

**MIOCENE AND PLIOCENE OSTRACODA
FROM NORTHEASTERN VENEZUELA**

BY

W. A. VAN DEN BOLD

**VERHANDELINGEN DER KONINKLIJKE NEDERLANDSE
AKADEMIE VAN WETENSCHAPPEN, AFD. NATUURKUNDE**

EERSTE REEKS, DEEL XXIII, No. 3

1966

**N.V. NOORD-HOLLANDSCHE UITGEVERS MAATSCHAPPIJ
AMSTERDAM**

Author's address

LOUISIANA STATE UNIVERSITY
BATON ROUGE

AANGEBODEN SEPTEMBER 1965

AANVAARD SEPTEMBER 1965

GEPUBLICEERD FEBRUARI 1966

CONTENTS

| | |
|---------------------------|----|
| INTRODUCTION | 5 |
| ACKNOWLEDGEMENT | 7 |
| BIOSTRATIGRAPHY | 9 |
| ECOLOGY | 16 |
| REFERENCES | 42 |

Abstract: 92 species of ostracodes are reported from surface and subsurface Upper Miocene and Pliocene strata of the island of Cubagua, the Araya Peninsula and Cumaná (Estado Sucre, Venezuela). Sixteen species are described as new. The faunas suggest correlation of the Cubagua Formation with the Springvale and Manzanilla Formations of Trinidad.

INTRODUCTION

In the summer of 1963 P. J. Bermudez and the writer set out to collect samples of the outcropping formation on the Araya Peninsula (Estado Sucre, Venezuela), and the island of Cubagua. Due to a breakdown of the vessel, kindly put at our disposal by the Oceanographic Institute of the University of Oriente, part of this trip had to be called off, and we were only able to make collections of the beds outcropping at Caigüire, Cumaná (Cumaná Formation). Later in the same year P. J. Bermudez and H.M. Bolli returned to this area and completed the proposed trip. They kindly turned the collected ostracod-material over to the writer for further study, to supplement the subsurface material from the wells Cubagua 1 and 2 from which the writer had been allowed to pick out the ostracodes. Locations of these samples can be found in the study of the pelagic foraminifera of the same section by H. M. BOLLI and P. J. BERMUDEZ, and in the study of the benthonic smaller foraminifera by P. J. BERMUDEZ, and A. N. FUENMAYOR.

The samples of the Cumaná Formation were taken in a small ravine which comes out of the hills close to the Texaco Service Station, about three blocks away from the Hospital at Caigüire (Cumaná). The highest beds in this section contain abundant *Palmerinellae*. The ostracodes from the *Palmarinella* beds were collected about one block west of the Texaco Service Station.

In a few cases holotypes or figured specimens have been selected from samples of recent deposits off the coast of Trinidad. The localities of stations 1021, 1185 and 1206 can be found on map 1 of DROOGER and KAASSCHIEFER (1958), the locality of Kugler 5121 on fig. 2, of VAN DEN BOLD (1963b).

Holotypes of new species have been deposited in the U.S. National Museum (USNM No. 64179-95), paratypes and other figured specimens in the H.V. Howe collections, Louisiana State University, Baton Rouge, (HVH No. 7903-33).

ACKNOWLEDGEMENTS

The writer is deeply indebted to P. J. Bermudez and H. M. Bolli for donating the greater part of the ostracod-material on which this paper is based, and to the Universidad Central de Venezuela and the Compañía Shell de Venezuela for use of laboratory facilities. Thanks are also due to F. A. Balda and G. A. Seiglie and the Oceanographic Institute of the Universidad de Oriente for help during the stay in Cumaná and donation of ostracod material from Recent deposits off the Venezuelan coast. M. Mumma (Louisiana State University) assisted in collecting, washing, and picking of the samples; L. Nichols (assistant curator, geological museum, Louisiana State University) made the photographs of the specimens. This study is part of an investigation of the Miocene-Recent Ostracod-faunas of the Caribbean Region sponsored by the National Science Foundation (Grant GB-416).

BIOSTRATIGRAPHY

It was recognized at an early stage, that the faunas of the Mio-Pliocene of Eastern Venezuela bear a close resemblance to the fauna of the Springvale Formation in Trinidad (BOLD, 1963b). However, on closer examination discrepancies are found between the ranges of individual species in Trinidad and Venezuela. The most striking dissimilarity is the total absence of species of the genus *Cytheridea* in the Venezuelan fauna (see ecology).

Some species, which appear to have a restricted range in Trinidad, occur over a greater stratigraphic interval in Venezuela; on the other hand fiarily long-ranged species from Trinidad Occur over narrower stratigraphic ranges in Venezuela. This is born out quickly by a comparison of the ranges in the upper and lower parts of Tables 1 and 2. On Cubagua deeper water conditions in the lower strata penetrated by wells Cubagua 1 and 2 were unfavourable to the development of the shallow water species so prolific in the surface material of Cubagua, Araya and Trinidad, and as a result many shallow-water species have not been found throughout their full range in the samples from these wells, but are replaced lower down by deeper water species of the "open sea" type (BOLD, 1960, 1963b).

Some species of *Munseyella* and *Cytheromorpha* were found in the deeper cores from these wells and evidently were able to persist in deeper water, than most other shallow-water species: *Munseyella bermudezi* n. sp., first described from the Springvale Formation of Trinidad, occurs in Cubagua 1 from the surface down to 759'. *Munseyella bollii* n. sp. on the other hand, previously described from the Manzanilla Formation of Trinidad, occurs from 258' down to the deepest parts of the well and appears to be well adjusted to deeper water conditions.

A few of the species with very short stratigraphic range, both in Trinidad and in Venezuela are: *Cytheromorpha apheles* van den Bold, and *Orionina fragilis* van den Bold. A slightly less restricted range have *Pumilocytheridea sandbergi* van den Bold, *Kangarina ancyla* van den Bold, *Cytheropteron sp. aff. leonensis* Puri and *Puriana minuta* van den Bold. They occur in the outcropping beds on Cubagua, in the upper part of Cubagua 1 and 2, and in the Araya Peninsula in the strata exposed in the Cerro Guamache, Cerro Macho and Cerro Verde, but not in those exposed in the Cerro Barrigón. The first group of two species is further restricted to the beds exposed in the Cerro Guamache, and on the Island of Cubagua. Correlation of the upper 482 feet penetrated by Cubagua 1 with the outcropping beds in the Cerro Macho and Cerro Verde, and with part of the Springvale Formation appears possible. The correlation favoured here is shown in Table 4.

The strata penetrated by Cubagua 1 below 945' show a deeper water facies than encountered in the outcropping beds, as born out by the presen-

ce of "open sea" genera, such as *Krithe*, *Parakrithe*, *Parakrithella*, *Bradleya*, *Henryhowella* (in Cubagua 2), and *Ambocythere*. The occurrence here of *Costa variabilocostata laticostata* n. subsp. and *Semiccytherura arayaensis* n. sp. suggests correlation with the beds outcropping in the Cerro Barrigón and the lower part of the beds exposed in the Cerro La Cantera. The species *Trachyleberis bermudezi crebripustulosa* van den Bold, *Acanthocythereis? kugleri* van den Bold, *Costa santacruzensis* van den Bold, *Krithe lambi* van den Bold and *Krithe sp. aff. reversa* van den Bold suggest correlation of the deeper parts of the Cubagua Formation with the higher parts of the Pozón Formation (BOLD, 1966), in Falcón and the Lengua Formation in Trinidad. As deeper water conditions ceased both in Falcón and in Trinidad in the *Sphaeroidinella seminula* zone, these species may actually range higher than suggested by their range in these areas.

Similarity in fauna between the Cumaná Formation and the highest beds exposed in the Cerro La Cantera suggests these beds to be of about the same age. The presence of *Campyloccythere? perieri* (Brady), *Cyprideis similis* (Brady) and *Loxoconcha levis* Brady suggests a younger age for these beds, than for those penetrated in the Cubagua wells and exposed in the Cerro Guamache and they could be a time equivalent of part of the Talparo Formation in Trinidad. Accepting for the time being the correlation suggested in Table 4, we may divide the Upper Miocene of this area into 4 subdivisions on the basis of ostracodes as shown in Table 3. Incidentally the range of the species suggests that the beds penetrated by the Biche wells (BOLD 1963b, p. 367) and placed provisionally in a position intermediate between Manzanilla and Springvale Formations should be correlated with the Gransaul member of the Springvale Formation.

In order to make an objective interpretation of the similarity of the different faunas, not based on restricted ranges of species, the Simpson coefficient of these faunas has been calculated (table 5). This shows close relationship between the faunas of the Cumaná Formation and the higher beds exposed in the Cerro La Cantera, and between those of the beds exposed in the Cerro Barrigón and the lower beds in the Cerro La Cantera. Less convincing is the similarity between the fauna of the surface beds and the upper part of the Cubagua Formation and the fauna of the beds exposed in the Cerro Guamache.

For comparison a list is given of the ostracodes of the Playa Grande Formation (Cabo Blanco), Pliocene:

Cytherella polita Brady, *Cytherella sp. aff. C. pulchra* Brady, *Cytherella* spp., *Cytherelloidea praecipua* van den Bold, *C. tewarii* van den Bold, *Propontocypris robusta* n. sp., *Argilloecia barrigonensis* n. sp., *Argilloecia* sp., *Bythocypris keiji* van den Bold, *Macrocypris decora* (Brady), *Perissocytheridea subrugosa* (Brady), *Pumilocytheridea sandbergi* van den Bold, *Munseyella bermudezi* n. sp., *Costa variabilocostata variabilocostata* (van den Bold), *Cativella sp. a.* *C. semitranslucens* (Crouch),

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---------------------------|----|----|----|----|----|-----|-----|----|----|----|----|
| 1 Cabo Blanco | | 55 | 55 | 55 | 30 | 45 | 40 | 60 | 40 | 20 | 10 |
| 2 Cumana | 55 | | 90 | 64 | 55 | 50 | 35 | 60 | 50 | 30 | 10 |
| 3 Cerro La Cantera (M 62) | 55 | 90 | | 50 | 30 | 25 | 20 | 65 | 50 | 30 | 10 |
| 4 Cerro Guamache | 55 | 65 | 50 | | 65 | 65 | 35 | 70 | 55 | 40 | 15 |
| 5 Cerro Macho & Verde | 30 | 55 | 30 | 65 | | 55 | 35 | 50 | 50 | 40 | 20 |
| 6 Cerro Barrigon | 45 | 5 | 25 | 65 | 55 | | 100 | 60 | 30 | 40 | 40 |
| 7 Cerro La Cantera (M 72) | 40 | 35 | 20 | 35 | 35 | 100 | | 40 | 30 | 30 | 60 |
| 8 Cubagua (surface) | 60 | 60 | 65 | 70 | 50 | 60 | 40 | | 60 | 40 | 40 |
| 9 Cubagua 1 (0-270) | 40 | 50 | 50 | 55 | 50 | 30 | 30 | 60 | | 60 | 30 |
| 10 Cubagua 1 (270-800) | 20 | 30 | 30 | 40 | 40 | 40 | 30 | 40 | 60 | | 30 |
| 11 Cubagua 1 (800-1600) | 10 | 10 | 10 | 15 | 20 | 40 | 60 | 25 | 30 | 30 | |

Table 3. Comparison of faunal similarity or dissimilarity by means of the Simpson coefficient, rounded off to nearest 5 or 0.

$$100 \frac{\text{number of species in common between two faunas}}{\text{number of species in the less diversified fauna}}$$

| | | Eastern Venezuela | | | Trinidad | | |
|---------------|-------------|---------------------------|---|---|----------|------------|-------------|
| Pliocene | Cabo Blanco | | | | Talparo | | |
| | | | | Cerro La Cantera (M 62) | | | Cumana |
| Upper Miocene | | Cubagua 1 270' 800' | 1 | Cerro Guamache | | Springvale | Melajo m. |
| | | | 2 | | | | Savaneta m. |
| | | | 3 | Cerro Macho & Verde | | | Gransaul m. |
| | | | 4 | Cerro Barrigón Cerro La Cantera (M 72) | | Manzanilla | |

Table 4. Suggested correlation on the basis of Ostracoda between surface and subsurface formations in Eastern Venezuela and surface formations in Trinidad.

Cativella navis Corywell & Fields, *Puriana minuta* van den Bold, *Puriana formosa* van den Bold, *Puriana rugipunctata* (Ulrich & Bassler), *Pterygocythereis* sp. aff. *jonesi* (Baird), *Mutilus confragosus* (Edwards), *Aurila conradi* (Howe & McGuirt), *Quadracythere* sp. aff. *Q. bichensis* (van den Bold), *Caudites angulatus* Puri, *Caudites nipeensis* van den Bold, *Orionina serrulata* (Brady), *Orionina similis* van den Bold, *Campylocythere?* *perieri* (Brady), *Basslerites minutus* van den Bold, *B. berchoni* (Brady), *Loxoconcha* sp. aff. *dorsotuberculata* (Brady) (= ? *L. ochlockliensis* Puri), *Loxoconcha avellana* Brady, *Loxoconcha fischeri* (Brady), *Loxoconcha levis* Brady, *Cytherura luciae* n. sp., *Cytherura* ex gr. *johnsoni* Mincher, *Cytherura swaini* van den Bold, *Hemicytherura cranekeyensis* Puri, *Eucytherura complexa* (Brady) *Kangarina ancyla* van den Bold, *Kangarina fieldsae* n. sp., *Cytheropteron renzi* van den Bold, *Luvula gigarton* n. sp., *Sclerochilus* sp., *Pellucistoma* sp. aff. *P. magniventra* (Edwards), *Xestoleberes* sp. aff. *X. margaritea* Brady.

