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PALÆONTOGRAPHICA AMERICANA

ILLUSTRATED CONTRIBUTIONS

TO THE

INVERTEBRATE PALEONTOLOGY

OF

AMERICA

Vol. I

No. 1—Atlantic Slope Arcas

BY PEARL G. SHELDON

ITHACA

HARRIS COMPANY

1916

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PREFACE

SEVERAL years ago we commenced a series of papers in "Bulletins of American Paleontology," dealing with the molluscan remains in the various horizons of our southern Tertiaries. In these the subject matter is treated stratigraphically; in other words, the Midway stage was first taken up, then the Lignitic, and now the Claiborne is in press. Other papers dealing with special localities or horizons have also been published. In future numbers we hope to discuss all important Tertiary horizons stratigraphically. This seems the natural way for all investigation of this preliminary nature. Witness for example Hall's works on the paleontology of New York as well as the paleontologic matter included in our various state survey reports. Such papers if printed in small octavo form are convenient for field use as well as laboratory study.

But as years pass by and the faunas of the various horizons are better understood, and vast amounts of material collect in our museums, there comes a time when a purely biologic phase of investigation may be advantageously undertaken. Note for example the more recent works of Clarke and Ruedemann of the New York survey. This calls for a larger sized publication, admitting plates of sufficient dimensions to contain for comparison representatives of many closely allied types of life. And, the larger size page will be found not inconvenient in laboratory and museum where desks and tables are at hand; in the field, a work arranged biologically would scarcely ever be called for. Accordingly, this new work has been begun to receive such papers on invertebrate paleontology as are arranged systematically, papers that will be of direct assistance to students of biologic evolution.

The first of these papers, unpretentious and seemingly easy of preparation, has cost the author a vast amount of study here and elsewhere to make sure that no serious omissions of specific or varietal forms have been made either in the text or plates, and that the figures and text indicate clearly the characteristic features of each form discussed.

Paleontological Laboratory
Cornell University
October 30, 1916

G. D. HARRIS

THE ATLANTIC SLOPE ARCAS

BY PEARL G. SHELDON

This treatment of the *Arcas** is intended to include: the synonymy, description, and distribution of the Tertiary and recent species of the genus which occur in the beds along the coast of the eastern United States; also references to the Cretaceous species, to the deep water forms which occur off the coast, and to the recent and Tertiary species of the Caribbean district.

In measuring the specimens they were placed on cross-section paper with the hinge along a horizontal line and the point of the beak on a vertical line. Measurements were taken from the line through the beak to the line touching the anterior point of the shell; from the line through the beak to the line touching the posterior point; from the hinge line to the highest and to the lowest points of the shell. Distances anterior to the beak and those above the hinge line were marked +, and those posterior to the beak and below the hinge line —. The diameter was measured at the widest part of the shell. Semidiam. means the diameter of a single valve.

Because of the radiating sculpture and convexity of the shell, in photographing the specimens it was usually impossible to bring out the details of sculpture with equal distinctness over the entire surface. In practice, the detail usually photographed best at the end away from the source of light. Ordinarily in this genus the sculpture is stronger toward the anterior and weaker toward the posterior end, therefore the specimens were usually photographed with the posterior end nearer the light in order to give a comparatively true figure. Likewise, the angle of the teeth on the hinge varies and some cast little or no shadow. For the same reason the crenulations along the ventral margin were often lost. The muscle scars photographed indistinctly. In general, detail was lost where the light rays were perpendicular to the surface of the shell or tended to be parallel to radial sculpture, crenulations, etc. The lighting was arranged to bring out the most important specific characters. Unless otherwise stated, the figures are natural size.

Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, 1898) placed all the species under the genus *Arca* and gave *Barbata*, *Noëtia*, *Scapharca*, etc., which at various times have been given the rank of genera, the rank of subgenera and groups or sections. These di-

*The major part of this paper formed a thesis presented to the faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Sincere thanks are due Professor G. D. Harris for aid, suggestions and criticism. Nearly all of the Tertiary material used was collected by Professor Harris or his students.

vitions intergrade thoroughly. Dall's treatment of the genus has been followed. Besides the groups represented here Dall recognizes the following:

Subgenus *Barbatia*.

Group of *A. rubrofusca* Smith (*Lissarca* Smith, 1876)

Group of *A. tortuosa* L. (*Trisidos* Bolten, 1798, + *Trisis* Oken, 1815).

Group of *A. celox* Benson (*Scaphula* Benson, 1835, not of Swainson, 1840; *Scaphura* Gray, 1847, by typographical error).

Subgenus *Scapharca*.

Group of *A. senilis* Lam. (*Senilia* (Gray, 1840) Adams, 1858).

Subgenus *Lunarca* (Gray) Adams, based on *L. costata* Gray. Possibly a malformed shell.

THE TYPICAL ARKS

The *Arcas* of the group to which *A. noë* Linné belongs have an opening in the ventral margin for the byssus; the form is often irregular; cardinal area wide and rather flat with low margins, diagonal grooves in the cardinal area disconnected instead of uniting to form continuous diamond-shaped grooves as in some of the other groups; beaks small and pointed; hinge straight and narrow; teeth small and numerous; inner margin of the valves smooth or nearly so.

Arca hatchetigbeensis Harris

Plate I, Figures 1, 2, 3

Arca subprotracta Aldrich, Geol. Surv. Ala., Bull 1, p. 50, 1886, *vide* Harris.

Arca hatchetigbeensis Harris, Bull. Am. Pal., vol. 2, no. 9, p. 47, pl. 7, figs. 10, 10a, 1897.

Arca hatchetigbeensis Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 622, 1898.

"Size and general form as indicated by the figure; surface covered by well-defined but somewhat irregular, imbricate, concentric lines, crossed by raised, radiating fine costæ; young shell not extremely elongate, with surface marking of equal strength everywhere; in adults the medial sinus becomes more pronounced, the radiating ribs before the sinus being stronger than those behind the same, and the shell is more or less distorted.

This species differs from *protracta* Con.—*subprotracta* Heilp.—by its much less elongate form, broader anterior, the presence of two particularly strong costæ located medially on the post-umbonal slope. By examining the type specimen of *A. protracta* in the Academy's collection at Philadelphia it will be seen that it agrees somewhat more nearly with this species than would be supposed from Conrad's figure, yet the agreement can scarcely constitute specific identity.

Locality (Lignitic).—Alabama: Hatchetigbee,—Harris," 1897.

A. hatchetigbeensis is closely related to the fossil form of *A. umbonata*, but the imbrication is finer and in *A. umbonata* the large ribs on the posterior slope begin about at the angle of the umbonal ridge and are subequal in size, while in *A. hatchetigbeensis* the largest ribs are near the center of the posterior slope; those near the cardinal margin are smaller and the fine sculpture extends over the umbonal ridge to the large central ribs.

Dimensions.—Lon. +11, -30; alt. +3, -16; semidiam. 11 mm.

Occurrence.—Lignitic Eocene of Hatchetigbee, Alabama.

Type.—C. U. Museum.

Arca subprotracta Heilprin

Plate I, Figure 4

Byssarca protracta Conrad, Acad. Nat. Sci. Phil., Proc. for 1847, p. 295, 1848; Journ., 2d. ser., vol. 1, p. 126, pl. 13, fig. 36, 1848.

Not *Arca protracta* Rogers, Am. Phil. Soc., Trans., vol. 5, p. 332, 1837; vol. 6, pl. 26, fig. 5, 1839.

Navicula protracta Conrad, Acad. Nat. Sci. Phila., Proc. for 1854, p. 29.

Arca subprotracta Heilprin, Acad. Nat. Sci. Phila., Proc. for 1881, p. 449, 1882.

"Trapezoidal, elongated, with numerous radiating lines, some of which are double, and others alternated in size and finely crenulated; dorsal margin parallel with the base; anterior margin truncated, posterior a little concave, oblique and very acutely rounded or subangular; basal margin slightly contracted; hinge long, rectilinear, very regular and gradually increasing in width towards the extremities from the apex; cardinal area wide, depressed concave, with a few fine, impressed, angular lines.

Length $1\frac{1}{3}$; height $1\frac{1}{2}$ in. nearly.

"A pretty species of which I found one valve only."—*Conrad*, 1848.

Occurrence.—"Newer Eocene [Oligocene] of Mississippi.—*Conrad*.

Arca paratina Dall

Plate I, Figures 5, 6, 7

Arca paratina Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 621, pl. 33, fig. 14, 1898.

"Shell elongated, not very thick or high, not much distorted, but with a variable byssal gape, inequilateral, the beaks at or near the anterior fourth; moderately alate in front and behind; beaks low, pointed, not inflated, their apices slightly prosogyrate; cardinal area long, narrow, lozenge-shaped, flattish, with longitudinal striae, the site of the resilium marked on each valve by two grooves forming a small triangle, within which are traces of the inception of other grooves; sculpture chiefly of fine radial riblets overrunning and somewhat imbricated by not prominent lines of growth; the radials which end on the margin of the byssal foramen are perceptibly finer than the rest, those on the posterior dorsal slope are more or less fasciculated, the ends of the fascicles dentating the posterior margin; on the dorsal anterior part the riblets increase somewhat in size, but are not fasciculated; the dorsal border in front is anterior to the rest of the margin; between the dorsal posterior extreme and the ventral posterior angle there is often an irregular, but not deep emargination; the borders of the byssal foramen are irregularly emarginate; interior smooth, the margin denticulated by the sculpture except at the foramen; hinge-line straight, minutely denticulate; the teeth in the center smaller, those towards the ends inclined outward slightly, above, and a little larger; there are about twenty three anterior and forty posterior teeth, with no marked hiatus between the series. Lon. of shell 28, alt. of hinge-line 8.5, of beaks 10, diam. at the umbonal part 10 mm. It is quite possible that the shell grows to a considerably larger size.

"This species is distinguishable at once from the *A. occidentalis* of the same size by its uniformly more delicate and much more numerous ribs, and by its greater length in proportion to its height. It is also usually less alate behind and of more uniform, undistorted shape. Differences of form and proportion seem to separate it sufficiently from *A. subprotracta* Heilprin * * *"—Dall, 1898.

Dimensions.—Small valve, lon. +4, -11; alt. +1, -5.5; semidiam, 3 mm.

Occurrence.—Oligocene of the Chipola beds on the Chipola River, and of the lower bed at Alum Bluff, Calhoun County, Florida.—Dall. Oligocene of Bailey's Ferry, Florida, and Pliocene of the Croatan beds of North Carolina.—*C. U. Museum*.

Arca occidentalis Philippi

Plate I, Figures 8, 9, 10, 11

Arca occidentalis Phil., Abbild. u. Beschr., 3, p. 14, pl. 17b, fig. 4a-c, 1847.

Arca zebra Swainson, Zool. Ill., No. 26, pl. 118, 1831; *ex parte*.

Arca noæ of many authors, not of Linné,

Dall has separated the east American form from the Mediterranean *A. noæ* with the above synonymy,

Shell oblong, inflated; hinge line as long or nearly as long as the shell; posterior end emarginate; ventral margin with an opening for the byssus; ribs numerous, smaller in the depression opposite the byssal opening, interspaces with from one to several fine riblets; along the posterior cardinal margin and the umbonal ridge radiating strips which are smooth or show only fine riblets; the depression between these smooth ridges with a few normal ribs; beaks small and pointed, little curved; cardinal area wide, flatly concave, ligament area with disconnected diagonal grooves; hinge straight, narrow, with numerous fine, vertical teeth; inner margin practically smooth; color white or yellowish with zigzag markings of reddish brown.

Dimensions.—Lon. +18, -50; alt. +5, -25; diam. 30 mm.

Occurrence.—Oligocene of the Bowden beds, Jamaica; Miocene (?) of Curaçao; Pliocene of the Caloosahatchie marls, Florida; Pleistocene of the Florida Keys, Yucatan and most of the West Indian Islands; recent in the Antilles generally, and along the eastern coast of the United States northward to the vicinity of Cape Hatteras, North Carolina.—Dall. Recent from Florida and the West Indies.—*C. U. Museum*.

Arca umbonata Lamarck

Plate I, Figures 12, 13, 14, 15, 16, 17

Arca umbonata Lamarck, An. s. vert, vol. 6, p. 37, 1819.

Arca imbricata of several authors.

Arca umbonata Arango, Fauna Malacologica Cubana, p. 261, 1879.

Arco umbonata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 620, 659, 1898; pt. 5, pl. 38, figs. 4, 4a, 1900

"A testâ transversim oblongâ, ventricosâ; angulato-sinuatâ; decussatim substriatâ; umbonibus magnis, arcuatis: latere postico brevissimo.

"List. Conch. t. 367. f. 207.

"Habite les mers de la Jamaïque. Mus. no. Elle est très-bâillante au bord supérieur. Largeur, 50 millimètres."—*Lamarck*, 1819.

Anterior and posterior are reversed in *Lamarck's* description.

Ribs on the center of the shell small and rather even, larger anteriorly; posterior slope with four to six larger, more widely spaced ribs; fine ribs in some of the interspaces, especially on the anterior part of the shell, ribs crossed by concentric raised lines which give the part of the shell anterior to the umbonal ridge an imbricated nodular appearance; radial sculpture predominant on the posterior slope; umbonal ridge usually angular; cardinal area wide with diagonal grooves; teeth numerous, nearly vertical, smaller where the grooves cross the hinge; posterior margin nearly straight; byssal opening large; shell unevenly stained with blackish or bluish brown; epidermis long and scaly, chiefly about the margin and posterior slope.

"Like all the group, this nestling species is variable in form according to its station, but I have been unable to find any characters to separate the fossil and recent shells when allowance is made for the deformations alluded to * * *. It probably retreated to warmer waters during the Miocene invasion of Florida and did not succeed in returning until the end of the Pliocene, as it has not turned up in the Caloosahatchie marls. The form doubtfully identified by Professor Heilprin with *A. Listeri* is connected by a fuller series with the others."—*Dall*.

Many authors have united the Atlantic and Pacific forms under the name of *A. imbricata* Bruguière. *Dall* placed *A. Listeri* (Tryon) Heilprin, W. F. I. S. Trans., vol. 1, p. 113, 1887, and *Barbatia Bonaczyi* Gabb, Am. Phil. Soc., Trans., vol. 15, p. 254, 1873, under *A. umbonata*. *A. americana* d'Orbigny, 1846, Voyage dans l'Amérique Méridionale, Moll., p. 632; Hist. Isla Cuba, pt. 2, vol. 5, Moll., p. 342, vol. 8, pl. 28, figs. 1, 2, is this species.

Dimensions.—Lon. +14, -31; alt. +7, -21; diam. 25 mm.

Occurrence.—"Oligocene of the Chipola beds, Calhoun County, Florida; of the Ballast Point Silex beds, Tampa Bay, Florida; of the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida. Also in the Pleistocene of the Florida Keys and the Antilles, and living from Cape Hatteras, North Carolina, south to Santa Caterina, Brazil, and throughout the Antilles."—*Dall*. Oligocene of Bailey's Ferry, Florida, and recent from Florida, Galveston, Texas, the West Indies, Aspinwall and Brazil.—*C. U. Museum*.

Arca wagneriana Dall

Plate I, Figures 18, 19

Arca (Arcoptera) aviculæformis Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 98, pl. 13, figs. 32, 32a, 1887.

Not *Arca aviculæformis* Nyst, Tabl., Synopt., p. 12, 1848; *Arca aviculoides* Reeve, 1844, *vide* Dall; not *A. aviculoides* de Koninck, Des. An. Fos., p. 114, 1844.

Arcoptera aviculæformis Dana, Man. Geol., 4th ed., p. 900, fig. 1510, 1895.

Arca Wagneriana Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 619, 1898; pt. 5, pl. 39, figs. 6, 7, 1900.

"Shell elongated, aviculaeform, rostrated anteriorly, winged posteriorly, with a prominent obtuse carination on the umbonal slope bounding the wing: rostrum declivous, marked off from the body of the shell by a broad hollow; basal margin of shell sinuous, showing a median opening, and rapidly sloping upward in the direction of the rostrum; posterior border deeply emarginate.

Umbones acute, very eccentric, moderately elevated, and but slightly incurved, with a gradual continuous slope to either extremity of shell; hinge-line nearly the whole length of shell, very narrow, pectinated with a crowded series of lamellar, transversely directed teeth, which exhibit a tendency to become oblique and v-shaped on the posterior half of the line; ligamental area broad, open, arching upward in a gentle curve, longitudinally lined, and irregularly grooved by numerous diagonal or v-shaped furrows resembling insect borings.

Surface of shell ornamented with numerous radiating, wavy lines, alternating in coarseness, which become more or less obsolete on the umbonal slope, and are wholly wanting on both the beak and wing, which only show concentric lines of growth, of the radiating lines on the anterior part of the shell the series runs about as follows: coarse line, followed by two finer lines, then a slightly more prominent single line, again two finer lines, and then a coarse line, same as first, marking the coarse lines at intervals of about six or seven; interior of shell deep, cuneiform; margin entire.

"Length, 5.4 inches; width across the beaks, 2.5 inches.

"Caloosahatchie, in the banks below Fort Thompson."—*Heilprin*, 1887.

"This fine species is quite variable in the development of the extended wings which suggested Professor Heilprin's name. In many specimens the posterior wing does not exceed that usual in *A. occidentalis*, while in others it may extend an inch beyond the rest of the shell. The anterior wing is less prominent and not a little more constant, but is frequently paralleled by fossil and even by recent specimens of *A. occidentalis* Phil. So far as yet known this species is confined to the Floridan Pliocene. The character of the cardinal area is similar to that of *A. noæ*."—*Dall*.

The anterior as well as posterior teeth may be v-shaped. The ribs are finer than in *A. occidentalis*.

Dimensions.—(Small valve), lon. +16, -29; alt. +3, -13; semidiam. 8 mm.

Occurrence.—Pliocene marls of the Caloosahatchie, Shell Creek, and Myakka River.—*Dall*. Pliocene of Shell Creek, Florida.—*C. U. Museum*.

Arca aquila Heilprin

Plate II, Figures 1, 2

Arca aquila Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 97, pl. 12, fig. 31, 1887.

Arca aquila Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 621, pl. 31, fig. 12, 1898.

"Shell (known only by its left valve) elongated, rectangular, winged, profoundly sulcated on the posterior slope; anterior border vertical, straight; basal line slightly sinuous beyond the middle; hinge-line straight, of nearly equal length with the base; teeth very numerous, gradually increasing in size toward either end, where they are

markedly oblique: hinge-area broad, obscurely furrowed in longitudinal lines; beak moderately elevated, incurved, the apex directed backward; surface of the shell radiately ribbed, the ribs sinuous, beaded—especially on the anterior portion of the shell, where they are separated by an intermediate fine line—becoming obsolete in the posterior sulcus and on the wing where they are represented by two pairs of lines; lines of growth prominent towards the base and on the wing; basal margin crenulated.

"Length 1.25 inches; height, from base to hinge-line, .5 inch.

"This winged ark is at once distinguished from *A. aviculaformis* * * * by the absence of the anterior rostrum and its rectangular form. The last character, in addition to differences in the ornamentation, also serves to distinguish it from the Miocene *Arca incile*, which resembles it somewhat in the pterination of the posterior slope.—"Heilprin, 1887.

"This very neat species appears to be somewhat rare, and has only been found in the original locality as yet."—Dall.

Occurrence.—"Pliocene marls of the Caloosahatchie River, Florida."—Dall.

Arca bowdeniana Dall; Plate II, Figure 3; (Wagner Free Inst. Sci., Trans., vol. 3, p. 622, pl. 33, fig. 12, 1898) from the Oligocene of the Bowden beds, Jamaica and Pliocene of Limon, Costa Rica, is a small species with very anterior beaks and sculpture like that of *A. umbonata* and the diameter is greatest posteriorly.

Subgenus *Barbatia* (Gray) Adams

Barbatia Gray, Synops. Brit. Mus., 1840, p. (?); *ibid*, 1844, p. 81. Type *Arca barbata* L., II and A. Adams, Gen. Rec. Moll., ii., p. 534, 1858.

"The type form of this group is tolerably regular and seldom deformed, like the typical Arks, from the anfractuositities of its station; the reticulated sculpture shows few irregularities; the cardinal area is narrow with numerous grooves for the resilium, which forms a series of elongated concentric lozenges on the area; the shell is not conspicuously truncate or keeled; the teeth are small and vertical in the middle of the series and toward the end diverge distally and become larger and more distant. In some species these distal teeth are often broken up, like those of *Cucullea*, but this feature is not constant in the species. Several groups or sections are recognizable, though they range into one another through their peripheral species. Such are the following:

"Group of *A. barbata* L. (*Barbatia* s. s.). This includes *A. (B.) mississippiensis* Conrad from the Vicksburgian Oligocene.

"Group of *A. candida* Gmelin (*Calloarca* Gray, 1857, + *Plagiarca* Conrad, 1875). This includes *A. cuculloid* Conrad (+ *A. lima* Conrad, 1847 not of Reeve, 1844, = *A. Conradi* Desh.) from the Jacksonian; *A. marylandica* Conrad and *A. arcula* Heilprin, Upper Oligocene and Older Miocene; and several other species. *Litharca (lithodomus)* Gray, 1840, is probably based on a specimen of *A. candida*, which had grown in the burrow of a *Lithodomus*. Upper Cretaceous to recent.

Group of *A. propatula* Conrad (*Granoarca* Conrad; 1862) = *A. hians* Tuomey and Holmes, 1855, not of Brown, 1842; nor of Reeve (?—*A. protracta* Rogers, not of Conrad, 1847). Miocene.

Group of *A. centenaria* Say (*Striarca* Conrad, 1862). Miocene.

Group of *A. donaciformis* Reeve (*Acar* Gray, 1847, + *Daphoderma* Moersch, 1853, + *Fossularca* Cossmann, 1887. Eocene to recent.

"In *Striarca* the lozenge occupied by the ligament and its transverse grooves for the resilium cover the entire cardinal area; in typical *Acar* the lozenge is obliquely directed backward, leaving the anterior part of the area bare; in *Fossularca* the lozenge is small, very short, and directly between the beaks, leaving a bare space before and behind it. *A. cælata* Conrad (*A. Adamsi* Shuttleworth) is a typical *Fossularca*.

"Group of *A. heterodonta* Desh. (*Les Cucullaires* Desh., 1860: *Cucullaria* Conrad, 1869, + *Nemodon* Conrad, 1869). Cretaceous (Ripley) to recent.

"In the *Barbatias* as well as in *G'ycymeris* (*Pectunculus auct.*) the growth of the shell often results in a greater or less absorption of the middle part of the series of teeth; the distal teeth are always more or less oblique, especially those behind the beaks. In *Cucullaria* the latter are about, if not quite, parallel with the hinge-line. Consequently, it may follow that in the process of growth the same individual may at an early stage have a series of vertical median denticles, and at a later stage may present a hiatus destitute of teeth between the anterior and posterior parts of the series. Judging from the species I have been able to examine, the entire narrow cardinal area is originally covered by the ligament, but the grooves containing the resilium extend very obliquely backward from the beaks, as in typical *Acar*. Notwithstanding the resemblance of the hinge in these Tertiary and recent species to that of the Paleozoic and early Mesozoic *Parallelodon*, I am of the opinion that the relations of the former are really closer with the true Arks, and that the similarities will prove to be analogical rather than homologous. The recent abyssal species I have formerly referred to *Macrodon*, should probably be grouped under *Cucullaria*."—Dall, 1898.

Arca barbata Linné

Plate II, Figures 4, 5, 6, 7

Arca barbata Linné, Syst. Nat., p. 693, 1758.

"*Pectunculus è fusco rufescens, admodum densè striatus*," Lister, Hist. Conch., tab. 231, fig. 65, 1170.

Arca barbata Gmelin, Syst. Nat., vol. 6, p. 3306, 1792.

Arca borbata Reeve, Conch. Icon., pl. 13. *Arca* no. 83, 1844.

Barbatia barbata H. and A. Adams, Gen. Rec. Moll., vol. 2. p. 534, pl. 124, figs. 4, 4a, 4b, 1858.

Arca barbata Arango, Fauna Malacologica Cubana, p. 263, 1879.

Arca (Barbatia) barbata Dall, U. S. Nat. Mus., Bull. 37, p. 40, 1889.

Barbatia barbata Dall, Wagner Free Inst., Sci. Trans., vol. 3, pt. 4, pp. 614, 615, 659, 1898.

"A. testa oblonga striata apicibus barbata, natibus incurvis approximatus, margine integerrimo clauso.

Mus. Tessin. 116. t. 6. f. 1,

Bonan. recr. 2. t. 79.

Guall. test. 91. f. F.

Argenv. conch. t. 25. f. M.

Habitat in M. Mediterraneo.

"*Testa apice rotundata, integra; striæ ex punctis callosis concatenatis: alternis striis majoribus. Barba ex striis versus apicem imprimis tenuiorem rigens.*"—Linné, 1758.

This species is irregularly colored with light and dark brown, the ribs are granulated, numerous and fine with slightly larger ribs at intervals on the middle of the valve; epidermis bristly; teeth fine at the center of the hinge, long and oblique distally; ligament area with several v-shaped grooves; inner margin smooth; byssal opening usually small.

Dimensions.—Lon. +17, -32; alt. +5, -22; diam. 20 mm.

Occurrence.—Recent from North Carolina to Barbados.—*Dall*. Recent from the Mediterranean, Florida and the West Indies.—*C. U. Museum*. This is a common recent and fossil European species.

