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A PLEISTOCENE OSTRACODE FAUNA FROM SOUTH FLORIDA

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I. ABSTRACT

A Pleistocene ostracode fauna with 41 species was recovered from carbonate sediments that occur in Palm Beach County, Florida. The fauna is described and three new species are named; these are *"Aurila" bellegladensis, Megacythere edwardsi* and *Hemicytherura vokesae*. Ostracode occurrence data and petrological evidence indicate that the sediments were deposited under fully marine conditions at a water depth of from 0 to 23 meters and in a tropical or subtropical climate regime.

II. INTRODUCTION

Ostracode remains were recovered from Pleistocene sediments located near the town of Belle Glade in Palm Beach County, Florida. Five samples were examined, three of which were collected at Tulane University Locality 201 (TU 201) and one each from localities TU 580 and TU 733 (see Section VIII for description). Four of the five samples were washed before they were received by the author. The unwashed sample (from TU 201) was analysed for grain size distribution and composition.

Two of the samples (TU 580 and TU 733) contained only juvenile valves, fragments of large species and complete valves and carapaces of small species (less than .55 mm in length). Inasmuch as all washed samples were prepared in the same manner, the samples containing only small specimens and fragments are interpreted as representing the results of differential transportation of the original material.

III. SEDIMENT ANALYSIS

The sample (from TU 201) used for lithologic analysis (379.2 grams) was a very light gray shell marl. More than 90% of the sediment grains were in the size range of 0.074 to 20.0 mm, that is, fine sand and larger. Those grains larger than 0.420 mm were whole or broken fossils.

The total carbonate fraction, 86.2% by weight, was composed chiefly of bivalves, gastropods, echinoid spines, bryozoa and coral fragments. The other material was insoluble residue composed of quartz (90%) and minor quantities of clay minerals, organic matter and a few dark mineral grains. The quartz grains were mostly angular or subangular with a few being subrounded or rounded.

Using Folk's classification (1962) for such materials, the sediment is categorized as a lime mud with fossils; it is the Type II carbonate composed of allochems and micrite. Conditions of short-lived currents or a rapid rate of formation of the microcrystalline ooze are thus indicated. The sediments may be placed in the Type II class of Plumley *et al.* (1962), which represents deposition in waters that were alternately quiet and agitated.

IV. AGE OF THE SEDIMENT

The stratigraphy of the region has been reviewed by Olsson *(in* Olsson and Petit, 1964), who concluded that the "Caloosahatchee Formation" of earlier workers was comprised of several units that should be described separately. The uppermost of the units was designated by Olsson to be "Unit A" (*ibid,* p. 521) and is the source of the material used in the present study. Olsson indicated that "the unit is referred to the late Pliocene, but an early Pleistocene age is also possible" (*ibid,* p. 525).

Emily H. Vokes (1973, personal communication) stated that "Unit A" is of Pleistocene age; this conclusion is based upon her studies of the molluscan faunas and their relationships to the Moín Formation of Costa Rica. Akers (1972) also indicated that the Moín Formation is of Pleistocene age. DuBar (1974) suggested that "Unit A" of Olsson was of a "medial Pleistocene age" and he informally proposed the name "Bermont Formation" for the unit.

Qualitative and quantitative comparisons (Cheetham and Hazel, 1969) to other nearby Pleistocene ostracode faunas are of little use in the determination of the exact age of the "Bermont Formation." That is, there are so few similarities at the species level that the results are inconclusive in an attempt to delineate which portion of the Pleistocene record is represented (see Hall, 1965; Hazel, 1968; Valentine, 1971).

V. PALEOENVIRONMENT

A summary of environmental conditions of modern representatives of fossil species is given in the systematics portion of this paper. It is not possible to compare the fauna directly with assemblages from nearby modern localities because there are few species in common with any single living assemblage (Puri, 1960; Benson and Coleman, 1963; Keyser, 1975). The closest relationships exist between this fauna and those from the Florida Keys-Florida Bay area. For example, 10 of the 14 species reported by Puri (1960) from the Keys are present in the "Bermont" material, but only 15 of Puri's 40 species from Alligator Point were recovered. This may indicate that differences in sediment characteristics are strongly reflected in the composition of faunal assemblages.

Based upon the modern occurrences of the ostracode species of the Belle Glade area the salinity range at the time of deposition ranged from 25 to 40 o/oo. About one-half of the species that occur in modern sediment (15 of 29) are normally found under such

conditions, while most of the other forms have been reported only from marine waters.

The species restricted to fresh or brackish waters comprise less than 5% of the total valve count. *Limnocythere* sp. and *Physocypria pustulosa* were probably transported from areas with relatively lower salinity to an area that was polyhaline or ultrahaline (Ager, 1963) or those specimens represent contamination from the overlying fresh water sediments (McGinty, 1970). *Paracytheridea vandenboldi* has been reported from only brackish water but its modern occurrence has been noted in only one study (Swain, 1955) therefore its total range is probably not known. Other taxa present in the assemblage from Belle Glade have been reported only from marine environments; these include *Bairdoppilata, (Bairdoppilata) cushmani, Loxocorniculum fischeri, Loxocorniculum postdorsolatum, Orionina bradyi, Paracypris sablensis, Paranesidea bradyi, Proteoconcha multipunctata,* and *Protocytheretta pumicosa*. The marine ostracode species indicate the same environment represented by the "Molluscan 'Glades' fauna" mentioned by McGinty (1970).

Some of the previous publications on modern ostracodes do not present exact information on water depth of sample sites, but it is usually possible to interpret the approximate depth range of a particular species. In the present study, if *Physocypria* and *Limnocythere* are eliminated from consideration, the remaining taxa are indicative of depths from near the shoreline to 23 meters. It is a depth range that the reported species have in common, that is, an interval in which all the species sometimes occur.

The marine climate is interpreted as having been subtropical or tropical. *Cyprideis mexicana, Cytherura* sp. C and *Xestoleberis rigbyi* have been reported only from tropical regions, whereas *Cyprideis salebrosa, Loxoconcha fischeri* and *Paracytheridea vandenboldi* have been reported only in subtropical areas. It should be noted that the species mentioned above are recorded in few papers dealing with modern sediments; the total of such environmental range of each species may not be known. All remaining species reported from modern sediments have been recovered from both subtropical and tropical areas. The climatic terms are used as proposed by Trewartha (1954) and Rumney (1968) and are based upon physical criteria.

In conclusion, the ostracode fauna (see Table 1) is interpreted to indicate that the deposition of the "Bermont Formation" at Belle Glade, occurred in a low-energy environment, at a water depth of less than 23 meters under fully marine conditions in a subtropical or tropical region.

VI. ACKNOWLEDGMENTS

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VII. SYSTEMATIC PALEONTOLOGY

All figured and type specimens are deposited at the U.S. National Museum (USNM). All illustrations for this paper are scanning electron micrographs.

Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Müller, 1894
Suborder PODOCOPINA Sars, 1866
Superfamily BAIRDIACEA Sars, 1866
Family BAIRDIIDAE Sars, 1866
Genus BAIRDOPPILATA Coryell, Sample and Jennings, 1935

BAIRDOPPILATA (BAIRDOPPILATA) CUSHMANI (Tressler, 1949)
Plate 1, figure 5

Nesidea cushmani TRESSLER, 1949, p. 342, figs. 4-8.

Bairdoppilata carinata KORNICKER, 1961, p. 66, pl. 1, figs. 5a-e; text figs. 9A-J, 10B-C, E.

Bairdoppilata triangulata Edwards. BENSON and COLEMAN, 1963, p. 20-21, pl. 3, figs. 1-3; text fig. ? (not *Bairdoppilata triangulata* Edwards, 1944, p. 507, pl. 85, figs. 5-7).

TABLE 1. OSTRACODE FAUNAL LIST

	Locality		
	TU 201	TU 580	TU 733
Actinocythereis triangularis Morales	9*	1AF 6JV	1AF
Aurila sp. cf. *A. amygdala* (Stephenson)	2	4JV	—
"Aurila" floridana Benson and Coleman	23	2AF 11JV	4AF 7JV
"Aurila" bellegladensis, n. sp.	37	1AF 12JV	1AF 17JV
Bairdoppilata (Bairdoppilata) cushmani (Tressler)	3	—	1JV
Basslerites sp.	—	2 1JV	2
Cyprideis mexicana Sandberg	3	1JV	—
Cyprideis salebrosa van den Bold	7	9JV	8JV
Cytherella sp.	2	2JV	3JV
Cytherelloidea sp. aff. *C. leonensis* Howe	4	2JV	2JV
Cytheromorpha paracastanea (Swain)	10	10 2JV	1 2JV
Cytherura sp. cf. *C. sandbergi* Morales	1	1JV	1JV
Cytherura sp. A	3	1	1
Cytherura sp. B	2	2	—
Cytherura sp. C	1	—	—
Haplocytheridea bradyi (Stephenson)	8	—	—
Haplocytheridea setipunctata (Brady)	34	—	—
Hemicytherura vokesae, n. sp.	1	8 2JV	7 1JV
Hulingsina ashermani (Ulrich and Bassler)	5	1AF 9JV	3JV
Limnocythere sp.	7	3AF 13JV	—
Loxoconcha sp. cf. *L. matagordensis* Swain	3	1JV	1JV
Loxoconcha sp. cf. *L. sarasotana* Benson and Coleman	11	—	—
Loxocorniculum fischeri (Brady)	43	5AF 10JV	4AF 9JV
Loxocorniculum postdorsolatum (Puri)	6	1AF 3JV	2AF 5JV
Macrocyprina sp.	—	2AF	2JV
Megacythere edwardsi, n. sp.	12	1AF	1AF
Neocaudites sp. cf. *N. triplistriata* (Edwards)	1	—	1AF
Neonesidea sp. cf. *N. gerda* (Benson and Coleman)	1	—	—
Orionina bradyi van den Bold	16	3AF 3JV	2AF
Paracypris sablensis Benson and Coleman	6	2JV	—
Paracytheridea tschoppi van den Bold	3	1JV	1JV
Paracytheridea sp. cf. *P. vandenboldi* Puri	4	1JV	—
Paradoxostoma sp.	1AF	1AF	1JV
Paranesidea sp. cf. *P. bradyi* (van den Bold)	3	?3JV	—

Pellucistoma sp. aff. *P. atkinsi* Hall	1	1 2JV	3 9JV
Physocypria sp. cf. *P. pustulosa* Sharpe	5	2 1JV	1JV
Proteoconcha multipunctata (Edwards)	6	2JV	–
Protocytheretta pumicosa (Brady)	5	1AF 3JV	–
Puriana rugipunctata (Ulrich and Bassler)	14	1JV	2AF 2JV
Radimella confragosa? (Edwards)	25	–	–
Xestoleberis rigbyi Morales	10	1AF 1JV	2AF 6JV

* valve count, adults
AF = fragments, adults
JV = valve count, juveniles

Bairdoppilata (Bairdoppilata) cushmani (Tressler). MADDOCKS, 1969, p. 68-71, figs. 34, 35h-m.

DIMENSIONS: Left valve, length 1.00 mm, height .68 mm.

