Upper Cretaceous-Paleogene marine ostracods from the Sergipe-Alagoas Basin, northeastern Brazil

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This paper illustrates 49 species of ostracods from the Sergipe-Alagoas basin; 32 of them have been recorded from the Caribbean and the Gulf Coast. It is shown that Brazil (Sergipe) for the Paleocene (including the Danian) has its strongest affinities with the Caribbean and northern South America; there are certain relationships with West Africa. The following genera are represented: *Cytherella*, *Bairdia*, *"Bythocypris"*, *Antibythocypris*, *Pontocypris*, *Argilloecia*, *Macrocypris*, *Hemicythere*, *Echinocythereis*, *Trachyleberis*, *Cythereis*, *"Quadracythere"*, *Cativella*, *Costa*, *Kingmaina*, *"Henryhowella"*, *Brachycythere*, *Pterygocythereis*, *Soudanella*, *Cytheridea*, *Krithe*, *"Parakrithe"*, *Eucytherura*, *Paracytheridea*, *Cytheropteron*, *Loxoconcha* and *Xestoleberis*.

E. M. H. Neufville, Geological Survey of Liberia, Monrovia, Liberia, June 14th 1979.

Introduction

The material studied here was kindly donated by the Brazilian National Petroleum Company, Petrobrás. Bore-hole samples from two localities (2-BG-1-SE and 2-IA-1-SE, see Fig. 1) were studied. The former is situated east of the town of Japaratuba, the latter locality lies 25 km east to south-east of the town of Itaporanga. The paper summarizes part of my doctoral dissertation, defended in 1973 (Neufville 1973).

Acknowledgements

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Technical assistance was given by Mrs. Dagmar Engström and Mr. Gustav Andersson.

The holotypes are kept in the National Museum of Brazil (NMB), Rio de Janeiro; the paratypes have been deposited in Paleontologiska Muséet, Uppsala (PM).

Stratigraphy

Only a brief discussion is given here of the stratigraphy. For details the reader is referred to Schaller (1969), Troelsen and Quadros (1970), Quadros and Gomide (1972), Meister and Aurich (1972), and Reyment and Tait (1972).

Current biostratigraphy by Petrobrás in Brazil is based on nannoplankton. The zonation for several boreholes is given by Quadros and Gomide

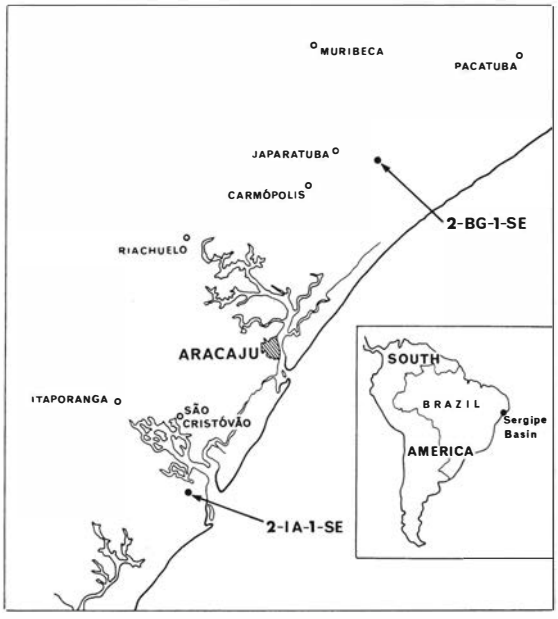

Fig. 1. Sketch map of portion of the Sergipe-Alagoas basin, showing the locations of the samples studied.

(1972). The original stratigraphical subdivision of the Sergipian Cretaceous was based on ammonites. The Cenozoic deposits are known mainly from boreholes, the original zonation of which was made by Petrobrás (Salvador) on planktonic foraminifers (Schaller 1969). The main occurrences of the ostracods described in this paper are localized to stratigraphical levels corresponding to the following three nannoplankton zones.

Zone of *Lithastrinus grilli.* This zone, according to Quadros and Gomide (1972), extends from the Turonian to the Santonian/Campanian and since it is the only zone that covers the Turonian, I have included herein the Lower Turonian material of this study.

Ostracod fauna: *Brachycythere sapucariensis* Krömmelbein.

Zone of *Cruciplacolithus tenuis.* This zone was defined by Hay (1964) and emended by Troelsen and Quadros (1970). It is considered by Quadros and Gomide (1972) to be Early Paleocene. The aspect of the ostracod fauna is partly West African "Danian".

Ostracod fauna: *Cytherella sergipensis* Neufville, *Cytherella piacabucuensis* Neufville, *Bairdia itaporangaensis* Neufville, *Bairdia* aff. *itaporangaensis* Neufville, *Bairdia hiwanneensis* Howe & Lea, *Bairdia* aff. *hiwanneensis* Howe & Lea, *Bairdia* aff. *hazzardi* Howe & Law, *Bairdia* sp. 2, *Echinocythereis garretti* Howe & McGuirt, *Cythereis? longicostata* Blake, *Costa barri* van den Bold, *Henryhowella? reymenti* Neufville, *Soudanella laciniosa triangulata* Apostolescu, *Krithe saundersi* van den Bold, *Cytheropteron* sp., *Trachyleberis bermudezi* van den Bold.

Zone of *Discoaster diastypus.* According to information released by Petrobrás in 1969, the Lower Eocene material described in this paper comes from the *Discoaster binodosus* zone of Hay & Mohler (1967). Since then, this zone has been replaced by the zonal index *Discoaster diastypus* in the Brazilian stratigraphical literature (Troelsen and Quadros 1971). These two authors have considered the *Discoaster diastypus* zone to correspond approximately to the zones of *Marthasterites contortus* (Hay 1964) and *Discoaster binodosus* (Hay & Mohler 1967).

Ostracod fauna: *Cytherella sergipensis* Neufville, *Cytherella harmoniensis* van den Bold, *Bairdia cespedesensis* van den Bold, *Bairdia dolicha* van den Bold, *Bairdia* sp., *Bairdia* sp. 1, "*Bythocypris*" sp., *Antibythocypris* sp., *Pontocypris dreikanter* Coryell & Fields, *Argilloecia faba* Alexander, *Macrocypris lanceolata* Neufville, *Hemicythere bellula* Howe, *Hemicythere* aff. *lemniscata* Howe, *Cythereis? longicostata* Blake, *Trachyleberis reticulospinosa* van den Bold, *Cythereis* aff. *dictyon* Brady, *Quadracythere* aff. *orbignyana?* Bosquet, *Quadracythere?* aff. *bicarinata* (Swain), *Cativella moriahensis* van den Bold, *Costa variabilocostata seminuda* van den Bold, *Kingmaina brazilensis* Neufville, *Pterygocythereis* aff. *miocenica* van den Bold, *Cytheridea* (*Cytheridea?*) aff. *mississippiensis* (Howe & Law), *Cytheridea* (*Cytheridea*) sp., *Krithe mutveii* Neufville, *Krithe guatemalensis* van den Bold, *Parakrithe? ovata* van den Bold, *Parakrithe?* aff. *ovata* van den Bold, *Eucytherura rohi* van den Bold, *Paracytheridea toleri* Howe & Law, *Paracytheridea* aff. *hispida* van den Bold, *Loxoconcha corrugata* Alexander, *Xestoleberis chamela* van den Bold, and *Xestoleberis* aff. *moriahensis* van den Bold.

Systematic descriptions

The species erected in my doctorial thesis (Neufville 1973) are not listed in the synonymies in order to avoid unnecessary repetition.

Cytherella sergipensis Neufville

Pl. 1, Figs. 1, a—c; Pl. 8, Fig. 6.

HOLOTYPE: Figure shown in Pl. 1, Figs. 1, a—c, MN-5225-I (NMB).

PARATYPES: 20 complete carapaces and four valves, PM-SA84: 1—24.

LOCUS TYPICUS: Borehole, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

OTHER OCCURRENCES: Borehole, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m and core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.
AGE: "Danian" — Early Eocene.

DIMENSIONS:	Length	Height	Width
Female	0,86 mm	0,60 mm	0,41 mm
Male	0,85 mm	0,43 mm	0,33 mm

(Here, and elsewhere, the dimensions refer to the figured material.)

DESCRIPTION: This species is characterized by a weak anterior rim or flange on the left valve; this rim extends approximately from the anterior half on the dorsal margin and narrows off on the anteroventral area then extends along the whole ventral margin before terminating at a point on the posterior margin. The carapace is ovate in the female and oblong ovate in the male.

The surface is smooth in the female and weakly punctate in the male.

The male carapace differs from the female in being oblong ovate in lateral view, highest in the middle or slightly posterior thereto; the maximum inflation lies behind the mid-point. The dorsal margin is slightly convex to almost straight; the ventral margin is concave in the middle. The anterior and posterior margins are almost equally broad. The posterior margin is slightly narrower and more regularly rounded, the anterior margin is obliquely rounded.

In dorsal view, the carapace is elongate with both ends pointed; the valves are less inflated and the posterior end is slightly more pointed. The right valve overlaps the left on the ventral margin, the rim on this valve does not extend along the ventral margin as in the female, apparently because of the ventral overlap of the right valve.

The valves are smooth in females and weakly punctate in males.

INTERNAL STRUCTURE: The hinge and the muscle field, which is situated just dorsal of the carapace mid-point, are typical for the genus.

TAXONOMIC REMARKS: Five growth stages for the females and probably four for the males have been distinguished.

The female of this species shows a seemingly close resemblance to *Cytherella navetensis* van den Bold, but can be distinguished by the anterior rim on the left valve. In *Cytherella navetensis*, the dorsal margin slopes more steeply toward the posterior than it does in *C. sergipensis* Neufville. *Cytherella symmetrica* Alexander is rather close to the male of this species, but lacks the concavity on the ventral margin which is a conspicuous feature on the male carapace of *C. sergipensis*.

DISTRIBUTION: The Piaçabuçu Formation, from borehole 2-BG-1-SE, zones of *Discoaster diastypus* at depth of 267—270 m and 423—426 m and the *Cruciplacolithus tenuis* at a depth of 1192—1195 m.

Cytherella piacabucuensis Neufville

Pl. 1, Figs. 3, a—d.

HOLOTYPE: Figure shown in Pl. 1, Figs. 3, a—d; MN-5303-I (NMB).

PARATYPES: 2 complete carapaces and 2 valves, PM-SA85: 1—4.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core no. 6, *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m.

OTHER OCCURRENCE: Core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
Female	0,63 mm	0,41 mm	0,35 mm
Male?	0,63 mm	0,38 mm	0,30 mm

DESCRIPTION: There is a distinct overhang of the right valve over the left at the site of greatest height; an almost symmetrically formed rim extends on the anterior margin of both valves. An almost vertical shallow pit occurs on the lateral surface of each valve. The female carapace is ovate and the male is oblong ovate. The surface of both valves is weakly punctate.

The female carapace is sub-ovate in lateral aspect and highest immediately posterior to the carapace mid-length. Below this location, there is a distinct but shallow pit which is almost vertical and runs approximately to the mid-point of the carapace lateral surface. The dorsal margin is convex. There is a strong overhang of the right valve over the left, just at the position of greatest height. The ventral margin is broad and evenly rounded; on its marginal area there is a rim on each valve. The rim on the left valve is slightly narrower than that on the right. However, both rims are symmetrically formed in relation to each other and run parallel with the margin. The posterior margin in the right valve is as broad or slightly narrower then the anterior and evenly rounded. In the left valve, the posterior margin is narrower and slightly obliquely rounded.

In dorsal aspect, the carapace is pear-shaped, the anterior end is bluntly rounded and the posterior end is rather squarely rounded. The maximum inflation lies posterior to the mid-length. The right valve overlaps the left peripherally but more strongly so on the ventral and dorsal margins than elsewhere.

The male carapace is similar in outline to the female but differs in the following respects. In lateral view, it is oblong ovate, its greatest height lies immediately anterior to the mid-length; the posterior margin is rounded in both valves. In dorsal view the valves are less convex and the maximum inflation, though posterior to the mid-length, is situated more anteriorly.

The surface of the valves is smooth to weakly punctate.

INTERNAL STRUCTURE: The hinge element is simple and the muscle scar pattern is typical for the genus.

TAXONOMIC REMARKS: The most closely related species is *Cytherella excavata* Alexander

from the Midway (Eocene) of Texas. That species is distinctly less convex on the dorsal margin, the posterior margin in both valves in obliquely rounded and the overlap of the right valve is uniform along the entire periphery. *Cytherella piacabucuensis* Neufville, on the other hand, is smaller, in dorsal view, the posterior end is plumper and more rounded than *C. excavata. Cytherella truncata* Bosquet, as figured by Jones (1849, p. 30, Pl. 7, Fig. 25, a), is similar in dorsal view to the female of this species, but has its maximum inflation closer to the posterior and lacks the pit on the lateral surface of the carapace.

DISTRIBUTION: The Piaçabuçu Formation, borehole 2-BG-1-SE core 6, and 7 at depth of 1035—1037 m and 1192—1195 m. This species was found to occur only in the *Cruciplacolithus tenuis* zone.

Cytherella harmoniensis van den Bold.

Pl. 1, Figs. 2, a—d.

1960 *Cytherella harmoniensis* van den Bold, p. 150, Pl. 1, Figs. 2, a—d.

MATERIAL: 3 complete carapaces, PM-SA86: 1—3.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
Female	0,90 mm	0,60 mm	0,45 mm
Male	0,87 mm	0,50 mm	0,40 mm

DESCRIPTION: The female carapace is oblong ovate in lateral aspect; the dorsal margin is sinuous in front of the middle, although more strongly so in the left valve. The ventral margin is weakly convex. The anterior and posterior margins are equally as broad; the anterior margin of the left valve is obscured by a carina.

The carapace in dorsal view is pear-shaped, the posterior end is wide and the maximum inflation is about one-third from the posterior end. The strongest overlap of the right valve is on the dorsal margin, just in front of the middle and in the middle of the ventral margin. The posteroventral area of the posterior margin is conspicuously less overlapped.

The male carapace is similar to that of the female but is sub-ovate in lateral aspect and highest just in front of the middle. The carina or rim on the anterior margin of the left valve is as in *Cytherella sergipensis* Neufville and it extends from the anterior margin along the entire ventral margin, terminating on the posterior margin ventral to the mid-length.

The male valves are smooth to very weakly punctate and the female valves punctate; the punctation tends to become denser towards each end.

INTERNAL STRUCTURE: The hinge element and the muscle scars are typical for the genus.

TAXONOMIC REMARKS: This Brazilian form shows on the antero-dorsal area a sinuosity in both valves and differs from the originally described material (van den Bold 1960, p. 150, Pl. 1, Figs. 2, a—c) in that respect.

DISTRIBUTION: This species was originally described by van den Bold (1960) from the Upper Eocene of Trinidad where it occurs in the Fernando Formation and the Hospital Hill marl of the Navet Formation.

Bairdia cespedesensis van den Bold.

Pl. 2, Figs. 1, a—d.

1946 *Bairdia cespedesensis* van den Bold, p. 75, Pl. 1, Figs. 8, a—b.
1950 *Bairdia cespedesensis* van den Bold; van den Bold, p. 83, Pl. 18, Figs. 3, a—b.
1957a *Bairdia cespedesensis* van den Bold; van den Bold, p. 5, Pl. 2, Figs. 2, a—b.
1958 *Bairdia cespedesensis* van den Bold; Howe & Laurencich, p. 66.
1960 *Bairdia cespedesensis* van den Bold; van den Bold, p. 150.

MATERIAL: 7 complete carapaces, including 3 instars, P.M.-SA87: 1—7.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
Female?	0,71 mm	0,50 mm	0,40 mm
Male?	0,85 mm	0,55 mm	0,45 mm

DESCRIPTION: The valves are moderately thick. In lateral view the carapace is sub-triangular and highest slightly anterior to the middle. In dorsal view, the carapace is egg-shaped to sub-ellipsoidal with almost equally shaped ends. The site of maximum inflation lies at the middle. The dorsal margin is strongly convex to arched. The central part is slightly convex to almost straight; it slopes from the position of greatest height towards the posterior to a point, where it steeply slopes in meeting the low and evenly rounded posterior margin. The slope toward the anterior is almost

straight and forms a somewhat rounded obtuse angulation at the point where it meets the anterior margin. The anterior margin is broad and evenly rounded, the posterior margin is narrower. The ventral margin is almost straight to convex in the left valve, and feebly concave in the middle in the right valve.

The left valve overlaps the right along the entire periphery, although stronger along the dorsal and ventral margins than elsewhere.

The anteroventral and posteroventral marginal areas may bear some short denticles, otherwise the valves are smooth.

SEXUAL DIMORPHISM: The form, which is herein considered the male, shows a close resemblance to *Bairdia cespedesensis* van den Bold, but differs in minor characteristics that could suggest sexual dimorphism. The carapace is more elongate although slightly higher; the greatest width lies just anterior to the mid-length.

