsal corner. Greatest length is through midline of valve; greatest height is anterior of midline, through anterodorsal corner. Length 400 um, height 212 um.

Ornamentation consists of reticulation, ridges, spines, and denticles. Reticulation forms triangular, rectangular, and semi-rounded pits. Ornament pits are arranged longitudinally in center of valve; pits are arranged in radial pattern at anterior and posterior ends. Four prominent longitudinal ridges: a short oblique ridge at anterodorsum, two median ridges, and one arcuate ventral ridge that originates in anteroventer and ends at posterodorsum. Low anterior marginal rim; stronger posterior marginal rim. Elongate triangular depressed region located just above dorsal-most ridge. Prominent, smooth, oval-shaped eye spot. Small denticles located at anterior margin; four spines at ventral half of posterior margin. Two sizes of normal pores, distributed evenly over valve surface: the larger pores are located within the ornament pits and the smaller pores are located on the reticulation ridges.

Occurrence.--7.07, 12.27, 14.91, 20.08, 26.84, 45.35, 69.64 m; Meting Shale, Meting Limestone.

Mosaleberis sp. 4
Plate 7, figures 4, 5

Description.--In lateral view, left valve is rectangular in shape. Dorsal margin is nearly straight, inclined slightly toward posterior; distinct raised anterodorsal corner; anterior margin rounded, forms crescentic shape; ventral margin with slight concavity; posterior margin is truncated, forms a smooth curve; obtuse posterodorsal corner. Greatest length is at middle of valve; greatest height is anterior of midline, through anterodorsal corner.

Ornamentation consists of reticulation, ridges, spines, and denticles. Reticulation forms rectangular, triangular, and subrounded pits. One series of pits arranged in a row along and parallel to ventral margin and ends at the posteroventral region. A second row of pits follows the same trend along the first row of pits. Central portion of the surface of valve is slightly swelled. One prominent ridge begins at the anterodorsal corner, follows the anterior, ventral, and posterior margins, and terminates at the anteroventral region. Dorsal ridge trends horizontally, overhangs margin, ends as posterodorsal spine. Arc-like

depression occurs along posterior. Anterior margin with broad, flattened crescentic region. Ovoid smooth eye spot. Two spines located along the posterior; at least ten marginal denticles at the anterior. Few, small normal pores, mostly on reticulation ridges.

Occurrence.--14.91, 22.83, 139.94, 151.1, 171.02 m; Meting Shale, Lakhra Formation.

Mosaleberis sp. 5

Occurrence.--183.35, 190.11 m; Lakhra Formation.

Family CYTHERIDEIDAE Sars, 1925
Subfamily CYTHERIDEINAE Sars, 1925
Genus SCHULERIDEA Swartz and Swain, 1946

Type species.--Schuleridea acuminata Swartz and Swain, 1946

Schuleridea sp. 1
Plate 5, figure 11

Description.--In lateral view, left valve is elongate-ovoid in shape. Dorsal margin is broadly arched; anterior margin is smoothly rounded, with greatest extent ventral of midline; ventral margin is convex, nearly straight; posterior margin is evenly curved. No cardinal angles. Greatest length is through valve midline; greatest height is midvalve. Length 633 um, height 423 um.

Primary ornamentation consists of ovoid to elongate-ovoid pits. The largest pits are at the middle of the valve; pits become smaller toward margins. Posterior end nearly smooth, with some very small pits. Anterior end with some low ridges parallel to the valve margin. Small scattered normal pores. Anterior end of carapace is laterally compressed; posterior end is inflated.

Occurrence.--14.91, 20.08, 22.83, 26.58 m; Meting Shale.

Schuleridea sp. 2
Plate 5, figure 9

Description.--In lateral view, left valve is oval in shape. Dorsal margin is subrounded, partly arched, having the middle portion slightly raised, curved gently toward the anterior and posterior margins; anterior margin evenly curved; ventral margin subrounded, convex in shape; rounded posterior margin. Greatest length is at midline of valve; greatest height is just anterior of midline of valve. Length 700 um, height 476 um.

Ornamentation consists of pitting. Ovoid and subrounded small pits occur in the central part of the valve. Valve surface is predominantly smooth.

Occurrence.--45.35, 68.58, 69.64, 72.34, 81.6, 147.96 m; Meting Limestone, Lakhra Formation.

Schuleridea sp. 3

Occurrence.--137.62 m; Lakhra Formation.

Cytherideid sp. 1
Plate 5, figure 10

Description.--In lateral view, left valve is elongate-ellipsoidal in shape. Dorsal margin is broadly arched; anterior margin is evenly rounded; ventral margin is broadly convex, nearly straight; posterior margin is smoothly curved, with greatest extent slightly ventral of midline. Dorsal and ventral margins converge toward posterior. Greatest length is through valve midline; greatest height is anterior of midline.

Ornamentation consists of ovoid pits arranged in middle of valve. Pits become smaller toward margins. The valve periphery is largely smooth. Anteroventral margin with three weak ridges parallel to valve margin. Numerous small normal pores scattered over valve surface.

Occurrence.--176.01 m; Lakhra Formation.

Cytherideid sp. 2

Occurrence.--244.73 m; Bara Formation.

Subfamily EUCYTHERINAE Puri, 1954
Genus EUCYTHERE Puri, 1954

Type species.--*Cythere declivis* Norman, 1865

Eucythere sp. 1

Occurrence.--20.08, 26.84 m; Meting Shale.

Subfamily KRITHINAE Mandelstam, 1958
Genus KRITHE Brady, Crosskey, and Robertson, 1874

Type species.--*Cythere bartonensis* Jones, 1857

Krithe sp. 1
Plate 5, figure 15

Description.--In lateral view, left valve is elongate-subcylindrical in shape. Dorsal margin is nearly straight; anterior margin is smoothly curved, with greatest extent dorsal of midline; ventral margin is broadly concave, nearly straight; posteroventral margin drawn-out and extends down toward venter; posterodorsal margin angles obliquely toward anterodorsum. No cardinal angles. Greatest length is slightly ventral of midline; greatest height is anterior of midline. Length 600 um, height 312 um.

No ornamentation. Few scattered simple-type normal pores.

Occurrence.--7.07, 12.27, 14.91, 26.84, 45.35, 69.64, 72.34 m; Meting Shale, Meting Limestone.

Genus PARAKRITHELLA Hanai, 1959

Type species.--*Neocyprideis pseudadonta* Hanai, 1959

Parakrithella sp. 1

Occurrence.--7.07, 12.27, 69.64, 72.34, 81.6, 147.96, 151.1, 172.4 m; Meting Shale, Meting Limestone, Lakhra Formation.

Parakrithella sp. 2

Occurrence.--7.07, 45.35 m; Meting Shale, Meting Limestone.

Family CYTHERURIDAE Mueller, 1894
Genus CYTHERURA Sars, 1866

Type species.--*Cythere gibba* O.F. Mueller, 1785

Cytherura sp. 1
Plate 5, figure 6

Description.--In lateral view, right valve is ellipsoidal in shape. Dorsal margin broadly arched; anterior margin scalloped due to three marginal protuberances; ventral margin forms broad concavity; posterior margin has a short, sharp caudal process at the center of margin. Greatest length at midline of valve, through caudal process; greatest height at midline of valve. Length 400 um, height 220 um.

Ornamentation consists of reticulation, pitting, and ridges. Reticulation forms elongate triangular and rectangular shapes, occurring along anterior, posterior, and ventral margins. Dorsal margin with small rounded pits. Center of valve is smooth. A broad ridge originates at the anterior margin and overhangs the concavity, ending at the caudal process. A second, narrow, weaker ridge is parallel to the first, occurring slightly more dorsally and bifurcating at the anterior margin. The anterior margin is scalloped due to the expression of these two ridges.

Occurrence.--7.07, 12.27, 14.91, 20.08, 26.84, 45.35 m; Meting Shale, Meting Limestone, Lakhra Formation.

Cytherura sp. 2

Occurrence.--151.1 m; Lakhra Formation.

Genus CYTHEROPTERON Sars, 1866

Type species.--*Cythere latissima* Norman, 1865

Cytheropteron sp. 1
Plate 5, figures 3, 4

Description.--In lateral view, left valve is trapezoidal in shape. Dorsal margin is straight, inclined slightly toward posterior; anterior margin is smoothly curved, with greatest extent ventral of midline; ventral margin is broadly convex; posteroventral margin is straight, angling sharply toward posterodorsum; blunt, small caudal process, located dorsal of midline. Obtuse, rounded antero- and posterodorsal cardinal angles. Greatest length through caudal process; greatest height through anterior hinge element. Length 388 um, height 240 um.

Ornamentation consists of reticulation, tubercles, and denticles. Reticulation forms a concentric pattern. Reticulation ridges are smooth and narrow, forming various ovoid pits. Posteroventral corner with a large tubercle that extends beyond the valve margin. Anterior margin with reduced ornament, consisting of radial ridges that extend to margin. Caudal process is smooth. Large, smooth, ovoid eye tubercle. Simple-type normal pores occur on reticulation ridges.