MATERIAL: Four valves.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of about 0.9 to 72.9 meters; marine; subtropical and tropical.

Genus PARANESIDEA Maddocks, 1969
PARANESIDEA sp. cf. P. BRADYI (van den Bold, 1957)
Plate 1, figure 6

Bairdia foveolata BRADY, 1868, p. 56, pl. 7, figs. 4-6. BRADY, 1880, p. 55, pl. 8, figs. 1a-f, 2a-f (not *Bairdia foveolata* Bosquet, 1852, p. 21, pl. 1, figs. 5a-d).

cf. *Bairdia bradyi* VAN DEN BOLD, 1957, p. 236, pl. 1, fig. 5. PURI, 1960, p. 130-131. VAN DEN BOLD, 1966, p. 45, pl. 1, figs. 5a-c. MORALES, 1966, p. 23, pl. 1, figs. 4a-d. SWAIN, 1967, p. 36, pl. 7, fig. 4.

Bairdia sp. cf. *B. bradyi* van den Bold. BENSON and COLEMAN, 1963, p. 18-19, pl. 2, figs. 1-3, text fig. 7.

DIMENSIONS: Carapace, length .85 mm; height .54 mm; width .45 mm.

MATERIAL: A damaged carapace, four valves.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths from near the shoreline to 2103 meters; marine; subtropical and tropical.

Genus NEONESIDEA Maddocks, 1969
NEONESIDEA sp. cf. N. GERDA (Benson and Coleman, 1963)
Plate 1, figure 8

cf. *Bairdia gerda* BENSON and COLEMAN, 1963, p. 19-20, pl. 1, figs. 14-16; text fig. 8.

Bairdia cf. *B. crosskeyana* Brady. BENDA and PURI, 1962, p. 324, pl. 5, figs. 12, 13 (not *Bairdia crosskeiana* Brady, 1866, p. 366, pl. 57, fig. 10).

Neonesidea gerda (Benson and Coleman). MADDOCKS, 1969, p. 24-26, figs. 7a-k.

MATERIAL: A single damaged valve.

REMARKS: The shape and muscle scars of the single valve appear to be identical to *N. gerda* (Benson and Coleman).

ENVIRONMENT: Previously reported from modern sediments deposited at water depths from near the shoreline to 15.2 meters; marine; subtropical and tropical.

Family MACROCYPRIDIDAE Müller, 1912
Genus MACROCYPRINA Triebel, 1960
MACROCYPRINA sp.
Plate 1, figure 7

DIMENSIONS: Juvenile, left valve, length .60 mm, height .28 mm.

MATERIAL: Two juvenile valves and two fragments of adult valves.

REMARKS: The limited nature of the material precludes identification at the species level. The juveniles were recovered from the sample taken at locality TU 733; the fragments are from TU 580.

Superfamily CYPRIDACEA Baird, 1845
Family PARACYPRIDIDAE Sars, 1925
Genus PARACYPRIS Sars, 1866
PARACYPRIS SABLENSIS Benson and Coleman, 1963
Plate 1, figure 4

Paracypris? sablensis BENSON and COLEMAN, 1963, p. 16-17, pl. 1, figs. 11-13; text fig. 5.

DIMENSIONS: Left valves, length .80-.83 mm; height .39-.40 mm.

MATERIAL: Eight valves.

REMARKS: The muscle scars could not be seen on any specimen, but all other characters were identical to those of the lectotype (USNM 113181).

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 5.8 to 29.0 meters; marine; subtropical and tropical.

Family CYTHERIDEIDAE Sars, 1925
Subfamily CYTHERIDEINAE Sars, 1925
Genus CYPRIDEIS Jones, 1857

CYPRIDEIS SALEBROSA van den Bold, 1963

Plate 1, figure 9

Cyprideis salebrosa VAN DEN BOLD, 1963b, p. 377-378, pl. 7, figs. 9a-d; pl. 11, figs. 1a-c. SANDBERG, 1964b, 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 (with synonymy). VAN DEN BOLD, 1971, p. 452, 454. VAN DEN BOLD, 1972b, p. 486. KEYSER, 1975, p. 490, 493, text fig. 3. KONTROVITZ, 1976, p. 93, pl. 2, fig. 1.

DIMENSIONS: Right valve, length 1.20 mm; height .65 mm.

MATERIAL: Twnety-four valves.

REMARKS: The specimens are larger than those reported by van den Bold (1963b), but are similar in size to the range presented by Sandberg (1964b).

ENVIRONMENT: Previously reported from modern sediments deposited in estuaries, mangrove swamps and on the continental shelf of the Gulf of Mexico; water depths from near shore to more than 18.3 meters; brackish and marine; subtropical.

CYPRIDEIS MEXICANA Sandberg, 1964

Plate 1, figure 1

Cyprideis mexicana SANDBERG, 1964b, p. 125, 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. MORALES, 1966, p. 32, pl. 2, figs. 1a,b.

DIMENSIONS: Carapace, length 1.05 mm; height .56 mm; width .41 mm.

MATERIAL: One carapace, two valves.

REMARKS: This species is similar to *Anomocytheridea locketti* Stephenson, 1938, but lacks the "thickened flange of clear shell material" at the posteroventral margin of the right valve.

ENVIRONMENT: Previously reported from modern sediments deposited in shallow lagoons and from depths as great as 6.1 meters; brackish to marine; tropical.

Genus HAPLOCYTHERIDEA Stephenson, 1936

HAPLOCYTHERIDEA BRADYI (Stephenson, 1938)

Plate 1, figure 2

Cytheridea (Haplocytheridea) bradyi STEPHENSON, 1938, p. 129-132, pl. 23, fig. 22; pl. 24, figs. 5, 6; text fig. 10.

Haplocytheridea bradyi (Stephenson). SWAIN, 1955, p. 618, pl. 59, figs. 12a,b. PURI, 1960, p. 110, pl. 2, figs. 3, 4; pl. 6, fig. 19; text figs. 4, 5. SANDBERG, 1964a, p. 362-363, pl. 2, figs. 7-16. HALL, 1965, p. 41, pl. 11, figs. 1-11. HULINGS and PURI, 1965, p. 321, fig. 12. HULINGS, 1966, p. 50, fig. 6f. HULINGS, 1967, p. 642, fig. 3p. GROSSMAN, 1967, p. 64a, pl. 11, fig. 2; pl. 17, figs. 15, 16, 18. SWAIN, 1968, p. D8, pl. 1, figs. 7a,b, 8a,b; pl. 2, fig. 8. KRUTAK, 1971, p. 16, pl. 2, figs. 5a,b. VALENTINE, 1971, p. D6, pl. 2, figs. 42, 46. SWAIN, 1974, p. 13, pl. 1, figs. 9, 10, 13; pl. 8, figs. 10a,b. KONTROVITZ, 1976, p. 93, pl. 2, fig. 3.

Haplocytheridea bradyi Swain *(sic).* BYRNE, LEROY, and RILEY, 1959, p. 240, pl. 4, fig. 10; pl. 5, fig. 11.

Cytheridea (Haplocytheridea) wadei STEPHENSON, 1941, p. 428-429, text figs. 3, 4, 14-18.

Haplocytheridea wadei (Stephenson). PURI, 1953b, p. 231, pl. 3, figs. 5, 6; text fig. 3g.

Cytheridea (Haplocytheridea) proboscidiala EDWARDS, 1944, p. 508-509, pl. 85, figs. 8-11.

Haplocytheridea proboscidiala (Edwards). BENSON and COLEMAN, 1963, p. 28-29, pl. 3, figs. 4-9; text fig. 15.

"Haplocytheridea" bradyi (Stephenson). HAZEL, 1975, p. 477, 479.

DIMENSIONS: Right valves, length .73-.75 mm; height .43-.45 mm.

MATERIAL: Eight valves.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 0.9 to 62.2 meters; brackish and marine; mild temperate, subtropical and tropical. Also reported from the Cape Hatteras area, North Carolina (Hazel, 1975).

HAPLOCYTHERIDEA SETIPUNCTATA (Brady, 1869)

Plate 1, figure 2

Cytheridea setipunctata BRADY, 1869, p. 124, pl. 14, figs. 15, 16.

Haplocytheridea setipunctata (Brady). SANDBERG, 1964a, p. 361-362, pl. 1, figs. 10-14; pl. 2, figs. 1-4 (with synonymy). HULINGS and PURI, 1965, p. 329, fig. 14. SANDBERG, 1965, p. 508, pl. 3, fig. 12. HULINGS, 1967, p. 643, fig. 3q. GROSSMAN, 1967, p. 64a, pl. 11, figs. 4, 7; pl. 16, figs. 13-18. SWAIN, 1968, p. D7-8, pl. 1, figs. 5a-c; pl. 7, figs. 1a,b. VALENTINE, 1971, p. D6, pl. 2, figs. 48, 49. SWAIN, 1974, p. 12-13, pl. 9, fig. 16. VAN DEN BOLD, 1971, p. 452, 454.

DIMENSIONS: Left valve, ? female, length 1.13 mm; height .74 mm.

MATERIAL: Thirty-two valves; one juvenile carapace.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 0.6 to 21.3 meters; brackish and marine; subtropical and tropical.

Subfamily NEOCYTHERIDEINAE Puri 1957

Genus HULINGSINA Puri, 1957

HULINGSINA ASHERMANI (Ulrich and Bassler, 1904)

Plate 2, figure 8

Cytherideis ashermani ULRICH and BASSLER, 1904, p. 126, pl. 37, figs. 10-16.

Hulingsina ashermani (Ulrich and Bassler). PURI, 1958a, p. 173, table 2. POOSER, 1965, p. 45, pl. 6, fig. 5; pl. 8, figs. 1-3. HULINGS and PURI, 1965, p. 323, fig. 12a. MCLEAN, 1966, p. 74, pl. 23, fig. 4. GROSSMAN, 1967, p. 68, pl. 14, fig. 2; pl. 20, figs. 13-14 (with synonymy). KONTROVITZ, 1976, p. 62, pl. 2, fig. 5.

Pontocythere ashermani (Ulrich and Bassler). HULINGS, 1966, p. 51, figs. 2a-g, 6n. HULINGS, 1967, p. 645, fig. 5e. SWAIN, 1968, p. D10, pl. 2, figs. 1a-d; pl. 6, fig. 4; text fig. 8. SWAIN, 1974, pl. 1, figs. 21, 24; pl. 2, figs. 1-3; pl. 9, figs. 12a,b.

DIMENSIONS: Left valve, length .73 mm; height .38 mm.

MATERIAL: Eighteen valves.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 1.5 to 91.4 meters; brackish to marine; subtropical and tropical.

Family CYTHERURIDAE Müller, 1894

Genus CYTHERURA Sars, 1866

CYTHERURA sp. cf. C. SANDBERGI Morales, 1966

Plate 2, figure 1

cf. *Cytherura sandbergi* MORALES, 1966, p. 50, 52, pl. 4, figs. 6a-d (with synonymy). KRUTAK, 1971, p. 20-21, pl. 2, figs. 3a,b. KONTROVITZ, 1976, p. 63, pl. 3, fig. 1.