Arca cuculoides Conrad

Plate II, Figures 8, 9, 10, 11, 12

Arca cuculoides Conrad, Fos. Tert. Form., p. 37, 1833.

Byssarca cuculoides Conrad, Am. Journ. Sci., 2d. ser., vol. 1, p. 219, 1846.

Byssarca lima Conrad, Acad. Nat. Sci. Phila., Proc. for 1847, p. 295; Journ., 2d. ser., vol. 1, p. 125, pl. 13, fig. 23, 1848=*A. Conradi* Deshayes.

Not *Arca lima* Reeve, Conch. Icon., *Arca* no. 101, 1844.

Navicula cuculoides et lima Conrad, Acad. Nat. Sci. Phila., Proc. for 1854, p. 29.

Cucullæarca lima et cuculoides Conrad, Am. Journ. Conch., vol. 1, p. 11, 1865.

Barbatia (Calloarca) cuculoides Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 615, 624, 1898.

"Shell compressed, thick, inequivalve, reticulated; with a broad subcentral sinus, passing from the beak to the basal margin: posterior side elongated, strongly ribbed, and carinated; anterior side with numerous striæ; anterior end truncated. Length $2\frac{1}{4}$ inches. Breadth $1\frac{1}{2}$ inches.

"The hinge of this shell approaches cucullæa, in the interval between the beaks, having arcuated grooves under the beak; line of series of hinge teeth widely interrupted, and transverse at the extremities.

"*Locality.* Claiborne, Alab.

"*Cab. Acad. N. S.*"—*Conrad*, 1833.

Ribs smallest near the middle of the valve, becoming wider and smoother toward the umbonal ridge and larger and more widely spaced anteriorly; posterior slope with small, smooth ribs, this region separated from the rest of the shell by a sharp radial ridge which is often serrate; ribs anterior to the umbonal ridge mostly nodular and with finer ribs in some of the interspaces; cardinal area longer behind with numerous regular grooves; teeth continuous in the young, those in the center very small, distal teeth long and oblique, usually irregular in old specimens; outline variable, shell higher posteriorly. The ribbing varies on different shells, but the species is characterized by the sharp rib down the umbonal ridge and the ribs usually are quite different on different parts of the shell.

The variety figured and described by Professor Harris (Bull. Am. Pal., vol. 2, no. 9, p. 47, pl. 8, figs. 1, 1a, 1897), has a more pointed posterior basal angle and rougher posterior ribs than the type. It is from the Sabine Eocene of Gregg's Landing, Alabama. *Navicula aspersa* Conrad, Wailes, Agr. and Geol. Mississippi, p. 289, pl. 14, fig. 5, 1854; *Navicula aspera* Conrad, Acad. Nat. Sci. Phila., Proc. for 1855, p. 258, 1855; not *Arca aspera* Phil., Moll. Sicil., 1836 (*vide* Dall) has been listed in synonymies as the young of *A. cuculloidis*, but the specimen in the Philadelphia Academy is *Acar reticulata*.

Dimensions.—Lon. +18, -40; alt. +7, -39; semidiam. 19 mm.

Occurrence.—Upper Eocene (Jacksonian) near Claiborne, Alabama; Jackson, Mississippi; Cleveland County, Arkansas; and in the Lower Oligocene at Vicksburg, Mississippi.—Dall. Sabine Eocene of Gregg's Landing, Alabama and Pendleton, Texas, and Jackson Eocene of Jackson, Mississippi, of Montgomery, Grandview Bluff, Gibson's Landing and Bunker Hill Landing, Louisiana and of Texas.—C. U. Museum.

Arca mississippiensis Conrad

Plate III, Figures 1, 2, 3, 4

Byssarca mississippiensis Conrad, Acad. Nat. Sci., Phila., Proc. for 1847, p. 295; Journ., 2d. ser., vol. 1, p. 125, pl. 13, fig. 32, 1848.

Not *Arca mississippiensis* Conrad, Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 1, p. 125, pl. 13, figs. 11, 15, 1848.

Navicula mississippiensis Conrad, Acad. Nat. Sci. Phila., Proc. for 1854, p. 29.

Cucullæarca mississippiensis Conrad, Am. Journ. Conch., vol. 1, p. 11, 1865.

Barbatia mississippiensis Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 625, 1898.

"Trapezoidal, with numerous closely arranged radiating lines, crenulated by fine concentric lines, the crenulation most distinct anteriorly, where the radii are largest; anterior end truncated or a little convex, direct; posterior margin obliquely truncated above; basal margin widely and profoundly arched; hinge line long, linear, minutely crenulated, expanded towards the extremities, and with prominent teeth; cardinal area with fine, very closely-arranged lines, angulated under the apex. Length 16-10.

"Differs from the preceding [*B. lima*] in having a longer hinge, finer radii, etc., and is a much smaller species and more abundant."—Conrad, 1848.

This species is much like *A. marylandica*. It is separated from *A. cuculloidis* by its even ribbing and lack of the sharp umbonal ridge which characterizes that species.

Dimensions.—(Small valve), lon. +9, -20; alt. +2.5, -16; semidiam. 6 mm.

Occurrence.—Vicksburg Oligocene of Vicksburg, Mississippi.—C. U. Museum.

Arca marylandica Conrad

Plate III, Figures 5, 6, 7

Byssarca marylandica Conrad, Fos. Med. Tert., p. 54, pl. 29, fig. 1, 1840.

Navicula marylandica Conrad, Acad. Nat. Sci. Phila., Proc. for 1854, p. 29.

Barbatia (*Byssarca*) *marylandica* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Arca marylandica Heilprin, Acad. Nat. Sci. Phila., Proc. for 1880, p. 21.

Barbatia (*Calloarca*) *marylandica* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 623, 1898.

Arca (*Barbatia*) *marylandica* Glenn, Maryland Geol. Surv., Miocene, p. 392, pl. 106, fig. 7, 1904.

"Shell oblong, compressed, thin, with very numerous radiating granulated striæ; beaks not prominent; base much contracted or emarginate anterior to the middle; posterior side dilated, the superior margin very oblique and emarginate; extremity angulated, and situated nearer to the line of the hinge than to that of the base; cardinal teeth minute, except towards the extremities of the cardinal line, where they are comparatively very large and oblique; inner margin entire.

"*Locality.* Cliffs of Calvert, Md. * * *,"—*Conrad*, 1840.

Ribs not varying conspicuously over the shell, often alternating with finer ribs anteriorly, smoother and usually double posteriorly; posterior part of the shell two-angled or broadly rounded; cardinal area with numerous v-shaped grooves; form of shell often irregular. This species lacks the sharp umbonal ridge of *A. cuculoides*.

Byssarca marilandica Lea, Acad. Nat. Sci. Phila., Proc. for 1848, p. 97, and *Arca marylandicus* Heilprin, Acad. Nat. Sci. Phila., Proc. for 1881, p. 451, are misprints for this species.

Dimensions.—Lon.+17,-36; alt.+6,-30; semidiam. 14 mm.

Occurrence.—Oligocene of the Ballast Point silex beds, Tampa Bay, the lower (Chipola) bed at Alum Bluff, the Chipola marl of the Chipola River, Florida; older Miocene of Jericho, Cumberland County, New Jersey; Middle Miocene of Plum Point, Calvert Cliffs, and Centreville, Maryland. Possibly also in the Jacksonian.—*Dall*. Calvert Miocene of three miles west of Centreville, Plum Point, Centreville, Maryland.—*Glenn*. Oligocene of Bailey's Ferry, Florida.—*C. U. Museum*.

Arca arcula Heilprin

Plate III, Figures 8, 9

Arca arcula Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 118. pl. 16, fig. 65, 1887.

Barbatia (Calloarca) arcula Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 624, pl. 33, fig. 4, 1898.

"Shell moderately elongated, sharply angulated on the posterior slope, the dorsal and ventral borders nearly straight and parallel with one another; dorsal (hinge) line not much more than half the length of shell; anterior border projecting forward basally; posterior border acutely angulated with the base; beaks anterior, not very prominent, nor very widely separated; ligamental area narrow; teeth almost obsolete in the middle of the hinge-line, becoming oblique toward either extremity; interior of shell deep; external surface closely ribbed, the ribs strongly imbricated by the rugose lines of growth; ribs most prominent on the posterior slope, where they are echinated.

"Length, 1.7 inch; height to top of umbo, 1 inch."—*Heilprin*, 1887.

"Shell subovate, thin, inflated, the beaks low and prosogyrous; the cardinal area narrow and very closely and minutely furrowed longitudinally, the furrows showing a slight angle behind the beaks; sculpture of close set, fine radial ribs, rather regularly imbricated at successive lines of growth; on the posterior dorsal slope are six or eight nodulous larger ribs; the beaks are situated a little behind the anterior third; byssal foramen narrow, very anterior; hinge with a few large v-shaped teeth at the ends, the

middle teeth vertical, small, or even obsolete mesially; margins of the valve slightly or not at all crenulated by the sculpture. Length of shell 47, of hinge-line 30, height 31, diameter 26 mm.

"This species is very evenly and regularly fluted at the imbrications, differing in that respect from any of the other species mentioned here. It is notable also for its inflated and thin valves and the bluntly truncate posterior end, though the latter may be abnormal.—*Dall*."

Occurrence.—Oligocene of the Ballast Point silex beds, Tampa Bay, Florida.—*Dall*.

Arca phalacra Dall

Plate III, Figure 10

Barbatia (*Calloarca*) *phalacra* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 626, pl. 33, fig. 3, 1898.

"Shell thin, moderately convex, equivalve, inequilateral; the prosogyrate beaks within the anterior fourth low and somewhat compressed; sculpture of very numerous fine, even, mostly dichotomous riblets without nodules or reticulation over the whole shell, crossed only by feeble incremental lines; cardinal area very narrow, with a few longitudinal grooves; hinge-teeth small, short, and vertical mesially without any gap in the series, distally longer, larger, and more oblique; hinge-line 0.6 of the whole length; internal margin of the valves smooth, byssal gape inconspicuous. Lon. 23.5, alt. 11, diam., 9 mm.

"This is a very modest and neat little species which does not seem identifiable with any of the others. It is, perhaps, nearest to *B. mississippiensis* Conrad, but is smaller, less flattened, and more regular."—*Dall*, 1898.

Occurrence.—Oligocene of the Chipola marls, Chipola River, and of the Oak Grove sands, Florida.—*Dall*.

Arca candida Gmelin

Plate III, Figures 11, 12

Arca candida *Helblingi*, Chemnitz, 7, p. 195, pl. 55, fig. 542.

Arca candida Gmelin, Syst. Nat., 6, p. 3311, 1792.

Arca Helblingii Bruguiere, Encyc. Meth., p. 195, 1797.

Arca jamaicensis Gmelin, Syst. Nat., 6, p. 3312, 1792.

Barbatia (*Calloarca*) *candida* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 626, 1898.

"A. testa pellucida rhomboidali antcrius producta posterius truncata decussatim striata: natibus remotis, margine posterius hiantc; hiatus ovato ciliato.

Chemn. Conch. 7. t. 55 f. 542.

β) *Chemn. Conch.* 7. t. 55. f. 544.

Habitat in Oceano americano *et ad* Africae littus occidentale, *testa alba, quasi granulata, epidermide villosa ex atro subfusca obducta*."—*Gmelin*, 1792.

The synonymy is taken from Dall, who says, "There are some difficulties in the

nomenclature of this species which I have not the literature to straighten out. As far as I am now able to ascertain, the first name applied to this shell was *candida*, and the first binomial Latin name was that of Gmelin. It is a well known West Indian species conspicuous for its large size, white shell, and compressed, flattish valves. It is quite possible that some of the early authors named this wide-spread species more than once, and in this connection the *A. ovata* and *complanata* should be examined."

Recent and fossil shells from the Caribbean district reported as *A. velata* Sowerby are probably this species.

"Shell thin to solid, rather compressed, subtrapezoidal, gaping at the anterior base; anterior end generally truncate; posterior end pointed and obliquely truncate above; beaks high, separated by a moderately wide area; surface sculptured with fine to rather strong double or single, large or small ribs which are heavier on the posterior slope. These are crossed by rude, irregular growth lines and ridges, causing the surface to appear somewhat cancellated and beaded; epidermis heavy, shaggy; teeth feebly developed. Color white.

"Length, 60; height, 35; diameter, 28 mm,"—*Dall and Simpson*, (Mollusca of Porto Rico, Bull. U. S. Fish Comm., vol. 20, for 1900, pt. 1, p. 460, 1901).

Occurrence.—Oligocene of the Bowden beds, Jamaica, of the Chipola beds at Alum Bluff and on the Chipola River, Florida; Pliocene of Trinidad; Pleistocene of the Antilles generally, and recent from Cape Hatteras, North Carolina, to Brazil at Santa Caterina, and possibly the African coast.—*Dall*. Recent from Santo Domingo.—*C. U. Museum*.

Arca caloosahatchiensis (new name)

Plate III, Figure 13

Barbatia (*Calloarca*) *irregularis* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 623, pl. 33, fig. 5, 1898.

Not *Arca irregularis* Deshayes, Des. Coq. Fos., vol. 1, p. 208, pl. 32, figs. 9, 10, 1830.

Not *Arca irregularis* d'Orbigny, Pal. Franç., Terr. Crét., vol. 3, p. 240, pl. 326, figs. 4, 5, 1844.

"Shell thin, elongate, irregularly distorted; beaks prosogyrate; at the anterior third rather low and compressed; cardinal area long, rather narrow, with very numerous (twelve) concentric grooves; surface irregular, sculptured with numerous fine radiating, somewhat imbricated ribs, of which those in front of the beaks and on the posterior dorsal slope tend to be larger and more elevated; there is a tendency to alternate or pair among the ribs in some specimens; the imbrications or nodules on the ribs are somewhat regularly spaced and correspond to elevated concentric lines in harmony with the lines of growth; the posterior dorsal slope is bounded by rounded ridges radiating from the beaks; the posterior cardinal margin is elevated and angular with more or less of a depression between it and the radial ridge on each side; the byssal foramen is wide and irregular; the hinge-line is long and straight; the teeth, vertical and very small medially, are sometimes obsolete in the middle of the hinge; distally they become rather distant and quite oblique, as well as larger; the internal margin, though irregular, is not fluted. Lon. of adult 51, alt. 25, diameter 20 mm.

"This species is distinguished from *B. marylandica* by its smaller altitude, its coarser and more prominent sculpture, and more irregular hinge; the beaks are also more anterior."—*Dall*, 1898.

Occurrence.—Oligocene of the silex beds at Ballast Point, Tampa Bay (fragment)? Pliocene marls of Shell Creek, Alligator Creek, and the Caloosahatchie.—*Dall*.

Arca nodulosa Müller

Plate III, Figures 14, 15

Arca nodulosa Müller, Zoologiæ Danicæ Prodomus, p. 247, 1776.

Arca nodulosa Gmelin, Syst. Nat., vol. 6, p. 3309, 1792.

Arca nodulosa Brøgger, Norges Geologiske Undersøgelse, No. 31, pl. 15, figs. 13a, 13b, 1901.

"*Arca testa oblonga nodulis striata, natibus incurvis remotis, margine integerrimo clauso. Müll. zool. dan. prodr.* 2984. *Habitat in omni mari europæo, fabæ equinæ magnitudine, natibus approximatis.*"—*Gmelin*, 1792.

Dall (U. S. Nat. Mus., Bull. 37, p. 42, 1889; Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 659, 1898), places this species in *Calloarca* and lists it from the Florida Keys. *Thiele* (Zool. Jahrb., Jena, Suppl. 11, pt. 2, p. 127, 1910), lists it from St. Thomas. It occurs as a fossil in Europe.

Arca propatula Conrad

Plate IV, Figure 1

Arca propatula Conrad, Acad. Nat. Sci. Phila., Proc. for 1843, p. 323; Fos. Med. Tert., p. 61, pl. 32, fig. 1, 1845.

Arca hians Tuomey and Holmes, Pleioc. Fos. S. Car., p. 34, pl. 14, figs. 4, 5, 1855. Not of Bronn, 1842 (*fide Dall*), or Reeve, Conch. Icon., Arca no. 62, 1844.

Arca hians Whitfield and Hovey, Am. Mus. Nat. Hist., Bull., vol. 11, pt. 4, pp. 444-447, 1901.

Barbatia (*Granoarca*) *propatula* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, pp. 290, 580, 1863.

Arca (*Granorca*) *propatula* Tryon, Struct. and Syst. Conch., vol. 3, p. 254, pl. 129, fig. 5, 1884.

Barbatia (*Granoarca*) *propatula* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 627, 1898; pt. 6, p. 1601, 1903.

"Rhomboidal, thick and ponderous; posterior side produced; sides flattened, slightly concave toward the base; umbonal slope rounded, rather elevated; ribs about 32, square, not profoundly prominent, about equal in width to the interstices, which have transverse imbricated lines; ribs largest about the umbonal slope, very distinct on the posterior slope, which is concave towards the hinge-line; posterior margin oblique, concave extremity widely rounded; summit of umbo moderately elevated, slightly retuse; cardinal area wide, with diverging grooves; series of teeth slightly sinuous anteriorly; teeth numerous; at the posterior extremity, the series suddenly becomes dilated, and the teeth interrupted or tubercular; inner margin crenate; crenæ profound and remote posteriorly. Length, four inches; height rather more than one and one-third inches.

"*Locality*. James River, below City Point. Petersburg, Mr. Tuomey; Ware River, Gloucester County, Virginia, Mr. Ruffin.

"Perhaps this may prove to be an old specimen of *A. arata*, Say."—*Conrad*, 1843.

Tuomey's shell was proportionately longer than Conrad's.

Occurrence.—Miocene of Virginia, on the James River below City Point, Petersburg, and on the Ware River, Gloucester County; Darlington, South Carolina; Sumter District, South Carolina.—*Dall*.

Arca virginiae Wagner

Plate IV, Figures 2, 3, 4

Arca virginiae W. Wagner, Trans. Wagner Inst., v., pl. 1, fig. 3 (*vide* Dall).

Arca virginiae Bronn, Index Pal. Nomencl., p. 99, 1848; Syst., p. 281, 1849.

Barbatia (*Granoarca*) *virginiae* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 627, pl. 32, fig. 23, 1898.

Arca (*Barbatia*) *virginiae* Glenn, Maryland Geol. Surv., Miocene, p. 392, pl. 106, fig. 8, 1904.

"*Arca virginiae* is a large, solid, elongated shell, equivalve but very inequilateral, the beaks being situated near the anterior fifth of the length, low and prosogyrate, distant, and separated by a wide cardinal area with numerous (nine) slightly angular longitudinal concentric grooves; sculpture of about twenty-five strong radial ribs, smaller on the posterior dorsal area, somewhat flattened, and on the posterior part with a shallow, wide mesial furrow; hinge-line .65 as long as the shell; teeth vertical, in two series, beginning mesially very small, distally larger, and with a tendency to break up or become irregular; muscular impressions deep; margin fluted in harmony with the ends of the ribs. Lon. 83, alt. 52, diam. 42 mm.

"This shell is about midway in its characters between *Barbatia* (*Granoarca*), *Anadara*, and *Scapharca*, illustrating very well the manner in which the subordinate groups of the genus *Arca* intergrade * * *."—*Dall*.

Occurrence.—Miocene of Virginia, (Nansemond River?)—*Dall*. St. Mary's Miocene of St. Mary's River, Maryland, (imperfect, probably this species).—*Glenn*. Miocene of Claremont Wharf, James River, Virginia.—*C. U. Museum*.

Arca centenaria Say

Plate IV, Figures 5, 6, 7

Arca centenaria Say, Acad. Nat. Sci. Phila., Journ., 1st. ser., vol. 4, p. 138, pl. 10, fig. 2, 1824.

Striarca (*Arca centenaria* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, pp. 290, 580, 1863.

Barbatia (*Striarca*) *centenaria* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 615, 628, 1898; pt. 6, p. 1601, 1903.

Arca (*Barbatia*) *centenaria* Glenn, Maryland Geol. Surv., Miocene, p. 391, pl. 106, figs. 5, 6, 1904.

"Shell transversely oval, subrhomboidal, obtusely contracted at the base with numerous alternate longitudinal striae.

"* * * Striae from one hundred to one hundred and eighty and more in number: disappearing on the hinge margin; with hardly obvious transverse minute wrinkles, and larger, remote, irregular ones of increment: beaks but little prominent, not remote: base widely but not deeply contracted, nearly parallel with the hinge margin: anterior and posterior margins obtusely rounded: series of teeth rectilinear, uninterrupted, decurved at the tips; space between the beaks with numerous grooves proceeding from the teeth:

inner margin not very distinctly crenated: muscular impressions elevated, and forming a broad line each side, from the cavity of the beak to the margin.

"Length nine-tenths of an inch, breadth nearly one inch and a half."—*Say*, 1824.

Say used the term length for height and breadth for length.

This species does not closely resemble any other American *Arca*. The beaks are elevated and little curved; the ligament area is transversely striated, each groove corresponding with a groove in the ligament; the teeth are usually partly dissolved so that they are hollow, as in the fossil *Adamsi*; the upper edge of the line of teeth is straight, but the lower edge is evenly arcuate, so that the teeth are very short at the center and increase in length toward the ends of the hinge, where they make an angle of 45 degrees with the hinge-line; the extreme distal teeth are shorter and nearly horizontal; the inner margin is nearly smooth except in the young.

Dimensions.—Lon. +15, -25; alt. +5, -24; semidiam. 12 mm.

Occurrence.—Older Miocene of Jericho, Cumberland County, New Jersey, and in the Virginia Miocene at Coggin's Point, Petersburg, Grove Wharf, on the James River, and the Miocene beds of the York River.—*Dall*. Choptank Miocene of Jones Wharf; Calvert Miocene of Church Hill, Fairhaven, Maryland.—*Glenn*. Miocene of Evergreen, James River, Yorktown, Kingsmill, Bellefield and Grove Wharf, Virginia.—*C. U. Museum*.

Arca reticulata Gmelin

Plate IV, Figures 8, 9, 10, 11, 12

Arca reticulata Gmelin, Syst. Nat., 6, p. 3311, 1792.

Arca reticulata Chemnitz, Conch. Cab., 7, p. 193, pl. 54, fig. 540.

Arca squamosa. domingensis et clathrata Lam., An. s. Vert., vol. 6, pp. 45, 40, and 46, 1819.

Arca gradata Brod. and Sby., Zool. Journ., vol. 4, p. 365, 1829.

Arca divaricata Sby., P. Z. S., 1833, p. 18; Reeve, Conch. Icon., *Arca*, pl. 16, fig. 108, 1844.

Barbatia (Acar) reticulata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 629, 1898.

"A. testa subrhomboidea decussatim striata alba: natibus approximatis, vulva cordata.

List. Conch. t. 233. f. 67.

Martini Besch, Berl. Naturf. 3. t. 6. f. 9.

Chemn. Conch. 7. t. 54. f. 540.

Habitat - - - *arcae Noae affinis; utrum hujus, an sequentis familiae?*"—*Gmelin*, 1792.

The synonymy is taken from *Dall*. This includes forms of varietal value. Specimens in the Newcomb collection from Panama and Trinidad are radiately and concentrically ridged, the concentric ridges the stronger on the middle of the shell, giving rise to the name *gradata*; the diverging, radiating ridges are about as strong as or stronger than the concentric ridges on the posterior slope, but the sculpture is not conspicuously different on different parts of the shell. Only the posterior part of the cardinal area is covered by the ligament; the inner margin is finely crenulated. A specimen from Cuba is very similar to one labelled *Acar donaciformis* from the Mediterranean. These are smaller and thicker and the crenulations on the posterior inner margin are not so closely

connected with the external sculpture, but form long, even ridges on the thick margin. Specimens labelled from Paumotus and from the Mediterranean which are evidently *A. divaricata* are thin and the sculpture of the posterior part is conspicuously different from that of the rest of the shell, the ribs there are fewer than in the other forms, more conspicuously diverging and are much stronger than the concentric sculpture. The posterior ribs rise along the umbonal ridge. The crenulations of the posterior margin are larger to correspond with the larger posterior ribs and a secondary set of fine wrinkles overruns the main crenulations.

Acar reticulata is characterized by its small, nearly white, well-sculptured shell, concentric ridges and posterior ribs rising along the umbonal ridge. The teeth are grooved at the sides and many of them are v-shaped. The name *clathrata* was used by DeFrance (1816), M'Coy and Reeve, *squamosa* by de Koninck (1842), and *reticulata* by M'Coy (1844). *Navicula aspersa* Conrad is this species, not the young of *A. cuculloidis*.

Dimensions.—Large shell, lon. +10, -17.5; alt. +3, -13; diam. 15 mm.

Occurrence.—Eocene of the Jacksonian at Moody's Branch, Jackson, Mississippi; Oligocene of the Bowden beds, Jamaica; Matura, Trinidad; of the Tampa silex beds at Ballast Point, Florida, and on the Chipola River, Pliocene of Limon, Costa Rica, and of the Caloosahatchie marls; Pleistocene of the Antilles generally; and recent from Cape Hatteras to Barbados and the Gulf of Campeachy.—*Dall*. Recent from Trinidad, Cuba, Panama, Paumotus and the Mediterranean.—*C. U. Muscum*.

Arca millifila Dall

Plate IV, Figures 13, 14

Arca (Acar) millifila Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, pl. 56, figs. 21, 24, 1903.

