PLIOCENE OSTRACODA OF SOUTHEASTERN MEXICO. PART I. ENCANTO AND CONCEPCION BIOFACIES

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ABSTRACT

The Ostracoda of twenty seven samples from the Encanto and Concepcion Beds (Pliocene) in Southern Veracruz are analyzed. Sixty seven species ere recovered, determined and described, and five new species are named:*, Buntonia boldi Eucytherura encantoensis, Eucytherura howei, Huligsina gioi,* and *Loxoconcha hazeli*. The Systematics of Mexican Pliocene Ostracoda is published for the first time and scanning electron microphotographs of the species are presented. Three Ostracode biofacies were recognized, each showing a different assemblage, indicative of a slightly different age and environment. The Ostracode fauna increases and diversifies as the strata become shallower (younger). Although there are few species restricted to one biofacies, their relative and absolute abundances, together with their presence/absence in the samples, makes each biofacies characteristic. These biofacies record a shallowing upwards trend in the area of study.

RESUMEN

Se publica la Sistemática de los Ostrácodos Pliocénicos del Sur de la Planicie Costera del Golfo de México, determinándose 67 especies en 27 muestras de las biofacies Concepción y Encanto. Cinco nuevos taxa: *Buntonia boldi, Eucytherura encantoensis, Eucytherura howei, Huligsina gioi*, y *Loxoconcha hazeli* son nombrados y descritos. Tres biofacies fueron determinadas en base a su ostracofauna, cada una de las cuales indica diferentes ambientes de depósito y edades. Las biofacies se pueden reconocer por la presencia y/o ausencia de sus especies características o por el cambio en la abundancia relativa de las mismas. Las faunas se vuelven más diversas y abundantes en los estratos más someros y evidencian el levantamiento de la Cuenca Salina del Istmo.

INTRODUCTION

This paper forms part of the study of Pliocene Ostracoda in the Isthmian Salt Basin, Veracruz, Mexico. The biostratigraphy and paleoecology of the area are already published (Machain-Castillo, 1986), and the systematics of ostracodes of the Agueguexquite Formation will be discussed later. In the present paper the ostracode systematics of the Encanto and Concepcion strata are presented.

Pliocene Ostracoda are well know in the Caribbean (Bold, 1963c, 1966c, 1971b, 1978b, etc), and in the U.S. Atlantic coastal plain (Edwards, 1944; Malkin, 1953; Hazel, 1971, 1977, 1983; Cronin and Hazel, 1980). However, they are poorly know in the Gulf of Mexico coastal plain, with the exception of neritic facies in Florida (Purl, 1954). With the exception of northwestern Florida, Pliocene outcrops are only found in the coastal plain in the Veracruz and Isthmian Salt Basins. The present research contributes to the knowledge of the ostracodes of this transitional area.

Previous Work

The Encanto and Concepcion strata have been know since the early 1900's. According to López-Ramos (1981), they were first formally published by Gibson (1936), althoug the names had already been used in private geological reports. These beds are important oil producing horizonts, and since their recognition and subdivision are based on

their foraminiferal content, this group has been widely studied (Thalmann, 1935; Romen, 1955; Viniegra, 1956; Sansores and Flores Covarrubias, 1972; Kohl, 1985). However, the ostracodes have not been systematically studied. Only a check-list of 32 species has been published from the area (Bold, 1978b). The present paper provides the first detailed systematic study of the Pliocene Ostracoda of Southern Veracruz.

Lithology

Encanto. Gibson (1936) describes the Encanto beds as: approximately 200 m thick formed by blue and brown fine to coarse grained sandstone, very sandy bedded shale. Contreras (1959) indicates that although the Encanto Formation actually corresponds to a micropaleontological zone, in the southern portion of the Isthmian Salt Basin it shows distinctive lithological characteristics as well. In this area it consist of three parts: The upper one is formed by well stratified, bluish-grey and greenish-grey, slightly sandy shales up to 100-150 m thick. The middle part consists of interstratified, bluish-gray and reddish-brown shales in beds generally 20 to 30 cm thick. In this area very thick fine to coarse sand bodies start to appear and a 6 to 8 m thick conglomerate in which pebbles (generally chert) 2 to 3 cm in diameter can also be found. The lower part is similar to the upper one, but the shales are better consolidated and very well stratified.

Throughout the Encanto, white to cream-colored ash layers are commonly present, and sometimes ash is intermixed with the shales. Also, it is not unussual to find calcareous concretions and layers of hard, well cemented sandstone with a high percentage of calcium carbonate. To the west of the Rio Coatzacoalcos, the Encanto Formation consists almost exclusively of shales.

The thickness of the Encanto is highly variable, and it can be up to 800 m thick, but near the area of Acayucan (the area of this study) it is only about 100 m thick.

Concepcion Inferior. Gibson (1936) reports blue, bedded shale with conglomerate beds in different areas for the Concepcion Inferior Formation. Contreras (1959) states that it consist, in almost the whole area, of very thickly bedded macro and micro-fossiliferous slightly sandy shales. It also contains fine to medium grained sand beds of different thicknesses in different areas, decreasing towards the west. The thickness of the Lower Conception varies from 80 to 300 m. The thinnest reported are from the Acayucan area.

Concepcion Superior. For the Upper Concepcion Gibson (1936) reports bluish bedded shales with some gastropods at the base, with variable thicknesses between 200 and 300 m. Contreras (1959) gives a more detailed description and partitions the Upper Concepcion into three areas with different lithologies. The first area, which is generally to the west of the Rio Uzpanapa in the flanks of the Molocan-Ixhuatlan structure and the flanks of the Potrerillos and Chinameca Domes, the Concepcion Superior essentially consists of pale-gray to blue-gray, soft and occasionally well stratified shales that are generally sandy, especially towards the top, and interstratified sands and shales.

In the second area, between the rivers Uzpanapa and Coachapa, in the so called Concepcion Nose, occur poorly stratified sandy shales with rare intercalations of sand and calcareous concretions, specially at the base of the formation.

The third area is located in the front of the Sierra Madre, and from the middle course of the Nanchital River to the west of the Coatzacoalcos River. Here the greatest thicknesses of these deposits are found, reaching thicknesses possibly up to 600 m. They are comprised at the base of about 300 m of very fossiliferous, soft, very sandy shale, in beds of three to four meters; less fossiliferous sandy shales interstratified beds less than 20 cm thick in the middle part, and very angular coarse-grained, reddish-brown loose sands.

In the area of study around the Potrerillos and Sayala Domes, the Encanto. Lower and Upper Concepcion beds consist of monotonous silty clay and no distinction can be made of them based on lithology alone. Division of this lithology can only be accomplished paleontologicaly.

MATERIAL

Concepcion and Encanto samples were collected to the east and west of the Coatzacoalcos River in the Potrerillos, Sayula and Tuzandepetl Domes, and at El Chapo railroad station. Additional samples were provided by

Dr. B. Kohl of Chevron Oil Co. (samples K21 to K66), and Drs. H.E. Vokes of Tulane University (samples TU 1025, 1030 and 1031). The last samples are peripheral to the main study area, and are in the border area of the Oaxaca and Veracruz states. The location and locality data of all samples are given in Machain-Castillo (1986).

Biofacies

In the 27 samples containing ostracodes, 67 species were recovered (Table 1). Some of these seem to have a wide tolerance to environmental changes (e.g. *Cytherella* sp aff. *C. hannai.* Howe and Lea, *Echinocythereis* sp) and occur in all the samples, but some are restricted to one (*Hulingsina gioi* nov. sp, *Bradleya normani, Ambocythere* sp, *A. Basslerites* sp) or two of the units *Hulingsina* sp 1, *Loxoconcha hazeli* nov. sp, *Parakrithe* spp, etc). Three ostracode biofacies were recognized in these beds, and are indicative of a slightly different age and environment.

Encanto Biofacies

The Encanto strata contained the least diverse and abundant fauna of the study. Only five samples yielded ostracodes. However, the assemblages found are very characteristic and easy to distinguish from the ones of the other beds. Thirty one species were found, of which the most abundant are: *Krithe trinidadensis, Echinocythereis* sp, *Cytherella* sp aff. *C. hannai, Malzella bellegladensis, Echinocythereis margaritifera, Parakrithe* sp 1*, Bradleya normani* and *Argilloecia posterotruncata.* Species restricted to this unit are: *Bradleya normani, Eucytherura encantoensis, Mutilus ?* sp, *Neocaudites scottae, Xestoleberis* sp *2* and *Ambocythere* sp A. Species more abundant here than in any other of the units are: *Ambocythere caudata, Argilloecia posterotruncata, Cytherella* sp aff*. C. hannai var. Echinocythereis* sp, *Krithe trinidadensis, Paracytheridea tschoppi Parakrithe* spp*, Quadracythere compacta* and *Radimela confragosa.*

As indicated in Machain-Castillo (1986), sample K4 shows a mixture of upper slope and shelf faunas probably due to slumping. *Malzella bellegladensis, Mutilus* sp*, Neocaudites scottae, Paracytheridea tschoppi, Quadracythere compacta* and *Radimella confragosa* are species characteristic of shelf environments and their presence in the Encanto assemblage is restricted to this sample.

The Encanto fauna encountered in these samples represents upper to middle bathyal environments and an Early Pliocene age, upper N18 to N19 zone (Blow, 1969; Machain-Castillo, 1986; Kohl, 1985; Akers, 1984).

Concepcion Biofacies

Upper and lower Concepcion beds share several species. As a whole, the Concepcion can be recognized by the presence of *Actinocythereis* sp cf. *A. vineyardensis, Protocytheretta* sp cf. *P. montezuma, Haplocytheridea-Peratocytheridea molts, Hulingsina* sp *1, Hulingsina gioi, Loxoconcha hazeli, Touroconcha lapidiscola.* In addition reworked brackish water species are present. Other taxa abundant in these beds, but also present in shallower facies (Agueguexquite) of the basin are: *Basslerites minutus, Orionina vaughani* and *Puriana* spp.

However, some distinctions can be made between Lower and Upper Concepcion strata by the presence/absence of some species or by changes in the relative abundance of species common to both.

Lower Concepcion Biofacies. Besides the species in common with Upper Concepcion, Lower Concepcion strata contain *Henryhowella* ex. gr. *asperrima, Puriana carolinensis, Echinocythereis* sp, *Cytherella* sp aff. *C. hannai, Krithe trinidadensis* and *Argilloecia posterotruncata* in greater abundances than in Upper Concepcion, and some deeper water forms characteristic of the Encanto Biofacies (*Ambocythere caudata, Parakrithe* spp*, Cytherella* sp aff. *C. hannai* var.) that do not occur in Upper Concepcion and younger (shallower) beds in the Basin. Brackish water species (*Cyprideis salebrosa, Loxoconcha matagordensis, Megacythere repexa, Perissocytheridea* spp) make up approximatelly 4 % of the total ostracode population.

This biofacies is characteristic of outer neritic to possibly upper slope environment, and is Early-Middle Pliocene in age zones N19-N20 (Machain-Castillo, 1986; Kohl, 1985; Akers, 1981).

Upper Concepcion Biofacies. This is the most diverse and abundant fauna of the three biofacies (60 species

from 14 samples). It is characterized by abundant *Malzella bellegladensis, Hulingsyina sp* 1*, Orionina vaughani Puriana gatunensis, Basslerites minutus*, by approximately 10 % of brackish water species, by the presence of *Basslerites* sp*, Cyprideis* sp cf. *C. mexicana* and *Hulingsina gioi* that do not occur in any other beds in the area, and by the absence of several Lower Concepcion and Encanto species (i.e. *Ambocythere* spp*, Parakrithe* spp).

The Upper Concepcion, also contains several species not found in Lower Concepcion, but present in other beds (shallower) in the Basin. These are: *Cytheropteron ? yorkotownensis, Hemicytherid molts, Loxocorniculum tricornatum, Malzella bellegladensis, Paracytheridea* spp, *Pellucistoma magniventra* and *Echinocythereis margaritifera,* among others.

This assemblage is the shallowest of the three biofacies (middle-outer neritic) and has been assigned to Blow's zone N20 and the latter part of N19 (Machain-Castillo, 1986; Kohl, 1985; Akers, 1979, 1981).

DISCUSSION

The ostracode assemblages of the Encanto and Concepcion Strata are abundant and diverse (67 species were recovered). The ostracode fauna increases and diversifies as the sediments were laid down in progressively shallower waters. Also, fewer samples from the Encanto contained ostracodes, whereas ostracodes are found in almost all of those from the Upper Concepcion. However, this trend could not be quantified because too few samples of the Lower Concepcion and Encanto units were sufficiently fossiliferous to make statistical analyses feasible.

Although there are few species restricted to individual biofacies, the assemblages, either by taxonomic content or species abundance, are characteristic enough to distinguish each biofacies and to record the environmental shallowing upward trend in the study area.

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SYSTEMATICS

The following abreviations were used in this section:

V = valve	W = width
RV = right valve	L = length
LV = left valve	H = heigth
M = molt	

Dimensions of specimens given in millimeters

HVH = Henry V. Howe collection number

USNM = U.S. National Museum collection number

Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Muller, 1894
Suborder PLATYCOPINA Sars, 1866
Family CYTHERELLIDAE Jones, 1849

Genus *CYTHERELLA* Jones, 1849

Cytherella sp aff. C. *hannai* Howe and Lea

(Plate 1, Figs. 1,2)

C. hannai Howe and Lea, in Howe and Law, 1936, p. 16, Pl. 1, Figs 1-5.

Dimensions: Females: L .800-.950; H .450-.550; W .400.

Males: L .758-.950; H .416-.550; W .350.

Remarks: The left valves of these specimens are very similar to *C. hannai*, but the right valves are more subquadrate. *C. burki* Bold (1946) is also similar, but has a more evently rounded posterior margin, a more arched dorsum and right valve exhibits stronger dorsal overlap. *C.* sp *B*. Cronin (1983) is more gently rounded posteroventrally, less subquadrate and with stronger overlap. Cronin's species shows anterior "wrinkles" and posterior denticles similar to the ones of the figured specimen. However, the other specimens found here are smooth.

Material: 50 valves and 35 molts.

Occurrence: Upper Concepcion (18v, 21m), Lower Concepcion (9v, 8m), Encanto (23 v, 6 m).

Cytherella sp aff. *C. hannai* var.

(Pl. 1, Fig. 3)

Dimensions: L .700-.800; H .425-.500.

Remarks: These specimens are very similar in shape and size to *C*. sp aff. *C. Hannai,* but they are densely pitted and with faint reticulations around the margins, and have a more pronounced centrodorsal depression. They are also more ovate and show stronger overlap.

C. postdenticulata Oertli (1961) also has a pitted surface, but it is more ovate, higher, lower posteriorly and with a prominent dorsal sulcus from the center of the valve to near the dorsal margin, and it is larger.

Material: 2 valves and 4 molts.

Occurrence: Lower Concepcion (1v, 1m), Encanto (1v, 3m).

Cytherella sp

(Pl. 1, Fig. 4)

Dimensions: L .716-.791; H .475-.508; W .341.

Remarks: This species differs from *C*. sp aff. *C. hannai* by being more ovate, less subrectangular, and more centrally inflated. It differs from *C. vermilionensis* Kontrovitz (1976) in being less dorsally arched, more elongated and higher anteriorly, and by having a wider anterior margin and being dorsally larger.

Material: 20 valves and 27 molts.

Occurrence: Upper Concepcion (9v, 21m), Lower Concepcion (6v, 5m), Encanto (5v, 1m).

Genus *CYTHERELLOIDEA* Alexander 1929

Cytherelloidea leonensis Howe

(Pl. 1, Fig. 5)

C. leonensis Howe, 1934, Pl. 5, Fig. 9; Coryell and Fields, 1937, p. 2, Figs. 1a-c; Bold, 1946, p. 62, Pl. 9, Fig. 23; Sexton, 1951, p. 815, Bold, 1958b, p. 396; 1963c, p. 372; Pooser, 1965, p. 29; Bold, 1967b, p. 308; 1978b, Table 11, Machain-Castillo, 1986, p. 139.

? *C. leonensis* Howe, Rodriguez, 1969, p. 167, Pl. 1, Figs. 3,4.

Not *C. leonensis* Howe, Bold, 1950, p. 1972b, p. 442.

Dimensions: L .550-596; H .300-325.

Material: 4 valves and 3 molts.

Occurrence: Upper Concepcion (3v, 3m), Lower Concepcion (1v).

Distribution: Previously reported from the Choctawhatchee Stage of Florida, the Rio Dulce and Herrería Formations of Guatemala, the Sprinvale Formation of Trinidad and the Gatun Formation of Panama. Middle-Miocene

to Recent.

Family PONTOCYPRIDIDAE G.M. Muller, 1894

Genus *ARGILLOECIA* Sars, 1866

Argilloecia posterotruncata Bold

(Pl. 1, Fig. 6)

Argilloecia sp Keij, 1854, p. 218 (part), Pl. 6, Fig. 1, Pl. 3, Fig. 8a, not Pl. 3, Fig. 8b.

Argilloecia posterotruncata Bold, 1966c, p. 18, Pl. 1, Fig. 1; 1972b, Table 2; Kontrovitz, 1976, p. 60, Pl. 1, Fig. 6; Machain-Castillo, 1986, p. 128, 138.

Dimensions: L .486; H .233; W .200.

Remarks: These specimens are very similar to the paratypes (HVH 7905), but bigger and with the dorsal margin higher and less sloping in the anterior third. *A. posterotruncata* Bold, of Kontrovitz, has the dorsal margin higher and less slope than *A.* sp 1 Kontrovitz (1976), which is more ovoid, less truncate posteriorly, more dorsally curved and more tumid.

Material: 27 valves.

Occurrence: Upper Concepcion (7v), Lower Concepcion (7v), Encanto (13 v).

Distribution: Lengua Formation, Trinidad; Recent North coast of Venezuela and Trinidad, and Louisiana Continental shelf, Upper Miocene to Recent.

Genus *BAIRDOPPILATA* Coryell, Sample and Jennings, 1935.

Bairdoppilata sp aff. *B. victrix* (Brady)

(Pl. 1, Fig. 7)

? *Bairdia victrix* Brady, Pury, 1960, p. 131, Pl. 6, Fig. 13; Benson and Coleman, 1963 (part), Pl. 2, Figs. 8-10.

Not *B. victrix* Brady, 1869, p. 162, Pl. 18, Figs. 17,18.

B. sp aff. *B. victrix* Brady, Bold, 1975c, p. 139, Pl. 15, Fig. 18; 1981, p. 58, Table 11; Machain-Castillo, 1986, p. 138.

Dimensions: L .950-1.00; H .550-.650.

Remarks: These specimens are very similar to Bold's *B.* sp aff. *B. victrix* Brady (1975c) and like them also lack the characteristic frills of *B. victrix*.