To aid in further comparison the fauna of a number of samples off the north coast of Venezuela (collected by the Oceanographic Institute of Oriente University and made available through the courtesy of G. A. Seiglie), ranging from latitude 63–66°W and 10°30'–12°N, is listed (alphabetical order):

Aglaioocypris sp., *Argilloecia* sp., *A. posterotruncata* n. sp., *Aurila floridana* Benson & Coleman, *Mutilus confragosus* (Edwards), *Aurila* sp. cf. *A. cicatricosa* (Reuss), *Bairdia bradyi* van den Bold, *B. longisetosa* Brady, *B. victrix* Brady, *B. sp.*, *Basslerites berchoni* (Brady), *B. minutus* van den Bold, *Bradleya* ex gr. *dictyon* (Brady), *Bythoceratina binodosa* n. sp., *B. sp.* aff. *B. scaberrima* (Brady), *B. sp.*, *Bythocypris keiji* van den Bold, *Callistocythere* sp., *Campylocythere?* *perieri* (Brady), *Cativella navis* Coryell & Fields, *C. sp.* aff. *C. semitranslucens* (Crouch), *Caudites angulatus* Puri, *C. howei* Puri, *C. nipeensis* van den Bold, *C. obliquicostatus* van den Bold, *Costa santacruzensis* van den Bold, *C. variabilocostata variabilocostata* (van den Bold) *Cyprideis salebrosa* van den Bold, *C. similis* (Brady), *Cytherella* sp. aff. *pandora* Kornicker, *C. polita* Brady, *C. sp.* aff. *pulchra* Brady, *C. sp.*, *Cytherelloidea sarsi* Puri, *C. precipua* van den Bold, *Cytheretta pumicosa* (Brady), *Cytheropteron renzi* van den Bold, *C. subreticulatum* van den Bold, *Cytherura* ex gr. *johnsoni* Mincher, *C. swaini* van den Bold, *C. luciae* n. sp., *Eucytherura complexa* (Brady), *Hemicythere* sp., *Hemicytherura cranekeyensis* Puri, *H. bradyi* Puri, *Hermanites hornbrookii* (Puri), *Jugosocythereis pannosa* (Brady), *Kangarina ancyla* van den Bold, *K. abyssicola* (Müller), *Krithe* sp., *Leptocythere* sp. aff. *inconspicua* (Brady), *Loxoconcha levis* Brady, *L. fischeri* (Brady), *L. avelana* (Brady), *L. lapidiscola* Hartmann, *L. ochlockoneensis* Puri = ? *L. dorsotuberulata* (Brady), *Macrocypris maculata* (Brady),

Microcythere sp., *Munseyella* sp., *Neocaudites neviranii* Puri, *Occultocythereis angusta* van den Bold, *Orionina serrulata* (Brady), *O. bradyi* van den Bold, *Palaciosa* sp., *Paracytheridea* spp., *Paracytheroma johnsoni* (Mincher), *Parakrithella* sp., *Paradoxostoma* sp., *Perissocytheridea bicelliformis* Swain, *Propontocypris robusta* n. sp., *P.* sp., *Pterygocythereis* sp. aff. *jonesi* (Baird), *Pumilocytheridea sandbergi* van den Bold, *P.* sp., *Puriana rugipunctata* (Ulrich & Bassler), *P. minuta* van den Bold, *Quadracythere compacta* (Brady), *Sarsiella punctata* Kornicker, *Schlerochilus* sp., *Triebelina coronata* (Brady), *T. bradyi* Triebel, *T. sertata* (Brady), *Uroleberis* sp., *Xestoleberis* spp.

ECOLOGY

It has been stated in the introduction, that the fauna of nearly the whole Upper Miocene and Pliocene section in Cubagua, Araya and Cumaná is very similar to that of the Springvale-Manzanilla Formations. A notable exception, however, is the total absence of species of the genus *Cytheridea*, represented in the Trinidad section by *Cytheridea bronnimanni*, *C. mediatena* and *C. kollmanni*. This absence is also notable in the fauna of the recent deposits off the north coast of Venezuela and Trinidad. Here species of *Cytheridea* and *Haplocytheridea* are absent, whereas recent deposits from other parts of the Caribbean often contain *Haplocytheridea setipunctata* (Brady) or *Haplocytheridea bradyi* (Stephenson). It is not known what ecological conditions cause this phenomenon. The genera *Cyprideis* and *Perissocytheridea* are generally represented in the recent fauna of nearcoastal deposits where they are very abundant in mangrove swamps, and species of these genera also occur also in the fossil deposits, although infrequent and probably washed in from nearby lagoons.

The similarity between fossil and recent fauna suggests similar ecological conditions and the Cubagua Formation probably represents deposition in a shallow body of water in open connection with the ocean.

(1) Playa Grande Formation: shallow, marine, open connection with the sea, depth 0–40 feet, normal salinity.

(2) Cumaná Formation: Shallow water, locally brackish, depth 0–40 feet.

(3) Deposits on the Araya peninsula, similar to Playa Grande.

(4) Cubagua surface deposits: the presence of *Perissocytheridea* together with "open sea" genera: *Parakrithe* and *Bythoceratina* suggest contemporaneous mixing of littoral and deeper water faunas, depth 0–70 feet.

(5) Cubagua 1, upper 800 feet, probably slightly deeper than the surface deposits (0–120').

(6) Cubagua 1, below 800 feet. Open sea forms predominate: *Parakrithe*, *Krithe*, *Ambocythere*, *Bradleya*, *Argilloecia*, *Trachyleberis bermudezi crebripustulosa*, *Acanthocythereis? kugleri*, *Costa santacruzensis*, *Henryhowella* (Cubagua 2:2732–42 feet). Almost total absence of shallow water genera. Deposition in deeper water (depth more than 200 feet), similar to the environment of deposition of the Brasso Formation in Trinidad or the Pozón Formation in Falcón.

SYSTEMATIC DESCRIPTIONS

Subclass: **Ostracoda** Latreille, 1806Order: **Popocopida** Müller, 1894Suborder: **Popocopina** Sars 1866Superfamily: **Cyridacea** Baird 1845Family: **Pontocyprididae** Müller, 1894Genus: **Propontocypris** Sylvester-Bradley 1947*Propontocypris robusta* n. sp.

Pl. 1, fig. 3 a-b

Name: *robustus* (L) — hard and strong (like an oak).*Holotype*: a complete carapace, USNM No. 649179*Paratypes*: 3 carapaces, HUH No. 7903*Type locality*: M 62, Cerro La Cantera, Araya peninsula, Estado Sucre, Venezuela.*Stratigraphic horizon*: highest beds exposed in the Cerro La Cantera, probably equivalent to Cumaná Formation, Pliocene.*Occurrence*: see Table 2, Playa Grande Formation, Cabo Blanco.*Description*: Carapace smooth, triangular, highest a little more than 1/3 of the length from the anterior extremity. Anterior end obliquely rounded, angled at the junction with the dorsal margin at the greatest height; dorsal margin slightly convex, sloping down towards the posterior end; ventral margin almost straight with a faint sinuation in front of the middle, converging strongly towards the dorsal margin posteriorly; posterior end very narrowly rounded ventrally; there is a slight angulation where dorsal and posterior margin meet, at about 1/5 of the length from the posterior extremity.

Dorsal view bombshaped, widest at about 2/5 of the length from the anterior end. Right valve slightly larger than the left and overlapping along the entire margin.

Dimensions: L: 0.88; H: 0.45; W: 0.32*Remarks*: *Pontocypris intermedia* Brady (BRADY 1868, p. 220, Pl. 14, fig. 1, 2, MÜLLER, 1894, p. 254, Pl. 9, fig. 1, 22-25, Pl. 10, fig. 9, Pl. 3, fig. 12, 13) is more bluntly pointed behind. *Pontocypris dispar* MÜLLER (1894, p. 252, Pl. 9, fig. 2, 3, 13-20, Pl. 10, fig. 10-17) is very similar but differs in the following characteristic: posterior end wider in dorsal view, greatest width lies more anteriorly, greatest height a little more towards the middle.Genus **Argilloecia** Sars 1866*Argilloecia barrigonensis* n. sp.

Pl. 1, fig. 2 a, b

Argilloecia sp. van den Bold, 1964, p. 9*Name*: after the type locality in the Cerro Barrigón, Araya peninsula.

Holotype: a complete carapace, USNM No. 649180

Paratypes: 4 carapaces, HVH No. 7904

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation "Barrigón beds", Upper Miocene

Occurrence: see Table 2, (Cerro Barrigón), Table 1 (Cubagua 1: 258–270 feet).

Description: Carapace elongate, ovate, highest about 3/8 of the length from the posterior extremity. Anterior end low, evenly and narrowly rounded below the middle, with a long, slightly convex dorsal slope, which forms a faint angulation with the dorsal margin at about 1/3 of the length from the anterior extremity; dorsal margin short, almost straight, very gently convex, parallel to the ventral margin, which is nearly straight, slightly concave in the middle; posterior end narrowly rounded just below the middle, slightly convex above and meeting the dorsal margin just behind the greatest height, slightly convex below and meeting the ventral margin at about 1/4 of the length from the posterior extremity.

Right valve larger than the left and overlapping along the entire margin. Strongest overlap along dorsal margin, diminishing in amount in the antero- and posterodorsal slopes, and along the ventral margin, diminishing in anterior third, and in the lower part of the posterior margin.

Dorsal view lanceolate, widest just behind the middle, anterior end acute, posterior end blunt.

Marginal area and muscle scar typical for the genus.

Dimensions: holotype: L: 0.59; H: 0.28; W: 0.24

Remarks: The lateral outline, which is reminiscent of *Paradoxostome*, distinguishes this species of other species of *Argilloecia*.

Argilloecia posterotruncata n. sp.

Pl. 1, fig. 1a, b

Argilloecia sp. KEIJ, 1954, p. 218 (part.), Pl. 3, fig. 8a, Pl. 6, fig. 1, not Pl. 3, fig. 8b.

Name: *post* (L)—after, behind, and *truncatus* (L)—shortened by cutting off.

Holotype: a complete carapace, USNM No. 649181

Paratypes: 3 carapaces, 3 right valves, 2 left valves, HVH No. 7905

Type locality: Station 1021, Paria Shelf, for location see Drooger and Kaaschieter, 1958, Map 1.

Stratigraphic horizon: Recent

Distribution: Recent, Northcoast of Venezuela and Trinidad; Cubagua 1 (1020–2200 feet), see Table 1; Trinidad, Lengua Formation, *Globorotalia menardii*-*Globigerina nepenthes* zone.

Description: Carapace thickshelled, ovate, obliquely truncate behind.

Anterior end obliquely rounded, angled just above the middle, with a long, slightly convex dorsal slope, which forms a blunt angle with the dorsal margin at about $2/5$ of the length from the anterior extremity; dorsal margin short, almost straight, slightly depressed in the middle, forming a rounded angulation at about $1/4$ of the length from behind with the posterior margin; ventral margin slightly concave in front of the middle, curving upward into the rounded lower portion of the posterior end; posterior end angled below the middle, straight and obliquely truncate above.

Dorsal view somewhat wedge-shaped, widest behind the middle; lateral outline of the right valve convex, of the left valve nearly straight, converging gradually anteriorly; anterior end acute, posterior end somewhat rounded, with projecting right valve. Right valve larger than the left and overlapping along the entire dorsal and ventral sides, largest amount of overlap around the anterior angulation of the dorsal margin, gradually decreasing in the anterodorsal slope. No distinct overlap visible in the lower, rounded part of the anterior end.

Muscle-scars, marginal area and hinge typical for the genus.

Dimensions: holotype: L: 0.42; H: 0.22; W: 0.18

Superfamily: **Bairdiacea** Sars, 1888

Family: **Bairdiidae** Sars, 1888

Genus: **Bythocypris** Brady 1880

Bythocypris sp. aff. *B. pachyconcha* van den Bold

Pl. 3, fig. 8

Bythocypris pachyconcha VAN DEN BOLD, 1946, p. 67, Pl. 1, fig. 11a, b
Occurrence: Cerro La Cantera (M 62), Cumaná Formation. Differences with *B. pachyconcha*: dorsal margin not angled at greatest height, posterior end slightly higher, carapace smaller and slightly less elongate.

Dimensions: L: 0.83; H: 0.44 (HVH No. 7906)

Superfamily: **Cytheracea** Baird, 1850

Family: **Cytherideidae** Sars, 1925

Subfamily: **Krithinae** Mandelstam, 1958

Genus: **Parakrithe** van den Bold, 1958

Parakrithe rhamphodes n. sp.

Pl. 1 fig. 4 a-d, Pl. 5, fig. 1

Parakrithe vermunti (van den Bold) VAN DEN BOLD, 1964, p. 9

Name: *rhamphodes* (Gr.): beak-like

Holotype: a complete carapace, USNM No. 649182

Paratypes: 6 ♀♀, 5 ♂♂, HVH No. 7907

Type locality: Cubagua 1: core 211 (1627–1637 feet)

Stratigraphic horizon: Cubagua Formation

Occurrence: Cubagua 1 (table 1) and Bolli 79; in Trinidad a few specimens in the Forest and the Point d'Or Formations.

Description: Carapace thin, hyaline, elongate subreniform in the ♀, pointed behind. Anterior end evenly rounded, dorsal margin gently convex, ventral margin sinuate in front of the middle, parallel to dorsal; posterior end obliquely rounded above, rather sharply angled ventrally. In the ♂ the dorsal margin is nearly straight and the posterior slope is more oblique, giving the posterior end a sharper angle.

Left valve overlaps the right along the dorsal margin, the overlap increasing posteriorly, then decreasing along the dorsal slope of the posterior end. In the posterior half of the ventral margin the overlap is only very small.

Dorsal view lanceolate in both sexes: in the ♀ the greatest width lies at about 5/8 of the length from the anterior end, slightly behind the middle, in the ♂ the greatest width lies in the middle. The ♂ is also more slender than the ♀.

Marginal area very broad in anterior end, line of concrescence makes a sinus-shaped curve, and it separated from the inner margin in the middle of the curve. Radial porecanals number 12 in the anterior end, and about 7–8 false radial porecanals occur here. The marginal area narrows in front of the middle of the ventral margin, then widens in the posterior half, narrower again in the posterior end.

Dimensions: holotype: L: 0.44; H: 0.22; W: 0.18

♀♀: L: 0.41–0.45; H: 0.21–0.23; W: 0.17–0.19

♂♂: L: 0.43–0.47; H: 0.18–0.21; W: 0.15–0.16

Remarks: *Parakrithe vermanti* (van den Bold) is larger and has a different curve of the posterior margin.

Family: Cytheridae Baird, 1850

Subfamily: Cytheromorphae Mandelstam, 1960

Genus: *Cytheromorpha* Hirschmann, 1909

Cytheromorpha caudata n. sp.

Pl. 2, fig. 3 a–c

Cytheromorpha n. sp. A. VAN DEN BOLD, 1964, p. 9.

Name: *cauda* (L) tail, after the, for *Cytheromorpha*, unusually extended ventroposterior end.

Holotype: a complete carapace of a ♀, USNM No. 649183

Paratypes: 10 carapaces, HVH No. 7908

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estade Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation

Distribution: See Tables 1 and 2.

Description: ♀: Carapace elongate ovate, highest 1/4 of the length from the anterior extremity. Anterior end obliquely rounded, dorsal margin slightly convex, ventral margin sinuate just in front of the middle; the posterior part of the ventral margin forms a blunt angle at about 1/3 of the length from the posterior end with the anterior part of the ventral margin; this posterior part is almost straight and runs slightly upward to the sub-ventrally situated posterior extremity; the lower portion of the carapace along this part is compressed; posterior end somewhat pointed below the middle, concave above. Part of the posterodorsal margin is obscured by the curved dorsal outline of the carapace. Dorsal view lanceolate, widest about 1/3 of the length from the anterior extremity. From this point the lateral outline is slightly convex, tapers anteriorly and is straight, slightly converging, posteriorly, to about 1/4 of the length from behind; from thereon the sides are concave and taper more strongly.

♂: Very similar to ♀, but more elongate. Carapace elongate subrectangular, dorsal margin straight and roughly parallel to the ventral. Greatest height at about 1/5 of the length from the anterior extremity. In dorsal view the greatest width lies at 1/4 of the length from behind; sides almost parallel, slightly converging forward to a point about 1/3 of the length from the anterior end. Ends as described for the ♀.

Marginal area broad in anterior end, line of concrecence sinus-shaped, separated from the inner margin. Radial porecanals few, straight and simple, widely spaced. Hinge typical for the genus.