Occurrence.--7.70 m; Meting Shale.

Cytheropteron sp. 2

Occurrence.--12.27, 14.91, 20.08, 22.83, 26.84 m; Meting Shale.

Cytheropteron sp. 3

Occurrence.--45.35 m; Meting Limestone.

Cytheropteron sp. 4

Occurrence.--69.64 m; Meting Limestone.

Cytheropteron sp. S
Plate 5, figure 5

Description.--In lateral view, left valve is subtrapezoidal to subtriangular in outline. Dorsal margin is straight, inclined downward toward posterior; anterior margin smoothly curved, with greatest extent near ventral margin; ventral margin forms a very broad curve, converging upward toward posterior; posterior with pronounced, sharp caudal process. Obtuse raised posterodorsal cardinal angle. Greatest length through caudal process; greatest height through anterodorsal corner. Length 432 um, height 220 um.

Ornamentation consists of an ala, ridges, and a sulcus. Valve surface is primarily smooth--no

reticulation or pitting. A deep sulcus extends from the anterodorsal corner to the middle of the valve; a low broad ridge that extends for the same length occurs anterior and immediately adjacent to the sulcus. Surface is dominated by a large, high ala which is ornamented toward the terminus by blunt, broad denticles. One narrow ridge that originates at the posterodorsal corner proceeds obliquely across the valve to the ala and continues along the posterior side of the ala to the top. A second, unusual, S-shaped ridge, narrow but pronounced, trends longitudinally in the middle of the valve, running across the sulcus. A third narrow marginal ridge originates in the middle of the anterior margin, paralleling it, and continuing along the anterior side of the ala to the top. Moderate flange-like structure extends beyond the valve edge along the ventral half of the anterior margin. Smooth, ovoid eye spot.

Occurrence.--14.91, 72.34 m; Meting Shale, Meting Limestone.

Genus EUCYTHERURA G.W. Mueller, 1894

Type species.--Cythere complexa Brady, 1867

Eucytherura sp. 1

Occurrence.--26.84 m; Meting Shale.

Eucytherura sp. 2
Plate 5, figure 1

Description.--In lateral view, left valve is trapezoid in shape. Dorsal margin is irregular, angling down toward posterior; obtuse, rounded anterodorsal cardinal angle; smoothly curved anterior margin; sinuous ventral margin with weak concavity; posteroventral margin concave; posterodorsal margin with blunt caudal process, located dorsal of midline. Greatest length is through caudal process; greatest height through anterior hinge element. Length 404 um, height 285 um.

Ornamentation consists of reticulation arranged in a chaotic pattern. Several reticulation ridges are stronger and more calcified. One ridge extends from the eye tubercle downward to near the subcentral tubercle. A short ridge extends vertically up from the tubercle. Three ridges radiate posteriorly from the subcentral tubercle: one ridge is L-shaped and proceeds toward the venter; a second ridge angles obliquely to the posteroventral corner; the third ridge extends to the posterodorsal corner. A connected ridge system occurs along the valve periphery, parallel to the dorsal, anterior, and ventral margins and extending vertically from the posterodorsal corner to the posteroventral corner. A weaker reticulation system occurs between these strong ridges. Few, very large, sieve-type normal pores occur in the pits. Elongate, smooth eye tubercle.

Occurrence.--137.62, 147.96, 151.1 m; Meting Shale.

Genus ORTHONOTACYTHERE Alexander, 1933

Type species.--Cytheridea? hannai Israelsky, 1929

Orthonotacythere sp. 1

Plate 5, figure 2

Description.--In lateral view, right valve is trapezoidal in shape. Dorsal margin is straight, angling obliquely toward the posterior; anterior margin is smoothly curved, with greatest extent ventral of midline; ventral margin is convex; posteroventral margin is straight, angles sharply toward posterodorsum; posterodorsal margin with blunt, small caudal process located dorsal of valve midline. Greatest length through caudal process; greatest height through anterior hinge element. Length 590 um, height 273 um.

Primary ornamentation is reticulation arranged in a chaotic pattern. Reticulation pits are ovoid, of varying sizes, generally becoming larger toward the valve margins. Five large tubercles dominate the valve: at the anterodorsal, posterodorsal, and posteroventral corners, in the middle of the ventral margin, and slightly dorsal of the anteroventral corner. The caudal process is smooth. Anterior and anteroventral margins with a flat, smooth, superimposed flange. Strong, irregular subcentral tubercle. Few, very large, sieve-type normal pores occur in reticulation pits. Large, smooth, ellipsoidal eye tubercle.

Occurrence.--7.07, 14.91, 20.08, 69.64 m; Meting Shale, Meting Limestone.

Genus PARACYTHERIDEA G.W. Mueller, 1894

Type species.--*Paracytheridea depressa* G.W. Mueller, 1894

Paracytheridea sp. 1
Plate 5, figure 7

Description.--In lateral view, left valve is very elongate, subtriangular to subtrapezoidal in shape. Dorsal margin is sinuous, extends along a horizontal line; anterior margin is smoothly rounded, with greatest extent dorsal of midline; ventral margin sinuous, mostly concave; posteroventral margin concave; posterodorsal margin very attenuated, drawn-out into a pronounced narrow caudal process. Greatest length through caudal process; greatest height through anterior hinge element.

No ornamentation; valve surface is smooth. A deep triangular sulcus proceeds from the middle of the dorsal margin to midvalve. An inflated region occurs at the posterodorsal valve region. Venter with an arcuate overhanging ridge that originates at midvalve and terminates at the posteroventral corner as a large protruding spine. Anterior and posterior margins with broad, flattened region.

Occurrence.--68.58 m; Meting Limestone.

Suborder PLATYCOPINA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLA Jones, 1849

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

Cytherella sp. 1

Occurrence.--7.07, 20.08, 22.83, 26.84, 28.8, 45.35, 68.58, 88.11 m; Meting Shale, Meting Limestone.

Cytherella sp. 2
Plate 6, figure 3

Description.--In lateral view, left valve is oval in outline. Dorsal margin is straight in the middle part and curves gently towards the anterior and posterior margins; anterior margin crescentic in outline; ventral margin very broadly convex and trends subparallel to the dorsal margin; posterior margin is rounded. Greatest length is at the midline of valve; greatest height is just anterior of midline. Length 600 um, height 366 um.

Ornamentation consists of pits distributed along the anterior, anterodorsal, and anteroventral regions. The remainder of the valve is smooth.

Occurrence.--12.27, 14.91, 22.83, 26.84, 69.64, 81.6, 88.11, 98.78, 151.1, 171.02 m; Meting Shale, Meting Limestone, Sohnari Formation, Lakhra Formation.

Cytherella sp. 3

Occurrence.--72.34 m; Meting Limestone.

Cytherella sp. 4

Occurrence.--139.94, 151.1, 152.7, 160.78, 171.02, 172.4, 183.35, 211.86 m; Lakhra Formation, Bara Formation.

Cytherella sp. 5
Plate 6, figure 4

Description.--In lateral view, left valve is oval in shape. Dorsal margin is straight in middle part, curves gently toward anterior and posterior margins; rounded crescentic outline from anterodorsal to anteroventral; ventral margin is nearly straight with slight concavity, and parallels the dorsal margin; posterior margin forms a rounded crescentic shape. Greatest length is at the midline of the valve; greatest height is slightly anterior of midline.

Valve surface is nearly smooth. Ornamentation consists of normal pores. Pores occur all over the surface of valve, becoming more abundant at the anterior and posterior margins. Elongated sulcus extends vertically from the middle of the valve nearly to the dorsal margin.

Occurrence.--139.94 m; Lakhra Formation.

Cytherella sp. 6
Plate 6, figure 1

Description.--In lateral view, right valve forms an inflated ovoid shape. Dorsal margin is highly arched, with straight anterior and posterior parts; anterior margin is broadly rounded; ventral margin is broadly convex; posterior margin is smoothly curved, with an inflated middle part. No cardinal angles. Greatest length dorsal of midvalve; greatest height slightly posterior of midvalve.

Ornamentation consists of pitting and pustules. Small rounded pits cover the valve surface except along the posterior margin and a small region in the middle of the valve. Pits become smaller marginally. A single row of large pustules occurs along the anterior margin. Few, small normal pores scattered over the valve surface.

Occurrence.--147.96, 172.4, 176.01, 190.11, 211.86 m; Lakhra Formation, Bara Formation.

Cytherella sp. 7
Plate 6, figure 2

Description.--In lateral view, right valve is elongate-ovoid in shape. Dorsal margin is broadly convex; anterior margin is evenly curved; ventral margin is straight, with hing of concavity; posterior margin is evenly rounded. No cardinal angles. Greatest length through midline; greatest height through middle of valve.