Material: 4 valves.

Occurrence: Encanto (4v).

Distribution: La Cruz and Santiago Formations of Cuba, "Thomonde" and Morne Delmas Formations of Haiti. Recent Northeastern Gulf of Mexico. Pliocene to Recent.

Superfamily CYTHERACEA Baird, 1850

Family CYTHERIDEIDAE Sars, 1926

Subfamily CYTHERIDEINAE Sars, 1925

Genus *CYPRIDEIS* Jones, 1856

Cyprideis salebrosa Bold

(Pl. 1, Fig. 8)

Cythere americana Sharpe, 1908. (part), p. 420. Not *C. americana* Dana, 1863, p. 1283, Pl. 89, Figs. 9a, b.

Cyprideis locketti (Stephenson) Swain, 1955 (part), p. 615, Pl. 59, Figs. 10a-c, not Pl. 64, Fig. 13; Engel and Swain, 1967, p. 412, Pl. 2, Fig. 36.

Not *Cytheridea locketti* Stephenson, 1935, p.193, Pl.5, Figs. 10-13, *C. torosa* (Jones), Swain, 1955, p. 616, Pl. 59, Figs. 8a,b, text-fig. 32c; Engel and Swain, 1967, p. 412, Pl. 1, Fig. 10, Pl. 2, Figs. 13, 37.

C. littoralis Brady, Byrne, LeRoy and Riley, 1959, p. 241, Pl. 4, Fig. 11, Pl. 5, Fig. 12, Pl. 6, Fig, 14, Gutentag and Benson, 1962, p. 47, 49, 50, Pl. 2, Figs. 4-7, text-Figs. 14a-d.

C. n. sp LeRoy in Byrne, LeRoy and Riley, 1959, p. 240, Pi. 6, Figs. 10, 11.

C. salebrosa Bold, 1963c, p. 377, Pl. 7, Figs. 9a-d, Pl. 11, Figs. 1a-c; Sandberg, 1964, p. 144-152, Pl. 8, Figs. 10-25, Pl. 9, Figs. 1-12, Pl. 14, Figs. 1-3, Pl. 17, Figs. 3a-f, Pl. 18, Fig. 10, Pl. 20, Figs. 5-10, Pl. 22, Figs. 5, 8; Bold, 1971c, Figs. 2, 4; 1972c, Table 1, Sanberg and Plesquellec, 1974, p. 22, Pl. 1, Fig. 20, Pl. 2, Figs. 1-3, text-Figs. 2e, 11, 12; Bold, 1975a, p. 587, 1975d, Table 2; Keyser, 1975b. p. 490, text-Fig. 3; Lister, 1975, p. 22, text-Fig. 24, Pl. 2, Figs. 11-14; Bold, 1976, p. 22; Keyser, 1976, p. 69, Pl. 3, Figs. 4-6; Kontrovitz, 1976, p. 93, Pl. 2, Fig. 1; Keyser, 1977a, p. 59, Pl. 2, Figs. 5-7, text-Fig. 6; 1977b, p. 208, text-Figs. 1-5; Kontrovitz, 1978, p. 140, Pl. 1, Fig. 9; Garbett and Maddocks, 1979, p. 902, Pl. 10, Figs. 9,10, Pl. 11, Figs. 1, 2; Cronin, 1980a, p. 142, Pl. 1, Figs. 5-8, Pl. 2, Figs. 5, 6, Pl. 3, Figs. 3, 4; Teeter, 1981, p. 346, Pl. 5, Figs. 7-10, Bold, 1981, p. 60, Pl. 2, Figs. 5a, b, Table 10; Stout, 1931, p, 898-900, text-Fig. 1; Machain-Castillo, 1986, p. 138.

C. giganta LeRoy, 1964, p. 1099, Pl. 170, Figs. 2a-f, 3a-c.

C. hartmanni Ramirez, 1967, p. 40-42, Pl. 11, Figs. 74-79, Pl. 12, Figs. 80-89.

Dimensions: L .808; H .433.

Remarks: The figured specimen is very similar to the female paratypes of the Talparo Formation, Trinidad (except smaller and with a better developed sulcus), and to Sandberg's specimens of Laguna de Tamiahua, Mexico (1964, Pl. 9, Fig. 7). Although this specimen does not show any tubercles, a few nodose Cyprideis molts were found. They all show 5 to 6 well developed nodes in the positions that Sandberg (1964) and Bold (1976) indicate are characteristic of *C. salebrosa*, except one molt that in addition to these six nodes has a seventh one (no. 3 of Sandberg, central of Bold) that both authors report absent from this species. *C. ovata* (Mincher) presents this node, but it lacks node No. 7 of Sandberg/posterior of Bold, which is present in all of the molts found here. Since all the other nodes are well developed in this specimen, it is possible that the conditions where it lived were favorable for the addition of an extra node, and since the position of all the other nodes and the ones in the other molts correspond to those of *C. salebrosa*, these specimens are referred here to that species.

Material: 1 valve and 6 molts.

Occurrence: Upper Concepcion (4m), Lower Concepcion (1v, 1m).

Distribution: Previously reported from low salinity Recent environments along the Atlantic and Gulf of Mexico coasts from Argentina to New York and the Caribbean. Fossil from the following formations Santiago (Cuba), Upper Las Cahobas, Upper Morne Delmas (Haiti), Jimani, Upper Las Salinas, Arroyo Blanco (Dominican Republic), Lajas (Puerto Rico), Talparo (Trinidad), Duplin Marl (North Carolina), Laverne (Kansas), Palmico, Caloosahatchee, Lake Flirt (Florida).

Cyprideis sp cf. *C. mexicana* Sandberg

(Pl. 1, Fig. 9)

Cyprideis mexicana Sandeberg, 1964, p. 125-128, Pl. 11, Figs. 11-14, Pl. 12, Figs. 1-5, Pl. 17, Fig. 1, Pl. 20, Figs. 1, 2, Pl. 22, Figs. 2. 9a, b, text-Figs. 9-16.

Dimensions: L .741-.841; H .376-408.

Remarks: The specimens described here are very similar to the holotype and topotype of the males of *C. mexicana* from Laguna de Terminos and Tamiahua Lagoon, Mexico, but slightly more oblique anterodorsally, the anteroventral margin is nearly straight to gently concave, and they show stronger ornamentation. Sandberg (1964) reports only a smooth to faintly fine pitted surface for this species, but he suggests that coarser ornamentation may occur under different environmental conditions as it is the case in other species.

The species identified as *C. bensoni* by King and Kornicker (1970, Pl. 12, Figs. 7-10) and C. sp (Pl. 13, Figs. 7, B), seem to be *C. mexicana* and they show a more similar ornamentation to the specimens found here; King and Kornicker's specimens are less elon-gated and more dorsally curved than the ones in this study.

Kontrovitz's specimens are very similar to the Saline Basin ones, but bigger and smooth.

C. ovata (Mincher) of Sandberg (1964) is less elongated and bigger, and less oblique anterodorsally.

C. castus of Sandberg (1964) (=*C. bensoni* Sandberg), is higher anterodorsally and the posteroventral margin is extended into a "beak"-like structure.

C. locketti (Stephenson) has a different anterior margin, is higher posteriorly, and has a posteroventral "tab".

Material: 5 valves and 1 molt.

Occurrence: Upper Concepcion.

Distribution: Previously reported from the Miocene: Duplin Marl (North Carolina) and Saint Marys Formations (Maryland), South Florida and Southeastern US Atlantic Coastal Plain. Recent: Tamiahua Lagoon and Laguna de Términos, Mexico; San Antonio and Copano Bays, Texas; Barataria Bay, Louisiana; Sapelo Sound, Georgia; Saint Helena Sound, South Carolina; Myrtle Sound, North Carolina and Chesapeake Bay Region.

Subfamily KRITHINAE Mandelstam, 1958

Genus *KRITHE* Brady, Crosekey and Robertson

Krithe trinidadensis Bold

(Pl. 1, Fig. 10)

Krithe trinidadensis Bold, 1958b, p. 398, Pl. 1, Figs. 3a-f, not Fig. 3g; 1960, p. 15g, chart 2; 1966f, p. 138, Pl. 44, Fig. 8; 1968b, Pl. 2, Figs. 10a-d, text-Figs. 11-12; 1971b, Table 6; Sanguinetti, 1979, p. 132, Pl. 4, Figs. 2a-b, Pl. 10, Figs. 4a-b; Bold, 1981, Tables 4, 8, 13, 14; Steineck, 1981, p. 347, Table 2, Pl. 2, Figs. 9-11; Machain-Castillo, 1986, p. 139.

? K. sp aff. *K. trinidadensis* Breman, 1982, Pl. 1, Fig. 6.

Dimensions: Females L .850-.975; H .500-.558; W .425.

Male L .850-1.00; H .380-.500; W .400.

Material: 22 valves and 59 molts.

Occurrence: Upper Concepcion (1v, 19m), Lower Concepcion (7v, 8m), Encanto (14v, 32m).

Distribution: Widely distributed in the Caribbean, from Upper Oligocene to Pliocene, in the following formations: Uscari (Costa Rica), Husito (Venezuela), Cipero, Lengua, Brasso (Trinidad), Oceanic (Barbados), Upper Lowerlands

(St, Martin), Kingshill (St. Croix), Trinchera, Gurabo (Dominican Republic), Riviere Grise, Madame Joie, Thomonde (Haiti), Buff Bay (Jamaica), Jaruco, Cojimar (Cuba).

Genus *PARAKRITHE* Bold, 1958

Parakrithe alta Bold

(Pl. 1, Fig. 11)

Parakrithe sp Howe and Bold, 1975, p. 308.

Parakrithe alta Bold 1988, Pl. 2, Figs. 3-4, text-Figs. 6a-b.

Parakrithe sp 1 Machain-Castillo, 1986, p. 127, 139.

Dimensions: Females L .508-.566; H .266-.304.

Males L .575-.600; H .258-.283.

Male carapace L .600; H .283; W .216.

Material: 20 valves and 2 molts.

Occurrence: Lower Concepcion (8v), Encanto (12v, 2m).

Distribution: Mississippi River Mudlumps and Pliocene of the Greater Antilles (Bold, pers. comm.)

Parakrithe sp

(Pl. 1, Fig. 12)

Parakrithe sp 2 Bold, 1971b, Pl. 2, Fig. 2, Pl. 4, Fig. 4; Machain-Castillo, 1986, p. 128, 130, 139.

Dimensions: L .558-.570; H .216-.235.

Remarks: The specimens found here are very similar to *Parakrithe* sp 2 Bold (1971b) in shape and internal structures except that they are much larger.

Parakrithe alta differs from P. sp in having a larger Height/Length ratio, being more vertically truncated posteriorly, and more rounded dorsally, having a less sinuous line of concrescence in the ventral region and a stronger hinge.

Material: 7 valves and l molt.

Occurrence: Lower Concepcion (2v), Encanto (5v, 1m).

Distribution: Previously reported from the Pliocene Lower Coastal Group, Bowden Formation of Jamaica.

Genus *PSEUDOPSAMMOCYTHERE* Carbonnel, 1966

Pseudopsammocythere ex. gr. *vicksburgensis* (Howe and Law)

(Pl. 1, Fig. 13)

Krithe vicksburgensis Howe and Law, 1936, p.73, Pl. 6, Figs. 12, 13.

Dimensions: L 575-.718; H .237-.318.

Remarks: The specimens found here are very similar to the paratypes and cotypes of Howe and Law (HVH 1764, 1765), but larger and with a split V-shaped frontal scar. The authors describe the muscle scar as "a vertical row of four oval spots in front of which are two others close together" (1936, D. 73}, and they figured them as two small rounded scars (Pl. 7, Figs. 12). However, other cotypes have different scars, more similar to the ones found in the specimens described here.

Material: 17 valves and 6 molts.

Occurrence: Upper Concepcion (1v, 6m), Lower Concepcion (4v), Encanto (2v).

Distribution: Previously reported from the Vicksburg Oligocene of Louisiana, Mississippi and Alabama.

Subfamily NEOCYTHERIDEIDINAE Puri, 1957

Genus *HULINGSINA* Puri, 1958

Hulingsina semicircularis (Ulrich and Bassler)

(Pl. 1, Fig. 14)

Cytherideis semicircularis Ulrich and Bassler, 1904, p.127, Pl. 37, Figs. 18-20.

C. longula Ulrich and Bassler, 1904, p. 128, Pl. 37, Figs. 21-27.

C. ashermani Ulrich and Bassler, 1904, (part), p. 126, Pl. 37, Figs. 11-13; Howe and grad. stud, 1935, (part) p. 14, Pl. 3, Figs. 8-10; Malkin, 1953, (part), p. 778, Figs. 1-11, 13(?); Puri, 1954 (part), p. 286, Pl. 9, Figs. 4, 5, 7, 8.

Hulingsina ashermani (Ulrich and Bassler), Bold, 1978b, Table 2; Gío-Argaez, 1982, Pl. 4, Fig. 9.

Hulingsina semicircularis (Ulrich and Bassler), Forester, 1980, p. 8, Pl. 2, Figs. 3-5; Machain-Castillo, 1986, p. 139.

Dimensions: L .791-.850; H .341-.400.

Remarks: Forester (1980) indicates that the syntipe series of *H. ashermani* contains three species, one of which is *H. semicircularis* and that this has been determined by some authors as *H. ashermani* (e.g. Puri, 1954). The specimens recovered from the Salina Basin were compared to Puri's paratypes of *H. ashermani* of the Chipola Formation and Choctawhatchee Stage and found to be Nonspecific. Therefore, following Forester's suggestions, they are referred here to *H. semicircularis*. They are also very similar to the specimens figured by Forester (1980, Pl. 2, Figs. 3, 5).

Material: 44 valves and 30 molts.

Occurrence: Upper Concepcion (40v, 29m), Lower Concepcion (4v, 1m),

Distribution: Previously reported from the Calvert, Choptank, St. Marys, Eastover and Chipola Formations and from the Choctawhatchee Stage of Florida, and the Tuxpan Formation of Mexico. Miocene to Pliocene.

Hulingsina gioi nov. sp

(Pl. 1, Fig. 15; Pl. 2, Figs. 1, 2)

Hulingsina sp 3 Machain-Castillo, 1986, p. 139.

Diagnosis: Small, elongate carapace with dorsal and ventral margins roughly parallel, posterior subtruncate, and the surface covered by faint ridges, broken into pustules at the anterior, and antero ventral margins.

Description: Carapace small, elongate, highest just behind the middle. Dorsal margin slightly curved anteriorly,

straight posteriorly, gently sloping backwards, giving the carapace a slightly triangular shape. Ventral margin broadly concave, with the maximum conacavity about the middle. Anterior margin broadly rounded below, obliquely rounded above. Posterior margin in the left valve subtruncate above, rounded below the middle, obliquely rounded in the right valve.

In some specimens the surface is covered with pustules aligned in rows parallel to the anterior and ventral margins. However, in most of the specimens examined, the valve is smooth because of poor preservation.

Marginal area moderately wide with an anterior vestibule. Selvage prominent all along the free margins. Marginal pore canals numerous straight, some paired, less abundant along the ventral and posterior areas. The hinge is a modified merodont type consisting in the right valve of a short anterior bar, a median groove and a posterior planar tooth. The muscle scars consist of a vertical row of four ovate ones and a V-shaped one in front.

Holotype: A left valve (Pl. 2, Fig. 1, HVH 10831) from sample SD 13.

Etymology: Named in honor of Raul Gío-Argaez of the Universidad Nacional Autónoma de México, a pioneer Mexican ostracod worker, for his assistance during the study.

Dimensions: L .558-.641; H .233-.260. Holotype L .635; H .288.

Remarks: The shape of the right valve is similar to that of *Cushmanidea anderseni* (Puri), but the latter taxon is smooth and much more elongated.

Material: 8 valves and 2 molts.

Occurrence: Upper Concepcion (6v, 2m), Lower Concepcion (2v).

Hulingsina sp 1

(Pl. 2, Figs. 3, 4)

Dimensions: L .850-.890; H .300-.347.

Remarks: This species has a very characteristics "cerebroid" ornamentation consisting of ridges, sometimes broken into pustules, more or less paralelling the nearest free margin, and some diagonal ones in the central part of the valve. Most of the specimens recovered were molts in which the orneamentation is well developed. The ridges seem to be prominent in the molts, whereas large pits occur only in the adults found. However, not enough adults were recovered to confirm this. *Cytherideis rugipustulosa* Edwards (1944) has a somewhat similar development of ridges but it has a prominent comma-shaped sulcus in the anterodorsal area, and the ridges posterior to it are horizontal whereas in the specimens described here they are diagonal.

Material: 6 valves and 189 molts.

Occurrence: Upper (3v, 169m), Lower Concepcion (3v, 20m).

Family CYTHEROMORPHIDAE Mandelstam, 1960

Genus *CYTHEROMORPHA* Hirschmann, 1909

Cytheromorpha warneri Howe and Spurgeon

C. warneri Howe and Spurgeon in Howe and grad, stud., 1935, p. 11, Pl. 2, Figs. 5, 8, 9, Pl. 4, Fig. 4, Pl. 2, Figs. 5, 8, 9; Bold, 1946, p. 105, Malkin, 1953, p. 787, Pl. 80, Figs, 18-19; Puri, 1954, p. 277, Pl. 6, Figs. 5-7, text-Figs. 11f-g; McLean, 1957, P. 70 r Pl. 7, Figs. 3ª-b; Brown, 1958, p. 67, Pl. 7, Fig. 9; Pooser, 1965, p. 51, Pl. 11, Figs. 3, 5, 8, 10, 11, 13; Bold, 1978b, Table 11; Hazel, 1983, Pl. 22,Fig. 6; Machain-Castillo, 1986, p. 139.

Not *C. warneri* Howe and Spurgeon, Bold, 1950, p. 86; Puri and Hulings, 1957, p. 174, Fig. 11; Benda and Puri, 1962, p. 324; Hulings and Puri, 1964, p. 321, text-Fig. 14; Hall, 1965, p. 51, Pl. 20, Figs. 16-25; Darby, 1965, p. 19, Pl. 2, Figs. 7-10; Grossman and Benson, 1967, p. 75, Pl. 13, Fig. 3, Pl. 18, Figs. 4, 6, 9.

? *C. warneri* Howe and Spurgeon, Puri, 1960, p. 114, Pl. 3, Figs. 11, 12, text-Fig. 36; Puri and Vanstrum, 1969, p. 77; King and Kornicker, 1970, p. 43, Pl. 8, Figs. 4a-b, Pl. 20, Figs. 1, 2.

Dimensions: L .458-.580; H .251-287.

Material: 5 valves and 1 molt.

Occurrence: Upper Concepcion (2v), Lower Concepcion (3v, 1m).

