THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

BY

JULIA GARDNER

PART II. ASTARTACEA, CARDITACEA, CHAMACEA

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DISTRIBUTION OF THE FAUNA

The following list shows the localities cited by number in the text and tables:

75. 6 miles west of Gainesville, Alachua County, Fla.
322b. Nigger Sink, 8 miles north of Newmansville, Alachua County, Fla.
323. Near Hawthorn, Alachua County, Fla.
356. Sullivan's field, Levy County, Fla.
359. Chimney Rock Quarry, half a mile north of Gainesville, Alachua County, Fla.
360. Preston's marl bed, 3½ miles north of Waldo, Alachua County, Fla.
361. Hogtown Creek, at old mill 2 miles northwest of Gainesville, Alachua County, Fla.
365. Johnsons Sink, 4 miles northwest of Hawthorn, Levy County, Fla.
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373. Phosphate rock of the Devil's Mill Hopper, 5 miles southwest of Gainesville, Alachua County, Fla.
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2116. Lapenotiere's Hammock, on Sixmile Creek, 1½ miles south of Orient Station, Hillsborough County, Fla.
2211. Lower bed, Alum Bluff, Liberty County, Fla.
2212. Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.
2213. 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.
2214. Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.
2238. Flournoy's mill race, 2 miles east of Argyle, Walton County, Fla.
2302. 2 miles west of Tallahassee, Leon County, Fla.
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2324. White Sulphur Springs (White Springs), Suwannee River, Hamilton County, Fla.
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2611. West bank of Suwannee River, SW. 1/4 NW. 1/4 SE. 1/4 sec. 8, T. 4 S., R. 11 E., near Dell, Lafayette County, and 15 miles south of Ellaville, Madison County, Fla.
2612. West bank of Suwannee River just below a sulphur spring 2½ miles below 2611, Lafayette County, 17 miles south of Ellaville, Madison County, Fla.
2645. McClellan farm, Shoal River, 5 miles west of Moseshead, Walton County, Fla.
2646. Oak Grove, Yellow River, Okaloosa County, Fla.
2652. Horse Creek, 1½ miles south of Oak Grove, Okaloosa County, Fla.
2653. "Otaheite beds," on east Blackwater Creek, 15 miles west of Oak Grove, Okaloosa County, Fla.
2675. 1 mile south of railroad bridge at Milligan, Okaloosa County, Fla.
2823. West bank of Suwannee River just below sulphur spring 2½ miles below 2612, 19½ miles south of Ellaville, Madison County, Fla.
2868. Fuller's earth bed, Quincy, Gadsden County, Fla.
3173. "Fuller's earth" mines of Chesebrough Co., Quincy, Gadsden County, Fla.
3385. Gastropod Gulch, 4 miles southeast of Bainbridge, Decatur County, Ga.
3386. Roseland Plantation, 3½ miles southeast of Bainbridge, Decatur County, Ga.
3396. Sam Dickenson's field, 7 miles southeast of Bainbridge, Decatur County, Ga.
3417. Alum Bluff, 35 miles below railroad bridge over Apalachicola River, Liberty County, Fla.
3419. McClelland farm 1 mile below Baileys Ferry, Calhoun County, Fla.
3424. J. C. Henderson's well, western limits of Tallahassee, Leon County, Fla.
3704. Quincy, Gadsden County, Fla.
3731. Near Mossyhead, sec. 6, T. 3 N., R. 21 W., Walton County, Fla.
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3773. Three-fourths mile west of Shell Bluff, Shoal River, Walton County, Fla.
3741. Shell Bluff, Shoal River, Walton County, Fla.
3747. 8 miles south of Lake De Funiak, Walton County, Fla.
3748. Summerville mill race, 1 mile east of Argyle, Walton County, Fla.
3749. Allen Senterfeit's mill, 3 or 4 miles north of Campton, Walton County, Fla.
3856. 6 miles west-northwest of Mossyhead, Walton County, Fla.
4966. 1,000 feet above Georgia, Florida & Alabama Railroad bridge over Ochlockonee River, Wakulla County, Fla.
4976. White Springs, Hamilton County, Fla.
4977. W. C. Rose's farm, West Sopchoppy, Wakulla County, Fla.
4978. Rose's Mill Creek, 3 miles west of Sopchoppy, Wakulla County, Fla.
4986. Miller's quarry, 1 mile from Ellenton, Manatee County, Fla.
4991. Ochlockonee River, 1 mile north of Holland, Leon County, Fla.
5079. One-half mile below Shell Bluff, Shoal River, Walton County, Fla.
5080. First ravine below Shell Bluff, Shoal River, Walton County, Fla.
5184. First ravine below Shell Bluff, Shoal River, Walton County, Fla.
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5193. Crowder's Crossing, 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.
5194. 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.
5195. First ravine below Shell Bluff, Shoal River, Walton County, Fla.
5613. Coronet phosphate mine, 5 miles southeast of Plant City, Hillsborough County, Fla.
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5629. Coronet phosphate mine, 5 miles southwest of Plant City, Hillsborough County, Fla.
5630. 100 yards below Oak Grove Bridge, Yellow River, Okaloosa County, Fla.
5631. Oak Grove Bridge, Yellow River, Okaloosa County, Fla.
5632. Oak Grove, Yellow River, Okaloosa County, Fla.
5633. Oak Grove, Yellow River, Okaloosa County, Fla.
6175. Left bank of Suwannee River three-fourths mile above White Springs, Columbia County, Fla.
6196. Rock stratum lying immediately above fuller's earth at Ellenton, Manatee County, Fla.
6197. Limestone underlying fuller's earth at Ellenton, Manatee County, Fla.

6208. Mari underlying phosphate of Pierce Phosphate Co., Pierce, Polk County, Fla.

6209. 2 1/2 miles southwest of Phosphate Mining Co.'s pit No. 4, Mulberry, Polk County, Fla.

6769. East bank of Suwannee River at wagon bridge at White Springs, Hamilton County, Fla.

6775. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6776. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6778. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6783. Langston's Sink, about 4 miles northwest of Lake City, on road to White Springs, Columbia County, Fla.

6800. Preston Sink, 3 miles north of Waldo, Alachua County, Fla.

6801. Lochloosa Creek, near Magnesia Spring, about 3 miles west of Hawthorn, Alachua County, Fla.

7054. 400 feet below bridge, Oak Grove, Okaloosa County, Fla.

7165. Old Senterfeit mill, 4 1/2 miles southwest of Laurel Hill, Walton County, Fla.

7148. Gastropod Gulch, 5 1/2 miles southeast of Bainbridge, Decatur County, Ga.

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7183. Alum Bluff (lower bed), Liberty County, Fla.

7256. Look and Tremble Shoals, Chipola River, Calhoun County, Fla.

7257. Sexton's marl bed, sec. 11, T. 1 N., R. 10 W., Tennmile Creek, Calhoun County, Fla.

7261. Upper Alaqua Lethu (?) Bluff, near De Funiak Springs, Walton County, Fla.

7284. De Funiak Cardium beds, Alaqua Creek, Walton County, Fla.

7468. Sopehopy, Wakulla County, Fla.

7847. Lake Butler, Bradford County, Fla.


9657. Gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6 1/2 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

9958. Site of Flournoy's old mill, about 1 1/2 miles northeast of Argyle, Walton County, Fla.

9959. One-fourth mile west by north of Pleasant Ridge Church, 5 2/3 miles southwest of De Funiak Springs, Walton County, Fla.

9960. Folk's Creek, sec. 21 or 22, T. 3 N., R. 18 W., 6 miles south of Argyle and 1.7 miles from Eucheeanna, Walton County, Fla.

9961. Horse Creek, 1 1/2 miles south of Oak Grove, Okaloosa County, Fla.

9994. John M. P. McColland's farm, Chipola River, Calhoun County, Fla.

10596. Waldon Bridge over Bruce Creek, 5 miles west of Red Bay, Walton County, Fla.

10603. Gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

10608. White's Creek, half a mile below bridge on Eucheeanna-Knox Hill road, Walton County, Fla.

10609. The Woodyard, three-fourths mile above Shell Landing, Holmes Creek, Washington County, Fla. (lower bed).

10610. The Woodyard, three-fourths mile above Shell Landing, Holmes Creek, Washington County, Fla. (upper limestone.)

10611. White's Creek near water's edge, half a mile below bridge over creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

10612. Chester Spence's farm, 5 miles southwest of De Funiak Springs, at head of Sconter's Mill Creek, Walton County, Fla.

10658. Shell Bluff, Shoal River, 6 miles west-northwest of Mossyhead, Walton County, Fla.

10659. Tanner's mill (Old Senterfeit mill), 4 miles southwest of Laurel Hill, Okaloosa County, Fla.

10660. Lower bed, Alum Bluff, Liberty County, Fla.

10661. Godwin Bridge over Shoal River, 5 to 6 miles northwest of Mossyhead, Walton County, Fla.

10662. Lower bed, Shoal River, between Godwin Bridge and Shell Bluff, 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.

10663. Crowder's Crossing, 1 1/2 miles below Shell Bluff, Shoal River, Walton County, Fla.

10869. Boynton Landing, 4 miles east of Miller's Ferry, Washington County, Fla.

10869. Folk's Creek, 6 miles south of Argyle, Walton County, Fla.
THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

By JULIA GARDNER

PART II. ASTARTACEA, CARDITACEA, CHAMACEA

INTRODUCTION

The first of the series of papers upon the Mollusca of the Alum Bluff group covered the orders of the Prionodesmacea and the Anomalodesmacea. The Mollusca were by the beginning of Miocene time so far advanced in development that the great majority are included under the highest of the three orders, the Teleodesmacea, characterized in the adult stages by the differentiation of the hinge teeth into distinct cardinals and laterals. This paper, the second of the series, covers the most primitive of the Teleodesmacea in the Alum Bluff group. All three of the superfamilies considered—the Astartacea, the Carditacea, and the Chamacea—are included under Dall's group of the Diogenodonta, which is characterized in the normal forms by one or two laterals and not more than three cardinals. The Carditacea are very closely related to the Astartacea in hinge armature but differ in the development of a pronounced radial sculpture. The Chamacea have until recently been considered an offshootting group from the Carditacea that have been greatly modified by their sessile habit. Some doubt has been thrown upon this relationship by the late morphologic studies of Odhner.