TAXONOMIC REMARKS: The dimensions suggest all four females carapaces in our collection to belong to different growth stages.

DISTRIBUTION: This species was originally described from the Upper Cretaceous of Cuba (van den Bold 1946). It was later reported from the Lower Eocene of Cuba and also from the Eocene and Oligocene of Trinidad, the Navet, San Fernando, and Cipero Formations (van den Bold 1950, 1960). In our collection it was limited to the *Discoaster diastypus* zone at a depth of 423—426 m of the Piaçabuçu Formation.

Bairdia dolicha van den Bold

Pl. 1, Figs. 4, a—b.

1957a *Bairdia dolicha* van den Bold, p. 5, Pl. 2, Figs. 2, a—b.
1960 *Bairdia dolicha* van den Bold; van den Bold, p. 153.

MATERIAL: 2 complete carapaces and a valve, P.M.-SA88: 1—3.

OCCURRENCE: Borehole 2-BG-1 SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,65 mm	0,35 mm	0,30 mm

DESCRIPTION: The carapace is rather elongate to sub-triangular in lateral aspect and elongate ellipsoid in dorsal aspect. The greatest carapace height and the maximum inflation lie in front of the middle. The dorsal margin forms a rather low arch and the ventral margin is slightly sinuous at, or in front of, the middle. The anterior margin is obliquely rounded and the posterior margin is sharply pointed and rounded at the edge. The left valve overlaps the right strongly along the ventral margin, less along the dorsal margin and least elsewhere. The valves are smooth.

INTERNAL STRUCTURE: The hinge element is typical for the genus. The muscle scars are indistinct.

TAXONOMIC REMARKS: Our form is not fully mature, but, nevertheless, all the characteristics of the species could be recognized.

DISTRIBUTION: This species was first recorded by van den Bold (1957a) from the Paleocene of Trinidad, from Soldado Rock and also from the Middle Eocene Navet Formation of Friendship Quarry. It is thought probably to be reworked in the Upper Eocene of Soldado Rock. It was reported to be one of the most common ostracods in the Guasare Formation of the oil fields west of Lake Maracaibo, Venezuela (van den Bold 1957a). In our collection, it occurred only in the *Discoaster diastypus* zone at a depth of 267—270 m.

Bairdia itaporangaensis Neufville

Pl. 2, Figs. 2, a—b.

HOLOTYPE: Figure shown in Pl. 2, Figs. 2, a—b, MN-5304-I (NMB).

PARATYPES: 3 complete carapaces and two valves, P.M.-SA89: 1—5.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	1,13 mm	0,70 mm	0,60 mm

DESCRIPTION: The middle of the dorsal margin is distinctly higher in the left valve than in the right; it slopes with a slight angulation towards the posterior; the main central region of its ventral margin if flat. The both ends bear some tubercle-like denticles; the posterior margin is dorsally deflected and there is a weak rim on the ventral area of the right valve. The surface is weakly punctate.

The carapace is sub-triangular in lateral view, in dorsal aspect it is spindle-shaped. The greatest height and maximum inflation lie anterior to the middle.

INTERNAL STRUCTURE: The hinge element is typical for the genus. The muscle scars are indistinct.

TAXONOMIC REMARKS: The closest relative to this species is that form which is here tentatively determined as *Bairdia* aff. *itaporangaensis*; this differs in being larger, the middle portion of the dorsal margin is rather horizontal and the both ends are strongly compressed. *Bairdia rotunda* Alexander (1929, Pl. 3, Figs. 2 and 6) is similar in dorsal view, but differs strongly in lateral aspect.

DISTRIBUTION: This species was only found to occur in the Piaçabuçu Formation, from the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

Bairdia aff. *itaporangaensis* Neufville

Pl. 2, Figs. 3, a—b.

MATERIAL: One complete carapace, P.M.-SA90.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	1,44 mm	0,85 mm	0,65 mm

TAXONOMIC REMARKS: In lateral aspect, this form, apart from being very close to *Bairdia itaporangaensis*, shows some resemblance to *Bairdia alexandrina* Blake, as figured and described by Swain (1952, p. 71, Pl. 8, Fig. 13). *B. alexandrina* is more arched along the dorsal margin. It is uncertain whether *B.* aff. *itaporangaensis* represents a new species, or whether it falls into the range of intraspecific variation of *B. itaporangaensis.*

DISTRIBUTION: As in the case with *Bairdia itaporangaensis* Neufville, *Bairdia* aff. *itaporangaensis* occurs only in the Piaçabuçu Formation, from the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

Bairdia hiwanneensis Howe & Lea

Pl. 2, Figs. 4, a—b.

1936 *Bairdia hiwanneensis* Howe & Lea, p. 27, Pl. 2, Fig. 9; Pl. 3, Fig. 1.
1957b *Bairdia hiwanneensis* Howe & Lea; van den Bold, p. 236.
1970 *Bairdia hiwanneensis* Howe & Lea; Huff, p. 74, Pl. Figs. 1—4.

MATERIAL: 3 complete carapaces, P.M.-SA91: 1—3.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,88 mm	0,55 mm	0,44 mm

DESCRIPTION: The carapace is ovate in lateral view, and highest at, or slightly in front of the middle; in dorsal aspect it is a compressed ovate. The maximum inflation lies anterior of the middle. The dorsal margin is conxev and the ventral margin, though flattened in the middle, is feebly convex to almost straight in outline. The anterior margin is narrow and obliquely rounded and the posterior margin is sub-acute and rounded. The left valve overlaps the right distinctly in the antero- and posterodorsal area of the dorsal margin. The mid-length of the ventral margin is also strongly overlapped. The surface is smooth to very weakly punctate.

TAXONOMIC REMARKS: The posterior margin in our material is slightly narrower than in the form originally figured and described by Howe and Lea (1936). Our form is much closer to that figured and described by Huff (1970, p. 74, Pl. 1, Figs. 3—4), which he questionably designated as female.

DISTRIBUTION: This species was first recorded by Howe & Lea (1936) from the Louisiana Vicksburg Oligocene, at localities 2, 16, 20 and 21. Van den Bold (1957b) reported the species from the Oligo-Miocene of southern Trinidad, in the Morne Diablo, Majias and Quinam Quarries. Huff (1970) further reported the species from the Jackson Eocene, in the Shubuta Clay Member, at locality 26. In our collection, this species was only found in the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m in the Piaçabuçu Formation.

Bairdia aff. *hiwanneensis* Howe & Lea

Pl. 3, Figs. 2, a—b.

MATERIAL: One complete carapace, P.M.-SA92.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	1,10 mm	0,65 mm	0,50 mm

TAXONOMIC REMARKS: This form shows a close resemblance to the originally described ma-

terial and could be no more than a variant, even though it is slightly larger and bears a weak rim on the anterior and posterior margins of the right valve.

DISTRIBUTION: The species *Bairdia hiwannaensis* Howe & Lea and this form occur in the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m in the Piaçabuçu Formation.

Bairdia aff. *hazzardi* Howe & Law

Pl. 3, Figs. 1, a—b.

MATERIAL: 3 complete carapaces, P.M.-SA93.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,90 mm	0,65 mm	0,45 mm

DESCRIPTION: The carapace is sub-triangular in lateral aspect and in dorsal aspect it is spindle-shaped. The greatest carapace height lies immediately anterior to the middle and the maximum inflation occurs in front of the middle. The dorsal margin is strongly arched and slopes in a straight line towards each end. The ventral margin is feebly convex. The anterior margin is slightly oblique and rounded below. The posterior margin is sub-acute and angled in the middle. The left valve is larger than the right and overlaps the latter conspicuously and uniformly along the entire dorsal margin, although it is also conspicuous at the middle of the ventral margin. The valves are more superimposed at the both ends than overlapping. The surfaces of the valves are smooth to punctate.

TAXONOMIC REMARKS: Our form differs from the originally described material in having a narrower posterior margin and a slightly stronger dorsal overlap. *Bairdia dozyi* van den Bold (1946) is comparable, but that species is more rounded on the anterior margin, and both ends bear short denticles.

DISTRIBUTION: *Bairdia hazzardi* Howe & Law was originally described from the Louisiana Vicksburg Oligocene; in our collection, this form has only been found in the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m in the Piaçabuçu Formation.

Bairdia sp.

Pl. 1, Fig. 5.

MATERIAL: One complete carapace, P.M.-SA94.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,75 mm	0,45 mm	0,28 mm

DESCRIPTION: The carapace is laterally compressed and in that respect it is ovate to subtriangular. The greatest height lies in the middle or slightly anterior therefrom. The dorsal margin is arched and consists of three almost straight portions. The ventral margin is weakly convex. The anterior margin is regularly rounded, and the posterior margin forms an acute angle.

In dorsal view, the carapace is an inflated oval with the both ends pointed. The left valve overlaps the right conspicuously along the anterior half of the dorsal margin and just behind the mid-point on the ventral margin. The surface is smooth.

TAXONOMIC REMARKS: This form is close to *Bairdia* sp. from the Danian of Tunisia (Esker 1968). This form could be a variant of the Tunisian species.

DISTRIBUTION: Esker (1968, Pl. 3, Fig. 6) reported this species from the locality of Oued R'mel, near Le Kef Tunisia. In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 423—426 m.

Bairdia sp.

Pl. 3, Figs. 4, a—b.

MATERIAL: One complete carapace, P.M.-SA95.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,95 mm	0,45 mm	0,35 mm

DESCRIPTION: The carapace is almond-shaped in lateral view, highest anterior of the middle. The dorsal margin is arched, more in the left valve than the right. The ventral margin is feebly convex to almost straight. The anterior and posterior margins are both laterally compressed. The anterior margin is obliquely rounded and the posterior margin is somewhat drawn out to form a sub-acute angle that is rounded. The mid-point of this margin lies below that of the anterior margin.

In dorsal view, the carapace is sub-ellipsoidal

with both ends pointed; the greatest inflation lies in front of the middle. The left valve overlaps the right along the entire periphery and conspicuously overhangs the right valve at about mid-point. The surfaces of the valves are smooth.

TAXONOMIC REMARKS: *Bairdia* sp. van den Bold (1946, p. 73, Pl. 1, Fig. 10) is close in shape to this species but lacks the overhang of the left valve so conspicuous for *Bairdia* sp. 1.

DISTRIBUTION: This species has only been found in the *Discoaster diastypus* zone at a depth of 423—426 m in the Piaçabuçu Formation.

Bairdia sp.

Pl. 3, Figs. 3, a—b.

MATERIAL: One complete carapace, P.M.-SA96.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 6, *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,95 mm	0,38 mm	0,28 mm

DESCRIPTION: The carapace is laterally compressed and elongate. The dorsal margin is slightly convex, sloping steeply to a low, pointed and rounded posterior margin. The ventral margin is sinuous in the middle. The anterior margin is bluntly and squarely rounded. The carapace greatest height and the maximum inflation occur in front of the middle. The left valve overlaps the right strongly along the ventral margin and less along the dorsal margin. The valves are smooth.

DISTRIBUTION: This species was found only in the *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m in the Piaçabuçu Formation.

"*Bythocypris*" sp.

Pl. 3, Figs. 7, a—b.

MATERIAL: One complete carapace, P.M.-SA97.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,40 mm	0,20 mm	0,18 mm

DESCRIPTION: The carapace is sub-rectangular and rather compressed in lateral view. The greatest height occurs at the antero-dorsal angle. The dorsal and ventral margins are sub-parallel converging slightly towards the posterior. The anterior and posterior margins are almost equally broad, the anterior margin being broadest, slopes steeply from the point of maximum height to the mid-point, then is rounded below. The margin is obliquely rounded.

In dorsal view, the carapace is elongate and the valves are rather compressed, the maximum inflation lies behind the middle. The left valve overlaps the right along the entire periphery; the strongest overlap is situated just behind the mid-point on the ventral margin. The valves are smooth to very weakly punctate.

TAXONOMIC REMARKS: In dorsal view this species is close to *Bythocypris obtusata* Sars, as figured and described by van den Bold (1946), but differs in lateral aspect. This species resembles a *Bairdiacypris* in lateral aspect, but, unfortunately, its internal structures could not be studied. It is most likely to be an immature *Bythocypris.*

DISTRIBUTION: This species was recorded from the *Discoaster diastypus* zone at a depth of 423—426 m in the Piaçabuçu Formation.

Antibythocypris sp.

Pl. 2, Figs. 5, a—b.

MATERIAL: 5 complete carapaces, P.M.-SA98: 1—5.

OCCURRENCE: Borehole 2-BG-1-SE core no. 1 & 2, *Discoaster diastypus* zone at a depth of 267—270 m and 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,65 mm	0,25 mm	0,20 mm

DESCRIPTION: The shell substance is thin; in lateral view the carapace is elongate ovate and highest at, or slightly behind the middle. In dorsal aspect, the carapace is a compressed ovate with the maximum inflation behind the middle. The dorsal margin is feebly and evenly convex, and the ventral margin is concave anterior of the middle. The anterior margin is rounded below; above it is straight, or almost so. The posterior margin is oblique and evenly rounded; the both margins are strongly compressed along the periphery. The right valve is larger than the left, and overlaps the latter along the entire periphery. The strongest overlap occurs on the ventral margin. The valves are smooth.

SEXUAL DIMORPHISM: Two of the forms are shorter than the others; this could suggest sexual dimorphism.

TAXONOMIC REMARKS: Viewed from the dorsum, this species is close to *Bythocypris obtusata* Sars, as figured and described by van den Bold (1946) but differs in lateral view. That species is sharply angled in the middle of the anterior margin; *Antibythocypris* sp. is evenly rounded on the anterior margin and furthermore, the right valve overlaps the left, which is the reverse in *Bythocypris obtusata.*

DISTRIBUTION: This species was recorded from the *Discoaster diastypus* zone at a depth of 267—270 m and 423—426 m in the Piaçabuçu Formation.

Pontocypris dreikanter Coryell & Fields

Pl. 3, Figs. 8, a—b.

1937 *Macrocypris dreikanter* Coryell & Fields, p. 3, Fig. 3.
1946 *Erythrocypris dreikanter* Coryell & Fields; van den Bold, p. 63, Pl. 3, Fig. 3.
1958 *Pontocypris dreikanter* Coryell & Fields; van den Bold, p. 397, Pl. 2, Figs. 2, a—b.

MATERIAL: One complete carapace, P.M.-SA99.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,60 mm	0,31 mm	0,25 mm

DESCRIPTION: The shell substance is thin. The carapace is sub-triangular in lateral aspect, its greatest height lies just in front of the middle. In dorsal view the carapace is lanceolate, with the greatest inflation in front of the middle. It is laterally depressed just below the position of greatest height. The dorsal margin is arched and slopes at an approximate angle of 30 degrees in relation to the length axis. The ventral margin is sinuous in the middle; the anterior margin is low and obliquely rounded. The posterior margin is sub-acute, narrow and rounded ventrally. The right valve overlaps the left along the entire periphery but more strongly so along the ventral margin and along the anterior half of the dorsal margin. The valves are smooth.

TAXONOMIC REMARKS: Our form is just slightly more concave on the ventral margin than the originally described material (*Macrocypis dreikanter* Coryell & Fields 1937). The form designated as *Erythrocypris dreikanter* Coryell & Fields by van den Bold (1946, p. 63, Pl. 3, Fig. 3) differs from our material in having a more broadly rounded and shorter anterior end and a more pointed posterior end. Our form is however, identical to *Pontocypris dreikanter* Coryell & Fields, as figured and described by van den Bold (1958, p. 397, Pl. 2, Figs. 2, a—b).

DISTRIBUTION: This species was originally described from the Gatun Formation, Miocene of Cativa, Panama (Coryell & Fields 1937). It was also recorded from the Miocene of Cuba (van den Bold 1946, p. 63) and the Miocene of Trinidad, the Navarro River member (*Globorotalia fohsi sensu lata* zone) of the Brasso Formation (van den Bold 1958, p. 937). In our collection, it was recorded from the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Argilloecia faba Alexander

Pl. 3, Figs. 6, a—b.

1934 *Argilloecia faba* Alexander, p. 213, Pl. 32, Fig. 16.

MATERIAL: 4 complete carapaces and two valves, P.M.-SA100: 1—6.

OCCURRENCE: Borehole 2-BF-1-SE core no. 1 & 2, *Discoaster diastypus* zone at a depth of 267—270 m and 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,50 mm	0,24 mm	0,20 mm

DESCRIPTION: The valves are transparent, the carapace is minute and in lateral view elongate. Its greatest height lies at, or slightly behind the middle. The dorsal margin is strongly convex to arched, sloping from the point of greatest height steeply towards the posterior and gently towards the anterior. The ventral margin is weakly concave in the middle; more distinctly so in the left valve than the right. The anterior margin is low and obliquely rounded. The posterior margin tapers ventrally into a sub-acute angle, rounded at the end.

In dorsal view, the carapace is elongate to lanceolate. The maximum inflation occurs in the middle. The right valve is larger than the left, the latter being overlapped along the entire periphery, strongest at the anterior halft of the dorsal margin and in the middle of the ventral margin. The valves are smooth and transparent.