DIMENSIONS: Right valve, length .60 mm; height .35 mm.

MATERIAL: Three valves.

REMARKS: The valves are larger than the specimens examined by Morales (1966); other characters are similar.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 3.1 to 54.9 meters; brackish to marine; subtropical and tropical.

CYTHERURA sp. A

Plate 2, figure 5

Cytherura sp. A KONTROVITZ, 1976, p. 63, pl. 3, fig. 7.

DIMENSIONS: Left valve, ? juvenile, length .41 mm; height .24 mm.

MATERIAL: Five valves.

REMARKS: The five valves reported here and the three previously described are insufficient to name the species.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 33.0 to 56.7 meters; marine; subtropical.

CYTHERURA sp. B

Plate 2, figure 3

DESCRIPTION: Right valve, moderately calcified, small. Lateral view, subrectangular. Cardinal angles rounded. Dorsal margin nearly striaght with slight concavity at mid-length, ventral margin parallel with slight concavity in front of mid-length. Anterior margin, broadly rounded; posterior, triangular with apex equal to the caudal process just above mid-height.

Surface: About 12 distinct longitudinal ridges joined to a posterior sub-vertical rib; three join anterior rim. The posteroventral rib is high, alalike. Eyespots, weak.

Internal features: Marginal area, wide at anterior, narrow elsewhere. Inner margin may be serrate (possibly eroded). Radial pore canals at anterior, few, sinuous or simply curved, a few false; at posterior, few, simple. Hinge normal for genus. Muscle scars not seen.

DIMENSIONS: Right valve, length .58 mm; height .31 mm.

MATERIAL: Four valves.

REMARKS: This species differs from *Cytherura wardensis* Howe and Brown,

1935, and *Cytherura pseudostriata* Hulings, 1966, in its shape and in lacking a retictulate surface. Valentine (1971) reported specimens identified as *C. pseudostriata* Hulings that are similar in shape, but those have a reticulate surface in contrast to this species.

CYTHERURA sp. C
Plate 2, figure 7

? *Cytherura* sp. aff. *C. forulata* Edwards. MORALES, 1966, p. 46, 48, pl. 4, figs. 7a,b (not *Cytherura forulata* Edwards, 1944, p. 526, pl. 88. figs. 17-20).

DIMENSIONS: Left valve, length .59 mm; height .33 mm.

MATERIAL: One valve.

REMARKS: This species differs from *Cytherura forulata* Edwards by not having an arched dorsal margin; it is slightly concave at mid-length.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of less than 1.8 meters; marine; tropical.

Genus HEMICYTHERURA Elofson, 1941

HEMICYTHERURA VOKESAE
Kontrovitz, n. sp.
Plate 2, figures 2, 4

DIAGNOSIS: Distinguished by its elongate rectangular shape, prominent horizontal ridges and distinct cross-ridges.

DESCRIPTION: Moderately calcified, small, rectangular in lateral view. Females, dorsal margin nearly straight; ventral margin slightly convex and subparallel. Males, dorsal and ventral margins nearly straight and parallel. Both sexes have anterior margin evenly rounded; posterior evenly rounded below mid-length, a slightly upturned caudal process above.

Surface is reticulate with high, delicate horizontal ridges. The dorsal and ventral marginal ridges are most prominent being fluted on well preserved specimens. Rib just above ventral rib bifurcates then unites again reaching the low anterior rim. All horizontal ribs connect to sinuous vertical rib just in front of posterior.

Sexual dimorphism: As above, males also lower.

Internal view: Valves deep. Hinge, right valve, selvage is extended into high blade-like elements that reach toward center just beyond cardinal angles; above hinge elements there is a distinct flange groove. Left valve, a long blade-like medial element expanded at each end; fits between terminal elements of right valve.

Inner lamella is wide at anterior, narrow elsewhere. Inner margin, slightly serrate at anterior. No vestibules. Radial pore canals, few and curved. Muscle scars not seen.

HOLOTYPE: Left valve, female, figured, USNM 236001; length .47 mm; height .26 mm.

PARATYPES: Right valve, female, figured, USNM 236002; length .44 mm, height .24 mm. Left valve, female, USNM 236003; length .45 mm, height .26 mm. Right valve, male, USNM 236004; length .46 mm, height .23 mm. Left valve, male, USNM 236005; length .45 mm, height .24 mm.

TYPE LOCALITY: Tulane University Department of Geology Locality 580 (see section VIII of this study).

DIMENSIONS: Females, right valves, length .44-.48 mm; height .24-.26 mm. Males, right valves, length .45-.46 mm; height .21-.24 mm.

MATERIAL: Nineteen valves.

REMARKS: This specimen is similar to *Hemicytherura sablensis* Benson and Coleman, 1963, in outline, but differs from the latter by having distinct cross-ribs between the horizontal ribs. An examination of the lectotype (USNM 113199) also revealed that *H. sablensis* has straight horizontal ribs; horizontal ribs are sinuous on *H. vokesae,* n. sp. The species is named in honor of Dr. Emily H. Vokes of Tulane University for her contributions to paleontology.

Genus PARACYTHERIDEA Müller, 1894

PARACYTHERIDEA sp.
cf. P. VANDENBOLDI Puri, 1953
Plate 3, figure 1

Cytheropteron nodosum ULRICH and BASSLER, 1904, p. 129-130, pl. 38, figs. 37-40. (Not *Cytheropteron nodosum* Brady, 1868, p. 448, pl. 34, figs. 31-34.)

Paracytheridea nodosa (Ulrich and Bassler). HOWE *et al.,* 1935, p. 37, pl. 3, fig. 7. VAN DEN BOLD, 1946, p. 86, pl. 16, fig. 7. SWAIN, 1951, p. 51, pl. 3, figs. 19-22.

cf *Paracytheridea vandenboldi* PURI, 1953c, p. 751. PURI, 1953b, p. 238, 240, pl. 3, fig. 7; text figs. 5a,b. MALKIN, 1953, p. 780, pl. 79, fig. 5. SWAIN, 1955, p. 625, pl. 62, figs. 2a, b. MCLEAN, 1957, p. 75-76, pl. 8, figs. 4a, 4b. HALL, 1965, p. 49, pl. 18, figs. 22-30. MCLEAN, 1966, p. 61-62.

Paracytheridea cf. *P. vandenboldi* Puri. SWAIN, 1968, p. D11, pl. 2, figs. 4a,b.

DIMENSIONS: Left valve, length .81 mm, height .42 mm.

MATERIAL: Five valves.

REMARKS: Although these specimens are larger than those reported by Ulrich and Bassler (length .68 mm; height .30 mm) they are similar in all other characteristics.

ENVIRONMENT: Previously reported from modern sediments deposited at water

depths of about 1.7 meters; brackish; subtropical (Swain, 1955).

PARACYTHERIDEA TSCHOPPI
van den Bold, 1946
Plate 2, figure 6

Paracytheridea tschoppi VAN DEN BOLD, 1946, p. 85, pl. 16, figs. 6, 7. KINGMA, 1948, p. 74, pl. 7, fig. 12. KEIJ, 1954, p. 220, pl. 4, fig. 4. VAN DEN BOLD, 1957, p. 245, pl. 4, fig. 7. BENSON AND COLEMAN, 1963, p. 33-34, pl. 6, figs. 7, 9, 10; text figs. 20a,b. VAN DEN BOLD, 1967a, p. 313. VAN DEN BOLD, 1968, p. 76, pl. 4, figs. 8a-d. VAN DEN BOLD, 1972a, p. 434.

Paracytheridea vanwessemi VAN DEN BOLD, 1946, p. 86, pl. 16, fig. 13.

Paracytheridea sp. 1, DROOGER and KAASSHIETER, 1958, p. 91.

DIMENSIONS: Right valve, length .63 mm; height .36 mm.

MATERIAL: Five valves.

REMARKS: These specimens are larger than the type individuals, but are similar in other characters.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of about 6.1 to 39.6 meters; marine; subtropical and tropical.

Family HEMICYTHERIDAE Puri, 1953
Subfamily HEMICYTHERINAE Puri, 1953
Genus AURILA Pokorný, 1955
AURILA sp. cf. A. AMYGDALA
(Stephenson, 1944)
Plate 2, figure 9

cf. *Hemicythere amygdala* STEPHENSON, 1944, p. 158, pl. 28, figs. 8, 9. PURI, 1953a, p. 176, pl. 1, fig. 3. PURI, 1953b, p. 266, pl. 11, fig. 14. PURI, 1960, p. 129, text figs. 31, 32.

Aurila amygdala (Stephenson). BENSON and COLEMAN, 1963, p. 36, pl. 8, figs. 6, 8, 9; text figs. 22a,b. BUTLER, 1963, p. 73, pl. 2, fig. 16; pl. 6, fig. C. VAN DEN BOLD, 1965, p. 394-395, pl. 5, fig. 10. MORALES, 1966, p. 56, pl. 5, figs. 6a-d. HULINGS, 1967, p. 647. VAN DEN BOLD, 1967b, p. 394-395, pl. 5, fig. 16. VAN DEN BOLD, 1972a, p. 427-428. VAN DEN BOLD, 1972b, p. 486, POAG, 1974, p. 59, pl. 6, fig. 5; text fig. 2.

DIMENSIONS: Carapace, length .56 mm; height .36 mm; width .26 mm.

MATERIAL: Two adult carapaces and four juvenile valves.

REMARKS: The few specimens do not allow exact identification, but the observed characters indicate that this is probably the species Stephenson (1944, p. 158) described.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 1.5 to 7.6 meters; brackish to marine (29-39 o/oo); subtropical and tropical.

"AURILA" FLORIDANA
Benson and Coleman, 1963
Plate 3, figure 2

Aurila conradi (Howe and McGuirt) *floridana* BENSON and COLEMAN, 1963, p. 35-36, pl. 8, figs. 10-12; text fig. 21. HALL, 1965, p. 32, pl. 6, figs. 20-22, 24, 29.

Aurila floridana Benson and Coleman. MORALES, 1966, p. 56-57, pl. 5, figs. 5a-d (with synonymy). VALENTINE, 1971, p. D4, pl. 1, figs. 43, 47. HAZEL, 1971b, p. 370. KONTROVITZ, 1976, p. 69, pl. 4, fig. 6.

Aurila? floridana Benson and Coleman. HAZEL, 1971b, p. 370.

Radimella floridana (Benson and Coleman). HAZEL, 1971a, p. 6.

Radimella? floridana floridana (Benson and Coleman). HAZEL, 1975, p. 478.

DIMENSIONS: Right valves, length .65-.68 mm; height .43-.45 mm.

MATERIAL: Two carapaces (juvenile), 43 adult valves.

REMARKS: The adult specimens examined for this study are larger than those of Benson and Coleman (1963) and Morales (1966), but are identical in other characters. A new genus is being proposed by J. E. Hazel (*Smithsonian Contributions to Paleobiology*, in press) for *A conradi, A. floridana* and related North American forms.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 1.5 to 62.2 meters; brackish to marine (27-40 o/oo); mild temperate, subtropical and tropical. Also reported by Hazel (1975) from the Cape Hatteras area, North Carolina.