"Pliocene marl of Shell Creek, Florida; the ligament is typical of *Acar*, the radial threads are minutely granular, especially on the posterior dorsal slope; the shell is thin and the scars obscure."—*Dall*, 1903.

Arca Harris (new name)

Plate IV, Figure 15

Arca inornata Meyer, Geol. Surv. Ala., Bull. 1, p. 79, pl. 1, fig. 24, 1886.

Arca inornata deGregorio, Faune Éocénique de l'Alabama, p. 197, pl. 24, fig. 29, 1890.

Arca (Fossularca?) inornata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 658, 1898.

Not *Arca (Cucullaea) inornata* Meek and Hayden, Acad. Nat. Sci. Phila., Proc. for 1858, p. 51, 1858.

"Trapezoidal; anterior side truncated, flat; beak small; ligament area very low; teeth smallest toward the middle; covered with indistinct concentric lines; margin entire.

"Resembles *Arca lævigata*, Caillat, from the Paris basin, but is less oblong."—*Meyer*, 1886.

From the descriptions this species appears to be nearest *Fossularca*. The name *inornata* is preoccupied by Meek and Hayden. Their species, from the Black Hills, has been placed in *Grammatodon*. Meyer's species is renamed in honor of Professor G. D. Harris for his work on the Eocene.

Occurrence.—Eocene of Claiborne, Alabama.—*Meyer*.

Arca Adamsi (Shuttleworth) Smith

Plate IV, Figures 16, 17, 18; Plate V, Figure 1

Arca cælata Conrad, Fos. Med. Tert., p. 61, pl. 32, fig. 2, 1845.Not *Arca cælata* Reeve, Conch. Icon., *Arca* no. 110, 1844.*Barbatia (Arca) cælata* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.*Arca lactea* of various authors, not of Linné.*Arca (Acar) Adamsii* Shuttleworth, MS.?, Smith, Lin. Soc., Zool., Journ., vol. 20, p. 499, pl. 30, figs. 6, 6a, 1890.*Arca Adamsi* Dall, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 243, 1886.*Barbatia (Fossularca) Adamsi* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 629, 1898.

"Trapezoidal, disk widely and not profoundly contracted; ribs numerous, alternated towards the base, tuberculated, aculeated anteriorly and posteriorly; posterior slope depressed; umbo acutely angulated behind; basal margin slightly arched; posterior margin obliquely truncated; beaks approximate.

"*Loc.* Wilmington, N. C., Mr. Hodge."—*Conrad*, 1845.

"This species is well distinguished from the similar looking *A. lactea* of Europe by the fact that its radial riblets are formed by rows of trailing blisters or hollow flutings, which are very friable and often entirely worn off, leaving the shell practically smooth. Though the shell has long been labelled with Shuttleworth's name in collections, the first published description I have met with is that of Mr. E. A. Smith, * * * Conrad's specific name is preoccupied. The fossils agree exactly with the living specimens, except that those from the Oligocene are usually somewhat smaller than the full-grown recent shells."—*Dall*.

Ligament occupying only a small, diamond shaped area between the beaks; line of teeth interrupted opposite the ligament. Dall, (Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 243, 1886; U. S. Nat. Mus., Proc., vol. 24, p. 508, pl. 31, fig. 1, 1902), called a dwarf, short, squarish form with greater proportional diameter the variety *Conradiana*.

Dimensions.—Lon. +4, -7; alt. +1, -6; semidiam. 3 mm.

Occurrence.—Oligocene of the Bowden beds, Jamaica, of the Chipola River and Oak Grove, Florida; Miocene of Duplin County, North Carolina; Pliocene marls of the Caloosahatchie, Shell Creek, and Alligator Creek, Florida, and the Waccamaw River, South Carolina. Recent, with a range from Cape Hatteras, North Carolina, to the island of Fernando Noronha, on the coast of Brazil, in five to one hundred and sixteen fathoms.—*Dall*. Oligocene of Bailey's Ferry, Florida; Miocene of Curry and the Natural Well, North Carolina; Pliocene of the Croatan beds, North Carolina; and recent from Cuba.—*C. U. Museum*.

Barbatia (Fossularca?) ovalina Dall; Plate V, Figure 2; (Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 630, pl. 32, fig. 18, 1898), from the Oligocene of Bowden, Jamaica, has the form of a *Nucula*, the cardinal margin of a *Limopsis*, and the teeth of an *Arca*. Lon. 3.2 mm.

Arca lignitifera Aldrich

Plate V, Figures 3, 4

Arca (Barbatia) lignitifera Aldrich, Nautilus, vol. 22, p. 75, pl. 5, figs. 6, 7, Dec. 1908.

"Shell small, thin, extremities rounded, moderately convex, beaks small and flattened; surface marked by many radial riblets crossed by irregularly spaced lines of growth; a depressed area running from beaks to base nearly central; valves smooth internally, but showing faint lines corresponding to some of the riblets. Hinge line long, slightly curved; the hinge carries four close-set teeth anteriorly, next a short vacant space, and then ten to thirteen small teeth, larger and more nearly parallel to the hinge line as they approach the posterior.

"Lon. 5 mm.; alt. 3 mm.

"LOCALITY. Six miles east of Thomasville, Ala., Wood's Bluff horizon."—Aldrich, 1908.

Occurrence.—[Sabine] Eocene of Alabama.—Aldrich.

Arca Aldrichi Dall

Plate V, Figure 5

Barbatia (Cucullaria) Aldrichi Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 630, fig. 19, 1898.

"Shell small, elongate, thin, somewhat pointed behind, rounded in front, moderately convex, with low, prosogyrate beaks; cardinal area very narrow and elongated, widest in front of the beaks; surface evenly sculptured by fine equal, flattish radial riblets, separated by narrower grooves and crossed by irregularly spaced impressed lines; inner margin of the valves smooth or slightly fluted in harmony with the ribs, especially behind; beaks in the anterior fourth; hinge-line about two-thirds the length of the shell; hinge anteriorly with four oblique, rather close-set teeth, separated by a wide gap from the posterior teeth, which are about six in number, smaller proximally, and parallel with the hinge-line. Lon. 8.3, alt. 5, diam. 4 mm.

"A single specimen of this interesting shell was obtained, adding a new group to the list of Eocene forms found in the Claibornian. The hinge is somewhat like that of *Arca (Cucullaria) Caillati* Deshayes, but wants the central vertical denticles. The form is more like that of *A. gracilis*, Desh., but wider and more regular."—Dall, 1898.

Occurrence.—Claiborne sands, Claiborne, Alabama.—Dall.

Arca taeniata Dall

Plate V, Figures 6, 7

Barbatia (Cucullaria) taeniata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 631, pl. 25, figs. 1, 1a, 1898.

"Shell thin, elongated, arcuate, mesially compressed, in general inflated; the beaks near the anterior fifth; anterior end rounded, short; posterior higher, produced, and

bent down; base receding mesially; cardinal area short and wide in front of the beaks, long and narrow behind them, in front smooth or longitudinally striated, behind with a few oblique grooves; sculpture of small, flat, radial ribs arranged in pairs with narrower interspaces, and between every set of two pairs and the next a wider interspace, as if the ribs were quadripartite; these ribs cover all the shell, more sparsely on the posterior dorsal slope, and are crossed at wide but not perfectly regular intervals by narrow, flat, concentric ridges; inner margin of the valves smooth, except when modified by the external ribbing; hinge two-thirds as long as the shell, with four rather large oblique anterior teeth separated by a wide edentulous gap from a row of about twenty short vertical teeth, which merge into a group of six or seven oblique posterior teeth, becoming larger distally; the extreme distal teeth in full-grown specimens sometimes break up into irregular granules. Length of adult shell 52, of hinge-line 29, alt. of shell 23, diam. 21 mm."—Dall, 1898.

Occurrence.—Pliocene marls of the Caloosahatchie and Shell Creek, Florida, and of the Croatan beds of North Carolina, at Mrs. Guion's marl pit.—Dall.

Macrodon asperula Dall; Plate V, Figures 8, 9; Dall, Bull. Mus. Comp. Zool. Harvard, vol. 9, p. 120, 1881; vol. 12, p. 244, p. 8, figs. 4, 4a, 1886; U. S. Nat. Mus., Bull. 37, p. 42, pl. 8, figs. 4, 4a; *Bentharca asperula* Verrill and Bush, Proc. U. S. Nat. Mus., vol. 20, p. 842, 1898; *Barbatia (Cucullaria) asperula* Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 659, 1898, is given by Dall as recent from Fernandina to Yucatan in three hundred and ten to fifteen hundred and sixty-eight fathoms. The name is preoccupied in *Arca* by Deshayes, An. S. Vert., vol. 1, p. 883, pl. 66, figs. 4-6, 1860. Dall's species might be called *Arca paserula*.

Macrodon sagrinata Dall; Plate V, Figure 10; Dall, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 245, 1886; U. S. Nat. Mus., Bull. 37, p. 42, 1889; *Barbatia (Cucullaria) sagrinata* Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 659; *Arca (Cucullaria) sagrinata* Dall, U. S. Nat. Mus., Proc., vol. 24, p. 508, pl. 31, fig. 2, 1902, is from water eighty fathoms deep northwest of Cuba.

Arca profundicola Verrill; Plate V, Figures 11, 12; Verrill, Trans. Conn. Acad., vol. 6, p. 439, pl. 44, figs. 23, 23a, 1885; Dall, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 245, 1886; *Macrodon profundicola* Dall, U. S. Nat. Mus., Bull. 37, p. 42, pl. 46, figs. 23, 23a, 1889; *Barbatia (Cucullaria) profundicola* Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 659, 1898; *Bathyarca profundicola* Verrill and Bush, Proc. U. S. Nat. Mus., vol. 20, p. 844, pl. 78, fig. 2, 1898, has been found in deep water off the northeastern and southern coasts of the United States.

Arca lactocomata Dall; Plate V, Figures 13, 14; Dall, Bull. Mus. Comp. Zool. Harvard, vol. 12, p. 243, pl. 6, figs. 9, 10, 1886; vol. 18, pp. 433-435, 1889; U. S. Nat. Mus., Bull. 37, p. 40, pl. 6, figs. 9, 10, 1889, is from eighty-two to one hundred and sixty-nine fathoms from Martinique and Barbados.

Arca (Barbatia) pteroëssa E. A. Smith; Plate V, Figures 15, 16, 17; Smith, Challenger Rep., Lam., p. 262, pl. 17, figs. 4-4b, 1885; *Bathyarca pteroëssa* Verrill and Bush, Proc. U. S. Nat. Mus., vol. 20, p. 843, 1898; *Arca (Cucullaria) pteroëssa* Dall, Bull. Mus.

Comp. Zool. Harvard, vol. 43, p. 399, 1908, was found off Culebra Island, West Indies, and near the Azores and in the North Pacific.

Subgenus *Noëtia* Gray

Noëtia Gray, Syn. Cont. Brit. Mus., 1840. (Dall).

Subgenus *Noëtia* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 616, 1898.

The *Noëtias* form a distinct division of the *Arcas*. Dall says the known fossils are all American and the recent species American and Indo-Pacific. The shell is equivalve, the posterior part is separated from the rest of the shell by a distinct umbonal ridge and in *A. reversa*, the type of the group, is so short that the beaks are posterior. The cardinal area usually appears twisted on account of its concave anterior part with raised margin and flat posterior part. The ligament is crossed by transverse grooves which usually extend the width of the ligament in front of the beaks but are weaker posteriorly. Behind the ligament is a bare strip of the cardinal area which is usually oblique to the hinge-line, but in *A. reversa* it lies between the beaks and the ligament is entirely anterior. At the anterior end of the hinge and part way between the center and posterior end the teeth are v-shaped. Nearly all the interspaces show a fine interstitial rib.

Arca incile Say

Plate V, Figures 18, 19, 20, 21, 22, 23, 24, 25

Arca incile Say, Acad. Nat. Sci. Phila., Journ., 1st ser., vol. 4, p. 139, pl. 10, fig. 3, 1824; Conrad,

Fos. Tert. Form., p. 16, pl. 2, fig. 1, 1832; Fos. Med. Tert., p. 56, pl. 29, fig. 5, 1840.

Anomolocardia (Arca) incile Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Anadara incile Meek, Miocene Check List, Smith Misc. Coll. (183), p. 6, 1864.

Noëtia protexta Conrad, Kerr's Geol. Rep. N. Car., App. A, p. 19, pl. 3, fig. 5, 1875.

Arca (Noëtia) incile Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 632, 1898.

"Shell transversely rhomboidal, with about twenty-seven ribs; anterior hinge margin compressed and angulated.

"Disk prominent from the beaks to the anterior part of the base: ribs with transverse granules; those anterior to the middle alternating with very slender and but little prominent lines and with a groove on each: anterior margin longer to the base than the posterior end, and contracted in the middle: series of teeth nearly rectilinear, entire; interval between the teeth and the apices with a few transverse lines or wrinkles; a single oblique groove from the apex to a little before the middle, and six or seven narrow ones from the teeth outwards behind the apices: beaks placed very far backward: inner margin crenated: muscular impressions a little elevated, posterior one short: basal margin not parallel with the hinge margin * * * ."—*Say*, 1824.

In Say's description anterior and posterior are reversed.

Ribs twenty-seven to thirty-two, one specimen has thirty-four; a fine interstitial rib in the interspaces, sometimes wanting near the middle of the shell; ribs close-set on the anterior part of the shell except near the hinge, broader, higher and with wider interspaces about the umbonal ridge; posterior ribs with a longitudinal sulcus; beaks very anterior, elevated; cardinal area long, the portion occupied by the ligament diamond shaped

and extending backward to a point about half way from the beaks to the posterior extremity of the hinge in the adult, shorter in the young; ligament area with transverse grooves which are stronger in front of the beaks; posterior part of the cardinal area longitudinally striated; hinge-line as long or nearly as long as the shell; umbonal ridge angular; shell long and rectangular, anterior margin rounded, ventral nearly straight and descending so that the lowest point of the shell is at the posterior end, posterior end usually emarginate and nearly at right angles to the hinge; hinge narrow; line of teeth straight, posterior teeth oblique, anterior teeth vertical except at the end of the hinge, where a few are usually bent at a right angle, as in *A. ponderosa*.

It is apparent that Conrad's *Noetia protexta* from the Miocene of North Carolina is the same as Say's *A. incile*. The specimen of *A. trigintinaria* Conrad (Acad. Nat. Sci. Phila., Proc., p. 289, 1862), in the museum of the Academy, is intermediate between *incile* and *limula*. It is not a separate species, but rather a variety of *incile*. It is from the Miocene of South Carolina. *A. incilis* Kerr, Geol. Rep. N. Car., 1875, is a misprint for *A. incile*.

Dimensions.—Lon.+8,-26; alt.+5,-18; diam. 22 mm. Large valve.—Lon. 45, alt. 30, semidiam. 14 mm.

Occurrence.—Miocene of Maryland, Virginia, and North Carolina; near Darlington, South Carolina, at various points near and at the Natural Well, Duplin County, North Carolina; Petersburg, Dinwiddie, York River, and borders of the Dismal Swamp, Virginia, and Choptank, Maryland.—*Dall*. Miocene of Grove Wharf, Evergreen, Kingsmill, Yorktown, Bellefield and Shackelford, Virginia; Magnolia, North Carolina; Darlington C. H., South Carolina; Tertiary of James River, Virginia.—*C. U. Museum*.

Arca limula Conrad

Plate V, Figure 26; Plate VI, Figures 1, 2, 3, 4, 5

Arca limula Conrad, Fos. Tert. Form., p. 15, pl. 1, fig. 1, 1832; Fos. Med. Tert., p. 60, pl. 31, fig. 3, 1845.

Noetia (Arca) limula Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Arca (Noetia) limula Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 617, 631, 659, pl. 31, figs. 14, 14b, 1898.

"Oblong, sinuous, rather thin; ribs numerous, crossed by striæ, which are equally distinct in the interstices; ribs double on the posterior side where they alternate with fine lines; umbo angulated behind; hinge area narrow, oblique, and transversely striated; basal margin contracted near the middle; inner margin crenate * * *.

"This shell has a general resemblance to *Arca ponderosa*, of Say, but cannot be confounded with that species."—*Conrad*, 1832.

Dall (Wagner Free Inst. Sci., Trans., vol. 3, p. 632, 1898) gives the two following varieties of *A. limula*:

Arca limula var. *platyura* Dall

Pliocene of the Caloosahatchie and Alligator Creek * * *.

Shell with the posterior end of the cardinal border elevated and forming nearly a right angle with the posterior margin of the valves, thus giving the posterior part of the shell a higher and more angular look, which at first seems very distinct.

Arca limula var. *filosa* Conrad

Noëtia ponderosa Say, var. *N. carolinensis* Conrad, Proc. Acad. Nat. Sci. Phila., for 1862, p. 290; not *Arca carolinensis* Wagner, 1847.

Arca carolinensis Heilprin, Proc. Acad. Nat. Sci. Phila. for 1881, p. 450.

Noëtia filosa Conrad, Kerr's Geol. Rep. N. Car., App. A, p. 20, pl. 4, fig. 3, 1875.

Miocene of North Carolina: at Sullivan's marl-pit, Green County, North Carolina, eight miles east of Snow Hill * * *.

This variety has more numerous (thirty-five) ribs when adult and a less angular outline than the typical form.

* * * A variety analogous to *platyura* is possessed by all the species of *Noëtia*, but is perhaps more conspicuous in *A. limula* * * *.

In *A. limula* there are from twenty-eight to thirty-five ribs. In the long, rounded form they are often narrower and more crowded anteriorly, as in *A. incile*. Ribs about the umbonal ridge often with a fine riblet like the interstitial rib in the mesial sulcus; interspaces crossed by even, concentric lines which give a beaded appearance to the interstitial ribs but are less marked on the primary ribs as a rule; posterior strip of the cardinal area not covered by the ligament; ligament transversely grooved, grooves stronger in front; anterior margin of the cardinal area elevated, posterior rounded; teeth as in *A. ponderosa*; muscle scars with raised margins; anterior margin of the shell rounded, basal curved or sinuous with the lowest part of the shell usually near the posterior end; posterior margin usually with a bend near the hinge.

Typical *A. limula* has a sinuous base and an angle near the top of the posterior margin. It is separated from *A. incile* by its larger size, irregular outline, by the angle in the posterior margin and especially by the hinge and position of the beaks. The long, irregular shape and more anterior beaks separate it from *A. ponderosa*. Specimens from South Carolina, probably from the Pliocene, are, however, closely related to *A. ponderosa*. They have a more rectangular outline than typical *limula*, a relatively longer hinge-line, less anterior beaks, and have little or no bend in the posterior margin. *A. limulus* Morton 1834 and *A. limatula* Emmons, 1858, are misprints for *A. limula*. Conrad (Acad. Nat. Sci. Phila., Proc. for 1864, p. 211) withdrew his variety *carolinensis* from the species *ponderosa*.

Dimensions.—Lon.+22,-35; alt.+9,-36; semidiam. 19 mm.

Occurrence.—Miocene: North Carolina, at Wilmington, New Berne; Virginia, at various points on the York and James Rivers; also in Maryland and South Carolina, and at Heislerville, Cumberland County, New Jersey. Pliocene: De Leon Springs, Florida; in the marls of the Caloosahatchie and Shell Creek; near Brunswick, Georgia; Waccamaw beds, South Carolina.—*Dall*. Pliocene of Waccamaw, South Carolina, and the Croatan beds, North Carolina.—*C. U. Museum*.

***Arca ponderosa* Say**

Plate VI, Figures 6, 7, 8, 9, 10

Arca ponderosa Say, Acad. Nat. Sci. Phila., Journ., 1st. ser., vol. 2, p. 267, 1822.*Arca contraria* Reeve, Conch. Icon., *Arca* no. 55, 1844.*Arca elegans* Phil., Zeitschr. Mal., 1847, p. 92 (*vide* Dall). Not *A. elegans* Perry, Conchology, pl. 60, fig. 1, 1811; *A. elegans* Roemer, 1836; *A. elegans* d'Orbigny, 1844; *A. elegans* Wood, 1846, or *A. elegans* de Koninck.*Noetia ponderosa* H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 537, 1858.*Arca* (*Noetia*) *ponderosa* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 617, 632, 633, 659, 1898.

"Shell somewhat oblique, very thick and ponderous, with from 25-28 ribs, each marked by an impressed line; interstitial spaces equal to the width of the ribs; umbones very prominent; apices remote from each other, and opposite to the middle of the hinge, spaces between them with longitudinal lines as prominent as their corresponding teeth; anterior margin cordate, flattened, distinguished from the disk by an abrupt angular ridge; posterior edge rounded, very short; inferior edge nearly rectilinear, or contracted in the middle * * *."—*Say*, 1822.

In the original description anterior and posterior are reversed.

Ribs twenty-five to thirty-two; width of ribs and interspaces not varying much on the different parts of the shell; ribs with a mesial sulcus, sometimes with two sulci; a fine interstitial rib in each interspace, more prominent on the umbonal ridge and sometimes indistinct on other parts of the shell; ribs and interspaces crossed by fine, evenly spaced, concentric lines which are stronger in the interspaces; umbonal ridge angular, posterior end produced, posterior margin nearly straight; muscle scars with an elevated border; anterior margin of cardinal area elevated; ligament area longer anteriorly and bounded posteriorly by a narrow uncovered strip extending diagonally backward from the beaks; transverse grooves in the ligament stronger anteriorly; line of teeth curved at the ends, central teeth fine and vertical, anterior teeth larger and v-shaped, posterior teeth large and oblique with smaller, v-shaped teeth toward the center of the line; epidermis brownish black.

This is a variable species. Specimens from the Pleistocene of Louisiana and South Carolina are mostly short and high like some recent shells from Ft. Barrance, Florida. A valve from the Pliocene of the Croatan beds is unusually long, low and flat, and another from the same beds is unusually large, 71 mm. long and 61 mm. high. Neither of these can be placed in the species *limula* which is present in the same beds.

It is apparent that Reeve's *A. contraria* is the same as Say's species. Dall places *A. elegans* in synonymy with *A. ponderosa* and says, "There can be little or no doubt that the names of Reeve and Philippi are based on young specimens of this somewhat variable shell." This is one of the best known of the recent *Arcas* and is easily recognized by its heavy shell, interstitial ribs and twisted appearance.

Dimensions (long form).—Lon.+25,-31; alt.+9,-34; diam. 40 mm.

Occurrence.—Pleistocene of Cape May and Atlantic City, New Jersey; of Maryland, near Cornfield Harbor, at Wailes Bluff, on the Potomac River; of Simmons Bluff, South Carolina; and many points on the coast of Florida; recent on the eastern coasts of North

America from Cape Cod to Yucatan.—*Dall*. Pliocene of the Croatan beds, North Carolina: Pleistocene of Georgetown, South Carolina; of Crowley Oil Company and Knapp's wells, Grand Chenier, and New Orleans, Louisiana: recent from Point au Fer, Louisiana; Galveston, Texas; and Long Key, Cedar Keys and Ft. Barrance, Florida.—*C. U. Museum*.

The Noëtias show a variation which reaches an extreme in *A. reversa* Gray (Plate VI, Figures 11, 12), from the west coast of tropical America. In *A. incile* the shell is long with a long hinge-line and very anterior beaks. In typical *limula* the beaks are nearly as anterior when distances are measured parallel to the base instead of parallel to the hinge, but the hinge-line is much shorter so that the beaks are a comparatively short distance in front of the center of the hinge. In *A. ponderosa* both shell and hinge are short and the beaks are opposite the center of the hinge. *A. reversa* is still shorter and all the ligament area and nearly all the hinge are anterior to the beaks. With the shortening of the hinge it has become wider, the line of teeth more curved and the v-shaped teeth, which are inconspicuous in *A. incile*, have become more prominent; the width of the bare strip behind the ligament has decreased; the shell has developed a truncation so pronounced in *A. reversa* that the posterior parts of the two valves lie nearly in the same plane. *A. reversa*, however, is probably not descended from the other species mentioned. *A. (Noëtia) modesta* Grzybowski, from the Tertiary of Peru, is as short as *reversa* and the posterior part is concave. Grzybowski's *A. reversa*, from the Tertiary of Peru, is much larger than the recent form. C. B. Adams, Carpenter, Kobelt and Dall place *A. hemicardium* Koch in synonymy with *A. reversa*.

