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CONTRIBUTIONS

TO THE

TERTIARY FAUNA OF FLORIDA

WITH ESPECIAL REFERENCE TO THE

SILEX BEDS OF TAMPA AND THE PLIOCENE BEDS OF THE CALOOSAHATCHIE RIVER

INCLUDING IN MANY CASES

A COMPLETE REVISION OF THE GENERIC GROUPS TREATED OF AND THEIR AMERICAN TERTIARY SPECIES

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PART IV.

I. PRIONODESMACEA: Nucula to Julia

II. TELEODESMACEA: Teredo to Ervilia

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PREFACE

THE following pages are in continuation of the work on the Tertiary Fauna of Florida which was published in the preceding parts of this volume. As it was thought by persons interested that the title of the work insufficiently indicated its present scope, it has been supplemented by one or two explanatory lines on the title-page.

When this work was begun the scheme included chiefly a description of the entire invertebrate fauna of the Pliocene beds of the Caloosahatchie, the silex beds of Ballast Point, and other Floridian localities explored by Mr. Joseph Willcox, Professor Heilprin, the writer, and others, with such references to allied forms as might be necessary for the proper elucidation of the material.

As time went on, however, the interest aroused by the explorations of the Wagner Institute and its friends, and by the United States Geological Survey in Florida and adjacent parts of the Coastal Plain, resulted in bringing in a constantly increasing mass of material. In particular, the existence of Upper Oligocene beds in Western Florida, containing hundreds of species many of which were new, added two populous invertebrate faunas to our Tertiary series. It was found that a number of the species belonging to these beds had been described from the Antillean Tertiaries. Hence it became necessary, in order to put the work on a sound foundation, not only to review the species of any given group known to occur in the United States, but also to extend the revision to the Tertiaries of the West Indies.

Owing to the chaotic condition of our Tertiary Paleontology, especially the Post-Eocene faunas, this work has involved an enormous amount of drudgery, occupying the writer's leisure to an extent not anticipated at the outset. It is believed that the results will be beneficial in clearing the way for subsequent students and putting the nomenclature on a more permanent and reliable basis. The clearing up of the stratigraphical relations of many of the older species is quite as important as the description of the numerous new ones which have turned up in the course of the work. It is hoped that another part will conclude this series of papers, and comprise, besides the remaining descriptions, a summary of the faunal population of each of the principal Neocene horizons.

To Dr. Charles D. Walcott, Director of the United States Geological Survey, to the authorities of the Smithsonian Institution and National Museum, and to numerous private correspondents and colleagues, thanks are due for facilities accorded and assistance rendered in the prosecution of the work.

William Healey Dall.

TERTIARY FAUNA OF FLORIDA

Order PRIONODESMACEA.

Superfamily NUCULACEA.

Family NUCULIDÆ.

Genus NUCULA Lamarck.

Nucula Lam., Prodr. Nouv. Class. Coq., p. 87, 1799. Type *Arca nucleus* Linné.
Nuculana Link, Rostock-sammlung, p. 155, 1807.
Glycymeris Da Costa, British Conch., p. 170, 1778, *ex parte*.

IN 1778 Da Costa proposed for the *Chama glycymeris* of Belon (1553) and the *Arca nucleus* of Linné a genus under the name of *Glycymeris*. In his System of Conchology published two years previously Da Costa had not adopted the Linnéan nomenclature, but in his British Conchology and later in the Museum Colonnianum, which tradition says Da Costa edited from a manuscript of Hwass for Humphrey, he used the binomial system. The name *Glycymeris* had not previously been used by any binomial author, for Klein, who is sometimes erroneously cited for scientific names, cannot by any stretch of courtesy be truthfully called binomial. In the same work Da Costa used the generic name *Pectunculus*, subsequently applied by Lamarck (1799) to the orbicular Arks, for the group which had already received the name of *Venus* from Linné. Da Costa's *Glycymeris* was intended to include all the rounded bivalves with a Taxodont hinge. Those of the type of *Chama glycymeris* were erected by Lamarck into a genus *Pectunculus* in 1799, leaving, according to modern rules of nomenclature, for *Glycymeris* Da Costa only the *Arca nucleus* and its congeners. I confess I am unable to see how a consistent application of our rules, if we accept *Pectunculus* Lamarck, can avoid the use of *Glycymeris* for the group usually called *Nucula*. *Pectunculus* preceded *Nucula* in Lamarck's Prodrome, and consequently must first be disposed of. If, on the principle of "once a synonyme always a synonyme," we reject *Pectunculus* Lamarck, on the ground that the name had already been used for another group by Da Costa in binomial form, we could then retain Lamarck's *Nucula* at the cost of adopting *Glycymeris* for the group usually called *Pectunculus*, which is probably the least inconvenient arrangement of the two.

According to Herrmannsen *Glycymeris* was used by Belon, or Belloni, in a quasigeneric sense two hundred years before its use by Klein; so, even if we resort to non-binomial authors, the latter's name would have no standing. This is probably the reason why Da Costa, who was a man of erudition not prejudiced against the non-binomial writers, adopted the name in its original sense.

I have already pointed out that the name *Nuculana* of Link is merely a modification, on the score of taste, of *Nucula* Lamarck. Link was enumerating the Rostock collection, and since it happened that they had only one species, *N. rostrata* (since separated as *Leda* by Schumacher), to represent the genus, it follows thė modified name; but there is nothing in this fact nor in the diagnosis of Link to intimate that he intended to subdivide the original *Nucula*. Link altered many names in this fashion, of which *Achatium*, for *Achatina* Lam.; *Anatium*, for *Anatifera* Lam.; *Cassidea*, for *Cassis* Brug.; *Cerium*, for *Cerion* Bolt.; *Harpalis*, for *Harpa* Lam.; *Limaria*, for *Lima* Lam.; *Nassaria*, for *Nassa* Lam.; *Pectinium*, for *Pecten* Mull.; *Pleurotome*, for *Pleurotoma* Lam.; *Tridachne*, for *Tridacna* Lam.; *Unionum*, for *Unio* Retz., etc., are examples. For this reason I can only regard *Nuculana* as an absolute and exact synonyme of *Nucula* Lamarck.

Subgenus ACILA H. and A. Adams.

The divaricately sculptured Nuculas in this group, in the recent state, are Pacific in their distribution; one species, *N. divaricata* Hinds, extending from Korea (as *N. mirabilis* Ads. and Rve.) to the China Seas (*N. insignis* Gould) and probably to the Bay of Bengal (*N. Fultoni* Smith), reaches a length of thirty millimetres; another, distinguished by smaller size, more ovate form, and a fine, regular, concentric over obsolete divaricate sculpture, is only known from Northern Japan (*N. japonica* Dall); another still (*N. divaricata* Val., + *castrensis* Hinds, + *Lyalli* Bd.) extends from the Aleutian Islands to California. In time the group recedes to the Cretaceous, with a much wider geographical range; two species are known from the Greensand of Europe, one (*N. Ermani* Girard) from the Upper Cretaceous of Alaska at Atka Island, another from the

Chico of California (*N. truncata* Gabb) which is reported by Gabb to extend upward into the Tejon Eocene (Pal. Cal., i., p. 198, pl. 26, fig. 184; ii., p. 197).

An examination of undoubted Cretaceous specimens of *N. truncata* shows that the species differs from the Tertiary forms by its more impressed escutcheon, its finer and more delicate divaricate sculpture, and its more prominent close set, regular and even concentric sculpture. Those I have seen are also smaller. They are quite distinct from *N. Ermani*, which may eventually prove to be of Tertiary age.

Some confusion has been caused by the too inclusive manner in which Gabb has treated the fossil forms of the Pacific coast. I find a large Eocene species which is not distinguishable from *N. decisa* Conrad, the latter being a second name for *N. divaricata* Conrad (1848), not of Valenciennes (1833), nor of Hinds (1843), which was afterwards named *N. Conradi* by Meek (S. I. Miocene Checklist, p. 27, 1864). This probably extends into the Miocene, and to assist in clearing up the difficulty I have included a figure of it (plate 40, figures 1, 3). In unmistakable Miocene of Oregon, on the Nehalem River, near Mist, Columbia County, another form is found of smaller size and much coarser sculpture, the posterior end more distinctly rostrate, but otherwise very similar, for which I propose the name of *Nucula* (*Acila*) *cordata* (plate 40, figure 4). The interesting point, however, is that none of the fossil forms can be properly united with the recent *N. divaricata* Val. in spite of Gabb's opinion. The latter is a more trigonal, compact, and less rostrate form, and clearly distinct. The fossil forms are more closely related to the recent species of Japan than to the existing west American shell. Like many other Pacific groups, *Acila* extended to the Antillean region through the gaps between the Central American archipelago in Oligocene times. It is represented by *N. Schomburgki* Forbes, from the San Fernando beds of Trinidad, which differs from the west American fossils by its more rostrate shell, and by *N. tuberculata* Gabb, from the Oligocene of Hayti. It is possible that deep-sea dredgings will eventually reveal a surviving species in the abysses, but to the present time no recent species is known from the Atlantic and only the *N. Cobboldiæ* from the Pliocene of the British Crag beds. No east American fossil species is known at all from the continent of North America. The species have, as a rule, twenty to twenty-two anterior and nine to eleven posterior teeth; the posterior tooth in the left valve nearest the chondrophore is larger than those immediately behind it. All the species have concentric sculpture.

Subgenus **NUCULA** s. s.

The Neocene species of *Nucula* are quite puzzling, owing to the close similarity of all the species in a general way, and the variability of each in minor details.

Nucula proxima Say.

Nucula proxima Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., ii., p. 270, 1822; Tuomey and Holmes, Pleiocene Fos. S. Car., p. 53, pl. 17, figs. 7–9, 1855; Emmons, Geol. N. Car., p. 287, fig. 208 B, 1858; Dall, Bull. 37, U. S. Nat. Mus., p. 42, pl. 56, fig. 4.
Nucula obliqua Say, Am. Journ. Sci., ii., p. 40, 1820; not Lam., 1819.

Older Miocene of New Jersey at Shiloh and Jericho, Burns; Yorktown beds of Virginia, Harris; north end of the Dismal Swamp, Virginia, Shaler; Pliocene of the Caloosahatchie and Shell Creek, Florida, Willcox and Dall; Pleistocene of Simmons Bluff, South Carolina, Burns; recent: (typical form) from Charlotte Harbor, Florida, northward to North Carolina in two to one hundred fathoms; (var. *trunculus* Dall) from Long Island Sound northward to Nova Scotia.

If a geographical series of this species be examined, it will be noticed that the northern specimens are almost smoothly truncate behind, the escutcheon is not impressed to any marked degree, and there is no angle at the margin below the escutcheon. On the other hand, the specimens from the southern coast, whence Say's type was derived, have a thinner shell with an impressed escutcheon, the middle of which pouts more or less strongly; the valve-margin below the escutcheon has a projecting angle; the shell is somewhat compressed, compared with the northern form, and has a paler and more delicate epidermis. Several of these characters are correlatives of the latitude, but the extreme forms without a connecting series would be taken by any careful observer for distinct species. Most of the conchologists of the United States having resided north of Delaware, the northern form is the more familiar both in books and collections, but it is not the original type, and I have therefore given it a varietal name. The fossils, so far as yet observed, are all more like the variety *trunculus*, corresponding to the cooler temperature of the sea in this region during Miocene times, while the Pliocene specimens are rather undersized, which may have been the result of the increasing temperature which characterized that epoch in Florida.

There is little doubt that the original *Nucula obliqua* of Say, from the Miocene of Petersburg, Virginia, was a variety of *N. proxima;* at any rate, the specific name had been used by Lamarck a year before it was applied by Say to the fossil, so that for the American shell the name must be discarded.

Nucula Shaleri Dall.

PLATE 40, FIGURE 6.

Nucula Shaleri Dall, Am. Journ. Sci., xlviii., p. 298, Oct., 1894.

Miocene gravelly conglomerate of Chilmark, Martha's Vineyard, and in the Pliocene of Gay Head; J. B. Woodworth.

This large species belongs to the group of *N. decussata* and *antiquata* Sby., of which the recent representative on our coast is the small *N. crenulata* Hinds. Lon. of shell 15, alt. 11, diam. 7 mm. There are eight to eleven anterior and sixteen to twenty posterior teeth.

Nucula chipolana n. s.

PLATE 32, FIGURE 10.

Oligocene ("Old Miocene") of the Chipola beds, Calhoun County, Florida, and of the lower (Chipola) bed at Alum Bluff, Appalachicola River, Florida; Burns and Dall.

Shell small, solid, polished, with faint radial striæ more conspicuous ventrally, and more or less obvious incremental lines; breaks turgid, low; posterior end of shell obliquely truncate, flattish; base arcuate, anterior dorsal line sloping, anterior end attenuated and rounded; there is no defined lunule; the escutcheon is elongate-cordate, ill-defined, the margins in the middle line slightly pouting; internally polished, hardly pearly, with the basal margin finely sharply crenulate; the chondrophore small, narrow, and very oblique, anteriorly directed; anterior teeth narrow, slender, about thirteen, posterior teeth four or five. Lon. of shell 4, alt. 2.75, diam. 20 mm.

The chief characteristics of this small species are its elongated form and fine radial striæ.

Nucula sinaria n. s.

PLATE 32, FIGURE 7.

Oligocene of the Alum Bluff beds on the Yellow River at Oak Grove, Santa Rosa County, Florida, and Miocene of the St. Mary's River, Maryland; Burns and Harris.

Shell small, solid, trigonal, polished, with fine radial striæ, more distinct near the basal margins, and faint, concentric, rather irregular furrows, obsolete over most of the valve, but tending to be stronger near the anterior and posterior slopes; here and there one crosses the whole shell like the indication of a resting stage; dorsal slopes nearly straight, base arcuate, ends rounded; lunule absent, escutcheon impressed; striated, the margins not pouting in the middle; beaks prominent, obtuse; interior brilliantly pearly, muscular impressions deep; the basal margin finely crenulate; hinge strong, wide; the chondrophore oblique, heavy; anterior teeth wide, strong, about seventeen, posterior about seven. Lon. of shell 4.75, alt. 4, diam. 2.5 mm.

This species differs from the preceding by its more trigonal, heavy, and pearly shell, its wider and proportionately heavier hinge, and its impressed instead of merely flattened escutcheon. The Maryland specimens are usually larger and more worn than the types from West Florida; both retain a purplish tint in their nacre.

Nucula taphria n. s.

PLATE 32, FIGURE 14.

Miocene of Magnolia and the Natural Well, Duplin County, North Carolina; Burns.

Shell small, very solid, rounded cuneiform, with few strong, distant concentric grooves, like marks of resting stages, which extend clear over the shell, otherwise smooth; beaks prominent, turgid; lunule absent; escutcheon faintly indicated; posterior end subtruncate, anterior produced and rounded, base moderately arcuate; interior hardly nacreous, muscular impressions large and distinct; basal margins entire; hinge strong and heavy; chondrophore wide, distinct, a little oblique; anterior teeth thirteen, posterior six or seven. Lon. of shell 2.9, alt. 2.25, diam. 1.5 mm.

This interesting species is related to the recent *N. delphinodonta* Mighels, which is a more rounded and less oblique shell, without the strong concentric grooves of *N. taphria.*

Nucula prunicola n. s.

PLATE 32, FIGURE 9.

Miocene of Plum Point, Maryland, Burns; and one mile south of Plum Point, Harris.

Shell small, inflated, polished, very inequilateral; surface with obsolete, obscure radial striæ, stronger where they cross between the concentric ridges and near the ventral margin; beaks, dorsal slopes, escutcheon, and the posterior two-thirds of the sides of the shell smooth or nearly so; on the anterior third sculpture of moderately elevated concentric lamellæ separated by wider radially grooved interspaces; these lamellæ break off abruptly anteriorly, and posteriorly become gradually obsolete in front of the middle of the shell; they are strongest in front and near the margin; lunular area lanceolate, large, not impressed, marked by the cessation of the lamellæ; escutcheon roundly cordate, impressed; the margins pouting in the middle; there is no circumscribing line; beaks turgid, recurved; interior brilliantly pearly, the basal margin strongly crenulate, the muscular impressions feeble; base arcuate, ends rounded; chondrophore narrow, not prominent, anteriorly directed; the anterior line of teeth long, slightly arched, the posterior meeting it at nearly a right angle, short, straight; anterior teeth about twenty, posterior six or seven. Lon. of shell 6, alt. 4.5, diam. 3.75 mm.

This is a very remarkable species which cannot be confounded with any other recent or fossil in the United States.

Other Tertiary species of *Nucula* known in North America and the Antillean region are as follows: From the Eocene: *N. ovula* Lea, Midway and Claibornian; *N. mediavia* Harris, Midway; *N. magnifica* Conr. (+ *N. Sedgwickii* Lea), and *N. monroensis* Aldr., from the Claibornian; *N. meridionalis* Mey. and Aldr., and *N. spheniopsis* Conr., from the Jacksonian; from the Oligocene: *N. vicksburgensis* Conr.; from the Miocene: *N. diaphana* and *N. dolabella* H. C. Lea, and *N. cuneiformis* Conr. (1848, Astoria), not of Sowerby; from the Pliocene: *N. exigua* Sby. (San Diego, California, Well), *N. baccata* Guppy, *N. crenulata* Hinds (+ *N. vieta* Guppy and *N. tenuisculpta* Gabb), and *N. limonensis* Gabb; *N. expansa* Rve. is reported from the Pleistocene of Hudson Bay, also with *N. tenuis* Mtg., its variety *inflata*, and *N. antiqua* Mörch, from the Leda clays of the northeastern United States and Canada.

It is not necessary to mention here the species described as *Nucula* and since referred to *Yoldia* or *Leda*, which will be found under those genera respectively, but I may note that *N. carinifera* Lea is the young of *Limopsis cuneus* Conr., *N. æquilatera* H. C. Lea is a *Crenella*, and *N. pectuncularis* Lea should be referred to *Trinacria*.

Family LEDIDÆ.

Genus **LEDA** Schumacher.

This genus is the *Nuculana* of Adams, Meek, and others, but not of Link. It has been divided by authors into a multitude of sections, subgenera, etc., some of which are convenient, but all intergrade as far as can be judged from the shells, though the extreme forms are very distinct. The number of species is probably larger than that of any other American Tertiary genus. They often require very critical treatment, and, unfortunately, very few have been adequately described, figured, or compared. Descriptions based on internal casts are of value only as indicating the presence in the horizon concerned of the genus or its near relatives. It would be impossible to identify a species from such data with any certainty. Yet quite a number of names in American lists rest on no better basis. A thorough review would probably increase the number of species while rejecting a certain proportion as unidentifiable. Much carelessness has also been shown in using preoccupied specific names for new American forms. Both Gabb and Conrad have given entirely distinct species at different times the same specific name, and names already applied by European writers to species of *Leda* have been repeatedly used for new species here. A few of these errors will be corrected here, but the subject needs a monographic revision.

Among the older Eocene species *Leda milamensis* Harris, *L. quercollis* Harris, *L. Aldrichiana* Harr. (*elongatoidea* Aldr. var. ? Harr., Midway, Bull. 4, not of Aldrich), *L. saffordana* Harr. (= *protexta* Gabb, pars), *L. robusta*, *L. corpulentoidea*, and *L. elongatoidea* Aldr. have been described; to which will be added here two apparently undescribed forms from Wood's Bluff.

The Claiborne and Jackson, or Middle Eocene group, has a larger number, some of them very peculiar species, of which we may enumerate *Leda albirupiana* and *L.* (*Adrana*) *aldrichiana* Harris, *L. æqualis* Conr. (non Reuss? + ? *media* Lea, non Wissm.), *L. bastropensis* Harr., *L. bella*, *L. cælata* (not of Hinds), and *L. calcarensis* Conr.; *L. cultelliformis* Rogers, *L. houstonia* Harr., *L. improcera* Conr., *L.* (*Adrana ?*) *lisbonensis* Aldr., *L. magna* and *media* Lea (? + *carolinensis* Conr.), *L. Vanuxemi* Dall (*L. mucronata* Conr., 1847, not of Sowerby, 1825), *L. opulenta* Conr., *L. parva* Rogers, *L. plana*, *plicata*, *pulcherrima*, and *semen* Lea, *L. semenoidea* Aldr., *L. subtrigona* Conr., *L. smirna* Dall (*L. eborea* Conr., 1860, not of Conr., 1846), *L. linifera* Conr., *L. mater* Meyer, *L. multilineata* Conr., and a new form now described from Wahtubbee.

The Oligocene, except in the Antilles, is less populous with *Leda*, but offers *L. parilis* and *serica* (not *sericea*) Conr. from the Vicksburgian, which also includes *L. multilineata* Conr., and from the Upper Oligocene *L. acuta* Conr. (1832, not of Sby., 1837, or Gabb., 1873), *L. floridana* Conr. (probably never described), *L. flexuosa* Heilprin, and *L. tellinula* Conr. From the Oligocene of the Antilles we have *L. indigena* Dall (*L. bisulcata* Guppy, 1867, not of Meek, 1861), *L. clara* Guppy, *L. illecta* Guppy, *L. Packeri* Forbes (+ *incognita* Guppy), *L. peltella* Dall (pl. 32, fig. 5; = *acuta* Gabb, 1873, not Conr., 1832), *L. Guppyi* Dall (*Cercomya ledæformis* Guppy), *L. perlepida* Guppy, and an undescribed species of *Tindaria*. There are several Darien species, probably new, but as yet represented by material insufficient for full description.

In addition to the species which persist from the Oligocene and the new forms about to be described, the following are known from the North American Miocene: *L. acutidens* and *carinata* H. C. Lea, *L. concentrica* Say (+ *eborea* Conr., 1846), *L. liciata* Conr., *L. vitrea* Orb. (+ *Milleri* Gabb), and the Californian *L. penita* Conr.

In the Pliocene there appear newly only *L. mœnensis* Gabb of Costa Rica, and on the Pacific side *L. peruviana* Dall (*acuminata* Nelson, 1870, not von Buch, 1845) and *L. taphria* Dall (*L. cœlata* Hinds, 1844, not Conr., 1832); while from the Pleistocene of Maine we have *L. Jacksoni* Gould (1841, + *buccata* (Stp.) Möller, 1842).

The Ledas have been divided into a number of groups variously regarded as sections, subgenera, or even genera. A synopsis of the principal ones may be of use to students, and is here given before proceeding to describe the species. I refer only to those represented in the Tertiary.

Subfamily LEDINÆ.

Genus LEDA Schumacher, *senso lato.*

A. *Leda* Schum., *senso stricto*, 1817. Type *L. rostrata* Mtg.
Shell elongate, rostrate, with conspicuous concentric sculpture, slightly gaping at the rostral end.

B. *Lembulus* (Risso em.) Fischer, 1886. Type *L. pella* (L.) = *L. Rossianus* Risso.
Shell shorter, with radial ribs on the rostrum, and oblique sculpture not wholly coinciding with the incremental lines. Ex. *L. cœlata* Conr. (not Hinds), Eocene.

C. *Jupiteria* Bellardi, 1875. Type *L. concava* Bronn.
Shell short, arcuate, inflated, sharply pointed behind the valves, not gaping, sculpture concentric or faint, without radial ribbing, usually small sized.

c. *Ledella* Verrill, 1897 (= *Junonia* Seguenza, 1876, not of Hübner). Type *L. messanensis* Seguenza.

Differs from *Jupiteria* by having a straighter rostrum, with the margin retuse below it. These differences disappear in a large series of species, and the transition between slightly rostrate forms and those with rounded posterior extremity is complete. *Leda pontonia* Dall, is a typical, but unusually large, *Jupiteria*.

cc. *Ledina* Dall. Type *L. eborea* Conr., 1860, not 1846, = *L. smirna* Dall, Eocene.

Shell solid, strong, arcuate below, both ends evenly rounded, valves nearly equilateral, smooth.

This section has been frequently placed with *Yoldia*.

D. *Perrisonota* Conrad, 1869. Type *L. protexta* Conr., Eocene.

Shell elongate, smooth, compressed, inequilateral, with valves closed in front, the rostrum very long, not ribbed, and slightly gaping at the end.

The recent *L. Carpenteri* and *L. extenuata* Dall belong to this group.

E. *Adrana* H. and A. Adams, 1858. Type *L. elongata* Sby., recent.

Very elongate and thin, flattish, subequilateral, gaping at both ends.

This group, as far as the shell is concerned, approaches very near some Yoldias, but on the other hand a complete series of species (such as *L. Guppyi* Dall, Oligocene, Trinidad) connect it by easy stages with typical *Leda*.

It should be borne in mind that the length and attenuation of the rostrum is not necessarily correlated with the length of the siphons, for many species with an extremely long rostrum have a very small and shallow pallial sinus; while others which are not rostrate at all (ex. *Yoldia scapania* Dall) have a large and deep sinus. The correlation is probably with the mantle lobes, which in the *Nuculacea* generally are apt to be peculiarly modified and often exhibit special appendages. While the typical members of the groups above alluded to seem quite distinct from one another, large series of species may be relied upon to bridge any of the indicated gaps.

The principal stress in the classification of the *Nuculacea* has been placed on the position of the ligament and resilium, after the grand division into pearly *Nuculidæ*, without siphons, and porcellanous *Ledidæ*, with siphons, had been made.

It is observable that the ascent of the ligament and the obsolescence of the resilium has taken place in shells of all types; so that, in the subfamily *Malletinæ*, related most nearly to the Ledas by the porcellanous constitution of the shell, we have Lediform, Yoldiform, and even Nuculiform types. It is also notable that the external ligament is sometimes amphidetic, and in some other cases, when functionally opisthodetic, is so supplemented by a continuation forward of the periostracum as to appear amphidetic. In *Malletia* proper there is a tendency for the edge of the hinge-plate to turn up so as to form an anterior lateral tooth of a feeble kind which corresponds to a groove in the hinge-plate of the opposite valve, while in *Pleurodon* (or *Nuculina*) the anterior lateral is fully formed and conspicuous. In several forms in which there is no internal resilium in any stages yet observed, there is a vacant triangular area between the anterior and posterior ranks of teeth which corresponds to the area occupied by the chondrophore in *Leda* and *Yoldia*, and which, if not observed with great care, might easily be mistaken in a fossil for a functional chondrophore.

Subfamily MALLETINÆ.

The groups included in this subfamily are as follows:

Genus MALLETIA Desmoulins, 1832.

(+ *Solenella* Sby., 1832, + *Ctenoconcha* Gray, 1840.)

Type *M. Norrisii* (Sby.) = *chilensis* Desm.

Shell yoldiform, with external opisthodetic ligament amphidetically extended by periostracum and resilium, but neither lunule nor escutcheon, the anterior tooth row short and the rostrum obsolete. *Pseudomalletia* Fischer is synonymous, *fide* Verrill.

Subgenus? NEILO A. Adams, 1852.

Type *N. australis* Quoy and Gaim. (+ *N. Cumingii* Ads.).

Shell like *Portlandia*, the anterior and posterior teeth more nearly equal in number.

N. gigantea Smith from Kerguelen is intermediate between this group and *Malletia* proper, both in amount of rostration and number of hinge-teeth. *M. obtusa* Sars, the type of *Pseudomalletia*, has absolutely no trace of rostrum, though, according to Sars, it has at least one long siphonal tube.

Genus TINDARIA Bellardi, 1875.

Type *T. arata* Bellardi; Pliocene of Italy.

Shell solid, closed, concentrically sculptured; ligament and resilium amphidetic, outside the hinge-plate or line of teeth; mantle open below, with an anal orifice above, but no tubular siphon; pallial line feebly waved or entire.

Sections:

a. *Tindaria* s. s.

Shell veneriform, not rostrate; ligament elongate, feeble, mostly posterior; resilium obsolete; pallial line not sinuated. Ex. *T. cytherea* and *amabilis* Dall, *T. callistiformis* V. and B., *T. virens*, and *T. smithii* Dall (+ *cuneata* Smith).

b. *Tindariopsis* V. and B., 1897. (Type *T. agathida* Dall.)

Shell more acute or even rostrate behind; ligament long; resilium short, central, in a socket or excavation above the tooth-line; pallial line feebly waved. Ex. *T. acinula* and *T. æolata* Dall.