Dimensions: holotype: L: 0.37; H: 0.19; W: 0.14

♀♀: L: 0.35–0.38; H: 0.18–0.20; W: 0.13–0.14

♂♂: L: 0.40–0.44; H: 0.18–0.20; W: 0.13–0.14

Remarks: This species is related to *Cytheromorpha?* *sp.* VAN DEN BOLD (1963b), p. 384, Pl. 5, fig. 6) from the Brasso Formation of Trinidad, which species has also been found in the Husito marly clay of the Pozón Formation of Falcon (VAN DEN BOLD, 1946, p. 6; 1966). It is, however, more elongate, especially in the ♂.

Subfamily: **Leptocytherinae** Hanai, 1957

Genus: **Munseyella** van den Bold, 1957

Munseyella bolli n. sp.

Pl. 2, fig. 2 a–b

Munseyella sp. A. VAN DEN BOLD, 1963b, p. 379, Pl. 5, fig. 2a, b

Munseyella n. sp. C. VAN DEN BOLD, 1964, p. 9

Name: after Prof. Dr. H. M. Bolli, Eidgenössige Technische Hochschule, Zürich, Switzerland.

Holotype: a complete carapace, ♀, USNM No. 649184

Paratypes: 12 ♀♀, 4 ♂♂, HVH No. 7909

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation

Distribution: Cubagua Formation (see Tables 1 and 2), Manzanilla Formation, Trinidad.

Description: Carapace small, subrectangular, highest about 1/4 of the length from the anterior extremity. Anterior end obliquely rounded, dorsal margin slightly convex, ventral margin sinuate in front of the middle, almost parallel in the ♂, fairly strongly converging in the ♀; posterior end almost vertically truncate, bearing 2 short, stout spines.

Anterior end heavily rimmed; this rim continues along dorsal, ventral and posterior margin, flattening ventral and dorsal surfaces and giving the carapace a box-like appearance. It is of about equal width everywhere. Behind the anterior rim and above the anterior part of the ventral rim is a depressed area, which narrows posteriorly until it disappears at about 1/3 of the length from the posterior end, where the elevated portion of the carapace above the depression, forming a faint ventral ridge behind the middle, reaches the ventral rim and then suddenly disappears. The dorsal ridge is part of the continuation of the anterior rim; it forms in dorsal view a flat triangular surface in the posterior part, but bends down sharply just in front of the posterior cardinal angle and reaches over on the lateral side till about the median line of the valve. Behind this the dorsal rim is greatly reduced in width. The surface of the carapace shows faint wrinkles and depressions without any regular pattern.

Dimensions: holotype: L: 0.37; H: 0.23; W: 0.18

♀♀: L: 0.35–0.37; H: 0.20–0.23; W: 0.15–0.18

♂♂: L: 0.37–0.39; H: 0.19–0.21; W: 0.15–0.17

Remarks: This species is rather similar to *Munseyella minuta* (van den Bold), but differs by a stronger dorsal and weaker ventral ridge.

Munseyella bermudezi n. sp.

Pl. 2, fig. 1a, b

Munseyella sp. in Moore et al., 1961, fig. 246A, 1a, b

Munseyella sp. B. VAN DEN BOLD, 1963b, p. 379, Pl. 5, fig. 1 a–b

Munseyella sp. B. VAN DEN BOLD, 1964, p. 9

Name: after Prof. Dr. P. J. Bermudez, Univ. Central de Venezuela, Caracas.

Holotype: a complete carapace, ♀, USNM No. 649185

Paratypes: 10 ♀ and ♂ carapaces. HVH No. 7910

Type locality: Cubagua 1 (core 10: 258–270 feet)

Stratigraphic horizon: Cubagua Formation

Distribution: Savaneta glauconitic sandstone of the Springvale Formation (Trinidad), Cubagua (surface and upper part of Cubagua 1, see Table 1),

Araya (table 2), Playa Grande Formation (Cabo Blanco) and Caujarao Formation.

Description: Carapace small, elongate, subtriangular, highest at anterior cardinal angle, nearly 1/3 of the length from the anterior extremity. Anterior end almost evenly founded; dorsal margin slightly convex, ventral margin sinuate in front of the middle, converging posteriorly; posterior end narrow, obliquely truncate, rounded ventrally, with two short spines, one in the upper portion, one in the lower curved part.

An anterior rim continues dorsally and branches into long dorsal ridges, one in each valve which form an elongate V in dorsal view. Just in front of the posterior cardinal angle the dorsal ridge bends downward and diverges from the dorsal margin, ending abruptly at median height. A very faint ventral ridge occurs, ending at about 1/4 of the length from the posterior end. This ridge is better visibly in ventral view.

Greatest width at about 1/3 of the length from the posterior end; dorsal view elongate, pearshaped.

In some specimens a short, weak median ridge can be seen in the posterior portion of the carapace.

Dimensions: ♀: L: 0.38; H: 0.22; W: 0.17

♂: L: 0.39; H: 0.21; W: 0.15

Remarks: The curved dorsal ridge sets this species aside from others of the same genus described so far. *Munseyella* sp. B (van den Bold, 1963b, p. 379, Pl. 5, fig. 1 a-b) was inadvertently given the same number in the H.V. Howe collections as *Hemisither bichensis*. (HVH No. 6860); this has to be changed for *Munseyella* sp. B to HVH No. 8300.

Munseyella sp.

Leptocythere cf hoptonensis (Brady) KELJ, 1954, p. 221, Pl. 4, fig. 5b, Pl. 6, fig. 6

Not *Cythere hoptonensis* Brady, Crosskey & Robertson, 1874, p. 168, Pl. 14, figs. 4-6.

Remarks: There is not sufficient material at present to establish a new species. In the Cubagua Formation this species has only been found in Cubagua I, one specimen was found in Trinidad in the Montserrat glauconitic sandstone member of the Manzanilla Formation.

Subfamily: Perissocytherideinae van den Bold, 1963

Genus: Pumilocytheridea van den Bold, 1963

Pumilocytheridea sandbergi van den Bold

Pl. 2, fig. 6 a-d

Pumilocytheridea sandbergi VAN DEN BOLD, 1963b, p. 382, Pl. 4, fig. 3a-d, Pl. 12, fig. 1 a-d, 2 a-b, 1964, p. 8, 9, 10, 11

This species is widespread in Venezuela. It has been found so far in the Cubagua Formation (surface and uppermost subsurface) on Cubagua and the Araya Peninsula (see Tables 1 and 2) and in the Cumaná Formation. Further in the Playa Grande Formation, the Cueparo Formation, the Socorro Formation, the Urumaco Formation and in marine shallow water off the coast of Venezuela. In Trinidad the species occurs from the Springvale Formation upwards.

Subfamily: **Leguminocytherideidinae** Howe, 1961

Genus: **Campylocythere** Edwards, 1944

Campylocythere? *perieri* (Brady)

Pl. 2, fig. 4 a–b, Pl. 5, fig. 2a, b

Cythere perieri BRADY, 1868b, Les Fonds de la Mer, vol. 1, p. 79, Pl. 8, fig. 25–26 (Karimata); 1870, Ibid., p. 238 (Santiago de Cuba).

Campylocythere strata VAN DEN BOLD, 1957 (part), Pl. 3, fig. 2 c, d, (Not Pl. 2, fig. a, b)

“*Campylocythere*” sp. van den Bold, 1963a, p. 33, textfig. 6, fig. 11

Campylocythere? sp. van Morkhoven, 1963, p. 129, fig. 192, 193

Campylocythere perrensis (Brady) van den Bold, 1964, p. 10, 11

Not *Cythere perrensis* Brady, 1869, Fonds de la Mer, vol. 1, p. 123, Pl. 14, fig. 9, 10

Description: Carapace elongate, about twice as long as high, greatest height at a little more than 1/3 of the length from the anterior extremity. Anterior end evenly rounded; dorsal margin slightly depressed behind the anterior cardinal angle, gently convex; ventral margin sinuate, concave in front of the middle, generally parallel to the dorsal margin, except in the posterior quarter of the carapace where they converge; posterior end bluntly angled in the middle, rounded below, concave above; the posterior cardinal angle forms a nodular projection.

Dorsal view more or less wedgedshaped, widest about 1/3 from posterior end; sides regularly convex and converging anteriorly; posterior end compressed.

Ornamentation consists of longitudinal riblets of varying degree of distinctness. In nearly all specimens 2 pairs of ribs stand out, forming an elongate V in the posterior half of the carapace, starting in the center, diverging towards the posterior cardinal angle and the posterior angulation. Usually a few more parallel riblets can be seen. In most specimens the anterior half is smooth, but two of the longitudinal ribs may continue forward, roughly parallel, till the anterior margin. The inside of the V is somewhat depressed. The anterior margin is thickened from the anterior cardinal angle down, and this swelling continues as a weak ventral rib parallel to the ventral margin.

Hinge: In the right valve a high, pointed anterior tooth, placed rather

far backward, followed by a small, shallow socket, narrowing into a narrow, crenulate, slightly convex groove; posterior tooth beanshaped, lolate, highest posteriorly. In the left valve: a large, round anterior socket, a small knoblike tooth attached to a narrow, crenulate, slightly convex bar; posterior socket inside the slightly projecting posterior cardinal angle, open to the interior.

Marginal area wide in anterior end where inner margin and line of concrescence are rather widely separated. Inside the vestibule a few pillars support the calcified portion of the inner lamella. Radial porecanals numerous, sometimes a few branching from a common indentation of the line of concrescence, the majority simple and short. In the posterior end the line of concrescence and inner margin are again separated for a short distance.

Normal porecanals are not very numerous and of the sieve type.

Muscle scars: a posterior row of 4 with two rounded scars in front.

Dimensions: L: 0.56; H: 0.27; W: 0.21

Remarks: This species is related to *Campylocythere striata* van den Bold, but the pattern of ridges is different, especially the ventral ridge is better developed in the latter species and the V-shaped ribs are not present.

The species is assigned provisionally to the genus *Campylocythere* with which it has a number of characteristics in common. This would place it in the Leguminocythereidinae according to Howe (see Moore, 1961, p. Q 306-307). However, the presence of sieve type porecanals, and the two rounded antennal scars suggest relationship to some of the Hemicytherinae and the shape, type of ornamentation and the pillar structures in the anterior marginal area are reminiscent of *Orionina*. *Cythere perieri* was originally described from Karimata (East Indies). Brady also had the same species in a sample from Guadeloupe, but did not report on it, although he mentions this species from Santiago de Cuba. The slides from the three localities are in the Hancock Museum, Newcastle on Tyne, and through the courtesy of Dr. Ph. Sandberg the writer was able to compare these with the present material. The species occurs in the recent Caribbean seas from Panama along the coast of South America and northward along the arc of the Lesser Antilles to Puerto Rico and Cuba. The species has been found in the beds exposed in the Cerro La Cantera (M 62), the Cumaná Formation and in the Playa Grande Formation, Cabo Blanco. It appears to be confined to Post Miocene deposits.

Genus: **Basslerites** Howe 1937

Basslerites cuspidatus n. sp.

Pl. 1, fig. 5a, b

Name: *cuspidatus* (L)-pointed,

Holotype: a complete carapace, ♀, USNM No. 649186.

Paratypes: 5 carapaces HVH No. 7913.

Type locality: Cubagua I, core 89 (734–739 feet).

Stratigraphic horizon: Cubagua Formation.

Description: ♀: Carapace ovate, highest behind the middle, at about 1/3 of the length from the posterior end. Anterior end evenly rounded, rather narrow, dorsal margin convex, slightly sinuate in the middle; ventral margin convex; posterior end angled just above the middle, rounded below, concave above in the left valve, in the right very slightly convex. The posterior cardinal angle projects somewhat knoblike in the left valve. Left valve overlapping here, along the dorsal part of the posterior margin, along the whole of the dorsal and ventral margin; greatest overlap in the region of greatest height. In the right valve the dorsal margin is almost straight and roughly parallel to the ventral margin.

Dorsal view bombshaped, widest 3/8 of the length from the posterior extremity, sides convex, converging forward, anterior end subacute; posterior outline somewhat irregular, owing to a lateral compression in the posterior third. This depression is badly visible in side view, but has a triangular shape with the apex pointing forward and lies a little below the middle of the valve.

♂: posterior end the same shape, but dorsal and ventral margin almost straight and parallel. Dorsal view more wedgeshaped, widest 1/3 of the length from behind, sides less convex, posterior end abruptly narrowed.

Marginal area and height as described for the type species.

Dimensions: ♀: L: 0.44; H: 0.26; W: 0.22

♂: L: 0.45; H: 0.25; W: 0.20

Remarks: The species is similar to *Basslerites miocenicus* (Howe), but differs by the shape of the posterior end, it is higher than *B. minutus* van den Bold.

Subfamily: **Hemicytherinae** Puri, 1953

Genus: **Aurila** Pokorný, 1955

Aurila sp. aff. *A. cicatricosa* (Reuss)

Pl. 3, fig. 6a, b

? *Cypridina cicatricosa* REUSS, 1850, p. 6, Pl. 9, fig. 21

Aurila aff. *convexa* (Baird) VAN DEN BOLD, 1964, p. 10.

Description: Carapace semicircular, highest in the middle. Anterior end obliquely rounded; dorsal margin arched, angled at the greatest height, gently convex and sloping fairly steeply down behind; ventral margin sinuate, concave in anterior third, curving upward in posterior end; posterior end angled below the middle, convex and bearing a few small knobs below, concave and steep above. Posterior cardinal angle at about 1/10 of the length from the posterior extremity. Ventral side slightly flattened, posteroventral margin projecting, compressed and fairly sharp.

Surface covered with deep punctations, which become larger away from

the center. Near anterior and ventral side they become coarser and are in fact angular reticulations, parallel to the nearest margin. Behind the anterior row of meshes is a slightly raised ridge, which contains the eyespot at 1/3 of the length of the carapace from the front, and continues parallel to the anterior part of the dorsal margin, meeting the dorsal margin behind the middle in the left valve, just in front of the middle in the right valve.

Left valve larger than the right and overlapping along the entire margin, strongest overlap along the dorsal margin, which is practically straight in the right valve, from 2/5 from the anterior end to the posterior cardinal angle.

Dorsal view elliptical, widest just behind the middle, sides regularly convex, anterior end subacute, posterior end slightly wider, incised in the middle and with slightly concave sides.

Dimensions: L: 0.76; H: 0.48; W: 0.39

Remarks: In *Aurila cicatricosa* (Reuss) (Keij, 1957, p. 114, Pl. 13, fig. 3, Pl. 20, fig. 8, Ruggieri, 1962, p. 38, Pl. 4, fig. 9) the posterior end is higher. In *Aurila punctata* (Münster) (Keij, 1957, p. 115, Pl. 13, fig. 7, Pl. 20, fig. 7) the posterior end is more pointed and the carapace is less heavily reticulate. In *Aurila convexa* (Baird) (Müller, 1894, p. 366, Pl. 28, fig. 14, 19, Wagner, 1957, p. 59, Pl. 25) the anterior end is more bluntly rounded and the carapace is also less strongly reticulate. This species is very similar, but not identical to recent specimens from the Gulf of Mexico which are very probably conspecific with *Aurila amygdala* Benson & Coleman, 1963, p. 36, Pl. 8, fig. 6, 8, 9, textfig. 22 a-b (not Stephenson). They differ from *Hemicythere amygdala* Stephenson (1944, p. 158, Pl. 28, fig. 8, 9) in which the anterior end is lower. Specimens from Castell' Arquato, Baden, the North Sea, the Gulf of Naples and the Gulf of Mexico have been used for comparison. In the present material the species occurs only in the Cumaná Formation.