"AURILA" BELLEGLADENSIS
Kontrovitz, n. sp.
Plate 3, figures 4, 5

DIAGNOSIS: Distinguished by the highly arched dorsum, polished ridges, blunt caudal process of the right valve and small tooth in the bottom of the posterior socket of the left valve hinge.

DESCRIPTION: Almond shaped, moderately calcified, medium size. In lateral view, ovate, pronounced overlap by left valve only at dorsum; dorsal margin is broadly rounded. In left view,

anterior cardinal angle is broadly rounded; posterior cardinal angle more sharply rounded. Dorsal margin slopes markedly to rear. Greatest height is at anterior cardinal angle, greatest length below middle (length/height ratio, left valves, 1.4). Anterior margin, rimmed and broadly curved below mid-height, more oblique above. Posterior margin has concavity above mid-height, caudal process below. Ventral margin, gently convex with slight sinuosity near mid-length. Sexual dimorphism not apparent.

Dorsal view: Ovate, greatest width at mid-length, slopes evenly to anterior and posterior. Left valve slightly larger.

End view, anterior: Ovate, greatest width below mid-height, venter slightly flattened.

Surface: Anterior is reticulate with about six coarse reticulations parallel to anterior rim. Smaller reticulations at mid-length; at posterior, shape of depressions becomes irregular. Area between depressions (the ridges) are flattened and polished. Some specimens have smooth subcentral area and weak posterodorsal ridge. A low ventrolateral ridge has about 10-11 pits giving a weakly fluted appearance. Eyespot small but distinct and on an arcuate ridge that is parallel to nearest margin.

Internal features: Valves deep; caudal process blunt in right valve. Hinge, right valve, anterior element is an oval tooth on a ramp, followed by a rounded socket, then a curved medial groove, a posterior tooth that is crescent-shaped and slightly enlarged at each end. Left valve, a rounded anterior socket followed by a large oval tooth that is the terminus of the long narrow crenulate medial bar; posterior socket is oval, elongate and has a small tooth at its bottom edge.

Inner lamella is narrow; anterior vestible is very narrow; posterior vestibule small and only at caudal process. Radial pore canals, numerous and closely spaced at lower anterior margin, more widely spaced and slightly sinuous at upper anterior.

Selvage, right valve, low but distinct at anterior, higher and sharper at the ventral margin where it is flexed inward just in front of mid-length; at posterior selvage is parallel to margin and forms a groove like depression with flange (a flange groove). Selvage continues onto caudal process. Selvage of left valve is low but distinct, fits into groove of right valve, is removed from outer margin on caudal process.

Muscle scars: Central scars, a group of three with the upper one circular; middle is horizontally elongate and divided; lower scar is elongate, divided and sloping toward anteroventral margin. Frontal scar is divided into three areas, slopes forward.

HOLOTYPE: Left valve, figured, USNM 235996; length .60 mm, height .39 mm.

PARATYPES: Right valve, figured, USNM 235997; length .55 mm, height .29 mm. Left valve, USNM 255998; length .60 mm, height .39 mm. Right valve, USNM 255999; length .59 mm, height .33 mm. Carapace, ? juvenile, USNM 236000; length .53 mm, height .35 mm, width .29 mm.

TYPE LOCALITY: Tulane University Department of Geology Locality 201 (see section VIII of this study).

DIMENSIONS: Carapaces, ? juveniles, length .53-.56 mm; height .35-.38 mm; width .29-.30 mm; left valves length .55-.60 mm; height .38-.41 mm. L/H ratio of left valves = 1.4.

MATERIAL: Eight carapaces, 52 valves.

REMARKS: This species is similar to *Aurila conradi* (Howe and McGuirt) *californica* Benson and Kaesler, 1963, but differs by having a blunt caudal process in the right valve, not a pointed one. This species also has a less distinct posteroventral ridge and larger eyespots. The course of the selvage is different in the ventral portion of the valves and this species lacks marginal denticles below the caudal process.

The species differs from *Aurila floridana* Benson and Coleman, 1963, by lacking marginal denticles, by the presence of a small tooth in the posterior socket of the left valve hinge and in the more subdued ridges of the surface ornamentation. This species is probably a member of a new genus that will be described by Joseph E. Hazel (Hazel, 1977, personal communication).

The species is named for its occurrence near the town of Belle Glade, Florida.

Genus RADIMELLA Pokorný, 1969

RADIMELLA CONFRAGOSA? (Edwards, 1944)

Plate 3, figure 3

? *Hemicythere confragosa* EDWARDS, 1944, p. 518, pl. 86, figs. 23-26.

? *Radimella confragosa* (Edwards). VAN DEN BOLD, 1975, p. 697, pl. 1, figs. 1-4, 16, 17; text figs. 3a, b (with synonymy).

DIMENSIONS: Carapaces, length .56-.60 mm; height .34-.36 mm; width .36-.38 mm.

MATERIAL: Six carapaces, 13 valves.

REMARKS: This species differs slightly from the Holotype of *Radimella confragosa* (Edwards) by having a more evenly rounded anterior margin, somewhat heavier ornamentation and by having two posterior marginal spines above the caudal process. The posterior marginal spines are similar to those of *Radimella confragosa* form A of van den Bold (1975) but the shape and general ornamentation differ from that form. The details

of the shape and ornamentation serve to differentiate this species from the other forms described by van den Bold (1975) in his study of *Radimella* ex gr. *confragosa* (Edwards).

Genus ORIONINA Puri, 1953
ORIONINA BRADYI van den Bold, 1963
Plate 3, figure 6

Orionina bradyi VAN DEN BOLD, 1963a, p. 45, 47, pl. 3, figs. 7, 8, text fig. 6, figs. 5-7 (with synonymy). MORALES, 1966, p. 85, 87, pl. 8, figs. 2a-c. VALENTINE, 1971, p. D8. VAN DEN BOLD, 1974, p. 217. HAZEL, 1975, p. 477.

? *Orionina bermudae* (Brady). BENSON and COLEMAN, 1963, p. 45-46, pl. 8, fig. 7; text fig. 29 (not *Cythere bermudae* Brady, 1880, p. 90, pl. 21, figs. 2a-d).

DIMENSIONS: Carapaces, length .56-.61 mm; height .31-.35 mm; width .26-.30 mm.

MATERIAL: Three carapaces, 18 valves.

REMARKS: The marginal area, hinge and "pillar" structures are identical to those described by van den Bold (1963a). The ornamentation is variable and is similar on some specimens to that of *Orionina vaughni* (Ulrich and Bassler, 1904).

ENVIRONMENT: Previously reported from modern sediments deposited from shallow depths to about 792.5 meters; marine; subtropical and tropical.

Subfamily CAMPYLOCYTHERINAE Puri, 1960
Genus PROTEOCONCHA Plusquellec and Sandberg, 1969
PROTEOCONCHA MULTIPUNCTATA (Edwards, 1944)
Plate 3, figure 8

Acuticythereis multipunctata EDWARDS, 1944, p. 520, pl. 87, figs. 14-16.

Proteoconcha multipunctata (Edwards). PLUSQUELLEC and SANDBERG, 1969, p. 457-459, pl. 2, figs. 1-11; pl. 5, fig. 9; pl. 6, figs. 12, 13; pl. 8, fig. 5; pl. 9, figs. 6, 10, 12-16; text figs. 2h-i, 3d, 4, 12. HAZEL, 1971b, p. 370. VALENTINE, 1971, p. D8. HAZEL, 1975, p. 378.

DIMENSIONS: Right valve, ? female, length .65 mm; height .36 mm.

MATERIAL: One carapace, six valves.

ENVIRONMENT: A modern specimen from Florida Bay has been identified, tentatively, as a representative of this species (Plusquellec and Sandberg, 1969, p. 458). In addition, the species has been reported from the Cape Hatteras area, North Carolina (Hazel, 1975).

Subfamily THAEROCYTHERINAE Hazel, 1967
Genus PURIANA Coryell and Fields, in Puri, 1953
PURIANA RUGIPUNCTATA (Ulrich and Bassler, 1904)
Plate 3, figure 7

Cythere rugipunctata ULRICH and BASSLER, 1904, p. 118 pl. 38, figs. 16, 17.

Cythereis rugipunctata (Ulrich and Bassler). HOWE *et al.*, 1935, p. 23, pl. 1, figs. 18, 20-22; pl. 4, figs. 22, 23.

Favella rugipunctata (Ulrich and Bassler). EDWARDS, 1944, p. 524, pl. 88, figs. 5, 6. VAN DEN BOLD, 1950, p. 797, pl. 83, fig. 24.

Puriana rugipunctata (Ulrich and Bassler). PURI, 1953c, p. 571. VAN DEN BOLD, 1965, p. 399. HULINGS, 1966, p. 55, fig. 8i. HULINGS, 1967, p. 654-655, fig. 8. SWAIN, 1974, pl. 7, figs. 19, 20 (with synonymy). HAZEL, 1971b, p. 370, VALENTINE, 1971, p. D8, pl. 4, figs. 31, 36. HALEZ, 1975, p. 478. KONTROVITZ, 1976, p. 69, 70, pl. 4, fig. 5.

DIMENSIONS: Left valves, length .58-.60 mm; height .28-.32 mm.

MATERIAL: Five carapaces, nine valves.

REMARKS: The specimens reported here are smaller than those described by Ulrich and Bassler (left valve, length .71 mm, height .38 mm).

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 1.5 to 381 meters with the most common occurrences at depths of less than 76.2 meters; brackish and marine; mild temperate, subtropical and tropical.

Family LOXOCONCHIDAE Sars, 1925
Genus LOXOCONCHA Sars, 1866
LOXOCONCHA sp. cf. L. SARASOTANA Benson and Coleman, 1963
Plate 4, figure 2

cf. *Loxoconcha sarasotana* BENSON and COLEMAN, 1963, p. 37, pl. 7, figs. 7-10; text fig. 23a.

? *Loxoconcha* sp. aff. *L. sarasotana* Benson and Coleman. MORALES, 1966, p. 71-72, pl. 6, figs. 2a,b.

DIMENSIONS: ? Female, right valve, length .55 mm; height .35 mm; ? male, right valve, length .59 mm; height .33 mm.

MATERIAL: Eleven valves.

REMARKS: None of the specimens examined have the distinct posterior ridge described by Benson and Coleman (1963). A posterior ridge is weakly formed on several valves, but it is not equally developed on all specimens. In addition, the valves reported here are smaller than the type specimens.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 6.1 to 19.2 meters; marine; subtropical. Morales (1966) reported a similar form from shallow, brackish to marine waters in the tropics.

LOXOCONCHA sp. cf. L. MATAGORDENSIS
Swain, 1955
Plate 4, figure 1

cf. *Loxoconcha matagordensis* SWAIN, 1955, p. 629, pl. 63, figs. 9a, b; pl. 64, figs. 1a, b; text figs. 36b, 39: 7a,b. MORALES, 1966, p. 66, 69, pl. 6, figs. 4a,b (with synonymy). GROSSMAN, 1967, p. 74, pl. 15, fig. 3; pl. 18, figs. 7, 8, 11. VALENTINE, 1971, p. D6, pl. 4, figs. 38-39, 43-44. HAZEL, 1971b, p. 370. HAZEL, 1975, p. 477. KONTROVITZ, 1976, p. 72, pl. 5, fig. 1.