This section is probably to be consolidated with the next.

c. *Neilonella* Dall, 1881 (+ *Saturnia* Seguenza, 1876, non Schrank, 1802).

Differs from *Tindariopsis* only in having a gap in the line of the teeth, dividing them into anterior and posterior series, through which the resilium, though above the tooth-line, can be seen from below. The type *N. corpulenta* Dall is attenuated behind but not distinctly rostrate, and the pallial sinus is a little more marked than in *T. agathida*. *T. pusio* Phil., Seguenza's type, is distinctly rostrate, and on a casual glance hardly to be distinguished from *T. agathida*. None of the Tindarias have an absolutely unbroken arch of teeth, though between the proximal ends of the two series there is often no empty space, yet the series are always distinguishable.

d. *Pseudoglomus* Dall. Type *Yoldia pompholyx* Dall.

Shell smooth, closed, thin, minute, subcircular, with the ligament short, a little sunken, but visible only externally; the teeth few, in equal series, separated by a short, empty gap; pallial line simple.

This shell has the form of *Glomus*, but no internal resilium. It differs from the rounded Ledas described by Jeffreys, such as *sericea*, *expansa*, and *subequilatera*, by the non-interruption of the tooth-line by the base of the ligament, and from *Tindaria* proper by its orbicular shape, thin shell, and smooth exterior.

If it were worth while to name all the stages in the very uniformly progressive series which connects the typical *Leda* with *Tindaria*, *Malletia*, etc., no doubt this list of sections might be largely extended.

In his interesting review of the genera of *Ledidæ* and *Nuculidæ* of the Atlantic coast of the United States (Am. Journ. Sci., Jan., 1897, pp. 51–63) Professor Verrill, in his remarks on his subfamily *Tindariinæ* (page 58), observes that the writer has proposed the family *Ctenodontidæ* to include the extinct genera *Paleoneilo*, *Nuculites*, and others, but that it is doubtful "whether *Ctenodonta* itself belongs here." He also cites "*Ctenodontidæ* Dall, pars" as synonymous with his subfamily *Tindariinæ*. All this expresses a complete misconception of the arrangement made by me (pp. 515–516). None of the members of *Tindariinæ*, Verrill, are comprised in the group suggested doubtfully by me as "? Family *Ctenodontidæ*," and I did not mention *Paleoneilo*, but expressly stated that "many forms" "described under the name of *Ctenodonta*" "belong in the *Nuculidæ* or *Ledidæ*," and placed all the members of Professor Verrill's *Tindariinæ*, as he does, under the *Ledidæ*. I had not the slightest intention of combining *Tindaria* and its allies with *Ctenodonta*, but indicated their separation as complete. *Ctenodonta* has been referred to *Arcidæ* by Zittel and several of the older authors, but the indications all point to the derivation of the very modern group of *Arcidæ* through the Pectunculoid Taxodonts at a much later period than the appearance of *Ctenodonta*. Not having a proper series of specimens of the older forms, I have preferred to avoid attempting a revision of the Paleozoic genera, which comprise the beginnings of so many different groups, and require for adequate comprehension a truly monographic treatment.

Subfamily SAREPTINÆ A. Adams.

Nuculacea with a more or less developed external ligament in addition to a sunken or internal resilium, a short hinge-plate, a simple pallial line, and a porcellanous shell. The species are usually small and rounded, smooth or concentrically striated externally, not rostrate, and without crenulations on the margins of the valves.

Genus SAREPTA A. Adams, 1860.

Shell rounded-ovate, with a feeble remnant of an external ligament above and at the end of the elongated narrow oblique resilium, which latter is seated on a wider triangular area of hinge-plate interrupting the short series of oblique attenuated teeth; valves closing completely. Type *S. speciosa* A. Adams, Japan.

While the resilium is still within the area usually occupied by a chondrophore, it is elongated and narrow, indicating a first step towards the condition found in the next genus. The teeth are elongated on one side of the Λ and shortened on the other, making the two limbs very disproportionate. There is no modification of the edge of the hinge-plate simulating a lateral lamina, as in *Pleurodon.*

Genus **GLOMUS** Jeffreys, 1876.

Shell rounded, the resilium larger and much extended below the teeth posteriorly, the extended chondrophores nymph-like, the limbs of the Λ-shaped teeth still more unequal, otherwise like *Sarepta*, the ligament perceptible. Type *G. nitens* Jeffreys, Proc. Roy. Soc., June, 1876.

Genus **MICROYOLDIA** Verrill, 1897.

Shell veneriform, closed, with a distinct external ligament and a strong internal resilium situated on the hinge-plate and not overrun by the posterior line of teeth; teeth few and short, less unequal-sided than in *Glomus* or *Sarepta.* Type *M. regularis* Verrill.

In the structure of the shell, according to Professor Verrill's figures, this genus differs from *Glomus* only in minor details.

The inequality in the sides of the angulated teeth seen in the above-mentioned forms, and also in some species of *Leda* (ex. *L. extenuata* Dall), is carried to its greatest extreme in a small Leda-like shell named *Silicula fragilis* by Jeffreys (1879), where the teeth are reduced to long, imbricated laminæ, in which the usual hook at the proximal end is missing. In its other characters *Silicula* hardly differs from some Yoldias.

I have included these forms to complete the synopsis of the more modern groups, and also because some of them are represented on our Atlantic coast and may be expected eventually to turn up in our Tertiary beds.

Leda protexta Gabb.

While considering matters of nomenclature it seems desirable to clear up a confusion of long standing involving the specific name of *protexta* in this genus. Several persons have attempted to do this, and each seems to have left a little added confusion of his own, while throwing some light on the subject.

In March, 1860, in the Journal of the Academy of Natural Sciences, 2d Ser., iv., p. 303, Gabb described a *Leda protexta* from the New Jersey Cretaceous marls. By some misfortune nearly all the figures on this plate are numbered discrepantly with the text. The figure of this species is No. 23 on the plate, as can be determined by comparing the description with the figure. On page 397 of the same volume, published in November of the same year, Gabb refers to the same species, describes and figures* (pl. 68, fig. 36) a *Leda* from the Ripley group of Hardeman County, Tennessee, which is undoubtedly distinct from his original *protexta* of New Jersey. Not content with this, in 1864 (Pal. Cal., i., p. 199, pl. 26, f. 185) he refers a third species of *Leda* from the Cretaceous of California to the New Jersey species of 1860.

In 1865 Conrad described (Am. Journ. Conch., i., p. 213, pl. 21, fig. 2) a cast of a *Leda*, distinct from any of the preceding, under the name of *Yoldia protexta*, from the Eocene of Shark River, New Jersey.

In 1866 (Smithsonian Checklist, Inv. Foss. N. Am., Eocene and Oligocene, pp. 3, 4) Conrad catalogues a *Nuculana Gabbii* from California without comment, which Gabb (Pal. Cal., ii., pp. 197, 250, 1869) states is a new name proposed for *Leda protexta* Gabb of California, 1864.

In the same Checklist Conrad (p. 4, No. 55) enumerates a *Nuculana protexta* Conrad from Alabama of which nothing had previously been printed, as well as his "*Yoldia*" (= *Leda*) *protexta* of New Jersey (p. 4, No. 65). The latter is correctly referred by Conrad to his genus *Nuculana* (= *Leda*) in his catalogue of the Eocene Testacea of the United States (Am. Journ. Conch., i., p. 13, Feb., 1865); and still later (Am. Journ. Conch., iii., p. 8, Apr., 1867) he corrects the synonymy of this species by renaming it *albaria*, and transfers it back to *Yoldia*, the wrong genus.

In 1869 Conrad (Am. Journ. Conch., v., p. 98, pl. 9, fig. 24) describes as a new genus *Perrisonota*, the internal cast of another *Leda*, which he called *Perrisonota protexta*. Thus, in spite of the elimination of two species of this specific name, there still remained three species, Gabb's Nos. 1 and 2 and Conrad's last, all called *protexta!*

In 1885 Professor R. P. Whitfield (Brach. and Lam. of the Raritan Clays of N. Jersey) took up the subject. For the first *Leda protexta* of Gabb he adopts the name *Nuculana protexta*, and gives a new description (p. 105, pl. xi., fig. 10) and a figure of the specimen from which it is supposed Gabb's original figure of *L. protexta* was made. For Gabb's second *protexta* Whitfield proposes the name *Gabbana*, and in illustration of it gives figures of a cast

* The figure mentioned in the text is 35, but the number on the plate is 36.

from Princeton College obtained from the marls of Freehold, N. J. (*op. cit.*, p. 108, pl. xi., figs. 12, 13), which he supposes to be identical with the Tennessee species, and also of a smaller specimen which should, from the figure, belong to another and distinct species. The Tennessee shell must, of course, keep the name, being the original type. This has been redescribed and figured (Bull. Am. Pal., iv., p. 55, pl. iv., fig. 9, 1896) by Harris, to whom Professor Safford lent the type specimen, which really came from the Midway Eocene and not from the Cretaceous Ripley beds as now restricted. Professor Harris apparently overlooked the name given by Whitfield and renamed the species *L. Saffordana.* In this connection it may be pointed out that the two casts figured by Professor Whitfield as illustrative of Conrad's *L. albaria* (*op. cit.*, p. 228, pl. xi., figs. 15 and 16) cannot, in my opinion, be regarded either as belonging to one and the same species themselves, nor can either of them be referred to Conrad's original species. As they cannot be specifically identified without better material it is best not to name them. In the synonymy of *Y. protexta* Conr. (= *albaria*) Professor Whitfield remarks "not *Yoldia protexta* Gabb," but this should read "not *Leda protexta* Gabb," since I believe Mr. Gabb did not describe a *Yoldia* with that specific name, though he gave the latter to three different species of *Leda.*

Lastly, Professor Harris, in his synonymy, queries whether the *Leda bella* var. Conr., from Alabama, may not be identical with *L. Gabbana.* It is possible that this may be the shell meant by Conrad in his Eocene Checklist when he catalogued a *Nuculana protexta* from Alabama, as above mentioned. But, since it is absolutely impossible to determine the question either way, it will not be profitable to discuss it. The lesson taught by this whole chapter of blunders is sufficiently obvious.

Leda acala n. s.

PLATE 32, FIGURE 3.

Wood's Bluff, Alabama, C. W. Johnson; Butler, Alabama, Aldrich.

Shell thin, nearly smooth, elongate, acutely rostrate, inequilateral, moderately convex; beaks small, prominent, but not high; anterior slope shorter, slightly descending; anterior end rounded; posterior slope nearly straight, posterior end narrow, bluntly pointed, base arcuate; lunule very narrow, almost linear, slightly raised, the incremental lines near it strong; escutcheon narrow, excavated, bordered by a sharp elevated line; outside of which is a wider furrow extending to the upper end of the rostrum; interior smooth; pallial sinus angular, well-marked; seventeen anterior and eighteen posterior teeth, which are small and delicate; chondrophore subumbonal, not projecting. Lon. 18, alt. 8, diam. 5.5 mm.

This species and another were in the hands of Mr. T. H. Aldrich when he described his *Leda elongatoidea* (Bull. Am. Pal., No. 2, p. 17, pl. v., fig. 2). His description and figure apply to that one, and his remark about larger specimens to the present species. From the types *L. elongatoidea* is a smaller and flatter species with a sculptured ray on the rostrum and stronger incremental lines. The same species has been found in the Zeuglodon bed of Alabama.

Leda pharcida n. s.

Plate 32, Figure 8.

Lignitic or Chickasawan Eocene of Wood's Bluff, Alabama, C. W. Johnson and T. H. Aldrich; also at McKay's marl bed, Suwashee Creek, two miles south of Meridian, Mississippi, L. C. Johnson.

Shell solid, large, elongated, sharply sculptured; anterior end shorter, posterior end longer, rostrate, obliquely truncate; surface covered with low, sharp, concentric, elevated laminæ with slightly wider interspaces, ending above anteriorly on the lunular carina, behind angulated at the lower border of the rostral ray, the interspaces much wider on the ray, and the laminæ strong and blunt on the dorsal edge or keel of the ray; beaks inconspicuous; lunule nearly linear, slightly excavated; escutcheon deep, flat, with an elevated line, inside of which are longitudinal and outside of which are oblique striæ; end of the rostrum obliquely truncate, slightly recurved; base arcuate; pallial sinus rounded, small; there are more than thirty-five teeth on each side of the moderately large subumbonal chondrophoric pit; the rostrum has no internal ridge. Lon. 36.5, alt. 14, diam. 7 mm.

This is nearest *L. opulenta* Conr., in which the sculpture of the rostral ray is divided into two areas of loops by a sharp groove, and the escutcheon is much smoother and divided into deeply excavated areas. This species is sometimes found in collections under the name of *L. protexta* Conrad, but there is no evidence of any connection specifically between them or any of the synonymes of *protexta*. *L. opulenta* is a much rarer shell from the Claibornian. *L. regina-jacksonis* Harris (Jacksonian) is higher behind, with the middle ventral margin straight, and feebler sculpture.

Leda multilineata Conrad.

PLATE 25, FIGURES 11, 11 *b*.

Leda multilineata Conr., Proc. Acad. Nat. Sci. Phila., vii., p. 258, 1855; Wailes, Geol. Miss., p. 289, xiv., fig. 4 (bad), 1854.

Eocene: Moody's branch beds, Jackson, Mississippi; Wahtubbee Hills, Clarke County, Mississippi; near Hickory; four and a half miles east of Shubuta, eight miles west of Enterprise, and six miles west of De Soto; Oligocene: Vicksburg limestone, Mississippi, Burns; nummulitic beds near Martin Station, Florida, Willcox. Length of figured shell 20 mm.

This fine species, which appears to range from the Middle Eocene to the top of the Lower Oligocene, has not hitherto been well figured, for which reason I have given an illustration of it.

Leda concentrica Say.

Nucula concentrica Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 141–42, 1824; not of Fischer, Fos. Gouv. Moscow, 1843.

Leda eborea Conr., Proc. Acad. Nat. Sci. Phila., xiv., p. 1846; *ibid.* for 1863, p. 581; not *L. eborea* Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 295, pl. 47, fig. 26 (= *L. smirna* Dall).

Upper Miocene of Alabama, of the Deep Well at Galveston, Texas (four hundred and forty to four hundred and fifty-eight feet below the surface), Pleistocene of the Gulf Coast, and recent in the Gulf of Mexico; Say, Harris, Mitchell, Dall, and others.

Leda catasarca n. s.

PLATE 32, FIGURE 13.

Eocene of the Wahtubbee Hills, Clarke County, Mississippi, at stations 2616, 2621, 2622, 2624, and 2625; Burns.

Shell small, very plump, nearly equilateral, concentrically sculptured, with on the beaks and body rather wide, flattish riblets, more crowded ventrally, obsolete dorsally behind and on the dorsal and anterior portions in front; lunule very narrow, excavated, with the valve margins slightly pouting; the escutcheon similar, wider, with an excavated, obliquely grooved furrow outside of it, with rounded outer edges, the whole forming a conspicuous lanceolate area extending from the point of the rostrum to the beaks; anterior end of shell rounded, base arcuate, posterior end with a short, bluntly pointed rostrum; hinge solid, with about sixteen anterior and fourteen posterior V-shaped teeth; chondrophore small, subumbonal; the rostrum without an internal ridge, the pallial sinus small. Lon. 5.2, alt. 3, diam. 2.5 mm.

This interesting little species appears to be rather common in beds of the Wahtubbee horizon. It differs from *L. robusta* Aldrich in details of sculpture, especially on the escutcheon.

Leda flexuosa Heilprin.

PLATE 38, FIGURES 5, 5 *a*.

Leda flexuosa Heilprin, Trans. Wagner Inst., i., p. 119, pl. 16, fig. 66, two views, 1887.

Oligocene silex beds of Ballast Point, Tampa Bay, Florida; Heilprin and Dall.

This species was imperfectly represented by the original figures, and at the suggestion of Mr. Willcox new figures of it have been included here.

Leda hypsoma n. s.

PLATE 32, FIGURE 2.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, polished, compressed, with the rostrum short, pointed, and gaping at the end; sculpture of flattened, wide, concentric waves or riblets, with their dorsal slope steeper; these waves are obsolete over the anterior dorsal and terminal part of the valves, and wholly absent from the rostrum; beaks nearly central, plump, low; lunule very narrow, bordered by an impressed line; escutcheon wider, bordered by a large, rounded rib on each side, the area longitudinally grooved; rostrum slightly recurved; base arcuate; interior polished, with a small pallial sinus; fourteen anterior and about eleven posterior teeth; the chondrophore minute, subumbonal; the rostral channel not divided by a ridge. Lon. 5.5, alt. 3.2, diam. 1.5 mm.

This species recalls *Nuculana linifera* Conr., but is larger and more elongated, with a more conspicuous rostrum.

Leda dodona n. s.

PLATE 32, FIGURE 6.

Oligocene of the Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, solid, slightly inequilateral, polished, strongly concentrically sculptured; sculpture of elegant, even, high, blunt-edged, slightly recurved lamellæ, with deeply excavated, wider interspaces, which are striated by the lines of growth; the sculpture ends anteriorly at the margin of the lunule, and behind ceases on the rostral carina, about equally strong throughout; a radial depression extends from the beak to the anterior ventral margin, which it slightly emarginates; lunule narrow, transversely ribbed; escutcheon wider, extending to the end of the rostrum, bounded by a strong, rounded carina, on which the lamellæ are conspicuous; within the carina the area is excavated and nearly smooth, except in the central part, where it is radially grooved; rostrum acute, slightly recurved near the tip, pallial sinus small; hinge with nineteen anterior and fourteen posterior rather solid teeth; chondrophore small, triangular. Lon. 9, alt. 5, diam. 4 mm.

This elegantly sculptured species is related to *L. robusta* Aldr., *L. bisulcata* Guppy, *L. acuta* Conrad, etc., but in the minor details of its sculpture differs from all of them.

Leda trochilia n. s.

PLATE 32, FIGURES 4, 12.

Miocene of the upper bed at Alum Bluff, Calhoun County, Florida; Dall and Burns.

Shell small, solid, nearly equilateral; sculpture of concentric riblets, not always continuous, with wider interspaces; the ribs when continuous extend forward to the margin of the shell; there is no lunule, or its area is barely indicated by a feebly impressed line which does not interrupt the sculpture; there is a very feeble anterior depressed ray which does not emarginate the base; anterior end rounded, shorter; base arcuate, posterior end rostrate, pointed; the escutcheon is almost as in the last species, but its carina bears no lamellæ, as the concentric sculpture is little elevated and only in certain specimens crenulates the carinæ; interior much as in *L. dodona* with the same number of stout teeth (sixteen) before and behind the small triangular chondrophore. Lon. 10, alt. 6, diam. 4 mm.

This is another species of the same group as *L. dodona*, but with coarser and less regular sculpture and obsolete lunule.

Leda acrybia n. s.

Chesapeake Miocene of Plum Point, Maryland; Burns.

Shell resembling *L. trochilia*, but thinner and more compressed, with a wider rostrum, which is nearly smooth and slightly recurved; the young are hardly rostrate; there is a narrow lunule and escutcheon, the latter subdivided by an oblique ridge and nearly smooth; there are sixteen teeth on each side of a small chondrophore. Lon. 10, alt. 5, diam. 3.75 mm.

The material for this species is sparse, and I await better specimens for figuring, but there is enough to indicate clearly that the species is distinct from any of those compared with it.

Leda (linifera Conrad, var. ?) **canonica** n. s. ?

Cf. *Leda linifera* Conr., Am. Jour. Conch., i., p. 139, pl. x., fig. 8, 1865.

Jacksonian of Garland's Creek, Clarke County, Mississippi, Spillman; the variety from the Oligocene marl of Chipola River, Calhoun County, Florida, Dall.

The shallow radial furrow on the rostral end of Conrad's shell is misrepresented as a rib on his figure. The shell is subrhomboidal and compressed with the concentric lines sparse, obsolete anteriorly and on the rostrum. The present form, represented by two small specimens about 2.5 millimetres long, is more elongate, less compressed, the rostrum has a rounded dorsal keel, and the surface is uniformly covered with fine, even, concentric sculpture. It is probably a distinct species, less robust than young *L. acuta* Conr. of the same size, but for which the material is hardly adequate to a full description and figure. The shell is near *L. calatabianensis* Seguenza (Nuc. terz., pl. ii., fig. 9 *a*) from the Astian of Italy.

The Chipola beds have afforded another species of the same group (Nat. Mus. 114,808) which in form and sculpture much resembles *L. linifera*, but the shell is more inflated, the rostrum more pointed, with a marked inflection of the basal margin below it, and the anterior end is more attenuated. For the present this may take the provisional name of *L. linifera* var. *chipolana*, though sufficient material would probably show it to be distinct. It is represented in the collection by only a single specimen 2.5 millimetres long.

Leda amydra n. s. ?

A single valve from one mile south of Plum Point, Maryland, was collected in the Miocene by Harris.

Shell small, smooth, polished, subequilateral, moderately convex, with an evenly arcuate base, no lunule, and the escutcheon small, narrow, excavated, bounded outside by a raised line beyond which is a second furrow extending nearly to the end of the rostrum; the chondrophore is small and deep-seated with about a dozen small teeth on each side of it; the rostrum is short, rounded, and without any internal partition. Lon. 5, alt. 2.5, diam. 1.5 mm.

This shell is remarkably like a small *Leda* from the Claiborne sands which I have without a name, but is more rounded behind. More material is needed to establish its exact relations. Another valve was found at Plum Point which may be distinct, or possibly a variety of this species, from which it differs by its thinner shell and by having fine concentric sculpture on and near the beaks and on the anterior dorsal slope.

Leda phalacra n. s. ?

Miocene of Plum Point, Maryland; Burns.

This shell, also represented by a single valve, is less arcuate and more compressed than *L. amydra;* the middle third of the convexity of the shell has a few conspicuous concentric waves which do not reach the base and end abruptly before and behind; the beaks are covered with concentric sculpture, which also appears on the anterior dorsal slope; there is a well-marked narrow, impressed lunule and escutcheon, but the hinge, though feeble, resembles that of *L. amydra.* Lon. 5.5, alt. 2.7 mm.

These little Yoldiform Ledas would be easily mistaken for Yoldias; and, in fact, many have been so referred by authors, but sufficient study will enable almost any of them to be properly referred. While the distinctions are chiefly anatomical, the solidity of the shell, the presence of a rostral ray, a lunule, and concentric or radial sculpture are all characteristic of *Leda* and not of *Yoldia*, and some of these characters are almost always present, and taken with the general habit of the shells are sufficient to distinguish them.

I may add that I have fragments of a beautiful *Adrana* from the Pliocene of Limon, Costa Rica, but prefer to await better specimens before attempting to name it.

Leda acuta Conrad.

Nucula acuta Conrad, Am. Mar. Conch., p. 32, pl. vi., fig. 1, 1831; not of Sby., Trans. Geol. Soc. Lond., 2d Ser., v., pl. 39, fig. 5, 1837.

Leda cuneata Sby., P. Z. S., 1832, p. 198.

Leda jamaicensis Orb., Moll. Cuba, ii., p. 262, pl. xxvi., figs. 27–29, 1846; Dall, Bull. Mus. Comp. Zool., ix., p. 124, 1881.

Leda unca Gld., Proc. Bost. Soc. Nat. Hist., viii., p. 282, 1862; Verrill, Trans. Conn. Acad., v., p. 572, 1882; not vi., p. 260, 1884.

Leda inornata A. Ads., *fide* Hanley, from type.

Leda acuta (Conrad) Dall, Bull. Mus. Comp. Zool., xii., p. 251, 1886; xviii., p. 438, 1889.

Oligocene of the Chipola beds, Calhoun County, Florida, Dall and Burns, and of the Alum Bluff beds at Oak Grove, Santa Rosa County, Florida, Burns. Miocene of Suffolk and Yorktown, Virginia; of Wilmington, North Carolina, of the Natural Well, Duplin County, North Carolina, and of Darlington, South Carolina; Burns and Harris. Pliocene of the Dismal Swamp, Virginia; of the Waccamaw beds, South Carolina; of the Caloosahatchie beds, Florida, on the Caloosahatchie, Alligator Creek, and Shell Creek; Johnson, Burns, Dall, and Willcox. Recent in thirty to one hundred and fifty-five fathoms on the southeast coast of the United States and in the Antilles and on the Pacific coast of California.

This widely distributed and ancient species is represented in the Oligocene of Bowden, Jamaica, by *L. bisulcata* Guppy (non Whitfield). Like some other species of the sub-genus *Lembulus* it is subject to a wide range of variation in its external sculpture. This may be finely and regularly concentric over the whole surface, or partly obsolete towards the ends and base. Occasional specimens are found in which the surface is nearly smooth and others in which the fine concentric ribbing is replaced by a few distant, coarse ribs or waves. In fact, the extremes are so discrepant that in the absence of a connecting series almost any one would doubt that the shells could belong to one and the same species. *L. robusta* Aldrich varies in a similar manner. Other species of the same group, such as *L. taphria* Dall (*cælata* Hinds, non Conrad) and *L. peltella* Dall, even when gathered in large numbers, show a gratifying uniformity of character. Hence it follows that much caution should be used in naming new forms from beds where named species of this group are already known to occur.

Genus YOLDIA Moller.

This group appears to be, on the whole, more modern than the typical *Leda*, and occurs for the most part rather sparingly in the Tertiary. Though the number of species is small, individuals are astonishingly numerous in some localities, and one stratum at Shell Bluff on the Savannah River is almost entirely composed of the fossilized valves of a single species of *Yoldia*. After eliminating the Yoldiform species of *Leda*, comparatively few species remain to be discussed. *Yoldia glacialis* Wood, described from recent specimens, was described from the Pleistocene of New England as *Y. portlandica* Hitchcock, and is the *Y. arctica* of several authors, but not of Gray. *Yoldia* *albaria* Conrad, from the New Jersey marls, was originally named *protexta*, and belongs to the genus *Leda* (*q. v.*). *Yoldia Cooperi* Gabb, a fine species, erroneously referred afterwards to *Y. impressa* Conrad, is found recent and in the later Tertiaries of California. *Y. impressa* Conrad was described from the Eocene of Oregon. *Y. lævis* Say, which has been confused with its probable descendant *Y. limatula* Say, is abundant in the Miocene of the eastern United States. *Y. abrupta* Conrad (1848, not of Dana, 1847) is an obscure species from the Oregon Tertiary. *Y. nasuta* and *ovalis* Gabb were described from the Oligocene of St. Domingo. The earliest Tertiary species I have noted from our own country is *Y. Kindlei* Harr., from the Midway Eocene of Tennessee. *Yoldia eborea* (Conrad) Harris is a *Leda*, but judging from the figure (Bull. Amer. Pal., iv., pl. 4, fig. 10), the species doubtfully referred to *Leda elongatoidea* Aldr. by Professor Harris, and which he has since named *Yoldia Aldrichiana*, belongs to the genus *Yoldia*. From the Claibornian we have the rare *Y. claibornensis* Conrad; from the Oligocene of the Antilles *Y. Crosbyana* Guppy; *Y. serica* Conrad is a good species from Red Bluff; and Shell Bluff, Georgia, and the Floridian Chipola beds have a species apiece. *Y. corpulentoidea* Aldr., with *eborea* Conrad and similar forms, are better placed in the genus *Leda*.

This genus has been variously subdivided, especially in Professor Verrill's paper above alluded to, but a conservative view, taking into account the variable characters exhibited by the respective species and the indubitably close relations with *Leda*, obliges me to withhold from the most marked of the several groups a more than sectional value, and to regard a large proportion of the names as synonymes. The following arrangement, based on the above considerations, may, perhaps, be accepted.

Genus **YOLDIA** Moller, 1842.

Two species were referred by Moller to his new genus, one of which was, according to Mörch, *Y. glacialis* Wood (=*Y.* "*arctica* Gray," Moller), and the other a young specimen of *Y. thraciæformis* Storer (= *Y. angularis* Moller). The original *Nucula arctica* Gray is indeterminable from the brief diagnosis, and was not figured. It has been identified by several naturalists (Hanley, Smith, and others) with *Y. hyperborea* Torell, and by others with *Y. glacialis* Wood (+ *Y. truncata* Brown, + *Y. portlandica* Hitchcock). From Moller's description of his *Y. arctica* as "planiuscula, lævi, nitida, luteo-vel fusco virente," and the number of teeth he ascribes to it, I feel compelled to believe that it could not have been *Y. glacialis*, whatever Gray's *N. arctica* was.*

Sections:

A. *Yoldia* s. s. Type *Y. hyperborea* (Loven MS.) Torell.

Shell elongate, smooth, compressed, more or less pointed behind, having a deep pallial sinus and with a wide pedal and moderate siphonal gape. Ex. *Y. lævis* Say, Miocene, Virginia.