INTERNAL STRUCTURE: The hinge structure is simple, the marginal zone is broad, the pore-canals are numerous and almost straight. The muscle scars are indistinct.

TAXONOMIC REMARKS: According to Alexander (1935, p. 357) *Argilloecia faba* Alexander and

Argilloecia taylorensis Alexander show the following differences: *A. taylorensis* is more evenly rounded on the anterior margin, the ventral margin swings slightly upwards posteriorly, while the posterior margin is less produced. In our form the anterior margin is identical with *A. faba* but the posterior outline is closer to *A. taylorensis*. In general outline, our material is intermediate between these two species although somewhat closer to *A. faba* than to *A. taylorensis*.

DISTRIBUTION: Alexander (1934, p. 213) reported this species from the Kincaid and Wills Point Formations of the Midway (Eocene) of Texas. In our collection it occurs in the *Discoaster diastypus* zone of the Piaçabuçu Formation, at a depth of 267—270 m and 423—426 m.

Macrocypris lanceolata Neufville

Pl. 3, Figs. 5, a—b.

HOLOTYPE: Figure shown in Pl. 3, Figs. 5, a—b, MN-5305-I (NMB).

PARATYPES: 6 complete carapaces, P.M.-SA 101: 1—6.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

OTHER OCCURRENCE: Borehole 2-BG-1-SE, 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,44 mm	0,20 mm	0,18 mm

DESCRIPTION: The carapace in lateral and dorsal views is lanceolate. The ventral margin is almost straight. The anterior margin is narrow and compressed peripherally; the posterior margin is sub-acute and ventrally deflected, being more pointed in the left valve than in the right. The surface is smooth and transparent.

TAXONOMIC REMARKS: *Macrocypris decora* Brady, as figured and described by van den Bold (1946, p. 65, Pl. 1, Fig. 14) is similar in general outline to this species. However, *M. lanceolata* differs in some important respects; the anterior margin is strongly compressed, the dorsal margin has a distinct flat zone at the site of greatest height; in dorsal view, there is a depressed zone on the left valve at about one third of the carapace length from the posterior end. *M. decora* is slightly more arched on the dorsal margin and is much larger.

DISTRIBUTION: This species occurs in the *Discoaster diastypus* zone at depths fo 267—270 m and 423—426 m in the Piaçabuçu Formation.

Hemicythere bellula Howe

Pl. 4, Figs. 2, a—b.

1951 *Hemicythere bellula* Howe, pp. 14—15, Pl. 3, Figs. 12—14.
1953 *Hemicythere bellula* Howe; Puri, p. 169.
1970 *Hemicythere bellula* Howe; Huff, p. 125, Pl. 12, Figs. 10—12.

MATERIAL: 3 complete carapaces, P.M.-SA102: 1—3.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1 & 2, *Discoaster diastypus* zone at depths of 267—270 m and 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,53 mm	0,30 mm	0,26 mm

DESCRIPTION: The shell substance is moderately thick. The carapace is small. In lateral view, it is roughly rectangular with the point of greatest height at the anterodorsal angle. In dorsal view, it is inflated ovate with a sub-acute posterior. The maximum inflation lies at, or slightly behind the middle. The valves are of almost equal size. The anterior margin is broad and obliquely rounded, bearing a rim-like thickening that gives it a lip-like impression. The posterior margin, is drawn out into a prominent sub-caudal process which lies ventrally; its dorsal half is strongly concave. The dorsal margin is roughly straight to feebly convex and lies in a shallow depression caused by the longitudinal riblets by which the valves are ornamented. The ventral margin is concave just in front of the middle; on the lateral surface, there is a longitudinal ridge which hangs slightly over the margin. This ridge apparently is a continuation of the anterior rim.

The surface of the valves is ornamented with wavy, indefinite longitudinal riblets and, immediately below the posterodorsal angle, there is a short ridge terminating into a spine. The eye tubercles are prominent and situated below the anterodorsal angle.

TAXONOMIC REMARKS: The dorsal margin in our form is slightly straighter, and the posterior caudal process is longer than in the originally described material (Howe 1951, p. 14, Pl. 3, Figs. 12—14).

DISTRIBUTION: This species was first described from the Tertiary of Levy County, Florida (Howe 1951, p. 14). Huff (1970, p. 125) reported it from

the Jackson Eocene of Mississippi, the Green Sand Member at localities 22 and 24 of the Moodys Branch Formation. In our collection, this species occurs in the *Discoaster diastypus* zone at depths of 267—270 m and 423—426 m in the Piaçabuçu Formation.

Hemicythere aff. *lemniscata* Howe

Pl. 4, Fig. 1.

MATERIAL: One left valve, P.M.-SA103.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,80 mm	0,45 mm

DESCRIPTION: The valve in lateral aspect is sub-rectangular and highest at the anterodorsal angle. The dorsal and ventral margins are subparallel and converge slightly towards the posterior. The anterior margin is rimmed and broadly rounded. The posterior margin is compressed and angled below the middle; it is slightly concave above and bears some denticles on its ventral area.

The valve is ornamented with longitudinal ribbon-like riblets which are almost equally spaced; they appear to be superimposed on a network of reticulations. There is a rather low ala running parallel with the ventral margin and a short dorsal ridge that is parallel with the posterodorsal angle. This ridge appears to be continuous, or almost continuous, with the ventral ala. The eye tubercle is prominent and ovate.

TAXONOMIC REMARKS: The absence of the marginal pore-canals and well-developed hinge structures indicate this specimen to be immature. Its external habitus is very close, or almost identical to *Hemicythere lemnicata* Howe and this may mean that it represents an instar of that species. On the other hand, there is a slight difference in the shape of the anterior margin. In our specimen, the anterior margin is more squarely rounded while in the originally described material the anterior margin is obliquely rounded. It was not clear as to whether or not the longitudinal riblets in our form are superimposed on a network of reticulation but they are interconnected by some short ribs, which give such an impression. *Bradleya approximata* (Bosquet), as figured and described by Keij (1957, p. 97, Pl. 18, Fig. 1), is comparable in general outline but differs in the following details: The surface of the valves is strongly reticulated, the posterior margin is much broader and the eye tubercles are smaller.

DISTRIBUTION: *Hemicythere lemnicata* Howe was originally reported from the Tertiary of Levy County, Florida (Howe 1951, p. 16, Pl. 3, Figs. 19, 22). In our collection this form derives from the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Echinocythereis garretti Howe & McGuirt

Pl. 4, Figs. 4, a—b.

1935 *Cythereis garretti* Howe & McGuirt, p. 20, Pl. 3, Figs. 17—19; Pl. 4, Figs. 5, 15.
1952 *Buntonia?* cf. *B.? garretti* Howe & McGuirt; Swain, pp. 39—40, Pl. 3, Fig. 6; Pl. 3, Figs. 4—6.
1953 *Echinocythereis garretti* Howe & McGuirt; Puri, p. 12, Figs. 2—5.

MATERIAL: One complete carapace, P.M.-SA104.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,76 mm	0,43 mm	0,40 mm

DESCRIPTION: The carapace is sub-rectangular in lateral view and highest at the anterodorsal angle. The dorsal margin is straight and lies in a shallow furrow. The ventral margin is slightly convex in outline converging toward the posterior. The anterior and posterior margins are rimmed and compressed, although the anterior margin is broader. In dorsal view, the carapace is egg-shaped with compressed ends; the maximum inflation lies in the middle or slightly posterior thereto. The left valve overlaps the right noticeably at the antero-dorsal and posterodorsal angles.

The ornament of the valves consists of numerous short spines superimposed on a network of reticulations. There is one spine in each corner, so formed as to give a rough concentric pattern. The eye tubercle is small and lies just below the anterodorsal angle.

TAXONOMIC REMARKS: Our form differs very slightly from the originally described material (Howe & McGuirt 1935, p. 20, Pl. 3, Figs. 17—19) in being less obliquely rounded on the anterior margin. The form figured by Puri (1953, Pl. 2, Figs. 1—4, not 5) is identical or almost so to our material. The other form of Puri's (1953, Pl. 2, Fig. 5) has a more convex ventral margin and a strongly oblique anterior margin. *Buntonia?* cf. *B.? garretti* Howe & McGuirt, as figured and described by Swain (1951, pp. 39—40, Pl. 3, Fig.

6; Pl. 4, Figs. 4—5), differs considerably in general outline.

DISTRIBUTION: This species was originally recorded from the *Arca* zone of the Choctawhatchee Miocene of Florida (Howe & McGuirt 1935, pp. 20—21). Swain (1952, pp. 39—40) reported this species from Esso Standard Oil Co. North Carolina Esso well no. 2, at depth of 400—410 ft., Upper Miocene, U.S.N.M. 560635, 560647; Esso Standard Oil Co. Hatteras Light well no. 1, at a depth of 900—910 ft., Middle Miocene, U.S.N.M. 560646. Puri (1953, p. 260) later reported the species from the *Arca* zone at locality no. 34, from the *Ecphora* facies at localities nos. 37, 38, 42, 43, 44, 45 and from the *Cancellaria* facies at localities nos. 50 and 53 in the Miocene of the Florida Panhandle.

Trachyleberis reticulospinosa van den Bold

Pl. 6, Figs. 2, a—b.

1946 *Cythereis reticulospinosa* van den Bold, p. 100, Pl. 6, Fig. 18.
1957b *Trachyleberis reticulospinosa* van den Bold; van den Bold, p. 241, Pl. 1, Fig. 10.
1960 *Trachyleberis reticulospinosa* van den Bold; van den Bold, p. 164.

MATERIAL: One complete carapace, P.M.-SA105.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	1,15 mm	0,65 mm	0,55 mm

DESCRIPTION: The shell substance is moderately thick. The carapace is elongate ovate to subquadrate in lateral view; the greatest height lies at the anterodorsal angle. In dorsal view the carapace is inflated ovate with the maximum inflation occurring posterior to the middle. The dorsal margin is almost straight and the ventral margin is feebly convex. The anterior margin is broadly rounded and slightly oblique, it bears two narrow rims, the anterior-most part of which is denticulated. The posterior margin is angled in the middle, then concave dorsally and weakly convex ventrally. The margin is ornamented with a few strong spines. The left valve is larger than the right and overlaps it a the anterodorsal angle.

The surface is ornamented with coarse reticulations together with three weak longitudinal ridges. The dorsal and median ridges are broken up and extend posteriorly, before terminating in a spine. The eye tubercle is prominent and situated immediately below the anterodorsal angle. As seen in dorsal view, it is symmetrically formed.

TAXONOMIC REMARKS: Except for the slight weakness of the ornament of our specimen, it agrees well with van den Bold's original description (1946, p. 100, Pl. 6, Fig. 18).

DISTRIBUTION: This species was first recorded from the Upper Eocene of Bonaire (van den Bold 1946, p. 100) and later reported by the same author (van den Bold 1957b, p. 241) from the Middle Eocene to Lower Miocene of Trinidad. The species was said by him to be fairly common in the St. Croix Quarry and also in the Navet, San Fernando and Brasso Formations. The latest occurrence was reported to be in the *Globoratalia fohsi zone.* In our collection, it was recorded from the *Discoaster diastypus* zone at depth of 267—270 m in the Piaçabuçu Formation.

Trachyleberis bermudezi (van den Bold)

Pl. 4, Figs. 5, a—b.

1946 *Cythereis bermudezi* van den Bold, p. 99, Pl. 10, Figs. 18, a—b.
1946 *Cythereis spinosa* Lienenklaus; van den Bold, *ibid.*, p. 90, Pl. 10, Fig. 10.
1960 *Trachyleberis bermudezi* van den Bold, p. 164, Pl. 4, Fig. 1; Pl. 8, Fig. 1.

MATERIAL: 2 complete carapaces, P.M.-SA106: 1—2.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,95 mm	0,55 mm	0,45 mm

DESCRIPTION: The shell substance is moderately thick. The carapace is sub-rectangular in lateral view and highest at the anterodorsal angle. In dorsal view the carapace is inflated ovate with compressed ends and widest posterior to the middle. The dorsal margin is roughly straight and the ventral margin is convex. The anterior margin is broad, slightly truncated above and evenly rounded below whereas the posterior margin is narrower and somewhat angular in the middle. These both margins are laterally compressed and rimmed. The left valve overlaps the right at the anterodorsal and posterodorsal angles; more strongly so at the anterodorsal angle.

The valves are covered by strong spines of different sizes. Each spine is open at the end and probably represent the opening of the normal pores. In addition, there is a somewhat ovate-shaped sub-central tubercle and a ventral ridge.

TAXONOMIC REMARKS: Our material is almost identical to the specimen figured and described by van den Bold (1960, p. 164, Pl. 4, Fig. 1) from the Eocene and Oligocene of Trinidad.

DISTRIBUTION: This species was originally described from the Upper Eocene and Lower Oligocene of Cuba (van den Bold 1946). The same author (van den Bold 1960) recorded the species from the Upper Eocene, Oligocene and lowermost Miocene of Trinidad. In our collection, it comes from the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m, in the Piaçabuçu Formation.

Cythereis? longicostata Blake

Pl. 4, Figs. 3, a—c.

1950 *Cythereis? longicostata* Blake, pp. 178—179, Pl. 29, Figs. 20—21.

MATERIAL: 3 complete carapaces and a valve, P.M.-SA105: 1—4.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m and core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian" — Early Eocene.

DIMENSIONS:	Length	Height	Width
Female	0,85 mm	0,45 mm	0,40 mm
Male	0,90 mm	0,44 mm	0,35 mm

DESCRIPTION: The carapace is elongate ovate to sub-rectangular in lateral aspect, highest at the anterodorsal angle. In dorsal aspect, the carapace is elongate ovate with rather bluntly pointed ends. The maximum inflation is situated posterior to the middle. The dorsal margin is feebly convex to straight and the ventral margin is concave in the middle; both margins converge slightly towards the posterior. The anterior margin is broadly rounded and slightly oblique; it is rimmed, which gives a lip-like appearance and there are two to three such rims running parallel with the margin. The posterior-most of the rims lies in a depression or furrow. The posterior margin is narrow; it may be rather rounded to almost straight in its dorsal half while rounded in the ventral half. This half is noticeably compressed and bears a few fine denticles. The left valve is larger than the right and overlaps it strongly at the anterodorsal angle.

The surface ornament consists of numerous longitudinal riblets which are closely spaced. They are connected by some faint and short horizontal ribs of irregular shape. The riblets seem to be superimposed on a network of reticulations. There is, however, a zone of such reticulations at the posterior end. On the dorsal half of the carapace lateral surface, the riblets are slightly convex; the dorsal-most riblet runs parallel with the dorsal margin. On the ventral half, the riblets are straight or almost so but converging posteriorly towards the dorsum.

INTERNAL STRUCTURE: The hinge is "holamphidont". The anterior hinge element in the right valve consists of a tooth which is conical; immediately below, there is an ocular socket. The posteromedian groove is smooth but broadens near its posterior end. There is a well-developed posterior tooth; in side view it is rounded, in dorsal view elongate and backwardly deflected. It is situated just below the posterodorsal angle.

SEXUAL DIMORPHISM: The form considered here as the female is shorter and slightly more inflated than the male.

TAXONOMIC REMARKS: It is still uncertain as to the true generic assignation of this species. In general outline, hinge element, and ornament, it shows a close resemblance to the genus *Leguminocythereis*. *Soudanella laciniosa laciniosa* Apostolescu shows a close resemblance in general outline to this species and also with respect to the ornament. That species differs in details of the posterior margin, which is more produced and angled in the middle or slightly below. In *Cythereis elongicostata* Blake, the posterior margin is more rounded in outline, though moderately concave above and strongly compressed along the ventral portion. In addition to the above mentioned differences, *S. laciniosa laciniosa* is ornamented with strong longitudinal ribs in the area between the furrow and the anterior margin. *C.? longicostata*, on the other hand, is ornamented in the corresponding area by three to four horizontal rims which are parallel to the anterior margin and interconnected with a few weak short ribs.

DISTRIBUTION: *Cythereis? longicostata* was recorded originally by Blake (1950, p. 178) from the Gosport Eocene, at Little Stave Creek and Claiborne Bluff, Alabama. In our collection it comes both from the *Discoaster diastypus* zone at a depth of 267—270 m and the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m, in the Piaçabuçu Formation.

Cythereis aff. *dictyon* Brady

Pl. 7, Fig. 1.

MATERIAL: One complete carapace, P.M.-SA108.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2,

Discoaster diastypus zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,95 mm	0,45 mm	0,31 mm

DESCRIPTION: The carapace is laterally compressed and sub-quadrate; the greatest height lies at the anterodorsal angle. The dorsal margin is almost straight, the ventral margin is feebly convex. The anterior margin is regularly rounded and rimmed; there are two such rims running parallel to this margin. The posterior margin forms a subcaudal process which is angled above and below, thus forming a sharp mid-point. The ventral area of this margin is denticulated.