Loxoconcha metagordensis [sic] Swain. HALL, 1965, p. 50, pl. 19, figs. 15-18.

DIMENSIONS: Carapace, length .55 mm; height .30 mm; width .16 mm.

MATERIAL: One carapace, three juvenile valves.

REMARKS: The subsidiary ridges described by Swain (1955) as characteristic of this species are visible only with low angle lighting on the adult specimen.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 0.6 to 128.0 meters; brackish to marine; subtropical and tropical.

Genus LOXOCORNICULUM
Benson and Coleman, 1963
LOXOCORNICULUM POSTDORSOALATUM
(Puri, 1960)
Plate 4, figure 4

Loxoconcha anderseni Puri. PURI and HULINGS, 1957, fig. 11 (not *Loxoconcha anderseni* Puri, 1953b, p. 269, pl. 10, fig. 4; text fig. 10c).

Loxoconcha postdorsoalata PURI, 1960, p. 111, pl. 3, figs. 17, 18; text figs. 35, 37.

Loxocorniculum postdorsolatum (Puri). BENSON and COLEMAN, 1963, p. 39-40, pl. 7, figs. 1, 2; text fig. 25.

DIMENSIONS: Carapace, male, length .65 mm; height .38 mm; width .30 mm.

MATERIAL: One carapace, 15 valves.

ENVIRONMENTS: Previously reported from modern sediments deposited at water depths from the shore line to 19.2 meters; marine; subtropical and tropical.

LOXOCORNICULUM FISCHERI
(Brady, 1869)
Plate 4, figure 3

PLATE 1

PLATE 1

Cythere fischeri BRADY, 1869, p. 152, 154, pl. 18, figs. 15, 16.

Loxoconcha fischeri (Brady). VAN DEN BOLD, 1963b, p. 393-394, pl. 8, figs. 8, 9 (with synonymy). VAN DEN BOLD, 1966, p. 51, pl. 3, fig. 7. HOWE and VAN DEN BOLD, 1975, p. 307, pl. 2, fig. 17.

Loxocorniculum fischeri (Brady). BENSON and COLEMAN, 1963, p. 39, pl. 7, figs. 3, 4; text fig. 24.

DIMENSIONS: Left valves, female, length .50 mm; height .33 mm; male, length .58 mm; height .34 mm.

MATERIAL: Four carapaces, 63 valves.

ENVIRONMENT: Previously reported from modern sediments deposited in waters ranging from shallow depths to about 259.1 meters; marine; tropical.

Genus CYTHEROMORPHA Sars, 1925
CYTHEROMORPHA PARACASTANEA (Swain, 1955)
Plate 4, figure 9

Leptocythere paracastanea SWAIN, 1955, p. 640, pl. 62, fig. 7; ? pl. 63, figs. 1a-c; ? text figs. 39: 5a, b. CURTIS, 1960, p. 478, pl. 2 (top), fig. 13. ENGEL and SWAIN, 1967, p. 413, pl. 2, fig. 20. SWAIN, 1974, p. 26, pl. 4, figs. 5-8, pl. 9, figs. 6a,b. KONTROVITZ, 1976, p. 74, 76, pl. 5, fig. 9. *Not* DARBY, 1965, p. 20, pl. 3, figs. 1-10; pl. 4, figs. 1-9.

Cytheromorpha paracastanea (Swain). MORALES, 1966, p. 66, pl. 6, fig. 20.

DIMENSIONS: Left valve, length .51 mm, height .26 mm.

MATERIAL: Eight carapaces and 15 valves.

REMARKS: The medial sulcus is less distinct than on the type specimen (Swain, 1955). All other characters are similar. Darby (1965) reported a form as being this species but his specimens differ by having more arched dorsal margins and by having the greatest length at or above mid-height. The hingement of this species is that of *Cytheromorpha* (see Van Morkhoven, 1963, p. 396-398).

ENVIRONMENT: Previously reported from modern sediments deposited at water depths of 1.5 to 152.4 meters; brackish to marine; subtropical and tropical.

Family PARADOXOSTOMATIDAE Brady and Norman, 1889
Subfamily PARADOXOSTOMATINAE Brady and Norman, 1889
Genus PARADOXOSTOMA Fischer, 1855
PARADOXOSTOMA sp.
Plate 2, figure 10

DIMENSIONS: Damaged valve, length .71 mm.

PLATE 2

Figures — Page

1. *Cytherura* sp. cf. *C. sandbergi* Morales, right valve
   USNM 236020, X110 141
2. *Hemicytherura vokesae* Kontrovitz, n. sp., Holotype, left valve
   USNM 236001, X100 142
3. *Cytherura* sp. B, right valve
   USNM 236022, X100 141
4. *Hemicytherura vokesae* Kontrovitz, n. sp., Paratype, right valve
   USNM 236002, X100 142
5. *Cytherura* sp. A, left valve
   USNM 236021, X100 141
6. *Paracytheridea tschoppi* van den Bold, left valve
   USNM 236038, X100 143
7. *Cytherura* sp. C, left valve
   USNM 236023, X100 142
8. *Hulingsina ashermani* (Ulrich and Bassler), left valve
   USNM 236026, X100 141
9. *Aurila* sp. cf. *A. amygdala* (Stephenson), left valve
   USNM 236012, X100 143
10. *Paradoxostoma* sp., left valve, damaged
    USNM 236040, X60 148

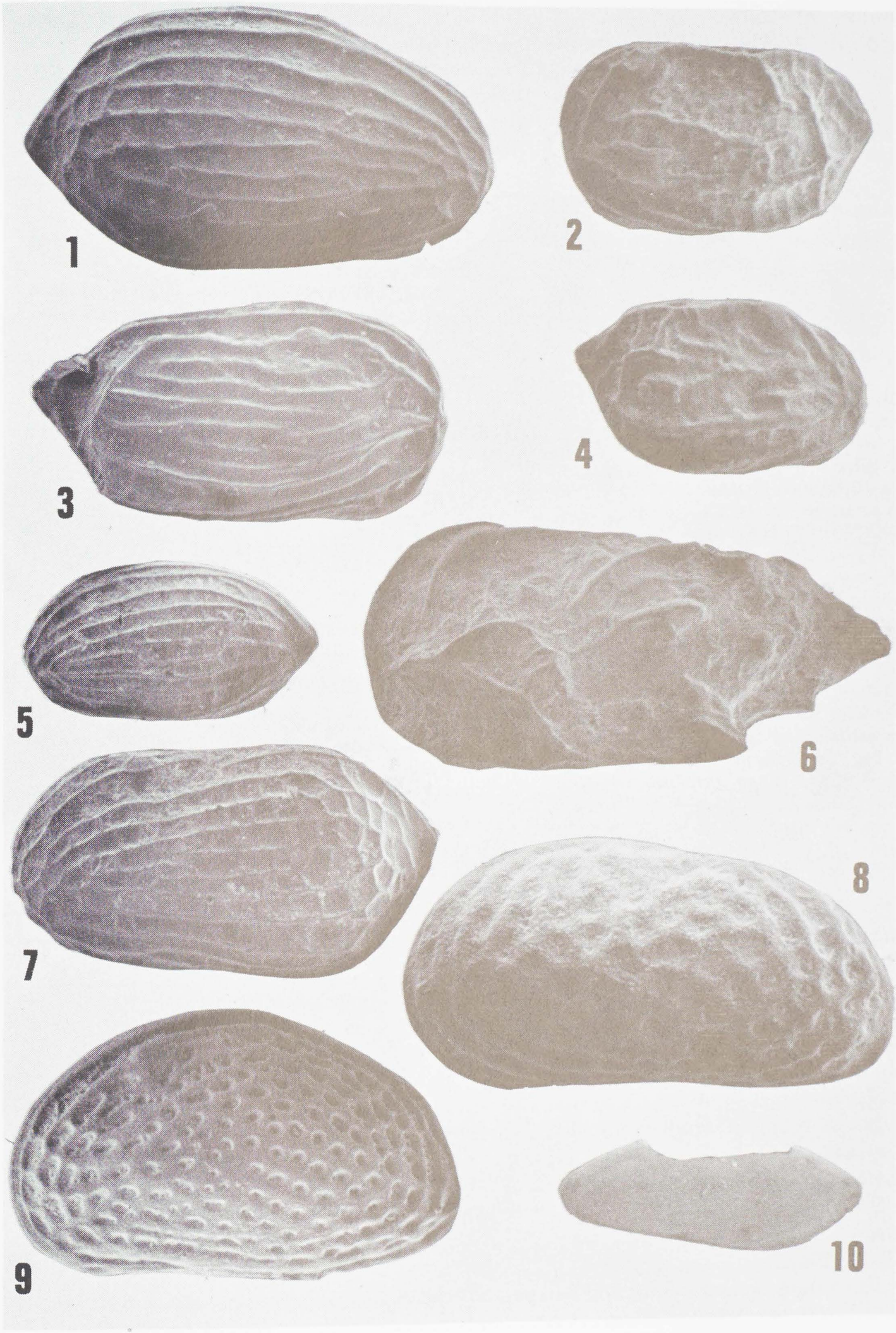

PLATE 2

MATERIAL: Two damaged right valves and one juvenile valve.

REMARKS: The material is insufficient for identification at the species level. The damaged adults were recovered from the sample taken at locality TU 580; the juvenile is from TU 733.

Genus MEGACYTHERE Puri, 1960

REMARKS: See Hall's (1965) discussion of the validity of this genus.

MEGACYTHERE EDWARDSI
Kontrovitz, n. sp.
Plate 4, figures 5, 6

DIAGNOSIS: Distinguished by the straight dorsum and sinuous ventrum that converge anteriorly, the acutely rounded caudal process in the right valve and the ornamentation of numerous sinuous longitudinal ridges and cross-ridges that give a reticulate appearance.

DESCRIPTION: Moderately calcified, medium size. Trapezoidal in lateral view. Dorsal margin is nearly straight; ventral margin is sinuous and converging anteriorly. Anterior margin broadly rounded; posterior margin, broadly rounded below mid-height, an acutely rounded caridal process at mid-height; above, straight and sloping up to posterior cardinal angle. No dimorphic features.

Surface: Reticulate, with about nine to 12 sinuous horizontal ridges; cross-ridges are distinct but less pronounced. Ornamentation becomes weak near anterior and posterior margins.

Internal features: Hinge, right valve, anterior element is elongate and curved with convex side toward center of valve, enlarged at anterior, A socket lies above anterior element. Medial element, an indistinct groove. Posterior element is an enlarged extension of selvage from posterior. Left valve, a long medial bar is enlarged anteriorly into a high thin tooth; bar is also slightly enlarged at posterior.

