

UNITED STATES DEPARTMENT OF THE INTERIOR

**THE MOLLUSCAN FAUNA OF THE
ALUM BLUFF GROUP OF FLORIDA**

**PART V. TELLINACEA, SOLENACEA, MACTRACEA
MYACEA, MOLLUSCOIDEA**

GEOLOGICAL SURVEY PROFESSIONAL PAPER 142-E

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THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP
OF FLORIDA

BY
JULIA GARDNER

PART V. TELLINACEA, SOLENACEA, MACTRACEA,
MYACEA, MOLLUSCOIDEA

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INTRODUCTION

The fifth and final paper on the Alum Bluff Pelecypoda includes representatives of some of the more significant groups of the Mollusca, such as the Tellinas, mactroids, and Corbulas. Most of these fossils are small or of medium size, and they constitute a much less conspicuous element in the fauna than the large prionodesmacean genera, the Cardiums, or the venerids. The general character of the faunas of the three formations indicated by these highly organized groups is consistent with that deduced from the more primitive groups and is possibly of greater significance. The remarkably prolific warm-water Chipola fauna, the cooler-water, less diversified Oak Grove fauna, and the Shoal River fauna, indicating a persistent southern element, are all clearly recorded in the Mollusca under discussion.

A number of outstanding details may well be emphasized in even a cursory introduction. The Tellinas, a highly organized group, conspicuous in the tropical and subtropical seas to-day, are so varied in the Alum Bluff that the eighteen species are apportioned among seven subgenera and sections. Even *Scissula*, which is characteristically later Tertiary and tropical, is represented in the Chipola by two species,

though it is unknown in the later Alum Bluff. *Macoma* s. s., a relatively cool-water group, is present in the Oak Grove and Shoal River but not in the Chipola. The warm-water analog, *Psammacoma*, occurs in the Chipola and Shoal River but not in the Oak Grove. The relationship between the Alum Bluff and later Tertiary Semeles is particularly obvious, possibly because *Semele* is characteristically an east American group. *Semele chipolana* Dall is clearly an ancestral form of *Semele perlamellosa* Heilprin, from the Caloosahatchee Pliocene, and *Semele compacta* Dall, from the Oak Grove, is genetically close to *Semele carinata* Conrad, from the Duplin and other formations of the Chesapeake Miocene. The Alum Bluff was a notable epoch of development among the mactroids. The earliest known *Maetra* is *M. chipolana* Dall, and *Mulinia orthria* is the first of its genus to be recognized in pre-Chesapeake formations. *Panope*, a characteristically cool-water genus, lived only in Oak Grove time. Among the Gastrochaenas, the Chipola species is allied to that from Bowden, Jamaica, and the Oak Grove species to that from the Chesapeake Miocene.

The Alum Bluff, with its conditions of unstable temperature, was an epoch exceptionally favorable to the recording of environmental changes in a shifting and developing molluscan fauna.

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA

Class PELECYPODA

Order TELEODESMACEA

Superfamily TELLINACEA Blainville

Dall,¹ in 1895, gave the following description:

Siphons distinct to their bases, usually long; pallial line sinuate; ligament external, seated on nymphs; hinge with normally an anterior and posterior lateral in each valve, two radial cardinals, of which the anterior is usually bifid and somewhat pedunculated and the posterior, as well as the laterals, often obsolete.

Family TELLINIDAE Deshayes

Genus TELLINA (Linnaeus) Lamarck

1758. *Tellina* Linnaeus, *Systema naturae*, 10th ed., p. 674.1799. *Tellina* Lamarck, *Prodrome d'une nouvelle classification des coquilles*: Soc. hist. nat. Paris Mém., p. 84.Type: *Tellina radiata* Linnaeus. (Recent in the West Indies.)

Tellina virgata Linnaeus (Recent in the Indo-Pacific) has been commonly cited as the type of the genus because it is the only species mentioned by Lamarck in his "Prodrome." Under the present rules, however, this is not considered sufficient to fix the type. *Tellina radiata* was definitely designated in 1822 in an article entitled, "Lamarck's 'Genera of shells.'"²

Shell transversely ovate to ovate-trigonal in outline, compressed; usually rostrate and flexed to the right posteriorly and broadly depressed in front of the rostrum. Umbones low, subcentral or posterior, often opisthogyrate. External surface rarely smooth; dominant sculpture concentric, regular, and, as a rule, more or less incremental in character; radial ornamentation commonly suggested by the color pattern and by the reinforcing internal rays, rarely by the sculpture; oblique sculpture developed in one group. Ligament external, opisthodontic. Two cardinals, one of them bifid, developed in each valve, interlocking in the closed valves so that the bifid teeth are flanked on either side by a simple laminar tooth. Anterior and posterior laterals developed in some groups in both

valves; in others, reduced to a single right anterior lateral. Sinus free or coalescent ventrally with the pallial line, often discrepant in the two valves, the dorsal margin of the sinus commonly uniting the anterior and posterior adductors.

Though the type of the genus is a West Indian shell, *Tellina* s. s. has not been recognized in the Alum Bluff fauna.

The *Tellina* fauna of the Alum Bluff group is more remarkable for the number of species than for the number of individuals. None of the 18 species represented are really abundant, and most of them are rather rare. All of them, apparently, are short-lived and restricted in the Alum Bluff to the single horizon at which they are found, though a few have close analogs at other horizons. The Chipola formation has yielded 11 out of the 18 species, a little more than 60 per cent, the Oak Grove sand 4, and the Shoal River formation 3, though at both the upper and middle horizons there are at least two additional species, too imperfectly preserved to warrant description. Two of the three *Tellinella* occur in the Chipola, the third in the Shoal River. *Arcopagia* (*Merisca*) *aequistriata* has been reported from the lower beds at Alum Bluff, but there is a possibility that the form may have come from higher up in the section. No trace of this species has been found in either the Oak Grove or the Shoal River. *Arcopagia* (*Phyllodina*) has a representative in the Oak Grove and another in the Shoal River, but it has not been recognized in the Chipola. *Arcopagia* (*Eurytellina*) *roburina* Dall is the most conspicuous member of the genus in the Oak Grove fauna, while the only other Alum Bluff *Eurytellina* is known only from the type specimen. Both species of *Arcopagia* (*Scissula*), one of them too imperfect to be named, are restricted in their known distribution to the Chipola. Eight species, most of them described under *Angulus*, are referred to *Moerella*. Of these, five are restricted to the Chipola and two to the Oak Grove; *piesa* is the only *Tellina* of common occurrence in the Shoal River. The diversity of this highly organized group of Mollusca is one of the most modern features of the Alum Bluff fauna.

Latitude of adult exceeding 15 millimeters:

External surface closely, sharply, and regularly threaded:

Shell transversely elongated:

Altitude of adult more than half the latitude.....*Tellina* (*Tellinella*) *chipolana* Dall.Altitude of adult less than half the latitude.....*Tellina* (*Tellinella*) *strophia* Dall.Altitude of adult approximately half the latitude.....*Tellina* (*Tellinella*) *waltonensis* Gardner, n. sp.Shell ovate-trigonal.....*Tellina* [*Arcopagia* (*Merisca*)] *aequistriata* Say.

External surface not closely, sharply, and regularly threaded:

Valves strikingly dissimilar; the right valve conspicuously flattened:

Right valve sharply but not closely sculptured concentrically; sculpture of left valve irregular and undulatory in character, strongest near the umbones.....*Tellina* [*Arcopagia* (*Phyllodina*)] *dodona* Dall.Right valve feebly sculptured anteriorly and medially; sculpture of left valve sharply raised posteriorly, more or less flattened medially and anteriorly.....*Tellina* [*Arcopagia* (*Phyllodina*)] *leptalea* Gardner, n. sp.Valves not strikingly dissimilar; the right valve only slightly less convex than the left; both valves sculptured with fine, flattened, closely overlapping lamellae.....*Tellina* [*Arcopagia* (*Eurytellina*)] *roburina* Dall.¹ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 3, p. 553, 1895.² Roy. Inst. Great Britain Quart. Jour. Sci., Literature, and the Arts, vol. 14, p. 306, 1822. The series of articles of which this is the first was published anonymously but later appeared in book form under the name of John George Children.

Latitude of adult valve not exceeding 15 millimeters:

Altitude of shell decidedly more than half the latitude:

Shell conspicuously flattened, subelliptical in outline..... *Tellina* [*Arcopagia* (*Eurytellina*)] *pressa* Dall.

Shell ovate-trigonal in outline, not flexuous nor conspicuously flattened:

Shell thin, lustrous, the sharp concentric threading developed over the greater part of the external surface.

Tellina (*Moerella*) *cloneta* Dall.

Shell rather heavy, dull, the sharp concentric threading restricted for the most part to the ventral margins.

Tellina (*Moerella*) *hypolispa* Dall.

Shell flexuous, smooth, except for incrementals..... *Tellina* (*Moerella*) *acloneta* Dall.

Altitude of shell approximately half the latitude:

Surface sculpture not oblique:

Surface very finely sculptured concentrically:

Sculpture irregularly developed..... *Tellina* (*Moerella*) *acosmita* Dall.

Concentric threading microscopically fine but developed over the entire external surface:

Shell rather sharply rostrate..... *Tellina* (*Moerella*) *agria* Dall.

Shell obtusely rostrate..... *Tellina* (*Moerella*) *ctenota* Gardner, n. sp.

Surface sculpture absent or reduced to a microscopically fine lamination:

Shell relatively inflated..... *Tellina* (*Moerella*) *acalypta* Dall.

Shell relatively compressed..... *Tellina* (*Moerella*) *piesa* Gardner, n. sp.

Surface sculpture oblique..... *Tellina* [*Arcopagia* (*Scissula*)] *lampira* Dall.

Subgenus *TELLINELLA* Mörch

1853. *Tellinella* Mörch, *Catalogus conchyliorum*, Comes de Yoldi, vol. 2, p. 13.

Type: *Tellina virgata* Linnaeus. (Recent in the Indo-Pacific.)

Tellina was credited by Mörch to "Gray, 1852."

The name may have been taken from a manuscript label, but no mention of it can be found in any of Gray's published papers. The type was selected by Meek.³

Shell subequivalve; transversely ovate to ovate-trigonal in outline; posteriorly rostrate. Umbones low, subcentral, feebly opisthogyrate. Sculpture concentric, lirate, or laminar. Ligament external, elongated parallel to the dorsal margin. Two cardinals and anterior and posterior laterals developed in each valve, the left laterals, however, often nothing more than the modified dorsal margins. Pallial sinus very deep but only partially coalescent ventrally with the pallial line, its dorsal extremity falling short of the anterior adductor.

Tellina (*Tellinella*) *chipolana* Dall

Plate XXIX, Figure 1

1900. *Tellina chipolana* Dall, *Wagner Free Inst. Sci. Trans.*, vol. 3, pt. 5, p. 1018, pl. 47, fig. 6.

Not *Tellina chipolana* Dall, *U. S. Nat. Mus. Bull.* 90, p. 151, pl. 22, figs. 1, 2, 1915.

Dall described this species in 1900, as follows:

Shell solid, ovate, inequilateral, the anterior side longer, beaks low, pointed; anterior end rounded, rather plump, posterior end more compressed, rostrate, strongly folded, dorsal area with two radial ridges, each with a shallow sulcus above it, posterior angle obliquely truncate; surface with obscure, fine radial striation, sculptured with strong, low, sharp, regular, elevated, concentric lamellae; hinge normal, left laterals obscure, lunule impressed, narrow, smooth; interior with an

obscure thickened ray behind the anterior adductor scar; pallial sinus low, ovate, about half confluent below. Longitude 38, altitude 23, diameter 11 millimeters.

The left valve is very sharply pointed and flexed behind. This form may be regarded as a precursor of such types as *T. interrupta* Wood, of the recent fauna.

Type: U. S. Nat. Mus. No. 114596.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The valves are pulled down at the posterior basal angle and the base line constricted in front of it. The concentric laminae follow the outline of the base and are most elevated upon the dorsal ridges. Because of the relatively thick shell the characters of the interior are unusually distinct. The adductor scars are rudely semielliptical in outline and set very close to the lateral margins. The dorsal margin of the pallial sinus lies well up toward the beaks, quitting the posterior adductor at the upper inner angle. The pallial line is very close to the base.

There is no coexistent species with which this fine shell can be confused. The Chipola species is a smaller, less flexuous shell than that from Ballast Point with lower posterior rays, a somewhat finer, sharper concentric sculpture, and a rather distinct umbonal ornamentation. In *T. chipolana* the sculpture is uniform in character from the tips of the umbones to the basal margin, a rather fine and sharp concentric lamination with crowded microscopic radial striae in the interspaces. In the Ballast Point species, on the contrary, the concentric laminae are much lower and more distant near the tips of the umbones, and the interspaces are threaded with about half a dozen exceedingly fine and crowded concentric lirae. This sculpture persists until the shell is between 1 and 2 millimeters in altitude.

Occurrence: Chipola formation, localities 2213^f, 2211^p, 7183^p, 10660^f.

³ Meek, F. B., A report on the invertebrate Cretaceous and Tertiary fossils of the upper Missouri country: U. S. Geol. Survey Terr. Rept., vol. 9, p. 193, 1876.

Tellina (Tellinella) strophia Dall

Plate XXIX, Figure 2

1900. *Tellina strophia* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1019, pl. 47, fig. 11.

Dall describes this species as follows:

Shell elongate, subequilateral, slender, with inconspicuous beaks, rostrate, and sharply sculptured, with low, elevated, close-set concentric lamellae, which become sparser and more prominent on the posterior part of the shell, especially on the rostrum; posterior dorsal area with two radial folds separated by a shallow sulcus, the upper fold obscure; lunule very narrow, moderately impressed; rostrum of the left valve ending in a narrow sharp point; teeth normal, small; in the left valve obscure; pallial sinus elongate, two-thirds confluent below, rounded behind. Longitude 27, altitude 11, diameter 5 millimeters, but probably reaching a size one-third greater, judging by fragments collected.

This shell recalls *T. cumingi*, though smaller and more delicate.

Type: U. S. Nat. Mus. No. 114659.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla. The species is known only from the type locality and has not been recognized in any of the later collections.

Occurrence: Chipola formation, locality 2213^p.

Tellina (Tellinella) waltonensis Gardner, n. sp.

Plate XXIX, Figures 3-5

Shell rather small for the group, thin, moderately compressed, transversely elongated, semielliptical in front of the beaks, shorter behind, slightly produced at the posterior basal angle with a very short vertical truncation near the base. Umbones small, not prominent, set behind the median line. Lunule linear. Escutcheon simulated by the modification of the dorsal edges. Anterior dorsal slope very gentle, the anterior extremity broadly and smoothly rounded. Posterior dorsal slope steeper and less regular. Base line horizontal medially, very gently upcurved anteriorly, slightly constricted in front of the posterior dorsal ray. Dorsal ridge narrow, obtuse, with a broad and ill-defined sulcus in front of it; a second ray nearer to the dorsal margin and terminating at the upper angle of the vertical truncation, suggested but not clearly defined. External sculpture on the anterior and medial portions of the shell of closely overlapping concentric lamellae not far from 50 in number, the free dorsal edges gradually developing on the posterior portion into raised threadlets; dorsal ray emphasized by the abrupt disappearance upon it of the alternate threadlets, the remaining lirae persisting and bent sharply upward in crossing the second incipient ray. Ligament groove narrow, produced. Dentition normal; a short, simple, laminar anterior cardinal and a short, rather stout bifid posterior cardinal in the right valve, with a similar bifid anterior and a simple posterior cardinal in the left; lateral sockets developed on either side of the umbo of the right valve to receive

the modified dorsal edges of the left. Interior feebly rayed; the adductor and pallial scars obscure. Adductor scars large, set close to the lateral margins. Pallial sinus very large, apparently not coalescent throughout its ventral extent.

Dimensions: Right valve (cotype), altitude, 10.5 millimeters; latitude, 21.3 millimeters; semidiameter, 2.6 millimeters. Left valve (cotype), altitude, 9.5 millimeters; latitude, 18.5 millimeters; semidiameter, 2.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 353912.

Type locality: No. 3733, three-fourths of a mile west of Shell Bluff, Shoal River, Walton County, Fla.

Tellina waltonensis shares with *T. chipolana* Dall and *T. strophia* Dall, of the Chipola fauna, the general characters of the outline and ornamentation. It is smaller than either of the Chipola species, and the posterior rays are less strongly developed. In relative dimensions it stands approximately midway between the two forms mentioned, the altitude of *T. waltonensis* being about half as great as the latitude, whereas in *T. chipolana* it is decidedly more than half, and in *T. strophia* Dall decidedly less.

Occurrence: Shoal River formation, locality 3733^p.

Subgenus ARCOPAGIA (Leach MS.) Thomas Brown

1827. *Arcopagia* (Leach MS.) Thomas Brown, Illustrations of the conchology of Great Britain and Ireland, pl. 16, fig. 8.

Type: *Tellina crassa* Pennant. (Recent on the Celtic and boreal coasts of Europe and extending, in the Pleistocene, as far south as Sicily.)

Dall,⁴ in 1900, gave the following description:

Shell large, solid, rounded, moderately convex, the flexure obsolete; posterior left lateral absent, and the anterior obsolete, other teeth normal; sinus free, ascending obliquely; internal radii thick and strong but ill defined; sculpture concentric, usually smoothish or not sharply lamellate, sometimes reduced to incremental lines. Warm, temperate, and tropical seas.

The chief feature of this group is the free sinus, but this in species otherwise closely allied becomes more or less confluent.

Section MERISCA Dall

1900. *Merisca* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 290.

Type: *Tellina crystallina* (Chemnitz) Wood. (Recent in the West Indies and on the west coast from Lower California to Panama.)

Dall describes this section as follows:

This group comprises more or less trigonal, usually rather convex shells of small or moderate size, with lamellose concentric sculpture and often fine radial lines in the interspaces. There is a narrow but sharp posterior flexure; the laterals of the right valve are strongly developed, but the left valve is without lateral teeth, its margin fitting above the laterals of the opposite valve. The pallial sinus is ample, frequently wholly confluent below, and always largely confluent, the dorsal portion often represented only by a line connecting the adductors.

⁴ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1011, 1900.

These shells are related to *Macaliopsis*, from which they differ in the absence of lateral teeth in the left valve; to *Moerella*, from which the sculpture and posterior fold separate them; and to *Pseudarcopagia*, which is not rostrate nor folded, while its radial sculpture is more conspicuous. The recent species are usually pale, without color markings, or white, and inhabit the warmer seas.

***Tellina (Merisca) aequistriata* Say**

Plate XXIX, Figure 6

1824. *Tellina aequistriata* Say, Acad. Nat. Sci. Philadelphia Jour., 1st. ser., vol. 4, p. 145, pl. 10, fig. 7.
 1896. *Tellina aequistriata* Say. Harris, Bull. Am. Paleontology, vol. 1, No. 5, p. 321, pl. 29, fig. 7.
 1900. *Tellina (Merisca) aequistriata* Say. Dall, U. S. Nat. Mus. Proc., vol. 23, p. 293.
 1900. *Tellina (Merisca) aequistriata* Say. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1020.
 1904. *Tellina aequistriata* Say. Glenn, Maryland Geol. Survey, Miocene, p. 297, pl. 72, fig. 13.

Say, in 1824, described this species as follows:

Shell transversely ovate-orbicular, with an elevated line or fold on the anterior margin; surface with fine, somewhat elevated, concentric, nearly equal, numerous striae, forming grooves between them; apex nearly central, acute: cardinal teeth deeply grooved; lateral teeth two; edge within, simple.

Length seven-tenths, breadth nineteen-twentieths of an inch.

In general outline, this species has a resemblance to *T. ostracea*, Lam. In one specimen the apex is central, and in another it is placed before the middle.

The shell described by Say was supposedly collected in Maryland, but it seems much more probable that the *Tellina*, together with a number of other species from the same collection, came from Yorktown, Va. The type has apparently been lost.

Shell ovate-trigonal, the dorsal margins oblique and meeting at an angle of approximately 120°. Anterior portion of the valves somewhat inflated, contracted in front of the narrow but pronounced posterior (not anterior) fold. Anterior end of shell broadly rounded. Posterior cuneate. Ventral margin not arched. Umbones low, sharp, slightly posterior. External sculpture of 60 to 75 sharply elevated, concentric lamellae, approximately uniform in size and spacing. Ligament seated on rather short and narrow nymphs. Cardinals of both right and left valves and laterals of right strong and clean-cut; no true laterals developed in left valve, the function being performed by slightly modified dorsal margins. Anterior muscle scar elongated. Posterior semielliptical. Sinus usually effaced, in perfectly fresh individuals seen to be confluent ventrally with the pallial line. Dorsal margin irregularly sinuous, ascending rather abruptly from the posterior muscle impression to a point underneath the umbones and then descending more gradually to meet the pallial line just behind its juncture with the anterior muscle impression.

There is no positive evidence that the *Tellina aequistriata* reported from the lower bed at Alum Bluff were

collected from the upper bed, and yet it seems strange that this unusually well-preserved species has not been recognized in any of the later collections.

Occurrence: Chipola formation, locality ?2211^r.

Outside occurrence: Miocene: Yorktown formation, Virginia; Duplin formation, North Carolina. Pliocene: Waccamaw formation, South Carolina; Croatan formation, North Carolina. Recent: North Carolina to Brazil in moderate depths.

Section PHYLLODINA Dall

1900. *Phyllodina* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 290.

Type: *Tellina squamifera* Deshayes. (Recent on the east coast from Hatteras to the West Indies.)

A section reserved for those species which combine the transversely ovate outline of *Phylloda* with the free pallial sinus of *Arcopagia*.

***Tellina (Phyllodina) dodona* Dall**

Plate XXIX, Figures 7-11

1898. *Tellina dodona* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 925, pl. 30, fig. 7 (no description).
 1900. *Tellina dodona* Dall, idem, vol. 5, p. 1023.

Dall, in 1900, described this species as follows:

Shell elongate, rather rude, solid, subequilateral, inequivalve, the right valve flatter; beaks low, compressed, with pustular apex and small, smooth nepionic shell; anterior part produced and rounded, passing evenly into the curve of the base; posterior end slightly rostrate, with a straight dorsal slope, the end nearly vertically truncate, the posterior basal angle in the left valve, pointed and produced; surface marked with rather irregular incremental lines, a conspicuous sulcus from the umbo radiating to a point just above the posterior basal angle; disk with a succession (up to 10) of low, rather obscure, concentric waves, obsolete distally but indicated by a sparse series of small triangular foliations on the posterior dorsal border, the anterior border being only obscurely waved; lunule long and very narrow; hinge normal, pallial sinus short, free, obliquely ascending; sculpture of the right valve similar but sharper, more emphatic, and the foliations more conspicuous. Longitude 34, altitude 21, diameter 6 millimeters. Longitude of figured specimen, 16 millimeters.

Since the young valve was figured, a considerably larger left valve has come to light, from which, and from fragments of the right valve, the above description has been drawn.

Cotypes (left valves): U. S. Nat. Mus. No. 107391. Topotype (right valve): U. S. Nat. Mus. No. 353913.

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

A very fine right valve probably referable to this species has been found at Oak Grove. The general effect of the sculpture is strikingly distinct from that of the left valve. Instead of the low, broad, concentric waves evanescent ventrally there are acutely elevated ridges, 13 in number, rather regular in spacing, though slightly broader toward the umbones. On crossing the dorsal ray these ridges dip sharply toward the base. On the dorsal sulcus they are almost or altogether obsolete but reappear at the margin and extend slightly beyond it, thus lending to it a finely crenate

outline. The shell is very flat and rather thin, so that the sculpture, both concentric and radial, is reflected in the interior. The simple anterior and bifid posterior cardinals are short but sharp, and the laterals are elevated medially, the anterior a little the stronger of the two. Unfortunately this lovely species is rather rare.

Dimensions of figured right valve: Altitude, 17 millimeters; latitude, 27 millimeters; semidiameter, 1.5 millimeters.

There is no described form which approaches it very closely.

Occurrence: Oak Grove sand, localities 2646^p, 5632^r.

Tellina (*Phyllodina*) *leptalea* Gardner, n. sp.

Plate XXIX, Figures 12-14

Shell of moderate dimensions for the group, compressed, inequivalve, inequilateral, exceedingly fragile; right valve almost flat; the left feebly convex. Umbones low, acutely pointed at the tips, orthogyrate, often with the minute, more inflated prodissoconch still preserved; umbonal angle not far from 135°. Lunule and escutcheon sublinear, wedging out altogether at the umbones. Anterior and posterior dorsal slopes nearly equal, the posterior a little less gentle. Anterior extremity very broadly and smoothly rounded. Base line horizontal medially, gently up-curved anteriorly, flexuous posteriorly. Posterior area set off in the left valve by a feeble ray terminating at the posterior basal angle, emphasized less by its elevation than by the character of the sculpture and by the constriction both in front of it and behind; a second broader and more elevated ray occupying almost the entire posterior area and widening toward the outer margin; a single broad ray developed in the right valve, terminating just behind the posterior basal angle, outlined by a shallow sulcus in front of it and a deeper sulcus behind. External sculpture concentric, dissimilar upon the two valves and also upon the anterior and posterior portions of the same valve; tips of umbones smooth in both valves except for incremental striae; three or four low, broad, acutely Λ -shaped ridges developed near the umbones similar to those on the right valve of *T. dodona* Dall; a rather close concentric liration developed over the greater part of the shell; the lirae flattened into overlapping laminae on the anterior medial portion of the left valve and over almost the entire area in front of the umbones on the right, raised again near the anterior ventral margin of the left valve of the adult and at the extreme anterior margin of both valves in the young and the right valve of the adult; posterior half of shell much more sharply sculptured, the lirae appearing in the right valve as free lamellae which persist with uni-

form elevation to the lunular margin, where they culminate in foliaceous processes which dentate the margin; lirae in the left valve sharply down-curved along the posterior rib, the alternating lirae tending to disappear upon it; remaining lirae persistent to the dorsal margin, not elevated as in the right valve though culminating at the margin of the escutcheon in scabrous processes. Lunule and escutcheon smooth excepting for incrementals. Ligament external, opisthodontic, linear. Dentition delicate; a short, simple, laminar anterior cardinal and a short, bifid posterior in the right valve and a bifid anterior and simple posterior cardinal in the left; deep lateral sockets developed on either side of the umbones in the right valve to receive the modified dorsal margins of the left. Interior somewhat reinforced laterally. Adductor scars rather large, set close to the dorsal margins. Pallial line obscure, rather close to the base; pallial sinus large, ovate, quitting the dorsal margin of the adductor and reaching about two-thirds of the distance across to the anterior margin; ventral margin of the sinus free throughout its extent, joining the base at an acute angle.

Dimensions: Left valve (type), altitude, 16 millimeters; latitude, 28.5 millimeters; semidiameter, 3.5 millimeters. Right valve (topotype, immature shell), altitude, 10 millimeters; latitude, 17 ± millimeters; semidiameter, 2.2 millimeters.

Type: U. S. Nat. Mus. No. 353914. Topotype: U. S. Nat. Mus. No. 353915.

Type locality: Shell Bluff, Shoal River, Walton County, Fla.; collected and deposited in the U. S. National Museum by Truman H. Aldrich.

The other member of the section *Phyllodina*, *T. dodona* Dall, is a larger and heavier shell, higher relatively and with a different type of sculpture.

Occurrence: Shoal River formation, localities 3856^p, 3742^p.

Section EURYTELLINA Fischer

1887. *Eurytellina* Fischer, Manuel de conchyliologie et de paléontologie conchyliologique, p. 1147.

Type: *Tellina punicea* Born. Born cited no locality, but his excellent figure indicates the tropical east Atlantic species commonly known as *T. angulosa* Gmelin. The references of *T. punicea* to the west American coast are probably incorrect.

Dall,⁵ in 1900, described this section as follows:

Valves compressed, flexure obsolete or absent, the surface feebly concentrically sculptured, a radial rib behind the anterior adductor scars, the left posterior lateral lamina obsolete or absent, the anterior laterals adjacent, the pallial sinus close to or touching the anterior adductor scar and (in the type) wholly coalescent below with the pallial line. Tropical and warm-temperate seas.

⁵ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1013, 1900.

Tellina (Eurytellina) roburina Dall

Plate XXIX, Figure 15

1900. *Tellina (Eurytellina) roburina* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1024, pl. 47, fig. 9.

Dall describes this species as follows:

Shell solid, subequilateral, rather elongate-trigonal, compressed; anterior end evenly rounded, posterior end pointed with a small truncation near the tip; beaks inconspicuous, pointed; lunule short and nearly linear; dorsal slopes nearly rectilinear; surface of the disk polished, closely, evenly, concentrically grooved sublammellose on the posterior dorsal area, which exhibits an obsolete fold and slight flexuosity; hinge as in *Angulus*, teeth well developed; valve thickened on the inner margin of the adductor scars; pallial sinus elongate, low, squarish at the anterior end where its distal angle nearly touches the adductor scar, wholly confluent below. Longitude 39, altitude 22.5, diameter 8 millimeters.

This is a fine species, a precursor of *T. angulosa* Gmelin, *T. rubescens* Hanley, and similar recent forms.

Type: U. S. Nat. Mus. No. 135893.

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

Tellina roburina Dall is the largest and probably the most abundant of the Oak Grove Tellinas. In the adult state there is no species with which it can be readily confused. *T. alternata* Say of the Pliocene and Recent faunas has the same general characters, though it is a larger shell and higher relatively as well as absolutely.

The type of the section, *T. angulosa* Gmelin, is also a possible descendant, but it is higher relatively and more nearly equilateral. The right laterals are stronger in the Miocene species than in either of the Recent forms mentioned, and the anterior lateral of *T. roburina* is farther removed from the cardinals than in either *T. angulosa* or *T. alternata*.

The young of *T. roburina* are very similar at first glance to the adult *T. acalypta* Dall. They may be distinguished by the more compressed shell, the more produced and conspicuous ligament area, and the coarser sculpture upon the dorsal area, which, however, is irregular like that of *T. acalypta*.

Occurrence: Oak Grove sand, localities 2646^c, 5632^r, 5630^p, 5633^r, 7054^r.

Tellina (Eurytellina) pressa Dall

Plate XXIX, Figure 16

1900. *Tellina (Angulus) pressa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1026, pl. 47, fig. 5.

Dall describes this species as follows:

Shell thin, compressed, inequilateral; beaks low, hardly interrupting the dorsal profile, but sharp and almost pustular; ligament rather long, hinge delicate but normal; surface polished, with rather distant, fine, concentric impressed lines; the posterior dorsal slope with sparse, sharp, little elevated concentric lamellae; near the beaks the shell is smooth; interior with a faint anterior elevated ray which separates the adductor scar from the anterior part of the long, high pallial sinus, which

is wholly confluent below; the interior more or less obscurely radially striate. Longitude 12.5, altitude 7.5, diameter 2 millimeters.

A thin and delicate species with no observable flexure or ridge on the posterior end, and whose especial characteristic is the high dorsal profile behind the beaks.

Type: U. S. Nat. Mus. No. 114664.

Typeloc ality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The imperfect type remains unique. The crushed left valve from the Bowden, which was referred to this species, lacks the characteristic outline and sculpture of the Chipola species and has since been described by Woodring under *Tellina (Eurytellina) spiekeri* Woodring.

In the same monograph Woodring⁶ indicates the error of referring to *Angulus* the numerous small species with a well-defined right posterior lateral, which have commonly been included under that subgenus. *Tellina lanceolata* Linnaeus, the type of the subgenus, is an Indo-Pacific species in which only a single lateral, the right anterior, is developed, and this, instead of being normal to the hinge plate, is rather an extension of it, thickened and upturned at the ventral extremity.

Occurrence: Chipola formation, locality 2213^r.

Section SCISSULA Dall

1900, November. *Scissula* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 291.

1900, December. *Scissula* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1014.

Type: *Tellina decora* Say. (Recent on the east coast from South Carolina to Venezuela. Caloosahatchee Pliocene of Florida.)

Dall gives the following characterization:

Surface with fine oblique grooving, not in harmony with the incremental lines.

Tellina (Scissula) lampra Dall

Plate XXX, Figure 11

1900. *Tellina (Scissula) lampra* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1028, pl. 46, fig. 14.

Dall describes this species as follows:

Shell solid, polished, moderately convex, subequilateral; anterior part slightly longer, rounded, posterior attenuated, rather bluntly pointed; beaks low, posterior dorsal area with delicate imbricated sculpture; disk with fine, close, sharp striations descending obliquely backward from the anterior dorsal margin toward the base; hinge normal, delicate; internal thickened rays in the right valve, the anterior touched by the anterior end of the pallial sinus, which is wholly confluent below. Longitude 8.6, altitude 7.3, diameter 4 millimeters.

This recalls *T. decora* Say, which is more inequilateral and has a blunter and differently shaped posterior end. The oblique sculpture also is differently disposed and more close set.

⁶ Woodring, W. P., Miocene mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub. 366, p. 169, 1925.

Dall's figure is rather deceptive. The posterior extremity of the type is broken away, and he has figured only the earlier two-thirds of the shell. The altitude (7.3 millimeters) is that of the figured portion. The latitude is obviously an error. The altitude of the type is 9.5 millimeters, the longitude of the figured portion 14, though the length of the perfect shell was probably between 17 and 18 millimeters.

Type: U. S. Nat. Mus. No. 114600.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

No further representatives of this interesting species have been recognized in the later collections. The fragments from Boynton Landing referable to this section indicate a species three times the dimensions of *T. lampra*.

Occurrence: Chipola formation, localities 2212^r, 2213^r, 2211^p.

Tellina (Scissula) sp.

A very fine species from the marls at Boynton Landing is represented by a couple of fragments. They indicate a thin shell nearly 3 centimeters high and perhaps half again as broad. The concentric laminae are low and closely overlapping the dorsal edges, free, and obliquely directed at a low angle to the base. The adductor scars and the fragment of pallial line are distinct, and the ventral portion preserved is finely and irregularly rayed.

Occurrence: Chipola formation, locality 7893^r.

Subgenus MOERELLA Fischer

1887. *Moerella* Fischer, Manuel de conchyliologie et de paléontologie conchyliologique, p. 1147.

Type: *Tellina donacina* Linnaeus. (Recent off the European coasts from the Hebrides to the Mediterranean. Fossil in the Coralline Crag of England.)

Shell rather small for the genus, transversely ovate, obscurely rostrate posteriorly. Sculpture dominantly concentric, the recent species often rayed with colors. Umbones low, opisthogyrate. Lunule and escutcheon extremely narrow, indicated but not well defined. Ligament external, opisthodetic. Two cardinal teeth in each valve, the anterior right and the posterior left simple and laminar, the posterior right and the anterior left stouter and bifid. True laterals not developed in the left valve, though the edges are beveled to function as laterals and are received within the lateral sockets of the right valve; the anterior lateral more elevated and closer to the umbone than the left. Pallial sinus confluent ventrally with the pallial line throughout the greater part of its extent.

Most of the Alum Bluff Tellinas referred in earlier publications to *Angulus* seem more closely allied to *Moerella*. *Angulus* is an Indo-Pacific group in which only a single lateral, the right anterior, is developed; it has not been recognized in the lower Miocene faunas of the east coast.

Tellina (Moerella) cloneta Dall

Plate XXX, Figures 1-2

1900. *Tellina (Macaliopsis) cloneta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1020, pl. 46, fig. 8.

1900. *Macoma? calhounensis* Dall, idem, p. 1046, pl. 47, fig. 10.

Dall describes this species as follows:

Shell small, thin, inequilateral, anterior end longer, more convex, and evenly rounded; posterior end shorter, rather suddenly pointed, and slightly flexed; beaks pointed, smooth, prominent; lunule and escutcheon obsolete; disk without radial striae, but with very thin, regular, rather distant concentric, elevated lamellae, easily worn off, the posterior end with an obsolete radial fold; hinge normal, pallial sinus large, gibbous, nearly reaching the anterior adductor scar, more than half confluent below. Longitude 13.5, altitude 8.5, diameter 4 millimeters.

Much more delicate and of a different form from the preceding species [*Tellina merula* Dall].

Type: U. S. Nat. Mus. No. 114667.

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

Macoma? calhounensis was described from a single left valve (U. S. Nat. Mus. No. 114669) from Chipola River. Without doubt, this is identical with *Tellina cloneta*.

Tellina cloneta is similar in general aspect and type of sculpture to *T. hypolispa* Dall, from Alum Bluff. The species from Chipola River is more elongated transversely, decidedly thinner, and more lustrous than the Alum Bluff form. The concentric sculpture is finer and sharper and appears at an earlier stage in the growth of the shell.

The characters of the hinge as well as of the pallial sinus ally this species with *Moerella* rather than with *Tellina* s. s.

Occurrence: Chipola formation, localities 10609^r, 7893^r, 2213^p, 3419^r.

Tellina (Moerella) hypolispa Dall

Plate XXX, Figure 3

1900. *Tellina (Merisca) hypolispa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1022, pl. 46, fig. 23.

Dall describes this species as follows:

Shell small, inequivalve, inequilateral, plump, polished, the right valve flatter; anterior end longer, rounded, the posterior rather roundly pointed; base arcuate, near the posterior end a little concave; beaks small, pointed; posterior end obscurely rayed, slightly flexed; surface smooth or with incremental lines but no radial sculpture; anteriorly near the base are usually a few sparse, concentric, elevated threads with irregular but wider interspaces; the posterior dorsal area, contrary to the usual rule, is smooth and shows no traces of lamellation; hinge normal, rather feeble; a narrow impressed lunule; interior with some obscure radii; pallial sinus as in *Angulus*. Longitude 13.5, altitude 8.5, diameter 5 millimeters.

This species is on the border line between *Angulus*, *Moerella*, and *Merisca*. The right valve seems flatter, less arcuate below, and higher than the left when considered separately.