Distribution: Choctawhatchee Stage (Florida), Calvert Formation (Maryland); Yorktown Formation of Virginia and North Carolina. Recent, North Carolina, Florida and Texas Bays. Miocene to Recent.

Family PECTOCYTHERIDAE Hannai, 1957

Genus *MUNSEYELLA* Bold, 1957

Munseyella bermudezi louisianensis Kontrovitz

Munseyella nov. sp aff. *M. bermudezi* Howe and Bold, 1975, p. 308, Pl. 3, Fig. 6.

M. bermudezi louisianensis Kontrovitz, 1976, p. 80, Pl. 6, Figs. 3, 4; Machain-Castillo, 1986. p. 139.

Dimensions: Females L .308; H .183; W .150.

Male L .375; H .200; W .150.

Material: 4 valves.

Occurrence: Upper Concepcion (2v), Encanto (2v).

Distribution: Previously reported from the Mississippi River Mudlumps and the Louisiana Continental Shelf.

Family CYTHERIDAE Baird, 1850

Subfamily PERISSOCYTHERIDEINAE Bold, 1963

Genus *PERISSOCYTHERIDEA* Stephenson, 1938

Perissocytheridea bicelliforma Swain

(Pl. 2, Fig. 5)

P. bicelliforma Swain 1955 p. 621 Pl. 61, Figs. 3a, b (not Pl. 64, Fig. 4); Bold, 1963c, p. 380, Pl. 4, Figs. 1a-d, Pl. 12, Fig. 11, Morales, 1966, p. 36, Pl. 3, Figs. 1a-c Swain and Gilby, 1967, p. 308, Pl. 31, Figs 4a, b, text-Fig. 11c; Krutak, 1971, p. 17, Pl. 3, Figs. 3a, b; Garbett and Maddocks, 1979, p. 893, Pl. 8, Figs. 7-10, text-Fig. 41; Bold, 1981, p. 22, Table 15; Machain Castillo, 1986, p. 139.

Not *Perissocytheridea bicelliforma* Swain, Hulings and Puri, 1964, text Fig. 16.

P. bicelliforma ? Swain, Bold, 1975a, p. 609.

P. sp cf. *P. matsoni* Stephenson, Bold, 1969, p. 121, Pl. 1, Figs. 10a-d.

Not *P. ? bicelliforma* Swain, Keyser, 1975b, p. 490, text-Fig. 3.

P. sp of. *P. bicelliforma* Swain, Krutak, 1982, p, 270, Pl. 6, Figs. 4- 9.

Dimensions: L .566-.591; H .300-323; W .325.

Remarks: The specimens found here are very similar to the ones of the Talparo Formation of Trinidad, and to the ones figured by Swain. Morales' specimens are smaller and some of them have stronger reticulations. The specimens illustrated by Garbett and Maddocks are smaller and less pointed posteriorly.

Material: 6 valves and 39 molts

Occurrence: Upper Concepcion (6v, 33m), Lower Concepcion (6).

Distribution: Previously reported in Recent environments in the Gulf of Mexico from Veracruz to Louisiana, and Cuba. Pliocene to Recent in the following formations: Springvale, Talparo (Trinidad), Upper Las Cahobas, Upper Morne Delmas (Haiti), Las Salinas, Angostura, Jimani, Mao (Dominican Republic).

Perissocytheridea subrugosa (Brady)

(Pl. 2, Fig. 6)

Cythere subrugosa Brady, 1870, p. 238, Pl. 30, Figs. 18, 19.

Perissocytheridea subrugosa Bold, 1958a, p. 71; 1963c, p. 380, Pl. 4, Figs. 2a-d; 1972a, Tables 2, 3; 1975a, Tables 2, 3, 6, 7; 1975c, Tables 2,5; 1978b, Table 9; Teeter, 1975, p. 432, Figs. 6j, 7f, g; Machain-Castillo, 1986, p. 139.

Dimensions: L .508-.583; H .266-.333.

Remarks: The specimens found here are very similar to *P. subrugosa* Brady of the Talparo Formation. They differ from *P. rugata* Swain, by the possession of a ventral ridge and a posteroventral node; and from *P. brachyforma* Swain (1955), in having a less conspicuous ventral ridge and a well developed knob-like ala; and from *P. bicelliforma* in being smaller, subtriangular, with a nodose posteroventral projection and strongly reticulated.

Material: 10 valves and 24 molts.

Occurrence: Upper Concepcion (9v, 23m), Lower Concepcion (1v, 1m).

Distribution: Previously reported from the following formations: Talparo, Upper Morne l'Enferr (Trinidad), Jimani, Las Salinas (Dominican Republic), El Abra, Jaimanitas, Matanzas, Canimar, Santiago (Cuba). Recent from Cuba, Trinidad and Belize.

Family HEMICYTHERIDAE Pury, 1953

Genus *AURILA* Pokorny, 1955

Aurila sp aff. *A. laevicula* (Edwards) sensu Cronin (1986)

(Pl. 2, Figs. 7-9)

Dimensions: L .530-.570; H .292-.320.

Remarks: These specimens are very similar to Cronin's (1986, Pl.10, Fig. 2), but less elongate. They differ from *A. laevicula* in being less dorsally arched, coarsely pitted and by the possession of peripheral ridges more or less parallel to the margins

Material: 5 valves and 3 molts.

Occurrence: Upper Concepcion (4v, 2m), Lower Concepcion (1v, 1m).

Distribution: Previously reported from the Quaternary of Southern Texas.

Genus *MALZELLA* Hazel, 1983.

Malzella bellegladensis (Kontrovitz)

(Pl. 2, Fig. 10)

Aurila bellegladensis Kontrovitz, 1978, p. 143, Pl. 3, Figs. 4, 5.

Malzella conradi (Howe and McGuirt), Machain-Castillo, 1986, p.139.

Dimensions: L .650; H .450.

Remarks: Most of the valves of this species were recovered from samples TU 1030 and 1031 (Upper Concepcion, a shallower facies outside the area of study. 127 specimens) and K4 (a sample from Encanto that shows reworked shallower water species. 21 specimens).

Material: 153 valves and 86 molts.

Occurrence: Upper Concepcion (139v, 78m), Encanto (14v, 8m).

Distribution: Pleistocene of Florida.

Genus *MUTILUS* Neviani, 1928

Mutilus ? sp

(Pl. 2, Figs 11, 12)

Dimension: L .783; H .416.

Remarks: This genus is similar to *Hemicythere*, 7 which also presents split second and third scars, but it only possesses two frontal ones, and its hinge is different. *Mutilus* has a more similar hinge to the specimens described here, and also shows three frontal scars, but the third abductor scar is not divided.

Material: 3 valves.

Occurrence: Encanto.

Genus *RADIMELLA* Pokorny, 1969

Radimella confragosa (Edwards)

(Pl. 2, Fig. 13)

Hemicythere confragosa Edwards, 1944, p. 518, Pl. 86, Figs. 23-26; Swain,1951, p. 43, Pl. 6, Figs. 13, 14; Puri 1953a, p.176, Pl. 1, Figs. 4-6; 1954, p. 266, Pl. 11, Figs. 10-12; Bold, 1958a, p. 71 (part); Brown, 1958, p. 66, Pl. 7, Fig. 1.

Aurila confragosa (Edwards), Bold, 1963c, p. 385 (part), not Pl. 8, Fig. 1.

Mutilus confragosus (Edwards), Bold, 1966c, Tables 1, 2, 5 (part); 1967a, p. 75; Swain, 1968, p. 21, Pl. 4, Figs. 8a-e, Pl. 5, Figs. 5a-c, Pl. 7, Figs. 3a-c; Bold, 1969, Table 1 (part).

Radimella confragosa (Edwards), Hazel, 1971a, Table 1; 1971b, Table 1; Swain, 1974, p. 36, Pl. 6, Figs. 11-13; Bold, 1975b, p. 697, Pl. 1, Figs. 1-4, 16, 17, text-Figs. 3a, b; 1975c, p. 145, Pl. 17, Fig. 1; Benson, 1976, p. 49-52, Pl. 50, Figs. 1, 2, Pl. 51, Fig. 1, Pl. 52, Figs. 1-4;Hazel, 1977, Fig. 6a; Cronin and Hazel, 1980, Fig. 4e; Hazel, 1983, Pl. 13, Fig. 2; Machain-Castillo, 1986, p. 139.

Radimella ex. gr. confragosa (Edwards) Bold, 1971b, p. 337 (part); 1973a, p. 334; 1974, p. 537 (part); 1975a, Tables 2, 7, 9, 10, 12, 15 (part); 1975d, Table 1; 1978b, Tables 2, 8, 9 (part).

Radimella confragosa ? (Edwards) Kontrovitz, 1978., p. 144, Pl. 3, Fig. 3; Bold, 1981, p. 18, 21, 36, 39, 107, 110, Table 15; Bate et al. 1981, p. 24, Figs. 16f-g.

Not *Mutilus confragosa* (Edwards) Puri, 1960, p. 130; Swain, 1967, p. 83, text-Fig. 52a, Pl. 6, Figs. 1a, b.

Not *A. confragosa* (Edwards) Baker and Hulings, 1966, p. 114, Pl. 1, Fig. 13.

Not *Mutilus confragosus* (Edwards) Bold, 1966d, Pl. 1, Fig. 13.

Dimensions: L .583-.641; H .358-.400.

Remarks: The specimens found here are very similar to the holotype (Bold, 1975b, Pl. 1. Figs. 1-4) from the Duplin Marl Of North Carolina and Bold's specimens from Cuba and Jamaica (HVH 9092-9095), and to Hazel's 1983 (Pl. 13, Fig. 2). The Costa Rican specimens (HVH 9992-9995) have a less well developed dorsal ridge which is located slightly below the dorsal margin.

There is some variation in the individual sine and shape of the reticulations, specially in the area between the central mesh and the dorsal area ("dc" of Bold, 1975, p. 695) which shows 2 or 3 subdivision or 2 and a partial third one; and in the anteroventral area where the subdivisions are well marked or at least partially so, but in general they follow the same pattern.

Material: 11 valves and 5 molts.

Occurrence: Upper Concepcion (3m), Encanto, (11v, 2m).

Distribution: Widely distributed in the Upper Miocene to Recent of the Caribbean and the Southeast United States in the following formations: Canimar, La Cruz, Capas de Gypsina (Cuba), Ponce (Puerto Rico), Bowden; (Jamaica), Morne Delmas, Las Cahobas, "Thomonde" (Haiti), Cubagua, Cabo Blanco, El Veral (Venezuela), Chorrera, Tubara (Colombia), Rio Banano Beds (Costa Rica), Ecphora, Cancelaria, Caloosahatchee, Duplin, Waccamaw, Yorktown, Croatan (southeastern United States).

Genus *QUADRACYTHERE* Hornibrook, 1952

Quadracythere compacta (Brady) sensu Bold, 1975

(Pl. 2, Fig. 14)

Q. compacta (Brady), Bold, 1975c. p. 132, Pl. 17, Fig. 12.

Dimensions: L .500-.550; H .300-.320; W .266.

Remarks: The specimens found here are almost identical to the females of *Q. compacta* (Brady) Bold from Cuba; the males are more elongate, and with slightly different reticulation pattern.

This species is similar to, *Q. bichensls* Bold (1963c), which seems to be the same species, but it is less elongate, has a more oblique anterodorsal margin, a less convex and more sloping dorsal margin, and shows stronger ornamentation.

Q. compacta (bardy) Bold, 1966d is different and maybe synonymus with *Q. lankfordi* Teeter (1975, p. 443, Figs. 9j, 1, 10c)

Material: 19 valves and 10 molts

Occurrence: Upper Concepcion (5v, 8m), Lower Concepcion (3v), Encanto (11v, 2m)

Distribution: Previously reported from the Pliocene of Cuba.

Genus *CAUDITES* Coryell and Fields, 1937

Caudites nipeensis Bold

(Pl. 2, Fig. 15)

C. nipeensis Bold, 1946, p. 103, Pl. 14, Fig. 1; Keij, 1954, p. 224, Pl. 4, Fig. 14, Pl. 6, Fig. 11a-d; Bold, 1957, p. 239; 1963c, p. 386, Pl. 6, Figs. 3a, b; 1964, Table 2; 1966d, Tables 1, 2; 1966e, p. 361; 1968b, p. 19, Tables 7-10; 1969, Table 1; 1970, p. 47, Pl. 2, Fig. 12; 1973b, Table 2; 1973a, p 334, 1975a, Tables 2, 4, 5; 1975d, Table 1; Teeter, 1975, p 442, Figs. 10d, 11a; Machain-Castillo, 1986, p. 138.

Dimensions: L .441-.500; H .225-.226.

Material: 6 valves and 1 molt.

Occurrence: Upper Concepcion (4v, 1m) Lower Concepcion (1v), Encanto (1v).

Distribution: Widespread in the Caribbean from Early Middle Miocene to Recent in the following formations: Herreria (Guatemala), Venado, Rio Banano, Moin (Costa Rica), Tubara, San Juan de Acosta, Chorrera (Colombia) Cubagua, Playa Grande, Punta Gavilan (Venezuela), Manzanilla, Taiparo, Springvale (Trinidad), Kingshill (St. Croix), Lajas, Ponce (Puerto Rico), Arroyo Blanco, Cercado, Mao, Gurabo (Dominican Republic), Thomonde (Haiti), Bowden, Buff Bay, Manchioneal (Jamaica), Cojimar, Guines, Jucaro, La Cruz, Matanzas, Santiago (Cuba).

Caudites rectangularis (Brady)

(Pl. 3, Fig. 1)

Cythere rectangularis Brady, 1869, p 153, Pl. 18, Figs. 13, 14.

Not *C. rectangularis* Brady, 1886, p 310, Pl. 40, Figs. 7-9; Neviani 1906, p. 194, Fig. 7.

Not *Caudites rectangularis* (Brady) Ruggieri, 1952, p. 125.

C. medialis Coryell and Fileds, Bold, 1957, Table 1 (part).

Caudites leguminosus Bold, 1963c, p. 387, Pl. 6, Figs. 2a, b.

C. rectangularis Bold, 1966d, p. 46, 47, Pl. 4, Figs. 2a, b; 1968, Tables 6, 9.

C. sp aff. *C. leguminosus* Bold, Swain and Gilby, 1969, p. 467.

C. rectangularis Bold, 1971b, (part), Pl. 3, Figs. 8a-c, not Figs. 8d-f; Tables 3 (part), 4 (part), 5, 6; 1978b, Table 9; 1981, Tables 14, 15; Machain-Castillo, 1986, p. 138.

Dimensions L 520- 523; H .246-.256.

Remarks: Most of the specimens recovered show very poor preservation, but the better ones are very similar to those of the Upper Morne L'Enfer Formation of Trinidad.

C. rectangularis is very close to *C. obliquecostatus* Bold (1963c), but has the median ridges coming from the center of the posterior ridge and not dorsally, and has a small loop-shaped posterodorsal ridge conecting with the median one and lacks a ventral ridge in the posterior region. *C*. sp aff. C. leguminosus Swain and Gilby (1967) is similar to the ones found here, but the posterodorsal ridge does not seem to close to form the "loop". *C. medialis* Coryell and Fields (1937) has a straight, not oblique, median ridge.

Material: 9 valves and 5 molts.

Occurrence: Upper Concepcion, (v, 5m), Lower Concepcion (1v).

Distribution: Previously reported from the following formations: Upper Morne L'Enfer, Springvale, Talparo (Trinidad), Bowden, August Town (Jamaica), Matanzas, Canimar, Capas de Gypsina (Cuba), Cercado, Gurabo (Dominican Republic), "Thomonde", Las Cahobas (Haiti), Recent from the North coast of Cuba, and in Colon Harbour, Panama. Upper Miocene to Recent.

Genus *ORIONINA* Puri, 1954

Orionina vaughani (Ulrich and Bassler)

(Pl. 3, Fig. 2):

Cythere vaughani Ulrich and Bassler, 1904, p. 109, Pl. 38, Fig.25.

Cythereis vaughani (Ulrich and Bassler) Howe and grad. Stud., 1935, p. 25, Pl 3, Figs 24-26, Pl. 4, Fig. 3; Edwards , 1944 , p 552 , Pl. 87 , Figs. 27, 28; Bold, 1946, p. 88 (part), Pl. 10, Fig. 1; 1950, p. 83 (part).

Trachyleberis vaughani (Ulrich and Bassler) Malkin, 1953, p. 794, Pl. 82, Fig. 14.

Orionina vaughani (Ulrich and Bassler) Puri, 1954, p. 254, Pl. 12, Figs. 15, 16, text-Fig. 8a; McLean, 1957, p. 88, Pl. 11, Figs. 6a, b; Brown, 1958, p. 64, Pl. 3, Fig. 2; Bold, 1963a, p. 41-44, Pl. 3, Figs. 1-5, text-Fig. 5; 1963c. p. 368, Pl. 6, Fig. 8; 1965, p. 394; Hall, 1965, p. 35, Pl. 7, Figs. 4, 5, 7; Bold, 1966f, p. 139, Pl. 45, Fig. 3; Swain, 1968, p. 21, Pl. 4, Figs. 4a-c, text-Fig. 19; Puri and Vanstrum, 1969, p. 74, 76, 78; Bold, 1970, Table 1; 1972a, Table 2; 1972b, p. 428, 1973b, Table 1; Lubimova and Sanchez, 1974, Pl. 15, Figs. 4, 4a; Bold, 1975d, Tables 3, 4; Hazel, 1977, Fig. 8a; Bold, 1978b, Table 2; Cronin and Hazel, 1580, Fig. 8e; Sanguinetti, 1979, p. 149, Pl. 6, Figs. 5a-c, Pl. 13, Figs. 2a-b; Forester, 1980, p. 19; Bold, 1981, p. 17, 102, 103.

O. bermudae (Brady) Bold, 1957, p. 242, Table 1, not Pl. 1, Figs. 12a,b; 1958b, Table 1; Pooser, 1965, p. 61, Pl. 17, Figs. 3, 8, 10, 11.

Dimension: 1 .750; H .375.

Material: 168 valves.

Occurrence: Upper Concepcion (164v), Lower Concepcion (4v).

Distribution: Canimar, Cojimar, Guines, Jaimanitas, Paso Real (Cuba), Thomonde (Haiti), Cercado, Gurabo, Trinchera (Dominican Republic), Cibao (Puerto Rico), Kingshill (St. Croix), Brasso, Tamana, St. Croix Beds (Trinidad), La Rosa (Venezuela), Cerrito, Sigmana (Colombia), La Boca (Panama), Herreria, Rio Dulce (Guatemala). Miocene to Pleistocene.

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Genus *ACTINOCYTHEREIS* Puri, 1953

Actinocythereis sp of. *A. gomillionensis* (Howe and Ellis)

(Pl. 2, Fig. 3)

Cythereis exanthemata var. *gomillionensis* Howe and Ellis in Howe and grad. stud., 1935, p. 19, Pl. 1, Figs. 6-12, Pl. 4, Fig. 3.