Ornamentation consists of pitting, ridges, and sulci. Few, large, ovoid pits occur just posterior of midvalve, extending in an area along the valve height; several pits occur in the anterodorsal corner; a third group of pits occurs along the anterior margin. One ridge occurs along the middle of the dorsal margin. A second short ridge trends vertically from near the middle of the dorsal margin to the adductor muscle scar field. A vertical sulcus is located posterior and parallel to the short ridge; a horizontal elongate sulcus occurs along the anterodorsal margin. Small normap pores are scattered over the valve surface.

Occurrence.--183.35 m; Lakhra Formation.

Genus CYTHERELLOIDEA Alexander, 1929

Type species.--*Cytherelloidea williamsoniana* Jones, 1849

Cytherelloidea sp. 1
Plate 6, figure 5

Description.--In lateral view, left valve is oval in shape. Dorsal margin is nearly straight, having a slight depression in the center and curving gently toward the anterior and posterior margins; rounded subcrescentic anterior margin; ventral margin nearly straight, with slight concavity; posterior margin is rounded. Greatest length is at the midline of the valve; greatest height is posterior of midline, through posterodorsal region. Length 432 um, height 240 um.

Ornamentation consists of ridges. A longitudinal ridge originates at the posterodorsal region of the valve, forms a U-turn at the middle of the posterior margin and parallels the ventral margin to the anteroventral region, where it makes a right angle turn at the anterior margin towards the anterodorsal region; the ridge turns at a right angle, next trending parallel to the dorsal margin, and terminates at the center of the valve. Adductor muscle scars are clearly visible as two rows at the center of the valve. A second marginal ridge originates at the middle of the posterior margin, trends parallel and adjacent to the ventral margin, and terminates at the middle of the anterior margin. Most of the valve surface is smooth. Five muscle scars in the anterior row and six scars in the posterior row; the two rows form a muscle group that is egg-shaped.

Occurrence.--7.07, 12.27, 14.91, 20.08, 26.84, 45.35, 69.64 m; Meting Shale, Meting Limestone.

Cytherelloidea sp. 2
Plate 6, figure 6

Description.--In lateral view, right valve is rounded, subquadrate in outline. Dorsal margin is weakly concave, nearly straight; anterior margin is evenly curved; ventral margin is broadly convex; posterior margin is smoothly curved. Dorsal and ventral margins are subparallel. No cardinal angles. Greatest length through midline; greatest height through posterior hinge element. Length 625 um, height 387 um.

Ornamentation consists of ridges and reticulation. One strong, broad, smooth ridge originates at the posterodorsal corner, follows the posterior and ventral margins, and end at the anteroventral corner. A second ridge forms an O-shape in the center of the valve. Secondary ornament consists of a fine reticulation pattern at the valve margins. The reticulation forms squared pits at the anterior and elongate ridges at the dorsal and posterior margins. Adductor muscle scars expressed externally.

Occurrence.--139.9, 171.02 m; Lakhra Formation.

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PLATE 1

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*"Alocopocythere" sp. 1*, lateral view of left valve exterior, 14.91-15.05 m.

2.--*Alocopocythere sp. 3*, lateral view of female left valve exterior, 12.27-12.4 m.

3.--*Alocopocythere sp. 3*, lateral view of male left valve exterior, 12.27-12.4 m.

4.--*Alocopocythere transcendens* Siddiqui, 1971, lateral view of female left valve exterior, 72.34-72.49 m.

5.--*Alocopocythere sp. 7*, lateral view of male left valve exterior, 139.94-140.11 m.

6.--*Alocopocythere sp. 8*, lateral view of male left valve exterior, 151.1-151.3 m.

7.--*Alocopocythere sp. 9*, lateral view of male left valve exterior, 211.86-212.0 m.

8.--*Buntonia sp. 1*, lateral view of left valve exterior, 22.8-22.97 m.

9.--*Protobuntonia sp. 1*, lateral view of left valve exterior, 22.8-22.97 m.

10.-*Buntoniid sp. 1*, lateral view of left valve exterior, 28.8-28.95 m.

11.-*New Genus B sp. 1*, lateral view of left valve exterior, 147.96-148.13 m.

12.-*New Genus B sp. 1*, lateral view of right valve interior, 147.96-148.13 m.

13.-*Schizoptocythere sp. 4*, lateral view of left valve exterior, 139.94-140.11 m.

14.-*Schizoptocythere sp. 3*, lateral view of left valve exterior, 139.94-140.11 m.

15.-*Schizoptocythere sp. 3*, lateral view of left valve exterior, 151.1-151.3 m.

Plate 1

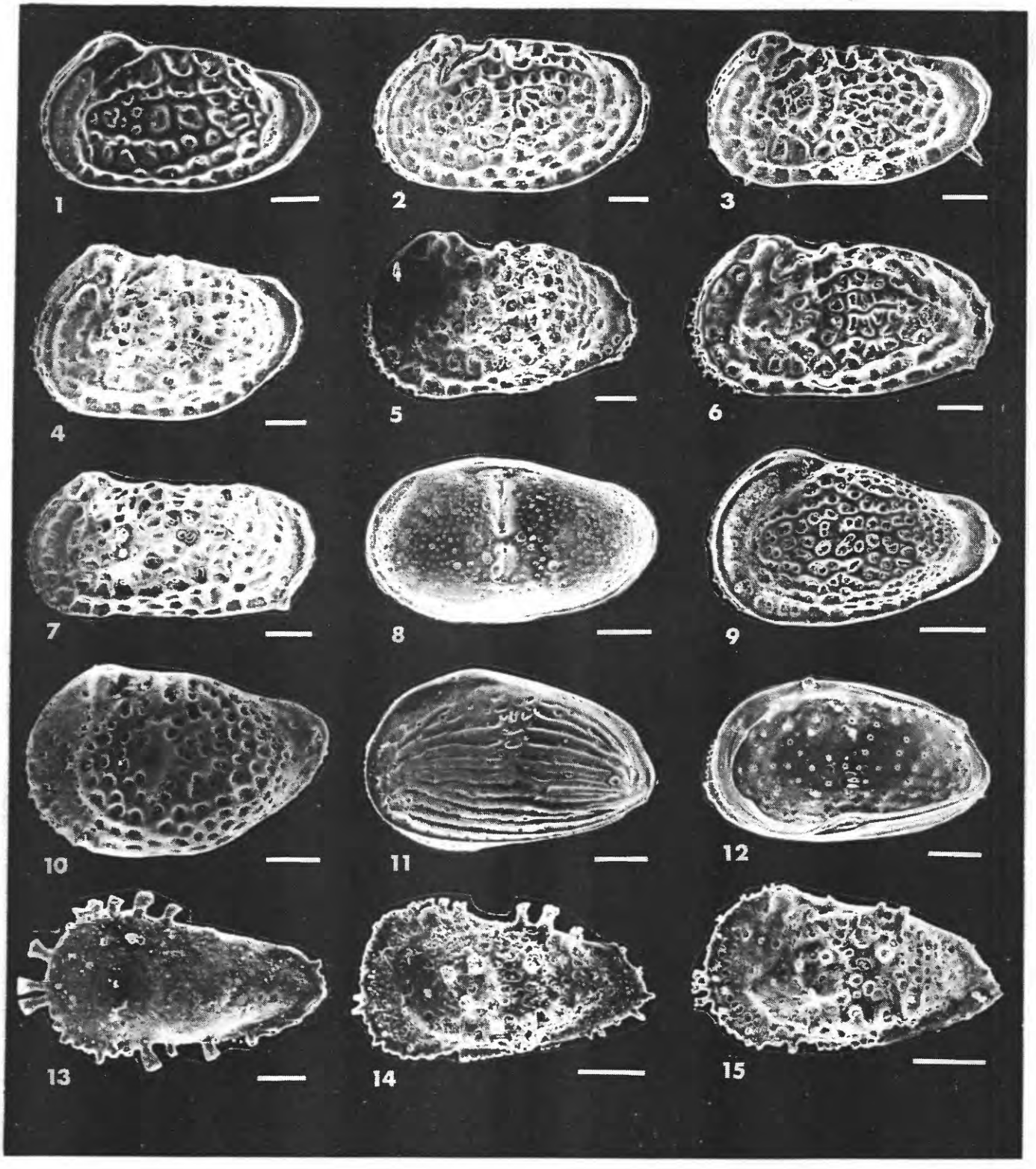


PLATE 2

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Anommatocythere sp. 1*, lateral view of left valve exterior, 69.64-69.84 m.

2.--*Gyrocythere sp. 1*, lateral view of left valve exterior, 69.64-69.84 m.

3.--*Stigmatocythere sp. 1*, lateral view of left valve exterior, 88-EB-43.

4.--*Acanthocythereis sp. 1*, lateral view of left valve exterior, 14.91-15.05 m.

5.--*Acanthocythereis sp. 1*, lateral view of right valve exterior, 12.27-12.4 m.

6.--*"Quadracythere" sp. 1*, lateral view of left valve exterior, 14.91-15.05 m.

7.--*Quadracythere sp. 1*, lateral view of left valve exterior, 26.84-26.96 m.

8.--*Quadracythere sp. 2*, lateral view of left valve exterior, 69.64-69.84 m.