B. *Cnesterium* Dall. Type *Y. arctica* Brod. and Sby., Zool. Journ., 1829; (not of Gray, Parry's Voy. App., 1824) = *Y. scissurata* Dall.

Shell like *Yoldia* with incised sculpture not in harmony with the incremental lines over more or less of the external surface. Ex. *Y. lanceolata* J. Sby., Pliocene.

C. *Orthoyoldia* Verrill. Type *Y. scapina* Dall.

Shell smooth, without rostrum or carina, the ends bluntly rounded. Eocene, recent.

D. *Yoldiella* Verrill. Type *Y. lucida* Lovèn.

Shell small, rounded ovate, smooth, with obscure rostration feebly developed, with a small or indistinct pallial sinus; resilium well developed, short, sometimes partly visible externally.

These are mostly small deep-sea forms, of rather generalized character, which verge on *Malletia* in their ligamental features, and are very much like the young of some of the larger forms. Professor Verrill ascribes to them a feeble external ligament, but it seems to me more like the continuous periostracum which is visible in a fresh specimen of *Y. thraciæformis*, and which has no real ligamentary function. The dorsal valve margins do not entirely close over the resilium, though its attachments appear to be wholly internal.

E. *Portlandia* Mörch. Type *Y. glacialis* Wood (+ *Y. portlandica* Hitchcock, Pleistocene and recent. *Megayoldia* Verrill).

Shell convex, more or less abruptly truncate behind, the rostral part laterally compressed; the pallial line with a deep sinus.

The gaping of the valves in *Y. thraciæformis* is merely a specific character and varies in the same species and in different ages of the same individual.

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* In this also I agree with Hanley and Smith in referring Gray's species to the *hyperborea* group rather than to that of *truncata* Brown, as supposed by Torell, Jeffreys, and Mörch. *Yoldia arctica* Brod. and Sby. (1829) is a totally distinct species, which I have named *Y. scissurata*.

Y. montereyensis Dall, otherwise very close to *Y. thraciæformis*, does not gape perceptibly more than *Y. glacialis.* The soft parts of *Y. thraciæformis* differ in no essential respect from those of *Portlandia glacialis.* I cannot regard the differences of any of the above forms as of more than sectional value. They all intergrade in a large series of species.

Yoldia lævis Say.

Nucula lævis Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 141, pl. x., fig. 5, 1824.

Miocene of Maryland (Say); St. Mary's County, Maryland; York River, Virginia; Warwick and Dismal Swamps, Virginia; Burns, Harris, Haldeman, etc.

This species is probably the ancestor of the Pleistocene and recent *Y. limatula* Say. It differs from the latter by its proportionally larger chondrophores, smaller and more numerous teeth, somewhat more pointed posterior end, and less compressed escutcheon. A very large series compared shows these differences to be constant.

Yoldia psammotæa n. s.

Plate 34, Figure 20.

Claiborne sands, at Claiborne, Alabama; Burns.

Shell smooth, or with faint incremental lines, inequilateral with low beaks, the dorsal and ventral margins subparallel; valves elongated, rounded in front and behind, the posterior part somewhat compressed and attenuated; anterior end with a moderate gape; lunule and escutcheon elongated, very narrow, almost linear. Lon. 21, alt. 9, diam. 6 mm.

This species is represented by two specimens with the valves closed and filled with a rather hard matrix, so that the hinge characters are inaccessible. It is clearly distinct from any of the described species of the American Eocene, and peculiar in its elongated solenoid form. It cannot be confounded with *Y. claibornensis* Conrad, from the same horizon. It would find a place in the section *Orthoyoldia* Verrill.

Yoldia frater n. s.

Plate 32, Figure 1.

Oligocene of the Chipola beds in Calhoun and Walton Counties, Florida, Dall, Burns, and Johnson; also in the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida, Burns.

Shell polished, thin, elongate, much resembling *Y. lævis*, from which it is distinguished by the less arcuate base, more attenuated anterior end, somewhat more compressed form, and, in the great majority of specimens, by having on the convexity of the beaks and the early part of their posterior slope a concentric sculpture of fine even riblets with about equal interspaces. There is also on the escutcheon an elevated radial line, absent on the corresponding part of *Y. lævis*, which also attains a nearly one-third larger size when full grown. There are about twenty-six teeth on each side of a small subumbonal chondrophore. Lon. 19, alt. 8, diam. 4 mm.

This shell is perhaps the ancestor of *Y. lævis*, from which it can usually be readily distinguished by its more rectangular form and sculptured umbones.

Yoldia tarpæia n. s.

Chesapeake Miocene of the upper bed at Alum Bluff, Calhoun County, Florida; Dall and Burns.

Shell small, smooth, ovoid, moderately convex, rather solid for its size, with the ends rounded, the posterior smaller, the base evenly arcuated; lunule very narrow; escutcheon smooth, or marked only by lines of growth, with a single lamellose elevated line very close to the shell margin, which in young or worn specimens is often obscured; beaks low, hinge-line nearly straight, pallial sinus rounded, deep, nearly reaching the vertical of the beaks; about twenty anterior and eighteen posterior small, narrow teeth, separated by a subumbonal chondrophore. Lon. of a large specimen, 14.25; a perfect but smaller one measures, lon. 9.5, alt. 5, diam. 3 mm.

This shell recalls *Y. sapotilla* Gld., and bears to *Y. lævis* much such a relation as *Y. sapotilla* does to *Y. limatula* Say.

Subfamily **MALLETIINÆ.**

Genus **PLEURODON** S. Wood.

Pleurodon Wood, Charlesworth's Mag., iv., p. 230, 1840. (Type *P. ovalis* Wood, *op. cit.*, p. 230, suppl. pl. xiii., fig. 1 *a–d.*) Not *Pleurodonte* Fischer, Tab. Syn. Zoog., p. 129, 1808.

Nuculina Orbigny, Pal. Franc., iii., p. 161, 1843. (Type *Nucula miliaris* Deshayes, non Wood, Coq. env. Paris, i., p. 235, pl. xxxvi., figs. 7–9, 1824.) Not *Nuculina* Agassiz or Filippi.

Nucinella Wood, Crag. Moll., ii., p. 72, 1850. (*N. miliaris* Wood, non Deshayes, pl. x., figs. 4 *a–c*, 1850.) Deshayes, An. s. Vert. bassin de Paris, i., p. 826, 1860.

Nuculina E. A. Smith, Challenger Pelecypods, p. 230, 1885. Verrill, Am. Journ. Sci., Jan., 1897, p. 51.

Range: Paris Eocene; Red and Coralline Crags of Britain; Caloosahatchie beds, Florida; Pliocene of Reggio, Italy; recent, Straits of Florida, in two hundred and five fathoms.

This very remarkable little genus combines characters which recall *Nucula*, *Limopsis*, *Tindaria*, and other genera, with features peculiar to itself. The history of the genus is quite complicated.

In 1840 Searles Wood described his genus *Pleurodon*, as above cited, for *P. ovalis* of the British Crag, at the same time querying the specific identity of his type with a shell described by Deshayes in 1824 under the name of *Nucula miliaris*, from the Paris Basin Eocene. They were not specifically identical, though Wood in 1850 concluded that they were, and therefore enumerated his Crag species under the specific name of *miliaris* among his Crag bivalves. But since there was a genus *Pleurodonte* already existing, he concluded (erroneously, in my opinion) that *Pleurodon* was preoccupied in zoölogy, and substituted for it the generic name of *Nucinella*. Meanwhile d'Orbigny had observed the peculiarities of Deshayes's species, and proposed in 1843 to make it the type of a genus *Nuculina*, being apparently ignorant of Wood's *Pleurodon*. The word *Nuculina* was used by Agassiz in 1847 to include the *Nuculidæ* in a family sense, and about 1850 Filippi, in a rare brochure, used the name *Nuculina* for a *Cythere* or allied entomostracan. The uncertainty of date common to many of d'Orbigny's works led to doubts as to which was the prior use of the name *Nuculina* in a generic sense. Lastly, in 1860 Arthur Adams named an allied recent shell from Japan *Huxleyia*, which, being preoccupied in sponges, he replaced by *Cyrilla* in the same year. In 1870 a recent species of *Pleurodon* was found by Dr. J. G. Cooper while dredging among the islands off Santa Barbara, California. At that time I investigated the relations of these minute forms and had some correspondence about them with Dr. P. P. Carpenter and the brothers Adams. But in the absence of specimens for comparison, and doubting the minute accuracy of the published figures, my notes remained unpublished. In 1886 Dr. W. H. Rush dredged a single valve of a new species of *Pleurodon* in the Straits of Florida, and I discovered still another in the Pliocene marls of the Caloosahatchie River, Florida. With a series of the Crag shells, specimens of the species described by Deshayes, and of those from Japan and California, I find myself at last in a position to review the group. In 1870 I was informed by Mr. Arthur Adams that his second species of *Cyrilla* (*C. decussata*) was a young *Limopsis*, which eliminates that form from the discussion. In 1885

Mr. E. A. Smith announced the discovery by the Challenger Expedition of *P. ovalis* at the Cape of Good Hope, in fifteen to twenty fathoms, at St. Simon's Bay. I have not examined these specimens.

The typical species of *Pleurodon* is characterized by a shell externally resembling *Nucula*, but having a structure much less nacreous. Mr. Wood, indeed, described his shell as nacreous, but none of the specimens given by him to Dr. Jeffreys have the least pearly lustre, and if the recent species are examined they appear hardly more nacreous than an ordinary *Leda*. The anterior side of the hinge-line is short, the cardinal border externally is produced and angulated, and in an excavation under this little angle lies the ligament which in a normal and perfectly preserved specimen is nearly or quite covered by the margin of the valves. In most specimens this covering, being extremely thin, is eroded or broken away, so that two valves in opposition show a small oval pocket in which the ligament was originally contained. In *P. miliaris* Deshayes the perfect shell completely hides the ligament, which is wholly internal, and the British specimens indicate that this may have been the case with *P. ovalis* also. In both of these species and in the recent *P. Adamsii* from Florida as well as the *P. Woodii* from the Caloosahatchie, the cavity for the ligament is rather flattish and small; in the *P. munita* Cpr. from California as well as the Japanese *Cyrilla* the cavity is large and nearly spherical.

The cardinal plate in all the species is rather broad, and terminates in the left valve with a prominent lateral tooth which is received into a corresponding depression in the plate of the opposite valve, the edge of the plate in most of the species being turned up like a tooth, but in *P. munita* remaining flat in the right valve. The cardinal teeth between the ligamentary fossette and the lateral tooth or socket vary in form and arrangement in each species. They are, from their minuteness and complexity, very difficult objects to observe and draw correctly. They are set in a sort of arch, under the beak, but a careful and minute study shows that the series is really composed of two distinct groups, one belonging to the anterior and one to the posterior side of the hinge, and the teeth in one group are usually of a different type from those in the other group. The two rows or groups approach one another at a more or less evident angle, recalling the two groups in *Nucula;* while a reminiscence of the internal fossette of *Nucula* remains in a slight broadening of the cardinal plate just below this angle. The edge in *P. Woodii* is actually produced into a little angular projection here, but the recent species do not indicate the presence of any resilium at this point, while in *Cyrilla* the broadening of the plate has disappeared. The teeth of the anterior group in *P. ovalis* are bent like a half-open book standing on its base. There are three of them and they are very elevated. In position they resemble those of *P. Woodii;* they are thin and compressed. The posterior teeth in horizontal section are rounded, they are stouter, not so close together, not bent, and rather conical. The widening of the hinge-plate in this species is not great, and the posterior cardinal teeth rise almost directly from its inner margin.

Pleurodon Woodii n. s.

PLATE 24, FIGURE 10.

Pliocene marls of the Caloosahatchie, Florida; Dall.

Shell small, smooth, oval, slightly truncate in front, very inequilateral; sculpture only of extremely fine incremental lines, visible only under magnification and stronger towards the margin; beaks small, prominent, anterior; margins internally smooth; hinge-plate wide, extended posteriorly more than half the length of the shell, its lower edge distally turned up and thickened to form a lateral tooth, to which in the right valve is added a small dorsal thickening or lamina; anterior teeth small, three in each valve, the hinge-plate slightly angular below the commissure between the anterior and posterior cardinals; posterior cardinals three in the right, four in the left valve, larger than the anterior teeth and separated from them by a slight gap, the hinge-plate grooved between them and its ventral margin. Lon. of shell 2.75, alt. 1.75, diam. 1 mm.

This species differs from *P. ovalis* in the groove and angle of the hinge-plate, but in other respects the teeth are much alike, and the two species are closely related and of nearly the same size, *P. Woodii* being a trifle larger.

P. miliaris Deshayes, when fully adult, is larger than the *P. ovalis* and has one more posterior tooth; the anterior teeth are flatter, more compressed, and more crowded together. The young resemble the *P. ovalis* more closely. The adults have the ligamentary fossette completely covered. The specimens were received from Dr. P. Fischer by Jeffreys.

P. Reussii Deshayes, from the Tertiary of Bohemia, which was referred to *P. miliaris* by Reuss, I have not been able to examine.

P. calabræ Seguenza, from the Tortonian Miocene, I have not seen, nor do I know if it has been described and figured. The name occurs in the list of the fossils of the various Tertiary beds of Reggio in Calabria.

P. Seguenzæ Dall, from the Astiano division of the Calabrian Pliocene, was sent to Dr. Jeffreys under the name of *P. ovalis*, and I suppose is the shell so catalogued by Seguenza in his Tert. Fos. of Reggio. It is much larger even than *P. miliaris*, and has the ligamentary fossette somewhat gaping; eight teeth, of which five are posterior, and all are much crowded. The inner edge of the hinge-plate is excavated behind the anterior teeth, and the width of the cardinal border at the lateral teeth is less, proportionally, than in the other species.

P. Adamsi Dall (plate 24, figure 9) was dredged seven miles east of Fowey Rocks, Straits of Florida, by Dr. W. H. Rush. It is proportionally shorter and wider than the other species. It has three squarish high anterior cardinal teeth and two stout conical posterior teeth in the right valve, perhaps three in the other. There is a well marked small shelf between the posterior teeth and the outer cardinal border, and no groove on the other side. The exterior is smooth and covered with a pale yellowish epidermis; the interior is glassy rather than nacreous. It is figured on the same scale as *P. Woodii*. The posterior wing of the cardinal border is wider than in any of the other species.

The reader will understand that all these notes are taken from authentic specimens and not from figures.

Subgenus CYRILLA A. Adams.

Huxleyia A. Adams, Ann. Mag. Nat. Hist., 3d Ser., v., p. 303, April 1860. Type *H. sulcata* A. Adams (not *Huxleyia* Bowerbank).

Cyrilla A. Adams, Ann. Mag. Nat. Hist., 3d Ser., v., p. 477, June, 1860; ix., p. 295, 1862. Journ. de Conchyl., xvi., p. 41, 1868.

In this division of the group the fossette for the ligament has been enlarged and rounded. The space occupied by the anterior cardinal teeth in typical *Pleurodon* has been so encroached upon that these teeth have been more or less absorbed or never developed, while the posterior cardinal teeth, upon which more would depend after the others were gone, have become wider and stronger and extend from the inner to the outer margin of the cardinal plate, being somewhat wedge-shaped in section or wider at the inner edge. In *Cyrilla sulcata* there are six cardinal teeth in the left valve. Of these, one, or possibly two, may have been originally part of the anterior series. All have been more or less modified into closer uniformity with the true posterior series; they no longer form an angle with one another, and the free inner edge of the cardinal plate has disappeared, so that the edge, as it now is, is close to the inner ends of the transverse teeth. The character of the lateral tooth remains much the same as in typical *Pleurodon*.

Cyrilla munita Cpr., from thirty fathoms off Catalina Island, California, shows a further step in modification. The fossette has become still larger, none of the anterior cardinal teeth is left. The four posterior cardinals are of the bent or V-shaped variety, and the cardinal plate and shell have become more solid and heavy, though the shell is smaller than that of *C. sulcata*. The ligament is still wholly internal and the cardinal plate solid and flat. The wing-like expansions of its outer margin, so notable in all the species of *Pleurodon*, are gone. The character of the shell in both sections of the genus is the same, that is, glassy or Leda-like, not nacreous.

In the preceding discussion of the group it will be observed that the differences exhibit a rather gradual modification from some such form as *Nucula* or *Leda*. These small shells, as in the case of the Gastropod *Liotiæ*, show that the line between nacreous and non-nacreous shells is very faintly marked at times, and the difference, in such cases, cannot have much systematic weight. The group in question is composed of small shells, as their relative measurements will show. Thus, in longest diameter we have *Pleurodon ovalis* 1.75, *P. miliaris* 3, *P. Seguenzæ* 5, *P. Woodii* 2.75, *P. Adamsi* 3.25, *Cyrilla sulcata* 2.25, *and Cyrilla munita* 2.12 mm.

The corresponding shorter anteroposterior diameter is for *P. ovalis* 1, *P. miliaris* 2, *P. Seguenzæ* 4; *P. Woodii* 1.75, *P. Adamsi* 2.87, *Cyrilla sulcata* 1.87, and *Cyrilla munita* 1.75 mm.

The form regarded by Mr. Smith as a variety of *P. ovalis* Wood, in a recent state, from the Cape of Good Hope, measures 3.5 mm. high by 2.5 long and 1.75 in transverse diameter. The figure does not show the teeth with sufficient clearness to determine its relations, but knowing the great difficulty of seeing and then representing so minute and complicated a structure, this is not to be wondered at. I have a doubt as to the identity of this species with the Crag fossil, but Mr. Smith's judgment in such a matter is not to be lightly set aside. In this discussion the side of the hinge bearing the lateral teeth has been treated as posterior, thus making the ligament anterior, as in *Cuspidaria*, but I am by no means satisfied that this is the correct view, and should not be surprised if it should be found necessary to reverse these terms when a living specimen shall have been examined. For those who object to the name *Pleurodon* on account of the existence of the prior name *Pleurodonte*, it will be necessary to adopt d'Orbigny's name of *Nuculina* for the genus.

Superfamily ARCACEA.

Family PARALLELODONTIDÆ.

Genus **Cucullæa** Lamarck.

Cucullæa Lam., Syst. des. An., 1801, p. 116; Bosc, Hist. Nat. Coq., iii., p. 121, 1802. Type *C.* (*Arca*) *concamerata* Martini.

Idonearca Conrad, Proc. Acad. Nat. Sci., 2d Ser., vi., p. 289, 1862. Type *I. tippana* Conrad, Cretaceous.

Latiarca Conrad, *op. cit.*, p. 289, 1862. Type *Cucullæa gigantea* Conr., Eocene.

The only general difference between the recent type of Lamarck's genus and the fossils named by Conrad, is that the fossil shells are thicker. For some unknown reason Conrad regarded *Latiarca* as a subgenus of *Trigonarca* Conrad, which appears to be a valid and recognizable group, though perhaps rather close to *Trinacria*.

The genus *Cucullæa* has not been reported from our Post-Eocene horizons. Professor W. B. Clark* has discussed the type species with numerous illustrations. I am inclined to believe that the Eocene of Virginia and Maryland affords two species of *Cucullæa*, *C. gigantea* Conr. (+ *onochela* Rogers) and *C. transversa* Rogers. The latter appears in the Chickasawan (Suessonian) Eocene at Gregg's Landing, Alabama, and may be what Harris (Bull. Pal. No. 4) has called *C. Saffordi* Gabb, which he reports from the Midway. Whether this is correct or not, the Gregg's Landing shells agree exactly with Maryland specimens of the same size. *C. gigantea*, abundant in Maryland, is not recorded authentically from the Gulf States. The differences between these two forms is not confined to aged and young, but is equally marked between adults, though *C. gigantea*, especially, is quite variable. *C. macrodonta* Whitfield appears to be unknown in the northern Eocene, but is abundant in the Lower Eocene of the Gulf States. Its most conspicuous characteristic is the discrepancy between the sculpture of its two valves, which is often very marked. The *Cucullæa levis* Tuomey, from the Eocene of Wilmington, North Carolina, has not been figured or sufficiently described, and must be regarded as a doubtful species.

I have retained *Cucullæa* in a distinct family from *Arca*, not because I

* Bull. U. S. Geol. Survey, No. 141, p. 84, 1896.

think there are probably family differences between the most nearly related recent species of the respective groups, but because some of the best paleontologists regard *Arca* and *Cucullæa* as having reached their present status through very different lines of descent. Doubtless they converge in geological time, but the *Arcidæ* appear to be a relatively very modern group, taken as a whole.

The name *Macrodontidæ* used for this family on pages 516–17 must be dropped, since the generic name *Macrodon* is preoccupied, and *Parallelodon* Meek proposed for the species which the former included; consequently, the family name must also be changed. Further study has also led me to the conclusion that the genus *Cucullaria* Conrad, which is referred to *Macrodontidæ* on page 517, should rather be included with the true Arks, in spite of the fact that the hinge-teeth are arranged with much similarity to those of the Paleozoic group. This similarity is probably only superficial and due to other causes than inheritance from such forms as *Parallelodon.*

Family LIMOPSIDÆ.

Genus **TRINACRIA** C. Mayer.

Trigonocælix Conrad, Am. Journ. Conch., i., p. 12, 1865 (*T. cuneus* Conr.).
Trinacria C. Mayer, Moll. Tert. du Mus. de Zurich, iii., p. 62, 1868.
Trigonocælia Desh., Descr. An. s. Vert. bassin de Paris, i., p. 838, 1860.
Not *Trigonocælia* Nyst and Galiotti, Bull. Acad. Brux., ii., pp. 287, 347, 1835.

This curious little genus is represented in the Clarbornian by *T. cuneus* Conrad (+ *carinifera* Lea), *T. pectuncularis* Lea, and *T. ledoidea* Meyer, which, described from a single worn valve, seems rather close to *pectuncularis.* The name *Trigonocælix,* used by Conrad in his catalogue of Eocene fossils, appears to have been a typographical error; if not it would antedate *Trinacria,* though no diagnosis was given.

Trinacria Meekii n. s.

Plate 32, Figure 17.

Oligocene of the Chipola beds, Chipola River, Calhoun County, and of the Alum Bluff beds, Oak Grove, Santa Rosa County, Florida; Dall and Burns.

Shell small, solid, moderately convex, sculptured only with fine concentric lines; anterior end rounded, posterior somewhat shorter, more pointed; beaks low, with (in the adult) an almost linear depressed amphidetic area, interrupted by an oblique impressed subtriangular ligament pit which, though external, interrupts also the line of teeth; interior smooth, muscular impressions large, not bounded by an elevated line; pallial line slightly indented below the posterior adductor scar; there are about eight anterior and six posterior teeth, small and delicate; basal margin smooth and nearly straight. Lon. 5.5, alt. 3.2, diam. 2.2 mm.

This pretty little species recalls *T. mixta* Mayer and *T. Baudoni* of the Paris basin, but is clearly distinct from either of the American species.

Genus **LIMOPSIS** Sassi.

The genus *Limopsis* is represented in the American Eocene, but, perhaps owing to the fact that they were deposited in comparatively shallow water, the Miocene and Pliocene of the United States have so far yielded no species of this genus. *Limopsis aviculoides* Conr. (+ "*Pectunculus*" *obliquus* Lea) is found in the Claibornian at Claiborne Bluff and Wahtubbee, Mississippi.

The shell figured by Cossmann (Suppl. Greg. Mon., p. 16, pl. 1, figs. 20–21) as *Limopsis perplana* Conr. is distinct from any of the known species of that genus in this formation, especially by its smooth inner margins, and may take the name of *L. Cossmanni*.

Limopsis radiatus Meyer is described by that author from Jackson, Mississippi. It is very close to and doubtless the descendant of the *L. aviculoides*, but has a different sculpture. The latter, according to Gregorio, was referred to *L. nana* Desh. by d'Orbigny, which is an erroneous identification, as pointed out by Cossmann. Bronn did not make it, as erroneously indicated by Gregorio (Mon. Faun. Eoc. Ala., p. 193), nor did Conrad or Heilprin. The typographical errors in Gregorio's work are almost endless, and this appears to be one of them.

In the researches necessitated by the present work I have been obliged to go over this group in the Claibornian, and find the errors so numerous in every author who has treated of them, in spite of some rectifications by Cossmann, that I feel the student will find the results useful, and so include them here. The following groups of species have been referred erroneously to *Limopsis*.

Trigonoarca Conrad, 1867. Type *Cucullæa maconensis* Conr.

This genus, which begins with large species in the Upper Cretaceous, is represented in the Eocene by several small, degenerate forms which have no descendants. They are:

T. ellipsis Lea (Contr. Geol., fig. 56). A good species, not identical with *Pectunculus perplanus* Conr.

T. perplana Conrad (*Limopsis perplanatus* d'Orb.). Very like *declivis*, but more rhomboidal and more flat. It is much larger than *T. ellipsis*.

T. corbuloides Conrad. This species has never been sufficiently described and is unfigured. By some blunder a specimen of *T. declivis* has been mounted as the type of *corbuloides* in the collection of the Academy of Natural Sciences. The descriptions, however, show that this specimen cannot be the original type. If it were, the name *declivis* should be adopted.

T. decisa (Conrad?). The original *decisa* is represented in the Academy's collection by a specimen of *Trinacria pectuncularis* Lea, but this does not agree well with Conrad's figure and brief description. Mr. T. H. Aldrich has obtained some specimens of a Claiborne *Trigonoarca* which agrees much better with Conrad's figure, and is probably the species he had in mind. It appears to be distinct from the others.

T. declivis Conrad. This is the largest Claiborne species and agrees well with Conrad's figure (Journ. Acad. Nat. Sci., 2d Ser., iv., pl. 47, fig. 13) and original description. It appears to be rare. It is not a *Trinacria* nor is it the same as *Pectunculus minor*, as asserted by Conrad and others. It has been collected at Wahtubbee as well as at Claiborne.

The following species belong to *Glycymeris* (= *Pectunculus*) proper:

G. trigonella Conrad (+ *P. deltoideus* Lea). This is very common at Claiborne and varies from trigonal to rounded, and from smooth to radiately ribbed. As the specimens intergrade completely, the mutations can hardly be named varieties. Conrad's name was first printed (Am. Journ. Sci., xxiii., p. 342, Jan., 1833), though he did not figure the species.

G. minor Lea (fig. 54). This species appears to me distinct from *G. trigonella*, to which it is most nearly allied. It differs in shape, is a thinner, wider, and more compressed shell. It reaches a length of nine millimetres, and the inner basal margins are sharply crenulated. Conrad's reference of it to *T. declivis*, as a synonym, is obviously erroneous.

The *Limopsis pectuncularis* (Lea) Conr. is a *Trinacria*, but Cossmann seems to have found a single small valve resembling it which he identifies as an *Arca*, in which case it must belong to a distinct species. Gabb described (1873) a *Limopsis ovalis* from the Tertiary of St. Domingo which is probably Oligocene. It may be the same as *L. subangularis* Guppy, from the Ditrupa bed at Pontapier, Trinidad (Proc. U. S. Nat. Mus., No. 1110, 1896), but Gabb's species is very briefly described and has not been figured. Guppy's shell is also found in the Oligocene marl of Bowden, Jamaica.

Family ARCIDÆ.

Subfamily PECTUNCULINÆ.

Genus **GLYCYMERIS** Da Costa.

Glycymeris Da Costa, Brit. Conch., p. 170, 1778; Humphrey, Mus. Calonnianum, p. 50, 1797. Type *Arca glycymeris* L.

Tuceta Bolten, Mus. Boltenianum, p. 172, 1798; *ibid.*, ed. ii., p. 120, 1819. First species *Arca pilosa* L.

Axinæa + *Axinæoderma*, Poli, Test. utr. Sicil., i., p. 32, 1791, and ii., p. 254, 1795.