Dimensions: Females: L .720-.725; H .400-.425.

Males: L .725-.823; H .387-.425.

Remarks: The specimens found here are similar to *A. gomillionensis*, but have a slightly different arrangement of spines in the median row. They are also similar to the ones of the Louisiana Continental Shelf (Kontrovitz, 1976) and the Mississippi River Mudlumps (Howe and Bold, 1975).

This species differed from *A. exanthemata* (Ulrich and Bassler, 1904) and *A. marylandica* (Howe and Hough, 1935) the smaller size and the arrangement of the spines, and from *A. captionis* (Hazel, 1983) in that it lacks the transverse ridges of spines that connect the median and ventral rows.

Material: 7 valves and 14 molts.

Occurrence: Upper Conception (5v, 14m), Lower conception (2v).

Actinocythereis sp cf. *A. vineyardensis* (Cushman)

(Pl. 3, Fig. 4)

Cythereis vineyardensis Cushman, 1906, p. 380, Pl. 37, Figs. ,10-114.

Dimensions: Females: L .725-.775; H .406-.475.

Males: L .725-.808; H .375-.437.

Remarks: The specimens found here show diversity in the ornamentation pattern from an anostomosing net of thin riblets and short spines to less reticulations with stronger riblets and stronger spines.

Some of these specimens are similar to Hazel's 1967, Pl. 5, Figs. 16,18, and Pl.11, Fig. 4 (USNM112784, 112785,112698), but show small differences in the arrangement of the ventral and median rows of spines. Most are more reticulated and with less strong spines.

Although the size of the Salina Basin specimens is more similar to the closely related species A. dawsoni (Brady) (USNM112700, 112779, 112783), this species has even stronger spines and sometimes faint ribletes conecting them, but these are rather transverse, curved ridges, and do not form a well developed network; however, Hezel's 1983, Pl. 9, Fig. 1 (USNM190458) does show reticulation. Also the spines in the central row are different than in the specimens found here. A. mundorfi Swain, has a similar pattern of riblets, but it is smaller and has a more triangular shape.

Material: 13 valves and 3 molts.

Occurrence: Upper Concepcion (10v, 3m), Lower Concepcion (3v).

Distribution: Pleistocene to Recent. Previously reported from Vineyard Sound, the Gulf of Maine and the Atlantic Shelf.

Genus *AMBOCYTHERE* Bold, 1957

Ambocythere caudata Bold

(Pl. 3, Fig. 5)

Ambocythere caudata Bold, 1966b, p. 11, Pl. 1, Figs. 12, 13, text-Figs. 3, 4.

Ambocythere sp aff. *A. caudata* Bold, 1966c, p. 12, Pl. 1, Fig. 9.

Ambocythere sp C. Cronin, 1983, Pl. 3. Fig. F.

Dimensions: 1 .608-.700; H .325-.350.

Remarks: These specimens are slightly less elongated and less caudate than Bold’s types; otherwise very similar.

Material: 9 valves.

Occurrence: Lower Concepcion (1v), Encanto (8v).

Distribution: North Atlantic Ocean and Southeast US Coast. Recent.

Ambocythere sp cf. *A*. sp *A*. Cronin

(Pl. 3, Fig. 6)

Ambocythere sp A. Cronin, 1983, Pl. 9, Fig. G.

Diagnosis: A species of *Ambocythere*_characterized by a well developed reticulated surface with 8 to 9 longitudinal ridges and a short posterior ventral cauda.

Dimensions: L .550-.590; H .291-.310.

Remarks: Only three specimens of this species were found. They are very similar to *Ambocythere* sp *A* Cronin (1983), but the reticulation pattern is better developed and they have less horizontal ridges and lack the posteroventral spine.

These specimens differ from *A. caudata* in being smaller reticulated with shorter and more numerous longitudinal ridges.

Material: 3 valves.

Occurrence: Encanto

Distribution: Southeast US Coast.

Genus *BRADLEYA* Hornibrook, 1952

(Pl. 3, Fig. 7)

Bradleya normani (Brady)

Cythere normani Brady, 1865, p. 379, Pl. 61, Figs. 5a-d; 1880, p. 101, Pl. 17, Figs. 3a-d (not Pl. 26, Figs. 4a, b).

Bradleya normani (Brady), Benson, 1972, p. 38, 39, Fig. 13c, Pl. 1, Fig. 7, Pl. 7, Fig. 8.

Not *Cythere normani* Brady, Chapman, 1916, p. 50, 73, Pl. 6, Fig. 2.

Dimensions: L .850; H .550.

Material: 4 valves and 10 molts.

Occurrence: Encanto.

Distribution: Recent, Eastern Pacific and Atlantic Southern Ocean.

Genus *BUNTONIA* Howe, 1935

Buntonia boldi nov. sp

(Pl. 3, Figs. 8-10)

Buntonia nov. sp Howe and Bold, 1975, Pl. 1, Fig. 8.

Buntonia ? sp Kontrovitz, 1976, p. 84, Pl. 6, Fig. 7.

? *Quasibuntonia* sp Cronin, 1983, Pl. 9, Fig. G.

Diagnosis: A small species of *Buntonia* characterized by a large flat and smooth anterior area, a series of curved ventral ridges in the central area, and small ridges and depressions in the ocular armada.

Description: Carapace small, subpyriform, compressed in the anterior and posterior areas, inflated centrally, widest ventrally, just posterior to midlength, highest about two fifths of the length from the anterior. Anterior margin broadly rounded, extending into the ventral which is slightly concave in the center, obscured in the females? by a ventral overhanging. Dorsal margin straight (RV) to slightly curved (LV), steeply stooping posteriorly; slightly concave anteriorly, more pronunced in the right valve where it forms sort of a notch just in front of the anterior cardinal angle. Posterior margin obliquely rounded, more so ventrally, with 4 to 5 marginal denticles.

The surface is covered by small rounded pits, larger in the central port of the valves. The anterior depressed area is smooth in some specimens. Three to six curved, small ridges are located in the median ventral portion of the carapace. In well preserved specimens a short vertical spines comes out of the posterior end of the middle one. Two small diagonal ridges and sulci are present in the anterodorsal area (in the ocular region), at the greatest height of the valve.

Internally the valves are moderately deep, deepest ventrally. The marginal area is moderately wide (wider anteriorly), with a narrow vestibulum. Line of concrescence and inner margin are parallel to the outer margin. Marginal pore canals are numerous, ovate ones plus a V-shaped one in front. The hinge in the RV consist of a strong, pointed, subtriangular (pyramidal) anterior tooth, an ovoid socket, a median crenulated groove, and a smaller triangular posterior tooth. In the LV it consist cuff an anterior elongated socket and triangular pointed tooth smaller than the one in the RV), a crenulated median bar, and an elongated posterior socket.

Holotype: Female left valve (Pl. 3, Fig. 8, HVH 10848) from sample PDK 63.

Etymology: Named in honor of Dr. W. A. van den Bold from Louisiana State University who first discovered this species and directed the present research.

Dimensions: L .441-.503; H .275-.333; holotype L .493; H .301.

Remarks: These specimens are very similar in size, shape and ornamentation to Kontrovitz's specimen, and also quite close to the mudlump forms, except that the last are smaller and seem to have a wider marginal area. Cronin's Quasibuntonia sp (1983, Fig. 9G) seems also very similar, but has a better developed eyespot and only a depressed area behind it, instead of the sulci and ridges of the specimens described here.

Material: 18 valves and 3 molts.

Occurrence: Upper Concepcion (12v, 3m), Lower Concepcion (3v), Encanto, (3v).

Distribution: Mississippi River Mudlumps, Louisiana Continental Shelf and. Southeastern US Atlantic Coast.

Genus *CATIVELLA* Coryell and Fields, 1937

Cativella navis Coryell and Fields

(Pl. 3, Fig. 11)

C. navis Coryell and Fields, 1937, p.9, Fig. 9; Bold, 1946, p. 104, Pl. 12, Fig. 11; 1950, p. 85; Puri, 1954, p. 262, Pl. 11, Figs. 3-7, text-Figs. 9i-k; Bold, 1958b, p. 404, Pl. 3, Fig. 4; 1967b, p. 311, Pl. 1, Fig. 5; Rodriguez, 1969, p. 187, Fig. 12, Pl. 3, Figs. 1, 2; Puri, 1974, Pl. 5, Figs. 8a, b; Bold, 1978b, Tables 8, 9, 10.

Navecythere delicata Coryell and Fields, 1937, p. 7, Fig. 7.

Not *Pterygocythereis delicata* (Coryell and Fields) Swain, 1967, p. 47, Fig. 39, Pl. 3, Figs. 3a, b, 4a-c.

Material: 14 valves and 21 molts.

Dimensions: l .550; H .330.

Occurrence: Upper Concepcion (16v), Lower Concepcion (19v).

Distribution: Previously know from the following formations: Caribe (Guatemala), Cerro Barrigon, Cerro Verde, Cerro Guamache, Cerro La Cantera, Cumana, Playa Grande (Venezuela), Manzanilla, Greensaul, Savaneta, Melejo, Talparo (Trinidad), Gurabo, Mao (Dominican Republic), Choctawhatchee Stage (Florida).

Genus *ECHINOCYTHEREIS* Puri, 1954

Echinocythereis margaritifera (Brady)

(Pl. 3, Fig. 11)

Cythere margaritifera Brady, 1870, p. 192, Pl. 27, Figs. 3, 4.

Not *C. margaritifera* terquem, 1878, p. 122, Pl. 14, Fig. 11a-c.

Cythereis garretti Howe and McGuirt, in Howe and grd. stud., 1935, p. 20, Pl. 3, Figs. 17-19, Pl. 4, Figs. 5, 15.

Echinocythereis margaritifera (Brady) Malkin, 1960, p. 478, Figs. 5, 13, Pl. 1, Fig. 19; Hazel, 1967, p. 36, Pl. 6, Figs. 6, 7, 9; Howe and Bold, 1972, Pl. 2, Fig. 3a,b; Kontrovitz, 1976, p. 84, Pl. 7, Fig. 1; Machain-Castillo, 1986, p. 139.

Echinocythereis garretti (Howe and McGuirt) Puri. 1954, p. 260, Pl. 12, Figs. 2-5, text-Figs. 9a,b; Benson and Coleman, 1963, p.46, Pl. 4, Figs, 3,5, text-Figs. 30 a, b; Bold, 1978b, Table 2 (not Table 1).

Dimensions: L .950; H .600.

Material: 75 valves and 31 molts.

Occurrence: Upper Concepcion (63v, 29m), Encanto (12v, 2m).

Distribution: Previously know from the Choctawhatchee Stage (Florida), Gulf of Mexico and US Atlantic Coast. Miocene to Recent.

Echinocythereis sp

(Pl. 3, Fig. 13)

Dimensions: L 1.00-1.12; H .650-.750.

Remarks: This species is more subquadrate and rounded than *E. margaritifera*, then spine/stubs are smaller and thinner, and are arranged in concentric rows parallel to the margins, and form a reticulated pattern (seen in weathered specimens) and has a more protuded posterior margin.

Material: 24 valves and 106 molts.

Occurrence: Upper Concepcion (7v, 50m), Lower Concepcion (6v, 31m), Encanto (11v, 25m).

Genus *HENRYHOWELLA* Puri, 1957

Henryhowella ex. gr. *asperrima* (Reuss)

(Pl. 3, Fig. 14)

Cypridina asperrima Reuss, 1849, p. 74, Pl. 10, Fig. 5.

Henryhowella asperrima (Reuss) Bold r 1960, p. 169, Pl. 4 , Fig. 10 , Pl. 8, Fig. 2.

Dimensions: L .725-.800; H .433-.571; W .416-.441.

Material: 24 valves and 101 molts.

Occurrence: Upper Concepcion (6v,50 m), Lower Concepcion (18v, 51m).

Distribution: Widely distributed in the Caribbean, Gulf Coast, Southeastern US and Europe. Eocene to Recent.

Genus *NEOCAUDITES* Puri, 1960

Neocaudites scottae Teeter

(Pl. 3, Fig. 15)

Neocaudites triplistriatus (Edwards) Bold, 1971b, Pl. 2, Fig. 11, Tables 3 (part), 4.

N. scottae Teeter, 1975, p. 455, Figs, 12j, 13k-m; Palacios-Fest et al , 1983, Table 1.

N. sp Bold, 1975c, Table 2; 1978b, Table 1.

Dimensions: Female: L .575; H .300; W .225.

Male: L .608; H .308; W .225.

Remarks: These specimens are very similar to Teeter's paratypes (HVH 9012-9013) except larger and overall stronger ornamented.

Material: 5 valves.

Occurrence: Encanto.

Distribution: Previously reported from the following formations: Arroyo Blanco, Mao (Dominican Republic), Guines, Canimar (Cuba), Caribbean Coast of Mexico and Belize. Pliocene to Recent.

Genus *PURIANA* Coryell and Fields, 1953

Puriana carolinensis Hazel

(Pl. 4, Figs. 2, 3)

Puriana sp A Cronin and Hazel, 1980, p. 84, Fig. 4a.

P. carolinensis Hazel, Cronin and Hazel, 1980, p. 84, Fig. 4b; Hazel, 1983, p. 11, Pl. 27, Figs. 1, 3, 4.

Puriana sp 1 Machain-Castillo, 1986, p. 139.

Dimensions: L .518-.541; H .241-.268; W .276.

Material; 95 valves and 5 molt.

Occurrence: Upper Concepcion (43v, 5m), Lower Concepcion (52v).

Distribution: Reported from the following formations: Tamiami, Pinecrest, Jackson Bluff, Cancellaria, Canepatch, Bermont, Galoosahatchee (Florida), Duplin, Bear Bluff, Raysor, Goose Creek, Flanner Beach, Penholoway, Waccamaw (Carolinas), Accomak (Maryland), Lisse (Texas), Holocene of Virginia North and South Carolina. Pliocene to Recent.

Puriana gatunensis (Coryell and Fields)

(Pl. 4, Fig. 1)

Cythereis rugipunctata (Ulrich and Bassler), Howe and grad. stud., 1935, p. 23, Pl. 1, Figs. 18, 20, 22, Pl. 4, Figs. 22, 23

C. rugipunctata var. *gatunensis* Coryell and Fields, 1937, p. 10, Fig. 11.

Favella puella Coryell and Fields, 1937, p. 8, Figs. 8a-c (molt).

F. rugipunctata (Ulrich and Bassler) Bold, 1946, p. 100, Pl. 10, Fig. 3; 1950, p. 86; Malkin, 1953, p. 797, Pl. 88, Fig. 24.

Puriana rugipunctata (Ulrich and Bassler) Puri, 1953b, p.751; 1954, p. 257, Pl.12, Figs. 18,19, text-Fig. 8k; Bold, 1958b, p-.404, Pl.3, fig.12; Puri and Hulings, 1957, p. 174,176,183; Benson and Coleman, 1963, p. 43, Pl. 8, Figs. 1, 2, 5, text-Fig. 27; Bold, 1963b, p. 698; 1963c, Table 6; 1964, Table 2; 1965, p. 399, Table 1; 1966c, Tables 1, 2; Hulgins, 1966, p. 55, Fig. 8i; Grossman, 1967, p. 77, Pl. 14, Fig. 8, Pl. 21, Figs. 11-13; Bold, 1967b, p. 311, Pl. 1, Fig. 7; 1968b, Tables 4, 5, 11; Rodriguez, 1969, p. 195, Fig. 15, Pl. 3, Figs. 7, 8; Puri and Vanstrum, 1969, p. 73, 74, 76-78; Bold, 1970, Tables 1, 4; 1971a, Table 2; 1972a, Tables 2, 3; 1976, Table 4; 1978b, Tables 2, 8, 10.

Puriana puella (Coryell and Fields) Puri, 1954, p.257, Pl. 12, Fig. 17 (molt).

P. sp Swain, 1955, p. 635, Pl. 63, Fig. 10.

P. floridana Puri, 1960, p. 127, Pl. 1, Figs. 7, 8, text-Figs. 20, 21; Valentine, 1971, Pl. 2, Figs. 32, 37; Cronin, 1980a, p. 147, Pl. 4, Figs. 9, 10; Cronin, 1987, Figs. 7.5-7.8, 11.1, 11.3, 11.5, 11.7, 21.4. P. ex. gr. *rugipunctata* (Ulrich and Basler) Bold, 1968a, Figs. 4-9.

P. rugipunctata gatunensis (Coryell and Fields) Bold, 1971b, Pl. 2, Fig. 15; 1973b, Table 1; 1973a, p. 334; 1975c, Pl. 19, Fig. 9, Tables 2, 4; 1978b, Table 9; 1981, p. 14, 17, 19, 21, 102-104, 108, Tables 2, 3, 14; Machain-Castillo, 1987, p. 139.

P. gatunensis (Coryell and Fields) Bold, 1971b, Tables 3, 5.

P. sp Krutak, 1971, p. 15, Pl. 4, Fig. 4a.

P. sp aff. *P. rugipunctata* (Coryell and Fields) Bold, 1975a, Table 5.

P. krutaki Kontrovitz, 1976, p. 70, Pl. 4, Figs. 9, 10; Krutak, 1982, p. 267, Pl. 6, Figs. 15-17.

Dimensions: L .600-.675; H .308-.391.

Remarks: The author examined material, provided by Dr. van den Bold from the Gatun Formation, probably from the same locality where Coryell and Fields described *P. ruginunctata* var. *gatunensis*. These specimens show variable ornamentation in the posterior region, consisting of vertically aligned tubercles. This vertical arrangement is more conspicuous in the dorsal half, where the tubercles are fused, at various degrees, into ridges, although these ridges are not as prominent as in *P. rugipunctata* (Ulrich and Bassler). In the ventral half, the vertical alignment is maintained, and sometimes two or three spines are fused, but no well developed ridges are found. There is a tendency of 3 to 5 spines to concentrate in the posteroventral third of the valve, just in front of the posterior ridge. The size and thickness of the tubercles is variable.

The Salina Basin specimens fall within the above mentioned pattern. They are ussually larger and with the posteroventral cluster of tubercles or spines more prominent. However' the position and number of tubercles/spines is generally the same. These specimens are also similar to Cronin's (1987) *P. floridana* (Puri, 1960), specially to the more tuberculate forms (Figs. 11.5, 11.7); however there are some forms similar to the spinose ones in Figs. 11.1,11.3 and 7.8. Forms similar to these also occur in the Gatun samples examined, although the spines seem to be thicker.

The specimens found here are smaller, more elongated, with the posterodorsal ridges less developed, more nodule-like, and with the posteroventral tubercles thinner, fewer, and lacking the distinct rugose pattern of the plesiotype of *Puriana rugipunctata ruginunctata* of the Choctawhatchee stage.