9.--*Quadracythere reticulospinosa* Sohn, 1959, lateral view of left valve exterior, 81.6-81.75 m.

10.-*Quadracythere sp. 1*, lateral view of left valve exterior, 45.35-45.48 m.

11.-*Quadracythere sp.*, lateral view of left valve exterior, 14.91-15.05 m.

12.-*Quadracythere sp. 2*, lateral view of right valve exterior, 12.27-12.4 m.

13.-*Quadracythere directa* Siddiqui, 1971, lateral view of left valve exterior, 12.27-12.4 m.

14.-*Hermanites sp. 2*, lateral view of left valve exterior, 45.35-45.48 m.

15.-*Hermanites sp. 3*, lateral view of left valve exterior, 69.64-69.84 m.

Plate 2

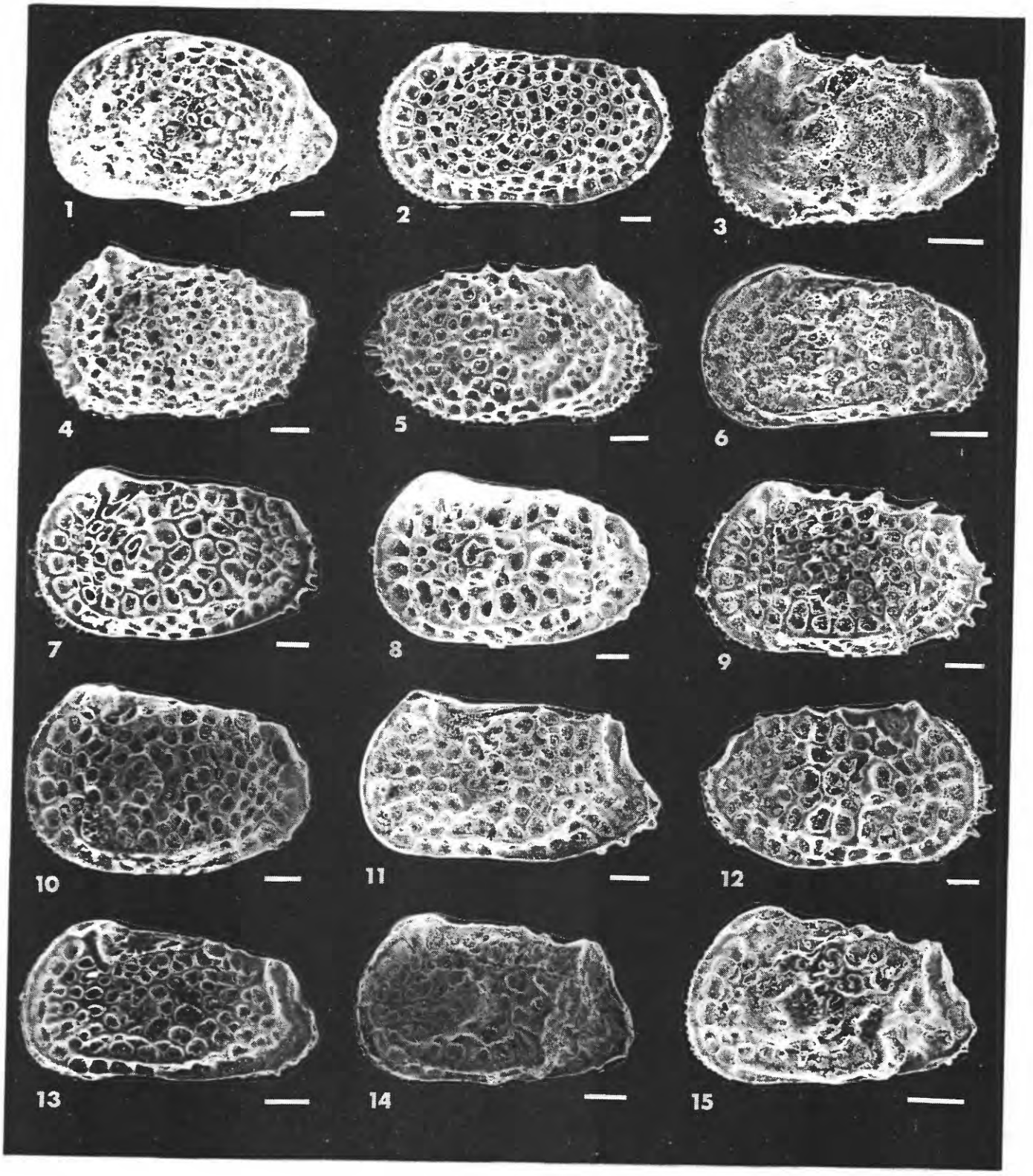


PLATE 3

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Veenia sp. 1*, lateral view of male left valve exterior, 12.27-12.4 m.

2.--*Veenia sp. 1*, lateral view of left valve exterior, 45.35-45.48 m.

3.--*Veenia sp. 3*, lateral view of left valve exterior, 190.11-190.3 m.

4.--*Veenia sp. 5*, lateral view of right valve exterior, 147.96-148.13 m.

5.--*New Genus C sp. 1*, lateral view of left valve exterior, 147.96-148.13 m.

6.--*New Genus C sp. 1*, lateral view of left valve exterior, 139.94-140.11 m.

7.--*New Genus C sp. 2*, lateral view of left valve exterior, 171.02-171.25 m.

8.--*Occultocythereis sp. 2*, lateral view of left valve exterior, 7.70-7.2 m.

9.--*Occultocythereis sp. 3*, lateral view of left valve exterior, 14.91-15.05 m.

10.-*Phalcocythere sp. 1*, lateral view of left valve exterior, 72.34-72.49 m.

11.-*Phalcocythere sp. 2*, lateral view of left valve exterior, 69.64-69.84 m.

12.-*Phalcocythere sp. 2*, lateral view of left valve exterior, 68.58-68.73 m.

13.-*Trachyleberid sp. 4*, lateral view of male left valve exterior, 147.96-148.13 m.

14.-*Trachyleberid sp. 4*, lateral view of female left valve exterior, 147.96-148.13 m.

15.-*Trachyleberid sp. 2*, lateral view of left valve exterior, 14.91-15.05 m.

Plate 3

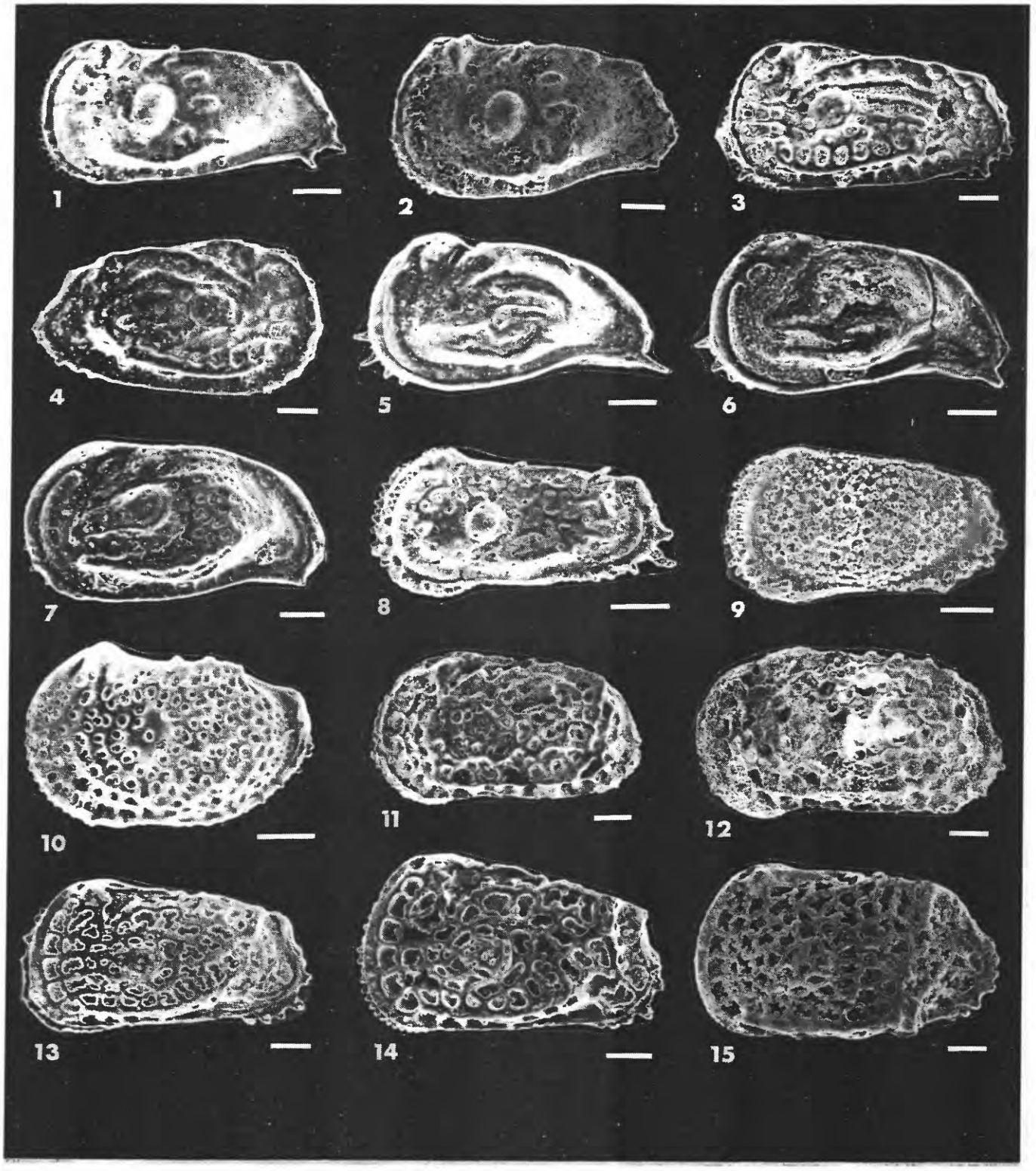


PLATE 4

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Schizocythere sorensis* Siddiqui, 1971, lateral view of left valve exterior, 139.94-140.11 m.

