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OSTRACODA OF THE YAGUE GROUP (NEOGENE) OF THE NORTHERN DOMINICAN REPUBLIC

W. A. van den Bold

Louisiana State University

ABSTRACT

One hundred and three species of Ostracoda have been recorded from the Neogene of the northwestern part of the Dominican Republic. Thirteen species are new, 50 have been described or recorded from other parts of the Caribbean; 13 are indicated by affinity and 26 have not received specific names. The new species are: *Cytherella dominicana, Cardobairdia glabra, Gangamocytheridea ? plicata, Costa dohmi, Paracytheretta dominicana, Pterygocythereis polita, Loxoconcha forda, Cytherura eresera, Kangarina depressa, Puriana scrupulosa, Puriana pustulosa, Uroleberis torquata,* and *Uroleberis triangula.* Throughout the Yague Group the ostracode fauna remains fairly similar, but several species appear to have restricted ranges, by means of which it is possible to recognize five ostracode-association-zones. Boundaries between these are vague and their stratigraphic significance is still uncertain. They do not parallel formational boundaries and these boundaries are in some cases uncertain. The ostracode fauna of the Gurabo Formation shows close affinity to that of the Springvale Formation (upper Miocene of Trinidad) and of the Bowden Formation (Jamaica). It is suggested, that the Gurabo Formation is transgressive over the Cercado Formation. Together the Cercado Formation and the Mao Formation represent an entire cycle of sedimentation.

INTRODUCTION

The Neogene deposits of the Dominican Republic are characterized, as are similar deposits in other parts of the Caribbean, by rapid facies changes which make correlation even in one small basin difficult. Between basins there may be strong differences in the nature of the sediments *e. g.* if we compare the northern basin (Cibao Valley), deposits of varying depth from brackish-water to fairly deep marine, with the Hoya de Enriquillo of thick successions of evaporites. Ostracodes from the latter basin will form the subject of a separate study. But even within the northern basin the facies of upper and middle Miocene deposits (Yague Group) varies over short distances from brackish-water over shallow marine to deep-water with changes in accompanying fauna. In the case of Foraminifera an abundance of *Amonia* and *Elphidium* shifts to an abundance of planktonic species. In the case of ostracodes the change is from *Cyprideis* to *Krithe, Bradleya,* and others. Changes of this sort make it desirable to study different groups of organisms so that their differences in reaction to variations in ecology can be taken into account. It is hoped, that a study of the ostracodes will

contribute to a better understanding of facies changes in the northern Dominican Republic and in the Caribbean as a whole.

In this article I have tried to reach some stratigraphic conclusions on the basis of the study of ostracodes alone. I do not feel that ostracodes may give more reliable information in this respect than other animals, but the scope of this work as a part of a larger study of the Neogene Ostracoda of the Caribbean did not allow a general consideration of the evidence presented by study of the mollusks (Maury, Woodring, Ramirez) and the Foraminifera (Bermudez). As a result none of the conclusions are entirely unambiguous. Because I had to point out uncertainties and discrepancies, the discussion of the biostratigraphy has become longer than desired. Where the general purpose of the study of the Caribbean Neogene Ostracoda is to find out how they migrated with time and changing ecology, I believe that this somewhat detailed treatment is justified.

In the work of Bermudez (1949) the Foraminifera were tabulated per stratigraphic unit and any lateral change in faunal content of the formations was, therefore, indetectable. The ostracodes are less numerous than the Foraminifera and lend themselves better to detailed tabulation per sample. By means of the tabulation the vertical and lateral changes in the fauna become more evident and allows me to suggest East-West facies changes within the Yague Group. I, therefore, believe that the large number of tables in this report is justifiable.

One aspect of the stratigraphy of the Cibao Basin (Caimito Formation) is discussed in some detail, although the ostracodes do not contribute towards a solution of this problem. This was (probably on purpose) left out in Bermudez' discussion of the stratigraphy. For a description of the other formations the reader is referred to Vaughan, *et al.*, (1921), Bermudez (1949), and Hoffstetter, *et al.* (1956). It should be emphasized that part of the discrepancies between litho-and bio-stratigraphic correlation is caused by the fact, that in the Neogene of the Dominican Republic the formations were originally established on the basis of the faunal content (Maury, 1917, 1919). Later workers (Cooke, Dohm, Beall, and others) tried to map lithological variations between sections where formational boundaries had been drawn on paleontological

evidence. Although the mapping was based on the lithology as found in the (later) established type sections, it is obvious that differences of opinion between field geologists and paleontologists will continue to exist.

ACKNOWLEDGMENTS

I am greatly indebted to C. F. Dohm, Vice-president of the American International Oil Co., who donated wash-residues and macrofossils from his fieldwork in the Dominican Republic to the Paleontological Museum of Louisiana State University and on whose material this report has been based. P. J. Bermudez of the Universidad Central de Venezuela kindly allowed location maps to be made of the copies of the maps of the Dominican Seaboard Oil Co. in his possession. C. W. Drooger, University of Utrecht, loaned me some type specimens from the collection in the Paleontological Museum in the University of Utrecht for comparative purposes. This made it possible to add some further corrections (see also van den Bold, 1961) to the writer's dissertation (van den Bold, 1946), a revision of which was undertaken in 1960. Due to my sudden departure from Utrecht in 1946 the collections were left in a state of considerable confusion with most of the labels in my handwriting. In 1960 new numbers were assigned to the holotypes (but not published) and I welcome this opportunity to supply additional information on some of the species and especially on some of the type localities.

The photographs of the specimens in this report have been made by L. Nichols, assistant curator of the Geological Museum at Louisiana State University. Types and illustrated specimens have been deposited in the H. V. Howe Collections (HVH No. 8291-8299, 8305-8398) at that institution. Dr. Howe kindly criticised an early draft of this report and made several pertinent suggestions toward its improvement. This study forms part of an investigation of the Neogene Ostracoda of the Caribbean Region, made possible by grant GB-416 of the National Science Foundation.

GENERAL STRATIGRAPHY

The Yague Group (Cooke, 1920) has been subdivided into three formations (age determinations after Bermudez, 1949):

MAO FORMATION (BERMUDEZ, 1949), UPPER MIOCENE

No type section established. By combining those for the Mao Clay and the Mao Adentro Limestone it is obvious that the type locality should be opposite Mao Adentro, on the right (east) bank of the Río Mao. (Text-fig. 4). (See Hoffstetter, *et al.,* 1956, pp. 386-388.)

GURABO FORMATION (MAURY, 1919), MIDDLE MIOCENE

Type section: zone F-A of Maury along the Río Gurabo from 3 km SSE of Gurabo Adentro to Bluff U (USGS station 8556), 2.6 km N of Gurabo Adentro. (Text-fig. 3). (See Hoffstetter, *et al.,* 1956, pp. 374-377.)

CERCADO FORMATION (MAURY, 1919), LOWER MIOCENE

Type locality: Bluff 3 of Maury (Cooke, *in* Vaughan, *et al.,* 1921, pls. 9, 12A), W side of Río Mao, 5-7 km S of Cercado de Mao above Paso del Perro and opposite Hato Viejo (Text-fig. 4). (See Hoffstetter, *et al.*, 1956, pp. 362-364.)

The sequence of events that lead to this subdivision can be summarized in the form of Table 1. The Tabera Formation underlies the Yague Group unconformably. Its age has generally been indicated as Oligocene (middle Oligocene, Bermudez, 1949) and correlated with the lower part of the Sombrerito Formation. According to present usage an early Miocene age appears more appropriate.

Duncan, 1963	Maury, 1917	Maury, 1919	Cooke, 1920		Vaughan et al., 1921	Bermudez, 1949
Nivaje sh. 1)			Yague	Mao clay	Mao clay	Mao F.* upper member 2)
				Mao Adentro ls.	Mao Adentro ls.	lower member 3)
	Siconsia laevigata F.	Gurabo F.*		Gurabo F.	Gurabo F.	Gurabo F.
	Aphera islacolonis F.	Cercado F.*	Gr.	Cercado F.	Cercado F.	Cercado F.
	Orthaulax inornatus F.			Baitoa F.*	Baitoa F.	
				Bulla congl.	Bulla congl.	Bulla member 4)

Table 1: Correlation of formations, members and zones within the Yague Group.
1. See Text-fig. 6.
2. Acc. to Hoffstetter, *et al.*, (1956) possibly equivalent to Caimito Formation (Maury, 1931).
3. May be equivalent to Nivaje Shale of Duncan.
4. Combines Baitoa Formation and Bulla Conglomerate of Cooke, 1920.
* First mentioned as formational name.

The initial subdivision of the Neogene of the Dominican Republic was based entirely on paleontology by Maury (1917), who later (1919) attached formational names to her biozones (mollusks). Cooke, Vaughan, Woodring, and Conkin (Vaughan, *et al.*, 1921) mapped and measured river sections but did not map lithological boundaries between these. This was done by Dohm and Beall for the Dominican Seaboard Oil Company (1940), who were aided by an aerial-photo survey. Their results are contained in company reports and only a summary of their survey and some location maps were published in Bermudez' study of the Foraminifera content of their samples (1949).

In addition to her two other formations, Maury (1931, p. 43) proposed the name Caimito Formation (and Caimitoan Stage) for the beds in the upper part of a section along the Río Caña, from 2 miles upstream from Caimito to 2 miles downstream (Text-fig. 3), which section she described in 1917 as follows (abbreviated):

Argillaceous limestone with tubes of *Teredo incrassata* (10-15 feet)
Sandy clay with fucoids and Bryozoa (30 feet)
Clay with 3 *Arca (Scapharca) patricia* beds (42-51 feet)
Chione bed (1 foot)
Lignites with *Arca (Scapharca) patricia* (3 feet)
Gravel (3 feet)
Clay and gravel (50 feet) } zone H
Clay with concretions (35 feet) }
Gravel (15 feet) }
Greenish clay (50 feet) } zone I
Sandy clay with concretions (50 feet) }
Sandy clay with lignite streaks (100 feet) }

Zones I and H (with *Aphera islacolonis*) belong to Maury's Cercado Formation; the beds above zone H were (1931) included in the Caimito Formation. Dohm mapped along the Río Caña in 1940 and reported Cercado Formation as far N as 8 km below Caimito. In Table 2 I have tried to combine Maury's and Dohm's sections. According to Bermudez (1949) Dohm's sample 15437 (at 6.5 km downstream from Caimito) is in the Gurabo Formation which is in agreement with the results of the present study.

There can be little doubt, that the beds with *Arca (Scapharca) patricia* belong either to the upper part of the Cercado Formation or (more likely) to the lower part of the Gurabo Formation. This pelecypod has often been thought to indicate a late Miocene

or Pliocene age, and Hoffstetter (1956, pp. 361, 387), therefore, suggested that the Caimito Formation should be younger in age than the *Sconsia laevigata* Beds of the Gurabo Formation and might be equivalent to the upper (unnamed) member of the Mao Formation. Bermudez ignored the Caimito Formation but remarked that large *Teredo* tubes are common in the basal Gurabo Formation and occur throughout the Yague Group.

MATERIAL

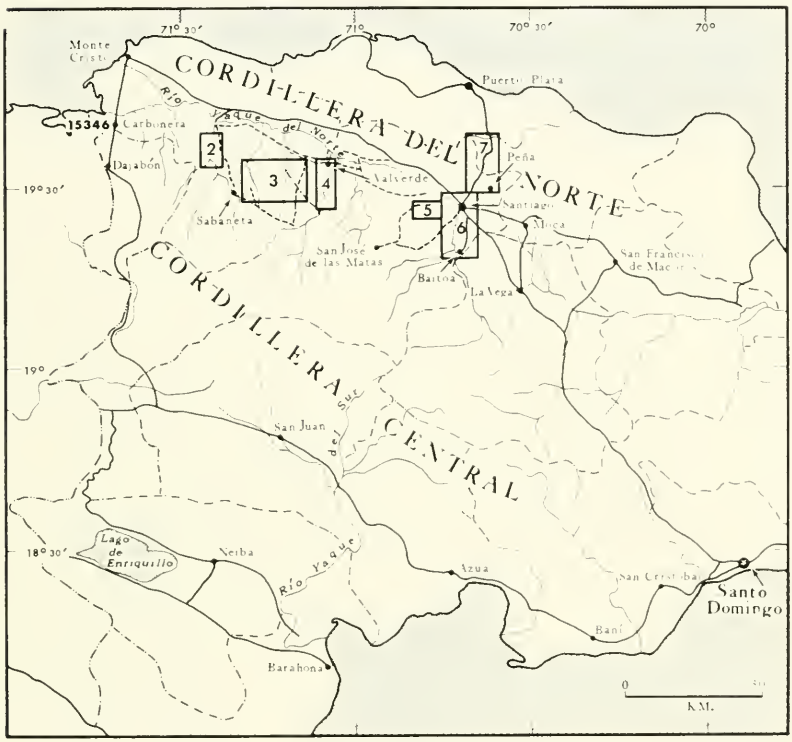
In 1940 the Dominican Seaboard Oil Company conducted geological investigation of the Cibao Valley in the northwestern Dominican Republic. A number of samples collected by C. F. Dohm, one of the field geologists, were donated by him to the Geological Museum of Louisiana State University and form the foundation for this report. A study of the smaller Foraminifera of part of these samples and of samples collected by the other geologists taking part in this exploration program was published by P. J. Bermudez (1949). A summary account of all the work undertaken in the Cibao Valley can be found in the first 17 pages of Bermudez' paper.

A total of 119 washed residues were in the collections of the geological museum at Louisiana State University. Thirty-eight of these contained the ostracodes described in this report. The majority of the samples were picked by M. Mumma (now with Humble Oil Co. in New Orleans) in the fall of 1963, the remainder by me in the spring of 1964. The files of the Museum contain short topographic and lithological descriptions of the samples and their localities and in combination with the sample maps provide accurate locations. The description of the locality in Dohm's notes is not always in entire agreement with the position on the map. These discrepancies are pointed out in the list of localities. In the list of localities it is mentioned, where possible, how Dohm's localities relate to those of Cooke, Vaughan, and others (Vaughan, *et al.*, 1921), and of Maury (1917).

Comparison of the field maps and notes with Bermudez' report reveals difference of opinion between field geologist and paleontologist as to where formational boundaries should be placed. It should

be noted, however, that Bermudez adhered in his location maps (Bermudez, 1949, figs. 1-3) to the boundaries as drawn by Dohm, so that these maps and his descriptions of localities do not always agree.

Examples: 15101 Dohm: Gurabo; Bermudez: Mao
15248 Dohm: Mao; Bermudez: Gurabo
15437 Dohm: Cercado; Bermudez: Gurabo



Text-fig. 1. Relative position of location maps.

LIST OF LOCALITIES

15000-15003. See Text-fig. 7.

15000. About 1 km S of Yasica on Puerto Plata - Santiago road. Massive, fine-grained sandy marl. Dohm: Gurabo; Bermudez (1949, p. 43): Gurabo. Type loc. of *Cardobairdia glabra*.

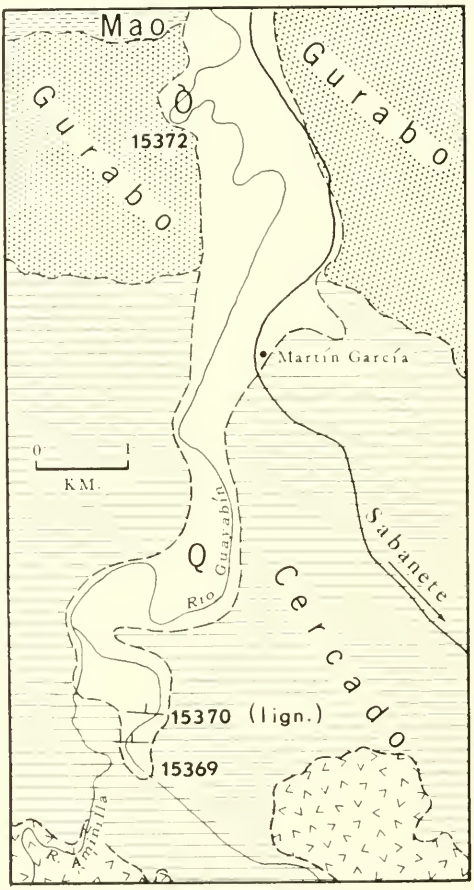
15001. On Santiago-Puerto Plata road, 300 m S of km 30 (from Puerto Plata). Thin to thick-bedded, locally laminated, cream to light buff-colored, loosely consolidated silty marl. Dohm: Gurabo.

15003. On Santiago-Puerto Plata road, stratigraphically just below 15001. *Teredo* tubes from massive, creambuff-colored, nodular, argillaceous coralline limestone. Dohm: Gurabo?

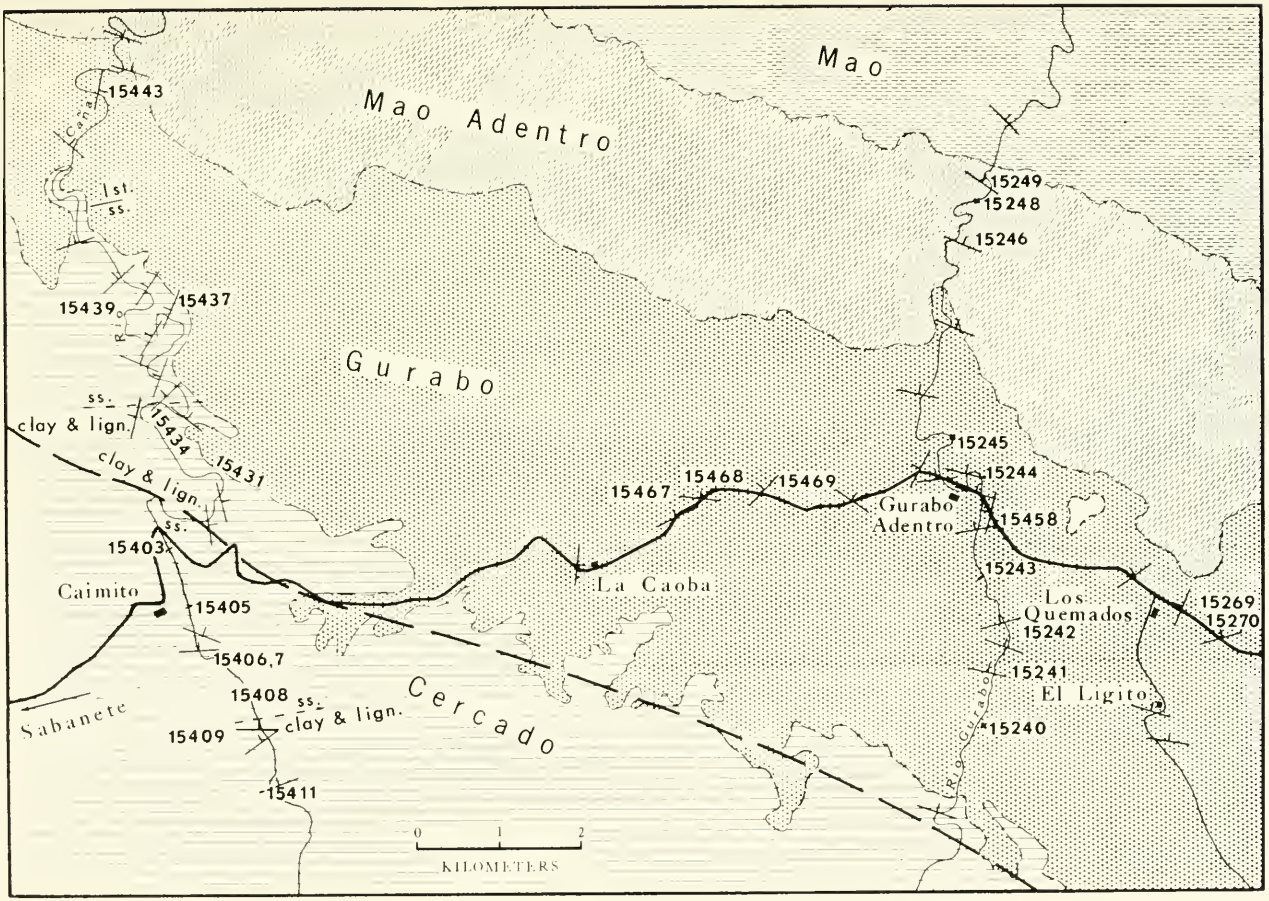
15092-15122. See Text-fig. 6.

15092. On Santiago-Puerto Plata road, at the s.c. Gurabo Hills of Cooke. 300 m N of km 58 from Puerto Plata. Buff-colored, thickly bedded, friable, argillaceous marl. Dohm: Mao (Cooke's Mao Adentro Formation).

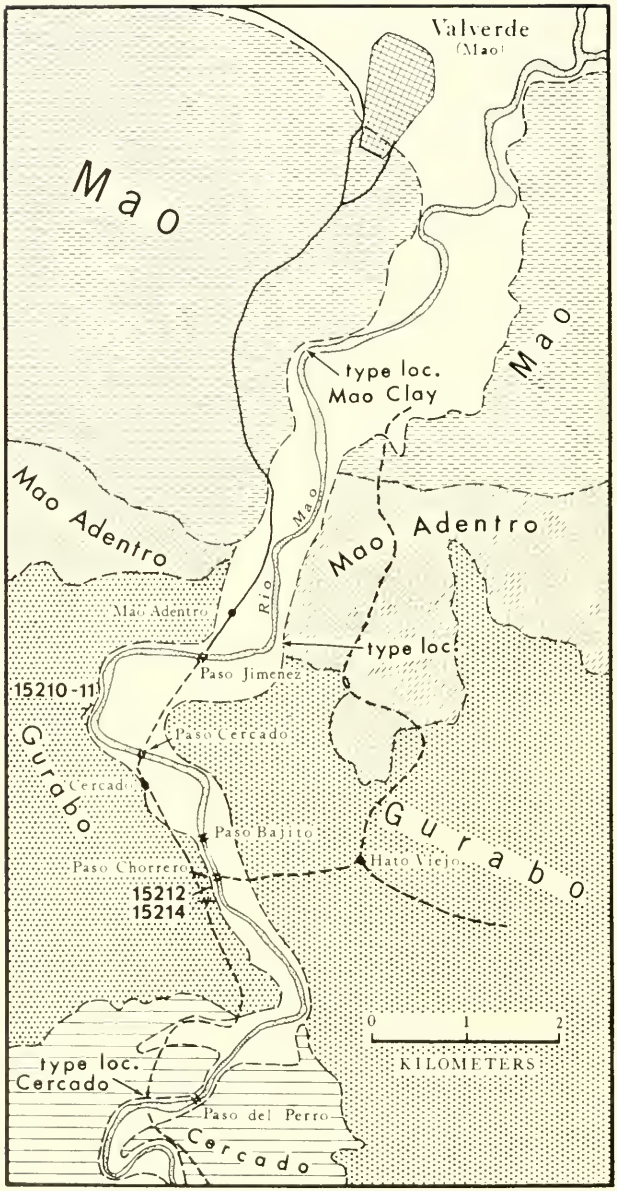
15095. On Santiago-Puerto Plata road, 300 m SW of 15092. Massive, locally indurated, buff-colored, coralline, argillaceous marl, grading into limestone. Dohm: Mao (Mao Adentro Formation). Type loc. of *Uroleberis torquata*.



Text-fig. 2. Location of samples along the Río Guayabín.



Text-fig. 3. Location of samples between Río Caña and Río Gurabo.



Text-fig. 4. Location of samples along the Río Mao.

15101. On Río Yague del Norte, 1300 m upstream from Santiago bridge. Thin-bedded light gray, friable, calcareous, fine sandstone. Dohm: possibly Gurabo (on map as Mao); Bermudez (1949, p. 45): Mao. Type loc. of *Cytherella dominicana*.

15102. About 300 m upstream from 15101. Thin-bedded and laminated, light gray, silty clay shale, Dohm: Gurabo (on map as Mao).

15117. Río Yague del Norte, 12.5 km S of Santiago, 2 km N of Baitoa. Gray arenaceous marl. Dohm: Baitoa Member of Cercado; Bermudez (1949, p. 42): Cercado.

15122. Río Yague del Norte, 9 km downstream from Santiago bridge. Thin-bedded, medium gray, calcareous, silty clay. Dohm: Mao; Bermudez (1949, p. 45): Mao.

15210 - 15214. See Text-fig. 4.

15210. Río Mao, 700 m downstream from Cercado Village = USGS 8733 (Vaughan, *et al.*, 1921). Thin-bedded, gray, silty clay. Dohm: Gurabo; Bermudez (1949, p. 43): Gurabo.

15211. Same locality as 15210, stratigraphically 10 m higher. Buff-colored, arenaceous coquina in silty clay. Dohm: Gurabo; Bermudez (1949, p. 43): Gurabo. Type loc. of *Puriana pustulosa*.

15212. Río Mao at Paso Bajito near Cercado de Mao (does not agree with map). At or near Maury's loc. 1 on the Río Mao-USGS 8527 (Vaughan, *et al.*, 1921). Dohm: Gurabo; Bermudez (1949, p. 43): Gurabo. Type loc. of *Cytherura cresera*, *Gangamocytheridea ? plicata*, *Kangarina depressa*, *Uroleberis triangula*.

15214. Río Mao, halfway between Paso Bajito and Paso Chorrero, 500 m upstream from 15212 (does not agree with map). Poorly bedded, gray, silty clay, probably Bluff 1 of Maury (1917) = USGS 8519, 8520 (Vaughan, *et al.*, 1921). Dohm: Gurabo.

15240 - 15270. See Text-fig. 3.

15240. Río Gurabo, about 4.5 km upstream from Gurabo Adentro. Massive gray fine sand to silt. Dohm: Gurabo.

15241. Río Gurabo, about 4 km upstream from Gurabo Adentro. Thin-bedded, gray, calcareous, friable sandstone, locally grading into coralline limestone. Dohm: Gurabo.

15242. Río Gurabo, about 2.5 km upstream from Gurabo Adentro. Poorly bedded, dull green-gray, coralline silty clay. Probably USGS 8541 (Vaughan, *et al.*, 1921). Dohm: Gurabo.

15243. Río Guarbo, about 2 km upstream from Gurabo Adentro. Poorly bedded, gray-greenish gray, coralline clay, probably USGS 8541 (Vaughan, *et al.*, 1921). Dohm: Gurabo.

15244. Río Gurabo, 1.5 km upstream from Gurabo Adentro, 200 m downstream from the first crossing (E-W) of the Los Quemados-Sabaneta road. Thick-bedded, light gray, calcareous, silty clay. Probably USGS 8544 (Vaughan, *et al.*, 1921) Dohm: typical Gurabo with *Sconsia laevigata;* Bermudez (1949, p. 43): Gurabo.

15245. Río Gurabo about 1 km downstream from 15244, 200 m downstream from the first roadcrossing, 1 km E of Gurabo Adentro. Light gray clay with *Sconsia laevigata*. Probably USGS 8549 (Vaughan, *et al.*, 1921). Dohm: Gurabo; Bermudez (1949, p. 43): Gurabo.

15246. Río Gurabo, about 4 km downstream from 15244, near or at Cooke's station "U" (top Gurabo of Cooke), USGS 8556 (Vaughan, *et al.*, 1921). Moderately thickly bedded, light gray clay with a bed of coralline clay to clayey limestone. Dohm: Mao.

15248. Río Gurabo, about 1 km downstream from 15246, 450 m N of the crossing of the Gurabo Adentro-Los Quemados road. Massive, light gray, calcareous, silty clay. Dohm: Mao; Bermudez (1949, p. 43): Gurabo.

15249. Río Gurabo, about 300 m downstream from 15248. Thick-bedded, light gray clay with interbedded buff-weathering, argillaceous, coralline limestone. Dohm: Mao.

15269. Valverde-Monción road, 300 m N (E?, does not agree with map) from Los Quemados. Thick-bedded gray, calcareous clay with large oysters (*Ostrea haitensis*). Dohm: Gurabo; Bermudez (1949, p. 44): Gurabo. Type loc. of *Costa dohmi*.

15270. Valverde-Monción road, about 1 km N (E?, does not agree with map) of Los Quemados. Massive, gray, calcareous, silty clay. Dohm: Gurabo.

15296 - 15307. See Text-fig. 5.

15296. Santiago-Las Matas road, 22.5 km from Las Matas. Thin-bedded, buff weathering sand, Dohm: Gurabo, Bermudez (1949, p. 44): Gurabo. Type loc. of *Paracytheretta dominicana*.

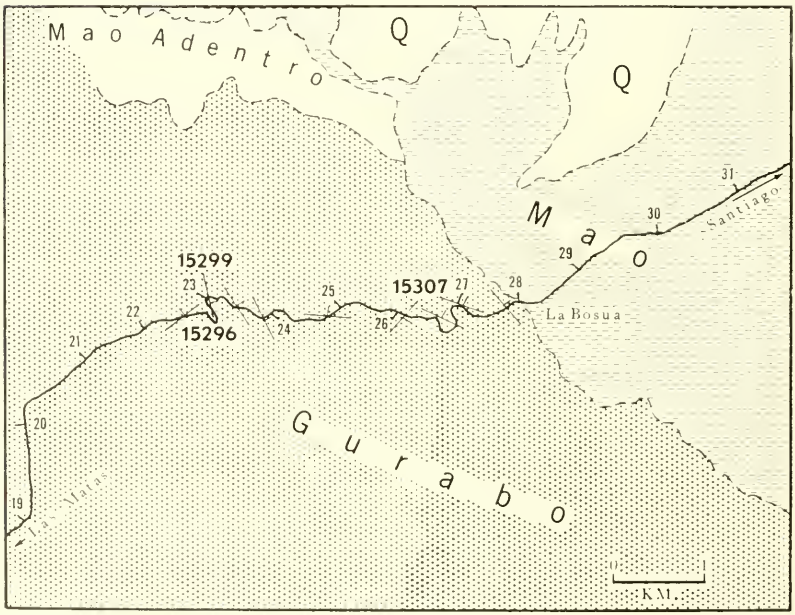
15299. Santiago-Las Matas road, 22.85 km from Las Matas. Massive, buff, moderately indurated to friable, fine sandstone with large oysters. Dohm: Gurabo. Type loc. of *Pterygocythereis polita*.