The Alum Bluff group, from which the fauna in question is derived, is divided in descending order into three formations, each of them highly fossiliferous—the Shoal River formation, the Oak Grove sand, and the Chipola formation. The Chipola carries a subtropical highly diversified fauna conspicuously rich in gastropods. The Oak Grove fauna includes little more than half as many species as that of the Chipola, but some of them, particularly among the bivalves, are exceedingly numerous. The temperature was probably lower than in the Chipola epoch and the water more shallow. In the uppermost formation, the Shoal River, the cool-water element is still strong, and there is evidence of the continued retreat of the sea. The Chipola fauna, as one might expect, is apparently the most widely spread. It has been recognized not only in west and west-central Florida but also on Savannah River and in eastern Texas. The Oak Grove is well developed in western Florida and is probably present across the line in southwestern Georgia and possibly in the Mobile well in southern Alabama at a depth of 1,000 feet. The Shoal River formation is restricted in its known distribution to western Florida. The detailed discussion of the stratigraphy of the Alum Bluff group will follow the systematic treatment of the fauna.
### Local distribution of species of Astartacea, Cardiacea, and Chamacea

<table>
<thead>
<tr>
<th>Species</th>
<th>Georgia—Oak Grove sand</th>
<th>Florida—Chipola formation</th>
<th>Florida—Oak Grove sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astarte eugonia Gardner, n. sp.</td>
<td>3268 Near St. Marks, Ga.</td>
<td>1869 6 miles south of Apalachee</td>
<td>1869 6 miles south of Apalachee</td>
</tr>
<tr>
<td>(Astarte) mima Gardiner, n. sp.</td>
<td>3268</td>
<td>1869 6.2 miles south of Apalachee</td>
<td>1869 6.2 miles south of Apalachee</td>
</tr>
<tr>
<td>(Bythiamena) isocoles Gardiner, n. sp.</td>
<td>3268</td>
<td>1909 Upper bed of Wood</td>
<td>1909 Upper bed of Wood</td>
</tr>
<tr>
<td>(Bythiamena) Wagneri Dall</td>
<td>3268</td>
<td>1909 1 mile west of Topeka</td>
<td>1909 1 mile west of Topeka</td>
</tr>
<tr>
<td>Crassatellides (Scambula) chitipina Dall</td>
<td>3268</td>
<td>1922 1 mile below Pickton</td>
<td>1922 1 mile below Pickton</td>
</tr>
<tr>
<td>Crassatellides (Crassinella) trianulatus Dall</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
<tr>
<td>tanicus Dall</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
<tr>
<td>Cardita (Carditana) mima Gardiner, n. sp.</td>
<td>3268</td>
<td>1922 1 mile below Pickton</td>
<td>1922 1 mile below Pickton</td>
</tr>
<tr>
<td>Venericardia brandi Dall</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
<tr>
<td>Venericardia (Pleurocerida) tellia Dall</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
<tr>
<td>Venericardia (Pleurocerida) tellia Dall</td>
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<td>3419 1 mile below Wales</td>
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</tr>
<tr>
<td>Pseudochama chitipina (Dall)</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
<tr>
<td>Pseudochama (Pholos) arcinella (Linnæus) Dall</td>
<td>3268</td>
<td>3419 1 mile below Wales</td>
<td>3419 1 mile below Wales</td>
</tr>
</tbody>
</table>

### Florida—Oak Grove sand

<table>
<thead>
<tr>
<th>Florida—Shoal River formation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Florida—Oak Grove sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astarte eugonia Gardner, n. sp.</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>(Astarte) mima Gardiner, n. sp.</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>(Bythiamena) isocoles Gardiner, n. sp.</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>(Bythiamena) Wagneri Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
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<td>Crassatellides (Scambula) chitipina Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
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<td>Crassatellides (Crassinella) trianulatus Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>tanicus Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>Cardita (Carditana) mima Gardiner, n. sp.</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>Venericardia brandi Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>Venericardia (Pleurocerida) tellia Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>Pseudochama chitipina (Dall)</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
<tr>
<td>Pseudochama (Pholos) arcinella (Linnæus) Dall</td>
<td>2005 4.5 miles northward of Plymouth Hill</td>
</tr>
</tbody>
</table>

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**Note:** Prolific; a, abundant; c, common; p, present; r, rare (not more than half a dozen individuals). The localities within each State and formation are arranged in geographic order from north to south and from west to east. Peninsular localities not listed.

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**THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA**
ASTARTACEA, CARDITACEA, CHAMACEA

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA
Class PELUCYPODA
Order TELEODESMACEA
Superfamily ASTARTACEA
Family ASTARTIDAE
Genus ASTARTE Sowerby


Type: Venus scotica Maton = Pectunculus sulcatus Da Costa. (Recent off the British coast.)

Dall 1 described this genus as follows:

Ligament enfolding the resilium, both external on narrow nympha. * * * A certain variability in characters usually stable is a marked feature of the genus. After much study of recent species and the diagnoses of groups found in the literature, I am of the opinion that these variations for the most part are such as can not be properly used for the subdivision of the genus. The crenulation of the margin of the valves is not more than of specific value; the obsolescence of the terminal cardinal teeth of the hinge, the greater or less prominence of the lateral laminae are characters which in this genus I have found inconstant even in the species. The flattening of the umbones, which is so conspicuous a character in many of the fossil species when a series of species is studied, is seen to be so gradually modified between one species and another as to admit of no hard and fast line being drawn between those with and those without this character. By taking a single recent species to compare with some fossil form it may chance that marked discrepancies will be found. These discrepancies will be inconstant.

Astarte not only originated but culminated as early as the Mesozoic. Though represented in the fossil faunas by approximately 300 species, the recent species number only about 20, most of them boreal. The genus is particularly prolific along the northern New England coast.

The distribution of this characteristically cold-water group is suggestive of the temperature during the deposition of the Alum Bluff. The group is apparently absent during the Chipola, represented in the Oak Grove by a single species, and in the Shoal River by four, one of them anticipating the Chesapeake undulata.

Shell rudely quadrate in outline; concentric sculpture rather fine and uniform from the umbones to the basal margin. Astarte eugonia Gardner, n. sp.

Shell rudely trigonal:

Umbones flattened; lunule not depressed directly in front of the umbones. Astarte (Ashtarotha) sina Gardner, n. sp.

Umbones not flattened; lunule depressed directly in front of the umbones.

Shell normally as high as broad, strongly and evenly sculptured from the umbones to the base.

Astarte (Bythiomena) sosceles Gardner, n. sp.

Shell not so high as broad; sculpture commonly feeble and more or less obsolete toward the base in the adult form. . . . . Astarte (Bythiomena) vogneri Dall.


Section ASTARTE s. s.

Type: Venus scotica Maton = Pectunculus sulcatus Da Costa. (Recent off the British coast.)

The restricted section is characterized by the sub-equilateral valves, the convex umbones, the strong middle cardinal of the right valve and anterior cardinals of the left, and the crenate inner margins.

Astarte eugonia Gardner, n. sp.

Plate XVI, Figure 1

Shell small, rather thin, rudely quadrate in outline, moderately inflated from the umbones to the posterior ventral margin; posterior portion of shell compressed. Umbones small, inconspicuous, feebly prosogyrate, flattened at their tips, strongly anterior in position. Posterior dorsal margin rudely parallel to the base; posterior lateral margin squarely truncate; anterior lateral margin bowed slightly in front of the lunule, rounding broadly into the feebly arcuate base. Lunule rather small, narrow, cordate, deeply sunken, sculptured only with increments. Escutcheon narrow, lanceolate, defined by the angulation of the shell and the disappearance of the sculpture. External surface sculptured with about 25 concentric ridges, increasing uniformly in size toward the ventral margin, separated by interspaces of approximately the same width. Hinge rather delicate but badly mutilated; middle cardinal of right valve deltoid, not very stout; anterior cardinal of left valve laminar; other teeth not preserved; anterior margin of right valve and posterior margin of left grooved to receive the beveled margins of the opposite valve. Adductor and pallial scars obscure; anterior adductor small, reniform, set close to the lateral margin; posterior adductor scar larger, less ventral in position. Inner margins finely crenate from the extremity of the lunule to the escutcheon.

Dimensions: Altitude, 5 millimeters; latitude, 5.7 millimeters; semidiameter, 2 millimeters.

Type: U. S. Nat. Mus. No. 352471.

Type locality: No. 5079, half a mile below Shell Bluff, Shoal River, Walton County, Fla.

There is no species which closely approaches this small, subquadrate, uniformly sculptured shell. However, there is little doubt of the generic affinities, although the hinge is so imperfectly known.

Occurrence: Shoal River formation, locality 5079.

Section ASHTAROTHA Dall

Dall 2 characterized this section as follows:

Umbones concentrically sculptured and conspicuously flattened; disk smoother outside of the flattened area; otherwise like Astarte.

Type: Astarte undulata Say. Miocene.

The type is abundant in the Chesapeake Miocene of the middle Atlantic coast. The section, as a whole.

is characteristic of this area, particularly of the Miocene of Maryland.

Astarte (Ashtarotha) sima Gardner, n. sp.