In dorsal view, the carapace is sub-rectangular, with the maximum inflation occurring behind the carapace mid-point. The left valve is larger than the right.

The ornament consists of coarse reticulations on which four longitudinal ridges are superimposed. The dorsal and ventral ridges are the continuation of the posteriormost anterior rim. The dorsal ridge continues to a point just below the posterodorsal angle before terminating and the ventral ridge converges posteriorly and then terminates immediately below the site of maximum inflation. Dorsal to the ventral ridge and slightly anterior to the mid-point of the carapace length is a second ventral ridge which runs posteriorly, terminating abruptly at the site of maximum inflation.

TAXONOMIC REMARKS: Our material is almost identical to that figured and described by van den Bold (1946, p. 90, Pl. 10, Fig. 13) as *Cythereis dictyon* Brady, except that the posterior end is more produced and sharply pointed in the middle. In addition, there is an additional ornamental ridge.

DISTRIBUTION: As was pointed out by van den Bold (1946, p. 90), this species may have a long stratigraphic range. He reported the species from the Oligocene of Cuba and the Plio-Pleistocene of Seran. The species was originally described by Brady (1880) from the Challenger dredgings off Culebra Island, the West Indies and off Sydney, New South Wales. In our collection, it comes from the *Discoaster diastypus* zone at a depth of 423—426 m in the Piaçabuçu Formation.

Quadracythere aff. *orbignyana?* Bosquet
Pl. 4, Fig. 6.

MATERIAL: 2 left valves, P.M.-SA109: 1—2.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,55 mm	0,38 mm

DESCRIPTION: The valve is sub-quadrate in lateral aspect and highest at the anterodorsal angle. The dorsal margin is roughly straight with a slight concave outline. The ventral margin is feebly convex. The lateral surface is inflated into a wing-like process which takes up a little more than half of the margin. The anterior margin is rimmed, broadly oblique and bluntly rounded. The posterior margin is drawn out into a subcaudal process that is concave above and rounded below.

The surface is ornamented with strong longitudinal riblets interconnected by short horizontal ribs. There is a faint sub-central tubercle and a short dorsal ridge running on the posterior half of the dorsal margin. The eye tubercle is situated below the anterodorsal angle.

TAXONOMIC REMARKS: The internal structures of the two valves in our collection are not well-developed. This could indicate that our form is an instar. With regard to the external habitus, the material is closest to the form figured and described by Keij (1957, pp. 107—108, Pl. 12, Fig. 14a), although differences do exist. In our material, the degree of dorsal concavity of the posterior end is sharper and the ventral roundness is more pronounced; furthermore, the jaggedness of the dorsal margin, which is conspicuous in Keij's form, is absent.

DISTRIBUTION: The original material was reported from the Paris Basin (Bosquet, 1852, p. 86, Pl. 4, Fig. 8) and later Keij (1957, pp. 107—108) reported the species from the Ledian of Ver, Acy, Pisseloup and Guépelle, France. In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Quadracythere? aff. *bicarinata* (Swain)
Pl. 4, Fig. 7; Pl. 8, Fig. 7.

MATERIAL: One left valve, P.M.-SA110.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS: Length 0,65 mm Height 0,38 mm

DESCRIPTION: The valve is sub-quadrate in lateral view and highest at the anterodorsal angle. The dorsal and ventral margins are sub-parallel. The anterior margin is broad and obliquely rounded, bearing two marginal rims that appear to be superimposed. The posterior margin is compressed, truncated above and rounded below. The mid-point is slightly lower than that of the anterior margin, the edge of which is roundly angled.

The valve is ornamented with three longitudinal ridges and a sub-central tubercle; the intercostal area is coarsely reticulated. The median ridge connects with the sub-central tubercle before obliquely extending posteriorly to join the dorsal ridge at the posterodorsal angle. The dorsal ridge curves along the dorsal margin and then slopes inward, immediately anterior to the mid-point, before terminating. The ventral ridge connects with the uppermost anterior rim, then rises to form a low ala. There are four to five additional short ridges in front of the muscle node, which connect the muscle node to the uppermost anterior rim. The eye tubercle is prominent and lies below the anterodorsal angle.

TAXONOMIC REMARKS: This form could be a molt-stage of *T. bicarinata.* As in the case of the above described *Q. orbignyana* Bosquet, the internal structures are undeveloped. Swain (1952, p. 35) pointed out the close resemblance of *Trachyleberis? bicarinata* Swain with *Trachyleberis? bassler* Ulrich but distinguished the two species on the basis of the former having more prominent ornament. Our material is, in this respect, closest to *T.? bicarinata.*

DISTRIBUTION: *Q.? bicarinata* was originally described from the Ocala Limestone, Eocene, Babson Park, Polk County, Florida. 320—330 ft., also from the lower part of the Ocala Limestone, Daytona Beach well, Volusia County, Florida. In our collection, the species derives from the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Cativella moriahensis van den Bold

Pl. 5, Fig. 1; Pl. 8, Fig. 9.

1957b *Cativella* sp. cf. *semitranslucens* (Crouch); van den Bold, p. 243, Pl. 2, Fig. 6.
1960 *Cativella moriahensis* van den Bold, p. 167, Pl. 4, Fig. 8; Pl. 8, Fig. 5.

MATERIAL: A right valve, P.M.-SA111.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS: Length 0,65 mm Height 0,40 mm

DESCRIPTION: The valve is elongate, sub-quadrate in lateral view and highest at the anterodorsal angle. The dorsal margin is straight but the marginal outline is convex due to the arching of the dorsal ridge. The ventral margin is sinuous at, or slightly in front of, the middle. The anterior margin is broad and obliquely rounded; it is provided with two rather high keels. The anteriormost keel extends dorsally beyond the eye tubercle and the inner ridge. This inner ridge continuous ventrally and extends along the ventral margin as far as to the posterior end. The posterior margin is narrow and drawn out so as to be angled slightly below the middle. The both margins seem to be ornamented by strong spines.

There are three longitudinal keels or flange-like ridges of a rather high and wavy nature. In addition, there is a network of coarse reticulations which supports or connects the ridges in such a way as to give them a fold-like appearance. There are also small nodes or tubercles in places. A dorsal ridge extends curvedly from just below and behind the eye tubercle to a point in front of the posterodorsal angle, where it abruptly terminates. There is a ventral ridge which starts just behind the anterior rim, extends posteriorly and terminates with a strong spine. The median ridge extends from near the anterior rim backwards in a wavy course towards the posterior.

INTERNAL STRUCTURE: The hinge element of this right valve consists of an anterior tooth which is conical; immediately below is a small socket. The median groove is narrow and extends posteriorly to a lobe-like tooth. The marginal pore-canals and the muscle scars are indistinct.

DISTRIBUTION: This species was first described from the Gulf of Paria, the Brasso Formation (*Globigerinatella insueta* zone to *Globorotalia fohsi lobata* zone), and from the Upper Eocene San Fernando Formation of Trinidad (van den Bold 1957, p. 244). He later recorded the species from the Harmony Hall well no. 2, at 1894—1906 ft., and the Paloma Alta Formation of Venezuela (van den Bold 1960, p. 168). In our collection, this species occurs in the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Costa variabilocostata seminuda van den Bold

Pl. 4, Figs. 8, a—b.

1958 *Costa variabilocostata seminuda* van den Bold, p. 405, Pl. 3, Figs. 1, a—b.

MATERIAL: One complete carapace, P.M.-SA112.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,70 mm	0,35 mm	0,35 mm

DESCRIPTION: The valves are moderately thick. In lateral view the carapace is sub-quadrate and highest at the anterodorsal angle. In dorsal view the carapace is sub-rectangular with the maximum inflation occurring behind the middle. The dorsal and ventral margins are sub-parallel. The anterior margin is rimmed and bears short denticles on its ventral area. It is oblique and broadly rounded. The posterior margin is drawn out into a sub-caudal process, which is compressed and then angled in the middle. The mid-point of this angle lies slightly below that of the anterior margin. The ventral area is denticulated. The left valve overlaps the right.

The ornament consists of coarse reticulations. On the right valve, there are three longitudinal ridges, a ventral ridge that runs along the ventral margin and terminating into a spine just at the point of maximum inflation; a median ridge that originates from about mid-anterior and then obliquely runs posteriorly to about the posterodorsal angle and a dorsal ridge which extends to a distance below the anterodorsal angle, then slopes inward before termination. On the left valve, slightly anterior from the mid-length, there is a horizontal ridge which curves between the median and dorsal ridges.

TAXONOMIC REMARKS: Our material exhibits a horizontal ridge on the right valve; this ridge curves between the median and dorsal ridges. The writer is of the opinion that it could be one of the intermediates between *Costa variabilocostata* van den Bold and the sub-species *seminuda*. It is, however, closer to the latter.

DISTRIBUTION: This species was originally described from the Oligo-Miocene of Trinidad, ranging from the Lower Miocene (*Globorotalia fohsi barisanensis* zone or the upper part of the *Globigerinatella insueta* zone to the *Globorotalia fohsi* zone) van den Bold (1958, p. 405). In our collection, this species was recorded from the *Discoaster diastypus* zone at a depth of 423—426 m in the Piaçabuçu Formation.

Costa barri van den Bold

Pl. 5, Figs. 6, a—b.

1960 *Costa barri* van den Bold, pp. 165—166, Pl. 4, Figs. 4, a—b.

MATERIAL: 2 complete carapaces, P.M.-SA112: 1—2.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,90 mm	0,50 mm	0,45 mm

DESCRIPTION: The shell substance is thick. In lateral aspect, the carapace is sub-ovate to sub-quadrate and highest at the anterodorsal angle. The anterior margin is broad and obliquely rounded; it bears some marginal denticles and a rim-like thickening which extends along the ventral margin. The posterior margin is laterally compressed; weakly concave to almost straight above and convex with some strong denticles below. It is roundly angled in the middle. The dorsal margin is almost straight and the ventral margin convex. The dorsal margin lies in a depression formed by the dorsal ridge which runs and hangs slightly over this margin. In dorsal view, the carapace is sub-ovate with compressed ends; the eye tubercles are symmetrically placed in relation to each other and the maximum inflation occurs at about one third from the posterior margin. The left valve is larger than the right and overlaps the latter distinctly on the anterodorsal and posterodorsal angles.

The surface is ornamented with three longitudinal ridges; the intercostal area is covered by pits of variable sizes and shapes, interconnected by strong riblets, so as to form a coarse mesh. A dorsal ridge originating at, or slightly in front of, the posterodorsal angle curves along the dorsal margin, to a point anterior of the carapace mid-length before obtusely sloping inward, then gently terminates. The median ridge extends from about the mid-posterior to about mid-anterior (the position of the muscle node) where it is sub-divided to form two parallel ridges, curving upwards and running anteroventrally for a distance before merging with the reticulation. The ventral ridge curves backwards then projects into a low wing-like process and terminates abruptly at about the site of maximum inflation.

TAXONOMIC REMARKS: Our form seems to be intermediate between the two species *Costa barri* van den Bold and *Costa harmoniensis* van den Bold. It is close to the latter species in the subdivision of the median ridge anteriorly, but is closer to *C. barri* in all other respects.

DISTRIBUTION: This species was originally described from the San Fernando Formation, Harmony Hall well no. 2, 828—840 ft., 1988—2000 ft. and the Vistabella Marl (van den Bold 1960). In our collection, it comes from the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m in the Piaçabuçu Formation.

Kingmaina brazilensis Neufville

Pl. 5, Fig. 3; Pl. 8, Figs. 4, a—c.

HOLOTYPE: Figure shown in Pl. 5, Fig. 3, MN-5306-I (NMB).

PARATYPES: 3 valves, P.M.-SA114: 1—3.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,65 mm	0,35 mm

DESCRIPTION: The carapace is sub-rectangular in lateral aspect and highest at the anterodorsal angle. The dorsal margin is almost straight and the ventral margin is slightly sinuous in the middle. The anterior margin is broad and obliquely rounded and the posterior margin is narrower but concave above and rounded below; both margins are rimmed and ornamented with denticles. The ornamental spines are stronger on the posterior margin than the anterior.

The surface is covered with coarse reticulations together with a sub-central tubercle. The ventrolateral surface is inflated into a wing-like process; this ala is pierced, or almost pierced, by four holes the edges of which are sharp. Immediately below are two conspicuous spines which point posteriorly.

INTERNAL STRUCTURE: The hinge is "hol-amphidont". In the right valve, the anterior tooth is high and conical, the posterior tooth is lower, ovate and smooth. In the left valve, there is a anterior socket and immediately behind is a well-developed tooth. The median bar extends posteriorly and ends at a lobe or knob-like impression immediately above the posterior socket. The line of concrescence coincides throughout, the selvage is peripheral and distinct. The marginal pore-canals are straight, forming groups of two to three. The normal pore-canals are not very numerous. The muscle scars are indistinct.

SEXUAL DIMORPHISM: The specimens here considered as males have a slightly broader anterior margin and the posterior tip of the ventral ala is more pointed and higher than in the females.

TAXONOMIC REMARKS: *K. brazilensis* differs from the type species *Cythere forbesiana* Bosquet, to which it is close in general outline, by lacking the concentric ridges on the anterior part of the lateral surface and in the shape of the posterior margin which is more concave above and pointed in the middle. *Cythereis? scutulata* Howe is similar, but that species is much smaller and the ala is more nearly parallel to the ventral margin.

DISTRIBUTION: This species has been recorded only from the *Discoaster diastypus* zone at a depth of 267—270 m in the Piaçabuçu Formation.

Henryhowella? reymenti Neufville

Pl. 5, Figs. 2, a—c.

HOLOTYPE: Specimen illustrated in Pl. 5, Figs. 2, a—b, MN-5307-I (NBM).

PARATYPES: 3 complete carapaces, P.M.-SA115: 1—3.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core 6, *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m.

OTHER OCCURRENCE: Borehole 2-BG-1-SE, core 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
Female	0,86 mm	0,50 mm	0,40 mm
Male	1,00 mm	0,58 mm	0,40 mm

DESCRIPTION: The shell substance is thick and in lateral aspect the carapace is sub-ovate to sub-rectangular; the greatest height lies at the anterodorsal angle and the maximum inflation is situated slightly behind the middle. The dorsal margin is roughly straight and lies in a depression caused by the overhang of a curved ridge running parallel to this margin. The ventral margin is convex in front of the middle and the lateral surface is inflated to hang somewhat over the margin. On the surface, there are two longitudinal ridges appearing to be formed through the strengthening of the reticulations. The posterior margin is narrow and evenly rounded. The both margins are compressed, rimmed and bear fine

denticulations. The left valve overlaps the right noticeably at the anterodorsal and the posterodorsal angles.

The valves are covered by small spines superimposed on a network of reticulations. There is a faint sub-central tubercle; in some specimens the spines are eroded so that the reticulation appears stronger. The eye tubercles are prominent and are situated below the anterodorsal angle; immediately below, is a conspicuous ovate depression.

SEXUAL DIMORPHISM: The form considered here as male is larger. The female is more obliquely rounded on both ends, the posterior margin is produced above.

TAXONOMIC REMARKS: *Henryhowella? reymenti* Neufville is close to the genera *Henryhowella* Puri and *Poscidonamicus* Benson. The reticulations and the ventral ridge in *H.? reymenti* are less conspicuous. Furthermore, there are some spines which appear to be superimposed on the reticulations. In this latter respect, it is closer to the genus *Henryhowella.* The type species of that genus, as figured and described by van Morkhoven (1963, Vol. 2, p. 210), is close in general outline to the female of our species although its spines are much stronger, and the posterior outline, though oblique, is more rounded than in our form.

DISTRIBUTION: This species has been recorded only from the *Cruciplacolithus tenuis* zone at a depth of 1935—1037 m and 1192—1195 m in the Piaçabuçu Formation.

Brachycythere sapucariensis Krömmelbein

Pl. 5, Figs. 4, a—b; Pl. 8, Figs. 8, a—b.

1964 *Brachycythere sapucariensis* Krömmelbein; pp. 489—495.
1966 *Brachycythere sapucariensis* Krömmelbein; Krömmelbein, pp. 119—121.
1973 *Brachycythere sapucariensis* Krömmelbein; Neufville, pp. 45—46, Pl. 1, Figs. 5—7.

MATERIAL: 7 complete carapaces and two valves, P.M.-SA116: 1—9.

OCCURRENCE: Borehole 2-IA-1-SE, core no. 1, *Lithastrinus grilli* zone at a depth of 278,9—280,9 m.

AGE: Early Turonian.

DIMENSIONS:	Length	Height	Width
Female	0,75 mm	0,43 mm	0,40 mm
Male	0,80 mm	0,43 mm	0,40 mm

INTERNAL STRUCTURE: The line of concrescence coincides. The marginal pore-canals are simple, few and branching near the outer margin. The hinge is hemiamphidont. In the right valve, the anterior tooth is smooth and the posterior is elongate, crenulate. The normal pore-canals are not very numerous. The details of the central muscle scars and the structure of the normal pore-canals are still unknown.