A. trinitaria Guppy; Plate VII, Figures 1, 2; (Quart. Jour. Geol. Soc., vol. 22, p. 583, pl. 26, figs. 3a, 3b, 1866; Schuchert, U. S. Nat. Mus., Bull. no. 53, pt. 1, p. 57, 1905), from Manzanilla, Trinidad, is very similar to *A. reversa*, but is smaller. It has forty ribs and a flat, cordate posterior portion. Dall (Wagner Free Inst. Sci., Trans., vol. 3, p. 658) lists this species as Oligocene. *A. centrola* Guppy; Plate VII, Figure 3; (Proc. Sci. Assoc. Trinidad, p. 175, Dec. 1867; Schuchert, U. S. Nat. Mus., Bull. no. 53, pt. 1, p. 55, 1905), fossil from Trinidad, also belongs to Noëtia. It is given by Dall as probably a Miocene species. The original description is repeated in Ann. Nat. Hist., 4th. ser., vol. 15, p. 51, 1875, and a figure is given in Geol. Mag., 1874, pl. 18, fig. 23. It has 36-38 ribs with fine interstitial ribs in the narrow interspaces and there is an angle in the posterior margin near the hinge. It is about 25 mm. long and resembles the young of *A. limula*, but is nearer to *A. Martinii* Recluz. Specimens in the C. U. Museum from Maranhão, Brazil; Plate VII, Figures 4, 5; are evidently the recent species which Guppy (Ann. Nat. Hist., 1875, p. 51, pl. 7, figs. 4a, 4b) collected from the Gulf of Paria and referred to *A. centrola*. They also agree well with *A. bisulcata* Lamarck (An. s. Vert., vol. 6, p. 45, 1819), and with *A. Martinii* Recluz (Jour. de Conch., vol. 3, p. 409, pl. 12, figs. 3, 4, 5, 1852), from southern Brazil. Dall states that the name *Martinii* is preoccupied by Bolten. The living species should probably receive the name *bisulcata* with *centrola* as an ancestral form or possibly the same species. The Maranhão shells have a small cardinal area not entirely covered by the ligament, the interspaces are rather narrow and are nearly filled by the fine interstitial ribs, the shell is often yellow

or pinkish, especially near the beaks; the posterior part shows two ridges running from the beaks, one, as in *A. limula*, to the angle with the ventral margin, the other to the angle in the posterior margin near the hinge. The margin is crenulated in the younger shells, but only feebly so in the old specimens.

Dall states that *Arca trapezia* Desh., from West Mexico, also belongs in *Noëtia*. Specimens in the Newcomb collection labelled *Scapharca trapezia* Desh., which correspond with Reeve's figure and description do not belong to this group, however.

Subgenus *Scapharca* Gray

Section *Scapharca*

"Group of *A. inequivalvis* Brug. [*Scapharca* (Gray, 1847) Adams, 1858.]

"Moderately thin, elongate-ovate, with prosocoelous beaks, rather narrow cardinal area, not wholly covered by the ligament and usually with concentric resiliary lozenge-like grooving; tooth series uninterrupted, the teeth small, similar, somewhat larger and more oblique distally, the right valve smaller, the sculpture on the two valves usually similar or not markedly discrepant; the epidermis much as in *Argina*."—*Dall*.

Arca rhomboidella Lea

Plate VII, Figures 6, 7, 8, 9, 10

Arca rhomboidella Lea, Contributions to Geol., p. 74, pl. 2, fig. 52, 1833.

Anomolocardia rhomboidella Conrad, Smith. Misc. Coll., Eocene and Oligocene Checklist, p. 4, 1866.

Arca rhomboidella de Gregorio, Faune Éoc. Alabama, p. 196, pl. 24, fig. 28, 1890.

Arca (*Cucullæarca*) *cuculloid*es de Gregorio, l. c., p. 195, pl. 24, figs. 17-20.

Arca rhomboidella Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 625, 1898.

"Description. Shell rhomboidal, very inequilateral, compressed at base, longitudinally and closely ribbed; substance of the shell thin; beaks small, pointed; ribs about thirty-three, obsoletely tuberculated on the anterior portion; teeth lamellar, oblique; cicatrices scarcely perceptible; cavity of the shell rather shallow; margin crenulate.

"Diam * * * Length .2, Breadth 7-10ths, of an inch.

"*Observations.* This pretty little species forms, by its parallel sides, nearly a perfect rhomboid. It has some resemblance to the *centenaria* of Say, which is described by him, as well as Mr. Conrad, as being 'subrhomboidal.' The figures, however, are both trapezoidal, and, therefore, differ in outline from the description. It may also be distinguished by the ribs, the *centenaria* being striate. The figure of Mr. Sowerby's *duplicata* has a close similarity to our shell, but differs in having the 'ribs sulcated along the middle.'" —*Lea*, 1833.

Lea's specimen was young. Shell with a wide sulcus over the umbo to the base, the ribs finest in this sulcus, the anterior and often the posterior ribs divided by a mesial groove; fine ribs alternate with the primary set and sometimes there are three sets formed by the secondary ribs between the large ribs and still smaller ribs rising in the interspaces between these two sets; cardinal area in the larger specimens with eight or nine close-set, v-shaped grooves posteriorly, fewer anteriorly; posterior margin of the

cardinal area elevated, anterior square or slightly raised; teeth fine and vertical at the center, rapidly becoming oblique and longer distally; sides of the teeth grooved; anterior margin of the shell rounded with an angle at the hinge-line, basal margin nearly parallel to the hinge, posterior margin in young shells nearly straight and perpendicular to the hinge and base lines, in larger specimens somewhat produced below and emarginate above with a sharp angle at the hinge-line; inner margin with fine crenulations.

This species lies between *Barbatia* and *Scapharca*. The outline of the shell and form of the cardinal area are like the *Scapharca*s, but the teeth and the close grooving of the cardinal area are like *Barbatia*. The ribbing is intermediate between the two groups.

Dimensions.—Lon.+12.5,-24; alt.+2.5,-17; semidiam. 8.5 mm.

Occurrence.—Lisbon, Alabama, the Eocene of Orangeburg, South Carolina, and according to Haldeman from the Eocene of Virginia.—*Dall*. Claiborne Eocene of Claiborne, Alabama.—*C. U. Museum*.

Arca Vaughani Casey

Plate VII, Figure 11

Arca rhomboidella var. *Vaughan*, U. S. Geol. Surv., Bull. 142, pl. 3, fig. 8. 1896.

Arca vaughani Casey, Acad. Nat. Sci. Phila., Proc. for 1903, p. 265, 1903.

" * * * A species, quite common in the Lower Claiborne at St. Maurice, La., and allied somewhat to *rhomboidella* Lea. It attained a length of more than 20 mm., with a height of 12 mm. or more, obliquely rhomboidal, moderately inequilateral, rounded anteriorly and posteriorly and broadly rounded ventrally. It is moderately inflated, the radiating concavity at the middle of the umbones almost obsolete and having merely slightly wider intervals between the ribs, the latter 41-43 in number. The hinge-line is long and straight, the teeth becoming larger and very oblique laterally but well developed throughout, with their sides finely ribbed, giving to each tooth a bipectinate appearance. The area under the beaks is ample and broadly, divaricately striate. This species differs from *rhomboidella* in its much larger size, more numerous ribs, rounded ventral edge and many other characters, and may be named *vaughani*. A fair illustration of it was given by Mr. Vaughan (Bull. Geol. Surv., 142, Pl. III, fig. 8), in whose honor it is named. A modification of the true *rhomboidella*, but still smaller in size, also occurs sparingly at St. Maurice."—*Casey*, 1903.

Unless *A. Vaughani* grows to a larger size than that given in the description the statement of the comparative size of *Vaughani* and *rhomboidella* would not hold true. The type of *rhomboidella* was a young specimen. Unlike *rhomboidella*, in *A. Vaughani* the ribs are only slightly or not at all grooved.

Dimensions.—Lon.+7,-13; alt.+2,-12; semidiam. 5 mm.

Occurrence.—Lower Claiborne of St. Maurice, Louisiana.—*C. U. Museum*.

Arca invidiosa Casey

Arca invidiosa Casey, Acad. Nat. Sci. Phila., Proc. for 1903, p. 264, 1903.

"From the Red Bluff formation of Mississippi I have before me specimens of a small

Arca, probably allied somewhat to the Claibornian rhomboidella of Lea. It is subrhomboidal, very inequilateral, moderately inflated, broadly rounded ventrally, the anterior and posterior sides oblique, the former rounded, the latter longer and nearly straight. The beaks are rather broad, moderately elevated above the hinge-line, bisected by a feeble depression which becomes obsolete ventrally. The hinge-line is straight externally, broadly feebly arcuate internally, the line of teeth more than three-fourths as long as the shell, the lateral teeth becoming longer and strongly oblique. The space between the beaks and the hinge-line is flattened, nearly smooth except some fine, close-set parallel lines of growth, but at the posterior end there are some coarser parallel and feebly oblique lines. The radial ribs are 28 to 31 in number, rather coarse and separated by much less than their own widths, except in the feebly depressed area radiating from the middle of the beaks where they become finer and relatively much more widely separated, and generally with one fine intermediate rib between them in this region toward the ventral margin only; the ribs also become smaller but very close-set posteriorly in the flattened area toward the hinge-line. The surface posteriorly at an angle of about 30 degrees with the hinge-line is convex, becoming rapidly declivous and explanate to the latter. The muscular scars are rather deep. Lines of growth produce feeble transverse and rather widely separated nodules on the ribs generally becoming obsolete posteriorly. The length of a moderately large individual of this species is 11.5 mm., the height 6 mm."—Casey, 1903.

Arca delicatula Casey

Arca delicatula Casey, Acad. Nat. Sci. Phila., Proc. for 1903, p. 265, 1903.

"Occurs in the Lower Vicksburg limestone in great abundance. It may be regarded as a homologue of *invidiosa* and is doubtless one of the smallest known members of the family. It is elongate, very inequilateral, obliquely parallelogramic, moderately inflated, becoming flattened posteriorly toward the hinge-line, the latter long, thin and straight, the teeth small. The space between the hinge-line and the beaks rather low, flat and smooth or nearly so, narrowing very gradually posteriorly. The umbonal impression, with its diminished ribs, is nearly as in *invidiosa* and many other species. The ribs are some 28 in number, relatively moderately coarse, being generally separated by their own widths, flattened. Length of a moderately large valve 6 mm., height 2.6-2.8 mm."—Casey, 1903.

Arca Lesueuri Dall

Plate VII, Figures 12, 13, 14, 15, 16

Lesueur, Walnut Hills Fos., pl. 5, fig. 8, 1829 (*fide* Dall).

Arca Mississippiensis Conrad, Acad. Nat. Sci. Phila., Proc. for 1847, p. 294; Journ., 2d. ser., vol. 1, p. 125, pl. 13, figs. 11, 15, 1848.

Not *Byssarca mississippiensis* Conrad, Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 1, p. 125, pl. 13, fig. 32, 1848.

Anomalocardia Mississippiensis Conrad, Am. Journ. Conch., vol. 1, p. 11, 1865.

Not *Cucullæarca Mississippiensis* Conrad, Am. Journ. Conch., vol. 1, p. 11, 1865.

Scapharca (*Scapharca*) *Lesueuri* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 643, 1898.

"A species of *Arca* occurs in great abundance at Vicksburg, which Lesueur obtained many years since and named it, but I have forgotten the name, and know not whether he published it in Europe or not. It is rhomboidal, ventricose, with rather distant ribs in the right valve, slightly grooved in the middle; in the left valve ribs double and granulated; inner margin profoundly toothed * * *."—*Conrad*, 1848.

Dall in 1898 named this species *Lesueuri*, retaining the name *mississippiensis* for Conrad's *Byssarca mississippiensis*.

Shell inequivalve with very different sculpture on the two valves; beaks incurved, mesially impressed at the tip; ribs twenty-four to twenty-eight, those of the left valve wider than the interspaces and divided by such a deep groove that they appear double except near the hinge, conspicuously beaded except on the distal parts of the posterior ribs; the ribs of the right valve narrower than the interspaces and much less grooved and beaded, especially near the middle of the shell; ribs square, rising from flat interspaces; cardinal area small, wider in front of the beaks, with several grooves, some of which usually do not extend in front of the beaks; hinge narrow, the teeth fine at the center, larger and more oblique distally; anterior and basal margins rounded, posterior end produced and rounded.

This abundant and characteristic species from the Vicksburg beds is readily distinguished by its small size and unusual sculpture.

Dimensions.—Lon. +6.5, -14; alt. +2.5, -12.5; semidiam. 6 mm.

Occurrence.—Vicksburgian Oligocene of Mississippi.—*Dall*. Oligocene of Vicksburg, Mississippi.—*C. U. Museum*.

Arca latidentata Dall

Plate VII, Figures 17, 18, 19, 20

Scapharca (*Scapharca*) *latidentata* Dall, *Wagner Free Inst. Sci., Trans.*, vol. 3, pt. 4, pp. 638, 647, pl. 32, fig. 15, 1898.

"Shell small, ovate, moderately convex, with low, quite anterior, mesially sulcate, prosocœlous beaks; left valve with about thirty rounded, radiating, undivided ribs, separated by slightly wider interspaces, and crossed by numerous smaller concentric ridges which become beadlike on the ribs and vary in prominence in different specimens; base evenly arcuate, ends rounded; cardinal area narrow, impressed, smooth, with one or two grooves behind the beaks, but none elsewhere; valves slightly twisted, so that the basal margin is not in a single plane; line of teeth interrupted a little behind the beaks, the anterior series having the anterior and posterior teeth larger and the intervening teeth thinner and more closely adjacent, all nearly vertical; posterior teeth vertical, shorter, the series longer, the teeth smallest proximally and regularly increasing in size towards the distal end of the series, equidistant and regular; inner margin of the valve deeply fluted. Lon. 18, height 11, diam. 9 mm.

"This little shell looks a good deal like the young of *Anadara aresta* Dall, but has the beaks less central, less prominent, and distinctly impressed mesially, giving a somewhat bilobed aspect to the very young."—*Dall*, 1898.

The original description applies only to valves about the size of the type. The majority of the specimens are larger and with age they thicken and become much inflated, the posterior part is more attenuate than in the smaller specimens and the ends of the ribs often have a medial groove; the cardinal area has more grooves, some of which usually extend in front of the beaks. There are twenty-nine to thirty-three ribs and the cardinal margin is elevated behind and also slightly elevated in front near the beaks as in *A. hypomela*. *A. latidentata* is distinguished from the young of *A. hypomela* by its semi-circular posterior margin.

Dimensions.—Lon. +7, -18; alt. +2.5, -12.5; diam. 14 mm. A large valve is 28 mm. long.

Occurrence.—Oligocene of Ballast Point, Tampa Bay, of the lower bed at Alum Bluff, and in the Chipola marls of Florida, and probably from the Oak Grove sands in western Florida.—*Dall*. Oligocene of Bailey's Ferry, Florida.—*C. U. Museum*.

Arca acompsa Dall

Plate VII, Figure 21

Scapharca (*Scapharca*) *acompsa* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 648, pl. 33, fig. 15, 1898.

"Shell rectangular, elongate, rather compressed, with low, prosocelous beaks, situated at about the anterior fourth of the whole length; right valve with about thirty-six flattened radial ribs, with much narrower interspaces; the anterior (twenty-two) ribs are mesially divided by a sharp groove and feebly rippled above; the posterior ribs are flat, smooth, and increase in width backward; the anterior end of the shell is evenly rounded, the base straight and parallel with the hinge-line, the posterior end wider, a little produced below and with a conspicuous angle above; cardinal area long, very narrow, with one or two grooves, and bordered behind with an elevated margin; hinge-line straight, long, with numerous small, uninterrupted teeth very short mesially, longer and somewhat more oblique distally; inner margin of the valves fluted, shell thin and delicate. Lon. 20, alt. 10.5, semi-diam. 4.5 mm.

"Only two right valves of this little species have been examined. It resembles the young of *A. hypomela* but is immediately distinguishable by its more compressed and rectangular form and smooth, flat posterior ribs."—*Dall*, 1898.

Occurrence.—Oligocene of the Chipola River, Florida, marl.—*Dall*.

Arca hypomela Dall

Plate VII, Figures 22, 23, 24, 25

Scapharca (*Scapharca*) *hypomela* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 637, 647, 648, pl. 33, fig. 1, 1898.

Arca (*Scapharca*) *hypomela* Maury, Bull. Am. Pal., vol. 3, p. 372, 1902.

"Shell of moderate size, long, inflated, with rather low, mesially compressed, prosogyrate beaks; left valve with about forty-three deeply channelled, flat-topped ribs with fine, regular, concentric beading, except on the posterior slope, where the ribs are lower,

flatter, and obsoletely channelled; near the margin some of the ribs have a second set of finer grooves; hinge-line straight, anterior end descending vertically, then obliquely rounded into the base, which is nearly parallel with the hinge-line; the posterior end descends more obliquely and the basal angle is prolonged a little and rounded; the interspaces between the ribs in both valves are very narrow, and on the right valve the beading is less conspicuous; the cardinal area is somewhat concave, flattish, with three or four concentric grooves in lozenge form; teeth of the hinge similar, numerous, not interrupted, short, vertical, the distal teeth a little longer and more oblique; margin of the valves fluted, the right valve slightly smaller than the other. Lon. 50, alt. 25, diam. 20 mm.

"This species has the appearance of being the Oligocene ancestor of the Miocene *A. lienosa*, from which it differs by its smaller size, closer and rather narrower ribbing."—Dall, 1898.

Ribs thirty-five to forty-three, commonly forty or more; sometimes the ribs are as narrow as, or narrower than the interspaces, but not commonly; posterior margin usually serrate.

Dimensions.—Lon. +13, -29; alt. +5, -20; diam. 25 mm. This is a rather small specimen.

Occurrence.—Oligocene of the Ballast Point silex beds, Tampa Bay, of the lower bed at Alum Bluff, and of the Chipola marl, Chipola River, Florida,—Dall. Oligocene of Bailey's Ferry, Florida.—C. U. Museum.

Arca lienosa Say

Plate VII, Figures 26, 27, 28; Plate VIII, Figures 1, 2

Arca lienosa Say, Am. Conch., 4, pl. 36, fig. 1, 1832.

Arca protracta Rogers, Am. Phil. Soc., Trans., vol. 5, p. 332, 1837; vol. 6, pl. 26, fig. 5, 1839.

Arca protracta Conrad, Fos. Med. Tert., p. 58, pl. 30, fig. 5, 1845.

Arca protracta Cushman, Boston Soc. Nat. Hist., Proc., vol. 33, p. 264, 1907.

Not *Byssosarca protracta* Conrad, Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 1, p. 126, pl. 13, fig. 36, 1848.

Arca lienosa Tuomey and Holmes, Pleioc. Fos. S. Car., p. 40, pl. 15, figs. 2, 3, 1855.

Arca lienosa Emmons, Geol. N. Car., p. 284, fig. 204, 1858.

Scapharca (Arca) lienosa Conrad, Acad. Nat. Sci., Phila., Proc. for 1882, p. 579, 1863.

Arca lienosa Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 97, 1887 (ex parte).

Scaphara (Scaphara) lienosa Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 636, 1898.

"Shell rather thin, transversely oblong; ribs about forty, somewhat flattened and much broader than the intervening spaces which are very narrow, and with a longitudinal impressed line, particularly on those of the posterior margin, which are almost bifid; and with numerous slightly elevated transverse lines, which being divided by the longitudinal striae appear granulated: *beak* but little prominent, and nearly opposite to the posterior third of the length of the hinge margin: *arca* narrow and elongated: *hinge margin* rectilinear, angulated at each extremity; teeth numerous, small; *posterior margin* obliquely rounded inwards, no part of it extending further backward than the angle: *anterior margin* obliquely truncate: *inner margin* crenate."—Say, 1832.

Anterior and posterior are reversed in the original description.

Ribs thirty-eight to forty-three, usually as wide or wider than the interspaces, somewhat more closely set on the middle of the valve; ribs near the umbonal ridge and generally on other parts of the shell with a finer secondary groove each side of the main longitudinal groove; ribs beaded; cardinal area rather narrow with about three or four irregular, concentric grooves and a transverse line between the beaks, cardinal area wider in front with raised margin posteriorly and near the beaks anteriorly; beaks mesially sulcate; posterior margin straight in the adult, emarginate in the young; basal margin slightly curved to arcuate, sometimes sinuate.

With age *A. lienosa* becomes long, narrow and inflated with produced posterior end and sometimes a sinuate basal margin and the cardinal area is wider with irregular grooves. *A. protracta* Rogers, from Prince George County, Virginia, is probably an old *A. lienosa*. A specimen from Kingsmill, Virginia, shows small, even teeth pointing away from the beaks, as in Rogers' specimen, though they are somewhat longer at the ends of the hinge and as a rule the teeth in old *A. lienosa* are larger and less regular. The teeth of *protracta* resemble those of *A. secticostata*. The lines of growth near the beak as drawn in Rogers' figure do not show the alation of the young *A. lienosa*. The Virginia specimens resembling *A. protracta* show this alation. Shells from North Carolina approach *protracta*. Heilprin united *lienosa* and *floridana* = *secticostata*. One of his specimens from the Caloosahatchie was six inches long and three inches high. *A. hypomela* lacks the posterior emargination or alation of *A. lienosa*.

Dimensions.—Lon. +18,-40; alt. +6,-30; semidiam. 17 mm. Lon. of a large valve 87, alt. 51 mm.

Occurrence.—Miocene of York and James River, Virginia, of Wilmington and Duplin County, North Carolina, and of the upper bed at Alum Bluff, Florida; Pliocene of the Waccamaw District, South Carolina, the Caloosahatchie River, Alligator and Shell Creeks, Florida * * *. Not known in the recent state.—*Dall*. Miocene of Kingsmill, and Bellefield, Virginia; Duplin County, North Carolina; the upper bed at Alum Bluff, Florida.—*C. U. Museum*.

Arca secticostata Reeve

Plate VIII, Figures 3, 4, 5

Arca secticostata Reeve, Conch. Icon., *Arca* no. 38, pl. 6, 1844.

Anadara secticostata Gray, Ann. Nat. Hist., 2d. ser., vol. 19, p. 371, 1857.

Anomalocardia Floridana Conrad, Am. Journ. Conch., vol. 5, p. 108, pl. 13, fig. 2, 1869.

Scapharca secticostata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 636, 637, 659, 1898; pt. 6, p. 1616, 1903.

"*Arca testâ elongato-ovalâ, gibbosissimâ, tenuiculâ, lateribus supernè angulatis, infrà subobliquè rotundatis; albidâ, fuscescente partim tinctâ; radiatim costatâ, costis numerosis, angustis, ad quadragenas, quamplurimis sulco subprnfondo divisis; ligamenti areâ elongatâ, latiusculâ; umbonibus tumidis.*

"THE CUT-RIBBED ARK. Shell elongately ovate, very gibbous, rather thin, sides angulated at the upper part, rather obliquely rounded beneath; whitish, partially stained

with light rusty brown; radiately ribbed, ribs numerous, narrow, about forty in number, most of which are cut or divided by a rather deep groove; area of the ligament elongated, rather wide; umbones full * * *.

"This shell is probably one of those that have been confounded with the *Arca antiquata* * * *; it differs in having a much greater number of ribs, and a larger proportion of them more distinctly grooved."—*Reeve*, 1844.

Three complete specimens of this rather rare species show thirty-three, thirty-four and thirty-seven ribs. One is stained with reddish brown on the umbo and near the hinge like *Reeve's* shell, the other two are nearly white like the shell *Conrad* named *Anomalocardia floridana*. Shell slightly inequivalve, posterior end produced, somewhat attenuate; teeth small and even; epidermis brown, thick and scaly near the margins. *A. secticostata* is very similar to its ancestor *A. lienosa*. The ribs are comparatively narrower, the secondary longitudinal grooves appear only near the umbonal ridge and the beading on the ribs is not so conspicuous. In two specimens the posterior margin is nearly straight in the young part of the shells, but in one the young is auriculate. Recent shells listed as *A. lienosa* are *A. secticostata*.

Dimensions.—Lon. +26, -58; alt. +8, -37; diam. 45 mm.

Occurrence.—Pleistocene of North Creek, Little Sarasota Bay, Florida.—*Dall*. Recent from Long Key, Gulf of Mexico; Galveston, Texas.—*Conrad*. Recent from Porto Rico.—*Dall*. Recent from Vera Cruz, Mexico.—*Baker*. Recent from Tampico, Mexico.—*Hinkley*. Recent from Florida.—*C. U. Museum*. Bull. 37, U. S. Nat. Mus., gives the range of *A. lienosa* Say, recent, as from Hatteras to Trinidad. This is *A. secticostata*.

Arca dodona Dall

Plate VIII, Figures 6, 7, 8, 9, 10

Scapharca (*Scapharca*) *dodona* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 640, pl. 31, figs. 1, 8, 8a, 1898.

Arca (*Scapharca*) *dodona* Maury, Bull. Am. Pal., vol. 3, p. 375, 1902.

"Shell small, solid, inequilateral, inflated, and rounded in front, pointed and attenuated behind; with mesially impressed, prosocœlous beaks; left valve with thirty-six squarish radial ribs, each with a deep central groove longitudinally, the portions on each side with a shallower longitudinal sulcus, so that each rib, except in young shells, is composed of four threads set in two pairs; the ribs separated from each other by channelled interspaces about half as wide as the ribs; concentric sculpture of numerous rather close set, regular, blunt, elevated lines, which appear on the riblets as fine undulations; beaks at the anterior third; cardinal area, with a raised margin, lozenge-shaped, rather wide, slightly narrower behind the beaks, with about four rather wavy sets of concentric grooves; hinge-line short, solid, the teeth not interrupted, larger distally, the most anterior tending to break up into granulations, about fifty in all, subvertical, shorter in the middle of the hinge; margins of the valve deeply fluted; right valve with wider interspaces and narrower, often tripartite, ribs. Lon. 40, alt. 28, diam. 30 mm.

"This fine shell has a neat and elegant surface sculpture, and is one of several which the Oak Grove marl contains and which appear to be new."—*Dall*, 1898.

The ornamentation of this species closely resembles that of *A. subrostrata*. The interspaces are narrower in *A. dodona*. Otherwise the two species are distinct. In *A. subrostrata* the posterior part is not so attenuate, the hinge is proportionately shorter, even in the largest specimens of *A. dodona* there is no gap in the hinge teeth as in the older specimens of *A. subrostrata* and the posterior margin of *A. dodona* makes a decided angle with the hinge-line, which is not the case in *A. subrostrata*. In general form *A. dodona* resembles *A. santarosana*, but it is proportionately longer and the ribbing is different.