Plate XVI, Figures 2-3

Shell of moderate dimensions, compressed, rudely trigonal. Umbones acute, their sides converging at an angle of a little less than 90°. Anterior end feebly excavated at the lunule, bowed out in front of the lunule; posterior margin obliquely truncate, rounding rather abruptly into the base; base line very slightly arched. Tips of umbones abruptly flattened, feebly prosogyrate. Lunule rather narrow, lenticular in outline, slightly wider in the left valve than in the right, defined chiefly by the disappearance of the concentric sculpture. Escutcheon of approximately the same width as the lunule and defined in the same manner but decidedly more produced. Sculpture flattened; tips of umbones closely sculptured, the obtuse ridges becoming gradually coarser and a short distance away from the apices dying out in a few broad waves; ventral portion of shell smooth except for microscopically fine incremental striae. Ligament external, opisthodetic, mounted on a linear nymph bounded dorsally by a deeply incised groove. Right valve armed with an obsolete anterior cardinal, a heavy, elongate, deltoid middle cardinal, and an atrophied posterior cardinal. Left valve with a robust anterior cardinal and, on the other side of the deep subumbonal socket, an almost equally strong and slightly more elongate middle cardinal; left posterior cardinal fused with the ligamentary nymph; all the cardinals transversely sulcate along their inner faces. Right anterior dorsal margin and left posterior dorsal margin sulcate to receive the beveled edges of the corresponding valve. Muscle impressions distinct, of moderate dimensions, the anterior obliquely ovate, the posterior semieliptical, set a little below the median horizontal, the two joined by a distinct pallial line parallel to the base but at some little distance from it. Inner margins very finely dentate.

Dimensions: Altitude 12.5 millimeters; latitude 13.3 millimeters.

Type: U. S. Nat. Mus. No. 352483.

Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

This species has an ornamentation similar to that of A. undulata Say, its possible descendant, but it is only about half as large as that form, is relatively higher, and has a more restricted sculpture.


Bythiamena, new section

Shell rather small, heavy, concentrically sculptured, characterized by the abrupt depression of that part of the lunule directly in front of the beaks.

Type: Astarte isosceles Gardner, n. sp. (Alum Bluff (Shoal River formation) of Florida.)

Astarte (Bythiamena) isosceles Gardner, n. sp.

Plate XVI, Figures 4-8

Shell rather small, heavy, approaching an isosceles triangle in outline, the base straight, the sides nearly equal. Apices narrow, attenuated, arched inward and twisted forward slightly, subcentral in position. Anterior dorsal slope excavated in the lunular region, expanded toward the base; posterior margin oblique or feebly arcuate; base line approximately horizontal, rounding rather abruptly into the lateral margins. Lunule similar in a general way to that of Wagneri but with its peculiarities much exaggerated; outer limits not very sharply marked, defined by the rather gradual disappearance of the concentric sculpture; area inclosed, wide, cordate, persisting almost to the base; beneath the umbones a smaller area less than half the extent of the larger, profoundly depressed, its outer margin bordered by a sharply defined ridge, the outline in the single valves suggesting a resilifer and striated in a similar manner. Escutcheon normal, not very broad nor very well defined, coexistent with the dorsal margin. External surface concentrically corrugated with rather broad, well-rounded ridges elevated high above the surface, regular in size and spacing from the umbones to the base, separated by slightly narrower, concave interspaces, not far from 25 in number. Inner margins finely dentate. Ligament external, opisthodetic, mounted on a slender nymph outlined dorsally by a deeply incised groove. Hinge area very high and much compressed by the invasion of the lunule. Right anterior and posterior cardinals atrophied; the middle cardinal heavy, cuneiform, very high and much produced; the two cardinals in the left valve stout, laminar, elevated and separated by a profound socket for the reception of the middle cardinal of the right valve; all the cardinals transversely striated on their inner faces. Anterior lateral margin of right valve and posterior lateral margin of left valve sulcated to receive the beveled edges of the corresponding valves. Adductor scars rather large for the group, very distinct, the anterior somewhat reniform in outline, the posterior semieliptical, placed a little below the median horizontal and joined by a simple pallial line rather distant from the basal margin.

Dimensions of right valve: Altitude, 9.0 millimeters; latitude, 9.0 millimeters. Left valve of another specimen: Altitude, 7.5 millimeters; latitude, 7.5 millimeters.


Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

Astarte wagneri Dall shares with A. isosceles the peculiar character of the lunule, though it is by no
means so conspicuous a character in the Oak Grove species. They differ further in the larger size and broader, less trigonal outline of \textit{A. wagneri} and its less vigorous and less uniform sculpture.

\textit{A. isoseles} is a common species at the type locality, though it is rare elsewhere.

Occurrence: Shoal River formation, localities 3742°, 5184°.

\textbf{Astarte (Bythiamaena) wagneri Dall}

Plate XVI, Figure 9


Dall described this species as follows:

Shell small, subtrigonal, nearly inequilateral, with high, pointed, convex, prosogyrate beaks overhanging a very short cordonate, deeply excavated lunule; escutcheon narrow, hardly defined; sculpture of about 15 low, rounded, concentric waves with narrower interspaces, and fine, concentric striation more or less obsolete; hinge compressed by the deep lunule, otherwise normal; inner margins smooth; muscular impressions rather small, impressed. Height 10, length 11, diameter 4 millimeters.

The most striking characteristic of this species is the deep and very short lunule.

Type: U. S. Nat. Mus. No. 135849.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The species is rare and most of the individuals badly worn. The same peculiar lunule occurs in \textit{A. isoseles} from the Shoal River but in an even more exaggerated form. The Shoal River species is also much higher relatively than \textit{A. wagneri} and strongly ribbed concentrically from the umbones to the base.

Occurrence: Oak Grove sand, localities 2646°, 9961°. Shoal River formation, localities 9960°, 9957°.

\textbf{Family CRASSATELLITIDAE}

\textbf{Genus CRASSATELLITES Krüger}


Type: \textit{Crassatellites sinuatus} Krüger = \textit{Crassatella gibbosula} Lamarck. (Eocene of the Paris Basin.)

Dall\textsuperscript{2} described this genus as follows:

Shell solid, inequilateral, slightly inequivalve, usually subtrigonal, the posterior end longer; valves closed, the ligament and resilium adjacent and internal; hinge of three cardinal in the right valve, of which the posterior is more or less effaced by the resilium, and two in the left valve; the anterior edge of the right and the posterior edge of the left hinge margin grooved to receive the edge of the opposite valve, which is beveled to serve as a lateral lamina; sculpture chiefly concentric and often obsolete except near the umbones.

The genus originated apparently in the Cretaceous, culminated in the Tertiary, and is represented in the Recent faunas by about 40 species, which are confined chiefly to the tropical seas. In the east coast and Gulf Eocene, and in the east coast Miocene, the genus is one of the most prolific and conspicuous of the bivalves.

Only four species have been recognized in the Alum Bluff, two of them large and heavy shells referable to \textit{Scambula}, the other two small, trigonal species referable to \textit{Crassinella}. Curiously enough, one species of \textit{Scambula} and one of \textit{Crassinella} are characteristic of the Chipola, whereas the other species of \textit{Scambula} and the other \textit{Crassinella} are both of them common to the Oak Grove and Shoal River. \textit{C. (Scambula) chipolanus} is not conspicuously common but the other three species are abundant and widely distributed.

Adult shell exceeding 10 millimeters in altitude:

- Neoponic shell free from sculpture during the first 2 millimeters..........................\textit{Crassatellites (Scambula) chipolanus} Dall.
- Neoponic shell concentrically sculptured during the first 2 millimeters..................\textit{Crassatellites (Scambula) densus} Dall.

Adult shell not exceeding 10 millimeters in altitude:

- Umbonal angle decidedly less than 90° as a rule; concentric sculpture generally sharp. \textit{Crassatellites (Crassinella) triangularis} Dall.
- Umbonal angle approaching 90°; concentric sculpture generally obtusus......\textit{Crassatellites (Crassinella) tanicus} Dall.

\textbf{Section SCAMBULA Conrad}


Type: \textit{Scambula perplana} Conrad. (Upper Cretaceous (Matawan) of New Jersey.)

Conrad characterized this section in 1869 as follows:

Hinge with two approximate teeth in the right valve, the posterior one direct and ending at the apex; a long anterior double tooth parallel with the straight cardinal line; anterior muscular impression small, rounded.

In 1872 he said:

Shell triangular, compressed; in the right valve one direct tooth under the apex, with a pit on each side of it, and a long lateral tooth anteriorly, posterior dorsal margin carinated, which prominent line fits into a doubled lateral tooth, in the opposite valve, left valve with 2 long approximate direct teeth, and a long anterior marginal lateral tooth, pallial line invisible, inner margin finely crenulated on a raised line.

Dall\textsuperscript{4} mentioned the following characters:

Valves with the neoponic shell flattened, the adult usually elongated, the third right cardinal obsolete or absent, the resilium large; the inner margins of the valves rarely crenate but usually smooth.

The type of \textit{Scambula} is commonly given as \textit{subplana}, another species from the Upper Cretaceous of New Jersey, but only the single species \textit{Scambula perplana} is cited by Conrad, both in his original description and in that of 1872.


\textsuperscript{2} Idem, p. 1467.
Crassatellites (Scambula) chipolanus Dall

Plate XVI, Figure 10


1903. Crassatellites (Scambula) chipolanus Dall, idem, pt. 6, p. 1472.

Dall described this species in 1903 as follows:

Shell subtrigonal, solid, in general form resembling C. jamaicaensis, but with the nepticone shell small and smooth or concentrically striate, followed by from two to four conspicuous rather distant concentric undulations, after which the whole surface (except the posterior dorsal area) is finely, closely, concentrically ribbed; other characters as in C. jamaicaensis. Longitude 44, altitude 33, diameter 18 millimeters.

A variety approaches C. jamaicaensis still more nearly by having the ribs obsolete on the middle of the disk. There is, as far as our material goes, no gradation between the two forms in the matter of the nepticone sculpture, but if further researches should demonstrate that such a gradation exists, this form would stand as a variety, chipolanus, of the Jamaican shell.

Type: U. S. Nat. Mus. No. 114713.