15307. Santiago-Las Matas road, 26.2 km from Las Matas. Thick-bedded, gray fossiliferous clay (*Amphistegina*). Dohm: Gurabo.

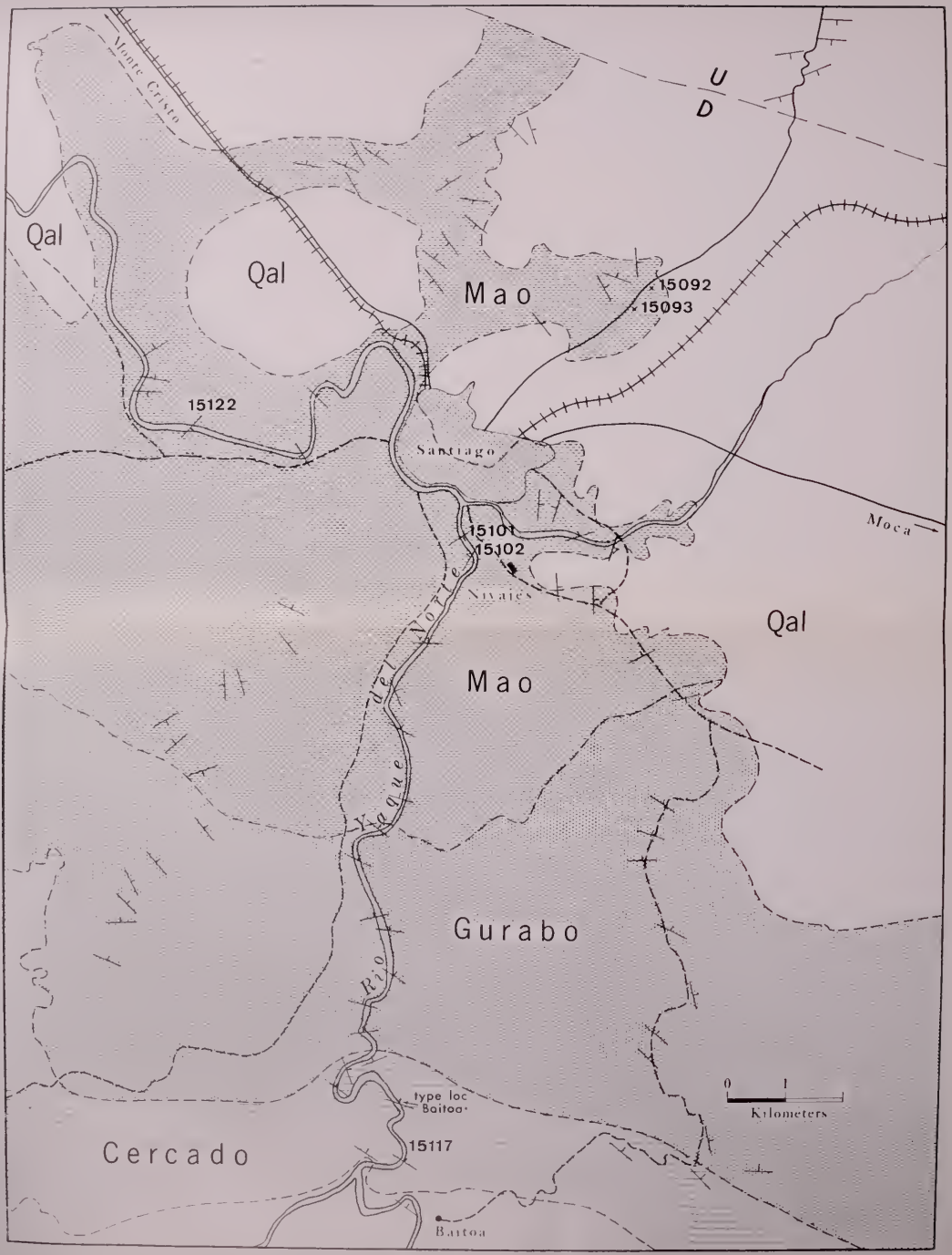
15346. On road from Monte Cristi to Dajabón at Carbonera village. (See Text-fig. 1). Fossiliferous clayey marl. Dohm: Gurabo Formation?

15369 - 15372. See Text-fig. 2.

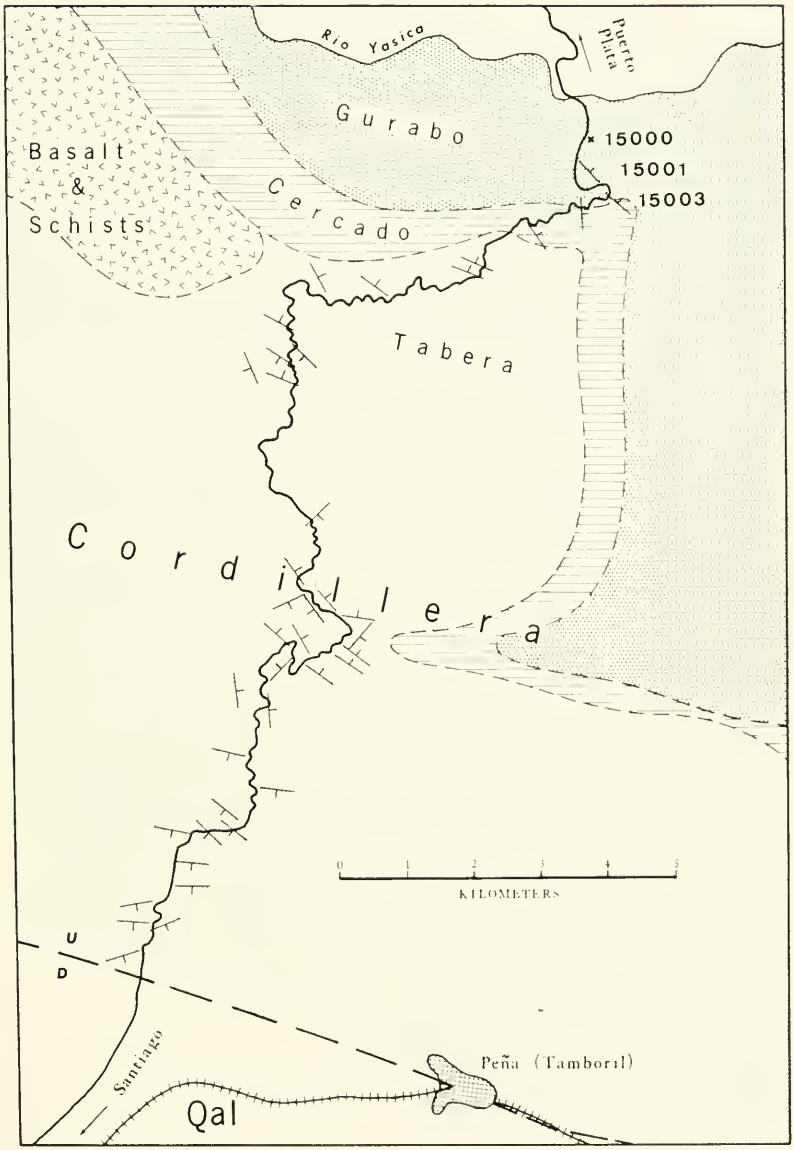
15369. Río Guayabín, about 6.5 km downstream from junction of Arroyo Yaguajal. Massive, buff-colored, friable grit to fine conglomerate. Dohm: Cercado?



Text-fig. 5. Location of samples between Río Mao and Río Yaque del Norte.



Text-fig. 6. Location of samples along and near the Río Yaque del Norte



Text-fig. 7. Location of samples along the Santiago-Puerto Plata road.

15370. Río Guayabín, 500 m downstream from 15369. Lignitic, gray, fossiliferous clay and sandy clay. Dohm: Cercado.

15372. Río Guayabín, about 4.5 km downstream from Martin Garcia village. Massive, buff weathering, argillaceous, fossiliferous limestone with numerous large oysters. Dohm: Gurabo.

15434 - 15469. See Text-fig. 3.

15434. Río Caña, about 4.5 km downstream from the crossing to the Sabaneta-Los Quemados road. Poorly bedded, gray, fossiliferous, silty clay. Dohm: Cercado.

15437. Río Caña, about 2 km downstream from 15434, 3 km N of El Caimito. Laminated, gray, fine, calcareous sandstone with thin lenses of mollusks. Dohm: Cercado; Bermudez (1949, p. 44); Gurabo.
Type loc. of *Puriana scrupulosa*.

15443. Río Caña, about 6.5 km downstream from 15437. Poorly bedded, gray, fossiliferous, fine sandstone and clay. Dohm: near top of Gurabo.

15458. On road between Los Quemados and Sabaneta, about 2.3 km from Los Quemados. Poorly bedded, locally laminated, buff weathering, indurated, limey siltstone to silty limestone *(Amphistegina)*. Dohm: Gurabo.

15467. Los Quemados-Sabaneta road, about 3.8 km W of the Río Gurabo, near Gurabo Adentro. Massive, light gray, slightly consolidated, fossiliferous siltstone *(Amphistegina)*. Dohm: Gurabo; Bermudez (1949, p. 44): Gurabo.

15468. Los Quemados-Sabaneta road, about 3.7 km W of Río Gurabo. Massive, poorly laminated, fossiliferous clay. Dohm: Gurabo?

15469. Los Quemados-Sabaneta road, about 3.2 km W of Río Gurabo. Laminated, light gray, friable, fossiliferous, fine sandstone. Dohm: Gurabo?
Type loc. of *Loxoconcha forda*.

LIST OF SPECIES

As only a portion of the fauna has been described in more detail in the systematic descriptions and several species occur only in one or two of the sections, it seems desirable to give a complete alphabetical list of the 105 species encountered and to the tables in which they are included. For described species, which are not treated in the systematic part, a short reference to the late literature is given in parenthesis.

Acuticythereis elongata van den Bold, Pl. 2, fig. 8; T. 4-6, 9, 11
Ambocythere exilis van den Bold, T. 7, 12
Argilloecia sp. 1, Pl. 4, fig. 4; Pl. 8, fig. 4; T. 7, 9, 12
Argilloecia sp. 2, T. 7, 12
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Bairdia sp. aff. *B. fortificata* Brady, Pl. 2, fig. 4; T. 7, 9, 11
Bairdia longisetosa Brady, Pl. 2, fig. 3; T. 11
Bairdia willisensis (Puri), (van den Bold, 1965b, p. 389); T. 4, 5, 7-10, 12
Bairdia sp. T. 4, 11
Brachycythere sp. aff. *B. russelli* Howe and Law, T. 11
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Bradleya hazelae (van den Bold), Pl. 3, fig. 6; T. 12
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Bythocypris keiji van den Bold (1963b, p. 374); T. 4, 5, 7, 9, 11
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Campylocythere sp., Pl. 2, fig. 7; Pl. 8, fig. 6; T. 5
Cardobairdia glabra, n. sp., Pl. 2, fig. 1; Pl. 8, fig. 2; T. 12
Cativella navis Coryell and Fields (1937, p. 9) ; T. 4, 10-12
Caudites medialis Coryell and Fields, (van den Bold, 1967b) , Pl. 4, fig. 1; T. 6, 8, 9, 10
Caudites nipeensis van den Bold (1963b, p. 386); T. 7-11
Caudites rectangularis (Brady), (van den Bold, 1966g) T. 6, 11
Costa dohmi, n. sp., Pl. 3, fig. 9; Pl. 9, fig. 1; T. 6-9, 11
Costa variabilocostata variabilocostata (van den Bold) 1966a, p. 183, T. 8
Cushmanidea anderseni (Puri) ?, Pl. 4, fig. 10; T. 9
Cushmanidea sp. aff. *C. howei* (van den Bold) , Pl. 4, fig. 9; T. 11
Cyprideis sp. aff. *C. pascagoulacnsis* (Mincher) Pl. 7, fig. 6; Pl. 8, fig. 3; T. 4, 7, 11
Cytherella caelata van den Bold (1963b, p. 370); T. 6, 11
Cytherella dominicana, n. sp., Pl. 1, fig. 1; T. 7, 8, 11
Cytherella sp. aff. *C. vulgata* Ruggieri, Pl. 2, fig. 2; T. 4, 7-9, 11, 12
Cytherella sp. A., Pl. 1, fig. 3; T. 5, 7, 9, 10
Cytherella sp. B., Pl. 1, fig. 4; T. 4, 9, 11
Cytherella sp., Pl. 1, fig. 2; T. 4, 5, 9, 11
Cytherelloidea sp., T. 4, 10
Cytheretta karlana Howe and Pycatt, Pl. 3, fig. 7; T. 11
Cytheretta, n. sp. aff. *C. karlana* Howe and Pycatt, T. 9
Cytheropteron sp. cf. *C. leonensis* Puri, (van den Bold, 1966c, p. 34), T. 5
Cytheropteron? trinidadensis van den Bold, Pl. 7, fig. 9; Pl. 8, fig. 5; T. 12
Cytheropteron sp., Pl. 7, fig. 2; Pl. 8, fig. 1; T. 7, 8
Cytherura cresera, n. sp., Pl. 7, fig. 3; T. 9
Eucytherura sp., T. 7, 9
Gangamocytheridea? plicata, n. sp., Pl. 7, fig. 4; Pl. 9, fig. 3; T. 7-10
Hemicythere? laevicula Edwards, (van den Bold, 1963b, p. 384)
Hemicytherura cranekeyensis Puri, Pl. 7, fig. 7, T. 9
Hermanites hornibrooki (Puri), Pl. 4, fig. 3; T. 7-9
Jugosocythereis sp. aff. *J. vicksburgensis* (Howe and Law), (van den Bold, 1963b, p. 388), T. 4, 7-9, 11, 12
Kangarina depressa, n. sp., Pl. 7, fig. 5; Pl. 8, fig. 7; T. 9
Kangarina quellita Coryell and Fields, (van den Bold, 1967b) ; T. 7, 9
Krithe dolichodeira van den Bold, Pl. 2, fig. 9; Pl. 10, fig. 4; T. 7, 8, 9, 12
Krithe morkhoveni van den Bold (1960, p. 160), T. 7, 11, 12
Krithe prolixa van den Bold (1966a, p. 180), T. 7, 11, 12
Krithe trinidadensis van den Bold (1958, p. 398), Pl. 2, fig. 10; T. 7, 11, 12
Loxoconcha antillea van den Bold (1965b, p. 102), T. 8, 11
Loxoconcha banesensis van den Bold (1946, p. 112) , Pl. 3, fig. 1; T. 7, 8, 11
Loxoconcha dorsotuberculata (Brady), (van den Bold, 1966g); T. 4-6, 9, 10
Loxoconcha fischeri (Brady), (van den Bold, 1963b, p. 393), T. 4, 6, 7, 9, 10
Loxoconcha forda, n. sp., Pl. 3, fig. 3; T. 4, 6, 7, 8, 9, 11
Loxoconcha lapidiscola Hartmann, (van den Bold, 1963b, p. 394), T. 5, 10
Loxoconcha levis Brady, (van den Bold, 1963b, p. 393) , T. 11
Loxoconcha rugosa van den Bold, (van den Bold, 1963b, p. 394), Pl. 3, fig. 2; T. 4, 7, 9, 11, 12
Macrocyprina decora (Brady) ?, T. 7, 9
Munseyella bermudezi van den Bold (1966c, p. 22); T. 9
Munseyella bollii van den Bold (1966c, p. 21); T. 7
Mutilus confragosus (Edwards) , T. 4-12
Neocaudites triplistriatus (Edwards) , (van den Bold, 1963b, p. 389), T. 4
Occultocythereis angusta van den Bold (1963b, p. 391), T. 8
Occultocythereis sp., T. 11
Orionina serrulata (Brady), (van den Bold, 1963a, p. 44) , T. 4-6, 9, 10, 11

Paracypris sp., Pl. 2, fig. 6; T. 4, 5, 7, 9-11
Paracytheretta dominicana, n. sp., Pl. 3, fig. 5; Pl. 9, fig. 2; T. 4-6, 10
Paracytheridea altila Edwards, Pl. 7, fig. 1; T. 6, 9, 10, 11
Paracytheridea sp. aff. *P. hispida* van den Bold, Pl. 4, fig. 6; T. 9, 10
Paracytheridea tschoppi van den Bold, Pl. 4, fig. 8; T. 4, 5, 8, 10, 12
Paracytheridea sp., Pl. 4, fig. 7; T. 4, 7, 8, 9,
Paradoxostoma sp., T. 9
Parakrithe vermunti (van den Bold) (1958, p. 399), T. 7
Parakrithella sp., T. 7, 9
Pellucistoma howei Coryell and Fields, (van den Bold, 1967b), T. 11
Perissocytheridea sp. aff. *P. bicelliforma* Swain, (van den Bold, 1963b, p. 380)
Procythereis sp. cf. *P. deformis* (Reuss), (van den Bold, 1965b, p. 396), T. 11, 12
Propontocypris sp., Pl. 4, fig. 11; T. 7, 11
Pseudoceratina droogeri van den Bold, Pl. 6, fig. 1; T. 9
Pseudocythere sp., Pl. 6, fig. 1; T. 5, 7, 9
Pterygocythereis miocenica van den Bold, T. 4-7, 9, 10
Pterygocythereis polita, n. sp., Pl. 3, fig. 4; Pl. 9, fig. 4; T. 6-8, 10
Puriana congestocostata van den Bold, (1963b, p. 390), Pl. 5, fig. 3; T. 4-8, 10
Puriana minuta van den Bold, (1963b, p. 390), T. 7
Puriana pustulosa, n. sp., Pl. 4, fig. 5; Pl. 9, fig. 6; T. 9
Puriana rugipunctata (Ulrich and Bassler), T. 4, 5, 11
Puriana scrupulosa, n. sp., Pl. 5, fig. 4; Pl. 9, fig. 5; T. 5, 9, 10
Quadracythere bichensis (van den Bold), (1963b, p. 385), Pl. 5, fig. 2; T. 4-6
Quadracythere producta (Brady), Pl. 5, fig. 1; T. 8, 9, 11
Trachyleberidea sp. aff. *T. cubensis* (van den Bold), Pl. 5, fig. 6; T. 8
Trachyleberidea mammidentata (van den Bold), Pl. 5, fig. 5, 7; T. 11, 12
Trachyleberis bermudezi crebripustulosa van den Bold, (1966a, p. 181); T. 11
Uroleberis angulata (Brady), Pl. 6, fig. 3
Uroleberis torquata, n. sp., Pl. 6, fig. 4; Pl. 10, fig. 2; T. 11
Uroleberis triangula, n. sp., Pl. 6, fig. 5; Pl. 10, fig. 1; T. 4, 9
Uroleberis sp., Pl. 6, fig. 6
Uroleberis sp., Pl. 6, fig. 7
Xestoleberis sp. 1, Pl. 6, fig. 9; T. 4, 9, 11
Xestoleberis sp. 2, Pl. 6, fig. 8; T. 7-12
Xestoleberis sp. 3, Pl. 1, fig. 6; T. 7, 11
Xestoleberis sp. 4, Pl. 1, fig. 5; T. 5, 7, 11
N. gen. N. sp., Pl. 4, fig. 2; Pl. 10, fig. 3; T. 9, 11

BIOSTRATIGRAPHY

GENERAL

Ostracoda from nine sections in the northwestern part of the Dominican Republic have been studied (Table 1). In some of these sections only a few samples yielded ostracodes, but a fairly complete picture of the faunal content of at least the Gurabo Formation could be obtained. Several faunal associations can be recognized and although the boundaries between these faunal association zones are not always sharp, they are believed to have stratigraphic significance. In some cases the faunal associations cross formational boundaries, but these do not appear to be firmly established as shown by controversies between the different workers

DOHM								MAURY	
Cerca do Form.	North		ss + slt dip 1-8°(dir. var.)		15439	(8)			
					15437	(6.5)	Gurabo (Berm.)		
		2.56		6.8					
					15434	(4.5)		2 miles from Caimito 10' arg. ls., 30' sdy clay 75' Scapharca patricia beds	Caimito
			clay, slt + lign. dip 2-3°(dir. var.)		15433	(3.5)	big Arca		
					15431	(2)			
		1.32		1.44	15430	(0.4)			
					15403	(0.1)		100' clay + gravel clay + concretions	Zone H
	crossing	0.96		0.96					
	Caimito	0		0	15405	(0.6)		gravel	
			ss., slt.+ congl. dip 1-3°(N5W-25E)		15406,7	(1.4)		100' gray clay sdy. clay + concr.	Zone I
					15408	(2.4)			
					15409	(2.8)			
		1.48		1.68					
	South		clay + lignite dip 3° (N35E-20W)		15411	(3.7)		100' sdy.clay + lignite 2 miles from Caimito	
		Distance from Caimito, perp. to strike (kms)		Distance from Caimito along Río Caña (kms)	samples (Dohm)		Distance from crossing (kms)	Thickness (feet)	

Table 2. Attempted correlation between the sections of Dohm and Maury along the Río Caña at Caimito (see Text-fig. 3).

in the region and the lithological variations within one formation (compare list of localities). The following associations can be recognized:

1. *Bairdia* sp. aff. *B. formosa, Bairdia longisetosa, Loxoconcha levis, Xestoleberis* spp. 3 and 4, *Uroleberis torquata*, n. sp. (upper Miocene-Pliocene). This association appears to be typical of the Mao Formation.
2. *Cytherella* sp. aff. *C. vulgata, Bythocypris keiji, Puriana minuta, Neocaudites triplistriatus, Ptergocythereis polita*, n. sp., *Ambocythere exilis*. Mao Formation and upper part of Gurabo Formation (upper Miocene).
3. Overlap in range of species from associations 2 and 4, together with *Costa dohmi*. Middle part of Gurabo Formation (upper Miocene).
4. *Gangamocytheridea plicata, Caudites medialis, Puriana scrupulosa, Puriana pustulosa, Quadracythere bichensis, Pterygocythereis miocenica, Paracytheretta dominicana, Kangarina quellita, Kangarina depressa, Cytherura cresera, Acuticythereis elongata, Pseudocythere* sp. (upper Miocene).

Of these *Puriana scrupulosa, Kangarina quellita*, and *Cytherura cresera* have not been found in association. 3. *Acuticythereis elongata* also occurs in association 5.

This association (4) appears typical of the lower part of the Gurabo Formation (in sections 1 and 2 possibly Cercado, see discussion of sections). *Mutilus confragosus, Orionina serrulata, Puriana congestocostata, Loxoconcha forda* and *Loxoconcha fischeri* occur in associations 1-4.

5. *Procythereis* cf. *deformis, Pellucistoma howei, Loxoconcha antillea* and *Cytheretta karlana, (Acuticythereis elongata)*. Cercado Formation (except in one case, see section 9) (middle Miocene).
Puriana rugipunctata, Caudites nipeensis, Caudites rectangularis, Loxoconcha banesensis have been found in all five associations.

These five associations have been indicated by number in the nine sections (Tables 4-12) and also in Tables 3 and 13.

DISCUSSION OF THE INDIVIDUAL SECTIONS

1. At the westerly end of the studied area, along the Río Guayabín (Text-fig. 2; Table 4) Dohm placed the boundary between Cercado and Gurabo Formations above loc. 15370. This sample only contained *Cyprideis* sp. aff. *C. pascagoulaensis* and represents a brackish-water facies with lignite. *Mutilus confragosus* occurs both above and below this sample. In 15369 the presence of *Acuticythereis elongata, Paracytheretta dominicana* and *Quadracythere bichensis* suggests association 4 although 3 is not wholley excluded. In 15372 the occurrence of *Neocaudites triplistriatus* and *Bythocypris keiji* suggests association 2.

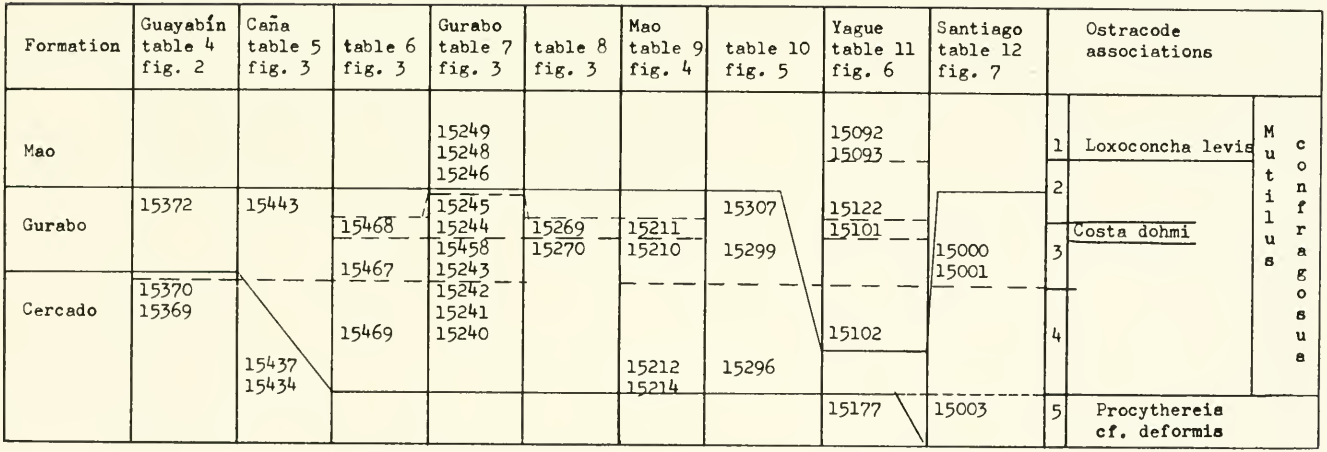


Table 3. Relative stratigraphic and geographic position of samples.

2. In the Río Caña (Text-fig. 3; Table 5) Dohm drew the boundary between Cercado and Gurabo Formations above locality 15437, which sample Bermudez (1949, p. 44) placed in the Gurabo Formation. *Mutilus confragosus* occurs in all three samples. The fauna of 15437 is similar to that of 15369 (association 4?), in the Río Guayabín. Sample 15434 appears to lie in or just above Maury's Caimito Formation, see Table 2.

3. Between Río Caña and Río Gurabo (Text-fig. 3; Table 6). *Costa dohmi* occurs in the upper sample (15468), and is believed to be indicative of association 3. The lower sample (15469) has a fauna similar to 15369 (Río Guayabín) and 15437 (Río Caña) which appears to indicate association 4.

4. Río Gurabo (Text-fig. 3; Table 7). Dohm drew the boundary between Gurabo and Mao Formations between loc. 15245 and 15246. The lower one of these contains *Costa dohmi* (association

Cercado	Gurabo	Formations acc. to Dohm
15369	15370 15372	Sample Numbers
	/	Cytherella sp. aff. C. vulgata
X / X		Cytherella sp.
		Cytherelloidea sp.
		Paracypris sp.
	X	Bythocypris keiji
/	/	Bythocypris sp.
O	O	Bairdia sp.
		Bairdia willisensis
		Bairdia antillea
		Cyprideis sp. aff. C. pascagoulensis
O	/	Orionina serrulata
● X X		Quadracythere bichensis
	/ O	Mutilus confragosus
	/	Jugosocythereis sp. aff. J. vicksburgensis
X O		Puriana congestocostata
		Puriana rugipunctata
	/	Cativella navis
	X	Neocandites triplistriatus
O		Acuticythereis elongata
X O ● O X O		Pterygocythereis miocenica
		Paracytheretta dominicana
	/	Loxoconcha forda
X /		Loxoconcha fischeri
		Loxoconcha dorsotuberculata
/ X /	/	Loxoconcha rugosa
	/	Paracytheridea sp.
	X	Paracytheridea tschoppi
	X	Xestoleberis sp. 1
X	/	Uroleberis triangula
4	2 3	Ostracode associations

Table 4. Distribution of ostracodes (Río Guayabín).

Cercado	Gurabo	Formations acc. to Dohm
15434	15437 15449	Sample numbers
	/	Cytherella sp. B
	/ O	Cytherella sp.
O	/ /	Paracypris sp.
O	/ /	Bythocypris keiji
		Bairdia antillea
	X	Bairdia willisensis
		Orionina serrulata
O	X	Quadracythere bichensis
O	●	Mutilus confragosus
	X X /	Puriana rugipunctata
	● O	Puriana congestocostata
		Puriana scrupulosa
	X ●	Acuticythereis elongata
		Campylocythere sp.
	X	Pterygocythereis miocenica
		Paracytheretta dominicana
	/ X O	Loxoconcha dorsotuberculata
	/ / X /	Loxoconcha lapidiscola
	/ / X /	Cytheropteron sp. aff. C. leonensis
	/ / X /	Paracytheridea tschoppi
	/ / X /	Pseudocythere sp.
	/ / X /	Xestoleberis sp.
1	3	Ostracode associations

Table 5. Distribution of ostracodes (Río Caña).

3) and the fauna above this sample appears indicative of association 2. In the lower part of the section *Gangamocytheridea ? plicata* and *Kangarina quellita* suggest association 4. The absence of species like *Acuticythereis elongata* and *Paracytheretta dominicana,* which are indicative of this association in the other three sections discussed, is probably due to difference in facies (possibly slightly deeper water).

5. Between Río Gurabo and Río Mao (Text-fig. 3; Table 8) only two samples have yielded ostracodes. *Costa dohmi* in the upper one (15269) appears indicative of association 3, the combination of *Paracytheretta dominicana* and *Pterygocythereis polita* in the lower one (15270) may be an indication that this fauna also belongs to the lower part of the range of association 3.

6. Río Mao (Text-fig. 4; Table 9) all Gurabo Formation. *Costa dohmi* in the upper sample (15211) appears to indicate association 3. In sample 15212 the occurrence of *Puriana scrupulosa* and *Kangarina quellita* indicates association 4.

7. Between Río Mao and Santiago de los Caballeros (Text-fig. 5; Table 10) only three samples from the Gurabo Formation yielded ostracodes. The upper sample is uncharacteristic, but the lower one (15296) is typical of association 4, the same as in Table 7. The intermediate one may represent 3 (combination of *Pterygocythereis polita* and *Paracytheretta dominicana*).