Subfamily: **Trachyleberidinae** Sylvester-Bradley, 1948

Genus: **Costa** Neviani, 1928

Costa variabilocostata variabilocostata (van den Bold)

Cythereis variabilocostata van den Bold, 1950, p. 83, Pl. 18, fig. 3a, b.

Costa variabilocostata (van den Bold) VAN DEN BOLD, 1957, p. 243 (part)

Table 1 (part) not Pl. 2, fig. 4=*Costa variabilocostata mulemanni* van den Bold (1966); 1958, Table 1; ? Gordon, 1961, p. 610, van den Bold, 1963, Table 6; 1964, p. 8, 9, 10, 11.

Occurrence: throughout the Cubagua Formation.

Costa variabilocostata laticostata n. subsp.

Pl. 3, fig. 7a, b

Costa variabilocostata n. subsp. B, VAN DEN BOLD, 1964, p. 9

Name: *laticostatus* (L)—broadly ribbed.

Holotype: a complete carapace, USNM No. 649187.

Paratypes: 9 carapaces, HVH No. 7915.

Type locality: Bermudez 4, Cerro Barrigón, Araya Peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation.

Distribution: In the beds exposed in the Cerro Barrigón, lower beds exposed in the Cerro La Cantera and in the lower part of Cubagua well 1: 945–1637 feet.

Description: Carapace subrectangular, highest at the anterior cardinal angle, about 1/3 of the length from the anterior extremity. Anterior and almost evenly rounded, denticulate; dorsal margin straight, ventral margin slightly sinuate in front of the middle, converging slightly posteriorly; posterior end triangular in side view, laterally compressed, angled below the middle, convex below and bearing a few short spines, straight to slightly concave above, meeting the dorsal margin under a 145° angle.

Main ornamentation consists of anterior rim and three longitudinal ridges, the median one of which splits into two branches in front of the middle, identical to the ornamentation in *Costa variabilocostata variabilocostata* and *C. variabilocostata muhlemanni*. The three ridges are connected by heavy crossridges, which run in a slightly oblique direction forward and downward from the dorsal ridge in the posterior half. These elongate meshes are not further divided by crossridges. Between median and ventral ridge a pattern of crossridges does occur, which forms an irregular oblique ridge from the middle of the ventral ridge in the general direction of the middle of the anterior ridge. Between this ridge and the ventral one a few meshes are strongly depressed, similar to those in *C. variabilocostata muhlemanni*.

Dorsal view elongate hexagonal, widest at the subcentral elevated area, where the median ridge divides; behind this point the sides are straight and almost parallel; both ends compressed with almost straight sides.

Dimensions: L: 0.72; H: 0.42; W: 0.36 (holotype)

Remarks: This subspecies is very similar to *Costa variabilocostata muhlemanni*, Van den Bold (1966, p. 00, Pl. 00, fig. 00). but differs by its broad ridges and elongate undivided meshes.

Costa santacrucensis van den Bold

Trachyleberis sp. Keij, 1954, p. 823, Pl. 5, fig. Ib

Costa santacrucensis VAN DEN BOLD, 1957, p. 241, Pl. 2, fig. 5a, b; 1958, Table 1; 1963b, Table 6; 1964, p. 9, 10; 1966.

In the present material the species has only been found in Cubagua 1 (core 93, 139 and 182 (754–1435 feet) and in Bolli 58 (Cerro Macho).

In Trinidad this species has not been found above the *Globorotalia fohsi* zones, presumably because the facies of younger deposits was not suitable for the existence of this species. The presence of this species in the Cubagua

Formation indicates that its stratigraphic range is much longer than was previously thought and it is quite possible that the few specimens found in recent deposits of the Gulf of Paria are not reworked as was previously assumed, but the species may actually be still living.

Subfamily: *Loxoconchinae* Sars, 1925

Genus: *Loxoconcha* Sars 1866

Loxoconcha avellana (Brady)

Pl. 2, fig. 5a, b

Normania avellana BRADY, 1866, p. 382, Pl. 59, fig. 15 a-c

Not *Loxoconcha avellana* (Brady), 1880, p. 117, Pl. 28, fig. 1a-f

Loxoconcha australis Brady, KELLY, 1954, p. 358; SWAIN, 1955, p. 63, fig. 11,

Pl. 64, fig. 2; MALKIN CRUTIS, 1960, vol. 44, No. 4, p. 479-481, 483, 484,

fig. 5, Pl. 2 (top), fig. 12, (Bottom), fig. 15, Pl. 3 (top) fig. 4; PURI &

HULINGS, 1957, p. 187, fig. 11; PURI, 1960, p. 111, textfig. 33, 34, 38.

Not *Loxoconcha australis* BRADY, 1880, p. 119, Pl. 28, fig. 5a-d, 7 Pl. 28, fig. 5e-f, ? Pl. 29, fig. 3a-d.

Loxoconcha sp. aff. *L. australis* Brady, BENSON & COLEMAN, 1963, p. 37, 38, fig. 23b, Pl. 7, fig. 5, 6.

Loxoconcha avellana (Brady) VAN DEN BOLD, 1964, p. 9, 11

Description: ♀, Carapace ovate, highest in the middle. Anterior end obliquely rounded; dorsal margin gently arched, ventral margin sinuate, concave in front of the middle; posterior part swinging upward in a broad curve into the posterior end, which is slightly produced subdorsally and concave below the posterior cardinal angle. Surface coarsely punctate, the punctations arranged in concentric rows around the center, generally parallel to the nearest margin. Dorsal view lens-shaped, widest in the middle, sides convex, anterior end subacute, posterior end compressed. ♂, elongate ovate in side view, ventral margin more strongly sinuate than in the ♀. Dorsal view lens-shaped, greatest width in front of the middle, sides only very slightly convex, converging anteriorly more strongly, posterior end compressed.

Dimensions: ♀: L: 0.54; H: 0.35; W: 0.28

♂: L: 0.55; H: 0.32; W: 0.26

Remarks: *Normania avellana* was described by Brady from the "West Indies," and the present species is the only *Loxoconcha* that resembles it among the many recent species of *Loxoconcha* found in the same neighbourhood. Although I have not seen Brady's type specimens I feel certain that in describing *Normania avellana* he meant the species under consideration here.

In the present material it is common in the surface beds of Cubagua, less common in those from Araya. It has not been found in the Cubagua wells and in the Cumaná formation, but also occurs in the Playa Grande Formation of Cabo Blanco.

Loxoconcha sp.

Pl. 4 fig. 5a, b

Description: Carapace ovate, highest at 1/3 of the length from the anterior extremity. Anterior end almost evenly rounded, dorsal margin straight, ventral margin convex, converging posteriorly; posterior end obliquely rounded, sometimes slightly angled above the middle. Dorsal view bomb-shaped; greatest width behind the middle; sides convex and converging anteriorly; posterior end irregularly compressed. Surface coarsely punctate without any clear alignment of the punctate.

Dimensions: L: 0.38; H: 0.25; W: 0.20

Remarks: Only closed carapaces were found. Therefore it is possible that we have to do with an instar, possibly of *Loxoconcha reticularis* Edwards, and it is preferred not to give it a specific name until this can be verified. It occurs only in the surface beds of Cubagua.

Subfamily: *Cytherurinae* Muller, 1894Genus: *Cytherura* Sars, 1866*Cytherura luciae* n. sp.

Pl. 4, fig. 1a-d

Cytherura cf. lineata Brady, VAN DEN BOLD, 1946, p. 119, Pl. 9, fig. 17

Cytherura sp., KELJ, 1954, p. 227, Pl. 5, fig. 11

Cytherura cf. lineata Brady, KELJ, 1954, p. 227, Pl. 5, fig. 12

Cytherura sp. 4, DROOGER & KAASSCHIEFER, 1958, p. 99.

Not *Cytherura lineata* BRADY, 1868a, p. 441, Pl. 32, fig. 30-34, 67

Name: after Lucia, my daughter, who helped by washing so many samples.

Holotype: a complete carapace of a ♀, USNM No. 649189

Paratypes: 3 ♀♀, 2 ♂♂, HVH No. 7921

Type locality: Kugler 5121, Chaguaramas Bay, Gulf of Paria, Trinidad (see van den Bold, 1963).

Stratigraphic horizon: Recent.

Distribution: In the Cumaná Formation, in the outcropping beds of the Cerro Guamache, Cerro Macho and Gerro La Cantera in the Araya peninsula.

Description: There is obvious sexual dimorphism present in this species, but it is not quite certain which are the ♂♂ and which the ♀♀. At the type locality the ♂♂ clearly outnumber the ♀♀, but at some of the fossil localities there appear to be more ♂♂ than ♀♀.

♀(?): Carapace ovate to subtriangular, highest in the middle, posterior end a median caudal process, surface finely striate. Anterior end almost evenly rounded; dorsal margin arched without angulation with either anterior or posterior margin; ventral margin almost straight, very slightly sinuate; posterior end produced in the middle, concave above and below. Ventral surface flattened. Left valve overlapping the right along the dorsal margin.

Dorsal view pearshaped, widest at 2/7 of the length from the posterior extremity, but the width just in front of the middle is almost equal to this. Posterior end strongly compressed, anterior end blunt, forming an angle of nearly 90°.

♂(?): elongate ovate, highest in the middle. Margins similar to the ♀(?), but the dorsal one is only gently convex and as a result the posterior part of the dorsal margin is less concave. Dorsal view pearshaped with the anterior portion less wide than in the ♀(?) with the result that the anterior end forms an angle of not more than 60°. Ventral surface less flattened than in the female (?).

The inflation of the posterior part of the carapace in the ♀(?) lies for the greater part below the middle; in the ♂(?) it lies largely above the middle of the valve and there is a depressed area below the swelling. Both ♂♂(?) and ♀♀(?) have a slightly depressed area in the center of the valve, just anterior to the posterior swelling.

Surface covered with a fine network, the meshes of which are aligned along very slightly raised longitudinal ridges. In the posterior portion these are parallel, but they converge gradually anteriorly, some of them eventually joining.

Dimensions: holotype (♀?): L: 0.40; H: 0.22; W: 0.21

(♂?): L: 0.39; H: 0.20; W: 0.23

Remarks: The finely striate appearance and the shape are reminiscent of *Cytherura lineata* Brady, but the pattern of longitudinal ridges is slightly different and the position of greatest width is more posteriorly situated in both ♂(?) and ♀(?).

Genus: **Semicytherura** Wagner, 1957

Semicytherura arayaensis n. sp.

Pl 4, fig. 3a, b

Semicytherura sp. VAN DEN BOLD, 1963b, p. 396.

Not *Cytherura* sp. VAN DEN BOLD, 1957, p. 245, Pl. 4, fig. 11.

Name: After its type locality in the Araya peninsula.

Holotype: a complete carapace, USNM No. 649190.

Paratypes: 8 carapaces, HVH No. 7922.

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation, "Barrigon" beds.

Distribution: Cerro Barrigón and lower beds of Cerro La Cantera; lower part of Cubagua 1, Manzanilla Formation.

Description: Carapace elongate ovate, highest behind the middle. Anterior end low, obliquely rounded, with a long dorsal slope, continuing without interruption into the convex dorsal margin; ventral margin slightly sinuate, parallel to the dorsal one, swinging upward in a broad

curve into the posterior end; posterior end a subdorsal caudal process, dorsal part of the posterior margin a continuation of the dorsal one, ventral part sinuate, concave near the posterior extremity. Dorsal view spindle-shaped, widest behind the middle, ends strongly compressed, the posterior one more than the anterior one; lateral outlines concave near the posterior end, less concave near the anterior end.

Ornamentation: ventral ridge, starting a little behind the anterior margin in its lower portion, swinging down to obscure the ventral margin from about 1/3 of the length from the anterior end backward; near the posterior end it swings upward. Parallel to the anterior part of the ventral ridge is another, which diverges from the ventral ridge behind the middle and encloses with the latter a loopshaped, depressed area. Also the area between the parallel anterior parts of the ridges is depressed. A third ridge occurs just above the second, also parallel in the anterior part. A fourth longitudinal ridge is almost straight and runs from about the middle of the anterior margin in the direction of the caudal process. A dorsal ridge begins in the upper part of the anterior end, converges towards the anterior portion of the dorsal margin, then forms a saddle-shaped loop behind the middle by curving down and again upward; this ridge loses its individuality soon afterwards.

Dimensions: L: 0.43; H: 0.22; W: 0.21

Remarks: This species from the Araya peninsula (Cerro Barrigón and Cerro La Cantera) has been described earlier from the Manzanilla Formation of Trinidad. The specimens from the Morne Diablo and Ste Croix quarries originally thought to be conspecific with this species, show a shorter posteroventrally depressed area and more (and less irregular) longitudinal ridges, and belong to a different species which should remain unnamed for the time being.

Genus: *Eucytherura* Muller, 1894

Eucytherura rohri (van den Bold)

Pl. 4, fig. 6a, b

Loxoconcha rohri VAN DEN BOLD, 1958, p. 408, Pl. 4, fig. 5a-b

Eucytherura? ruggierii van den Bold, VAN DEN BOLD, 1963b (Part), Table 7

Eucytherura aff. *ruggieri* van den Bold, VAN DEN BOLD, 1964, p. 9

Loxoconcha rohri van den Bold, VAN DEN BOLD, 1966, Table 1.

Dimensions: L: 0.39; H: 0.22; W: 0.21

Remarks: This species has been found in the uppermost beds of Cubagua 1 and in all exposed sections in the Araya peninsula, in the Springvale and the Manzanilla Formations in Trinidad. In all these specimens the dorsal margin is a little straighter than in the holotype from the *Globorotalia barisanensis* zone of Trinidad. However, the ornamentation is so similar, that for the present time, I prefer to regard them as one species. Specimens from the Springvale, Upper Brasso, and Cubagua Formations belong to the

genus *Eucytherura*; this could not be verified for specimens from the lower Brasso formation, from which the types were selected.

Genus: **Cytheropteron** Sars, 1866

Cytheropteron palton n. sp.

Pl. 1, fig. 7a, b

Cytheropteron n. sp. A., VAN DEN BOLD, 1964, p. 9.

Name: *palton* (Gr.)- dart, javelin.

Holotype: a complete carapace, USNM No. 649188.

Paratypes: 12 carapaces, HVH No. 7920.

Type locality: Bermudez 8, Cubagua.

Stratigraphic horizon: Cubagua Formation.

Distribution: Surface beds of Cubagua; one specimen in the Savaneta glauconitic sand member of the Springvale Formation.

Description: Carapace strongly elongate, low, strongly alate, highest in the middle, posterior end a long, drawnout caudal process. Anterior end bluntly and slightly obliquely rounded; dorsal margin arched, rather narrowly bent at the greatest height, almost straight, but slightly irregularly convex on both sides, sloping down towards anterior and posterior end, the posterior part becoming concave just before reaching the posterior extremity; ventral margin slightly sinuate; posterior end pointed just above the middle, slightly concave below. All margins continue into each other without angulations.