Type locality: No. 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

This is a higher shell than C. densus Dall, and the posterior extremity is not so produced nor so squarely truncate. Specific differences show up, even in the young, for the umbones of the Chipola species are more acute and the shell is perfectly flat and free from concentric sculpture until it is a couple of millimeters high. Heavy concentric ridges are then abruptly initiated. In the later Alum Bluff form a fine concentric sculpture is developed at the very tips of the umbones, which gradually strengthens until at 2 or 3 millimeters it is very similar to the earliest sculpture of chipolanus.

C. chipolanus is much less conspicuous in the Chipola fauna than is the analogous C. densus in the Oak Grove and Shoal River.

Occurrence: Chipola formation, localities 10609', 7803', 2212', 2213', 2564', 3419'.

Crassatellites (Scambula) densus Dall

- Plate XVI, Figures 11–14


1903. Crassatellites (Scambula) densus Dall, idem, pt. 6, p. 1472.

Dall described this species in 1903 as follows:

Shell elongate, plump, solid, and thick, the anterior end slightly shorter, the valves subequal; anterior end rounded, posterior end briefly truncate, subbrostrate; lunule and escuteoon subequal, lanceolate, deeply impressed; beaks high, full, flattened at the apex; nepticone shell flat, apeially smooth, with about five low, sharp, concentric rather distant waves, followed on the anterior slope by fine, close, concentric threading; the remainder of the shell smooth except for incremental lines; posterior dorsal area bounded by a rounded radial ridge, in front of which the shell is slightly constricted; halfway between this ridge and the border of the lunule is a second radial ridge but more faint; hinge normal, laminar grooves and adductor scars deep; internal margins of the valves smooth. Longitude 50, altitude 35, diameter 26 millimeters.

This is well-marked and elegant, recalling on a smaller scale the Miocene C. turdifulus.


Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Crassatellites densus is almost equally abundant and widely distributed in the Oak Grove and the Shoal River. This distribution, together with its rather large size and thick shell, makes it one of the more conspicuous elements in the middle and late Alum Bluff. The Oak Grove individuals have as a rule retained their polish better than those from Shoal River, especially on the dorsal portion of the shell in the depression in front of the posterior keel. The Chipola analogue C. chipolanus is decidedly higher and generally heavier. The nepticone sculpture is not initiated at the tips as in C. densus but makes its first appearance when the young chipolanus is about 2 millimeters tall. C. jamaicaensis from the Bowden beds resembles C. chipolanus in outline, but in the character of the nepticone sculpture it is more closely allied to C. densus.


Subgenus CRASSINELLA Guppy


Type: Thetis parva C. B. Adams. (Recent in the West Indies.)

Dall 5 described this group in 1903 as follows:

Shell minute, subtriangular, much compressed; the umbones acute, subcentral; hinge with two cardinals in each valve, the lateral laminae developed, the posterior left lateral lamellae behind the ligament; ligament and resilium internal; inner margins of the valves smooth.

Crassatellites (Crassinella) triangulatus Dall

- Plate XVI, Figure 15


1903. Crassatellites (Crassinella) triangulatus Dall, idem, pt. 6, p. 1476.

Dall described this species in 1903 as follows:

Shell small, solid, rather compressed, subtriangular, subequilateral; dorsal slopes straight, nearly equal; beaks small, subacute, inclined toward each other; lunule and escuteoon narrow, elongate, emphatically impressed, smooth, subequal; sculpture varying from concentrically striate and nearly smooth to rather distantly feebly lamelliform with wider inter-

spaced, the sculpture more distinct, distant, and clean-cut, but
less lamelllose near the beaks; hinge margin narrow; hinge
delicate. Height 3.3, length 3.0, diameter 1.3 millimeters.

Not unlike C. bowdeneensis but more compressed, higher and
shorter, with a different sculpture.

Type: U. S. Nat. Mus. No. 114607.
Type locality: No. 2211, Alum Bluff (lower bed),
Liberty County, Fla.

_Crassatellites_ (Crassinella) _triangulatus_ suggests _lanu-
latus_, which is so abundant in the later Tertiary, in
its general features and in its range of variation.
When the concentric sculpture is laminar, with free
sharp edges laid across the shell at regular intervals
and an irregular concentric sculpture between, the
species is very easily recognized and isolated, but
when the lamination becomes obtuse and restricted
to the apical region the form approaches very closely
to _C. tanicus_ of the Oak Grove and Shoal River.
It runs smaller than _tanicus_, however, and the average
altitude is relatively higher, but it is by the totality
of characters that the two species must be separated.

Occurrence: Chipola formation, localities 10609P,
Shoal River formation, locality 9957P.

_Crassatellites_ (Crassinella) _tanicus_ Dall

Plate XVI, Figure 16

1900. _Crassatellites_ (Crassinella) _tanicus_ Dall, Wagner Free Inst.
    Sci. Trans., vol. 3, pt. 5, pl. 49, fig. 11.
1903. _Crassatellites_ (Crassinella) _tanicus_ Dall, idem, pt. 6, p.
    1477.

Dall described this species in 1903 as follows:

Shell small, resembling the last species (_C. triangulatus_ Dall)
in a general way, but with the concentric sculpture in small,
smooth, low waves, more numerous and distinct on the beaks
and becoming obsolete on the basal half of the shell, which
is nearly smooth; there also appears to be rather more tendency
to inequilaterality. Height 4.3, length 4.0, diameter 2.2 milli-

The sculpture of _C. triangulatus_ is in rather sharp, raspy
lamellae, but that of _C. tanicus_ is in low, rounded, rather flattish
waves.

Type locality: No. 2646, Oak Grove, Yellow River,
Okaloosa County, Fla.

The shell is not quite so small as that of _C. triangu-
latus_ and is usually a little more compressed and rela-
tively broader. The dorsal slopes are nearly straight
and approximately equal, and the base strongly
arcuate, the resulting outline approaching closely in
typical forms to a sector of 90°. The lunule and
escutcheon are coextensive with the dorsal margins,
are decidedly impressed, and are defined both by the
angulation of the valve and the abrupt disappearance
of the concentric sculpture. The sculpture dies away
from the umbones more rapidly as a rule than it does
in _triangulatus_ and is usually absent altogether upon
the ventral portion of the shell. In a number of in-
dividuals there is a very pronounced resting stage
about halfway between the umbones and the base,
and below this the shell increases less rapidly in
latitude and is perfectly smooth. The shell is con-
sequently decidedly higher relatively than the normal	anics and is less ornamented. The fact that this
peculiar outline and conspicuous lack of sculpture
almost invariably accompanies a pronounced resting
stage suggests some local environmental condition but
nothing which might induce permanent characters.
The species is more abundant and more widely
distributed in the Shoal River than in the type
formation.

Occurrence: Oak Grove sand, localities 2646°, 5633°,
7054°, 9961°, 10659°. Shoal River formation, locali-
ties, 3556°, 3742°, 10658°, 5079°, 10661°, 10662°, 3733°,
3748°, 7261°, 7264°, 9960°, 9057°, 10603°, 10608°,
5618°, 9959°.

**Superfamily CARDITACEA**

Dall 4 said:

This group seems to have branched off from the astartoid
radical in the early Mesozoic, forming in one sense a sort of
parallel series with the Astardidae, with which it is contrasted
most obviously by its prevailing radial sculpture and pro-
longed posterior cardinal tooth.”

**Family CARDITIDAE**

Dall 7 gives the following description:

This family is of ancient origin and is represented in the
Mesozoic by several groups. ** **

The hinge has been compared to that of the Veneridae, but
in my opinion the resemblance is slight and superficial. The
venerid hinge has never less than three left cardinals, which
show no traces of torsion, while the Carditidae have never more
than two, and the posterior one invariably long drawn out, a
feature characteristic of the family. The most fully developed
hinge is met with in such forms as _Carditamera_, which exhibits
a hinge with the formula _L_ o.o.o.o.o though the anterior and
posterior right cardinals are in the adult shell almost obscured
by the stem of the anterior right lateral and the nymph respec-
tively, though quite recognizable in the young shells. The
cardinals are almost invariably finely, transversely striated.
In such forms as _Venericardia antiquata_ Linne the formula is
reduced to _L_ o.o.o.o by degeneration. It is evident when such
changes take place in the growth of the individual, and when
certain of the teeth are or may be obsolete in the developed shell,
that too much stress in classification should not be placed on
these mutable features. In fact, the subdivisions of the prin-
cipal genera must be based chiefly on form, the types of which,
it must be acknowledged, are rather unexpectedly constant in
the faunas following that of the early Eocene.

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7 Idem, pt. 6, p. 1406, 1903.
Genus CARDITA (Bruguière) Lamarck


1801. Cardita Lamarck, Système des animaux sans vertèbres, p. 118.

Type: Cardita variegata Lamarck = Cardita calyculata (Bruguière) Linnaeus. (Recent in the Mediterranean.)

Shell slightly gaping ventrally, elongate, subquadrate, very inequilateral. Umbones usually low, notably anterior. Lunule small but well differentiated. Escutcheon ill-defined. Sculpture strong, radial, the ribs commonly imbricated or squamose. Ligament external, opisthodetic, parivincular. Hinge armature cardinals, the posterior much elongated, with the nals, the posterior obliquely elongated, and with an strongly defined. Pallial line simple. Inner margins adduction, in the subgenus Carditamera, of well-defined laterals; hinge of left valve furnished with two cardinals, the posterior obliquely elongated, and with an anterior and a posterior lateral; muscle impressions strongly defined. Pallial line simple. Inner margins crenate.

The genus has been recognized in strata as early as the Triassic. During the Tertiary it constituted one of the more notable elements in the pelecypod faunas, and, though it is never a dominant factor in the recent seas, its distribution in the shallow waters is almost universal.

Section CARDITAMERA Conrad


Type: Cypricardia arata Conrad. (Miocene and Pliocene of the middle and southern Atlantic slope.)

Conrad described this section, which he termed a genus, as follows:

Shell equivalue, oblong; cardinal tooth in the right valve single, much elongated, compressed and nearly parallel with the basal margin; in the left valve two, profoundly diverging, the posterior one corresponding with that in the opposite valve; lateral teeth two, distant, short, pyramidal; muscular impressions large; pallial impression entire.