8. Río Yague del Norte (Text-fig. 6; Table 11). The lowermost sample (Cercado) contains species characteristic for zone 5 *(Procythereis* cf. *deformis, Pellucistoma howei, Acuticythereis elongata).* Dohm drew the boundary between Gurabo and Mao Formations stratigraphically below sample 15102, (with *Acuticythereis elongata* and, therefore, probably association 4). The next higher sample contains *Costa dohmi* (association 3) which species we have only found in the Gurabo Formation. Only sample 15093 with characteristic species of *Bairdia, Loxoconcha levis,* and *Uroleberis torquata* together with sample 15092 belongs, undoubtedly, to association 1. The incoming here of a deeper water facies, represented by species of *Krithe, Bradleya, Trachyleberis,* and *Trachyleberidea* obscures the correlation with association 3.

9. Along the Santiago-Puerto Plata road, is out of the Cibao Valley and in the Cordillera del Norte. (Table 12, text-fig. 7).

The deeper water facies observed in the last section becomes more pronounced. According to Dohm all three samples were taken in the Gurabo Formation, but *Procythereis* cf. *deformis* occurs in the lowermost (15003) association 5. The fauna of the other two is similar to that of association 3 in section 8, but only *Ambocythere exilis* may be indicative of a faunal association (2 or 3). The

Formations acc. to Dohm	Gurabo		
Sample numbers	15469	15467	15465
Cytherella caelata	/	/	
Bythocypris sp.			
Bairdia antillea			
Orionina serrulata			X
Caudites rectangularis			
Caudites medialis			
Quadracythere bichensis	O	/	
Mutilus confragosus	X	O	O
Costa dohmi	/	/	X
Acuticythereis elongata	/	/	/
Pterygocythereis miocenica	/	/	/
Pterygocythereis polita	/	/	/
Paracytheretta dominicana	O	O	/
Puriana congestocostata	/	/	X
Loxoconcha forda	O	/	/
Loxoconcha fischeri	/	X	/
Loxoconcha dorsotuberculata	X	/	/
Paracytheridea altila	/	X	/
Ostracode associations	4	2	3

Table 6. Distribution of ostracodes (between Río Caña and Río Gurabo).

Formations acc. to Dohm	Gurabo								Mao		
Sample numbers	15003	15211	15212	15213	15215	15214	15245	15246	15248	15249
Cytherella sp. aff. C. vulgata	/	/	/	/	/	/	X	/	X	/
Cytherella dominicana	/	X	/	/	/	O	X	/	/	/
Cytherella sp. B	/	/	/	/	/	/	/	/	/	/
Paracypris sp.	/	/	/	/	/	/	/	/	/	/
Argilloecia sp. 1	/	/	/	/	/	O	/	/	/	/
Argilloecia sp. 2	/	/	/	/	/	/	/	/	/	/
Propontocypris sp.	/	/	/	/	/	/	/	/	/	/
Macrocypris decora	/	/	/	/	/	/	/	/	/	/
Bythocypris keiji	/	/	/	/	/	/	/	/	/	/
Bairdia willisensis	/	/	/	/	/	/	/	/	/	X
Bairdia antillea	/	/	/	/	/	/	/	/	/	/
Bairdia sp. aff. B. fortificata	/	/	/	/	/	/	/	/	/	/
Krithe dolichedeira	/	/	/	/	/	O	X	O	/	/
Krithe trinidadensis	/	/	/	/	/	/	X	X	/	/
Krithe morkhoveni	/	/	/	/	/	/	/	X	/	/
Krithe prolixa	/	/	/	/	/	X	/	X	/	/
Parakrithe vermunti	/	/	/	/	/	/	/	X	/	/
Parakrithella sp.	/	/	/	/	/	/	/	/	/	/
Cyprideis sp. aff. C. pascagoulensis	/	/	X	/	/	/	/	/	/	/
Munseyella bollii	/	/	/	/	/	/	/	/	/	/
Gangamocytheridea plicata	/	/	X	/	/	/	/	/	/	/
Caudites nipecensis	/	/	/	/	/	/	/	/	/	/
Mutilus confragosus	/	O	O	/	●	X	O	/	O	O
Jugosocythereis sp. aff. J. vicksburgensis	/	/	/	/	/	/	/	/	/	/
Hermanites hornibrooki	/	/	/	/	/	/	/	/	/	/
Costa dohmi	/	/	/	/	/	X	X	/	/	/
Puriana congestocostata	/	●	/	/	O	/	O	/	/	O
Puriana minuta	/	/	/	/	/	/	/	/	/	/
Pterygocythereis miocenica	/	/	/	/	/	/	/	/	/	/
Pterygocythereis polita	/	/	/	/	/	/	/	/	/	/
Ambocythere exilis	/	/	/	/	/	/	/	/	/	/
Loxoconcha forda	/	/	/	/	/	/	/	/	/	/
Loxoconcha banesensis	/	/	/	/	/	/	/	/	/	/
Loxoconcha fischeri	/	X	/	/	/	/	/	/	X	/
Loxoconcha rugosa	/	/	/	/	/	/	/	/	/	/
Cytheropteron sp.	/	/	/	/	/	/	/	/	/	/
Kangarina quellita	/	/	X	/	/	/	/	/	/	/
Paracytheridea sp.	/	/	/	/	/	/	/	/	/	/
Paracytheridea tschoppi	/	/	X	/	/	X	/	/	/	/
Eucytherura sp.	/	/	/	/	/	/	/	/	/	/
Pseudocythere sp.	/	/	/	/	/	/	/	/	/	/
Xestoleberis sp. 2	/	/	/	O	/	/	/	/	/	/
Xestoleberis sp. 3	/	/	/	O	/	/	/	/	/	/
Xestoleberis sp. 4	/	/	/	/	/	/	/	/	/	/
Ostracode associations	4	5							12	

Table 7. Distribution of ostracodes (Río Gurabo).

Gurabo	Formations acc. to Dohm
15270 15269	Sample numbers
/ 0	Cytherella sp. aff. C. vulgata
0	Cytherella dominicana
0 / /	Bairdia willisensis
/ ● ●	Krithe dolichodeira
/ / X	Gangamocytheridea plicata
● X / 0 /	Caudites nipeensis
● / X X /	Caudites medialis
X / / X /	Mutilus confragosus
● / / 0 /	Quadracythere sp. aff. Q. producta
/ / X /	Jugosocythereis sp. aff. J. vicksburgensis
/ / /	Hermanites hornibrooki
/ /	Costa dohmi
/	Costa variabilocostata var.
	Trachyleberidea sp. aff. T. cubensis
	Puriana congestocostata
	Occultoeythereis angusta
	Pterygocythereis polita
	Ambocythere exilis
	Paracytheretta dominicana
	Loxoconcha forda
	Loxoconcha banesensis
	Cytheropteron sp.
	Paracytheridea sp.
	Paracytheridea tschoppi
	Xestoleberis sp. 2
3	Ostracode associations

Table 8. Distribution of ostracodes (between Río Gurabo and Río Mao).

Gurabo	Formations acc. to Dohm
15214 15213 15210 15211	Sample numbers
/ X /	Cytherella sp. aff. C. vulgata
/ /	Cytherella sp.
0 / X 0 / X	Cytherella sp. B
	Cytherella caelata
	Paracypris sp.
0 / X X 0 /	Argilloecia sp. 1
X /	Macrocypris decora
/ X /	Bairdia willisensis
/ /	Bairdia sp. aff. B. fortificata
X / / X /	Bythocypris keiji
0 / X / X /	Krithe dolichodeira
X / X /	Parakrithella sp.
/ X / 0 /	Cushmanidea anderseni ?
X / X / 0	Gangamocytheridea plicata
● X / X /	Munseyella bermudezi
X / X /	Orionina serrulata
/ /	Caudites medialis
0 X /	Caudites mipeensis
● X 0	Mutilus confragosus
X 0 0 0	Jugosocythereis sp. aff. J. vicksburgensis
X / / X /	Quadracythere sp. aff. Q. producta
X / X /	Costa dohmi
/ X /	Puriana scrupulosa
/ /	Puriana pustulosa
/	Hermanites hornibrooki
	Aurila sp.
X / X /	Acuticythereis elongata
/ X /	Pterygocythereis miocenica
/ X /	Cytheretta sp. aff. C. karlana
X /	Loxoconcha forda
	Loxoconcha dorsotuberculata
X /	Loxoconcha fischeri
/ /	Loxoconcha rugosa
/ X X 0 0	Cytherura cresera
	Kangarina depressa
	Kangarina quellita
/ X /	Hemicythemura cranekeyensis
/	Paracytheridea sp.
X /	Paracytheridea altila
0 / / / / /	Paracytheridea tschoppi
	Paracytheridea sp. aff. P. hispida
	Eucytherura sp.
	Pseudocythere sp.
	Pseudoceratina droogeri
	Bythoceratina sp.
	Paradoxostoma sp.
0 0 0 / / /	Xestoleberis sp. 1
	Xestoleberis sp. 2
	Uroleberis triangula
X /	Nov. gen. s. nsp.
4 3	Ostracode associations

Table 9. Distribution of ostracodes (Río Mao).

Formations acc. to Dohm	Garabo	
Sample numbers	15296	15299	15307
Cytherella sp. B	0	/	/
Cytherelloidea sp.	/	/	
Paracypris sp.		X	
Bairdia willisensis	X	/	0
Gangamocytheridea plicata	/	0	
Orionina serrulata	/		
Caudites nipeensis	/		
Caudites medialis	/		
Mutilus confragosus	●	0	0
Puriana scrupulosa	/	0	
Puriana congestocostata	/		
Puriana pustulosa	X		
Cativella navis	/	/	
Pterygocythereis miocenica	/	0	
Pterygocythereis polita	/		
Paracythereta dominicana	0	/	
Loxoconcha dorsotuberculata			/
Loxoconcha fischeri	/	X	
Loxoconcha lapidiscola	0	X	
Paracytheridea sp.		/	
Paracytheridea altila	0		
Paracytheridea tschoppi	X		
Paracytheridea sp. aff. P. hispida		X	
Nestoleberis sp. 2	/		
Ostracode associations	4	3	

Table 10. Distribution of ostracodes (between Río Mao and Río Yague del Norte).

Formation acc. to Dohm	Mao				Cerezalo
Sample numbers	15092	15093	15122	15101	15102	15117
Cytherella sp. aff. C. vulgata	/	/	/		/	
Cytherella sp.	/	X				/
Cytherella caelata						
Cytherella dominicana				●	/	
Cytherella sp. A						X
Propontocypris sp.	/					
Paracypris sp.	X	X				
Bythocypris keiji	0	X				
Bairdia sp. aff. B. formosa	0	0				
Bairdia longisetosa	0	X				
Bairdia willisensis	0	0				
Bairdia sp. aff. B. fortilicata		/				
Bairdia sp.		X				
Krithe morkhoveni			X			
Krithe prolixa				/	/	
Krithe trinidadensis						
Cushmanidea sp. aff. C. howei	0	X				
Cyprideis sp. aff. C. pascagoulensis		0				
Caudites rectangularis	/					
Caudites nipeensis	/					
Orionina serrulata		X				
Mutilus confragosus		0	0		/	
Quadraeythere sp. aff. Q. producta		X				
Jugosocythereis sp. aff. J. vicksburgensis						/
Bradleya ex. gr. dictyon				X	X	
Procythereis cf. deformis						X
Brachycythere sp. aff. B. russelli				X		
Trachyleberidea mamidentata					/	
Trachyleberis bermudezi crebripustulosa				X		
Costa dohmi				/		
Puriana rugipunctata						X
Cativella navis		/				
Occultocythereis sp.		/				
Acuticythereis elongata					X	
Cytheretta karlana						0
Loxoconcha antillea						X
Loxoconcha rugosa	X	/				
Loxoconcha banesensis					X	
Loxoconcha levis	X	0				
Loxoconcha forda	X	0				
Paracytheridea altila		X				
Pellucistoma howei						/
Nestoleberis sp. 1	/					
Nestoleberis sp. 2		0				
Nestoleberis sp. 3	0	0				
Nestoleberis sp. 4		X				
Uroleberis torquata	X					
Nov. gen. n. sp.	/					
Ostracode associations	1	1	2	3	3	5

Table 11. Distribution of ostracodes (Río Yague del Norte).

abundance of specimens of the genus *Krithe,* together with *Cardobairdia, Bradleya,* and *Trachyleberidea* and *Cytheropterontrinidadensis,* furnishes a link with the development of the upper Miocene of Jamaica.

10. Not included in Table 3 is sample 15346 (Carbonera village on the road from Monte Cristi to Dajabón (see Text-fig. 1). The sample yielded the following ostracodes:

Bythocypris sp., *Bairdia* sp., *Cyprideis* sp. aff. *C. pasacagoulaensis* (Mincher), *Perissocytheridea* sp. aff. *P. bicelliforma* Swain, *Hemicythere? laevicula* Edwards, *Orionina serrulata* (Brady), *Mutilus confragosus* (Edwards), *Cativella navis* Coryell and Fields, *Neocaudites triplistriatus* (Edwards), *Cytheretta,* n. sp. aff. *C. karlana* [same species found in sample 15211 (Table 9), mentioned in the description of *Cytheretta karlana* and also present in the Ponce Formation and deposits of the Lajas Valley in Puerto Rico],

Garabo		Formations acc. to Dohm
15003 / 15001	15000	Sample numbers
X	O	Cytherella sp. aff. C. vulgata
/	/	Argilloecia sp. 1
/	/	Argilloecia sp.
/	/	Bythocypris sp.
/	/	Bairdia willisensis
/	/	Bairdia sp.
/	X	Cardobairdia glabra
X	O	Krithe dolichodeira
X	O	Krithe morkhoveni
X	X	Krithe prolixa
/	O	Krithe trinidadensis
/	X	Mutilus confragosus
/	/	Jugosocythereis sp. aff. vicksburgensis
/	X	Bradleya hazelae
/	/	Bradleya ex. gr. dictyon
X	/	Procythereis cf. deformis
/	X	Trachyleberidea mammidentata
X	X	Ambocythere exilis
/	X	Loxoconcha rugosa
/	/	Cativella navis
/	/	Paracytheridea tschoppi
/	X	Cytheropteron trinidadensis
X	/	Xestoleberis sp. 2
5	2 - 3	Ostracode associations

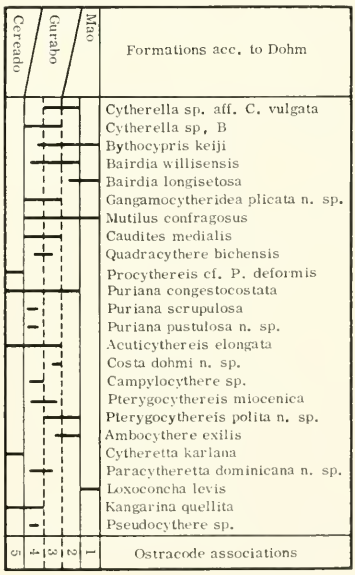


Table 12. Distribution of ostracodes (Santiago-Puerto Plata road).

Table 13. Range of possibly stratigraphically significant ostracodes in the Yague Group.

Loxoconcha forda, n. sp., *Loxoconcha levis* Brady, *Loxoconcha dorsotuberculata* (Brady), *Paracytheridea altila* (Edwards), *Xestoleberis* sp. 1 and 3. The presence of *Perissocytheridea* sets this fauna apart from that of the other samples in the Cibao Valley. The presence of *Loxoconcha levis* and *Xestoleberis* sp. 3 suggests correlation of these beds with the Mao Formation rather than with the Gurabo Formation to which Dohm provisionally assigned them.

Table 13 shows the range of stratigraphically more important species in the Yague Group which are related to the faunal associations 1-5.

COMPARISON WITH OTHER REGIONS WITHIN THE CARIBBEAN

Tables 14, 15

In different places within the Caribbean region, I find slightly different relative ranges for some of the ostracode species (see van den Bold, 1966c-1967b). In the Dominican Republic *Caudites nipeensis* occurs together with both *Mutilus confragosus* and *Procythereis* cf. *deformis*. The first is in agreement with its range in Trinidad, where it has not been found with the latter species. However, when originally described, *Caudites nipeensis* occurred with *P.* cf. *deformis* in Cuba (van den Bold, 1946). Therefore, it appears that the base of the range of this species becomes younger in an easterly direction. *Puriana congestocostata* was originally described from the top of the San José calcareous member of the Manzanilla Formation (van den Bold, 1963b), where it was reported with *P.* cf. *deformis*. In Jamaica and the Dominican Republic its range extends into the upper Miocene and it co-exists with *Mutilus confragosus*.

Not withstanding such discrepancies there is a good faunal resemblance between the Gurabo Formation and the Springvale Formation of Trinidad and the Cubagua Formation of Venezuela (see Table 14, Trinidad and Venezuela, zones 1-3). In the other areas used for comparison with the distribution of ostracodes in the Yague Group, the Miocene has been subdivided into ostracode association zones, similar to those used in the Dominican Republic. In Venezuela and Trinidad (van den Bold, 1966c, Table 4) four such zones were recognized, and to these can be added zone 5 (lower part of the Manzanilla Formation) and 6 Tamana Formation (see van den Bold, 1963b, Table 3), which are correlated re-

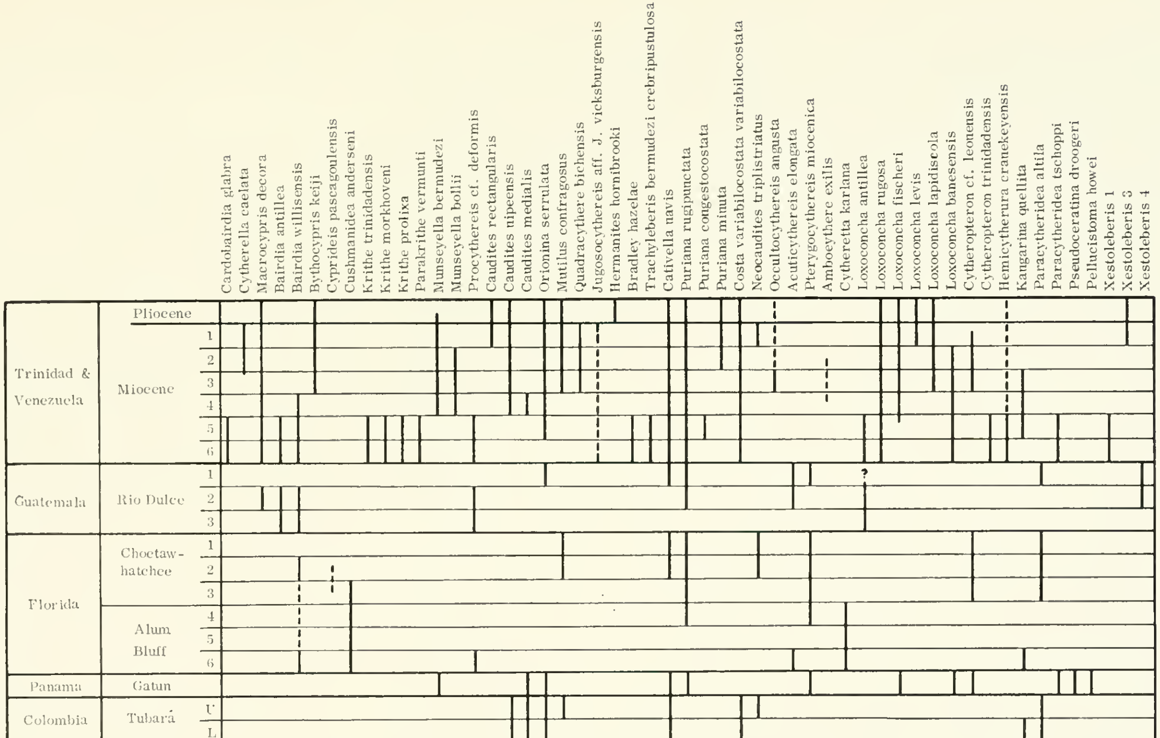


Table 14. Distribution or stratigraphic range of previously described species of ostracodes in the Caribbean Miocene.

TRINIDAD AND VENEZUELA: 1. Upper Cubagua Fm., Melajo cl. Mem. Springvale Fm.; 2. Upper Cubagua Fm., Savaneta glauconitic sand Mem. Springvale Fm.; 3. Middle Cubagua Fm., Gransaul cl. Mem. Springvale Fm.; 4. Lower Cubagua Fm., Telemaque sand Mem. Manzanilla Fm.; 5. San Jose Mem. Manzanilla Fm., lower Cruse Fm., Lengua Fm., Huso Mem. Pozon Fm.; 6. Tamana Fm., Lengua Fm., upper Husilla Mem. Pozon Fm. **GUATEMALA:** 1. Upper Rio Dulce Fm., with Costa walpolei, Pterygocythereis miocenica; 2. Middle Rio Dulce Fm., with Procythereis cf. deformis, Acuticythereis elongata; 3. Lower Rio Dulce Fm., with Procythereis cf. deformis, Haplocytheridea subovata, Triebelina crumena. **FLORIDA:** 1. Cancellaria Beds; 2. Ecphora Beds; 3. Arca Beds; 4. Shoal River Beds; 5. Oakgrove Beds; 6. Chipola Fm.

spectively with the Huso and upper part of the Husito Member of the Pozón Formation in Falcón. In Guatemala the Río Dulce Formation has been subdivided into three zones (van den Bold, 1966e), the middle one of which is correlative with the Cercado Formation, whereas the upper zone appears to be absent in the Yague Group. In Florida I have gone back to the classical subdivision of the Alum Bluff and Choctawhatchee stages into faunal zones. Puri (1954) argued that these zones are in part contemporaneous, and although I agree with this in the case of the Alum Bluff Stage, the distribution of ostracodes in the Choctawhatchee Formation suggests that the *Arca* Zone is older than the *Ecphora* and *Cancellaria* zones and is possibly separated from the Alum Bluff by a hiatus. In northern Colombia (van den Bold, 1966f) the Tubará Formation is correlative in its upper part with the Gurabo Formation, but an equivalent of the lower part is apparently missing in the Dominican Republic.

In Jamaica *Costa dohmi* occurs in the Bowden section (Table 16) from the "Shellbed" to about 50 feet below it. In the San San Bay section it occurs at the top of the San San Clay. In the Buff Bay section the species occurs in the Bowden Formation, which rests on top of the Buff Bay Formation. A detailed account of the distribution of ostracodes in the Jamaican coastal formations will be given later. The fact that *Mutilus confragosus* in the Bowden section occurs for the first time in the sample just above the base of *Costa dohmi,* whereas in the Buff Bay section it occurs one

		Dominican Republic	Trinidad & Venezuela	Colombia	Guatemala	Florida	
MIOCENE	Upper	1	1			1	Gq. altispira altispira
		2					Gr. crassata
		3	2	U. Tubará		2	
		4	3				Gr. margaritea
	Middle		4	L. Tubará	1	3	Gr. dutertrei Gs. obliquus extremus
		5	5		2	4	Gr. acostaensis
			6				Gr. menardii
	Lower				3	5	Gr. fohai s.l.
						6	

Table 15. Tentative correlation of ostracode association zones used in Table 14.

sample below it, and in the San San Bay section only in the Navy Island Member may indicate, that both species are similarly affected by changes in environment, in this case probably by depth of deposition. As in all cases, the underlying parts of the formations carry abundant planktonic Foraminifera and an ostracode fauna in which "open sea" genera such as *Krithe, Cardobairdia, Bradleya,* or *Henryhowella* predominate. It therefore appears that the base of the occurrence of these two species does not form a basis for correlation in Jamaica. *Costa dohmi* appears slightly better adapted to deeper water conditions than *Mutilus confragosus,* and it is not excluded that the base of the range of this form may be used for correlation purposes. *Gangamocytheridea? plicata,* which in the Dominican Republic ranges up to the *Costa dohmi* "zone," occurs in the Bowden section up to the Bowden "Shellbed," which may indicate that it has about the same stratigraphic range in both islands. Other similarities in range suggest that the association

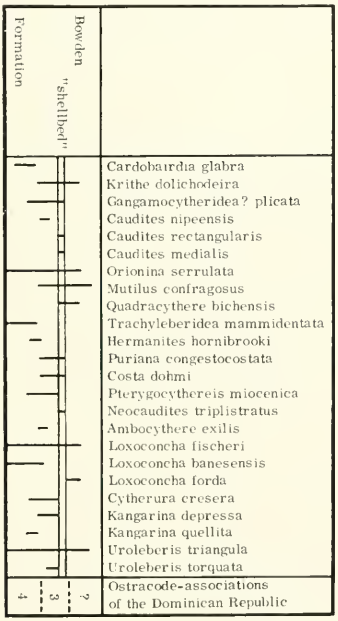


Table 16. Preliminary range chart of ostracodes from the Yague Group in the Bowden section (Jamaica).

of *Cardobairdia glabra,* and *Trachyleberis mammidentata* could be indicative of the lower part of the Gurabo Formation.

Woodring (1965, p. 961) commented on the endemism of molluscan faunae of the Gurabo-Cercado Formations, the Bowden Formation, Manzanilla Formation, Tubará Formation, and others in different regions of the Caribbean middle-upper Miocene faunal province. Among these the combined Gurabo-Cercado Formations top the list with 60% endemic forms (Bowden 55%). Although a certain number of apparently strictly endemic forms appear in the study of ostracodes of each new area, the greater part of the fauna is known from other places. In the fauna of the Yague Group only 6% appear to be strictly endemic forms, and 13% have a restricted geographical distribution. Examples of the latter group are: *Acuticythereis elongata* (Guatemala, Puerto Rico), *Gangamocytheridea? plicata* (Jamaica), *Costa dohmi* (Jamaica), *Loxoconcha forda* (Jamaica, Puerto Rico), and *Trachyleberis mammidentata* (Cuba, Jamaica).

Several of the species with a wide geographic distribution belong to the "open sea" fauna (van den Bold, 1960) and are only found where deeper water deposits are present. *Trachyleberidea mammidentata* may belong to this group of species, among which can be mentioned: *Trachyleberis bermudezi crebipustulosa, Bradleya hazelae, Bradleya* ex gr. *dictyon, Cardobairdia glabra,* and species of the genus *Krithe,* all of which have relatively long stratigraphic ranges and can be used to establish a rough correlation over the entire Caribbean region.

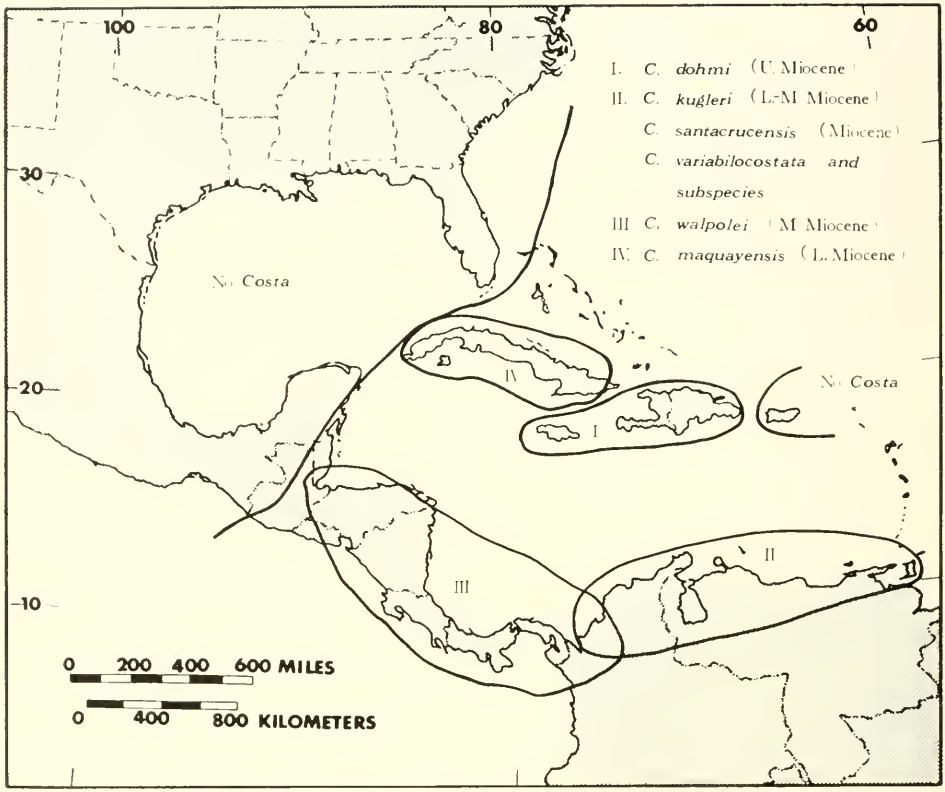
Shallow-water ostracodes have often a limited geographical distribution. An example of this is the genus (?) *Hulingsina* which is restricted to a northern province (Mexico-Maryland) and apparently did not reach further south than Guatemala (where only few specimens have been found). Hulings (1966) suggested that *Hulingsina* may be synonymous of *Pontocythere.* Several of the species, with which this form is associated in the Gulf Coast Province, occur in the Miocene of the Dominican Republic and Puerto Rico.

Another case of regional restriction is demonstrated by the geographical and stratigraphical distribution of the genus *Costa.* No species of *Costa* have been reported from the Gulf Coast Mio-

cene, and in Cuba so far none have been discovered above the lower Miocene. The genus also appears to be absent in the Miocene of Puerto Rico, but it does occur there in the Oligocene. From the distribution of the species of this genus four subprovinces may be recognized in the Miocene: I. Dominican Republic-Jamaica, *Costa dohmi* II. Northern South America, *Costa variabilocostata, Costa santacrucensis, Costa kugleri;* III. Central America, *Costa barrocoloradensis, Costa stokesae;* IV. Cuba, *Costa maquayensis.* This is shown in Text-fig. 8 and Table 17.