2.--*Schizocythere sp. 1*, lateral view of left valve exterior, 12.27-12.4 m.

3.--*Schizocythere sp. 5*, lateral view of left valve exterior, 139.94-140.11 m.

4.--*Schizocythere sorensis* Siddiqui, 1971, lateral view of left valve exterior, 137.62-137.8 m.

5.--*Schizocythere sp. 3*, lateral view of left valve exterior, 68.58-68.73 m.

6.--*Schizocythere sp. 5*, lateral view of left valve exterior, 137.62-137.8 m.

7.--*Paijenborchella sp. 1*, lateral view of right valve exterior, 14.91-15.05 m.

8.--*Paijenborchella sp. 2*, lateral view of left valve exterior, 14.91-15.05 m.

9.--*Caudites sp. 3*, lateral view of right valve exterior, 88-EB-3.

10.-*Caudites sp. 2*, lateral view of left valve exterior, 68.58-68.73 m.

11.-*Caudites sp. 2*, lateral view of right valve exterior, 45.35-45.48 m.

12.-*Caudites sp. 2*, lateral view of left valve exterior, 26.84-26.96 m.

13.-*New Genus A sp. 1*, lateral view of left valve exterior, 68.58-68.73 m.

14.-*New Genus A sp. 2*, lateral view of left valve exterior, 68.58-68.73 m.

15.-*Ornatoleberis sp. 1*, lateral view of left valve exterior, 20.08-20.2 m.

Plate 4

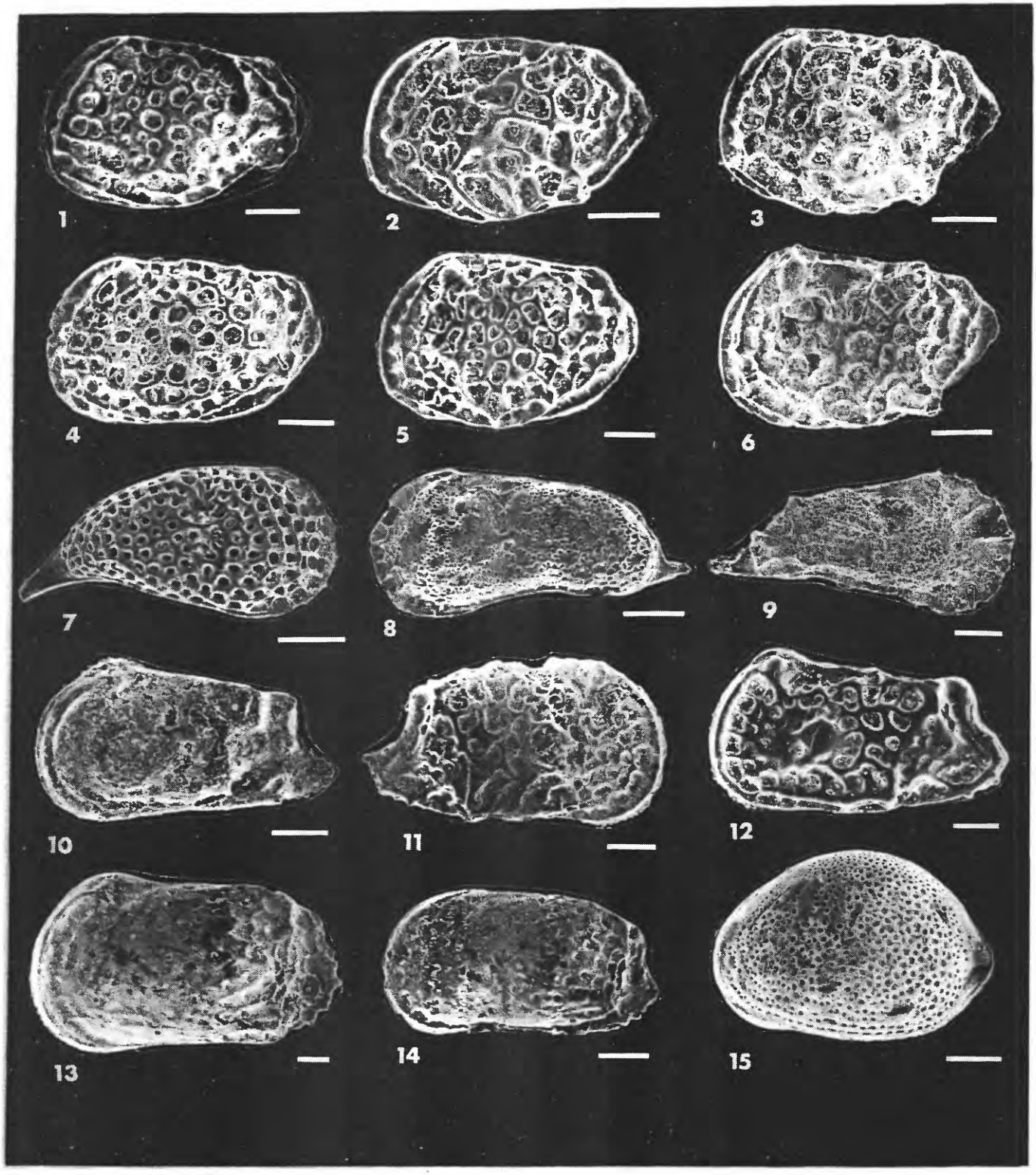


PLATE 5

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Eucytherura sp. 2*, lateral view of left valve exterior, 137.62-137.8 m.

2.--*Orthonotacythere sp. 1*, lateral view of right valve exterior, 14.91-15.05 m.

3.--*Cytheropteron sp. 1*, lateral view of left valve exterior, 26.84-26.96 m.

4.--*Cytheropteron sp. 1*, lateral view of left valve exterior, 7.07-7.2 m.

5.--*Cytheropteron sp. S*, lateral view of left valve exterior, 14.91-15.05 m.

6.--*Cytherura sp. 1*, lateral view of right valve exterior, 12.27-12.4 m.

7.--*Paracytheridea sp. 1*, lateral view of left valve exterior, 88-EB-31.

8.--*Phlyctocythere sp. 1*, lateral view of right valve exterior, 88-EB-33.

9.--*Schuleridea sp. 2*, lateral view of left valve exterior, 69.64-69.74 m.

10.-*Cytherideid sp. 1*, lateral view of left valve exterior, 176.01-176.15 m.

11.-*Schuleridea sp. 1*, lateral view of left valve exterior, 14.91-15.05 m.

12.-*Paracypris sp. 1*, lateral view of left valve exterior, 147.96-148.13 m.

13.-*Paracypris sapperi* van den Bold, 1961, lateral view of left valve exterior, 12.27-12.4 m.

14.-*Paracypris sp. 1*, lateral view of right valve exterior, 45.35-45.48 m.

15.-*Krithe sp. 1*, lateral view of left valve exterior, 12.27-12.4 m.