Dorsal view saggitate, triangular. The alae are backwardly deflected; greatest width at the tip of the alae at 1/4 of the length from the posterior extremity. The concave posterior sides of the alae bear small fringes or tufts; anterior side of the alae almost straight, sometimes very slightly convex or sinuate. Ends of the carapace laterally strongly compressed, posterior one very long.

Ventral side of the carapace concave.

Dimensions: L: 0.52; H: 0.18; W: 0.45

Remarks: I have not come across many species of *Cytheropteron* that bear so much resemblance in dorsal view to *Pterygocythereis*. Closest are *Cytheropteron alatum* Sars, *Cytheropteron pacificum* LeRoy, and *Cytheropteron coryelli* Puri (1954, p. 242, Pl. 4, fig. 13-15, textfig. 6e). The latter species has a straight dorsal margin.

Cytheropteron sp. aff. *C. hamatum* Sars

Pl. 3, fig. 2a, b

Cytheropteron hamatum Sars, 1866, p. 172; 1927, p. 226, Pl. 104, fig. 2.

Description: Carapace elongate ovate to subtriangular in outline, highest in the middle, posterior end a median caudal process. Anterior end oblique-

ly rounded; dorsal margin arched, ventral margin slightly sinuate; posterior end pointed in the middle, concave above and below; the dorsal part of the posterior margin forms an obtuse but distinct angle with the dorsal margin, situated at 1/5 of the length from the posterior extremity.

A strong ala obscures the middle part of the ventral margin. Surface smooth or very finely punctate, except for a deep pit in the anterior side of the ala, a shallow groove that extends from this pit to the tip of the ala, and three faint but distinct wrinkles that run from the posterior attachment of the ala to the carapace, almost vertically, a little obliquely backwards, nearly to the posterior cardinal angle, but bend forward before reaching it.

Dorsal view saggitate, widest at the posterior end of the ala at about 2/7 of the length from the posterior extremity. The tip of the ala shows a small, laterally projecting, hooklike spine, exactly as the one in *Cytheropteron hamatum* Sars. The alae are broadly convex in front. Ends of the carapace laterally strongly compressed, the posterior one much longer.

Dimensions: L: 0.58; H: 0.30; W: 0.38

Remarks: Especially in dorsal view this species is almost exactly like *Cytheropteron hamatum* Sars, except for the faint wrinkles above the posterior side of the alae; it is more slender in side view.

Occurrence: See Tables 1 and 2.

Cytheropteron sp. aff. *C. leonensis* Puri

Pl. 3, fig. 1a-c

?*Cytheropteron leonensis* PURI, 1954, p. 242, Pl. 4, fig. 11, 12, textfig. 6c, d
Not *Cytheropteron leonensis* Puri, VAN DEN BOLD, 1957, p. 246, Pl. 4, fig. 4a, b
?*Cytheropteron* cf. *leonensis* Puri, MALKIN, 1960, p. 478, fig. 5, Pl. 1, fig. 12

Dimensions: L: 0.34; H: 0.21; W: 0.19

Remarks: The present species is consistently smaller than Puri's material from the Miocene of Florida. It is also doubted whether the specimens from the Morne Diablo Quarry (BOLD, 1957) belong to Puri's species. This species is very similar and certainly closely akin to *Cytheropteron subreticulatum* van den Bold. It differs, however, by its lower posterior end and the absence of a forked ridge bordering the posterior side of the ala.

In Trinidad three specimens have been found in the Springvale Formation (Kugler 9872, Savaneta glauconitic sandstone). In the present material it occurs in the Cumaná Formation and a single specimen has been found in Cubagua 1 (470-482 feet).

Genus: *Kangarina* Coryell & Fields, 1937

Kangarina fieldsae n. sp.

Pl. 4, fig. 2 a-c

Name: after Suzanna Fields, co-author of the genus.

Holotype: a complete carapace, USNM No. 649191.

Paratypes: 9 specimens, HVH No. 7924.

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation, ("Cerro Barrigón beds.")

Distribution: See Table 2.

Description: Carapace ovate, highest in the middle, posterior end a subdorsal caudal process. Anterior end obliquely rounded, continuing into the arched dorsal margin; ventral margin sinuate, swinging upward into the posterior margin in a broad curve, becoming concave just before reaching the posterior extremity.

Left valve overlapping the right along the dorsal margin.

Dorsal view broadly lens-shaped, widest just behind the middle, ends subequal, the posterior one somewhat more compressed.

A ventral ridge swings down from behind the lower part of the anterior margin, obscuring the ventral margin from 1/3 of the length from the anterior onward. In the posterior third of the carapace it swings upward in a sharp curve, and, turning forward, becomes a median ridge, which is irregular and runs from its highest point forward along a line between the posterior process and the middle of the anterior margin. A dorsal ridge parallels the dorsal margin. Crossridges between these three longitudinal ridges enclose strongly depressed meshes. The most important of these is an almost rectangular depressed area in the posteroventral portion of the valve, enclosed by ventral ridge and its posterior upward curve, median ridge, and an almost vertical, Y-shaped ridge just behind the middle of the valve.

Dimensions: holotype: L: 0.35; H: 0.18; W: 0.30

Remarks: This species differs from *Kangarina guellita* and *K. ancyla* in its more ovate shape and a different arrangement of the ridges.

Subfamily: **Bythocytherinae** Sars, 1936

Genus: **Bythoceratina** Hornibrook, 1952

Bythoceratina binodosa n. sp.

Pl. 2, fig. 7a-c, Pl. 5, fig. 3

Bythoceratina aff. utilazea Hornibrook, KELJ, 1954, p. 227, Pl. 5, fig. 10.

Bythoceratina sp. VAN DEN BOLD, 1964, p. 9.

Not *Bythoceratina utilazea* HORNIBROOK, 1952, p. 65, Pl. 17, fig. 279, 280, 282.

Name: *binodosus* (L)—with two knobs.

Holotype: a right valve, USNM No. 649192.

Paratypes: 2 right and one left valve, HVH No. 7925.

Type locality: St. 1185, Paria Shelf, For location see Drooger & Kaas-schieter, 1958, map 1.

Stratigraphic horizon: Recent.

Distribution: (fossil): Surface beds (Cubagua, Bermudez 8), Tubará Formation (Columbia), Savaneta glauconitic sand member of Springvale Formation (Trinidad).

Description: Carapace subrectangular to trapezoid, alate. Anterior end blunt, slightly obliquely rounded, forming an obtuse but distinct cardinal angle with the dorsal margin; dorsal margin straight, obscured over its entire length by a parallel ridge in each valve; ventral margin slightly sinuate, parallel, but swinging upward into the posterior margin; posterior end dorsally located, posterior margin almost straight over its greater part and meeting the dorsal margin in the posterior extremity at an angle of 60° .

Anterior end denticulate and bearing a thin ridge, which is denticulate in its lower portion and disappears under the ala; the smooth upper portion continues parallel to the dorsal margin till about $1/3$ of the length from the anterior end. The dentition of the margin becomes obscure along the ventral side, but the dentitions increase in size again in the posterior upward curve; they end below the median line of the valve. Part of the ventral margin is obscured by a strong ala, which ends ventrally in two strong, spinose knobs, which are connected by a bridge-like ridge, which spans the sulcus which divides the ala into two distinct parts. This sulcus is slightly inclined backwards and its anterior side curves backwards and upwards, and becomes the dorsal ridge, cutting off the dorsal extension of the anterior rim. This dorsal ridge is irregularly scalloped and ends just in front of the posterior extremity.

On the ventral surface the two knobs of the ala are also connected by a weaker ridge, which in side view obscures the ventral margin between the two knobs. The anterior knob is situated just in front of the middle, the posterior one has its farthest lateral projection at $2/3$ of the length from the anterior end. There are two slightly diverging rows of flattened spines from the posterior end of the ala in the direction of the posterior extremity, and one row on the anterior side of the anterior knob of the ala.

In dorsal view the ends are strongly compressed; greatest width at the posterior knob of the ala. The rows of spines on anterior and posterior side of the ala are well visible in dorsal view.

Hinge: Right valve with a small, short, finely crenulate tooth in the anterior cardinal angle, followed by a long, narrow, crenulate groove, which terminates close to the posterior extremity in front of a small, short, crenulate posterior tooth. In the left valve: crenulate socket, long, finely crenulate bar, crenulate socket. Marginal area not very broad. There is a small, sickle-shaped vestibule in the anteroventral curve and an irregularly shaped one in the posterior end. In the anterior end, the radial porecanals are not numerous, mostly simple and slightly curved. In the posterior end the line of concrescence forms small, irregular indentations from which the radial porecanals start.

Normal porecanals numerous, large, possible of the seive type, very regularly distributed.

Muscle-scars: a curved row of 5 scars with an irregular antennal scar in front.

Dimensions: holotype (right valve): L: 0.51; H: 0.27; W: 0.23

Family: **Paradoxostomatidae** Brady & Norman, 1889

Subfamily: **Paradoxostomatinae** Brady & Norman, 1889

Genus: **Paradoxostoma** Fischer, 1855

Paradoxostoma artum n. sp.

Pl. 3, fig. 4a-b

Paradoxostoma sp. VAN DEN BOLD, 1963b, p. 404, Pl. 10, fig. 8; 1964, p. 9.

Name: *artus* (L) — narrow.

Holotype: a complete carapace, USNM No. 649193.

Paratypes: 5 carapaces, HVH No. 7926.

Type locality: Bermudez 8, Cubagua.

Stratigraphic horizon: Cubagua Formation.

Description: Carapace strongly elongate, ovate, highest at 3/5 of the length from the anterior extremity. Anterior end very low, obliquely and narrowly rounded; dorsal margin broadly arched; ventral margin sinuate, curved upward into the posterior end, which is narrowly rounded above the middle, slightly convex above and below. Dorsal view lanceolate, widest in the middle.

Valves subequal. Posterior part of ventral margin strongly compressed laterally, sharp.

Dimensions: L: 0.65; H: 0.27; W: 0.18 (holotype). In the Cerro La Cantera, M 62, two specimens have been found which are identical in shape but larger: L: 0.78; H: 0.32; W: 0.22

Remarks: The species is rather similar in size and shape to *Paradoxostoma robustum* Puri (nom. corr. for *P. robusta* Puri, 1954, p. 289, Pl. 15 fig. 1. Pl. 14. fig. 7-9), which is, however, less drawnout posteriorly.

Genus: **Paracythere** Müller. 1894

Paracythere sp.

Pl. 1, fig. 6a, b, Pl. 5, fig. 5

Paracythere sp. VAN DEN BOLD, 1964, p. 9

Description: Carapace minute, hyaline, thinshelled, about semicircular in outline, highest in the middle. Anterior end obliquely rounded; dorsal margin convex, ventral margin slightly sinuate in front of the middle; posterior end obliquely rounded, almost the mirror-image of the anterior end, but slightly more narrowly rounded below. Left valve larger than the right, overlapping along dorsal margin and dorsal slopes of both ends; also, but slightly, midventrally; greatest overlap anterodorsally.

Surface smooth, but covered with scattered, wide orifices of normal porecanals. Dorsal view lens-shaped, widest in the middle, sides evenly convex, ends almost equal, subacute.

Marginal area fairly narrow, line of conerescence and inner margin appear to coincide; radial porecanals few, widely spaced, short and simple.

Hinge consists of a groove below the dorsal margin of the left valve into which fits the margin of the right valve.

Dimensions: L: 0.28; H: 0.17; W: 0.14

Remarks: *Paracythere minima* MÜLLER (1894, p. 286, Pl. 16, fig. 37-41) is very similar in shape, but has less overlap of the dorsal margin of the left valve, which is also more flattened. Shape of the ends, normal porecanals and radial porecanals are almost identical to those in Müller's species, which is also of about the same size (L: 0.31).

This species has been found in the deeper water of the Paria Shelf (St. 1206) and one specimen was found in Cubagua 1, core 211 (1627-1637 feet).

Genus: *Luvula* Coryell & Fields, 1937

Luvula? *gigarton* n. sp.

Pl. 4, fig. 4a-c, Pl. 5, fig. 4a-c

Luvula? sp. B. VAN DEN BOLD, 1963b, p. 416, Pl. 10, fig. 12 a, b,; 1964, p. 9, 10.

Name: *gigarton* (Gr.)—grape-seed.

Holotype: a complete carapace, USNM No. 649194.

Paratypes: 12 complete carapaces, HVH No. 7928.

Type locality: Bolli 72, Cerro Barrigón, Araya peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation, "Barrigon" beds.

Distribution: Cubagua and Cumana Formation (see Tables 1, 2). Cueparo Formation, Playa Grande Formation.

Description: Carapace small, ovate, highest about 1/4 of the length from behind. Anterior end low, obliquely rounded with a long dorsal slope passing into the arched dorsal margin, which is angled at the greatest height, convex and sloping down in front and behind; ventral margin sinuate, concave in front of the middle, broadly convex in the posterior half and continuing upward into the power portion of the posterior margin; posterior end narrowly rounded, almost angled below the middle, rather steep and convex above, rounded below. Left valve overlapping the right at the greatest height and in the posterior half of the ventral margin. Dorsal view lanceolate, ends acute, greatest width behind the middle.

In Cubagua 2 (40-150 feet). (HVH No. 7929, 7930), and in R 11862 (Melajo member of the Springvale Formation) these specimens are accompanied by a few individuals exhibiting the same marginal area, but with a shape more resembling *Parakrithella*. This is assumed to be the ♂.

♂ (?): Carapace elongate, highest behind the middle. Anterior end evenly rounded, dorsal margin convex, ventral margin sinuate, diverging posteriorly from the dorsal margin, then swinging upward in the posterior margin; posterior end almost regularly rounded.

Hinge: in the right valve consists of a short groove which widens at both ends. In the left valve a short bar with blade-like projection terminal flanges. Marginal area broad in anterior end with a large vestibule, similar in shape to the one described in *Parakrithella*, *Kritha* or *Munseyella*. Radial porecanals not numerous, short, sometimes bifurcating.

Muscle-scars: a posterior vertical row of 4 with an irregularly shaped antennal scar in front.

Dimensions: holotype (♀): L: 0.46; H: 0.25; W: 0.18

♂?: L: 0.44; H: 0.23; W: 0.17

♀♀: L: 0.40–0.48; H: 0.20–0.25; W: 0.17–0.20

Remarks: The shape of the ♀ (?) resembles that of *Luvula palmerae* Coryell & Fields. The hinge, marginal area and shape of the ♂ (?) however are very close to those described in the genus *Cytheroma*. A restudy of the type material from the Gatun of Panama is necessary to decide the taxonomic position of the genus *Luvula*. Its inclusion in the Bythocytherinae (Sylvester-Bradley, 1961, in Moore et al. Treatise on Invertebrate Paleontology, vol. Q, p. 268) as synonym of *Jonesia* Brady is without foundation and inclusion in the Paradoxostomatidae appears more likely.

Subfamily: Cytheromatinae Elofson, 1939

Genus: *Paracytheroma* Juday, 1907

Paracytheroma? *punctata* n. sp.

Pl. 2, fig. 8 a–d

Nov. gen A., nov. sp. A. VAN DEN BOLD, 1964, p. 8, 9.

Name: *punctatus* (L)—punctate.