Whereas the absence of certain forms in some areas may be due to geographic distribution or unfavourable living conditions, in other cases this appears to be caused by slight differences in age between deposits of the same type of facies. In this way I tentatively explained the absence of *Mutilus confragosus* in the Río Dulce Formation of Guatemala, the Gatun Formation in Panama around Cativa (this species does occur in the higher parts of the Gatun Formation in Costa Rica), and in the Lower Tubará Formation of Colombia, by accepting an older age for these deposits than for the Gurabo or Springvale Formations (van den Bold, 1966e, p. 1029). The presence of *Mutilus confragosus* is thought to indicate upper Miocene or younger. Its absence in the lower part of the Bowden Formation, on the other hand, may be due to the deeper water facies of these deposits, especially of the San San Clay of the Bowden Formation. *Procythereis* cf. *deformis,* has been taken to indicate an age older than late middle Miocene. In most of the Caribbean (van den Bold, 1966e) there is a zone in which neither *Procythereis* cf. *deformis* nor *Mutilus confragosus* occurs and which consequently should be late middle Miocene in age. In the Dominican Republic, however, this zone has not been found. This may be an indication of nondeposition during this time interval.

Much more work is needed to arrive at definite conclusions about the stratigraphic ranges and the migration of ostracode species in the Caribbean region, possibly necessitating an extension of the studied area to include the Pacific coastal region of Colombia, Equador, and Peru (compare Woodring, 1965).



Text-fig. 8. Distribution of species of the genus *Costa* in the Caribbean Miocene.

CONCLUSIONS

In the Río Caña section Bermudez (1949, fig. 3, p. 24) copied Dohm's map, but indicated in his list of localities, that sample 15437, which on the map lies within the Cercado Formation, belongs to the Gurabo Formation. The study of the ostracodes tends to confirm that the uppermost portion of the Cercado Formation as mapped by Dohm in the Río Caña and Río Guayabín should be assigned to the Gurabo Formation. If we try to correlate the mapping by Dohm with the measured section of Maury (see Table 2) we need to place the beds upstream from Caimito along the Río Caña (zones H and I of Maury) in the Cercado Formation. The lignitic clays downstream from Caimito [Maury's *Arca (Scapharaca)*

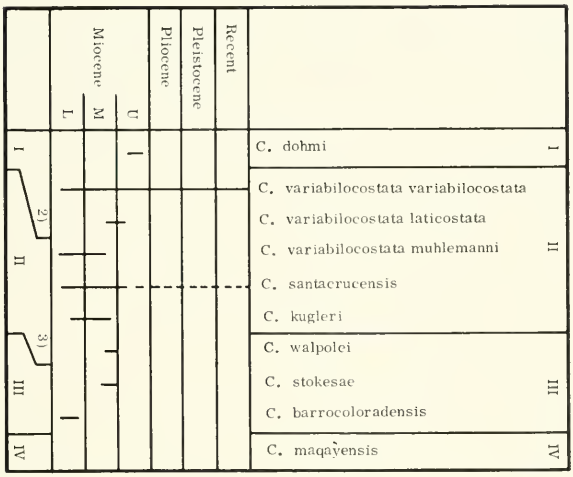
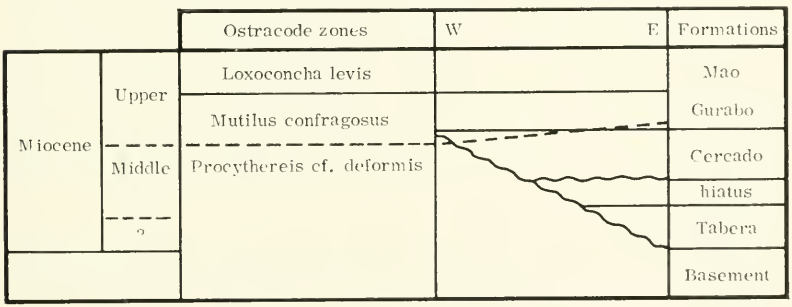


Table 17. Stratigraphic distribution of species of the genus *Costa* in the Caribbean Miocene.

patricia Beds] appear to form the basal portion of the Gurabo Formation. The presence of this pelecypod should then indicate a similarity of environment of the basal Gurabo in this section with the younger Talparo Formation of Trinidad (brackish water?). Sample 15437 has a strong resemblance in fauna to sample 15369 in the Río Guayabín (Cercado according to Dohm), which lies immediately below lignitic beds with brackish-water ostracodes (15370). It should be noted that the strike of the beds in the upper part of the Cercado Formation deviates strongly from the direction of the Cercado-Gurabo boundary as drawn by Dohm.



Text-fig. 18 a

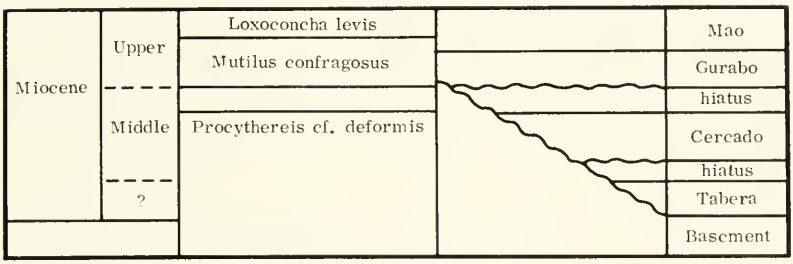
Text-fig. 18 (a,b). Two alternative possibilities of relationship between bio-(ostracode)-and litho-stratigraphy in the Yague Group.

Although it cannot be ascertained without further field study, one cannot help wondering if there is not an unconformity between Cercado and Gurabo Formations which lies at the base of the *Arca (Scapharaca) patricia* Beds in the Río Caña section. It could be that the whole of the Cercado Formation is missing in the Río Guayabín section and the Gurabo Formation is transgressive over the "basement". Further east the superposition of beds appears to be conformable, but a hiatus between the two formations would explain the absence of a zone without either *Procythereis* cf. *deformis* or *Mutilus confragosus*. Such a zone appears to occur over most of the Caribbean area (see Tables 14 and 15, and discussion in van den Bold, 1966e).

At the far eastern end of the area under consideration (Santiago-Puerto Plata road) *Procythereis* cf. *deformis* occurs in what has been mapped by Dohm as Gurabo Formation. (This particular occurrence is just above the top of the Cercado Formation.) At the far western end of the Cibao Valley I have only one sample (15346 at Carbonera village) which has been assigned to the Gurabo Formation by Dohm, and its position on Dohm's map is not far above the base of the Gurabo Formation. It may be significant that at this side of the valley the ostracodes suggest a stratigraphic position similar to that of 15092-93 (Mao Formation) (Text-fig. 6; Table 11).

If we assume that Dohm mapped the boundaries of the formations correctly, it appears that the base of the Gurabo Formation becomes progressively older towards the east (Table 18a). Alternatively if the beds containing *Mutilus confragosus* are assigned to the Gurabo Formation, whereas the beds assigned by Dohm to the Gurabo Formation along the Santiago-Puerto Plata road belong to the Cercado Formation, it would appear, that the Gurabo Formation laps over the Cercado Formation and onto the basement rocks from an easterly direction. Thus there might be a period of nondeposition between Gurabo and Cercado Formations (Table 18b).

Two slightly different faunas appear to have developed in association 4 (lower Gurabo): one with dominance of the genera *Bairdia, Acuticythereis*, and *Loxoconcha,* with in addition *Paracy-*



Text-fig. 18 b

theretta, Quadracythere: the second with greater variety of species but lesser abundance in specimens, with *Gangamocytheridea, Pseudocythere, Puriana, Pterygocythereis,* and *Xestoleberis.* The second is supposed to represent a slightly deeper water facies and occurs generally further east than the first. Within the shallow-water facies a few brackish-water intercalations occur.

In associations 2 and 3 there are apparently shallower water faunas in the west; slightly further east are faunas comparable to the second group in association 4, and finally deeper water faunas with *Krithe, Bradleya, Trachyleberidea,* and others occur in the east. In the few places where association 1 is found it is always of shallow-water character, comparable to group 1 of association 4 (with brackish-water intercalations). Therefore, it appears that during the deposition of the Gurabo Formation the sea transgressed in a westerly direction, depositing shallow-water sediments which were similar to those of the Cercado Formation in the west, deeper water sediments in the east. In Mao times a regression took place covering the deeper water sediments in the east with shallow-water deposits (in places of the Mao Adentro limestone type).

The lithologic similarity of the shallow-water facies in the upper Cercado in the east and the lower Gurabo in the west may explain why Dohm drew the boundary between the formations differently from what is proposed here. It should be pointed out once again, that the Cercado and Gurabo Formations were originally established by Maury as biostratigraphic zones. Therefore, the mapping of the boundary between them on the basis of lithology must necessarily conflict in places with the paleontological correla-

tion whether based on Mollusca, Foraminifera, or Ostracoda. Perhaps it would be better to go back to Maury's original nomenclature and use the names *Aphera islacolonis* Zone and *Sconsia laevigata* Zone; however, the names Cercado and Gurabo are by now so firmly entrenched in the literature that it seems preferable to continue their use.

SYSTEMATIC DESCRIPTIONS

Subclass OSTRACODA Latreille

Order PODOCOPIDA Müller

Suborder PLATYCOPINA Sars

Family **CYTHERELLIDAE** Sars

Genus **CYTHERELLA** Jones, 1849

Cytherella sp. aff. **C. vulgata** Ruggieri — Pl. 2, fig. 2

Cytherella vulgata Ruggieri, 1962, p. 9, pl. 1, figs. 9, 10; Dieci and Russo, 1964, p. 53, pl. 9, fig. 3; Colalongo, 1965, p. 86, pl. 10, figs. 1a, b.

Description. — Carapace roundly rectangular to broadly elliptical in side view; highest in the anterior part. Anterior end broadly and evenly rounded; posterior end evenly rounded, but slightly more narrowly than anterior end; dorsal margin almost straight, slightly concave in the middle; ventral margin similar and slightly converging posteriorly. Left valve of same general shape as the right; posterior end more obliquely rounded, which causes more pronounced overlap of the right valve at the posteroventral corner. Elsewhere the overlap is about equal. The posteroventral region is finely papillate. Dorsal view cuneiform, widest at about two-sevenths of the length from behind; slightly compressed in and just in front of the middle; anterior third wedge-shaped; posterior end broadly rounded.

Dimensions. — Right valve: L 0.89 mm; H 0.45 mm; W 0.28 mm.

Remarks. — The Caribbean species differs from *Cytherella vulgata* Ruggieri by its more evenly rounded posterior end and the posteroventral overlap of the right valve. It is in general shape similar, and both species exhibit the posterior papillation mentioned above. *Cytherella vulgata*, and its nearest allies *C. postdenticulata* (Oertli 1961, p. 19, pl. 1, figs. 1-11) and *Cytherella serratula* (Brady) *(Cythere? serratula* Brady, 1880, p. 77, pl. 43, fig.

7a-d), have been found in deep or fairly deep-water deposits, and the same mode of occurrence is suggested for the present form.

Occurrence. — Upper and middle part of the Gurabo Formation.

Cytherella dominicana, n. sp. Pl. 1, figs. 1 a-e

Name. — After its occurrence in the Dominican Republic.

Holotype. — A female right valve (HVH No. 8317).

Paratypes. — Two female right valves, three female left valves, two male right valves (HVH Nos. 8318, 8319).

Type locality. — Locality 15101 (Text-fig. 7; Table 12).

Stratigraphic horizon. — Gurabo Formation.

Description. — Female: Carapace ovate, highest at three-sevenths of the length from the anterior extremity. Anterior end almost regularly rounded, slightly oblique with the greatest convexity above the middle; dorsal margin convex, gradually sloping down into the posterior end, which is obliquely rounded, narrowly rounded below; ventral margin convex, middle part almost straight. Left valve similar in general shape, but lower and dorsal and ventral margin nearly straight and parallel. Strongest overlap of the right valve near the greatest height dorsally and along the ventral margin; overlap about equal elsewhere. Surface smooth with a subcircular subcentral pit, indicating the place of attachment of the adductor muscles, situated a little above the centre of the valves, about one-third of the greatest height below the dorsal margin. The anterior end in the left valve bears a thin carina, which is broken in most specimens and tends to obscure the anterior overlap of the right valve. Dorsal view elongate ovate, widest about one-third of the length from behind; posterior end somewhat truncate, wide, anterior end wedge-shaped. Male: Similar in side view to the female but with steeper slope of dorsal margin and posterior end; the greatest height lies at about one-third of the length from the anterior end. In dorsal view it is narrower than the female, especially in the more narrowly rounded posterior end; greatest width also about one-third from behind, but only slightly wider than just in front of the middle; sides in the middle third about parallel. Left valve of male and female are practically identical in side view, in dorsal view the males are

narrower posteriorly. The subcentral pit is situated somewhat closer to the dorsal margin than in the female.

Dimensions. — Female right valve: L 1.05 mm; H 0.71 mm; W 0.31 mm. Female left valve: L 0.99 mm; H 0.56 mm; W 0.23 mm. Male right valve: L 1.05 mm; H 0.66 mm; W 0.29 mm. Male left valve: L 0.99 mm; H 0.55 mm; W 0.22 mm.

In side view this species is similar in shape to *Cytherella lata* Brady (1880, p. 173, pl. 44, figs. 5a-e) from Culebra Island but differs in dorsal view by its more truncate posterior end; also in *Cytherella lata* the subcentral pit is absent. *Cytherella navetensis* van den Bold (1960, p. 149, pl. 1, figs. 1a-e) is more oblique in side view. Both these species are from deep-water sediments, *C. navetensis* from Eocene *Globigerina* marls, *C. lata* from dredgings varying from 155-675 fathoms. The same species has been found in Trinidad in the Lengua Formation.

Cytherella sp. A Pl. 1, figs. 4a, b

Description. — Female: Carapace broadly elliptical, highest in the middle. Anterior end evenly rounded, dorsal margin broadly arched, posterior end broadly rounded, ventral margin almost straight, slightly concave in the middle. Left valve highest behind the middle. Overlap of right valve increasing forward along the dorsal margin, elsewhere it is about equal and small. Dorsal view cuneiform, widest near the posteroventral corner, anterior end subacute. Male: Carapace subrectangular in side view, highest behind the middle. Anterior end evenly rounded, dorsal margin slightly convex, posterior end almost evenly rounded, ventral margin straight, roughly parallel to dorsal margin. Left valve similar in shape to female, overlap of right valve smaller in anterodorsal portions than in the female. In both male and female a shallow, median sulcus occurs below the dorsal margin which, therefore, stands out as a faint ridge. In the male a subcentral and subcircular pit forms the lower boundary of this sulcus.

Dimensions. — Female: L 0.59 mm; H 0.37 mm; W 0.19 mm (right valve). Male: L 0.59 mm; H 0.34 mm; W 0.15 mm (right valve).

Occurrence. — Cercado Formation.

Cytherella sp. B Pl. 1, figs. 5a, b

Description. — Carapace roundly rectangular, highest near the posterior end. Anterior end evenly rounded, dorsal and ventral margin nearly straight and converging anteriorly, posterior end broadly rounded. Overlap of right valve small and of same size throughout the margin; the left valve has the same shape as the right one but is narrower. Dorsal view cuneiform, widest at about one-fourth of the length from the posterior extremity.

Dimensions. — Right valve: L 0.70 mm; H 0.33 mm; W 0.19 mm. Left valve: L 0.59 mm; H 0.32 mm; W 0.15 mm.

Occurrence. — Gurabo and Mao Formations.

Cytherella sp. Pl. 1, fig. 2

Description. — Carapace roundly rectangular in the female, slightly higher in the posterior half. Anterior end evenly rounded, posterior end broadly and somewhat obliquely rounded; dorsal margin straight almost parallel to the slightly sinuate ventral margin. In the left valve both margins are slightly sinuate and converge somewhat anteriorly. Right valve overlapping the left dorsally and ventrally, slightly reduced overlap in anterior end and posteroventral corner. Surface punctate in a zone parallel to the margins; the size of the punctations diminishes towards the center and a strip of about one-third of the height and two-thirds of the length is smooth. Dorsal view cuneiform, widest near the posterior end. Male: Dorsal view narrow, lanceolate, widest at about two-sevenths of the length from behind. In side view the dorsal margin is more sinuate than in the female and slopes down somewhat in the posterior part.

Dimensions. — Female: L 0.59 mm; H 0.35 mm; W 0.28 mm. Male: L 0.60 mm; H 0.35 mm; W 0.21 mm.

Occurrence. — The species occurs in the Mao and Gurabo Formations. In the Cercado a few specimens have been found that may belong to this species. However, there the valves are somwhat compressed laterally in front of the middle (Pl. 1, fig. 3). They occur in samples 15369 and 15437.

Suborder ? METACOPINA Sylvester-Bradley

Superfamily **HEALDIACEA** Harlton

Family **SAIPANELLIDAE** McKenzie

Genus **CARDOBAIRDIA** van den Bold, 1960

Type species.—*Cardobairdia ovata* van den Bold, 1960.

The systematic position of this genus is uncertain. In 1960 the muscle-scar pattern was thought to indicate relationship to the Bairdiidae. However, it may also suggest similar or even closer relationship to the Macrocypridinae or the Healdiidae. In the discussion of *"Bythocypris" pykna* van den Bold (1960, p. 155) the latter form was compared to species of the genus *Hungarella* (= *Ogmoconcha*) which belongs to the Healdiacea. In *Hungarella* the number of muscle scars is much larger than in *"Bythocypris" pykna,* but the pattern is similar to that in *Cardobairdia.* See: *Bairdia? problematica* Méhes (1911, p. 21, pl. 2, figs. 14-18), *Bairdia? problematica reniformis* Méhes (1911, p. 22, pl. 2, figs. 19-23), or *Ogmoconcha contractula* Triebel (1941, p. 378, pl. 14, figs. 156-160). *"Bythocypris" pykna* and *Cardobairdia ovata* (van den Bold, 1960, p. 155) also resemble *Pseudophanasymmetria* Sohn and Berdan (1952, p. 10) which genus shows relationship to the Healdiacea (Sohn, 1965, pp. 69-72). Sohn pointed out that the muscle-scar pattern of *Pseudophanasymmetria* is similar to that of *Pseudohealdia (Ledahia)* Gründel (1964). That of *Cardobairdia* on the other hand is more similar to that of *Hungarella.* Therefore, it is suggested that *Cardobairdia, "Bythocypris" pykna* and the Cretaceous and Tertiary representatives of *"Krausella"* (van den Bold, 1960, pp. 155-156) should be placed with *Pseudophanasymmetria* in the Healdiacea. Teeter (Rice Univ., doctoral dissertation) reported a *Cardobairdia* from shallow-water deposits off the coast of British Honduras; this species appears to belong to McKenzie's new genus *Saipanella* which occurs in lagoonal deposits in the western Pacific. So far McKenzie and I have found real *Cardobairdia* only in deeper water deposits. It is probable, that the two genera belong to the same family. For *Saipanella* the soft parts are now known and a full discussion of the family based on this genus by McKenzie is in press. If these genera belong to the Healdiacea this will throw a new light on the position of this superfamily and upon the suborder Metacopina. It is suggested here, that the following genera belong to the Saipanellidae: *Cardobairdia, Saipanella, Pseudophanasymmetria, "Krausella"* of van den

Bold and others, and *Hungarella*. For the fact that McKenzie discovered in the appendages of *Saipanella* some characteristic resemblance to those of *Darwinula*, it is of interest to note that the Russians (Mandelstam, 1960, p. 339) have for some time placed *Darwinula* in the Healdiacea of the suborder Podocopina.

Cardobairdia glabra, n. sp. Pl. 2, figs. 1, a, b; Pl. 8, figs. 2a,b

Cardobairdia ovata van den Bold, 1960, p. 155 (part), pl. 2, fig. 2c; not pl. 2, figs. 2a, b.

Name. — *Glaber* (L) - smooth.

Holotype. — A left valve, HVH No. 8305.

Paratypes. — A right valve (HVH No. 8306, loc. 15000, Dominican Republic), one complete carapace (HVH No. 8307, Hickson 114, Lengua Formation, Trinidad), three left and one right valve HVH No. 8308, loc. J 6a, Bowden Formation, Jamaica).

Type locality. — Locality 15000 (see Text-fig. 7; Table 12), Dominican Republic.

Stratigraphic horizon. — Gurabo Formation, massive fine-grained sandy marl.

Distribution. — Gurabo Formation, Dominican Republic; Cipero Formation (*Globorotalia fohsi robusta* Zone), Lengua Formation (*Globorotalia menardii* Zone), Trinidad; Mont Pellier Limestone (*Globorotoalia fohsi s.l.* Zone), Buff Bay Formation, Bowden Formation (below Bowden "Shellbed"), Jamaica.

Diagnosis. — A species of the genus *Cardobairdia* with ventrally rounded posterior end.

Description. — Carapace egg-shaped, highest just anterior to the middle, slightly varying in different specimens from 0.39-0.45 of the length from the anterior extremity; height nearly two-thirds of the length, width more than one-half of the length, situated in the middle. Left valve larger than the right and overlapping strongly on all sides. The margin of the left valve is strongly folded inwards, so that in the description a distinction between margin and outline is necessary.

Anterior end obliquely rounded, greatest convexity below the middle; dorsal outline strongly arched, flattened or even slightly concave in the posterior slope, so that the posterior card-

inal angle is emphasized, although it is smoothly rounded; ventral outline almost the mirror-image of the dorsal one but less convex in the middle and slightly more convex in the posterior half; posterior end obliquely rounded, more strongly convex at or just below the middle. Margin of the left valve: anterior margin obliquely rounded, narrowly rounded ventrally, dorsal and ventral margin gently convex and converging posteriorly from about one-third from the anterior extremity (at the anterior hinge tooth); posterior margin almost regularly rounded. The margin of the right valve follows practically the same course. The outline of the right valve projects, especially dorsally, so that the dorsal outline is arched, highest in the middle. Dorsal view short, thickset, spindle-shaped: lateral outline of the left valve slightly concave near the ends, greatest width in the middle. The hinge consists in the left valve of terminal sockets and a median groove. The anterior socket is finely crenulate, the groove is largely covered by the infolded dorsal margin. In the holotype no crenulations can be seen in the posterior socket, but this has been observed in other specimens. In the right valve, the dorsal margin shows a sharp median ridge which is enlarged terminally to fit the sockets of the left valve. On both anterior and posterior thickenings crenulations have been observed. No porecanals were seen. Muscle scar pattern consists of 15 scars in a circular area.

Dimensions. — Holotype: L 0.80 mm; H 0.45 mm. Other specimens: L 0.64-0.82 mm; H 0.38-0.45 mm.

Remarks. — In 1960 the writer included all specimens studied at that time into one species, ranging from middle Eocene-Miocene. However, a difference between the Miocene and Eocene specimens has been noticed, although it is slight: in *C. glabra* the position of the greatest convexity of the posterior end lies below the middle, whereas in *C. ovata* it lies above the middle; as the right valve of *C. glabra* has its posterior convexity somewhat higher, the overlap of the left valve is stronger posteroventrally than posterodorsally; in *C. ovata* this is the reverse.

Suborder PODOCOPINA

Superfamily CYPRIDACEA

Family CYPRIDIDAE

Subfamily **PONTOCYPRIDINAE**

Genus **ARGILLOECIA** Sars, 1866

Argilloecia sp. 1 Pl. 4, fig. 4; Pl. 8, fig. 4

Description. — Carapace elongate ovate, highest just behind the middle. Anterior end almost evenly rounded, dorsal margin arched, ventral margin slightly convex, posterior end obliquely rounded, narrowly rounded below, almost truncate above. Right valve overlapping the left along the entire dorsal, posterior and ventral margin, strongest overlap anterodorsally. Marginal area broad in anterior end, line of concrescence forms a loop towards the outer margin as is normal in this genus; muscle scars typical. The selvage which forms the outer edge of the margin is curved inward in the posteroventral part, typical for this species.

Dimensions. — L 0.41 mm; H 0.21 mm.

Remarks. — Several of Müller's species from the Gulf of Naples (1894) and *Argilloecia hiwanneensis* Howe and Lea (Howe and Law, 1936, p. 25, pl. 1, figs. 25-29) show similarity to this species, but all are more sharply pointed behind.

Occurrence. — Gurabo Formation, Bowden Formation (Jamaica). A second species (referred to as *Argilloecia* sp. 2) also occurs in the Gurabo Formation. It is more elongate and more sharply pointed behind. Because of its rare occurrence it has not been figured or described, but it is more common in the Bowden Formation and will be described in the report on the young Neogene of Jamaica.

Genus **PROPONTOCYPRIS** Sylvester-Bradley, 1947

Propontocypris sp. Pl. 4, fig. 11

This species shows resemblance to several of the species of *Erythrocypris* described by Müller (1894) from the Gulf of Naples. Only a few specimens have been found, and it would not merit mentioning if the same species had not been encountered in the August Town Formation of Jamaica.

Subfamily **PARACYPRIDINAE** Sars

Genus **PARACYPRIS** Sars, 1966

Paracypris sp. Pl. 2, fig. 6

Species rare and not well preserved. It is mentioned here, because it also occurs in the Ponce Formation of southern Puerto Rico.

Occurrence. — Localities 15093 (Mao), 15437, 15369 (Cercado, *fidé* Dohm).

Superfamily **BAIRDIACEA**

Family **BAIRDIIDAE**

Genus **BAIRDIA** M'Coy, 1844

Bairdia sp. aff. **formosa** Brady Pl. 2, figs. 5a, b

Bairdia formosa Brady, 1868, p. 221, pl. 14, figs. 5-7; Seguenza, 1883, p. 258; 1884, p. 127; Carus, 1885, p. 317; Neviani, 1928, p. 126; Sylvester-Bradley, 1950, figs. 2a, b; Ruggieri, 1949, p. 28; 1949, p. 50; 1959, p. 184; Dieci and Russo, 1964, p. 54, pl. 9, fig. 5.
Bairdia peloritana Seguenza,, 1883, p. 59 (*fide* Neviani, 1928).
Bairdia serrata G. W. Müller, 1894, p. 273, pl. 13, fig. 41, pl. 14, figs. 13-15, pl. 15, fig. 23; Medioli, 1960, p. 214.
Not *Bairdia formosa* Brady, 1880 = *Bairdia subcircinata* Brady and Norman.

Description. — Carapace ovate, highest in the middle. Anterior end angled a little above the middle, rounded and irregularly spinose below; dorsal margin strongly arched; ventral margin slightly convex: posterior end angled below the middle, spinose and rounded below.

Dimensions. — L 0.73 mm; H 0.48 mm.

Remarks. — The species resembles in shape and in the coarse character of the marginal denticulation *Bairdia serrata* Müller, which is generally placed in synonymy with *Bairdia formosa* Brady, but is distinctly higher according to the figures by Müller. The specimens from the Dominican Republic are considerably smaller and the ventral margin is not concave *(B. serrata)* or straight *(B. formosa)*.

Bairdia longisetosa Brady Pl. 2, figs. 3a, b

Bairdia longisetosa, Brady, 1902, p. 197, pl. 25, figs. 8, 9.
Bairdia crosskeyana Brady, Puri, 1960, p. 130, pl. 6, figs. 11, 12, not *Bairdia crosskeyana* Brady, 1880.
Bairdia gerda Benson and Coleman, 1963, p. 19, pl. 1, figs. 14-16, text-figs. 8, a, b.

This species from the same locality (H 15092) as the preceding one, Mao Formation, has a longer row of small serrations at the posterior end of the ventral margin than indicated in *Bairdia gerda*. The same species occurs in the Bowden Formation of Jamaica.

Dimensions. — L 0.98 mm; H 0.59 mm.

Bairdia sp. aff. **fortificata** Brady Pl. 2, fig. 4

?*Bairdia fortificata* Brady, 1880, p. 59, pl. 11, fig. 4a, b.
Bairdia cf. *B. fortificata* Brady, Swain, 1951, p. 16, pl. 1, fig. 14.

In shape this species is closely similar to *Bairdia fortificata* Brady, but is smaller and exhibits much longer spines both at the anterior and the posterior end.

Dimensions. — L. 0.75 mm (without spines), 0.82 mm (with); H 0.46 mm.

Figured specimen is from H 15242, in Río Gurabo, Gurabo Formation.

Bairdia antillea van den Bold Pl. 7, figs. 8 a, b

Bairdia antillea van den Bold, 1946, p. 69, pl. 1, fig. 2a-c; 1965, p. 387, pl. 1, fig. 13.
? *Bairdia antillea* van den Bold, Ruggieri, 1960, p. 3.

Occurrence. — Cercado? Formation, localities 15369, 15469.

Dimensions. — L 0.94 mm; H 0.68 mm.

Genus **BYTHOCYPRIS** Brady and Norman, 1889

Bythocypris sp. Pl. 2, fig. 11

A few specimens of this typical *Bythocypris* species occur both in the Gurabo and in the Bowden Formations. It is related to the type species of the genus and like that species is probably a deep-water form.

Superfamily **CYTHERACEA**

In this paper I have deviated from the subdivision of the Cytheracea in a large number of unrelated families as done by the authors of the *Treatise on Invertebrate Paleontology* and tried to reassemble them as subfamilies under a relatively small number of families. In several ways this system is closer to a zoological approach as was suggested by Hartmann (1963).

Family	Subfamily
Cytheridae	Cytherinae Leptocytherinae Cytheromorphinae Perissocytherideinae
Cytherideidae	Cytherideinae Neocytherideidinae Krithinae Schulerideinae Cumeocytherinae
Trachyleberididae	Trachyleberidinae Hemicytherinae Cytherettinae Campylocytherinae Brachycytherinae?

Loxonconchidae	Loxoconchinae Cytherurinae Cytheropterinae Paracytherideinae
Bythocytheridae	
Paradoxostomatidae	Paradoxostomatinae Cytherominae Microcytherinae
Xestoleberdidae	
Limnocytheridae	
Progonocytheridae?	
Entocytheridae	

Family **CYTHERIDEIDAE**

Subfamily **CYTHERIDEINAE**

Genus **CYPRIDEIS** Jones, 1857

Cyprideis sp. aff. **C. pascagoulaensis** (Mincher) Pl. 7, figs. 6 a, b; Pl. 8, figs. 3 a, b

Anomocytheridea pascagoulaensis Mincher, 1941, p. 341, pl. 46, figs. 1a-f.
Cyprideis pascagoulaensis (Mincher), Sandberg, 1964, p. 111, pl. 12, figs. 6-9; pl. 15, figs. 3-6, pl. 21, figs. 3 a, b.