Plate 5

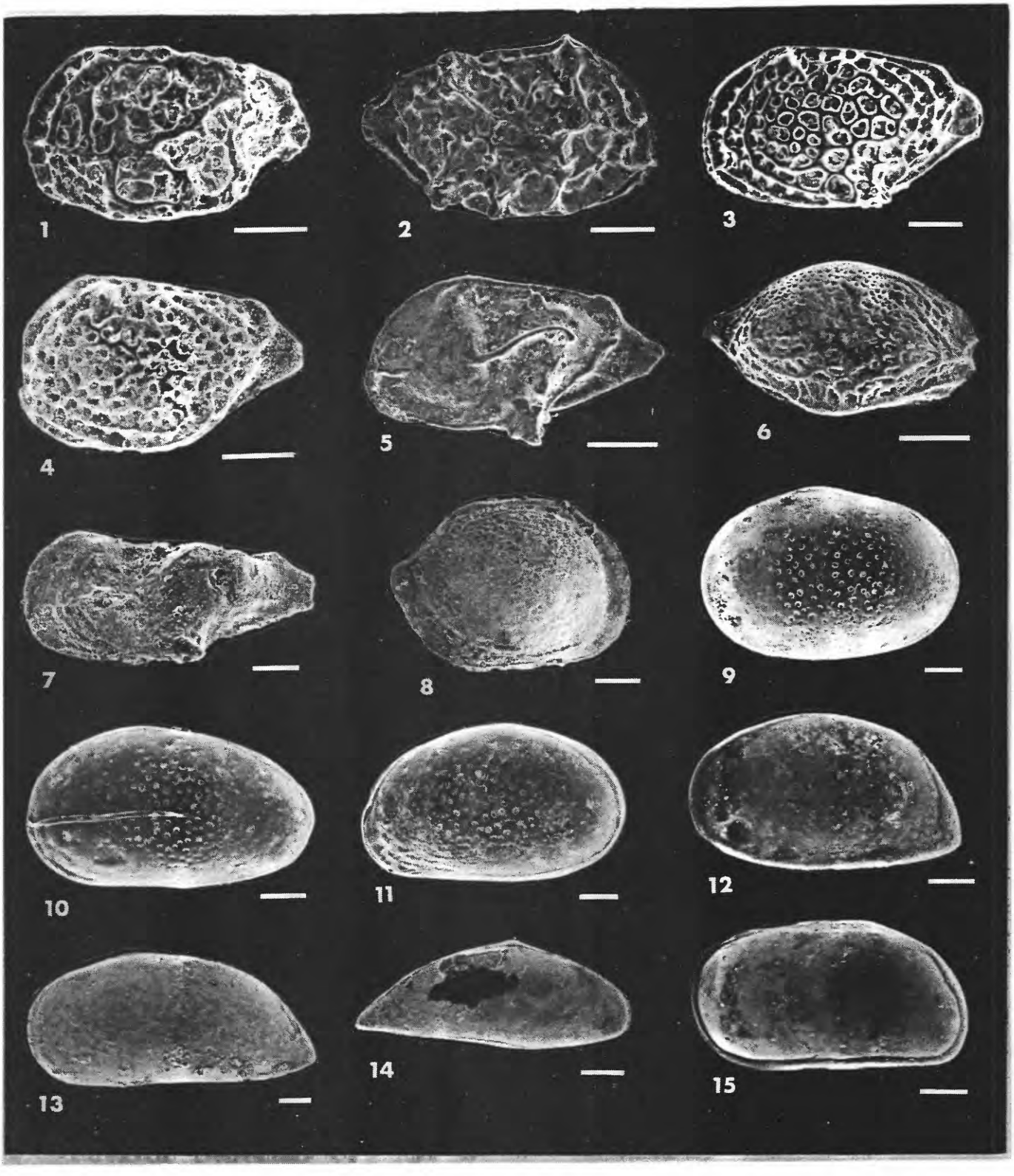


PLATE 6

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Cytherella sp. 6*, lateral view of right valve exterior, 147.96-148.13 m.

2.--*Cytherella sp. 7*, lateral view of right valve exterior, 183.35-183.55 m.

3.--*Cytherella sp. 2*, lateral view of left valve exterior, 12.27-12.4 m.

4.--*Cytherella sp. 5*, lateral view of right valve exterior, 139.94-140.11 m.

5.--*Cytherelloidea sp. 1*, lateral view of right valve exterior, 7.07-7.2 m.

6.--*Cytherelloidea sp. 2*, lateral view of right valve exterior, 139.94-140.11 m.

7.--*Brachycythere sp. 1*, lateral view of female left valve exterior, 147.96-148.13 m.

8.--*Brachycythere sp. 1*, lateral view of male left valve exterior, 190.11-190.3 m.

9.--*Bythocypris sp. 1*, lateral view of right valve exterior, 26.84-26.96 m.

10.-*Brachycythere sp. 1*, lateral view of female left valve exterior, 139.94-140.11 m.

11.-*Bairdia sp. 2*, lateral view of left valve exterior, 139.94-140.11 m.

12.-*Bairdia sp. 1*, lateral view of left valve exterior, 12.27-12.4 m.

13.-*Bairdia sp. 2*, lateral view of left valve exterior, 171.02-171.25 m.

14.-*Argilloecia sp. 1*, lateral view of right valve exterior, 147.96-148.13 m.

15.-*"Neocythere" sp. 1*, lateral view of left valve exterior, 147.96-148.13 m.

Plate 6

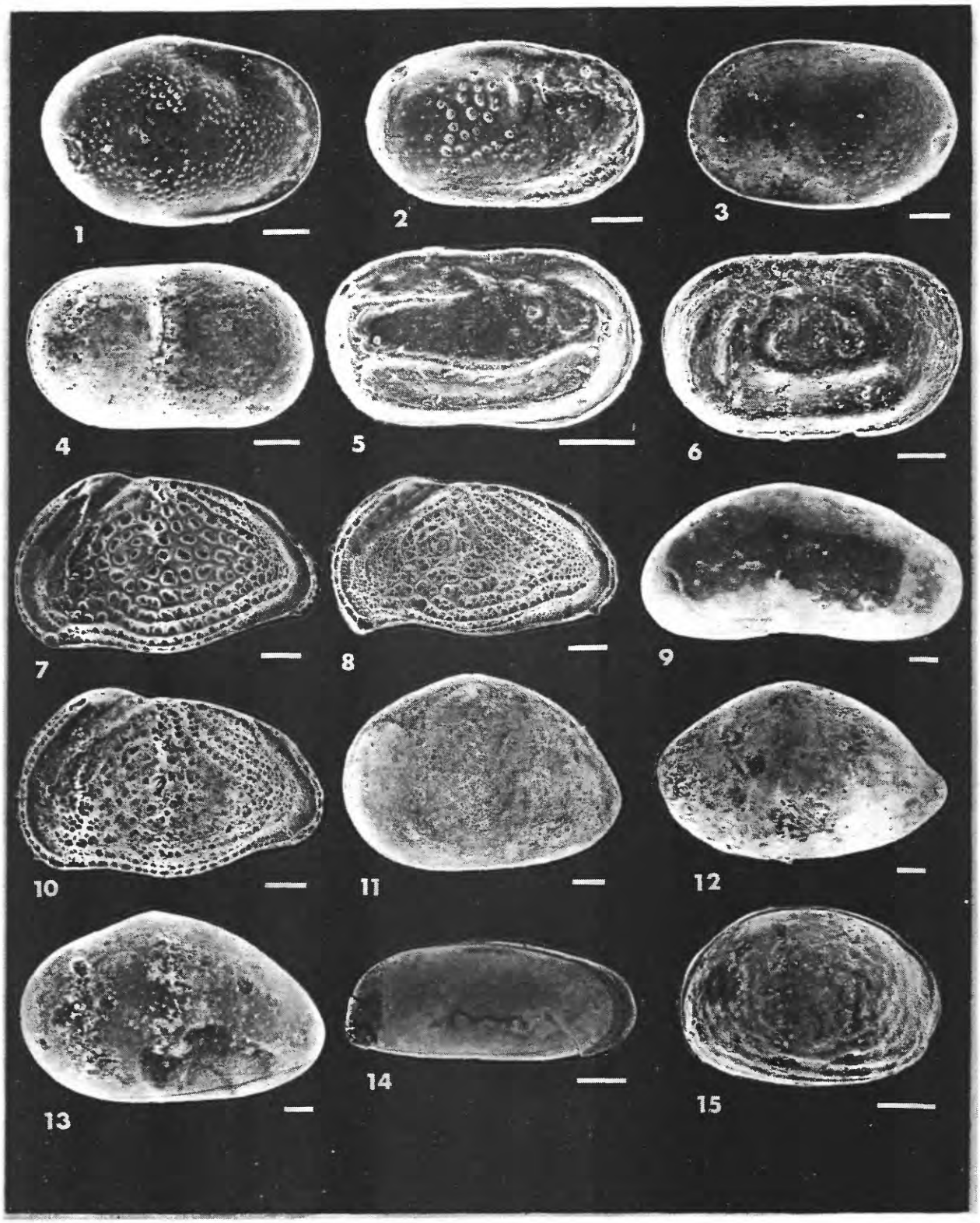


PLATE 7

All figures are scanning electron photomicrographs.
White bar equals 100 micrometers.

FIGURE

1.--*Mosaleberis sp. 3*, lateral view of left valve exterior, 12.27-12.4 m.