Type: U. S. Nat. Mus. No. 114597.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

Tellina hypolispa has a peculiarly dull and lusterless shell, a character which serves to separate it from *Tellina cloneta* Dall, a species of similar dimensions and outline though more elongated transversely. The concentric threading is very sharp in both and appears abruptly in *T. hypolispa*, though at an earlier stage in some individuals than in others, and consistently earlier in *T. cloneta* Dall. The pallial sinus is coalescent ventrally with the pallial line, and both are very obscure.

The Oak Grove individuals referred to this species are few in number and all of them are immature. They indicate a more strongly convex form with more prominent umbones and a more decided posterior sinus. As only the left valve is represented the status can not be satisfactorily determined.

The general outline and characters of the hinge of *T. hypolispa* seem to ally it to *Moerella* rather than to *Merisca*.

Occurrence: Chipola formation, localities 2213^p, 2211^c, 7183^c; Oak Grove sand, locality ?2646^c.

***Tellina (Moerella) aconeta* Dall**

Plate XXX, Figure 4

1900. *Tellina (Moerella) aconeta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1025, pl. 46, fig. 16.

Dall describes this species as follows:

Shell minute, elongate, very inequilateral, moderately inflated; anterior end rounded, posterior end somewhat produced, flexed, the right valve showing a shallow sulcus extending from the umbo to the base behind the posterior basal angle; surface polished, smooth except for incremental lines; hinge normal, beaks low, almost pustular; lunule present, slightly impressed; pallial sinus rounded, short, reaching two-thirds of the way from the posterior to the anterior adductor scar; below mostly confluent. Longitude 4.7, altitude 3, diameter 1.5 millimeters.

This form is near *T. simpsoni*, but is smaller, and when compared with specimens of that species of the same size appears more compressed and more elongated.

Type: U. S. Nat. Mus. No. 114665.

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

This small and dainty form has no decided characters except, possibly, the "almost pustular" umbones and the unusually flexuous shell. Still, there is no species with which it is readily confusable.

Occurrence: Chipola formation, locality 2213^p.

***Tellina (Moerella) acosmita* Dall**

Plate XXIX, Figure 17

1900. *Tellina (Angulus) acosmita* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1026, pl. 46, fig. 1.

Dall describes this species as follows:

Shell small, thin, elongate, inequilateral, rounded in front, produced and pointed behind; beaks small, pointed, low; disk with usually an obscure constriction mesially; surface polished, concentrically feebly striated, near the margins with

regularly spaced concentric grooving; on the posterior dorsal slope fine, close, low imbrications; hinge delicate, normal; interior thickened ray anteriorly not prominent, touched by the anterior end of the high pallial sinus, which is wholly confluent below. Longitude 10.5, altitude 5, diameter 2.5 millimeters.

The most common of the Chipola Tellinidae. The young are proportionately longer and perceptibly flexed and rostrate behind, characters which lose their prominence in the adults. From the following species [*Tellina (Angulus) agria* Dall] this is distinguished especially by its rather sparse concentric sculpture, giving the effect of *T. alternata* Say in miniature.

Type: U. S. Nat. Mus. No. 114668.

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

Tellina acosmita is a thinner, more delicate, and more lustrous shell than *T. acalypta*, of the Oak Grove. In fact, it bears much the same relation to *T. acalypta* as *T. cloneta* bears to *T. hypolispa*.

Occurrence: Chipola formation, localities 7257^p, 2213^c, 2564^p, 3419^p, 7151^c.

***Tellina (Moerella) agria* Dall**

Plate XXX, Figure 5

1900. *Tellina (Angulus) agria* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1027, pl. 46, fig. 11.

Dall describes this species as follows:

Shell resembling the preceding species [*Tellina (Angulus) acosmita* Dall], but more slender and evenly covered with close-set regular concentric threading; beaks small, the minute protoconch distinct, giving a pustular effect; hinge normal, interior normal, the thickened ray present but ill defined, the pallial sinus as in *T. acosmita*. Longitude 6.7, altitude 3.5, diameter 2 millimeters.

By its fine close striation this species recalls the recent *T. sybaritica* Dall, which is a larger, more solid, and much more flexuous shell.

Type: U. S. Nat. Mus. No. 135896.

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

Shell very small, thin, inequivalve, strongly inequilateral, the anterior portion of the shell produced and broadly rounded, the posterior portion much shorter, sharply rostrate, obtusely truncate at its extremity. Depression in front of the rostrum broad and shallow in the right valve, scarcely perceptible in the left; a second very obscure rostral ray developed upon the posterior area and terminating at the dorsal extremity of the posterior truncation. A smooth sublinear area developed both in front of and behind the inconspicuous umbones. Concentric threading less crowded but much sharper behind the rostrum than upon the medial and anterior portions of the shell. Ligament area short and sublinear, opisthodontic. Anterior cardinal of right valve short and laminar; posterior short, with a distal sulcus so shallow that the tooth appears simple in weathered specimens. Left valve with a bifid anterior and a laminar

posterior cardinal. Lateral sockets of right valve deep to receive the dentate processes developed upon the dorsal margins of the left. Characters of interior obscure. Shell reinforced in adults on the inner margin of the adductor scars. Dorsal margin of pallial sinus arching across to the anterior thickened ray; ventral margin of sinus confluent with the pallial line.

Tellina ctenota, from the Chipola formation at Alum Bluff, is heavier and relatively shorter, with a less regular concentric threading.

Occurrence: Oak Grove sand, localities 2646^p, 7054^r.

***Tellina (Moerella) ctenota* Gardner, n. sp.**

Plate XXX, Figure 6

Shell small, rather thin, inequivalve, strongly inequilateral, produced and broadly rounded in front, short and rather sharply rostrate behind; right valve less compressed and more flexuous than the left. Umbones small, not conspicuous, with a slight posterior inclination. Lunule sublinear. Escutcheon not defined. Posterior keel obtusely angulated, emphasized in the right valve by the broad and shallow depression in front of it. Entire external surface very finely, closely, and regularly laminated. Ligament short, opisthodontic. Hinge normal, very delicate, a simple anterior and bifid posterior cardinal in the right valve and a bifid anterior and simple posterior cardinal in the left; anterior right lateral laminar, produced almost to the tip of the umbone; posterior lateral much shorter and more remote; dorsal margins of left valve slightly modified to function as laterals. Interior feebly rayed, the anterior ray of the right valve the stronger. Muscle scars rather large, irregular in outline. Pallial scar very obscure, large, and entirely coalescent ventrally.

Dimensions: Right valve (type), altitude, 5.2 millimeters; latitude, 9 millimeters; semidiameter, 1.5 millimeters. Left valve (topotype), altitude, 4.5 millimeters; latitude, 8.5 millimeters; semidiameter, 1.4 millimeters.

Type: U. S. Nat. Mus. No. 353916.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

Tellina ctenota n. sp. is the close analog of *T. acalypta* Dall in the Oak Grove fauna and of *T. piesa* in the Shoal River. It runs a little smaller, higher, and heavier than either of the other two and differs from both in the character of the close, sharp, concentric lamination which covers the entire shell.

Tellina ctenota has been recognized only at the type locality.

Occurrence: Chipola formation, locality 2211^p.

***Tellina (Moerella) acalypta* Dall**

Plate XXX, Figure 7

1900. *Tellina (Angulus) acalypta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1027, pl. 47, fig. 12.

Dall describes this species as follows:

Shell small, polished, slightly inequivalve, inequilateral; anterior end longer, rounded, posterior end produced, attenuated, obliquely truncate, obtusely pointed; beaks small, low, the disk near them smooth, polished; surface of the valve toward the margins with fine, regular, rather distant concentric grooves, the posterior dorsal area with fine concentric wrinkles or smooth, the shell showing traces of darker and lighter zones and obscure slightly depressed rays; valves moderately convex, the right slightly less so than the left; hinge normal, extremely fine and delicate; interior polished, thickened ray in left valve present but feeble; pallial sinus high, long, reaching the ray, and wholly confluent below. Longitude 10.5, latitude 5.5, diameter 2.5 millimeters.

This form is not unlike *T. polita* Say but is a constantly less elevated shell.

Type: U. S. Nat. Mus. No. 135894.

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

Among the Oak Grove Tellinas this species is second only to *T. roburina* in abundance. In outline and surface characters it is similar to the young of the larger *roburina*, with which it is so commonly associated, but the valves are more highly convex, the sculpture upon the dorsal area is finer though equally irregular, and the ligament area is more reduced.

The species is restricted in its known distribution to the Oak Grove sand, though the analogs in the Chipola and Shoal River faunas are very close. *T. ctenota*, of the Chipola, is uniformly sculptured, with a very fine, close lamination; *T. piesa*, which is widely distributed in the Shoal River, is consistently more compressed.

Occurrence: Oak Grove sand, localities 2646^c, 5632^r, 5631^r, 5633^r, 9961^r.

***Tellina (Moerella) piesa* Gardner, n. sp.**

Plate XXX, Figures 8-10

Shell small, thin, transversely elongated in outline, inequivalve; right valve more strongly compressed than the left, strongly inequilateral, much produced and broadly rounded anteriorly, very short and obtusely rostrate posteriorly. Umbones very small and inconspicuous, posteriorly inclined. Lunule sublinear. Escutcheon not developed. Posterior keel obtusely angulated, the area behind it obliquely flattened. External surface smooth except for a very fine, close concentric lamination usually restricted to the posterior area and the ventral portion of the adults; a concentric color banding also exhibited in the majority of forms, which probably bears a direct relation to the

original color pattern. Ligament very short, opisthodontic, mounted on short and slender nymphs. Hinge normal, very delicate; a simple anterior and bifid posterior cardinal in the right valve and a bifid anterior and simple posterior cardinal in the left; laterals set very close to the umbones; anterior lateral of right valve laminar, produced almost to the apex of the umbones; posterior lateral very short and more remote; anterior dorsal margin of left valve and to a slight degree, the posterior dorsal margin modified to function as laterals. Interior not reinforced except for a feeble anterior ray. Adductor scars rather large, irregular in outline. Pallial scars obscure. Pallial sinus produced almost but not quite to the posterior adductor scar, coalescent ventrally with the pallial line.

Dimensions: Left valve (type), altitude 5.2 millimeters; latitude, 9.5 millimeters; semidiameter, 1.5 millimeters. Double valves of figured specimen, altitude, 6.7 millimeters; latitude 11 millimeters; diameter, 3 millimeters. The double valves were broken after figuring, so that the single valve remains as the unique type.

Type: U. S. Nat. Mus. No. 353917. Figured specimen: U. S. Nat. Mus. No. 353918.

Type locality: No. 3742 (type), Shell Bluff, Shoal River, Walton County, Fla. No. 3856 (figured specimen), 6 miles west-northwest of Mossyhead, Walton County, Fla.

The differences which separate *Tellina piesa* from *Tellina acalypta* Dall, of the Oak Grove fauna, are slight but constant. The Shoal River species is persistently more compressed, with little or no suggestion of a second posterior ray. The absence of a uniformly developed concentric lamination will serve to separate *T. piesa* from the Chipola analog *T. ctenota* Gardner, n. sp. The specimens collected 3½ miles southwest of De Funiak Springs are relatively very large and exhibit a microscopically fine concentric striation toward the umbones, which usually evanesces, however, a little in front of the posterior keel.

Occurrence: Shoal River formation, localities 3856^p, 3732^r, 3742^p, 10658^r, 5079^c, 10661^p, 3733^r, 7261^r, 7264^p, 5192^r, 9960^r, 9957^r, 10603^p, ?5618^r.

Genus STRIGILLA Turton

1822. *Strigilla* Turton, *Conchylia insularum britannicarum*, Dithyra, p. 117.

Type: *Tellina carnaria* Linnaeus. (Recent on the east coast from Hatteras, N. C., to Brazil.)

Shell moderately convex, suborbicular; external sculpture oblique over a whole or a part of the valve; hinge of right valve armed with two discrepant cardinals, of which the posterior is the larger and usually bifid, and with two lateral teeth; hinge of left valve with two cardinals and two feeble laterals;

pallial sinus varying widely within the limits of the genus.

Dall,⁷ in 1900, described this genus as follows:

This genus is remarkably characteristic and is found with its full development as early as the Oligocene. It is divisible into three groups, one typified by *S. carnaria*, in which the pallial sinus is discrepant in the two valves above and wholly coalescent below, the upper line uniting the adductors, the external chiseled sculpture covering the whole shell; a second in which the external sculpture is similar to the preceding but the pallial sinus is alike in the two valves and falls short of uniting the adductor scars; lastly, a third in which the adductors are connected by the pallial line in one valve and the sinus falls short in the opposite valve, externally the oblique sculpture covers part of the shell, while over the rest it is absent or the sculpture is purely concentric, the boundary between the two areas being sharply defined by a radial line; these may be regarded as sections, viz:

1. *Strigilla* s. s. Type *S. carnaria* Linné.
2. *Rombergia* Dall. Type *S. rombergi* Mörch.
3. *Aeretica* Dall. Type *S. senegalensis* Hanley.

The fossils so far as yet known belong to the typical section. The oblique external sculpture, which is the most marked characteristic of this genus, is in the commoner forms convexly waved near the anterior third of the disk, and this region often has the sculpture obsolete or even absent in individual specimens; the posterior dorsal slope usually has the sculpture in chevron, the lines sometimes more or less broken up, and the sculpture of this part of the shell, as any one may convince himself by examining large series of specimens, has not the constancy in pattern of that on the disk of the shell, and therefore should not be used as a specific character within narrow limits.

The genus has a rather meager representation in the Tertiary and in the warm waters of the Recent seas.

Strigilla has a decidedly local distribution in the Alum Bluff group. All of the three species determined are common within a very restricted area but have not been recognized elsewhere. *Strigilla georgiana* is known only from Decatur County, Ga., *S. paraflexuosa* from the lower bed at Alum Bluff and Sopchoppy, and *S. sphaerion* from the type locality in the Shoal River formation of Walton County. *S. georgiana* and *S. paraflexuosa* are closely allied to *S. eulykta* Gardner and Aldrich from the Miocene and Pliocene of the middle Atlantic Coastal Plain and to *S. flexuosa* of the Recent fauna, but *S. sphaerion* has no very near relatives in the described fauna of the east coast.

Valves more or less compressed in adult:

Latitude of adult usually exceeding 10 millimeters; umbones decidedly anterior in position.

Strigilla georgiana Gardner, n. sp.

Latitude of adult rarely exceeding 10 millimeters; umbones subcentral in position.

Strigilla paraflexuosa Gardner, n. sp.

Valves strongly inflated in adult.

Strigilla sphaerion Gardner n. sp.

⁷ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1038, 1900.

Strigilla georgiana Gardner, n. sp.

Plate XXX, Figures 12-13

Shell moderately large for the group, thin, compressed, somewhat obliquely ovate in outline, obtusely rostrate posteriorly. Umbones low and inconspicuous, the tips minute and orthogyrate, set a little in advance of the median line. Anterior dorsal margin very gently sloping. Posterior dorsal margin a little steeper. Anterior extremity very broadly rounded or obscurely truncate. Posterior extremity compressed, obliquely produced, and truncated. Base line feebly arcuate, more strongly upcurved in front than behind. Lunule and escutcheon linear in the right valve, slightly wider in the left. External sculpture very fine, the lamellae running about 6 to the millimeter, the dorsal edges free, slightly flexuous anteriorly but not arched; posterior area very finely zigzagged, the chiseling obscure, as a rule, directly behind the rostrum, stronger toward the margin of the escutcheon. Ligament external, opisthodontic, mounted on a slender nymph, the groove extending more than half the length of the escutcheon. Dentition delicate; the anterior cardinal of the right valve and the posterior cardinal of the left short, simple, and laminar; the posterior cardinal of the right valve and the anterior cardinal of the left short, slender, bifid; modified dorsal margins of right valve received in the lateral sockets of the left. Characters of interior obscure. Adductor scars rudely circular, placed rather low. Pallial sinus observed only in the left valve but probably similar in the right; dorsal margin of sinus arching across from the posterior to the anterior adductor scar, entirely coalescent ventrally. Pallial line rather close to the margin.

Dimensions: Left valve, altitude, 9.8 millimeters; latitude, 11 millimeters; semidiameter, 3 millimeters.

Type: U. S. Nat. Mus. No. 353919.

Type locality: No. 7148, near Bainbridge, Decatur County, Ga.

Strigilla georgiana is larger than *S. paraflexuosa* of the Chipola formation, more compressed, more produced posteriorly, and with a distinct sculpture pattern upon the posterior area. These differences will serve even more readily to separate it from *S. flexuosa* Say of the Recent east coast fauna. *S. sphaerion* of the Shoal River formation is decidedly more convex, with a much wider lunule and escutcheon, an upcurving of the lamellae upon the anterior third, and a different detail in the sculpturing of the posterior area.

Occurrence: Oak Grove sand, localities 3386°, 3385°, 7148°.

Strigilla paraflexuosa Gardner, n. sp.

Plate XXX, Figures 14-15

Shell small, thin, moderately compressed, equivalve, inequilateral, ovate-trigonal in outline, obtusely rostrate posteriorly. Umbonal area well rounded, the

tips of the umbones minute, orthogyrate, very slightly anterior in position. Posterior dorsal slope steeper and more produced than the anterior. Anterior extremity very broadly rounded, the posterior narrower, obtusely and somewhat obliquely truncate. Basal margin feebly arcuate, broadly and smoothly upcurved anteriorly. Lunule and escutcheon depressed, very narrow, slightly wider in the left valve than in the right. External sculpture very fine, the lamellae running about 6 to the millimeter, not flexuous anteriorly but sweeping across with a very slight downward curvature from the anterior dorsal margin to the posterior basal angle; sculpture upon the posterior area uniform in the limited number of individuals available for observation and following a rather complicated pattern of asymmetric chevrons which split into five unequal rays. Ligament external, opisthodontic, the ligament groove produced more than half the length of the escutcheon. Dentition delicate; anterior cardinal of right valve and posterior cardinal of left short, simple, laminar; posterior cardinal of right valve and anterior cardinal of left short, bifid; lateral sockets of right valve moderately deep and close to the umbones; dorsal margins of left valve modified to function as laterals. Characters of adductor and pallial scars too obscure to determine.

Dimensions: Right valve (cotype), altitude, 7.2 millimeters; latitude, 7.8 millimeters; semidiameter, 2.2 millimeters. Left valve (cotype), altitude, 6.3 millimeters; latitude, 7.1 millimeters; semidiameter, 2 millimeters.

Cotypes: U. S. Nat. Mus. No. 114602.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

Strigilla paraflexuosa is the possible precursor of *S. flexuosa* Say, of the Recent fauna. The Chipola species runs a little smaller and more compressed than the Recent, the lunule and escutcheon are narrower, and the teeth, especially the lateral sockets of the right valve, are more delicate. The external sculpture of the two species is very similar in design, though that of the Recent form is a little coarser and differs in the details of the posterior area. *S. georgiana* is larger than the Chipola species, more compressed, more produced posteriorly, and with a distinct sculpture pattern upon the posterior area. *S. sphaerion* is very much more inflated, with a wider lunule and escutcheon, an upcurving of the lamellae upon the anterior third, and a distinct sculpturing posteriorly. The common species at Sopchoppy, in Wakulla County, is imperfectly preserved but probably referable to *S. paraflexuosa*. *S. pisiformis* Lamarck, from the Bowden and Recent faunas, has much the same general aspect, though it is more oblique.

Occurrence: Chipola formation, localities 2211°, 10660°, ?7468°.

***Strigilla sphaerion* Gardner, n. sp.**

Plate XXX, Figures 16-18

Shell moderately large for the genus, rather heavy, globose, equivalve, slightly inequilateral. Umbones inconspicuous, slightly anterior, the tips minute and feebly opisthogyrate. Lunule rather small, depressed, smooth except for incrementals, very unequal in the two valves, very small relatively and subtrigonal in the right valve, larger in the left valve, feebly concave and with a flangelike projection which fills the angle of the right valve formed by the dorsal margin and the margin of the lunule. Escutcheon linear in the right valve, decidedly wider in the left. Anterior dorsal margin short, scarcely sloping. Posterior margin more produced and more oblique. Anterior extremity obtusely truncate. Posterior extremity much shorter and more decidedly truncate. Base line feebly arcuate, rounding broadly and smoothly into the anterior margin, more abruptly into the posterior. External chiseling very fine, the lamellae running 5 or 6 to the millimeter, the dorsal edges free, broadly upcurved anteriorly, feebly concave toward the posterior keel; sculpture of posterior area appearing, in most adults, in the form of two smooth rays, one directly behind the keel, the other a little less than midway between the keel and the margin of the escutcheon, these two smooth rays separated by a narrow obliquely sculptured ray; behind the second smooth ray a wider and more strongly sculptured area; the lamellae on both the sculptured surfaces directed downward and backward from the umbones; sculpture in young and unusually fresh adults persistent across the entire keel, the lamellae upcurved but not acutely angulated upon the anterior of the two smooth rays, acutely angulated upon the posterior, the shorter side of the angle toward the escutcheon. Ligament external, opisthodontic, not very long, sunk in a deep groove. Dentition normal; anterior cardinal in right valve and posterior cardinal in left short, simple, laminar; the posterior cardinal in the left and the anterior in the right stouter and bifid; lateral sockets of right valve deep, with strong inner margins, elevated and obtusely angulated medially; dorsal margins of left valve produced to function as laterals. Muscle and pallial scars usually obscure; adductor scars relatively rather large, irregular in outline. Pallial line quite close to the margin; the pallial sinus very large, not discrepant in the two valves, the dorsal margin of the sinus arching across from the posterior to the anterior adductor, the ventral margin entirely coalescent with the pallial line.

Dimensions: Right valve (cotype), altitude, 9.8 millimeters; latitude, 10.1 millimeters; semidiameter, 4 millimeters. Left valve (cotype), altitude, 11 millimeters; latitude, 11.6 millimeters; semidiameter, 4.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 353920.

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

Strigilla sphaerion is well characterized by the highly inflated valves, the anterior upcurving of the lamellae, and the details of the sculpture upon the posterior keel.

The species is restricted in its known distribution to the type locality.

Occurrence: Shoal River formation, locality 5079^e.**Genus METIS H. and A. Adams**1858. *Metis* H. and A. Adams, Genera of Recent Mollusca, vol. 2, p. 399.Type: *Tellina meyeri* Dunker. (Recent in the East Indies.)

H. and A. Adams described this genus as follows:

Shell suborbicular, compressed, surface of valves sulcate; hinder flexuosity submedian. Lateral teeth wanting.

This genus, assigned by many conchologists to subgeneric rank under *Tellina*, originated in the Tertiary and still persists in the waters of the tropical seas.

Only the single species has been recognized in the Alum Bluff group, and that has a restricted distribution in the Chipola formation.

***Metis chipolana* Dall**

Plate XXX, Figure 19

1900. *Metis chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1042, pl. 47, fig. 21.

Dall describes this species as follows:

Shell small for the genus, nearly equilateral, not quite equivalve, the left valve slightly larger, evenly rounded in front, pointed and attenuated behind; beaks low, lunule and escutcheon deeply impressed, narrow; posterior end markedly flexed, with an obvious fold or emargination of the valve just above the posterior basal angle; surface finely radially striate, with a fine concentric lamellation which is more distinct toward the base and over the fold; pallial sinus obliquely ascending, free from the pallial line below, as in *Arcopagia*. Longitude 44, altitude 36, diameter 16 millimeters.

This species is smoother and more regular than any of the other forms known from America and recalls *M. dombeyi* of the Pacific recent fauna.

Type: U. S. Nat. Mus. No. 114629.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The occurrence of this rather rare species in the beds near Tallahassee is very interesting.

Occurrence: Chipola formation, localities 2213^p, 2211^r, 10660^r, 2302^r.**Genus MACOMA Leach**1819. *Macoma* Leach, in Ross, John, A voyage of discovery made under the orders of the Admiralty in His Majesty's ships *Isabella* and *Alexander* for the purpose of exploring Baffin's Bay and inquiring into the probability of a northwest passage, App. 2, p. lxii.1819. *Macoma* Leach, Jour. physique, vol. 88, p. 465

Type: *Macoma tenera* (Leach) = *Tellina calcarea* Gmelin. (Recent in the north Atlantic and Arctic Oceans.)

Outline transversely ovate or subtrigonal, strongly flexuous, as a rule, posteriorly; external surface smooth or feebly sculptured concentrically; two divergent cardinals in each valve; laterals absent; pallial sinus often discrepant in the two valves, varying widely within the limits of the genus.

The genus is fairly common from the Miocene on and is represented in the recent seas by about 100 species. Though not restricted to the cooler waters, the typical members are characteristic of the higher latitudes.

Only three species from the Alum Bluff group have been described, though there is at least one other present. *Macoma* s. s. has not been found in the Chipola formation. In the cooler-water faunas of the Oak Grove sand and in the Shoal River formation, however, it is represented, though not abundantly. *Psammacoma*, the subgenus which includes most of the tropical species, is found in the Chipola and is not uncommon in the Shoal River. There is no member of the genus that constitutes any considerable factor in the bivalve faunas of the Alum Bluff.

Umbones anterior.....*Macoma paralenis* Gardner, n. sp.
Umbones posterior.....*Macoma (Psammacoma)*.

Posterior extremity very narrow; concentric sculpture behind the rostrum relatively feeble.

Macoma (Psammacoma) marmorea Gardner, n. sp.

Posterior extremity moderately narrow; concentric sculpture behind the rostrum relatively strong.

Macoma (Psammacoma) torynoides Gardner, n. sp.

Macoma calhounensis Dall

1900. *Macoma? calhounensis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1046, pl. 47, fig. 10.

The type is a left valve of *Tellina cloneta* Dall and is from the type locality of *T. cloneta*. The associated fragments are not determinable.

Macoma paralenis Gardner, n. sp.

Plate XXX, Figures 20-21

1900. *Macoma lenis* Conrad, Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1047 (part).
Not *Tellina lenis* Conrad, 1843.

Shell large, very thin, transversely ovate, moderately inflated anteriorly and medially, produced, compressed, and obtusely rostrated posteriorly. Umbones small, inconspicuous, slightly opisthogyrate, set in advance of the median line; umbonal angle not far from 135°. Anterior dorsal margin shorter and more gently sloping than the posterior; anterior extremity broadly rounded. Posterior extremity obliquely produced and obtusely truncate. Base line nearly horizontal medially, broadly upcurved anteriorly, obtusely angulated posteriorly. Neither lunule nor escutcheon developed. Surface sculpture incremental in character, feebly developed toward the umbones, very much more decided upon the medial and ventral portions

of the shell and particularly behind the rostrum. Ligament external, opisthodontic, mounted on a slender nymph, the ligament groove extending about one-third the length of the posterior dorsal margin. Dentition very delicate; the right anterior and the left posterior cardinals short, simple, laminar; the right posterior and the left anterior cardinals also very short, slender, elevated, medially sulcate; laterals not developed. Shell reinforced by two inner rays, the anterior decidedly the stronger, especially near the umbones, gradually evanescent near the inner ventral extremity of the anterior adductor; posterior ray scarcely discernible near the umbones, least feeble along the inner margin of the posterior adductor; entire inner surface away from the umbones obscurely rayed and concentrically corrugated. Adductor scars irregular and obscure. Pallial sinus in right valve very large, ovate, covering more than three-fourths the distance between the adductor scars, coalescent ventrally; pallial line moderately removed from the base. Inner margins slightly thickened.

Dimensions: Right valve, altitude, 26.3 millimeters; latitude, 41.5 millimeters; semidiameter, 6 millimeters.

Type: U. S. Nat. Mus. No. 157907.

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

Macoma paralenis has no close allies among the described species from Alum Bluff. There is, however, a representative of the group which is fairly common at Shell Bluff (locality 3742), on Shoal River in Walton County, but which is too poorly preserved to warrant description. It runs larger than the Oak Grove individuals but is not so high relatively. The umbones are apparently more nearly central and the umbonal angle larger than in *Macoma paralenis*. The anterior ray is very strongly marked upon the casts, but the posterior ray seems to have been little or not at all developed. These forms are the probable precursors of the group of *Macoma constricta* Bruguière.

Occurrence: Oak Grove sand, locality 2646^r.

Subgenus PSAMMACOMA Dall

1900. *Psammacoma* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 292; Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1045.

Type: *Tellina candida* Lamarck = *Tellina galathea* Hanley. (Recent in the Indo-Pacific.)

Dall gives the following description:

Valves equal, produced anteriorly, bluntly truncate and hardly flexed posteriorly, with a smooth surface and inconspicuous periostracum. Tropical waters. Type: *Tellina candida* (Lam.) Bertin (= *T. galathea* Hanley, Reeve).

This group by its elongated *Tagelus*-like form, its delicate, often radially hirsute periostracum, and its habitat in the warmer seas, where it replaces the Arctic type of *Macoma*, is easily separable from the latter. The pallial sinus is usually about half free instead of wholly coalescent below, as more usual in typical *Macoma*.

Most of the Alum Bluff *Macomas* are referable to this warm-water group.

Macoma (Psammacoma) tracta Dall

Plate XXXI, Figure 1

1900. *Macoma (Psammacoma) tracta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1053, pl. 47, fig. 13.

1925. *Macoma (Psammacoma) tracta* Dall. Woodring, W. P., Miocene mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub. 366, p. 176, pl. 24, fig. 19.

The type (U. S. Nat. Mus. No. 135702) is from the Bowden beds of Jamaica, and I have been unable to find the Chipola individuals referred to this species. *Macoma marmorea* Gardner, n. sp., from the Chipola, and *Macoma torynoides* Gardner, n. sp., from the Shoal River, are closely allied but are less elongated transversely.

Macoma (Psammacoma) torynoides Gardner, n. sp.

Plate XXXI, Figures 2-4

Shell small, very thin, moderately inflated, subequivalve, strongly inequilateral, the umbones decidedly posterior in position. Outline in front of the beaks semicylindrical; the dorsal and ventral margins approximately parallel, the extremity broadly rounded. Shell short and obtusely rostrate behind the beaks; posterior dorsal margin slightly excavated directly behind the umbones, quite steeply declining; posterior extremity short and obtusely truncate, rounding quite sharply into the slightly upcurved base. Umbones rather prominent, inflated even to their very tips, which are feebly opisthogyrate. Lunule suggested by a flattening of the shell in front of the umbones but not defined. Escutcheon absent. Surface sculpture restricted to microscopically fine concentric striations, except for the fine and irregular corrugation developed behind the rostrum. Ligament external, moderately produced. Cardinals two in number in each valve, very short and delicate. Adductor scars rather small, the anterior irregular in outline, the posterior semi-elliptical. Pallial sinus of right valve ovate, produced over about two-thirds of the intervening distance between the adductors, partially coalescent ventrally; sinus of left valve very obscure, probably with a less arcuate dorsal margin. Interior faintly rayed and corrugated in harmony with the growth stages.

Dimensions: Right valve (type), altitude, 6.3 millimeters; latitude, 12.5 millimeters; semidiameter, 1.5 millimeters. Left valve (paratype), altitude, 5.4 millimeters; latitude, 11.5 millimeters; semidiameter, 1.4 millimeters.

Type: U. S. Nat. Mus. No. 353923. Paratype: U. S. Nat. Mus. No. 353921.

Type locality: Right valve (type), No. 5618, 3½ miles southwest of De Funiak Springs, Walton County, Fla. Left valve (paratype), No. 3747, 8 miles south of Lake De Funiak, Walton County, Fla.

There are a number of poorly preserved individuals from Shell Bluff which have been doubtfully referred

to this species, though they are more than double the dimensions of the type. *Macoma marmorea*, from Tenmile Creek, is a close analog, but it is more produced and attenuated behind and more feebly sculptured upon the rostrum.

Occurrence: Shoal River formation, localities 2645^r, 3742^p, 10658^r, 5079^r, 3748^r, 3747^r, 5618^r.

Macoma (Psammacoma) marmorea Gardner, n. sp.

Plate XXXI, Figures 5-6

Shell small, very thin, fragile, glistening white, inequivalve, inequilateral, the right valve apparently less inflated than the left; both valves compressed, attenuated and obtusely rostrate behind. Umbones relatively prominent for the group, well rounded even to their tips, feebly opisthogyrate, decidedly posterior. Outline in front of the beaks semicylindrical, the dorsal and ventral margins nearly parallel, the extremity broadly rounded; posterior dorsal margin slightly excavated, the lateral margin short and squarely truncate. Base line nearly horizontal. Posterior keel obtuse, persistent from the umbones to the base; a secondary keel, defined rather by the sculpture than the contour, developed behind the first, extending from the umbones to the dorsal angle of the posterior truncation. Lunule and escutcheon suggested by the flattening of the shell over a narrow area and by the evanescence of the concentric striae. External sculpture of conch reduced to faint and microscopically fine incremental striae except upon the rostrum, where the markings are less feeble and flexuous. Prodissoconch concentrically striated. Ligament external, opisthodontic, rather short, mounted on a slender nymph. Dentition normal, very delicate; the two cardinals in each valve very short, slender, and elevated; anterior cardinal of right valve and posterior cardinal of left simple, laminar; posterior cardinal of right valve and anterior cardinal of left medially sulcate. Interior faintly rayed and concentrically wrinkled, often with a slight thickening along the inner surface of the posterior adductor but no defined ray of callus. Adductor scars rather small, the anterior irregular in outline, the posterior semielliptical. Pallial line and sinus obscure; sinus large, oval, extending about two-thirds of the distance across to the inner margin of the anterior adductor, coalescent ventrally over about two-thirds of its extent, probably with a more arcuate dorsal margin in the right valve than in the left; pallial line rather close to the margin.

Dimensions: Altitude, 6.6 millimeters; latitude, 14.5 millimeters; semidiameter, 2.2 millimeters.

Type: U. S. Nat. Mus. No. 353922.

Type locality: No. 7257, Sexton's marl bed, Tenmile Creek, Calhoun County, Fla.

Macoma marmorea is the close analog of *Macoma torynoides*, of the Shoal River fauna. It seems to be a little more attenuated posteriorly and is less strongly

sculptured upon the posterior area. Both the Chipola and the Shoal River species are relatively higher than *Macoma tracta*, from the Bowden of Jamaica.

Occurrence: Chipola formation, locality 7257^p.

Family SEMELIDAE Dall

The family Semelidae is most readily separable from the Tellinidae by the presence of an internal resilium.

Genus SEMELE Schumacher

1817. *Semele* Schumacher, Essai d'un nouveau système des habitations des vers testacés, p. 165.

Type: *Tellina reticulata* Spengler = *Tellina proficua* Pulteney. (Pliocene of South Carolina and Florida and living from Virginia to Fernando de Moronha and east to Bermuda in less than 50 fathoms.)

Shell oval or suborbicular, slightly inequivalve, usually more or less rostrate posteriorly; umbones subcentral, low, proximate, prosogyrate; ligament short, external; resilium strong, internal; hinge armature consisting of two cardinals and two laterals in each valve, the laterals of the right valve usually the stronger; adductor impressions large, semielliptical; pallial sinus profound.

The genus is represented in the Tertiary formations by some 30 species, many of them very attractive, and in the recent waters by about 60 species, most of them tropical.

Though by no means a conspicuous factor in the fauna, *Semele* is represented in the Alum Bluff by 11 species, some of them rather common. Most of them are obviously related to forms prominent in the later Tertiary and Recent faunas. *Semele chipolana* is apparently an ancestral type of *Semele leana* Dall and *Semele perlamellosa* Heilprin, of the Caloosahatchee Pliocene. The rare *Semele smithii*, also from the Chipola, has no very near relatives among the described Tertiary and Recent species. Seven of the 11 species—*Semele mutica* Dall, *S. stearnsii* Dall, *S. scintillata* Dall, and *S. sellardsi* Gardner, n. sp., from the Chipola; *S. compacta* Dall, from the Oak Grove; and *S. taracodes* Gardner, n. sp., and *S. paramutica* Gardner, n. sp., from the Shoal River—are members of the group of *Semele carinata* Conrad, *S. subovata* Say, and *S. bella* Conrad, so prominent in the later Miocene and Pliocene. The subgenus *Semelina* is established in the Chipola by *S. striulata* Dall and in the Oak Grove by *S. cytheroidea*, both of them closely related to the Tertiary and Recent *S. nuculoidea* Conrad. No trace of the existence of this well-characterized group has yet been detected in the Shoal River.

The Chipola, with seven species, shows a greater diversity than either of the other two formations, but the Shoal River, with two species, is perhaps the best represented in number of individuals. The Oak Grove has a single not uncommon representative in each of two subgenera.

Latitude of adult shell exceeding 7 millimeters; sculpture variable but not sharp, crowded and concentric over the entire shell:

Latitude of adult shell usually exceeding 20 millimeters:

Surface sculptured with thin, elevated, concentric lamellae, uniformly spaced...*Semele chipolana* Dall.
Surface smooth except for incrementals and microscopically fine radials.....*Semele smithii* Dall.

Latitude of adult shell rarely exceeding 20 millimeters:

Latitude of adult shell rarely exceeding 12 millimeters; shell thin and transversely elongate:

Umbones sculptured with fine, sharp, elevated lamellae, closely and regularly spaced; shell away from the umbones sculptured with compressed concentric waves or ridges, fairly uniform over the adult shell...*Semele mutica* Dall.

Umbones sculptured with fine, sharp lamellae relatively distant and often irregular; shell away from the umbones sculptured with broad, concentric waves, tending to become irregular and evanesce anteriorly and medially.

Semele stearnsii Dall.

Umbones sculptured with a fine and crowded concentric liration; shell away from the umbones radially threaded, the radial sculpture developed over the entire shell or restricted to one or both of the lateral margins.

Semele scintillata Dall.

Latitude of adult shell usually exceeding 12 millimeters; shell usually rather heavy and ovate-trigonal:

Adult sculptured with numerous concentric folds or lamellae not conspicuously flattened over the entire adult shell:

Sculpture of concentric folds often tending to evanesce anteriorly but not flattened:

Juvenile sculpture fine, sharp, laminar, close-set, regular...*Semele compacta* Dall.