Only left valves have been encountered.

Dimensions. — Left valve, female: L 0.88 mm; H 0.48 mm. Left valve, male: L 1.00 mm; H 0.50 mm.

Remarks. — As only left valves have been found a certain amount of transport after death is indicated; moreover this makes identification somewhat doubtful. Differences with left valves of *C. pascagoulaensis* in the H. V. Howe collections (2072, 2073) are only slight, consisting in slightly flatter dorsal and ventral margins and the presence of faint crenulations in the posteroventral corner. These differences are not sufficient to warrant separation from the above mentioned species, but since the description cannot be complete it is necessary to leave open the possibility that right valves would prove this species to be not identical to *C. pascagoulaensis*.

Occurrence. — Cercado Formation, locality 15370 (Text-fig. 2, Table 4); Gurabo Formation, locality 15242 (Text-fig. 3, Table 7); Mao Formation, locality 15093 (Table 11, Text-fig. 6).

Cyprideis pascagoulaensis occurs in a sample from Forest Park anticline (four miles NE of Pointe-à-Pierre, Trinidad), and in another from the Redwater River, Trinidad (K. Rohr 233), presumably from the Springvale Formation, but the exact locality is unknown to me.

Subfamily **KRITHINAE**

Genus **KRITHE** Brady, Crosskey, and Robertson, 1874

Krithe dolichodeira van den Bold
Pl. 2, figs. 9, a, b, 12 a, b; Pl. 10, figs. 4 a-d

Krithe dolichodeira van den Bold, 1946, p. 75, pl. 4, figs. 14 a, b.
Krithe pretexta (Sars), van den Bold, 1946, p. 76, pl. 4, figs. 16 a, b.
Not *Ilyobates praetexta* Sars, 1866, p. 60.
?*Krithe* sp. cf. *K. dolichodeira* van den Bold, Ruggieri, 1960, p. 3, pl. 2, figs. 9 a, b.
Krithe, n. sp. van den Bold, 1966b, p. 5.
Krithe dolichodeira van den Bold, van den Bold, 1966d, p. 161, pl. 4, fig. 4.

Holotype. — A complete carapace of a male, Pal. Mus. Univ. Utrecht, S 12986 (Pl. 2, fig. 12a).

Paratypes. — Two male carapaces Pal. Mus. Univ. Utrecht, D 27072; 14 female carapaces, D 27077, 1 female carapace (HVH No. 8337, Pl. 2, fig. 12b).

Type locality. — Tschopp, 1139, Nipe Basin, Cuba (see Keyzer, 1945, pp. 52-56, Table V), outcrop 2 km SW of Banes along the road to Santa Isabel de Nipe.

Stratigraphic horizon. — Upper part of the "Oligo-Miocene" of the Nipe Basin (*Globorotalia menardii* Zone).

Occurrence. — Middle Miocene of Cuba, upper Miocene of Dominican Republic and Jamaica, M'Bega Formation (middle Miocene) of Gabon, ? middle? Miocene of Sicily.

Description. — Female: Carapace elongate subrectangular to subcylindrical. Anterior end evenly rounded, dorsal and ventral margin almost straight and parallel, posterior end obliquely rounded, descending more steeply in the left valve than in the right, where the posterior margin projects slightly beyond the regular curve down from the posterior cardinal angle. Dorsal view bomb-shaped, widest just behind the middle, posterior end blunt and incised, anterior end subacute. Male: more elongate than the female; dorsal and ventral margin converging slightly posteriorly, so that the greatest height lies near the anterior end; posterior end more oblique and projecting more sharply beyond the regular curvd margin. Marginal area in both sexes with a fan-shaped loop of the line of concrescence in the anterior end. This loop is more strongly narrowed at its base in the left valve than in the right. Radial porecanals not numerous, short and simple.

Dimensions. — Holotype: L 0.58 mm; H 0.28 mm; W 0.20 mm (male). Paratype: L 0.52 mm; H 0.25 mm; W 0.22 mm (female);

locality 15269 (female) L 0.53 mm; H 0.25 mm; W 0.22 mm; locality 15000 (largest female): L 0.62 mm; H 0.30 mm.

Remarks.—The writer originally did not recognize that *Krithe dolichodeira* and *Krithe pretexta* were male and female of the same species. However, when a dimorphous species, the female of which was similar to *K. pretexta*, was found in the Dominican Republic and Jamaica, it was suspected, that the same might have been the case in Cuba. The types of *K. dolichodeira* and specimens of *K. pretexta* were kindly loaned to the author by Dr. C. W. Drooger, Professor of Micropaleontology at the University of Utrecht, and examination of these confirmed the opinion expressed above. *Krithe praetexta* (Sars) is a different species with a much wider anterior vestibule (compare Sars, 1925, pl. LXXVI). I reaffirm my statement of 1946, page 76, that I did not believe that *K. praetexta* (Sars) and *K. bartonensis* (Jones) were the same species. *Krithe hiwanneensis* Howe and Lea (Howe and Law, 1936, p. 72, pl. 5, figs. 32-34) is fairly similar to the female of *Krithe dolichodeira* but differs in anterior marginal area and is narrower posteriorly in dorsal view.

Subfamily **NEOCYTHERIDEIDINAE**

Genus **CUSHMANIDEA** Blake, 1933

Cushmanidea sp. aff. **C. howei** (van den Bold) Pl. 4, fig. 9

Cushmanidea howei (van den Bold), van den Bold, 1965, p. 392, pl. 2, fig. 4.

Description.—Carapace elongate, dorsal and ventral margin almost parallel. Anterior end in the left valve almost evenly rounded, slightly oblique in the right valve with the stronger convexity below; posterior end obliquely rounded, narrowly rounded below, almost obliquely truncate above in the left valve, more obliquely rounded throughout in the right valve.

Dimensions.— (Left valve). L 0.94 mm; H 0.46 mm.

Remarks.—This species differs from *C. howei* by its nearly parallel dorsal and ventral margins; by the same token it differs from *C. ulrichi* Howe and Johnson (Howe, *et al.*, 1935, p. 16, pl. 3, figs. 11-14) which has also a higher and slightly more regular posterior end.

This species has been found only in the Mao Formation near Santiago de los Caballeros.

Cushmanidea anderseni (Puri)? Pl. 4, fig. 10

Cytherideis anderseni Puri, 1952, p. 908, pl. 130, figs. 15-17, text-fig. 8, 10; Puri, 1954, p. 286, pl. 9, figs. 15-17.
Not *Cushmanidea anderseni* Malkin, 1960, pp. 479, 483, fig. 5, pl. 2 (top), fig. 6, pl. 2 (bottom), fig. 7, pl. 3 (top), fig. 15.

Only one specimen was found at locality 15212, Gurabo Formation. It agrees well with one of the "co-types" from the Chipola Formation, but it appears uncertain if the specimens of the other "co-types" are conspecific. It seems best to refer this specimen questionably to *C. anderseni*.

Family **CYTHERIDAE**

Subfamily **PERISSOCYTHERIDEINAE**

Genus **GANGAMOCYTHERIDEA** van den Bold, 1963

Gangamocytheridea? plicata, n. sp. Pl. 7, figs. 4 a-c; Pl. 9, fig. 3

Name. — *Plicatus* (L) — folded.

Holotype. — A right valve, HVH No. 8329.

Paratypes. — Two left and one right valve (HVH No. 8330) (loc. 15212); one left and one right valve (HVH No. 8331) (loc. 15211); one right valve (HVH No. 8332) (loc. 15242).

Type locality. — Locality 15212 on the Río Mao at Paso Bajito = USGS st. 8527 (Table 9; Text-fig. 1).

Stratigraphic horizon. — Gurabo Formation (massive gray fossiliferous clay).

Occurrence. — Lower part Gurabo Formation, Bowden Formation (Jamaica).

Description. — Carapace ovate, alate; highest just in front of the middle. Anterior end obliquely rounded, almost angular ventrally; dorsal margin arched, ventral margin almost straight, slightly concave in the middle; posterior end angled subventrally, convex below, obliquely truncate above in the left valve, concave in the right. Dorsal view widest at the posterior end of the ala, one-third of the length from the posterior extremity; sides convex, converging gently anteriorly, increasing their convergence in the anterior third; anterior end acute, posterior end strongly compressed, lateral sides concave between the posterior end and the termination of the alae.

Ornamentation with a broad and heavy ala, from the edge of which two to three ridges strike obliquely upward in the an-

terior part, about parallel to the anterior margin. In the posterior portion of the carapace there is a short, horizontal median ridge above and below which there are several vertical plications. Hinge in the right valve consists of short, crenulate, terminal teeth and a curved, crenulate median groove. In the left valve a curved, crenulate bar lies below the dorsal outline; below the ends of the bar short, crenulate, terminal teeth occur. Marginal area of moderate width, line of concrescence and inner margin coincide. Porecanals not numerous, wide, several false radial canals occur.

Dimensions. — Holotype: L 0.42 mm; H 0.25 mm; (right valve). Paratypes: left valve L 0.38 mm; H 0.21 mm; W 0.16 mm; right valve L 0.39 mm; H 0.22 mm; W 0.17 mm.

Remarks. — The generic position of this species is not certain. On the basis of shell structure it is difficult to assign it with certainty to a family of the Cytheracea and it might be placed in the Cytheridae (Perissocytherideinae) or Loxoconchidae (Cytheropterinae), although the first choice appears more likely.

Family TRACHYLEBERIDIDAE

For subdivision of the Trachyleberididae I have used five subfamilies: Trachyleberidinae, Hemicytherinae, Cytherettinae, Campylocytherinae, and Brachycytherinae. The majority of the genera in Trachyleberididae can be assigned to these subfamilies without serious difficulties. However, there are some groups of genera that do not fit: 1. *Phacorhabdotus, Ambocythere, Buntonia*?, 2. *Ruggieria, Thalmannia, Soudanella.* These should perhaps be treated as distinct subfamilies. Others seem to take intermediate positions between Trachyleberidinae and Hemicytherinae (*e.g., Henryhowella* and *Echinocythereis*), or Trachyleberidinae and Campylocytherinae (*e.g., Anticythereis* and *Velarocythere*). Debatable is also the validity of the Brachycytherinae as only *Brachycythere* and *Bosquetina* appear to be assignable without restrictions. The genus *Procythereis* appears to be related to this subfamily, but the soft parts show close relationship to the Hemicytherinae.

I have to admit that after studying Ostracoda for more than 20 years, I do not know enough about them to provide answers to these questions that are entirely satisfactory to myself, let alone to others.

Subfamily **CYTHERETTINAE**

Genus **CYTHERETTA** G. W. Muller, 1894

Cytheretta karlana Howe and Pyeatt Pl. 3, figs. 7 a, b

Cytheretta karlana Howe and Pyeatt, Howe, *et al.*, 1935, p. 34, pl. 1, figs. 30, 34; pl. 3, figs. 3, 4; van den Bold, 1946, p. 106, pl. 9, fig. 18; Swain, 1952, p. 46, pl. 6, fig. 19; Puri, 1954, p. 284, pl. 7, figs. 5, 6.
Paracytheretta karlana (Howe and Pyeatt), Puri, 1952, p. 209, pl. 40, figs. 3-5, text-fig. 8.

Dimensions. — Left valve: L 0.80 mm; H 0.42 mm. Right valve: L 0.80 mm; H 0.40 mm.

Remarks. — The specimens from the Cercado Formation are slightly smaller and slenderer than the type specimens from the Miocene of Florida.

In the Gurabo Formation a specimen of a similar looking form has been found (*Cytheretta* sp. aff. *C. karlana,* Table 9, 15211); the same species also occurs in locality 15346 (at Carbonera Village, Text-fig. 1) and has been found in the Ponce Formation of Puerto Rico and in Neogene beds in the Lajas Valley of Puerto Rico. This species, which is somewhat intermediate between *Cytheretta karlana* and *Cytheretta pumicosa* (Brady), will be described later.

Genus **PARACYTHERETTA** Triebel, 1941

Paracytheretta dominicana, n. sp. Pl. 3, figs. 5, a, b; Pl. 9, fig. 2

Name. — After its occurrence in the Dominican Republic.

Holotype. — A complete carapace (HVH No. 8347).

Paratypes. — One left valve, one right valve, one immature left valve, one abnormally large left valve (HVH No. 8348), one carapace, and one left valve (HVH No. 8349).

Type locality. — Locality 15296, on Santiago-Las Matas road (Text-fig. 5; Table 10).

Stratigraphic horizon. — Gurabo Formation (thin-banded, buff-weathering, fossiliferous sand).

Occurrence. — Gurabo and Cercado? Formations.

Description. — Carapace subrectangular, highest at the anterior cardinal angle, at just a little more than one-fourth of the length from the anterior end, where the left valve strongly overlaps the right in a "Schlossohr". Anterior end obliquely rounded in the left valve (less oblique in the right); dorsal margin straight, sunk in sharply behind the anterior cardinal angle in the left valve;

parallel to the ventral margin, which is slightly sinuate in the middle; posterior end angled at or a little above the middle, rounded below and denticulate till somewhat above the angulation; steeply truncate above in the left valve where the knoblike posterior cardinal angle projects strongly over the right valve; in the right valve the dorsal part of the posterior margin is concave and slopes less steeply down from the less pronounced posterior cardinal angle.

Left valve larger than the right and overlapping strongly along the entire ventral and ventral part of the posterior margin, both ends of the dorsal margin and the upper part of the posterior end.

Ornamentation consists of a network of ridges. Three longitudinal ridges stand out: dorsal ridge, straight and obscuring almost the entire length of the dorsal margin. Medium ridge, oblique, running from below the middle of the anterior margin upward in the direction of the middle of the dorsal part of the posterior margin. It is slightly convex upward in the posterior half, slightly concave in the anterior and more strongly developed just in front of the centre of the valves, simulating a subcentral tubercle. Ventral ridge starts just below the median one in the anterior end and is parallel to the ventral margin. Two parallel ridges, just below and above it, develop more strongly posteriorly as the ventral ridge becomes weaker, and converging to a point, take its place in forming the posterior end of the ridge which breaks off with an angular process behind which the carapace is strongly laterally compressed.

The meshes of the reticulation are angular, or hexagonal in shape and often irregular due to projections of the ridges into the mesh.

In dorsal view both ends are compressed, greatest width at the elevation of the median ridge at one-third of the length from the anterior end. The median ridges converge slightly posteriorly; the ventral ridges diverge slightly and the width at their posterior ends (about one-fourth of the length from the posterior end) is only slightly smaller than greatest width. In dorsal view it can be seen more distinctly than in side view, that the anterior end of the left valve has a low ridge.

Hinge consists in the right valve of a high, slightly upwardly deflected tooth, with a steep anterior side and a sloping posterior side, followed by a relatively shallow, round socket, which merges

with a straight groove. The groove is narrower in the middle but widens towards the ends. In the posterior cardinal angle is a large triangular tooth, highest posteriorly. In the left valve there are large, terminal, open sockets in the projecting cardinal angles, and a median bar which widens towards the ends (particularly the posterior) and carries a knoblike tooth at its anterior end.

Marginal area wide in the anterior end. Line of concrescence and inner margin coincide but do not form a regular curve.

Dimensions. — Holotype: L 0.66 mm; H 0.42 mm (0.39 mm in right valve); H 0.34 mm.

Remarks. — The species differs from ridged similar species of *Cytheretta* (or *Protocytheretta*) by its strongly projecting cardinal angles. In this respect it is close to *Paracytheretta reticosa* Triebel (1941, p. 389, pl. 15, figs. 165-168) but differs by its less developed anterior ridge and more strongly developed ventral ridge system.

Subfamily **HEMICYTHERINAE**

Genus **QUADRACYTHERE** Hornibrook, 1952

Quadracythere producta (Brady) Pl. 5, figs. 1 a, b

Cythere producta Brady, 1866, p. 378, pl. 59, figs. 7 a-c.
Cythere compacta Brady, Brady, 1869, p. 238.
Not *Cythere compacta* Brady, 1866, p. 381, pl. 62, figs. 3 a-d; Brady, 1869, pp. 152, 241, pl. 30, figs. 18, 19.

Apparently Brady confused *Cythere compacta* and *Cythere producta*. *Cythere producta* is longer and more rectangular in outline, approaching *Quadracythere antillea* (van den Bold), which may be ancestral to both species. *Quadracythere antillea* is succeeded in the upper Miocene by *Q. bichensis* (van den Bold) which in turn may be the direct ancestor of *Q. compacta*. In this lineage the form becomes short and more ovate. *Q. producta* occurs in the Yague Group together with *Q. bichensis* (Pl. 5, fig. 2).

Ranges of these related species, as far as they can be ascertained at this stage, are shown in Table 19.

Subfamily **TRACHYLEBERIDINAE**

Genus **TRACHYLEBERIDEA** Bowen (emend. Hazel)

Trachyleberidea mammidentata (van den Bold) Pl. 5, figs. 5 a, b; figs. 7 a, b

Cythereis cubensis var. *mammidentata* van den Bold, 1946, p. 91, pl. 10, figs. 23 a-d.
Cythereis blanpiedi mammidentata van den Bold, van den Bold, 1950, p. 107.
Trachyleberidea cubensis mammidentata (van den Bold) van den Bold, 1966b, p. 5.

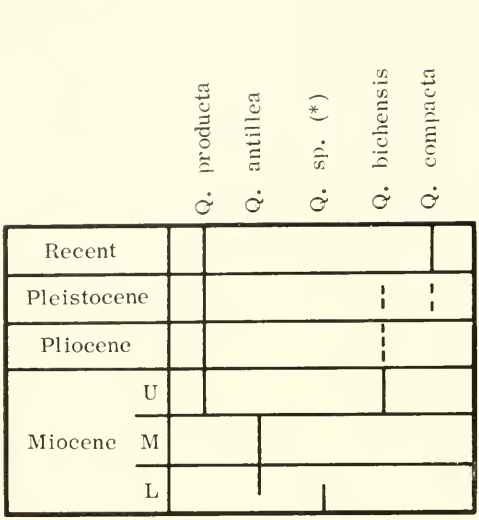


Table 19. Stratigraphic range of some species of the genus *Quadracythere* in the Caribbean. (*) "*Hemicythe palosensis* LeRoy" (van den Bold, 1957).

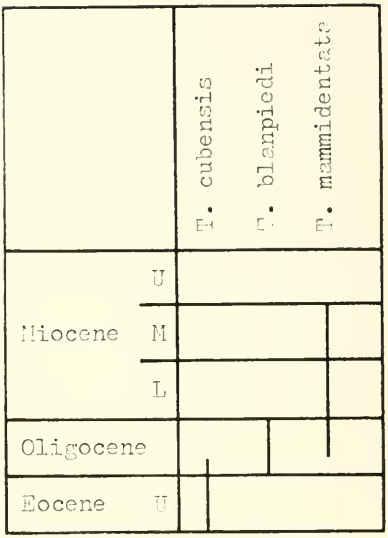


Table 20. Stratigraphic range of some species of the genus *Trachyleberidea* in the Caribbean.

Holotype. — A right valve (van den Bold, 1946, pl. 10, figs. 23 a, c) Pal. Mus. Univ. Utrecht, S 13012.

Paratypes. — Pal. Mus. Univ. Utrecht, S 13013.

Type locality. — Tschopp 1479, outcrop on road from Sierra de Nipe to Mayari, 1.8 km N of the serpentine massive of the Sierra de Nipe and about 4.5 km S of Banes, Province of Oriente, Cuba (see Keijzer, 1945, p. 59, Tables IV and V, fig. 6).

Stratigraphic horizon. — Nipe series, lower Miocene, about *Globigerinatella insueta* Zone.

This species occurs in the Dominican Republic in the Gurabo Formation (15000) and the Mao? Formation (15122), in Jamaica in the coastal formations below the Bowden "Shellbed." It is closely related to *Trachyleberis blanpiedi* (Howe) but more squarely and robustly built.

Trachyleberidea cubensis (van den Bold)

Cythereis cubensis van den Bold, 1946, p. 91, pl. 10, figs. 22 a-b.
Cythereis blanpiedi Howe, van den Bold, 1950, pp. 107, 108.
Not *Cythereis blanpiedi* Howe, Howe and Law, 1936, p. 44, pl. 4, fig. 27; pl. 5, fig. 18.

Holotype. — A complete carapace (van den Bold, 1946, pl. 10, figs. 22 a, b), Pal. Mus. Univ. Utrecht, S 10311.

Paratypes. — Pal. Mus. Univ. Utrecht, D 27130.

Type locality. — R (de Vletter) 276, outcrop of San Luis Formation, N of the Sierra de Canasta, on the road from Figuaboa to Almaida, about 3 km W of Figuaboa, East Oriente Province, Cuba (see Keijzer, 1945, Table II).

Stratigraphic horizon. — San Luis Formation, *Porticulosphaera semiinvoluta* Zone, upper Eocene.

Trachyleberidea sp. aff. **T. cubensis** (van den Bold) Pl. 5, figs. 6 a, b

This species has been found in the Gurabo Formation (15269). Specimens are badly preserved and belong certainly to a new species, undoubtedly related to *Trachyleberis cubensis,* but distinct from that species, from *Trachyleberidea mammidentata* and from *Trachyleberidea blandpiedi.*

Genus **COSTA** Neviani, 1928

Costa dohmi, n. sp. Pl. 3, figs. 9 a-d; Pl. 9, figs. 1 a, b

Costa n. sp., van den Bold, 1966b, p. 5.

Name. — After Dr. H. Dohm, who collected the sample from which the type of this species is selected.

Holotype. — A left valve, HVH No. 8311.

Paratypes. — Four left and two right valves, HVH No. 8312.

Type locality. — Locality 15269 (Text-fig. 5; Table 10).

Stratigraphic horizon. — Gurabo Formation, thickly bedded, gray, calcareous, fossiliferous clay with large oysters, presumably *Ostrea haitensis* (Bermudez, 1949, p. 44).

Occurrence. — Gurabo Formation, Bowden Formation (Jamaica).

Diagnosis. — A species of the genus *Costa* with a spinose dorsal ridge and a secondary ridge between median and ventral ridge.

Description. — Carapace subrectangular, highest at the anterior cardinal angle in the left valve at one-third of the length from the anterior end. Anterior end obliquely rounded in the left, evenly rounded in the right valve, denticulate over its entire length and bearing a parallel ridge which has a double row of spines, one

projecting forward, the other projecting sideways. Dorsal margin sunk in behind the anterior cardinal angle in the left valve, thereafter straight and converging slightly posteriorly towards the ventral margin which is almost straight, slightly sinuate. Posterior end triangular, laterally compressed, angled below the middle, slightly concave above, curved and denticulate below. It also bears a marginal rim, which is denticulate from just above the posterior angulation down. Left valve overlapping the right conspicuously at the anterior cardinal angle.

Ornamentation.—Surface reticulate. In the anterior end with concentric ridges parallel to the anterior rim and ridges radiating from an elevated area just in front of the centre of the valve. This area is elongate in a downward and forward direction and covered with small reticulations in which the ridges have become wider at the expense of the meshes, so that it forms an oblique, elongate, pitted, glossy boss. From its posterior end extends a short heavy median ridge horizontally till about one-third of the length from the posterior end. The anterior rim continues parallel to the ventral margin to form a ridge which ends about one-fourth of the length from the posterior end. Immediately above it is a ventral ridge, which is the continuation of the second concentric ridge behind the anterior rim, and which runs parallel to the first one and ends also at one-fourth from the posterior end in a short stout spine. At its end it gives off a branch, forward and slightly deviating from it, which ends before reaching the subcentral boss. About halfway its length this ridge is connected to the end of the median ridge by an oblique crossridge.

The dorsal ridge is irregularly spinose, having at least five elevations, some of which may bear more than one spine; the anterior of the spines is higher than the others, but the whole ridge projects over the dorsal margin and obscures it from above the subcentral boss to just in front of the posterior cardinal angle, about one-sixth of the length from the posterior end. At its anterior end it curves down sharply in the direction of the subcentral boss.

Interior: Hinge in right valve exhibits an anterior tooth, which consists of a low rounded anterior knob and a high posterior one; behind it is a deep, round socket followed by a narrow, crenulate groove, ending in front of a large, round tooth in the posterior

cardinal angle. Marginal area broad in anterior end; line of concrescence and inner margin coincide; radial porecanals numerous, long, thin, closely spaced, slightly sinuate and slightly widened near the selvage.

Muscle scar: A posterior vertical row of four with one horseshoe-shaped frontal scar.

Dimensions. — Left valve: L 0.63 mm; H 0.40 mm; right valve: L 0.59 mm; H 0.35 mm.

Remarks. — Shape, especially of the projecting anterior cardinal angle, and to a certain extent the ornamentation are reminiscent of *Acanthocythereis ? kugleri* (van den Bold, 1966a, p. 182, pl. 22, figs. 3 a, b), but the pattern of ridges is different and the absence of spines on the ridges of the reticulation makes it necessary to refer this species to *Costa* rather than to *Acanthocythereis.*

Genus **PURIANA** Coryell and Fields, 1954

Puriana scrupulosa, n. sp. Pl. 5, figs. 4 a-c; Pl. 9, figs. 5 a, b

Name. — *Scrupulosus* (L) — rugged, full of stones, rough.

Holotype. — A left valve, HVH No. 8361.

Paratypes. — Two right valves, HVH No. 8362, 8363.

Type locality. — Locality 15137 (Text-fig. 3; Table 5).

Stratigraphic horizon. — Cercado Formation (*fide* Dohm), Gurabo Formation (*fide* Bermudez, 1949, p. 44). Laminated gray calcareous fine sandstone with thin lenses of molluscs.

Diagnosis. — A species of *Puriana* of small size and with a rugged ornamentation.

Description. — Carapace elongate subrectangular, highest at one-fourth of the length from the anterior end at the anterior cardinal angle, which in the left valve forms a backwardly deflected process, which is only suggested in the right valve. Anterior end obliquely rounded, smooth, dorsal margin straight, ventral margin almost straight and subparallel; posterior end angled above the middle, concave above in both valves, rounded below and bearing up to six rather large spines, the three upper ones of which form a vertical truncation. Surface irregularly ornamented with a large number of bladelike spines and ridges, among which stand out: 1. A row of four oblique short ridges ending in saw-toothed projections over the dorsal margin; the two anterior ones are much larger and

resemble in shape the projection at the anterior cardinal angle; 2. An irregular, vertical knobby ridge just in front of the posterior cardinal angle, resembling the one in *"Cletocythereis noblissimus"* Swain (1963, p. 824, pl. 98, fig. 5; pl. 99, figs. 15 a, b, Text-fig. 10a); 3. A high, bladelike anteroventral ridge, from below the middle of the anterior margin concave downward in the direction of the middle of the ventral margin, where it breaks up in an agglomeration of spines and small ridges; 4. Just above the posterior end of this group is another cluster of spines among which one represents the greatest lateral extension of the carapace, at one-fourth of the length from the posterior end.

Dorsal view irregular, spinose. Carapace without the projecting spines is widest in front of the middle, anterior end fairly broad, due to anterior marginal rim, posterior end strongly compressed.

Hinge in right valve consists of an anterior knoblike tooth with post-adjacent small socket and straight groove, posterior tooth larger and slightly lobate; left valve has anterior round socket, knoblike tooth and straight, finely crenulate bar, posterior round socket.

Marginal area of moderate width, line of concrescence and inner margin coincide.

Dimensions. — Right valve: L 0.51 mm; H 0.25 mm; W 0.19 mm. Left valve: L 0.49 mm; H 0.26 mm; W 0.19 mm. Right valve: L 0.43 mm; H 0.23 mm; W 0.13 mm.

Remarks. — The assignment to the genus *Puriana* is questionable, but the character of the ridges and the truncate posterior end strongly suggest this relationship. The only species even remotely similar, but different in a number of respects and assigned doubtfully to the same genus, is *Favella pijpersi* van den Bold (1946, p. 101, pl. 9, fig. 1), from the upper Eocene of Bonaire.

The species is rare, and it was impossible to find completely clean specimens as there are always bits of material sticking between the spines which could not be cleaned off. Therefore, the figures presented here are not satisfactory, but the ornamentation is so characteristic and easily recognizable, that the species seems worthy of a specific name.

Puriana pustulosa, n. sp. Pl. 4, figs. 5 a-c; Pl. 9, figs. 6, a, b

Name. — *Pustulosus* (L) — pustulous.

Holotype. — A complete carapace (HVH No. 8364).

Paratype. — One carapace, one left valve (HVH No. 8365), left and right valves from 15296 (HVH No. 8366).

Type locality. — H 15211, Cooke's 8733; Text-fig. 4; Table 9).

Stratigraphic horizon. — Gurabo Formation (Bermudez, 1949, p. 43). Coquina in thin-bedded, gray fossiliferous clay with *Candeina nitida.*

Description. — Carapace elongate subrectangular; anterior end obliquely rounded, dorsal margin straight, ventral margin sinuate in anterior third, almost straight behind, parallel to dorsal margin; posterior end angled above the middle, short and blunt, concave above, rounded and bearing five short stout spines below; the upper three spines give the posterior end the impression of being vertically truncate. Dorsal view irregularly pustulous, greatest width at one-fourth from the posterior end, anterior end with wide anterior rim and pointed margin in front of it; posterior end strongly compressed. Ornamentation consists of an anterior ridge, parallel to the anterior margin, a subcentral node at about one-third of the length from the anterior end, weak ventral and dorsal ridges, the latter one connected at its posterior end to an irregular knobby, vertical ridge, behind which the posterior end is laterally compressed. Further the carapace is covered with large pustules, the most prominent one of which is situated subventrally at one-fourth of the length from the posterior end.