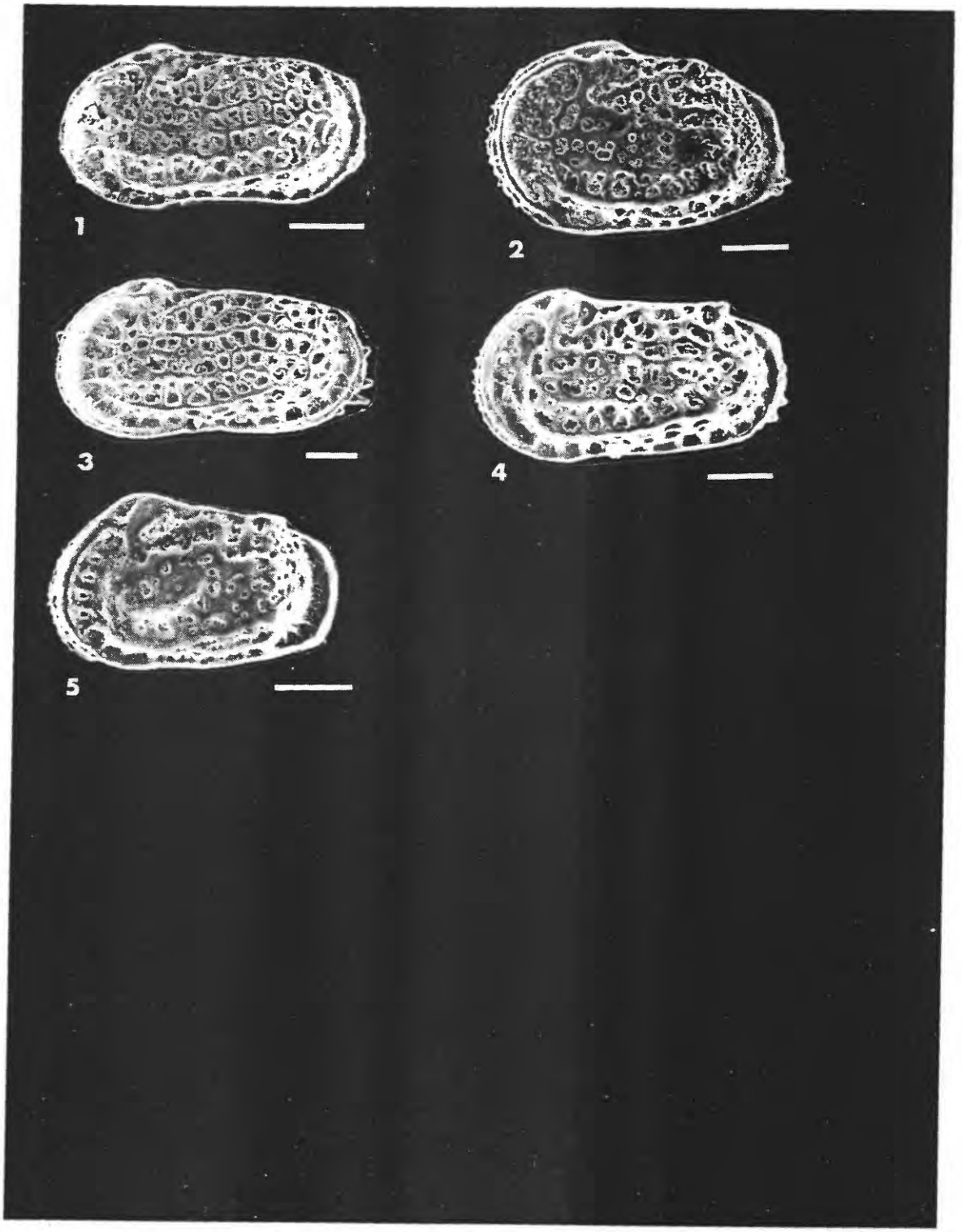
2.--*Mosaleberis sp. 2*, lateral view of left valve exterior, 139.94-140.11 m.

3.--*Mosaleberis sp. 3*, lateral view of left valve exterior, 69.64-69.84 m.

4.--*Mosaleberis sp. 4*, lateral view of left valve exterior, 151.1-151.3 m.

5.--*Mosaleberis sp. 4A*, lateral view of left valve extertior, 151.1-151.3 m.

Plate 7



Appendix 1.--Listing of species in each sample.

7.07-7.20 m

Acanthocythereis sp.
Alocopocythere sp. 1
Alocopocythere sp. 2
Cytherella sp. 1
Cytherelloidea sp. 1
Cytheropteron sp. 1
Cytherura sp. 1
Krithe sp. 1
Mosaleberis sp. 1
Mosaleberis sp. 2
Mosaleberis sp. 3
Occultocythereis sp. 1
Orthonotacythere sp. 1
Paijenborchella sp. 1
Paijenborchella sp. 2
Paracypris sp. 1
Parakrithella sp. 1
Parakrithella sp. 2
Phalcocythere sp.
Schuleridea sp.
Veenia sp. 1
Xestoleberis sp. 1

12.27-12.40 m

Acanthocythereis sp. 1
Alocopocythere sp. 3
Alocopocythere sp. 4
Bairdia sp. 1
Buntonia sp. 1
Cytherella sp. 2
Cytherelloidea sp. 1
Cytheropteron sp. 2
Cytherura sp. 1
Krithe sp. 1
Mosaleberis sp. 3
Occultocythereis sp. 2
Occultocythereis sp. 3
Ornatoleberis sp. 1
Paijenborchella sp. 1
Paijenborchella sp. 3
Paracypris sp. 1
Parakrithella sp. 1
Quadracythere directa
Quadracythere sp. 1
Quadracythere sp. 2
"Quadracythere" sp. 1
Schizocythere sp. 1
Veenia sp. 1

12.27-12.40 m (continued)

Xestoleberis sp. 1
Xestoleberis sp. 2

14.91-15.05 m

Acanthocythereis sp. 1
Alocopocythere sp. 3
Alocopocythere sp. 4
"Alocopocythere" sp. 1
"Argilloecia" sp. 1
Bairdia sp. 1
Caudites sp. 1
Cytherella sp. 2
Cytherelloidea sp. 1
Cytheropteron sp. 2
Cytheropteron sp. S
Cytherura sp. 1
Krithe sp. 1
Mosaleberis sp. 3
Mosaleberis sp. 4
Occultocythereis sp. 2
Occultocythereis sp. 3
Orthonotacythere sp. 1
Paijenborchella sp. 1
Paijenborchella sp. 2
Paracypris sp. 1
Protobuntonia sp. 1
Quadracythere sp. 1
Quadracythere sp. 2
Quadracythere sp. 3
Quadracythere sp. 4
"Quadracythere" sp. 1
Schizocythere sp. 1
Schizocythere sp. 2
Schuleridea sp. 1
Stigmatocythere sp. 1
Trachyleberid sp. 1
Veenia sp. 1
Xestoleberis sp. 1

20.08-20.20 m

Acanthocythereis sp. 1
"Alocopocythere" sp. 1
Argilloecia sp. 2
Bairdia sp. 1
"Brachycythere" sp. 1
Caudites sp. 1
Cytherella sp. 1
Cytherelloidea sp. 1
Cytheropteron sp. 2
Cytherura sp. 1
Eucythere sp. 1

20.08-20.20 m (continued)

Mosaleberis sp. 2
Mosaleberis sp. 3
Occultocythereis sp. 2
Occultocythereis sp. 3
Ornatoleberis sp. 1
Orthonotacythere sp. 1
Paijenborchella sp. 2
Paijenborchella sp. 3
Protobuntonia sp. 1
Quadracythere sp. 2
Schizocythere sp. 1
Schizoptocythere sp. 1
Schuleridea sp. 1
Trachyleberis sp. 2
Veenia sp. 1
Xestoleberis sp. 1

22.83-22.97 m

Acanthocythereis sp. 1
Alocopocythere sp. 2
"Alocopocythere" sp. 1
Bairdia sp. 1
Buntonia sp. 1
Caudites sp.
Cytherella sp. 1
Cytherella sp. 2
Cytheropteron sp. 2
Mosaleberis sp. 4
Paijenborchella sp. 1
Protobuntonia sp. 1
"Quadracythere" sp. 1
Schizocythere sp. 1
Schuleridea sp. 1
Stigmatocythere sp. 1

26.84-26.96 m

"Alocopocythere" sp. 1
Argilloecia sp. 1
Bairdia sp. 1
Buntonia sp. 1
Bythocypris sp. 1
Caudites sp. 2
Cytherella sp. 1
Cytherella sp. 2
Cytherelloidea sp. 1
Cytheropteron sp. 2
Cytherura sp. 1
Eucythere sp. 1
Eucytherura sp. 1
Gyrocythere sp. 1
Krithe sp. 1

26.84-26.96 m (continued)

Mosaleberis sp. 3
Occultocythereis sp. 2
Occultocythereis sp. 3
Occultocythereis sp. 4
Ornatoleberis sp. 1
Paijenborchella sp. 1
Paracypris sp. 1
Quadracythere sp. 2
Quadracythere sp. 5
"Quadracythere" sp. 1
Schizocythere sp. 1
Veenia sp. 1
Xestoleberis sp. 2

28.80-28.95 m

Alocopocythere sp. 1
Alocopocythere sp. 2
Buntonia sp. 1
"Buntoniid" sp. 1
Cytherella sp. 1
Phalcocythere sp.
Protobuntonia sp. 1
Schizoptocythere sp. 2
Veenia sp. 1