Dimensions.—Lon. +17, -34; alt. +7, -27; diam. 35 mm. This is an unusually large specimen.

Occurrence.—Oligocene marl of Oak Grove, Santa Rosa County, Florida.—*Dall*. Oligocene of Oak Grove, Florida.—*C. U. Museum*.

Arca santarosana Dall

Plate IX, Figures 1, 2, 3

Scapharca (*Scapharca*) *santarosana* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 641, 642, pl. 31, figs. 2, 10, 1898.

Arca (*Scapharca*) *santarosana* Maury, Bull. Am. Pal., vol. 3, p. 375, 1902.

"Shell small, short, plump, rostrate, with moderately elevated, mesially sulcate pros-ocœlous beaks; left valve with thirty elevated, squarish, radial ribs, separated by slightly narrower channelled interspaces; the ribs on the posterior slope are low, smaller, and nearly smooth; those on the middle of the shell have mostly near the margin a shallow mesial sulcus; in those still more anterior the sulcus is deeper and wider, dividing each rib over most of its length into two more or less rounded riblets; concentric sculpture of regularly spaced elevated lines, which on the ribs appear as prominent ripples; right valve having the ribs narrower and less strongly sculptured, and the sulci less distinct; cardinal area short, with about three concentric grooves; beaks within the anterior fourth; hinge-line short, with about fifty-seven rather irregular, closely adjacent, nearly vertical teeth, longer and more oblique distally; margins strongly fluted; base flexuous, posterior end narrow, pointed, without any marked angle at the end of the hinge-line. Lon. 36.5, alt. 28, diam. 28 mm.

"This species is most nearly related to *A. staminata* Dall, from which it can be distinguished especially by its lower beaks, more oblique posterior slope, more flexuous base, and attenuated posterior end."—*Dall*, 1898.

Ribs twenty-eight to thirty-two; some of the specimens from Bailey's Ferry are short and have a wide cardinal area with many grooves. The beaks are more anterior and more sulcate than in *A. staminata*. This species somewhat resembles a variety of *A. staminea* from Patuxent River, Maryland, but the latter is less nodulous on the central and anterior portions and the ribs on the umbonal ridge are striated.

Dimensions.—Lon. +9, -24; alt. +7, -20; semidiam. 14 mm.

Occurrence.—Oligocene of the Chipola River marl, of the lower bed at Alum Bluff,

of the Sopchoppy limestone, and of the Oak Grove sands, Santa Rosa County, Florida.—*Dall*. Oligocene of Oak Grove and Bailey's Ferry, Florida.—*C. U. Museum*.

Arca staminata Dall

Plate IX, Figures 4, 5, 6

Scapharca (*Scapharca*) *staminata* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 641, 642, pl. 31, figs. 11, 13, 1898.

Scapharca staminata Maury, Bull. Am. Pal., vol. 3, pp. 369, 372, 1902.

"Shell of moderate size, plump, rhombic, with well-elevated, hardly sulcate, slightly prosocelous beaks, situated in the anterior third of the length; left valve with twenty-eight or twenty-nine radial ribs, the posterior of which are smooth and almost rounded; those on the middle of the valve are squarish, with wider channelled interspaces, and rippled or furnished with transverse nodulation above, which grows stronger and more crowded anteriorly; the ribs are not sulcate or dichotomous, and hardly differ on the two valves; hinge-line straight, rather long, and with conspicuous angles at the ends; anterior end of the valve rounded, base nearly parallel with the hinge-line, posterior end somewhat produced; beaks narrow, cardinal area with from three to five sets of lozenge-shaped groovings; hinge strong, the teeth in two adjacent series, somewhat oblique, smaller mesially, at the anterior end of the hinge sometimes more or less broken into granules; inner margin of the valves fluted, interior radially striate. Lon. of a large valve 47, alt. 37 mm.; lon. of figured shell 39, alt. 30, diam. 28 mm,

"This species differs from *A. santarosana*, which occurs in the same beds, by its more rhombic form, proportionately longer hinge-line, and unsulcate ribs. It is also a larger and less elegantly sculptured shell. *A. staminea* Say, of which *staminata* may prove to be an Oligocene race, has a proportionately longer hinge-line, is more sharply truncate behind, and more obliquely rounded in front, the beaks are less elevated and wider, the ribs anteriorly are only sparsely and feebly nodular, while the aspect of the whole shell is less elegant."—*Dall*, 1898.

Ribs twenty-six to thirty.

Dimensions.—Lon. +16, -33; alt. +8, -30; diam. 42 mm.

Occurrence.—Oligocene of the lower bed at Alum Bluff, and perhaps at Roberts, Escambia County, Florida.—*Dall*. Oligocene of the lower bed at Alum Bluff, and Bailey's Ferry, Florida.—*C. U. Museum*.

Arca staminea Say

Plate IX, Figures 7, 8, 9, 10, 11, 12, 13

Arca staminea Say, Am. Conch., 4, pl. 36, fig. 2, 1832.

Arca elevata Conrad, Fos. Med. Tert., no. 1, cover, 1840.

Arca callipleura Conrad, Fos. Med. Tert., pp. 54, 56, 59, pl. 29, fig. 2, 1840.

Arca triquetra Conrad, Acad. Nat. Sci. Phila., Proc., vol 1, p. 305, 1843; Fos. Med. Tert., p. 59, pl. 31, fig. 2, 1845.

Scapharca (*Arca*) *callipleura* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 579, 1863.

Scapharca (*Arca*) *triquetra* Conrad, l. c., p. 580.

Scapharca (Scapharca) staminea Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 642, 657, 658, 1898.

Arca (Scapharca) staminea Glenn, Maryland Geol. Surv., Miocene, pp. 386, 387, 390, pl. 105, figs. 2-6, 1904.

"Shell thick, prominently convex; with about twenty-eight ribs which are rounded and narrower than the intervening spaces, excepting on the anterior side, where they are broader, and simply wrinkled, those of the anterior part of the disk have one or two longitudinal impressed lines; they are crossed by numerous transverse, elevated lines, which are hardly more distant from each other than their own width; intervening spaces wrinkled: *beaks* distant, curved a little backward, and the tip a little behind the middle of the hinge margin: *arca* flattened, a little curved, rather spacious, with obvious impressed, oblique lines: *hinge margin* rectilinear, with small, numerous teeth: *posterior margin* regularly arcuated: *base* subrectilinear, very deeply crenated: *anterior margin* oblique, rectilinear: *anterior side* abruptly compressed * * *.

"It seems to be related to some of the varieties of *A. granosa*, L.; but the ribs are more slender; the apex is curved a little backward, &c."—Say, 1832.

In Say's description posterior and anterior are interchanged. Anterior part of the shell inflated, posterior sharply flattened, forming almost a right angle with the rest of the shell; between the anterior inflation and umbonal ridge the shell is flattened and often shows a wide, shallow sulcus which increases toward the ventral margin; outline rhomboidal, anterior margin rounded, basal nearly straight and parallel to the hinge-line or somewhat sinuate posteriorly, posterior margin nearly straight, forming a sharp angle with the hinge-line and almost a right angle with the ventral margin; ribs twenty-six to thirty, commonly about twenty-seven; anterior ribs often divided by a shallow sulcus, ribs about the umbonal ridge often with two or more longitudinal sulci producing a striated appearance; ligament area wide, with five or six concentric furrows usually; teeth often irregular at both ends of the hinge.

It is apparent that Conrad's *A. elevata* is the same as *A. staminea* Say. Glenn (Maryland Geol. Surv., Miocene, p. 388), says, "A careful comparison of what are doubtless the type specimens of *A. callipleura* shows that it is but a short, elevated, thickened and well sculptured form of *A. staminea*." *A. triquetra* Conrad is a short, high and little sculptured form of *A. staminea*. Short, high specimens of the species are not uncommon. A long, rounded, well-sculptured variety of *A. staminea* approaches *A. idonea* closely.

Dimensions.—Lon. +16, -32; alt. +11, -30; diam. 44 mm.

Occurrence.—Miocene of Calvert Cliffs, Choptank River and Jones's Wharf, near Centreville, Maryland; of York River, Virginia, and Walton County, Florida.—Dall. Choptank Miocene of Governor Run, two miles south of Governor Run, Flag Pond, Jones Wharf, Cuckold Creek, Turner, Dover Bridge, Peach Blossom Creek, Greensboro, Maryland.—Glenn. Miocene of Choptank River, Governor Run and Patuxent River, Maryland.—C. U. Museum.

Arca idonea Conrad

Plate IX, Figures 14, 15, 16, 17

Arca idonea Conrad, Fos. Tert. Form., p. 16, pl. 1, fig. 5, 1832.*Arca stillicidium* Conrad, l. c., p. 15, pl. 1, fig. 3, (young).*Arca idonea* Conrad, Fos. Med. Tert., p. 55, pl. 29, fig. 3, 1840.*Scapharca (Arca) idonea* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 579, 1863.*Scapharca (Scapharca) idonea* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 639, 1898.*Arca (Scapharca) idonea* Glenn, Maryland Geol. Surv., Miocene, pp. 387, 389, pl. 106, figs. 1, 2, 1904.

"Cordate, inequivalve, ventricose, and slightly sinuous; ribs about 25, narrow and crenulated; the crenulations most distinct on the larger valve; beaks very prominent and distant; area with undulated grooves; hinge with the series of teeth contracted in the centre, and a little decurved at the ends.

"*Locality.* St. Mary's River. Md. Upper Tertiary."—*Conrad*, 1832.

Shell large and heavy; ribs twenty-four to thirty-two; ribs on the middle of the shell broad and flat and as wide as or wider than the interspaces, anterior ribs usually narrower than the interspaces, posterior ribs rounded; the anterior ribs and the distal part of the central ribs with a longitudinal sulcus, ribs about the umbonal ridge often with two or more sulci, making them appear striated; interspaces about the umbonal ridge sometimes striated; cardinal area wide, with four to eight, commonly five, concentric grooves on the larger specimens; distal teeth usually irregular in the older specimens; posterior end produced.

This species is related to *A. staminea* from which it differs by its larger size and more rounded form, the posterior side is more produced, the posterior and ventral margins more rounded, the umbonal ridge less angular, the hinge-line is proportionately shorter, the ends of the hinge do not form a conspicuous angle with the anterior and posterior margins, the shell is more evenly inflated, there is only a slight flattening or none anterior to the umbonal ridge, in *A. staminea* the ribs are mostly high and narrow while in *A. idonea* they are broader and flatter, specimens of *idonea* from Maryland have less anterior beaks, but this does not hold true for specimens from Florida.

This abundant species has a wide variation in form. Conrad's type, from St. Mary's River, is short and has only twenty-five ribs. The upper bed at Alum Bluff, Florida, also contains a short form with twenty-five or twenty-six ribs. The ribs are high and square. It resembles *A. staminea* in its little produced, nearly straight posterior margin and beaks nearer the anterior end of the hinge than in the Maryland forms. It is separated from *A. staminea* by its square ribs and rounded umbonal ridge.

The common variety from St. Mary's River, which was described by Conrad in 1840, usually has twenty-nine or thirty ribs and is more produced posteriorly than the type. It is also found at Alum Bluff, Florida.

In the preceding varieties the shell is little, if any, higher posteriorly than near the middle. A variety from the upper bed at Alum Bluff is elongated along the umbonal ridge so that the greatest height of the shell is behind the middle. The anterior margin curves outward a little from the hinge for a short distance, then evenly around to the posterior margin, which is oblique to the hinge. There are twenty-four to twenty-six ribs

which, as in the other varieties from the same locality, are rather nodulous, square, and have only shallow sulci. In general *A. idonea* from Alum Bluff has more anterior beaks than in specimens from Maryland and in this last variety the short anterior and produced posterior parts bring the beaks well within the anterior third. The beaks are little elevated, and are prosogyrate and the cardinal area is wider in front of the beaks than behind, unlike the common variety.

Conrad, himself, in 1840 stated that his species *A. stillicidium* was the young of *A. idonea*. *A. stillicidium* Heilprin, 1881 and 1882 and *stillicidium* Glenn, 1904, are misprints for *A. stillicidium*, and *idoneus* Morton, 1834, is a misprint for *idonea*.

Dimensions.—Lon. +24, -41; alt. +14, -40; diam. 50 mm.

Occurrence.—Typical form from the Miocene of St. Mary's River, Maryland, and the upper bed at Alum Bluff, Florida; the elongated variety with thirty-one ribs from St. Mary's, at Windmill Point, and in Surry County, Virginia, and in the Miocene of Alum Bluff, Florida; a more angular type than either of these from the Miocene of St. Mary's River, Maryland.—*Dall*. St. Mary's Miocene of Cove Point, Langley's Bluff, St. Mary's River, Maryland.—*Glenn*. Miocene of St. Mary's, Maryland, and the upper bed at Alum Bluff, Florida.—*C. U. Museum*.

Arca carolinensis Wagner

Plate X, Figures 1, 2

Arca carolinensis Wagner, Wagner Inst., Trans., 5, p. 9, pl. 1, fig. 4. 1847 (*vide* Dall).

Arca Carolinensis Bronn, Index Pal., Nom., p. 93, 1848; Syst., p. 281, 1849.

Not *Noëlia* (*Arca*) *Carolinensis* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Not *Barbatia Carolinensis* Conrad, Kerr's Geol. Rep. N. Car., App. A, p. 4, pl. 1, fig. 11, 1875.

Scapharca (*Scapharca*) *carolinensis* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 615, 632, 639, pl. 33, fig. 11, 1898.

"Shell large, solid, squarish, moderately inflated, with subcentral, prosocœlous, rather elevated beaks; left valve with about thirty ribs, with subequal interspaces, the anterior ribs squarish, with a shallow median sulcus near the margin, and irregular concentric ripples; the ribs of the middle of the valve not sulcate, with less rippling, more closely adjacent, the interspaces very squarely channelled; the posterior ribs smaller, rounded, and more closely set; cardinal area short, rather wide, smooth, or longitudinally striate, with three concentric lozenge-shaped groovings; hinge-line short, solid; the teeth not interrupted, strong, about forty-five in all, the anterior more vertical, the middle teeth inclining towards the middle line of the area, the posterior teeth distally, more oblique and longer; margins of the shell strongly fluted. Lon. 56, alt. 55, diam. 43 mm. (type specimen).

"As this species seems never to have been described, the references in Bronn being merely to Wagner's unpublished plates, I have given a diagnosis from Professor Wagner's original type specimen, and refigured the interior of the left valve. The shell is remarkable for its squarish form, which is rather distantly approached by some specimens of *A. idonea*. It is singular that in all the years which have elapsed since this shell was collected and figured by Professor Wagner no one has recognized or described it."—*Dall*, 1898.

Occurrence.—Miocene of North Carolina? Wagner; of York River, Virginia, station 2250; of Duplin County, North Carolina (young).—*Dall*. Miocene of North Carolina.—*C. U. Museum*.

Arca callicestosa Dall

Plate X, Figures 3, 4, 5

Scapharca (*Scapharca*) *callicestosa* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 638, pl. 34, figs. 17, 18, 1898.

"Shell of moderate size, rather thin, rhomboidal, with small, prominent, mediosulcate, prosocelous beaks situated at about the anterior third of its length; left valve with about thirty-seven squarish subequal radial ribs, separated by narrower channelled interspaces; on the tops of these ribs are four longitudinal threads, the inner pair larger and more prominent but separated by a somewhat deeper sulcus than those external to the inner threads; concentric sculpture of fine, close, rounded, slightly elevated threads, which overrun the whole shell, ribs, and interspaces, and at short intervals, at the intersection with the inner pair of rib-threads, they become minutely nodulous, while the reticulations have a punctate appearance, giving a surface somewhat like fine lace and peculiar, as far as observed, to this species; cardinal area short, rather narrow, with sharply elevated boundaries and a single incised set of grooves forming a lozenge-shaped figure anteriorly; hinge-line short, teeth in two adjacent series, anterior with fifteen, posterior with twenty-six or twenty-seven teeth set vertically, a little oblique at the distal ends of the series; each individual tooth more or less grooved or striate in the direction of motion, as in some recent species; anterior end of shell produced, rounded; posterior end subtruncate, base slightly arched; inner margin of the valves with rather long, deep flutings, corresponding to the external ribs. Lon. 32, alt. 27, diam. 20 mm. (twice the diameter of the single valve).

"A single valve of this very elegant species was obtained by Mr. Burns. Its sculpture differentiates it from all our other Tertiary species. *Arca callipleura* Conrad, in which the ribs have a minute nodular sculpture, has the radial threading predominant, while in this species the concentric threads overrun all the rest. The two species are entirely distinct otherwise."—*Dall*, 1898.

The type specimen is not full-grown. About a dozen valves of this distinct species are in the C. U. Museum. The adult shell has a somewhat more produced posterior end and the cardinal area is wider with several grooves; there are often six riblets nearly equal in size on each rib; besides the characteristic lace like reticulation the anterior ribs usually show a coarser nodulation; on the right valve the ribs from the center of the shell to the umbonal ridge are smoother as in *Cunearca*; ribs thirty-six to thirty-eight.

A single left valve fossil from Nicaragua somewhat resembles this species in form and markings. It is larger and more oblique, the young more inflated, the ribs narrower and the fine reticulation, though present, is inconspicuous except near the umbonal ridge. The shell is labelled *Scapharca holoserica* Reeve, but it is distinct from that species.

Dimensions.—Lon. +17,-33; alt. +5,-35; semidiam. 16 mm.

Occurrence.—Upper bed (Miocene) at Gaskin's Wharf, on the Nansemond River, sixteen miles below Suffolk, Virginia.—*Dall*. Miocene of North Carolina.—*C. U. Museum*.

Arca arata Say

Plate X, Figures 6, 7, 8

Arca arata Say, Acad. Nat. Sci. Phila., Journ., 1st. ser., vol. 4, p. 137, pl. 10, fig. 1, 1824.

Arca arata Conrad, Fos. Med. Tert., p. 58, pl. 30, fig. 6, 1845.

Scapharca (*Arca*) *arata* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 579, 1863.

Scapharca (*Scapharca*) *arata* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 643, 644, 645, 1898.

Arca arata Bullen Newton, Geol. Mag., n. s., vol. 9, pp. 304, 305, 1902.

Arca (*Scapharca*) *arata* Glenn, Maryland Geol. Surv., Miocene, p. 388, pl. 105, figs. 7a, 7b, 1904.

"Shell transversely oblong, subrhomboidal, with about twenty-six longitudinal ribs; basal edge nearly parallel to the hinge margin, which latter terminates anteriorly in an angle.

"*Ribs* somewhat flattened, as wide or rather wider than the intervening spaces; the whole surface concentrically wrinkled: *umbones* not remarkably prominent: *apices* remote, the intervening space rhomboidal, with continued indented lines, arcuated under the apices: *hinge margin* perfectly rectilinear, angulated at the extremities, the anterior one a little projecting: *teeth* in a continued, uninterrupted line, parallel, excepting at the two extremities of the line, which decline a little, and the teeth are there decidedly longer and oblique with respect to the others of the range: *posterior end* obliquely rounded to the base: *base* nearly rectilinear and parallel to the hinge margin, and deeply crenated on the inner margin: *anterior end* produced below the middle and rounded, and a little contracted near the superior angle.

"Length from the hinge margin to the base one inch and three-tenths, breadth two inches and a half * * *."—*Say*, 1824.

In the original description anterior and posterior and length and breadth are interchanged.

Dimensions.—Small valve, lon. +12, -23; alt. +3, -18; semidiam. 9 mm.

Occurrence.—Miocene of St. Mary's County, Maryland.—*Dall*. St. Mary's formation, St. Mary's River (quite rare).—*Glenn*. St. Mary's, Maryland.—*C. U. Museum*.

Arca improcera Conrad

Plate X, Figures 9, 10, 11, 12, 13, 14, 15, 16

Arca improcera Conrad, Fos. Med. Tert., p. 60, pl. 31, fig. 5, 1845.

Scapharca (*Arca*) *improcera* Conrad, Acad. Nat. Sci., Phila., Proc. for 1862, p. 579, 1863.

Arca plicatura (juvenis) Heilprin, Acad. Nat. Sci., Phila., Proc. for 1881, p. 451, 1882.

Scapharca (*Scapharca*) *improcera* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 643, 644, 646, 1898.

"Trapezoidal; disk slightly flattened from beak to base; ribs about 34, square, approximate, little prominent, convex and crenulated anteriorly; anterior margin rounded,

extremity of hinge angulated; basal margin straight or slightly contracted in the middle; posterior margin oblique, emarginate above, extremity rounded; cardinal area narrow, with two or three angulated grooves; series of teeth slightly arched towards the extremities; margin densely crenate.

"Loc. Wilmington, N. C.

"This is probably identical with a recent species of the southern coast, abundant in the Post Pliocene marl of the Potomac river, St. Mary's Co., Md. The Miocene shell is thicker than the more recent specimens."—*Conrad*, 1845.

"This shell should not, in my opinion, be united with *A. plicatura*, as has been done by Heilprin. When properly discriminated it is a smaller and more rhombical shell, with lower and more anterior beaks, and more produced and pointed posterior end; the base and hinge-line are nearly parallel, and the latter is narrower in specimens of the same size than in *A. plicatura*. Both have about thirty-five ribs, but in *A. improcera* these are plain, while in *A. plicatura* the anterior ribs are prettily nodulous.

"*Arca buccula* Conrad (Fos. Med. Tert., p. 60, pl. 31, fig. 4) appears to be a short, heavy, stunted, and abnormally thickened variety of this species, such as might be produced by an unfavorable environment. It is confined to the Upper Miocene marls of Duplin County, North Carolina."—*Dall*.

A. improcera, *A. buccula*, *A. subsinuata*, *A. transversa* and the forms placed by Dall under *A. plicatura* are closely related, are difficult to separate satisfactorily and have been arranged differently by different authors. The synonymy given here for *improcera* and *plicatura* follows Dall. In general the specimens fall into groups corresponding with certain species. Those with a small, thick shell, rather low posteriorly, oblong shape and long hinge may be placed in *A. improcera*. There are short, thick shells from Duplin County, North Carolina, which Conrad called *A. buccula*, (Plate X, Figures 17, 18). *A. transversa* is thinner than *A. improcera* and higher posteriorly. The larger, irregular, rounded shells may all be placed under *plicatura* for convenience. They vary much and grade into both *improcera* and *transversa*. The distinctions Dall has made in the sculpture of *plicatura* and *improcera* will not hold true for all specimens. Some have the discrepant sculpture and the nodulation of *plicatura* and the form of *improcera*. *A. subsinuata* should perhaps be included in *plicatura*. Specimens from the Croatan beds show a variation from the nearly straight base of *subsinuata* to the rounded base of *plicatura*.

Dimensions.—Lon.+10,-18; alt.+3,-15; diam. 16 mm.

Occurrence.—Upper Miocene of Warwick, Virginia; of Duplin County and Wilmington, North Carolina; of Timminsville and Darlington, South Carolina; Pliocene of the Caloosahatchie River and Shell Creek, Florida.—*Dall*. Miocene of Magnolia, North Carolina, and Darlington Church House, South Carolina.—*C. U. Museum*.

Arca plicatura Conrad

Plate X, Figures 19, 20

Arca plicatura Conrad, Fos. Med. Tert., p. 61, pl. 32, fig. 4, 1845; Heilprin, Acad. Nat. Sci. Phila., Proc. for 1881, p. 451, 1882 (*ex parte*).

Arca lincolata Conrad, Fos. Med. Tert., p. 61, pl. 32, fig. 3, 1845; not of Roemer. 1836.

Arca sublineolata Orbigny, Prodr. Pal., 3, p. 125.

Arca æquicostata Conrad, Fos. Med. Tert., p. 60, pl. 31, fig. 6, 1845; Tuomey and Holmes (?), Pleioc. Fos. S. Car., p. 44, pl. 16, figs. 3, 4, 1856.

Arca brevidesma Conrad, Fos. Med. Tert., p. 62, pl. 32, fig. 5, 1845.

Scapharca (*Arca*) *plicatura* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 579, 1863.

Scapharca (*Scapharca*) *plicatura* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 643, 644, 1898.

"Trapezoidal, ventricose; ribs about 31, rounded, approximate, rough with coarse concentric wrinkles; umbonial slope rounded; posterior margin oblique, curved; basal margin slightly tumid posterior to the middle; posterior extremity acutely rounded; series of cardinal teeth narrow, obsolete about the middle of the hinge line; within sulcated.

! 'Loc. Occurs with the preceding species. [Neuse River, Craven co., N. C.]

"The furrows within corresponding to the ribs are very distinct in this species, and the marginal teeth very long and profound posteriorly."—Conrad, 1845.

"This is a considerably larger species than *A. improcera*, more rounded and with a tendency to nodulation of the ribs. I am somewhat doubtful if the shell figured by Tuomey and Holmes is to be identified with it. It has a very close resemblance to *A. arata* Say, and is much larger than any specimens of *plicatura* I have seen. The sculpture of the two valves in *plicatura* is markedly discrepant, which is not the case in *improcera*. In this, the former more nearly approaches *A. transversa*, but the latter has reverted to the rhombical form of *improcera*.