Hinge consists in the right valve of an anterior pointed tooth with post-adjacent round socket, narrowing into a crenulate groove; posterior tooth slightly lobate. In the left valve terminal, open sockets occur with in between a straight, crenulate, median bar at the anterior end of which is a small knoblike tooth. Marginal area of moderate width throughout.

Dimensions. — Holotype: L 0.40 mm; H 0.21 mm; W 0.20 mm.

Remarks. — In size the species comes close to *Puriana minuta* van den Bold (1963, p. 390, pl. 8, figs. 2a-b), but the ornamentation is different. Its ornamentation is much simpler than that of *Puriana scrupulosa,* n. sp., which in other respects appears to be closely related.

Genus **AMBOCYTHERE** van den Bold, 1958

Ambocythere exilis van den Bold

Ambocythere exilis van den Bold, 1966b, p. 5, 13, pl. 1, figs. 3-6, text-fig. 6.

This species was described from the Gurabo Formation and also occurs in the Mao Formation, in the Bowden Formation of Jamaica, and the Forest Formation of Trinidad. Recently F.P.C.M. van Morkhoven (Shell Oil Co., Houston, Texas) has found this species in deeper water deposits of the Gulf of Mexico (50-100 fathoms).

Genus **PTERYGOCYTHEREIS** Blake, 1933

Pterygocythereis polita, n. sp. Pl. 3, figs. 4 a-c; Pl. 9, figs. 4 a-b

Pterygocythereis n. sp. van den Bold, 1966b, p. 5

Name. — *Politus* (L) — smooth.

Holotype. — A left valve (HVH No. 8357).

Paratype. — One right and three left valves (HVH No. 8358).

Type locality. — Locality 15299 (Text-fig. 5; Table 9), on Santiago-Las Matas road.

Stratigraphic horizon. — Gurabo Formation (massive, buff, fossiliferous, fine sandstone, with numerous large oysters).

Diagnosis. — A species of *Pterygocythereis* with blunt anterior end, sharply keeled ala and nonornamented carapace.

Description. — Carapace subrectangular, short, alate; highest at about one-third of the length of the carapace from the anterior extremity. Anterior outline broadly and obliquely rounded, with a steep, convex, dorsal slope; the anterior margin carries up to nine spines, almost obscured when viewed from the outside by the flattened outer edge. Dorsal margin almost straight in the left valve, slightly sinuate, due to a small convexity of the anteromedian part and a projection of the posterior cardinal angle; straight in the right valve; ventral margin almost straight and parallel to the dorsal margin; posterior end laterally flattened, angled just above the middle, rounded and bearing up to six spines (the highest at the median angulation) below, and obliquely truncate above, slightly concave in the left valve. The anterior margin is flattened bladelike and continues into the sharp, flattened, anterior edge of the ala, which is supported by rather obscure crossridges.

The ala is sharply pointed at its posterior end and has a short, two-pointed process on its posterior side. Dorsal view arrow-shaped, greatest width at the posterior end of the alae, about one-fourth of the length from the posterior extremity. Both ends laterally compressed, as is the dorsal part of the carapace in general.

Hinge. — In the right valve: terminal teeth and a median groove and anteromedian socket. The anterior tooth is high and pointed, at the posterior end of a long, flat base. Posterior tooth short and square and slightly lobate. In the left valve there are terminal sockets and a straight bar, which lies well below the dorsal margin and carries a knoblike tooth at its anterior end.

Marginal area of moderate width throughout. Line of concrescence and inner margin coincide, except for a short distance anteroventrally. Radial porecanals not numerous, about 20 in the anterior end, alternatively ending in the spines or between them. Muscle scars not observed.

Dimensions. — Left valve: L 0.66 mm; H 0.36 mm; W 0.30 mm. Right valve: L 0.64 mm; H 0.33 mm; W 0.28 mm.

Remarks. — The lobate posterior tooth and the strongly oblique anterior end suggest relationship to *Alatacythere*. The differences between *Alatacythere*, *Pterygocythere*, and *Pterygocythereis* are more of degree than of principal characters, and the validity of the two first genera is somewhat doubtful. *Pterygocythereis howei* Hill (1954, p. 812, pl. 98, figs. 2 a, b; pl. 99, figs. 4 a-d) and *Alatacythere westi* Stephenson (1945, p. 158, pl. 28, figs. 2, 10) have short curved dorsal ridges which are absent in *P. polita*. The new species is similar to *Pterygocythereis cornuta* (Roemer) (*non* Reuss, 1845) (see Keij, 1957, p. 94, pl. 13, fig. 13; pl. 14, figs. 5 a, b) but has a more obliquely curved anterior margin and a more sharply projecting posterior cardinal angle.

Occurrence. — Gurabo Formation (if Dohm's lithological subdivisions are accepted also in Cercado and Mao Formations).

Pterygocythereis miocenica van den Bold

Cythereis (Pterygocythereis) cornuta var. *americana* (Ulrich and Bassler), Howe, *et al.*, 1935, p. 26, pl. 2, figs. 19, 22-24; pl. 24, fig. 21.
Pterygocythereis miocenica van den Bold, 1967b, p. 310, pl. 1, figs. 19a-b with synonymy.

Occurrence. — Gurabo Formation.

Genus **HERMANITES** Puri, 1949

Hermanites hornibrooki (Puri) Pl. 4, fig. 3

Hermanites aff. *thoracophora* (van den Bold), Keij, 1954, p. 223, pl. 4, figs. 12 a, b.
Not *Cythereis thoracophora* van den Bold, 1946, p. 92, pl. 10, figs. 25 a, b.
Hermanites aff. *hutchisoni* van den Bold, 1957, p. 240.
Hermanites sp. 2, Drooger and Kaasschieter, 1958, p. 90.
Bradleya hornibrooki Puri, 1960, p. 123, pl. 1, figs. 9, 10, text-figs. 27, 28.
Hermanites hornibrooki (Puri), van den Bold, 1966b, p. 5; van den Bold, 1966g, pl. 1, fig. 14.

This species occurs in the Gurabo Miocene of the Dominican Republic. It should be noted here, that the paratypes HVH No. 4720 of *Bradleya hornibrooki* Puri do not belong to this species.

Genus **BRADLEYA** Hornibrook, 1952

"Bradleya" hazelae (van den Bold) Pl. 3, fig. 6

Cythereis hazeli van den Bold, 1946, p. 92, pl. 10, fig. 4.
Trachyleberis? hazelae (van den Bold), van den Bold, 1957, p. 241, pl. 1, fig. 11 (gender corrected, named for Hazel van den Bold); van den Bold, 1960, p. 165.
? *Hermanites hazelae* (van den Bold), Ruggieri, 1960, p. 3, pl. 1, fig. 8.

Holotype.—A right valve (van den Bold, 1946, pl. 10, figs. 4 a-c), Pal. Mus. Univ. Utrecht, S 13015.

Paratypes.— Pal. Mus. Univ. Utrecht, D 27124.

Type locality.—Tschopp, 1479 [see type locality of *Trachyleberidea mammidentata* (van den Bold) Oriente Province, Cuba].

Remarks.—The synonymy of this species clearly shows that its generic assignment is highly questionable. After describing it as a *Cythereis,* I subsequently assigned it to *Trachyleberis,* which I then took in a much wider sense than at present. Ruggieri, for the same or a similar species from Italy, referred it to *Hermanites* remarking, however, that it had many characteristics in common with some species referred to *Bradleya.* Whereas this species differs readily from the *Bradleya arata* group, to which van Morkhoven (1963, pp. 160,161) restricted the genus, it has features in common with the *Bradleya ? dictyon* group, but also shows some distinguishing characteristics which appear more of degree than of an essential nature. The subcentral tubercle is more prominently developed in *"B" hazelae* than in the *B. ? dictyon* group, the dorsal ridge is more irregular and strongly spinose and also the anterior

ridge, which is smooth in *Bradleya? dictyon,* is spinose in *"B" hazelae.*

Another notable fact is, that both species are common in deeper water deposits. *Bradleya? dictyon* (although admittedly taken in too wide a sense) is reported by the Challenger Expedition (Brady, 1880, pp. 100,101) from an impressive list of deep-water stations. Similar specimens that I originally reported as *Bradleya dictyon,* but later more cautiously as *Bradleya* ex. gr. *dictyon,* occur together with foraminiferal faunas where the Globigerinidae strongly predominate. In these *Globigerina*-rich samples they often occur together with specimens of *"B" hazelae* (*e.g.* Cipero and Lengua Formations of Trinidad). It would be possible to use any of these species as the type species for a new genus, but the fact that there are several difficulties inherent to this group makes one hesitant. In the first place it has to be ascertained which specimen is to be considered as the type of *Cythere dictyon* (Brady). In the second place, what is the relation between *Cythere dictyon* Brady and *Cythere normani* Brady (1966, p. 379, pl. 59, figs. 5a-d) from the Abrolhos? Presumably a fair amount of the specimens attributed to *Bradleya? dictyon* in the Western Hemisphere belong in reality to *Bradleya? normani* (Brady). A selection of *Cythereis hazelae* as type for a new genus would still leave the *"Bradleya* problem" unsolved, because *Cythere dictyon* could only be questionably placed in this new genus (and moreover, which of the "dictyons" would we be referring to?). *"B" hazelae* occurs only in relatively deep-water sediments of the upper and middle Tertiary which are poor in ostracodes and produce at the most three or four specimens of this species per sample.

Distribution. — Trinidad: *Catapsydrax dissimilis* Zone — *Globorotalia menardii* Zone (Cipero and Lengua Formations). Questionably in middle and upper Eocene Navet Formation (here the spinose ornamentation is never preserved, and although the shape and reticulation are similar it is not certain that they belong to the same species). Cuba: Jaruco and Cojímar Formations. Dominican Republic: Gurabo Formation. Jamaica: Buff Bay Formation; San San Clay (Bowden Formation).

Subfamily **CAMPYLOCYTHERINAE**

Genus **CAMPLYOCYTHERE** Edwards, 1944

Campylocythere sp. Pl. 2, figs. 8 a-d; Pl. 8, fig. 6

Description. — Carapace subrectangular. Anterior end obliquely rounded, dorsal margin almost straight, gently convex and parallel to the ventral margin which is slightly sinuate; posterior end rounded in the middle, straight above, convex below. Dorsal view lens-shaped, widest just in front of the middle, posterior end slightly more compressed than anterior end. Left valve overlapping the right antero- and posterodorsally and midventrally. Surface smooth.

Hinge in right valve: anterior elongate tooth, with knoblike anterior part, gradually sloping down into a shallow postadjacent socket which narrows to a long, straight groove; posterior tooth elongate.

Marginal area of moderate width; line of concrescence and inner margin widely separated in front, radial porecanals number about 20 in the anterior end; they tend to stand in pairs and their bases are slightly enlarged. In the posterior end about 10 porecanals occur, here also the bases are enlarged, but the line of concrescence lies close to the inner margin.

Muscle scar: a posterior row of four in which the second one from above is divided into two separate scars, the two lower ones are elongate. In front of the second scar from above is a double scar.

Dimensions. — Right valve: L 0.70 mm; H 0.38 mm; W 0.20 mm. Left valve: L 0.70 mm; H 0.39 mm; W 0.21 mm.

Remarks. — Less elongate than *Campylocythere laeva* Edwards (1944, p. 515, pl. 86, figs. 8-14).

Occurrence. — Cercado? and lower Gurabo Formations.

Genus **ACUTICYTHEREIS** Edwards, 1944

Acuticythereis elongata van den Bold Pl. 2, figs. 7 a-d

Acuticythereis elongata van den Bold, 1946, p. 106, pl. 12, fig. 4 a-c.

Holotype. — A left valve (van den Bold, 1946, pl. 12, figs. 4a-c), Pal. Mus. Univ. Utrecht, S 13045.

Paratypes. — S 30749 (Pal. Mus. Univ. Utrecht).

Type locality. — T 99, Río Salinas at San Francisco, Guatemala (N 16° 04′, W 90° 25′).

Stratigraphic horizon. — Caribe Formation, middle Miocene.

Description. — Female: Carapace elongate ovate, pointed behind, highest about one-third of the length from the anterior end. Anterior end obliquely rounded; dorsal margin slightly sinuate, almost parallel to the ventral margin, which is sinuate in front of the middle, convex behind; posterior end narrowly rounded below the middle, straight or slightly concave above, convex below; the posterior cardinal angle lies about one-seventh of the length from the posterior end. Dorsal view lens-shaped, widest just behind the middle, anterior end rounded, posterior end compressed, with the lateral outline of the valve slightly concave in the posterior one-sixth of the right valve.

Left valve larger than the right and overlapping antero- and posterodorsally and midventrally. Surface of the valves smooth, only slightly punctuate by the orifices of normal porecanals.

Male: Elongate, height about equal in the middle half of the carapace but less than the height of the female; dorsal margin parallel to ventral.

Hinge: In the right valve, a somewhat elongate, horizontally compressed tooth which is higher in front, a postadjacent round socket, narrowing to a long, straight groove; posterior tooth triangular, highest posteriorly.

Marginal area fairly broad in anterior end; line of concrescence and inner margin separated, the first forming a wavely line, caused by the enlarged bases of the radial porecanals. These are numerous, fairly short and thick and somewhat irregular.

Dimensions. — Female: L 0.81 mm; H 0.40 mm; W 0.40 mm. Male: L 0.85 mm; H 0.38 mm.

Remarks. — This species from the Miocene of the Guatemala (both Caribe and Río Dulce Formations) has been found in the Dominican Republic in both the Cercado and the Gurabo Formations (lower part of the latter); in Puerto Rico it is found in the Lajas Valley and recently I have discovered a single specimen in the Chipola Formation of Florida.

Subfamily **BRACHYCYTHERINAE**

Genus **BRACHYCYTHERE** Alexander, 1933

Brachycythere sp. cf. **B. russelli** Howe and Lea

Brachycythere watervalleyensis Howe and Chambers, 1935 (part), p. 46, pl. 3, fig. 4 (not figs. 1-3, 5, 6; pl. 4, fig. 1; pl. 6, fig. 7).
Brachycythere russelli Howe and Lea, Howe and Law, 1936, p. 41, pl. 2, figs. 1, 4, 5, 8 text-fig. 1 (19-24), text-fig. 2 (1).
Brachycythere watervalleyensis Howe and Chambers, Bergquist, 1943, p. 109, pl. 11, fig. 22 (not fig. 21).
Brachycythere russelli Howe and Lea, van den Bold, 1946, p. 107, pl. 13, figs. 8 a-c; Stephenson, 1946, pp. 333, 334, pl. 44, fig. 22; pl. 45, fig. 19.
Digmocythere russelli (Howe and Lea) Mandelstam, 1958, p. 277; Mandelstam, Osnovy Paleontologii, 1960, fig. 144.
Digmocythere russelli (Howe and Lea), Howe, 1963, p. 18, pl. 1, fig. 14, 15; Deboo, 1965, pl. 11, fig. 16.

Remarks. — In sample 15101 a few broken specimens were found which appear to belong to this species, but no certainty in identifications was possible due to the broken condition. Because *B. russelli* has so far not been found in the Miocene it is thought best to make a comparative identification. The writer prefers to leave this species in the genus *Brachycythere* until more species of the same group (with anterior crenulate tooth) have been found. Incidentally no crenulation of the anterior tooth was observed in the material of the Dominican Republic.

Family **LOXOCONCHIDAE**

Subfamily **LOXOCONCHINAE**

Genus **LOXOCONCHA** Sars, 1866

Loxoconcha forda, n. sp. Pl. 3, figs. 3a-e

Name. — *Fordus* (L) — pregnant.

Holotype. — Left valve of a female (HVH No. 8341).

Paratypes. — Male and female left and right valves (HVH Nos. 8342, 8343).

Type locality. — H 15469, Text-fig. 3; Table 6.

Stratigraphic horizon. — Probably Gurabo, laminated light gray, friable, fine, fossiliferous sandstone.

Occurrence. — Gurabo Formation, (Dominican Republic), Bowden Formacion (Jamaica), and Ponce Formation (Puerto Rico).

Description. — Carapace subquadrate to subcircular. Anterior end short, obliquely and broadly rounded, with dorsal slope al-

most straight in the right valve; dorsal margin straight in right valve, gently convex in the left; ventral margin almost straight and parallel to dorsal; posterior end short, bluntly angled above the middle, broadly rounded below, obliquely truncate above.

Dorsal view broadly lens-shaped, widest just behind the middle, ends compressed, with the lateral outline slightly concave there.

The greatest width lies at a point just behind and below the centre of the valve and it is also the centre of the concentric reticulate pattern. Pits in the center generally rounded, becoming elongate parallel to the nearest margin towards the periphery.

Hinge and marginal area typical for the genus.

Dimensions. — Left valve: L 0.56 mm; H 0.41 mm; W 0.21 mm. Right valve: L 0.55 mm; H 0.40 mm.

This species is similar in general features to *L. endocarpus* Sharapova (Schweyer, 1949, p. 46, pl. 6, fig. 3; Agalarova, *et al.*, 1961, p. 145, pl. 88, fig. 3, fa-c; Mandelstam, *et al.*, 1962, p. 174, pl. 27, fig. 12) from the upper Pliocene (Apsheron Stage) and Post-Pliocene of the USSR, but it differs in details.

Subfamily **CYTHERURINAE**

Genus **CYTHERURA** Sars, 1866

Cytherura cresera, n. sp. Pl. 7, figs. 3 a-d

Name. — *Kresera* (Gr) - a flour sieve.

Holotype. — A left valve (HVH No. 8326).

Paratypes. — Left and right valves (HVH Nos. 8327, 8328).

Type locality. — H 15212, at or near Maury's locality No. 1 = St. 8527 (USGS) (Text-fig. 4; Table 9).

Stratigraphic horizon. — Gurabo Formation. Massive gray, fossiliferous clay (Bermudez, 1949, p. 43).

Occurrence. — Lower part of Gurabo Formation (Dominican Republic), Bowden Formation (Jamaica).

Diagnosis. — An alate species of *Cytherura* with the ala extending obliquely across the ventral margin, a dorsal ridge and fine reticulation.

Description. — Carapace subrectangular, highest just behind the middle at the dorsal ridge, alate. Anterior end blunt, broadly rounded, dorsal margin nearly straight, slightly convex and some-

what depressed behind the anterior end; ventral margin parallel, slightly sinuate in front of the middle; posterior end a subdorsal caudal process, concave above and below.

Surface finely reticulate. Dorsal ridge long, low, slightly convex, extending from the eyespot to the posterior end and obscuring the dorsal margin; ventral ridge starting below the middle of the anterior margin, converging towards the ventral margin, concave ventrally first, than, behind the middle, becoming convex and obscuring the ventral margin. It forms an oblique ala, which is pointed at its greatest lateral extension, then narrows rapidly behind this point and becomes somewhat irregular, ending about one-sixth of the length from the posterior end. Greatest width at about one-fourth of the length from behind. Dorsal view arrow-shaped, posterior end much more compressed than anterior.

Dimensions. — L 0.41 mm; H 0.22 mm; H 0.14 mm (in left valve).

Remarks. — *Cytherura byramensis* Howe and Law (1936, p. 69, pl. 6, fig 3) shows no dorsal ridge and a slightly differently shaped ala but is otherwise similar.

Genus **HEMICYTHERURA** Elofson, 1941

Hemicytherura cranekeyensis Puri Pl. 7, figs. 7 a-b

Cytherura clathrata (Sars), van den Bold, 1946, p. 118, pl. 14, figs. 9-10.
Not *Cytherura clathrata* Sars 1866, p. 77.
Hemicytherura videns (Müller), van den Bold, 1957, p. 245 (part, not pl. 4, fig. 12).
Not *Cytheropteron videns* Müller, 1894, p. 303, pl. 20, figs. 2, 8.
Hemicytherura cranekeyensis Puri, 1960, p. 115, pl. 4, fig. 4, 5.
Hemicytherura sp. van den Bold, 1963, p. 398, pl. 9, fig. 5.

The synonymy of this species has been more complicated because of the failure by the author to recognize in 1963 the identity of it as *H. cranekeyensis* Puri. This was caused by the fact that Puri indicated the holotype to be No. 4738 in the H. V. Howe collection. That specimen is a paratype, right valve, and not complete. The complete specimen, the holotype, is in the Florida Geol. Survey and is so different from Puri's figure that I ignored it. However, a later examination of topotypes proved the species from the Miocene of Trinidad to be identical to *H. cranekeyensis* and also to the species found in the Miocene of the Dominican Republic and Jamaica.

Subfamily **CYTHEROPTERINAE**

Genus **CYTHEROPTERON** Sars, 1866

Cytheropteron sp. Pl. 7, figs. 2a-c; Pl. 8, fig. 1

Description. — Carapace in lateral view ovate, alate, pointed behind; greatest height in the middle. Anterior end almost evenly rounded, dorsal margin arched, ventral margin convex, slightly flattened in the middle, swinging upward in the posterior end; posterior end pointed in the middle, almost straight below, slightly convex above. A strong ventral ala occurs, backwardly swept and sharply pointed at the end, with a depression in its middle, which does not reach median height of the valve. In dorsal view the ala forms a regular curve in front, concave behind and has a separate spine projecting backwards from its lower side, close to the outline of the valve; posterior end more strongly compressed than anterior; greatest width at the end of the ala. Hinge in left valve: terminal rounded sockets and an intermediate, straight, crenulate bar below the curve of the dorsal margin. Marginal area of equal width throughout. Line of concrescence and inner margin coincide.

Dimensions. — Left valve: L 0.35 mm; H 0.21 mm; W 0.16 mm.

Occurrence. — H: 15269; 15244; Upper Gurabo Formation.

Cytheropteron? trinidadensis van den Bold Pl. 7, figs. 9 a-d; Pl. 8, figs. 5a, b

Cytheropteron? trinidadensis van den Bold, 1960, p. 176, pl. 5, figs. 5 a-c.

Remarks. — In 1960 (p. 177) I compared this species in shell structure to moults of *Brachycythere russelli* Howe and Lea and referred it questionably to *Cytheropteron*. Since then Rajagopalan (1962, p. 67) described a similar species, *Neocytheridea inflata* Rajagopalan (1962, p. 67, pl. 4, figs. 20-24) for which he set up a new genus. Unfortunately the name *Neocytheridea* has been used three times for different ostracodes. Grekoff (1953, p. 377) referred *Candona ansata* Jones (1885), *Cythere boloniensis* Jones, (1882) (not *Candona bononiensis* Jones, 1885), and *Cypris henfieldensis* Anderson (1939) to the genus *Neocytheridea* Anderson (1952, in lit.). Neocytheridea was never described and is ignored in Anderson's later work (1966). It is a *nomen nudum*. *Candona ansata* and *Cythere boloniensis* are now placed in *Fabanella* Mar-

tin (1961). As a further complication Wolburg (1962, p. 219) referred his earlier described *Fabanella polita inflata* (Wolburg, 1961) to *Neocytheridea* Anderson under the name *Neocytheridea bononiensis inflata*. Then Rome (1962, p. 291) created a subgenus *Neocytheridea* of the genus *Haplocytheridea*.

Under these conditions I prefer to leave the present species in *Cytheropteron* until it can be decided which of the *Neocytheridea* genera is valid.

Dimensions. — L: 0.55 mm; H: 0.41 mm.

Occurrence. — Trinidad (middle Eocene, *Hantkenina aragonensis* zone), Oligocene, Miocene (Lengua Formation, *Globorotalia menardii* zone) Dominican Republic (Gurabo Formation), Jamaica (San San Clay).

Genus **KANGARINA** Coryell and Fields, 1937

Kangarina depressa, n. sp. Pl. 7, figs. 5a, b; Pl. 8, fig. 7

Name. — *Depressa* after the name given to the type species of *Paracytheridea* at the time of the erection of the genus.

Holotype. — A left valve (HVH No. 8335).

Paratypes. — Six left and right valves (HVH No. 8336).

Type locality. — H 15212 = USGS st. 8527 (Bermudez, 1949, p. 43), on the Río Mao at Paso Bajito, near Cercado de Mao. At or near Maury's loc. 1 on the Río Mao (Text-fig. 4; Table 9).

Stratigraphic horizon. — Gurabo Formation. Massive gray, fossiliferous clay.

Occurrence. — Lower Gurabo Formation (Dominican Republic), Bowden Formation (Jamaica).

Diagnosis. — A species of *Kangarina* that bears resemblance to *Paracytheridea*.

Description. — Carapace small, elongate, subrectangular, highest at about one-sixth of the length from the anterior end. Anterior end obliquely and broadly rounded, dorsal margin straight, ventral margin nearly straight and parallel, swinging upward into the posterior end in a wide curve; posterior end a subdorsal caudal process, margin just above and below it, concave.

Ornamentation more complex than usual in this genus and resembling in some respects that of *Paracytheridea*. The posterior loop-shaped ridge, which is typical for species of *Kangarina*, is

well developed but lacks the anterior extension it has in the type species. Instead the anterior part of the loop, which runs in a short curve down from the connecting ridge with the dorsal, meets the ventral ridge at its greatest lateral extension, about two-fifths of the length from behind. From this point the ventral ridge runs forward and upward and meets the anterior margin a little below the middle. From the eyespot, just below and behind the anterior cardinal angle, a steep ridge runs down, slightly backward, meeting the ventral ridge at about one-third of the length from the anterior end, just below a strong subcentral swelling. Dorsal ridge low, convex, obscuring the dorsal margin from the middle to nearly the posterior end. The ventral ridge obscures the posterior part of the ventral margin and swings upward in the posterior branch of the loop, which exhibits a strong hook-shaped tooth.

Dorsal view: Widest behind the middle at the greatest extension of the ventral ridge; slightly less wide at the subcentral swelling at one-third from the anterior end, just above the ventral ridge, and slightly narrower at the junction of the posterior loop and the transverse ridge which meets the dorsal ridge a little in front of its middle.

Hinge. — Left valve: an elongate, crenulate anterior socket and a shorter posterior one, with an intermediate, long, crenulate bar. In the right valve there is a long, anterior, crenulate tooth and long, crenulate groove. Posterior tooth could not be observed.

Dimensions. — Holotype: left valve, 0.36 mm; H 0.17 mm; W 0.11 mm.

Remarks. — Because of its alate shape, its subcentral and postero-dorsal swellings, and the upward swinging ventral ridge, this species shows much in common with species of *Paracytheridea*. On the other hand it resembles species of *Kangarina (e.g. Kangarina chipolensis* Puri) with their posteroventral loop-like ridge. No species of *Kangarina* and *Paracytheridea* were found which resemble this species closely enough to warrant a comparison.

Subfamily **PARACYTHERIDEINAE**

Genus **PARACYTHERIDEA** Müller, 1894

Paracytheridea altila Edwards Pl. 7, figs. 1 a-d

Cytheropteron nodosum Ulrich and Bassler, 1904, p. 129, pl. 38, figs. 37-40; Howe *et al.*, 1955, p. 37, pl. 4, fig. 7; van den Bold, 1946, p. 86, pl. 16, fig. 14; Swain, 1952, p. 51, pl. 3, figs. 19-22.
Paracytheridea altila Edwards, 1944, p. 512, pl. 85, figs. 20-21; Puri, 1954, p. 235, pl. 3, fig. 15, 16, text-figs. 5 j, k.
Paracytheridea vandenboldi Puri, 1953, p. 751; Malkin, 1953, p. 780, pl. 79, fig. 5; Puri, 1954, p. 238, pl. 3, fig. 7, text-figs. 5 a, b; Swain, 1955, p. 625, pl. 62, figs. 2 a, b; McLean, 1957, p. 75, pl. 8, figs. 4 a, b.
Paracytheridea washingtonensis Puri, 1954, p. 240, pl. 3, figs. 10, 11, text-figs. 5 d-f; Puri, 1960, p. 110, pl. 1, fig. 11, 12, text-figs. 6, 7.

Dimensions. — L 0.68 mm; H 0.32 mm.

Remarks. — This species occurs together with *Paracytheridea tschoppi* in the Gurabo Formation. It shows some variation which has led various authors to attribute different names to this species, but these variations grade into each other so gradually that there appears little doubt that they are basically the same species.

Paracytheridea sp. aff. **P. hispida** van den Bold Pl. 4, figs. 6 a, b

Paracytheridea hispida van den Bold, 1946, p. 87, pl. 9, figs. 10 a, b.

Only one specimen of this easily recognizable species was found (H 15299, Gurabo). It has much the same characters of *P. hispida*, except that all features are more exaggerated. The high anterior cardinal angle is elevated to a spinose projection, the subcentral swelling becomes a long backwardly curved spine and the ala ends in a long, slender, backwardly deflected spine.

Dimensions. — L 0.50 mm; H 0.32 mm; W 0.32 mm (left valve).

J. Baker has found the same or a similar species off the coast of Puerto Rico.

Paracytheridea tschoppi van den Bold Pl. 4, figs. 8 a-d

Paracytheridea tschoppi van den Bold, 1946, p. 85, pl. 16, figs. 6, 7; Kingma, 1948, p. 74, pl. 7, fig. 12; Keij, 1954, p. 220, pl. 4, fig. 4; van den Bold, 1957, p. 245, pl. 4, fig. 7; Benson and Coleman, 1963, pp. 33, 34, pl. 6, figs. 7, 9, 10, text-figs. 20 a, b; van den Bold, 1967b, p. 313.
Paracytheridea vanwessemi van den Bold, 1946, p. 86, pl. 16, fig. 13.
Paracytheridea sp. 1, Drooger and Kaasschieter, 1958, p. 91.

Present series of specimens show all gradations between *P. vanwessemi* and *P. tschoppi* and, therefore, is thought to belong to one species.

Dimensions. — L 0.53 mm; H 0.27 mm; W 0.18 mm (left valve).