Marginal area, widest at anterior, narrows slightly at posteroventral and ventral regions. Anterior vestibule is distinct. Radial pore canals, widely spaced, often bifurcating with funnel-shaped openings at anterior; few false.

Muscle scars not observed.

HOLOTYPE: Left valve, figured, USNM 236006; length .60 mm, height .30 mm.

PARATYPES: Right valve, figured, USNM 236007; length .55 mm, height .29 mm. Left valve, USNM 236008; length .60 mm, height .30 mm. Right valve, USNM 236009; length .59 mm, height .33 mm. Left valve, USNM 236010; length .61 mm, height .31 mm.

TYPE LOCALITY: Tulane University Department of Geology Locality 201 (see section VIII of this report).

DIMENSIONS: Right valves, length .55-.61 mm; height .29-.33 mm; left valves, length .60-.63 mm; height .29-.32 mm.

MATERIAL: Fourteen valves.

REMARKS: This species differs from *Megacythere striata* (Puri, 1953b), by the presence of a distinctly reticulate surface. *Megacythere robusta* Puri, 1960, is similar, but the new species described here can be distinguished by its lack of large scattered normal pore canals, the greater length/height ratio (2), its smaller size and more distinctly reticulate ornamentation. This species is named in honor of Dr. Richard A. Edwards,

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PLATE 3

Figures

PLATE 3

University of Florida, who introduced the writer to the study of micropaleontology.

Subfamily CYTHEROMATINAE
Elofson, 1939
Genus PELLUCISTOMA
Coryell and Fields, 1937
PELLUCISTOMA sp. aff. P. ATKINSI
Hall, 1965
Plate 4, figure 7

DIMENSIONS: Left valve, length .56 mm; height .29 mm.

MATERIAL: Sixteen valves, of which 11 are juveniles.

REMARKS: The external outline and most of the internal features of this species are similar to those of *P. atkinsi* Hall, 1965. The latter differs by having obviously branching radial pore canals and in being smaller than the species reported here.

Family TRACHYLEBERIDIDAE
Sylvester-Bradley, 1948
Subfamily TRACHYLEBERIDINAE
Sylvester-Bradley, 1948
Genus ACTINOCYTHEREIS Puri, 1953
ACTINOCYTHEREIS TRIANGULARIS
Morales, 1966
Plate 4, figure 10

Actinocythereis cf. *A. exanthemata* (Ulrich and Bassler). CURTIS, 1960, p. 478, pl. 3, fig. 10 (not *Cythere exanthemata* Ulrich and Bassler, 1904, p. 117-118, pl. 36, figs. 1-5).

Actinocythereis sp. aff. *A. exanthemata* (Ulrich and Bassler). BENSON and COLEMAN, 1963, p. 48, pl. 6, fig. 12, text figs. 31a-d.

Actinocythereis triangularis MORALES, 1966, p. 80-81, 83, pl. 8, figs. 1a-d.

DIMENSIONS: Carapace, ? female, length .75 mm; height .40 mm; width .38 mm.

MATERIAL: Two carapaces, 13 valves.

REMARKS: These specimens are larger than those described by Morales (1966) from the southeast coast of Mexico; the size is similar to those from the west coast of Florida (Benson and Coleman, 1963). The radial pore canals are slightly curved at the anterodorsal and anteroventral margins in these valves. This species differs from *Actinocythereis vandenboldi* Kontrovitz, 1976, by its rounded, not pointed posterior and its less distinct ornamentation that is arranged in a different pattern.

ENVIRONMENT: Previously reported from modern sediments deposited in shallow brackish and marine waters; subtropical and tropical.

Genus NEOCAUDITES Puri, 1960

PLATE 4

Figures Page

1. *Loxoconcha* sp. cf. *L. matagordensis* Swain, carapace, left valve USNM 236029, X100 146
2. *Loxoconcha* sp. cf. *L. sarasotana* Benson and Coleman, right valve USNM 236030, X100 145
3. *Loxocorniculum fischeri* (Brady), left valve USNM 236031, X100 146
4. *Loxocorniculum postdorsolatum* (Puri), left valve USNM 236032, X100 146
5. *Megacythere edwardsi* Kontrovitz, n. sp., Paratype, right valve USNM 236007, X100 150
6. *Megacythere edwardsi* Kontrovitz, n. sp., Holotype, left valve USNM 236006, X100 150
7. *Pellucistoma* sp. aff. *P. atkinsi* Hall, left valve USNM 236042, X100 152
8. *Neocaudites* sp. cf. *N. triplistriata* (Edwards), left valve USNM 236034, X100 154
9. *Cytheromorpha paracastanea* (Swain), left valve USNM 236027, X100 148
10. *Actinocythereis triangularis* Morales, right valve USNM 236011, X100 152

PLATE 4

NEOCAUDITES sp. cf. N. TRIPLISTRIATA
(Edwards, 1944)
Plate 4, figure 8

cf. *Cythereis triplistriata* EDWARDS, 1944, p. 522, pl. 87, figs. 24-26.

Neocaudites triplistricata (Edwards). VAN DEN BOLD, 1963b, p. 389, pl. 8, fig. 4 (with synonymy). SWAIN, 1968, p. D16, pl. 3, figs. 1a-d; text fig. 14. VALENTINE, 1971, p. D8.

DIMENSIONS: Left valve, length .51 mm; height .28 mm.

MATERIAL: Two valves.

REMARKS: There has been some confusion as to the identification of *N. triplistriata* (Edwards, 1944) and *N. nevianii* (Puri, 1960); see van den Bold (1963b), Morales (1966) and Swain (1968). The specimens reported here each have lateral ridges that are not joined at the posterior, therefore this form is not *N. nevianii.*

Subfamily CYTHERETTINAE Triebel, 1952
Genus PROTOCYTHERETTA Puri, 1958
PROTOCYTHERETTA PUMICOSA
(Brady, 1866)
Plate 5, figure 1

Cythere pumicosa BRADY, 1866, p. 379, pl. 61, figs. 3a-c.

Cythere danaiana BRADY, 1869, p. 124, pl. 14, figs. 13, 14. *Not* CURTIS, 1960, p. 478, pl. 2 (top), fig. 2.

Paracytheretta daniana (sic) (Brady). PURI, 1952, p. 210, pl. 40, figs. 10, 11; text fig. 11.

Cytheretta daniana (sic) (Brady). PURI and HULINGS, 1957, p. 174, 187, fig. 11. HULINGS, 1966, p. 46, fig. 6b. HULINGS, 1967, p. 642, fig. 3.

Protocytheretta daniana (sic) (Brady). PURI, 1958b, p. 188, pl. 3, figs. 7-11. PURI, 1960, p. 111, pl. 1, figs. 1, 2; text figs. 18, 19. BENSON and COLEMAN, 1963, p. 26-27, pl. 5, figs. 5, 7, 9, 10; text fig. 13.

Protocytheretta danaiana Brady. HAZEL, 1975, p. 478, 481. VALENTINE, 1971, p. D8.

DIMENSIONS: Left valve, length .96 mm; height .53 mm.

MATERIAL: Six valves and three juvenile valves.

REMARKS: Van den Bold (1971, personal communication) has indicated that *Protocytheretta pumicosa* (Brady, 1866) is a senior synonym of *P. danaiana* (Brady, 1869).

ENVIRONMENT: Previously reported from modern sediments occurring from near the shoreline to water depths of about 152.4 meters; marine; mild temperate, subtropical and tropical.

? Subfamily
Genus BASSLERITES Howe, 1937
BASSLERITES sp.
Plate 5, figure 7

DIMENSTIONS: Carapace, ? female, length .39 mm; height .20 mm; width .16 mm.

MATERIAL: One carapace, two damaged valves.

REMARKS: Exact identification is not possible with these specimens. This form is similar to *Basslerites minutus* van den Bold, 1958b, but differs by having a more rounded posterior cardinal angle in the left valve; the shape of the posterolateral depressions is

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PLATE 5

also different. This species differs from *B. miocenica* (Howe, 1935) by its size and shape and from *B. vokesi* Kontrovitz, 1976, by its less convex dorsal and ventral outlines.

Family XESTOLEBERIDIDAE Sars, 1928
Genus XESTOLEBERIS Sars, 1866
XESTOLEBERIS RIGBYI Morales, 1966
Plate 5, figure 4

Xestoleberis rigbyi MORALES, 1966, p. 87, 89, pl. 8, figs. 4a-d.

DIMENSIONS: Left valve, length .55 mm; height .36 mm.

MATERIAL: One carapace and 18 valves.

ENVIRONMENT: Previously reported from modern sediments deposited at water depths less than 5.5 meters; brackish and marine; tropical.

Family CYCLOCYPRIDIDAE Kaufman, 1900
Genus PHYSOCYPRIA Várva, 1898
PHYSOCYPRIA sp. cf. P. PUSTULOSA (Sharpe, 1897)
Plate 5, figure 2

cf. *Cypria pustulosa* SHARPE, 1897, p. 461-462.
Physocypria pustulosa (Sharpe). SWAIN, 1955, p. 610, pl. 60, figs. 5a, b (with synonymy).

PLATE 5

DIMENSIONS: Carapace, ? female, length .58 mm; height .40 mm; width .30 mm.

MATERIAL: Two carapaces, five valves.

REMARKS: This species is somewhat similar to *Physocypria fadeewi* Dubowski, 1927, as reported by Furtos (1936), but differs by having a more narrow inner lamella and in being more compressed in dorsal view.

ENVIRONMENT: Previously reported from fresh water bodies and from brackish water in the upper portion of San Antonio Bay, Texas (Swain, 1955). Species of this genus have been reported as living only in fresh water (Swain, 1961; Van Morkhoven, 1963).

Family LIMNOCYTHERIDAE Klie, 1938

Genus LIMNOCYTHERE Brady, 1868

LIMNOCYTHERE sp.

Plate 5, figure 3

? *Limnocythere* sp. PURI and VANSTRUM, p. 26, fig. 2.

? *Limnocythere* ? sanctipatricii Brady and Robertson. KEYSER, 1975, p. 490, text fig. 3 (not *Limnocythere sancti-patricii* Brady and Robertson, 1969, p. 17, pl. 18, figs. 8-11; pl. 21, fig. 4).

DESCRIPTION: Moderately calcified, medium size. Right valve, lateral view, trapezoidal, sloping toward posterior; greatest height at anterior cardinal angle. Dorsal margin, straight and sloping toward posterior; ventral margin slightly concave. Anterior margin broadly rounded, posterior more acutely rounded.

Surface: Faintly pitted with a sub-vertical sulcus just in front of mid-length; two nodes, one above the other, just behind mid-length. Lower node gives an alate appearance to valve. Behind lower node, a deep sulcus from ventral margin to mid-height.

DIMENSIONS: Right valve, ? female, length .60 mm; height .34 mm.

MATERIAL: Twenty-three valves.

REMARKS: This species differs from *Limnocythere sanctipatricii* Brady and Robertson, 1869, by being less coarsely pitted, less elongate and by being larger. The specimens are poorly preserved, thus, a complete description is not possible.

ENVIRONMENT: Probably the form reported from the mangrove swamps of southwestern Florida (Keyser, 1975).