"* * *This species [*A. transversa*] has the rounded nodulous ribs and discrepantly sculptured valves of *A. plicatura*, with the more rhombic form and solidity of *A. improcera*, with both of which it is doubtless genetically connected."—Dall.

Dimensions.—Lon. +13, -24; alt. +4, -21; diam. 23 mm.

Occurrence.—Upper Miocene of Duplin County, North Carolina, of the Sumter District, South Carolina, and of De Leon Springs, Florida; Pliocene of the Waccamaw beds of South Carolina.—Dall. Pliocene of the Waccamaw beds of South Carolina and the Croatan beds of North Carolina.—C. U. Museum.

Arca subsinuata Conrad

Plate X, Figures 21, 22

Arca subsinuata Conrad, Fos. Med. Tert., p. 62, pl. 32, fig. 6, 1845.

Scapharca (*Arca*) *subsinuata* Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Scapharca (*Scapharca*) *subsinuata* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 645, 1898.

"Subrhomboidal, inequivalved, slightly sinuous, or subreflected posteriorly; disk flattened; ribs about 34, square, little prominent, narrower than the interstices; concentric wrinkles somewhat imbricated; umbonial slope rounded; posterior slope somewhat flattened, not depressed; posterior margin straight, oblique, extremity rounded; basal margin nearly straight; summits prominent, distant; cardinal area with angulated grooves; series of teeth narrow, the teeth fine, interrupted towards the extremities of the series.

"Loc. Near Newbern, N. C."—Conrad, 1845.

This belongs with the larger fossil members of the *A. transversa* group and perhaps should be united with *A. plicatura*.

Dimensions.—Lon. +12, -21; alt. +4, -18; semidiam. 8 mm.

Occurrence.—Pliocene of the Croatan beds, near New Berne, North Carolina.—*Dall*.
Pliocene of the Croatan beds, N. C.—*C. U. Museum*.

Arca campyla Dall

Plate XI, Figures 1, 2, 3

Scapharca (*Scapharca*) *campyla* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 644, pl. 31, figs. 3, 4, pl. 32, fig. 22, 1898.

"Shell of moderate size, solid, rather rude, the posterior end strongly twisted to the right, the beaks low, and the form somewhat compressed; the umbones are very slightly bent forward, and are situated at about the anterior third; left valve with about thirty low, flat radial ribs, becoming wider and sparser posteriorly, crossed by rather rude incremental lines, but not nodulous or dichotomous, and with subequal, rather shallow channelled interspaces; the right valve is similarly sculptured and somewhat smaller; cardinal area rather long, narrow, with numerous slightly angular, longitudinal grooves; ends of the hinge-line moderately angular, anterior end of shell rounded, posterior produced, base flexuous, inner margins fluted; teeth numerous, small, uninterrupted, nearly vertical, the distal ones larger and tending to break up into granules. Lon. of a large valve 50, alt. 34 mm; of figured specimen, lon. 38, alt. 27, diam. 20 mm.

"This species is one of the most abundant in the Floridan Pliocene, and is easily distinguished from any other by its compressed appearance and twisted shape. Some of the allied species have a slight flexuosity, but in none is this feature so pronounced as in *A. campyla*. A variety with thinner shell and narrower and slightly more elevated ribs was at first thought to be distinct, and may be named var. *arctica*."—*Dall*, 1898.

Occurrence.—Pliocene of the Caloosahatchie, Shell Creek, Alligator Creek, and Myakka River, Florida.—*Dall*.

Arca transversa Say

Plate XI, Figures 4, 5, 6

Arca transversa Say, Acad. Nat. Sci. Phila., Journ., 1st. ser., vol. 2, p. 269, 1822.

Arca transversa Gould, Invert. Mass., p. 96, 1841.

Arca transversa De Kay, Nat. Hist. N. Y., vol. 5, p. 177, pl. 12, fig. 212, 1843.

Scapharca (*Scapharca*) *transversa* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 643-646, 659, 1898.

Not *Arca transversa* Portlock, Rep. Geol. Londonderry, p. 428, pl. 34, fig. 4, 1843.

Not *Cucullæa transversa* Rogers, Am. Phil. Soc., Trans., vol. 6, p. 373, pl. 29, fig. 1, 1839, = *A. (C.)*

Rogersiana Nyst, Tabl. Synopt. Arcacées, p. 63, 1848, *fide* Dall, = *A. Rogersi* Heilprin, Acad. Nat. Sci. Phila., Proc. for 1881, p. 449, 1882.

"Shell transversely oblong, rhomboidal, with from thirty-two to thirty-five ribs, placed at nearly the length of their own diameters distant from each other; apices separated by a long narrow space, and situate at the termination of the posterior third of

the length of the hinge margin; extremities of the hinge margin angulated; anterior edge, superior moiety rectilinear; posterior edge rounded; inferior edge nearly rectilinear, or very obtusely rounded; on the hinge space one or two angulated lines are drawn from the apex, diverging to the hinge edge * * *."—*Say*, 1822.

The name *transversa* arose from the fact that *Say* interchanged length and height and anterior and posterior.

Shell inequivalve; ribs thirty to thirty-five, those on the left valve entire, high, narrow, rounded and irregularly nodulous, those on the right valve broader and flatter anterior to the umbonal ridge; beaks mesially sulcate; cardinal area narrow with two or three v-shaped grooves; posterior margin of the cardinal area elevated; hinge narrow; teeth fine at the center, longer and more oblique distally where the ends of the series curve downward; anterior margin rounded, basal margin rounded or nearly straight, posterior margin rounded below, nearly straight above with an angle at the hinge; inner margin fluted; epidermis brown.

A. transversa var. *busana* Harris, (Bull. Am. Pal., vol. 1, no. 3, p. 6, 1895), is from the Deep Well of Galveston, Texas. It is longer and less inflated than the usual form.

Shells from the Pleistocene of New Orleans, Louisiana, are larger and more irregular than the recent *transversa*, but are not so large as shells of this group from the Waccamaw beds of South Carolina which have been placed under *A. plicatura*.

A. transversa Portlock was renamed *A. Portlocki* by Deshayes. It has been placed in *Ctenodonta*.

Dimensions.—Lon.+8,-17; alt.+2.5,-15; diam. 14 mm.

Occurrence.—Pliocene of Myakka River and De Land, Florida; Pleistocene of North Creek, Little Sarasota Bay, Florida; of Simmons Bluff, South Carolina, Wailes Bluff, Maryland, and Sconset, Rhode Island. Recent from Cape Cod south to Key West, Florida, and southwest to Vera Cruz and the Gulf of Campeachy, Mexico, in shallow water. * * * It is not known below the Upper Pliocene.—*Dall*. Pleistocene from New Orleans, Chenier, Knapp's Wells, Gymnasium Well and Lydia, Louisiana, and of Wailes Bluff, Maryland; recent from Cameron and Point-au-Fer, Louisiana, Galveston, Texas, Ft. Barrance, Florida, and from Aspinwall.—*C. U. Museum*.

Arca triphera Dall

Plate XI, Figure 7

Scapharca (*Scapharca*) *triphera* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 648, pl. 33, fig. 6, 1898.

"Shell subequivalve, of moderate size, elongate, not much inflated, subrectangular, with low beaks slightly prosocœlous and marked by a conspicuous wide mesial sulcation; umbones situated at the anterior third of the length; left valve with about thirty-eight rounded subequal ribs separated by narrower interspaces; in the adult about a dozen of the anterior ribs may be squared off and deeply mesially sulcate near the margin, while a few of the ribs on the posterior dorsal slope are narrower, smoother, and more widely separated; transverse sculpture of elevated lines which are somewhat regularly spaced, and

in crossing the ribs develop into sharp, thick transverse nodulations; cardinal area very narrow and with an elevated margin behind, slightly wider in front of the beaks longitudinally striate; ends of the hinge-line angular; anterior end bluntly rounded, base parallel with the hinge-line, posterior end subtruncate, a little produced below; hinge with numerous rather crowded subvertical teeth in an uninterrupted series; inner margin of the valves deeply fluted. Lon. of largest valve 28, alt. 14; of younger valve 18, alt. 8.5, diam. 7 mm.

"The larger valves of this rare species are distorted or worn so that a younger one has been selected for figuring. The most conspicuous feature of the shell is the deep sulcation of the beaks, which gives them a bilobed appearance."—Dall, 1898.

Occurrence.—Pliocene marls of the Caloosahatchie River, Florida.—Dall.

Gabb described *Arca Chiriquiensis* from the Tertiary of Chiriqui, Central America (Acad. Nat. Sci. Phila., Proc. for 1860, p. 567, 1861). Later, (Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 8, pp. 345 and 378), he placed this species, together with fossils from St. Domingo and Costa Rica and Sowerby's *A. patricia* (Quart. Journ. Geol. Soc. Lond., vol. 6, p. 52, 1850) from St. Domingo, all under *A. grandis* Broderip and Sowerby, (Zool. Journ., vol. 4, p. 365; Reeve, Conch. Icon., *Arca* no. 4, 1843). Dall, (Wagner Free Inst. Sci., Trans., vol. 3, p. 642), calls the Chiriqui and St. Domingo fossils Oligocene and separates them from *grandis* under the name *Scapharca (Scapharca) chiriquiensis* Gabb. He says that the species "has about thirty rounded ribs with subequal channelled interspaces, the anterior ribs being granulose or nodiferous, the shell remarkably high, short, solid, and wide. The measurements of a well-grown specimen are: alt. 42, lon. 45, and diam. 44 mm.; the length of the cardinal area is 28 mm. It is one of the species on the border line between *Scapharca* and *Anadara*, the two valves being similarly sculptured and almost equal."

Evidently at least two species of fossil shells have been confused here. In the Gabb collection from St. Domingo there are two valves as large and heavy as specimens of *A. grandis* from the west coast. These fossils do not show enough variation from the recent form to warrant placing them in a separate species. There are a few small valves, the largest 23 mm. long, of a short, well-sculptured *Scapharca* which are distinct from the young of *A. grandis*. They are short and high like *A. chiriquiensis*, but unlike this, the left valve is more nodulous than the right, conspicuous nodules extending over nearly the entire valve, and the ribs of the left valve are square and wider than the interspaces. There are also from St. Domingo two worn valves which resemble the young of *A. grandis* in form but appear to be a separate species. The lack of figures of *A. patricia* and *A. chiriquiensis* has added to the confusion.

Scapharca (Scapharca) halidonata Dall; Plate XI, Figure 8; (Wagner Free Inst. Sci., Trans., vol. 3, p. 646, pl. 33, fig. 24, 1893), from the Bowden beds, Jamaica, and of Curaçao is of the general type of *A. secticostata* but is proportionately much shorter. The fossil *A. consobrina* Sowerby; Plate XI, Figures 9, 10; (Quart. Journ. Geol. Soc. Lond., vol. 6, p. 52, pl. 10, fig. 12, 1850), from St. Domingo also belongs to the group of which *A. secticostata* is the recent representative. The name *consobrina* had already been used

by d'Orbigny for a French fossil (Pal. Française, Terrains Crétacés, vol. 3, p. 209, pl. 311, figs. 4-7, 1844). In the Gabb collection from St. Domingo are shells of another species with the general form of this group but ribbing like that of *A. aresta* and *A. campsa*.

Arca inequilateralis Guppy; Plate XI, Figures 11, 12; (Quart. Journ. Geol. Soc. Lond., vol. 22, p. 293, pl. 18, figs. 2a, 2b, 1866; Schuchert, U. S. Nat. Mus., Bull., no. 53, p. 56, 1905), from the Oligocene of Bowden, Jamaica, is referred to the group *Scapharca* by Dall, who says, "This species is closely related to *A. latidentata* Dall, * * * but may be distinguished from it at once by the shorter, more delicate, and much more numerous hinge-teeth of the Jamaica shell. The latter is also thinner and more elegant in sculpture and less inflated. It somewhat resembles the young of *A. hypomela* Dall and *A. floridana*."

Scapharca (Scapharca) actinophora Dall; Plate XI, Figure 13; (Wagner Free Inst. Sci., Trans., vol. 3, p. 647, pl. 33, fig. 26, 1898), from the Oligocene of Monkey Hill, Panama Railway, is a long shell with beaks in the anterior fourth, about forty entire ribs, arcuate base and narrow, attenuated and rounded posterior end.

Scapharca (Scapharca) donacia Dall; Plate XI, Figure 14; (Wagner Free Inst. Sci., Trans., vol. 3, p. 649, pl. 33, fig. 13, 1898), from the Oligocene of Bowden, Jamaica, is a small, donaciform shell (6.8 mm. long), with about twenty-four smooth, entire ribs and attenuated posterior end.

Dall lists *A. auriculata* Lamarck; Plate XI, Fig. 19; (An. s. Vert., vol. 6, p. 43, 1819; Reeve, Conch. Icon., *Arca* no. 35, pl. 6, 1844), under the section *Scapharca* and gives its occurrence as follows:—?Oligocene of Bowden, Jamaica; Pliocene of Limon, Costa Rica; Pleistocene of the Antilles; Recent from Key West to Martinique, in fifteen to forty fathoms.

A. Deshayesii Hanley; Plate XI, Figures 15, 16, 17, 18; [Ill. Cat. Biv. Shells, p. 157, 1842, (Dall, Moll. Porto Rico, Bull. U. S. Fish Comm. for 1900, vol. 20, pt. 1, p. 461, 1901); Reeve, Conch. Icon., *Arca* no. 47, pl. 7, 1844] is found recent in the West Indies and has been reported fossil from the mainland of southern North America. Dall lists it recent from Pernambuco, (Wash. Acad. Sci., Proc., vol. 3, p. 141, 1901). It has about twenty-seven narrow, rounded and finely nodulous ribs, the anterior with a median groove; epidermis brown, thick, scaly between the ribs with bristles near the umbonal ridge. The shell is practically equivalve and is as near *Anadara* as *Scapharca*. The young is auriculate behind and has evidently been confused with *A. auriculata* Lamarck. Dautzenberg, (Mém. Soc. Zool. France, vol. 13, p. 236, 1900), unites the *A. hemidermos* Philippi of d'Orbigny, (Hist. Isla Cuba, pt. 2, vol. 5, Moll., p. 345), with *Deshayesii*.

Arca Websteri Pilsbry (Acad. Nat. Sci. Phila., Proc., vol. 62, p. 488, 1910), appears to be a *Scapharca*. It is from the Oligocene of Haiti. There is also an *Arca* sp. undet. from the same place, (l. c., p. 489).

Section *Anadara* Gray

"Group of *A. antiqua* L. (*Anadara* (Gray, 1847) Adams, 1858, in synonymy, + *Anomalocardia* Adams, 1858, not of Schumacher, 1817).

"Shell heavy, trigonal or oblong, inflated, with prosocœlous beaks, with a wide area

wholly covered by the ligament and usually with numerous furrows for the resilium forming concentric lozenges; teeth similar, in a long, uninterrupted series, slightly larger and more oblique distally; valves equal and similarly sculptured; epidermis usually pilose and profuse.

"The young shell is often and the adult sometimes auriculate behind. The transition to *Scapharca* s. s. is very gradual and complete."—*Dall*, 1898.

Arca subrostrata Conrad

Plate XII, Figures 1, 3, 3, 4

Arca subrostrata Conrad, Acad. Nat. Sci. Phila., Proc., vol. 1, p. 30, 1841; Journ., 1st. ser., vol. 8, pt. 2, p. 185, 1842; Fos. Med. Tert., p. 58, pl. 30, fig. 7, 1845.

Not *Arca subrostrata* Sowerby, Quart. Journ. Geol. Soc. Lond., vol. 3, pp. 413, 418, pl. 15, figs. 8, 9, 1847.

Scapharca tenuicardo Conrad, Am. Journ. Conch., vol. 5, p. 39, pl. 2, fig. 4, 1869.

Scapharca (Arca) subrostrata Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Scapharca (Anadara) subrostrata Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 655, 1898.

Arca (Scapharca) subrostrata Glenn, Maryland Geol. Surv., Miocene, p. 385, pl. 104, figs. 2, 3a, 3b, 1904.

"Ovate; profoundly ventricose; ribs about 30, little prominent, flat, longitudinally sulcated; posterior side produced, cuneiform; rounded at the extremity; hinge linear in the middle, teeth obsolete, except towards the extremities; within slightly sulcated; crenulations of the margin sulcated in the middle. Length 2 inches."—*Conrad*, 1841.

Shell slightly inequivalve; beaks mesially sulcate; ribs twenty-nine to thirty-two, each rib with a longitudinal sulcus and usually a shallower sulcus on each side of this, dividing each rib into four riblets, sometimes more than four riblets posteriorly; central ribs sometimes nodulous; interspaces usually narrower than the ribs; cardinal area with five to eight concentric grooves; hinge-line short; older shells with central teeth obsolete and distal teeth irregular. In the ribbing this species resembles *A. dodona*, but otherwise the two species are distinct. It is evident that *Scapharca tenuicardo* Conrad, is a synonym of *A. subrostrata*. This is one of the species that show the close relation between the sections *Scapharca* and *Anadara*. The young has the characters of *Scapharca*, but the old shell shows some of the characters of *Anadara*. It is placed by Dall in the latter group.

Dimensions.—Lon. +15,-35; alt. +7,-29; semidiam. 14 mm.

Occurrence.—Miocene of Maryland in Talbot and Calvert Counties, at Calvert Cliffs, Skipton, Centreville, Plum Point, and other localities. A single valve, stated to be from the Miocene of North Carolina, is in the National Museum.—*Dall*. Calvert Miocene of Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, White's Landing, Church Hill, 3 miles West of Centerville, Reed's Wye Mills, near Skipton.—*Glenn*. Miocene of Plum Point and Chesapeake Landing, Maryland.—*C. U. Museum*.

Arca elnia Glenn

Plate XII, Figures 5, 6

Arca (Scapharca) elnia Glenn, Maryland Geol. Surv., Miocene, p. 386, pl. 104, figs. 4a, 4b, 1904.

"Shell large, moderately thick, but slightly elongated, not inflated, with prominent prosocœlous beak; cardinal area wide, with numerous irregular, zigzag, longitudinal grooves, bounded by a single deep curved groove from the beak to the ends of the hinge-line; hinge-line narrow; teeth small, obsolete medially, tending to become irregular at both ends of the series; right valve with about thirty-one low ribs hardly as wide on anterior dorsal slope as intervening spaces, broader and more elevated on posterior dorsal slope; each rib mesially sulcated by a groove with one or more subordinate grooves on either side; growth lines distinct; margin a continuous curve from anterior end of hinge line to posterior end of base, there sharply curved; posterior margin oblique to hinge line; interior margin crenulated; dorsal and posterior slopes meet in an angle that becomes rounded near the basal margin.

"This species seems to be intermediate between *A. staminea* and *A. subrostrata*, being perhaps more nearly related to the latter.

"Length, 60 mm.; height, 48 mm.; diameter, 22 mm."—Glenn, 1904.

Occurrence.—Choptank Miocene of Jones Wharf, lower bed at Governor Run, 2 miles south of Governor Run, Maryland.—Glenn.

Arca clisea Dall

Plate XII, Figures 7, 8

Scapharca (Anadara) clisea Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 657, pl. 33, fig. 25, 1898.

Arca (Scapharca) clisea Glenn, Maryland Geol. Surv., Miocene, p. 386, pl. 105, fig. 1, 1904.

"Shell large, heavy, inflated, short, with small, high, somewhat prosocœlous beaks, the two halves of the wide cardinal area inclined to one another in the adult at an angle of about forty-five degrees; left valve with about thirty strong, flattened subequal radial ribs with narrower interspaces; in the young the ribs are furnished with small transverse nodulations, which gradually become obscure in the adult; the only transverse sculpture is of the ordinary incremental lines; the ribs in the adult are flat topped and rarely show any tendency to mesial sulcation, and when present it appears only on a few of the anterior ribs near the margin; the anterior end is obliquely rounded to the base, the posterior end a little produced basally; the cardinal area is exceptionally wide, with a single impressed line joining the beaks and six or seven concentric lozenges defined by sharp grooves; a deep groove also bounds the area; hinge-line straight with numerous small vertical teeth, becoming much larger distally and tending to break up into granules at both ends of the series in the senile shell. Lon. 51, alt. 53, diam. 53 mm.

"This shell is apparently related to *A. callipleura* and *A. staminea* Conrad, and a larger series of specimens may oblige us to unite all three as varieties of a single species. At present, however, the differences seem too great to admit of this course. In *A. callipleura* the ribs are granulated and triply sulcate, while in the present form they are simple. *A. clisea* has no posterior truncation like that figured by Conrad in *A. callipleura*. *A. staminea* is more squarely compressed before and behind, with a tendency

to incurvation of the posterior basal margin; it is a smaller shell with more posterior beaks, and less roundly inflated. We have a large series of this species from many localities, and these differences characterize them all. The forms are easily differentiated, so far as our present knowledge goes, and therefore are better kept apart. In all the pairs of *A. staminea* in the collection the right valve is distinctly smaller than and fits into the other, while in *A. disca* the margins meet evenly."—*Dall*, 1898.

Glenn thinks this shell is more closely related to *A. idonea* than to any other. Some of the short, high forms of *A. staminea* approach *A. disca*. A left valve from Evergreen, Virginia, which resembles *A. disca* is related to *A. staminea*, but is well rounded instead of angular. The specimen figured is related to *idonea*.

Occurrence.—Chesapeake Miocene of Maryland, and at St. Mary's River and Crisfield; of Nomini Cliffs, Virginia; and of Walton County, Florida.—*Dall*. St. Mary's Miocene of St. Mary's River, Crisfield well at depth of 140 feet.—*Glenn*. Miocene of North Carolina.—*C. U. Museum*.

Arca aresta Dall

Plate XII, Figures 9, 10, 11

Scapharca (Anadara) aresta Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 638, 655, pl. 33, fig. 2, 1898.

"Shell of moderate size and thickness, arcuate below, straight above, with small but prominent prosocœlous beaks, left valve with twenty-seven square-topped, narrow, entire radial ribs, separated by wider interspaces; the ribs on the middle of the shell are somewhat narrower than the others; all are crossed by evenly spaced, moderately prominent elevated lines, festooned in the interspaces, and forming small, square ripples on the ribs; both valves similarly sculptured; cardinal area narrow, with elevated margins behind, wider and short in front of the beaks; the portion in front of the beaks is longitudinally striated, behind the beaks there are three or four concentric, lozenge-shaped groovings; a single transverse groove usually passes between the beaks; hinge-line straight; teeth in two nearly equal series, overlapping a little proximally, the teeth rather crowded and nearly vertical; base of the valves arcuate, rounded into the anterior end, posterior end a little produced; internal margins of the valves fluted. Lon. 41, alt. 28, diam. 26 mm.

"This very neat and distinct species appears to be the most common Ark in the upper or Miocene bed at Alum Bluff."—*Dall*, 1898.

Ribs twenty-four to twenty-nine, usually twenty-seven; beaks mesially sulcate. The prominent characters of this species are the broad, rounded and festooned interspaces, the narrow, square-topped ribs and the unusual form. The anterior and posterior extremities are both nearer to the hinge-line than to a parallel line through the lowest point of the base; the posterior portion is often attenuated, but in young specimens this part is relatively broader and more evenly rounded; the greatest inflation is anterior to the middle of the shell.

Dimensions.—Lon. +15, -31; alt. +6, -24; diam. 32 mm.

Occurrence.—Chesapeake Miocene of Alum Bluff, Calhoun County, Florida.—*Dall*. Miocene of the Upper bed at Alum Bluff, Florida.—*C. U. Museum*.

Arca campsa Dall

Plate XII, Figure 12; Plate XIII, Figures, 1, 2, 3

Scapharca (Anadara) campsa Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 656, pl. 32, fig. 21, 1898.

"Shell of moderate size, solid, and heavy, with a straight and angulate upper margin, obliquely rounded anterior, produced posterior, and arcuate basal margin; beaks low, much incurved, mesially impressed, and rather anterior; left valve with about twenty-two narrow ribs separated by wider interspaces, crossed by little elevated, regularly spaced incremental lines; the ribs are not nodulous, the anterior ones are flattish or rarely have a shallow sulcus mesially near the margin; they are subequal, but in specimens in which the mesial depression of the valve is especially strong, the ribs included in it are narrower and closer together than usual; hinge-line nearly as long as the shell, angular, but not auriculate distally; the beaks are within the anterior third; cardinal area wider in front, narrow behind, longitudinally striated with a few grooves which circumscribe a 'stemmed' arrow-head figure, few of them reaching as far forward as the beaks; teeth in two adjacent series, the anterior shorter with a pronounced thickening of the shell below it, over the vertical face of which the teeth extend rather irregularly or are supplemented by denticular wrinkles; posterior series longer, numerous, vertical, distally much wider, and more or less oblique; interior margin of the valves with strong, short flutings. Lon. 47; alt. 28; diam. 27 mm.

"This is quite a peculiar species, the teeth of which recall *Argina*, while all the other characters of the shell indicate its section to be *Anadara*, another instance, if one were needed, to illustrate the mutability of the dental forms in this family. It cannot be confounded with any of our other species."—*Dall*, 1898.

Ribs twenty-one or twenty-two; cardinal area with margin elevated behind the beaks; the mesial sulcation of the beaks passing over the umbo and down to the ventral margin as a broad flattening or sulcation. This shell is distinguished by its wide, rounded interspaces and narrow, square-topped ribs crossed by elevated lines as in *A. aresta* and by its mesial depression. In a pair of valves which belong together this depression is more marked on the left valve.