Pectunculus Lamarck, Prodr., p. 87, 1799; Hist. An. s. Vert., vi., 1, p. 47, 1819 (not of Da Costa *et al.*). Type *Arca pectunculus* L.

? *Deshagesia* Berge, Conch.-buch, p. 80, pl. x., fig. 9, 1847. (? err. typogr. for *Deshayesia.*)

Not *Glycymeris* Lam. et auct. aliis var.

The history of this name has been detailed under *Nucula* and need not be repeated here.

The Eocene species of the United States comprise, besides *G. minor* and *G. trigonella* Conr., the larger *G. staminea* Conr. (+ *G. Broderipii* Lea), *G. idonea* Conr., all Claibornian, and *G. filosa* Conr., from the Jacksonian. The latter appears to include as synonymes "*Glossus*" *filosus* Conr. (in Wailes's Rep., 1854), *Axinæa filosa* Conr. (Pr. Ac. Nat. Sci., ix., p. 166, 1858), *Axinæa inequistria* and *duplistria* Conr. (Am. J. Conch, i., p. 139, 1865). The two latter names were given to mutations which intergrade completely according to the large series I have studied.

In the Vicksburgian Oligocene *G. arctata* Conr. (1848, of which *Axinæa intercostata* Gabb is a synonym, as well as the unfigured *A. bellasculpta* Conr.), a very variable species, is found. It has been with little warrant united by Gabb with the Cretaceous *G. hamula* Morton of the Prairie Bluff horizon.

The small Vicksburgian *G. mississippiensis* Conr. recalls the rounded form of the Eocene *G. trigonella.*

In the Upper Oligocene of Bowden, Jamaica, is found the well marked *G. acuticostata* Sby., described from St. Domingo, and *G. jamaicensis* Dall. From the same horizon in St. Domingo Gabb has described *G. approximans.*

The Eocene *Pectunculus circulus* Conr. (Mort. App., p. 7) has never been described or figured. An anonymous species from the Midway formation is mentioned by Harris in his monograph of that horizon.

In the Upper Tertiaries of the Pacific coast are a number of ill-defined species. *Pectunculus patulus* Conr. was described (1849, Geol. Wilkes Expl. Exp.) from an internal cast; *P. nitens* Conrad, which follows it, is equally unrecognizable; *G. Kashevarovi* Grewingk (Beitr., p. 352, 1850) is a well marked, strongly ribbed, probably Miocene species from Alaska; *P. barbarensis* Conr. (P. R. R. Rep., vi., p. 314, 1856) is hardly recognizable, and is referred to *P. patulus* by Gabb. There are several Chico-Tejon species. The recent *Axinæa intermedia* of Carpenter has been reported from the Californian Pliocene.

Glycymeris jamaicensis n. s.

Oligocene of the Bowden marl, Jamaica. This species has been referred to *G. pennacea* Lam. by Guppy and Gabb, but appears to be distinct. The specimens I have examined are all of moderate size, nearly circular, quite convex, externally sculptured with fine, even, radiating striæ, impressed at intervals so as to give the effect of obsolete ribs, which are more apparent on the middle of the shell; on the beaks some of the threads are stronger; umbones low and plump; cardinal area impressed, narrow, short, and smooth; teeth small, uninterrupted, about twenty-four in all, the line gently arcuate; inner margin fluted, with a slight insinuation near the base in front. Lon. 35, alt. 33, diam. 22 mm.

Glycymeris pennacea Lamarck.

Pectunculus pennaceus Lam., An. s. Vert., vi., 1, p. 51, 1819; Reeve, Conch. Icon. *Pectunculus,* pl. v., fig. 24, 1843.

Pectunculus carolinianus Conr., Med. Tert. No. 1., cover p. 3, 1839.

Pectunculus carolinensis Conr., Med. Tert., p. 63, pl. 35, fig. 2, 1845; Am. Journ. Sci., xli., p. 346, 1841.

Pectunculus lineatus Heilprin, Trans. Wagner Inst., i., p. 103, 1887; not of Lamarck or Reeve.

Not *P. carolinensis* Holmes, P.-Pl. Fos. S. Car., p. 15, pl. iii., fig. 4, 1860.

Miocene of North Carolina, at Wilmington, Conrad; Pliocene of Dominica, West Indies, Guppy; Pliocene of the Caloosahatchie marl, Heilprin; recent in the West Indies.

This species is easily recognized by its nearly smooth surface and angulated outline. It appears to be rare.

Glycymeris parilis Conrad.

Pectunculus parilis Conr., Proc. Acad. Nat. Sci., i., p. 306, 1843; Med. Tert., p. 64, pl. 36, fig. 2, 1845.

Older Miocene of Maryland at St. Mary's River and Plum Point, Tilghman's Station, Skipton, and Blake's Cliffs; Burns and Harris.

This characteristic species is rarely found in thoroughly good preservation.

Glycymeris lævis Tuomey and Holmes.

Pectunculus lævis T. and H., Pleioc. Fos. S. Car., p. 50, pl. 17, fig. 5, 1857.

Pectunculus virginiæ Wagner (name only) on unpublished pl. 3, fig. 5, *fide* Bronn, Ind. Pal., i., p. 940, 1848; ii., p. 283, 1849.

Miocene of Waccamaw, South Carolina, Tuomey, and of Virginia (Wagner).

This species differs by its smaller size and more wedge-shaped form from *G. parilis*, and from the young of *G. parilis* of the same size by its subtriangular rather than circular outline, absence of any small ribs, and especially by its broader cardinal area and steeply arched line of larger hinge-teeth. Wagner's name, though earlier, was never accompanied by any description. The plates are still in the possession of the Wagner Institute, and have no names engraved upon them, so the name given by Tuomey and Holmes takes precedence. (See Trans. Wagn. Inst., v., p. 11, pl. 3, fig. 5, 1897.)

Glycymeris americana Defrance.

Pectunculus americanus Defr., Dict. Sci. Nat., vol. 39, p. 225, 1829.

P. pulvinatus Conr., Fos. Tert. Form., p. 17, pl. 2, fig. 2, 1832; not of Lamarck.

P. lentiformis Conr., Fos. Tert. Form., 2d edition, p. 36, note, 1837; Med. Tert., No. 3, p. 64, pl. 36, fig. 2, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 48, pl. 17, fig. 2, 1857 (senile stage).

P. tricenarius Conr., Med. Tert., p. 63, pl. 35, fig. 1, 1845 (= immature shell).

P. carolinensis Holmes, P.-Pl. Fos. S. Car., p. 15, pl. 3, fig. 4, 1860.

P. passus Conr., Med. Tert., p. 64, pl. 35, fig. 3, 1845.

P. transversus Tuomey and Holmes, Pleioc. Fos. S. Car., p. 51, pl. 17, fig. 6*c*, 1857; not of Deshayes, 1835, or Dubois; (internal cast of young *passus*.)

P. tumulus Conr., Med. Tert., p. 72, pl. 41, fig. 4, 1845.

P. quinquerugatus Conr., Am. Journ. Sci., xli., p. 346, 1841; Med. Tert., p. 63, pl. 34, fig. 3, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 49, pl. 17, fig. 4, 1857.
P. undatus Dall, Bull. Mus. Comp. Zool., xii., No. 6, 238, 1886, *ex parte*.

Miocene of Jericho, New Jersey; of Calvert and Charles Counties, Maryland; Prince George and Dinwiddie Counties, the banks of the Nansemond River near Suffolk, and on the York River, and Petersburg, Virginia; Wilmington and Cape Fear, North Carolina; Pliocene of the Waccamaw beds, South Carolina, and of the marls of the Caloosahatchie, Florida; living on the southeastern coast of the United States, in fifteen to sixty-five fathoms, from Cape Hatteras to the West Indies.

When I wrote my report on the Blake Pelecypoda, I had not had an opportunity of studying well preserved *G. pennacea*, and was in doubt as to its relations. I also accepted the traditional identifications of the names given by Linnæus, Lamarck, and other early writers to our American species. It would seem that several of these names can never be absolutely determined, and in the present synonymy I have dropped them and adopted the earliest name which unmistakably refers to our shells.

The unusually long synonymy which the present species possesses arises from two causes,—carelessness and ignorance of the changes due to age.

The large *Glycymeris* has two sorts of modifications,—one which is due to variation, and the other correlated with growth and senility.

In the very young shell the surface sculpture is always sparser, more uneven, and sharper; in the adolescent specimen the ribs are usually well marked and extend clear to the base; the teeth are delicate and not interrupted by an invasion of the cardinal area. In the adult this invasion begins, but otherwise the hinge is normal, the ribbing begins to become obscure distally, and the cardinal area enlarges. In the senile shell the cardinal area is very large, only the ends of the arch of teeth remain, and these teeth are usually enlarged; the concentric sculpture, due to intermittent instead of steady marginal growth, becomes conspicuous.

Individuals vary in regard to strength of sculpture and its lateral extension; the two ends of the shell are rarely as clearly ribbed as the middle, and sometimes have no ribs. The size of the hinge-teeth varies considerably between different specimens of the same size of shell; in general a larger cardinal area and greater expansion of the valves near the hinge-line is correlated with larger teeth. Specimens differ in amount of inflation and in outline from nearly circular to transversely oval, and even sometimes a little oblique.

When these two sets of mutations are surperimposed it naturally happens that the extreme instances are quite unlike; without connecting links one would, as Conrad and others have done, suppose them to represent distinct species. A very careful and conscientious scrutiny of a large number of specimens has resulted in the above synonymy. *G. passa* is the normal adult; *G. lentiformis*, the senile adult; *G. tricenaria* is a half-grown, well developed form; *G. carolinensis* Holmes is a variety with feeble ribbing, obsolescent at the ends of the shell; *G. transversa* T. and H. (non Deshayes) is founded on the internal cast of a rather wide young shell; *G. tumulus* Conr. is founded on a rather inflated half-grown specimen. The only form which may possibly be varietal, but which I am inclined to refer to some pathologic cause, is *G. quinquerugata.* This is almost entirely confined to Duplin County, North Carolina. Well-marked specimens have on each dorsal slope, from the beaks laterally, three to six little irregular ripples, which are much more conspicuous in the young. These might indicate the presence of some parasite in the individual. They are never uniform or regular; some specimens have them only on one side, in others they are obsolete, and, finally, others do not have them; and between the normal *americana* and the *quinquerugata* without rugæ there is absolutely no distinction to be made. The recent shell is identical with Miocene specimens and reaches fully as large a size.

The preceding species have more or less distinct radial striation, whether there are ribs or not; in those that follow there is no radial striation but more or less distinct, fine, concentric sculpture and strong radial ribbing.

Glycymeris subovata Say.

Pectunculus subovatus Say, Journ. Acad. Nat. Sci., 1st Ser., iv., p. 140, pl. 10, fig. 4, 1824; Conrad, Fos. Tert. Form., p. 17, pl. 2, fig. 3, 1832; Med. Tert., p. 62, pl. 34, fig. 1, 1845; Emmons, Geol. Rep. N. Car., p. 286, fig. 207, 1858.

G. subovata var. **Tuomeyi** Dall.

Pectunculus subovatus Tuomey and Holmes, Pleioc. Fos. S. Car., p. 47, pl. 17, fig. 1, 1857.

G. subovata var. **plagia** Dall.

Oligocene: Vicksburgian of Martin Station, Florida; Chipolan of Chipola River and Alum Bluff, Calhoun County, and Oak Grove, Santa Rosa County, Florida; Miocene of Walton County, Florida; of Dargan Point and Darlington, South Carolina; of Duplin County, Edgecombe County, Green County, and Wilmington, North Carolina; of Grove Wharf, James River, Bellefield, Yorktown, and other points on the York River and on the Eastern Shore of Virginia, and Davis's Mill, Choptank River, Maryland.

Variety *plagia* Dall, Edgecombe County, North Carolina.

Variety *Tuomeyi* Dall, Petersburg, City Point on James River, and near Suffolk, Nansemond River, Virginia.

Shell asymmetrically developed, inequilateral, the impressed lines more or less arcuate and obsolete on the produced anterior side.

This species is the oldest of those which reach the Upper Miocene. The Chipola specimens are slightly smaller than the average Miocene shell, but this may be an accident of collecting; otherwise they agree very well with Miocene specimens.

The normal adult is subcircular, with radiating impressed lines, the interspaces being gently rounded and rather wide. The grooves are closer at the ends of the shell and the interspaces less rounded. In the young the shell seems to have close-set rounded ribs; in senile specimens the radial grooves are obsolete towards the base. The principal mutations of the normal adult are greater or less prominence of the rounded interspaces, greater persistence distally of the grooves, and smaller or larger, sparser or more crowded, hinge-teeth and areal grooving.

In the variety *Tuomeyi* the alternate interspaces are not rounded but flat, forming channelled spaces, subequal to and between the ribs, which are often more or less flattened on top and obsolete distally.

In the variety *plagia* the shell is obliquely produced with the grooves obsolete laterally.

The Oak Grove series contains many specimens in which intercalary incised lines appear on the rounded interspaces distally and the lines are much crowded at the ends of the shell. An occasional specimen turns up where the whole shell is nearly smooth, the incised lines being obsolete. In this state it is much like *G. lævis* T. and H. externally, but larger and more rounded dorsally.

Glycymeris pectinata Gmelin.

Arca pectinata Gmel., Syst. Nat., vi., p. 3313, 1792.

Pectunculus aratus Conr., Am. Journ. Sci., xli., p. 346, 1841 ; Med. Tert., p. 62, pl. 34, fig. 2, 1845 ; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 50, pl. 17, fig. 6, 1857.

Pectunculus pectiniformis Orb., Moll. Cuba, ii., p. 313, 1853 ; not of Lamarck.

Pectunculus charlestonensis Holmes, P.-Pl. Fos. S. Car., p. 16, pl. 3, fig. 5, 1860.

Pectunculus pectinatus Dall, Bull. Mus. Comp. Zool., xii., No. 6, p. 239, 1886.

Miocene of Wilmington, Cape Fear, and Duplin County, North Carolina; Pliocene of the Waccamaw beds, South Carolina, and of the marls of the Caloosahatchie and Shell Creek, Florida. Recent, in two to one hundred and seventy-five fathoms, from the vicinity of Cape Hatteras, North Carolina, to the West Indies, Nicaragua, and Barbadoes.

The differences upon which Conrad founded his species *aratus* are such as may be observed in any large series of the recent *pectinatus*. The ribs vary from twenty to forty in number, very greatly in prominency and adjacency, and the incremental lines from obscure to sublamellose. The truncation varies in amount and sharpness. In a variety *carinata*, the ribs, instead of being rounded, are more or less carinate, like those of *acuticostata*. All the differences of the fossils can be paralleled in the recent shells.

Glycymeris duplinensis n. s.

PLATE 34, FIGURES 6, 7.

Miocene of the Natural Well and Magnolia, Duplin County, North Carolina; Burns.

Shell small, rounded-triangular, solid, moderately convex, with pointed, small, low beaks and a flattened lunular area; sculpture of strong, distally bifurcated radial ribs, separated by slightly narrower channelled interspaces; nine anterior and nine posterior ribs on the lateral slopes are smaller, while on the middle of the shell are about ten larger ribs; transverse sculpture of regularly spaced, elevated concentric lines overrunning the whole shell; cardinal area small and short, with three or four concentric angular grooves; teeth small, vertically striated, six or seven on each side, the line strongly arched and uninterrupted; anterior margin straight, base rounded, posterior slightly arcuate; basal inner margin with about ten flutings. Largest valve, lon. 9, alt. 10, diam. 6.5 mm.

This pretty little species is readily distinguished from any of the varieties of *G. pectinata* by its bifurcated and prettily sculptured ribs. It seems to be rather abundant at the locality mentioned.

Subfamily **ARCINÆ.**

Genus **ARCA** (Linné) Lamarck.

Arca (L.) Lamarck, Prodrome, p. 87, 1799. Type *A. noæ* Linné.

In the selection of the "Noah's Ark Shell" as the type of the restricted genus, Lamarck followed the ancient usage and continuous practice of naturalists. Bruguière placed this species first in his list in 1789. Poli, who did not adopt the Linnean nomenclature but had two genera, one for the shell and one for the soft parts, called it *Daphne* and *Daphneoderma* in 1795. In 1835 Swainson gave it the name of *Byssoarca;* it was included in his section *Les navicules* by Blainville in 1825, though he did not name it *Navicula*, as sometimes stated. *Cyphoxis* Rafinesque, 1819, was probably intended to cover fossil species of this type, but as no described species were referred to it, it remains unrecognizable; *Thyas* Gray (Figures of Moll. An., v., p. 24, pl. 358, fig. 4, 1857) is another synonyme, but the name was used for another group in 1835; Browne was not a binomial writer, and his *Cibota*, used by Mörch in 1852, also falls into synonymy. Lastly, *Arcoptera* Heilprin, based on the following species, does not present, when a large series is compared, any constant characters which would separate it from the restricted genus *Arca*.

Before proceeding to describe the species collected it is necessary to review the nomenclature and settle on the characters of the subdivisions to be adopted. This has been a work of considerable labor; the inaccuracy of the diagnostic characters given in the text-books is so astonishing, when they are compared with a series of the species, that one is tempted to believe such diagnoses are written without any reference to specimens or, at best, with only a single specimen for comparison. The examination of over one hundred species of fossils and a majority of the known recent species of *Arca* has entirely confirmed the opinion expressed by several authors, that a gradual transition may be traced between the groups which have been described as genera and subgenera with extremely few exceptions.

Subgenus BARBATIA (Gray) Adams.

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

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

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

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

Group of *A. propatula* Conrad (*Granoarca* Conrad, 1862) = *A. hians* Tuomey and Holmes, 1855, not of Brown, 1842; nor of Reeve (? = *A. protracta* Rogers, 1837, not of Conrad, 1847). Miocene.

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

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

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

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

In the Barbatias as well as in *Glycymeris* (*Pectunculus* auct.) the growth of the shell often results in a greater or less absorption of the middle part of the series of teeth; the distal teeth are always more or less oblique, especially those behind the beaks. In *Cucullaria* the latter are almost, if not quite,

* *Plagiarca* is based on *Barbatia carolinensis* Conrad, 1875 (Ripley beds of North Carolina), not *Arca carolinensis* Wagner, 1847, nor *A.* (*Noëtia*) *carolinensis* Conrad of 1862. *Polynema* Conrad (Kerr. Geol. Rep. N. Car., 1875, App. A., p. 4), based on *Barbatia lintea* Conrad, 1875 (not *Arca lintea* Conrad, Dead Sea Expedition, 1852), does not appear to differ from *Plagiarca* or *Calloarca* in any characters of importance. The name *Polynema* is, at any rate, preoccupied in Entomology since 1833. *Navicula aspersa* Conrad and *Barbatia aspersa* Conrad, 1855 (not of Philippi, 1836), are synonymes of *A. cuculloides.*

parallel with the hinge-line. Consequently, it may follow that in the process of growth the same individual may at an early stage have a series of vertical median denticles, and at a later stage may present a hiatus destitute of teeth between the anterior and posterior parts of the series. Judging from the species I have been able to examine, the entire narrow cardinal area is originally covered by the ligament, but the grooves containing the resilium extend very obliquely backward from the beaks, as in typical *Acar*. Notwithstanding the resemblance of the hinge in these Tertiary and recent species to that of the Paleozoic and early Mesozoic *Parallelodon*, I am of the opinion that the relations of the former are really closer with the true Arks, and that the similarities will prove to be analogical rather than homologous. The recent abyssal species I have formerly referred to *Macrodon* should probably be grouped under *Cucullaria*.

Verrill has recently proposed to separate generically the above-mentioned recent species from forms like *A. heterodonta* Desh., the type of *Cucullaria*, and to call them *Bentharca*. The degree of inclination of the anterior teeth in these shells is hardly more than a specific character in my opinion, differing but slightly between many of the species, though the extremes of the series, taken alone, differ widely.

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

Umbones nearly terminal, equivalve, hinge-line arched with an edentulous hiatus in the middle, sculpture concentric, area lineal, with a central very small ligament. This occupies to *Barbatia* much such a relation as *Bathyarca* does to *Scapharca*.

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

A small group of thin shells with a long, straight hinge-line and many small similar teeth, the valves more or less spirally twisted. The latter character is not particularly valuable in classification, but the group is easily recognized.

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

Small, keeled, smooth externally, inhabiting Indian River. The soft parts do not appear to have been studied.

Subgenus NOËTIA Gray.

Noëtia Gray, Syn. Cont. Brit. Mus., 1840; Agassiz Nomenclator, Mollusca, 1842. Type *Arca reversa* Gray.

Shell equivalve, inequilateral; the beaks anterior, opisthogyrate, rather adjacent; ligament transversely grooved, lozenge shaped, not occupying the whole cardinal area; posterior slope of the valves usually longer, subtruncate, or bounded on either side by an umbonal keel or ray; tooth-line rather long, terminal teeth often Λ-shaped.

This group is American and Indo-Pacific in its recent distribution; the known fossils are all American. Besides those enumerated in this paper, Guppy has described from Trinidad *Arca trinitaria* (Manzanilla) and *A. centrota* (Matura), both of which belong to this group. The former might pass for an ancestor of the (now Pacific) *A. reversa*, while *A. centrota*, probably a Miocene species, offers a diminutive facsimile of *A. limula*. *Arca trapezia* Desh., from West Mexico, and *A. Martinii* Recluz, 1852, from Santa Caterina, Brazil, belong to this group. The latter is probably the shell living in the Gulf of Paria, which Guppy has referred to his *A. centrota*. They are very similar, and the living shell may perhaps be the unfigured *A. bisulcata* of Lamarck. The name *Arca Martinii* is preoccupied by Bolten, and must be dropped. *A. hemicardium* Koch, as figured by Philippi, also belongs here.

This subgenus is intermediate between the typical Arks and *Scapharca*. The original type has the anterior side of the shell longer and the posterior side short and truncate, but in *N. ponderosa* the two sides of the hinge are subequal, and in the fossils the posterior side is much longer than the anterior. The definition in the text-books, drawn from *A. reversa*, must therefore be materially modified to be true of the very natural group to which it belongs.

Subgenus SCAPHARCA (Gray) Dall.

Scapharca Gray, P. Z. S., 1847, p. 206; H. and A. Adams, Gen. Rec. Moll., ii., p. 537, 1858. Type; *A. inequivalvis* Brug.

It is a matter of some difficulty to decide which of the various names bestowed at various times by Gray should be regarded as most inclusive and predominate in the necessary consolidation of the group. The names *Senilia, Argina, Lunarca* (and, according to Agassiz, *Noëtia*, though Gray does not mention it in his list of 1847) appeared first without diagnosis or figures in the little manual entitled "Synopsis of the Contents of the British Museum," prepared for the use of visitors to that institution. According to the rules of nomenclature, these names were not fully established either by their nude insertion in this list or in that of the synonymy of 1847. The latter contained, in addition, *Anadara* Gray for *A. antiquata* and *Scapharca* for *A. inequivalvis*, neither of which were defined. So far as I have been able to discover, the proper definition of all these names was first made in Adams's Genera in 1858, so that as regards priority all stand on a practically equal footing. *Anadara* was not adopted by the Adams brothers, who placed it in the synonymy of an unacceptable polynomial of Klein, and of all the names *Scapharca*, as used by Adams, comprises by far the larger number of species. I have therefore decided to adopt it in a subgeneric sense, reducing the less tenable names to sectional rank. As thus understood, *Scapharca* comprises the following groups or sections:

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

Heavy, trigonal, equivalve, with a short furrowed area; beaks prosogyrate; with a smooth epidermis; with the hinge-teeth separated by a sinus into two straight subequal short series; both valves similarly sculptured; inhabiting brackish water.

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

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

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

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

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

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

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

Shell heavy, trigonal or oblong, inflated, with prosocœlous beaks, with a wide area wholly covered by the ligament and usually with numerous furrows for the resilium forming concentric lozenges; teeth similar, in a long, uninterrupted series, slightly larger and more oblique distally; valves equal and similarly sculptured; epidermis usually pilose and profuse.

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

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

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

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

Subgenus LUNARCA (Gray) Adams.

Lunarca (Gray, 1840) H. and A. Adams, Gen. Rec. Moll., ii., p. 541, 1858.

The only species known, *L. costata* Gray, is not unlike *Argina*, but has no anterior taxodont teeth. These are replaced by a single, large, horizontal tooth in the right valve, fitting into a socket in the left valve, forming a remarkable exception to the usual rule in this family.

In a manuscript of Stimpson's in my custody he queries whether this shell is not a monstrous malformation of a specimen of *Argina*. I have never seen a specimen and have never been able to purchase one from any dealer, so I am unable to express a valuable opinion on this point, but perhaps the question is worth investigation.

In the descriptions of the species which follow, for convenience of recognition the subgeneric name followed by the sectional name in parentheses will introduce the paragraphs relating to each form.

Arca Wagneriana Dall.

PLATE 39, FIGURES 6, 7.

Arca (*Arcoptera*) *aviculæformis* Heilprin, Trans. Wagner Free Inst. Sci., i., p. 98, pl. 13, figs. 32, 32 *a*, 1886.

Not *Arca aviculæformis* Nyst, Tabl. Synopt., p. 12, 1848; = *Arca aviculoides* Reeve, 1844, not of De Koninck, 1844.
Arcoptera aviculæformis Harris, in Dana, Man. Geol., 4th ed., p. 900, fig. 1510, 1895.

Pliocene marls of the Caloosahatchie, Shell Creek, and Myakka River; Heilprin, Willcox, and Dall.

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

Arca occidentalis Philippi.

Arca occidentalis Phil., Abbild. u. Beschr., iii., p. 14, pl. xvii. *b*, fig. 4 *a–c*, 1847.
Arca zebra Swainson, Zool. Ill., No. 26, pl. 118, 1831; *ex parte*.
Arca noæ of many authors, not of Linné.

Oligocene of the Bowden beds, Jamaica, Guppy, Henderson, and Simpson; Miocene (?) of Curaçao, U. S. Fish Commission; Pliocene of the Caloosahatchie marls, Florida, Dall; Pleistocene of the Florida Keys, Yucatan, and most of the West Indian Islands; recent in the Antilles generally, and along the eastern coast of the United States northward to the vicinity of Cape Hatteras, North Carolina.

A careful comparison shows that the American shell should not be united with the Mediterranean *A. noæ*. The restricted *A. zebra*, according to Swainson, comes from the Mediterranean, but Reeve refers it to Manila. The west American recent analogue appears distinct. Although in taking up the species I doubted if the Bowden fossil could be the same as the recent shell, I am obliged after careful comparisons to regard them as identical. The species is very rare in the Caloosahatchie marls, and only represented in my collection from them by a few young valves.

Arca umbonata Lamarck.

PLATE 38, FIGURES 4, 4 *a*.

Arca umbonata Lam., An. s. Vert., vi., p. 37, 1819; *ibid.*, 2d ed., vi., p. 432, 1835 (syn. partim excl.); Philippi, Abbild. u. Beschr., iii., p. 13, pl. xvii. *b*, fig. 3 *a–c*, 1847.
Arca noæ Stimpson, S. I. Checklist, E. Am. Mar. Shells, p. 2, 1860.

Arca imbricata (Brug.) Dall, Bull. U. S. Nat. Mus., No. 37, p. 40, 1889; Heilprin, Trans. Wagner Inst., i., p. 118, 1887.
Arca Listeri (Tryon) Heilprin, Trans. Wagner Inst., i., p. 118, 1887.
Barbatia Bonaczyi Gabb, Geol. San Domingo, p. 254, 1873.

Oligocene of the Chipola beds, Calhoun County, Florida; of the Ballast Point silex beds, Tampa Bay, Florida; of the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida. Also in the Pleistocene of the Florida Keys and the Antilles, and living from Cape Hatteras, North Carolina, south to Santa Caterina, Brazil, and throughout the Antilles.

Like all the group, this nestling species is variable in form according to its station, but I have been unable to find any characters to separate the fossil and recent shells when allowance is made for the deformations alluded to. It may be distinguished from *A. aquila* Heilprin by the less alate anterior end and smoother ribs, otherwise they are closely allied. The name *imbricata*, cited as of Bruguière, is somewhat doubtfully applicable to this shell, and no diagnosis was given in the Encyclopédie Methodique. It probably retreated to warmer waters during the Miocene invasion of Florida and did not succeed in returning until the end of the Pliocene, as it has not turned up in the Caloosahatchie marls. The form doubtfully identified by Professor Heilprin with *A. Listeri* is connected by a fuller series with the others.