SEXUAL DIMORPHISM: The males are longer than the females.

TAXONOMIC REMARKS: The sexual dimorphism of this species seems to be rather weak, apparently due to the individual variation of the shape of the carapace. Krömmelbein (1964) pointed out the difficulties in distinguishing the both sexes; Neufville (1973) attempted this by using the ratio of the height to length between the both sexes and found the variation to be small. The length of carapace was found to be the main distinguishing feature. For a detailed discussion of this method, see Reyment and Neufville (1974).

DISTRIBUTION: As was pointed out by Krömmelbein (1966), this species occur in stratigraphically equivalent strata in Northeastern Brazil and Gabon, West Africa. Neufville (1973, pp. 45—46) reported the species from the Eze-Aku Shale, Lower Turonian, East Central State, Nigeria. In the present study, this species was only found in the *Lithastrinus grilli* zone at a depth of 278,9—280,9 m, in the Cotinguiba Formation.

Pterygocythereis aff. *miocenica* van den Bold

Pl. 5, Figs. 5, a—b.

MATERIAL: One complete carapace, P.M.-SA117.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	1,30 mm	0,80 mm	0,75 mm

DESCRIPTION: The carapace is laterally compressed and the shell substance is moderately thick; in lateral view it is sub-quadrate, in dorsal view arrow-shaped. The anterior margin is broad and regularly rounded, denticulated along the ventral area. Only two to three such denticles are preserved. The posterior margin is narrower and obliquely rounded. The both margins are rimmed. On the anterior marginal rim, some knob-like equispaced tubercles are superimposed. The posterior marginal rim is weaker but becomes stronger towards the posterodorsal angle and ter-

minates a short distance dorsal on the dorsal margin. The site of greatest height lies at the anterodorsal angle and the maximum inflation occurs at the tip of the ventrolateral ala.

The dorsal margin is almost straight and bears a weak, broken ridge; this ridge continues from the anterior rim along the dorsal margin and gently falls off at a point below the posterior cardinal angle; this angle is rounded. The ventral margin is straight, and lies in a depression formed by the ventrolateral inflation of the ventral surface. This ala takes up the whole length of the ventral margin and is apparently formed by the continuation of the anterior rim. The left valve is larger than the right; it overlaps the latter distinctly on the dorsal end of the posterior margin.

TAXONOMIC REMARKS: Benson and Coleman (1963, p. 22) drew attention to the co-occurrence of crested heteromorphs and uncrested tecnomorphs in *Pterygocythereis* aff. *americana* Ulrich & Bassler. Van den Bold (1967, p. 311), observed the two forms in the Miocene of the Caribbean but noted each to be restricted to a particular biozone; he therefore, proposed their separation. Our form, though uncrested and closest to *Pterygocythereis miocenica* van den Bold, differs in a number of respects: its anterior margin is regularly rounded and the marginal rims is weaker by far; the posterior margin is obliquely rounded, more rounded below and slightly produced above.

DISTRIBUTION: The species was originally described from the Miocene of Trinidad (van den Bold 1967). In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 423—426 m, in the Piaçabuçu Formation.

Soudanella laciniosa triangulata Apostolescu

Pl. 6, Figs. 1, a—b.

1961 *Soudanella laciniosa triangulata* Apostolescu, p. 810, Pl. 7, Figs. 130—135.
1963 *Buntonia* (*Protobuntonia*) *triangulata* Apostolescu; Reyment, p. 237, Pl. 6, Figs. 6, a—b; Pl. 7, Fig. 4.

MATERIAL: 3 complete carapaces, P.M.-SA118: 1—3.

OCCURRENCE: Borehole 2-BG-1-SE, core nos. 6 & 7, *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m and 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
Female?	1,00 mm	0,60 mm	0,40 mm
Male	1,14 mm	0,60 mm	0,43 mm

DESCRIPTION: In lateral view, the carapace is elongate-ovate, and in dorsal view it is a compressed oval. The greatest height is near the anterior margin and the carapace maximum inflation is in the middle. The dorsal margin is convex but becomes concave towards the posterior margin. The ventral margin is slightly convex to almost straight and converges towards the posterior. The anterior margin is broad and obliquely rounded. The posterior margin is narrow and angled in the middle. It is roughly straight above and rounded below. The left valve overlaps the right strongly along the ventral margin, less on the dorsal and posterior margins.

The surface of the valves is covered by some ribbon-like longitudinal ribs. The ribs are cut by a depression or furrow which runs parallel with the anterior margin. In one of the specimens, the ornament is less conspicuous, the carapace being almost smooth. The eye tubercle is glassy and situated immediately below or a little anterior to the position of the anterodorsal angle.

SEXUAL DIMORPHISM: The form here considered as female is shorter and bears a short but strong spine at the middle of the posterior margin.

TAXONOMIC REMARKS: Our material, in external habitus, agrees well with the originally described material (Apostolescu 1961, p. 810, Pl. 7, Figs. 131—133); it is also close to some forms figured and described by Reyment (1963, pp. 237—238, Pl. 6, Figs. 6, a—b, not Pl. 7, Fig. 4) under the sub-generic assignation of *Buntonia* (*Protobuntonia*) *triangulata* Apostolescu. The genus *Soudanella* was proposed by Apostolescu (1961) for forms with shape as in *Protobuntonia* but having a vestibule. Reyment (1963) thought this feature insufficient to allow generic differentiation but now believes (oral communication) this to be a stable feature rather than a variation within the sub-genus *Protobuntonia*, as he previously thought. Althought the internal structure of our form is unknown, the writer, considering the identical external habitus of this form and Apostolescu's (1961) figures, would prefer the location of this form in the genus *Soudanella.*

DISTRIBUTION: This species was originally recorded from the *Globigerina* zone at a depth of 567 m, Danian, type locality Sangalkam, Sénégal (Apostolescu 1961, p. 810). Reyment (1963) reported the species from a borehole at Ilaro, a borehole at Araromi at a depth of 460—439 m and from a borehole at Gbekebo at a depth of 878 m, Danian-Paleocene, Nigeria. In our collection, this species occurs in the *Cruciplacolithus*

tenuis zone at a depth of 1035—1037 m, and 1192—1195 m in the Piaçabuçu Formation.

Cytheridea (*Cytheridea?*) aff. *mississippiensis* Howe & Law

Pl. 8, Figs. 1, a—b.

MATERIAL: One complete carapace, P.M.-SA119.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,55 mm	0,30 mm	0,25 mm

DESCRIPTION: The valves are thin and transparent. In lateral aspect, the carapace is subtriangular to sub-ovate with its greatest height occurring at, or just anterior to the carapace mid-length. The dorsal margin is convex and slopes at a slight angle more steeply towards the anterior than the posterior. The ventral margin is convex in its anterior half and almost straight in its posterior half, before meeting the rounded posterior margin which is slightly truncated above. The anterior margin is broad and obliquely rounded.

In dorsal view, the carapace is elongate ovate, the maximum inflation being situated slightly behind the middle. The left valve overlaps the right along the entire periphery, the least overlap occurring at the posteroventral area of the ventral margin. The surface is smooth.

TAXONOMIC REMARKS: In valve shape, our form is very close to the individual rather schematically figured by Howe & Law (1936). The species was described from the Vicksburg Oligocene by Howe & Law under the generic assignation *Pontocypris?* but would seem nearer to *Cytheridea.*

DISTRIBUTION: This species was recorded by Howe & Law (1936, pp. 23—24) from the Vicksburg Oligocene, Alabama, ranging from the Upper Red Bluff to the top of the Byram. In our collection, it comes from the *Discoaster diastypus* zone at a depth of 423—426 m, in the Piaçabuçu Formation.

Cytheridea (*Cytheridea*) sp.

Pl. 6, Fig. 6.

MATERIAL: A right valve, P.M.-SA120

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,65 mm	0,35 mm

DESCRIPTION: The valve is elongate ovate in lateral view and highest in the middle. The dorsal margin is strongly convex and the ventral margin is roughly straight. The anterior margin is moderately broad and evenly rounded except for a slight truncation towards the ventral margin. The posterior margin is narrower and obliquely rounded. The surface is smooth to weakly punctate.

INTERNAL STRUCTURE: The hinge elements are typical for *Cytheridea* (*Cytheridea*). The muscle scars and the marginal pore-canals are indistinct.

DISTRIBUTION: This species was only found to occur in the *Discoaster diastypus* zone at a depth of 267—270 m, Piaçabuçu Formation.

Krithe mutveii Neufville

Pl. 5, Fig. 7; Pl. 6, Figs. 7, a—c; Pl. 8, Fig. 5.

HOLOTYPE: Figures shown in Pl. 6, Figs. 7, a—b, MN-5226-I, a male carapace.

PARATYPES: 18 complete carapaces and 8 valves, P.M.-SA121: 1—26.

LOCUS TYPICUS: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

OTHER OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
Female	0,65 mm	0,40 mm	0,35 mm
Male	0,80 mm	0,40 mm	0,35 mm

DESCRIPTION: The female carapace is rhomboidal in lateral view, highest and widest in the middle. The dorsal margin is arched, curving downward towards the posterior in an unbroken curve, but more steeply in the left valve than the right. The ventral margin forms a flat surface; it is roughly straight to weakly convex. The anterior margin is truncated ventrally to form a rounded sub-acute angle.

In dorsal view, the carapace is elongate ovate and the valves convex. The left valve is larger than the right and overlaps the latter strongly toward the anterior end.

The outline of the male carapace is similar to that of the female but is more elongate, the valves are less convex and the posterior margin is more pointed in the left valve.

INTERNAL STRUCTURE: The hinge and the anterior marginal area are typical for the genus. The muscle scar pattern consist of five adductor scars and a V- to U-shaped frontal scar. Four adductor muscle scars form a vertical row, decreasing in length ventrally. Immediately below the frontal scar is another adductor scar.

TAXONOMIC REMARKS: This species is close in general outline to *Krithe parattica* Alexander, but differs in the following respects. The left valve is distinctly higher than the right; the slope on the posterior end is steeper; the left valve overlaps the right strongly near the anterior end. This species has an additional adductor muscle scar in front and immediately below the V- to U-shaped frontal scar.

DISTRIBUTION: This species was recorded only from the *Discoaster diastypus* zone at a depth of 267—270 m and 423—426 m, in the Piaçabuçu Formation.

Krithe guatemalensis van den Bold

Pl. 6, Figs. 4, a—c.

1946 *Krithe guatemalensis* van den Bold, p. 77, Figs. 7, a—b; 8, a—b.
1957b *Krithe guatemalensis* van den Bold; van den Bold, p. 7, Pl. 1, Figs. 5, a—b.
1960 *Krithe guatemalensis* van den Bold; van den Bold, p. 151.

MATERIAL: 2 complete carapaces and 2 valves, P.M.-SA122: 1:—4.

OCCURRENCE, Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
Female	0,70 mm	0,43 mm	0,38 mm
Male	0,73 mm	0,40 mm	0,33 mm

DESCRIPTION: The female carapace is subtriangular to sub-ovate in lateral aspect, highest and widest in the middle. The dorsal margin is arched and slopes towards the posterior more steeply in the left valve than the right. On the right valve, just anterior to the carapace greatest height, there is a slight depression. The ventral margin is feebly convex and lies on a flat surface caused by the slight inflation of the ventralateral surface. The anterior margin is slightly compressed and rounded. The posterior margin is roundly truncated; it is sharply angled in the middle of the right valve.

In dorsal view the carapace is inflated ovate, with a sub-acute anterior and a blunt posterior. The left valve overlaps the right strongly in the anterior half.

The male carapace is similar in outline, but is elongate-ovate in lateral aspect and lower and less arched on the dorsal margin. The posterodorsal margin is evenly truncated and the margin is produced in both valves. The depression on the anterodorsal margin of the right valve is less pronounced. The valves are smooth.

INTERNAL STRUCTURE: The hinge and marginal pore-canals are typical for the genus.

DISTRIBUTION: This species was originally described from the Paleocene of Guatemala and British Honduras (van den Bold 1946). It was later reported from the Paleocene to the lower part of the Middle Eocene of Trinidad (The Lizard Springs and the Navet Formations), van den Bold (1957b, 1960). In our collection, it comes from the *Discoaster diastypus* zone at a depth 267—270 m, in the Piaçabuçu Formation.

Krithe saundersi van den Bold

Pl. 6, Figs. 3, a—b.

1946 *Krithe bartonensis* (Jones); van den Bold, pp. 76, 77, Pl. 4, Figs. 15, a—d.
1960 *Krithe saundersi* van den Bold, p. 157, Pl. 3, Figs. 3, a—b.

MATERIAL: One complete carapace, P.M.-SA123.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 7, *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m.

AGE: "Danian".

DIMENSIONS:	Length	Height	Width
	0,75 mm	0,40 mm	0,35 mm

DESCRIPTION: The carapace is elongate, subrectangular in lateral view. In dorsal view it is inflated oval with a rather acute anterior and a blunt posterior. The greatest height and the maximum inflation are in the middle. The dorsal margin in weakly convex to almost straight and the ventral margin is slightly concave at, or just in front of, the middle. The anterior margin is compressed and evenly rounded. The posterior margin is obliquely truncated to sub-acute, with a rather rounded angle below. The left valve overlaps the right strongly at the anterodorsal and posterodorsal angles, but less elsewhere. The surface is smooth.

DISTRIBUTION: This species was originally reported from the Middle Eocene to Lower Oligocene of Trinidad (Friendship Quarry Marl, *Hantkenina aragonensis* zone and the *Globigerina amphiapertura* zone), van den Bold (1960). In our collection, it occurs in the *Cruciplacolithus tenuis* zone at a depth of 1192—1195 m, in the Piaçabuçu Formation.

Parakrithe? ovata van den Bold

Pl. 6, Figs. 5, a—b.

1960 *Parakrithe? ovata* van den Bold, p. 161, Pl. 6, Figs. 7, a—c.

MATERIAL: 4 complete carapaces, P.M.-ST124: 1—4.

OCCURRENCE: Borehole 2-BG-1-SE, core nos. 1 & 2, *Discoaster diastypus* zone at depths of 267—270 m and 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,46 mm	0,30 mm	0,23 mm

DESCRIPTION: The carapace is roughly ovate in lateral view. It is highest in the middle, or immediately behind. The maximum inflation is very slightly behind the middle. The dorsal margin is strongly convex, sloping more abruptly and steeply towards the posterior than the anterior. The ventral margin is feebly convex. The anterior margin is weakly oblique, broadly rounded and slightly produced just above the middle. The posterior margin is broad, obliquely truncated above and acutely rounded below.

In dorsal view, the carapace is ovate with a rather sharp acute anterior and a narrowly rounded posterior. The left valve is larger than the right and overlaps the latter along the entire periphery but more strongly at the anterodorsal angle. The valves are smooth.

DISTRIBUTION: This species was originally described from the Upper Eocene to the Lower Oligocene (San Fernando Formation, above the non-calcareous Mount Moriah Silt) of Trinidad (van den Bold 1960, p. 161). In our collection, it comes from the *Discoaster diastypus* zone at depths of 267—270 m, and 423—426 m in the Piaçabuçu Formation.

Parakrithe? aff. *ovata* van den Bold

Pl. 7, Fig. 3.

MATERIAL: One complete carapace, P.M.-SA125.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,58 mm	0,31 mm	0,25 mm

DESCRIPTION: The carapace is oblong ovate in lateral view and highest just anterior to the middle. In dorsal view the carapace is inflated ovate, with the maximum inflation in the middle. The dorsal margin is convex and slopes smoothly towards the posterior. The ventral margin is feebly convex to almost straight in the left valve and slightly sinuous in the middle of the right. The anterior margin is broad, slightly oblique, evenly rounded anda weakly compressed. The posterior margin is sub-acute and rounded ventrally.

The left valve is larger than the right and overlaps the latter along the entire periphery; the strongest overlap occurs at the anterodorsal half of the dorsal margin and behind the mid-length on the ventral margin.

DISTRIBUTION: This species occurs in the *Discoaster diastypus* zone at a depth of 267—270 m, in the Piaçabuçu Formation.

Eucytherura rohri van den Bold

Pl. 7, Figs. 2, a—b.

1958 *Loxoconcha rohri* van den Bold, p. 408, Pl. 4, Figs. 5, a—b.
1966a *Loxoconcha rohri* van den Bold; van den Bold, p. 32, Pl. 4, Figs. 6, a—b.
1966b *Eucytherura rohri* van den Bold; van den Bold, p. 32, Pl. 4, Figs. 6, a—b.