Material: 175 valves.

Occurrence: Upper Concepcion (158v), Lower Concepcion (16v), Encanto (1v) .

Distribution: Widely distributed in the Miocene to Recent sediments of the Caribbean, Gulf Of Mexico and

Southeastern United States.

Genus *PTERYGOCYTHEREIS* Blake, 1933

Pterygocythereis alophia Hazel

(Pl. 4, Fig. 4)

Pterygocythereis cornuta americana (Ulrich and Bassler) Puri, lost, p. 261 (part), Pl. 13, Fig. 2, 4.

P. sp aff. P.american a Benson and Coleman, 1963 (part), p. 22, Pl. 5, Figs. 2, 3; Swain, 1968, p. 19, *P*l. 2, Figs. 7a-d.

P. sp A Valentine, 1971, p. 8.

P. sp aff. P. americana (Ulrich and Bassler) Howe and Bold, 1975, Pl. 3, Fig. 17.

P. alophia Hazel, 1983, p. 104, Pl. 7, Figs. 2, 4.

Dimensions: L .791; H .416.

Material: 8 valves and 10 molts.

Occurrence: Upper Concepcion (7v, 10m), Lower Concepcion (1v).

Distribution: Choctawhatchee Stage, Jackson Bluff, and Tamiani Formations and the Pinecrest Beds of Olson (1964) of Florida; Bear Bluff (of DuBar et al., 1974, p. 156) and Waccamaw Formations of the Carolinas; Recent from off Virginia to Florida. Pliocene to Recent.

Pterygocythereis inexpectata (Blake)

(Pl. 4, Fig. 5)

Cythereis inexpectata Blake, 1929, p. 12, Fig. 7.

C. (Pterygocythereis) inexpectata Blake, 1933, p. 240.

Pterygocythereis americana (Ulrich and Bassler) Hazel, 1967, p. 39.

P. americana inexpectata (Blake) Hazel, 1968, p. 1266, 1269.

P. inexpectata (Blake) Hazel, 1971, p. 6; 1983, Pl. 7, Fig. 3.

Dimensions: L 1.00; H .575.

Material: 6 valves and 4 molts.

Occurrence: Upper Concepcion ($v, 4m), Lower Concepcion (2v).

Distribution: Upper Miocene (Palmico River), Pliocene (Yorktown Formation), Pleistocene of the US Atlantic Coast off Cape Hatteras to New England and Recent from Virginia to Nova Scottia.

Pterygocythereis sp 1

(Pl. 4, Fig. 6)

Dimensions: L .800; H .450.

Remarks: This species differs from *P. alophia* by the plumper shape the possession of a fluted crest and the shape of the ala and the two posterior spines. It differs from *P. inexpectata* in the more rounded shape, the possession of an undivided fluted crest that breaks out in two posterodorsal spines. the shape of the ala and the presence of two tablike seines posterior to it.

Material: 6 valves, 2 molts and several fragments.

Occurrence: Upper Concepcion (3v, 1m), Lower Concepcion (3v).

Subfamily CAMPYLOCYTHERINAE Puri, 1960

Genus *BASSLERITES* Howe, 1937

Basslerites minutus Bold

(Pl. 4, Fig. 7)

*Basslerites teres (*Brady) Keij, 1954, p. 224, Pl. 5, Figs. 2a, b.

Not *Cythereis teres* Brady, 1870, p. 147, Pl. 14, Figs. 17. 18.

B. berchoni (Brady) Bold, 1957, p. 244; 1958a, p. 71.

Not. *Cythere berchoni* Brady, 1870, p. 117, Pl. 14, Figs. 3, 4.

B. minutus Bold, 1958b, p 405, Pl. 3, Fig. 8, Pl. 5, Figs. 5a-c; 1963b, p. 698; 1963c, p. 392, Table 6; 1964, Table 2; Morales, 1966, p. 62, Pl. 5, Figs. 3a,b; Bold, 1966a, Table 1; 1966c, p. 14, Tables 1, 2; 1966e, Table 1; 1970, Table 2; 1973b, Table 1; 1973a, p. 334; 1975a, Tables 2, 3, 6; 1978a, Table 3; 1978b, Table 9.

Dimensions: L .416-.466; H .216-.258; W .208-.216.

Remarks: This species is very similar to *B. cuspidatus* Bold, but it has more rounded posterior margin. *B. miocenicus* (Howe), is also similar but it is larger, has a different shape of the posterior depression, a large vestibulum and simpler pore canals.

Material: 104 valves and 13 molts.

Occurrence: Upper Concepcion (82v, 13m), Lower Concepcion (22v).

Distribution: Miocene to Recent from the following formations: Brasso, Tamana, Manzanilla, Talparo (Trinidad); Las Salinas, Jimani (Dominican Republic); Agua Clara, Cuajaro, Cubagua, Cumana, Freites, Husito, Menecito, Socorro, Chaguaramas, Roblecito, Pascuas, Playa Grande (Venezuela); Gatun (Costa Rica); Rio Dulce (Guatemala). Recent from shallow marine waters around Trinidad, Venezuela and off Alacran Reef and Laguna de Terminos, Mexico.

Basslerites sp

(Pl. 4, Fig. 8)

Dimensions: L .600; H .300.

Remarks: The taxonomic position of the species is uncertain since it posseses characteristics of at least two genera. The shape, posterior depressed area and the V-shaped frontal scar resemble those of Basslerites, but the hinge is weaker, closer to that of *Acuticythereis* Edwards. Also the shape of the inner lamella, the numerous marginal pore canals and posterior vestibulum, show similarity to Acuticythereis. However, this genus (Plusquellec and Sandberg, 1969, p. 433, text-Fig. 1), has two more or less rounded frontal scars and a different shape.

Material: 9 valves.

Occurrence: Upper Concepcion.

Family CYTHERETTIDAE Tribel, 1952

Genus *PROTOCYTHERETTA* Puri, 1958

Protocytheretta sp cf. *P. montezuma* (Brady)

(Pl. 4, Fig. 9)

Cytheretta montezuma Brady, 1869, p. 123, Pl. 14, Figs. 11, 12.

Dimensions: L .792; H .400.

Remarks: The specimens found here are very similar to *C. montezuma* Brady, but since his types were not available it was not possible to precise from his pictures if they were the same species. The holotype (HVH09524) of *Protocytheretta montezuma louisianensis* Kontrovitz (1976, Pl. 7, Fig. 5) is also similar to the Concepcion taxon, but it is slightly larger and shows slightly different ornamentation. *Cythere ambifaria* Krutak (1971, Pl. 1, Figs. 5a, b), may be synonimous with the specimens found in this study, but the specimens examined (HVH-8972) seem to be worned out and the ornamentation is difficult to compare.

Material: 4 valves and 21 molts.

Occurrence: Upper Concepcion (1v, 17m), Lower Concepcion (3v, Am).

Protocytheretta pumicosa (Brady)

(Pl. 4, Fig. 10)

Cythere pumicosa Brady, 1866, p. 370, Pl. 61, Figs. 3a-c; 1869, p. 238, 240.

C. daniana Brady, 1869` p. 124, Pl. 14, Figs. 13, 14, p. 243.

Paracytheretta danaiana (Brady) Puri, 1952, p. 210, Pl. 40, Figs. 10, ll, text-Fig. 11.

Cytheretta danaiana (Brady) Puri and Hulings, 1957, p. 174, Fig. 11; Malkin, 1960, p. 481, Pl. 3 (Top), Fig. 2; Hulings, 1967, p. 642, Fig. 3o; Puri, 1974, Pl. 11, Fig. 6a, b.

Protocytheretta danaiana (Brady) Puri, 1960, p. 111, Pl. 1, Figs. 1, 2, text-Figs. 18, 19; Benson and Coleman, 1963, p. 26, Pl. 5, Figs. 5, 7, 9, 10, text-Figs. 13a-d.

Cytheretta pumicosa (Brady) Bold, 1975c, Tables 2, 5; Palacios-Fest et al., 1983, Table 1.

Protocytheretta pumicosa (Brady) Teeter, 1975, p. 463, Figs. 15q, 16b; Kontrovitz, 1978, p. 154, Pl. 5, Fig. 1.

Dimensions: L .900; H .550.

Material: 23 valves, 5 molts.

Occurrence: Upper Concepcion (32v, 5m), Lower Concepcion (1v).

Distribution: Recent from the Gulf of Mexico and the Caribbean Sea (Quintana Roo, Mexico and Belize). Pleistocene from Southern Florida and Pleistocene of Cuba (Matanzas Jaimanitas and Canimar Formations).

Family LOXOCONCHIDAE Sars, 1866

Genus *LOXOCONCHA* Sars, 1866

Loxoconcha hazeli nov. sp

(Pl. 4, Figs. 12, 13)

Loxoconcha purisubrhomboidea Edwards, Puri, 1954, p. 274, Pl. 10, Fig. 8, text-Fig. 10h.

L. sp A Hazel, 1977, Fig. 9h.

L. sp A Cronin and Hazel, 1980, Fig. 9b.

L. sp A Machain-Castillo, 1986, p. 139.

Diagnosis: An elongated species of *Loxaconcha* characterized by a straight to slightly curved dorsal margin with a posterior "bulge" right above the posterior cardinal angle, a strong ventral overhang in females, and a finely to medium pitted surface with or without weak ventral concentric ridges.

Description: Carapace subrectangular-ovate, with dorsal and ventral margins subparallel and a thin keel around the free margins. Anterior margin broadly rounded, slightly more oblique dorsally. Posterior margin subtriangular pointing just above midheight, slightly concave above it. Dorsal margin straight to slightly curved, with a "bulge" at the posterior cardinal angle. Ventral margin sinuous, obscured by a strong overhang in females. Valves noncentrally inflated, especially in the ventral half Males more elongate and less ventrally inflated.

Surface covered with small, rounded (in the center) to elongate (periphery) pits disposed in concentric rows, more prominent in the ventral portion where they form three to four distinct curved ridges bordering the ventral overhang in the females.

Internally the valves are deep. Inner lamella broad, with anterior and posterior vestibule. Marginal pore canals numerous, simple, straight to slightly curved. Hinge gongylodont.

Holotype: Left valve (Pl. 4, Fig. 12, HVH-10866) from sample SD 14.

Etymology: Named in honor of Dr. J. E. Hazel of Louisiana State University who first discovered this species.

Dimensions: L .550-.561; H .333-.359. Holotype L .564; H .358.

Remarks: The specimens assigned to this species present a gradation of shape and ornamentation from very finely pitted without ridges, to finely pitted with weak ridges, to coarser pitted with distinct ridges.

The figured specimen is very similar to Cronin and Hazel's 1980 Fig. 9b (USNM-252039) except for slightly wider anterior and posterior depressed clear regions, and in being slightly bigger.

L. purisubrhomboidea Edwards of Puri, 1954, is very similar to this species. However, Puri's form is not the same as Edwards' *L. purisubrhomboidea (=L. subrhomboidea*) Edwards, 1944, p.527, Pl. 88, Figs. 28-32, not Brady, 1880). It is more subrectangular-ovate, the posterior margin is more pointed and not as truncated above, the anterior margin is wider and the dorsal margin is strainght to slightly curved with a small triangular projection above the posterior cardinal angle.

L. sp *B* Cronin and Hazel, 1980, Fig. 9a (USNM-252038) is more subrectangular, has a shorter and straight dorsal margin, is has better developed concentric ridges around the free margins.

Occurrence: Upper Concepcion (30v, 12m), Lower Concepcion (4v).

Distribution: Ecphora Facies of the Choctawhatchee Stage, Duplin and Yorktown Formations. Pliocene.

Loxoconcha matagordensis ? Swain

(Pl. 4, Fig. 11)

L. matagordensis Swain, 1955, p. 629, Pl. 63, 39, Figs. 7a, b; Puri and Hulings, 1957, p. 187, Fig. 11; Puri, 1960, p. 111, Pl.3, Figs. 15, 16, text-Figs. 39, 40; Morales, 1966, p. 66, 68, Pl. 6, Figs. 4a-d, Pl. 8, Figs. 7, 8, 11; Benson and Grossman (in Grossman and Benson), 1967, p. 74, Pl. 15, Fig. 1, Pl. 18, Figs. 10, 12, 14, 15, 17; Valentine, 1971, p. 8, Pl. 4, Figs. 38, 39, 43; Garbett and Maddocks,

1979, p. 875, Pl. 4, Figs. 7-10; Cronin and Hazel, 1980, Fig. 9c; Cronin, 1980a, p. 145, Pl. 11, Figs. 1, 3. 5, 7, Fig. 2f.

Not *L. matagordensis* Swain, Hall, 1965, p. 50, Pl. 19, Figs. 15-18.

Not *L.* sp cf. *L. matagordensis* Swain, Kontrovitz, 1976, p. 72, Pl. 5, Fig. 1.

L. purisubrhomboidea Edwards, King and Kornicker, 1970, p. 43, Pl. 9. Figs. 1a-b, Pl. 20, Figs. 3-6; Grossman, 1965, p.148, Pl. 2, Fig. 1, text-Figs. 22-36; Hall, 1965, p. 50, Pl. 19, Figs. 9, 10, 12-14.

L. rhomboidea Kontrovitz and Bitter, 1976, p. 79, Pl. 1, Fig. 1.

Dimensions: Female: L .541; H .366; W .283.

Male: L .583; H .333.

Remarks: The differences between *L. purisubrhomboidea* and *L. matagordensis* are not very clear. According to the original descriptions *L. purisubrhomboidea* Edwards (1944, p. 527) has a curved dorsal margin in the left valve, and finely pitted surface, and *L. matagordensis* Swain, has straight dorsal margin in both valves, and a "subsidiary reticulate network of weak surface ridges" Swain, 1955, p. 629.

In the literature there is a spectrum of forms in degrees of curvature of the dorsal margin and ornamentation from very finely pitted to coarsely pitted, with and without ridges. When the end members are considered, they seem to be separate species, but when put together, a gradation of forms exists and it is not clear where to stablish a natural break. The consensus seems to be that the reticulated forms are referred to *L. matagordensis* and the finely pitted to *L.. ubrhomboidea*. However, in some very finely pitted forms weak concentric ridges can be spotted and the better development of the ornamentation could be related to ecologic conditions.

There is also a variation in the overall shape of these and related forms occurring in the same locality among the different authors, specially in the L/H ratios and the sinuosity of the ventral margin.

Since not enough material was found in this study, I will refer at this point these specimens to *L. matagordensis* because of the weak concentric ridges they posses.

Material: 6 valves and 1 molt.

Occurrence: Upper Concepcion (6v), Lower Concepcion (1m).

Distribution: Bear Bluff Formation (Pliocene), Waccamaw, Canepatch and Norfolk Formations and the Southeastern Atlantic Coastal Plain (Pleistocene). Recent from the Gulf of Mexico and US Atlantic coasts of North Carolina, Virginia and New Jersey.

Loxoconcha sp aff. *L. helenae* Crouch

(Pl. 4, Fig. 14)

L. helenae Crouch, 1949, p. 596, Pl. 96, Figs. 9-11.

Dimensions: L .417-.540; H .240-.336.

Remarks: This species is similar in shape to *L. helenae* Crouch (in Cronin et al., 1983, Pl. 12, Fig. 1), but the ornamentation is not exactly the same, and the posterodorsal margin is more oblique.

L. helenae Crouch of Valentine (1976, Pl. 7, Fig. 6), seems to have different (less rectangular), the dorsal and ventral margins converge posteriorly, and the dorsal half of the posterior margin is curved instead of oblique.

Material: 14 valves and 2 molts.

Occurrence: Upper Concepcion (9v), Lower Concepcion (4v), Encanto (1v, 2m).

Distribution: *L. helenae* has been reported from the Pliocene to Recent of California.

Genus *TOUROCONCHA* Ishizaki and Gunther, 1976.

Touroconcha lapidiscola (Hartmann)

(Pl. 4, Fig. 15; Pl. 5, Figs. 1-3)

Loxoconcha lapidiscola Hartmann, 1959, p. 223, Pl. 41, Figs. 128-129, Pl. 42, Figs. 131-133; Bold, 1963c, p. 394, Pl. 8, Fig. 6; 1966d, p. 51, Pl. 4, Figs. 4a, b.

Not *L. lapidiscola* Hartmann, Swain, 1969, p.469, Pl. 6, Figs. 6a,h, Pl. 11, Fig. 1.

L. lapidiscola Hartmann, Swain and Gilby, 1974, p.324, Pl. 5, Figs. 9a, b, text-Fig. 24; Bold, 1978b, Table 9.

Touroconcha lapidiscola (Hartmann) Ishizaki and Gunther, 1976, p.20, Pl. 1, Fig. 10, Pl.3, Figs. 10, 11; Bate et al., 1981, p. 48, Figs. 30i-l, 31g, h, m.

T. mosqueraensis Bate et al., 1981, p.48, Figs. 31a-f, i-n, 32d, 33a.

Dimensions: Females: L .425-.486; H .250-.275.

Males: L .512; H .275.

Remarks: Two forms are considered here under this species:

Females: subquadrate, with a short posterior reticulum and a non or weakly indented posteroventral triangulation.

Males: elongated, with larger and subdivided posterior reticulum, and a closed (non indented) posteroventral triangulation. The reticulation pattern in both is very similar, except for the posterior area which is more expanded in the males, basically the same but compacted in females (Pi. 4, Fig. 15; Pl.5, Fig. 1), show the three vertical divisions behind the posterior ridge characteristic of the males, but smaller.

Bold (1984, per. comm.) recognizes three forms of *T. lapidiscola*: 1) a Central American form with posteroventrally indented females; 2) a Caribbean form with non indented males and ocasionally and weakly indented females; 3) a Galapagos form with indented males and females. Bate et al. (1981), separated *T. mosqueraensis* from *T. lapidiscola* based on the presence of an open posteroventral triangulation formed by three straight ridges and a subdivided posterior reticulum, present in the only two specimens (males) they found.

The Mexican specimens are almost identical to the Caribbean form of Bold (1963c) with occasionally weakly indented females, but the males have a larger and more subdivided posterior reticulum as in *T. mosqueraensis* (Bate et al., 1981), but a closed posteroventral triangulation as in Caribbean forms.

Bold's (1966d) Colon Harbour males and Swain and Gilby's (1974) males from Nicaragua (Pacific side) are very similar in the posterior (undivided) and posteroventral (non indented, open) reticulum. Both are also similar to *T. mosqueraensis* in the posteroventral reticulum, but not in the posterior one that is better developed in the last species. The Mexican male specimen are very similar to Bate et al.'s ones in the posterior reticulum, but not in the posteroventral triangulation (closed, non indented).

The females of Colon Harbour are similar to the females of the Galapagos *T. lapidiscola*, but Bate et al.'s males are also indented, and the Colon Harbour and Nicaragua ones are not.