Holotype: a complete carapace, ♀, USNM No. 649195.

Paratypes: 3 ♀♀, 4 ♂♂. HVH No. 7931.

Type locality: Bolli 72, Cerro Barrigón, Araya Peninsula, Estado Sucre, Venezuela.

Stratigraphic horizon: Cubagua Formation. ("Barrigón" beds).

Distribution: Throughout the Cubagua Formation (Tables 1 and 2), Caujarao Formation; a single specimen was found in the Springvale Formation (Trinidad, Savaneta glauconitic sand, Kugler 10172).

Description: ♀, Carapace small, trapezoid, highest at the anterior cardinal angle, about 1/3 of the length from the anterior extremity. Anterior end obliquely rounded, narrowly rounded below the middle, somewhat "bairdoid", with a long, slightly convex dorsal slope, which meets the dorsal margin under a 140° angle; dorsal margin almost straight, slightly sinuate near the anterior cardinal angle, sloping down somewhat backwards;

ventral margin slightly sinuate, about parallel to the dorsal, very slightly converging posteriorly; posterior end angled below the middle, rounded below, slightly convex above and meeting the dorsal margin under a $\pm 130^\circ$ angle at 1/3 of the length from behind.

Surface finely punctate, without a distinct pattern. In the central portion of the carapace rows of punctations appear to be longitudinally arranged, slightly inclined forward; peripherily rows of punctations are generally parallel to the nearest margin, but only distinct near the ventral one.

Left valve overlapping the right along anterodorsal, dorsal and postero-dorsal margins. Dorsal view spindle-shaped, widest in the middle, sides converging rather strongly backward and forward, the anterior sides slightly concave, the posterior ones straight. Posterior end slightly compressed.

♂: Carapace more slender than the ♀; anterior end obliquely rounded with shorter dorsal slope, posterior end narrowly rounded just below the middle; dorsal and ventral margin parallel, dorsal straight, ventral slightly sinuate. Dorsal view elongate lens-shaped, widest in the middle, sides gently convex, converging less strongly than in the ♀.

Only complete carapaces were found and as the shell is very hard and robust for such a tiny species, attempts to open them were unsuccessful. The generic assignment is highly questionable, but the species is so common in the Cubagua Formation that it could not be ignored.

Dimensions: ♀ holotype: L: 0.43; H: 0.26; W: 0.18

♂ L: 0.42; H: 0.21; W: 0.16

Subfamily: *Microcytherinae* Klie, 1938

Genus: *Microcythere* Müller, 1894

Microcythere howei (Puri)

Pl. 5, fig. 6a, b

Xestoleberis triangularis PURI, 1954, p. 298, Pl. 16, fig. 1-4, textfig. h, i.

Not *Xestoleberis triangularis* WEBER, 1937, p. 40, fig. 5A, B.

?*Microcythere* cf. *M. inflexa* Müller, PURI, 1960, p. 119, Pl. 5, fig. 13, 14.

Not *Microcythere inflexa* MÜLLER, 1894, p. 328, Pl. 24, fig. 30-32, 40-42, 48, 50.

Xestoleberis howei PURI, 1964, p. 787

Microxestoleberis sp. VAN DEN BOLD, 1964, p. 9.

Distribution: Cubagua 1 (table 1) and surface beds in Cubagua, Cerro Barrigón (Bolli 72), Cumaná Formation (Caiguire 2, 6) (Table 2).

Remarks: This species is assigned here to *Microcythere* for the following reasons: 1) shape, 2) flattened ventral portion of the carapace; 3) absence of a "Xestoleberid" spot, 4) structure of marginal area.

In nearly all cases the calcified portion of the inner lamella was broken, but the shape of a rather large anterior vestibule can be seen. Porecanals

short, not quite reaching the outer margin in the anterior end. In the posterior end they could not be observed with sufficient accuracy.

The hinge is slightly anomalous for *Microcythere* as the anterior dental area is broken up into three crenulations. In the left valve the median hinge-element is a bar, crenulate, with a somewhat knoblike anterior thickening. Posterior tooth in the right valve not distinctly developed, it appears more as a thickening of the selvage here.

Normal porecanals not numerous, scattered, rather large, but due to the preservation it could not be ascertained whether they belong to the seive-type.

Family: *Xestoleberididae* Sars, 1928

Genus: *Xestoleberis*, Sars 1866

Xestoleberis sp. A

Pl. 3, fig. 5a-b

Xestoleberis sp. VAN DEN BOLD, 1964, p. 9.

Description: Carapace ovate, highest in the middle. Anterior end obliquely rounded, rather low, dorsal margin arched, ventral margin sinuate; posterior end obliquely rounded, broadly rounded below. Dorsal view ovate, widest behind the middle, rounded posteriorly, subacute anteriorly.

Dimensions: L: 0.39; H: 0.25; W: 0.23

Remarks: The species is rather similar to *Xestoleberis* sp. A. VAN DEN BOLD, 1946 (p. 120, Pl. 16, fig. 17a-f) but is smaller and less elongate. It has been found only in the Cubagua subsurface.

REFERENCES

- BENSON, R. H. & COLEMAN, G. L., 1963: Recent marine Ostracodes from the eastern Gulf of Mexico. Univ. Kansas, pal. contr., Arthr. 2, p. 1-52, Pl. 1-8, textfigs. 1-33.
- BOLD, W. A. VAN DEN, 1946: Contribution to the study of Ostracoda with special reference to the Tertiary and Cretaceous microfauna of the Caribbean Region. Univ. Diss. Utrecht, 167 pp. 18 pls., 2 maps, 8 textfigs., 6 tables.
- , 1950: Miocene Ostracoda from Venezuela. Journ. Paleontology, vol. 24, No. 1, p. 76-88, Pl. 18, 19, 4 textfigs.
- , 1957: Oligo-Miocene Ostracoda from southern Trinidad. Micropaleontology, vol. 3, No. 3, p. 231-254, Pl. 1-4, 2 textfigs. 1 table.
- , 1958: Ostracoda of the Brasso Formation of Trinidad. Micropaleontology, vol. 4, No. 4, p. 391-418, Pl. 1-5, 1 table.
- , 1963a: The Ostracode genus *Orionina* and its species. Journ. of Paleontology, vol. 37, No. 1, p. 33-50, Pl. 3, 4, 6 textfigs.
- , 1963b: Upper Miocene and Pliocene Ostracoda of Trinidad. Micropaleontology, vol. 9, No. 4, p. 361-424, Pl. 1-12, 6 textfigs., 7 tables.
- , 1964: Nota preliminar sobre los ostracodos del Miocene-Reciente de Venezuela. Geos. No. 11, p. 7-13, 2 tables.
- , 1966 Ostracoda from the Pozón section, Falcón, Venezuela. Jour. Paleont. vol. 40, no. 1 (in press).
- BRADY, G. S. 1866: On new or imperfectly known Species of Marine Ostracods. Trans. Zool. Soc. London, vol. 5, No. 10, p. 359-393, Pl. 57-62.
- , 1868a: A monograph of the Recent British Ostracoda. Trans. Linn. Soc. London, vol. 26, No. 2, p. 353-495, Pl. 23-41.
- , 1868b: Ostracoda in: De Folin et Périer: Les Fonds de la Mer, vol. 1, p. 49-112.
- , 1869: Ostracoda in: De Flin et Périer: Les Fonds de la Mer, vol. 1, p. 113-176.
- , 1870: Ostracoda in: De Folin et Périer: Les Fonds de la Mer, vol. 1, p. 177-256.
- , 1880: Report on the Ostracoda dredged by HMS Challenger during the years 1873-76. Report on the scientific results of the voyage of HMS Challenger Zool. Vol. 1, part 3, p. 63-270, pl. 8-23.
- BRADY, G. S. & NORMAN, A. M., 1889: Monograph of the marine and freshwater Ostracoda of the North Atlantic and Northwest Europe. Sci. Trans. Roy. Dublin Soc., vol. 4, ser. 2, p. 63-270, Pl. 8-23.
- DROOGER, C. W. & KAASSCHIEETER, J. P. H., 1958: Foraminifera of the Orinoco-Trinidad-Paria shelf. Rep. Orinoco Shelf Exp., vol. 4, Verh. Kon. Nederl. Akad. Wetensch. afd. Natuurk. ser. 1, pt. 22. Description of ostracods, p. 88-92, Pl. 4 (part.).
- EDWARDS, R. H., 1944: Ostracoda from the Duplin marl (U. Miocene) of North Carolina. Journ. of Paleontology, vol. 18, No. 6., p. 505-528, Pl. 85-88.
- GORDON, W. A., 1961: Miocene Foraminifera from the Lajas Valley, SW Puerto Rico. Journ. of Paleontology, vol. 35, No. 5, p. 610-619, textfigs. 1(1-25), 2(1-21).

- KEIJ, A. J., 1954: Ostracoda: Identification and description of species in: Van Andel & Postma: Recent sediments of the Gulf of Paria, Rep. Orinoco shelf Expedition, vol. 1. Verh. Kon. Nederl. Akad. Wetensch., afd. Natuurk., ser. 1, pt. 20, No. 5, p. 218-231, pl. 3-5.
- , 1957: Eocene and Oligocene Ostracoda of Belgium. Inst. Roy. Sci. Nat. de Belgique, Mém. 136, 210 pp. 23 pls.
- LEROY, L. W., 1943: Pleistocene and Pliocene Ostracoda of the coastal region of Southern California. Journ. of Paleontology, vol. 17, No. 4, p. 354-373, Pl. 58-62.
- MALKIN, CURTIS D., 1960: Relation of environmental energy levels and ostracod biofacies in East Mississippi Delta area. Bull. A.A.P.G., vol. 44, No. 4, p. 471-494, 17 figs., 3 pls., 1 table.
- MÜLLER, G. W., 1894: Die Ostracoden des Golfes von Neapel. Flora und Fauna des Golfes von Neapel, Mon. 21, p. 1-404, pls. 1-40.
- PURI, H. S., 1954: Contribution to the study of the Miocene of the Florida Panhandle. Florida Geol. Surv. Geol. Bull. 36, pt. 1: Stratigraphy, p. 11-67; pt. 2: Foraminifera, p. 69-151, 30 pls.; pt. 3: Ostracoda, p. 217-309, 17 pls.
- , 1960: Recent Ostracoda from the West Coast of Florida. Trans. Gulfcoast Assoc. Geol. Soc., vol. 10, p. 107-149, pls. 1-6, textfigs. 1-46.
- , 1964: New names for Ostracod homonyms. Journ. of Paleontology, vol. 38, No. 4, p. 787.
- PURI, H. S. & HULINGS, N. C., 1957: Recent Ostracode Facies from Panama to Florida Bay area. Trans. Gulf Coast Assoc. Geol. Soc., vol. 7, p. 167-190, Pl. 1-2, figs. 1-10, table.
- RUGGIERI, G., 1962: Gli Ostracodi marini del Tortonian (Miocene medio superiore) di Enna, nella Sicilia centrale. Palaeontographica Italica, vol. 56, (n. ser. vol. 26) Mem. No. 2, p. 1-68, Pl. 11-17, 15 textfigs.
- SARS, G. O., 1866: Oversigt af Norges marine Ostracoder. Forh. Vid.-Selck, Christiania (1865), p. 1-130.
- 1922-1928: An Account of the Crustacea of Norway, IX.
- SWAIN, F. M., 1955: Ostracoda of San Antonio bay, Texas, Journ. of Paleontology, vol. 29, No. 4, p. 561-646, 31 maps, 6 pls., 54 textfigs.
- WEBER, H., 1937: Neue Aufschlüsse im Untermiozän bei Bruchsal. Jahresber. Oberrheinische Geol. Ver. (N.F.) 26, p. 33-42.

PLATE 1

- Fig. 1. *Argilloecia posterotruncata* n. sp., holotype, (USNM No. 649181), St. 1021, Paria Shelf, recent. Magn. 85 ×
a: left valve view, b: dorsal view.
- Fig. 2. *Argilloecia barrigonensis* n. sp., holotype. (USNM No. 649180), Bolli, 72, Cerro Barrigón, Araya Peninsula. Magn. 85 ×
a: left valve view, b: dorsal view.
- Fig. 3. *Propontocypris robusta* n. sp., holotype, (USNM No. 649179), M. 62, Cerro La Cantera, Araya Peninsula, Magn. 55 ×
a: right valve view, b: dorsal view.
- Fig. 4. *Parakrithe, rhamphodes* n. sp. Magn. 85 ×
a: ♀, right valve view, holotype (USNM No. 649182), Cubagua-1: 1627-1637 feet.
b: ♀, dorsal view, holotype.
c: ♂, right valve view (HVH No. 7907), Cubagua-1: 1425-1435 feet.
d: ♂, dorsal view, same specimen as c.
- Fig. 5. *Basslerites cuspidatus* n. sp., holotype (USNM No. 649186), Cubagua-1: 734-739 feet. Magn. 100 ×
a: right valve view, b: dorsal view.
- Fig. 6. *Paracythere* sp. (HVH No. 7927), St. 1206, Paria Shelf. Magn. 150 ×
a: right valve view, b: dorsal view.
- Fig. 7. *Cytheropteron palton* n. sp., holotype (USNM No. 649188), Bermudez 8, Cubagua. Magn. 80 ×
a: right valve view, b: dorsal view.