The genus is nearly allied to Cypricardia, but wants the three cardinal teeth and the long lateral tooth of that genus; from Cardita it is distinguished by the lateral teeth. The projection of the lunule in the right valve gives it the appearance of having two cardinal teeth. I know of this fossil species only, and a recent one nearly allied to it on the coast of Florida.

Shell less than twice as broad as it is high; radii not conspicuously flattened upon their summits.

Cardita (Carditamera) apotegea Gardner, n. sp.

Shell approximately twice as broad as it is high; radii conspicuously flattened upon their summits.

Cardita (Carditamera) defuniak Gardner, n. sp.

Cardita (Carditamera) apotegea Gardner, n. sp.


Dall described C. tegea as follows:

Shell elongate inequilateral, with low, rather anterior beaks and about 16 strong radial more or less carinated and imbricated ribs, the anterior ribs more distinctly and regularly crenulate, the posterior more irregular; the interspaces about as wide as the ribs, and on the anterior half of the shell squarely channeled; posterior end of the shell produced and pointed, anterior end rounded, base mesially slightly concave; lunule small, deeply impressed, the anterior lateral tooth very prominent; hinge teeth normal, rather slender; inner margins of the valves deeply fluted. Length 43, height 24, diameter 22 millimeters. The beaks are situated at about the anterior sixth of the shell. The original figure of this species in Part I was taken from a silicious pseudomorph, which perhaps had been derived from a specimen which had been somewhat worn before being fossilized. Though certainly identical with the Chipola specimens from which the description is written, the sculpture is less well preserved and smoother.

Dall’s description was made for the most part from the specimens from Chipola River, though his type locality is Ballast Point. The earlier species is much more elongated transversely than C. apotegea and probably never attains so great a size. The radials are more commonly 17 or 18 in number than 16. From the anterior margin to the posterior keel they gradually increase in prominence and become less and less closely spaced. There is a gradual transition, too, from the nodose incremental sculpture of the anterior area to the posterior sculpture, characterized by exceedingly fine incremental striae and, especially in the young forms, by here and there a spinose process. There are generally two or three subequal costals which radiate from the umbones to the posterior basal angle and which are coarser and more distinctly spaced than any others upon the shell. Behind them, in most individuals, are two relatively fine lirae and behind these a costal almost as coarse and as spiny as those outlining the posterior angle. The marginal rib is also spinose but not so coarse as that next to it. The costals are all of them abruptly arched and form sharp angles with the flattened interspaces. The muscle impressions are large and very distinct, though united by an obscure pallial line. The figured specimen from Ballast Point, which serves as the type of C. tegea Dall, measures 33.0 millimeters in latitude and 16 millimeters in altitude with a semidiameter of 5.5 millimeters.

Dimensions of right valve: Altitude, 23.5 millimeters; latitude, 41.0 millimeters; semidiameter, 11.3 millimeters. Dimensions of left valve of another specimen: Altitude, 22.5 millimeters; latitude, 40.0 millimeters; semidiameter, 11.3 millimeters.
Type locality: No. 2211, Alum Bluff (lower bed), Liberty County, Fla.

The young forms are higher relatively than the adults and much more inclined to expand posteriorly. C. apotegea is closely allied to the type of the section. The umbones are slightly more prominent in arata, though otherwise the outlines of the two forms are very similar. The number of ribs is also the same in both and they are similarly arranged. The sculpture upon the anterior portion of the shell is, however, less laminar and more nodose on the Chipola species and the sculpture upon the posterior portion more spiny.

The group is by no means so commonly represented in the Alum Bluff as in the later formations. No trace of it has been found in the Oak Grove of Florida, and in the Shoal River it is represented by a single rare and restricted species readily separable from C. apotegea by the smaller size, more elongated outline, lower umbones, and more compressed anterior portion and the rather more numerous, more flattened, and more closely spaced radials. The forms from Decatur County, Ga., are probably identical with this species, though too poorly preserved for positive identification.

Occurrence: Chipola formation, localities 7893°, 2212°, 7257°, 2213°, 2564°, 3419°, 9994°, 2211°, 7183°, 10660°, 16613°. Oak Grove sand, localities 13386°, 13385°, 77148°.

Cardita (Carditamera) defuniak Gardner, n. sp.

Plate XVII, Figure 3

Shell rather small, much elongated transversely, approximately twice as broad as it is high, compressed anteriorly, noticeably expanded along the posterior keel. Umbones low, broadly rounded, acute and prosogyrate at their incurved tips, placed within the anterior fourth in the adult but relatively farther back in the young. Anterior margin steeply sloping at the lunule, bowed out in front of the lunule; posterior dorsal margin parallel to the base except for the broad mesial constriction of the basal margin; posterior lateral margin obliquely truncate, rounding rather abruptly into the base. Lunule small, depressed, bounded by an incised linear groove. Sculpture similar in general character to that of the type of the section; radials 18 (rarely 19), flattened upon their summits, the seven or eight upon the anterior portion of the shell separated by little more than linear interspaces, those upon the medial depression wider and less closely spaced, the two or three upon the posterior keel much more prominent than the others and separated by interspaces of approximately their own width; behind them, as in C. apotegea, two rather fine lirations followed by two moderately prominent marginal ribs, that next the dorsal margin finer than the one in front of it; nodes or spines altogether absent, the incremental lamellae commonly distinct anteriorly though obsolete, as a rule, upon the posterior half of the shell. Inner margins fluted in harmony with the external sculpture. Ligament external, opisthodetic, mounted on a slender and much elongated nymph. Hinges of the only right valves available too badly worn to preserve any but generic characters; left anterior cardinal short, trigonal, separated from the elongated laminar posterior cardinal by an asymmetrically cuneate pit; anterior lateral in left valve merely a small, rather compressed tubercle, the left posterior margin grooved beyond the ligament nymph to receive the posterior lateral of the right valve. Anterior adductor scar large, elliptical in outline, impressed, set far forward just within the expanded anterior margin, the marginal flutings reaching almost to the edge of the scar; posterior adductor rudely quadrato, set high up under the posterior extremity of the dorsal margin so that the ventral limit of the posterior adductor is nearly in line with the dorsal limit of the anterior. Pallial line obscure.

Dimensions: Altitude, 16.0 millimeters; latitude, 32.0 millimeters; semidiameter, 6.5 millimeters.

Type: U. S. Nat. Mus. No. 352477.

Type locality: No. 7264, De Funiak “Cardium beds,” Alacqua Creek, Walton County, Fla.

C. defuniak suggests the Miocene C. protracta in its elongated outline but differs from it and from all the other described species of the group in the simplicity of the costals and their close spacing, especially upon the anterior portion.

Occurrence: Shoal River formation, localities, 7264°, 10608°, 5618°, 19959°.

Genus VENERICARDIA Lamarck

1801. Venericardia Lamarck, Système des animaux sans vertèbres, p. 123.

Type: Venericardia Lamarck, Système des animaux sans vertèbres, p. 123.

Genus Venericardia Lamarck

Shell nonbyssiferous, closed, rounded, trigonal or cordate. Umbones anterior, prosogyrate. Lunule small but deep. Escutcheon narrow and elongate. Sculpture dominantly radial. Ligament external, opisthodetic, parivincular. Hinge dentition in the right valve consisting of three oblique cardinals; in the left valve of two; laterals of both valves absent or very feeble. Muscle impressions strongly defined. Pallial line entire. Inner margins crenate.

The group is largely restricted in the Alum Bluff to the Chipola and Oak Grove formations. Each of these two formations has a characteristic Venericardia s. s., which forms a conspicuous element in the fauna. Each has also a representative of Pleuromeris, the Chipola form, however, being much more common than the Oak Grove and so variable that one race of
variants has been given subspecific rank. An indeterminate species closely allied to the Oak Grove *Pleuromeris scitula* occurs in the Shoal River formation.

Adult shell exceeding 10 millimeters in altitude:

Outline of interior somewhat obliquely elliptical; umbones very strongly anterior. *Venericardia hadra* Dall.

Outline of interior subcircular to elliptical; umbones within the anterior fourth. *Venericardia himerta* Dall.

Adult shell not exceeding 10 millimeters in altitude. *Pleuromeris*.

Outline normally ovate; costals rarely exceeding 13 in number. *Venericardia (Pleuromeris) tellia* s. 1.

Costals very narrow, finely beaded upon their summits. *Venericardia (Pleuromeris) tellia* Dall.

Costals relatively wide, corrugated upon their summits. *Venericardia (Pleuromeris) tellia dase* Gardner, n. subsp.

Outline rounded, trigonal; costals commonly exceeding 13 in number. *Venericardia (Pleuromeris) scitula* Dall.

**Venericardia hadra** Dall

Plate XVII, Figures 11–12


Dall described this species as follows:

Shell solid, robust, obliquely oblong, the beaks full, prominent, prosogyrate, and nearly anterior; anterior side short, bluntly rounded, posterior side longer, compressed, roundly subtruncate behind; sculpture of about 19 radial ribs, of which the posterior five or six are smaller and less elevated than the others; anterior ribs stout, sometimes with a thread or terrace laterally, the summit articulated rather sparsely with small, squarish, transverse nodules, which have a tendency to become obsolete behind and below; interspaces narrower than or subequal to the ribs, partially channeled; lunule extremely small and deeply incised; hinge normal; the anterior cardinal pustular, the interior margins with shallow flutings. Length 47, height 38, diameter 36 millimeters.

A remarkably fine species, abundant in the Chipola beds, and not likely to be confused with any but the following species [*V. himerta* Dall].

The length of the type is 41.5 millimeters; the altitude, 38.0 millimeters; the diameter, 31.0 millimeters.