Ishizaki and Gunther's species (male) has a closed, but not triangular posteroventral reticulation, and a different shaped and individed posterior one.

At the present time it does not seem clear what is the exact relationship between these forms. They all can be treated as different species or subspecies in which case we could have: 1) a Central American form, with indented posteroventral reticulum in females, and non indented in males, open, and non subdivided posterior; 2) a Caribbean form, with non indented and closed posteroventral reticulum, and non subdivided posterior in the females; 3) a Galapagos form with indented, closed posteroventral reticulum, and non subdivided posterior in males and females; 4) a Pacific form (Ishizaki and Gunther's) with non indented, closed, and different shaped posteroventral reticulum, and non subdivided posterior; 5) a Mexican form, with non indented, closed posteroventral reticulum and undivided posterior in females and subdivided in males, and 6) a Galapagos *T. mosqueraensis* with non indented, open posteroventral reticulum and subdivided posterior in males. Or, since they all share many characteristics and apparently inconsistent differences, they can be considered as a highly polymorphic species and probably as ecotypes. Changes in the substrate may affect the reticulation along the ventral margin and change the shape of the posteroventral triangulation.

The differences in the posterior reticulum seem to be matter of degree of development. Some males have overall better developed reticulations (*T. mosqueraensis*), some have fewer and look "incomplete" (Swain and Gilby's, Bold's Colon Harbour).

In the Mexican specimens the different reticulate pattern in males and females seems to be matter of space,

with the males having a larger posterior reticulum able to acomodate more ridges, and therefore more expended and clearer subdivisions than the females. However, the reticulation pattern is the same, and so is the posteroventral triangulation.

At this time all the Mexican specimens are referred to *T. lapidiscola,* but more information is needed before a proper definition of the taxonomic position of all the forms involved in this group can be made.

Material: 54 valves and 2 molts.

Occurrence: Upper Concepcion (49v, 2m), Lower Conception (5v).

Distribution: Upper Miocene to, Recent from the following formations: Canimar (Cuba), Manchioneal, San San (Jamaica), Morne Delmas (Haiti), Cercado. Mao, Arroyo Blanco, Gurabo (Dominican Republic), Rockly Bay (Tobago) Springvale, Talparo, Morne L'Enfer (Trinidad), Cubagua, Cumana, Playa Grande (Venezuela), Rio Banano, Moin (Costa Rica). Recent from Antigua, Venezuela, Miskito Keys (Panama), Pacific coast of Central America and Galapagos.

Family CYTHERURIDAE G.W. Muller, 1894

Subfamily CYTHERURINAE Muller, 1894

Genus *CYTHERURA* Sars, 1866

Cytherura sandbergi Morales

(Pl. 5, Fig. 4)

Cytherura johnsoni Mincher, Swain, 1955, p. 627, Pl. 64, Figs. 8a-c, text-Figs 35b, 38: 8a, b, 39: 1a-c; Puri and Hulings, 1957, p. 174, text-Fig. 11; Puri, 1960, p. 114-115, Pl. 4, Figs. 14, 15; Benda and Puri, 1962, p. 324, Pl. 3, Figs. 25, 26; Benson and Coleman, 1963, p. 31. Pl. 6, Figs. 1-5, text-Figs. 18a, b; Hulings and Puri, 1964, text-Fig. 14; Baker and Hurlings, 1966, p. 114, 116, Pl. 1, Figs. 1a, b; Engel and Swain, 1967, p. 413, Pl. 2, Figs. 21a, b; King and Kornicker, 1970, p. 36, Pl. 7, Figs. 1a, b, Pl. 17, Figs. 1, 2; Keyser, 1975b P. 490, text-Fig. 4

Not *Cytherura johnsoni* Mincher 1941, p. 343, Pl. 47, Figs. 1c-d; Benson and Kaesler, 1963, p. 22, Pl. 3, Figs. 7, 8, text-Fig. 11; Bold, 1963c, p. 395, Pl. 9, Fig. 3; Maddocks, 1974, p. 209, Pl. 3, Figs. 4, 5, 7, 8,

C. sandbergi Morales, 1966, p. 50, Pl. 4, Figs. 6a-d; Krutak, 1971, p. 20, Pl. 2, Figs. 3a, b; Kontrovitz, 1976, p. 63, Pl. 3, Fig. 1; Krutak, 1978, p. 240, Pl. 2, Figs. 10-13; Garbett and Maddocks, 1979, p. 886, Pl. 7, Figs. 7-10; Krutak, 1982, Pl. 3, Figs. 5-8.

C. ex. gr. *johnsoni* Mincher, Teeter, 1975, p.463, Figs.16c,d, 17a,b.

Not *Semicytherura sandbergi* Morales, Ishizaki and Gunther, 1974, p. 21, Pl. 1, Fig. 14, Pl. 5, Figs. 1-5, text-Fig. 9.

Dimensions: L .583; H .308.

Remarks: These specimens are very similar to the ones of Morales, Kontrovitz and Teeter. Besides the typical *C. sandbergi*, dorsally curved form, more elongated specimens occur in the samples. Forms like these have been regarded as the same species by Keyser (1976, Pl. 6, Fig. 7), Swain (1955, Pl. 64, Fig. 8c), and others. In the population studied here they only differ in being more elongated and less dorsally arched, and they are also considered to be conspecific.

This species differs from *C. johnsoni* in having an ornamentation predominantly of longitudinal ridges with weak cross ridges, and from C. fiscina Maddocks, by a higher posterior region and more conspicuous reticulations, and Y-shaped posterior radial pore canals. *C. maya* Teeter, has a more central and larger caudal process and is more reticulate.

Material: 13 valves and 9 molts.

Occurrence: Upper Concepcion (11v, 9m), Lower Concepcion (2v).

Distribution: Puerto Rico, Belize and all around the Gulf of Mexico from Campeche to Florida. Recent.

Genus *EUCYTHERURA* G.W. Muller, 1894

Eucytherura howei nov. sp

(Pl. 5, Figs. 5, 6)

Eucytherura sp 1 Howe and Bold, 1975, Pl. 2, Fig. 7.

E. sp 1 Machain-Castillo, 1986, p. 139.

Diagnosis: A species of *Eucytherura* characterised by a strong posteroventral tubercle, a posterodorsal curved ridge, and a median vertical one that crosses just below and anterior to the center of the carapace; surface covered by subtriangular to irregular meshes.

Description: Carapace small, subquadrate, of nearly equal height throughout, dorsally caudate. Dorsal portion of anterior margin slightly curved, nearly vertical, ventrally with 5-7 spines and a low marginal rim that continues along the ventral margin and dies out below the posteroventral tubercle. Dorsal margin sinuous. Ventral margin gently convex, obscured by the rim and the tubercle. Posterior margin caudate, nearly straight from the ventral margin to the caudal process which is located just below the dorsal margin, above it the posterior margin is subvertically truncate.

The ornamentation consist of subtriangular to irregular meshes that cover the entire surface except for the caudal process; a strong elongate posteroventral tubercle bordered on the ventral side by a strong ridge which is interrupted in the middle and obscures the ventral margin, and three ridges (there are a few other ridges that blend with the reticulation). The first one is a posterodorsal curved ridge, that becomes sinuous and extends foreward until about midlenght. The other two ridges are more or less perpendicular and cross just anterior and ventral to midvalve. The vertical one dies out before reaching the dorsal and ventral margins; the horizontal one in sinuosus, starts near the anterior margin at about one third from the ventral margin, and slightly goes up and backwards until just after midlenght where it changes slope forming a diagonal bend, until about on third from the posterior end; there it curves down until it reaches a small vertical ridge coming from the posteroventral tubercle that more or less parallels the posterior margin, and ends where these two ridges meet. An elongated eyespot is present below the anterior cardinal angle.

Inner lamella wide, both anteriorly and posteriorly. Marginal pore canals few, straight. Hinge in the left valve consists of an anterior rounded socket, a rounded tooth, and a rounded socket. Muscle scars obscured by the ornamentation.

Holotype: Left valve (Pl. 5, Fig. 5, MVH-10871) from sample K4.

Etymology: Named after Dr. H. V. Howe who first discovered this species.

Dimensions: L .333-.341; H .208-.250. Holotype L .327; H .202.

Remarks: These specimens are very similar to Howe and Bold's *Eucytherura* sp 1 but bigger. They are also similar to *E. weingeisti* Puri (1954, p. 246, Pl. 4, Fig. 8), but the last rune only presents a faint, irregular and larger longitudinal ridge, and lacks the perpendicular one; and it has an anterior ridge parallel to the anterior margin. Also the reticulation pattern is different, and the reticulations are more square and non indented.

Material: 8 valves, 3 molts.

Occurrence: Upper Concepcion (2v, 1m), Encanto (6v, 2m).

Distribution: Previously reported from the Mississippi River Mudlumps.

Eucytherura encantoensis nov. sp

(Pl. 5, Figs. 7, 8)

Eucytherura sp 2 Howe and Bold, 1975, Pl. 2, Fig. 8.

E. sp 2 Machain-Castillo, 1986, p. 139.

Diagnosis: A species of *Eucytherura* with strong postroventral knob and a rounded subcentral tubercle.

Description: Carapace subrectangular, with posterodorsal caudal process. Anterior margin obliquely rounded, with a clear, depressed area, wider ventrally, and relatively large marginal denticles. A carina-like rim (better developed ventrally) borders this margin and continues along the ventral one which is gently convex to slightly sinuous, obscured by this structure. Dorsal margin nearly straight to slightly sinuous, obscured by the ornamentation pattern. A low sinuous ridge runs along this margin and forms a curve below the posterior cardinal angle, where it is more prominent. Posterior end forms a short caudal process just below the dorsal margin.

The ornamentation consists of subquadrate to irregular reticulation a rounded subcentral tubercle from which radiating faint ridges occur in some specimens, and an elongate posteroventral boss. Internal characteristics similar to E. sp 1.

Holotype: Left valve (Pl. 5, Fig. 7, HVH-10872) from sample K4.

Etymology: From the Encanto Beds.

Dimensions: Female?: L 341; H .241.

Male?: L .358; H .183.

Holotype: L .365; H .206.

Remarks: These specimens are very similar to *Eucytherura sp* 2 Howe and Bold, but with weaker posteroventral and central tubercles, and with coarser reticulation. This species differs from *E.* sp 1 in the possesion of the subcentral node, the stronger posteroventral one, and the lack of central cross ridges.

Material: 9 valves.

Occurrence: Encanto.

Distribution: Mississippi River Mudlumps.

Genus *CYTHEROPTERON* Sars, 1866

Cytheropteron hamatum Sars, sensu Kontrovitz, 1976

(Pl. 5, Figs. 9-11)

Cytheropteron sp aff. *C. alatum* Sars, Malkin, 1960, p. 478, Pl. 1, Fig. 13 (not C. alatum Sars, 1866, p. 82).

? C. sp 2 Howe and Bold, 1975, Pl. 1, Fig. 17.

C. hamatum Sars, Kontrovitz, 1976, p. 64, Pl. 3, Fig. 8 (not *C. hamatum* Sars, 1928, p. 266, Pl. 104, Fig. 2).

C. sp aff. *C. hamatum* Sars, Machain-Castillo, 1986, p. 139.

Dimensions: L .425-.475; H .233-.291; W .100-.125.

Remarks: The specimens studied here were compared to Kontrovitz types and found to be conspecific. Sars' specimens were not available, but his Fig. 2 (Pl. 104, 1927), shows a pointed ala with a terminal spine and a smooth posterior; and from his description the ala and the ornamentation are different from the ones of Kontrovitz' species.

The specimens found in the Saline Basin present a gradation in the shape and size of the ala, from specimens with a pointed ala with a posterior well developed spine, to a more posteriorly extended, and curved one without posterior spines as in *C. assimiloides* Swain (1967). Since no objetive separation can be made within this continuum, all of this forms are considered here as the same species until more information is know about the development of this structure.

C. assimiloides Swain (1967, Pl. 9, Fig. 8c) is larger, higher, and has a wider, stronger ala without a posterior

spine, It has more strongly arched dorsum (which is found in some of the specimens here, but most of them have a much less curved dorsal margin).

Material: 9 valves and 18 molts.

Occurrence: Upper Concepcion ($v, 7m), Lower Concepcion (2v, 7m), Encanto (3v, 4m).

Distribution: Louisiana Continental Shelf and Mississippi River Mudlumps.

Cytheropteron ? yorktownensis (Malkin)

Eocytheropteron ? sp Swain, 1951, p. 47, Pl. 7, Fig. 16.

E. yorktownensis Malkin, 1953, p. 780, Pl. 79, Figs. 1-4.

Cytheropteron leonensis Puri, 1954, p.242, Pl. 4, Figs. 11,12, text-Figs. 6c, d; Bold, 1978b, Table 1.

? C. sp cf. *leonensis* Puri, Malkin, 1960, p. 478, Pl. 1, Fig. 12.

C. yorktownensis (Malkin) Hall, 1965, p. 47, Pl. 15, Figs. 1-4, 9, 10; Swain, 1968, p. 13, Pl. 4, Figs. 7a-c, text-Fig. 11.

Shattuckocythere yorktownensis (Malkin) Swain, 1974, p. 22, Pl. 3, Figs. 9-12, 14, 15; not Ol. 3, Fig. 13, Pl. 9, Figs. 9a-b.

C. yorktownensis (Malkin) Hazel, 1977, Fig. 6g; Forester, 1980, p. 9, Pl. 2, Fig. 7; Hazel, 1983, Pl. 9, Fig. 3.

C. sp aff. *C. leonensis* Puri, Bold, 1978b, Table 2 (not 9).

Dimensions: L .365; H .225.

Remarks: The specimens found here are less elongated than Forester's Hazel's specimens (1977, 1983), although less anteroventrally extended.

These specimens are smaller and with the greatest height more medially than Puri's (1954).

Material: 5 valves.

Occurrence: Upper Concepcion.

Distribution: Previously reported in the following formations: Yorktown, Duplin, Waccamaw, Tamiami, Choctawhatchee Stage and the Lower Pleistocene of the US Atlantic Coastal Plain. Pliocene to Early Pleistocene.

Subfamily PARACYTHERIDEINAE Puri, 1957

Genus *PARACYTHERIDEA* G.W. Muller, 1984

Paracytheridea tschoppi Bold

(Pl. 5, Fig. 12)

P. tschoppi Bold, 1946, p. 85, Pl. 16, Figs. 6, 7; 1957, p 245, Pl. 4, Fig. 7; Keij, 1954, p. 220, Pl. 4, Fig. 4; Bold, 1958b, Table 1; Benson and Coleman, 1963, p. 33, 34, Pl. 6, Figs. 7, 9, 10, text-Figs. 20a, b; Bold, 1967a, Table 1; 1967c, Table 1; 1968b, p. 76, Pl. 4, Figs. 8a-d; 1970, Tables 3, 4; 1971a, Table 2; 1971b. Tables 2-5; Allison and Holden, 1971, p. 191, Figs. 17, 18, 19a-g; Bold, 1972a, p. 434; 1973b, Table 1; Ishizaki and Gunther, 1974, p. 35, Pl. 1, Fig. 10, Pl. 4, Fig. 10, Pl. 8, Figs. 3-9; Maddocks, 1974, p. 211, Pl. 4, Figs. 1-6, 9, 12, 13, 18, 19; Teeter, 1975, p. 471, Figs. 17o, 18a; Bold, 1975c, p. 150, Pl. 16, Figs. 3, 4; 1978b, Table 9; 1981, p. 22, Table 15; Breman, 1982, Pl. 2, Fig. H; Palacios-Fest et al., 1983, Table 1; Machain-Castillo, 1986, p. 139.

P. sp cf. *P. tschoppi* Sold, Krutak, 1992, p.274, Pl. 5, Figs. 10-14.

P. sp aff. *P. tschoppi* Bold, Lubimova and Sanchez, 1974, Pl. 17, Figs. 4, 4a.

P. vanwesseni Bold, 1946, p. 86, Pl. 16, Figs. 3a, b.

P. chipolensis Howe and Stephenson, Puri, 1954, p. 235 (part), Pl. 3, Fig. 13. *P*. sp 1 Drooger and Kaaschieter, 1958, p. 91.

Dimensions: L .583-.665; H .275-.308.

Remarks: The specimens found here are very similar to the ones from Cuba (Bold, 1975) and the Dominican Republic (Bold, 1968b). They differ from *P. toleri* Howe and Law (1936, p. 35, Pl. 2, Figs. 23, 24, Pl.3, Fig.13) in having a more straight dorsal and ventral margins, a longer caudal process, and a more complicated posterodorsal swelling.

Material: 14 valves and 9 molts.

Occurrence: Upper Concepcion (6v, 7m), Encanto (8v, 2m).

Distribution: Widely distributed from the Miocene to Recent of the Caribbean in the following formations: Cojimar, Canimar, Jucaro, La Cruz, Santiago (Cuba), Buff Bay, Bowden, Manchioneal (Jamaica), "Thomonde" "Las Cohobas" (Haiti), Arroyo Blanco, Cercado, Gurabo, Mao (Dominican Republic), Kingshill (St. Croix), Chorrera (Colombia), Cipero, Lengua (Trinidad), La Boca, Gatun (Panama), Rio Banano, Main and, Pueblo Nuevo Beds (Costa Rica). Recent from the Gulf of Mexico, western Atlantic, and Pacific Ocean.

Paracytheridea sp *A* Bold

(Pl. 5, Fig. 13)

Paracytheridea sp Bold, 1968b, p. 76, Pl. 4, Figs. 7a, b.

Paracytheridea sp A Bold, 1988, Pl. 11 Fig. 3; Machain-Castillo, 1986, p. 139.

Dimensions: L .591-.675; H .308-.358.

Remarks: These specimens are very similar to the types of *P. sp* Bold (HVH-8350, 8352), but with less well developed tubercles, and a more sinuous ala. They are also similar to *P. sp* Bold (1975c, p. 151, Pl. 16, Fig. 6, HVH-9150), but Bold's species is less subquadrate, has a concave dorsal margin, a larger caudal process, stronger reticulation and a different ala. They differ from *P. tschoppi* in breing more subquadrate, less caudate, with less developed tubercles and depressions and in the different shape of the ala.

Material: 5 valves and 22 molts

Occurrence: Upper Concepcion.

Distribution Gurabo Formation (Upper Miocene-Pliocene) of the Dominican Republic.

Family PARADOXOSTOMATIDAE Brady and Norman, 1889

Subfamily CYTHEROMATINAE Elofson, 1939

Genus *MEGACYTHERE* Puri, 1960

Megacythere repexa Garbett and Maddocks

(Pl. 5, Fig. 14)

Microcythere johnsoni Mincher, Swain, 1955, p. 641, Pl. 63, Fig. 2a-c, Pl. 64, Fig. 7, text-Fig. 39-3; Malkin, 1960, p. 478, Pl. 3, (upper), Fig. 13.