Juvenile sculpture fine, obtuse, relatively distant, often irregular.

Semele taracodes Gardner, n. sp.

Sculpture of concentric lamellae sharply elevated posteriorly, more or less flattened anteriorly and medially.

Semele paramutica Gardner, n. sp.

Adult sculptured with numerous concentric lamellae flattened over the entire adult shell.

Semele sellardsi Gardner, n. sp.

Latitude of adult shell not exceeding 7 millimeters; sculpture sharp, crowded, concentric:

Outline relatively short and trigonal.

Semele (Semelina) cytheroidea Dall.

Outline relatively elongated transversely.

Semele (Semelina) striulata Dall.

Section SEMELE s. s.

Type: *Semele reticulata* Spengler = *Tellina proficua* Pulteney. (Pliocene of South Carolina and Florida and living from Virginia to Fernando de Noronha and east to Bermuda in less than 50 fathoms.)

Dall,⁸ in 1900, gave the following description:

Shell large, sculpture radial and concentric or oblique, reticulate, or nearly absent; chondrophore elongate, resilium large and strong, ligament external, feeble; left valve with feeble

⁸ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pp. 985-986, 1900.

laterals, the posterior cardinal slender; right valve with well-developed laterals, cardinals subequal, entire; pallial sinus large, rounded, obliquely ascending, free of the pallial line.

Semele chipolana Dall

Plate XXXI, Figure 7

1900. *Semele chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 986, pl. 37, fig. 3.

1910. *Semele perlamelloides* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 37, pl. 9, fig. 8.

Dall, in 1900, described this species as follows:

Shell large, solid, rather inflated, nearly equilateral, slightly inequivalve; beaks low, adjacent; anterior end longer, sloping above, rounded in front and below into the arcuate base; posterior end high, bluntly rounded, subtruncate near the base the posterior flexure feeble; escutcheon long and narrow, lunule wider, elongate, both chiefly impressed on the dorsal edge of the left valve; sculpture of regularly spaced, numerous low, sharp, thin concentric lamellae, with wider microscopically radially striate interspaces; about fifteen lamellae to the centimeter; hinge and other internal characters normal. Altitude 46, latitude 54, diameter 21 millimeters.

This fine shell is not unlike the Pliocene *S. leana*, but the sculpture in the latter is coarser and more prominent and the valves thinner and flatter.

Type: U. S. Nat. Mus. No. 114630.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The single broken valve from Oak Grove which has been referred to *S. chipolana* represents a distinct though analogous species, differing in the thinner shell, wider lunule, and less closely spaced concentric lamellae. The later collections have yielded only a fragment or two of this unusually interesting form.

Occurrence: Chipola formation, localities 2212^p, 2213^r, 2211^r, 7183^r.

Semele smithii Dall

Plate XXXI, Figure 8

1900. *Semele smithii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 987, pl. 43, fig. 6.

Dall describes this species as follows:

Shell small, slightly inequilateral, thick, solid, the valves moderately convex, with a perceptible posterior fold; beaks low, small; lunule and escutcheon narrow; anterior end slightly longer, sloping above, rounded in front and on the base; posterior end higher, rounded, scarcely truncate below; sculpture of hardly perceptible incremental lines and obscure sparse radial striations, imperceptible on some parts of the shell; teeth well developed; pallial sinus obliquely ascending, rounded in front, and rather shorter than usual. Altitude 19, latitude 23, diameter 7 millimeters.

Fragments of two valves were obtained of this interesting, nearly smooth species, which is named in honor of Prof. Eugene A. Smith, State geologist of Alabama, whose valuable work on the geology of the Southern States is well known.

Type: U. S. Nat. Mus. No. 114657.

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

Not even a fragment of this interesting species has appeared in the later collections.

Occurrence: Chipola formation, locality 2213^r.

Semele mutica Dall

Plate XXXI, Figure 9

1900. *Semele mutica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 988, pl. 43, fig. 12.

Dall describes this species as follows:

Shell small, compressed, thin, rather elongate, with small, low, pointed beaks; anterior end slightly longer, rounded; posterior end shorter, obscurely folded and subtruncate below; sculpture * * * with the waves numerous, compressed, elevated into narrow, somewhat irregular lamellae, with wider interspaces over the whole, sharper and more crowded near the posterior dorsal slope; no radial sculpture. * * *

All these forms show a pretty uniform, minute, concentric threading, close and almost microscopic, most evident in the interspaces, but covering the whole surface, though often worn from the more projecting portions, such as the tops of the waves. * * *

The variations of this pretty little shell are much greater than in any of the recent species I have seen, but it appears to be a precursor of such species as the Miocene *S. bella* Conrad and the Pliocene and recent *S. cancellata* Orbigny.

Dimensions: Altitude, 6.9 millimeters; latitude, 10 millimeters; semidiameter, 1.5 millimeters.

Type: U. S. Nat. Mus. No. 155781.

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

The supports for the external ligament are very feeble, but the chondrophore is deep and produced posteriorly. The dentition is normal, the anterior cardinal of the right valve and the posterior cardinal of the left simple and laminar, the posterior cardinal of the right valve and the anterior cardinal of the left relatively stout and bifid. The dorsal margins of the left valve are strongly modified to function as laterals and are received in the deep lateral sockets of the right valve. The adductor scars are impressed, semielliptical, and placed at the extremities of the laterals. The pallial line is obscure, the pallial sinus large, ovate, its dorsal margin arching high up under the umbones.

Semel. mutica is much less common than the related *S. stearnsii* and *S. scintillata*. The differences in the ornamentation of the shell show up even in the adolescent stages. The early sculpture of *S. mutica* is very fine, sharp, and regular, somewhat similar to that of *S. stearnsii* but sharper and closer and with no trace of the radial ornamentation of *S. scintillata*. The uniformity of the sculpture characters in the early stages of development and the constant differences in the young of the three forms under discussion make their specific separation advisable.

Occurrence: Chipola formation, locality 2213^p.

Semele stearnsii Dall

Plate XXXI, Figure 10

1900. *Semele mutica* var. *stearnsii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 988, pl. 43, fig. 16.

Dall gives the following description:

Shell small, compressed, thin, rather elongate, with small low, pointed beaks; anterior end slightly longer, rounded; posterior end shorter, obscurely folded and subtruncate below; sculpture * * * with few obscure concentric waves stronger about the middle of the disk; there is no radial sculpture, and the umbones have a slightly compressed appearance.
* * *

All these forms show a pretty uniform, minute, concentric threading, close and almost microscopic, most evident in the interspaces, but covering the whole surface, though often worn from the more projecting portions, such as the tops of the waves.

Dimensions: Altitude, 8 millimeters; latitude, 11.5 millimeters; semidiameter, 1.6 millimeters.

Type: U. S. Nat. Mus. No. 114656.

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

The prodissoconch is a smooth little knob similar to that of *Semele mutica* Dall, but the differences in the two species appear with the development of the sculpture. The concentric lamellae are initiated earlier and more abruptly upon *S. mutica* and are sharper and more elevated than those of *S. stearnsii* Dall. The secondary concentric striation shows up better than in *S. mutica*, though this is due in part to the character of the primary sculpture. The character of the adult sculpture is much more suggestive of the *Astartacea* than it is of *Semele*. The concentric undulations are most prominent toward the posterior keel, tending to evanesce anteriorly and becoming narrower but relatively more elevated behind the rostrum. The characters of the ligament and dentition are similar to those of *S. mutica*—a feeble external ligament, a well-defined resilifer, two divergent cardinals, and sturdy laterals. There is a decided thickening of the shell laterally from the umbones down to the adductor scars, which are distinctly impressed. The pallial sinus arches high up under the umbones as in *S. mutica*, and the pallial line is rather distant from the hinge. In spite of the thickened rays and the impressed adductor and pallial scars there is a curiously immature aspect about all of this group.

Occurrence: Chipola formation, localities 10609^r, 2213^p, 3419^p.

Semele scintillata Dall

Plate XXXI, Figure 11

1900. *Semele mutica* var. *scintillata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 988, pl. 43, fig. 2.

Dall gives the following description:

Shell small, compressed, thin, rather elongate, with small, low, pointed beaks; anterior end slightly longer, rounded; posterior end shorter, obscurely folded and subtruncate below; * * * sculpture like either of the preceding [*Semele mutica* Dall and *S. stearnsii* Dall], to which is added radial

threading visible first toward the ends of the shell, in some specimens covering the whole disk with rounded radial threads with wider interspaces; in the specimens with the strongest sculpture the threads overrun the ridges and even become nodulous toward the ends of the shell at the intersections.
* * *

All these forms show a pretty uniform minute concentric threading close and almost microscopic, most evident in the interspaces but covering the whole surface, though often worn from the more projecting portions such as the tops of the waves.
* * *

The variations of this pretty little shell are much greater than in any of the recent species I have seen, but it appears to be a precursor of such species as the Miocene *S. bella* Conrad and the Pliocene and Recent *S. cancellata* Orbigny.

Dimensions: Altitude, 6.7 millimeters; latitude, 9.5 millimeters; semidiameter, 1.6 millimeters.

Type: U. S. Nat. Mus. No. 155782.

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

The prodissoconch is smooth and rounded like that of *S. mutica* and *S. stearnsii*. The adolescent shell is very finely and regularly striated concentrically, but it does not exhibit the sharp primary lamination that is characteristic of the other two forms. The secondary striation on the adult is fine but remarkably regular and distinct and overrides the radials. The radial sculpture is variable in its development but always more prominent laterally than medially and posteriorly than anteriorly. In some individuals the radial sculpture is restricted to the posterior area, and when developed over the entire surface the posterior threads are strong and well rounded and separated by interspaces of approximately their own width, the anterior radials less elevated and more closely spaced, the medial radials flattened and separated by linear interspaces. The characters of the hinge are similar to those of *S. mutica* and *S. stearnsii*—a feeble external ligament, a well-excavated resilifer, two rather delicate divergent cardinals, and strong laterals placed rather close to the beaks. The interior is thickened laterally from the umbones to the adductor scars as in *S. stearnsii* Dall, and the characters of the impressed scars and the high, arching pallial sinus are similar to those of the other members of the group. *Semele scintillata* is more closely related in both the juvenile and the adult characters to *S. stearnsii* than it is to *S. mutica*.

A juvenile similarly sculptured but more inflated occurs in the Shoal River formation on Whites Creek.

Occurrence: Chipola formation, localities 2213^p, 3419^p.

Semele compacta Dall

Plate XXXI, Figures 12-13

1900. *Semele carinata* var. *compacta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 988, pl. 36, figs. 23, 26.

Dall gives the following description:

This species is of moderate size, rather compressed, with concentric waves separated by equal or wider interspaces; the waves vary from sharp edged to flattened; there is fine concen-

tric and radial striation, feebler on a marked posterior fold and somewhat compressed, well-sculptured beaks. Conrad's *Abra holmesii* was founded on Tuomey and Holmes's figure, but I am unable to see any discriminating characters either in specimens or figures. The figured specimen in the present work is from Oak Grove and is characterized by a somewhat more elongated form and more uniform and close-set sculpture, especially over the posterior dorsal area. The size of those collected is also smaller than that of the full-grown Miocene specimens. It may perhaps be separated from the type as a variety *compacta*.

Type: U. S. Nat. Mus. No. 107378.

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

Dimensions: Figured type, altitude, 12.2 millimeters; latitude, 16.7 millimeters; semidiameter, 2.7 millimeters.

Semele carinata Conrad, from the later Miocene, reaches an altitude of over 20 millimeters. The two species follow much the same range of variation in outline, though the umbones are more prominent as a rule in *S. carinata* and the umbonal angle smaller. The prodissoconch is smooth, shining, and somewhat bulbous. The adolescent shell, though relatively higher and less elongated transversely than that of the Chipola *S. mutica* Dall, has a similar sculpture of fine, sharp concentric laminae. Away from the umbones the sculpture offers a wide range of variation. In some individuals the concentric folds are very sharp and fairly uniform in character, though flattening anteriorly. They are usually discontinuous upon the obtuse rostrum and much sharper behind it. In other individuals the concentric waves become very low and ill defined toward the base and quite obsolete anteriorly, though usually more prominent posteriorly than upon the medial portion of the shell. A very fine and regular concentric secondary striation similar to that of the *S. mutica* group is developed over the entire shell, becoming relatively stronger, however, with the weakening of the primary sculpture. The radial striation is not visible except upon decorticated surfaces. There is a feeble attachment for the external ligament and a well-excavated, posteriorly produced chondrophore. The dentition is normal, a simple anterior cardinal, and a stouter bifid posterior cardinal in the right valve and a bifid anterior and laminar posterior cardinal in the left valve. The laterals are strong and not far removed from the umbones. The shell is reinforced, as in *S. mutica*, by a lateral thickening in the umbonal region. The adductor scars are distinct and impressed dorsally. The pallial sinus is also distinct and obliquely ovate in outline. The dorsal margin of the sinus, though falling, in part, within the dorsal third of the shell, is lower than in *S. mutica*. The ventral margin is entirely free.

The smaller, relatively wider, and more elliptical shell and the earlier initiation of the concentric sculpture will serve to separate *S. compacta* Dall from *S. carinata* Conrad. The larger, relatively higher, and

less elliptical shell, particularly in the early growth stages, together with the lower dorsal margin of the pallial sinus will serve to separate *S. compacta* from the group *S. mutica* Dall.

Of the two related Shoal River species *Semele paramutica* differs primarily in the adult sculpture, *Semele taracodes* in the juvenile. The adult *S. paramutica* develops, normally, a very regular ornamentation of concentric laminae, usually flattened and *Tellina*-like upon the anterior and medial portions of the shell and free and elevated posteriorly. The young of *S. taracodes* are sculptured with fine but obtuse lirations, rather distantly spaced and often irregular, and are therefore readily separable from the young of *S. compacta*, which have sharp, close, and regular threading.

Occurrence: Oak Grove sand, localities 2646°, 9961°, 10659°.

***Semele taracodes* Gardner, n. sp.**

Plate XXXI, Figures 14-15

Shell moderately thin and compressed, not very large, ovate-trigonal to transversely elongate in outline. Prodossoconch minute, smooth, shining, and bulbous. Umbones low, flattened, placed a little behind the median horizontal. Posterior dorsal margin more steeply sloping than the anterior. Anterior extremity produced and very broadly rounded, posterior obscurely rostrate and obtusely truncate. Base line arcuate. External surface sculptured away from the umbones with compressed concentric ridges, often irregular, which tend to evanesce anteriorly and are more elevated and more sharply pinched posteriorly; a very fine secondary striation also developed over the greater part of the shell; both primary and secondary sculpture little or not at all developed near the umbones, least feeble behind the rostrum. External ligament support short and light. Chondrophore narrow but deeply excavated, posteriorly produced parallel to the posterior dorsal margin. Hinge normal; dentition rather concentrated; anterior cardinal of right valve thin, laminar, coalescent at its base with the dorsal margin; posterior cardinal of right valve and anterior cardinal of left rather slender, deltoid, medially sulcate; right lateral sockets deep, their inner margins elevated medially; dorsal margins of left valve modified to function as laterals; interior thickened in the umbonal region. Muscle scars distinct, semielliptical in outline, their dorsal margins impressed, set rather high at the extremities of the laterals. Pallial line moderately close to the margin; pallial sinus large, somewhat obliquely ovate, covering about three-fourths of the distance between the inner margins of the muscle scars; dorsal margin of sinus feebly arcuate; lateral margin broadly rounded; ventral margin almost entirely free from the pallial line.

Dimensions: Right valve, altitude, 12.1 millimeters; latitude, 16.5 millimeters; semidiameter, 3 millimeters.

Type: U. S. Nat. Mus. No. 353926.

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

Semele taracodes is very close in its adult characters to *S. compacta* Dall. The examination of a large number of the young of both species makes it certain, however, that the juvenile characters are constantly distinct. In place of the fine, rather close, and regular lamination of *S. compacta* there is developed in *S. taracodes* only an obtuse and irregular threading, least feeble posteriorly. The adult sculpture of *S. paramutica* is closer than that of *S. taracodes*, sharper, more elevated posteriorly, and flattening rather than evanescent anteriorly.

Occurrence: Shoal River formation, localities 5079^p, 9957^r, 10603^p.

***Semele paramutica* Gardner, n. sp.**

Plate XXXI, Figures 16–17; Plate XXXII, Figure 28

Shell rather small, compressed, moderately thin, ovate-trigonal in outline. Anterior extremity produced and very broadly rounded. Posterior extremity shorter, obtusely rostrate. Base line arcuate, broadly upcurved anteriorly. Umbones low, flattened. Lunule and escutcheon not defined. External surface sculptured with concentric laminae, very fine, sharp, and closely spaced upon the umbones, flattened and closely overlapping anteriorly and medially in *Tellina*, increasingly elevated posteriorly and less closely spaced behind the rostrum; traces of a very faint secondary concentric and radial striation sometimes visible posteriorly. External ligament groove very shallow. Chondrophore deeply excavated, posteriorly produced. Cardinals rather frail; a simple laminar anterior and a mesially sulcate posterior cardinal in the right valve and a sulcate anterior and simple posterior cardinal in the left. Lateral sockets of right valve deep, their inner margins acutely elevated medially; dorsal margins of left valve modified to function as laterals. Adductor scars distinct but scarcely impressed, rudely semi-elliptical in outline. Pallial line moderately distant from the base, the sinus apparently a little lower and smaller in the right valve than in the left, somewhat obliquely ovate in both, the dorsal margin feebly or not at all arcuate, the ventral margin not coalescent.

Dimensions: Right valve (type), altitude, 10.5 millimeters; latitude, 14.5 millimeters; semidiameter, 2.2 millimeters. Left valve (paratype), altitude, 11.4 millimeters; latitude, 14.5 millimeters; semidiameter, 2.7 millimeters.

Type: Right valve, U. S. Nat. Mus. No. 353924. Paratype: Left valve, U. S. Nat. Mus. No. 355925.

Type locality: Right valve (type), No. 3742, Shell Bluff, Shoal River, Walton County, Fla. Left valve (paratype), No. 3748, Somerville mill race, Walton County, Fla.

Semele paramutica is rather widely distributed in the Shoal River and seems to be peculiar to it.

This species has a fashion of weathering in broad and somewhat irregular concentric waves that give to the shell much the aspect of the smaller, thinner *Semele stearnsii* Dall from the Chipola.

The allied Shoal River species *S. taracodes* has a more obtuse, more distant, and less regular juvenile sculpture than *S. paramutica*. The adult sculpture of *S. taracodes* is less crowded and less regular than that of *S. paramutica*.

Semele subovata Say and *Semele bella* Conrad, of the later Miocene, are probable descendants of this group.

Semele mutica Dall, from the Chipola, and *Semele compacta*, from the Oak Grove, are analogous species. *S. mutica* is smaller than *S. paramutica*, more elongated transversely, with a concentric sculpture of compressed ridges, only a little sharper and more crowded posteriorly than anteriorly. *S. compacta* is very close to *S. paramutica* in general dimensions and outline, but, as in the Chipola *S. mutica*, the concentric ridges are only a little less elevated upon the anterior and medial portions of the shell than they are upon the posterior, neither the Chipola nor the Oak Grove species exhibiting the *Tellina*-like flattening of the crowded concentric laminae upon the anterior and medial portions of the shell. The secondary concentric and radial sculpture is much less commonly and more feebly developed in *S. paramutica* than in either *S. mutica* or *S. compacta*. The pallial sinus is smaller in *S. paramutica* than it is in *S. mutica*, and the dorsal margin does not arch so high beneath the umbones.

Occurrence: Shoal River formation, localities 3742^p, 5184^r, 2238^p, 9958^p, 3748^c, ?5618^r.

***Semele sellardsi* Gardner, n. sp.**

Plate XXXI, Figures 18–19

Shell rather small and thin, moderately compressed, ovate-trigonal in outline. Umbones flattened, not very prominent, orthogyrate, set a little behind the median vertical. Anterior dorsal margin less steeply sloping than the posterior. Anterior end of shell more compressed than the posterior and broadly rounded laterally. Posterior dorsal margin obliquely descending, the lateral margin arcuate. Base line nearly horizontal medially, broadly upcurved laterally. Posterior area obscurely defined by an incipient fold. Prodissoconch smooth, shining, somewhat bulbous. Conch finely sculptured concentrically over its entire surface; earliest sculpture of sharp lirations; the adolescent shell ornamented with laminae less crowded and

more elevated, posteriorly flattened and closely overlapping anteriorly, the free edges dorsally inclined; change from adolescent to adult sculpture abrupt; a sculpture of very fine and regular lamellae similar to that upon the anterior portion of the adolescent shell developed over the entire anterior and medial portions of the adult; sculpture reduced directly behind the obscure posterior fold to a few irregular incrementals, becoming sharp and laminar directly in front of the dorsal margin, the lamellae similar to those developed upon the adolescent shell and like them ventrally inclined. Ligament internal, the chondrophore narrow but rather deeply excavated, posteriorly produced, slightly undercutting the dorsal margin. Dentition rather delicate, imperfectly preserved; two cardinals in each valve diverging slightly beneath the tips of the umbones; the posterior cardinal of the right valve and the anterior cardinal of the left stouter and possibly bifid; lateral sockets of right valve deep, their inner margins elevated medially into a dentate process; the dorsal margins of the left valve modified to function as laterals. Interior slightly thickened laterally toward the umbones. Adductor scars distinct, irregular in outline, set rather high. Pallial line moderately distant from the base, the sinus very large, obliquely ascending and ovate in outline, its broadly rounded extremity rather close to the thickened inner margin of the anterior adductor; dorsal margin of sinus feebly arcuate, the ventral margin not coalescent.

Dimensions: Altitude, 11 millimeters; latitude, 14.5 millimeters; semidiameter, 3.3 millimeters.

Type: U. S. Nat. Mus. No. 353927.

Type locality: No. 7893, Boynton Landing, Choctawhatchee River, Washington County, Fla.

Semele sellardsi is remarkable among the Alum Bluff members of the genus for its high ovate outline and the fineness and regularity of the adult sculpture. It is doubtless a member of the large group of *Semele subovata* Say, but its closer relations are not obvious.

I have the honor of dedicating this species to its collector, Dr. E. H. Sellards, formerly State geologist of Florida, now acting director of the Texas Bureau of Economic Geology and Technology.

Occurrence: Chipola formation, locality 7893^r.

Subgenus SEMELINA Dall

1900. *Semelina* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 986.

Type: *Semelina nuculoidea* Conrad. (Upper Miocene of Virginia and North Carolina; Pliocene (Caloosahatchee) of Florida; Recent from Hatteras to the West Indies.)

Dall gives the following description:

Shell small, nuculiform; sculpture uniform, close, concentric; chondrophore short; left valve without distinct laterals, the dorsal margins fitting above the laterals of the right valve; left posterior cardinal absent or obsolete, the anterior cardinal bifid; otherwise as in *Semele s. s.*

The species of this section are very similar to one another and have extended from the Oligocene through all the Tertiary horizons to the present fauna. For this reason it seems worthy of sectional rank. The characters by which the shell differs from *Semele* proper are only such as are usually correlated with diminished size.

An exceedingly thin and laminar left posterior cardinal is developed in both of the Alum Bluff species. In most individuals it is broken, but in a few it is preserved entire.

Semele (Semelina) cythereoidea Dall

Plate XXXII, Figures 1-5

1900. *Semele cythereoidea* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 994, pl. 44, fig. 5.

Dall describes this species as follows:

This species, which is abundant in the Chipola marl, is much like the preceding (*Semele nuculoidea* Conrad), from which it differs by its shorter and more triangular form, like a miniature *Cytherea*, and by its very fine, close, concentric striation. In the latter feature it surpasses the Oak Grove *S. nuculoidea* var. *striulata*, which in its turn is more finely sculptured than the Miocene type, but the *striulata* is not intermediate in form, being more elongated and parallel-sided than either its ancestor or its descendant, if we may so term the Chipola and Duplin species, respectively. The *S. cythereoidea* is also on the whole a smaller species than either of the others mentioned, the largest specimens among a large number measuring 5 millimeters long by 3.75 high and having a diameter of 1.7 millimeters. These differential characters with the figure will serve better to define the present species than a more elaborate description, which would merely recapitulate for the most part the characters of *S. nuculoidea*.

Type: U. S. Nat. Mus. No. 114678.

Type locality: No. 2564, McClelland farm, 1 mile below Baileys Ferry, Calhoun County, Fla.

The slight flattening of the anterior portion of the shell in Figure 1 is badly expressed and much exaggerated by the artist. The angular outline of the anterior extremity is due to the broken margin of the shell.

Both *Semele striulata* and *S. cythereoidea* vary rather widely within their small limits, so that there are a large number of peripheral forms which it would be exceedingly difficult to separate on outline alone. The sculpture of the Chipola species is not so much finer than that of the Oak Grove form, but it is relatively more flattened anteriorly and more elevated posteriorly. In addition there is developed in most of the Chipola forms an exceedingly faint radial striation upon the posterior area. This is also discernible on some of the Oak Grove individuals but is usually fainter. The characters of the interior are similar in the two species, though the shell of *S. cythereoidea* is the thinner, as a rule, and the dentition more delicate. There is a minute subumbonal chondrophore, a simple anterior cardinal and a stouter, feebly bifid posterior cardinal in the right valve, and a bifid anterior and simple laminar posterior cardinal in the left valve. The strong, produced lateral sockets of the right valve receive the modified dorsal margins

of the left valve. The adductor scars are obscure, the pallial sinus large, ovate, obliquely ascending, not coalescent ventrally.

No representative of these small nuculoid forms has yet been recognized in the Shoal River formation.

Occurrence: Chipola formation, localities ?10609^r, ?7893^r, 2213^p, 2564^r, 3419^r.

Semele (Semelina) striulata Dall

Plate XXXII, Figures 6-8

1900. *Semele nuculoidea* var. *striulata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 994.

Dall describes this variety as follows:

The variety *striulata* Dall, from the uppermost Oligocene of Oak Grove, Fla., differs from the typical Miocene phase of this species by its finer and, closer striation, and in most of the specimens by its more parallel-sided and elongated shell.

Shell very small, moderately heavy, evenly inflated, ovate-trigonal to subcylindrical in outline. Umbones minute, acutely pointed and opisthogyrate, thrown into prominence by the excavation of the dorsal margin behind them, placed within the posterior third. Anterior extremity produced, the dorsal and ventral margins rudely parallel, the lateral margin broadly rounded. Posterior end short, flattened but not rostrate, feebly concave directly behind the umbones, convex toward the base. External surface sculptured with a microscopically fine and close concentric lamination, more or less flattened anteriorly and erect posteriorly; a microscopically fine and fortuitous radial striation sometimes perceptible upon the posterior area. Ligament internal, lodged in a minute, subumbonal chondrophore. Dentition normal; cardinals two in number in each valve, the anterior of the right valve simple and laminar, the posterior bifid, the posterior cardinal of the left valve bifid, and the anterior very thin and simple; lateral sockets of right valve remarkably strong for so small a shell, the inner margins elevated into dentate processes; dorsal margins of left valve modified to function as laterals. Interior often slightly thickened over the area of the attached mantle surface; adductor scars distinct, the anterior comparatively large and irregular in outline, the posterior subcircular. Pallial line distinct; the sinus very large, obliquely ascending, covering perhaps one-third of the entire inner surface of the shell, extending about three-fourths of the distance across to the anterior adductor and almost as high as it is broad; lateral extremity arcuate; ventral margin not confluent with the pallial line.

Dimensions: Right valve (cotype), altitude, 3.3 millimeters; latitude, 4.5 millimeters; semidiameter, 1.1 millimeters. Left valve (cotype), altitude, 3 millimeters; latitude, 4.2 millimeters; semidiameter, 0.9 millimeters.

Cotypes: U. S. Nat. Mus. No. 353928.

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

The Chipola analog *S. cythereoidea* Dall is higher relatively and more finely and sharply sculptured.

Occurrence: Oak Grove sand, localities 2646^p, 5632^r, 7054^r, 9961^r.

Genus ABRA (Leach MS.) Lamarck

1818. *Abra* (Leach MS.) Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 492.

Type: *Maetra tenuis* Montagu. (Recent off the English and Irish coasts.)

Most of the European conchologists, including Forbes and Hanley, Stoliczka, and Lamy, reject *Abra* in favor of *Syndesmya* Recluz, 1843. Lamarck, in listing Leach's manuscript name, did not, to be sure, characterize the genus, but he gave a new name to a known and recognizable shell, and as Cossmann⁹ pointed out, the genotype is beyond question. Whether or not Lamarck had it in his mind to create a new genus is not the concern of nomenclature.

Shell small, ovate to trigonal or rudely quadrate in outline; rather compressed, flexuous posteriorly. Umbones low, subcentral to posterior, prosogyrate. Outer surface smooth or finely sculptured concentrically. Internal ligament stronger than the external, the chondrophore narrow but produced and deeply inset beneath the umbones. Dentition delicate; normally two simple cardinals developed in each valve; the modified dorsal margins of the left valve received in the lateral sockets of the right. Pallial sinus deep, confluent ventrally with the pallial line.

The Recent forms are relatively few in number but have a wide geographic and bathymetric range.

Two species have been recognized in the Alum Bluff group—*Abra cylicion* Gardner, n. sp., from the Shoal River formation, known only from a single valve, and the rather common Chipola species *Abra lapochi* Gardner, n. sp., a form curiously close in its external aspect to a coexistent *Tellina*.

External surface smooth.....*Abra cylicion* Gardner, n. sp.
External surface concentrically laminated away from the umbones.....*Abra lapochi* Gardner, n. sp.

***Abra cylicion* Gardner, n. sp.**

Plate XXXII, Figures 9-10

Shell small, thin, flexuous, strongly convex anteriorly, less strongly posteriorly, ovate-trigonal in outline. Umbones small but well rounded, feebly prosogyrate, placed a little behind the median horizontal. Neither lunule nor escutcheon defined. Anterior extremity produced and very broadly rounded. Posterior extremity shorter and obtusely rostrate. Anterior dorsal margin more gently sloping than the posterior. Anterior lateral margin broadly and smoothly rounded;

⁹ Cossmann, A. E. M., and Peyrot, A., Conchologie néogénique de l'Aquitaine, vol. 1, p. 215, 1910.

posterior lateral margin quite squarely truncate. Base line flexuous, down-curved anteriorly along the area of the maximum convexity. External surface smooth excepting for faint incremental striae, least feeble behind the rostrum. A strong color banding preserved, possibly inherited from the original pattern. External ligament support very frail, the groove behind it shallow. Chondrophore narrow but deep, posteriorly produced and undercutting the posterior dorsal margin. Right cardinals delicate, the anterior simple, laminar, free from the dorsal margin, the posterior also slender but mesially sulcate. Lateral sockets very shallow and distant from the umbones. Interior feebly corrugated, the adductor and pallial scars moderately distinct for so thin a shell. Muscle scars not very large, rudely semielliptical in outline, placed at the extremities of the lateral sockets. Pallial sinus large, produced, about three-fourths of the distance across to the anterior adductor; the dorsal margin of the sinus nearly horizontal and falling only a little above the median line of the shell, its lateral extremity rather narrowly rounded, obliquely descending to the pallial line, which falls rather close to the basal margin.

Dimensions: Altitude, 7.5 millimeters; latitude, 10 millimeters; semidiameter, 2.8 millimeters.

Type: U. S. Nat. Mus. No. 353929.

Type locality: No. 3856, 6 miles west-northwest of Mosseyhead, Walton County, Fla.

The inflated, almost cup-shaped outline and the absence of external sculpture will readily separate the Shoal River form from *Abra lapochi*, of the Chipola. *Abra triangulata* Dall, from the Bowden, is more closely allied, but the shell is smaller and thinner and the laterals even more reduced than in *A. cylicion*.

Occurrence: Shoal River formation, localities, 3856^r, 7264^r.

***Abra lapochi* Gardner, n. sp.**

Plate XXXII, Figures 11-13

Shell small, rather thin, strongly inflated, inequivalve, inequilateral, transversely ovate-trigonal in outline. Umbones well rounded, acute at their tips, feebly prosogyrate, posterior in position. Lunule rather short, lanceolate, depressed, outlined by a narrow keel, wider in the right valve than in the left. Escutcheon linear in the right valve, perceptibly wider in the left, extending the entire length of the posterior dorsal margin. Anterior extremity of shell produced and broadly rounded; the anterior dorsal margin rudely parallel with the base; the anterior lateral margin smoothly rounded. Posterior extremity short and flexuous, obliquely truncate. Right valve obtusely rostrate, the rostrum emphasized by the rather sharp constriction behind it. Left valve with an obscure fold corresponding to the depression

in the right valve and a very shallow depression corresponding to the keel in the right valve, with a second narrow and obscure fold directly behind the escutcheon. Basal margin flexuous, sharply produced at the posterior basal angle. External surface polished, smooth toward the umbones except for feeble incrementals, sculptured on the medial and ventral portions with fine, sharp, closely and regularly spaced concentric laminae inclined to be somewhat flattened anteriorly and medially and more nearly erect upon the rostrum, particularly of the left valve. External ligament attached to a short and frail support with a narrow groove behind it. Resilifer narrow but rather deep, posteriorly produced parallel to the dorsal margin. Cardinals two in number in each valve; the right anterior and the left posterior simple and laminar; the left anterior and the right posterior slender and deltoid but not mesially sulcate; lateral sockets in right valve fairly close to the umbones, fairly deep, with strong, medially elevated inner margins; dorsal margins of left valve modified to function as laterals. Adductor and pallial scars often obscure; adductor scars rather large, irregular in outline. Pallial sinus apparently similar in the two valves, the dorsal margin rising a little after quitting the upper inner margin of the posterior adductor, then gently descending and near the anterior adductor scar rounding rather sharply into the pallial line; ventral margin entirely coalescent with the pallial line; pallial line running nearer to the base posteriorly than anteriorly.

Dimensions: Right valve (cotype), altitude, 6.7 millimeters; latitude, 9.5 millimeters; semidiameter, 2.5 millimeters. Left valve (cotype), altitude, 6.9 millimeters; latitude, 10.5 millimeters; semidiameter, 2.6 millimeters.

Cotypes: U. S. Nat. Mus. No. 353930.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

Abra lapochi is readily separated from *Abra cylicion*, the only other representative of the genus in the Alum Bluff group, by the more transversely elongate, less inflated valves and the development of a surface sculpture. There is, however, an extraordinarily close superficial resemblance between *Abra lapochi* and the coexistent *Tellina hypolispa* Dall. The general dimensions and contour of the two species are the same, though the *Abra* is a little more inflated, and there is a remarkable resemblance in the surface polish and sculpture. In fact, if the characters of the interior were not known it would be a matter of no little difficulty to discriminate between the two forms.

Occurrence: Chipola formation, localities 2213^r, 2211^c.

Family DONACIDAE Deshayes

Genus DONAX (Linnaeus) Lamarck

1758. *Donax* Linnaeus, Systema naturae, 10th ed., p. 682. (No type selected.)
 1799. *Donax* Lamarck, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 85.
 1847. *Donax* Gray, Zool. Soc. London Proc., vol. 15, p. 187.

Type: *Donax rugosa* Linnaeus. (Recent in the West Indies.)

Shell rather solid, moderately inflated, of varying dimensions, elongate cuneate to trigonal to subcylindrical in outline. Umbones subcentral to posterior, opisthogyrate. Sculpture finely radial, often subcutaneous, sometimes punctate. Ligament both external and internal; external ligament short, heavy, inset; the resilium seated on short, usually excavated nymphs. Dentition rather rude; normally two cardinals in each valve, one of them commonly bifid; laterals varying widely in strength and relative position within the genus. Pallial sinus deep, partly confluent ventrally with the pallial line. Inner margins serrate.

The genus is remarkably uniform and well characterized by its solid, more or less pronounced cuneate and flexuous valves, opisthogyrate and usually posterior umbones, and serrated inner margins. The earliest known occurrence of the form is in the Eocene. The living species, about 100 in number, inhabit the sandy beaches of the warm and tropical seas. They are lovely little bivalves, ornamented with varicolored rays upon a dull gray or dun background. The "pampalone shells," as they are called along the Florida coast, where they are particularly abundant, are used to a considerable extent for food.

Considering that the genus was fairly well established in the early Miocene and that the Alum Bluff was laid down under warm temperate to subtropical conditions, *Donax* has a surprisingly meager representation. Five species and subspecies have been described, and there is at least one other indicated only by fragments, but all of these are comparatively rare. The three Chipola forms are closely related, but they are quite distinct from either the Oak Grove or the Shoal River species. The Oak Grove *D. aldrichi* is without close allies, but the Shoal River *D. valhosierr* is probably referable to the group of *D. fossor* Say and *D. emmonsi* Dall, of the later Miocene and Pliocene, and *D. variabilis* Say, of the Recent fauna.

Umbones conspicuously posterior; the anterior extremity very much narrower and more produced than the posterior; posterior area not concentrically laminated:

Shell only a little more than half as wide as it is high, not flexuous nor constricted behind the anterior rostrum.

Donax chipolanus Dall s. l.

Shell compressed anteriorly, not rostrate; posterior dorsal margin short, rectilinear.

Donax chipolanus Dall s. s.

Shell obtusely rostrate anteriorly; posterior dorsal margin scarcely perceptible, merging with the lateral margin.

Donax chipolanus subsp.? *curtulus* Dall.

Shell decidedly more than half as wide as it is high, flexuous, constricted behind the anterior rostrum.

Donax trueloides Gardner, n. sp.

Anterior dorsal margin subparallel to the base; posterior area concentrically laminated.

Donax (Paradonax) aldrichi (Dall MS.), Gardner.

Umbones not conspicuously posterior; the anterior extremity only a little narrower and more produced than the posterior; posterior area not concentrically laminated.

Donax (Paradonax) valhosierr Gardner, n. sp.

Section DONAX s. s.