Type: U. S. Nat. Mus. No. 114730.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The Chipola species is certainly very close to its Oak Grove analogue, and the young hadra, which are relatively higher and more rounded than the adults, are very difficult to separate from the young himerta. Even at this stage, however, the Oak Grove forms show a constantly higher relative altitude. The sculpture characters of the two forms are inseparable, even the microscopically fine honeycomb texture of the intercostals being exhibited by both species. Young hadra are rather easily confused, too, with *Pleuromeris tellia* Dall, though the greater number of costals and their finer sculpture will serve to isolate the hadra.

*Venericardia chipolana* Maury is nothing more than a half-grown hadra. The costals widen very decidedly toward the base, so that the adults appear much more closely and heavily sculptured than the adolescents.

Occurrence: Chipola formation, localities 10610°, 10610°, 7893°, 22120°, 7257°, 22130°, 2564°, 3419°, 9994°, 7151°, 22110°, 2704°, 1677°, 16800°, 15629°, 1486°.

**Venericardia himerta** Dall

Plate XVII, Figure 13


Dall described this species in 1903 as follows:

Shell robust, large, convex, with full, prosogyrate beaks which completely conceal the lunule and are situated at the anterior fourth of the valve; hinge line horizontal, the dorsal margin slightly arched over it, the anterior end produced near the hinge line, rounded, and then curved obliquely toward the lower posterior end of the valve; posterior end very bluntly rounded, almost at right angles to the hinge line; sculpture of about 20 strong, broad, slightly rounded, flattened ribs, crossed by narrow, sharp, low imbrications with their short slopes on the dorsal side, separated by somewhat narrower channeled interspaces, the whole crossed by rather irregular, coarse, concentric striations. In the young the ribs are relatively narrower, higher, and more regularly and distantly imbricate; hinge normal, the hinge plate narrower than in *V. hadra*, the inner margins heavily and deeply fluted. Length 53, height 46, diameter 37 millimeters.

This fine species externally has a good deal the look of *V. hadra*, but on looking at the inner face of an adult valve we see that the beaks in the latter are more anterior, the hinge line broader and more arched, the lunule exposed, and the outline of the disk, omitting the beaks, is nearly a regular oval, while in *V. himerta* the form is more nearly rounded trigonal, more abrupt behind, and more produced just in front of the beaks. The latter species also attains a larger size.

The length of the type is 54.0 millimeters; the height, 52.0 millimeters; the diameter of the single valve, 24.5 millimeters.

Type: U. S. Nat. Mus. No. 164555.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The species listed as *V. himerta* Dall from the "silex beds" of the Tampa formation is apparently an ill-preserved *V. serricosta* Heilprin. It is certainly not the Oak Grove species.

*V. (Pleuromeris) scitula* Dall is much more easily separated from young himerta than is *Pleuromeris tellia* from young hadra. *Pleuromeris scitula* is a more trigonal, less inequilateral form than the juveniles of himerta, the radials are less numerous, less sharply sculptured upon their summits, increase more rapidly in width, and are less arcuate.
Occurrence: Oak Grove sand, localities 2646°, 5632°, 5631°, 5630°, 5633°, 7054°, 9961°, 10659°, 7055°.

Subgenus PLEUROMERIS Conrad

Type: Pleuromeris decemcostata Conrad = Venericardia tridentata Say var. decemcostata Conrad. (Recent off the Florida coast; fossil in the Pliocene and Pleistocene of the southern Atlantic coast.)

Conrad described this group as follows:

Equivalve, triangular, radiately ribbed; hinge in the right valve with one broad, nearly direct concave or broadly furrowed recurved tooth, the upper extremity acute and opposite or above the apex of the shell; hinge in the left valve with three teeth, the anterior one small and fitting into a cavity in the opposite valve.

Venericardia (Pleuromeris) tellia Dall
Plate XVII, Figure 5

Dall described this species as follows:

Shell small, solid, rounded or ovate, slightly inequilateral, with a lanceolate escutcheon and a subcordate, smooth, impressed lunule; sculpture of 12 to 13 narrow, squarish, closely nodulous radial ribs separated by wider interspaces, faintly concentrically striated; beaks rather low, slightly prosogyrate, situated at the anterior third; hinge heavy, the laterals distinct; internal margins strongly fluted. Length 4.0, height 3.5, diameter 2.75 millimeters.

Exceptional specimens may reach a length of 5 millimeters, and some specimens are shorter and higher than others.

Type: U. S. Nat. Mus. No. 114611.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The shell is thinner than in the subspecies dasa, and the costals are more narrow and more finely beaded upon their summits. The sculpture in tellia is more regular than that exhibited by the young of V. hadra, and furthermore the costals are less numerous and less arcuate.

Occurrence: Chipola formation, localities 10609°, 7257°, 2213°, 2564°, 3419°, 7151°, 7183°, 2211°, 10660°.

Venericardia (Pleuromeris) tellia dasa Gardner, n. subsp.
Plate XVII, Figure 6

Dall described this species as follows:

Shell very small, heavy, inflated, subtrigonal in outline. Umbones only slightly anterior. Anterior dorsal slope a little less gentle than the posterior, the base line strongly arcuate, merging with no perceptible break into the rounded lateral margins. Lunule very small, quite deeply impressed. Escutcheon exceedingly narrowly, lanceolate. Radials rather wide, elevated lirae corrugated upon their summits, arcuate upon the anterior part of the shell but more oblique posteriorly; intercostals deeply channeled, not so wide as the costals except toward the lateral extremities. Inner margins fluted in harmony with the external ribbing. Ligament external, opisthodetic, mounted on a slender laminar nymph. Hinge normal for the species but not heavier than in tellia s. s. Muscle scars similar in size and position to those of tellia s. s. but more distinct because of the heavier shell. Pallial line obscure.

Dimensions: Altitude, 3.3 millimeters; latitude, 3.5 millimeters.

Type: U. S. Nat. Mus. No. 352478.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Venericardia tellia dasa differs from tellia s. s. in the heavier shell and less delicate sculpture. The costals are quite wide in the subspecies and corrugated by the incremental sculpture, but they do not appear to be finely beaded upon their summits as in tellia s. s.

In the extreme end members of this subspecies, the costals are reduced to 10 or 11 in number, with a corresponding increase in width. The resulting sculpture is very far removed from that of the type of tellia s. s.

Occurrence: Chipola formation, localities 10609°, 2213°, 2564°, 3419°, 7151°, 7183°.

Venericardia (Pleuromeris) scitula Dall
Plate XVII, Figure 4

Dall described this species as follows:

Shell small, much resembling the last species (Venericardia (Pleuromeris) tellia) but larger, more elevated, and triangular, with 12 to 16 low, broad ribs with narrower interspaces, the ribs crossed by small, elevated, concentric threads or ridges, more prominent distally than in the middle of the disk, and nowhere very conspicuous; lunule and escutcheon smooth, large for the size of the shell, the ribs on the dorsal slopes smaller and feeble than those on the disk; beaks small, high, erect, nearly central. Length 5, height 5, diameter 4 millimeters.

While in many respects similar to the last species, the differences seem to authorize its separation specifically.

Type: U. S. Nat. Mus. No. 135853.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The Oak Grove species runs a little larger than its Chipola analogue and is decidedly higher relatively. The radials are lower and broader as a rule and less arcuate distally. The nearly central umbones, rudely trigonal outline, and broad, straight ribs will also serve to separate this small species from the juvenile V. himerta. Closely allied forms are imperfectly represented in the Shoal River formation.

Occurrence: Oak Grove sand, localities 2646°, 5632°, 5631°, 5630°, 5633°, 7054°, 9961°.

Superfamily CHAMACEA
Family CHAMIDAE

One of the most comprehensive and satisfactory of the group studies has been made upon this family by Odhner, and I offer no apology for incorporating his results into this paper in considerable detail.
Genus CHAMA (Linnaeus) Bruguieré


Type: *Chama lazarus* Linnaeus. (Recent in the Indian Ocean.)

Dall * described this genus as follows:

In the typical *Chama* the shell is sessile, very inequivalve, with the free valve (as in all sessile mollusks) flatter, with more or less lamellose or spiny irregular sculpture; there is no defined lunule; the ligament is narrow, set in a deep, narrow groove, revolving with the rotation of the valves, the resilium sometimes partly separated and deeply submerged; the pallial sinus simple, the adductor scars large, subequal, usually rough, the mantle adhering by minute processes which penetrate the tubules of the inner shell layer in some species. **

The name *Chama* is derived from a Greek word meaning a hiatus or a gap, and hence Da Costa and some of the other early writers objected to the Linnean use of it for a genus which closes very tightly, but the objection has not been sustained.

As is natural, owing to their variability and the fact that the spines or lamellae may in individuals become obsolete, the number of species of *Chama* seems to have been exaggerated by authors. On the other hand, these very factors render it more difficult to discriminate between nearly allied species which may really deserve separation.

Odhner, in his paper listed in the synonomy above, restricts the genus *Chama* to forms characterized by "shell with the apices twisted to the right and the left valve attached to the substratum; nepionic shell very small (about 0.5 millimeter), with concentric and radial sculpture; lateral teeth persistent; no marginal teeth of the adult shell; dentition

\[
\begin{align*}
\text{II} & = 2(a+b) + 4b + 6b + 11 \\
\text{I} & = 3a + 1 + 3b + 5b + 1
\end{align*}
\]

Animal with a finger-shaped coecal appendage projecting forward from the left side of the stomach; nephridia with the pericardial tubes entirely embedded in the distal sacs."

Only a single species of the true *Chama* has been recognized in the Alum Bluff—*C. draconis* Dall—apparently absent in the Oak Grove but present in the Chipola and the Shoal River.

Shell attached in adult stage; the two valves differing widely in convexity:

- Shell attached by right valve—*Chama draconis* Dall.
- Shell attached by left valve—*Pseudochama chipolana* (Dall).
- Shell not attached in adult stage; the two valves not differing in convexity—*Behiinochama arecella* Linnaeus.