MATERIAL: One complete carapace, P.M.-SA126.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,33 mm	0,20 mm	0,20 mm

DESCRIPTION: The carapace is small and the valves are of equal size. In lateral view, the carapace is elongate to sub-rectangular. The dorsal margin is straight and lies in a narrow furrow formed by the overhang of the dorsal rim. The ventral margin is slightly convex and converges towards the posterior. The anterior margin is obliquely rounded with two to three strong denticles in the middle. The posterior margin is compressed and drawn out into a rather short

caudal process, situated above the carapace mid-point; it forms an angle of approximately 90 degrees with the posterodorsal angle. The carapace greatest height lies at the middle or slightly in front and the maximum inflation occurs at the posteroventral angle.

The valves are ornamented with coarse reticulation. There are two longitudinal ventral ridges and two transverse ridges; the latter run parallel to each other, just about the carapace mid-length. One of the ventral ridges starts from the ventral part of the anterior margin, extending curvedly posteriorly to about the carapace mid-point where the second ventral ridge starts before projecting into an ala. Posterior to this ala, there is a spine on each valve. The eye tubercles are large and rounded; they are symmetrically situated below the anterodorsal angle.

TAXONOMIC REMARKS: Van den Bold (1966b, p. 32) grouped two forms under *Eucytherura rohri* and reported them to be very similar, one having a straighter dorsal margin than the other. Our material is straight along the dorsal margin and is closest to that individual figured and described by van den Bold (1967, pp. 312—313, Pl. 1, Figs. 13, a—b). However, it is less rounded on the anterior margin than the latter.

DISTRIBUTION: This species was originally described from the Springvale and Upper Brasso Formations of Trinidad (van den Bold 1958, p. 410). It was later reported by him (1966b, p. 32) from the Miocene and Pliocene of Venezuela (The Cubagua Formation) and still later from the Gatún Formation, Panama (van den Bold, 1967, pp. 312—313). In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 267—270 m, in the Piaçabuçu Formation.

Paracytheridea toleri Howe & Law

Pl. 7, Figs. 8, a—b.

1936 *Paracytheridea toleri* Howe & Law, pp. 35—36, Pl. 2, Figs. 23—24; Pl. 3, Fig. 13.

MATERIAL: A right valve, P.M.-SA127.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,58 mm	0,30 mm

DESCRIPTION: The valve is elongate in lateral view and highest at the anterodorsal angle. The dorsal margin is somewat sinuous in the middle, tapering from the posterodorsal angle to a rather bluntly pointed posterior margin. The ventral margin is slightly convex and converges towards the posterior; the ventrolateral surface is inflated into a sharp backwardly pointed ala. The anterior margin is somewhat compressed and broadly rounded.

The surface of the valve is irregular. There is a large swelling immediately below the posterodorsal angle. Another small swelling is situated at the position of the muscle node; these swellings appear to be formed by groups of small tubercles. The surface is further ornamented with an irregular net-work of ridges. From the tip of the ala, along the edge, runs one such ridge which connects with the anterior margin. Below, and on the ventral surface, there are two more such ridges running parallel with the first.

INTERNAL STRUCTURE: The hinge element of this right valve is the continuation of the dorsal marginal edge; it is crenulated and possesses a rather low projecting tooth. The anterior marginal area is moderately broad. The marginal pore-canals and the muscle scars are indistinct.

TAXONOMIC REMARKS: The spine between the ala and the posterior caudal process of the ventral margin, in the originally described material (Howe & Law 1936, pp. 35—36) was not observed in our material. All other features are identical.

DISTRIBUTION: Howe & Law (1936, pp. 35—36) first recorded this species from the Louisiana Vicksburg Oligocene. It later reported from the Yague Group (Neogene) of the Northern Dominican Republic (van den Bold 1968). In our collection, it occurs in the *Discoaster diastypus* at a depth of 267—270 m, in the Piaçabuçu Formation.

Paracytheridea aff. *hispida* van den Bold

Pl. 7, Figs. 7, a—b.

MATERIAL: A right valve, P.M.-SA128.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height
	0,60 mm	0,28 mm

DESCRIPTION: The valve is elongate in lateral view and highest at the anterodorsal angle. The dorsal and ventral margins are sub-parallel. The anterior margin is broadly rounded and the

posterior margin is drawn out into a long, sharp and pointed caudal process, dorsally deflected.

At the site of the muscle node, is a swelling upon which are two ridges forming a loop, before extending parallelly towards the posterior. The dorsalmost of the ridges terminates abruptly while the ventralmost projects into a rather high, sharp and blade-like ala. Below this ala, and overhanging the ventral margin, is a sharp spine. Dorsally on the corresponding side of the ala, there is an elongate tubercle which extends to a short distance just below the posterodorsal angle. The intercostal area is ornamented with like, smaller tubercles.

INTERNAL STRUCTURE: The anterior part of the hinge in our material is crushed. The posterior part of the hinge is formed by the extension of the dorsal marginal edge, and it is crenulated. The anterior marginal area is moderately broad; the marginal pore-canals and the muscle scars are indistinct.

TAXONOMIC REMARKS: Though our form is close to the originally described material (van den Bold 1946, p. 87), it differs in the following respects: its posterior caudal process is less dorsally deflected, the anterior margin is more rounded, while the dorsalmost part of the mid-anterior ridges is posteriorly less extended. The Brazilian form could be a variant. Owing to our insufficient material, we can not say with certainty whether this is so; the writer therefore hesitates in considering the both forms specifically identical.

DISTRIBUTION: This species was originally reported from the Eocene of the Bonaire Formation (van den Bold, 1946, p. 87). In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 267—270 m, in the Piaçabuçu Formation.

Cytheropteron sp.

Pl. 7, Figs. 4, a—b.

MATERIAL: A left valve, P.M.-SA129.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 6, *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m.

AGE: "Danian".

DIMENSIONS:	Length	Height
	0,60 mm	0,33 mm

DESCRIPTION: In lateral view the valve is sub-ovate and highest slightly behind the middle. The dorsal margin is convex sinuous in the middle. The ventral margin is sinuous anterior of the middle, then convex before converging towards the posterior. The anterior margin is broad and obliquely rounded. The posterior margin forms a sharp sub-caudal process which is angled above the middle.

The valve is covered with square pits connected by reticules. The ventrolateral area is inflated into a winglike process which is sharply pointed. This bears two conspicuous ribs running parallel, from the top, to connect with the anterior margin just below the middle of this margin. The reticulation on the ventral surface tends to develop into longitudinal ribs.

INTERNAL STRUCTURE: The hinge element of this left valve, consists of a crenulate bar and elongate posterior and anterior sockets. The posterior socket is conspicuously open towards the posterior end. The both sockets show stronger crenulations than that of the median bar. The marginal pore-canals are few and widely spaced. The muscle scars are indistinct.

TAXONOMIC REMARKS: The Brazilian form is slightly longer and its posterior margin is more regularly angled than in similar provisionally described material from Panama (van den Bold 1967, p. 312). Unfortunately, our inadequate material did not allow a more definite comparison.

DISTRIBUTION: This species was originally reported from the Gatún Formation, Panama (van den Bold 1967, p. 312). In our collection, it occurs in the *Cruciplacolithus tenuis* zone at a depth of 1035—1037 m in the Piaçabuçu Formation.

Loxoconcha corrugata Alexander

Pl. 7, Figs. 9, a—b.

1934 *Loxoconcha corrugata* Alexander, p. 228, Pl. 33, Fig. 13.

MATERIAL: One complete carapace, P.M.-SA130.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 2, *Discoaster diastypus* zone at a depth of 423—426 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,45 mm	0,28 mm	0,30 mm

DESCRIPTION: The carapace is sub-quadrate in lateral view and widest in the middle. The dorsal margin is straight; the ventral margin is slightly sinuous at, or just in front of the middle. It lies in a depression formed by the ventrolateral inflation of the ventral surface. The anterior and posterior margins are strongly compressed and very weakly rimmed. The anterior is obliquely

rounded and the posterior margin forms a short caudal process, curving downwards to meet the ventral margin. On the dorsal half of this margin there is a slight concavity. In dorsal view, the carapace is ovate, with both ends pointed and the valves of equal size.

The surface ornament consists of reticulations of varying strength. It is most prominent on the inflation of the ventrolateral surface, on which it forms three to four longitudinal ridges, curving downward and running parallel with the margin. The anterior and posterior margins are very weakly ornamented to smooth.

TAXONOMIC REMARKS: Our form differs from the originally described material by having the maximum inflation in the middle, and the posterior sub-caudal process slightly shorter. All other features are identical.

DISTRIBUTION: This species was originally recorded from the Midway (Eocene of Texas (Alexander 1934, p. 228). In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 423—426 m, in the Piaçabuçu Formation.

Xestoleberis chamela van den Bold

Pl. 7, Figs. 6, a—b.

1960 *Xestoleberis chamela* van den Bold, p. 182, Pl. 6, Figs. 10, a—b.

MATERIAL: 4 complete carapaces, P.M.-SA131: 1—4.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,65 mm	0,40 mm	0,39 mm

DESCRIPTION: The carapace is pyriform in lateral aspect and highest and widest behind the middle. The dorsal margin is arched and slopes obtusely to the low and evenly rounded anterior. The posterior margin is truncated and broadly rounded. The ventral margin is sinuous at, or in front of the middle. The left valve is larger than the right, overlapping it along the entire periphery but more strongly so at the site of greatest height. The surface is smooth.

DISTRIBUTION: This species was originally reported from the Eocene and Oligocene of Trinidad (San Fernando Formation). In our collection, it occurs in the *Discoaster diastypus* zone at a depth of 267—270 m, in the Piaçabuçu Formation.

Xestoleberis aff. *moriahensis* van den Bold

Pl. 7, Figs. 5, a—b.

MATERIAL: 3 complete carapaces, P.M.-SA132: 1—3.

OCCURRENCE: Borehole 2-BG-1-SE, core no. 1, *Discoaster diastypus* zone at a depth of 267—270 m.

AGE: Early Eocene.

DIMENSIONS:	Length	Height	Width
	0,40 mm	0,30 mm	0,30 mm

DESCRIPTION: The carapace is sub-globular in side view. In dorsal aspect, it is egg-shaped. The greatest height is immediately behind the middle and the maximum inflation is in the middle. The dorsal margin is strongly arched and the ventral margin is almost straight, hidden in a rather shallow depression formed by the inflation and overhang of the ventrolateral surface. The anterior margin is low, narrow and compressed, producing a flange-like rim. The margin is obliquely rounded. The posterior margin is truncated, broad and roundly angled below. The left valve overlaps the right strongly along the dorsal margin. The surface is smooth.

TAXONOMIC REMARKS: It is uncertain whether this form is a new species or a variant within the species *Xestoleberis moriahensis* van den Bold. The general outline, the detail of the anterior slope, the greatest height and the maximum inflation agree with the male figured by van den Bold (1960, Pl. 6, Figs. 9, a—b). In our form, there is a compression of the anterior margin into a flange-like rim.

DISTRIBUTION: This species was originally recorded from the Lower Oligocene (*Globorotalia opima opima* zone) to the Middle Miocene (*Globorotalia menardii* zone) van den Bold (1960, pp. 180—182). In our collection it occurs in the *Discoaster diastypus* zone at a depth of 267—270 m, in the Piaçabuçu Formation.

Concluding discussion

Krömmelbein and Wenger (1966) and Krömmelbein (1965) pointed out the great similarity between the "Neocomian" non-marine ostracod fauna of Gabon and that of northeastern Brazil (Bahia and Sergipe). Thus, of the 40 odd species of ostracods known from the Cocobeach Formation and 90 species from northeastern Brazil, 33 occur in the Bahia-Sergipe area and Gabon. Little so

Table 1. Distribution of Brazilian Upper Cretaceous-Paleogene ostracods in the Gulf coast region and West and North Africa.

Species	Sergipe	Texas	Louisiana	Florida	Alabama	Mississippi	Arkansas	Tunisia	Sénégal	Nigeria	Gabon
Bairdia hiwanneensis H&L	×		×			×					
B. aff. *hazzardi* H&La	×		×								
B. aff. sp. E	×							×			
Argilloecia faba A	×	×									
Hemicythere bullula H	×			×		×					
H. aff. *lemniscata* H	×			×							
Echinocythereis garretti H&M	×			×			×				
Cythereis? longicostata B	×				×						
Quadracythere? aff. *bicarinata* (S)	×			×							
Brachycythere sapucariensis K	×									×	×
Soudanella laciniosa triangulata Ap	×								×	×	
Cytheridea? aff. *mississippiensis* H&La	×				×	×					
Paracytheridea toleri H&La	×		×								
Loxoconcha corrugata A	×	×									

Explanation of abbreviations: A = Alexander, H&L = Howe and Lea, H&La = Howe and Law, H&M = Howe and McGuirt, Ap = Apostolescu, (S) = Swain, K = Krömmelbein, B = Blake, H = Howe.

far is known about the marine ostracod fauna (at least for northeastern Brazil). As it is known at present to the writer, besides the species *Brachycythere sapucariensis* Krömmelbein, fossil marine ostracods have not been described and figured from the Sergipe basin.

The present study of the two boreholes, mentioned above, shows that:

1. The regions of particular comparative importance for this study are:
   a) The Caribbean
   b) The Gulf Coast
   c) North Africa

2. In general, the distribution of the ostracods indicates that for the Cretaceous, correlations outside of the southern South Atlantic are not important. This observation accords with that obtained by Reyment and Tait (1972) for the ammonites and bivalves but differs in that these groups show a wider Atlantic distribution after the Turonian, whereas the ostracods appear to have remained isolated in the South Atlantic realm until at least the Campano-Maastrichtian, as far as can be judged from Gabonese material and the work of Reyment (1960) and Berthels (1968 a—b).

3. Even in the "Danian", there are definite affinities between West Africa and South America, but for the first time, Caribbean and Gulf Coast relationships become strong in the South Atlantic faunas. Although, the Brazilian (Sergipe) Paleogene material shows more species in common with Trinidad than any other part of the Caribbean and the Gulf Coast region (see Tables 1 & 2), it is strange that the collections described by Berthels (1968 a—b; 1973), show so little in common with Brazil and the Caribbean. A paleogeographical reason for this has recently come to light (Melguen et al., 1978). Boltenhagen (1979) has obtained analogous results for fossil plants.

Table 1, shows correlations between Brazil (Sergipe), North and West Africa and the Gulf Coast. Table 2, shows correlations between Brazil (Sergipe) and the Caribbean.

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Table 2. Distribution of Brazilian Paleocene ("Danian")-Lower Eocene ostracods in the Caribbean.

Species	Sergipe	Trinidad	British Honduras	Dominican Republic	Cuba	Guatemala	Panama	Venezuela	Bonaire
Cytherella harmoniensis v.d.B.	×	×							
Bairdia cespedesensis v.d.B.	×	×			×			×	
B. dolicha v.d.B.	×	×						×	
B. hiwanneensis H&L	×	×							
Pontocypris dreikanter C&F	×	×			×		×		
Trachyleberis reticulospinosa v.d.B.	×	×							×
T. bermudezi v.d.B.	×				×				
Cativella moriahensis v.d.B.	×	×						×	
Costa barri v.d.B.	×	×						×	
C. variabilocostata seminuda v.d.B.	×	×							
Pterygocythereis aff. *miocenica* v.d.B.	×	×							
Krithe guatemalensis v.d.B.	×	×	×		×	×			
K. saundersi v.d.B.	×	×							
Parakrithe? ovata v.d.B.	×	×							
Eucytherura rohri v.d.B.	×	×					×	×	
Paracytheridea toleri H&La	×			×					
P. aff. *hispida* v.d.B.	×								×
Cytheropteron aff. sp. v.d.B.	×						×		
Xestoleberis chamela v.d.B.	×	×							
X. aff. *moriahensis* v.d.B.	×	×							

Explanation of abbreviations: A = Alexander, v.d.B. = van den Bold, C&F = Coryell & Fields, H&La = Howe & Law, H&L = Howe & Lea.

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Plate 1

Fig. 1, a—d. *Cytherella sergipensis* Neufville (all figures are × 130). Holotype. a, lateral view of a female left valve; b, dorsal view of same carapace; c, dorsal view of male carapace; d, lateral view of same carapace left valve. MN-5225-I (NMB).

Fig. 2, a—b. *Cytherella harmoniensis* van den Bold a, dorsal view of male carapace; b, lateral view of same carapace left valve, × 80. P.M.-SA86-1. c, dorsal view of female carapace; d, lateral view of same carapace left valve, × 100. P.M.-SA86-2.

Fig. 3, a—d. *Cytherella piacabucuensis* Neufville Holotype (all figures are × 100); a, dorsal view of female carapace; b, lateral view of same carapace left valve. MN-5303-I. c, dorsal view of male carapace; d, lateral view of same carapace left valve. P.M.-SA85.

Fig. 4, a—b. *Bairdia dolicha* van den Bold (all figures are × 120); a, lateral view of carapace right valve; b, dorsal view of same carapace. P.M.-SA88.

Fig. 5. *Bairdia* sp. lateral view of carapace right valve. × 100. P.M.-SA94.

Plate 2

Fig. 1, a—d. *Bairdia cespedenesis* van den Bold a, lateral view of female right valve, × 90; b, dorsal view of same carapace, × 100. P.M.-SA87-1. c, dorsal view of male carapace; d, lateral view of same carapace, × 90. P.M.-SA87-2.