Dimensions.—Lon. +16, -36; alt. +6, -25; diam. 29 mm. Dimensions of a large valve, lon. 64, alt. 43 mm.

Occurrence.—Chesapeake Miocene or upper bed at Alum Bluff, Florida.—*Dall*. Miocene of the upper bed at Alum Bluff, Florida.—*C. U. Museum*. Dr. Maury lists this species from the Oligocene of Alum Bluff, but the specimens listed prove to have come from the upper bed.

Arca rustica Tuomey and Holmes

Plate XIII, Figures 4, 5

Arca rustica Tuomey and Holmes, Pleioc. Fos. S. Car., p. 39, pl. 15, fig. 1, 1857.

Not *A. rustica* Contejean, 1859 (*vide* Dall).

Scapharca (Arca) rustica Conrad, Acad. Nat. Sci. Phila., Proc. for 1862, p. 580, 1863.

Arca crassicosta Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 96, pl. 13, fig. 30, 1887.

Arca crassicosta Dana, Man. Geol., 4th. ed., p. 900, fig. 1508, 1895.

Scapharca (Anadara) rustica Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 653, pl. 31, figs. 6, 9, 1898.

"A. testa crassa, sub-quadrata, radiatim costata; costis sub-squamosis; latere buccali brevioribus, costis crenatis; latere anali carinato, angulato, truncato, costis majoribus; umbonibus inter se fere contingentibus.

"Shell thick, somewhat square, radiately, and unequally ribbed; ribs almost squamose; buccal side very short, ribs crenate; anal side carinate, angular, truncate, ribs very large; ligament area narrow, umbones nearly touching.

"This fossil is readily distinguished by the coarse ribs and deeply excavated interstices on the anal side. The margin is strongly crenulated * * *."—*Tuomey and Holmes*, 1857.

"The collection of more material since Professor Heilprin's publication leaves no doubt whatever as to the identity of this splendid species with that of Tuomey and Holmes. It seems to be characteristic of the southern Pliocene. The beaks are much incurved and distinctly prosocelous, the cardinal area short and wide in front of them, long and narrow with much elevated margins behind; the anterior part of the area is transversely grooved at right angles to the hinge-line; the posterior part has converging grooves, thus forming three or four concentric triangles. The hinge is composed of a short anterior and long posterior series of subequal vertical teeth vertically striated on their flat surfaces; there are over forty teeth, of which twelve are anterior; the two series are closely approximated. Many of the specimens have a strong posterior auriculation which is more prominent in the young; one specimen measures thirty-two millimeters on the hinge-line and twenty-eight millimeters below the auriculation. An adult measures fifty-three millimeters long, thirty-six millimeters high, and forty millimeters in diameter. The largest valve obtained is seventy-one millimeters long and has fifty-four posterior and seventeen anterior teeth. In this specimen there are nine longitudinal grooves, and the three or four middle ones are extended in front of the beaks, contrary to the rule in younger specimens, giving the grooved area as a whole the form of a long, narrow "stemmed" arrow-head. In this valve the hinge-line is sixty millimeters long and the vertical of the beak is ten millimeters from the anterior end.

"On the whole, this is one of the finest and most striking species in our whole Tertiary fauna."—*Dall*.

Ribs seventeen to twenty-two, large and coarse near the umbonal ridge, smaller and more closely set anteriorly and posteriorly. Several Old World fossil species have been called *A. rustica* since Tuomey and Holmes used the name.

Dimensions.—(Small valve), lon. +10, -36; alt. +5, -29; semidiam. 18 mm.

Occurrence.—Pliocene of the Waccamaw beds of South Carolina; and of the Caloosahatchie, Shell Creek, Alligator Creek, and Myakka River, Florida.—*Dall*. Pliocene of Shell Creek, Florida.—*C. U. Museum*.

***Arca catasarca* Dall**

Plate XIII, Figure 6

Scapharca (Anadara) catasarca Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 654, pl. 32, fig. 20, 1898.

"Shell elongate, solid, subrhomboidal, with very anterior, high, prosocœlous beaks; right valve with twenty-three strong, narrow, rounded ribs, separated by wider, very deep channelled interspaces; concentric sculpture of incremental lines, which are slightly elevated at regular intervals, and cause over much of the valve the tops of the ribs to appear obscurely nodulous; the ribs on the anterior end, though simple in the young, are sharply mesially sulcate in the adult, those on the posterior dorsal slope lower and more rude than those on the body of the shell; the hinge-line is straight, the cardinal area differs from that of *A. rustica* only by having but a single transverse groove anteriorly between the beaks; both valves are similarly sculptured, but no adult left valve was collected; the hinge-line is straight and shorter than the shell; there are about fifteen anterior and four times as many similar vertical posterior teeth, the proximal ends of the series slightly overlapping; the hinge-line in the specimen figured is forty-six millimeters long, the vertical of the beak falls at 8.5 millimeters from the anterior end; inner margins thickened, with short flutings. Lon. 55, alt. 36, diam. 45 mm.

"This fine species appears to be rare, and was found only at Alligator Creek * * *. The young has much the outline of *A. auriculata*, but is not markedly auriculate. It is proportionately shorter than the adult. The species belongs to the same subordinate group as *A. rustica*, as is shown by the minor characters.

"A single broken valve, probably of this species, is among the material from Shell Creek."—*Dall*, 1898.

Occurrence.—Pliocene marl of Alligator and Shell Creeks, Florida.—*Dall*.

Section ***Cunearca*** Dall, 1898

"Group of *A. incongrua* Say. (*Cunearca* Dall.)

"Thin, trigonal, inflated, with erect beaks; the cardinal area short, amphidetic, equilateral, set off by deep grooves from the rest of the sculpture, smooth or transversely striated, without furrows; hinge-teeth divisible into two series, smaller proximally, larger and more oblique distally, often more or less Δ -shaped; the right valve smaller; sculpture of the two valves obviously discrepant; the epidermis smooth or not pilose."—*Dall*.

***Arca initiator* Dall**

Plate XIII, Figures 7, 8, 9

Scapharca (Cunearca) initiator Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 634, pl. 32, fig. 11, 1898.

"Shell small, solid, oblique, with prosogyrate beaks, somewhat impressed mesially near the apices of the valves; right valve ovate-rhombic with twenty strong, rounded, nodulous, radial ribs, separated by wider interspaces; left valve decidedly smaller, with the ribs smooth, squarish, and without nodules, except a few on some of the shorter anterior ribs; cardinal area wider in front of the beaks, narrower behind them; margins of the valves internally fluted; hinge-line short, with about twenty-two subequal vertical teeth. Lon. (of left valve) 5, alt. 4.7, diam. 5 mm.

"This little shell was at first thought to be the young of a larger species, but nothing allied to it of a larger size has turned up at any locality in the formation, while its solidity gives it a mature appearance. The cardinal area differs in form from any of the known species in the adult state."—*Dall*, 1898.

Evidently the words right and left are interchanged in the original description. More than half of the ligament lies behind the beaks and it does not cover the entire cardinal area, but leaves a broad, uncovered band along the anterior and posterior margins of the cardinal area. There is no sulcation parallel to the umbonal ridge as in *A. incongrua*.

Dimensions.—(Left valve), lon.+2.5,-4; alt.+1,-4.5; semidiam. 3 mm.

Occurrence.—Oligocene of the Chipola beds, Chipola River, Florida.—*Dall*. Oligocene of Sour Lake, Texas.—*C. U. Museum*.

Arca scalaris Conrad

Plate XIII, Figures 10, 11

Arca scalaris Conrad, Acad. Nat. Sci. Phila., Proc. for 1843, p. 324, 1843.

Arca scalaris Conrad, Fos. Med. Tert., p. 59, pl. 31, fig. 1, 1845.

Arca scalaris Tuomey and Holmes, Pleiocene Fos. S. Car., p. 43, pl. 16, figs. 1, 2, 1856.

Scapharca (Arca) scalaris Conrad, Acad. Nat. Sci., Phila., Proc. for 1862, p. 580, 1863.

Scapharca (Cuncarca) scalaris Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 634, 1898.

"Obliquely rhomboidal, elevated, ventricose, ribs about twenty-three, broad, square, prominent, profoundly and robustly crenate, wider than the interstices, seven on the posterior slope, prominent; posterior slope flattened; umbonial slope angulated; summit elevated, narrowed; anterior margin obliquely truncated; anterior basal margin obliquely subtruncated; posterior extremity subangulated; beaks remote; area with transverse slightly impressed lines; cardinal teeth irregular, oblique towards the extremities of the hinge line; within with furrows corresponding to the ribs; margin profoundly crenate. Length two inches; height, one and a half inches * * *.

"Allied to *A. incongrua* Say. The description applies to the left valve only as the opposite one has not yet been found."—*Conrad*, 1843.

Dimensions (Small left valve).—Lon.+12,-15; alt.+4,-20; semidiam. 10 mm.

Occurrence.—Darlington District, South Carolina.—*Tuomey* and *Holmes*. Miocene of Petersburg, Virginia; of Duplin County, North Carolina, and of the upper bed at Alum Bluff, Florida.—*Dall*. Miocene of North and South Carolina (young), and of Petersburg, Virginia.—*C. U. Museum*.

Arca scalarina Heilprin

Plate XIII, Figure 12; Plate XIV, Figures 1, 2, 3

Arca scalarina Heilprin, Wagner Free Inst. Sci., Trans., vol. 1, p. 94, pl. 12, fig. 29, 1887.*Scapharca* (*Cunearca*) *scalarina* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 634, 1898.

"Shell obliquely rhomboidal, elevated, ventricose, angulated posteriorly, flattened; anterior end short, evenly rounded; beaks prominent, transverse, about eight, distant; ligament-area diamond-shaped, nearly smooth in the young shell, with delicate transverse lines—in the adult, with a limited number of coarse, sinuous longitudinal lines; hinge-line straight, somewhat more than one-half the greatest length of shell; teeth numerous, somewhat oblique toward either end.

"Ribs prominent, about twenty-four, broad, square, robustly crenate, those of the left valve broader than the interspaces, flattened posteriorly, about eight on the anal angulation; those of the right valve of about the same width as the interspaces (the anterior ones the broadest), with an interstitial secondary rounded rib in the center of the interspace; the two valves unequal, the basal margin of the left valve greatly protruding beyond that of the right; base profoundly crenulated.

"Length, 3.3 inches; height, 2.5 inches.

"* * * It closely resembles the shell identified by Tuomey and Holmes with *Arca scalaris* of Conrad * * *. Through the kindness of Prof. Whitfield I have been permitted to make a comparison with the type-forms described and figured by Tuomey and Holmes, and find that their shell differs very materially from the Florida fossil. In the first place it is decidedly more oblique, and secondly, the ribs adjoing the posterior slope (on the left valve) are not nearly as broad relatively, nor as flattened, as they are in *A. scalarina*; the ribs of the left valve are more remotely placed from one another, and lack the pronounced interstitial secondary rib, which is so prominently defined in the Florida fossil. Its place is taken by a hair line, which is present in some of the intercostal spaces. The characters of the Florida shell are remarkably constant * * * and were I as positive of the stability of characters of the Carolina fossil, I should have no hesitation in regarding the two as specifically distinct * * *. As it is, the characters of the two are sufficiently distinct, indeed, fully as well-marked as those which separate the Florida fossil from the recent *Arca incongrua* of the Southern coast, which may, with much plausibility, be looked upon as its immediate descendant. The recent species agrees more nearly in the general outline of the shell, being upright rather than oblique, but differs in the less width (in the left valve) of the ribs, and in lacking the true interstitial rib of the right valve (although an indication of it appears in a faint elevated line), agreeing in this respect with the South Carolina fossil. That the three forms are most intimately related there can be no question, and I believe there is likewise little or no question that all lie on the same line of descent."—*Heilprin*, 1887.

"This magnificent species is the largest and most distinct of the entire group, and so far has been obtained only on the Caloosahatchie River * * *."—*Dall*.

Occurrence.—Pliocene marls of the Caloosahatchie, Florida.—*Dall*.

Arca incongrua Say

Plate XIV, Figures 4, 5, 6, 7

Arca incongrua Say, Acad. Nat. Sci. Phila., Journ., vol. 2, p. 268, 1822.*Arca incongrua* Reeve, Conch. Icon., *Arca* no. 50, 1844.*Scapharca (Cunearca) incongrua* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 618, 635, 659, 1898.

"Shell somewhat rhomboidal, with from twenty-six to twenty-eight ribs, placed nearer to each other than the length of their own diameters, and crossed by elevated, obtuse, equal and equidistant lines, which are altogether wanting on ten rays of the disc of the left valve; apices opposite to the middle of the hinge, distant from each other, with a lanceolate space between them, of which the breadth is about one-third of its length; extremities of the hinge margin angulated; posterior edge rounded; inferior edge rounded, that of the left valve extended a little beyond the regular curve in the middle; anterior margin cordate, flattened; anterior edge nearly rectilinear * * *.

"This species, which is very abundant on our coast, strongly resembles *A. rhombea*, but, agreeably to the figure in the Encyc. Meth., it differs in the width of the space on the hinge margin, in the width of the spaces between the ribs, and in its more rectilinear anterior edge."—*Say*, 1822.

In the original description right and left, anterior and posterior are interchanged.

Left valve much the larger; ribs twenty-six to thirty; left valve with all the ribs wider than the interspaces, which are very narrow about the center of the shell; anterior ribs coarse, posterior finer; interspaces widest on the anterior part; ribs with transverse, conspicuous, raised lines which are long and narrow except near the umbo, where they are rounder; ribs of the right valve from the center to the umbonal ridge narrow and nearly smooth; left valve with a shallow sulcus anterior and parallel to the umbonal ridge; ligament covering practically all the cardinal area and bounded by a deep groove; ligament area with faint transverse striations; teeth longer and oblique distally. *A. incongrua* shows hardly a trace of an interstitial rib on the right valve. There is a thin light brown epidermis.

This is one of the commonest east coast shells. The closely related form *A. brasiliana* Lamarck; Plate XIV, Figure 8; (An. s. Vert., vol. 6, p. 44, 1819), is smaller than *A. incongrua*, it is proportionately shorter and higher with a short, abrupt posterior slope and straight posterior margin. The abrupt change from nodulous to smooth ribs on the right valve produces an apparent sulcus on the side of the umbo. The shell from the West Coast figured by Reeve as *A. Brasiliana* is referred by Dall to *A. nodosa* Wood. Dall says, (Wagner Free Inst. Sci., Trans., vol. 3, p. 635), "The typical *A. incongrua* is quite variable in form, and I have not seen specimens which could be unhesitatingly referred to it from older beds than the Pleistocene, or more southern localities, living, than the coast of Texas. Here it is mixed with specimens of the *brasiliana* type, towards which the *incongrua* tends to vary. The Costa Rica Pliocene fossils are exactly like *brasiliana*; the Antillean shells also, while varying a good deal, retain the dimensions of *brasiliana* and more or less of its other characters. It is probable that the two forms would

better be kept apart, at least until more is known."

Dimensions.—Lon. +24, -29; alt. +7, -37; diam. 40 mm.

Occurrence.—Upper Miocene of the Galveston artesian well (?); Pliocene of Port Limon, Costa Rica; typical specimens from Pleistocene of Wailes Bluff, Maryland, Simmons Bluff, South Carolina, and Brunswick, Georgia; recent from North Carolina south to Texas, and (var. ? *braziliana*) from Texas south and east to Cape Roque and south to Rio, Rio Grande do Sul, San Paulo, and Santa Caterina, Brazil.—*Dall*. Pleistocene of New Orleans and Grand Chenier, Louisiana, and of Simmons Bluff and Georgetown, South Carolina; recent from Point-au-Fer and Cameron, Louisiana, Galveston, Texas, and from Florida.—*C. U. Museum*. *A. brasiliana* recent from Aspinwall.—*C. U. Museum*.

Arca alcima Dall

Plate XV, Figures 1, 2

Scapharca (Cuncarca) alcima Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 635, pl. 31, figs. 5, 7, 1898.

"Shell of moderate size, short, high, inflated, with elevated prosogyrate beaks; left valve with thirty strong, squarely nodulous, radial ribs somewhat narrower than the interspaces, without obvious concentric sculpture, front edge rounded, posterior less rounded and longer, meeting the base at a rather blunt angle, this part of the shell being somewhat produced; right valve with twenty-seven less prominent ribs, of which the posterior dozen have the nodules obsolete or absent and those on the anterior ribs somewhat less marked than on the other valve; cardinal area short, wide, with the beaks incurved over it; inner margin of the valves sharply fluted; hinge-teeth slightly larger and more oblique distally, in general nearly vertical, close set, and about thirty-two in number, not obviously divided in the center. Lon. 27, alt. 27, diam. 22 mm.; lon. of hinge-line 15 mm.

"This is one of those species on the border-line of groups which make it so difficult to divide the Arks into clear-cut sections; it has the hinge, cardinal area, and discrepant sculpture of *Cuncarca*; the valves are slightly unequal, and it seems most properly assigned to a place in this section. It is obviously a form ancestral to such species as *Arca Chemnitzii* Phil. (*A. bicops* Orb. + *A. antillarum* Dunker, *fide* Kobelt, + *A. Orbignyi* Kobelt), which is referred to *Anomalocardia* (= *Anadara*) by Ihering, and is found recent in the West Indies. This species, which has been distributed under the (MS.?) name of *A. rhombica* Rawson, is also inequivalve, with discrepant sculpture, and probably should be referred to this section.

"From *A. Chemnitzii* the present species differs by its larger size, more oblique shape, narrower and more numerous ribs * * *."—*Dall*, 1898.

A. Chemnitzii is figured on Plate XV, Figures 3, 4.

Occurrence.—Pliocene marls of the Caloosahatchie at Alligator Creek, Florida.—*Dall*.

Arca filicata Guppy; Plate XV, Figure 5; (Quart. Journ. Geol. Soc., vol. 22, p. 583, pl. 26, fig. 5, 1866; Schuchert, U. S. Nat. Mus., Bull., no. 53, p. 56, 1905), from Manzanilla, Trinidad, evidently belongs to *Cunearca*. It is small, "rather inequivalve, with about thirty ribs, broader than their interstices, and nodosely crenate, becoming nearly smooth on the disk of the right valve," and the ligament area is wide. Dall (Wagner Free Inst. Sci., Trans., vol. 3, p. 636) calls the beds in which this occurs Eocene. *Scapharca* (*Cunearca*) *cumanensis* Dall, (Wagner Free Inst. Sci., Trans., vol. 3, p. 633, 1898) from the Oligocene of Cumana, Venezuela, and an island in Lake Henriquillo, St. Domingo, is the species listed by Guppy (Geol. Mag., Oct. 1874, p. 443) as *A. incongrua* from Cumana. "Shell small, resembling *S. incongrua* Say in miniature, but with higher, more prominent, and uncompressed beaks, with the ribs of the posterior slope of the right valve smooth instead of nodulose; the valve higher and shorter, with the beaks more anterior, and the hinge-line somewhat shorter. Lon. of adult shell 26, alt. 25, diam. 21 mm. * * *,"—Dall.

Section *Argina* Gray

"Group of *A. pexata* Say. (*Argina* (Gray, 1840) Adams, 1858.)

"Thin, ovate-oblong, rounded; beaks prosocelous, with the right valve smaller, the cardinal area opisthodontic, or nearly so, and very narrow, the hinge-teeth in two series—the anterior shorter, usually irregular or broken up, the posterior longer, normal; the epidermis imbricated and profuse; inhabiting salt water."—Dall, 1898.

Arca campechensis Dillwyn

Plate XV, Figures 6, 7, 8, 9, 10, 11, 12, 13

"*Pectunculus densè et profundè striatus, ovali figurâ*," Lister, Hist. Conch., tab. 237, fig. 71, 1770; Bay of Campeachy.

Arca No. 22; Schroeter, Einleit. Conch., 3, p. 288, 1786.

Arca campechensis Gmel., Syst. Nat., 6, p. 3312, 1792.

Arca ovalis Bruguière, Enc. Meth., p. 110, 1792.

Arca declivis Solander MSS., fide Dillwyn, 1817.

Arca campechensis Dillwyn, Descr. Cat. Rec. Sh., vol. 1, p. 238, 1817 (Syn. partim exclus.), Jamaica and Carolina; not of Wood, Ind. Test., p. 46, pl. 9, fig. 28, 1825.

Arca pexata Say, Acad. Nat. Sci. Phila., Journ., vol. 2, p. 268, 1822.

Arca scapha Ravenel, Cat., p. 5, 1834, fide Stimpson.

Not *Arca scapha* Lamarck, An. s. Vert., vol. 6, p. 42, 1819; Reeve, Conch. Icon., *Arca* no. 25, 1844.

Arca americana (Gray) Wood, Index Test. Suppl., pl. 2, *Arca*, fig. 1, 1828; *ibid.*, ed. Hanley, p. 205, 1856; Tryon, Am. Mar. Couch., p. 179, pl. 37, fig. 470, 1874.

Arca americana Reeve, Conch. Icon., *Arca*, fig. 21, 1844; Holmes, Post.-Pl. Fos. S. Car., p. 19, pl. 4, figs. 2, 2a, 1858.

Arca pexata Greene, Mass. Cat., 1833; Gould, Rep. Inv. Mass., p. 95, fig. 60, 1841; Reeve, Conch. Icon., *Arca*, fig. 22, 1844; De Kay, Nat. Hist. N. Y., Moll., p. 176, p. 12, fig. 211, 1843; Tryon, Struct. and Syst. Conch., vol. 3, p. 255, pl. 126, figs. 46, 47, 1884.

Arca campechensis Ravenel, Cat. Coll., p. 5, 1834; Arango, Moll. Cubana, p. 262, 1880.

Arca Holmesii Stimpson, S. I. Checklist, p. 2, 1860; Tryon, Am. Mar. Conch., p. 179, pl. 37, fig. 471, 1874.

Not *Arca americana* Orb., Moll. Cuba, 2, p. 317, pl. 28, figs. 1, 2, 1853.

Scapharca (Argina) campechensis Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 650, 659, 1898.

"Shell ovate-heart-shaped, with longitudinal ribs, and crowded transverse striae; margin crenated * * *.

"Shell about an inch and a quarter long, and an inch and three quarters broad; white, tinged with flesh colour at the margin and summits; it has about twenty-five longitudinal ribs, which are crossed with crowded imbricated striae, and at first sight has more the appearance of a *Cardium* than of an *Arca*."—*Dillwyn*, 1817.

Shell inequivalve, nearly round to rounded quadrate, with much incurved beaks which nearly touch so that the posterior part of the cardinal area appears lens shaped from above; ribs twenty-six to thirty-seven, square on the right valve, often rounded on the left, especially on the posterior part of the shell; ribs usually as wide as or wider than the interspaces; ribs of the left valve often, and of the right valve sometimes with a median groove, sometimes practically all the ribs of both valves are grooved, sometimes little grooving on either valve, the species is very variable in this respect, but the grooving is usually stronger on the left valve; beaks very far forward; hinge-line somewhat curved; posterior series of teeth long, teeth oblique distally, v-shaped near the middle of the series; anterior series short, broad and irregular; cardinal area long and very narrow posteriorly, wider and very short anteriorly; margin fluted.

Although this species varies widely in form and ribbing it is easily distinguished from other east coast species by its hinge and cardinal area.

"This very interesting species, of which the synonymy might be much extended, affords an excellent illustration of the effects of environment upon the recent form. Its northern limit is at Cape Cod, where the shell is often large, always coarse, and with a dense hirsute periostracum * * *. As we proceed southward, in this species, as in many other shells, we find the shell becoming less earthy and more porcellaneous, the sculpture more neat, the periostracum less profuse, and the general size less. South of Cape Hatteras the chalky, thin type, common in the north, is seldom if ever found. In the Gulf of Mexico and the Antilles the shell is still smaller than in the Carolinas * * *. A somewhat similar series of differences is observable in the Pleistocene fossils, though less pronounced.

"Gmelin's description was inadequate, and only identifiable by his reference to Lister. The species was elucidated by Dillwyn * * *.

"The typical *A. campechensis* is the rounded southern form which Stimpson afterwards called *A. Holmesii*, as he himself recognized. Say's description of *A. pexata* included all the varieties of our eastern coast, but Gould first described the shell so as to make this name apply more particularly to the somewhat elongated, earthy northern variety. Gray's *A. americana* was founded on a very elongated, more porcellaneous form, such as is common in South Carolina waters. The study of a large series of recent specimens, ranging from Jamaica to Cape Cod, obliges me to recognize that no sharp line of discrimination can be drawn between the several varieties. The number of ribs varies

from twenty-six in the roundest, *A. Holmesii*, to thirty-five in the most elongated, *A. americana*; but the short, round ones often have as many ribs as the elongated specimens * * *. The anterior granular series of teeth is much shorter than in *A. tolepis*, and does not extend much in front of the beaks."—Dall.

The synonymy is largely taken from Dall. The references to Lister, Schroeter, Gmelin, Bruguière and Solander are also given by Dillwyn. Dillwyn's reference to Lister, Enc. Meth., t. 310, f. 1, is incorrect. The *A. ovalis* included in the synonymy is not *A. ovalis* Gabb, (Acad. Nat. Sci. Phila., Journ., 2d ser., vol. 8, pp. 291, 321, pl. 41, figs. 10, 10a), from the Cretaceous of Peru. European fossils have also been named *A. ovalis*.