Type: *Donax rugosa* Linnaeus. (Recent in the West Indies.)

Donax s. s. includes the elongate cuneate forms with the radial sculpture relatively well developed, the posterior of the two right cardinals heavy and often bifid, the laterals usually close to the beaks and fairly strong. The group is abundantly represented in the West Indies and has a wide distribution in the warm waters of the Atlantic and Pacific Oceans.

Donax chipolanus Dall

Plate XXXII, Figure 18

1900. *Donax chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 966, pl. 44, fig. 20.

Dall describes this species as follows:

Shell small, thin, smooth, with faint radial striation behind; anterior end smaller, produced, rather bluntly rounded at the end; anterior dorsal margin rectilinear, basal margin nearly straight; posterior end wider, short, not carinate or markedly truncate but bluntly rounded; right valve with well-marked sockets for the laterals, the anterior one longer; ventral edge finely serrate, the serrations shorter below the beak; pallial sinus subquadrate, horizontal, ventral portion largely confluent with the pallial line. Longitude 9.5, altitude 5.5, diameter 3 millimeters.

A single valve was obtained by Burns, which has been bored by a gastropod. The shell is remarkably fresh and still retains traces of purple coloration along the hinge line.

Type: U. S. Nat. Mus. No. 114682.

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

The type remains unique.

The short, wide posterior end and the produced and tapering anterior end readily separate the species from the larger, heavier, trigonal *D. trueloides*, the relatively lower *D. aldrichi*, and the less strongly inequilateral *D. valhosierr*.

Occurrence: Chipola formation, locality, 2213^r.

Donax chipolanus subsp.? *curtulus* Dall

Plate XXXII, Figure 19

1900. *Donax chipolana* subsp. *curtula* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 966.

Dall gives the following description:

With it [*Donax chipolana* Dall] was another valve of smaller size which may represent a distinct species or an extreme varia-

tion of the preceding. The umbo is more posterior, the anterior end more pointed, and the posterior end shorter and more rounded. In view of the variability of species of this group I prefer, until more material comes to hand, to regard it as a variety *curtula* of the *D. chipolana*.

Dimensions: Altitude, 3.5 millimeters; latitude, 5.5 millimeters.

Type: U. S. Nat. Mus. No. 108446.

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

No further material has been obtained to aid in establishing the status of this single valve. The shell is worn but seems to be heavier than that of *D. chipolanus* and is decidedly more convex, especially toward the umbones. The dentition of the inner margins is stronger in the smaller shell, though the relative strength of the anterior and posterior series is much the same. On the other hand, there is a remarkable similarity in the general contour of these two unusual shells. Further evidence is needed before a satisfactory decision can be made.

Occurrence: Chipola formation, locality 2213^r.

***Donax trueloides* Gardner, n. sp.**

Plate XXXII, Figures 20-22

Shell of moderate dimensions, polished, rather heavy, flexuous, high, trigonal in outline, quite strongly inflated posteriorly, rather compressed anteriorly, obscurely rostrate posteriorly, rather sharply rostrate anteriorly and constricted behind the rostrum. Umbones prominent, somewhat angular, flattened upon their summits, the tips acute, incurved, and opisthogyrate. Lunule and escutcheon suggested by a slight change in the surface texture and the absence of any radial lineation. Anterior extremity obliquely truncate from the umbones to the anterior basal margin, obtusely angulated ventrally. Posterior dorsal margin projecting slightly behind the umbones, then rounding sharply into the lateral margin. Posterior lateral margin steeply descending, very feebly arcuate, merging rather smoothly into the base. Base line flexuous, produced at the anterior rostral angle, constricted behind it, and broadly curved posteriorly. External surface faintly lineated radially, the radials least feeble over a cordate area behind the posterior rostrum; a fine lineation also discernible in front of the posterior rostrum and behind the anterior, absent altogether directly behind the anterior margin and over a cordate area behind the umbones. Ligament probably amphidetic, the portion in front of the beaks, however, much reduced, penetrating the hinge plate behind the beaks; area of attachment behind the beaks somewhat V-shaped, the two arms of the V separated by a shelly plate projecting from underneath the umbones. Dentition much concentrated; anterior cardinal of right valve apparently atrophied; posterior cardinal subumbonal, very stout and deltoid; anterior

and posterior cardinals of left valve diverging on either side of the deep, triangular, subumbonal socket; the anterior more laminar, the posterior stouter at the base; laterals very short and close to the umbones, reduced to an anterior and a posterior dentate process in the left, received in corresponding sockets of the right. Characters of interior obscure. Adductor muscle scars apparently small, the anterior placed down near the anterior basal angle, the posterior much higher. Pallial line and sinus obscure.

Dimensions: Left valve (immature paratype), altitude, 7 millimeters; latitude, 10.2 millimeters; semidiameter, 2.6 millimeters. Right valve (type), altitude, 9.5 millimeters; latitude, 12.2 millimeters; semidiameter 3.7 millimeters.

Types: U. S. Nat. Mus. No. 353932.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The immature forms are much less elevated than the adults.

Donax trueloides is much higher relatively and more flexuous than any other Alum Bluff *Donax*.

Occurrence: Chipola formation, locality 2211^r.

***Donax* sp.**

A fragment of a large species, possibly 20 millimeters long and 30 millimeters wide, was collected near Shell Bluff on Shoal River. It is totally unlike any of the described forms from the Atlantic Coastal Plain and suggests rather *Donax denticulata* Linnaeus or *Donax striata* Linnaeus, of the Recent West Indian fauna, a group recognized also in the Pliocene of Costa Rica.

Occurrence: Shoal River formation, locality 3733^r.

Section PARADONAX Cossmann

1910. *Paradonax* Cossmann. Cossmann and Peyrot, *Conchologie néogénique de l'Aquitaine*, vol. 1, p. 293.

Type: *Donax transversa* Deshayes. (Miocene of southern France.)

The section is characterized by the trigonal to subcylindrical outline, the subcutaneous radial sculpture, the small, concentrated hinge, and the feeble or obsolete anterior laterals.

Donax aldrichi Gardner from the Oak Grove sand, bears a remarkable resemblance to the type species—a resemblance that is probably not without significance, for *Donax transversa* Deshayes and its allies were widely distributed in southern Europe through Miocene and possibly Pliocene time.

***Donax (Paradonax) aldrichi* (Dall MS.) Gardner, n. sp.**

Plate XXXII, Figures 14-15

Shell rather small, very highly polished, subcylindrical in outline, over twice as wide as it is high; the umbones placed near the posterior fourth. Anterior end accordingly very much produced; the anterior dorsal margin rudely parallel to the base, the anterior

lateral margin quite strongly rounded. Posterior end acutely rostrate, the posterior lateral extremity bowed out slightly from the umbones to the rostral angle, rounding abruptly into the base. Umbones angular, inconspicuous, the tips acute and opisthogyrate. Both lunule and escutcheon suggested but not defined. Prodissoconch much less elongated transversely than the conch, smooth, polished. A faint but very uniform and regular radial lineation developed over the disk of the conch from directly behind the anterior curvature to directly in front of the rostrum, strengthening slightly toward the ventral margin; area behind the rostrum sculptured with concentric ridges which become increasingly acute and more distantly spaced ventrally. Ligament amphidetic, the portion in front of the beaks linear and much reduced; the area of attachment behind the beaks very short and irregular in outline, invading the hinge plate; left valve only known. Dentition much concentrated; cardinals two in number, the anterior the more robust, diverging on either side of a deep, triangular, subumbonal socket; short, dentate lateral processes also developed on either side of the cardinals, the anterior lateral separated from the cardinal only by a shallow sulcus; the posterior a little more removed. Characters of interior obscure. Adductor scars rather large and rudely semi-elliptical in outline. Pallial line running closer to the base posteriorly than anteriorly. Pallial sinus rudely quadrate, its lateral extremity approximating the median vertical, coalescent ventrally. Inner margins strongly fluted in harmony with the external radials.

Dimensions: Altitude, 7.5 millimeters; latitude, 15.8 millimeters; semidiameter, 2.2 millimeters.

Type: U. S. Nat. Mus. No. 109199.

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

The species is known only from a single left valve remarkable for its high polish, transversely elongated subcylindrical outline, and sharp concentric sculpture behind the acute posterior keel.

The similarity between *Donax aldrichi* and the type species of the section, *Donax transversa* Deshayes, from the Miocene of southern France, is most striking. In outline, dimensions, and general appearance of both the outer and inner surfaces the two shells are practically identical. The one character by which they may be readily separated is the greater prominence and isolation of the left anterior lateral of the American species.

Occurrence: Oak Grove sand, locality 2646^r.

Donax (Paradonax) valhosierr Gardner, n. sp.

Plate XXXII, Figures 16, 17

Shell small, rather thin, fragile, not strongly inequilateral, moderately inflated, compressed anteri-

orly, obtusely rostrate posteriorly. Umbones small, inconspicuous, the tips acute and feebly opisthogyrate, slightly posterior. Neither lunule nor escutcheon defined. Dorsal margins diverging from the umbones at an angle of a little more than 90°, the anterior more gently sloping than the posterior, particularly in the adult forms, and also more produced. Anterior lateral margin rather sharply rounded. Posterior lateral margin broader. Base line very feebly arcuate. External surface smooth and polished with a subsurficial radial lineation developed over the greater part of the disk, strongest medially. Ligament amphidetic, reduced and sublinear anteriorly; the posterior area of attachment irregular; the nymph somewhat spoon-shaped. Dentition much concentrated; anterior cardinal of right valve simple, laminar; posterior cardinal subumbonal, stout, deltoid, mesially sulcate; cardinals of left valve diverging on either side of the deep, triangular, subumbonal pit; the posterior cardinal a little heavier than the anterior; a dentate lateral developed on either side of the left cardinals and very close to them; corresponding sockets excavated in the right valve. Interior slightly thickened laterally toward the umbones. Adductor scars irregular in outline, the anterior smaller and closer to the base. Pallial line moderately removed from the hinge; the sinus deep, covering about two-thirds of the distance to the anterior adductor, partially coalescent below. Inner margins finely crenate in harmony with the subsurficial radials.

Dimensions: Right valve, altitude 7 millimeters; latitude, 12 ± millimeters; semidiameter, 2.3 millimeters.

Type: U. S. Nat. Mus. No. 353931.

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

Donax valhosierr is decidedly less inequilateral than any other Alum Bluff *Donax* and approaches more closely to the dominant forms of the later Miocene and Pliocene, such as *Donax fossor* Say and *Donax emmonsii* Dall.

Occurrence: Shoal River formation, locality 5079^p.

Family PSAMMOBIIDAE Dall

Genus PSAMMOBIA Lamarck

1818. *Psammobia* Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 511.

1822. *Psammobia* Bowdich, Elements of conchology, pt. 2, p. 6, pl. 1, fig. 10.

Type: *Tellina feröensis* Gmelin. (Recent off the shores of northern Europe.)

Shell moderately large, transversely elongated, slightly gaping, rudely elliptical in outline, more or less rostrate posteriorly; umbones subcentral; dorsal margins gently sloping; anterior extremity broadly rounded; posterior extremity more or less truncate;

surface sculpture usually feeble and irregular upon the anterior and medial portions of the disk, stronger and more uniform upon the posterior area; ligament strong, external, opisthodontic; dental formula variable—usually two subumbonal cardinals in each valve, the posterior cardinal of the right valve and the anterior cardinal of the left often feebly sulcate; pallial line distant from the margin; pallial sinus profound, the ventral margin wholly or in part coalescent with the pallial line.

The Recent species are not very numerous, but they have a wide distribution in the shallow waters.

The genus is represented in the Alum Bluff group by only a single rare species, which is, however, found in both the Chipola and the Shoal River formations.

***Psammobia bowdichi* Gardner, n. sp.**

Plate XXXII, Figures 23-26

Shell of moderate dimensions for the group, highly polished when fresh, rather thin and compressed, transversely elliptical in outline, obscurely rostrate posteriorly. Neither lunule nor escutcheon defined. Umbones subcentral or slightly anterior, low, compressed, acutely pointed at their tips, orthogyrate, proximate. Both anterior and posterior dorsal margins very gently declining, the posterior a little higher than the anterior. Lateral margins very broadly rounded. Base line nearly horizontal. Surface sculpture, for the most part, incremental in character, the medial portion of the shell smooth excepting for occasional growth striae, which become more pronounced ventrally and anteriorly, the growth stages indicated behind the rostrum by acute, regularly spaced concentric ridges, tending to develop into overlapping laminae, the free edges ventrally inclined. Ligament external, opisthodontic, the nymph produced about half the length of the posterior dorsal margin, the groove narrow but deep. Dentition reduced to two proximate cardinals in each valve springing from directly beneath the umbones, those of the right valve elevated, the posterior a little more robust than the anterior and feebly sulcated upon its upper surface. Teeth imperfectly preserved in the left valve, apparently a little more slender than those of the right valve. Inner surface thickened slightly within the area of the attached mantle. Adductor scars distinct, irregular in outline, not very high, placed rather high up under the dorsal margins. Pallial sinus distinct, ovate, covering a little more than half the intervening distance between the two adductors, the dorsal margin slightly curved, the lateral extremity broadly rounded, the ventral margin partially coalescent. Pallial line removed from the base.

Dimensions: Left valve, altitude, 11.5 millimeters; latitude, 19.5 millimeters; semidiameter, 3 millimeters.

Type: U. S. Nat. Mus. No. 353933.

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

Imperfect individuals attaining an altitude of 35 millimeters are found in both the Chipola and Shoal River formations.

Psammobia bowdichi Gardner n. sp., has been confused in the check lists and collections with *Psammobia papyria* Conrad, a Jackson species with a well-defined *Tellina*-like sculpture of overlapping lamellae dorsally inclined.

The three imperfect valves from Shoal River are tentatively referred to *P. bowdichi*, though they may prove subspecifically distinct. They seem to be a little more elongated transversely and somewhat more compressed than the Chipola individuals. The Shoal River forms exhibit a rather strong concentric banding inherited possibly from the original color pattern.

Psammobia bowdichi has been referred to *Psammobia* s. s. rather than to *Gobraeus*, the subgenus to which most of the fossil species are assigned.

Occurrence: Chipola formation, localities 2212^r, 2213^r. Shoal River formation, locality ?3733^r.

Genus TAGELUS Gray

1847. *Tagelus* Gray, Zool. Soc. London Proc., vol. 15, p. 189.

1817. *Siliquaria* Schumacher, Essai d'un nouveau système des habitations des vers testacés, p. 129.

Not *Siliquaria* Bruguière, 1789, Encyclopédie méthodique, vol. 6 (Histoire naturelle des vers), p. 15.

Type: *Solen gibbus* Spengler. (Fossil from the late Miocene to Recent from Cape Cod to Brazil and on the west coast of Africa.)

Dall,¹⁰ in 1900, described this genus as follows:

Beaks median or subposterior; teeth two in each valve, simple pedunculate; valves without constriction or clavicle, straight; pallial sinus deep, reaching to or beyond the beaks; posterior adductor scar rounded; pallial sinus with the ventral part partially coalescent with the pallial line; situs estuarine or marine.

The Recent forms are separated from certain members of the Solenidae which they closely resemble by the hinge characters and the very much longer siphons. The genus has been recognized in rocks as old as the Cretaceous.

Though the number of species referable to *Tagelus* is very small, yet this genus includes two species of remarkable longevity—one the type of *Tagelus* s. s., the other of the subgenus *Mesopleura*. *Tagelus gibbus* Spengler has not been found in strata older than the Yorktown formation, but the ancestors of *Tagelus divisus* Spengler were flourishing certainly as early as Chipola time.

Subgenus MESOPLEURA Conrad

1867. *Mesopleura* Conrad, Am. Jour. Conchology, vol. 3, app., p. 23.

Type: *Mesopleura (Solen) bidentata* Spengler = *Solen divisus* Spengler. (Pliocene and Pleistocene of the

¹⁰ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 982.

southeast coast and Recent from Massachusetts to the West Indies.)

The subgenus is characterized by the presence of an internal rib. This is apparently an archaic character, as it is stronger in Miocene forms than in the Recent and stronger in the young than in the adults.

Tagelus (Mesopleura) sp. cf. T. divisus (Spengler)

Plate XXXII, Figure 27

1794. *Solen divisus* Spengler, Skrivter af Naturhistorie Selskabet, vol. 3, p. 96, Kioebenhavn.

1900. *Siliqua subaequalis* Gabb. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 956 (part).

Not *Siliqua subaequalis* Gabb. Am. Philos. Soc. Trans., vol. 15, p. 247, 1873.

Shell rather small for the group, thin, gaping, subcylindrical, equivalve, slightly inequilateral, moderately compressed, somewhat flattened laterally but not rostrate. Umbones inconspicuous, orthogyrate, proximate, slightly anterior. Anterior end the shorter, obtusely truncate at its extremity. Posterior end produced, broadly but asymmetrically rounded. Base line nearly rectilinear. External surface smooth except for incrementals, least feeble upon the lateral areas. Ligament external, mounted on a linear nymph a little less than one-half as long as the posterior dorsal margin. Cardinals two in number in each valve, springing from beneath the umbones; the anterior cardinal of the right valve long, slender, recurved at the pointed tip, flattened on the inner surface; posterior right cardinal also long and recurved and flattened upon its inner surface but spatulate, the extremity expanded horizontally and feebly sulcated; anterior cardinal of left valve thin and laminar to fit between the flattened and proximate inner surfaces of the right cardinals; posterior left cardinal also laminar but more nearly parallel to the dorsal margin than to the anterior cardinal. Laterals not developed. Internal rib sharply defined dorsally, widening slightly and evanescent toward the base. Adductor scars distinct, rather large and irregular, set high up under the dorsal margins. Pallial line distinct, rather far removed from the base. Pallial sinus ovate, expanded at its extremity, almost but not quite touching the inner rib, coalescent ventrally with the pallial line. Margins very thin.

Figured specimen: U. S. Nat. Mus. No. 27437.

In *Siliqua*, to which these fragments have been referred in previous check lists, the posterior right cardinal is elongated parallel to the dorsal margin and received between two horizontal laminae in the left valve. There are, in addition, in the left valve two laminar subumbonal cardinals, all of them quite distinct from the *Tagelus* teeth. In *Siliqua* the pallial sinus is short and broad; in *Tagelus* it is very deep.

The Chipola form is well represented by fragments, but no perfect individuals are available. There is only

one character in which it seems to differ from the Recent species—namely, the strength of the internal rib. In the Miocene type this rib, though it is slightly broader and less elevated away from the umbones, is sharply defined as far as the pallial line. In the Recent species both the rib and the streak of yellowish-brown color that defines the rib externally and internally often disappear halfway between the umbones and the ventral margins. By whatever name these forms are called, they represent a remarkably persistent race. *Tagelus gibbus*, the type of the genus, has itself existed unchanged since the late Miocene. It is rather common in the Miocene cliffs below Yorktown, and in the waters at the base of the cliffs the Recent representatives are flourishing.

The Shoal River species, on the other hand, is certainly distinct. The shell is larger and thinner, and the pallial sinus is not expanded at its extremity.

Occurrence: Chipola formation, localities 2564^p, 3419^c, 2211^r.

Tagelus (Mesopleura) sp.

Fragments of a second member of the *Tagelus* group are present in the Shoal River formation. They indicate a species differing from both the Chipola form and the recent *T. divisus* (Spengler) in the larger, thinner shell and the narrower pallial sinus. In the other forms of the *Tagelus divisus* group the dorsal margin is decidedly arcuate and the outline of the sinus decidedly ovate. In the Shoal River species the dorsal margin of the sinus is nearly or quite parallel to the ventral margin, and its lateral extremity is symmetrically rounded.

Occurrence: Shoal River formation, localities 3856^p, 5192^r.

Genus PSAMOSOLEN Risso

1826. *Psammobia* Risso, Histoire naturelle de l'Europe méridionale, vol. 4, p. 375.

Not *Psammobia* Risso, 1826, idem, p. 350.

1826. *Psamosolen* Risso, idem, vol. 5, Index corrigendum, p. 397.

Type: *Solen strigilatus* Linnaeus. (Recent in the Mediterranean.)

Psamosolen has been commonly written with two m's. The single m was possibly an error on the part of Risso, but the word as it stands in the index, the only place in his volume in which it appears, is written *Psamosolen*. The correction of the popular misspelling was made by Woodring¹¹ in 1925.

Shell thin, gaping, often rather high, subcylindrical in outline, obtusely truncate laterally; umbones low, subcentral or anterior; external sculpture incised, oblique, similar in character to that of *Divaricella*, more rarely concentric; ligament external, opisthodic; two elevated, often recurved, subumbonal cardinals in each valve; laterals not developed; adductor

¹¹ Woodring, W. P., Miocene mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub. 366, p. 182, 1925.

scars dorsal in position; pallial sinus deep, not coalescent ventrally.

The characters of the hinge and the sinus ally *Psamosolen* with *Tagelus* and the Psammobiidae rather than with *Solen* and the Solenidae.

Psamosolen has had a meager distribution in the temperate and tropical waters from the Tertiary period on. A single species in the Chipola known from rather numerous fragments and a juvenile from Shoal River establish the presence of the genus in the upper and lower beds of the Alum Bluff group.

***Psamosolen aldrichi* Gardner, n. sp.**

Plate XXXIII, Figures 2-3

1900. *Psamosolen vicksburgensis* Aldrich. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 960 (part).

Not *Solecortus vicksburgensis* Aldrich, Cincinnati Soc. Nat. Hist. Jour., vol. 8, p. 145, 1885.

Not *Macha vicksburgensis* Aldrich, Alabama Geol. Survey Bull. 1, p. 37, pl. 2, fig. 1, 1886.

Shell thin, gaping both laterally and dorsally, subcylindrical in outline, about twice as wide as it is high, moderately and evenly compressed. Umbones low, flattened, the tips proximate and orthogyrate, slightly anterior, produced a little beyond the dorsal margin. Lunule and escutcheon not defined. Anterior dorsal margin very gently declining. Posterior dorsal margin nearly rectilinear and parallel to the base. Lateral margins broadly rounded. Prodissoconch minute, flattened, smooth, shining. Characteristic incised sculpture developed over the medial and posterior portions of the conch, ceasing abruptly along a line dropped from directly in front of the umbones and inclined slightly forward; anterior portion ornamented only with rather strong incrementals and obscure and irregular radials; sculpture upon medial and posterior portions fine and quite regular, the free edges of the grooves inclined medially and running at a high angle to the base, sinuous posteriorly, sharply upcurved along an imaginary diagonal from the umbones to the posterior basal margin. Ligament external, opisthodontic, attached to relatively short but heavy nymphs. Cardinals two in number in each valve, elevated and slightly recurved, the anterior tapering subacutely, the posterior laminar and oblique to the dorsal margin; anterior cardinal of left valve also laminar and somewhat twisted; the posterior cardinal much reduced and usually broken away even in the Recent shells; the heavier teeth medial and clasping in the closed valve; the more slender teeth anterior and posterior. Inner surface strengthened by feeble and irregular radials and concentric corrugations. Adductor scars and pallial sinus obscure. Adductors close to the dorsal margin, irregular in outline, the anterior larger. Pallial sinus rather narrow but produced beyond the beaks.

Dimensions: Altitude, $15 \pm$ millimeters; latitude, $35 \pm$ millimeters; semidiameter, 4.5 millimeters.

Type: U. S. Nat. Mus. No. 353934.

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

It is regrettable that the material is so fragmentary, but because of the confusion in the synonymy and the chances against finding so thin and delicate a shell perfectly preserved it has seemed unwise to await more suitable material.

The type of *P. vicksburgensis* Aldrich (Pl. XXXIII, fig. 1) has been kindly loaned by Johns Hopkins University. It represents a smaller, more compressed species, more elongated transversely. The surface is much worn, and the details of the sculpture are rather obscure. The anterior area is, however, much narrower than in the Alum Bluff form. The oblique groovings are certainly continued well over the anterior basal angle, whereas in *P. aldrichi* they disappear abruptly along a line which falls almost horizontally from the umbones. This character is constant in all the individuals examined. The Bowden form, which has also been included under *P. vicksburgensis*, is apparently closer to the Vicksburg than to the Alum Bluff species.

Psamosolen aldrichi is remarkable for the fineness and uniformity of the ornamentation. In outline it suggests *Psamosolen sanctae-marthae* D'Orbigny, of the Recent fauna, a species with a coarser grooving developed over a larger area.

I have the pleasure of naming this interesting form in honor of Truman H. Aldrich, of Birmingham, Ala., who has kept the love for natural science so often obscured in these days of high specialization.

Occurrence: Chipola formation, locality 2213^o.

***Psamosolen* sp.**

A single juvenile suggesting *Psamosolen cumingianus* Dunker more closely than any other species described from the east coast was collected from Shell Bluff, on Shoal River in Walton County, Fla. It is decidedly more than half as wide as it is high, strongly rounded laterally, and sculptured with about a dozen irregular groovings.

Occurrence: Shoal River formation, locality 3742^r.

Superfamily SOLENACEA Lamarck

Dall ¹² gives the following description:

Dwellers in soft bottom, narrow, elongated, modified for burrowing, with anterior and posterior ends both gaping; foot elongated, distally modified to serve as a piston or stilt within the burrow; aorta with postventricular dilation; hinge without lateral laminae.

¹² Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 3, p. 555, 1895.

Family SOLENIDAE Leach

Dall¹³ describes this family as follows:

Shell substance as in *Tellina*, but the external layer showing its cellular structure more clearly; with a pronounced epidermis; valves equal, free, usually truncate at both ends, and more or less inequilateral, with low beaks, smooth margins, smooth or feebly sculptured, not rostrate; adductor scars narrow, elongate, dorsally distributed, pedal distinct; pallial sinus small in species, with anterior umbones and vice versa; ligament and resilium external, parivincular, seated on nymphs; area obscure or none; hinge plate hardly developed; hinge often with a thickened ray crossing the valves and serving as a buttress; cardinals varying from one to four in each valve, usually a single slender radial laminar cardinal in the right, and two in the left valve; with or without one or two placed parallel with the hinge margin, simulating laterals; radial teeth usually more or less pedunculated, rarely bifid.

Genus SOLEN (Linnaeus) Lamarck

1758. *Solen* Linnaeus, *Systema naturae*, 10th ed., p. 672.
 1777. *Solen* Scopoli, *Introductio ad historiam naturalem sistens genera lapidum, plantarum et animalium hactenus detecta characteribus essentialibus donata in tribus divisa sub inde ad legas naturae*, Prague. (No type selected.)
 1799. *Solen* Lamarck, *Prodrome d'une nouvelle classification des coquilles*: Soc. hist. nat. Paris Mém., p. 83.

Type: *Solen vagina* Lamarck (not *Solen vagina* Linnaeus) = *Solen marginatus* Pulteney. (Recent on the European shores from Scandinavia to the Mediterranean and possibly to the Red Sea.)

Shell long, narrow, generally straight, subcylindrical; umbones anterior, subterminal; external surface polished, smooth or feebly sculptured; ligament external, elongated; hinge armature limited to a single cardinal in each valve; anterior adductor muscle impression very long and narrow, near and parallel to the dorsal margin; posterior impression semielliptical; pallial line distinct, sinus shallow.

Indubitable species of this genus are known to occur in the Triassic and some doubtful mid-Paleozoic forms have been included under it by certain authors. The recent species are about 50 in number and world-wide in distribution. The majority are littoral. At the approach of danger they burrow rapidly downward by means of the alternate extension and contraction of the foot, which serves first as a blade to cut through the sand and then as an anchor to which they may hold until the valves can be pulled down.

The genus has been recognized as edible since the days of Aristotle, and the clam fishers along the French coasts use the same type of tackle to-day as that employed by the ancient Greek fishermen.

The genus is known from the Alum Bluff by a single splendid species restricted to the two lower horizons.

¹³ Dall, W. H., op. cit., pt. 3, p. 555.

Solen amphistemma Dall

Plate XXXIII, Figure 4

1900. *Solen amphistemma* Dall, *Wagner Free Inst. Sci. Trans.*, vol. 3, pt. 5, p. 952, pl. 39, fig. 8.

Dall describes this species as follows:

Shell large, short, straight, rather convex; anterior end obliquely truncate, with the inner margin thickened, but no external furrow; posterior end squarely truncate; basal parallel with the dorsal margin; exterior smooth, except for incremental lines; beaks inconspicuous, slightly behind the anterior dorsal angle of the valve, the teeth normal, the nymphs narrow, elongate, not prominent; anterior adductor scar irregularly reniform, posterior rounded triangular; the pallial sinus shallow. Longitude of shell 112, altitude 27.5, diameter 18 millimeters.

This very fine species is almost invariably in fragments. It does not closely approach any other of our Solens.

Type: U. S. Nat. Mus. No. 135901.

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

The incremental sculpture strengthens abruptly along the diagonal from the umbones to the posterior basal margin. In front of this line the incrementals are scarcely perceptible except perhaps toward the base which they parallel. Behind the diagonal they turn and abruptly develop into a somewhat irregular but well-defined grooving parallel to the posterior and lateral margins and at right angles to the dorsal margin. The single tooth in each valve is flattened on its inner surface and moderately broad at the base.

Solen amphistemma is common in the Chipola and present in the Oak Grove, but no indication of the genus has yet been found in the Shoal River formation.

Occurrence: Chipola formation, localities 2212^p, 2213^p, 3419^p, 7151^r, 7468^p. Oak Grove sand, localities 2646^p, 7054^r.

Genus ENSIS Schumacher

1817. *Ensis* Schumacher, *Essai d'un nouveau système des habitations des vers testacés*, p. 143.

Type: *Ensis magnus* Schumacher. (Recent on the north European shores.)

Valves thin, scabbard-shaped, slightly gaping, usually somewhat arcuate; umbones flattened, subterminal; ligament external, opisthodontic; hinge of right valve armed with one vertical and one horizontal lamelliform cardinal, that of the left valve with two proximate vertical cardinals and one horizontal; anterior adductor impression conspicuous, elongated in the general direction of the major axis; pallial line rather distant from the ventral margin, sinuate posteriorly.

Ensis resembles *Solen* externally, but internally it differs in the possession of two vertical cardinals in the left valve instead of a single one, as in *Solen*.

The genus has not been found in beds older than the beginning of the Tertiary, though the family has been traced back into the Paleozoic. The Recent representatives are confined to a few prolific species and are among the most interesting of the inhabitants of the soft inshore muds and sands. They are surprisingly agile, and by means of the strong extensile foot they are able to retreat into their burrows with astonishing ease and rapidity. It is doubtless this unusual agility that has enabled these thin, gaping forms to continue to flourish in the midst of enemies through so many thousands of years.

Ensis is indicated in the Oak Grove sand and the Shoal River formation by numerous fragments but by no individuals sufficiently perfect to make it possible to establish the relationships definitely.

***Ensis* sp. cf. *E. directus* (Conrad)**

Plate XXXIII, Figures 5-6

1842. *Solen ensis* Lamarek [not Linnaeus]. Conrad, Nat. Inst. Washington Proc., vol. 2, p. 191.

1843. *Solen directus* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 1, p. 325 (and authors).

Conrad, in 1843, described this species as follows:

Linear, straight, except toward the summit, where it is slightly recurved, gradually widening from the hinge downward; basal margin rounded slightly toward the posterior extremity; anterior margin obliquely truncated, not reflected; cardinal teeth, one in the right valve, compressed, in the opposite valve two, the superior one very small and near the extremity, the other somewhat distant, elevated, robust, slightly recurved. Length, 4 inches.

Type locality: Neuse River below New Bern, N. C.

Conrad's erroneous description of the hinge characters of this species is due, doubtless, to the imperfections of his type. The armature of the right valve consists of a vertical cardinal and, back of it, a rather broad, grooved horizontal tooth, which projects, shelf-like, from the hinge margin; in the left valve, two strong vertical cardinals, recurved at their pointed tips and separated by a deep, narrow cleft; back of them, a grooved horizontal tooth bifid terminally, the extremities slightly incurved toward each other. In addition to the true teeth, which are common to all species of the genus, there is a rude denticle in front of the vertical cardinal in the right valve, a specific diagnostic feature which serves to separate it from the closely allied *Ensis ensiformis* of Conrad. The diagnostics, aside from the hinge characters, are the posterior and anterior truncations—the former almost straight, the latter straight or slightly oblique—and the large size which the species often attains. The greatest dimension of the recent forms along the

northern part of the east coast may reach 8 or 9 inches. The Tertiary and Recent forms of the warmer waters run decidedly smaller. The remnants of the old color pattern are discernible in many of the later Tertiary forms, included between a line very slightly concave upward, extending from the anterior dorsal margin to the posterior ventral and another line, also concave upward, extending from the anterior dorsal to the posterior dorsal margin. Within this narrow wedge-shaped area incrementals, often tinged with brown, are visible in the better-preserved individuals. As these are parallel to the posterior margin they serve to indicate the former outline, even in the broken shells. In the ventral anterior portion and a small arcuate area along the dorsal margin the coloring is absent and is replaced in the recent shells by a heavy olive-green epidermis; in these sections the incrementals are less strong and run approximately parallel to the ventral and dorsal margins.

The recent forms are numbered among the edible mollusks. The razor clams, as they are known in popular parlance, are, however, very difficult to capture, because by means of their strong, flexible foot they can burrow downward more rapidly than an average man can dig. The species is abundant along the sandy and muddy beaches of the east coast from Labrador to the Florida Keys.

Small, thin fragments representing ancestral types of this species and possibly of *E. ensiformis*, as well, are by no means rare in the Oak Grove and the Shoal River. They may be specifically identical with *Ensis directus* in whole or in part. Certain individuals from the Shoal River, however, have more the aspect of *Ensis ensiformis*. At all events the group was well established in the Alum Bluff, and the exact determinations of the forms must await better material.

Occurrence: Oak Grove sand, localities 2646^c, 7054^p. Shoal River formation, localities 5079^c, 5194^r.

Superfamily MACTRACEA Gray

Dall's statement¹⁴ of the results of his extensive studies on the *Maत्रacea* is given below:

The essential parts of a true mactroid hinge are as follows: In the left valve, an anterior and posterior lateral lamina, and a bifid or Λ -shaped cardinal tooth in front of a pit for the resilium; above the latter a scar or surface of insertion for the ligament. In the right valve, two anterior and two posterior laminae, between which the laterals of the opposite valve are received; two lamellar cardinal teeth, inclined to each other at an angle above and usually more or less solidly united at this line of junction, below which the cardinal of the opposite valve fits; behind them the chondrophore, and above it the scar of the ligament. The ligament and cartilage start in the youngest stage of the shell from a point immediately under the beaks. Once started, each remains continuous between the two valves of the shell and persistent, so that as they lengthen with growth

¹⁴ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, pp. 862-863, 1898.

the portion below each umbo remains intact. According to the amount of expansion of the shell margin between the beaks and the direction of growth of the valves, the form of the adult cartilage and ligament may be crescent-shaped, with a posterior convexity; sagittate, like a barbed arrowhead; or lanceolate, like a leaf-shaped spearhead. The distance between the points of the barbs is determined dynamically by the distance between the umbones of the valves: when they are widely separated, as in *Mactra spengleri*, we have the most extreme crescent shape; when they are but slightly separated, the sagittate form ensues; when the umbones are close together, the species must have a lanceolate ligament. A steep slope of the dorsal shell margin backward from the umbonal region necessitates a short ligament, while a nearly horizontal long posterior cardinal margin promotes a long and narrow ligamentary connection. The correlations are purely dynamic. There is little doubt that the existence of a separate resilium and ligament is due to mechanical forces acting on a thick ligament. * * * Why the ligament should become embedded in the cardinal border so as to become subject to these forces is not so clear but is probably accounted for in part by the fact that the hinge line is rigid in proportion to its length, and, in general, if high up in the dorsal arch it must be short and can gain length only by descending. Whatever the reason may be, it is doubtless analogous to that which would account, in a species where ligament and resilium have become fully differentiated, for the further subsidence of the ligament until it, in its turn, may be wholly submerged below the cardinal margin, so that the latter closes over it, leaving no ligamentary substance whatever external to the shell. In the *Mactridae* every stage of this process may be observed, from the condition where we have a marginal external ligament walled off by a lamina of shell from the resiliary pit to one where ligament and resilium occupy different portions of a single cavity, wholly invisible from the exterior when the valves are closed.

Family MACTRIDAE Gray

Subfamily MACTRINAE Dall

Genus MACTRA Linnaeus

1766. *Mactra* Linnaeus, *Systema naturae*, 12th ed., p. 1125.

1799. *Mactra* Lamarck, *Prodrome d'une nouvelle classification des coquilles*: Soc. hist. nat. Paris Mém., p. 85.

Type: *Mactra stultorum* Linnaeus. (Recent on the west European shores from Norway southward to the Mediterranean and possibly to the Red Sea. Fossil in the Crag.)

Dall,¹⁵ in 1898, described this genus as follows:

Dentition normal in number and distribution of teeth; ligament set off by a shelly lamina rising between chondrophore and ligament; cardinals generally coalescent above; laterals smooth or finely granular.

A genus prominent in the molluscan faunas since Tertiary time. The Recent species—about 150 in number—are to be found, for the most part, along the sandy beaches and in the shallow waters of the tropical seas.

The extensive later collections have yielded a large amount of new mactroid material of the less modern *Spisula* type but only a fragment or two of the true *Mactra*. Possibly the slight cooling of the waters at the end of the Chipola epoch was sufficient to retard the development of the group temporarily. The

Chipola species, *Mactra chipolana* Dall, is the earliest described member of the genus from the east coast fauna. The Oak Grove species, *Mactra cymata*, represents a distinct subgenus and is the precursor of a rather prominent Pliocene group. The genus has not been recognized in the Shoal River faunas.

Umbones not concentrically undulated...*Mactra chipolana* Dall.
Umbones concentrically undulated.

Mactra (Mactrotoma) cymata Dall.

Subgenus MACTRA s. s.