45.35-45.48 m

Alocopocythere sp. 2
Argilloecia sp. 1
Argilloecia sp. 3
Bairdia sp. 1
Bairdia sp. 2
Caudites sp. 2
Cytherella sp. 1
Cytherelloidea sp. 1
Cytheropteron sp. 3
Cytherura sp. 1
Hermanites sp. 2
Hornibrookella sp. 1
Krithe sp. 1
Mosaleberis sp. 2
Mosaleberis sp. 3
Occultocythereis sp. 3
Ornatoleberis sp. 1
Paijenborchella sp. 4
Paracypris sp. 1
Paracypris sp. 3
Parakrithella sp. 2
Phalcocythere sp. 1
Phlyctocythere sp. 1
Pterygocythereis sp. 1
Quadracythere sp. 2

45.35-45.48 m (continued)

"Quadracythere" sp. 1
Schizocythere sp. 1
Schizoptocythere sp. 2
Schuleridea sp. 2
Stigmatocythere sp. 1
Veenia sp. 1
Veenia sp. 2
Xestoleberis sp. 1

63.82-63.99 m

Bairdia sp. 1
Bythocypris sp. 2
Hornibrookella sp. 1
Ornatoleberis sp. 1
"Quadracythere" sp. 1

68.58-68.73 m

Anommatocythere sp. 1
Bairdia sp. 2
"Brachycythere" sp. 1
Bythocypris sp. 1
Caudites sp. 1
Cytherella sp. 1
Hornibrookella sp. 1
Hornibrookella sp. 2
Ornatoleberis sp. 2
Paracytheridea sp. 1
Phalcocythere sp. 2
Phlyctocythere sp. 1
Quadracythere sp. 2
Schizocythere sp. 3
Schuleridea sp. 1
Stigmatocythere sp.
Xestoleberis sp. 2
Xestoleberis 3
New Genus A sp. 1

69.64-69.84 m

Acanthocythereis sp. 1
Alocopocythere transcendens
Alocopocythere sp. 6
Anommatocythere sp. 1
Bairdia sp. 2
Caudites sp. 1
Caudites sp. 3
Caudites sp. 4
Cytherella sp. 2
Cytherelloidea sp. 1
Cytheropteron sp. 4
Gyrocythere sp. 1
Hermanites sp. 3

69.64-69.84 m (continued)

Hermanites sp. 4
Krithe sp. 1
Mosaleberis sp. 3
Occultocythereis sp. 3
Occultocythereis sp. 5
Ornatoleberis sp. 1
Orthonotacythere sp. 1
Parakrithella sp. 1
Phalcocythere sp. 2
Quadracythere sp. 2
"Quadracythere" sp. 1
Schizocythere sp. 3
Schizocythere sp. 4
Schuleridea sp. 2
Trachyleberid sp. 1
Xestoleberis sp. 4
New Genus A sp. 1

72.34-72.49 m

Acanthocythereis sp. 1
Alocopocythere transcendens
Cytherella sp. 3
Cytheropteron sp. S
Gyrocythere sp. 1
Hermanites sp. 3
Krithe sp. 1
Parakrithella sp. 1
Phalcocythere sp. 1
Quadracythere sp. 2
Schizocythere sp. 2
Schizocythere sp. 3
Schuleridea sp. 2

81.60-81.75 m

Anommatocythere sp. 1
Argilloecia sp. 1
Bairdia sp. 2
Bairdia sp. 3
Bythocypris sp. 2
Cytherella sp. 2
Hermanites sp. 4
Occultocythereis sp. 3
Paracypris sp. 2
Parakrithella sp. 1
Phalcocythere sp. 2
Phalcocythere sp. 3
Schizoptocythere sp. 2
Schuleridea sp. 2
Xestoleberis sp. 1

88.11-88.23 m

Alocopocythere transcendens
Argilloecia sp. 1
Bairdia sp. 2
Bairdia sp. 4
Cytherella sp. 1
Cytherella sp. 2
Phalcocythere sp. 3

98.78-98.95 m

Acanthocythereis sp. 1
Bairdia sp.
Cytherella sp. 2

137.62-137.80 m

Alocopocythere sp. 6
Eucytherura sp. 2
Phalcocythere sp. 1
Schizocythere sp. 5
Schizocythere sorensis
Schuleridea sp. 3

139.94-140.11 m

Alocopocythere sp. 7
Anommatocythere sp. 2
Bairdia sp. 2
Bairdia sp. 4
Brachycythere sp. 1
Cytherella sp. 4
Cytherella sp. 5
Cytherelloidea sp. 2
Mosaleberis sp. 2
Mosaleberis sp. 4
"Neocythere" sp. 1
Occultocythereis sp. 3
Phalcocythere sp. 1
Phalcocythere sp. 3
Schizocythere sp. 5
Schizocythere sorensis
Schizoptocythere sp. 3
Schizoptocythere sp. 4
Trachyleberid sp. 3
Trachyleberid sp. 4
New Genus B sp. 1
New Genus C sp 1
New Genus C sp. 2

147.96-147.13 m

Alocopocythere sp. 8
Anommatocythere sp. 2
Argilloecia sp. 1
Bairdia sp. 2

147.96-147.13 m (continued)

Bairdia sp. 5
Brachycythere sp. 1
Cytherella sp. 6
Eucytherura sp. 2
"Neocythere" sp. 1
Occultocythereis sp. 3
Paracypris sp. 1
Parakrithella sp. 1
Phalcocythere sp. 1
Phalcocythere sp. 4
Pterygocythereis sp. 1
Quadracythere sp. 3
Schizocythere sorensis
Schizoptocythere sp. 4A
Schuleridea sp. 2
Trachyleberid sp. 4
Veenia sp. 3
Xestoleberis sp. 5
New Genus B sp. 1
New Genus C sp. 1

151.10-151.30 m

Alocopocythere sp. 8
Bairdia sp. 2
Brachycythere sp. 1
Cytherella sp. 2
Cytherella sp. 4
Cytherura sp. 2
Eucytherura sp. 2
Mosaleberis sp. 4
Paracypris sp. 1
Parakrithella sp. 1
Schizoptocythere sp. 3
Schizoptocythere sp. 4
Veenia sp. 3
New Genus C sp. 1

152.70-152.85

Anommatocythere sp. 2
Bairdia sp. 4
Bairdia sp. 5
Caudites sp. 4
Cytherella sp. 4
Hermanites sp. 5
"Neocythere" sp. 1
Ornatoleberis sp. 1
Paracypris sp. 3
Quadracythere sp. 3
Schizocythere sp. 5
Trachyleberid sp. 4
Veenia sp. 3

152.70-152.85 m (continued)
Xestoleberis sp. 1

160.78-160.94 m
Anommatocythere sp. 2
Anommatocythere sp. 3
Bairdia sp. 2
Cytherella sp. 4
Phalcocythere sp. 4
Veenia sp. 4

171.02-171.25
Alocopocythere sp. 8
Alocopocythere sp. 9
Anommatocythere sp. 2
Bairdia sp. 2
Brachycythere sp. 1
Cytherella sp. 2
Cytherella sp. 4
Cytherelloidea sp. 2
Mosaleberis sp. 4
Paracypris sp. 3
Phalcocythere sp. 4
Veenia sp. 5
New Genus C sp. 2

172.40-172.60
Alocopocythere sp. 8
Brachycythere sp. 1
Cytherella sp. 4
Cytherella sp. 6
Parakrithella sp. 1
Schizocythere sorensis
Schizoptocythere sp. 4
New Genus B sp. 1
New Genus C sp. 2

176.01-176.15 m
Alocopocythere sp. 8
Alocopocythere sp. 9
Anommatocythere sp. 2
Brachycythere sp. 1
Brachycythere sp. 2
Cytherella sp. 6
Cytherideid sp. 1
Gyrocythere sp. 2
Paracypris sp.
Schizocythere sorensis
"Tanella" sp. 1
New Genus B sp. 1
New Genus C sp. 1
New Genus C sp. 2

176.01-176.15 m (continued)
Genus D sp. 1

183.35-183.55 m
Alocopocythere sp. 10
Brachycythere sp. 1
Cytherella sp. 4
Cytherella sp. 7
Mosaleberis sp. 5
Phalcocythere sp. 4
Schizocythere sp. 5
Schizoptocythere sp. 4A
Veenia sp. 3
New Genus B sp. 1
New Genus C sp. 1

190.11-190.30 m
Anommatocythere sp. 2
Bairdia sp. 2
Brachycythere sp. 1
Cytherella sp. 6
Mosaleberis sp. 5
Occultocythereis sp. 4
Phalcocythere sp. 5
Schizocythere sp. 5
Schizoptocythere sp. 4
Veenia sp. 3
Xestoleberis sp. 5
New Genus B sp. 1
New Genus C sp. 1

211.86-212.01 m
Alocopocythere sp. 9
Brachycythere sp. 1
Brachycythere sp. 2
Cytherella sp. 6
Cytherideid sp.
Trachyleberid sp. 5

244.73-244.90 m
Cytherideid sp. 2