Suborder PLATYCOPINA Sars, 1866

Family CYTHERELLIDAE Sars, 1866

Genus CYTHERELLA Jones, 1849

CYTHERELLA sp.

Plate 5, figure 5

DESCRIPTION: Left valve, lateral view, short. Dorsal margin, straight at anterior, sloping behind mid-length. Ventral margin, slightly concave at middle. Anterior margin, broadly rounded; posterior more narrowly rounded. Surface, smooth. Internal features normal for genus.

DIMENSIONS: Left valve, length .57 mm; height .34 mm.

MATERIAL: Seven valves.

REMARKS: The few specimens are insufficient for establishing the identity of this form at the species level.

Genus CYTHERELLOIDEA Alexander, 1929

CYTHERELLOIDEA sp. aff. C. LEONENSIS Howe, 1934

Plate 5, figure 6

DIMENSIONS: Carapace, length .65mm; height .35 mm; width .26 mm.

MATERIAL: One carapace and six valves.

REMARKS: The ornamentation on this form differs from *C. leonensis* Howe, 1934, by being more subdued and in having the dorsal rib flexed inward at about one-third of the length from the anterior. The outline of the carapace is similar to Howe's species.

VIII. LOCALITY DATA

The following are Tulane University fossil locality numbers:

201, "Bermont Formation," pit just south of Belle Glade, Palm Beach Co., Florida.

580, "Bermont Formation," North New River Canal spoil banks, one mile south of South Bay, Palm Beach Co., Florida.

733, "Bermont Formation," North New River Canal spoil banks, one mile north of Florida Highway 80, at South Bay, Palm Beach Co., Florida.

IX. LITERATURE CITED

AGER, D.V., 1963, Principles of Paleoecology: McGraw-Hill Book Co., Inc., New York, 371 p.

AKERS, W.H., 1972, Planktonic Foraminifera and biostratigraphy of some Neogene formations, northern Florida and Atlantic coastal plain: Tulane Stud. Geol. Paleont., v. 9, nos. 1-4, p. 1-139, 60 pls., 3 text figs.

BENDA, W.K., and H.S. PURI, 1962, The distribution of Foraminifera and Ostracoda off the gulf coast of the Cape Romano area, Florida: Gulf Coast Assoc. Geol. Soc., Trans., v. 12, p. 303-341, 12 figs., 8 tables.

BENSON, R.H., and G.L. COLEMAN, 1963, Recent marine ostracodes from the eastern Gulf of Mexico: Kansas Univ. Paleont. Contr., Anthropoda, art. 2, p. 1-52, 8 pls., 31 text figs., 2 tables.

BENSON, R.H., and R.L. KAESLER, 1963, Recent marine and lagoonal ostracodes from the Estero de Tastiota region, Sonora, Mexico (northeastern Gulf of California): Kansas Univ. Paleont. Contr., Arthropoda, art. 3, p. 1-34, 4 pls., 20 text figs.

BOLD, W.A. VAN DEN, 1946, Contributions to the Study of Ostracoda with Special Reference to the Tertiary and Cretaceous of the Caribbean Region: J.H. de Bussy, Amsterdam, 167 p.

BOLD, W.A. VAN DEN, 1950, Miocene Ostracoda from Venezula: Jour. Paleontology, v. 24, no. 1, p. 76-88, 2 pls., 4 figs., 3 tables.

BOLD, W.A. VAN DEN, 1957, Oligo-Miocene Ostracoda from Trinidad: Micropaleontology, v. 3, no. 3, p. 231-254, 4 pls., 2 text figs., 1 table.

BOLD, W.A. VAN DEN, 1963a, The Ostracode genus *Orionina* and its species: Jour. Paleontology, v. 37, no. 1, p. 33-50, 2 pls., 6 text figs.

BOLD, W.A. VAN DEN, 1963b, Upper Miocene and Pliocene Ostracoda of Trinidad: Micropaleontology, v. 9, no. 4, p. 361-424, 12 pls.

BOLD, W.A. VAN DEN, 1965, Middle Tertiary Ostracoda from northeastern Puerto Rico: Micropaleontology, v. 11, no. 4, p. 381-414, 7 pls.

BOLD, W.A. VAN DEN, 1966, Ostracoda from Colon Harbour, Panama: Caribbean Jour. Sci., v. 6, nos. 1-2, p. 43-64, 4 pls.

BOLD, W.A. VAN DEN, 1967a, Ostracoda from the Gatun Formation, Panama: Micropaleontology, v. 13, no. 3, p. 306-318, 2 pls.

BOLD, W.A. VAN DEN, 1967b, Middle Tertiary Ostracoda from northwestern Puerto Rico: Micropaleontology: v. 13, no. 4, p. 381-414, 7 pls., 1 text fig., 5 tables.

BOLD, W.A. VAN DEN, 1968, Ostracoda of the Yague Group (Neogene) of the Northern Dominican Republic: Bulls. Amer. Paleontology, v. 54, no. 239, 106 p., 10 pls., 18 text figs., 20 tables.

BOLD, W.A. VAN DEN, 1971, Ostracode associations, salinity and depth of deposition in the Neogene of the Caribbean region: *in* H.J. Oertli, ed., Paléoécologie Ostracodes, Centre Rech. Pau-SNPA, Bull. 5 suppl., p. 449-460, 5 text figs.

BOLD, W.A. VAN DEN, 1972a, Ostracoda of the La Boca Formation, Panama Canal Zone: Micropaleontology, v. 18, no. 4, p. 410-442, 5 pls.

BOLD, W.A. VAN DEN, 1972b, Contribution of Ostracoda to the correlation of Neogene formations of the Caribbean region: Caribbean Geol. Conf., Trans., no. 6, p. 485-490, 1 text fig., 6 tables.

BOLD, W.A. VAN DEN, 1974, Ostracode associations in the Caribbean Neogene: Verhandl. Naturf. Ges. Basel, v. 84, no. 1, p. 214-221, 4 text figs.

BOLD, W.A. VAN DEN, 1975, Distribution of the *Radimella confragosa* group (Ostracoda, Hemicytherinae) in the late Neogene of the Caribbean: Jour. Paleontology, v. 49, no. 4, p. 692-701, 2 pls., 3 text figs.

BOSQUET, J.A.H., 1852, Descriptions des Entomostraces fossiles des terrains de la France et de la Belgique: Acad. Roy. Sci., Lettres Beaux-Arts Belgique, Mém. Cour. (Brussels), v. 24, p. 1-142, 6 pls.

BRADY, G.S., 1866, On new or imperfectly known species of Ostracoda: Zool. Soc. London, Trans., v. 5, p. 359-393, 6 pls.

BRADY, G.S., 1868, Descriptions of Ostracoda: *in* L. DE FOLIN and L. PERIER, Les Fonds de la Mer, Paris, v. 1, pl. 113-176, 32 pls.

BRADY, G.S., 1869, Descriptions of Ostracoda: *in* L. DE FOLIN and L. PERIER, Les Fonds de la Mer, Paris, v. 1, pl 113-176, 32 pls.

BRADY, G.S., 1880, Report on the Ostracoda dredged by H.M.S. *Challenger* during the years 1873-1876: *Challenger* Rept., Zoology, v. 1, 179 p., 44 pls.

BRADY, G.S., and D. ROBERTSON, 1869, Notes of a week's dredging in the west of Ireland: Annals and Mag. Nat. History (4th ser.) v. 3, p. 353-374, 5 pls.

BUTLER, E.A., 1963, Ostracoda and correlation of the upper and middle Frio from Louisiana to Florida: Louisiana Geol. Survey, Bull., no. 39, 100 p., 6 pls., 6 text figs.

BYRNE, J.V., D.O. LEROY and C.M. RILEY, 1959, The Chenier Plain and its stratigraphy, southwestern Louisiana: Gulf Coast Assoc. Geol. Soc., Trans., v. 9, p. 237-259, 6 pls., 9 text figs.

CHEETHAM, A.H., and J.E. HAZEL, 1969, Binary (presence-absence) similarity coefficients: Jour. Paleontology, v. 43, no. 5, p. 1130-1136, 1 table.

CURTIS, D.M., 1960, Relationship of environmental energy levels and ostracode biofacies in the east Mississippi Delta area: Amer. Assoc. Petroleum Geologists, Bull., v. 44, no. 4, p. 471-494, 3 pls., 17 text figs., 1 table.

DROOGER, C.W., and J.P.H. KAASSHIETER, 1958, Foraminifera of the Orinoco-Trinidad-Paria Shelf: Rept. Orinoco Shelf Exp., v. 4, 108 p., 5 pls., 4 text figs.

DUBAR, J.R., 1974, Summary of the Neogene stratigraphy of southern Florida: *in* R.Q. OAKS and J.R. DUBAR, eds., Post-Miocene Stratigraphy, Central and Southern Atlantic Coastal Plain; Utah State Univ. Press, Logan, p. 206-231, 5 text figs., 9 tables.

EDWARDS, R.A., 1944, Ostracoda from the Duplin Marl (Upper Miocene) of North Carolina: Jour. Paleontology, v. 18, no. 6, p. 505-528, 4 pls.

ENGEL, P.L., and F.M. SWAIN, 1967, Environmental relationships of Recent Ostracoda in Mesquite, Aransas and Copano Bays, Texas Gulf coast: Gulf Coast Assoc. Geol. Soc., Trans., v. 17, p. 408-427, 2 pls., 5 text figs.

FOLK, R.L., 1962, Spectral subdivision of limestone types: *in* W.E. HAM, ed., Classification of Carbonate Rocks, Amer. Assoc. Petroleum Geologists, Mem. 1, p. 62-84, 7 text figs., 3 tables.

FURTOS, NORMA, 1936, Freshwater Ostracoda from Florida and North Carolina: Amer. Midland Naturalist, v. 17, no. 2, p. 491-522, 15 text figs.

GROSSMAN, STUART, 1967, Living and subfossil rhizopod and ostracode populations: *in* Ecology of Rhizopodea and Ostracoda of southern Pamlico Sound region, North Carolina, Kansas Univ. Paleont. Contr., ser. no. 44, Ecology, art. 1, p. 7-82, 21 pls., 17 text figs., 13 tables.

HALL, D.D., 1965, Paleoecology and taxonomy of fossil Ostracoda in the vicinity of Sapelo Island, Georgia: *in* Four Repts. of Ostracode Investigations, NSF Project GB-26, Univ. Michigan, Rept. 1, 79 p., 20 pls., 10 text figs.

HAZEL, J.E., 1968, Pleistocene ostracode zoogeography in Atlantic submarine canyons: Jour. Paleontology, v. 43, no. 3, p. 1264-1271, 3 text figs., 2 tables.

HAZEL, J.E., 1971a, Ostracode biostratigraphy of the Yorktown Formation (upper Miocene and lower Pliocene) of Virginia and North Carolina: U.S. Geol. Survey, Prof. Paper 704, p. 1-13, 6 text figs.