Arca aquila Heilprin.

PLATE 31, FIGURE 12.

Arca aquila Heilprin, Trans. Wagner Inst., i., p. 97, pl. 12, fig. 31, 1887.

Pliocene marls of the Caloosahatchie River, Florida; Willcox and Dall.

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

Arca paratina n. s.

PLATE 33, FIGURE 14.

? = *A.* (*Byssoarca*) *protracta* Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 126, pl. 13, fig. 36, 1848 (not of Rogers, 1837) = *subprotracta* Heilprin, 1881.

Oligocene of the Chipola beds on the Chipola River, and of the lower bed at Alum Bluff, Calhoun County, Florida; Dall and Burns.

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

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

Arca hatchetigbeensis Harris from the Lignitic or Chickasawan stage is shorter and more finely sculptured, though closely related.

Arca bowdeniana n. s.

PLATE 33, FIGURE 12.

Oligocene of the Bowden beds, Jamaica, and Pliocene of Limon, Costa Rica; Bland, Henderson, and others.

Shell small, inflated, somewhat irregular, very inequilateral, the beaks almost posterior; dorsal slope conspicuous; its outer border with a stout keel and its surface somewhat excavated; beaks small, pointed, prosogyrate; cardinal area wide, lozenge-shaped, flattish, with a few grooves for the resilium forming a smaller lozenge near the beaks; sculpture as in *A. umbonata*, the imbrications close and subnodulous; shell not alate in front and with the anterior margin nearly vertical from the hinge-line; posterior end obliquely truncate, the basal angle most extended, the dorsal one forming nearly a right angle; anterior teeth ten, posterior twenty-seven, with no noticeable hiatus in the line, the teeth resembling those of *A. paratina* but proportionally larger; interior smooth, the posterior end with a few flutings, the rest of the margin entire; the byssal foramen narrow and its margins encroaching only moderately on the valves. Lon. 15, alt. of hinge-line 6, of beaks 8, diam. (greatest posteriorly) 9 mm.

This odd little shell is peculiar in being narrower near the very anterior beaks and widest about the middle of the posterior slope. It appears to be easily discriminated from the other species of this variable group known to the region.

Subgenus BARBATIA (Gray) Adams.

Section *Calloarca* Gray.

Barbatia (Calloarca) marylandica Conrad.

Byssoarca marylandica Conrad, Fos. Medial Tert., p. 54, pl. 29, fig. 1, 1840.
Barbatia marylandica Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 580, 1863.

Oligocene of the Ballast Point silex beds, Tampa Bay, the lower (Chipola) bed at Alum Bluff, the Chipola marl of the Chipola River, Florida; older Miocene of Jericho, Cumberland County, New Jersey; Middle Miocene of Plum Point, Calvert Cliffs, and Centreville, Maryland; Willcox, Burns, Dall, and Harris. Possibly also in the Jacksonian.

Careful comparisons of typical material show no specific differences between the Miocene and Oligocene shells.

Barbatia (Calloarca) irregularis n. s.

Plate 33, Figure 5.

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

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

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

Barbatia (Calloarca) arcula Heilprin.

PLATE 33, FIGURE 4.

Arca arcula Heilprin, Trans. Wagner Inst., i., p. 118, pl. 16, fig. 65, 1887.

Oligocene of the Ballast Point silex beds, Tampa Bay, Florida; Willcox.

Shell subovate, thin, inflated, the beaks low and prosogyrous; the cardinal area narrow and very closely and minutely furrowed longitudinally, the furrows showing a slight angle behind the beaks; sculpture of close set, fine radial ribs, rather regularly imbricated at successive lines of growth; on the posterior dorsal slope are six or eight nodulous larger ribs; the beaks are situated a little behind the anterior third; byssal foramen narrow, very anterior; hinge with a few large Λ-shaped teeth at the ends, the middle teeth vertical, small, or even obsolete mesially; margins of the valve slightly or not at all crenulated by the sculpture. Length of shell 47, of hinge-line 30, height 31, diameter 26 mm.

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

Barbatia (Calloarca) cuculloides Conrad.

Arca cuculloides Conr., Fos. Tert. Form., No. 3, p. 37 (not fig'd), 1833.

Byssoarca lima Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 125, pl. 13, fig. 23, 1848; not *Barbatia lima* Rve., P. Z. S., 1844.

Cucullæarca lima et cuculloides Conr., Am. Journ. Conch., i., p. 11, 1865.

Navicula aspersa Conr., Wailes, Agr. and Geol. Mississippi, p. 289, pl. 14, fig. 5 (young shell), 1855.

Navicula aspera Conr., Proc. Acad. Nat. Sci. Phila., vii., p. 258, 1855; not *Arca aspera* Phil., Moll. Sicil., 1836.

Upper Eocene (Jacksonian) near Claiborne, Alabama; Jackson, Mississippi; Cleve County, Arkansas; and in the Lower Oligocene at Vicksburg, Mississippi.

This fine shell was separated from the true Arks by Conrad because in the fully adult specimens the distal teeth are usually (though not invariably) broken up into granular parts. This character occurs occasionally in individuals or particular species in most groups of the genus *Arca* and is too mutable to be taken as a basis for a genus. The other Vicksburg species, *Barbatia mississippiensis* Conr. (*op. cit.*, 1848, p. 125, pl. 13, fig. 32), is distinguished from *A. cuculloides* by its smaller size, finer sculpture, and the absence of any radial ridges setting off a posterior area as in the latter species. These ridges are very strong in the young, in which also the distal teeth are entire, giving the young shell such a different aspect that Conrad described it as a distinct species. Conrad described another *Arca*, belonging to the section *Scapharca*, under the specific name of *mississippiensis*, in the same paper (p. 125, pl. 13, figs. 11, 15), which appears to be that figured by Lesueur in his Walnut Hills Fossils, pl. 5, fig. 8, 1829. This species may take the name of *A.* (*Scapharca*) *Lesueuri.* The *Barbatia mississippiensis* was also well figured by Lesueur on the same plate, figure 9.

The *Arca rhomboidella* Lea, Contr. Geol., p. 74, pl. 2, fig. 52, from the Claibornian appears to be referable to *Scapharca.* We have it also from Lisbon, Alabama, the Eocene of Orangeburg, South Carolina, and according to Haldeman from the Eocene of Virginia, the exact locality not being recorded on the label. I suppose it must have been through an accidental confusion that Cossmann came to identify *B. cuculloides* with this species. Omitting to notice that Conrad described his shell as two and a half inches long, Gregorio (*op. cit.*, pl. xxiv., figs. 17–20) has figured a specimen of *A. rhomboidella* three millimetres long as *A. cuculloides* Conrad. It seems singular that he should not have noticed its practical identity with the figure of Lea which he reproduces on the same plate (fig. 28). Cossmann has very properly united the two, though he did not see that neither represented *A. cuculloides* of Conrad. Gregorio's figure very fairly represents *A. rhomboidella*, which, however, reaches a length of over twenty millimetres in the adult state. It is possible it may be a *Barbatia*, to which group I at first referred it, but after a complete study of all our fossil Tertiary species I concluded it would best be referred to *Scapharca*.

Barbatia (Calloarca) phalacra n. s.

PLATE 33, FIGURE 3.

Oligocene of the Chipola marls, Chipola River, and of the Oak Grove sands, Florida; Burns.

Shell thin, moderately convex, equivalve, inequilateral; the prosogyrate beaks within the anterior fourth low and somewhat compressed; sculpture of very numerous fine, even, mostly dichotomous riblets without nodules or reticulation over the whole shell, crossed only by feeble incremental lines; cardinal area very narrow with a few longitudinal grooves; hinge-teeth small, short, and vertical mesially without any gap in the series, distally longer, larger, and more oblique; hinge-line $\frac{14}{23}$ of the whole length; internal margin of the valves smooth, byssal gape inconspicuous. Lon. 23.5, alt. 11, diam. 9 mm.

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

Barbatia (Calloarca) candida Gmelin.

Arca candida Helblingi, Chemnitz, vii., p. 195, pl. 55, fig. 542.
Arca candida Gmelin, Syst. Nat., vi., p. 3311, 1792.
Arca Helblingii Bruguière, Ency. Meth., p. 195, 1797.
Arca jamaicensis Gmelin, Syst. Nat., vi., p. 3312, 1792.

Oligocene of the Bowden beds, Jamaica, of the Chipola beds at Alum Bluff and on the Chipola River, Florida; Pliocene of Trinidad; Pleistocene of the Antilles generally, and recent from Cape Hatteras, North Carolina, to Brazil at Santa Caterina, and possibly the African coast.

The fossils show no diagnostic features by which I can separate them from the recent shells.

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

Another species which seems distinct is represented in the collection by a number of young valves from the Oligocene of Bowden.

Section *Granoarca* Conrad.

Barbatia (Granoarca) propatula Conrad.

Arca propatula Conr., Proc. Acad. Nat. Sci. Phila., i., p. 323, Dec., 1843; Fos. Med. Tert., p. 61, pl. 32, fig. 1, Jan., 1845.

Arca hians Tuomey and Holmes, Pleioc. Fos. S. Car., p. 34, pl. 14, figs. 4, 5, 1855, not of Bronn, 1842, or Reeve, 1844.

Granoarca propatula Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 580, 1863.

Miocene of Virginia, on the James River below City Point, Petersburg, and on the Ware River, Gloucester County, Conrad, Tuomey, and Ruffin; Darlington, South Carolina, Burns; Sumter District, South Carolina, Tuomey.

The differences separating Conrad's shell from Tuomey's are merely individual mutations. The section was established by Conrad on account of the granular breaking up of the distal teeth, a feature of little systematic value. It may be retained, if at all, for Barbatias of elongate form, mesially compressed, with coarse even ribbing, not reticulated, and a very narrow byssal gape. *Arca protracta* Rogers (Trans. Am. Phil. Soc., v., p. 332, 1835, and vi., pl. 26, fig. 5, 1839) from the Miocene of Prince George County, Virginia, probably belongs to the same section, but I have not seen a specimen. This must not be confounded with *Arca protracta* Conr. from the Vicksburgian described in 1848, which is a typical *Arca* and will take the name of *Arca subprotracta* Heilprin. Hon. T. H. Aldrich reports it from the Eocene.

A. protracta Rogers is figured as having quite regular and rather small teeth, which may be partly due to the influence of age, the type having been evidently a very old specimen. It seems to be rare, and I have never been able to examine a specimen.

Barbatia (Granoarca) virginiæ Wagner.

Plate 32, Figure 23.

Arca virginiæ W. Wagner, Trans. Wagner Inst., v., pl. 1, fig. 3; Bronn, Index Pal. Nomencl., p. 99, 1848; Syst., p. 283, 1849.

Miocene of Virginia; Wagner (Nansemond River?).

The founder of the Wagner Institute, Professor William Wagner, in the early thirties made some paleontological collections in Virginia and the adjacent parts of North Carolina. Some of the species appeared to be new and were named and figured by Professor Wagner, who had three fairly good lithographic plates prepared, of which a certain number were distributed. In Bronn's Index Paleontologicus Wagner's names are catalogued and the plate references given. A large number of copies of the prints and some of the original type specimens are still in existence and in the possession of the Wagner Institute. Among them are two Arcas, both of which appear to be good species, not otherwise named, and which will be included in this paper.

Arca virginiæ is a large, solid, elongated shell, equivalve but very inequilateral, the beaks being situated near the anterior fifth of the length, low and prosogyrate, distant, and separated by a wide cardinal area with numerous (nine) slightly angular longitudinal concentric grooves; sculpture of about twenty-five strong radial ribs, smaller on the posterior dorsal area, somewhat flattened, and on the posterior part with a shallow, wide mesial furrow; hinge-line $\frac{11}{17}$ as long as the shell; teeth vertical, in two series, beginning mesially very small, distally larger, and with a tendency to break up or become irregular; muscular impressions deep; margin fluted in harmony with the ends of the ribs. Lon. 83, alt. 52, diam. 42 mm.

This shell is about midway in its characters between *Barbatia* (*Granoarca*), *Anadara*, and *Scapharca*, illustrating very well the manner in which the subordinate groups of the genus *Arca* intergrade. It seems quite surprising that so large and conspicuous a shell should not have been collected and described by other paleontologists.

Section *Striarca* Conrad.

Barbatia (Striarca) centenaria Say.

Arca centenaria Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 138, pl. 10, fig. 2, 1824.

Striarca centenaria Say, Proc. Acad. Nat. Sci. Phila. for 1862, p. 580, 1863.

Older Miocene of Jericho, Cumberland County, New Jersey, and in the Virginia Miocene at Coggin's Point, Petersburg, Grove Wharf, on the James River, and the Miocene beds of the York River; Burns and others.

This is a remarkably characteristic shell, and I believe has no synonymes. The erosion which acts upon fossils has in nearly all cases hollowed out the teeth, so that they look as if naturally grooved or hollow, and in the examination of many specimens only one or two were found in which any large number of the teeth were intact. Conrad seems to have supposed that this condition of the teeth was normal, but I regard it as a phenomenon of erosion merely, and have noticed similar excavations in the teeth of other species.

Section *Acar* Gray.

Barbatia (Acar) reticulata Gmelin.

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

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

Arca squamosa, domingensis et clathrata Lam., An. s. Vert., vi., pp. 35, 40, and 46, 1819.

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

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

Eocene of the Jacksonian at Moody's Branch, Jackson, Mississippi; Oligocene of the Bowden beds, Jamaica; Matura, Trinidad; of the Tampa silex beds at Ballast Point, Florida, and on the Chipola River; Pliocene of Limon, Costa Rica, and of the Caloosahatchie marls; Pleistocene of the Antilles generally; and recent from Cape Hatteras to Barbadoes and the Gulf of Campeachy.

The fossils are identical with the recent shells in every particular, and there can be no doubt that this species has existed continuously in the Antillean region since the Upper Eocene.

Section *Fossularca* Cossmann.

Barbatia (Fossularca) Adamsi (Shuttleworth) Smith.

Arca cœlata Conrad, Fos. Medial Tert., p. 61, pl. 32, fig. 2, 1845; not of Reeve, Conch. Icon., 1844.

Arca lactea C. B. Adams, not of Linné.

Arca Adamsi Shuttlew. (MS.), Smith, Jour. Lin. Soc. Zool., vol. xx., p. 499, pl. 30, figs. 6, 6*a*, 1888. Dall, Bull. Mus. Comp. Zool., xii., p. 243, 1886.

Oligocene of the Bowden beds, Jamaica, of the Chipola River and Oak Grove, Florida; Miocene of Duplin County, North Carolina; Pliocene marls of the Caloosahatchie, Shell Creek, and Alligator Creek, Florida, and the Waccamaw River, South Carolina. Recent, with a range from Cape Hatteras, North Carolina, to the island Fernando Noronha, on the coast of Brazil, in five to one hundred and sixteen fathoms.

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

Barbatia (Fossularca?) ovalina n. s.

PLATE 32, FIGURE 18.

Oligocene marl of Bowden, Jamaica; rare; Henderson and Simpson.

Shell minute, solid, ovate, with rather inflated valves; beaks low in the anterior fourth, prosogyrate; cardinal area short, narrow, smooth, or longitudinally striate, the part occupied by the ligament forming a small excavated triangle with the apex at the beak in each valve; surface nearly smooth, sculpture of faint, irregular, concentric lines, crossed by still fainter sparse radiations which are not pronounced enough to modify the surface; inner margin of valves smooth; muscular impressions large; hinge short with about three crowded anterior and four oblique posterior teeth, the two series separated by a wide gap below the ligament. Lon. 3.2, alt. 2.5, diam. 2 mm.

A single specimen of this curious little shell, with the form of a *Nucula*, the cardinal margin of a *Limopsis*, and the teeth of an *Arca*, was found in the marl. It should, perhaps, be referred to *Lissarca* Smith.

Section *Cucullaria* Conrad.

Barbatia (Cucullaria) Aldrichi n. s.

PLATE 32, FIGURE 19.

Claiborne sands, Claiborne, Alabama; Burns.

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

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

Barbatia (Cucullaria) tæniata n. s.

PLATE 25, FIGURE 1, 1 *a*.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox, and of the Croatan beds of North Carolina, at Mrs. Guion's marl pit, C. W. Johnson.

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

Subgenus NOËTIA Gray.

Arca (Noëtia) limula Conrad.

PLATE 31, FIGURES 14, 14 *b*.

Arca limula Conr., Fos. Tert. Form., p. 15, pl. 1, fig. 1, 1832. New Berne, North Carolina.

Miocene: North Carolina, at Wilmington, New Berne; Virginia, at various points on the York and James Rivers; also in Maryland and South Carolina, and at Heislerville, Cumberland County, New Jersey. Pliocene: De Leon Springs, Florida, Wright; in the marls of the Caloosahatchie and

Shell Creek, Willcox and Dall; near Brunswick, Georgia, Couper; Waccamaw beds, South Carolina, C. W. Johnson.

Arca limula var. **platyura** Dall.

Pliocene of the Caloosahatchie and Alligator Creek; Willcox and Dall.

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

Arca limula var. **filosa** Conrad.

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

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

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

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

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

Arca limula is, with little doubt, the progenitor of *A. ponderosa* Say, from which it differs by a more quadrate outline and more anterior beaks. The sculpture is usually more elegant, but specimens of *A. ponderosa* occasionally turn up which exhibit equally fine reticulation and divarication of the ribs. A variety analogous to *platyura* is possessed by all the species of *Noëtia*, but is perhaps more conspicuous in *A. limula*. I have not found this species in any positively Post-Pliocene beds; in such it is represented by *A. ponderosa*.

From *A. incile*, when adult, *A. limula* is distinguished by its smaller and shorter cardinal area and usually by its considerably larger size; the line of teeth is shorter and the teeth are larger and wider, and more horizontally extended at the ends of the series.

Arca (Noëtia) incile Say.

Arca incile Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 139, pl. 10, fig. 3, 1824. Miocene of Maryland. Conr., Fos. Tert. Form., p. 16, pl. 2, fig. 1, 1832; Fos. Medial Tert., p. 56, pl. 29, fig. 5, 1840. James River and Smithfield, Virginia.

Noëtia protexta Conr., Kerr's Geol. Rep. N. Car., App. A, p. 19, pl. 3, fig. 5, 1875. Miocene of North Carolina.

Miocene of Maryland, Virginia, and North Carolina, Say and Conrad; near Darlington, South Carolina, at various points near and at the Natural Well, Duplin County, North Carolina; Petersburg, Dinwiddie, York River, and borders of the Dismal Swamp, Virginia, and Choptank, Maryland, Harris, Burns, and others.

There can be no doubt that Conrad's *N. protexta* is identical with *A. incile*.

This species has not yet turned up in the Floridian Miocene, but a knowledge of it is necessary to discriminate between the species of *Noëtia*.

Arca (Noëtia) ponderosa Say.

Arca ponderosa Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., ii., p. 267, 1822. Recent in Florida.

Arca contraria Reeve, Conch. Icon., *Arca*, pl. 8, fig. 55, 1844.

Arca elegans, Phil. Zeitschr. Mal., 1847, p. 92.

Arca ponderosa Tryon, Am. Mar. Conch., p. 178, pl. 36, figs. 467–8, 1874.

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

This is the type of the subgenus. In this species the beaks are more nearly in the middle of the shell than in either of the others. The ligament does not occupy the whole of the cardinal area, and the greater portion of it is in front of the beaks and strongly transversely striated. The borders of the adductor scars are sometimes marked by an elevated ridge as strong as in many Cucullæas.

It is curious that Conrad should state (Proc. Acad. Nat. Sci., 1862, p. 290) that he had not seen a recent specimen of this species, and that he supposed it to be extinct. It is probable that he was thinking of *A. lienosa* Say when he recorded these remarks, as the present species is almost the commonest recent species of our shores. There can be little or no doubt that the names of Reeve and Philippi are based on young specimens of this somewhat variable shell.

Subgenus SCAPHARCA Gray.

Section *Cunearca* Dall.

Scapharca (Cunearca) cumanensis Dall.

Arca incongrua Guppy, Proc. Sci. Assoc., Trinidad, p. 163, Dec., 1867; Geol. Mag., Dec., 1874, p. 451; not of Say.

Oligocene of Cumana, Venezuela, Guppy; island in Lake Henriquillo, St. Domingo, Rowell.

Shell small, resembling *S. incongrua* Say in miniature, but with higher, more prominent, and uncompressed beaks, with the ribs of the posterior slope of the right valve smooth instead of nodulose; the valve higher and shorter, with the beaks more anterior, and the hinge-line somewhat shorter. Lon. of adult shell 26, alt. 25, diam. 21 mm.

With a rather close general resemblance to *A. incongrua* Say, this little species differs in details, which, taken in connection with the great disparity in size and the geological horizon, authorize us to regard it as distinct.

Scapharca (Cunearca) initiator n. s.

PLATE 32, FIGURE 11.

Oligocene of the Chipola beds, Chipola River, Florida; Burns.

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

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

Scapharca (Cunearca) scalaris Conrad.

Arca scalaris Conr., Proc. Acad. Nat. Sci. Phila., i., p. 324, 1843; Fos. Medial Tert., p. 59, pl. 31, fig. 1, 1845; Emmons, Geol. N. Car., p. 285, 1858; Tuomey and Holmes, Pleiocene Fos. S. Car., p. 43, pl. 16, fig. 1, 1856.

Miocene of Petersburg, Virginia, Tuomey; of Duplin County, North Carolina, Burns, and of the upper bed at Alum Bluff, Florida, Dall.

This species is doubtless the ancestor of *S. scalarina* Heilprin, the young of which it much resembles, though sufficiently distinct from the adult.

Scapharca (Cunearca) scalarina Heilprin.

Arca scalarina Hp., Trans. Wagner Inst., i., p. 94, pl. 12, fig. 29, 1887.

Pliocene marls of the Caloosahatchie, Florida; Heilprin, Willcox, and Dall.

This magnificent species is the largest and most distinct of the entire group, and so far has been obtained only on the Caloosahatchie River. The *S. incongrua* has not yet been found in these marls.

Scapharca (Cunearca) incongrua Say.

Arca incongrua Say, Journ. Acad. Nat. Sci. Phila., ii., p. 268, 1822; Reeve, Conch. Icon., *Arca*, pl. viii., fig. 50, 1844.

Not *Arca braziliana* Reeve, Conch. Icon., *Arca*, pl. iii., fig. 17, 1844, = *A. nodosa* Wood.

? *Arca braziliana* Lam., An. s. Vert., vi., p. 44, 1819; Philippi, Abbild. u. Beschr., i., *Arca*, p. 2, pl. 1, fig. 3, 1843.

Upper Miocene of the Galveston artesian well (?), Singley; Pliocene of Port Limon, Costa Rica, Gabb; typical specimens from Pleistocene of Wailes Bluff, Maryland, Simmons Bluff, South Carolina, Burns, and Brunswick, Georgia, Couper; recent from North Carolina south to Texas, and (var.? *braziliana*) from Texas south and east to Cape Roque and south to Rio, Rio Grande do Sul, San Paulo, and Santa Caterina, Brazil (Ihering).

This species is a very puzzling one, and a large geographical series is required to determine its exact limits. The figure given by Reeve is poor, and has probably helped to continue the confusion.

The typical *A. incongrua* is quite variable in form, and I have not seen specimens which could be unhesitatingly referred to it from older beds than the Pleistocene, or more southern localities, living, than the coast of Texas. Here it is mixed with specimens of the *braziliana* type, towards which the *incongrua* tends to vary. The Costa Rica Pliocene fossils are exactly like *braziliana;* the Antillean shells also, while varying a good deal, retain the dimensions of *braziliana* and more or less of its other characters. It is probable that the two forms would better be kept apart, at least until more is known.

Scapharca (Cunearca) alcima Dall n. s.

Plate 31, Figures 5, 7.

Pliocene marls of the Caloosahatchie at Alligator Creek, Florida; Dall.

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

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

From *A. Chemnitzi* the present species differs by its larger size, more oblique shape, narrower and more numerous ribs.

Arca filicata Guppy from the Eocene beds of Manzanilla, Trinidad, is probably, though much smaller, a precursor of the above-mentioned species.

Section *Scapharca* s. s.

Scapharca (Scapharca) lienosa Say.

Arca lienosa Say, Am. Conch., iv., pl. 36, fig. 1, 1832; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 40, pl. 15, figs. 2, 3, 1855; Emmons, Geol. N. Car., p. 284, fig. 204; 1858.

Scapharca lienosa Meek, Smithsonian Checkl. Miocene Fos., p. 6, 1864.

Arca floridana Heilprin, Trans. Wagner Inst., i., p. 97, 1887; not of Conrad, Am. Journ. Conch., v., p. 108, pl. 12, fig. 2, 1869 (as *Anomalocardia*) = *A. secticostata* Rve., Icon., fig. 38, 1844.

Miocene of York and James River, Virginia, of Wilmington and Duplin County, North Carolina, and of the upper bed at Alum Bluff, Florida; Pliocene of the Waccamaw District, South Carolina, the Caloosahatchie River, Alligator and Shell Creeks, Florida; Tuomey, Burns, Willcox, and Dall. Not known in the recent state.

This species has always been rather rare, and has been confounded with its undoubted descendant, the *Arca floridana* of Conrad, found living in Florida waters. Nevertheless, the recent and the fossil shells are readily distinguished on comparison. It is probable that the rarity of the living shell has prevented the comparisons being made. This species had previously been named *secticostata* by Reeve, from a specimen of which the habitat was unknown. This name, of course, will have to be adopted.

In *A. licnosa* there are about forty ribs in a specimen one hundred and eight millimetres long; these ribs are deeply grooved down the centre, and the ridges on either side of the grooves are likewise longitudinally grooved with one or two incised lines. The interspaces between the ribs are narrower than the ribs; the beaks are less anterior than in *A. secticostata.* In the latter the ribs are much narrower than their interspaces, flat-topped, and distally for a little more than half their length in the adult the top of the rib has a broad, shallow channel. In no case are there any subsidiary grooves. Minute concentric ridges are quite obvious in both species, but the fossil has the ridges more generally and conspicuously beaded. In other respects the shells are extremely similar.

Scapharca (Scapharca) hypomela n. s.

Plate 33, Figure 1.

Oligocene of the Ballast Point silex beds, Tampa Bay, of the lower bed at Alum Bluff, and of the Chipola marl, Chipola River, Florida.

Shell of moderate size, long, inflated, with rather low, mesially compressed, prosogyrate beaks; left valve with about forty-three deeply channelled, flat-topped ribs with fine, regular, concentric beading, except on the posterior slope, where the ribs are lower, flatter, and obsoletely channelled; near the margin some of the ribs have a second set of finer grooves; hinge-line straight, anterior end descending vertically, then obliquely rounded into the base, which is nearly parallel with the hinge-line; the posterior end descends more obliquely and the basal angle is prolonged a little and rounded; the interspaces between the ribs in both valves are very narrow, and on the right valve the beading is less conspicuous; the cardinal area is somewhat concave, flattish, with three or four concentric grooves in lozenge form; teeth of the hinge similar, numerous, not interrupted, short, vertical, the distal teeth a little longer and more oblique; margin of the valves fluted, the right valve slightly smaller than the other. Lon. 50, alt. 25, diam. 20 mm.

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

Scapharca (Scapharca) latidentata n. s.

PLATE 36, FIGURE 15.

From the Oligocene of Ballast Point, Tampa Bay, of the lower bed at Alum Bluff, and in the Chipola marls of Florida, and probably from the Oak Grove sands in western Florida.

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

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

Scapharca (Scapharca) callicestosa n. s.

PLATE 34, FIGURES 17, 18.

Upper bed (Miocene) at Gaskin's Wharf, on the Nansemond River, sixteen miles below Suffolk, Virginia; F. Burns.

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

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

Scapharca (Scapharca) idonea Conrad.

Arca idonea Conrad, Fos. Tert. Form., p. 16, pl. 1, fig. 5, 1832.
Arca stillicidium Conrad, *op. cit.*, p. 15, pl. 1, fig. 5 (young shell).
Arca idonea Conrad, Fos. Med. Tert., p. 55, pl. 29, fig. 3, 1840.
Scapharca idonea Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 579, 1863.