Dall¹⁶ gives the following description:

Shell subequilateral, ovate-trigonal; spur distinct, roofing the apical part of the chondrophore; anterior laterals radiating from the anterior sinus, not confluent with the anterior arms of the cardinals, and the latter without accessory lamella; dental armature not concentrated.

The majority of old-world *Mactras* belong to this group, which is represented only by a single small species in the Caribbean and none on the Pacific shores of America.

Mactra chipolana Dall

Plate XXXIII, Figure 7

1898. *Mactra chipolana* Dall, *Wagner Free Inst. Sci. Trans.*, vol. 3, pt. 4, p. 892, pl. 27, fig. 19.

Dall describes this species as follows:

Shell rather thin, subovate, compressed, sculptured chiefly by lines of growth which are emphasized at short intervals by being slightly elevated; judging from recent shells, these lines in life bore fringes of epidermis; dorsal areas narrow, elongate, the anterior obscurely impressed, the posterior convex with the inner margin depressed, the outer margin marked by a slightly elevated line parallel to and outside of which at a short distance runs another which extends from the umbo to the posterior ventral margin, much as in *Mactrotoma*; interior rather smooth, the pallial sinus wide, rounded, and extending forward nearly to a vertical line from the beaks; hinge normal, the septum below the ligament inconspicuous, the laterals short and smooth, the left cardinal well developed, prominent; the accessory lamella thin and usually lost; the chondrophore not prominent, with slightly raised edges and a small apical roof, over which the ligament was sagittate. Longitude of a well-grown specimen about 45, altitude 35, semidiameter 12 millimeters.

Only fragments of the left valve of four individuals were obtained. The measurements are, therefore, only approximate. The shell represents the first step of transition from the *Spisula* to the *Mactra* stage and is therefore intermediate in its characters between *Spisula* and *Mactrotoma*.

Type: U. S. Nat. Mus. No. 114650.

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

This is the earliest representative of *Mactra* s. s. reported from the east coast fauna.

Occurrence: Chipola formation, localities 2212^f, 2213^f.

Subgenus MACTROTOMA Dall

1894. *Mactrotoma* Dall, *Nautilus*, vol. 8, p. 23.

1898. *Mactrotoma* Dall, *Wagner Free Inst. Sci. Trans.*, vol. 3, pt. 4, p. 876.

¹⁵ Dall, W. H., op. cit., pt. 4, p. 874.

¹⁶ Dall, W. H., op. cit., pt. 4, p. 874.

Type: *Maetra fragilis* Gmelin. (Recent on the east coast from Hatteras to Brazil.)

In 1894 Dall said: "Anterior left lateral tooth bidentate, right ventral tooth tridentate." In 1898 he gave this further description:

Shell subequilateral, elongate; with a thin, silky epidermis, posterior dorsal areas bordered by an impressed fasciole over which the epidermis is darker colored and differently wrinkled; beaks adjacent; pallial sinus large; valves convex, gaping markedly; ligament lanceolate; chondrophore large, shallow, apically roofed; anterior laminae issuing from the dorsal sinus; cardinals prominent, thin, their posterior arms projecting over the chondrophore; each anterior arm attended by a high accessory lamella in nearly the same plane, closely appressed in the right valve to the ventral lamina and in the left valve to the anterior lateral, so that, to a cursory inspection, the lamina appears tridentate and the tooth bidentate.

Section MICROMACTRA Dall

1894. *Micromactra* Dall, Nautilus, vol. 8, p. 40.

1898. *Micromactra* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 876.

Type: *Maetra californica* Conrad, not Deshayes. (Recent on the west coast from Vancouver to Central America.)

In 1894 Dall wrote: "Hinge like the typical section, beaks sulcate, shell small."

Maetra (Mactrotoma) cymata Dall

Plate XXXIII, Figure 8

1898. *Maetra (Mactrotoma) cymata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 893, pl. 33, fig. 23.

Dall describes this species as follows:

Shell small, thin, with prominent undulated beaks; subequilateral, rounded in front, rather pointed behind, the base moderately arcuate; surface sculptured with fine incremental lines, the umbones with ten or more distinct concentric ripples; the posterior slope moderately angulated or carinate anteriorly; pallial sinus rather short, rounded. Longitude 31.5, altitude 20, diameter 10 millimeters.

This species much resembles the Pliocene *M. undula* and differs from it chiefly in being smaller, more triangular, and more pointed behind.

Type: U. S. Nat. Mus. No. 107615.

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

The concentric undulation of the umbones sets this species apart from all the other Oak Grove mactroids.

Occurrence: Oak Grove sand, locality 2646^r.

Genus SPISULA Gray

1837. *Spisula* Gray, Mag. Nat. Hist., new ser., vol. 1, p. 372, London, Edward Charlesworth.

1898. *Spisula* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 878.

Type: *Maetra solida* Linnaeus. (Recent on the west coast of Europe. Fossil in the Crag.)

Shell often large and rather heavy, moderately inflated, subequilateral, ovate-trigonal in outline,

slightly produced and obscurely rostrate posteriorly. Umbones prominent, subcentral. Surface smooth or incrementally sculptured. Ligament inset, not cut off from the resilium by a shelly ridge. Hinge armature strong. Right anterior and posterior cardinals coalescent under the umbones, the anterior arm near the dorsal margin, the posterior bordering the chondrophore and partly separating it from the socket in which the small inverted V-shaped cardinal of the left valve is lodged. Strong lateral teeth, developed within the dorsal margins of the left valve, received in the double sockets of the right; teeth and sockets both transversely striated in most of the groups. Muscle scars large and sunken in the heavier shells. Pallial sinus distinct, short, broadly U-shaped, nearly horizontal.

The absence of a shelly lamina between the chondrophore and the ligament separates *Spisula* from *Maetra*. Furthermore, the laterals of *Maetra* are smooth or finely granular, whereas those of *Spisula* are as a rule, transversely striated¹⁷.

The genus extends well back into the Cretaceous, and though not abundantly represented in the recent seas, it is of almost universal occurrence.

It is extraordinary that the small heavy *Mulinia*-like group so abundantly represented at the Oak Grove and Shoal River horizons should have no precursor in the Chipola formation. The two remaining species of *Spisula* referable to the section *Mactromeris* are more closely related to later Miocene forms than they are to each other, but of this group, too, there is no trace in the Chipola.

Laterals grooved; altitude of adult not exceeding 20 millimeters: Concentric sculpture feeble or absent.

Spisula (Hemimactra) densa Dall.
Concentric sculpture strongly and regularly developed toward the basal margin of the adult.

Spisula (Hemimactra) craspedota Gardner, n. sp.
Laterals smooth; altitude of adult exceeding 20 millimeters:

Shell very thin; posterior keel acute, outlined by an elevated thread.----*Spisula (Hemimactra) dodona* Dall.
Shell rather thick; posterior keel obscure.

Spisula (Hemimactra) valhosier Gardner, n. sp.

Subgenus HEMIMACTRA Swainson

1840. *Hemimactra* Swainson, Treatise on malacology, p. 369.

Type: *Hemimactra gigantea* Lamarck = *Maetra solidissima* Dillwyn. (Recent on the east coast from Labrador to Hatteras.)

Dall,¹⁷ in 1898, described this group as follows:

Shell large, ovate-trigonal, with grooved laterals and rather concentrated hinge; the dorsal areas are not grooved and the anterior arm of the right cardinal is confluent with its ventral lamina; cardinals markedly compressed.

Hemimactra is a new-world type, for the most part, while the typical *Spisula* is old world, especially European, in its recent distribution, though represented in the American Tertiaries.

¹⁷ Dall, W. H., op. cit., pt. 4, p. 878.

Dall¹⁸ says further:

This comprises a group of species which differ from the typical *Spisula* in being thinner, usually larger and more elongated, and agree with it in having the lateral laminae cross-striated, while in the section *Mactromeris* Conrad they are smooth, though this character is not one to which I attach any great importance.

Section **HEMIMACTRA** s. s.

Laterals grooved; cardinals compressed; anterior arm of right cardinal confluent with ventral lamina.

***Spisula (Hemimactra) densa* Dall**

Plate XXXIII, Figure 9

1898. *Spisula (Hemimactra) densa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 900, pl. 27, fig. 22.

Dall describes this species as follows:

Shell small, solid, smooth, or concentrically sculptured, with fine incremental lines, and sometimes obscure radial striae near the margin; subtriangular, subequilateral; beaks small and low, hinge strong, the laminae sharply cross striated; pallial sinus rounded, small, and very short. Longitude 14, altitude 9.5, diameter 6 millimeters.

This solid little species is stronger and larger than the majority of the Eocene forms and has the aspect of a *Mulinia*. Its height is less than in the allied Miocene types of about the same size, and its ends are more pointed.

Type: U. S. Nat. Mus. No. 135906.

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

The specimens found near Bainbridge, Decatur County, Ga., probably represent an allied but distinct species differing in the larger and usually higher and more compressed valves.

Spisula densa Dall averages shorter and higher than *Spisula craspedota*, of the Shoal River fauna. The grooving is stronger upon the type of *S. densa* than upon most other individuals, and it is never so deep nor so regular as in the adult *S. craspedota*. This species is one of the most widespread and abundant of the Oak Grove bivalves, occupying a position in the Oak Grove similar to that held by *Mulinia congesta* Conrad in the later Miocene formations. The analogy to *Mulinia congesta* is more striking because of the similarity in outline and dimensions and the range of variation.

Occurrence: Oak Grove sand, localities ?3386^p, ?3385^c, ?7148^c, ?3396^r, 2646^{pr}, 5632^a, 5631^p, 5633^p, 7054^c, 9961^a, ?7055^p.

***Spisula (Hemimactra) craspedota* Gardner, n. sp.**

Plate XXXIII, Figures 10-12

Shell small, rather heavy, trigonal, moderately inflated medially. Umbones gibbous, flattened upon their summits, the minute tips acute and prosogyrate, central or slightly anterior. Umbonal angle not far from 135°. Posterior slope a little steeper and usually a little more produced than the anterior. Anterior extremity rather narrow but smoothly rounded. Pos-

terior extremity sharply rounded or obtusely rostrate. Base line arcuate. Both anterior and posterior areas flattened, the posterior defined by a rather sharp keel. Lunule very large, extending almost the entire length of the dorsal margin, and nearly as wide medially as the area, smooth and circumscribed by a shallow impressed line. Escutcheon occupying a little more than half the posterior area, defined by the abrupt disappearance of the sculpture at its outer margin. Young and adolescent shell smooth except for incremental striae. Adult ornamented with a rather deep and regular grooving, developed first toward the anterior margin and increasing in prominence toward the base; an exceedingly fine radial lineation developed fortuitously upon the anterior keel. Area of ligament attachment very small, close under the dorsal margin. Chondrophore moderately large and deeply excavated, undercutting the umbones and roofed by the dorsal margin. Dentition robust, rather concentrated; anterior and posterior cardinals of right valve coalescent under the umbones, diverging almost at right angles, the anterior arm nearly parallel with the dorsal margin; cardinal of left valve sharply elevated above the margin, acutely Λ -shaped, the posterior arm a little shorter and heavier than the anterior; posterior accessory lamella close to and parallel to the posterior arm, exceedingly thin and fragile and usually broken away; both right and left laterals well developed close to the umbones, the sockets of the right valve and the raised lamellae of the left finely striated transversely. Characters of interior distinct, the shell often slightly thickened over the area of the adherent mantle. Adductor scars distinct and relatively large. Pallial sinus shallow, linguiform.

Dimensions: Right valve (cotype), altitude, 10.4 millimeters; latitude, 15.3 millimeters; semidiameter, 4 millimeters. Left valve (cotype), altitude, 9.9 millimeters; latitude, 14.1 millimeters; semidiameter, 3.9 millimeters.

Cotypes: U. S. Nat. Mus. No. 352006.

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

Spisula craspedota occupies a position in the Shoal River fauna similar to that held by the closely allied *S. densa* Dall in the Oak Grove. The Shoal River species is a little lower relatively and more produced and pointed posteriorly. The most obvious difference is the development of a strong concentric grooving toward the ventral margins of the adults of *S. craspedota*. Both forms suggest the Miocene *Mulinia congesta* Conrad in their relative outlines and proportions, in their rather wide range of variation in general outline and dimensions, and in their ubiquitous abundance.

Occurrence: Oak Grove sand, localities 10659^p, 3749^p. Shoal River formation, localities 3856^p, 5184^r, 5079^{pr}, 10661^c, 10662^p, 5193^r, 5194^r, 3733^p, 9957^p, 10603^c, 10608^p, ?5618^r.

¹⁸ Idem, p. 896.

Section **MACTROMERIS** Conrad

1868, January. *Mactromeris* Conrad, Am. Jour. Conchology for 1867, vol. 3, app., p. 45.

Type: *Spisula ovalis* Gould = *Spisula polynyma* (Stimpson). (Recent from Hudson Bay to Cape Ann, Mass.)

The section is characterized by the smooth laterals, the noncompressed cardinals, and the isolation of the anterior arm of the right cardinal from the ventral lamina.

***Spisula (Hemimactra) dodona* Dall**

Plate XXXIII, Figures 13-15

1898. *Spisula (Hemimactra) dodona* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 896, pl. 27, figs. 7, 13, 25.

Dall describes this species as follows:

Shell of moderate size, compressed, subtriangular, arcuate, nearly smooth or with fine incremental lines, subequilateral; the anterior side a trifle shorter, anterior slope impressed, slightly concave, anterior end rounded; base arcuate; posterior slope convex, mesially impressed, bounded by a slender, elevated line, with the intervening area minutely wrinkled; pallial sinus rounded, extending in front of the vertical of the beaks; hinge concentrated, the anterior arm of the right cardinal in line with the ventral lamina, both very short. Longitude 50, altitude 34, diameter 15 millimeters.

This species is perhaps as near *S. delumbis* as any other, but is smaller and more compressed. The laminae are quite short and not striated.

Type: U. S. Nat. Mus. No. 135905.

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

The species is remarkable for the narrow and angular umbones. It is an exceedingly thin and fragile form and very rarely preserved in any degree of perfection. Like the Shoal River *S. valhosierr*, *S. dodona* is more closely allied to a Chesapeake Miocene species than it is to any described form from the Alum Bluff. The differences between *S. dodona* and *S. delumbis* Conrad—the smaller, thinner, more compressed shell of the earlier species—are similar to the differences that separate *S. valhosierr* from *S. marylandica* Dall but are much more marked.

Occurrence: Oak Grove sand, localities 2646^p, 5630^r.

***Spisula (Hemimactra) valhosierr* Gardner, n. sp.**

Plate XXXIII, Figures 16-17

1898. *Spisula (Hemimactra) marylandica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 897 (part; figure excluded).

Shell large, rather thick but fragile, ovate-trigonal in outline, inflated, medially compressed toward the margins. Umbones broadly arched, the tips acute and prosogyrate, slightly anterior. Lunule simulated by the large cordate depression in front of the umbones. Area behind the umbones also depressed, even narrowly concave. Posterior rostral area indicated by the texture rather than the contour of the shell.

Umbonal angle not far from 135°. Anterior slope a little steeper than the posterior. Anterior extremity broadly rounded. Posterior end of shell more produced than the anterior, obscurely truncate. Base line arcuate. External surface smooth except for incremental sculpture and the traces of the lineated epidermis, most distinct laterally; posterior area apparently sharply defined in the epidermis by faint but persistent radials and numerous interlacing threads. Hinge rather concentrated. Ligament mounted on a narrow wedge-shaped base close to the dorsal margin. Chondrophore large, deltoid, subumbonal, with a slight posterior inclination separated from the ligament area by a narrow, smooth space but no trace of a shell lamina. Right cardinal slender, the posterior arm usually broken away; anterior arm short, elevated, more nearly in line with the dorsal lamina than with the ventral; lateral grooves deep but rather short and close to the hinge, not striated; ventral laminae more elevated than the dorsal. Left cardinal small, prominently elevated above the hinge-plate, acutely V-shaped, the anterior arm a little heavier and more produced than the posterior; lateral grooves not striated, deep, the inner margins elevated and laminar, clasped between the dorsal and ventral laminae of the opposite valve. Adductor scars large, rudely semielliptical in outline. Pallial line distinct but not conspicuous, the sinus elliptical, the dorsal margin nearly horizontal, produced, the rounded extremity in line with the umbones.

Dimensions: Altitude, 50 ± millimeters; latitude, 75 ± millimeters; diameter, 27 ± millimeters.

Type: U. S. Nat. Mus. No. 351998.

Type locality: No. 3748, Somerville Mill Race, Walton County, Fla.

It is rather significant that *Spisula valhosierr* is much more closely affiliated with *S. marylandica* Dall and *S. subponderosa* D'Orbigny, of the Maryland Miocene, than with any of the Alum Bluff species. The southern species is more compressed than the northern, the umbones more evenly rounded, the anterior area less depressed, the posterior area less strongly indicated, and the anterior arm of the right cardinal more nearly in line with the dorsal lamina of the lateral.

Occurrence: Shoal River formation, localities 3856^p, ?3742^r, 2238^p, 3748^p.

Genus **MULINIA** Gray

1837. *Mulinia* Gray, Mag. Nat. Hist., new ser., vol. 1, p. 375, London, Edward Charlesworth.

Type: *Mulinia typicus* Gray = *Macra edulis* King. (Recent off Patagonia and in the Straits of Magellan.)

Gray describes this genus as follows:

Shell ovate, trigonal, subangular at each end. Cardinal and lateral teeth like *Macra*. Siphonal inflection ovate, distinct. Ligament internal in a triangular groove in the upper surface of the deep oblique cartilage pit quite hid from view.

Mulinia represents among the Mactridae the final stage in the submersion of the ligament. In both the fossil and recent species, however, traces of the external ligament are often retained.

Mulinia orthria is the first of the genus to be reported from the east coast faunas in strata older than the Chesapeake Miocene. The Recent species are few in number but for the most part prolific in individuals, most of them denizens of the warm and temperate waters.

***Mulinia orthria* Gardner, n. sp.**

Plate XXXIV, Figures 1-3

Shell small, very thin, high, rounded, trigonal, inflated, acutely rostrate and flattened posteriorly. Umbones subcentral, small, angulated laterally, the tips slightly incurved, the dorsal margins projecting beyond them. Lunule large, extending almost the entire length of the anterior dorsal margin, flattened, obscurely defined by a faintly incised line. Escutcheon relatively short, lanceolate, indicated by the abrupt disappearance of the incrementals. Anterior dorsal margin steeply declining, sharply rounded or obtusely angulated at its extremity. Posterior dorsal margin feebly arched, the posterior extremity obtusely truncate and rather sharply angulated at the terminus of the rostrum. Base line arcuate, quite strongly upcurved in front. External surface polished, smooth except for incrementals, least feeble behind the rostrum. Ligament internal, much reduced, almost obsolete. Resilium sunken, attached to a narrow chondrophore, deeply undercutting the umbones and overhung by the dorsal margin. Dentition extremely delicate, concentrated; anterior and posterior right cardinals very thin and laminar, not coalescent, set nearly at right angles to each other, the anterior parallel to the dorsal margin; left cardinals fused into an acute Λ , the anterior arm slightly more produced than the posterior; posterior accessory lamella exceedingly thin, proximate and parallel to the posterior arm; laterals short and close to the umbones, the double sockets in the right valve receiving the slender, elevated laminae of the left. Interior often corrugated concentrically and subject to irregularities of surface. Adductor scars distinct, the anterior relatively small and irregular in outline, the posterior rudely semielliptical. Pallial line distinct. Pallial sinus very short, the dorsal margin nearly horizontal, turning at an obtuse angle which often approaches 90° and joining the pallial line at an acute angle.

Dimensions: Right valve (cotype), altitude, 7.7 millimeters; latitude, 9.6 millimeters; semidiameter, 3.0 millimeters. Left valve (cotype), altitude, 9.0 millimeters; latitude, 12.1 millimeters; semidiameter, 4.0 millimeters.

Cotypes: U. S. Nat. Mus. No. 353935.

Type locality: No. 5618, 3½ miles southwest of DeFuniak Springs, Walton County, Fla.

Mulinia orthria is of unusual interest because it is not only the sole representative of the genus in the Alum Bluff but the earliest *Mulinia* recognized in the east coast faunas. It is remarkable for the delicacy of the shell and dentition. In general characters it approaches more closely the Recent *Mulinia lateralis* subsp. *corbuloides* Deshayes than any of the Tertiary forms.

Occurrence: Shoal River formation, localities 9958^c, 3747^p, 7264^p, 5618^p.

Family MESODESMATIDAE Deshayes

Dall¹⁹ characterizes this family as follows:

This family, with a hinge formed on much the same plan as that of *Mactra*, is sharply distinguished from the latter by its separate, free, and naked retractile siphons, and also by a certain excessive solidity and thickness of its valves relatively to their comparative dimensions. It is by this latter habit of growth that the fossil species may be distinguished from the Mactras rather than by any clearly marked differential characters.

Subfamily ERVILINAE

Dall²⁰ gives the following description:

Shells small, thin, equilateral, concentrically sculptured or smooth; ligament marginal, obsolete, or absent; resilium small; hinge much concentrated; laterals small, dorsal anterior lamina absent, the ventral more or less coalescent with anterior arm of the right cardinal; left cardinal large, bifid; pallial sinus well marked.

This group has representatives in European seas, the West Indies and southeastern coast of North America, the Red Sea, and the Indo-Pacific region.

The right and the left cardinals have been transposed in the description.

Genus ERVILIA Turton

1822. *Ervilia* Turton, *Conchylia insularum britannicarum: Dithyra*, p. 55.

Type: *Mya nitens* Montagu. (Recent from the Tortugas to the northern coast of South America.)

Shell small, oval to triangular; umbones low, subcentral, slightly opisthogyrate; external ligament obsolete; internal, lodged in a small resifier, situated between the anterior and posterior cardinals; lateral armature feeble; grooves developed in right valve; lateral teeth of left usually replaced by modifications of the dorsal margins; pallial sinus well defined.

These lentil-shaped bivalves form an inconspicuous factor in the marine faunas of the Tertiary and post-Tertiary seas. The recent forms are, for the most part, tropical.

¹⁹ Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, pp. 907-908, 1898.

²⁰ Idem, pp. 913-914.

This denizen of the warm seas is well represented at each of the Alum Bluff horizons. In number of individuals and ubiquitous distribution, *Ervilia chipolana* Dall is probably first, though at no locality does it form so prominent a factor in the fauna as *E. valhosierr* near Shell Bluff, on Shoal River. The characteristic Chipola species persists in diminished numbers into the Oak Grove and possibly into the Shoal River. The characteristic Oak Grove form, however, is a very plain little shell suggesting that life in the cooler waters of the Oak Grove was more difficult than during the Chipola. *Ervilia planata* also may have persisted into the Shoal River, though apparently it left no descendants. The Shoal River species *E. condra* and *E. valhosierr* seem to be more closely related to *E. chipolana* than to the Oak Grove *E. planata*. Neither is very near to the more ovate forms of the later Tertiary faunas.

Valves not conspicuously flattened over the umbonal area; prodissoconch not remarkably prominent:

Concentric sculpture usually developed over the whole or a part of the surface; valves often inflated and obtusely rostrate posteriorly:

Shell often produced and attenuated posteriorly, relatively inflated and obtusely rostrate.

Ervilia chipolana Dall s. l.

Shell relatively low, produced and attenuated posteriorly.....*Ervilia chipolana* Dall s. s.

Shell relatively high, not produced and attenuated posteriorly.

Ervilia chipolana subsp. *triangularis* Dall.

Shell not produced and attenuated posteriorly, relatively compressed and obscurely rostrate.

Ervilia condra Gardner, n. sp.

Sculpture reduced to incrementals and a microscopically fine concentric striation.....*Ervilia valhosierr* Gardner, n. sp.

Valves conspicuously flattened over the umbonal area; prodissoconch remarkably prominent.....*Ervilia planata* Dall.

Ervilia chipolana Dall

Plate XXXIV, Figure 4

1898. *Ervilia chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 914, pl. 33, fig. 10.

Dall describes this species as follows:

Shell small, inflated, pointed behind, the posterior part slightly longer, the anterior end shorter and rounder; the base evenly arched, the pallial sinus moderately wide, rounded in front, not reaching the vertical of the beaks; umbones low, not prominent; the sculpture of rather irregular concentric threads and grooves, absent from the umbones and frequently from a great part of the valves. Longitude 4.5, altitude 3, diameter 2 millimeters.

This species, which is very common in the beds, is readily distinguished from *E. concentrica*, to which it is most nearly allied, by its more pointed posterior end, its coarser and less regular sculpture, its less conspicuous beaks, and generally smaller size.

Type: U. S. Nat. Mus. No. 114603.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The high trigonal convex end members have been segregated under the subspecies *triangularis* Dall. Half a dozen other subspecies might be erected on the variations in outline and sculpture characters, but the intergrading is so close and uninterrupted that there is little to be gained by the multiplicity of names. There is not only a remarkable specific variation in sculpture, but the age variation as well is unusually wide. In some individuals the umbones are nearly smooth, with a later developed concentric sculpture; in others the early sculpture evanesces with maturity.

In the Oak Grove sand the species is much less common but more constant in its characters. The high trigonal subspecies has not been recognized and the great majority of the forms are produced and attenuated posteriorly and closely and regularly sculptured. A few juveniles from the Shoal River formation offer no characters by which they may be separated from *E. chipolana*. *Ervilia condra*, from the Shoal River, is a possible descendant. It runs smaller and usually higher than the Chipola form and develops a fine and regular umbonal sculpture which weakens or disappears rather abruptly about halfway to the base.

Occurrence: Chipola formation, localities 10609^p, 7893^p, 7257^p, 2213^a, 2564^a, 3419^a, 7151^c, 2211^c, 7183^p, 10660^r; Oak Grove sand, localities 2646^p, 5632^p, 5630^r, 5633^r, 7054^r, 9961^r; Shoal River formation, locality ?5079^r.

Ervilia chipolana subsp. *triangularis* Dall

Plate XXXIV, Figure 5

1898. *Ervilia triangularis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 915, pl. 33, fig. 19.

Dall describes this species as follows:

Shell small, solid, plump, subtriangular, inequilateral, with steep nearly straight dorsal slopes and an evenly arched base; surface smooth or marked only by rather irregular incremental lines; pallial sinus rounded, falling a little short of the vertical from the beaks; umbones low, calyculate; hinge strong, with the cardinal teeth prominent, and the marginal grooves in the right valve to receive the dorsal edges of the opposite valve long and well marked. Longitude 5.5, altitude 4, diameter 2.5 millimeters.

This form may prove to be an extreme variety of *E. chipolana*, but the specimens so far collected are distinguished by their smoother surface, much more triangular form, and more inequilateral shell. It seems to be comparatively rare in the marl, and further study is required to settle its systematic value.

Type: U. S. Nat. Mus. No. 114704.

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

This group shares with other groups of the Mac-tracea a wide range of variation in outline and sculpture. *Ervilia chipolana* subsp. *triangularis* includes the relatively high and convex end members. The sculpture in both the species and subspecies is exceedingly variable, ranging from nearly smooth individuals to those developing a close and regular ornamentation.

The subspecies is restricted apparently to the single horizon, though *E. chipolana* s. l. occurs in the Oak Grove sand and possibly even in the Shoal River.

Occurrence: Chipola formation, locality 2213^p.

Ervilia condra Gardner, n. sp.

Plate XXXIII, Figures 18-21

Shell small, rather solid, relatively high, trigonal in outline, moderately inflated in the umbonal region. Umbones subcentral, somewhat flattened upon their summits, the tips proximate and feebly opisthogyrate. Neither lunule nor escutcheon defined. Anterior dorsal margin a little higher than the posterior. Anterior extremity broadly rounded. Posterior extremity narrower, rounded or obscurely truncate. Base line arcuate. Prodissoconch preserved in many specimens, smooth, shining. Conch ornamented with an exceedingly variable concentric sculpture, usually fine, close, and regular in the young and adolescent shell and tending to become irregular and evanescent in the adult. External ligament obsolete. Internal ligament lodged in a minute triangular chondrophore sunk deep beneath the umbones. Dental armature heavy for so small a shell; anterior cardinal of right valve robust, cuneate; dorsal margin directly behind the umbone of the right valve, slightly elevated and modified to function as the posterior cardinal; anterior and posterior cardinals of left valve distinct but not prominent, partially fused with the dorsal margins; inner margin of chondrophore in left valve elevated and acute dorsal margins of right valve sulcated to receive the beveled edges of the corresponding valve. Interior slightly thickened over the area of the attached mantle. Adductor scars distinct, the anterior more elongated than the posterior. Pallial line distant from the base. Pallial sinus very broad, the dorsal margin nearly horizontal, produced almost to the median vertical.

Dimensions: Right valve (cotype), altitude, 2.5 millimeters; latitude, 3.3 millimeters; semidiameter, 1.2 millimeters. Left valve (cotype), altitude, 3.1 millimeters; latitude, 4.3 millimeters; semidiameter, 1.25 millimeters.

Cotypes: U. S. Nat. Mus. No. 352015.

Type locality: No. 3748, Somerville mill race, Walton County, Fla.

Ervilia condra Gardner, n. sp., seems to be little more than a sculptured *E. valhosierr*. Though smaller than the *E. valhosierr* from the type locality and perhaps a little higher, *E. condra* is very similar in general build and in the characters of the hinge. It is possibly the parent stock developed from *E. chipolana*, retaining the sculpture in the early stages of growth. In *E. valhosierr*, on the other hand, a species more closely identified with the Shoal River fauna, the concentric sculpture is undeveloped even in the earliest stages.

The three juveniles referred in early check lists to *E. lata* Dall probably belong to this species. *E. lata*

is more nearly ovate in outline than any of the Alum Bluff species and develops a rather sharp but often irregular sculpture, strongest toward the base.

Occurrence: Shoal River formation, localities ?2238^r, 3748^p.

Ervilia valhosierr Gardner, n. sp.

Plate XXXIV, Figures 6-9

Shell very small but solid, lustrous when fresh, feebly but evenly inflated, slightly produced and obscurely rostrate posteriorly. Umbones central or slightly anterior, low, somewhat flattened, proximate and feebly opisthogyrate. Lunule and escutcheon suggested by the marginal flattening of the shell but not defined. Dorsal margins diverging from the umbones at an angle of not far from 135°. Anterior extremity broadly rounded. Posterior extremity narrower, a little more produced and more sharply rounded. Base line quite strongly arcuate. Prodissoconch frequently preserved, smooth, shining and more highly inflated than the conch. External surface of conch smooth except for an incremental sculpture more or less regularly developed, a microscopically fine fortuitous concentric striation, and an occasional faint suggestion of radials. External ligament obsolete. Internal ligament lodged in a minute triangular chondrophore, the apex directly beneath the umbones. Dentition strong for so small a shell; anterior cardinal of right valve heavy, deltoid, not sulcate upon its upper surface; posterior right cardinal obsolete though the dorsal margin directly behind the umbone is slightly expanded and fits into a corresponding depression in the left valve; anterior cardinal of left valve well developed, produced, free from the dorsal margin; chondrophore separated from the trigonal socket that receives the anterior right cardinal by the raised and beveled inner margin of the chondrophore; posterior left cardinal obsolete; laterals feebly developed; a shallow sulcus running the entire extent of the anterior dorsal margin of the right valve and receiving the dorsal margin of the left; posterior dorsal margins very slightly modified. Interior often a little thickened over the surface of the attached mantle, a thickened vertical ray developed beneath the umbones of many individuals. Muscle scars distinct, slightly impressed; the posterior adductor semi-elliptical, the anterior more elongated; pedal scar small, distinctly impressed directly above the anterior adductor. Pallial line distant from the base. Pallial sinus short, broad, reaching almost or quite to the vertical dropped from the umbones.

Dimensions: Right valve (cotype), altitude, 4.2 millimeters; latitude, 5.75 millimeters; semidiameter, 1.55 millimeters. Left valve (cotype), altitude, 4.2 millimeters; latitude, 5.8 millimeters; semidiameter, 1.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 352017.

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

Ervilia valhosierr shares with *E. planata* Dall an outer surface smooth except for incrementals. *E. valhosierr* is readily separable, however, by the higher and more inflated outline and the less prominent prodissoconch. The species is very abundant at the type locality and is the characteristic representative of the genus in the marl.

Occurrence: Shoal River formation, localities 5079^{pr}; 10661^p, 10662^p, 3733^p, 3748^c, 5618^r, 10612^r.

Ervilia planata Dall

Plate XXXIV, Figures 10-12

1898. *Ervilia planata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 915.

Dall describes this species as follows:

Shell small, subtriangular, flattened, smooth or obscurely concentrically ridged, subequilateral; the beaks low, calyculate; the dorsal slopes slightly rounded, subequal; the base evenly arched, not projecting; hinge well developed, the marginal grooves in the right valve almost as long as the dorsal margins; pallial sinus small, rounded in front, falling considerably short of the vertical from the beaks. Longitude 3.25, altitude 2.25, diameter 1.5 millimeters.

This small form is distinctly flattened and looks not unlike the flat valve of some *Corbulas*. Only a few valves were obtained, but all agreed in this character. The sculpture seems to have been not unlike that of *E. chipolana*.

A single type was not selected, and I have not been able to identify the individual measured in the vial of worn and immature specimens labeled "Types." The specimens figured are from the same collection at the same locality. The measurements of the figured individuals are as follows: Right valve (paratype), altitude, 3.4 millimeters; latitude, 5.0 millimeters; semidiameter, 1.5 millimeters. Left valve (paratype), altitude, 3.4 millimeters; latitude, 4.9 millimeters; semidiameter, 1.5 millimeters.

Paratypes: U. S. Nat. Mus. No. 353936.

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

These small shells are highly polished when fresh, and though flattened in the young and adolescent stages, the adults are as a rule, moderately inflated. The prodissoconch is preserved in many specimens as a minute but rather prominent and shining knob at the apex of the umbonal angle. The external surface is smooth except for an incremental sculpture best developed toward the margins and, on very fresh surfaces, a microscopically fine concentric striation. The resilifer is small, trigonal, and depressed beneath the umbones. The right anterior cardinal is relatively large and heavy and feebly sulcate upon its upper surface. The posterior cardinal is obsolete. The cardinals of the left valve are very much reduced and largely fused with the dorsal margins. The interior is thickened over the umbonal area of the adult.

The muscle scars are small but distinct and the pallial sinus usually produced in the adult as far as the vertical from the beaks.

Ervilia planata differs from both *E. chipolana* and *E. valhosierr* in the less inflated shell, the greater flattening toward the umbones, and the more prominent prodissoconch. The less attenuated posterior extremity and the absence of any but an incremental sculpture are additional criteria in differentiating it from *E. chipolana*.

Ervilia planata Dall is remarkable for its solidity and the prominence of the minute prodissoconch.

The Shoal River individuals are all immature and doubtfully referable to this species.

Occurrence: Oak Grove sand, localities 2646^c, 5632^p, 5631^r, 5633^r, 7054^r, 10659^p, Shoal River formation, localities ?5079^r, 3733^r.

Superfamily MYACEA

Family CORBULIDAE Fleming

Genus CORBULA (Bruguière) Lamarck²¹

1798. *Corbula* Bruguière, Tableau encyclopédique et méthodique des trois règnes de la nature, vol. 1, pl. 230. (Figures only; no names.)

1799. *Corbula* Lamarck, Prodrôme d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 89. (No species cited.)

1801. *Corbula* Lamarck, Système des animaux sans vertèbres, p. 137.

Type: *Corbula gibba* (Olivi). (Recent off the west coast of Europe and in the Mediterranean; Tertiary of southern Europe.)

Bruguière²² in 1798 published a plate of 18 figures which he headed *Corbula*. He used no specific names, but his figures have been identified as follows:

1a-c. *Corbula sulcata* Lamarck (= *Corbula guineensis* Mühlfeldt.)

2a-c. An indeterminate bivalve, probably a *Chama*.

3a-c. *Corbula porcina* Lamarck. Not identified with assurance. Possibly a varietal form of *C. gibba* (Olivi) from the Mediterranean; more probably an exotic; cf. *C. acutangula* Rissel, from the Red Sea.²³

4a-d. *Corbula nucleus* Lamarck (= *Corbula gibba* (Olivi)). Recent on the west coast of Europe and in the Mediterranean. Tertiary of southern Europe.

5a-c. *Corbula gallica* Lamarck. Eocene of the Paris Basin.

6a-b. *Corbula margaritacea* Lamarck (= *Anatina trapezoides* Lamarck).

Lamarck determined most of the species on the original plate but cited no type. There is a reference to the plate in the Prodrôme,²⁴ 1799, but no species is mentioned. The first specific list which appeared in the Système,²⁵ 1801, included *Corbula sulcata*, *C. laevigata*,

²¹ The following discussion has already appeared in similar but not identical form: Gardner, Julia, Nautilus, vol. 40, pp. 41-47, October, 1926.

²² Bruguière, J. G., Tableau encyclopédique et méthodique, vol. 1, pl. 230, Paris, 1798.

²³ Buequoy, Eugène, Dautzenberg, Philippe, and Dollfus, G. F., Mollusques marins du Roussillon, vol. 2, pp. 582, 587, 1896.

²⁴ Lamarck, J. B., Prodrôme d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 89, 1799.

²⁵ Lamarck, J. B., Système des animaux sans vertèbres, p. 137, 1801.

C. margaritacea, *C. gallica*, and *C. striata*. *Corbula nucleus* was added in 1818 in the *Histoire naturelle*.²⁶ There is apparently no record of the selection of a type before the anonymous publication of "Lamarck's Genera of shells" in 1822. In this publication, which was later fixed upon Children,²⁷ *Corbula nucleus* Lamarck (= *C. gibba* (Oliv)) is definitely designated as the type of the genus.