**Chama draconis** Dall

Plate XVII, Figures 7–8


Dall describes this species as follows:

Shell irregular, attached by the anterior end of the right valve, which usually acquires a trigrinal or semicircular outline; sculptured on the right valve with a curious, blistered verruculation not unlike convex scales of a saurian or Gila monster, and also at the margin of the attachment with broad, irregular, concentrically striated foliati; on the posterior slope there is a tendency to form two or three radial series of small, rather distant foliati, which, or part of them, are often obsolete; near the posterior dorsal margin is a well-marked radial sulcus and often another parallel to it but much more feeble; left valve much flatter, irregularly concentrically lamellose, the lamellae rising into foliati in two or three radial series behind, the foliati and most of the surface with fine verrucose or partly divaricate radial fluting or threading; adductor scars small; internal margins finely crenulate. Average diameter about 25 millimeters.

This is a rather common species with a surface recalling that of *Echinochama*.


Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The sculpture is more simple and more laminar in character than in *Pseudochama chipolana*, and the twist of the beaks of the attached valve is normally in the opposite direction. Differences between the two species show up even in the prodiosisconch, for that of *C. draconis* is perceptibly more elongated transversely than that of *P. chipolana*. A couple of large right valves in the collections of the National Museum from Shoal River have many characters in common with *draconis*, but they are double the size of the Chipola species and seem to be more finely sculptured radially. The normal form is present, however, in the Shoal River material collected by Mr. Aldrich.


Genus PSEUDOCHAMA Odhner


Type: *Pseudochama cristella* (Lamarck). (Recent from the Gulf of Siam to Java, the Moluccas, and Australia.)

Odhner says:

I have referred this species to a new genus, *Pseudochama*, which comprises the so-called "inverse" Chamas, opposite to the normal or dextrally twisted ones, to which the old name is to be restricted. A complete discussion of this opinion and the reasons for establishing the new genus will be published in a special paper; here I only give a summary of the distinguishing points and the characteristics of the new genus. The dentition of these "inverse" or "sinistral" Chamas is developed in a quite different manner from that of *Chama* s. s.; the final result becomes a feature that is somewhat like the mirror image of the dentition of a *Chama*, so that the attached valves, in the former case the right, in the latter the left end, grow symmetric to each other, which has given rise to a misinterpretation of the conditions prevailing, known as the theory of the symmetric valves, and to a new denomination (by Munier-Chalmas) in opposition to the rule of homology. **

After a close investigation of many forms of Chamas, considering their ontogeny as well as the conchological and the anatomical conditions, I was convinced that a division into the **
two genera Chama and Pseudochama (comprising also Echinochama) is necessary. The distinguishing characteristics are the following:

The dentition in Chama may be expressed (in accordance with Bernard, 1895) thus: Left valve: \[2a + b + 4b II \]
Right valve: \[3a + 3b I \]. That of Pseudochama has the formulae:
Left valve: \[2a 2b 4b II \]
Right valve: \[1 + 3b I \]. The difference is more obvious in young than in older shells. The nepionic shell in Chama is very small (about 0.5 millimeter) and has a distinct sculpture of close radiating and somewhat more distant concentric riblets (cf. Anthony, 1905). In Pseudochama the nepionic shell is sculptured just as in Echinochama with rather remote concentric lamellae, and no or only traces of radiating riblets; further its size is more considerable (1.4 to 2.5 millimeters). There are also some points of difference in the anatomical characteristics, inasmuch as Chama has a stomachal coecum directed forward, which is wanting in Pseudochama, and the nephridia of the former genus have the pericardial tubes wholly embedded in the external sacs, while in Pseudochama they are left uncovered on their median side.

In 1919 Odhner brought out a much more extended and elaborate discussion entitled "Studies on the morphology, the taxonomy and the relations of recent Chamidae." In this paper he characterized his genus as follows:

Shell with the apices twisted to the left and the right valve attached; nepionic shell distinct; adult shell with a left marginal tooth. Animal without lateral coecal appendage of the stomach; nephridia with the pericardial tubes not covered on their median side by the distal sacs.

A detailed study of the conchologic and morphologic characters of the group led him to the following conclusions in regard to its genesis 10:

Our investigation has led to the result that the recent Chamidae must be divided into two well-defined genera Chama and Pseudochama, of which the former is to be derived from sinistral, the latter from dextral forms of Diceras. In consideration of their great agreement in form and the taxonomy and the relations of recent Chamidae. The nepionic shell varies considerably in size in Pseudochama. It seems to be larger in Echinochama (where it attains 2.4 millimeters in length and has six lamellae) than in other forms of Pseudochama (at least P. ferruginea, where it seems to vary from 1.2 millimeters with four lamellae to a somewhat larger size with five, and in P. gryphina, where it attains 1.4 millimeters with about four lamellae). In Pseudochama (Eopseuma) pusilla it is about 2 millimeters; the upper and smoother portion measures 0.8 to 0.9 millimeter and has about four rather prominent lamellae and traces of about four radial rows of squamulae; the peripheral part has many radiating squamuliferous ridges. Further, in Chama the nepionic shell is very small (0.5 millimeter) and its smoother upper portion is only about one-fourth of the entire umbonal shell. In the spinosa group of Chama, however, the nepionic shell is comparatively larger. Hence we find that the more the characteristics of the hinge or the sculpture of the shell differ from a more primitive stage (most in Echinochama and the Chama spinosa section, less in Eopeuma and the remaining Chamas), or the more specialized these characters become when full grown, the larger is the smooth or only concentrically sculptured portion of its nepionic shell. It seems as if smoothness or a radial sculpture were primitive in the earliest stages of development; during the course of specialization a concentric ornamentation appears, which ultimately occupies the whole of the nepionic shell as this becomes larger. Or, to put it briefly, the nepionic shell is subject to a caenogenetic specialization, relative to the advanced development of the adult shell. In Eopeuma, we may repeat, teeth 1 and 3b are separated and of uniform size during life, while in the Pseudochamas mentioned 3b is still traceable as a distinct tooth separated from 1, but the latter has greatly exceeded 3b in size; in Echinochama...
chama a separation of these teeth is scarcely visible, and besides
that the shell has become almost equivale, which seems to be a
secondarily acquired property. In Eospina the nepionic shell
strikingly recalls that of Chama, and this genus shows a
closer resemblance to its presumed ancestors (the sinistral
Diceras) than does Pseudochama to the dextral Diceras. In
Chama the caenogenous metamorphosis and the subsequent
progressive development has made the type less distanced
from its ancestors than has been the case in Pseudochama.
It is evident that the genus Pseudochama has consequently
been subject to a progressive development both as regards
its full-grown and its nepionic stages, while Chama has re­
mained more constant and conservative. It is perhaps even
possible that the concentric sculpture of the nepionic Pseu­
dochama is an atavism, being a reappearance of that of the
earliest known Cretaceous species, such as Chama haueri
Zittel. If a true member of Chamidae at all, this form appears
most likely to belong to Pseudochama.* * *
Finally we may admit the possibility that both Veneridae
and Cardiidae, which, from an anatomical point of view, seem
to have a common origin with Chamidae, might have origi­
nated from forms closely related to the nepionic stages pre­
vailing in Chamidae, as the nepionic shell of a Pseudochama
reminds one of a Venerupis and that of a Chama is like a
Cardium. Both families appear at a relatively late period,
and their origin from Chamidae is admitted by paleontologists.
No facts on which an exact opinion on these questions can
be based have hitherto been presented, and both anatomical
and ontogenetical investigations must be carried out before
we are able to judge with certainty about the mutual relations
of Chamidae, Cardiidae and Veneridae.

The general distribution of the Recent species of
Pseudochama is similar to that of Chama, and like
it there is a single Alum Bluff species referable to it.
The subgenus Echinochama is excluded.

Pseudochama chipolana (Dall)
Plate XVII, Figures 9–10
1903. Chama chipolana Dall, Wagner Free Inst. Sci. Trans.,
vol. 3, pt. 6, p. 1398, pl. 56, figs. 19, 20.
Dall described this species as follows:
Shell irregular in shape, but usually rounded, with the lower
valve deep and the upper one nearly flat, with a rotation of
nearly two whorls in old specimens; sculpture of the attached
valve (usually the left but sometimes the right) low, irregular,
concentric lamellae and rounded radial ridges, which become on
the lamellae short channeled spines; the radials vary in size but
are usually close set; the free valve has the concentric sculpture
more or less suppressed, the radials finer and more regular,
hardly spinose; there are frequently radials on which the spines
are better developed set at regular intervals, the intervening
radials without spines; the adductor scars are rather short and
rounded; there is a polished, smooth border between the pallial
line and the margin, the latter being finely radially grooved or
striate. The shell is commonly an inch in diameter but reaches
usually rounded, with the lower
valve deep and the upper one nearly flat, with a rotation of
nearly two whorls in old specimens; sculpture of the attached
valve (usually the left but sometimes the right) low, irregular,
concentric lamellae and rounded radial ridges, which become on
the lamellae short channeled spines; the radials vary in size but
are usually close set; the free valve has the concentric sculpture
more or less suppressed, the radials finer and more regular,
hardly spinose; there are frequently radials on which the spines
are better developed set at regular intervals, the intervening
radials without spines; the adductor scars are rather short and
rounded; there is a polished, smooth border between the pallial
line and the margin, the latter being finely radially grooved or
striate. The shell is commonly an inch in diameter but reaches
only small valves are figured, since the older valves are
invariably worn and do not show the sculpture well.
Type locality: No. 2213, 1 mile below Baileys
Ferry, Chipola River, Calhoun County, Fla.
This species might more properly have been christened dodona, as it is a much more conspicuous
element in the Oak Grove fauna than in the Chipola.
The sculpture is much finer and more detailed than
that of the coexistent C. draconis, and the clockwise
twist of the beaks when the attached valve is viewed
with the inner surface uppermost will normally serve as an
excellent diagnostic for separation.
Occurrence: Chipola formation, localities 10609°,
7893°, 2212°, 2213°, 3419°, 19994°, 2211°, 7183°,
10606°. Oak Grove sand, localities 2649°, 5632°,
5631°, 5630°, 5633°, 7054°, 9961°, 7055°, 10659°.
Shoal River formation, localities 10063°, 10068°,
9959°, Aldrich collection from the Shoal River (rare).
Subgenus ECHINOCACHA Fischer
Type: Echinochama arcinella Linnaeus. (Recent
along the east coast of the Americas from Hatteras to
Brazil.)
Dall 12 says:
In the genus Echinochama the shell is nearly equivale, and
sessile in most cases only while young; the sculpture is radial,
spinose, and regular; a large impressed and conspicuous lunule
exists, and also an obscure escutcheon.