The typical form has twenty-five ribs, and has been obtained from the Miocene of St. Mary's River, Maryland, and the upper bed at Alum Bluff, Florida. The more elongated variety, with thirty-one ribs, figured in the Medial Tertiary, is also found at St. Mary's, at Windmill Point, and in Surry County, Virginia, and in the Miocene of Alum Bluff, Florida. A somewhat more angular type than either of the above is obtained from the Miocene of St. Mary's River, Maryland.

The species is one of the most abundant and finest of the Chesapeake Miocene.

Scapharca (Scapharca) carolinensis Wagner.

PLATE 33, FIGURE 11.

Arca carolinensis Wagner, Trans. Wagner Inst., v., p. 9, pl. 1, fig. 4; Bronn, Index Pal. Nom., p. 93, 1848; Syst., p. 283, 1849.

Miocene of North Carolina? Wagner; of York River, Virginia, station 2250, Harris; of Duplin County, North Carolina (young), Burns.

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

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

Scapharca (Scapharca) dodona n. s.

PLATE 31, FIGURES 1, 8, 8*a*.

Oligocene marl of Oak Grove, Santa Rosa County, Florida; Burns.

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

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

Scapharca (Scapharca) santarosana n. s.

PLATE 31, FIGURES 2, 10.

Oligocene of the Chipola River marl, of the lower bed at Alum Bluff, of the Sopchoppy limestone, and of the Oak Grove sands, Santa Rosa County, Florida; Burns and Dall.

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

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

Scapharca (Scapharca) staminata n. s.

PLATE 31, FIGURES 11, 13.

Oligocene of the lower bed at Alum Bluff, and perhaps at Roberts, Escambia County, Florida.

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

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

Scapharca (Scapharca) staminea Say.

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

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

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

Scapharca triquetra Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 580, 1863.

Miocene of Calvert Cliffs, Choptank River, and Jones's Wharf, near Centreville, Maryland; of York River, Virginia, and Walton County, Florida; Say, Burns, Harris, and Johnson.

The differences between this and *A. staminata* are detailed under that species.

Scapharca (Scapharca) chiriquiensis Gabb.

A. chiriquiensis Gabb, Proc. Acad. Nat. Sci. Phila., xii., p. 567, 1861.

Oligocene of Chiriqui, Central America, and of an island in Lake Henriquillo, St. Domingo; Gabb and Rowell.

The absurdity of referring this species to *A. grandis* Broderip is evident on a comparison, and the *A. patricia* of Sowerby (Quart. Journ. Geol. Soc.

London, vi., p. 52, 1850) not being figured, the number of ribs and the proportional measurements being omitted from Sowerby's diagnosis, can hardly be identified, though it probably resembles this species, which has about thirty rounded ribs with subequal channelled interspaces, the anterior ribs being granulose or nodiferous, the shell remarkably high, short, solid, and wide. The measurements of a well-grown specimen are: alt. 42, lon. 45, and diam. 44 mm.; the length of the cardinal area is 28 mm. It is one of the species on the border line between *Scapharca* and *Anadara*, the two valves being similarly sculptured and almost equal.

Scapharca (Scapharca) Lesueuri Dall.

Lesueur, Walnut Hills Fos., pl. v., fig. 8, 1829.

Arca mississippiensis Conrad, Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 125, pl. 13, figs. 11, 15; Proc. Acad. Nat. Sci. Phila., iii., p. 294, 1848. Not

Byssoarca mississippiensis Conrad, Journ. Acad. l. c., p. 125, pl. 1, fig. 323.

Anomalocardia mississippiensis Conrad, Am. Journ. Conch., i., p. 11, 1865. Not

Cucullæarca mississippiensis Conrad, Am. Journ. Conch., i., p. 11, 1865.

Vicksburgian Oligocene of Mississippi.

It is obvious that the same specific name cannot be used twice in the same genus for a valid species, and so I have proposed to call the present one *Arca Lesueuri*, in honor of the excellent naturalist who was the first to call attention to it.

Scapharca (Scapharca) arata Say.

Arca arata Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 137, pl. 10, fig. 1, 1824; Conrad, Fos. Med. Tert., No. 3, p. 58, pl. 30, fig. 6, 1845.

Miocene of St. Mary's County, Maryland; Burns.

This species is the oldest of the group to which it belongs, which includes *A. improcera*, *A. buccula*, *A. plicatura*, etc., and which is represented in the recent fauna by *A. transversa* Say.

Scapharca (Scapharca) improcera Conrad.

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

Scapharca improcera Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 579, 1863.

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

Upper Miocene of Warwick, Virginia; of Duplin County and Wilmington, North Carolina; of Timminsville and Darlington, South Carolina, Burns; Pliocene of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox.

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

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

Scapharca (Scapharca) plicatura Conrad.

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

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

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

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

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

Upper Miocene of Duplin County, North Carolina, of the Sumter District, South Carolina, and of De Leon Springs, Florida; Pliocene of the Waccamaw beds of South Carolina; Burns and Johnson.

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

Scapharca (Scapharca) campyla n. s.

PLATE 31, FIGURES 3, 4; PLATE 32, FIGURE 22.

Pliocene of the Caloosahatchie, Shell Creek, Alligator Creek, and Myakka River, Florida; Willcox and Dall.

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

This species is one of the most abundant in the Floridian Pliocene, and is easily distinguished from any other by its compressed appearance and twisted shape. Some of the allied species have a slight flexuosity, but in none is this feature so pronounced as in *A. campyla*. A variety with thinner shell and narrower and slightly more elevated ribs was at first thought to be distinct, and may be named var. *ærctea*. It is figured plate 32, figure 22.

Scapharca (Scapharca) subsinuata Conrad.

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

Pliocene of the Croatan beds, near New Berne, North Carolina.

I have seen only one specimen of this shell, which was identified by Conrad and has been many years in the National collection. It is very close to *A. arata* Say, from which the individual referred to differs chiefly by having two or three more ribs, and in being somewhat less angular at the posterior end of the hinge-line. A good series would probably connect them.

A species near to this is represented in the Upper Miocene fauna of the deep artesian well at Galveston, Texas, but the specimens are too young to be specifically identified.

Scapharca (Scapharca) transversa Say.

Arca transversa Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., ii., p. 169, 1822; Conrad, Fos. Tert. Form., p. 15, pl. 1, fig. 2, 1832; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 42, pl. 15, fig. 6, 7, 1856; Emmons, Rep. Geol. N. Car., p. 285, 1858.

Pliocene of Myakka River and De Land, Florida; Pleistocene of North Creek, Little Sarasota Bay, Florida; of Simmons Bluff, South Carolina, Wailes Bluff, Maryland, and Sconset, Rhode Island. Recent from Cape Cod south to Key West, Florida, and southwest to Vera Cruz and the Gulf of Campeachy, Mexico, in shallow water.

This is not the *Arca transversa* of Portlock (1843), nor of Rogers (Dec., 1839). The latter, a *Cucullæa*, has been renamed *A.* (*C.*) *Rogersiana* by Nyst (Tabl. Synopt. Arcacées, p. 63, 1848), and *A.* (*C.*) *Rogersi* by Heilprin (Proc. Acad. Nat. Sci. Phila. for 1881, p. 449).

This species has the rounded nodulous ribs and discrepantly sculptured valves of *A. plicatura*, with the more rhombic form and solidity of *A. improcera*, with both of which it is doubtless genetically connected. It is not known below the Upper Pliocene.

Scapharca (Scapharca) halidonata n. s.

PLATE 33, FIGURE 24.

Oligocene of the Bowden beds, Jamaica, and of Curaçao; Henderson, Simpson, etc.

Shell subequivalve, ovate, oblique, inflated; beaks rather high, strongly bent forward, almost reaching the anterior fourth of the length; left valve larger, with about thirty-four clear-cut, elegantly sculptured radial ribs; the anterior dozen ribs are usually dichotomous or deeply sulcate; the ribs on the middle of the shell are grooved with one or two shallow, sharp, incised lines; the more posterior ribs are wider and flatter with three or more grooves; those on the posterior dorsal slope are angular, narrower, and usually have not more than one groove, which is nearly obsolete; the concentric sculpture is of evenly spaced, fine, elevated lines arched in the interspaces and finely nodulating the anterior ribs; the sculpture is similar on both valves; the anterior end of the shell is rounded, the base arcuate, the posterior end oblique above and produced below; the ends of the hinge-line are angulated; the cardinal area is moderately wide with about three concentric lozenges outlined by the grooving; the hinge-line is straight, the teeth numerous and mostly vertical, the two series not interrupted, the posterior distal teeth tending to become irregular in the adult. Lon. of shell 55, of hinge-line 41, alt. 40, diam. 40 mm.; large specimens reach a length of 68 mm.

This shell is usually named *A. consobrina* Sby. in collections, but when compared with the excellent figure of the St. Domingo species given by Sowerby, it is evident the two cannot be united. Sowerby's species is more elongated, with a much straighter base, the beaks smaller and lower, and the height of the shell proportionately much less than in *A. halidonata*.

Moreover, the name *consobrina* had been used by d'Orbigny six years earlier for a French fossil species, and was therefore not available for the West Indian fossil. Sowerby's diagnosis is not distinctive and would apply equally well to several species. *A. inequilateralis* Guppy, from Bowden, is more like his figure than is the present species.

There are in the Oligocene rocks of Gatun and other localities on the Isthmus of Darien, near Panama, several species of *Arca* of which I have imperfect specimens, some of which are nearly allied and may prove identical with *A. halidonata*. The *A. consobrina* of Guppy's papers is the present species, which was erroneously referred to *A. floridana* Conr. by Gabb.

Scapharca (Scapharca) inequilateralis Guppy.

Arca inequilateralis Guppy, Quart. Journ. Geol. Soc. Lond., xxii., p. 293, pl. xviii, fig. 2, 1866.

Oligocene of the marls of Bowden, Jamaica; Guppy, Henderson, and Simpson.

This species is closely related to *A. latidentata* Dall, of the Chipola, Florida, Oligocene marls, but may be distinguished from it at once by the shorter, more delicate, and much more numerous hinge-teeth of the Jamaica shell. The latter is also thinner and more elegant in sculpture and less inflated. It somewhat resembles the young of *A. hypomela* Dall and *A. floridana*.

Scapharca (Scapharca) actinophora n. s.

PLATE 33, FIGURE 26.

Shell subequivalve, ovate, moderately inflated, attenuated behind; beaks low, mesially impressed, much bent forward, situated in the anterior fourth of the length; left valve slightly larger, with about forty squarish, uniform, entire radial ribs, with narrower channelled interspaces, the ribs slightly flatter and wider distally; transverse sculpture of fine, low, equidistant, subequal, rather close-set elevated lines which are concavely arched as they pass over the ribs; sculpture nearly identical on both valves; hinge-line long, straight, anterior end nearly a right angle, the valve margin evenly rounded to the arcuate base; posterior end narrower, produced; cardinal area lanceolate, wider in front, with six or seven concentric grooves, angular near the beaks; teeth numerous, vertical, larger distally in two series, about thirty-five anterior and fifty-two posterior, separated by a short vacant gap; inner margins of the valves deeply fluted. Lon. 46, alt. 27, diam. 26 mm.

This species is easily recognized by its numerous oblique ribs and compressed posterior end.

Scapharca (Scapharca) acompsa n. s.

PLATE 33, FIGURE 15.

Oligocene of the Chipola River, Florida, marl.

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

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

Scapharca (Scapharca) triphera n. s.

PLATE 33, FIGURE 6.

Pliocene marls of the Caloosahatchie River, Florida; Dall.

Shell subequivalve, of moderate size, elongate, not much inflated, subrectangular, with low beaks slightly prosocœlous and marked by a conspicuous wide mesial sulcation; umbones situated at the anterior third of the length; left valve with about thirty-eight rounded subequal ribs separated by narrower interspaces; in the adult about a dozen of the anterior ribs may be squared off and deeply mesially sulcate near the margin, while a few of the ribs on the posterior dorsal slope are narrower, smoother, and more widely separated; transverse sculpture of elevated lines which are somewhat regularly spaced, and in crossing the ribs develop into sharp, thick transverse nodulations; cardinal area very narrow and with an elevated margin behind, slightly wider in front of the beaks, longitudinally striate; ends of the hinge-line angular; anterior end bluntly rounded, base parallel with the hinge-line, posterior end subtruncate, a little produced below; hinge with numerous rather crowded subvertical teeth in an uninterrupted series; inner margin of the valves deeply fluted. Lon. of largest valve 28, alt. 14; of younger valve 18, alt. 8.5, diam. 7 mm.

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

Scapharca (Scapharca) donacia n. s.

PLATE 33, FIGURE 13.

Oligocene marl of Bowden, Jamaica; Bland.

Shell small, donaciform, moderately plump, with rather elevated prosocœlous beaks at about the anterior third; valves almost similarly sculptured; left valve with about twenty-four low, strap-like, narrow radial ribs with somewhat wider interspaces; the ribs are plain, smooth, and entire on both valves; on the left valve the interspaces are crossed by numerous equidistant elevated lines which do not appear on the ribs; on the right valve the interspaces are only marked by lines of growth; hinge-line short, cardinal area very narrow, smooth; anterior end larger, rounded; posterior end produced and attenuated; hinge-teeth small, similar, slightly divergent; internal margin of the valves with deep short flutings. Lon. 6.8, alt. 4.5, diam. 3 mm.

This little shell has no very marked characters, but appears to be adult, and not very similar to the young of any of the species associated with it.

Scapharca (Scapharca) auriculata Lamarck.

Arca auriculata Lam., An. s. Vert., vi., p. 43, 1819; Reeve, Conch. Icon., *Arca*, pl. vi., fig. 35, 1844.

? Oligocene of Bowden, Jamaica, Henderson; Pliocene of Limon, Costa Rica, Gabb; Pleistocene of the Antilles, various collectors. Recent, from Key West to Martinique, in fifteen to forty fathoms.

The fossil from Bowden seems to be this species, though somewhat worn; that from Port Limon is certainly the same as the recent shell.

Section *Argina* Gray.

Scapharca (Argina) tolepia n. s.

PLATE 33, FIGURES 7, 8.

Arca pexata Guppy, Geol. Mag., Oct., 1874; not of Say, 1822.

Oligocene of Rio Amina, St. Domingo; Bowden, Jamaica, and Cumana, Venezuela.

Shell small, thin, greatly inflated, rounded, with incurved prosocœlous beaks; the left valve larger, the sculpture of the two valves slightly discrepant; left valve with about thirty-four subequal, rounded, minutely nodulous, radial ribs, separated by narrower channelled interspaces, and crossed by fine incremental lines; right valve with the ribs narrower, flat, and straplike, only a few of the anterior ones showing nodulation; hinge-line short, straight, hardly angular at the ends; the beaks nearly attaining the anterior fourth of the length of the shell; cardinal area very narrow behind the beaks and with elevated margins; in front of the beaks slightly wider, very short; its surface with a few irregular longitudinal grooves; hinge-teeth in two series, the anterior short and more or less broken up into granules, separated by a very narrow gap from the posterior series, which is about twice as long, with small, numerous vertical teeth, becoming longer and more oblique distally; internal margins of the valves with short, deep flutings. Lon. 28, alt. 26, diam. 27 mm.

This little shell is doubtless an ancestor of Say's shell, from which it differs by its smaller size, more rotund shape, finer and more nodulose sculpture, and greater inflation.

Scapharca (Argina) campechensis Dillwyn.

"*Pectunculus dense et profunde striatus, ovali figura,*" Lister, Hist. Conch., tab. 237, fig. 71, 1770; Bay of Campeachy.

Arca No. 22; Schröter, Einleit. Conch., iii., p. 288, 1786.

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

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

Arca declivis Solander MSS., *fide* Dillwyn, 1817.

Arca campechensis Dillwyn, Descr. Cat. Rec. Sh., 1, p. 288, 1817 (Syn. partim. exclus.), Jamaica and Carolina; not of Wood, Ind. Test., p. 46, pl. 9, fig. 28, 1825.

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

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

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

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

Arca pexata Greene, Mass. Cat., 1833; Gould, Rep. Inv. Mass., p. 95, fig. 60, 1841; Reeve, Conch. Icon., *Arca*, fig. 22, 1844; De Kay, Nat. Hist. N. Y., Moll., p. 176, pl. 12, fig. 311, 1843; Stimpson, Shells of N. Engl., p. 8, 1851.

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

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

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

This very interesting species, of which the synonymy might be much extended, affords an excellent illustration of the effects of environment upon the recent form. Its northern limit is at Cape Cod, where the shell is often large, always coarse, and with a dense hirsute periostracum. Like many of the Scapharcas, it varies in outline from quite round to ovate quadrate; the sculpture of the two valves is discrepant, that of the left valve showing ribs which are narrower, flatter, and less prominent than those of the other valve and often impressed in the middle longitudinally, or even divided by a mesial groove more or less extended from the margin. The ribs of the other side are not grooved, and the literature is so at variance with itself and the facts, in attempts to discriminate the several varieties, that I can only suggest as an explanation that the writers in some cases were unaware of the discrepancy between the valves and compared opposite sides. As we proceed southward, in this species, as in many other shells, we find the shell becoming less earthy and more porcellanous, the sculpture more neat, the periostracum less profuse, and the general size less. South of Cape Hatteras the chalky, thin type, common in the north, is seldom if ever found. In the Gulf of Mexico and the Antilles the shell is still smaller than in the Carolinas, and, with its decrease in size, the sulcation of the ribs becomes more generally obsolete. A somewhat similar series of differences is observable in the Pleistocene fossils, though less pronounced.

Gmelin's description was inadequate, and only identifiable by his reference to Lister. The species was elucidated by Dillwyn, who noted its resemblance to *Cardium* (*edule*), but whose reference to a figure in the Encyclopédie Methodique should be expunged from the synonymy.

The typical *A. campechensis* is the rounded southern form which Stimpson afterwards called *A. Holmesii*, as he himself recognized. Say's description of *A. pexata* included all the varieties of our eastern coast, but Gould first described the shell so as to make this name apply more particularly to the somewhat elongated, earthy northern variety. Gray's *A. americana* was founded on a very elongated, more porcellanous form, such as is common in South Carolina waters. The study of a large series of recent specimens, ranging from Jamaica to Cape Cod, obliges me to recognize that no sharp line of discrimination can be drawn between the several varieties. The number of ribs varies from twenty-six in the roundest, *A. Holmesii*, to thirty-five in the most elongated, *A. americana;* but the short, round ones often have as many ribs as the elongated specimens. The cardinal area is extremely narrow and depressed, and the portion in front of the beaks is very small. The anterior granular series of teeth is much shorter than in *A. tolepia*, and does not extend much in front of the beaks.

The species does not descend below the uppermost Miocene, if, indeed, any of the specimens are so old. I have only identified it with certainty from the Pleistocene of Georgia, of Simmons Bluff, South Carolina, of New Jersey, and southern New England.

Section *Bathyarca* Kobelt.

Scapharca (Bathyarca) Spenceri n. s.

PLATE 32, FIGURES 16, 24.

Pliocene of Tehuantepec; Dr. J. W. Spencer.

Shell large for the section, inflated, ovate, with prominent prosocœlous beaks; left valve with fine, rounded, concentric elevated lines, close set, and with very narrow interspaces, which show fine, close radial striæ, some of which on the anterior end of the shell are more prominent; right valve with fine, close-set radial ribs, coarser on the middle of the shell, separated by narrower, sharp, channelled grooves; transverse sculpture of evenly spaced, low, sharp elevated lines which cross the ribs without becoming much thickened; cardinal area very narrow behind, wider but not distinctly limited in front, the cardinal margin elevated anteriorly, with seven or eight concentric grooves mostly behind the umbones; ends of the hinge angular behind; the teeth in two series hardly separated, eight to twelve in front, ten to fourteen behind, not crowded, smaller mesially, larger and more oblique distally, the anterior series somewhat irregular; inner margin of the valves with fine crenulations, stronger in the left valve, the outer edge almost or quite entire. Lon. 18, alt. 15, diam. 14 mm.

This is the largest species of the section, and was collected by Dr. J. W. Spencer about seventy kilometres west of the eastern terminus of the Tehuantepec Railway from a cutting, together with a number of other species, all of which indicated that they were deposited in deep water, probably between one hundred and fifty and four hundred fathoms in depth, judging by analogous recent species. The matrix is a fine, soft, grayish mud like that of deep-water deposits of the same kind, and its presence with the fossils points to a Post-Pliocene elevation of this part of the land of at least one thousand feet. For the formation in which it occurs, and which is clearly distinct from any yet described from middle America, Spencer has proposed the name of the Coatzocoalcos formation, from the Coatzocoalcos River, which drains the coastal plain immediately to the eastward. The species is named in honor of Dr. Spencer, who collected it.

Scapharca (Bathyarca) Hendersoni n. s.

PLATE 33, FIGURE 9.

Oligocene of the Bowden beds, Bowden, Jamaica, where it was collected by J. B. Henderson, Jr., and Mr. Charles T. Simpson.

Shell very small, much inflated, the hinge-line as long as the shell, which is of a rounded triangular form, with rather prominent prosocœlous beaks; left valve with fine, elevated, rounded concentric lines, crossed by closer, less prominent, and finer radial lines; in the right valve, as usual in this section of the genus, the radial sculpture predominates over the concentric, the latter though present being inconspicuous; cardinal area moderately wide, the beaks being nearly medial, the surface of the area longitudinally striated; hinge with about five nearly vertical anterior teeth separated by a wide unarmed gap from six or seven smaller, more oblique posterior teeth; margin of the valves thin, entire, or microscopically crenulated; the inner edges of the adductor scars slightly raised above the inner surface of the valve. Lon. 2, alt. 2, diam. 2 mm.

This minute little species is obviously adult, and about ten valves were obtained. It resembles *A. pectunculoides* Scacchi and *A. glomerula* Dall, of the recent fauna, but is smaller, more inflated, and more triangular than either of them. It is named in honor of Mr. Henderson, during whose explorations in Jamaica it was collected.

Another species of the same group with more conspicuous radial sculpture and a marked depression radiating mesially from the beaks was obtained by Professor R. T. Hill from the Oligocene of Monkey Hill, on the line of the Panama Railway, but the two valves obtained are hardly perfect enough for description.

Section *Anadara* Gray.

Scapharca (Anadara) rustica Tuomey and Holmes.

PLATE 31, FIGURES 6, 9.

Arca rustica Tuomey and Holmes, Pleioc. Fos. S. Car., p. 29, pl. 11, figs. 6–10, 1857. Not *A. rustica* Contejean, 1859.

Arca crassicosta Heilprin, Trans. Wagner Inst., i., p. 96, pl. 13, fig. 30, 1887; Dana, Man. Geol., 4th ed., p. 900, fig. 1508, 1895.

Pliocene of the Waccamaw beds of South Carolina; and of the Caloosahatchie, Shell Creek, Alligator Creek, and Myakka River, Florida; Willcox and Dall.

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

On the whole, this is one of the finest and most striking species in our whole Tertiary fauna. The specimen figured is comparatively young.

Scapharca (Anadara) catasarca n. s.

PLATE 32, FIGURE 20.

Pliocene marl of Alligator and Shell Creeks, Florida; Willcox.

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

This fine species appears to be rare, and was found only at Alligator Creek, where two adult right valves, one young pair, and some fragments were obtained. The young has much the outline of *A. auriculata*, but is not markedly auriculate. It is proportionately shorter than the adult. The species belongs in the same subordinate group as *A. rustica*, as shown by the minor characters.

A single broken valve, probably of this species, is among the material from Shell Creek.

Scapharca (Anadara) subrostrata Conrad.

Arca subrostrata Conr., Proc. Acad. Nat. Sci., vol. i., p. 30, 1841; Fos. Med. Tert., p. 58, pl. 30, fig. 7, 1845.

Scapharca tenuicardo Conr., Am. Journ. Conch., v., p. 39, pl. 2, fig. 4, 1869.

Scapharca subrostrata Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 580, 1863.

Miocene of Maryland in Talbot and Calvert Counties, at Calvert Cliffs, Skipton, Centreville, Plum Point, and other localities; Conrad, Cope, Burns, and Harris. A single valve, stated to be from the Miocene of North Carolina, is in the National Museum.

This species appears to be rather common. The cardinal area is grooved longitudinally with numerous rather irregular concentric grooves. This is not the *A. subrostrata* of Sowerby (1847) or of Smith, Quart. Journ. Geol. Soc. Lond., 3, pp. 413, 418, figs. 8, 9. *A. callipleura* Conrad is probably founded on an unusually short specimen of this species.

Scapharca (Anadara) aresta n. s.

PLATE 33, FIGURE 2.

Chesapeake Miocene of Alum Bluff, Calhoun County, Florida; Dall and Burns.

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

This very neat and distinct species appears to be the most common Ark in the upper or Miocene bed at Alum Bluff.

Scapharca (Anadara) campsa n. s.

Plate 32, Figure 21.

Chesapeake Miocene or upper bed at Alum Bluff, Florida; Dall and Burns.

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

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

Scapharca (Anadara) clisea n. s.

PLATE 33, FIGURE 25.

Chesapeake Miocene of Maryland, at St. Mary's River and Crisfield; of Nomini Cliffs, Virginia, Harris; and of Walton County, Florida, Johnson.

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

This shell is apparently related to *A. callipleura* and *A. staminea* Conrad, and a larger series of specimens may oblige us to unite all three as varieties of a single species. At present, however, the differences seem too great to admit of this course. In *A. callipleura* the ribs are granulated and triply sulcate, while in the present form they are simple. *A. clisea* has no posterior truncation like that figured by Conrad in *A. callipleura*. *A. staminea* is more squarely compressed before and behind, with a tendency to incurvation of the posterior basal margin; it is a smaller shell with more posterior beaks, and less roundly inflated. We have a large series of this species from many localities, and these differences characterize them all. The forms are easily differentiated, so far as our present knowledge goes, and therefore are better kept apart. In all the pairs of *A. staminea* in the collection the right valve is distinctly smaller than and fits into the other, while in *A. clisea* the margins meet evenly.

It now remains to enumerate the other Tertiary species of *Arca* not hitherto mentioned, but which have been referred to American beds by various authors.

Nomina nuda. *A. diplcura* Conrad, Bull. Nat. Inst., 1842, mentioned by name as from the Miocene of Maryland, appears never to have been described. *A. granulifera* Conrad appears by name only in the list of species furnished by Conrad for the appendix to Morton's Synopsis.

Unidentifiable. *A. cancellata* Tuomey, briefly described and unfigured, from the Eocene of North Carolina, in 1854, is not *A. cancellata* Gmelin, 1792, or Phillips, 1829, and should be expunged from our lists. *A. maxillata* Conrad was based on an unrecognizable internal cast from the Miocene of Maryland, and, though briefly described in 1830, has never been figured.

Eocene. *Arca* (*Fossularca?*) *inornata* Meyer, 1886, from Claiborne, Alabama, is very minute and has not been seen by me. *A. gigantea* Conrad is probably identical with *Cucullæa onochela* Rogers. *Noëtia pulchra* Gabb, from the Eocene of Texas, 1860, is *Trinacria decisa.* There is an *A. pulchra* of Sowerby, dating from 1824.

Oligocene. *A. oronlensis* Gabb, 1875, is abundant in the black shales of Gatun on the Panama Isthmus. The following species described or mentioned by Gabb from the Oligocene of St. Domingo have not been figured: *A. multilineata* Gabb, *A. patricia* Sowerby, *A. pennelli* Gabb. *Arca trinitaria* Guppy, 1866, from the Manzanilla beds of Trinidad, appears to be a good species of the subgenus *Noëtia.*

Miocene. "*Anomalocardia*" *trigintinaria* Conrad, 1862, from the Miocene of South Carolina, seems to be an *Anadara* from the brief description, but has never been figured.

The following nominal species from the Pacific coast have been so wretchedly figured and described that further study is necessary to identify or discriminate them; they are supposed to be from the Miocene: *Arca trilineata* Conrad, *A. canalis* and *devincta* Conrad, all of which by Gabb are united specifically with *A. microdonta* Conrad, the most common of the Pacific Miocene species; *A. congesta* Conrad, and *A. obispoana* Conrad.