This is at variance with the common usage and involves a realignment of the superspecific groups. The long synonymy of *Corbula gibba* testifies to its wide range and great variability. The type of the species, according to Bucquoy, Dautzenberg, and Dollfus, probably came from the Adriatic. The Mediterranean shells, as a rule, are not so large as those from the British waters. The species is characterized by the unequal, discrepantly sculptured valves; the right valve, is larger, relatively higher, and more trigonal in outline, obtusely rostrate posteriorly, concentrically rugose; the left valve smaller, transversely elongate, not rostrate posteriorly, with a sparse and irregular radial lineation and the concentric sculpture restricted largely to the ventral area. These are the characters which, at least in the east coast Tertiary and Recent faunas, have been commonly associated with *Aloidis*. Cossmann, Gray, and some of the other Europeans have included such forms under *Agina* Turton²⁸ and have cited, as the type of *Agina*, *Mya inaequalis* Montagu (= *Corbula gibba* (Oliv)). *Agina*, however, is monotypic and the type, *Mya purpurea* Montagu, is a *Saxicava*, probably *S. arctica* (Linnaeus), so that *Agina* falls into the synonymy of *Saxicava* rather than of *Corbula*.

Aloidis Mühlfeldt²⁹ is also monotypic. The type, *Corbula sulcata* Lamarck, a Recent shell from the coast of Senegal (figs. 1a-c on Bruguière's original plate), has been considered by Gray,³⁰ Fischer,³¹ Cossmann,³² Bucquoy, Dautzenberg, and Dollfus,³³ Woodring,³⁴ and others as the type of the genus *Corbula*. The species is not represented in the collections of the United States National Museum, but through the courtesy of the Academy of Natural Sciences, Philadelphia, the loan of good adult material has been obtained. The shell is large and coarse; the altitude of the right valve is 19 millimeters, the latitude, 25 millimeters; the altitude of the left valve, 15.5 millimeters, the latitude, 23 millimeters; the diameter of the double

valves, 15.5 millimeters. The posterior keel is very sharp and defined posteriorly by a deep sulcus which persists from the nepionic shell to the margin. Both valves are coarsely rugose, the sculpture upon the right valve heavier than upon the left. Radial sculpture is absent upon the conch. The tips of the umbones are conspicuously capped by the nepionic valves, which differ from the adult valves to a remarkable degree. The prodissoconch valves are nearly equal, compressed, acutely rostrate posteriorly, and similarly sculptured with concentric rugae which strengthen toward the ventral margin. These are characters which suggest *Cuneocorbula* Dall rather than *Aloidis*. As a matter of fact, there are no east American shells sufficiently close to the large coarse Senegalese shell to suggest the representation of the *C. sulcata* group in east American waters in either Tertiary or Recent time. The species formerly referred to *Aloidis* by American conchologists are included under *Corbula* s. s.

Caestocorbula Vincent,³⁵ type *Corbula henckeliusi* Nyst, is also a synonym of *Corbula* s. s. *Caestocorbula* was founded upon the supposed presence of a siphonal plate. The nature of the plate and the mode of attachment are not obvious from the description or the figure, but the plate is either quite foreign to the shell or a fortuitous character resulting possibly from some of the peculiar phenomena of breakage that the *Corbula*s occasionally show.

*Cuneocorbula*³⁶ was erected by Cossmann to include transversely elongated birostrate shells headed by *Corbula biangulata* Deshayes (Eocene of the Paris Basin) as the type of the subgenus. *Corbula biangulata* is a small, thin shell, much produced posteriorly, strongly bicarinate, feebly and irregularly sculptured and with little more than generic characters to ally it with the forms with which it has been commonly associated by most of the American conchologists. There seems to be no subgenus available to which the small, subequivalve, biconvex, transversely elongate, posteriorly rostrate, concentrically sculptured *Corbula*s, so common through the east coast and Gulf Tertiary deposits and in the Recent east American waters, may be referred. A new subgenus, *Caryocorbula*,³⁷ has been proposed for the accommodation of this group.

Bicorbula Fischer³⁸ is monotypic, and the type is *Corbula gallica* Lamarck. Fischer accepted *Corbula sulcata* Lamarck as the type of the genus and established *Bicorbula* to include the large, subtrigonal, obtusely or not at all rostrate, and for the most part feebly sculptured shells. An obscure radial lineation is frequently developed on the right valve and is more

²⁶ Lamarck, J. B., *Histoire naturelle des animaux sans vertèbres*, vol. 5, p. 496, 1818.

²⁷ Children, J. G., *Quart. Jour. Sci.*, vol. 14, p. 301, 1822.

²⁸ Turton, William, *Conchylia insularum Britannicarum*, Dithyra, p. 54, 1822.

²⁹ Mühlfeldt, Megerle von, *Entwicklung eines neuen System der Schalthiergehäuse: Gesell. Naturf. Freunde Mag.*, 5. Jahr, p. 67, 1811.

³⁰ Gray, J. E., *Zool. Soc. London Proc.*, vol. 15, p. 191, 1847.

³¹ Fischer, Paul, *Manuel de conchyliologie et de paléontologie conchyliologique*, p. 1123, 1887.

³² Cossmann, M., *Catalogue illustré des coquilles fossiles de l'Éocène des environs de Paris*, App. 5, p. 15, 1913.

³³ Op. cit., p. 577.

³⁴ Woodring, W. P., *Contributions to the geology and paleontology of the West Indies, Miocene mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub.* 366, p. 185, 1925.

³⁵ Vincent, E., *Soc. roy. zool. et malacol. Belgique Annales*, vol. 44, p. 141, 1909.

³⁶ Cossmann, M., op. cit., vol. 1, p. 37, 1886.

³⁷ Gardner, Julia, *Nautilus*, vol. 40, p. 46, October, 1926.

³⁸ Fischer, Paul, *Manuel de conchyliologie et de paléontologie conchyliologique*, p. 1123, 1887.

obvious, as a rule, in the decorticated shell. Dall and others who considered *Corbula gallica* the type of *Corbula* s. s. could not, of course, recognize *Bicorbula*, but if *Corbula gibba* is accepted as the type of *Corbula* s. s. *Bicorbula* must be reinstated.

Bothrocorbula Gabb,³⁹ characterized by the deep lunular pit beneath the beaks, retains its status unchanged. The monotype is *Corbula viminea* Guppy, from the Miocene (Bowden beds) of Jamaica.

Corbula s. l., as here considered, has the following characteristics: Shell small, thick, ovate, more or less rostrate; valves unequal, the left usually smaller and flatter; umbones prominent, prosogyrate or erect, the right usually higher than the left; hinge line of right valve fitted with a single prominent tooth in front of the resilial pit; lateral laminae absent; left valve with a chondrophore and a deep cardinal socket; surface sculpture variable, commonly discrepant on the two valves of the same individual, usually concentric, never strongly radial; adductor scars distinct; pallial line indistinct; sinus feeble or obsolete.

A prominent genus among the small bivalves since the beginning of the Mesozoic. The recent *Corbula*s include some 70 species of almost universal distribution but more prolific in the warmer waters, particularly in the China seas.

The genus *Corbula* is one of the most numerous and most diversified in the Alum Bluff. Sixteen species and subspecies have been recognized, and others are indicated by fragments too imperfect to describe. The Chipola formation offers the most varied series. Each of its seven species is peculiar to the marl, though some

of them have near allies in the higher Alum Bluff beds. Five species from the Oak Grove have been described and five from the Shoal River, of which three are common to the two horizons. *Corbula* s. s. is abundantly represented by *C. chipolana*, a species intimately related to the later *C. waltonensis* and to *C. heterogenea* Guppy of the Bowden. The group of relatively large, transversely elongated Caryocorbulas reminiscent of the Vicksburg *C. engonata* and represented by *C. sphenia*, *C. sarda*, *C. franci*, and *C. wakullensis* is entirely restricted to the Chipola. The group *C. whitfieldi* Dall, on the other hand, possibly the precursor of the Recent *C. barrattiana*, is characteristic of the Oak Grove and Shoal River, though it has a forerunner in *C. whitfieldi boyntoni* Gardner, found in the Chipola at Boynton Landing. The small, solid Caryocorbulas of the *seminella* type occur abundantly in the Chipola and Shoal River and are present in the Oak Grove. *Caryocorbula funiakensis* is, apparently, a later offshoot of this group and has been found only in the uppermost beds of the Shoal River formation. The one *Bicorbula* occurs in the Chipola, though in a fragmentary state. *Bothrocorbula* is a remarkably compact and strikingly characterized group restricted to the middle and later Tertiary of Florida and the Antilles. It is represented in the Alum Bluff by a single not uncommon species in the Chipola and another closely allied and of similar occurrence in the Oak Grove, but it has not been detected in the Shoal River.

In *Corbula*, as in many other genera, the earlier Alum Bluff faunas, particularly the Chipola, are more obviously allied with the Antillean faunas than are those from the later horizons.

Valves conspicuously dissimilar in form and sculpture:

Altitude of adult rarely exceeding 6.0 millimeters.....*Corbula chipolana* (Dall MS.) Gardner, n. sp.

Altitude of adult commonly exceeding 6.0 millimeters.....*Corbula waltonensis* Gardner, n. sp.

Valves not conspicuously dissimilar in form and sculpture:

Lunule not impressed:

Shell transversely elongated; latitude of adult exceeding 7.5 millimeters:

Latitude of adult exceeding 13.0 millimeters; surface sculpture coarse.....*Corbula (Caryocorbula) sphenia* Dall.

Latitude of adult not exceeding 13.0 millimeters; surface sculpture fine, often irregular:

Latitude of adult normally exceeding 9.0 millimeters:

Shell moderately inflated.....*Corbula (Caryocorbula) sarda* Dall.

Shell much compressed.....*Corbula (Caryocorbula) franci* Gardner, n. sp.

Latitude of adult not exceeding 9.0 millimeters.....*Corbula (Caryocorbula) wakullensis* Gardner, n. sp.

Shell relatively high; latitude of adult exceeding 7.5 millimeters.....*Corbula (Caryocorbula) antoniae* Maury.

Latitude of adult not exceeding 7.5 millimeters:

Latitude of adult exceeding 6.0 millimeters:

Shell relatively elongated transversely:

Radial beading little or not at all developed.....*Corbula (Caryocorbula) whitfieldi* Dall s. s.

Radial beading developed over the whole or a part of the shell.

Corbula (Caryocorbula) whitfieldi stikta Gardner, n. subsp.

Shell relatively high:

Concentric sculpture relatively fine and regular...*Corbula (Caryocorbula) whitfieldi boyntoni* Gardner, n. subsp.?

Concentric sculpture rude and more or less irregular...*Corbula (Caryocorbula) parawhitfieldi* Gardner, n. sp.

Latitude of adult not exceeding 6.0 millimeters:

Radial lineation developed to a greater or less degree:

Shell compressed; concentric sculpture very irregular...*Corbula (Caryocorbula) semenoides* Gardner, n. sp.

Shell moderately inflated; concentric sculpture fairly regular.....*Corbula (Caryocorbula) seminella* Dall.

Radial lineation not developed; shell conspicuously compressed...*Corbula (Caryocorbula) funiakensis* Gardner, n. sp.

Lunule impressed:

Shell relatively high.....*Corbula (Bothrocorbula) synarmostes* Dall.

Shell relatively elongated transversely.....*Corbula (Bothrocorbula) radiatula* Dall.

³⁹ Gabb, W. M., Acad. Nat. Sci. Philadelphia Proc. for 1872, p. 274, 1873.

Subgenus CORBULA s. s.

1798. *Corbula* Bruguière, Tableau encyclopédique et méthodique des trois règnes de la nature, vol. 1, pl. 230. *Aloidis* of authors [not *Aloidis* Mühlfeldt, 1811].
Agina of authors, not Turton, Conchylia insularum Britannicarum, Dithyra, p. 54, 1822.
1909. *Caestocorbula* Vincent, Soc. roy. zool. et malacol. Belgique Annales, vol. 44, p. 141.

Type: *Corbula gibba* (Olivi). (Recent on the west coast of Europe and in the Mediterranean; Tertiary of southern Europe.)

Shell rather small, inequivalve, inequilateral, discrepantly sculptured even in the juvenile stages; right valve larger, relatively higher and more trigonal in outline, obtusely rostrate posteriorly, concentrically rugose; left valve smaller, transversely elongate, not rostrate posteriorly, with a sparse and irregular radial lineation and a concentric sculpture restricted largely to the ventral area.

Corbula chipolana (Dall MS.) Gardner, n. sp.

Plate XXXIV, Figures 13-17

1898. *Corbula* (*Aloidis*) *heterogenea* (Guppy MS.). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 850 (part, figure excluded).

Shell small, solid, very strongly inequivalve; the margin of the left valve produced about 1 millimeter beyond that of the right but not recurved; the altitude of the left valve only about two-thirds that of the right. Umbones prominent, strongly rounded; that of the right valve much higher and more strongly incurved than that of the left; the tips acute, incurved, and prosogyrate, falling a little in front of the median vertical. Right valve rudely elevated, trigonal in exterior outline; the outline of the interior rudely quadrate; the umbones well above the gently sloping dorsal margins; anterior extremity smoothly rounded; posterior extremity squarely truncate; base line arcuate, anteriorly upcurved, subacutely angulated at the posterior basal margin; posterior keel subacute, with a less strongly defined secondary keel near the dorsal margin. Left valve ovate-trigonal in outline, smoothly rounded, with only a suggestion of a posterior keel; the anterior extremity and base arcuate; the posterior extremity obtusely truncate. Right and left valves differing as strongly in sculpture as in outline; umbones smooth and shining in both valves; right valve concentrically corrugated from near the umbones to the base, the rugae from 20 to 30 in number, becoming increasingly elevated toward the base and somewhat irregular, reduced upon the posterior area to growth wrinkles; sculpture of dorsal portion of left valve restricted to incrementals until the shell is nearly half grown; very fine radial lirae initiated away from the umbones, becoming slightly stronger toward the base, 6 to 12 in number, absent upon the lateral areas but arranged with a fair degree of regularity over the disk.

Hinge characters rather delicate for so solid a shell. Ligament internal, attached to a small cuneate chondrophore projecting from the posterior dorsal margin and received in a deep subumbonal socket in the right valve. The single right cardinal moderately strong, conical, slightly recurved at the tip; socket beneath the left umbone correspondingly deep. Interior little or not at all thickened over the area of the attached mantle. Adductor scars small, obscure. Pallial sinus scarcely defined; pallial line usually obscure, simulated in the right valve by a well-defined groove which receives the edge of the left valve in the closed shell.

Dimensions: Double valves (cotype, immature individual), altitude, 4.5 millimeters; latitude, 4.5 millimeters; diameter, 3.5 millimeters. Right valve (cotype), altitude, 5.75 millimeters; latitude, 6.5 millimeters; semidiameter, 4.1 millimeters. Left valve of a larger individual (cotype), altitude, 4.2 millimeters; latitude, 5.75 millimeters; semidiameter, 2.1 millimeters.

Cotypes: U. S. Nat. Mus. No. 354021.

Type locality: No. 3419, McClelland farm, 1 mile below Baileys Ferry, Calhoun County, Fla.

The name *chipolana* was used by Dall upon the labels of the United States National Museum specimens, though the species was listed and discussed under the name *heterogenea* Guppy.

This, the earliest member of the group so widely distributed through the Floridian and West Indian provinces, runs smaller than any of its descendants. It is peculiar, too, in that both the concentric sculpture of the right valve and the radial sculpture of the left valve are usually initiated at a later stage of development than in any of the succeeding forms. The species is abundant and widespread in the Chipola but apparently did not survive the close of the epoch. The later *waltonensis* runs larger and relatively higher and more narrow.

Occurrence: Chipola formation, localities 10609^p, 7893^p, 2212^c, 7257^p, 2213^a, 2564^a, 3419^a, 7151^p, 2211^c, 7183^p, 10660^p.

Corbula waltonensis Gardner, n. sp.

Plate XXXIV, Figures 18-21

Shell rather large for the group, moderately heavy, conspicuously inequivalve. Right valve high, narrow, rudely trigonal, strongly inflated, subacutely rostrate posteriorly, with a more obtuse secondary keel near the dorsal margin. Left valve transversely ovate-trigonal, moderately inflated, obscurely rostrate; the secondary keel indicated by a narrow groove, usually filled with callus, developed near the ventral margin. Umbo very much higher in the right valve than in the left, broad upon its summit, incurved; the tips of both valves prosogyrate and slightly anterior. Dorsal margins gently sloping, the anterior a little more steeply than the posterior. Anterior extremity strongly arcuate. Posterior extremity squarely truncate in the

The species is restricted in its known distribution to the type locality.

Occurrence: Chipola formation, locality 2211^p.

***Corbula (Caryocorbula) wakullensis* Gardner, n. sp.**

Plate XXXV, Figures 5-6

Shell small, transversely elongated, the right valve slightly higher than the left, inequilateral, acutely rostrate posteriorly. Umbones moderately inflated, flattened upon their summits, the tips acute, proximate, and prosogyrate; umbonal angle not far from 135°. Anterior extremity broadly and smoothly rounded. Posterior end attenuated, pinched and produced behind the rostrum, obliquely truncate. Base line feebly arcuate. Umbonal area smooth, except for feeble incrementals; medial and ventral portions of shell sculptured with about 15 concentric cords, fairly regular in size and spacing, evanescent near the anterior margin and directly in front of the rostrum; sculpture behind the rostrum incremental in character, strongest toward the ventral margin. Characters of ligament and hinge not known. Posterior adductor scar more prominent than the anterior. Pallial line entire, distinct.

Dimensions: Altitude, 4.8 millimeters; latitude, 9 millimeters; semidiameter, 1.5 millimeters.

Type: U. S. Nat. Mus. No. 354024.

Type locality: No. 7468, Sopchoppy, Wakulla County, Fla.

Corbula wakullensis is much smaller and more finely sculptured than *C. sarda* Dall from Alum Bluff but similar in outline. The seedlike casts are very abundant at the type locality, but the available collections show no specimens from other localities.

Occurrence: Chipola formation, locality 7468^a.

***Corbula (Caryocorbula) antoniae* Maury**

1910. *Corbula antoniae* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 34, pl. 9, fig. 1.

Maury describes this species as follows:

Shell very thick and solid, inflated, nearly equilateral, rounded in front, compressed and pointed behind so as to look as if pinched, and having a well-defined carina extending from the back to the posterior margin; beaks low; sculpture of rather unequal and not very regular concentric ribs which are absent from the region near the beaks.

Length of shell 10 millimeters; height 8 millimeters; diameter of inflated valve 6 millimeters.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.

The species has not been recognized in the available material.

Occurrence: Chipola formation, Cornell University collection.

***Corbula (Caryocorbula) whitfieldi* Dall**

Plate XXXV, Figure 7

1898. *Corbula (Cuneocorbula) whitfieldi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 849.

1900. *Corbula (Cuneocorbula) whitfieldi* Dall, idem, pt. 5, p. 1192, pl. 36, fig. 18.

Dall describes this species as follows:

Shell small, solid, inflated, nearly equilateral, rounded in front, very obliquely truncate, and pointed behind, with a well-marked rostral carina and a slight emargination of the border of the valve below the rostrum; beaks low and inconspicuous; sculpture of rather coarse incremental lines and somewhat irregular concentric undulations, stronger in the middle of the shell, feeble on the beaks and with wider interspaces; base of the right valve folded upon the basal margin of the left valve. Longitude 7, altitude 4.5, diameter 3.4 millimeters. A small tubercle behind the socket and resilifer on the cardinal margin of the left valve.

This species is close to *C. barrattiana* C. B. Adams [see Pl. XXXVI, fig. 8], from which it differs by greater inflation and usually by the smaller number of concentric undulations and especially by the absence of any radial threads on the dorsal area of the rostrum. It recalls *C. subcontracta* Whitfield, which is a proportionately shorter shell and not as large.

Type: U. S. Nat. Mus. No. 135911.

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

Corbula whitfieldi is a more delicately formed and sculptured shell than its descendant *parawhitfieldi*. The earlier form, *C. whitfieldi boyntoni* Gardner, is smaller, relatively shorter and heavier, and, as a rule, more uniformly sculptured concentrically. The Oak Grove individuals that develop a radial sculpture have been isolated under the subspecies *stikta*. *Corbula whitfieldi* is the most abundant of the Oak Grove *Corbula*s and is common in the lower beds of the Shoal River.

Occurrence: Oak Grove sand, localities 2646^a, 5632^a, 5631^p, 7054^c, 9961^c, 10659^p, 3749^r. Shoal River formation, localities 5079^c, 10661^p, 10662^r, ?3733^r.

***Corbula (Caryocorbula) whitfieldi stikta* Gardner, n. subsp.**

Plate XXXV, Figures 8-9

Shell small, flexuous, inequilateral, inequivalve, the right valve more strongly overlapping posteriorly than anteriorly. Umbones broadly rounded upon their summits, the tips incurved and prosogyrate, subcentral. Anterior end of shell strongly rounded. Posterior end bicarinate, broadly constricted in front of the subacute primary keel; secondary keel very close to the dorsal margin, acute in the left valve, obtuse in the right, the left posterior dorsal margin overlapped by the right almost to the keel; posterior extremity obliquely truncate. Base line flexuous in the right valve, nearly horizontal in the left. External surface concentrically wrinkled, the rugae feebler and more regular upon the right valve than the left, obsolete behind the primary keel; a microscopically fine and close radial beading developed in some individuals over the entire shell, in others upon the posterior area only. Ligament internal, seated upon a narrow chondrophore in the left valve, received in a subumbonal pit in the right. Right cardinal stout, tapering rapidly to the acute upcurved tip; cardinal socket in the left valve correspondingly wide and deep. Adductor scars distinct, the anterior

reniform, the posterior subcircular. Pallial line truncate posteriorly but not sinuate.

Dimensions: Double valves, altitude, 4.5 millimeters; latitude, 7.2 millimeters; diameter, 3 millimeters.

Type: U. S. Nat. Mus. No. 354026.

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

The subspecies is characterized by the development of an exceedingly fine *barrattiana*-like threading. In some individuals the entire shell is covered except for the umbones and the area behind the secondary keel, but more commonly the radial sculpture is confined to the posterior half of the shell.

The distribution is similar in a general way to that of *C. whitfieldi* s.s., though much more restricted.

Occurrence: Oak Grove sand, localities 2646^p, 5632^p.

***Corbula (Caryocorbula) whitfieldi boyntoni* Gardner, n. subsp.?**

Plate XXXV, Figures 10-13

Shell small, solid, ovate-trigonal, inequilateral, inequivalve; the right valve a little larger than the left, more convex and somewhat flexuous. Umbones broadly rounded upon their summits, the tips proximate, acute, and prosogyrate, falling a little in front of the median vertical; umbonal angle not far from 135°. Lunule not defined. Dorsal margins oblique, the anterior a little higher than the posterior. Anterior extremity broadly rounded. Posterior extremity obliquely truncate. Base line flexuous in the right valve, quite strongly arcuate medially, and broadly constricted in front of the posterior keel; base line in the left valve almost rectilinear. Posterior primary keel subacute; area obliquely flattened behind the keel; a secondary keel developed very close to the dorsal margin, obtuse in the right valve and acute in the left, the right dorsal margin in the closed valves overlapping the left to the secondary keel. External surface concentrically wrinkled, the rugae coarser upon the right valve than upon the left and coarser and less evenly spaced posteriorly than anteriorly; concentric sculpture behind the rostrum reduced to more or less laminar incrementals; microscopically fine radials fortuitously developed, most common behind the keel. Ligament internal, seated upon a short, laminar chondrophore in the right valve, received in the subumbonal socket of the left; a tubercle developed at the distal extremity of the chondrophore. Right cardinal strong, horizontally compressed, upcurved at the tip, received in a correspondingly wide and deep socket in the left valve. Adductor impressions distinct, the anterior reniform, the posterior subcircular. Pallial line running closer to the base posteriorly than anteriorly, slightly indented but with no well-defined sinus; line of closure in the right valve much more conspicuous

than the pallial line, running closer to the base anteriorly than posteriorly.

Dimensions: Right valve (cotype), altitude, 4 millimeters; latitude, 5.6 millimeters; semidiameter, 2.25 millimeters. Left valve of another individual (cotype), altitude, 3.5 millimeters; latitude, 5.3 millimeters; semidiameter, 2 millimeters.

Cotypes: U. S. Nat. Mus. No. 354025.

Type locality: No. 7893, Boynton Landing, Choctawhatchee River, Washington County, Fla.

Corbula boyntoni is possibly nothing more than a short, solid, small subspecies of *C. whitfieldi* of the Oak Grove and Shoal River. It is very interesting to find this apparent precursor in the higher zone of the Chipola.

Occurrence: Chipola formation, localities 10609^r, 7893^p, ?6175^r.

***Corbula (Caryocorbula) parawhitfieldi* Gardner, n. sp.**

Plate XXXV, Figures 14-17

Shell rather small and heavy, inequilateral, inequivalve; the right valve more strongly overlapping the left posteriorly than anteriorly. Umbones low, broad, the right slightly higher than the left: the tips proximate and prosogyrate, subcentral. Lunule not defined. Posterior area bicarinate, the primary keel acute, the secondary very close to the dorsal margin and more sharply defined on the left valve than on the right; right posterior margin overlapping the left almost to the secondary keel. Anterior extremity of shell broadly and smoothly rounded. Posterior extremity obliquely truncate. Base line strongly arcuate in the right valve, slightly constricted behind the keel, nearly horizontal in the left valve. External surface concentrically corrugated, the wavelets usually sharper and less irregular in arrangement in the right valve than in the left, strengthening toward the base; secondary striae often developed toward the keel; both the primary and the secondary sculpture abruptly disappearing at the keel; posterior area smooth except for incrementals, which are often somewhat laminar toward the base; faint traces of a fortuitous radial lineation occasionally visible posteriorly. Ligament internal, the laminar chondrophore produced from the posterior dorsal margin of the left valve, received in a deep subumbonal socket in the right; a small tubercle developed at the distal extremity of the chondrophore. Right cardinal somewhat compressed, upcurved and subacute at the tip, the cardinal socket of the left valve broadly trigonal. Adductor scars distinct; anterior adductor reniform, the posterior subcircular. Pallial line distinct, truncate posteriorly but not sinuate; line of closure of right valve strongly defined, running nearer to the base anteriorly than posteriorly.

Dimensions: Right valve (cotype), altitude, 4.8 millimeters; latitude, 6.8 millimeters; semidiameter, 2.55 millimeters. Left valve (cotype), altitude, 4.7

millimeters; latitude, 6.3 millimeters; semidiameter, 2.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 354027.

Type locality: No. 3856, 6 miles west-northwest of Mossyhead, Walton County, Fla.

Corbula parawhitfieldi is the close analog in the Shoal River of *Corbula whitfieldi* in the Oak Grove. The shell is higher relatively and ruder and has a more irregular sculpture. The species is common and widespread at the single horizon at which it occurs.

Occurrence: Shoal River formation, localities 3856^c, 3742^c, ?5079^r, 9958^r, 3748^p, 7264^p, 9960^r, 9957^c, 10603^a, 10608^{pr}, 5618^p, 10612^r.

***Corbula (Caryocorbula) semenoides* Gardner, n. sp.**

Plate XXXV, Figures 18–21

Shell minute but solid, moderately inflated, inequivalve; the margin of the larger, more convex right valve overlapping the left; the external outline rudely trigonal; the outline of the interior transversely ovate-trigonal. Umbones low, flattened upon their summits, prosogyrate, slightly anterior. Anterior end of shell strongly rounded. Posterior end produced along the rostrum, the lateral extremity obliquely truncate. Base line flexuous, constricted in front of the rostrum, arcuate anteriorly. Primary keel acute, the area behind it relatively wide; secondary keel directly in front of the dorsal margin. External sculpture incremental in character, absent upon the umbones and relatively heavy and crowded toward the base, not continued across the keel; concentric sculpture upon the posterior area reduced to fine incrementals; a minutely pustulose radial lineation developed upon fresh surfaces both upon the disk and behind the keel, crowded upon the posterior area and rather closely spaced upon the disk. Chondrophore short, relatively stout; a tubercle developed at the outer extremity; resilifer deep, undercutting the dorsal margin. Cardinal tooth in right valve short, horizontally compressed, upcurved at the tip; the cardinal socket of the left valve correspondingly wide and deep. Adductor scars relatively large; the anterior reniform; the posterior subcircular. Pallial line distant from the base; sinus a mere dent. Line of closure of left valve well defined upon the right, running closer to the margin anteriorly than posteriorly.

Dimensions: Right valve (cotype), altitude, 3.5 millimeters; latitude, 4 millimeters; semidiameter, 1.5 millimeters. Left valve of a larger individual (cotype), altitude, 3 millimeters; latitude, 4.5 millimeters; semidiameter, 1.3 millimeters.

Cotypes: U. S. Nat. Mus. No. 354028.

Type locality: No. 7151, Tenmile Creek, Calhoun County, Fla.

Corbula semenoides runs a little smaller than *C. seminella* Dall from the Oak Grove and Shoal River and is decidedly less inflated. The concentric sculp-

ture is ruder than in the later form, and the radial sculpture is even finer and less constantly developed.

Corbula semenoides is the probable precursor of the more finely sculptured *Corbula nucleata* Dall, of the later Miocene and Pliocene of the southeast coast.

Occurrence: Chipola formation, localities 2212^p, 7257^p, 2213^a, 2564^a, 3419^a, 7151^p.

***Corbula (Caryocorbula) seminella* Dall**

Plate XXXIV, Figure 24

1898. *Corbula (Cuneocorbula) seminella* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 848.

1900. *Corbula (Cuneocorbula) seminella* Dall, idem, pt. 5, p. 1192, pl. 36, fig. 11.

Dall describes this species as follows:

Shell small, inflated, compact, with low beaks a little anterior to the middle line, the left valve slightly smaller and enfolded below by the basal margin of the right valve, which has a flexuous edge; beaks nearly smooth, the valves below them with somewhat irregular, concentric undulations, and more or less faint radial striation; anterior end rounded, posterior end pointed, with a single strong rostral carina, below which the basal margin is a little emarginate. Longitude 4.5, altitude, 3, diameter 2 millimeters.

This is a very compact, solid, seedlike little shell, recalling *C. aldrichi* Meyer on a smaller scale.

Type: U. S. Nat. Mus. No. 135910.

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

Corbula seminella is apparently the descendant of the abundant *Corbula semenoides* of the Chipola. The later species is a little larger than the earlier and more inflated, with a more strongly overlapping right valve and a less faint and more persistent radial threading. The young of *C. whitfieldi* coexistent in the Oak Grove are thinner shelled and more elongated transversely, the concentric sculpture is coarser, and the radial lineation undeveloped.

Corbula seminella is much more abundant and more diversified in the Shoal River than at the horizon which furnished the type. The species attains greater dimensions in the Shoal River than it does in the Oak Grove, though the average individual is little larger than the type.

Occurrence: Oak Grove sand, localities 2646^p, 5632^p, 5633^r, 7054^r, 9961^c, 10659^a, 3749^p. Shoal River formation, localities 3856^a, 3732^r, 3742^a, 10658^p, 5195^r, 5079^c, 10661^r, 9958^p, 3748^c, 3747^p, 7261^p, 7264^p, 9960^p, 9957^r, 10603^r, 5618^c, 10612^p.

***Corbula (Caryocorbula) funiakensis* Gardner, n. sp.**

Plate XXXV, Figures 22–25

Shell small, compressed, compact, inequivalve. Right valve slightly higher and less compressed than the left; the right posterior and ventral margins slightly overlapping those of the left, inequilateral, acutely rostrate posteriorly. Anterior dorsal margin more steeply declining than the posterior. Anterior

lateral margin smoothly rounded. Posterior extremity squarely truncate. Base line flexuous, particularly in the right valve, feebly constricted in front of the dorsal keel. Umbones low, flattened, the tips proximate and feebly prosogyrate, falling a little in front of the median vertical. Lunule and escutcheon not defined. Area behind the acute primary keel rather wide; secondary keel nearly obsolete in the left valve, fairly well defined and close to the dorsal margin in the right. Prodissoconch minute, smooth, shining, subcircular. External surface sculptured with feeble and irregular concentric waves, stronger in the left valve than in the right and initiated at an earlier growth stage, not persistent across the keel in either valve; sculpture upon the posterior area reduced to fine incremental striae and minute wrinkles; no trace of a radial sculpture detected. Ligament internal, mounted upon a slender lamina in the left valve, received in a subumbonal pit undercutting the dorsal margin; a small tubercle developed at the distal extremity of the nymph. Right cardinal laterally compressed, wide but not conspicuously elevated, slightly recurved, received in the trigonal subumbonal pit of the left valve. Adductor scars deeply impressed, very close to the lateral margins; the anterior elongated, slightly reniform; the posterior subcircular. Pallial line distinct, running closer to the posterior margin than to the anterior, rising at almost a right angle to the posterior adductor but not sinuated; line of closure of the left valve very distinctly marked in the right.

Dimensions: Altitude, 3 millimeters; latitude, 4.3 millimeters; diameter, 2.8 millimeters.

Type: U. S. Nat. Mus. No. 354029.

Type locality: No. 5618, 3½ miles southwest of De Funiak Springs, Walton County, Fla.

Corbula funiakensis suggests a very compressed and feebly sculptured *C. seminella* Dall. The slight dimensions, compressed valves, feeble concentric sculpture, and absence of any radial lineation readily isolate the species. It has been observed only in the upper zone of the Shoal River formation.

Occurrence: Shoal River formation, localities 3747^p, 7264^p, 5618^c.

Subgenus BICORBULA Fischer

1887. Fischer, Manuel de conchyliologie et de paléontologie conchyliologique, p. 1123.

Type: *Corbula gallica* Lamarck. (Eocene of the Paris Basin.)

Shell large, inequivalve; right valve larger and higher; left valve ovate-trigonal in outline; posterior keel obsolete or obscure on both valves; concentric sculpture feeble and irregular; a fortuitous radial lineation frequently developed on the left valve, most obvious on the decorticated shell; ligament pit profound; anterior cardinal prominent, the posterior not developed; an incipient pallial sinus usually developed.

Corbula (Bicorbula) sp. indet.

Two poorly preserved valves of a species apparently closely allied to *C. idonea* Conrad (see Pl. XXXV, figs. 26–28), of the Chesapeake group of Maryland, were collected at White Springs, on Suwannee River. They are much smaller than the Maryland individuals. Whether they represent a distinct species or are merely juvenile *idonea* can not be determined from the available material.

Occurrence: Chipola formation, locality 6769^r.

Subgenus BOTHROCORBULA Gabb

1873. *Bothrocorbula* Gabb, Acad. Nat. Sci. Philadelphia Proc. for 1872, p. 274.

Type: *Bothrocorbula viminea* Guppy. (Miocene of the Bowden beds of Jamaica.)

Shell moderately large and heavy, transversely ovate in outline, slightly inequivalve, acutely rostrate posteriorly; a coarse concentric corrugation and an inconstant radial striation developed on both valves; the deep lunular depression in front of the umbones the characteristic feature of the group; hinge heavy but otherwise normal.

Corbula (Bothrocorbula) synarmostes Dall

Plate XXXVI, Figures 1–2

1898. *Corbula (Bothrocorbula) synarmostes* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 850.

1898. *Corbula (Cuneocorbula) engonata* var. *burnsii* Dall, idem, p. 847 (part).

1900. *Corbula (Cuneocorbula) synarmostes* Dall, idem, pt. 5, p. 1192, pl. 36, figs. 12, 13.

Dall describes the species as follows:

Shell of moderate size, solid, ovate, pointed behind, nearly equilateral; beaks moderately elevated, small; anterior end rounded, base prominently arcuate; posterior end pointed, hardly rostrate, with a single rostral carina, below which the base is slightly emarginate; sculpture of strong, rounded undulations (about nine in number) not extending behind the carina, separated by about equal interspaces; sculpture feebler on the beaks; rostral area concentrically striated; lunular area slightly impressed but without any cellular excavation; surface, when perfect, with fine incremental lines and minute, irregularly distributed radial threads; cardinal tooth strong; a small tubercle on the hinge margin of the left valve behind the chondrophore; muscular scars deep; pallial line with a small sinus. Longitude 15, altitude 10, diameter 7.6 millimeters.

This species, though smaller, is externally very like the *C. viminea*, except that the lunular area is only slightly depressed, so that if attention were not particularly directed to it the depression might pass unnoticed, as it is not definitely limited.

Type: U. S. Nat. Mus. No. 154501.

Type locality: No. 2564, McClelland farm 1 mile below Baileys Ferry, Calhoun County, Fla.

The umbones are approximately central, but there is a marked discrepancy in the outline of the anterior and posterior ends of the shell. The posterior keel is sharply pinched at its extremity and slightly produced.

The Chipola River individuals referred to *C. engonata* var. *burnsii* Dall are young and for the most part weathered *C. synarmostes*. The depression in front of the umbone is sufficient to separate the species from the members of other subgenera and from all other described species from the Chipola. The relatively high outline separates it from *C. radiatula* Dall, of the Oak Grove.

Occurrence: Chipola formation, localities 10609^r, 7893^p, 7257^p, 2213^c, 2564^p, 3419^p, 7151^p.

***Corbula (Bothrocorbula) radiatula* Dall**

Plate XXXVI, Figures 3-7

1898. *Corbula (Bothrocorbula) radiatula* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 851.

1898. ?*Corbula (Bothrocorbula) radiatula* var. *tenella* Dall, idem, p. 851.

1900. *Corbula (Bothrocorbula) radiatula* Dall, idem, pt. 5, p. 1192, pl. 36, figs. 1, 2, 3.

Dall, in 1898, described this species as follows:

Shell resembling the last species [*Corbula synarmostes* Dall], but smaller, less high in proportion, and longer, with the radiating threads more numerous and constant and the lunular area more deeply impressed, forming an elongated cellule with definite limits. Longitude 13, altitude 8.6, diameter 6.2 millimeters.

Variety *tenella* Dall; shell quite thin and delicate, the surface closely covered with minute radial threads.