Paracytheridea sp. Pl. 4, figs. 7 a, b

Description. — Carapace subrectangular, highest at anterior

cardinal angle, about one-fourth of the length from the anterior end; alate, compressed and triangular behind; this posterior triangle makes the impression of being at an angle to the carapace because of the oblique trend suggestd by the ala. Anterior end obliquely rounded, narrowly rounded, almost angular below; dorsal margin straight, except for the projecting posterior cardinal angle; ventral margin sinuate, generally convex and grading into the ventral part of the posterior end; posterior end flat, angled at 90° above the middle, truncate above and below; the lower part has a small spine, projecting backwards, about halfway down. The ala starts at the anterior margin above its narrowest curve and extends, with a straight and knife-edged forward rim obliquely downward and backward, obscuring the ventral margin behind a point about one-third of the length from the anterior. Ala sharply pointed at its greatest lateral extension. The posterior rim of the ala connects with a subdorsal swelling in front of the posterior cardinal angle. This swelling is low, hardly obscuring the dorsal margin, and sharply truncate behind. A median ridge, which extends from just below the middle of the anterior end over the subcentral swelling and then curves sharply down to the spot where the ventral ala starts obscuring the ventral margin, is less clearly developed than usual in species of *Paracytheridea*. The surface of the carapace is irregularly reticulate and wrinkled.

Hinge in the left valve consists of an anterior long crenulate socket, a median long crenulate bar, and a short posterior socket in the posterior cardinal angle.

Dimensions. — L 0.68 mm; H 0.35 mm.

Remarks. — Only a few left valves were found, so that the species cannot be completely described. It should be easily recognizable because of its peculiar looking posterior end.

Occurrence. — Gurabo Formation, 15299, (Table 10) 15369 (Table 4).

Family **BYTHOCYTHERIDAE**

Genus **PSEUDOCYTHERE** Sars, 1866

Pseudocythere sp. Pl. 6, fig. 1

Description. — Carapace ovate, small, dorsally produced behind, highest just in front of the middle. Anterior end broadly rounded;

dorsal margin sinuate, curving upward slightly in the caudal process; ventral margin slightly sinuate in front of the middle, curving upward into the steep and nearly straight posterior margin, which is sharply compressed behind the tumid ventral portion of the carapace. Dorsal view spindle-shaped, tumid, widest just in front of the middle, strongly compressed at both ends.

Hinge margin without teeth; marginal area of moderate width, line of concrescence and inner margin apparently coincident throughout; porecanals of moderate number, widely spaced and with slightly widened bases.

Dimensions. — L 0.38 mm; H 0.23 mm.

Remarks. — This species appears to be confined to the lower part of the Gurabo Formation (subst. Cercado Formation *sensu* Dohm).

Genus **PSEUDOCERATINA** van den Bold, 1965

Pseudoceratina droogeri van den Bold Pl. 6, fig. 2

Pseudoceratina droogeri van den Bold, 1965, p. 161, pl. 1, figs. 1-4, text-figs. 1, 2; van den Bold, 1966 g, table 1; van den Bold, 1967 b, p. 313.

Occurrence. — Gurabo Formation.

Family **XESTOLEBERIDIDAE**

Genus **XESTOLEBERIS** Sars, 1866

Xestoleberis sp. 1 Pl. 6, figs. 9 a-c

Xestoleberis sp. van den Bold, 1963, p. 402, pl. 10, figs. 14 a, b.

Description. — Carapace elongate ovate, highest behind the middle. Anterior end obliquely rounded, broad; dorsal margin with a small angulation at the greatest height, it slopes more steeply backward than forward; ventral margin gently convex, slightly sinuate in front of the middle; posterior end almost vertically truncate, slightly convex. Dorsal view pyriform, widest behind the middle.

Dimensions. — L 0.61 mm; H 0.37 mm; W 0.35 mm.

Figured specimen is from 15372 (Table 4).

Xestoleberis sp. 2 Pl. 6, figs. 8 a-d

Description. — Carapace almost semicircular in side view, highest just behind the middle; anterior end more obliquely rounded than posterior end, both narrowly rounded ventrally. An-

terior end obliquely rounded, dorsal margin arched, without angulation with anterior end. In the left valve there is also no posterodorsal angulation, but in the right valve the dorsal margin forms a small angulation with the posterior margin which slopes steeply down to the narrowly rounded, ventrally situated posterior end. Ventral margin almost straight in both valves.

Dorsal view ovate, widest behind the middle.

Hinge and marginal area are typical for the genus; muscle scars form a slightly oblique row of four with a V-shaped one in front. The xestoleberid scar is elongate.

Dimensions. — Left valve: L 0.45 mm; H 0.30 mm. Right valve: L 0.43 mm; H 0.28 mm.

Figured specimen is from 15242 (Table 7).

Xestoleberis sp. 3 Pl. 1, figs. 7 a-c

Xestoleberis margaritea Brady ?, van den Bold, 1963, p. 402, pl. 10, fig. 13.

Description. — Carapace about semicircular in side view, highest in the middle. Anterior end obliquely rounded, narrowly rounded below; posterior end more broadly and more regularly rounded; dorsal margin arched, slightly flattened in the middle; ventral margin almost straight. Dorsal view pyriform, widest behind the middle, anterior end compressed somewhat pointed, posterior end broadly rounded.

Dimensions. — L 0.50 mm; H 0.32 mm; W 0.34 mm.

Figured specimen is from H 15093.

Xestoleberis sp. 4 Pl. 1, figs. 6 a-d

? *Xestoleberis* sp. A, van den Bold, 1946, p. 120, pl. 16, figs. 17 a-d.
? *Xestoleberis* sp. E, van den Bold, 1946, p. 120, pl. 9, figs. 25 a, b.

Description. — Female: Carapace pyriform in side view, highest just behind the middle. Anterior end obliquely rounded, narrowly rounded below; dorsal margin arched, slightly angled at the greatest height, ventral margin sinuate anterior to the middle, broadly rounded behind and curving upward in the broadly and slightly obliquely rounded posterior end. Posterior extremity just below the posterior cardinal angle. Dorsal view pyriform, widest just behind the middle. Male similar in outline but more elongate; posterior end more regularly and slightly more narrowly rounded than in the female.

Dimensions. — Small female left valve: L 0.35 mm; H 0.22 mm; Female right valve: L 0.40 mm; H 0.24 mm; Male left valve: L 0.38 mm; H 0.23 mm; Male right valve: L 0.37 mm; H 0.21 mm.

Figured specimens from H 15242 (Table 7).

Remarks. — The species is almost certainly identical to *Xestoleberis* sp. A which may be the same as X. sp. E. *Xestoleberis* sp. A occurs in the La Cruz Formation (middle Miocene) of Cuba and in the uppermost part of the Nipe series, presumably of middle Miocene age. *Xestoleberis* sp. E was found in the upper part of the Río Dulce Formation in Guatemala which I consider now (van den Bold, 1966e, p. 1092) to be equivalent in age of part of the Gatun Formation of Panama. The Gurabo Formation appears to be slightly younger than either the Nipe Series or the Río Dulce Formation.

Genus **UROLEBERIS** Triebel, 1958

Uroleberis triangula, n. sp. Pl. 6, figs. 5a-c; Pl. 10, figs. 1 a, b

Name. — *Triangulus* (L) — three-angled.

Holotype. — A left valve (HVH No. 8374).

Paratypes. — One left and 2 right valves (HVH No. 8375).

Type locality. — Locality 15212 (Text-fig. 4, Table 9) = Station 8527 USGS, at or near Maury's station 1 on the Río Mao.

Stratigraphic horizon. — Gurabo Formation (Bermudez 1949, p. 13). Massive gray, fossiliferous clay.

Distribution. — Gurabo and Cercado Formations (Dominican Republic), Bowden Formation (Jamaica).

Description. — Carapace subtriangular in side view, highest in the middle. Anterior end obliquely rounded, with straight upper slope and narrowly rounded ventral portion; dorsal margin arched, obtusely angled at the junction with the anterior margin, slightly convex in front of the middle, convex behind it and sloping rapidly down into the steeply truncate posterior margin; ventral margin almost straight from the anterior to the posterior rounding; posterior end angled ventrally with a small backwardly projecting process in both valves.

Dorsal view ovate, widest behind the middle; anterior end narrowly rounded, posterior end with two small processes, incised in between.

Left valve larger than the right, overlapping along almost the entire margin, strongest overlap in the anterodorsal region. The right valve in side view is more irregular in shape than the left, and the posterodorsal slope is abrupt.

Hinge in the left valve consists of terminal, elongate, crenulate sockets and a curved, crenulate, median bar; in the right valve the dorsal margin forms a sharp ridge below which lie the terminal elongate dental areas and the median groove.

Marginal area broad in the anteroventral rounding, with a small but deep vestibule. Porecanals are crowded in the vestibule area but widely spaced above it. Several false radial canals are present. In the posteroventral angle is a smaller vestibule.

Muscle scars: A posterior vertical row of four with a V-shaped scar in front. Mandibular scars not distinct. Below the anterior hinge tooth socket a curved xestoleberid scar is found which is J-shaped in the left valve and L-shaped in the right valve, seen from the interior.

Dimensions. — L 0.50 mm; H 0.31 mm; W 0.32 mm complete carapace, H 15372. Left valve, holotype: L 0.53 mm; H 0.34 mm. Right valve, paratype: L 0.43 mm; H 0.29 mm.

Uroleberis torquata, n. sp. Pl. 6, fig. 4; Pl. 10, fig. 2

Name. — After the type species of *Procythereis* Skogsberg *(Procythereis torquata)* because of the outward resemblance to this species.

Holotype. — A complete carapace (HVH No. 8377).

Paratypes. — A right and left valve (HVH No. 8378).

Type locality. — H 15093 (Text-fig. 6, Table 11), on Santiago-Puerto Plata road.

Stratigraphic horizon. — Mao Formation. Buff-coloured, thickly bedded, friable, argillaceous marl with numerous casts of branching corals.

Diagnosis. — A species of *Uroleberis* with knoblike, alate lateral extension.

Description. — Carapace ovate in side view, highest in the middle, resembling species of the genus *Procythereis* in outline; bluntly alate, concavely truncate behind. Anterior end obliquely rounded, dorsal margin convex, ventral margin almost straight,

slightly concave in front of the middle; posterior end obliquely truncate above, concave, and narrowly rounded below with a ventral, backwardly projecting process in each valve. Surface of the valves punctuate. About one-third of the length from the posterior end the lateral valve surface extends sidewards into a knoblike, blunt ala.

Left valve larger than the right and overlapping strongly along the dorsal margin. Greatest width at the alae, posterior end incised between the two backwardly projecting processes. Ventral surface striate because of longitudinal arrangement of the puncta.

Hinge in the right valve consists of strong, crenulate, terminal teeth and a deep straight, crenulate groove below the convex dorsal margin.

Marginal area and muscle scars could not be studied because of the opaqueness of the shell.

Below the anterior hinge tooth in the right valve is a distinct xestoleberid scar.

Dimensions. — L 0.53 mm; H 0.32 mm.

Remarks. — This species is similar to *Xestoleberis angulata* Brady (1870, Fonds de la Mer, p. 241, pl. 32, fig. 5, 6) from the Bahamas (see Pl. 6, figs. 3 a, b) but the anterior end is more obliquely rounded and the position of the ala extends more backward in the Recent species. As a comparison two other species of *Uroleberis* are figured: *Uroleberis* sp. from Los Rocques, Venezuela (Recent) (P. 6, figs. 6 a, b) and *Uroleberis* sp. from the Rosaria Formation (middle Miocene) of Cuba (Pl. 6, fig. 7). The latter species has also been found in the Ponce Formation of Puerto Rico.

Distribution. — Mao Formation (Dominican Republic), Matanzas Formation (Cuba), Bermudez No. 218 (HVH No. 8379).

CYTHERACEA incertae familiae

"N. gen., N. sp." Pl. 4, fig. 2; Pl. 10, fig. 3

Description. — Carapace minute, about twice as long as high, subovate to subrectangular in outline, highest in anterior third. Anterior end evenly rounded; dorsal margin almost straight, converging somewhat posteriorly towards the almost straight ventral margin. The dorsal margin is obscured in the posterior half

by a dorsal ridge. Posterior end angled in the middle, almost straight both above and below, the two parts forming an angle of about 130°. Left valve overlapping the right in the upper part of the anterior margin, overlap along dorsal and ventral margin is small. Surface covered with longitudinal ridges among which a dorsal and a median ridge are the most prominent; small irregular crossridges between the longitudinal ridges form a relatively coarse reticulate pattern. The meshes of this reticulation are minutely pitted (visible only in transmitted light). Dorsal view wedge-shaped, widest almost one-fourth of the length from the compressed posterior end; anterior end blunt.

Hinge observed in right valve only: anterior tooth placed backward, small, rounded; posterior tooth bean-shaped; intermediate groove narrow, no crenulation observed, widening anteriorly to a narrow socket.

Marginal area broad, especially in anterior end, where there is a small sickle -shaped vestibule; radial porecanals fairly numerous, about 20 in anterior end, with in addition a few false radial ones. Radial porecanals are widened in the distal third, widening of the false radial ones occurs about in the middle of the concrescence zone. Of the muscle scars only the frontal scar could be observed properly: it is V-shaped.

Dimensions. — L 0.33 mm; H 0.17 mm.

Remarks. — In several Recent samples a strongly related, but somewhat larger species is found, *Leptocythere yoni* Puri (1960, p. 114, pl. 4, figs. 8, 9). The specimens from the west coast of Florida (holotype) measure L 0.46 mm; H 0.26 mm; those from Chichiriviche (Venezuela) L 0.48 mm; H 0.25 mm; W 0.22 mm; from British Honduras (Teeter referred it to *Basslerites)* L 0.44 mm; H 0.24 mm; other material comes from the north coast of Cuba (Bronnimann 22), Pidgeon Point (Tobago), and Las Minas Bay (Panama, I 271: 45-55′ and 55-56′).

Relationship. — The generic position of this genus remains doubtful. It has been referred to *Leptocythere* and *Basslerites* but exhibits enough differences with these to separate it. Shell characters suggest affinity to the Leptocytherinae, but it will be necessary to wait until we have Recent material with preserved appendages before any definite assignment should be made.

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PLATES

EXPLANATION OF PLATE 1

Figure — Page

1. **Cytherella dominicana,** n. sp. — 41

   From 15101, Gurabo Formation: 30 X. a. Female right valve, holotype, HVH No. 8317. b. Interior of female right valve, paratype, HVH No. 8318. c. Female left valve, paratype, HVH No. 8318. d. Male right valve, paratype, HVH No. 8319. e. Interior of male right valve, paratype, HVH No. 8319.

2. **Cytherella** sp. — 43

   Left valve from 15093, Mao Formation, HVH No. 8316; 50 X.

3. **Cytherella** sp. — 43

   Left valve from 15369, Cercado Formation, HVH No. 8315; 50 X.

4. **Cytherella** sp. A — 42

   From 15117, Cercado Formation, HVH No. 8320; 50 X. a. Female right valve. b. Male right valve.

5. **Cytherella** sp. B — 43

   From 15212, Gurabo Formation, HVH No. 8321; 50 X. a. Right valve. b. Left valve.

6. **Xestoleberis** sp. 4 — 79

   From 15242, Gurabo Formation, HVH No. 8386. a. Female right valve; 90 X. b. Male left valve; 100 X. c. Male right valve; 90 X. d. Female left valve; 80 X.

7. **Xestoleberis** sp. 3 — 79

   From 15093, HVH No. 8385. 70 X. a. Right valve. b. Left valve. c. Dorsal view of complete carapace


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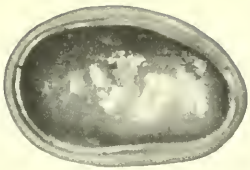
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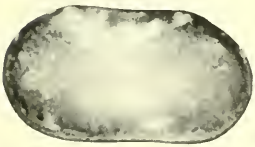
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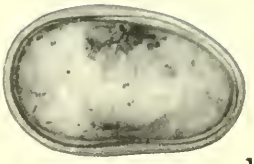
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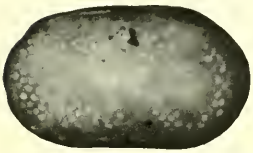
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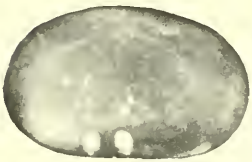
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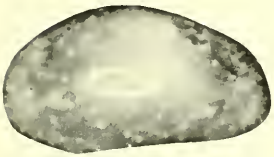
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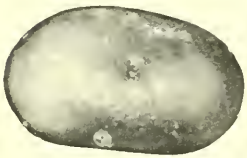
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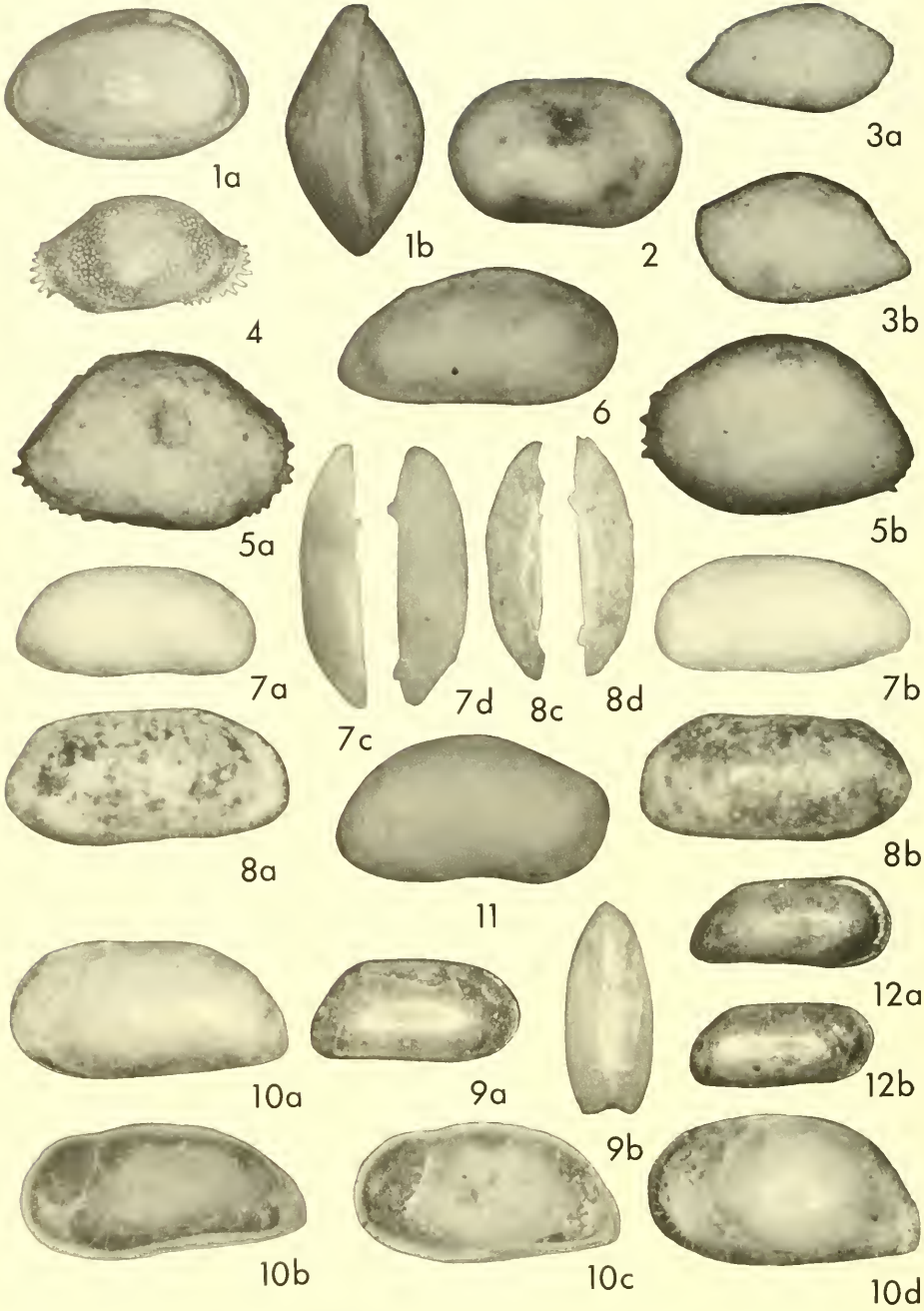
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EXPLANATION OF PLATE 2

Figure — Page

1. **Cardobairdia** glabra, n. sp. — 45
   a. Right valve view, Lengua Formation, Balata area, Trinidad, HVH No. 8307. b. Dorsal view; 40 X.

2. **Cytherella** sp. aff. C. vulgata Ruggieri — 40
   From 15000, HVH No. 8314, Gurabo Formation, right valve view; 35 X.

3. **Bairdia longisetosa** Brady — 48
   From 15092, HVH No. 8293, Mao Formation; 30 X. a. Right valve. b. Left valve.

4. **Bairdia** sp. aff. **B. fortificata** Brady — 48
   From 15242, HVH No. 8295, Gurabo Formation; 40 X. Left valve.

5. **Bairdia** sp. aff. **B. formosa** Brady — 48
   From 15092, HVH No. 8292, Mao Formation; 50 X. a. Right valve view. b. Left valve view.

6. **Paracypris** sp. — 47
   From 15092, HVH No. 8397, Mao Formation; 50 X. Right valve view.

7. **Acuticythereis elongata** van den Bold — 68
   From 15369, HVH No. 8299, Gurabo Formation. a. Right valve. b. Left valve; 40 X. c. Dorsal view, left valve. d. Dorsal view, right valve; 45 X

8. **Campylocythere** sp. — 68
   From 15437, HVH No. 8309, Gurabo Formation; 55 X. a. Right valve. b. Left valve. c. Dorsal view, left valve. d. Dorsal view, right valve, 45 X.

9. **Krithe dolichodeira** van den Bold — 51
   From 15269, HVH No. 8338, Gurabo Formation; 50 X. a. Right valve view. b. Dorsal view.

10. **Krithe trinidadensis** van den Bold — 19
    From 15248, HVH No. 8340, Mao Formation; 50 X. a. Left valve, male. b. Interior right valve, male. c. Interior right valve, female. d. Left valve, female.

11. **Bythocypris** sp. — 49
    From 15001, HVH No. 8395, Gurabo Formation; 35 X. Right valve.

12. **Krithe dolichodeira** van den Bold — 51
    From T 1439, Cuba; 45 X. a. Holotype, male, S 12986, right valve view. b. Paratype, female, HVH No. 8337, right valve view.

EXPLANATION OF PLATE 3

Figure — Page

1. **Loxoconcha banesensis** van den Bold 19

From 15244, HVH No. 8346, Mao Formation; 80 X. a. Right valve. b. Left valve.

2. **Loxoconcha rugosa** van den Bold 19

From 15369, HVH No. 8345, Cercado? Formation; 60 X. a. Right valve view. b. Dorsal view.

3. **Loxoconcha forda,** n. sp. 70

a. Female, left valve, holotype, HVH No. 8341, from 15469, Gurabo Formation. b. Right valve, female, paratype, HVH No. 8342. c. Dorsal view, female, left valve, paratype, HVH No. 8342. d. Dorsal view, female, right valve, paratype, HVH No. 8342. e. Male, left valve, HVH No. 8343; 50 X.

4. **Pterygocythereis polita,** n. sp. 64

From 15299, Gurabo Formation. a. Left valve, holotype, HVH No. 8357. b. Dorsal view same specimen. c. Dorsal view, right valve, paratype, HVH No. 8358.

5. **Paracytheretta dominicana,** n. sp. 55

From 15296, Gurabo Formation. a. Right valve view, holotype, HVH No. 8347, 55 X. b. Dorsal view, same specimen; 45 X.

6. **"Bradleya" hazelae** (van den Bold) 66

From 15000, HVH No. 8296, right valve.

7. **Cytheretta karlana** Howe and Pyeatt 55

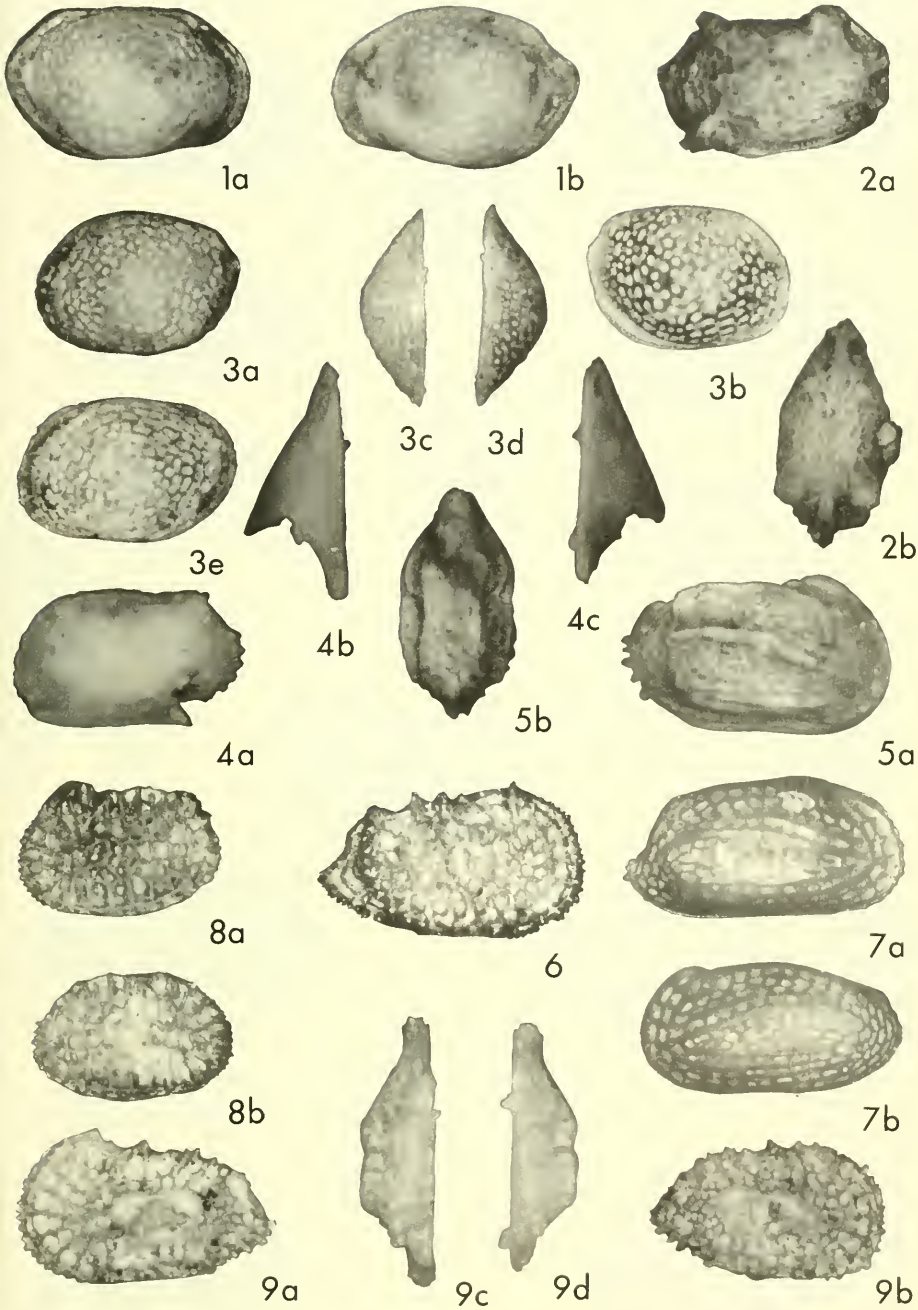
From 15117, Cercado Formation, HVH No. 8322; 45 X. a. Right valve. b. Left valve.

8. **Bradleya** ex gr. **dictyon** (Brady) 18

From 15101, HVH No. 8297, 35 X. a. Right valve. b. Left valve.

9. **Costa dohmi,** n. sp. 59

From 15269, Gurabo Formation; 55 X. a. Left valve, holotype, HVH No 8311. b. Right valve, paratype, HVH No. 8312. c. Dorsal view, left valve. d. Dorsal view, right valve, paratypes, HVH No. 8312.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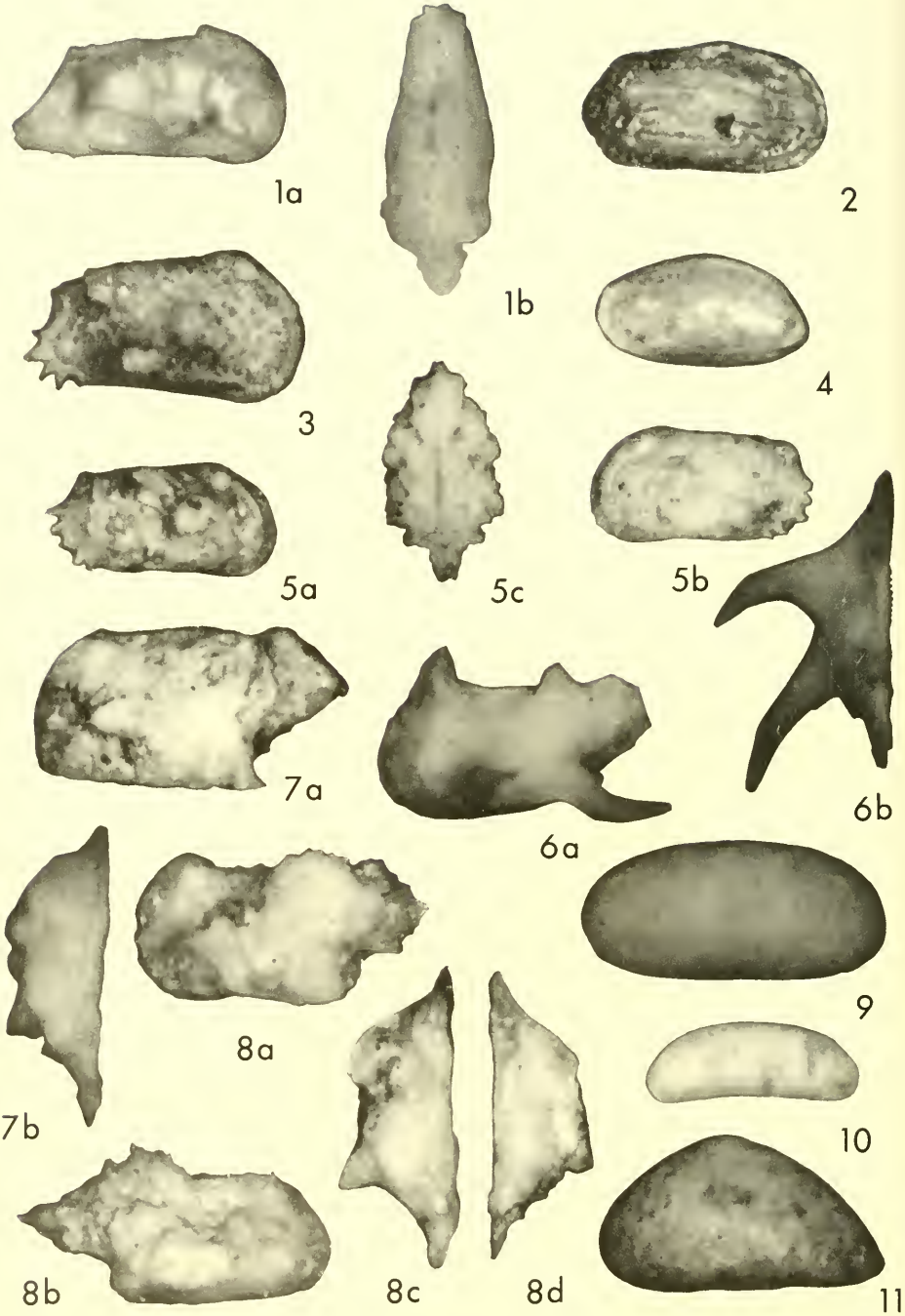
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EXPLANATION OF PLATE 4

Figure — Page

1. **Caudites medialis** Coryell and Fields — 19

From 15296, Gurabo Formation, HVH No. 8310; 70 X. a. Right valve view. b. Dorsal view.