Not *M. johnsoni* Mincher 1941, p. 344, Pl. 47, Fig. 4.

Megacythere johnsoni (Mincher) Puri, 1960, p. 122; Hulings and Puri, 1964, text-Fig. 16; Morales, 1966, p. 73, Pl. 7, Figs. 3a, b; Engel and Swain, 1967, p. 413, Pl. 2, Fig. 3; King and Korniker, 1970, p. 46, Pl. 9, Figs. 3a, b, Pl. 21, Figs. 1-4; Krutak, 1971, Pl. 3, Figs. 2a-g; Dickau and Puri, 1976, p. 100, Pl. 5, Figs. 1, 2, Pl. 6, Figs. 3, 4.

Megacythere repexa Garbett and Maddocks, 1979, p. 873, Pl. 2, Fig. 12, Pl. 3, Figs. 9-12; Machain-Castillo, 1986, p. 139.

Not *M. johnsoni* (Mincher) Benson and Kaesler, 1963, p. 28, Teeter, 1975, p. 484, text-Figs. 20g, 21 1.

Not *Paracytheroma johnsoni* (Mincher) Bold, 1963c, p. 412, Pl. 10, Fig. 10, Pl. 11, Figs. 7a, b.

Dimensions: L .608-.683; H .300-.350.

Remarks: The specimens found here are very similar to Garbett and Maddocks specimens from Aransas Bay (HVH-100083) and to Krutak's ones from Laguna Mandinga, Veracruz (HVH-9057), but bigger and more robust.

Microcythere johnsoni Mincher is more ovoid, with the dorsal margin slightly convex, more inflated centrally, with thinner ridges, and wider posterior and anterior smoth areas. M robusta Puri (1960, p. 122, Pl. 2, Figs. 14, 15, text-Figs. 10, 11) has a more convex dorsal margin, sinuous venter and a pointed posterior, and a slightly different ridge pattern. Teeter's *M. johnsoni* Mincher is more ovoid, pointed posteriorly, less oblique anterodorsally, and with thinner ribs arranged in a slightly different pattern.

Material: 13 valves and 4 molts.

Occurrence: Upper Concepcion (10v, 3m), Lower Concepcion (3v, 1m).

Distribution: Recent from the Gulf of Mexico.

Genus *PELLUCISTOMA* Coryell and Fields, 1937

Pellucistoma magniventra Edwards

(Pl. 5, Fig. 15)

Pellucistoma magniventra Edwards, 1944, p. 528, Pl. 88, Figs. 33-35; Puri, 1954, p. 289, Pl. 15, Fig. 4, text-Figs. 4, 12a; Puri and Hulings, 1957, p. 187, Fig. 11:6; Puri, 1960, p. 119, Pl. 2, Figs. 10, 11, text-Figs. 8, 9; Benson and Coleman, 1963, p. 41, Pl. 6, Fig. 11, text-Figs. 26a-c; Bold, 1963c, p. 404, Pl. 10, Fig. 6, Table 7; 1964, Table 2 (part); Hall, 1965, p. 52, Pl. 17, Figs. 9-15; Morales, 1966, p. 77, Pl. 7, Figs. 4a-d; Bold, 1966c, p. 14, Tables 1, 2; Grossman, 1967, p. 75, Pl. 14, Fig. 5, Pl. 20, Figs. 1, 3; Rodriguez, 1959, p. 183, Pl. 2, Figs. 7, 8, text-Fig. 10; Bold, 1970a, Table 1; Valentine, 1971, Pl. 2, Fig. 39; Bold, 1972a, Tables 2 (part), 3 (part); 1973c, p. 335; 1975a, Table 12; 1975c, Table 3; Kontrovitz, 1976, p. 78, Pl. 6, Fig. 5; Bold, 1978b, Table 2, 9; Garbett and Maddocks, 1979, p. 864, Pl. 2, Figs. 1-6, text-Fig. 30; Cronin, 1980, p. 149, Pl. 19, Figs. 7, 9, 10; Krutak, 1982, p. 282, Pl. 6, Figs. 13; Cronin, 1986, Pl. 2, Fig. 1; Machain-Castillo, 1986, p. 139.

Paradoxtoma sp cf. *P. obliquum* Sars, Keij, 1954, p. 229, Pl. 5, Fig. 17, Pl. 6, Fig. 14.

Pellucistoma sp Bold, 1966e, Pl. 3, Fig. 10; 1969, Table 1. *Paradoxostoma sp* 1 Drooger and Kasschieter, 1958, p. 91.

Pellucistoma howei Coryell and Fields, Teeter, 1975, p. 483, Fig. 21q, 22i.

Dimensions: L .525; H .283.

Remarks: *P. howei* Coryell and Fields is similar to this species, but less elongated, has a more pointed caudal process, a straight dorsal margin, and a different vestibulum and arrangement of radial pore canals.

Material: 4 valves and 2 molts.

Occurrence: Upper Concepcion.

Distribution: Widely distributed in the Miocene to Recent of the Caribbean, in the following formations: Jucaro, La Cruz (Cuba), Las Cahobas, Morne Delmas (Haiti), Gurabo (Dominican Republic), Ponce (Puerto Rico), Springvale, Talparo, Manzanilla, Morne L'Enfer (Trinidad), Capadare, Cuajaro, Cubagua, Cueparo, Cumana, El Veral, Playa Grande, Punta Gavilan (Venezuela), Chorrera, Tubara (Colombia), Rio Banano, Moin (Costa Rica). Recent from the Gulf of Mexico and Western Atlantic.

Family XESTOLEBERIDIDAE Sars, 1928

Genus *XESTOLEBERIS* Sars, 1866

Xestoleberis sp 1

(Pl. 5, Figs. 16, 17)

Xestoleberis sp 2 Bold, 1967a, p. 81, Pl. 1, Fig. 15.

Xestoleberis sp Bold, 1967b, p. 316, Pl. 2, Figs. 6-9.

Xestoleberis sp 1 Machain-Castillo, 1986. p. 139.

Dimensions: Females: L .416-.450; H .283-.308.

Males: L .391-.441; H .250-.275.

Remarks: The specimens described here are very similar to those of the Gatun Formation of Costa Rica (HVH-8228) and Panama (HVH-8232), and they are all considered to be the same species.

Material: 31 valves and 2 molts.

Occurrence: Upper Concepcion (23v, 2m), Lower Concepcion (8v).

Distribution: Gatun Formation of Costa Rica and Panama. Miocene-Pliocene.

Xestoleberis sp 2

(Pl. 5, Fig. 18)

Xestoleberis sp 2 Machain-Castillo, 1986, p. 139.

Dimensions: L .466-.541; H .308-333.

Material: 7 valves.

Occurrence: Encanto.

SPECIES	UPPER CONCEPCION												SAMPLES		LOWER CONCEPCION					SAMPLES			ENCANTO				
	1030	1031	14	K29	K22	13	15	K21	18	K63	K64	I66	K39	K40	56	57	59	I43	K49	1075	71	72	K52	K4	19	60	78
Actinocythereis sp. cf. A. gomillionensis	14			2		1			1	4										2							
Actinocythereis sp. cf. A. vineyardensis				2	12	2			1		2		6							3							
Ambocythere caudata																		2							8		
Ambocythere sp. cf. A. sp.A																									3		
Argilloecia posterotruncata								2	2			4		1				2			1	5		6	1	7	2
Aurila sp. aff. A. laevicula			1			1	1	6							1		1										
Bairdoppilata sp. aff. B. victrix			1																					4			
Basslerites minutus	5		8		2	3	4	12		15	8	48	16	22	9	3		6	2		5	2					
Basslerites sp.			2	1	2	2	1																				
Bradleya normani																											14
Buntonia boldi									1	14	6	2	8	2					2			2		6			
Cativella navis			6	4	4		2			6	8	2			16	1	1										
Caudites nipeensis					2		1				4											1		2			
Caudites rectangularis				2	6	1		10			2		2			1											
Cyprideis salebrosa				1									4		1		1										
Cyprideis sp. cf. C. mexicana							1	6																			
Cytherella sp. aff. C. hannai									1		2	48	14							2	4	11		42	5		3
Cytherella sp. aff. C. hannai var.																					2			8			
Cytherella sp.									6		2	38	8								4	7		12			
Cytherelloidea leonensis			1	1	2						2				1												
Cytheromorpha warneri										4					4												
Cytheropteron morgani																1				1							
Cytheropteron hamatum									1	10	4		6		5	1	1		2				4	4	1		
Cytheropteron? yorktownensis	4									2																	
Cytherura sandbergi			3	6	6		5	10		4		2			1	1											
Echinocythereis madremaestrae	10	8					7	2	1	8	18	36	6	8	1			12	32		10	4	2	62	2	1	1
Echinocythereis margaritifera	77	8									4		4											21			
Eucythere sp. aff. E. triangulata										2																	
Eucytherura encantoensis																								19			
Eucytherura howei										2														16			
Haplocytheridea molts		1	14	34	12	1	5	14		2	4				7	6	2										
Hemicytherid molts			1							6																	
Henryhowella ex. gr. asperrima								2	1			24	32	40		1		24	40	5	18	12					
Hulingsina glosi		2	1	2		1	1			4		2	2														
Hulingsina semicircularis	16	55						7								3	2										
Hulingsina sp. 1			19	58	16	20	28	22	2			28	72		3	8	3		2	2							
Krithe trinidadensis									3		34										8	7		10	24	2	
Loxoconcha hazeli			15		1	2	2	4		4	8	22	2	2	2				4								
Loxoconcha matagordensis		2		6				2							1												
Loxoconcha sp. aff. L. belemae											10	8			4									1			
Loxocorniculum tricornatum										2	2																
Malzella bellestadensis	4	10	1	2			2			12	18	8												12	1		
Megacythere repexa				6	4	3		4			2	2	2		1	1								4			
Munseyella bermudezi louisianensis										4														6			
Nutilus?																								10			
Neocaudites scottae	108	32	3	10	6	3	3	6	1	2	2	2			1	1	?										
Orionina vaughani			2	7	2			4				1	10											18			
Paracytheridea tschoppi	1	3	1	16	4	1		14			4	8															
Paracytheridea sp.																		2			2	1	18	6	2		
Parakrithe alta																		2		1			4	4		2	
Parakrithe sp.	2		3			1																					
Pellucistoma magniventra			11	24	6		5					17	4		3	3	1										
Perissocytheridea bicelliformis			2	28	8	3	2					6	8			1	1										
Perissocytheridea subrugosa			3	16	6		1	1				7			1			3									
Protocytheretta sp. cf. P. mosterusa	16	3				1				2						1											
Protocytheretta puricosa		4			4					2	4	8		2					4		1	1	2	2			
Pseudopsammocythere ex. gr. vicksburgensis	5	3					2	6				8			1												
Pterygocythereis alophia	2	1	2								2									2							
Pterygocythereis inexpectata	2	1								4					5												
Pterygocythereis sp. 1			1	38	8	1	3	10	1	8	2		14		5	7	4			2							1
Puriana carolinensis	102	16	2	14	10	5	5	18	1				14		2	16	58										
Puriana gatunensis			3	14		1	5	14		8	12		11		1		2										
Puriana molts			1					4			6	8			6			?				2		26			
Quadracythere compacta										6														26			
Radimella confragosa		7	4	14	14	2	13	8		6	4		1		5												
Tauroconcha lepidiscola			1				2			8	12	12	4	6	8								10	4			
Xestoleberis sp. 1																											
Xestoleberis sp. 2																											

TABLE 1. DISTRIBUTION OF OSTRACODE SPECIES IN NUMBER OF ORGANISMS PER 300g. OF SEDIMENT

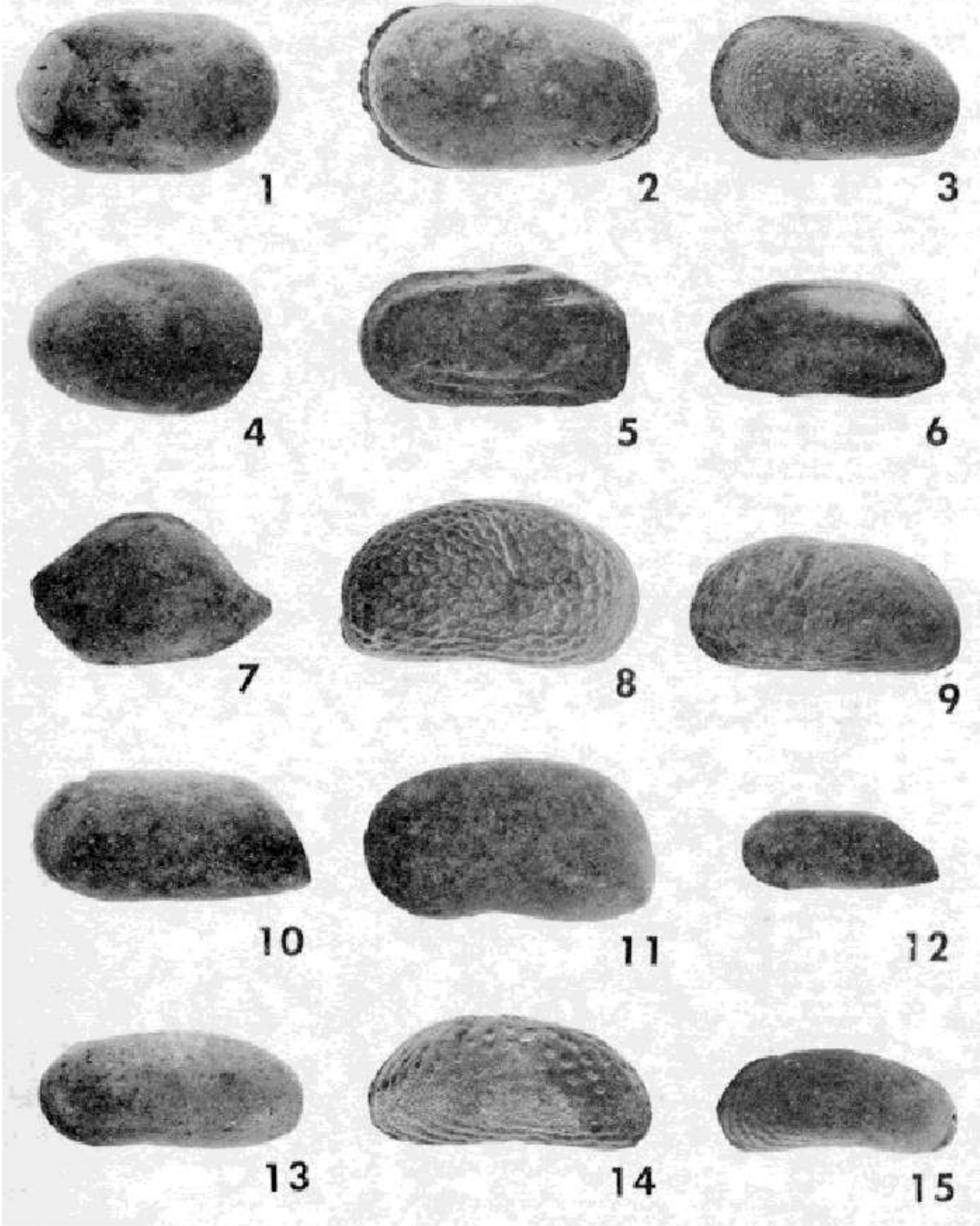
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PLATE 1

1. *Cytherella* sp aff. *C. hannai.* RV, sample K4, HVJ 10817, 42.2x. 2. *C*. sp. aff. *C. hannai* LV, sample K4, HVH 10817, 42.2x. 3. *C*. sp aff. *C. hannai* var. LV, sample K4, HVH 10818, 43.5x. 4. *C*. sp RV, sample M56, HVH 10819, 39x. 5. *Cytherelloidea leonensis* LV, sample K29, HVH 10820, 60x. 6. *Argilloecia posterotruncata.* Complete carapace, sample M60, HVH 10821, 60.8x. 7. *Bairdoppilata* sp aff. *B. victrix.* LV, sample K4, HVH 10822, 32. 6x. 8. *Cyprideis salebrosa* RV, sample K56, HVH 10823, 45.4x. *Cyprideis* sp. cf. *C. mexicana* LV, sample K21, HVH 10824, 42.2x. 10. *Krithe trinidadensis* LV, sample K60, HVH 10824, 42.2x. 11. *Parakrithe alta* LV, sample K52, HVH 10826, 64x. 12. *Parakrithe* sp LV, sample K4, HVH 10827, 42.2x. 13. *Pseudopsammocythere* ex. gr. *vicksburgensis* LV, sample K64, HVH 10828, 53.8x. 14. *Hulingsina semicircularis* LV, sample M57, HVH 10829, 39.7x. 15. *Hulingsina gioi* LV, sample K63, HVH 10830, 48x.