This species has the lunular depression intermediate in depth between that of the last species [*Corbula (Bothrocorbula) synarmostes* Dall] and *C. viminea*.

Type: U. S. Nat. Mus. No. 107388; "var. *tenella* Dall," No. 135904.

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

Corbula radiatula is the largest and heaviest of the Oak Grove Corbulas. The right valve is a little larger and more convex than the left, with a more strongly arcuate hinge. The umbones are somewhat flattened upon their summits, central or slightly anterior. The anterior extremity is strongly bowed, the posterior keel acute, produced, and attenuated ventrally. In front of the rostrum the base line is rather broadly constricted. The concentric undulations are very heavy and persist almost to the anterior dorsal margin, though they evanesce toward the umbones and a little in front of the keel. Behind the keel the sculpture is reduced to closely crowded laminae, incremental in character, laminar toward the base. The radials are exceedingly fine but sharply elevated lirae, absent upon the umbones and the posterior area and inclined to evanesce on the dorsal slope of the concentric ribs. The ligament is internal and is attached to a cuneate projection of the posterior dorsal margin of the left valve, which fits into a deep subumbonal socket directly behind the heavy conical tooth of the right valve. The cardinal socket of the left valve is correspondingly deep, the dorsal margins

sharply raised on either side, and a small tubercle developed at the ventral extremity of the chondrophore. The adductor scars and the scarcely sinuated pallial line are very distinct.

The status of the half dozen individuals from Oak Grove referred by Dall to the variety *tenella* can not be determined absolutely from the material available. They are probably specifically identical with *Corbula radiatula* Dall. The shell is not only conspicuously thin, but the base line is nearly horizontal from the rostrum to the anterior margin and markedly distinct from the convex anteriorly, concave posteriorly base of the normal adult *radiatula*. The concentric ribbing is similar in general characters to that of *C. radiatula* but more delicate. The microscopic radials are sharply beaded and in one individual crowd the posterior area. As in *C. radiatula*, however, they are absent upon the umbones. The characters of the interior suggest immaturity. It is obvious from a close observation of the adult *C. radiatula* that the attenuated rostrum, the constriction in front of the rostrum, and the overlapping ventral margin of the right valve with the consequent strongly arcuate outline are characters not acquired until the later adult stages. The sharpness of detail of the radial lirae also suggests immaturity. Apparently the animal did not begin to deposit on the inner surface until it had nearly completed its growth, so that we have the juvenile characters persisting through an unusually long period.

The type locality of Dall's var. *tenella* is the same as that of his *radiatula*, and the distribution, though more restricted, is similar.

Occurrence: Oak Grove sand, localities 2646^c, 5632^p, 5631^r, 5633^r, 7054^r. "Var. *tenella*," Oak Grove sand, localities 2646^p, 5632^p.

Family SPHENIOPSISIDAE

Genus SPHENIOPSIS Sandberger

1863. *Spheniopsis* Sandberger, Conchologie des Mainzer Tertiär-Beckens, p. 289.

Type: *Spheniopsis scalaris* Brown. (Oligocene of the Mainzer beds of Germany.)

Except for the single Chipola species this genus is restricted in its known distribution to beds of the epoch from which it was first described, the Oligocene of Germany.

The shell is porcelaneous, small, compressed, equi-valve, rudely trigonal, the posterior keel produced and the base line arcuate. The sculpture when developed is concentric. The ligament is internal and lodged in a deep subumbonal pit. There are two laminar teeth in the right valve, one on each side of the resilifer. The left valve is edentulous except for the marginal grooves which receive the cardinal lamellae of the right. The pallial sinus is rounded and moderately deep.

The general characters of shell texture and outline, surface sculpture, and ligament attachment ally the genus, as suggested by Dall⁴⁰ in 1903, more closely with the Corbulidae than with any other family.

The dentition of *Spheniopsis*, however, is far removed from that of the typical Corbulas—too far, in the absence of peripheral forms, to permit their inclusion in the family group. Only the single species has been reported from the Western Hemisphere.

***Spheniopsis americana* Dall**

Plate XXXVI, Figures 9–10

1903. *Spheniopsis americana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1508, pl. 57, figs. 28, 29.

Dall describes this species as follows:

Shell small, equivalve, rostrate; beaks small, pointed, sub-central; sculpture of a few, nearly concentric, relatively large waves, sometimes obsolete, and fine concentric striation; dorsal slopes steep, forming an angle of nearly 90° at the umbones; the anterior end rounded, base arcuate, posterior end rostrate, slightly twisted, subtruncate terminally; hinge in the right valve of two diverging relatively strong lamellar teeth, between which is the resiliary pit and above which the margins are grooved to receive those of the opposite valve, which is edentulous; the fossette is subumbonal and not elevated; the muscular impressions are distinct, as is the pallial line, which has a short, wide, rounded sinus; the inner margins are entire. Length 3, height 2, diameter 1 millimeter.

The waves near the beaks are inconstant in strength and extent, but seldom cover more than a third of the disk.

Type: U. S. Nat. Mus. No. 114679.

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

These small but exceedingly interesting forms are restricted in their known distribution to the environs of the type locality. There is no known species with which they can be confused, but, on the other hand, it is very difficult when first they are met to determine even their broadest alliances.

Occurrence: Chipola formation, localities 7257^r, 2213^p, 7151^r.

Family SAXICAVIDAE Gray

Genus PANOPE Menard de la Groye

1807. *Panope* Menard de la Groye, Mémoire sur un nouveau genre de la famille des solénoïdes, p. 31.

Type: *Panope aldrovandi* Menard de la Groye. (Recent in the Mediterranean.)

Shell equivalve, oblong, gaping at both ends; surface smooth or concentrically furrowed; ligament external, conspicuous; a single prominent conical tooth in each valve; pallial sinus deep.

A genus that has been in existence since the end of the Cretaceous, culminated in the Tertiary, and is represented to-day by about a dozen species occurring chiefly in cooler waters.

Panope is represented at each of the three horizons of the Alum Bluff but at only one of them by material

sufficiently entire to describe. The Chipola and Shoal River forms are very similar and may be identical. *Panope parawhitfieldi*, from the cooler water deposits of the Oak Grove, is distinct and more closely allied to *P. whitfieldi* Dall, from the lower Chesapeake of the middle Atlantic slope.

***Panope parawhitfieldi* Gardner, n. sp.**

Plate XXXVI, Figures 11–12

1898. *Panopea whitfieldi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 829 (part).

1915. *Panope whitfieldi* Dall, U. S. Nat. Mus. Bull. 90, p. 156, pl. 18, figs. 1, 2 (part).

Shell large, thin, inflated, equivalve, inequilateral, more widely gaping posteriorly than anteriorly. Umbones slightly anterior, broad, rising above the dorsal margins, flattened upon their summits, the tips acute, incurved, and twisted slightly forward. Dorsal margins rectilinear, parallel to the base. Anterior extremity relatively short, broad, broadly rounded. Posterior extremity produced, slightly attenuated and expanded, strongly arcuate. Base line horizontal, more abruptly upcurved in front than behind. External surface rather strongly and evenly undulated concentrically in the umbonal region, the waves dying out away from the umbones and the sculpture reduced to incrementals rather sharply raised toward the dorsal margins. Surface microscopically pustulose, the pustules most crowded over the umbonal area and toward the posterior extremity, radially oriented near the posterior dorsal margin, frequently imbricated toward the lateral extremities. Nymphs heavy but rather short. A single slender, slightly upcurved, laterally compressed conical tooth in each valve. Interior somewhat thickened over the area of the attached mantle. Adductor scars relatively small, distinct, the anterior irregularly elongated, the posterior rudely reniform. Pallial line ragged, rather distant from the base; pallial sinus produced almost but not quite to the vertical dropped from the beaks.

Dimensions: Type, altitude, 48 ± millimeters; latitude, 90 ± millimeters; diameter, 33 millimeters. A less perfect individual attains an altitude of 60 millimeters and a probable latitude of 110 millimeters.

Type: U. S. Nat. Mus. No. 135913.

Type locality: Oak Grove, Yellow River, Okaloosa County, Fla.

Panope whitfieldi Dall averages about 45 millimeters long by 83 millimeters wide in New Jersey and a little larger in Maryland but does not approach the size attained by some of the fragmentary individuals in Florida. The concentric sculpture upon the umbones is stronger and more regular in the southern species, and the pallial sinus in the few specimens observed is less profound.

The Chipola species is apparently distinct from the Oak Grove, differing in the more produced and attenuated posterior extremity. The material is too fragmentary to name.

⁴⁰ Dall, W. H., Contributions to the Tertiary fauna of Florida; Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1507, 1903.

The cast from Shoal River exhibits a similar outline.

The specimen figured in Bulletin 90 of the National Museum under the name *whitfieldi* is from Oak Grove and will serve as the type. The fragment from the "silex beds" lacks the strong sculpture that is characteristic of the Oak Grove race.

Occurrence: Oak Grove sand, localities 2646^p, 5630^r.

Panope sp. indet.

1898. *Panopea whitfieldi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 829 (part).

1915. *Panope whitfieldi* Dall, U. S. Nat. Mus. Bull. 90, p. 156, pl. 18, figs. 1, 2 (part).

The casts from the Chipola formation which have been referred to *P. whitfieldi* Dall apparently represent a race distinct at least subspecifically from both *Panope whitfieldi* Dall from the lower Chesapeake of the middle Atlantic coast, and *Panope parawhitfieldi* Gardner, n. sp., from the Oak Grove sand. The umbones are more decidedly anterior than in either of the other two species and the posterior extremity more attenuated. The umbonal sculpture lacks the strength and regularity which are shown by that of *P. parawhitfieldi*, and the sinus is produced to the vertical dropped from the beaks. The cast from the Shoal River formation is similar in outline to those from the Chipola.

Occurrence: Chipola formation, localities 2213^p, ?3419^r, Shoal River formation, locality ?5184^r.

Family GASTROCHAENIDAE Gray

Genus GASTROCHAENA Spengler

1783. Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter, vol. 2, p. 179.

Type: *Gastrochaena cuneiformis* Spengler. (Recent in the West Indies.)

Shell inequilateral, thin, ovoid, or cuneiform, widely gaping ventrally and posteriorly; beaks low, anterior; ligament external; hinge edentulous; myophore developed for the support of the soft parts; adductor impressions unequal; pallial sinus deep, angular; bore cylindrical or flask-shaped, lined with calcareous matter.

Geologic range from the Mesozoic to the Recent. Geographic range, the warmer waters throughout the globe.

Two species have been recognized in the Alum Bluff—*Gastrochaena rotunda* Dall, from the Chipola, and *Gastrochaena dodona* Gardner, n. sp., from the Oak Grove, the former identical with the species from the tropical fauna of the Bowden beds, the latter most closely allied to a more northern species from the

Chesapeake of Virginia. Additional evidence such as this for the cooling of waters at the end of Chipola time is always interesting.

Latitude approximately half the altitude; incremental sculpture almost obsolete medially.....*Gastrochaena rotunda* Dall. Latitude perceptibly less than half the altitude; incremental sculpture well developed medially.

Gastrochaena dodona Gardner, n. sp.

Gastrochaena rotunda Dall

Plate XXXVI, Figure 13

1898. *Gastrochaena ovata* var. *rotunda* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 825.

1915. *Gastrochaena rotunda* Dall, U. S. Nat. Mus. Bull. 90, p. 157, pl. 19, fig. 2 (part).

1922. *Gastrochaena rotunda* Dall. Olsson, Bull. Am. Paleontology, vol. 9, No. 39, p. 438 (part).

1925. *Gastrochaena (Gastrochaena) rotunda* Dall. Woodring, Carnegie Inst. Washington Pub. 366, p. 192, pl. 26, figs. 11, 12.

Dall, in 1898, described this species as follows:

Shell resembling the *ovata* of the same size, but not attaining so large a size as the adult *ovata*, with a more rounded posterior end and rather shorter gape, the myophore decidedly larger, wider, and more conspicuous. Longitude 7, latitude 3.5, diameter 2.8 millimeters.

The differences between the recent and the Oligocene shells are so slight, and the range of variation in the living specimens so marked, that I feel unwilling, though the distinctive characters above mentioned seem constant, to give the fossil shells more than varietal rank until I have seen a larger number of specimens.

Type: U. S. Nat. Mus. No. 114705.

Type locality:⁴¹ No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The shell is very thin, ovate, and widely gaping posteriorly and ventrally, only partly covering the animal. The umbones are anterior and nearly terminal, the dorsal margin broadly arcuate, produced a little beyond the tips of the beaks and acutely angulated at the extremity. The posterior end is slightly expanded and evenly rounded, the ventral margin broadly constricted. The surface sculpture is incremental in character, the growth lines most elevated and most crowded ventrally, relatively distant along a cuneiform area extending from the umbones to the posterior margin, slightly more elevated and more closely spaced dorsally. The ligament is external and attached to slender nymphs extending about one-third the length of the dorsal margin. The hinge is edentulous, but there is a slender myophore springing from beneath the umbones. The inner margin is also rein-

⁴¹ The correctness of the locality label of the type has been questioned. Unfortunately, many of both the Chipola and the Bowden specimens show a reddish stain, and it is impossible to be sure from the appearance of the shell whether it was collected in Florida or in Jamaica.

forced in the umbonal region by frail buttresses. The adductor scars are obscure and placed high up under the dorsal margin, the posterior irregular in outline and much larger than the anterior. The pallial sinus is produced almost or quite to the anterior third and is acutely angulated at its extremity.

Gastrochaena rotunda is a little smaller, relatively wider, and less strongly sculptured concentrically than the Oak Grove species.

The differences between the fossil and the recent species seem to be sufficiently constant to justify the raising of the Miocene form to specific rank.

A flask-shaped tube from the "silex beds" of the Tampa formation is assigned to this species, though there is little evidence of its identity with the shells described from Bowden and Chipola River.

Occurrence: Chipola formation, locality 2213^r.

Outside occurrence: Miocene: Silex beds?" of Tampa formation, Florida; Bowden beds, Jamaica.

***Gastrochaena dodona* Gardner, n. sp.**

Plate XXXVI, Figure 14

1898. *Gastrochaena ligula* H. C. Lea. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 825.

Not *Gastrochaena ligula* H. C. Lea, Am. Philos. Soc. Trans., vol. 9, p. 234, 1845.

Shell small, slender, mytiliform, thin, widely gaping posteriorly and ventrally, moderately inflated, flattened dorsally. Umbones low, inconspicuous, the tips obtuse and nearly terminal, the dorsal margin produced slightly beyond them and subacutely angulated at its extremity. Dorsal margin behind the umbones feebly arcuate. Posterior extremity rather sharply rounded. Ventral margin flexuous, broadly constricted medially. Incremental sculpture well developed over a cuneate area extending from the umbones to the posterior extremity, the incrementals following the outline of the margins, relatively crowded and elevated ventrally, inconspicuous though closely spaced dorsally. Ligament external, mounted on slender nymphs extending about one-third the length of the dorsal margin. Hinge edentulous. Myophore not preserved. Umbonal margin reinforced internally by feeble buttresses. Adductor impressions obscure, the posterior large, semielliptical, set high up under the dorsal margin. Pallial scars also obscure, the sinus apparently produced into the anterior third of the shell and obtusely angulated at its extremity.

Dimensions: Altitude, 6.2 millimeters; latitude, 2.7 millimeters.

Type: U. S. Nat. Mus. No. 354030.

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

Gastrochaena dodona Gardner, n. sp., is apparently consistently smaller than *G. ligula* (Pl. XXXVI, figs. 15, 16), from Petersburg, Va. It differs from the young of that species in the less flexuous ventral margin and the relatively wider dorsal flattening. *Gastrochaena rotunda* Dall, from the Chipola, is more expanded posteriorly, and in neither that species nor in the later *Gastrochaena cuneiformis* Spengler is the incremental sculpture so pronounced as that of *G. dodona*.

Gastrochaena dodona is restricted in its known distribution to the Oak Grove horizon.

Occurrence: Oak Grove sand, locality 2646^p.

Phylum MOLLUSCOIDEA Huxley

Class BRACHIOPODA Cuvier

Order NEOTREMATA Beecher

Superfamily DISCINACEA Waagen

Family DISCINIDAE Gray

Genus DISCINISCA Dall

1871. *Discinisca* Dall, Am. Jour. Conchology, vol. 7, pt. 2, p. 74.

Type: *Discina lamellosa* Broderip. (Recent off Peru.)

Dall describes this genus as follows:

Lower valve more or less flattened, concave or compressed. Upper valve more convex; apices of both subcentral or subposterior. Lower valve with a small septum as in *Discina*, behind which is an impressed disk or area, externally concave, and internally elevated. This is perforated by a longitudinal fissure, extending from a short distance behind the septum nearly to the posterior margin, which is often slightly indented behind it. Shell more or less horny in texture, minutely tubulous.

The discovery of a *Discinisca* allied to the Chesapeake *lugubris* in earlier and more southern deposits is of especial interest. The new species, *Discinisca aldrichi*, is apparently restricted to the youngest of the Alum Bluff beds.

***Discinisca aldrichi* Gardner, n. sp.**

Plate XXXVI, Figures 21, 22

Shell thin, fragile, laminar, phosphatic, dark brown. Ventral valve not known. Dorsal valve ovate-elliptical, asymmetrically convex, evenly declining from the obtuse apex which falls within the anterior fifth or sixth. Surface concentrically banded in varying shades of brown; sculpture reduced to incremental striae, the laminae discrete at the margin but not upon the apical surface; radials not developed. Adductor impressions distinct; anterior adductor scars large, somewhat reniform, a little more than one-third the altitude of the valve, their anterior extrem-

ities nearer one another than their posterior; posterior adductor scars small, rudely ovate, in line with the posterior extremities of the larger adductors.

Dimensions: Altitude, 9.5 millimeters; latitude, 9.5 millimeters; diameter, 2.5 millimeters.

Type: U. S. Nat. Mus. No. 354031; collected and donated to U. S. National Museum by Truman H. Aldrich.

Type locality: Shoal River, Walton County, Fla.

Discinisca aldrichi is apparently the ancestor of *Discinisca lugubris* (see Pl. XXXVI, figs. 17-20) so characteristic of the Chesapeake Miocene. The valves of the earlier species run a little smaller and

thinner than those of the later and are less readily warped. The component concentric laminae are rarely visible except upon the margin, and radial sculpture is not developed.

I have the pleasure of dedicating this species to Truman H. Aldrich, a pioneer in the paleontologic work upon the southern Atlantic and Gulf Tertiary deposits. His collection, made and worked over during a life filled with business affairs, is one of the most remarkable in the country, and his persistent interest is an inspiration to those who are following.

Occurrence: Shoal River formation, Shoal River, Walton County, Fla.

PLATES XXIX-XXXVI

PLATE XXIX

[The specimen figured is the type unless otherwise stated. These type specimens have been remeasured, and some of the dimensions here given differ from those in the original descriptions]

FIGURE 1. *Tellina (Tellinella) chipolana* Dall (p. 190). Exterior of right valve (type); altitude, 23.0 millimeters; latitude, 38.0 millimeters. (After Dall.)

FIGURE 2. *Tellina (Tellinella) strophia* Dall (p. 191). Exterior of right valve (type); altitude, 9.5 millimeters; latitude, 22.0 millimeters. (After Dall.)

FIGURES 3-5. *Tellina (Tellinella) waltonensis* Gardner, n. sp. (p. 191).

3. Exterior of right valve (cotype); altitude, 10.5 millimeters; latitude, 21.3 millimeters.

4. Interior of right valve (cotype); altitude, 10.5 millimeters; latitude, 21.3 millimeters.

5. Interior of left valve (cotype); altitude, 9.5 millimeters; latitude, 18.5 millimeters.

FIGURE 6. *Tellina [Arcopagia (Merisca)] aequistriata* Say (p. 192). Exterior of left valve; altitude, 36.4 millimeters; latitude, 24.0 millimeters. (After Glenn.)

FIGURES 7-11. *Tellina [Arcopagia (Phyllodina)] dodona* Dall (p. 192).

7. Exterior of left valve (cotype); altitude, 10.0 millimeters; latitude, 17.0 millimeters. (After Dall.)

8. Exterior of right valve (topotype); altitude, 17.0 millimeters; latitude, 27.0 millimeters.

9. Interior of right valve (topotype); altitude, 17.0 millimeters; latitude, 27.0 millimeters.

10. Interior of left valve (cotype); altitude, 20.5 millimeters; latitude, 33.5 millimeters.

11. Exterior of left valve (cotype); altitude, 20.5 millimeters; latitude, 33.5 millimeters.

FIGURES 12-14. *Tellina [Arcopagia (Phyllodina)] leptalea* Gardner, n. sp. (p. 193).

12. Exterior of right valve (topotype); altitude, 10.0 millimeters; latitude, 17.0± millimeters.

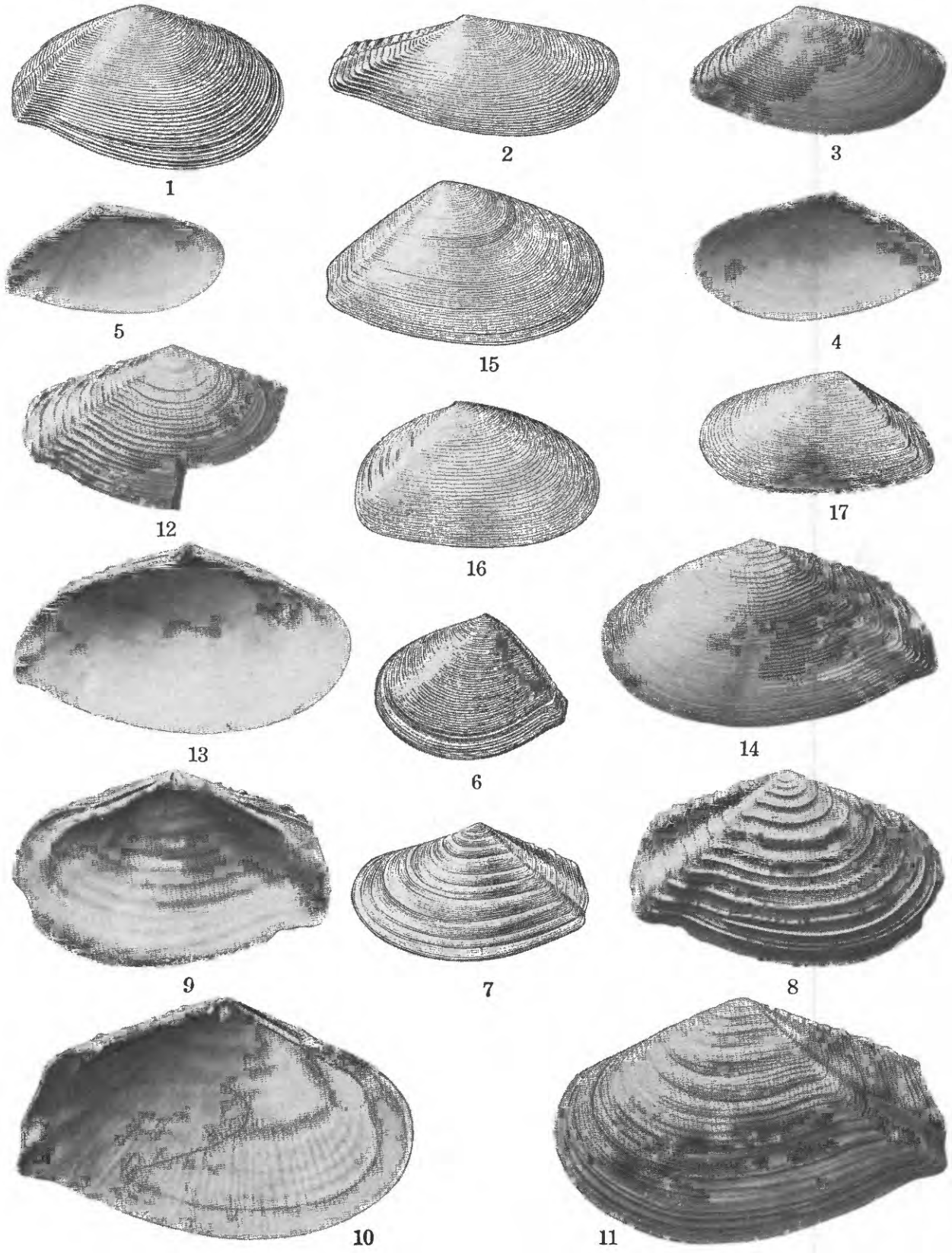
13. Interior of left valve (type); altitude, 16.0 millimeters; latitude, 28.5 millimeters.

14. Exterior of left valve (type); altitude, 16.0 millimeters; latitude, 28.5 millimeters.

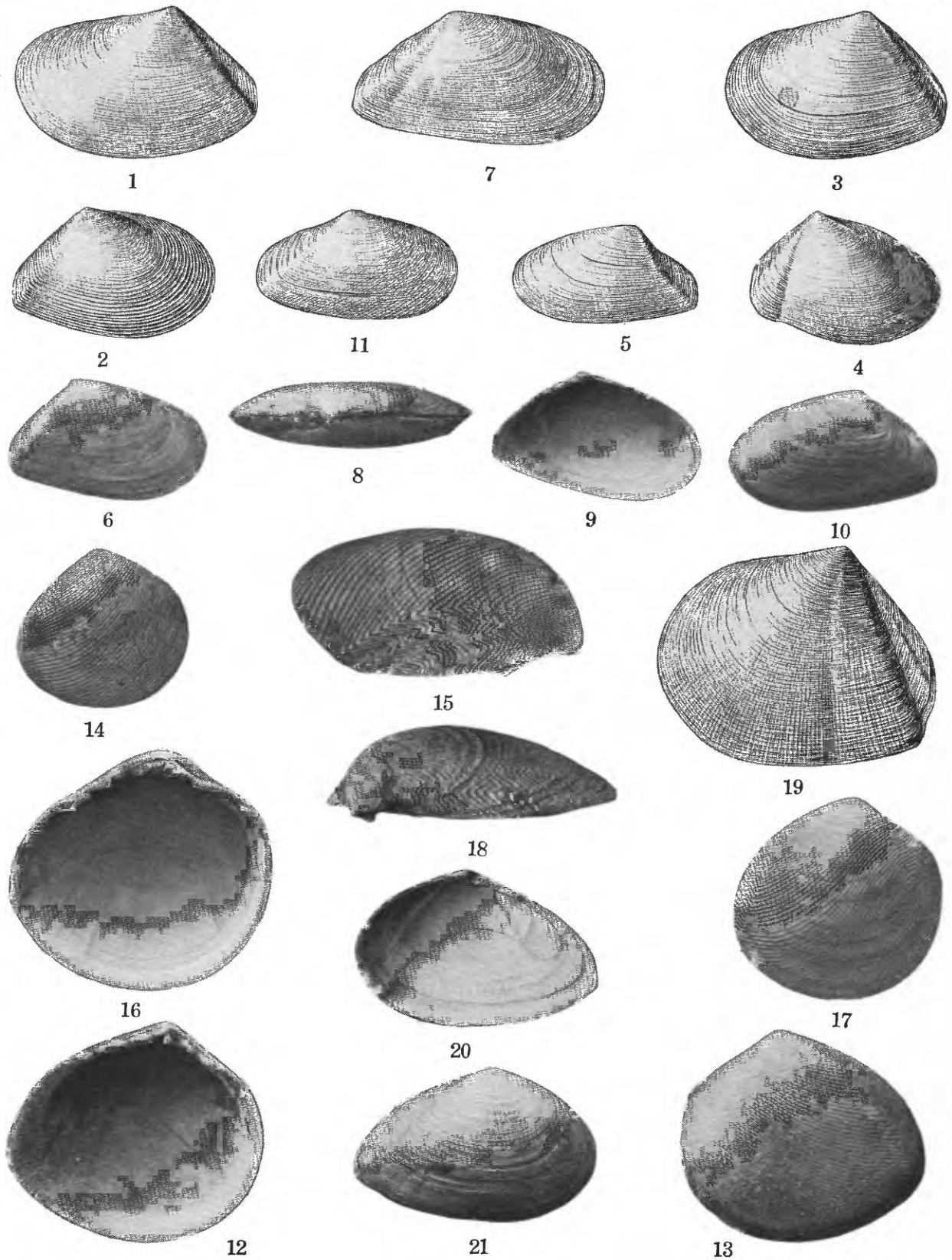
FIGURE 15. *Tellina [Arcopagia (Eurytellina)] roburina* Dall (p. 194). Exterior of right valve (type); altitude, 22.5 millimeters; latitude, 39.0 millimeters. (After Dall.)

FIGURE 16. *Tellina [Arcopagia (Eurytellina)] pressa* Dall (p. 194). Exterior of right valve (type); altitude, 7.5 millimeters; latitude, 12.5 millimeters. (After Dall.)

FIGURE 17. *Tellina (Moerella) acosmita* Dall (p. 196). Exterior of left valve (type); altitude, 5.0 millimeters; latitude, 10.5 millimeters. (After Dall.)



TELLINACEA OF THE ALUM BLUFF GROUP



TELLINACEA OF THE ALUM BLUFF GROUP

PLATE XXX

FIGURES 1-2. *Tellina (Moerella) cloneta* Dall (p. 195).

1. Exterior of left valve; altitude, 6.25 millimeters; latitude, 10.5 millimeters. (After Dall.)

2. Exterior of right valve (type); altitude, 8.5 millimeters; latitude, 13.5 millimeters. (After Dall.)

FIGURE 3. *Tellina (Moerella) hypolispa* Dall (p. 195). Exterior of left valve (type); altitude, 8.5 millimeters; latitude, 13.5 millimeters. (After Dall.)

FIGURE 4. *Tellina (Moerella) aconeta* Dall (p. 196). Exterior of right valve (type); altitude, 3.0 millimeters; latitude, 4.7 millimeters. (After Dall.)

FIGURE 5. *Tellina (Moerella) agria* Dall (p. 196). Exterior of left valve (type); altitude, 3.5 millimeters; latitude, 6.7 millimeters. (After Dall.)

FIGURE 6. *Tellina (Moerella) ctenota* Gardner, n. sp. (p. 197). Exterior of right valve (type); altitude, 5.2 millimeters; latitude 9.0 millimeters.

FIGURE 7. *Tellina (Moerella) acalypta* Dall (p. 197). Exterior of right valve (type); altitude, 5.5 millimeters; latitude, 10.5 millimeters. (After Dall.)

FIGURES 8-10. *Tellina (Moerella) pisa* Gardner, n. sp. (p. 197).

8. Umbonal view of double valves; altitude, 11.0 millimeters; diameter, 3.0 millimeters.

9. Interior of left valve (type); altitude, 5.2 millimeters; latitude, 9.5 millimeters.

10. Exterior of left valve (type); altitude, 5.2 millimeters; latitude, 9.5 millimeters.

FIGURE 11. *Tellina [Arcopagia (Scissula)] lampra* Dall (p. 194). Exterior of right valve (type); altitude, 9.5 millimeters; latitude, 17.0± millimeters. (After Dall.)

FIGURES 12-13. *Strigilla georgiana* Gardner, n. sp. (p. 199).

12. Interior of left valve (type); altitude, 9.8 millimeters; latitude, 11.0 millimeters.

13. Exterior of left valve (type); altitude, 9.8 millimeters; latitude, 11.0 millimeters.

FIGURES 14-15. *Strigilla paraflexuosa* Gardner, n. sp. (p. 199).

14. Exterior of right valve (cotype); altitude, 7.2 millimeters; latitude, 7.8 millimeters.

15. Detail of sculpture of left valve (cotype); altitude, 6.3 millimeters; semidiameter, 2.0 millimeters.

FIGURES 16-18. *Strigilla sphaerion* Gardner, n. sp. (p. 200).

16. Interior of left valve (cotype); altitude, 11.0 millimeters; latitude, 11.6 millimeters.

17. Exterior of right valve (cotype); altitude, 9.8 millimeters; latitude, 10.1 millimeters.

18. Detail of sculpture of right valve (cotype); altitude, 6.7 millimeters; latitude, 7.0 millimeters.

FIGURE 19. *Metis chipolana* Dall (p. 200). Exterior of left valve (type); altitude, 36.0 millimeters; latitude, 44.5 millimeters. (After Dall.)

FIGURES 20-21. *Macoma paralenis* Gardner, n. sp. (p. 201).

20. Interior of right valve (type); altitude, 26.3 millimeters; latitude, 41.5 millimeters.

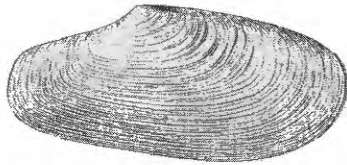
21. Exterior of right valve (type); altitude, 26.3 millimeters; latitude, 41.5 millimeters.

PLATE XXXI

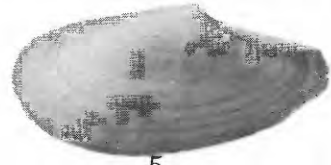
- FIGURE 1. *Macoma (Psammacoma) tracta* Dall (p. 202). Exterior of right valve (type); altitude, 5.0 millimeters; latitude, 12.7 millimeters. (After Dall.)
- FIGURES 2-4. *Macoma (Psammacoma) torynoides* Gardner, n. sp. (p. 202).
2. Exterior of right valve (type); altitude, 6.3 millimeters; latitude, 12.5 millimeters.
 3. Interior of right valve (type); altitude, 6.3 millimeters; latitude, 12.5 millimeters.
 4. Exterior of left valve (paratype); altitude, 5.4 millimeters; latitude, 11.5 millimeters.
- FIGURES 5-6. *Macoma (Psammacoma) marmorea* Gardner, n. sp. (p. 202).
5. Exterior of left valve (type); altitude, 6.6 millimeters; latitude, 14.5 millimeters.
 6. Interior of left valve (type); altitude, 6.6 millimeters; latitude, 14.5 millimeters.
- FIGURE 7. *Semele chipolana* Dall (p. 204). Exterior of right valve (type); altitude, 46.0 millimeters; latitude, 54.0 millimeters. (After Dall.)
- FIGURE 8. *Semele smithii* Dall (p. 204). Exterior of right valve (type); altitude, 19.0± millimeters; latitude, 23.0 millimeters. (After Dall.)
- FIGURE 9. *Semele mutica* Dall (p. 204). Exterior of right valve (type); altitude, 6.9 millimeters; latitude, 10.0 millimeters. (After Dall.)
- FIGURE 10. *Semele stearnsii* Dall (p. 205). Exterior of right valve (type); altitude, 8.0 millimeters; latitude, 11.5 millimeters. (After Dall.)
- FIGURE 11. *Semele scintillata* Dall (p. 205). Exterior of right valve (type); altitude, 6.7 millimeters; latitude, 9.5 millimeters. (After Dall.)
- FIGURES 12-13. *Semele compacta* Dall (p. 205).
12. Exterior of right valve (type); altitude, 12.2 millimeters; latitude, 16.7 millimeters. (After Dall.)
 13. Interior of right valve (type); altitude, 12.2 millimeters; latitude, 16.7 millimeters. (After Dall.)
- FIGURES 14-15. *Semele taracodes* Gardner, n. sp. (p. 206).
14. Interior of right valve (type); altitude, 12.1 millimeters; latitude, 16.5 millimeters.
 15. Exterior of right valve (type); altitude, 12.1 millimeters; latitude, 16.5 millimeters.
- FIGURES 16-17. *Semele paramutica* Gardner, n. sp. (p. 207).
16. Interior of left valve (paratype); altitude, 11.4 millimeters; latitude, 14.5 millimeters.
 17. Exterior of right valve (type); altitude, 10.5 millimeters; latitude, 14.5 millimeters.
- FIGURES 18-19. *Semele sellardsi* Gardner, n. sp. (p. 207).
18. Interior of left valve (type); altitude, 11.0 millimeters; latitude, 14.5 millimeters.
 19. Exterior of left valve (type); altitude, 11.0 millimeters; latitude, 14.5 millimeters.