2. "N. gen. N. sp." — 82

From 15212, Gurabo Formation, HVH No. 8394; 100 X. Right valve.

3. **Hermanites hornibrooki** (Puri) — 66

From 15269, Gurabo Formation, HVH No. 8334; 70 X. Right valve view.

4. **Argilloecia** sp. 2 — 47

From 15244, Gurabo Formation, HVH No. 8291; 70 X. Left valve view.

5. **Puriana pustulosa,** n. sp. — 63

From 15211, Gurabo Formation; 70 X. a. Right valve view, paratype, HVH No. 8365. b. Left valve, paratype, HVH No. 8365. c. Dorsal view, holotype, HVH No. 8364.

6. **Paracytheridea** sp. aff. **P. hispida** van den Bold — 76

From 15299, Gurabo Formation, HVH No. 8352; 70 X. a. Left valve. b. Dorsal view of same specimen.

7. **Paracytheridea** sp. — 76

From 15369, Gurabo Formation, HVH No. 8351; 60 X. a. Left valve. b. Dorsal view, left valve.

8. **Paracytheridea tschoppi** van den Bold — 76

From 15369, Gurabo Formation, HVH No. 8355; 70 X. a. Left valve. b. Right valve. c. Dorsal view, left valve. d. Dorsal view, right valve.

9. **Cushmanidea** sp. aff. **C. howei** (van den Bold) — 52

From 15092, Gurabo Formation, HVH No. 8344; 45 X. Left valve.

10. **Cushmanidea anderseni** Puri ? — 53

From 15212, Gurabo Formation, HVH No. 8398; 60 X. Left valve.

11. **Propontocypris** sp. — 20

From 15242, Gurabo Formation, HVH No. 8396; 45 X. Left valve.

EXPLANATION OF PLATE 5

Figure — Page

1. **Quadracythere products** (Brady) 57

From 15212, Gurabo Formation, HVH No. 8368; 50 X. a. Right valve. b. Left valve.

2. **Quadracythere bichensis** (van den Bold) 57

From 15369, Cercado Formation, HVH No. 8367; 50 X. Right valve view.

3. **Puriana congestocostata** van den Bold 20

From 15469, Gurabo Formation, HVH No. 8360; 40 X. a. Right valve, male. b. Right valve, female. c. Left valve, male.

4. **Puriana scrupulosa** n. sp. 61

a. Right valve, paratype, HVH No. 8363, from 15296, Gurabo Formation. b. Right valve, paratype, HVH No. 8362, from 15437, Cercado Formation. c. Left valve, holotype, HVH No. 8361, from 15437, Cercado Formation; 60 X.

5. **Trachyleberidea mammidentata** (van den Bold) 57

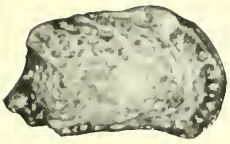
From J 6b, Bowden Formation, Jamaica, HVH No. 8369; 45 X. a. Right valve. b. Left valve.

6. **Trachyleberidea** sp. aff. **T. cubensis** (van den Bold) 59

From 15269, Gurabo Formation, HVH No. 8373; 50 X. a. Left valve. b. Right valve.

7. **Trachyleberidea mammidentata** (van den Bold) 57

From Bermudez 209, Cuba, Tinguaro Formation, Finca Adelina (*Globigerina ciperoensis ciperoensis* Zone), HVH No. 8370; 45 X. a. Right valve. b. Left valve.



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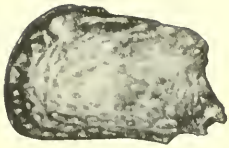

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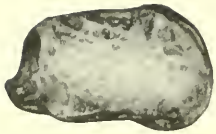

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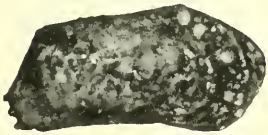

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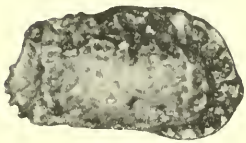

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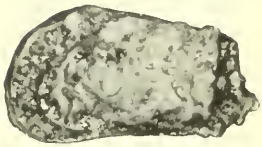

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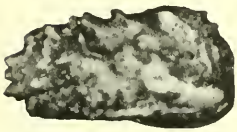

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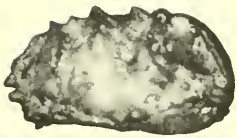

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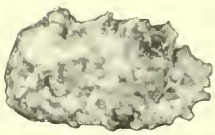

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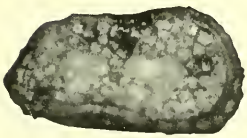

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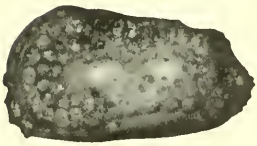

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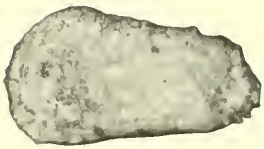

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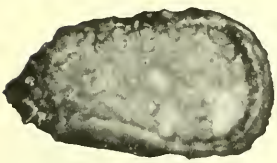

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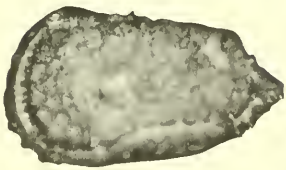

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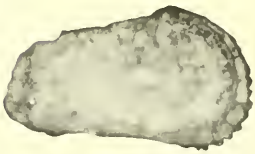

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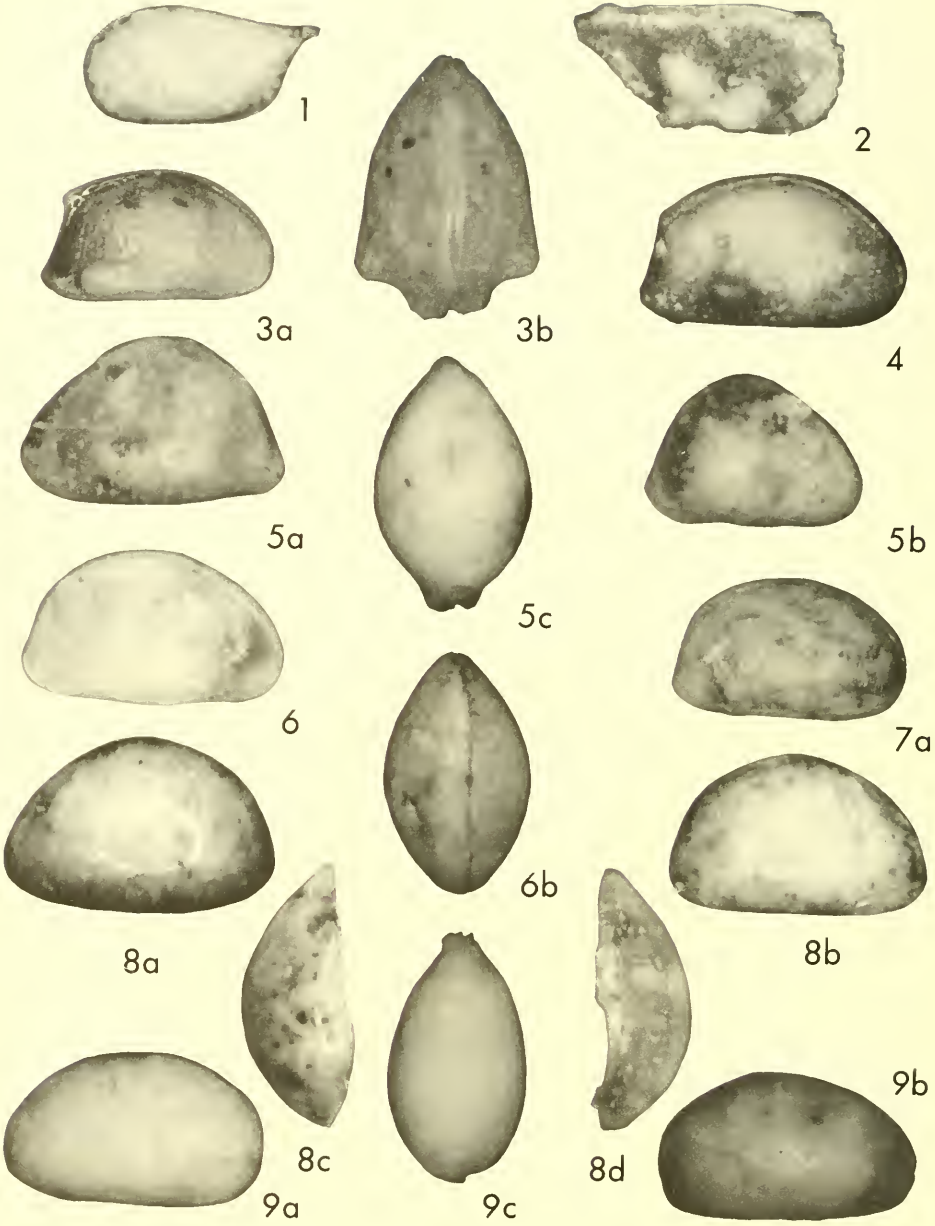
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EXPLANATION OF PLATE 6

Figure — Page

1. **Pseudocythere** sp. — 77

From 15212, Gurabo Formation, HVH No. 8356; 80 X. Left valve.

2. **Pseudoceratina droogeri** van den Bold — 78

From 15212, Gurabo Formation, HVH No. 8298; 65 X. Right valve.

3. **Uroleberis angulata** (Brady) — 20

From the Bahamas, Recent, HVH No. 8376; 65 X. a. Right valve view. b. Dorsal view.

4. **Uroleberis torquata,** n. sp. — 81

From Bermudez 218, Matanzas Formation, Pliocene, Cuba, cut at Río Canimar, 800 m S of the mouth, Matanzas Province. HVH No. 8379; 60 X. Right valve view.

5. **Uroleberis triangula,** n. sp. — 80

From 15212, Gurabo Formation; 70 X. a. Left valve, holotype, HVH No. 8374. b. Right valve, paratype, HVH No. 8375. c. Dorsal view of complete specimen.

6. **Uroleberis** sp. — 82

From Los Roques, Venezuela, Recent. HVH No. 8380; 80 X. a. Right valve view. b. Dorsal view. [6 on plate.]

7. **Uroleberis** sp. — 82

From Bermudez 623, Rosario Formation, L-M Miocene, Cuba, Habana Province, Villa Rosa, San Francisco de Paula, HVH No. 8381; 50 X. Right valve view. [7a on plate.]

8. **Xestoleberis** sp. 2 — 78

From 15242, Gurabo Formation, HVH No. 8384; 80 X. a. Left valve. b. Right valve. c. Dorsal view, left valve. d. Dorsal view, right valve.

9. **Xestoleberis** sp. 1 — 78

a. Left valve view, from 15372, Gurabo Formation; 55 X. HVH No. 8382. b. Right valve view, HVH No. 8283. c. Dorsal view, HVH No. 8382, from 15346.

EXPLANATION OF PLATE 7

Figure — Page

1. **Paracytheridea altila** Edwards 76

From 15211, Gurabo Formation. a. Right valve, HVH No. 8353. b. Left valve, HVH No. 8353; 45 X. c. Dorsal view, left valve. d. Dorsal view, right valve, HVH No. 8353; 55 X.

2. **Cytheropteron** sp. 73

a. Left valve, HVH No. 8323, from 15269, Gurabo Formation; 100 X. b. Dorsal view, left valve, same specimen; 70 X. c. Interior of left valve, HVH No. 8324, from 15244, Gurabo Formation; 70 X.

3. **Cytherura cresera,** n. sp. 71

From 15212, Gurabo Formation; 80 X. a. Right valve, paratype, HVH No. 8327. b. Left valve, holotype, HVH No. 8326. c. Dorsal view, left valve, paratype, HVH No. 8328. d. Dorsal view, right valve, HVH No. 8328, paratype.

4. **Gangamocytheridea? plicata,** n. sp. 53

From 15212, Gurabo Formation; 80 X. a. Right valve, holotype, HVH No. 8329. b. Dorsal view left valve, paratype, HVH No. 8330. c. Dorsal view of right valve, paratype, HVH No. 8330.

5. **Kangarina depressa,** n. sp. 74

From 15212, Gurabo Formation; 80 X. a. Left valve, holotype, HVH No. 8335. b. Dorsal view of same specimen.

6. **Cyprideis** sp. aff. **C. pascagoulaensis** (Mincher) 50

From 15370, Cercado Formation, HVH No. 8313; 35 X. a. Left valve, female. b. Left valve, male.

7. **Hemicytherura cranekeyensis** Puri 72

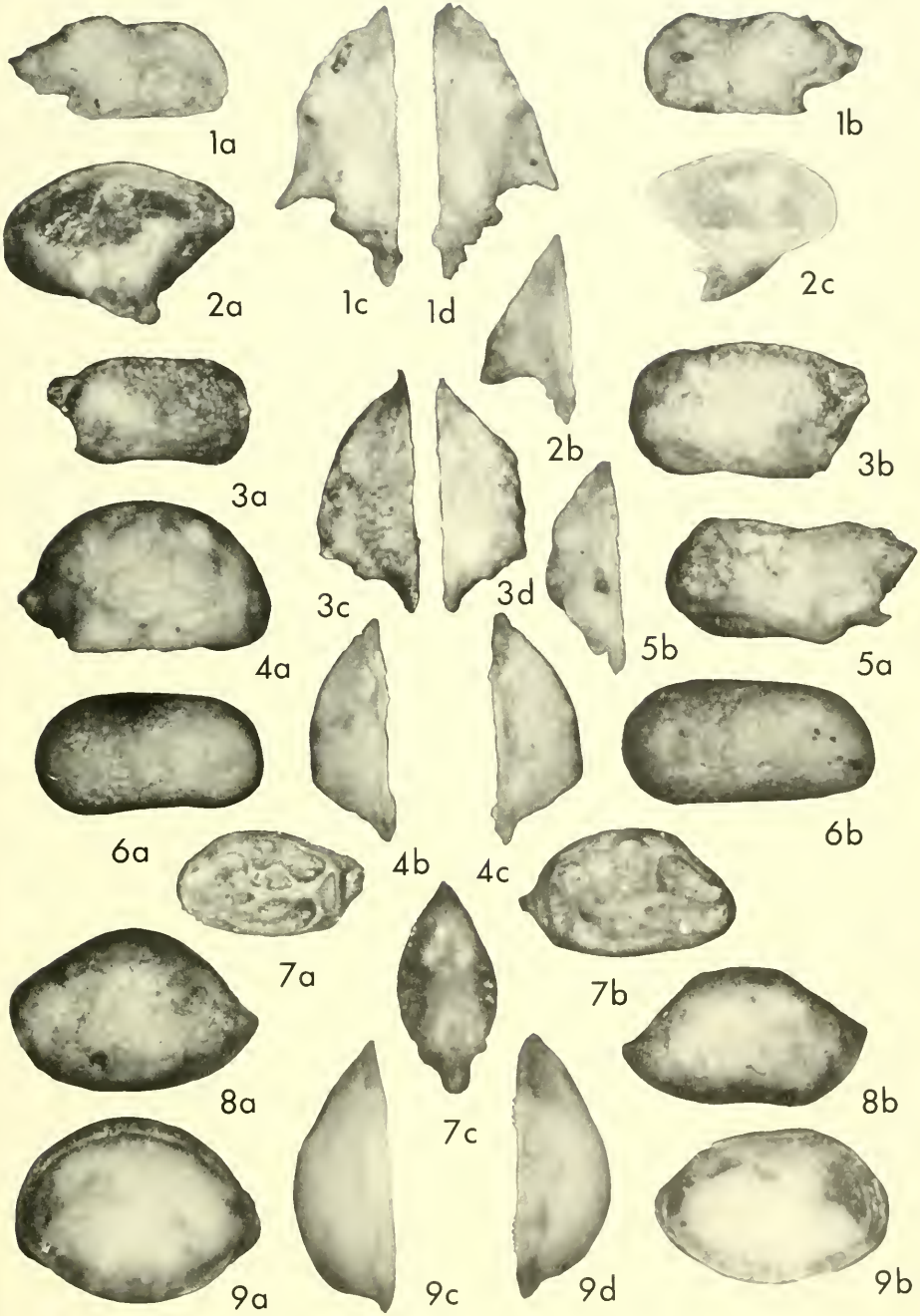
From 15212, Gurabo Formation, HVH No. 8333. a. Left valve; 70 X. b. Right valve; 90 X. c. Dorsal view; 90 X.

8. **Bairdia antillea** van den Bold 49

From 15369, Cercado Formation, HVH No. 8294; 35 X. a. Left valve. b. Right valve.

9. **Cytheropteron? trinidadensis** van den Bold 73

From 15000, Gurabo Formation, HVH No. 8325. a. Left valve. b. Right valve; 60 X. c. Dorsal view, left valve. d. Dorsal view, right valve; 65 X.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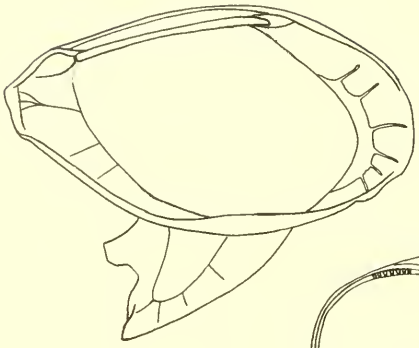

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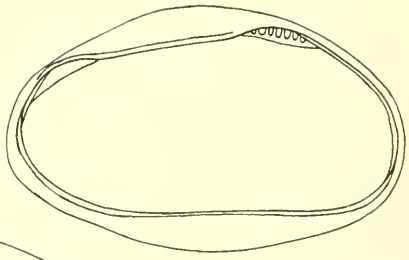

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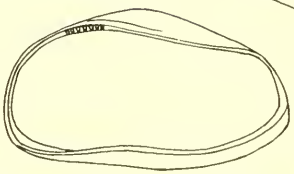

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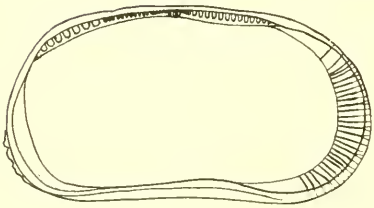

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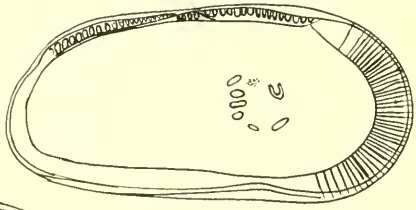

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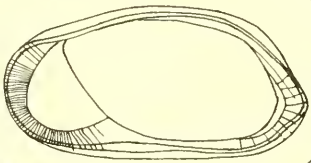

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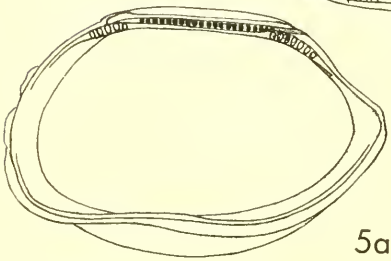

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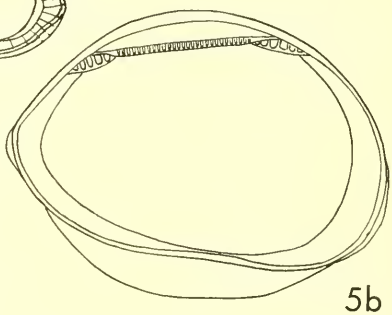

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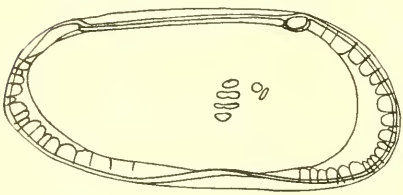

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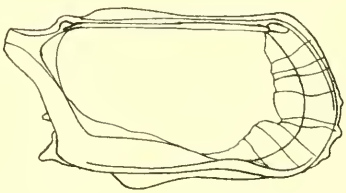


7

Explanation of Plate 8

Figure — Page

1. **Cytheropteron** sp. 73

From 15244, Gurabo Formation, HVH No. 8324; 155 X. Interior, left valve.

2. **Cardiobairdia glabra,** n. sp. 45

From 15000, Gurabo Formation; 70 X. a. Interior, left valve, holotype, HVH No. 8305. b. Interior, right valve, paratype, HVH No. 8306.

3. **Cyprideis** sp. aff. **C. pascagoulaensis** (Mincher) 50

From 15370, Cercado Formation, HVH No. 8313; 55 X. a. Interior, left valve, female. b. Interior, left valve, male.

4. **Argilloecia** sp. 1 47

From 15244, Gurabo Formation, HVH No. 8291; 100 X. Interior of right valve.

5. **Cytheropteron? trinidadensis** van den Bold 73

From 15000, Gurabo Formation, HVH No. 8325; 100 X. a. Interior, right valve. b. Interior, left valve.

6. **Campylocythere** sp. 68

From 15437, Cercado Formation, HVH No. 8309; 80 X. Interior, left valve.

7. **Kangarina depressa,** n. sp. 74

Paratype, from 15212, Gurabo Formation, HVH No. 8336; 120 X. Interior, left valve.

EXPLANATION OF PLATE 9

Figure — Page

1. **Costa dohmi,** n. sp. 59

From 15269, Gurabo Formation, paratypes, HVH No. 8312; 95 X. a. Interior, right valve. b. Interior, left valve.

2. **Paracytheretta dominicana,** n. sp. 55

From 15296, Gurabo Formation, paratypes, HVH No. 8348; 95 X. Interior, right valve.

3. **Gangamocytheridea? plicata,** n. sp. 53

From 15212, Gurabo Formation, paratype, HVH No. 8330; 135 X. Interior, left valve.

4. **Pterygocythereis polita,** n. sp. 64

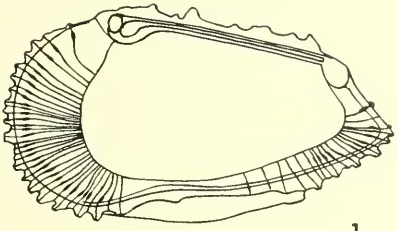
From 15299, Gurabo Formation; 95 X. a. Interior, right valve, HVH No. 8358, paratype. b. Interior, left valve, HVH No. 8358, paratype.

5. **Puriana scrupulosa,** n. sp. 61

From 15347, Cercado Formation; 95 X. a. Interior, left valve, holotype, HVH No. 8361. b. Interior, right valve, paratype, HVH No. 8362.

6. **Puriana pustulosa,** n. sp. 63

From 15296, Gurabo Formation, paratypes, HVH No. 8366; 115 X. a. Interior, right valve. b. Interior, left valve.



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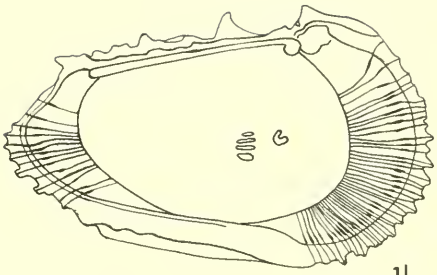

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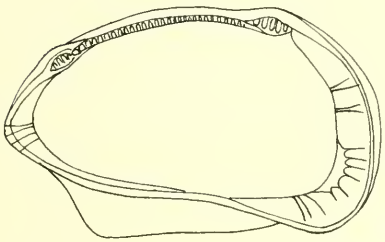

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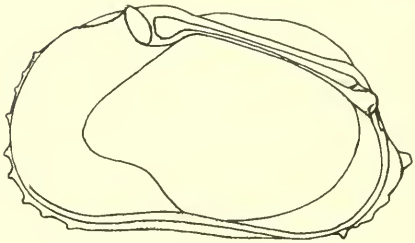

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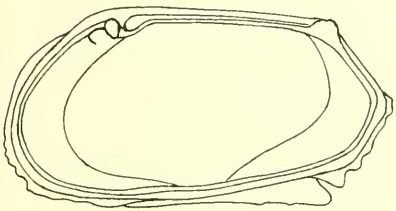

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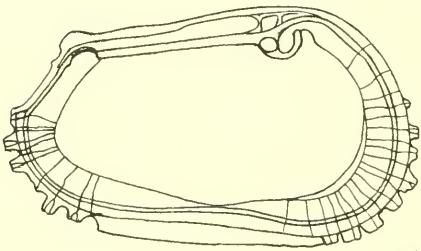

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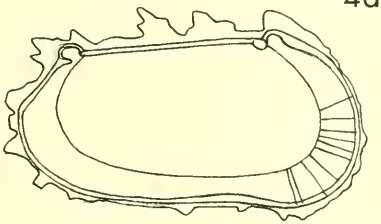

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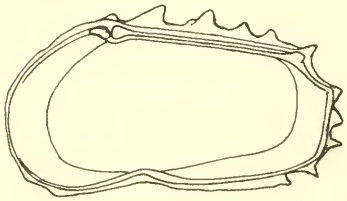

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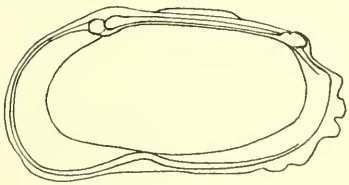

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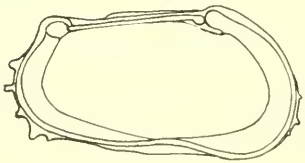

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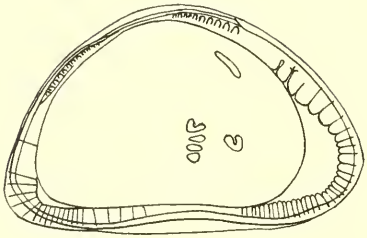

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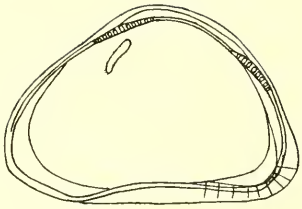

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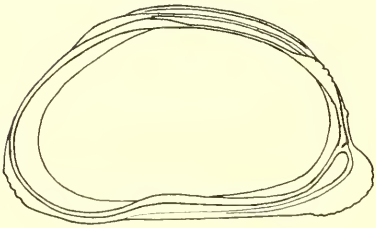

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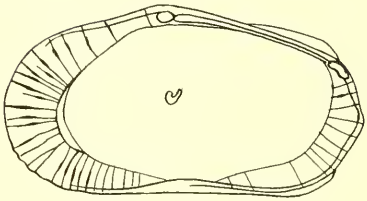

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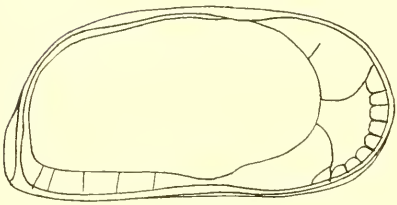

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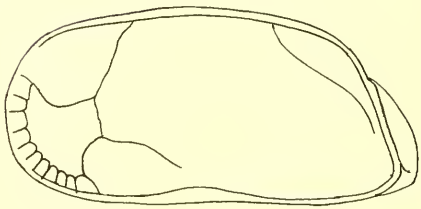

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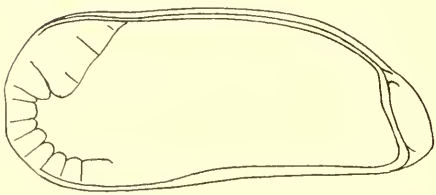

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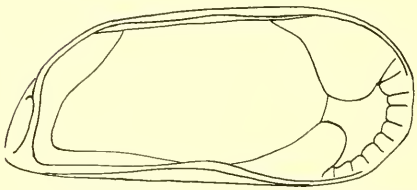

4d

Explanation of Plate 10

Figure — Page

1. **Uroleberis triangula,** n. sp. — 80

From 15212, Gurabo Formation; 90 X. a. Interior, left valve, holotype, HVH No. 8374. b. Interior, right valve, paratype, HVH No. 8375.

2. **Uroleberis torquata,** n. sp. — 81

From Bermudez 218, Matanzas Formation, Pliocene, Cuba, cut at Río Canimar, 800 m S of the mouth, Matanzas Province, HVH No. 8379; 90 X. Interior, right valve.

3. "N. gen., N. sp." — 82

From 15212, Gurabo Formation, HVH No. 8394; 145 X. Interior, right valve.

4. **Krithe dolichodeira** van den Bold — 51

From 15248, Mao Formation, HVH No. 8339; 100 X. a. Interior, left valve, female. b. Interior, right valve, female. c. Interior, right valve, male. d. Interior, left valve, male.

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