Arca limatula Emmons, 1858, Geol. N. Car., is a typographical error for *A. limula* Conrad. *A. lintea* Conrad (in App. Kerr's Geol. N. Car., 1875) is not *A. lintea* Conrad, 1852 (Rep. Dead Sea Expedition under Lieut. Lynch).

Pliocene and later. *A. Deshayesii* Hanley is reported by Gabb from the Pliocene of Costa Rica. Nelson has described and figured an *A. Larkini* from the Pliocene (?) of Peru. Gabb describes and figures *A. sulcicosta* from the Pliocene of California (1866), but the name had previously been used by Nyst in 1836 for a Belgian fossil, and Gabb's species may take the specific name of *schizotoma*. *Arca velata* Sowerby (Indopacific) is reported by Gabb from the Pleistocene of St. Domingo, but his shell is probably a distorted specimen of *Arca candida* or *Helblingi*.

The following is a list of the recent species of *Arca* belonging to the southern coast of the United States, and any of which might be expected to occur in our later Tertiary or Pleistocene beds:

Arca occidentalis Phil., *A. umbonata* Lam.; *Barbatia barbata* Linné, *B.* (*Calloarca*) *candida* Gmel., *B.* (*C.*) *nodulosa* Müll., *B.* (*Acar*) *reticulata* Gmel., *Barbatia* (*Fossularca*) *Adamsi* (Shuttlew.) Smith; *B.* (*Cucullaria*) *asperula* Dall, *B.* (*Cucullaria*) *sagrinata* Dall, *B.* (*Cucullaria*) *profundicola* Verrill; *Noëtia ponderosa* Say, *Noëtia bisulcata* Lam.; *Scapharca secticostata* Rve., *S. transversa* Say, *S. Deshayesii* Hanley, *S. auriculata* Lam., *S.* (*Cunearca*) *incongrua* Say, *S.* (*Cunearca*) *Chemnitzii* Phil., *S.* (*Argina*) *campechensis* Dillwyn with varieties *pexata* Say and *americana* Gray, *S.* (*Bathyarca*) *pectunculoides* Scacchi, *S.* (*Bathyarca*) *polycyma* Dall, *S.* (*Bathyarca*) *glomerula* Dall.

Superfamily PTERIACEA.

Family PINNIDÆ.

The ancient genus *Pinna* of Linnæus, as represented in our Tertiaries, is divided into two genera:

1. *Pinna* proper; with the fibrous layer of the valves mesially sulcate longitudinally while the inner nacreous layer is bilobed deeply by the same (closed) sulci. The type of the genus is *P. rudis* L., the red *Pinna* of the West Indies. *P. flabellum* Lam. and *P. carnea* Gmelin belong to it.

2. *Atrina* Gray; has the valves unsulcate or without the median carina, and the internal nacreous layer is entire. The type is *P. nigra* Ch., and it is represented in our recent fauna by *P. rigida* Dillwyn (*P. muricata* auct.) and *P. serrata* Sby.

The fossil Pinnas are very difficult to handle, as the fibrous layer is often entirely lost, the fragile shell is almost invariably crushed and fragmentary, while internal casts are defective in the external ornamentation. For this reason the literature says very little in regard to the genus in our Tertiaries, and only one species has been formally described.

Genus **PINNA** (L.) Lamarck.

Pinna quadrata n. s.

PLATE 29, FIGURE 7.

Shell straight, thin, acute anteriorly with the valves mesially carinate, the dorsal and ventral areas making about the same angle at the carina as the valves do at the hinge-line; byssal gape long, extending well towards the beaks, narrow behind; sculpture of some five longitudinal ribs on the dorsal areas and two or three below the carina, the surface near the ventral edges almost smooth. Lon. of type 56, vert. diam. 26, carinal diam. 25, apical diam. 6.5 mm.

A single internal cast was collected by Mr. Willcox at Richard's quarry, Ocala, Florida, in the Nummulitic or Ocala horizon of the Vicksburgian Oligocene. Specimens nearly twice as large as the above-mentioned were found by L. C. Johnson at Johnson's lime sink, Levy County, and Arredondo, Alachua County, Florida, in the Vicksburg limestone. They are remarkable for their rapid increase in diameter.

Pinna caloosaënsis n. s.

PLATE 26, FIGURE 4.

Shell long, slender, straight, narrow, thick, with the valves moderately rounded; carina not conspicuous in the fossils, but the sulcus very long, deep, and sharp, represented on the interior by a large rounded rib; dorsal area sculptured with about three feeble irregularly longitudinal ridges; ventral area with about the same number, but stronger and sharper. Lon. of type 120, max. dorso ventral height 40, min. do. 10, convexity of the valve at the sulcus behind 12 mm.

A single broken valve without the fibrous layer and the apical part of another was obtained from the Pliocene marl of the Caloosahatchie.

This species is not unlike *P. rudis* in form, but is proportionally much thicker and the sulcus is much larger than in the recent shell, which has no such strong, rounded internal rib.

Pinna carnea Gmelin.

Pinna haud ignobilis Chemn., Conch. Cab., viii., p. 212, pl. 87, fig. 769, 1785.

Pinna pernula Chemn., *op. cit.*, viii., pp. 211, 242, pl. 92, fig. 785, 1785; Arango, Moll. Cuba, p. 264, 1878; Orbigny, Moll. Cuba, ii., p. 325, 1853; not of Reeve.

Pinna carnea Gmelin, Syst. Nat., p. 3365, 1792; Solander, Portland Cat., 1796; Deshayes, in Lam. An. s. Vert., ed. ii., vol. vii., p. 61, 1836.

Pinna degenera Link, Beschr. Rostock Samml., p. 159, 1807.

Pinna flabellum (Lam.), Reeve, Conch. Icon., *Pinna.*, pl. x., fig. 18, 1858.

Pinna varicosa Lamarck, An. s. Vert., vi., p. 133, 1819; Orbigny, Moll. Cuba, ii., p. 325, 1853.

? *Pinna bullata* (Swains.) Reeve, Conch. Icon., *Pinna*, pl. ix., fig. 16, 1858.

Post Pliocene of the Florida Keys; recent in the West Indies as far south as Trinidad and north to Cape Hatteras, also in the Red Sea.

As Chemnitz was not systematically binomial in nomenclature, his accidentally binomial name cannot be accepted, though the earliest. This species seems to be distinct from *P. rudis*, though it is often spinose or strongly ribbed; further study on this point is desirable. The typical *P. rudis* is not known from Florida, though said to be abundant on the Bahamas. The *P. carnea* varies from pale salmon color to a brownish white, and may be smooth, or sparsely muricate; it is always thin, straight, and obliquely truncate. *P. rudis* is the only other true *Pinna* known from the east American subtropical region; the true *P. muricata* (L.) Rve. is probably an Oriental species, the *muricata* of American authors belonging to the genus *Atrina*.

Pinna rudis (Linné) Dillwyn.

Pinna rudis L., Syst. Nat., ed. xii., No. 1159, 1766, *ex parte;* Chemn. Conch. Cab., viii., p. 218, pl. 88, fig. 773, 1785; Dillwyn, Cat., p. 322, 1817; Hanley, Shells of Lin., p. 148, 1855; Reeve, Conch. Icon., *Pinna*, pl. x., fig. 19, 1858; Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 378, 1881.

Pinna pernula Reeve, Conch. Icon., *Pinna*, pl. 12, fig. 22, 1858; not of Chemnitz.

Pliocene of Costa Rica, Gabb; recent in the West Indies, Bahamas, Bermuda, etc., Reeve, Jones, *et al.*

This species is included on the authority of Gabb; I have seen no Florida specimens unless *P. carnea* is a degenerate form of it. It is not the *P. rudis* of authors from the Mediterranean and vicinity; the latter is a form of *P. nobilis.*

Genus **ATRINA** Gray.

The condition of the material is such that only provisional descriptions can be given of several of the following species, though their distinctness appears beyond doubt.

Atrina jacksoniana n. s.

Lesueur, Walnut Hills Fossils, pl. 5, fig. 5, 1829.

In the Jacksonian Eocene of Green's marl bed, at Jackson, Mississippi, and Garland's Creek, near Shubuta, Clarke County, Mississippi, Burns; and at Creole Bluff, Grant Parish, Louisiana, Vaughan and L. C. Johnson.

Shell thin, fragile, rapidly widening, somewhat compressed along the ventral border; sculpture of near the beaks numerous feeble, more or less wavy, longitudinal elevated lines, which become less distinct ventrally, and are obsolete over the greater portion of the shell, which appears from the numerous fragments to have been nearly smooth posteriorly, or with a few feeble concentric wavelets, most prominent ventrally. A fragment (including the beaks), forty-five millimetres long, has a dorso-ventral maximum diameter of thirty-four, and a transverse diameter of about twenty millimetres. The valves are evenly arched, and become more convex behind.

The material is abundant but very fragmentary, yet sufficient to establish the identity of the species at these localities and its distinctness from the others mentioned.

Atrina argentea Conrad.

Pinna argentea Conr., Proc. Acad. Nat. Sci. Phila., iii., pp. 295–6, 1848; Journ. Acad. Nat. Sci., 2d Ser., i., p. 126, pl. 13, fig. 31, 1848.

Vicksburgian Oligocene of Vicksburg, Mississippi, where it is abundant in the form of impressions in a brownish clay; Conrad and Worthen.

It is quite certain from the appearance of the casts that the surface of the valves originally possessed a certain number of small, feeble, spinose processes along the principal radial ribs. The specimens examined average about eighty millimetres in length.

Atrina (**argentea** var. ?) **chipolana** n. s. ?

Upper Oligocene of the Chipola marl, Calhoun County, and of the Oak Grove sands, Santa Rosa County, Florida; Burns.

This form is only represented by fragments. It would appear to attain about the size of *A. argentea*, but to be somewhat more convex and arcuate. The chief distinction is in the sculpture; the dorsal areas of the valves of both have about five equidistant radial riblets; the ventral areas in *argentea* have a few radial ribs near the middle of the valve, below which the sculpture becomes obsolete; in *chipolana* the ventral areas are sculptured with distinct oblique, concentric waves, with about equal interspaces; the upper ends of these waves terminate abruptly where they meet the longitudinal riblets, so that the sculpture of the ventral is strongly contrasted with that of the dorsal areas. This form also appears to increase in width more rapidly than the *argentea.* On the whole, the two appear specifically distinct, but a complete description must be deferred until better material enables the characters to be fully elucidated.

Atrina Harrisii n. s.

Plate 29, Figure 11.

Types collected by G. D. Harris (in honor of whom the species is named) from the Miocene at Jones's Wharf on the Patuxent River, Maryland; other specimens were found by him near Plum Point, Maryland, and a fragment at Magnolia, Duplin County, North Carolina, by Burns.

Shell rather thick (the fibrous layer lost in the specimens), ovately rounded behind, moderately convex; hinge-line straight, ventral margin slightly incurved; the surface of the pearly layer shows the dorsal region with numerous fine longitudinal elevated lines, below which the shell is at first nearly smooth, then the ventral region is sculptured with numerous close-set concentric riblets. Length of portion preserved about 150, max. width 60, diam. 32 mm.

This species appears to have been not unlike *A. serrata* Sowerby, but was a much heavier shell with a blunter anterior end.

Atrina rigida Dillwyn.

Pinna tenuis striata muricata Lister, Conch., t. 370, f. 310; Sloane, Hist. Jamaica, p. 254.

Pinna nobilis Chemn., Conch. Cab., vii., p. 224, *ex parte,* pl. 88, fig. 775, non Linné.

Pinna pectinata Born, Test. Mus. Vind., p. 132, non Linné.

Pinna rigida (Solander MSS.) Dillwyn, Cat., p. 327, 1817; Reeve, Conch. Icon., *Pinna,* pl. v., fig. 7, 1858.

Pinna seminuda Lam., An. s. Vert., vi., p. 131, 1819; not Reeve, Conch. Icon., *Pinna,* pl. ii., fig. 2, 1858 (= *serrata* Sby.).

Pinna alta Sby., P. Z. S., 1835, p. 84; Reeve, Conch. Icon., vi., fig. 11.

Pinna subviridis Reeve, Conch. Icon., *Pinna,* xvii., fig. 32, 1858.

Pinna d' Orbignyi Hanley, P. Z. S., 1858, p. 227; Reeve, *op. cit.,* xxvi., fig. 49, 1858.

Pinna carolinensis Hanley, P. Z. S., 1858, p. 225; Reeve, *op. cit.,* xxxiv., fig. 66, 1859.

Pinna ramulosa Reeve, *op. cit.*, xxviii., fig. 52, 1858.

Pinna seminuda Holmes, P.-Pl. Fos. S. Car., p. 14, pl. iii., fig. 2, 1858.

Pinna muricata of American authors, not Linné or Reeve.

Post Pliocene of Simmons Bluff, South Carolina, Holmes; of Charlotte Harbor, Florida, Dall; recent from the vicinity of Cape Fear, North Carolina, through the Antillean and Caribbean region, the eastern coast of Central America, and the northern shore of South America.

The variations of the *Pinnidæ* in connection with their station have been insufficiently taken into account, probably because these rough and fragile shells are unattractive to collectors and rarely gathered in any numbers. If the ground on which they live is hard and stony the shells will be short and wide, with coarse, irregular spines and distorted margins. On soft bottom the shells are more elongate and may be spiny or nearly smooth; on fine, clean sand the spinous processes are often beautifully developed and perfectly preserved. The young have a smaller number of dorsal radii which may or may not be spiny, the ventral area is generally nearly smooth, while the same individuals, when full grown, will have a profusion of small ridges and minor spines upon them in this area. In clear, still water, especially on sandy bottom, the tubulation of the spines seems to become especially marked. Such a specimen formed the type of Reeve's *P. ramulosa*. *P. alta* Sowerby was founded on a finely grown specimen with shorter spines, and the figure of Chemnitz upon which *P. rigida* Dillwyn and *seminuda* Lamarck were founded is derived from an adolescent shell, as is *d'Orbignyi* Hanley. *P. subviridis* Reeve is an old, worn specimen, and *P. carolinensis* the normal adult state. The *P. muricata* of Linné included several types. That upon which the name has finally been fixed is a true *Pinna*, and not an *Atrina*.

Atrina serrata Sowerby.

Pinna serrata Sby., Tank. Cat. App., p. v., 1825; Genera, fig. 1; Reeve, Conch. Icon., *Pinna*, xxxiv., fig. 65, 1859.

Pinna squamosissima Phil., in Roemer's Texas, p. 454, 1849; Hanley, P. Z. S., 1858, p. 226; Phil. Zeitsch. Mal., v., p. 164.

Pinna seminuda Reeve, Conch. Icon., *Pinna*, ii., fig. 2, 1858; not of Lamarck.

Pinna muricata Holmes, P.-Pl. Fos. S. Car., p. 15, pl. iii., fig. 3, 1858; not of Linné.

Pliocene of Costa Rica, Gabb; Post Pliocene of Simmons Bluff and Abbapoola, South Carolina, Holmes; of Tampa and Little Sarasota Bays, west Florida, Dall; recent from near Cape Hatteras, North Carolina, to the Caribbean Sea (Guadelupe Island.).

The *P. serrata* was founded upon a very finely spinulose young shell, which is, however, quite recognizable. The *P. squamosissima* was described from adult Texan specimens. It is the *Pinna seminuda* of most American authors, following Reeve, but not of Lamarck.

The only other fossil *Pinnæ* which I find recorded from the American Tertiaries are *P.* (*Atrina*) *alamedensis* Yates, from the Miocene of Alameda Creek, Alameda County, California, and *P.* (*Atrina*) *venturensis* Yates, from the Pliocene of Casitas Pass, Ventura County, California. These are figured and described in Bull. No. 4, Cala. State Mining Bureau, San Francisco, 1894, p. 56, pl. iv., figures 53 and 54. The two figures do not afford any evident distinction between the two species. A *Pinna aleutica*, described from Alaska by Eichwald (Geogn. Pal. Bemerk, p. 183, pl. xv., fig. 11, 1871), appears to be of Mesozoic age.

Aldrich notes the presence of a very large *Pinna* (*senso lato*) in Monroe County, Coffeeville, Alabama, in the lower bed of the Wood's Bluff group, and also at Nanafalia. Vaughan found a species, possibly referable to *A. argentea*, in the Jacksonian, at Creole Bluff, Louisiana.

Family MELINIDÆ.

(*Pernidæ*, p. 483.)

Genus MELINA Retzius.

Ostrea (sp.) Linn., Syst. Nat., ed. x., 1758, p. 699; ed. xii., p. 1149.

Mya (sp.) Linné, Syst. Nat., ed. x., p. 671; ed. xii., p. 1113.

Melina Retzius, Diss., p. 22, 1788.

Perna Lam., Prodr. Nouv. Class., p. 82, 1799; Systéme d'un Nouv. Class. des Vers, p. 134, 1801; Roissy, Conch., vi., p. 105, 1805; not of Retzius, 1788, p. 20.

Isogonum (sp.) Bolten, Mus. Bolt., p. 168, 1798; ed. ii., p. 117, 1819; (type *Ostrea isognomon* Gmelin.)

Isognomon Link, Beschr. Rostock Samml., p. 155, 1807; Desh. Enc. Meth., Vers., ii., p. 322, 1830; H. and A. Ads., Gen. Rec. Moll., ii., p. 526, 1857.

Pedalion Solander (MSS., 1786), *fide* Dillwyn, Cat. Rec. Sh., p. 282, 1817.

Sutura Muhlfeldt, Entw., p. 65, 1811; type *Ostrea ephippium* L.

Hippochæta Sangiovanni, *fide* Phil., Moll. Sicil., ii., p. 55, 1844.

Melina Schum., Essai, pp. 39, 111, 1817; Gray, P. Z. S., 1847, p. 200; Phil. Handb. Conch., p. 372, 1853; Meek, Smiths. Checkl. Mioc. Fos., p. 6, 1864; Inv. Upper Miss., p. 24, 1876.

Not *Perna*, Adanson, 1757, Klein *et al.*

The ancient Continental custom of a professor writing for a favorite pupil a dissertation for the latter to defend on his examination for a degree, is responsible for the confusion which has led to the ascription of this genus and others contained in the same paper to Philippson, for whom the dissertation was written, as well understood by the earlier writers.

It is less clear why the acceptance of the genus (which even Linnæus had it in mind to adopt in his proposed thirteenth edition of the Systema Naturæ) should have been made under a wrong name, and a name already proposed for a different group by Retzius himself. In preparing the list of families (p. 483 *antea*) the name *Perna* was incautiously accepted from Fischer without investigation. The latter, while admitting it to be "well characterized and prior to *Perna* Lam.," objects that Retzius's first species cited is an *Avicula* (*A. semiaurita* L.). It is enough that the name *Perna* was already in use and not available for Lamarck to use again; but, apart from this, Chemnitz, the chief iconographer of that time, had figured a *Melina* under the name of *Ostrea semiaurita* Linnæus, whence Retzius doubtless derived it; Linnæus himself, in his manuscript notes on *Ostrea semiaurita* for the proposed thirteenth edition of the Systema, states that its hinge was like that of *Ostrea perna*, of which Solander thought it only a variety, and authors since have differed as to the generic place of the species. If every genus in which a single species not belonging to it was included by the originator is to be rejected, only monotypical genera will remain. There is no warrant for the assumption that the first species is necessarily the type, and if it is found to differ from the generic diagnosis while others in the list agree with the generic characters given in the diagnosis, that is sufficient to exclude the divergent species from the position of type. As a matter of fact, it appears clearly from Retzius's paper that no type was selected, though *O. perna L.* may be inferred, and *Ostrea ephippium* was recognized and this species fixed as type by Schumacher and all subsequent revisers until the advent of Fischer's Manual.

The synonymy might be much extended, but that given contains the essential citations.

Subsequent writers have fixed two sections or subgenera under *Melina:*

1. *Isognomon* (Bolten) Link.

Shell plain, ventrally produced, with a posterior wing. Type *Ostrea isognomon* Gmelin.

The name *Isogonum* appears to have been a misprint, as the word is spelled in several different ways in the Museum Boltenianum.

2. *Mulletia* Fischer.

Shell ribbed, with a strong posterior wing. Type *Melina Mulleti* Deshayes.

The typical *Melina* is mytiliform, compressed, and without auriculation, or, at least, with no differentiated wing; the acute anterior beak in the young becomes obscure in the adult.

The genus in America seems to have been confined to temperate waters during the earlier Miocene, though the recent species are subtropical. One fossil *Melina* is reported from the Gulf tertiaries in the lowest Eocene.

Melina maxillata (Deshayes).

Perna maxillata Lam., An. s. Vert., vi., i., p. 142 (syn. excl.), 1819; ed. Deshayes, vii., p. 78, 1836.

Perna torta Say, Am. Journ. Sci., ii., p. 38, 1820; not of Gmelin (*Ostrea*), Syst. Nat., p. 3339, 1792.

Perna maxillata Conrad, Med. Tert., p. 52, pl. xxvii., fig. 1, 1840.

Perna Conradi Orbigny, Prodr., iii., p. 127.

Isognomon torta Conr., Cat. Mio. Fos., Proc. Acad. Nat. Sci. for 1862, p. 579, 1863.

Melina torta Meek, Smithsonian Checkl. Mio. Fos., p. 6.

Perna torta Whitfield, Crust. Moll. Mio. N. J., p. 36, pl. 5, figs. 12–13, 1895.

Lower Miocene of New Jersey at Shiloh and Jericho; of Maryland near Easton, Leonardstown, and on the Patuxent; Burns and Palmer.

The National Museum has an internal cast which measures twenty-seven centimetres in length, the shell of which could hardly have been less than fifteen inches long. Remarkably perfect specimens of this almost invariably imperfect shell were collected by Mr. W. Palmer at Leonardstown.

The identity of the American shell described by Lamarck shortly before Say with the *Perna Soldani* Desh. of the Italian tertiaries (figured by Knorr, Sowerby [as *maxillata*] in his Genera, Goldfuss *et al.*) has been disputed.

They are certainly very similar, but in any case Lamarck says his shell came from Virginia, and the specific name *torta* had been previously applied by Gmelin to a variety of *Melina mytiloides* Gmelin, so that it was unavailable for use a second time by Say. It seems that Collini in his Voy. Min. (p. 10, pl. 1, fig. 1), printed at Mannheim in 1776, had named the European shell *Ostreum polyleptoginglymum;* but, as I have not seen the work, I cannot say whether the binomial system of nomenclature is used in it or not. It is most convenient at present to regard the American as distinct from the European shell. Orbigny, regarding the European form as the true *maxillata*, renamed the American shell *P. Conradi.*

Several species of *Perna* occur in the literature which do not belong to the genus as here understood, but to *Modiolus*. The only other species of *Melina* reported from our Tertiary are the unfigured *M. montana* Conr. (Pac. R. R. Reps., vii., p. 195, 1857), from San Buenaventura, California, of which nothing seems to have been seen since it was described by Conrad, and the *Perna cornelliana* Harris, from the Midway stage of Alabama, near Clayton. The remains of this species are quite imperfect, and it is not practicable to make comparisons with *M. maxillata.*

Family PTERIIDÆ.

Genus **PTERIA** Scopoli.

Pteria Scopoli, Intr. ad Hist. Nat., p. 397, 1777; (sole ex. *Mytilus hirundo* L.)

Avicula Olivi, Zool. Adriat., p. 125, 1792.

Margaritifera Humphrey (*ex parte*), Mus. Calon., p. 44, 1797 (*apud* Da Costa, 1776, non binom.).

Pinctada Bolten, Mus. Boltenianum, p. 167, 1798.

Avicula Lam., Prodr., p. 82, 1799.

Unionum Link, Beschr. Rostock Samml., p. 155, 1807.

Margaritiphora Meg. v. Muhlf., Entw., p. 66, 1811.

Meleagrina Lam., Extr. d'un Cours, p. 104, 1812; An. s. Vert., vi., 1, p. 150, 1819.

Margarita Leach, Zool. Misc., i., p. 107, 1814; Swainson, Zool. Ill., 2d Ser., ii., pl. 55, 1831; not of Leach, 1819, or of Lea, 1838.

Perlamater Schum., Essai, p. 107, + *Avicula*, p. 136, 1817.

Anonica Oken, Handb. d. Zool., 1815; Naturg. für Schulen, p. 652, 1821.

The present group was called *Margaritifera* by J. Woodward in 1728, a name long antedating Klein's *Avicula*, but not introduced into binomial nomenclature until after the publication of *Pteria* by Scopoli. The Tertiary and recent forms include the following subgenera:

Pteria s. s. Type *Mytilus hirundo* Linné.

Margaritifera Humphrey. Type *M. margariferus* Linné.

Electroma Stoliczka. Type *Avicula smaragdina* Reeve.

Of these the latter may be represented in the recent fauna of the Antilles by *Avicula Candeana* Orb., which seems to owe its characters to commensalism with sponges; *Margaritifera* is represented by the Antillean pearl-oyster, *M. radiata* Leach, but, curiously enough, neither is known as an American Tertiary fossil.

Of typical *Pteria* there are but few in our Tertiary, and these are often represented by very imperfect material. In the Eocene of New Jersey, Conrad has found an unrecognizable internal cast to which he has given the name of *P. annosa.* It is regarded as a Gastropod fragment. A well-established species is *P. limula* Conrad (+ *claibornensis* Lea, and *trigona* Conr. non Lam.) from the Claiborne sands. The Oligocene of Vicksburg has furnished the *P. argentea* Conr., that of St. Domingo and Bowden, Jamaica, the *P. inornata* of Gabb, the Miocene of Virginia, the *P. multangula* of H. C. Lea. An unnamed species has been observed in the Midway stage of the Eocene of Georgia by Professor G. D. Harris. De Gregorio has named an unrecognizable fragment from Claiborne *Avicula cardiacrassa*, but there is nothing to indicate any distinctive specific characters in it. Cossmann, after the examination of a full series, unites it to *A. claibornensis.*

Pteria argentea Conrad.

Avicula argentea Conr., Journ. Acad. Nat. Sci., 2d Ser., i., p. 126, pl. 12, fig. 10, 1848; Proc. Acad. Nat. Sci. Phila., iii., p. 295, 1847.

Lower Oligocene of Vicksburg, Mississippi; Conrad.

Pteria (argentea var. ?) **chipolana** Dall.

Upper Oligocene of the Chipola beds on the Chipola River, the lower bed at Alum Bluff, etc., Calhoun County, Florida; Burns and Dall.

Small, with a straight hinge-line and narrow, deep ligamentary sulcus, the right valve with a small, well-marked cardinal tooth fitting into a small pit in the opposite valve; anterior wing short, small, with a narrow byssal sinus marked on the auricle by a short groove, external surface smooth, the posterior wing feebly set off; valves rather compressed, none of the valves exceeding twenty-five millimetres in length.

It is probable that this represents a species distinct from that of Vicksburg, but the material in my possession is insufficient to determine the question, but the type of *P. argentea* shows little trace of a byssal sinus and is more inequilateral than our shell.

Pteria multangula H. C. Lea.

Avicula multangula H. C. Lea, Trans. Am. Phil. Soc., ix., p. 245, pl. 35, fig. 31, 1845.

Miocene of Petersburg, Virginia, Lea; and of the upper bed at Alum Bluff, Florida, Burns.

This species, from the fragments, should reach a considerable size. Lea's type was a very small shell. The beaks are less prominent than in *P. argentea*, the byssal sinus is obsolete or feeble, the right valve has a marked semilunar pit apparently to receive a tooth from the opposite valve; the surface appears to be more or less lamellose in the adult.

Pteria colymbus Bolten.

Pinctada colymbus Bolten, Mus. Boltenian., p. 167, 1798; Chemn., Conch. Cab., viii., p. 141, pl. 81, fig. 723, 1785; Mörch, Cat. Yoldi, ii., p. 53, 1851.
Avicula atlantica Lam. (*ex parte*), An. s. Vert., vi., 1, p. 148, 1819.
Avicula hirundo Gmelin, Syst. Nat., p. 3357, 1792, *ex parte*, non Bolten.
Avicula aluco Phil., Zeitschr. f. Mal., vi., p. 20, 1850.
Avicula chloris Phil., Zeitschr. f. Mal., viii., p. 54, 1853.
Avicula macroptera Beau, Journ. de Conchyl., ii., p. 426, 1851; Krebs, Cat., p. 132, 1864, not of Reeve.
Avicula communis Krebs, Cat., p. 131, 1864, not of Lam.
Avicula heteroptera Krebs, Cat., p. 131, 1864, not of Reeve.
Avicula pteria Krebs, Cat., p. 131, 1864, not of Scopoli.
Avicula atlantica Holmes, P.-Pl. Fos. S. Car., p. 14, pl. 3, fig. 1, 1858.
Avicula hirundo Say *et al.*, non Bolten.