PLATE 2

- Fig. 1. *Munseyella bermudezi* n. sp., holotype, (USNM No. 649185), Cubagua-1; 258-270 feet. Magn. 100 ×.
a: right valve view, b: dorsal view.
- Fig. 2. *Munseyella bollii* n. sp., holotype (USNM No. 649184), Bolli 72, Cerro Barrigón, Araya Peninsula. Magn. 100 ×.
a: right valve view, b: dorsal view.
- Fig. 3. *Cytheromorpha caudata* n. sp., Magn. 100 ×, Bolli 72, Cerro Barrigón, Araya Peninsula.
a: ♀, right valve view, holotype (USNM No. 649183)
b: ♀, dorsal view, holotype
c: ♂, right valve view, paratype (HVH No. 7908).
- Fig. 4. *Campylocythere? perieri* (Brady), *Palmerinella* beds, Caiguire, Cumana, (HVH No. 7912). Magn. 65 ×.
a: left valve view, b: dorsal view, same specimen.
- Fig. 5. *Loxococoncha avellana* (Brady), Bermudez 8, Cubagua (HVH No. 7916). Magn. 55 ×.
a: right valve view, b: dorsal view, same specimen.
- Fig. 6. *Pumilocytheridea sandbergi* van den Bold, Caiguire 6, Cumana, (HVH No. 7911). Magn.
a: ♀, left valve view, b: ♀, dorsal view, same specimen;
c: ♂, left valve view, d: ♂, dorsal view, same specimen.
- Fig. 7. *Bythoceratina binodosa* n. sp., St. 1185, Paria Shelf. Recent. Magn. 65 ×.
a: exterior of right valve, holotype (USNM No. 649192)
b: dorsal view of left valve, paratype (HVH No. 7925)
c: dorsal view of right valve, paratype (HVH No. 7925)
- Fig. 8. *Paracytheroma? punctata* n. sp., Bolli 72, Cerro Barrigón, Araya Peninsula.
a: ♀, right valve view, holotype (USNM No. 649195), Magn. 95 ×
b: ♀, dorsal view holotype, Magn. 85 ×
c: ♂, paratype (HVH No. 7931), right valve view, Magn. 100 ×
d: ♂, dorsal view (HVH No. 7931) Magn. 110 ×

PLATE 1

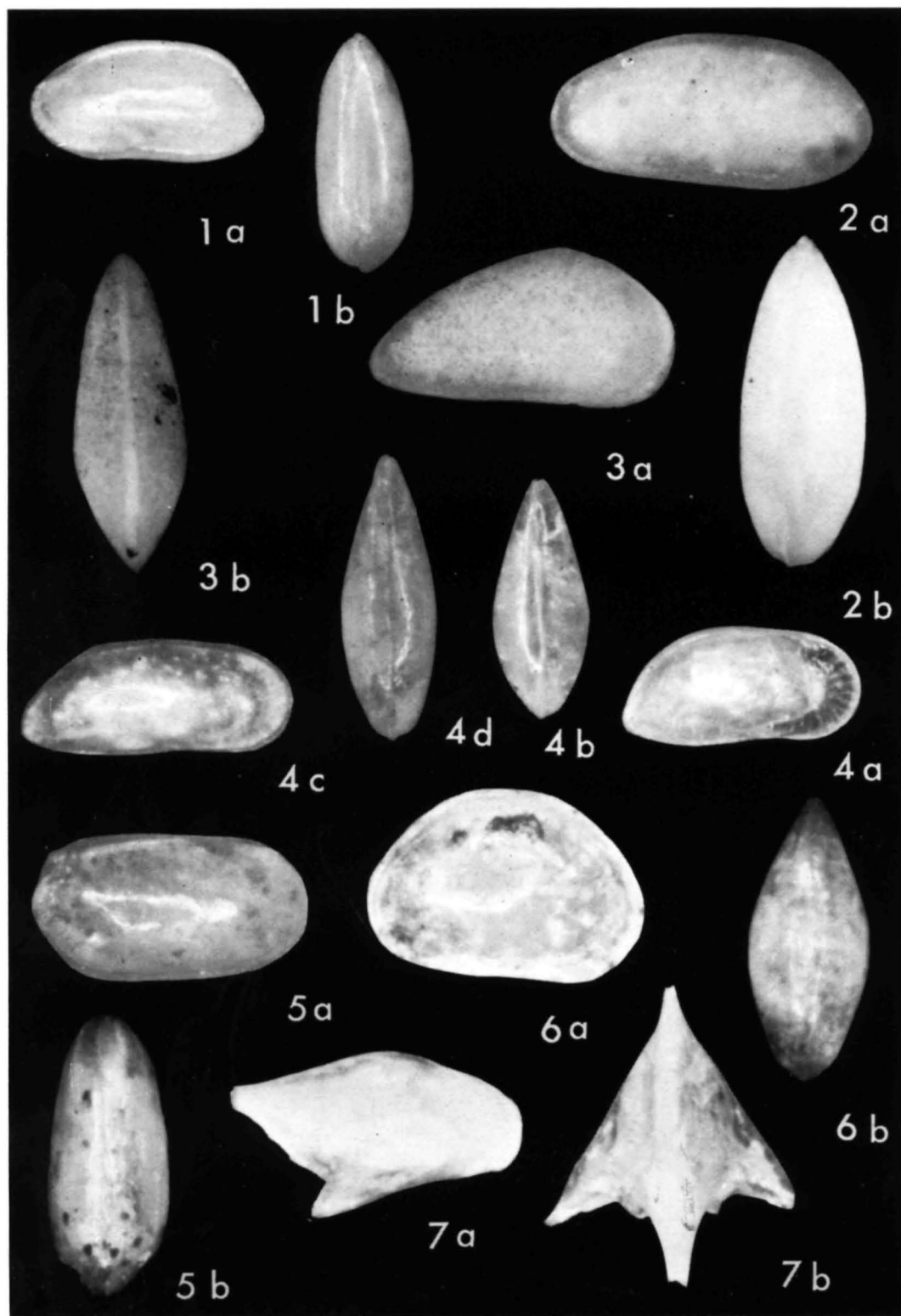


PLATE 2

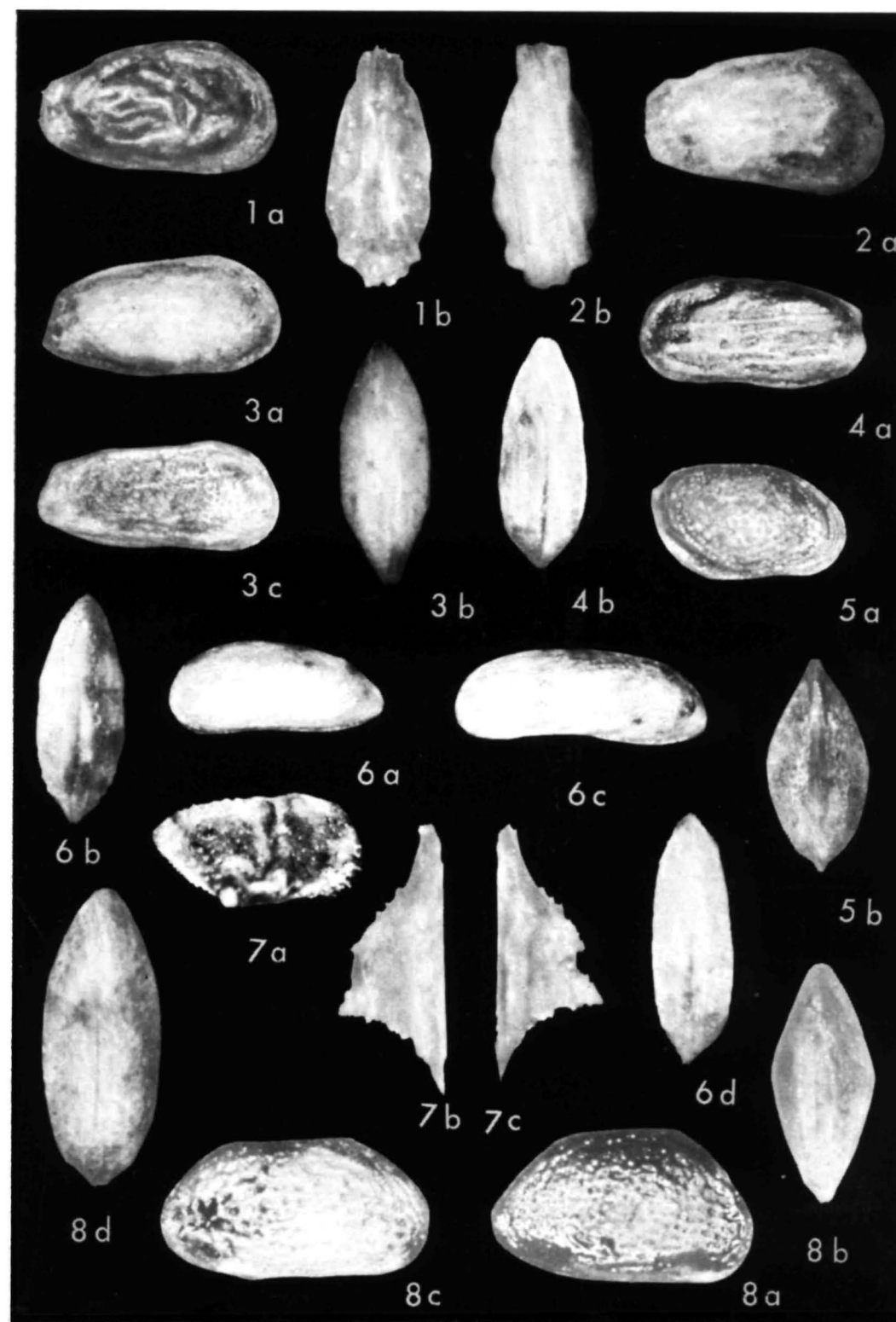


PLATE 3

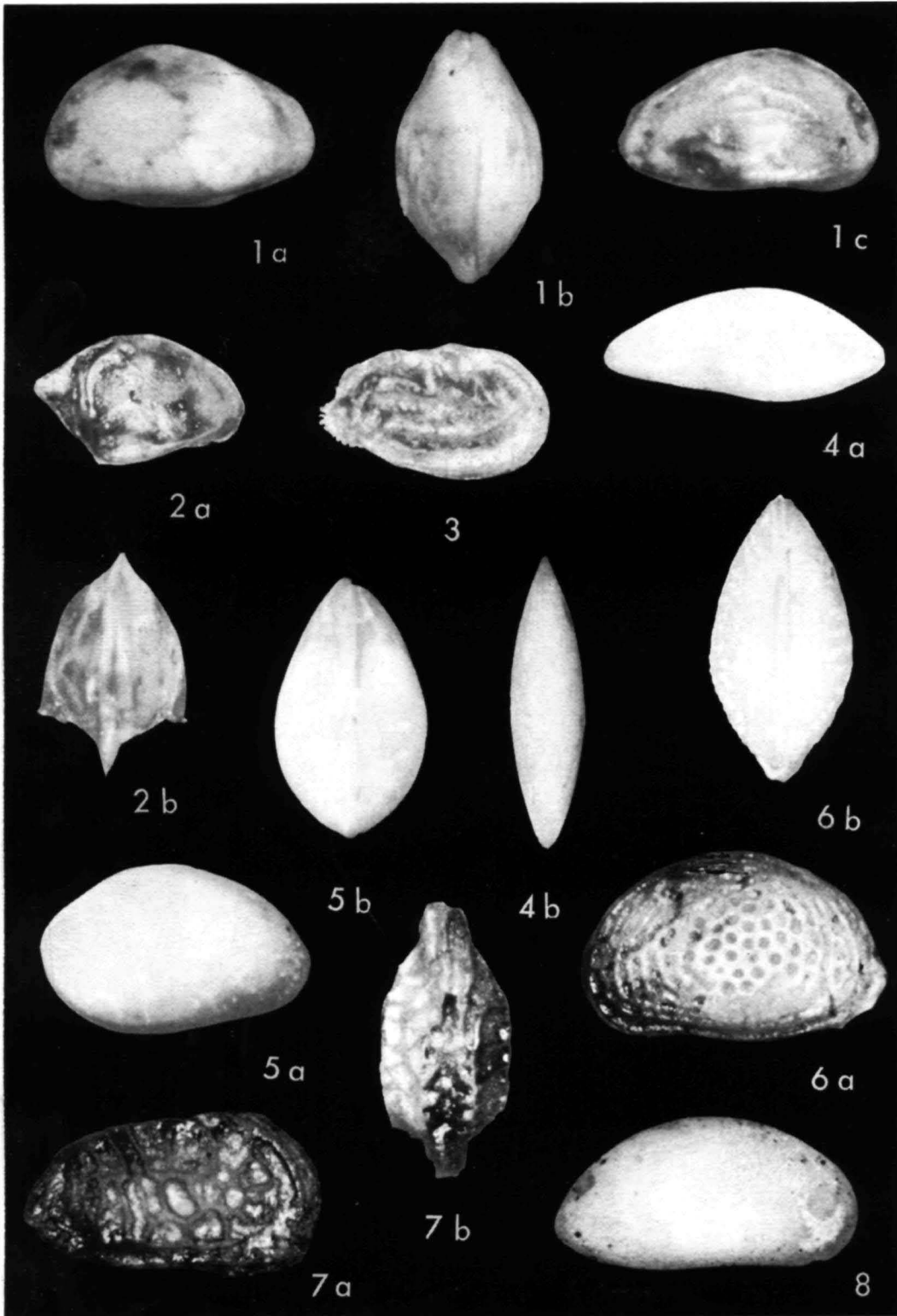


PLATE 4

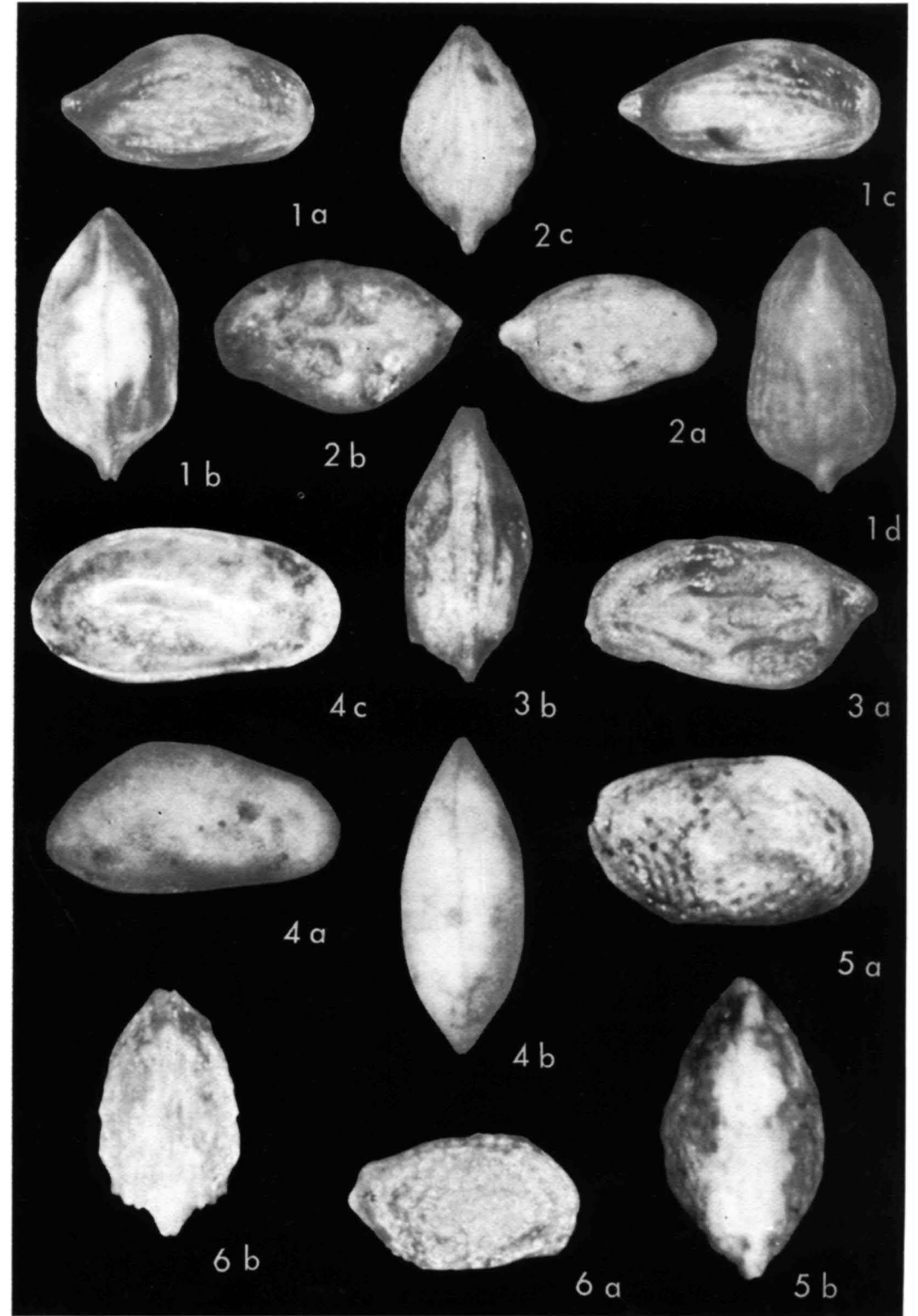


PLATE 3

- Fig. 1. *Cytheropteron* sp. aff. *C. leonensis* Puri, Caiguire 4, Cumaná (HVH 7918), Magn. 120 ×
a: left valve view, b: dorsal view, c: right valve view.
- Fig. 2. *Cytheropteron* sp. aff. *C. hamatum* Sars, M 72, Cerro La Cantera, Araya Peninsula, (HVH No. 7919), Magn. 60 ×.
a: right valve view, b: dorsal view.
- Fig. 3. *Ambocythere subreticulata* van den Bold, Cubagua-1: 1425-feet. Magn. 60 ×, right valve view.
- Fig. 4. *Paradoxostoma artum* n. sp., Bermudez 8, Cubagua, holotype (USNM No. 649193), Magn. 65 ×
a: left valve view, b: dorsal view.
- Fig. 5. *Xestoleberis* sp. A., Cubagua 1: 1627-1637 feet (HVH No. 7933), Magn. 100 ×
a: right valve view, b: dorsal view.
- Fig. 6. *Aurila* sp. cf. *A. cicatricosa* (Reuss), Cumaná, Caiguire 2 (HVH No. 7914), Magn. 65 ×
a: left valve view, b: dorsal view.
- Fig. 7. *Costa variabilocostata laticostata* n. subsp., holotype (USNM No. 649187), Bermudez 4, Cerro Barrigón, Araya Peninsula, Magn. 65 ×.
a: right valve view, b: dorsal view.
- Fig. 8. *Bythocypris*? sp. aff. *B. pachyconcha* van den Bold, M 62, Cerro La Cantera, Araya Peninsula (HVH No. 7906), Magn. 60 ×, right valve view.