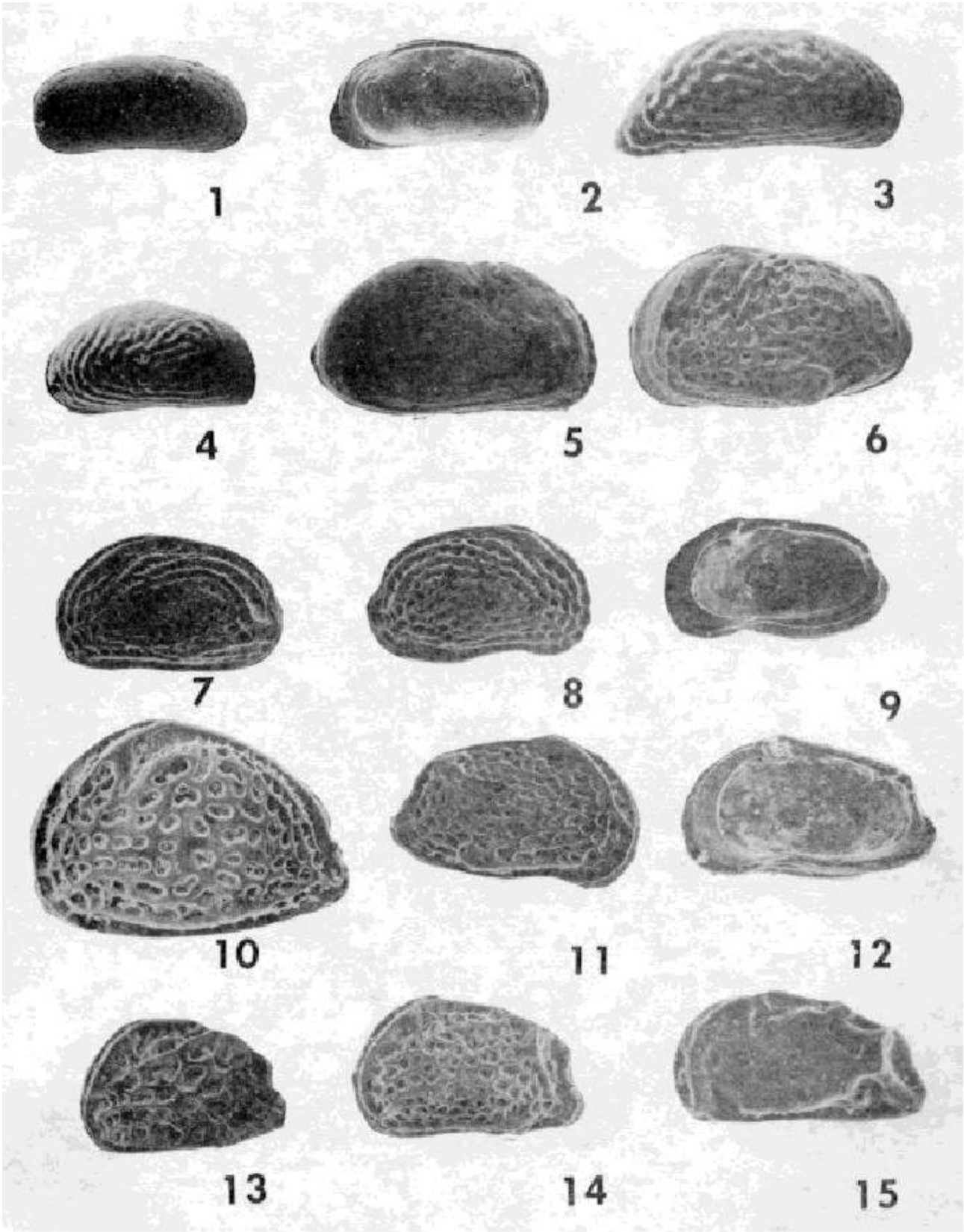
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PLATE 2

1. *Hulingsina gioi* RV, sample SD13, HVH 10831, 42.2x. 2. *Hulingsina gioi* RV, sample SD15, 48x. 3. *Hulingsina* sp 1 RV, sample 5D13, HVH 10832, 39x. 4. *Hulingsina* sp 1 (molt) LV, sample SD14, 39x. 5. *Perissocytheridea bicelliforma* RV, sample K29, HVH 10833, 59.5x. 6. *Perissocytheridea subrugosa* LV, sample K29, HVH 10834, 76.8x. 7. *Aurila* sp aff. *A. laevicula* LV, sample SD13, HVH 10835, 52.5x. 8. *A*. sp aff. *A. laevicula* RV, sample K21, HVH 10835, 53.8x. 9 *A*. sp aff. *A. laevicula* RV, sample SD15, 53.1x. 10. *Malzella bellegladensis* LV, sample K4, HVH 10836, 63.4x. 11. *Mutilus? sp* RV sample K4, HVH 10837, 49.3x. 12. *Mutilus? sp* RV sample K4, 49.9x. 13. *Radimella confragosa* LV, sample K4, HVH 10838, 42.9x. 14. *Quadracythere compacta* LV, sample K64, HVH 10839, 53.8x. 15. *Caudites nipeensis* LV, sample SD15, HVH 10840, 73.6x.

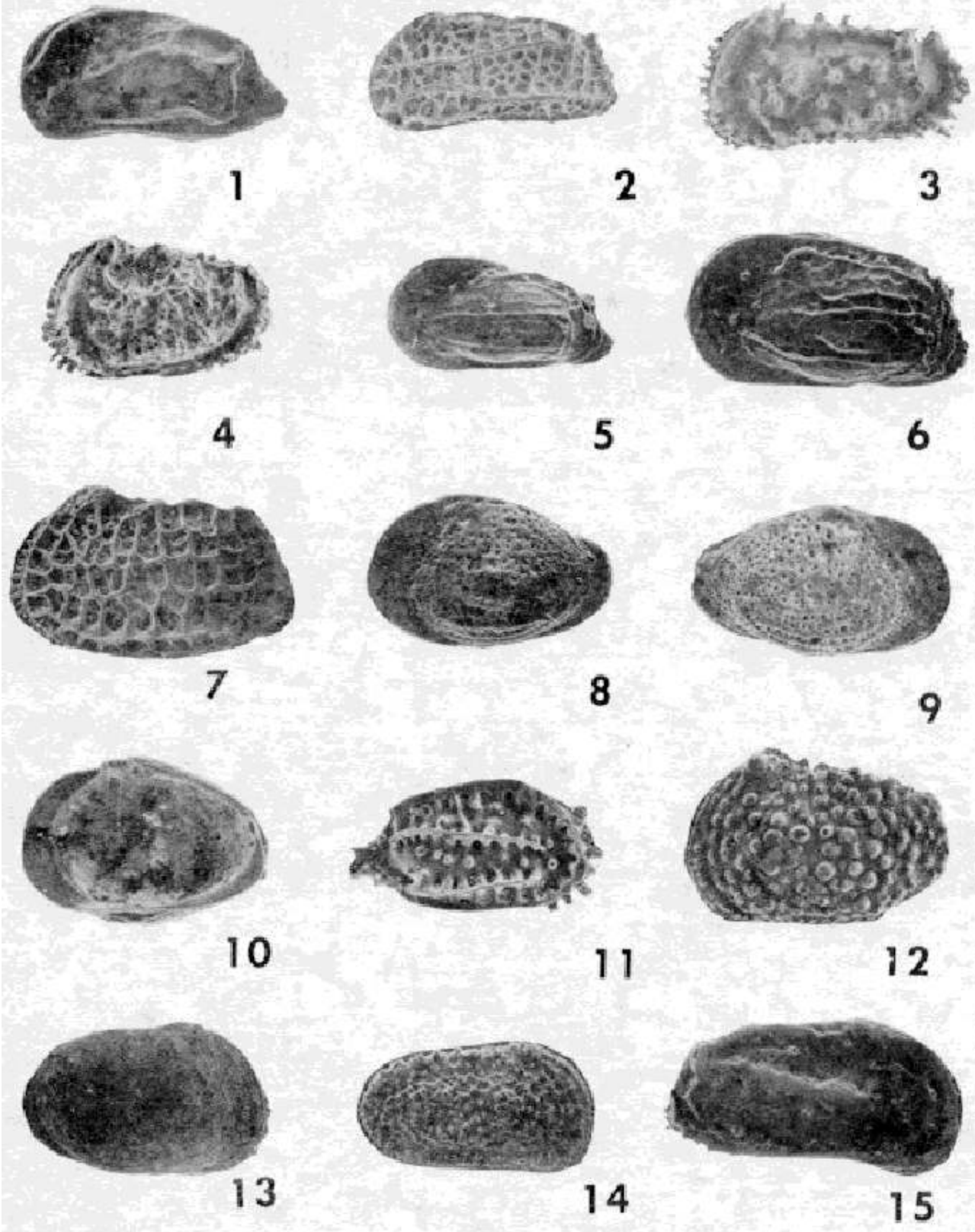
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PLATE 3

1. *Caudites rectangularis* LV, sample K21, HVH 10841, 59.5x. 2. *Orionina vaughani* LV, sample TU 1030, HVH 10842, 46.1x. *3. Actinocythereis* sp cf. *A. gomillionensis* LV, sample TU 1030, HVH 10843, 41 *6x. Actinocythereis* sp cf. *A. vineyardensis* LV, sample K22, HVH 10844. 5. *Ambocythere caudata* LV, sample M58, HVH 10845, 42.2x. 6. *Ambocythere* sp cf. *A*. sp A. Cronin LV, sample PD19, HVH 10846, 59.5x. 7. *Bradleya normani* LV, sample M78, 4VH 10847, 39.7x. 8. *Buntonia boldi* LV, sample K63, HVH 10848, 60.8x. 9. *Buntonia boldi* RV, sample K39, 60.8x. 10. *Buntonia boldi* RV, sample K63, HVH 10849, 66.5x. 11. *Cativella navis* RV, sample M56, HVH 10850, 53.8x. 12. *Echinocythereis margaritifera* LV, sample TU 1030, HVH 10851, 39x. 13. *Echinocythereis sp* RV, sample K4, HVH 10852, 29.4x. 14. *Henryhowella* ex. gr. *asperrima* RV, sample PD18, HVH 10853, 42.2x. 15. *Neocaudites scottae* RV, sample K4, HVH 10854, 42.2x.

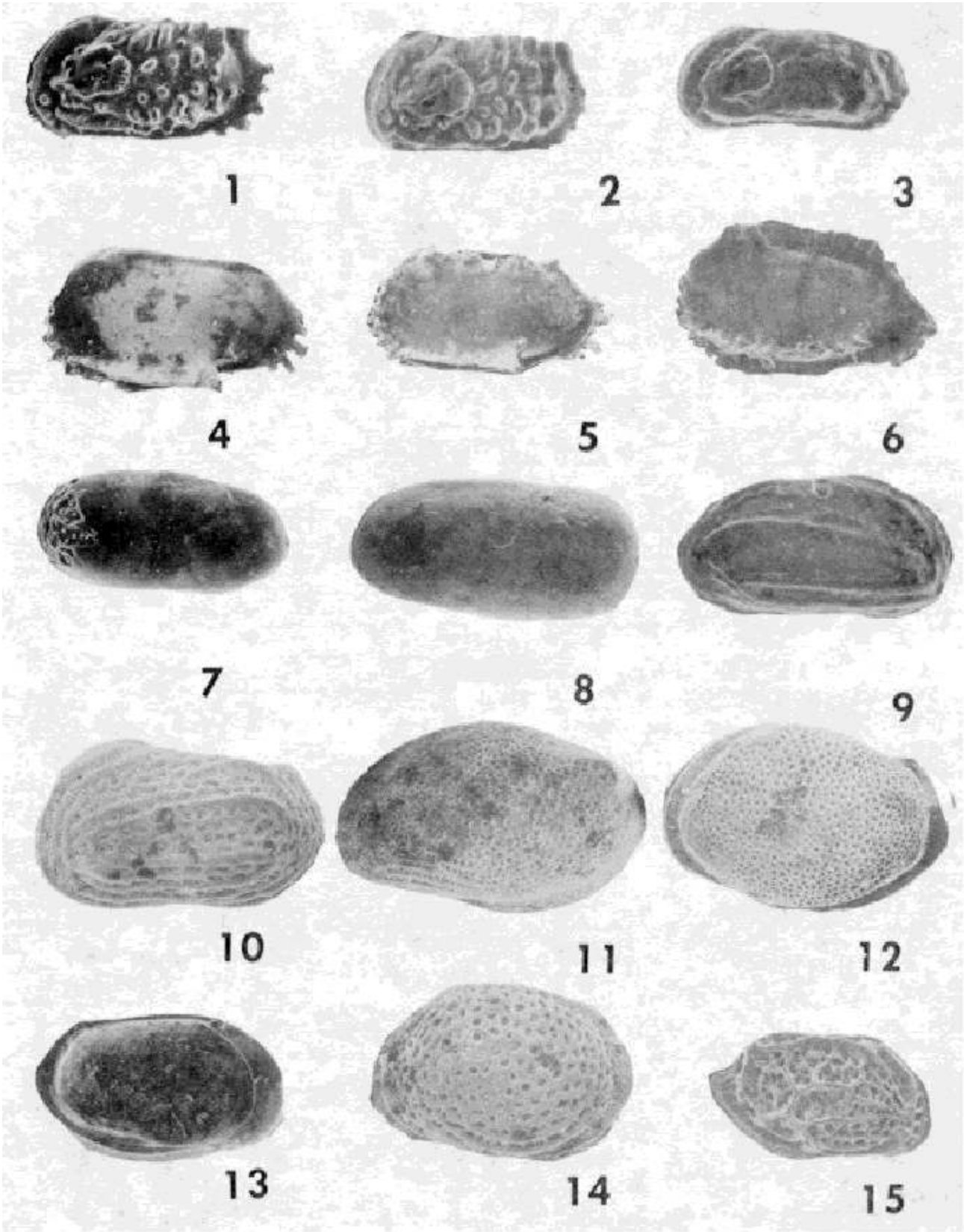
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PLATE 4

1. *Puriana gatunensis* LV, sample SD14, HVH 10855, 50x. 2. *Puriana gatunensis* LV. sample M56. 3. *Puriana carolinensis* LV, sample K29, HVH 10857, 48.6x. 4. *Pterygocythereis alophia* LV, sample TU 1030, HVH 10859, 42.2x. 5. *Pterygocythereis* sp 1 LV, sample K66, HVH 10861, 39x. 6. *Pterygocythereis inexpectata* LV, sample SD14, HVH 10860, 34.6x. 7. *Basslerites minutus* RV, sample K66, HVH 10862, 65.3x. 8. *Basslerites* sp LV, sample TV 1030, HVH 10865, 60.8x. 9. *Procytheretta sp* cf. P. *montezuma* RV, sample K43, HVH 10864, 44.2x. 10. *Protocytheretta pumicosa* LV, sample TU 1030, HVH 10865, 41.6x. 11. *Loxoconcha matagordensis* LV, sample K29, HVH 10867, 61.4x. 12. *Loxoconcha hazeli* LV, sample SD14, HVH 10866, 63.4x. 13. *Loxoconcha hazeli* LV, sample K64, 53.8x. 14. *Loxoconcha* sp aff. *L. helenae* LV, sample K64, HVH 10868, 56.9x. 15. *Touroconcha lapidiscola,* Female RV, sample M56, HVH 10869, 62.1x.

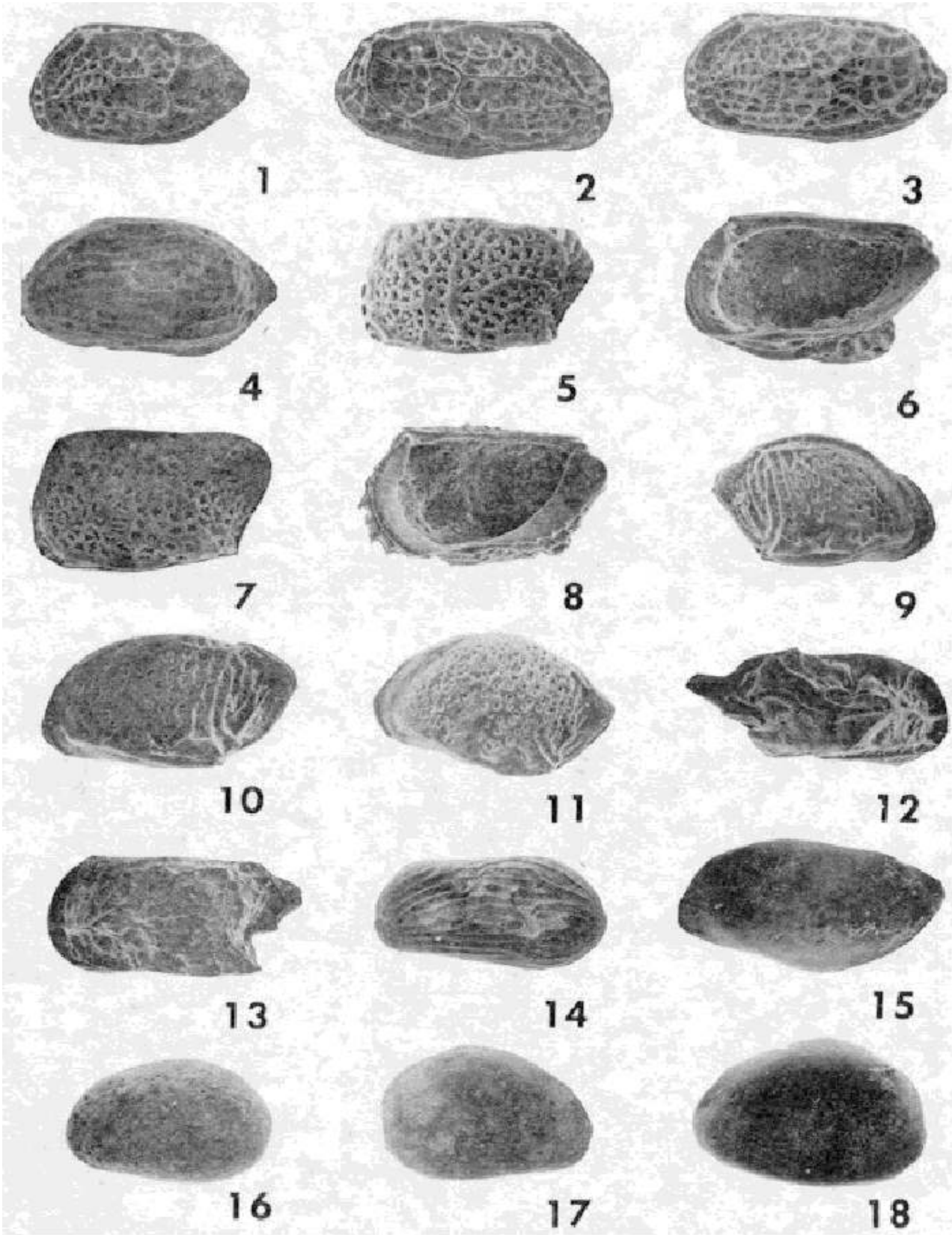
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PLATE 5

1.Touroconcha lapidiscola, Female LV, sample SD14, HVH 10869, 60.2x. 2. *Touroconcha lapidiscola,* Male RV, sample SD14, HVH 10869, 60.8x. 3. *Touroconcha lapidiscola,* Male LV, sample SD15, HVH 10869, 60.2. 4. *Cytherura sandbergi* LV, sample K29, HVH 10870, 62.1x. 5. *Eucytherura howei* RV, sample K4, HVH 10871, 85.8x. 6. *Eucytherura howei* RV, sample K66, 82x. 7. *Eucytherura encantoensis* LV, sample K4, HVH 10872, 77 4x 8. *Eucytherura encantoensis* RV, sample K4, 82x. 9. *Cytheropteron hamatum* RV, sample M56, HVH 10873, 69.1x. 10. *Cytheropteron hamatum* LV, sample SD14, 76.6x. 11. *Cytheropteron hamatum* LV, sample M56, 60.8x. 12. *Paracytheridea tschoppi* RV, sample K66, HVH 10874, 53.8x. 13. *Paracytheridea sp* LV, sample K4, HVH 10874, 41.0x. 14. *Megacythere repexa* LV, sample K21, HVH 10876, 41.6x. 15. *Pellucistoma magniventra* LV, sample SD14, HVH 10877, 62.7x. 16. *Xestoleberis* sp 1 LV, sample K64, HVH 10878, 62.7x. 17. *Xestoleberis* sp 1 RV, sample M56, 57.6x. 18. *Xestoleberis* sp 2 RV, sample K52, HVH 10879, 62.7x.