Fig. 2, a—b. *Bairdia itaporangaensis* Neufville Holotype. a, dorsal view of carapace; b, lateral view of carapace right valve, (all figures are × 70). MN-5304-I (NMB).

Fig. 3, a—b. *Bairdia* aff. *itaporangaensis* Neufville a, lateral view of carapace right valve; b, dorsal view of same carapace, (all figures are × 70). P.M.-SA90.

Fig. 4, a—b. *Bairdia hiwanneensis* Howe & Lea a, lateral view of carapace right valve; b, dorsal view of same carapace, (a = × 100; b = × 80). P.M.-SA91.

Fig. 5, a—b. *Antibythocypris* sp. a, lateral view of carapace left valve; b, dorsal view of same carapace, (all figures are × 100). P.M.-SA98.

Plate 3

Fig. 1, a—b. *Bairdia* aff. *hazzardi* Howe & Law a, lateral view of carapace right valve; b, dorsal view of same carapace, (all figures are × 80). P.M.-SA93.

Fig. 2, a—b. *Bairdia* aff. *hiwanneensis* Howe & Lea a, lateral view of carapace right valve; b, dorsal view of same carapace, (all figures are × 100). P.M.-SA92.

Fig. 3, a—b. *Bairdia?* sp. a, lateral view of carapace right valve; b, dorsal view of same carapace, (all figures are × 100). P.M.-SA96.

Fig. 4, a—b. *Bairdia* sp. a, lateral view of carapace right valve; b, dorsal view same carapace, (all figures are × 100). P.M.-SA95.

Fig. 5, a—b. *Macrocypris lanceolata* Neufville Holotype. a, dorsal view of carapace; b, lateral view of same carapace left valve, (all figures are × 150). MN-5305-I (NMB).

Fig. 6, a—b. *Argilloecia faba* Alexander a, dorsal view of carapace; b, lateral view of same carapace left valve, (all figures are × 140). P.M.-SA100.

Fig. 7, a—b. *"Bythocypris"*? sp. a, lateral view of carapace right valve; b, dorsal view of same carapace, (all figures are × 140). P.M.-SA97.

Fig. 8, a—b. *Pontocypris dreikanter* Coryell & Fields a, lateral view of carapace left valves; b, dorsal view of same carapace, (all figures are × 100). P.M.-SA99.

Plate 4

Fig. 1. *Hemicythere* aff. *lemniscata* Howe lateral view of a left valve, × 120. P.M.-SA103.

Fig. 2, a—b. *Hemicythere bellula* Howe a, dorsal view of carapace, × 100; b, lateral view of same carapace, × 120. P.M.-SA 102.

Fig. 3, a—c *Cythereis? longicostata* Blake a, lateral view of a female carapace; b, dorsal view of same carapace. P.M.-SA-105A. c, lateral view of a male carapace. P.M.-SA105B. (all figures are × 100).

Fig. 4, a—b *Echinocythereis garretti* Howe & McGuirt a, lateral view of a carapace left valve; b, dorsal view of same carapace, (all figures are × 120). P.M.-SA104.

Fig. 5, a—b. *Trachyleberis bermudezi* van den Bold a, dorsal view of a carapace; b, lateral view of same carapace, (all figures are × 90). P.M.-SA107.

Fig. 6. *Quadracythere* aff. *obignyana?* Bosquet lateral view of a left valve, × 120. P.M.-SA109.

Fig. 7. *Quadracythere?* aff. *bicarinata* (Swain) lateral view of a left valve, × 120. P.M.-SA110.

Fig. 8, a—b. *Costa variabilocostata seminuda* van den Bold a, lateral view of a carapace; ventral view of same carapace, (all figures are × 100). P.M.-SA112.

Plate 5

Fig. 1. *Cativella moriahensis* van den Bold
lateral view of a right valve, × 120. P.M.-SA111.

Fig. 2, a—c. *Henryhowella? reymenti* Neufville
a, dorsal view of a male carapace; b, lateral view of same carapace. MN-5307-I, Holotype. c, lateral view of a female carapace, × 100. P.M.-SA115 (NMB).

Fig. 3. *Kingmaina brazilensis* Neufville
lateral vieww of a left valve, × 130. MN-5306-L (NMB), Holotype.

Fig. 4, a—b. *Brachycythere sapucariensis* Krömmelbein
a, dorsal view of a male carapace; b, lateral view of same carapace, × 100. P.M.-SA116.

Fig. 5, a—b. *Pterygocythereis* aff. *miocenica* van den Bold
a, lateral view of a carapace right valve; b, dorsal view of same carapace, × 100. P.M.-SA117.

Fig. 6, a—b. *Costa barri* van den Bold
a, dorsal view of a carapace; b, lateral view of same carapace left valve, × 100, P.M.-SA113.

Fig. 7. *Krithe mutveii* Neufville
angular view of a female carapace; showing dorsal margin, × 110. P.M.-SA121-2, Paratype.

Plate 6

Fig. 1, a—b. *Soudanella laciniosa triangulata* Apostolescu
a, lateral view of a male right valve. P.M.-SA116. b, lateral view of a female carapace, × 100. P.M.-SA116-2.

Fig. 2, a—b. *Trachyleberis reticulospinosa* van den Bold
a, lateral view of a carapace right valve; b, dorsal view of same carapace, × 100. P.M.-SA105.

Fig. 3, a—b. *Krithe saundersi* van den Bold
a, dorsal view of a carapace; b, lateral view of same carapace, × 120. P.M.-SA123.

Fig. 4, a—c. *Krithe guatemalensis* van den Bold
a, lateral view of a male carapace right valve. P.M.-SA122-1. b, lateral view of a female carapace right valve; c, dorsal view of same carapace, × 120. P.M.-SA122-2.

Fig. 5, a—b. *Parakrithe? ovata* van den Bold
a, dorsal view of a carapace; b, lateral view of same carapace left valve, × 120. P.M.-SA124.

Fig. 6. *Cytheridea* (*Cytheridea*) sp.
lateral view of a right valve, × 100. P.M.-SA120.

Fig. 7, a—c. *Krithe mutveii* Neufville
a, lateral view of a male left valve; b, dorsal view of same carapace. MN-5226-I (NMB), Holotype. c, dorsal view of a female carapace, × 100. Holotype. P.M.-SA121-1.

Plate 7

Fig. 1. *Cythereis* aff. *dictyon* Brady
lateral view of a carapace right valve, (Light micrograph, × 100). P.M.-SA108.

Fig. 2, a—b. *Eucytherura rohri* van den Bold
a, dorsal view of a carapace; b, lateral view of same carapace left valve, (all figures are × 120). P.M.-SA126.

Fig. 3. *Parakrithe?* aff. *ovata* van den Bold
lateral view of a carapace right valve, × 120. P.M.-SA125.

Fig. 4, a—b. *Cytheropteron* sp.
a, ventral view of a left valve, showing the ventrolateral wing; b, ventral view of same valve, (all figures are × 100). P.M.-SA129.

Fig. 5, a—b. *Xestoleberis* aff. *moriahensis* van den Bold
a, dorsal view of carapace; b, lateral view of same carapace, (all figures are × 120). P.M.-SA132.

Fig. 6, a—b. *Xestoleberis chamela* van den Bold
a, dorsal view of carapace; b, lateral view of same carapace right valve, (all figures are × 120). P.M.-SA131.

Fig. 7, a—b. *Paracytheridea* aff. *hispida* van den Bold
a, dorsal view of a right valve; b, lateral view of same valve, (all figures are × 120). P.M.-SA128.

Fig. 8, a—b. *Paracytheridea toleri* Howe & Law
a, lateral view of a right valve; b, dorsal view of same valve, (all figures are × 120). P.M.-SA127.

Fig. 9, a—b. *Loxoconcha corrugata* Alexander
a, dorsal view of carapace; b, lateral view of same carapace, × 120. P.M.-SA130.

Plate 8

Fig. 1, a—b. *Cytheridea* (*Cytheridea*) aff. *mississippiensis* Howe & Law
a, dorsal view of a carapace; b, lateral view of same carapace, (all figures are × 120). P.M.-SA119.

Fig. 2. *Cytheropteron* sp.
Detail of hinge element, × 140, light micrograph.

Fig. 3. *Cythereis? longicostata* Blake
Dorsal view of hinge element, × 150.

Fig. 4. a—c. *Kingmaina brazilensis* Neufville
a, detail of marginal pore-canals, × 120 (light micrograph). b, detail of hinge element in the left valve, in lateral view; note the normal pores, × 150; c, detail of hinge element in the right valve, in dorsal view, × 120. MN-5306-I (NMB), P.M.-SA114-1.

Fig. 5. *Krithe mutveii* Neufville
Detail of the muscle scars, × 80 (light micrograph). P.M.-SA-121-3.

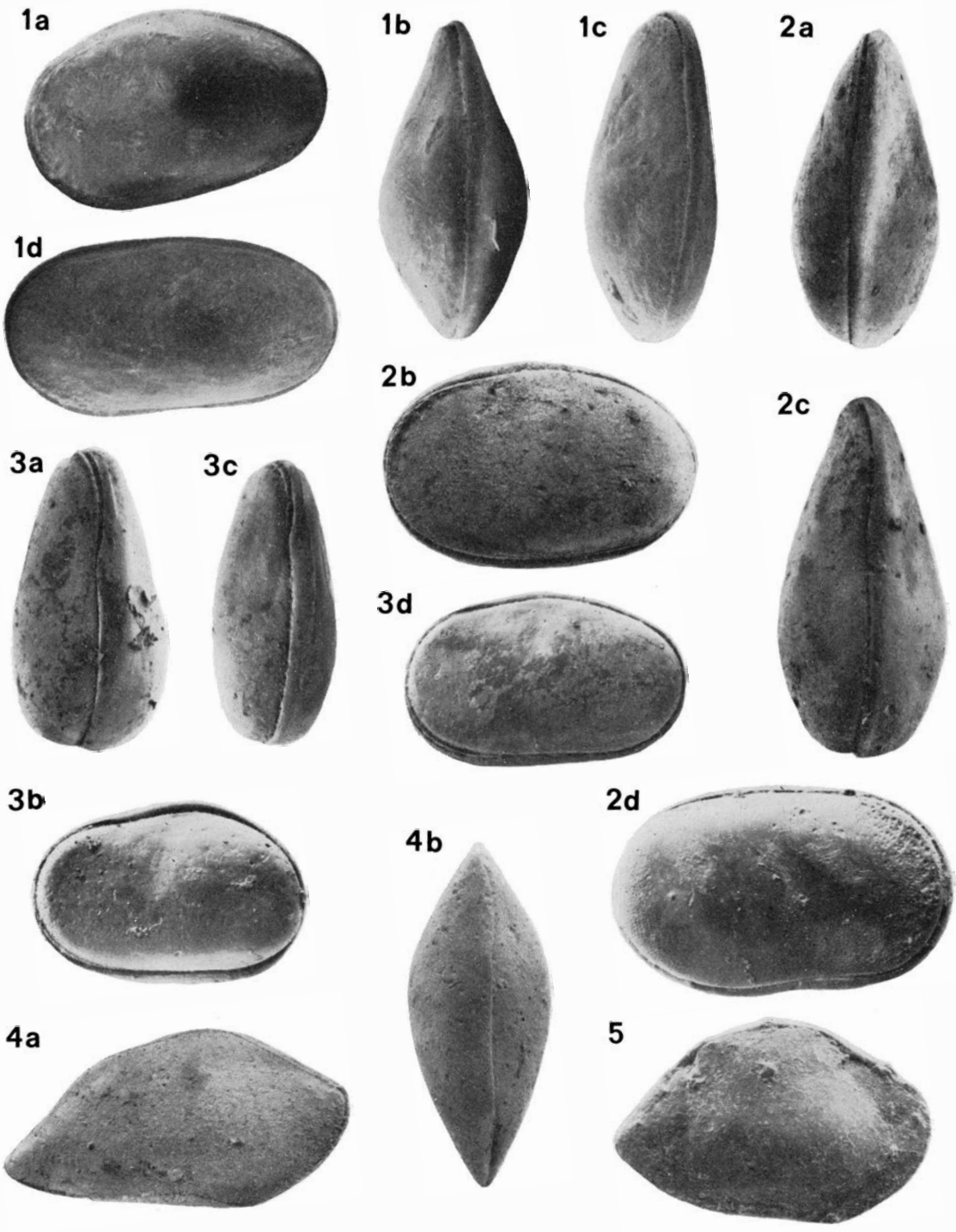
Fig. 6. *Cytherella sergipensis* Neufville
Detail of hinge element of a male left valve, × 130.

Fig. 7. *Quadracythere?* aff. *bicarinata* (Swain)
Detail of the anterior marginal area, note the underdeveloped structures, × 100 (light micrograph). P.M.-SA110.

Fig. 8, a—b. *Brachycythere sapucariensis* Krömmelbein
a, detail of anterior and posterior marginal area, × 100 (light micrograph); b, detail of hinge element in dorsal view, × 130. P.M.-SA116.

Fig. 9. *Cativella moriahensis* van den Bold
Detail of hinge element in dorsal view, × 130.

Plate 1



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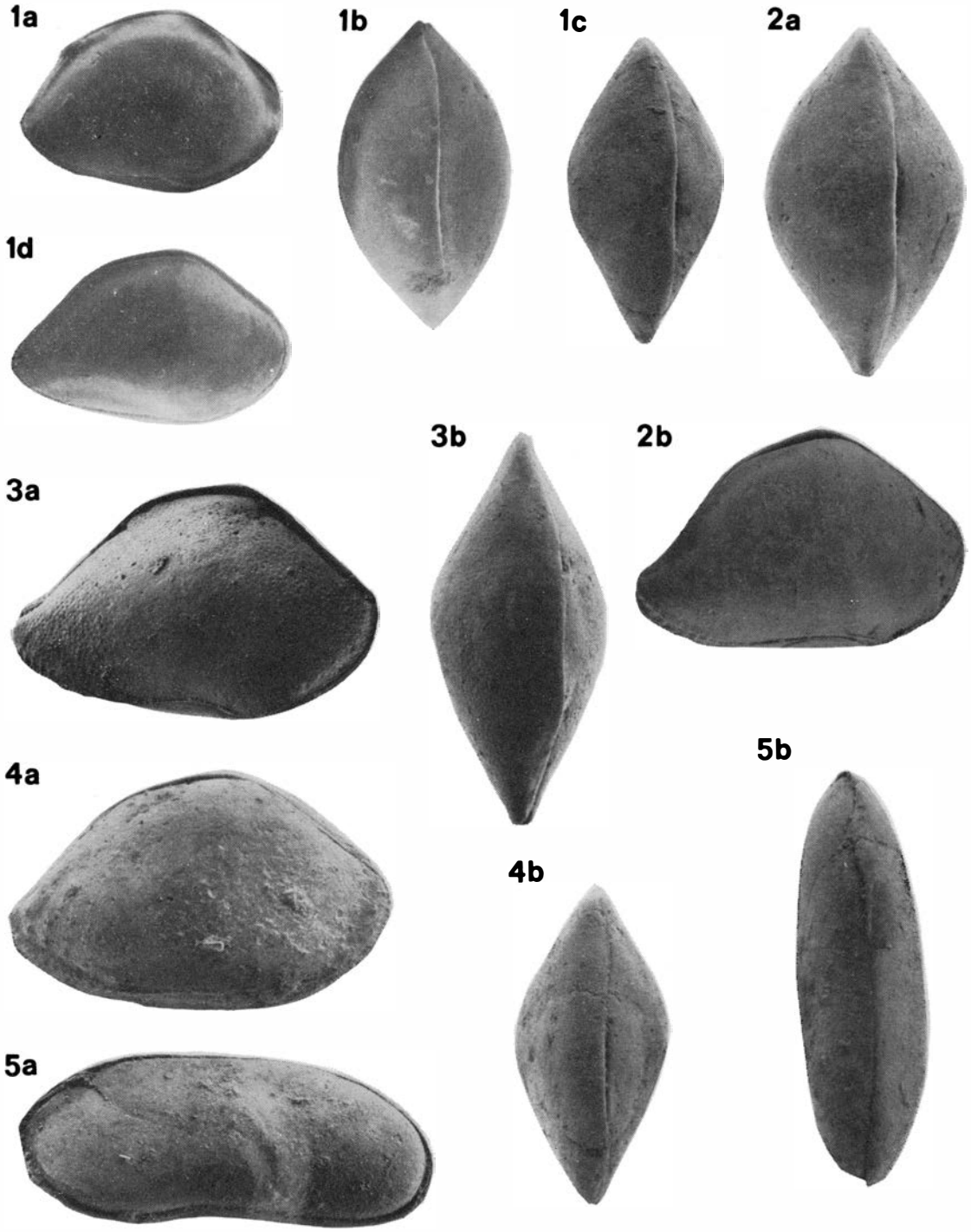