PLATE 4

- Fig. 1. *Cytherura luciae* n. sp., Kugler 5121, Gulf of Paria, Chaguaramas Bay. Magn. 100 ×.
a: ♀, right valve view, holotype, (USNM No. 649189);
b: dorsal view, holotype
c: ♂, right valve view, paratype, (HVH No. 7921).
d: dorsal view same specimen.
- Fig. 2. *Kangarina fieldsae* n. sp., Bolli 72, Cerro Barrigón, Araya Peninsula. Magn. 100 ×.
a: right valve view, holotype, USNM No. 649189; b: left valve view, paratype, HVH No. 7924; c: dorsal view, holotype.
- Fig. 3. *Semicytherura arayaensis* n. sp., holotype (USNM No. 649190), Bolli 72, Cerro Barrigón, Araya Peninsula. Magn. 110 ×
a: left valve view, b: dorsal view.
- Fig. 4. *Luvula?* *gigarton* n. sp., Bolli 72, Cerro Barrigón, Araya Peninsula.
a: ♀, right valve view, holotype, (USNM No. 649194) Magn. 90 ×.
b: ♀, dorsal view, holotype. Magn. 100 ×.
c: ♂? right valve view (HVH 7930). Magn. 110 ×.
- Fig. 5. *Loxoconcha* sp., HVH 7917, Bermudez 1, Cubagua. Magn. 110 ×.
a: right valve view, b: dorsal view.
- Fig. 6. *Eucytherura rohri* (van den Bold), (HVH No. 7923), M 72, Cerro La Cantera, Araya Peninsula. Magn. 100 ×
a: right valve view, b: dorsal view.

PLATE 5

Fig. 1. *Parakrithe rhamphodes* n. sp., interior of left valve (HVH No. 7907),
Cubagua-1: 1425-1435 feet. Magn. 200×.

Fig. 2. *Campylocythere? perieri* (Brady), (HVH No. 7912), Caiguire 2, Cumana.
Magn. 170×.

a: Interior of right valve; b: interior of left valve.

Fig. 3. *Bythoceratina binodosa* n. sp., interior of right valve, holotype, (USNM
No. 649192), St. 1185, Paria Shelf. Magn. 200×.

Fig. 4. *Luvula? gigarton* n. sp., Cubagua-2: 150-160 feet. Magn. 270×.

a: ♀, interior of left valve (HVH No. 7929);
b: interior of right valve (HVH No. 7929).
c: ♂(?), right valve view (HVH No. 7930).

Fig. 5. *Paracythere* sp., right valve view (HVH No. 7927), St. 1206, Paria Shelf.
Magn. 230×.

Fig. 6. *Microcythere howei* (Puri), (HVH No. 7932), Cubagua-1: 470-482 feet.
Magn. 400×.

a: interior of left valve, ♀; b: interior of right valve, ♂.

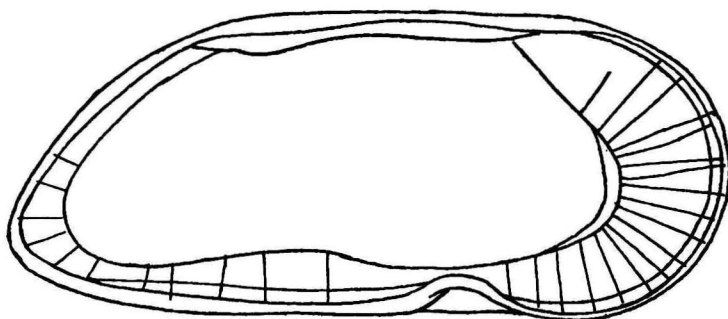


Fig. 1

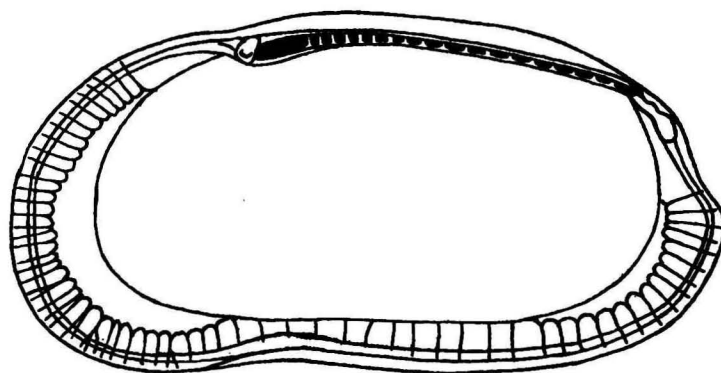


Fig. 2a

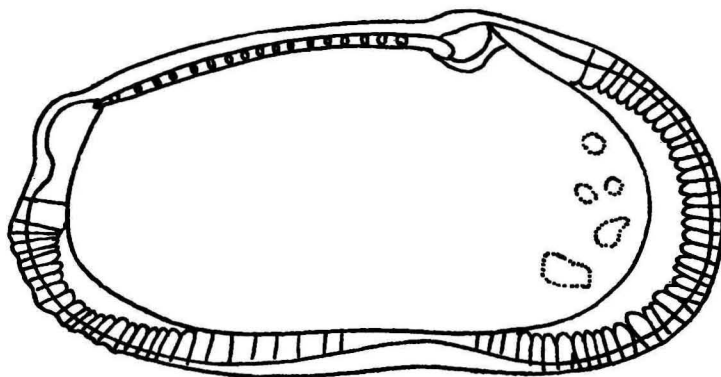


Fig. 2b

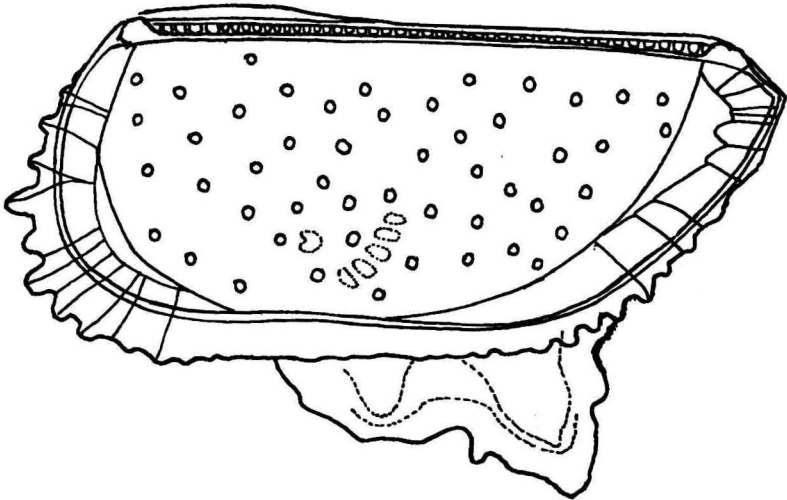


Fig. 3

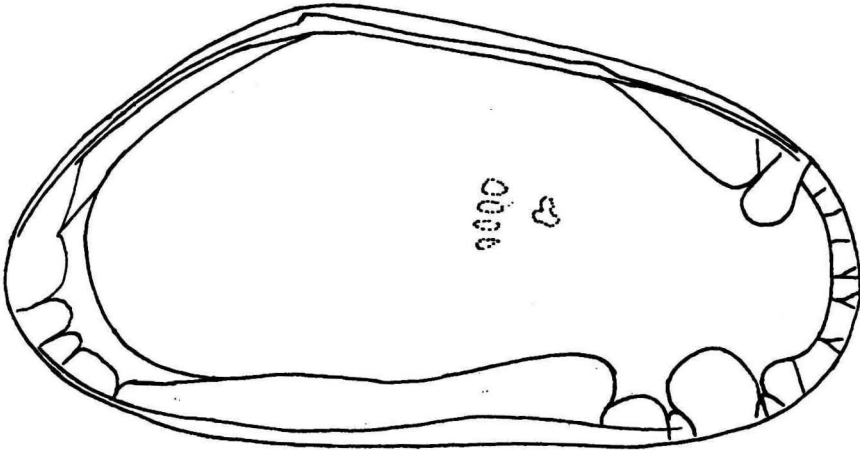


Fig. 4a

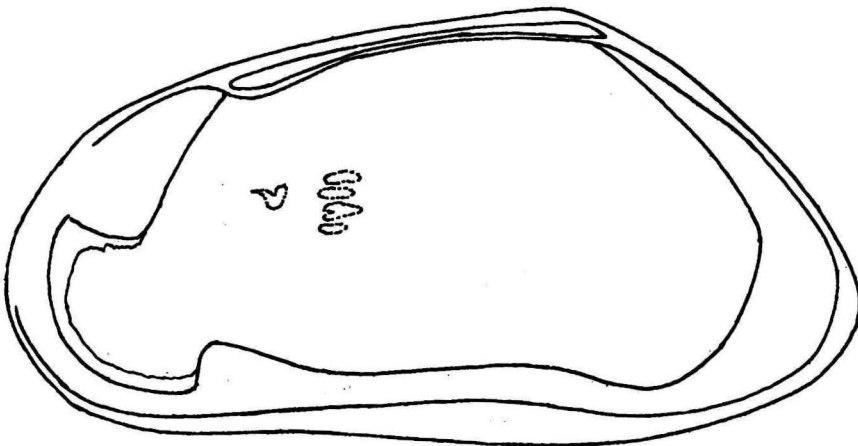


Fig. 4b

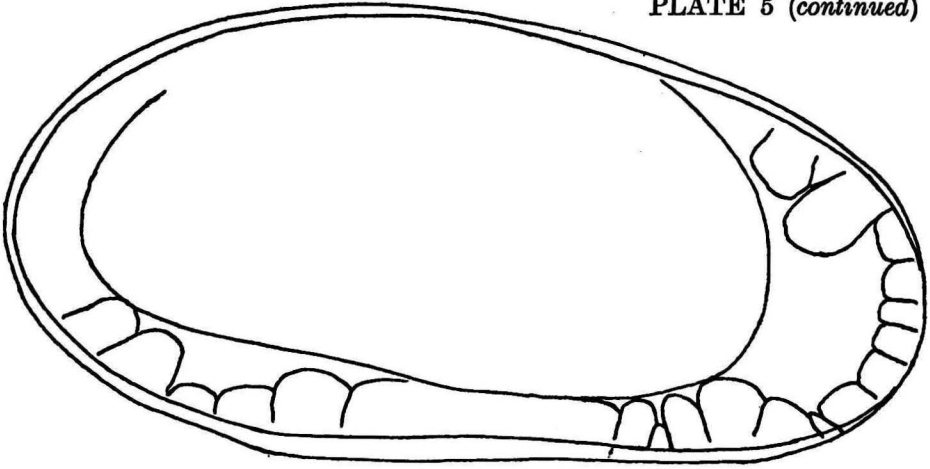


Fig. 4c

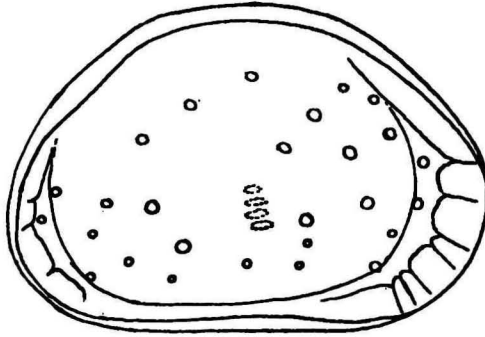


Fig. 5

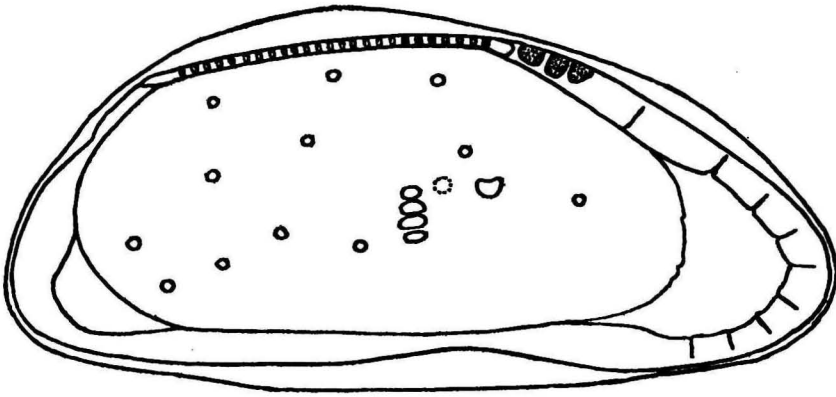


Fig. 6a

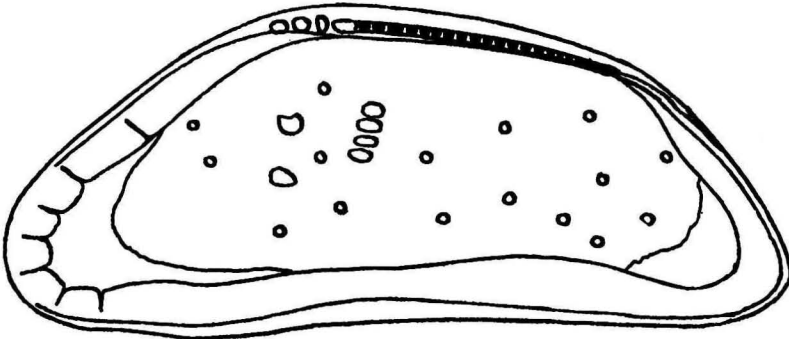


Fig. 6b