HAZEL, J.E., 1971b, Paleoclimatology of the Yorktown Formation (upper Miocene and Lower Pliocene) of Virginia and North Carolina: *in* H.J. OERTLI, ed., Paléoécologie Ostracodes, Centre Rech. Pau-SNPA, Bull. 5 suppl., p. 361-367, 6 text figs., 1 table.

HAZEL, J.E., 1975, Ostracode biofacies in the Cape Hatteras, North Carolina, area: *in* F.M. SWAIN, ed., Biology and Paleobiology of Ostracoda, Bulls. Amer. Paleontology, v. 65, no. 282, p. 463-487, 8 text figs., 2 tables.

HOWE, H.V., 1934, The ostracode genus *Cytherelloidea* in the Gulf coast Tertiary: Jour. Paleontology, v. 8, no. 1, p. 29-34, 1 pl.

HOWE, H.V. and W.A. VAN DEN BOLD, 1975, Mudlump Ostracoda: *in* F.M. SWAIN, ed., Biology and Paleobiology of Ostracoda, Bulls. Amer. Paleontology, v. 65, no. 282, p. 303-316, 3 pls., 3 text figs.

HOWE, H.V., *et al.,* 1935, Ostracoda of the *Arca* zone of the Choctawhatchee Miocene of Florida: Florida Dept. Conser., Geol. Bull., no. 13, 47 p., 4 pls.

HULINGS, N.C., 1966, Marine Ostracoda from western North Atlantic Ocean off the Virginia coast: Chesapeake Sci., v. 7, no. 1, p. 40-56, 8 figs., 2 tables.

HULINGS, N.C., 1967, Marine Ostracoda from western north Atlantic Ocean between Cape Hatteras, North Carolina, and Jupiter Inlet, Florida: Bull. Marine Sci., v. 71, no. 3, p. 627-659, 6 figs., 1 table.

HULINGS, N.C., and H.S. PURI, 1965, The ecology of shallow water Ostracoda of the west coast of Florida: Pubbl. Staz. Zool., Napoli, v. 33, (suppl.), p. 308-344, 17 figs.

KEIJ, A.J., 1954, Ostracoda, identification and description of species: Rept. Orinoco Shelf Exp., v. 1, p. 218-231, 4 pls.

KEYSER, DIETMAR, 1975, Ostracodes of the mangroves of south Florida: *in* F.M. SWAIN, ed., Biology and Paleobiology of Ostracoda, Bulls. Amer. Paleontology, v. 65, no. 282, p. 489-499, 4 text figs.

KINGMA, J.T., 1948, Contributions to the knowledge of the young-Cenozoic Ostracoda from the Malayan Region: Dissertation Univ. Utrecht, 106 p., 11 pls.

KRUTAK, P.R., 1971, The Recent Ostracoda of Laguna Mandinga, Veracruz, Mexico: Micropaleontology, v. 17, no. 1, 4 pls., 10 text figs., 6 tables.

KONTROVITZ, MERVIN, 1976, Ostracoda from the Louisiana Continental Shelf: Tulane Stud. Geol. Paleont., v. 12, no. 2, p. 49-100, pls. 1-8, 5 text figs., 1 table.

KORNICKER, L.S., 1961, Ecology and taxonomy of Recent Bairdiinae (Ostracoda): Micropaleontology, v. 7, no. 1, p. 55-70, 1 pl., 10 text figs., 3 tables.

MADDOCKS, R.F., 1969, Revision of Recent Bairdiidae (Ostracoda): U.S. National Museum, Bull., no. 295, 126 p., 63 figs., 2 tables.

MALKIN, D.S., 1953, Biostratigraphic study of Miocene Ostracoda of New Jersey, Maryland, and Virginia: Jour. Paleontology, v. 27, no. 6, p. 761-799, 5 pls., 14 text figs.

McGINTY, T.L., 1970, Mollusca of the "Glades" unit of southern Florida: Part 1 Introduction and observations: Tulane Stud. Geol. Paleont., v. 8, no. 2, p. 53-58.

McLEAN, J.D., JR., 1957, The Ostracoda of the Yorktown Formation in the York-James Peninsula of Virginia: Bulls. Amer. Paleont., v. 38, no. 167, p. 57-103, 5 pls.

McLEAN, J.D., JR., 1966, Miocene and Pleistocene Foraminifera and Ostracoda of southeastern Virginia: Virginia Division Mineral Resources, Rept. Invest., no. 9, 123 p., 23 pls., 5 text figs., 5 tables.

MORALES, G.A., 1966, Ecology, distribution and taxonomy of Recent Ostracoda of the Laguna de Terminos, Campeche, Mexico: Univ. Nacional Auto. de Mexico, Bol. 81, 118 p., 8 pls., 46 text figs., 1 table.

OLSSON, A.A. and R.E. PETIT, 1964, Some Neogene Mollusca from Florida and the Carolinas: Bulls. Amer. Paleontology, v. 47, no. 217, p. 509-574, 7 pls.

PLUMLEY, W.J., *et al.,* 1962, Energy index for limestone interpretation and classification: *in* W.E. HAM, ed., Classification of Carbonate Rocks, Amer. Assoc. Petroleum Geologists, Mem. 1, p. 85-107, 5 pls., 5 text figs., 1 table.

PLUSQUELLEC, P.L., and P.A. SANDBERG, 1969, Some genera of the ostracode subfamily Campylocytherinae: Micropaleontology, v. 15, no. 4, p. 427-480, 10 pls.

POAG, C.W., 1974, Late Oligocene ostracodes from the United States Gulf coastal plain: Revista Española de Micropaleontologia, v. 6, no. 1, p. 39-74, 10 pls., 2 text figs.

POOSER, W.K., 1965, Biostratigraphy of Cenozoic Ostracoda from South Carolina: Kansas Univ. Paleont. Contr., Arthropoda, art. 5, p. 1-80, 22 pls., 7 text figs.

PURI, H.S., 1952, Ostracode genera *Cytheretta* and *Paracytheretta* in America: Jour. Paleontology, v. 26, no. 2, p. 199-212, 2 pls., 4 text figs.

PURI, H.S., 1953a, The ostracode genus *Hemicythere* and its allies: Washington Acad. Sci., Jour., v. 43, no. 6, p. 169-179, 2 pls.

PURI, H.S., 1953b, Contributions to the study of the Miocene of the Florida Panhandle: Florida Geol. Survey, Bull., no. 36, 345 p., 13 pls., 14 text figs., 12 tables.

PURI, H.S., 1953c, Taxonomic comment on: "Ostracoda from wells in North Carolina, part 1: Cenozoic Ostracoda" by F.M. Swain: Jour. Paleontology, v. 27, no. 5, p. 750-751.

PURI, H.S., 1958a, Ostracode genus *Cushmanidea:* Gulf Coast Assoc. Geol. Soc., Trans., v. 8, p. 171-182, 2 pls., 2 tables.

PURI, H.S., 1958b, Ostracode subfamily Cytherettinae: Gulf Coast Assoc. Geol. Soc., Trans., v. 8, p. 183-196, 3 pls., 2 text figs., 2 tables.

PURI, H.S., 1960, Recent Ostracoda from west coast of Florida: Gulf Coast Assoc. Geol. Soc., Trans., v. 10, p. 107-149, 6 pls., 46 text figs., 1 table.

PURI, H.S., and N.C. HULINGS, 1957, Recent ostracode facies from Panama City to Florida Bay area: Gulf Coast Assoc. Geol. Soc., Trans., v. 7, p. 167-190, 11 figs.

PURI, H.S., and V.V. VANSTRUM, 1971, Stratigraphy and paleoecology of late Cenozoic sediments of south Florida: *in* H.J. OERTLI, ed., Paléoécologie Ostracodes, Centre Rech. Pau-SNPA, Bull. 5 suppl., p. 433-448, 4 figs.

RUMNEY, G.R., 1968, Climatology and the World's Climates: Collier-MacMillan, Ltd., London, 656 p.

SANDBERG, P.A., 1964a, Larval-adult relationships in some species of the ostracode genus *Haplocytheridea:* Micropaleontology, v. 10, no. 3, p. 357-368, 2 pls.

SANDBERG, P.A., 1964b, The ostracode genus *Cyprideis* in the Americas: Acta. Univ. Stockholmiensis, Contr. Geol., v. 12, 178 p., 22 pls., 33 text figs., 5 tables.

SANDBERG, P.A., 1965, Notes on some Tertiary and Recent brackish-water Ostracoda: Staz. Zool. Napoli, Pubbl., v. 33, Suppl., p. 496-514, 3 pls., 1 text fig.

SHARPE, R.W., 1897, Contribution to a knowledge of the North American freshwater Ostracoda in the families Cytheridae and Cyprididae: Illinois Lab. Nat. Hist., Bull., v. 4, p. 414-482, 10 pls.

STEPHENSON, M.B., 1938, Miocene and Pliocene Ostracoda of the genus *Cytheridea* from Florida: Jour. Paleontology, v. 12, no. 2, p. 127-148, 2 pls.

STEPHENSON, M.B., 1941, Notes on the subgenera of the ostracode genus *Cytheridea:* Jour. Paleontology, v. 15, no. 4, p. 424-429, 20 text figs.

STEPHENSON, M.B., 1944, New Ostracoda from subsurface middle Tertiary strata of Texas: Jour. Paleontology, v. 18, no. 2, p. 156-161, 1 pl.

SWAIN, F.M., 1955, Ostracoda of San Antonio Bay, Texas: Jour. Paleontology, v. 29, no. 4, p. 561-646, 5 pls., 39 text figs.

SWAIN, F.M., 1961, Family Cyclocyprididae Kaufmann: *in* R.C. MOORE, ed., Treatise on Invertebrate Paleontology, Part Q, Arthropoda 3, p. 234.

SWAIN, F.M., 1968, Ostracoda from the upper Tertiary Waccamaw Formation of North Carolina and South Carolina: U.S. Geol. Survey, Prof. Paper 573-D, p. D1-37, 7 pls., 30 text figs., 2 tables.

SWAIN, F.M., 1974, Some upper Miocene and Pliocene (?) Ostracoda of Atlantic coastal region for use in hydrogeologic studies: U.S. Geol. Survey, Prof. Paper 821, p. 1-50, 13 pls., 1 text fig.

TRESSLER, W.L., 1949, Marine Ostracoda from Tortugas, Florida: Washington Acad. Sci., Jour., v. 39, no. 10, p. 335-343, 25 figs., 1 table.

TREWARTHA, G.T., 1954, An Introduction to Climate: McGraw-Hill Book Co., Inc., N.Y., 402 p.

ULRICH, E.O., and R.S. BASSLER, 1904, Systematic Paleontology of the Miocene deposits of Maryland: Ostracoda: Maryland Geol. Survey, Miocene volume, p. 98-130, 4 pls.

VALENTINE, P.C., 1971, Climatic implication of a late Pleistocene ostracode assemblage from southeastern Virginia: U.S. Geol. Survey, Prof. Paper 683-D, p. D1-28, 4 pls., 11 text figs., 2 tables.

VAN MORKHOVEN, F.P.C.M., 1963, Post-Palaeozoic Ostracoda, v. 2: Elsevier Publ. Co. Amsterdam, 478 p.