Dimensions.—Long form, lon.+21,-45; alt.+7,-50; semidiam. 23 mm. Round form, lon.+15,-35; alt.+5,-38; diam. 36 mm.

Occurrence.—"The species does not descend below the uppermost Miocene, if, indeed, any of the specimens are so old. I have only identified it with certainty from the Pleistocene of Georgia, of Simmons Bluff, South Carolina, of New Jersey, and southern New England."—Dall. Pleistocene of Grand Chenier, Pumping Station no. 7, and New Orleans, Louisiana and Georgetown, South Carolina; recent from Cameron and Point-au-Fer, Louisiana; Galveston, Texas, Mobile, Alabama, Ft. Barrence, Florida, and from South Carolina.—C. U. Museum.

Scapharca (Argina) tolepis Dall; Plate XV, Figures 14, 15; (Wagner Free Inst. Sci., Trans., vol. 3, p. 649, pl. 33, figs. 7, 8, 1898), from the Oligocene of Rio Amina, St. Domingo; Bowden, Jamaica, and Cumana, Venezuela, is smaller (28 mm. long) than *A. campechensis*, is much more inflated and rotund and has finer and more nodulose sculpture. It has about thirty-four ribs. Dall places in synonymy with his species the *Arca pexata* listed by Guppy, (Geol. Mag., Oct. 1874), fossil from Caribbean beds. Guppy also listed *A. pexata* Say from St. Domingo and Cumana in Quart. Journ. Geol. Soc. Lond., vol. 22, pp. 575, 576, 1866. Among fossils from St. Domingo in the C. U. Museum there are specimens belonging to several small, inflated species varying from *Argina* to section *Scapharca*.

Section *Bathyarca*, Kobelt

"Group of *A. pectunculoides* Scacchi (*Bathyarca* Kobelt, 1891.)

"Shell small, usually abyssal, inflated, with prosogyrate beaks and a rather narrow but long furrowed area, the hinge-margin nearly or quite as long as the shell; teeth few, oblique, in two series, often separated by a wide gap in the center; the right valve smaller, the sculpture of the two valves often very discrepant; epidermis usually imbricated.

"These small deep-water Arks go back to the Eocene in time and form a very recognizable group, related to *Scapharca* as *Lissarca* is to *Barbatia*."—Dall.

Scapharca (Bathyarca) Hendersoni Dall; Plate XVI, Figure 1; (Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 653, pl. 33, fig. 9, 1898), from the Oligocene of the Bowden beds, Jamaica, is very small (2 mm. long), "much inflated, the hinge-line as long as the

shell, which is of a rounded triangular form, with rather prominent prosocœlous beaks; left valve with fine, elevated, rounded concentric lines, crossed by closer, less prominent, and finer radial lines; in the right valve, as usual in this section of the genus, the radial sculpture predominates over the concentric, the latter though present being inconspicuous; cardinal area moderately wide, the beaks being nearly medial, the surface of the area longitudinally striated; hinge with about five nearly vertical anterior teeth separated by a wide unarmed gap from six or seven smaller, more oblique posterior teeth; margin of the valves thin, entire, or microscopically crenulated; the inner edges of the adductor scars slightly raised above the inner surface of the valve * * *. It resembles *A. pectunculoides* Scacchi and *A. glomerula* Dall, of the recent fauna, but is smaller, more inflated, and more triangular than either of them."

Scapharca (Bathyarca) Spenceri Dall; Plate XVI, Figures 2, 3; (Dall, Wagner Free Inst. Sci., Trans., vol. 3, p. 652, pl. 32, figs. 16, 24, 1898), from the Pliocene of Tehuantepec, is large for the section, (18 mm. long), "inflated, ovate, with prominent prosocœlous beaks; left valve with fine, rounded, concentric elevated lines, close set, and with very narrow interspaces, which show fine, close radial striae, some of which on the anterior end of the shell are more prominent; right valve with fine, close-set radial ribs, coarser on the middle of the shell, separated by narrower, sharp, channelled grooves; transverse sculpture of evenly spaced, low, sharp elevated lines which cross the ribs without becoming much thickened; cardinal area very narrow behind, wider but not distinctly limited in front, the cardinal margin elevated anteriorly, with seven or eight concentric grooves mostly behind the umbones; ends of the hinge angular behind; the teeth in two series hardly separated, eight to twelve in front, ten to fourteen behind, not crowded, smaller mesially, larger and more oblique distally, the anterior series somewhat irregular; inner margin of the valves with fine crenulations, stronger in the left valve, the outer edge almost or quite entire."

Scapharca (Bathyarca) glomerula Dall; Plate XVI, Figures 4, 5; (Dall, Bull. Mus. Comp. Zool. Harvard, vol. 9, p. 121, 1881; vol. 12, p. 241, pl. 8, figs. 9, 9a, 1886; U. S. Nat. Mus., Bull. 37, p. 42, pl. 8, figs. 9, 9a, 1889; Wagner Free Inst. Sci., Trans., vol. 3, p. 659, 1898), recent from Hatteras to St. Vincent in one hundred to six hundred and eighty-three fathoms, is similar in general shape, size and sculpture to *A. pectunculoides*, but is shorter and higher; the hinge is straight with from fifteen to seventeen stout nearly vertical teeth, usually in a continuous series, those at the ends of the series oblique; the sculpture of the two valves is different, the radiating sculpture stronger on the right valve; the radiating sculpture appears inside the shell within the margin in a series of small ridges, generally with the same level as the rest of the interior, but sometimes rising into little tubercles, and separated by rather deep, short, narrow depressions, which do not extend far inward nor over the smooth margin. The dimensions of *A. glomerula* are: lon. 5.75, alt. 5.0, diam. 5.0; lon of hinge-line, 4.25 mm. Dall places *Arca (Scapharca?) inaequisculpta* E. A. Smith, (Challenger Rep. Lam., p. 267, pl. 17, figs. 8-8c, 1885), from deep water off Culebra Island, West Indies, in synonymy with this species.

Scapharca (Bathyarca) polycyma Dall; Plate XVI, Figures 6, 7; (Dall, Bull. Mus.

Zool. Harvard, vol. 9, p. 122, 1881; vol. 12, p. 241, pl. 8, figs. 3, 3a, 1886; U. S. Nat. Mus., Bull. 37, p. 42, pl. 8, figs. 3, 3a, 1889; Wagner Free Inst. Sci., Trans., vol. 3, p. 659, 1898), recent from Barbados and Grenada, has the dimensions: lon. 9.75, alt. 6.0, max. diam. 5.0; lon. of hinge-line, 6.0 mm. It is "slightly inequilateral, nearly equivalve, moderately evenly inflated, whitish, with little or very fugacious epidermis; sculpture very remarkable, consisting, first, of very even, broad, rounded, regular, concentric waves (twelve or thirteen in number), separated by sharp, deep grooves. In dead or worn shells these waves are smooth, or nearly so, but in perfectly fresh (and especially young) shells on the surface of the broad slightly flattened waves may be seen what look like two rows of subcylindrical, slightly irregular grains of sand, arranged side by side, with their longer axes radiating from the beak; these granules, if so they may be termed, are really hollow, and are the thinnest possible bubbles of shelly matter which leave, when rubbed off by any slight friction, a couple of zigzag slightly elevated lines where their bases were fixed to the shell; a very slight friction will obliterate this, and then the shell will be nearly smooth * * *; the narrow furrow for the ligament goes straight across to the margin from the beak (which is nearly opposite the middle of the hinge-line) instead of obliquely * * *."

Arca pectunculoides Scacchi; Plate XVI, Figures 9, 10, 11; (Scacchi, Not. Conch. foss. Gravina in Ann. Civ. due Sicil., vol. 6, p. 82, 1834; Broegger, Norges Geologiske Undersoegelse, no. 31, pl. 13, figs. 17a, 17b, 1901; var. *orbiculata* Dall; Plate XVI, Figure 8; Dall, Bull. Mus. Comp. Zool. Harvard, vol. 9, p. 121, 1881; vol. 12, p. 240, pl. 8, fig. 5, 1886; U. S. Nat. Mus., Bull. 37, p. 42, pl. 8, fig. 5, 1889; var. *crenulata* Verrill, Trans. Conn. Acad., vol. 5, p. 575, 1882; *Scapharca* (*Bathyarca*) *pectunculoides* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pp. 619, 659, 1898), belongs to *Bathyarca*. Its range is given by Dall as from Norway to St. Vincent. It is a well-known European species and is found as a fossil. The shell is thin, with fine radiating and concentric lines; left valve slightly larger; cardinal area wider in front of the beaks; ligament occupying only the posterior part of the cardinal area; teeth oblique, in two series, with a gap opposite the beaks; anterior part of the shell with a shallow sulcation extending to a notch in the ventral margin; inner margin smooth.

Dall says that the American specimens are shorter and rounder than those from farther east in the Atlantic sea-bed and the Norwegian and Arctic seas. He described a nearly round variety from the Gulf of Mexico as variety *orbiculata*. "*Arca grenophia* Risso may be this species, but it was not figured, and the description is quite insufficient. *Arca pectunculoides* var. *crenulata* Verrill, appears to have the form of var. *orbiculata*, the teeth of the Gulf specimens above mentioned, the marginal crenulations of *glomerula*, and the sculpture of the type of *pectunculoides*."—Dall.

Arca glacialis Gray; Plate XVI, Figures 12, 13, 14; (Gray, Parry's First Voyage, Supp. to App., p. 244, 1824; Bjoerlykke, Norges Geologiske Undersoegelse, no. 25, p. 69, fig. 1, 1898; Broegger, l. c., no. 31, p. 120, pl. 6, figs. 1-4, 1901; Friele and Grieg, Norwegian North-Atlantic expedition, vol. 7, Mollusca 3, p. 19, 1901), is found recent in the Arctic seas and has been reported south to New England. It is also found in the Pleis-

tocene. It has a thin shell, evenly rounded in front and produced behind with an oblique posterior margin; surface with numerous fine radiating lines; hinge-line short; teeth small, with a gap opposite the beaks; cardinal area wider in front, narrower behind, with a raised margin; posterior part of the cardinal area with several fine, close-set longitudinal grooves; inner margin smooth.

Bathyarca abyssorum Verrill and Bush; Plate XVI, Figure 16; (Verrill and Bush, Proc. U. S. Nat. Mus., vol. 20, p. 843, pl. 76, fig. 9, 1898), was found in 1825 to 1859 fathoms, off Delaware Bay. A single specimen of a form related to *pectunculoides*, from a depth of 27 fathoms, Gulf of Maine, was named *Bathyarca anomala* by Verrill and Bush, (Proc. U. S. Nat. Mus., vol. 20, pp. 843, 844, pl. 77, fig. 8, 1898); Plate XVI, Figure 15. It is not *Arca anomala* Reeve, (Conch. Icon., *Arca* no. 9, pl. 2, 1843); *Arca anomala* Blake and Hudleston, (Quart. Journ. Geol. Soc. London, vol. 33, p. 398, pl. 15, fig. 7, 1877); or *Arca anomala* d'Eichwald, [Naturhist. Skizze, p. 211, (Lethaea Rossica, vol. 3, p. 78, pl. 4, fig. 12, a, b, c, 1853)]. The *Bathyarca* might be called *Arca* (*Bathyarca*) *Verrillbushi*.

Arca (*Scapharca*) *culebrensis* E. A. Smith; Plate XVI, Figures 17, 18, 19; (Challenger Rep., Lam., p. 268, pl. 17, figs. 9-9b, 1885), is similar to the variety *septentrionalis* of *A. pectunculoides* and was obtained off Culebra Island, West Indies, in 390 fathoms.

Cretaceous Species

Barbatia Carolinensis Conrad, (Kerr's Rep. N. Car., App. A, p. 4, pl. 1, fig. 11, 1875; Tryon, Struct. and Syst. Conch., vol. 3, p. 254, pl. 127, fig. 79), is from the Cretaceous of North Carolina. It is not *A. carolinensis* Wagner, 1847. *Barbatia lintea* Conrad, (l. c., p. 4, pl. 1, fig. 12), is also from the Cretaceous of North Carolina. Dall states that it is not *Arca lintea* Conrad, Dead Sea Expedition, 1852. *Barbatia lineata* Tryon, (Struct. and Syst. Conch., vol. 3, p. 254, pl. 127, fig. 65), and *Barbatia lineata* Meek, (U. S. Geol. Surv. Territories, vol. 9, p. 78; 1876), are misprints for the former species, not *Arca lineata* Goldfuss. Conrad also described a *Cibota lintea* from the Cretaceous of Mississippi, (Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 3, p. 328, pl. 34, fig. 11, 1858.)

Dall, (Wagner Free Inst. Sci., Trans., vol. 3, p. 615), includes *Nemodon* Conrad, (Am. Journ. Conch., vol. 5, p. 97, 1869), in the subgenus *Barbatia*. The following Cretaceous species have been referred to *Nemodon* by Whitfield, (U. S. Geol. Surv., Monographs, vol. 9, pp. 83-86, 1885), Johnson, (Acad. Nat. Sci. Phila., Proc. for 1905, vol. 57, p. 9) and Weller, (Geol. Surv. N. Jersey, Cret. Pal., pp. 385-391, 1907):—*Arca* (*Macrodon*) *Eufalensis* Gabb, Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 4, p. 398, pl. 68, fig. 39, 1860, from New Jersey, Georgia, Alabama, Mississippi and Arkansas; *Trigonarca eufalensis* Conrad, Am. Journ. Conch., vol. 3, p. 9, 1867=*Nemodon conradi* Johnson, 1905, from New Jersey; *Leda angulata* Gabb, Acad. Nat. Sci. Phila., Proc. for 1860, p. 95, pl. 2, fig. 12=*Nemodon angulatum* Gabb, Acad. Nat. Sci. Phila., Proc. for 1876, p. 316, from New Jersey; *Nemodon brevifrons* Conrad, Kerr's Geol. Rep. N. Car., App. A, p. 4, pl. 1, fig. 15, 1875, from New Jersey, North Carolina and Mississippi. This last is not *Arca brevifrons* Sowerby, Zool. Soc. London, Proc. for 1833, p. 22, or *Arca brevifrons*

Conrad, Dead Sea Expedition, p. 215, 1852. The preceding species is not *Arca angulata* King, Zool. Journ., vol. 5, p. 336, 1831.

Weller, (Geol. Surv. N. Jersey), has referred the following New Jersey Cretaceous species to *Arca*:—

Cibota obesa Whitfield, U. S. Geol. Surv., Monog., vol. 9, p. 93, pl. 11, figs. 30, 31, 1885; not *Arca obesa* Sowerby, Zool. Soc., Proc., pt. 1, p. 21, 1833; Reeve, Conch. Icon., *Arca* no. 3, 1843.

Arca uniopsis Conrad, Acad. Nat. Sci., Phila., Journ., 2d. ser., vol. 2, p. 275, pl. 24, fig. 17, 1853=*Cibota uniopsis* Whitfield, U. S. Geol. Surv., Monog., vol. 9, p. 92, pl. 11, figs. 32, 33, 1885.

Arca rostellata Morton, Synop. Org. Rem. Cret. Gr. U. S., p. 64, pl. 3, fig. 11, 1834=*Cibota rostellata* Gabb.

Arca quindecemradiata Gabb, Acad. Nat. Sci. Phila., Proc. for 1860, p. 95, pl. 2, fig. 2. Weller places in synonymy with this species *Cibota multiradiata* Gabb, l. c., p. 95, pl. 2, fig. 1; *Arca altirostris* Gabb, Acad. Nat. Sci. Phila., Proc. for 1861, p. 325; *Cucullaea transversa* Gabb, l. c., p. 326, and *Cucullaea gabbi* Johnson, Acad. Nat. Sci. Phila., Proc. for 1905, p. 8.

Nemoarca cretacea Conrad, from the Cretaceous of New Jersey, likewise *Arca Saffordii* Gabb, from the Cretaceous of New Jersey, have sometimes been classed as *Arcas*. Weller places them in *Nemoarca* and *Breviarca* respectively. The former is not *Arca cretacea* d'Orbigny. A number of Mesozoic species from the interior states and Texas have been classed as *Arcas*. The *Cucullaeas* have often been called *Arcas*. Of Eocene species Dall says, "*A. gigantea* Conrad is probably identical with *Cucullaea onochela* Rogers. *Noëtia pulchra* Gabb, from the Eocene of Texas, 1860, is *Trinacria decisa*. There is an *A. pulchra* of Sowerby dating from 1824."

The following species are undescribed, described from incomplete specimens, etc.:—

Eocene.—In the Report on the Geology of South Carolina, 1848, pp. 156, 161, 210, Tuomey named an undescribed species *A. obliqua* T. It may have been figured in the unpublished plates mentioned in the preface. The name was used by Portlock in 1843, in the Report on the Geology of the County of Londonderry, for a Paleozoic fossil. It has also been used for a South American fossil, and for recent shells by Reeve and Philippi.

Eocene.—In the Acad. Nat. Sci. Phila., Proc. for 1852, p. 194, 1854, Tuomey described a species from North Carolina as follows: "ARCA CANCELLATA: shell thin, very inequilateral, cancellated by radiating lines and approximating transverse lines; umbones prominent; beaks close; hinge-line slightly curved; posterior margin rounded, compressed; anterior margin much contracted.

"*Dimen.* Length 2.5 in.; br. 3.5 in."

It was not figured and the name is preoccupied by Gmelin, Syst. Nat., 6, p. 3308, 1792. In 1809 Martin used the name *Arcites cancellatus* for a British fossil which Sowerby in 1824 called *Arca cancellata*.

Oligocene.—In the 16th Ann. Rep. of the State Geologist of Indiana, p. 414, 1889, "*Arca acuminata*, Vicksburg Group, Mississippi", is given in a list of specimens in the state museum. There is a recent *Arca acuminata* Krauss from South Africa, (Südafrikani-schen Mollusken, p. 14, pl. 1, fig. 11, 1848).

Oligocene.—*A. oronlensis* Gabb, Acad. Nat. Sci., Phila., Journ., 2d. ser., vol. 8, p. 346, pl. 44, fig. 21; Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 658, is from Panama and Costa Rica. *Arca (Anadara) Pennelli* Gabb, Am. Phil. Soc., Trans., 2d. ser., vol. 15, p. 254, 1873, and *Arca multilincata* Gabb, l. c., p. 254, from St. Domingo, were not figured. Dall lists them as Oligocene.

Miocene.—*A. maxillata* Con., Acad. Nat. Sci. Phila., Journ., vol. 6, p. 264, 1831, from Maryland, was briefly described and was not figured. The specimen was a cast.

Miocene.—In the Second Bulletin of the Proc. Nat. Institution Promotion Sci., p. 181, 1842, Conrad lists *A. depleura* Conrad together with *A. subrostrata* from a locality in Maryland. On p. 183 it is listed from another locality and spelled *dipleura*. Apparently it was never described and doubtless is a synonym of some of Conrad's other species.

Miocene.—Among the Galveston deep well fossils Professor Harris found specimens most nearly like the west coast *A. labiata* and he called them *Arca labiata* Sowerby, var., Bull. Am. Pal., vol. 1, no. 3, p. 7, pl. 1, figs. 1, 1a, 1895. They were young specimens and fragments.

Middle Tertiary.—*Arca granulifera* Conrad is given in the list of Middle Tertiary fossils in Morton's Synopsis Organic Remains Cretaceous Group, 1834, Appendix, p. 2. Apparently it was not described.

Tertiary.—*A. costata* Heilprin, Acad. Nat. Sci. Phila., Proc. for 1882, p. 154, was evidently intended for *A. caelata*. It is not *A. (Lunarca) costata* Gray.

Tertiary.—*Arca Ruffini?* is given in a list of fossils from Mexico, (Inst. Geol. Mexico, Bol., nums. 4, 5, 6, p. 230, 1897). This is probably due to a mistake in copying *A. Ruffini?*, which is *Anomia Ruffini*, from an earlier list, (l. c., num. 3, p. 9, 1896), taken from Heilprin, (Acad. Nat. Sci. Phila., Proc. for 1891, p. 142, 1891).

Recent.—*Arca contracta* Reeve, Conch. Icon., *Corbula* no. 27, pl. 4, 1844, was intended to be *Corbula contracta* Say.

This text was written chiefly in 1910 and 1911. Since then the following new species of *Arca* have been published:

Arca dariensis Brown and Pilsbry, Acad. Nat. Sci. Phila., Proc., vol. 63, p. 362, pl. 22, fig. 10, 1911, from the Oligocene of the Isthmus of Panama.

Arca gatunensis Toula, Jahrb. Geol. Reichsanstalt, Wien, vol. 61, p. 493, pl. 30, fig. 4, 1911, from Gatun, Panama Canal.

Barbatia simondsi Whitney, Univ. Texas, Bull., no. 184, p. 11, pl. 1, fig. 6, 1911, from the Cretaceous of Texas.

Arca (Scapharca) limonica Dall, Smith Misc. Coll., vol. 59, no. 2, p. 2, 1912, from the Pleistocene of the Isthmus of Panama.

Arca (*Noëtia*) *Macdonaldi* Dall, l. c., p. 9.

Arca (*Scapharca*) *Pittieri* Dall, l. c., p. 9. These last two species are from Costa Rica and may be older than *limonica*.

Arca (*Noëtia*) *sheldoniana* Maury, Acad. Nat. Sci. Phila., Journ., 2d. ser., vol. 15, p. 43, pl. 8, figs. 10, 11, 1912, from the Oligocene of Trinidad.

Arca (*Cunearca*) *chemnitzoides* Maury, l. c., p. 44, pl. 7, figs. 13, 14, 15, pl. 8, fig. 1, from the Oligocene of Trinidad.

Arca (*Argina*) *billingsiana* Maury, l. c., p. 45, pl. 8, figs. 2, 3, from the Oligocene of Trinidad.

Arca (*Argina*) *schultzana* Maury, l. c., p. 46, pl. 7, figs. 10, 11, 12, recent from Trinidad.

Arca (*Argina*) *brightonensis* Maury, l. c., p. 46, pl. 8, figs. 4, 5, 6, from the Oligocene of Trinidad.

Arca (*Argina*) *pariaensis* Maury, l. c., p. 47, pl. 8, figs. 7, 8, 9, recent from Trinidad.

Arca sp. indet. Maury, l. c., p. 47, pl. 7, fig. 16, from the Oligocene of Trinidad.

Arca sp. indet. Maury, l. c., p. 47, from the Oligocene of Trinidad.

Arca dalli Brown and Pilsbry, Acad. Nat. Sci. Phila., Proc., vol. 64, p. 510, pl. 24, fig. 4, 1913, from the Oligocene of the Isthmus of Panama. This is not *Arca* (*Macrodon*) *dalli* E. A. Smith, (Challenger Rept. Lam., p. 269, pl. 17, figs. 10-10b, 1885). The Panama species might be called *Arca Balboai*.

Arca grammatodonta Dall, U. S. Nat. Mus., Bull. 90, p. 118, pl. 20, figs. 1, 2, pl. 22, fig. 3, 1915, from the Oligocene of the Tampa silex beds at Ballast Point, Tampa Bay, Florida. This species belongs to the True Arks.

Arca (*Barbatia*) *uandi* Gardner, Maryland Geol. Surv., Upper Cretaceous, pp. 96, 535, 539, 917, pl. 21, figs. 5, 6, 1916, from the Cretaceous of Delaware.

Nemodon Stantoni Gardner, l. c., pp. 94, 525, 527, 915, pl. 19, fig. 15, from the Cretaceous of Maryland.

Nemodon ccilius Gardner, l. c., pp. 94, 525, 528, 916, pl. 20, figs. 5-7, from the Cretaceous of Maryland.

Arca (*Scapharca*) *staminea* Say, subspecies *rubisiniana* Mansfield, U. S. Nat. Mus., Proc., vol. 51, p. 603, pl. 113, figs. 1, 3, 10, 1916.

The Zoological Record lists the following species: *Arca* (*Scapharca*) *chavesi*, Mexico Miocene, Engerrand and Urbina, "Primera nota acerca de la Fauna Miocenica de Zulu-zum (Chiapas). Mexico Bol. Soc. Geol. Mex. 6 1910 (119-140)."

Notes on *Noëtia*.—It has been stated, (p. 25), that the known fossils are all American. *Arca Okeni* Mayer, as figured and described by Mayer, (Journ. de Conch.; t. 6, p. 185, pl. 14, figs. 7, 8, 1857), and Dollfus and Dautzenberg, (Mém. Soc. Géol. France, Paléont., t. 20, Mém. No. 27, p. 337, pl. 27, figs. 19-27, 1913), from the Middle Tertiary of France and central Europe, is a characteristic *Noëtia*. Dollfus and Dautzenberg compare it with *A. Martinii* Recluz. Mayer compared it with True Arks. This is interesting since the subgenus *Noëtia* appears to be more closely related to the Typical Arks than to any other group. *Barbatia cyfria* Bartsch, (U. S. Nat. Mus., Bull. 91, p. 183, pl. 38, figs. 1, 5, 1915), recent from Port Alfred, South Africa, is clearly a *Noëtia* also

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7	17	For "height $1\frac{1}{2}$ " read "height $\frac{1}{2}$ ".
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9	38	Read " <i>=Arca aviculoides</i> Reeve".
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10	40	After "middle;" insert "posterior border deeply emarginated;"
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12	2	For "?— <i>A. protracta</i> Rogers" read "?= <i>A. protracta</i> Rogers 1837".
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