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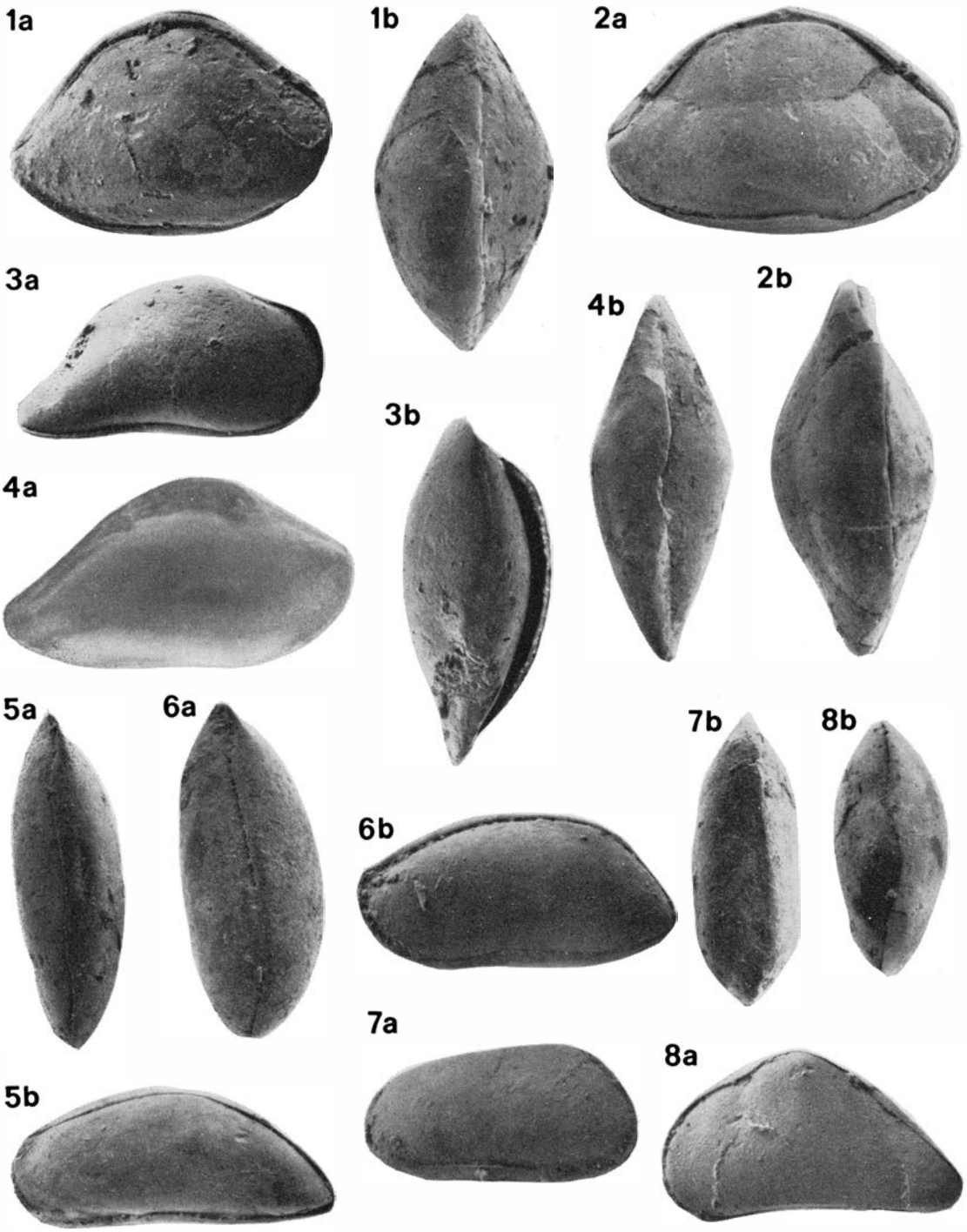

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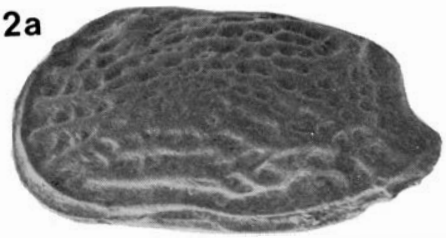

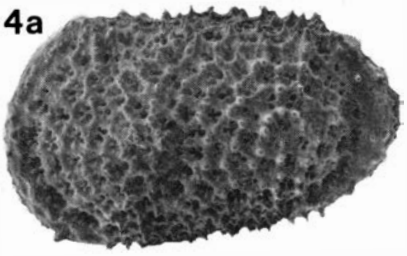

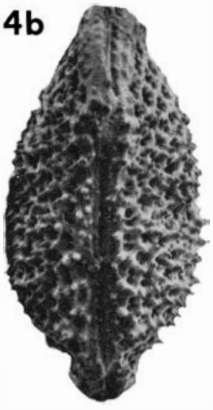

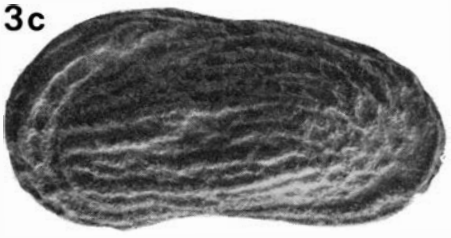

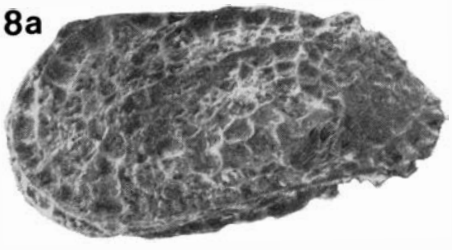

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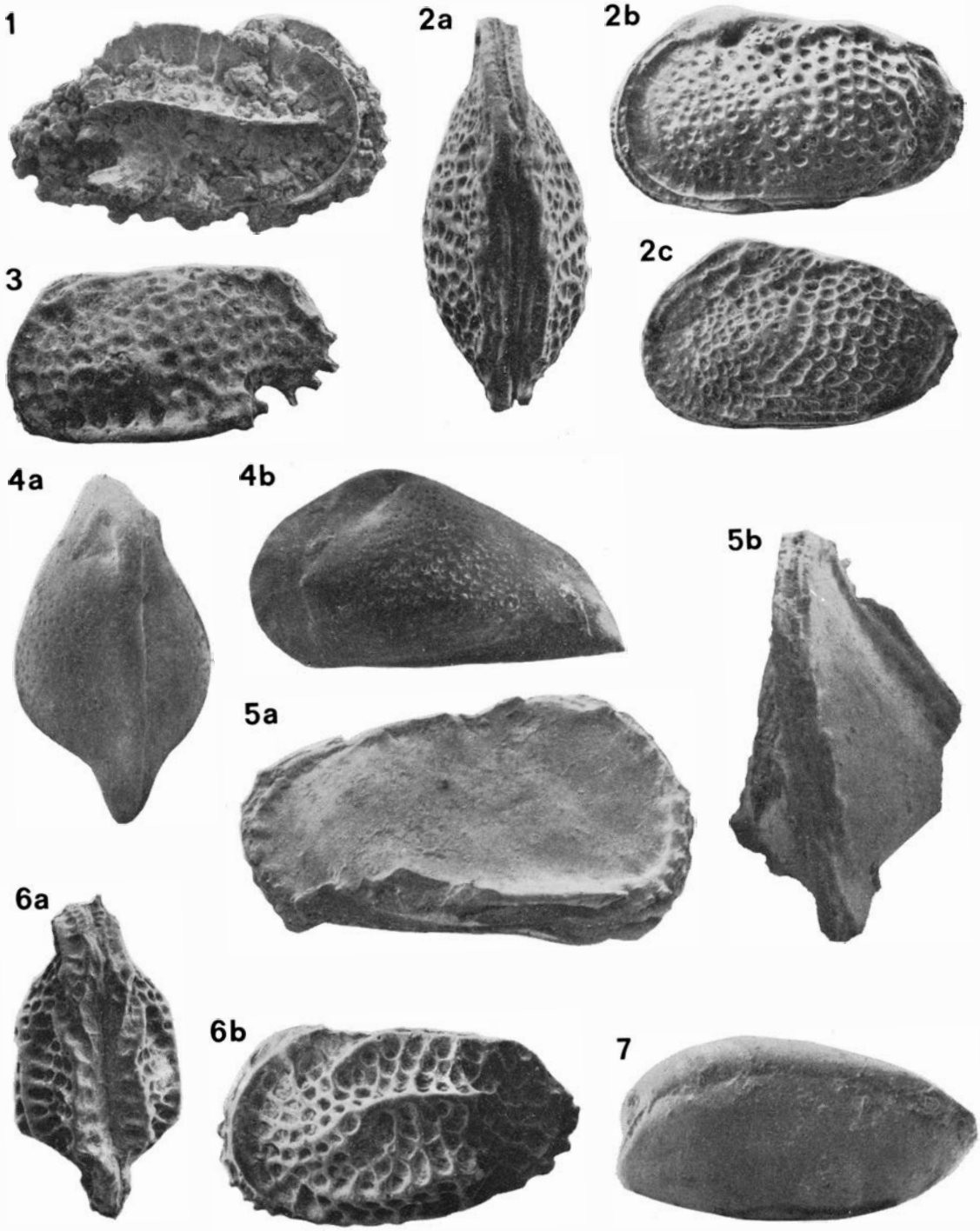

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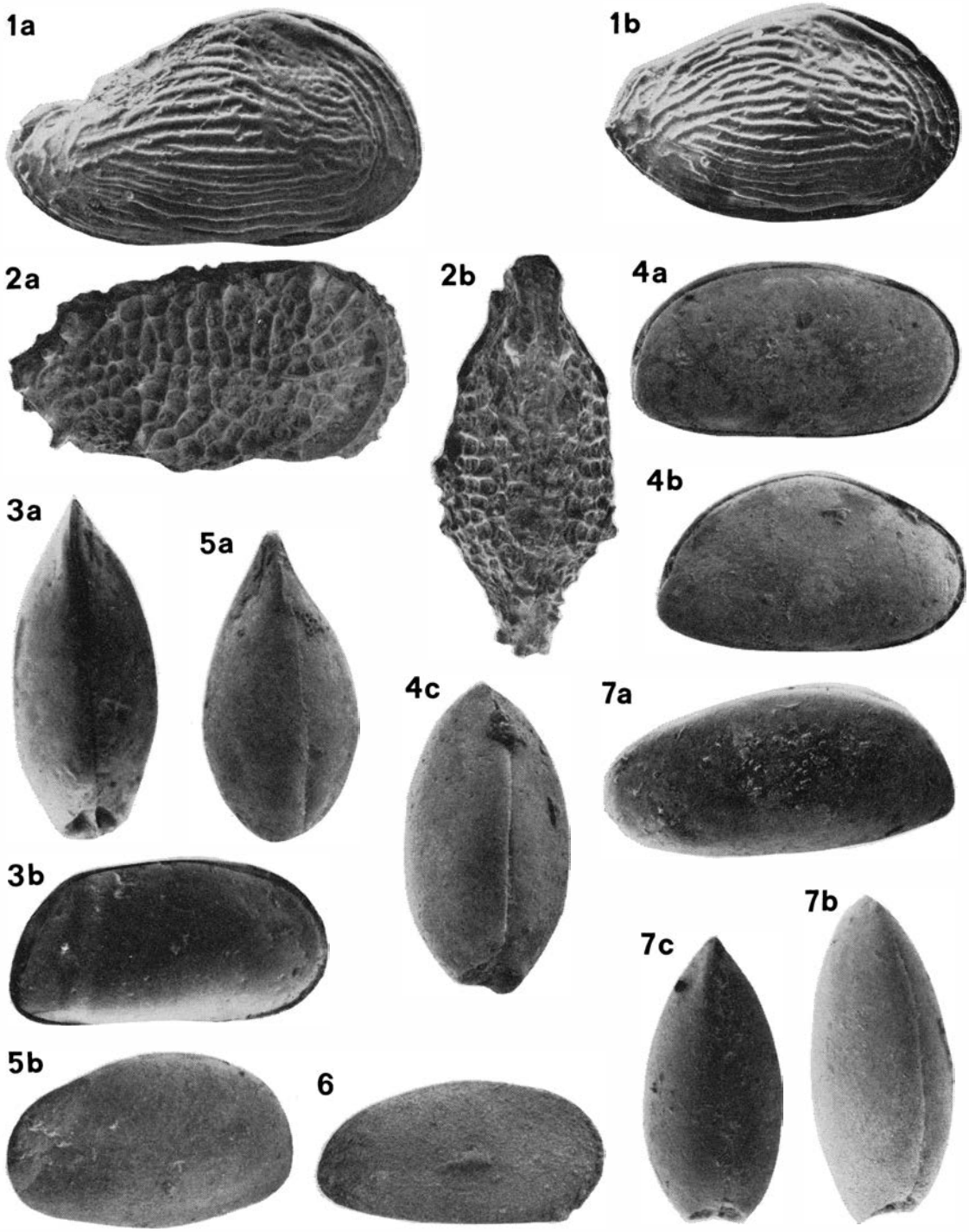

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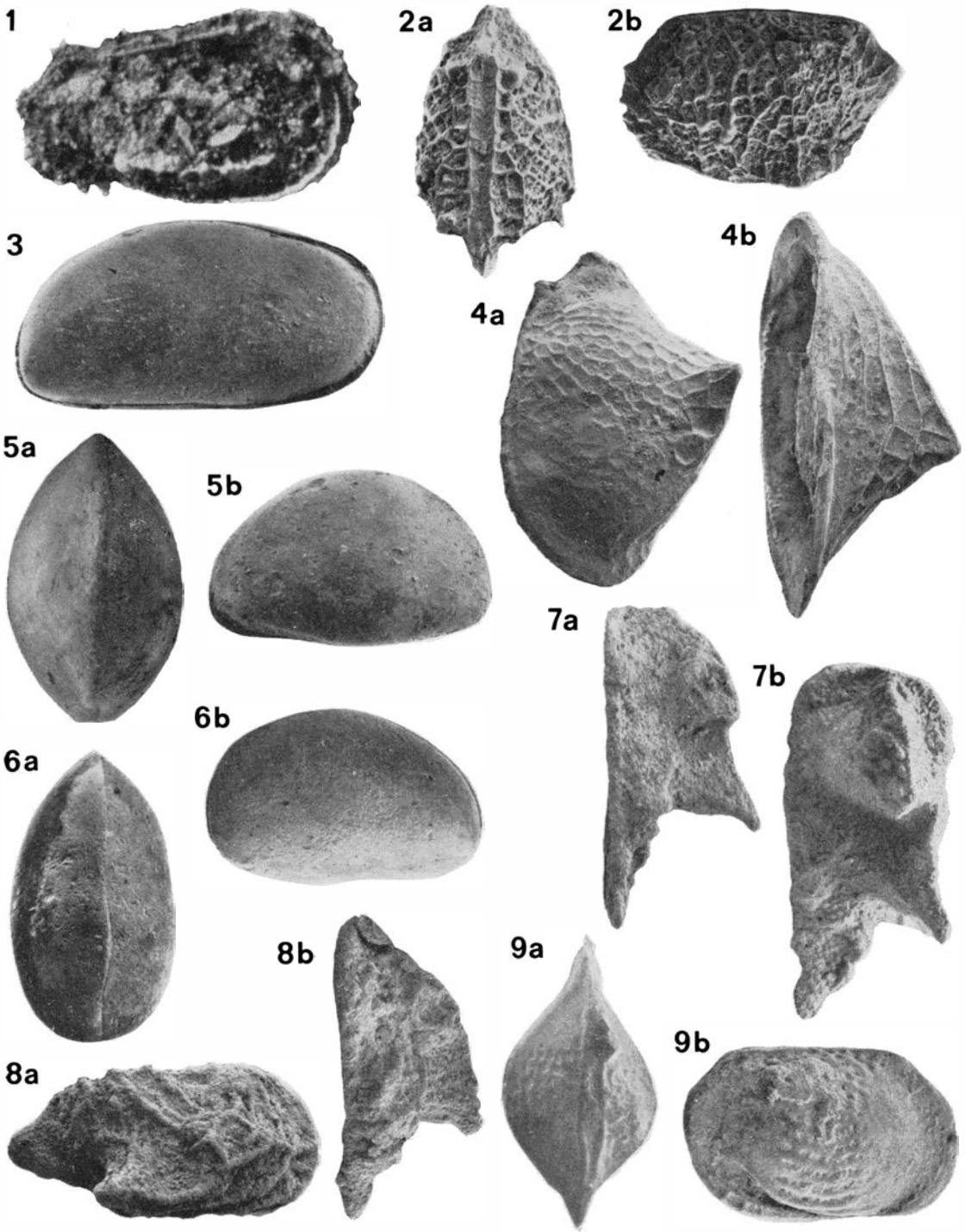

Plate 8