The geologic and geographic range of the group are
not extensive, for it has been in existence only since
the early Miocene, and the Recent species are confined,
apparently, to the waters bordering the shores of
tropical America. Odhnner 13 characterized this group as follows:
Shell with distinct lunula, nearly regular and equivale,
attached when young, usually free when adult, ribbed and
spiny. Nepionic shell large, elongated (about 2.4 millimeters).

Only the single species is known in the Alum Bluff
and that the type of the genus first described from the
Antilles.

The hinge construction of the group is similar to that
of the normal Pseudochama, but as the characters of the
genus as proposed by Fischer are based largely
upon the character of the type species Echinochama
has been retained as a subgeneric name.

Pseudochama (Echinochama) arcinella (Linnaeus) Odhnner

Plate XVII, Figures 14–16
1767. Chama arcinella Linnaeus, Systema naturae, 12th ed.,
1789. Cochlea histrix Martyn, Universal conchology, pl. 132,
fig. 2.
1789. Cochlea crisata galli Martyn, idem, pl. 132, fig. 1.
1817. Arcinella spinosa Schumacher, Essai d’un nouveau sys­
tème des habitats des vers testaces, p. 142, pl. 13,
fig. 1.
1846. Chama arcinella Linnaeus. Reeve, Conchologica Iconica,
vol. 4, Chama, pl. 5, figs. 26, 26a.

13 Odhnner, N. H., Results of Dr. E. Mjöberg’s Swedish Scientific Expeditions to
p. 75, 1919.


1859. *Chama arcinella* Linnaeus. Holmes, Post-Pleisocene fossils of South Carolina, p. 23 (pl. 5, fig. 1, excluded).


Linnaeus described this species in 1767 as follows:

C. testa sulcata muriaca excavato punctata cardinis callo sessili. Habitat in O. Americano Spengler.

Testa magnitudine pruni, longitudinaliter sulcata sulcis excavato, punctatis, portis imbricato, muriatis; margo crenulatus. Natis subaequales. Asi regio cordata, intrusa, papillosa rugosa. Cardinis callus prominens, valde singularis sulcis 4-angustis quas lamellae totidem, in opposita cavitate, intrant.

Shell equivalent, inequilateral, attached only in the young, moderately inflated. Umbones broad, tumid, involute, prosogyrate. Lunule broadly cordate, conspicuously, clearly defined. Escutcheon suggested but not defined. Outline of inner margins rudely subcircular, excepting for a pronounced lobate projection in front of the lunule. External surface bristling with 5 or 6 radial series of spines, which are strongest on the medial and anterior portions of the valves, where, in the recent shells, they not uncommonly exceed half an inch in length; interradial spaces and lunule roughly tuberculated. Ligament groove moderately deep. Right valve furnished with a single prominent, subumbonal dental projection, corrugated on both its dorsal and ventral surfaces; socket in left valve correspondingly deep and correspondingly rugose. Muscle impressions irregularly oblong, the anterior a little more elongated and a little higher; pallial line simple, not very distant from the ventral margin. Inner margins crenate.

The Shoal River species does not attain the dimensions reached by some of the Recent individuals and the spines seem a little heavier, but there is no constant difference by which the mid-Tertiary form can be separated from the Recent. In fact, there is more variation shown among the Recent forms than between the fossil and the Recent. The characters of the Shoal River individuals are remarkably constant.

The species was apparently first initiated at this horizon, for certainly temperature conditions must have been equally favorable during Chipola time. The absence of the group during the Chesapeake, however, is probably due to the cooling of the waters.

The Bowden species, *E. antiquata*, is less inflated and much more closely sculptured than *E. arcinella*.

Occurrence: Shoal River formation, localities 2645, 3732, 3742, 10658, 5184, 5195, 10603.

Outside occurrence: Miocene: Duplin formation, North Carolina, Georgia. Pliocene: Waccamaw formation, South Carolina; Nashua marl, Florida. Pleistocene: South Carolina to Florida. Recent: Hatteras to São Paulo, Brazil, in 0 to 26 fathoms.
PLATES XVI-XVII
PLATE XVI

[The figured specimen is the type unless otherwise stated]

FIGURE 1. Astarte eugonia Gardner, n. sp. (p. 83). Exterior of left valve; altitude, 5.0 millimeters; latitude, 5.7 millimeters.

FIGURES 2-3. Astarte (Ashlarotha) sima Gardner, n. sp. (p. 84).
2. Interior of right valve; altitude, 12.5 millimeters; latitude, 13.3 millimeters.
3. Exterior of right valve; altitude, 12.5 millimeters; latitude, 13.3 millimeters.

FIGURES 4–8. Astarte (Bythiamena) isosocles Gardner, n. sp. (pp. 84–85).
4. Exterior of left valve (cotype); altitude, 7.5 millimeters; latitude, 7.5 millimeters.
5. Interior of left valve (cotype); altitude, 7.5 millimeters; latitude, 7.5 millimeters.
6. Interior of right valve (cotype); altitude, 9.0 millimeters; latitude, 9.0 millimeters.
7. Exterior of right valve (cotype); altitude, 9.0 millimeters; latitude, 9.0 millimeters.
8. Profile of right valve (cotype), showing lunule.

FIGURE 9. Astarte wagneri Dall (p. 85). Exterior of left valve; altitude, 10.0 millimeters; latitude, 11.0 millimeters. (After Dall.)

FIGURE 10. Crassatellites (Scambula) chipolanus Dall (p. 86). Exterior of right valve; altitude, 33.0 millimeters; latitude, 44.0 millimeters. (After Dall.)

FIGURES 11–14. Crassatellites (Scambula) densus Dall (p. 86).
11. Apical view of double valves (cotype). (After Dall.)
12. Exterior of left valve (cotype); altitude, 34.5 millimeters; latitude, 48.0 millimeters. (After Dall.)
13. Exterior of left valve (cotype); altitude, 35.0 millimeters; latitude, 50.0 millimeters. (After Dall.)
14. Interior of right valve (cotype); altitude, 39.0 millimeters; latitude, 58.0 millimeters. (After Dall.)

FIGURE 15. Crassatellites (Crassinella) triangulatus Dall (pp. 86–87). Exterior of left valve; altitude, 3.3 millimeters; latitude, 3.0 millimeters. (After Dall.)

FIGURE 16. Crassatellites (Crassinella) tanicus Dall (p. 87). Interior of left valve (cotype); altitude, 3.5 millimeters; latitude, 3.7 millimeters. (After Dall.)

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TELEODESMACEA OF THE ALUM BLUFF GROUP
TELEODESMACEA OF THE ALUM BLUFF GROUP
Figures 1–2. *Cardita (Carditamera) apotegea* Gardner, n. sp. (pp. 88–89).
1. Exterior of left valve (cotype); altitude, 22.5 millimeters; latitude, 40.0 millimeters.
2. Interior of right valve of another individual (cotype); altitude, 23.5 millimeters; latitude, 41.0 millimeters.

Figure 3. *Cardita (Carditamera) defuniak* Gardner, n. sp. (p. 89). Exterior of right valve; altitude, 16.0 millimeters; latitude, 32.0 millimeters.

Figure 4. *Venericardia (Pleuromeria) scutula* Dall (p. 91). Exterior of left valve; altitude, 5.0 millimeters; latitude, 5.0 millimeters.

Figure 5. *Venericardia (Pleuromeria) tellia* Dall (p. 91). Exterior of left valve; altitude, 3.3 millimeters; latitude, 3.8 millimeters.

Figure 6. *Venericardia (Pleuromeria) tellia* subsp. *dasa* Gardner, n. subsp. (p. 91). Exterior of right valve; altitude, 3.3 millimeters; latitude, 3.5 millimeters.

Figure 7–8. *Chama draconis* Dall (p. 92).
7. Exterior of attached right valve (cotype); altitude, 27.0 millimeters; latitude, 26.0 millimeters (exclusive of projecting lamellae). (After Dall.)
8. Exterior of free left valve of another individual (cotype); altitude, 20.0 millimeters; latitude, 19.0 millimeters. (After Dall.)

Figures 9–10. *Pseudechinochama chipolana* (Dall) (p. 94).
9. Exterior of free right valve (cotype); altitude, 20.0 millimeters; latitude, 21.0 millimeters. (After Dall.)
10. Exterior of attached left valve (cotype); altitude, 30.0 millimeters; latitude, 25.0 millimeters. (After Dall.)

Figures 11–12. *Venericardia hadra* Dall (p. 90).
11. Exterior of left valve; altitude, 38.0 millimeters; latitude, 41.5 millimeters. (After Dall.)
12. Apical view of double valves of same individual; altitude, 38.0 millimeters; latitude, 41.5 millimeters; diameter, 31.0 millimeters. (After Dall.)

Figure 13. *Venericardia himerta* Dall (pp. 90–91). Interior of right valve; altitude, 52.0 millimeters; latitude, 54.0 millimeters.

(After Dall.)

Figures 14–16. *Pseudechinochama (Echinochama) arcinella* (Linnaeus) Odhner (pp. 94–95).
14. View of double valves showing lunate (not the type); natural size. (After Tuomey and Holmes.)
15. Interior of left valve (not the type); natural size. (After Tuomey and Holmes.)
16. Exterior of left valve (not the type); natural size. (After Tuomey and Holmes.)

Note.—The types of formerly described species have been remeasured, and some of the dimensions stated differ from those given in the original descriptions.

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