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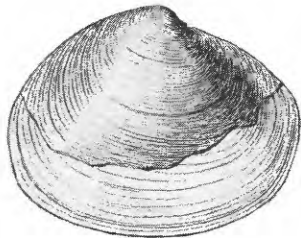
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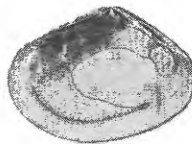
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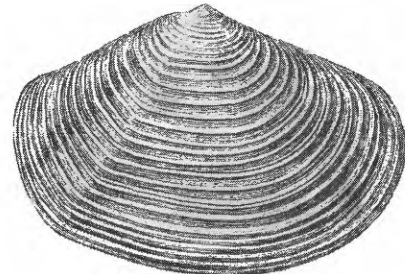
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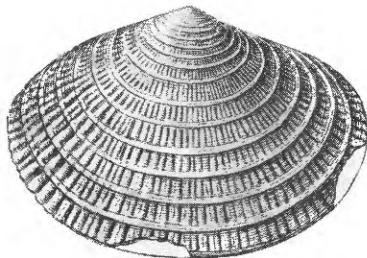
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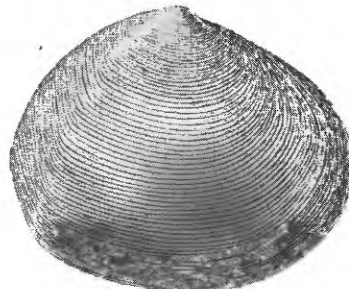
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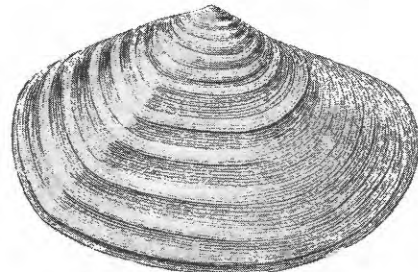
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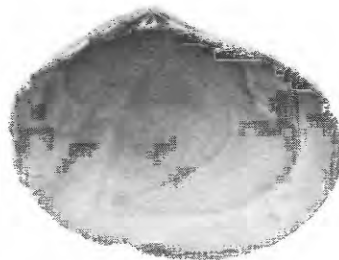
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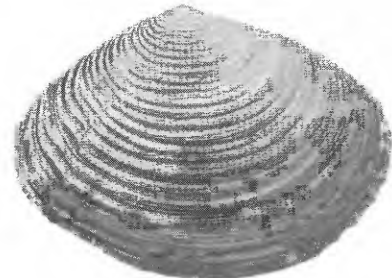
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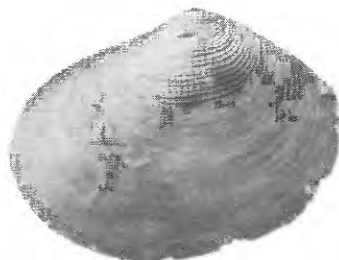
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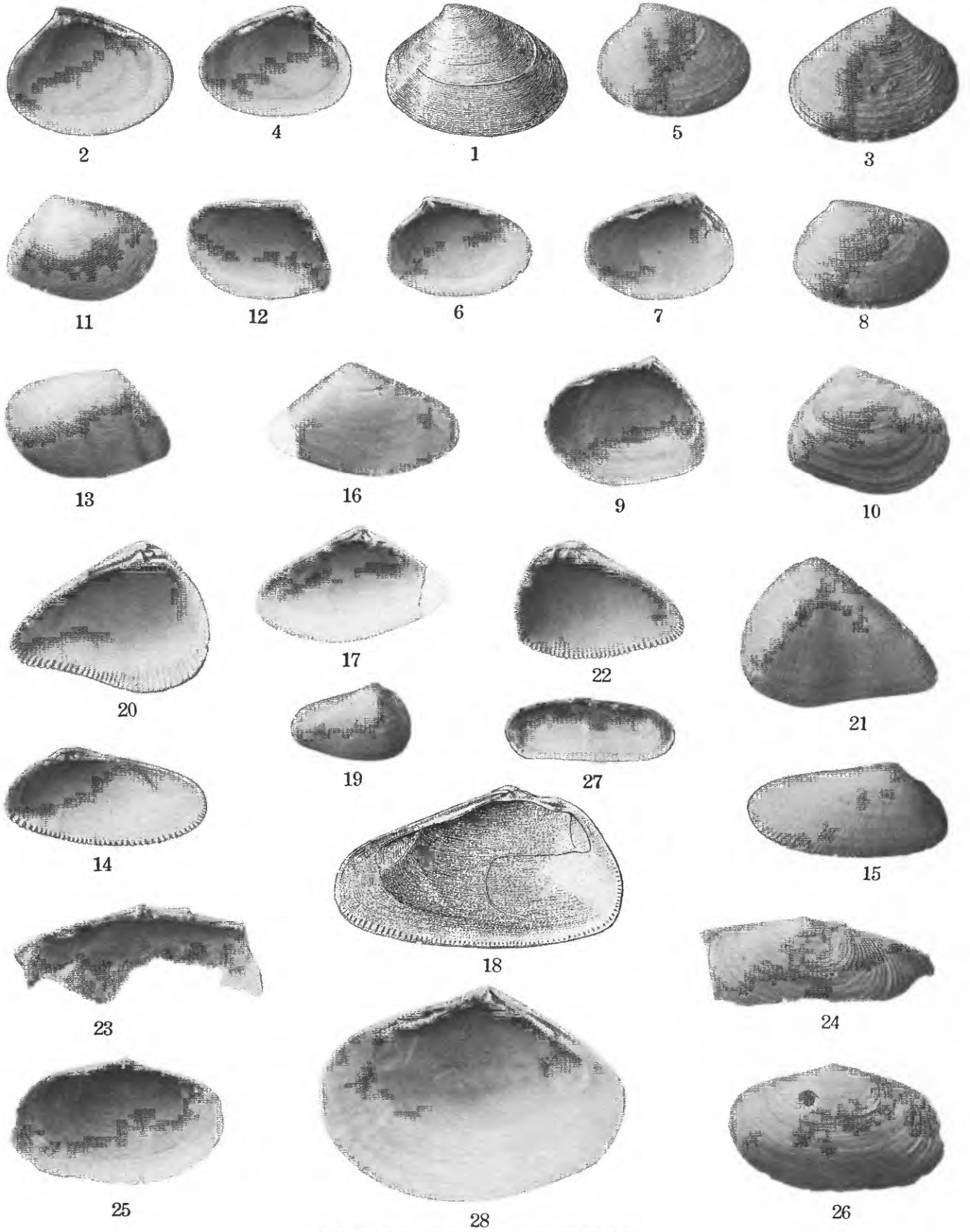


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17

TELLINACEA OF THE ALUM BLUFF GROUP



TELLINACEA OF THE ALUM BLUFF GROUP

PLATE XXXII

FIGURES 1-5. *Semele (Semelina) cytheroidea* Dall (p. 208).

1. Exterior of left valve (cotype); altitude, 3.5 millimeters; latitude, 4.75 millimeters. (After Dall.)
2. Interior of right valve (cotype); altitude, 3.75 millimeters; latitude, 5.0 millimeters.
3. Exterior of right valve (cotype); altitude, 3.75 millimeters; latitude, 5.0 millimeters.
4. Interior of left valve (paratype); altitude, 3.5 millimeters; latitude, 4.5 millimeters.
5. Exterior of left valve (paratype); altitude, 3.5 millimeters; latitude, 4.5 millimeters.

FIGURES 6-8. *Semele (Semelina) striulata* Dall (p. 209).

6. Interior of right valve (cotype); altitude, 3.3 millimeters; latitude, 4.5 millimeters.
7. Interior of left valve (cotype); altitude, 3.0 millimeters; latitude, 4.2 millimeters.
8. Exterior of left valve (cotype); altitude, 3.0 millimeters; latitude, 4.2 millimeters.

FIGURES 9-10. *Abra cylicion* Gardner, n. sp. (p. 209).

9. Interior of right valve (type); altitude, 7.5 millimeters; latitude, 10.0 millimeters.
10. Exterior of right valve (type); altitude, 7.5 millimeters; latitude, 10.0 millimeters.

FIGURES 11-13. *Abra lapochi* Gardner, n. sp. (p. 210).

11. Exterior of right valve (cotype); altitude, 6.7 millimeters; latitude, 9.5 millimeters.
12. Interior of right valve (cotype); altitude, 6.7 millimeters; latitude, 9.5 millimeters.
13. Exterior of left valve (cotype); altitude, 6.9 millimeters; latitude, 10.5 millimeters.

FIGURES 14-15. *Donax (Paradonax) aldrichi* Gardner, n. sp. (p. 212).

14. Interior of left valve (type); altitude, 7.5 millimeters; latitude, 15.8 millimeters.
15. Exterior of left valve (type); altitude, 7.5 millimeters; latitude, 15.8 millimeters.

FIGURES 16-17. *Donax (Paradonax) valhosierri* Gardner, n. sp. (p. 213).

16. Exterior of right valve (type); altitude, 7.0 millimeters; latitude, 12.0± millimeters.
17. Interior of right valve (type); altitude, 7.0 millimeters; latitude, 12.0± millimeters.

FIGURE 18. *Donax chipolanus* Dall (p. 211). Interior of right valve (type); altitude, 5.5 millimeters; latitude, 9.5 millimeters. (After Dall.)

FIGURE 19. *Donax chipolanus* subsp.? *curtulus* Dall (p. 211). Exterior of left valve (type); altitude, 3.5 millimeters; latitude, 5.5 millimeters.

FIGURES 20-22. *Donax trueloides* Gardner, n. sp. (p. 212).

20. Interior of right valve (type); altitude, 9.5 millimeters; latitude, 12.2 millimeters.
21. Exterior of right valve (type); altitude, 9.5 millimeters; latitude, 12.2 millimeters.
22. Interior of left valve (paratype); altitude, 7.0 millimeters; latitude, 10.2 millimeters.

FIGURES 23-26. *Psammobia bowdichi* Gardner, n. sp. (p. 214).

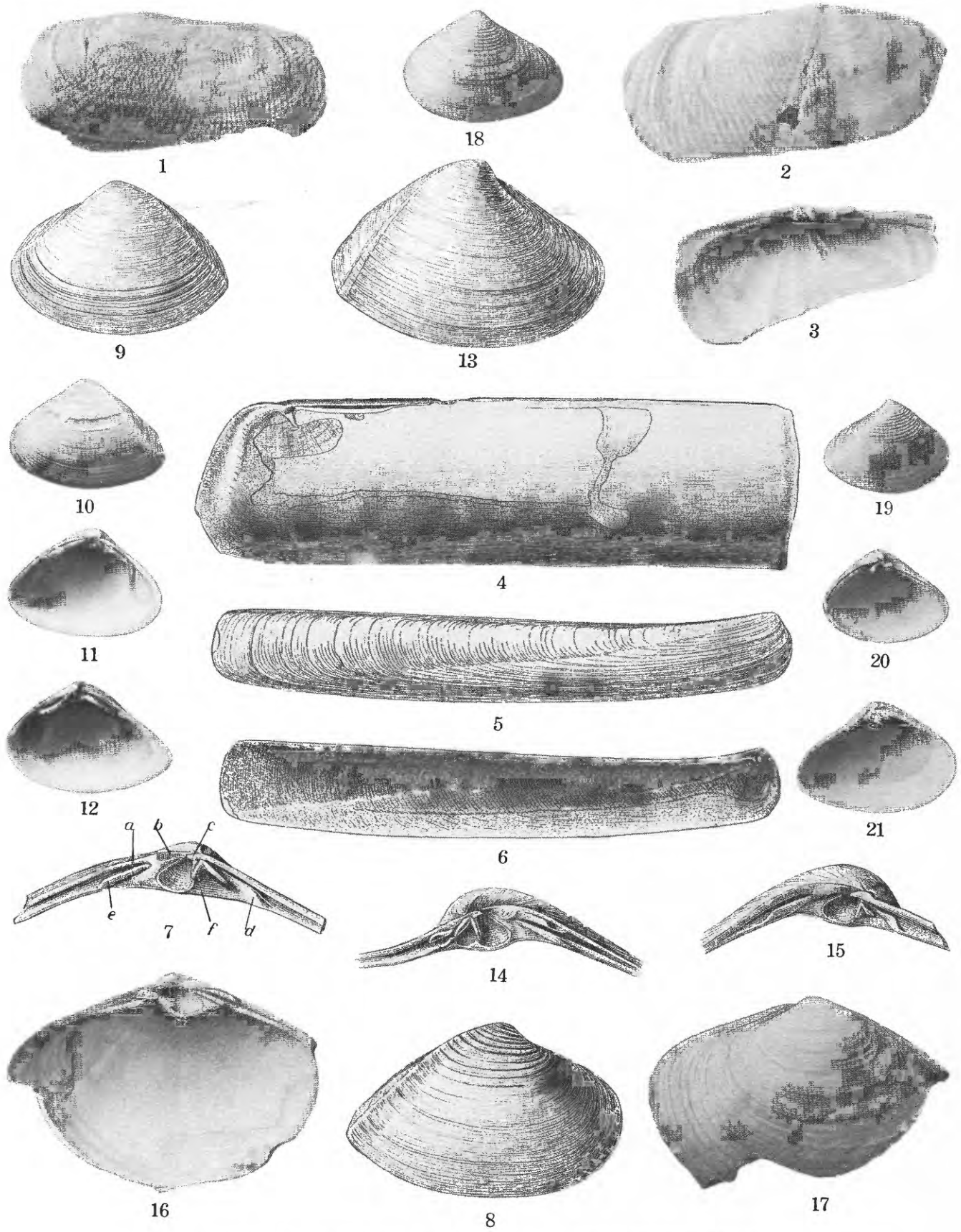
23. Hinge of right valve.
24. Umbonal area of left valve.
25. Interior of left valve (type); altitude, 11.5 millimeters; latitude, 19.5 millimeters.
26. Exterior of left valve (type); altitude, 11.5 millimeters; latitude, 19.5 millimeters.

FIGURE 27. *Tagelus* sp. cf. *Tagelus divisus* (Spengler) (p. 215). Interior of right valve; altitude, 11.0 millimeters; latitude, 30.5 millimeters.

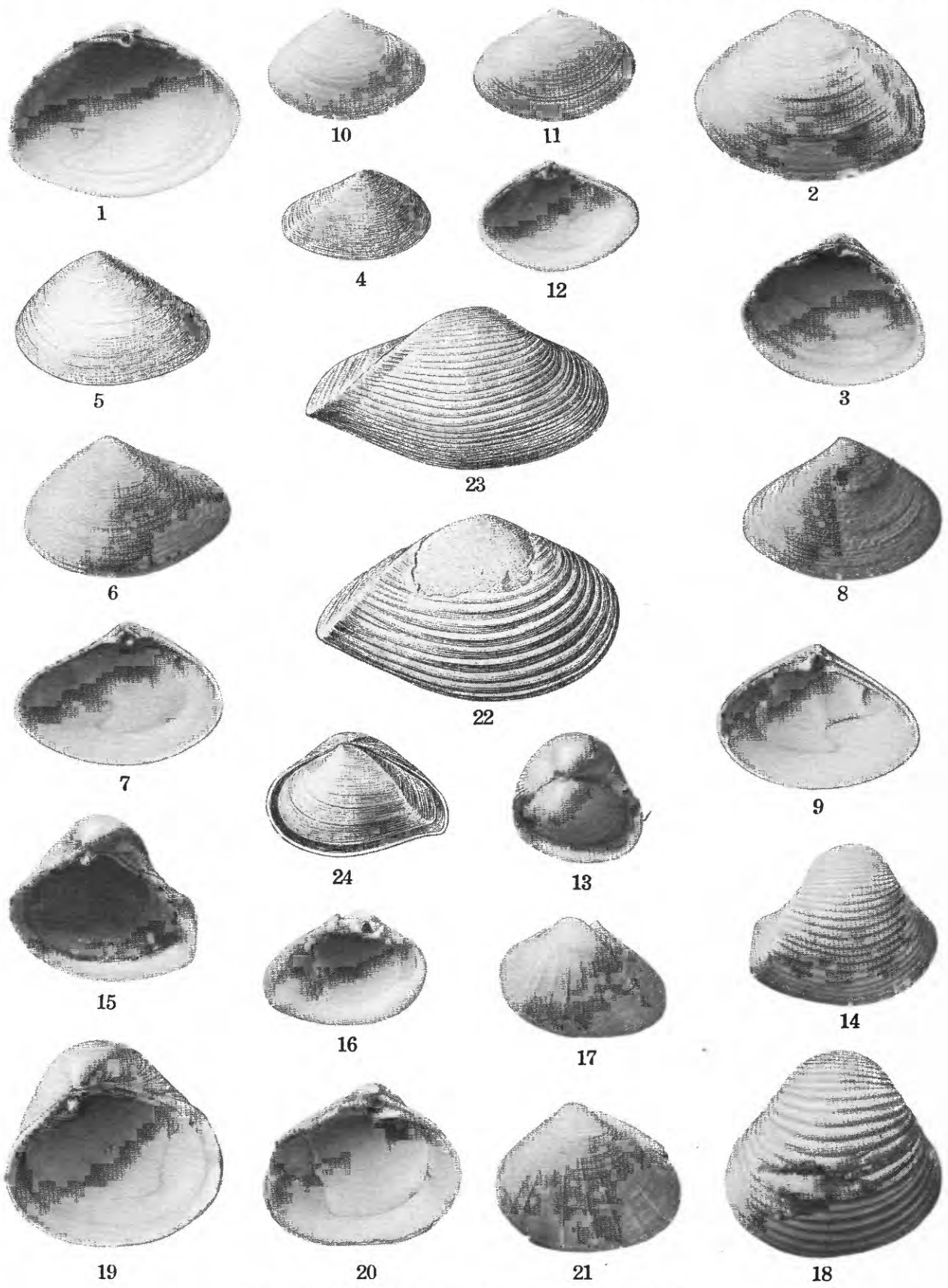
FIGURE 28. *Semele paramutica* Gardner, n. sp. (p. 207). Interior of right valve (type); altitude, 10.5 millimeters; latitude, 14.5 millimeters.

PLATE XXXIII

- FIGURE 1. *Psamosolen vicksburgensis* Aldrich (p. 216). Exterior of left valve (type, Johns Hopkins University collections); altitude, 13.5 millimeters; latitude, $29.0 \pm$ millimeters.
- FIGURES 2-3. *Psamosolen aldrichi* Gardner, n. sp. (p. 216).
2. Exterior of right valve (type); altitude, $15.0 \pm$ millimeters; latitude, $35.0 \pm$ millimeters.
3. Hinge of right valve.
- FIGURE 4. *Solen amphistemma* Dall (p. 217). Interior of right valve (type); altitude, 27.5 millimeters; latitude, 112.0 millimeters. (After Dall.)
- FIGURES 5-6. *Ensis directus* (Conrad) (p. 218).
5. Exterior of right valve; altitude, 12.0 millimeters; latitude, 102.0 millimeters. (After Glenn.)
6. Interior of left valve; altitude, 12.0 millimeters; latitude, 98.5 millimeters.
- FIGURE 7. *Mactra chipolana* Dall (p. 219). Hinge of left valve (type). (After Dall.)
- FIGURE 8. *Mactra (Mactrotoma) cymata* Dall (p. 220). Exterior of right valve (type); altitude, 20.0 millimeters; latitude, 31.5 millimeters. (After Dall.)
- FIGURE 9. *Spisula (Hemimactra) densa* Dall (p. 221). Exterior of left valve (type); altitude, 9.5 millimeters; latitude, 13.5 millimeters. (After Dall.)
- FIGURES 10-12. *Spisula (Hemimactra) craspedota* Gardner, n. sp. (p. 221).
10. Exterior of left valve (cotype); altitude, 9.9 millimeters; latitude, 14.1 millimeters.
11. Interior of left valve (cotype); altitude, 9.9 millimeters; latitude, 14.1 millimeters.
12. Interior of right valve (cotype); altitude, 10.4 millimeters; latitude, 15.3 millimeters.
- FIGURES 13-15. *Spisula (Hemimactra) dodona* Dall (p. 222).
13. Exterior of right valve (type); altitude, 34.0 millimeters; latitude, 50.0 millimeters. (After Dall.)
14. Hinge of right valve (paratype). (After Dall.)
15. Hinge of left valve (paratype). (After Dall.)
- FIGURES 16-17. *Spisula (Hemimactra) valhosierr* Gardner, n. sp. (p. 222).
16. Interior of right valve (type); altitude, $50.0 \pm$ millimeters; latitude, $75.0 \pm$ millimeters.
17. Exterior of left valve (type); altitude, $50.0 \pm$ millimeters; latitude, $75.0 \pm$ millimeters.
- FIGURES 18-21. *Ervilia condra* Gardner, n. sp. (p. 225).
18. Exterior of left valve (cotype); altitude, 3.1 millimeters; latitude, 4.3 millimeters.
19. Exterior of right valve (cotype); altitude, 2.5 millimeters; latitude, 3.3 millimeters.
20. Interior of right valve (cotype); altitude, 2.5 millimeters; latitude, 3.3 millimeters.
21. Interior of left valve (cotype); altitude, 3.1 millimeters; latitude, 4.3 millimeters.



TELLINACEA, SOLENACEA, AND MACTRACEA OF THE ALUM BLUFF GROUP



MACTRACEA AND MYACEA OF THE ALUM BLUFF GROUP

PLATE XXXIV

FIGURES 1-3. *Mulinia orthria* Gardner, n. sp. (p. 223).

1. Interior of left valve (cotype); altitude, 9.0 millimeters; latitude, 12.1 millimeters.

2. Exterior of left valve (cotype); altitude, 9.0 millimeters; latitude, 12.1 millimeters.

3. Interior of right valve (cotype); altitude, 7.7 millimeters; latitude, 9.6 millimeters.

FIGURE 4. *Ervilia chipolana* Dall (p. 224). Exterior of right valve (type); altitude, 3.0 millimeters; latitude, 4.5 millimeters. (After Dall.)

FIGURE 5. *Ervilia chipolana* subsp. *triangularis* Dall (p. 224). Exterior of left valve (type); altitude, 4.0 millimeters; latitude, 5.5 millimeters. (After Dall.)

FIGURES 6-9. *Ervilia valhosierr* Gardner, n. sp. (p. 225).

6. Exterior of left valve (cotype); altitude, 4.2 millimeters; latitude, 5.8 millimeters.

7. Interior of left valve (cotype); altitude, 4.2 millimeters; latitude, 5.8 millimeters.

8. Exterior of right valve (cotype); altitude, 4.2 millimeters; latitude, 5.75 millimeters.

9. Interior of right valve (cotype); altitude, 4.2 millimeters; latitude, 5.75 millimeters.

FIGURES 10-12. *Ervilia planata* Dall (p. 226).

10. Exterior of left valve (paratype); altitude, 3.4 millimeters; latitude, 4.9 millimeters.

11. Exterior of right valve (paratype); altitude, 3.4 millimeters; latitude, 5.0 millimeters.

12. Interior of right valve (paratype); altitude, 3.4 millimeters; latitude, 5.0 millimeters.

FIGURES 13-17. *Corbula chipolana* Gardner, n. sp. (p. 229).

13. Double valves (cotype); altitude, 4.5 millimeters; latitude, 4.5 millimeters.

14. Exterior of right valve (cotype); altitude, 5.75 millimeters; latitude, 6.5 millimeters.

15. Interior of right valve (cotype); altitude, 5.75 millimeters; latitude, 6.5 millimeters.

16. Interior of left valve (cotype); altitude, 4.2 millimeters; latitude, 5.75 millimeters.

17. Exterior of left valve (cotype); altitude, 4.2 millimeters; latitude, 5.75 millimeters.

FIGURES 18-21. *Corbula waltonensis* Gardner, n. sp. (p. 229).

18. Exterior of right valve (cotype); altitude, 7.0 millimeters; latitude, 7.5 millimeters.

19. Interior of right valve (cotype); altitude, 7.0 millimeters; latitude, 7.5 millimeters.

20. Interior of left valve (cotype); altitude, 5.4 millimeters; latitude, 6.5 millimeters.

21. Exterior of left valve (cotype); altitude, 5.4 millimeters; latitude, 6.5 millimeters.

FIGURE 22. *Corbula (Caryocorbula) sphenia* Dall (p. 230). Exterior of right valve (type); altitude, 10.0 millimeters; latitude, 17.0 millimeters. (After Dall.)

FIGURE 23. *Corbula (Caryocorbula) sarda* Dall (p. 231). Exterior of right valve (type); altitude, 7.0 millimeters; latitude, 12.0 millimeters. (After Dall.)

FIGURE 24. *Corbula (Caryocorbula) seminella* Dall (p. 234). Double valves (type); altitude, 3.0 millimeters; latitude, 4.5 millimeters. (After Dall.)

PLATE XXXV

FIGURES 1-4. *Corbula (Caryocorbula) franci* Gardner, n. sp. (p. 231).

1. Exterior of right valve (cotype); altitude, 5.6 millimeters; latitude, 8.8 millimeters.
2. Interior of right valve (cotype); altitude, 5.6 millimeters; latitude, 8.8 millimeters.
3. Exterior of left valve (cotype); altitude, 5.0 millimeters; latitude, 8.5 millimeters.
4. Interior of left valve (cotype); altitude, 5.0 millimeters; latitude, 8.5 millimeters.

FIGURES 5-6. *Corbula (Caryocorbula) wakullensis* Gardner, n. sp. (p. 232).

5. Exterior of right valve (cast of external mold); altitude, 4.5 millimeters; latitude, 8.0 millimeters.
6. Internal mold of double valves (type); altitude, 4.8 millimeters; latitude, 9.0 millimeters.

FIGURE 7. *Corbula (Caryocorbula) whitfieldi* Dall (p. 232). Exterior of right valve (type); altitude, 5.0 millimeters; latitude, 7.0 millimeters. (After Dall.)

FIGURES 8-9. *Corbula (Caryocorbula) whitfieldi stikta* Gardner, n. subsp. (p. 232).

8. Double valves (type) from left side; altitude, 4.5 millimeters; latitude, 7.2 millimeters.
9. Exterior of right valve (type); altitude, 4.5 millimeters; latitude, 7.2 millimeters.

FIGURES 10-13. *Corbula (Caryocorbula) whitfieldi boyntoni* Gardner, n. subsp.? (p. 233).

10. Exterior of left valve (cotype); altitude, 3.5 millimeters; latitude, 5.3 millimeters.
11. Interior of left valve (cotype); altitude, 3.5 millimeters; latitude, 5.3 millimeters.
12. Exterior of right valve (cotype); altitude, 4.0 millimeters; latitude, 5.6 millimeters.
13. Interior of right valve (cotype); altitude, 4.0 millimeters; latitude, 5.6 millimeters.

FIGURES 14-17. *Corbula (Caryocorbula) parawhitfieldi* Gardner, n. sp. (p. 233).

14. Exterior of right valve (cotype); altitude, 4.8 millimeters; latitude, 6.8 millimeters.
15. Interior of right valve (cotype); altitude, 4.8 millimeters; latitude, 6.8 millimeters.
16. Interior of left valve (cotype); altitude, 4.7 millimeters; latitude, 6.3 millimeters.
17. Exterior of left valve (cotype); altitude, 4.7 millimeters; latitude, 6.3 millimeters.

FIGURES 18-21. *Corbula (Caryocorbula) semenoides* Gardner, n. sp. (p. 234).

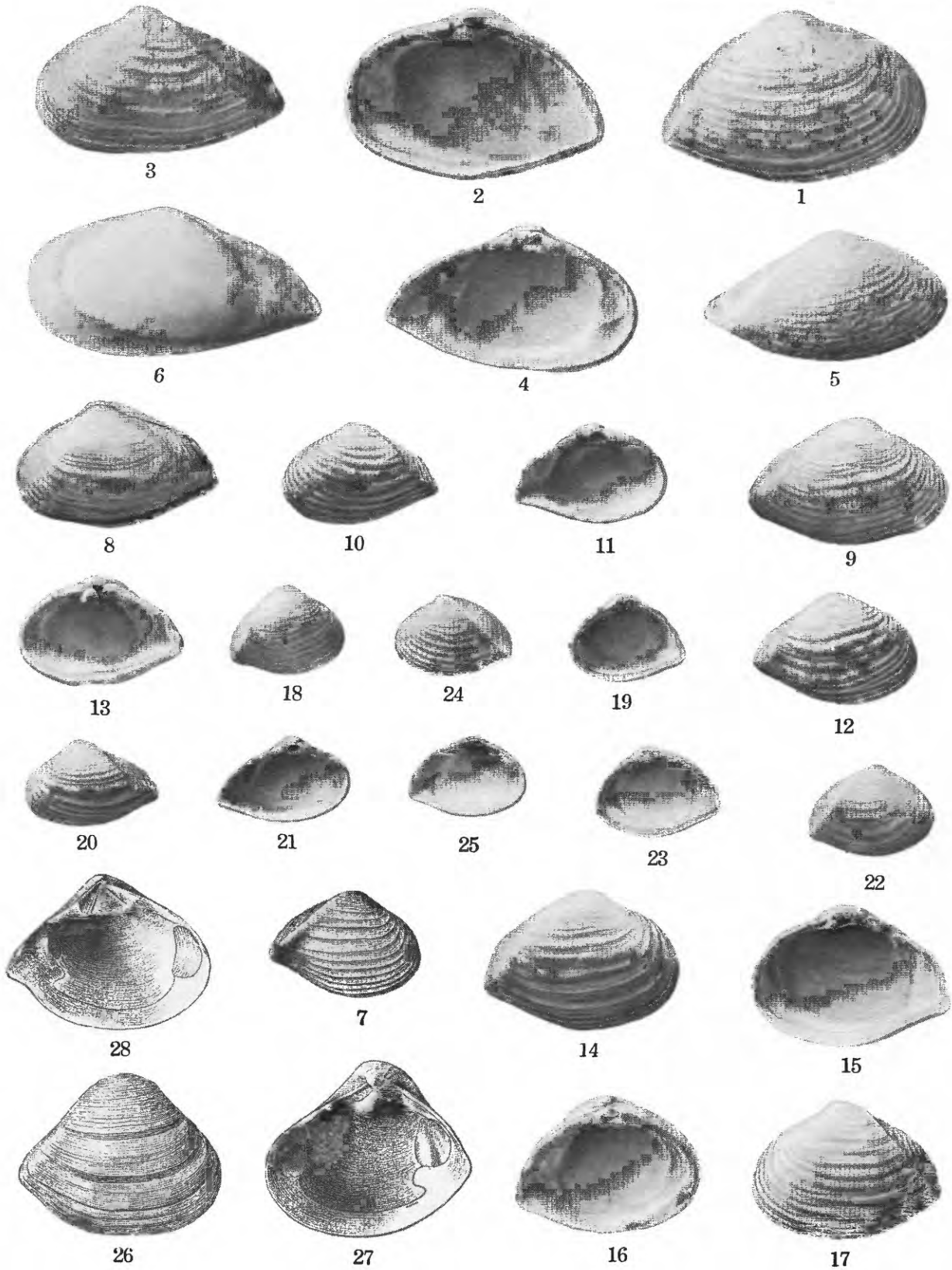
18. Exterior of right valve (cotype); altitude, 3.5 millimeters; latitude, 4.0 millimeters.
19. Interior of right valve (cotype); altitude, 3.5 millimeters; latitude, 4.0 millimeters.
20. Exterior of left valve (cotype); altitude, 3.0 millimeters; latitude, 4.5 millimeters.
21. Interior of left valve (cotype); altitude, 3.0 millimeters; latitude, 4.5 millimeters.

FIGURES 22-25. *Corbula (Caryocorbula) funiakensis* Gardner, n. sp. (p. 234).

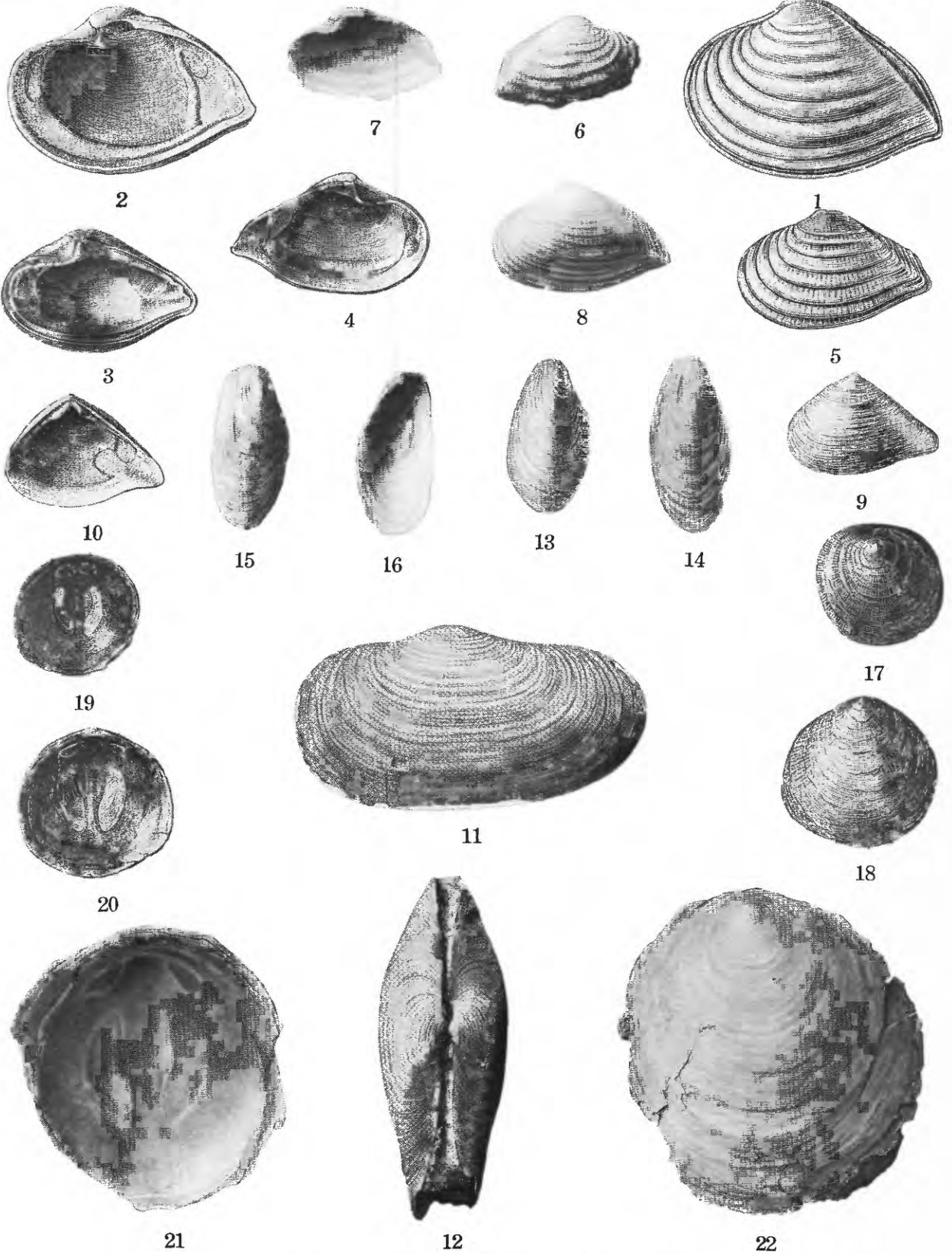
22. Exterior of right valve (type); altitude, 3.0 millimeters; latitude, 4.3 millimeters.
23. Interior of right valve (type); altitude, 3.0 millimeters; latitude, 4.3 millimeters.
24. Exterior of left valve (type); altitude, 3.0 millimeters; latitude, 4.3 millimeters.
25. Interior of left valve (type); altitude, 3.0 millimeters; latitude, 4.3 millimeters.

FIGURES 26-28. *Corbula (Bicorbula) idonea* Conrad (p. 235).

26. Exterior of right valve; altitude, 2.8 millimeters; latitude, 3.3 millimeters. (After Glenn.)
27. Interior of right valve; altitude, 2.8 millimeters; latitude, 3.3 millimeters. (After Glenn.)
28. Interior of left valve; altitude, 2.5 millimeters; latitude, 3.3 millimeters. (After Glenn.)



MYACEA OF THE ALUM BLUFF GROUP



MYACEA AND DISCINACEA OF THE ALUM BLUFF GROUP

PLATE XXXVI

FIGURES 1-2. *Corbula (Bothrocorbula) synarmostes* Dall (p. 235).

1. Exterior of left valve (type); altitude, 9.0 millimeters; latitude, 13.5 millimeters. (After Dall.)
2. Interior of right valve (type); altitude, 9.0 millimeters; latitude, 13.5 millimeters. (After Dall.)

FIGURES 3-7. *Corbula (Bothrocorbula) radiatula* Dall (p. 236).

3. Interior of right valve (type); altitude, 8.6 millimeters; latitude, 13.0 millimeters. (After Dall.)
4. Interior of left valve (type); altitude, 8.6 millimeters; latitude, 13.0 millimeters. (After Dall.)
5. Exterior of left valve (type); altitude, 8.0 millimeters; latitude, 13.0 millimeters. (After Dall.)
6. Interior of right valve (juvenile); altitude, 5.5 millimeters; latitude, 8.5 millimeters.
7. Exterior of right valve (juvenile); altitude, 5.5 millimeters; latitude, 8.5 millimeters.

FIGURE 8. *Corbula (Caryocorbula) barrattiana* C. B. Adams (p. 232). Exterior of left valve (not the type); altitude, 5.0 millimeters; latitude, 8.0 millimeters. Neill's Eddy Landing, N. C. (lower Pliocene, Waccamaw).

FIGURES 9-10. *Spheniopsis americana* Dall (p. 237).

9. Exterior of left valve (type); altitude, 2.0 millimeters; latitude, 3.0 millimeters. (After Dall.)
10. Interior of right valve (type); altitude, 2.0 millimeters; latitude, 3.0 millimeters. (After Dall.)

FIGURES 11-12. *Panope parawhitfieldi* Gardner, n. sp. (p. 237).

11. Exterior of left valve (type); altitude, 48.0± millimeters; latitude, 90.0± millimeters. (After Dall.)
12. Apical view of double valves (type); latitude, 90.0± millimeters; diameter, 33.0 millimeters. (After Dall.)

FIGURE 13. *Gastrochaena rotunda* Dall (p. 238). Exterior of left valve (type); altitude, 7.0 millimeters; latitude, 3.5 millimeters. (After Dall.)

FIGURE 14. *Gastrochaena dodona* Gardner, n. sp. (p. 239). Exterior of right valve (type); altitude, 6.2 millimeters; latitude, 2.7 millimeters.

FIGURES 15-16. *Gastrochaena ligula* H. C. Lea (p. 239).

15. Exterior of right valve; altitude, 4.5 millimeters; latitude, 2.0 millimeters.
16. Interior of left valve; altitude, 4.5 millimeters; latitude, 2.0 millimeters.

FIGURES 17-20. *Discinisca lugubris* Conrad (p. 240).

17. Exterior of dorsal valve; altitude, 17.0 millimeters; latitude, 17.8 millimeters. (After Glenn.)
18. Exterior of dorsal valve; altitude, 25.0 millimeters; latitude, 26.0 millimeters. (After Glenn.)
19. Interior of dorsal valve (not the type); altitude, 17.0 millimeters; latitude, 17.8 millimeters. (After Glenn.)
20. Interior of dorsal valve (not the type); altitude, 25.0 millimeters; latitude, 26.0 millimeters. (After Glenn.)

FIGURES 21-22. *Discinisca aldrichi* Gardner, n. sp. (p. 239).

21. Interior of dorsal valve (type); altitude, 9.5 millimeters; latitude, 9.5 millimeters.
22. Exterior of dorsal valve (type); altitude, 9.5 millimeters; latitude, 9.5 millimeters.

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