Pliocene of the Caloosahatchie beds, south Florida, Dall; Post Pliocene of Abbapoola and John's Island, South Carolina, Holmes; recent on the southeastern coast of the United States and in the West Indies in shallow water.

Pteria hirundo Bolten.

Mytilus hirundo Linné, Syst. Nat., xii., p. 1159, 1766, *ex parte*.
Pinctada hirundo Bolten, Mus. Boltenian., p. 167, 1798; Chemn., Conch. Cab., viii., p. 142, pl. 81, fig. 725.
Avicula tarentina Lam., An. s. Vert., vi., 1, p. 148, 1819.

Mediterranean.

Pteria hirundo var. **vitrea** Reeve.

? *Avicula strix* Phil., Zeitschr. f. Mal., vi., p. 22, 1850; (on Sargasso.)
Avicula vitrea Reeve, Conch. Icon., *Avicula*, pl. 18, fig. 68, 1857; (West Indies.)
Avicula hirundo var. *nitida* Verrill, List Fish Com. Moll., p. 281, 1884.

Post Pliocene of the West Indies and Costa Rica; recent, on the southeastern coast of the United States and in the West Indies in rather deep water.

Superfamily OSTRACEA.

Family OSTREIDÆ.

Genus **OSTREA** (L.) Lamarck.

Type *Ostrea edulis* Linné.

The genus *Ostrea*, as restricted by Lamarck and represented in our Tertiaries, comprises several conchological groups. The typical *Ostrea*, which is monœcious, producing large embryos which are incubated for a considerable period in the parental gill-laminæ, is not known to occur in America. Our common oysters belong to a group characterized by being diœcious and discharging the seminal products directly into the water, which must take the name of *Crassostrea* Sacco.* This is typified by *Ostrea virginica* Gmel. and represented in the present European fauna by *Ostrea angulata* Lam., known there as the Portuguese oyster. It being impracticable to determine the affinities of the fossil oysters with relation to these two subgenera, they will be considered here under the common generic name. It is not improbable that all the American oysters belong to the subgenus *Crassostrea.*

Conchologically, the ostrean element of the American invertebrate fauna presents three types which exist in the present fauna and may be traced throughout the Tertiary, their outlines becoming less sharp as we recede in time. In the Eocene a fourth group may be added which seems to have left no descendants.

Subgenus *Crassostrea* (Sacco, emend.) Dall (+ *Gigantostrea* Sacco, 1897). Valves discrepant, the upper valve smoother, the lower valve coarsely and irregularly plicate, with the distal margins little if at all crenulated, the hinge-margin not alate, the apices straight or oblique but not spirally twisted. Type *O. virginica* Gmel. Eocene to recent.

Section *Cymbulostrea* Sacco, 1897 (*Cubitostrea* Sacco, 1897).

Shell with the plications of the lower valve regular and fine, species usually of small size. Type *O. cymbula* Lamarck. Eocene.

It is a curious commentary on the distance from nature attained by a certain school of systematists, that their classifications enable them to put

* This name has been published since the present revision was completed, and is therefore substituted for the MS. name I had used. It is to be regretted that the diagnosis offered by the author of *Crassostrea* has no systematic value and is even opposed to the facts.

two oysters bred of the same parent in different subgenera, according to their growth in quiet water on a pebble, or in running water on a twig.

Subgenus *Lopha* Bolten, 1798 (*Rastellum* [Llhwyd, 1699] Fischer, 1886; *Alectryonia* Fischer de Waldheim, 1807; *Dendostrea* Swainson, 1840). Valves similarly sculptured, sharply radially plicated, with their margins similarly crenulated, without alæ; their apices not spiral, the shell frequently arcuate. Type *Ostrea crista-galli* Linné. Eocene to recent.

Subgenus *Ostreola* Monterosato, 1884. Valves with small, close radial riblets, less conspicuous on the upper valve, but ending on the margins with small crenulæ, otherwise as in *Crassostrea*. Type *Ostrea stentina* Payreaudeau; ex. *O. equestris* Say. Eocene to recent.

Subgenus *Gryphæostrea* Conrad, 1865. Valves discrepant, the lower valve smooth or concentrically striate, larger, with incurved apex; hinge-line with a posterior and sometimes an anterior wing; upper valve with distant elevated concentric laminæ, flattish or concave, with short apex; the margins of the valves entire. Type *Ostrea subeversa* Conrad = *O. eversa* (Mellv. ?) Conrad, + ? *O. vomer* Morton. Eocene.

As we recede in time the lines of demarcation between these groups gradually fade, and yet, even in the Cretaceous, species are found which illustrate them. The oldest type is that of *Crassostrea*. The group called *Gryphæa* is connected by slow gradations with *Ostrea*, but of the species which best illustrate *Gryphæa* none is known from Tertiary or recent faunas. *Exogyra* is a clearly distinct genus when confined to species with the typical characters. The subgenus *Gryphæostrea* Conrad was founded on an Eocene shell closely resembling a French Eocene species (cf. Smithsonian Checklist Inv. Fos.; Eocene, by T. A. Conrad, p. 33, 1866) and hardly distinct from the Cretaceous *Ostrea vomer* Morton.

Subgenus GRYPHÆA Lamarck.

Gryphæa Lam., Syst., An. s. Vert., p. 398, 1801, *ex parte*.

Gryphæa Bosc, Hist. Nat. Coq., ii., p. 307, pl. 15, fig. 1, 1802; Roissy, Hist. Nat. Moll., vi., p. 202, 1805; Cuvier, Regne An., ii., p. 459; Woodward, Man., p. 255, 1851.

Gryphæa (sp.) Lam., Hist. An. s. Vert., vi., p. 197, 1819; Fischer, Man. de Conchyl., p. 927, 1886.

Gryphæa A. Blainville, Man. de Mal., p. 522, 1825.

Pycnodonta F. de Waldh., Bull. Mosc., viii., 1835. (*G. vesicularis* Lam.)

Type *Gryphæa arcuata* Lam., Enc. Meth., pl. 189, figs. 1, 2; not *Gryphæa* Sacco, Moll. Terz. Piem., xxiii., p. 21, 1897.

Although there are no true Gryphæas in our Tertiary, the general confusion in the literature in regard to the type of this group, and its bearing on the nomenclature of the genus *Ostrea* seem to make it desirable to clear up the synonymy.

Gryphæa was described as a genus by Lamarck in 1801, no type being selected, but a number of species cited, part of which had been figured in other works, to which figures Lamarck applied names; others were undescribed, and these names were, of course, *nomina nuda* until such time as they might be habilitated. The figures to which Lamarck gave names were to be found in the Encyclopédie Methodique of Bruguière, pl. 189; Bourget, Mem. hist. nat. petr., pl. 14, 15; and Knorr, Naturg. Verst., ii., part 1, pl. 20, 60, and 62. The first two columns of the following table show the original nomenclature of Lamarck and the figures upon which it was based. The names opposite the first in the third column show the equivalent names, and the fourth column references for the same fossils, used by Lamarck in 1819 when the manuscript species of the first list were first described. Only one reference is given in the second column for each of the first list of names, and preference has been given to the plate of the Encyclopédie, which has by far the most recognizable figures.

Lamarck, 1801.	Authority.	Lamarck, 1819.	No. Page.
G. angulata Lam.	MS.	*G. angulata* Lam.	1, 198
G. suborbiculata Lam.	Enc., f. 34.	*G. columba* Lam.	2, 198
G. cymbula Lam.	Kn., pl. 20, f. 7.	*G. cymbium* Lam.	3, 198
G. arcuata Lam.	Enc., f. 1, 2.	*G. arcuata* Lam.	4, 198
G. africana Lam.	Enc., f. 5, 6.	*G. secunda* Lam.	5, 199
G. carinata Lam.	B. 15, f. 89, 90.	*G. plicata* Lam.	8, 199
G. latissima Lam.	B. 14, f. 84, 85.	*G. latissima* Lam.	7, 199
G. depressa Lam.	MS.	*G. silicea* Lam.	12, 200
G. angustata Lam.	MS.	*G. angusta* Lam.	10, 200

As Lamarck selected no type, the type must be sought from the first reviser. This was Bosc, in the following year, who cites the described species and figures as an example the *G. arcuata*, which he refers to the *Anomia gryphus* of Linné.

The next author to treat the group was Roissy, who cites as examples *G. suborbiculata* and *G. arcuata*, and figures the latter to illustrate the genus.

He mentions that the *G. angulata* was still (1805) undescribed, and that it was not even known in what collection it then was. Cuvier follows in 1817, and gives a diagnosis of the genus and refers for illustration to plate 189 of the Encyclopédie, figures 1 and 2 of which were originally named by Lamarck *G. arcuata.*

It is certain that an undescribed species cannot be accepted as a type, and the type must be selected from the described species of the original list according to the rules of nomenclature. It would seem from the above notes that this type must be the *G. arcuata* or, if they are identical, the *G. gryphus* (L.), from which the genus derived its name.

In 1819 Lamarck describes the genus again and gives a longer list of species, in which for the first time *G. angulata* is described. In this list, as the third column of the above table shows, nearly every one of the species of the original list had its name changed, for what reason is unknown; while the reference to Encyclopédie, plate 189, figures 1 and 2, is transferred from *G. arcuata* to *G. cymbium*, perhaps by a copyist's error. To *G. arcuata* is added as a synonym *G. incurva* Sowerby, from the Min. Conch., ii., p. 21, pl. 112, fig. 1, 1818.

In his remarks Lamarck states that the group has long been known under the name of *Gryphites*, which is the name Linné applied to his *Anomia gryphus* in the Museum Tessinianum, 1753.

In 1825, in the first section of his *Gryphæa*, Blainville cites as examples Lamarck's *G. cymbium* (Enc. Meth., pl. 189, figs. 1, 2) and *G. arcuata* Lam., which he figures to illustrate the genus. Woodward in 1851 cites *G. incurva* Sby.

In spite of all this, we find in Gray, Fischer, Tryon, Stoliczska, and Sacco the assumption that *G. angulata* is Lamarck's type, an opinion entirely without proper foundation. Hanley and Salter, from an examination of Linné's type, refer it to the *G. obliquata* Sby. The relations of this to the *G. arcuata* I am unable to determine, and therefore retain the specific name of Lamarck.

It is perhaps fortunate that *G. angulata* is not the type of *Gryphæa*, as anatomical and embryological investigation has shown that this species is simply an oyster of the same type as *O. virginica*, and has only a slightly twisted beak to connect it with the fossils properly called *Gryphæa*. This fact was recognized by Sowerby as soon as he became acquainted with the species, and is now beyond question.

The characters of this group can hardly be held to be generic, unless by those who are disposed to make a genus of every well-defined species. In allowing it even a subgeneric place I feel that I am giving it more than its just rank, in view of its very feeble distinctive characters.

Origin of the Mutations of Ostrea.

The oysters are a proverbially difficult group, owing partly to their adherent situs and partly to the fact that they have not hitherto been studied with regard to the direct influence of the environment on individual specimens. That this is very great I have convinced myself from a prolonged study of a multitude of specimens of *O. virginica* of which the provenance was known, and of many hundred specimens of our Tertiary species, which usually show from the character of the scar of attachment something of the circumstances in which they grew. The conclusions to which I have been led by this study may be regarded as in part provisional, but in the main highly probable, and as furnishing a first contribution to the sort of study which is essential if we would understand the processes of nature through which these animals acquire their most conspicuous external characters. They may be regarded as especially applicable to the *Crassostrea* group.

Leaving out of account the nepionic characters, the characteristics of the adult shell may be summarized and derived as follows: The most permanent characters of the shell, and the best, if not infallible, guide to specific recognition among the puzzling mutations a large series presents, are the form of the hinge-margin, the minute sculpture of the superficial layer of the shell (often denuded in otherwise perfect fossils), and the sculpture of the valve-margins near the hinge and on each side of it. While not invariable in all specimens, these characters, taken together, will usually enable one to refer the individual to its proper place.

The characteristics due to situs may be partially summarized as follows: When a specimen grows in still water it tends to assume a more rounded or broader form, like a solitary tree compared with its relatives in a crowded grove. When it grows in a tideway or strong current the valves become narrow and elongated, usually also quite straight. Specimens which have been removed from one situs to the other will immediately alter their mode of growth, so that these facts may be taken as established. When specimens are crowded together on a reef, the elongated form is necessitated by the struggle for existence, but, instead of the shells being straight, they will be irregular, and more or less compressed laterally. When the reef is dry at low stages of the tide, the lower shell tends to become deeper, probably from the need of retaining more water during the dry period. Such oysters are the so-called "raccoon oysters," a name which they get from the visits of that animal at low water to feed upon them. The so-called "raccoon oysters" figured in Dr. C. A. White's Review of the *Ostreidæ* (Ann. Rep. U. S. Geol. Survey, 1883, pl. 81–2) are not the reef oysters which first acquired this name, but deep-water specimens which had grown in a place where they were subjected to current action. When an oyster grows in clean water on a pebble or shell, which raises it slightly above the bottom level, the lower valve is usually deep and more or less sharply radially ribbed, acquiring thus a strength which is not needed when the attachment is to a perfectly flat surface which acts as a shield on that side of the shell. Perhaps for the same reason oysters which lie on a muddy bottom with only part of the valves above the surface of the ooze are less commonly ribbed. When the oyster grows to a twig, vertical mangrove root, or stem of a Gorgonian, it manifests a tendency to spread laterally near the hinge, to turn in such a way as to bring the distal margin of the valves uppermost, and the attached valve is usually rather deep, the cavity often extending under and beyond the hinge-margin; while the same species on a flattish surface will spread out in oval form with little depth and no cavity under the hinge.

The average life of the ordinary *O. virginica* when "planted" for sale is about four or five years. In prehistoric times when the reefs were undisturbed the favored individual might attain a much greater age; in which case the lower valve especially took on excessive thickness, and the cavity of the shell often became considerably elongated and somewhat hourglass-shaped, as in *O. contracta* Conr., whose characters in typical specimens are distinctly senile, while younger specimens of the same species have the normal form.

In the hinge of the oyster the resilium occupies the central ridge, while the ligament covers the edge of the depressions on each side of that ridge. The form and relative position of the muscular scar of the adductor is within certain limits a useful character, but its depression below the general interior surface of the valve or its occasional elevation above it, as in *Plicatula*, is of no systematic value, being merely a corollary of the rate of growth from the various secreting surfaces. The habit of rapid growth, causing a vesicular character of the shell substance, is more pronounced in some species than in others, and in some specimens of a species than in others; it is rarely the case that this habit (as in *O. percrassa* Conr.) has attained a constancy entitling it to systematic significance.

Having thus pointed out some of the features which are liable to mislead the student in estimating specific values, we may proceed to consider the species of our Tertiary.

Ostrea crenulimarginata Gabb.

O. crenulimarginata Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 398, pl. 68, figs. 40, 41, 1860.

? *O. denticulifera* Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., iii., p. 330, pl. 34, fig. 18, 1858.

O. præcompressirostra Harris, Rep. Ark. Geol. Surv., ii., p. 39, 1894.

O. tumidula Aldr., Rep. Geol. Surv. Ala., p. 242, pl. 14, figs. 1, 2, pl. 15, figs. 1, 2, 1894.

Midway stage of the southern Eocene, from the well at Little Rock, Arkansas; Prairie Creek, Wilcox County, Alabama; and the Chattahoochie River, near the mouth of Pataula Creek, Alabama.

Conrad's species is described from a specimen too young to show its specific characters; otherwise it is probably identical with that of Gabb.

Ostrea pulaskensis Harris.

O. pulaskensis Harris, Rep. Ark. Geol. Surv., ii., p. 40, pl. 1, fig. 3, 1894.

Midway horizon, at various points in Arkansas.

This species is represented in the collection by rather poorly preserved and young material which leaves a suspicion that it is extremely closely allied to *O. thirsæ* Gabb, though not sufficient to show their identity. The valves recall the lower valve of *O. subeversa*, but have no auriculation.

Ostrea sellæformis Conrad.

O. sellæformis Conr., Fos. Tert. Form., p. 27, pl. 13, fig. 2, 1832 (upper valve).

O. radians Conr., *loc. cit.*, fig. 1 (lower valve).

O. divaricata Lea, Contr. Geol., p. 91, pl. 3, fig. 70, 1833.

O. semilunata Lea, *op. cit.*, p. 90, pl. 3, fig. 69, *fide* Conrad.

O. falciformis Conr., Am. Journ. Conch., i., p. 140, pl. xi., fig. 1, 1865; Proc. Acad. Nat. Sci. Phila. for 1863, p. 291.

O. lingua-felis Whitfield, Lam. Rar. Clays, p. 223, pl. 29, fig. 1, 1885.

O. glauconoides Whitf., *loc. cit.*, fig. 2.

O. stellæformis Conr., Am. Journ. Conch., i., p. 15. 1865 (err. typogr.).

Eocene of Claiborne, Alabama; Coffeeville, Alabama; Coggins Point and City Point, James River, Virginia.

Variety *divaricata* Lea, Choctaw Bluff, Alabama; Natchitoches Parish, Louisiana; City Point, James River, Virginia.

Variety *perplicata* Dall.

Eocene, Caton's Bluff, Conecuh River, Alabama; L. C. Johnson.

Shell very heavy, arcuate triangular, with coarse, rounded, numerous divaricating ribs (twenty-five to forty), no auriculation or posterior sinuosity of the margin near the hinge, the upper valve extraordinarily ponderous, the general form regular and uniform, the valve margins nearly or quite simple.

Variety *rugifera* Dall.

Middle Oligocene of the Chipola beds at Alum Bluff and on the Chipola River, Florida, and in the silex beds at Ballast Point, Tampa Bay, Florida; Dall and Burns.

Shell rather thin, irregular, coarsely ribbed, more or less imbricated, margin plicate, form tending to ovate or rounded.

The above varieties belong to the section *Cymbulostrea* of Sacco.

Variety *pauciplicata* Dall.

Upper Oligocene of the Oak Grove Sands, Santa Rosa County, Florida; Burns.

Shell fan-shaped with acute beaks, thin, with few (seven to fifteen) rather large, loosely imbricated radial but not divaricating ribs, the scales more or less fluted, thin, and elevated; upper valve falcate, with concentric laminæ; structure flattish and thin.

This seems remarkably distinct from the others and points towards such species as *subfalcata* Conrad; but the whole series seems to be a continuous development from the Lower Eocene *divaricata* to the present form. The typical *sellæformis* appears to be a merely local development, probably from some peculiarity of situs of the individuals concerned. It was some time before I could bring myself to unite some of the very distinct looking forms which have been called *divaricata* with the *sellæformis* type, but careful study of a large series has convinced me that this is the proper course. It would seem as if there must be some especial reason for the singularly massive and regular character of the variety *perplicata*, but occasional specimens of *divaricata*, verging on typical *sellæformis*, exhibit a similar thickening. Gregorio adds a variety *vermilla* and another variety *læta* for modifications of sculpture.

Ostrea alabamiensis Lea.

O. alabamiensis Lea, Contr. Geol., p. 91, pl. 3, fig. 71, 1833.

O. linguacanis Lea, *op. cit.*, p. 92, pl. 3, fig. 72, 1833.

O. pincerna Lea, *op. cit.*, p. 92, pl. 3, fig. 73, 1833. (Misprinted *pincera*, *princerna*, and *pincema* in various works.)

O. cretacea Morton (*ex parte*), Syn. Org. Rem., p. 52, pl. 19, fig. 3, 1834.

O. claibornensis (Conr. MS.), Harris, Bull. Pal., i., pp. 3, 11, 1895.

? *O. semilunata* Lea, Contr. Geol., p. 90, pl. 3, fig. 69, 1833.

Eocene of Claiborne and Gosport, Alabama; Oligocene of Vicksburg, Mississippi, and perhaps of Florida and California.

The reason why the name *semilunata* was not originally adopted for the synonymous oysters of Lea was partly on account of a suspicion that the type of *semilunata* was a worn, immature specimen of *sellæformis*, and partly because the name is less appropriate. There is no reason why the original decision should be changed at present.

The *O. alabamiensis*, when its outer layer is preserved, shows, as noted by Cossmann, fine radial grooving, which is usually lost with the thin dehiscent coating referred to. The species which is here termed *O. mauriciensis* would form a direct continuation of the line of the *alabamiensis*, and it is not impossible that they should be specifically united, but I have never been able to obtain an absolutely complete specimen of Gabb's shell, so as to see if the prismatic layer agreed. From *mauriciensis* to *virginica* the gap is hardly noticeable. The Californian oyster which has been called *O. Tayloriana* Gabb is suspiciously close to the present series.

Ostrea compressirostra Say.

O. compressirostra Say, Journ. Acad. Nat. Sci. Phila., iv., p. 132, pl. viii., fig. 2, 1824.

Gryphæa mutabilis Morton, Journ. Acad. Nat. Sci. Phila., vi., p. 81, pl. iv., fig. 3, 1828; Synops. Org. Rem., p. 53, pl. iv., fig. 3, 1834.

O. sinuosa Rogers, Trans. Am. Phil. Soc., N. S., v., p. 340, 1831, and vi., pl. xxvii., fig. 1, 1839.

O. disparilis Conr., Medial Tert., p. 51, pl. 26, 1840.

O. Tuomeyi Conr., Proc. Acad. Nat. Sci., ix., p. 184, 1865 (not of Coquand, 1869, Mon. Ostr., p. 68).

? *O. pandiformis* Aldr., Journ. Cin. Soc. Nat. Hist., p. 79, 1887, as of Gabb, Proc. Acad. Nat. Sci. Phila. for 1861, p. 328, 1862.

O. Raveneliana Tuomey and Holmes, Pleioc. Fos. S. C., p. 21, pl. 6, fig. 1, 1855; Conr., Proc. Acad. Nat. Sci. Phila. for 1863, p. 582.

O. bellovacina Conr., Bull. Nat. Inst., ii., p. 172, 1842, not of Lamarck.

Eocene: of Piscataway Creek, Upper Marlboro, and Leland, Prince George County, Maryland; lower bed Aquia Creek, of Evergreen, Gloster City, City Point, and Coggins Point, Virginia; also on the Eastern Shore of

Virginia, Fort Washington, Virginia, in the North Carolina Eocene, and that of Bell's Landing, Alabama; a variety *alepidota*, without raised lamellæ externally but with radial grooves, is noted from Aquia Creek and the South Carolina Eocene.

Oligocene: of the lower bed at Alum Bluff, Florida.

Miocene: of the upper bed at Alum Bluff, Florida; of Grove, St. Thomas, Cooper River, and Darlington, South Carolina; Snow Hill and Duplin County, North Carolina; Grove Wharf, James River, and the Nansemond River, near Suffolk, Virginia, and Imlaytown, New Jersey.

Pliocene: of Peace Creek, near Arcadia, Florida?

This well-known shell, though not exceptionally variable, has had many names. A specimen of *Gryphæa mutabilis* Mort., given by Dr. Morton to Dr. Lea and agreeing precisely with Morton's figure and description, is simply a somewhat worn, smoothish specimen of this species. There is little or no uncertainty about the other synonymes.

It is first distinctly noted in the upper bed at Bell's Landing, Alabama, in the Chickasawan series, whence it occurs through the Eocene, Oligocene, Lower and Upper Miocene, and even, if one or two rather poor specimens can be referred to it, in the Pliocene sands of south Florida. These last may be Miocene redeposited. The specimens from Virginia which grew under advantageous circumstances are often widely alate with much elevated, elegantly fluted concentric lamellæ. The average specimen, however, has much less prominent alæ and imbrications. Comparatively smooth specimens are very close to *O. trigonalis*.

Ostrea thirsæ Gabb.

Gryphæa thirsæ Gabb, Proc. Acad. Nat. Sci. Phila. for 1861, p. 329.
Ostrea thirsæ Heilprin, Ann. Rep. U. S. Geol. Surv. for 1883, p. 311, pl. 63, figs. 4, 5, 6, 1884.

Eocene of the lower Chickasawan series at Nanafalia Bluff, Tombigbee River, and at Eufaula, Alabama.

This appears to be a well-marked species, smooth with hardly any tendency to plication, almost nautiloid in form, and belonging to the same group as the next species.

Ostrea Johnsoni Aldrich.

O. Johnsoni Aldr., Geol. Surv. Ala., Bull, p. 41, pl. 6, fig. 6, 1886.

Lower Claibornian Eocene of the Monroe County, Alabama, calcareous sand bed; Claiborne, Lisbon, and Newton, Alabama, and at Caton's Bluff, Conecuh River, Alabama.

This is an excellent species with a few strong plications, making the valves claw-like; otherwise close to *O. thirsæ.*

Ostrea (Gryphæostrea) subeversa Conrad.

Gryphæostrea subeversa Conr., Am. Journ. Conch., 1, p. 15, 1865; Checkl. Inv. Fos. Eocene, p. 33, 1866.

Gryphostrea eversa (Deshayes) Conr., Checkl. Inv. Fos. Eocene, p. 3, 1866.

Ostrea eversa (Mellv.) Heilprin, Ann. Rep. U. S. Geol. Surv. for 1883, p. 310, pl. 64, figs. 5–8, 1884.

? *Gryphæa vomer* Morton, Synops. Org. Rem., p. 54, pl. ix., fig. 5, 1834; *not* in Journ. Acad. Nat. Sci. Phila., vi., pl. v., figs 1–3, 1828.

Cf. *Ostrea lateralis* Nilsson, Petr. Suec., p. 29, pl. 7, figs. 7, 10, 1827, and *Gryphæa canaliculata* Sby., Min. Conch., pl. 26, fig. 1, 1812 (as *Chama*).

? Cretaceous of the lower Greensand and upward in New Jersey, especially near New Egypt.

Eocene of Upper Marlboro', Maryland, Conrad; Jacksonian Eocene of Fail Post-Office, and the Zeuglodon bed at Cocoa Post-Office, Choctaw County, Alabama.

This species is worth more thorough study by some one familiar with the Cretaceous forms of both Europe and America. Its relations are merely indicated by the above synonymy.

Ostrea trigonalis Conrad.

Ostrea trigonalis Conr., Proc. Acad. Nat. Sci. Phila., vii., p. 259, 1855; Wailes, Geol. Miss., p. 289, pl. xiv., fig. 10 (bad), 1854; Lesueur, Walnut Hills Fos., pl. 4, fig. 17, pl. 5, fig. 1, 1829.

? *O. Attwoodii*, Gabb, Pal. Cal., ii., pp. 33, 106, pl. 10, fig. 58, pl. 11, fig. 58 *b*, 1869.

? *O. subjecta* Conr., Pac. R. R. Rep., vii., pt. 1, p. 193, pl. 2, fig. 3, 1857. (Young shell.)

Upper (Jacksonian) Eocene of Jackson, Mississippi; Fail Post-Office and Cocoa Post-Office, Choctaw County, Alabama; Turks Cave, Alabama; Hinds County, Mississippi; Creole Bluff, Grant Parish, Louisiana.

Lower Oligocene (Vicksburgian) of Vicksburg, Mississippi; Upper Oligocene of White Beach, Little Sarasota Bay, Florida, and Oak Grove, Santa Rosa County, Florida.

Miocene of Greensboro', Choptank River, Maryland; Edgecombe County, North Carolina.

Pliocene of Peace Creek, near Arcadia, and Alligator Creek, Florida.

The original figure of Conrad is very poor. The species is widespread and recognized by its flat upper valve, few-ribbed lower valve, straight hinge-line, flat hinge-area, with excavated central channel and the peculiar vermicular sculpture of the submargin on each side near the hinge-line. It is not improbable that *O. percrassa* Conrad is a peculiar local race of this species and that *O. Mortoni* Gabb and *O. vicksburgensis* Conrad are young pebble-grown shells of the same species as the large, well-grown specimens which I regard as normal *trigonalis*. The differences are, however, so marked that it is probably best to keep them separate for the present, until more is known. *O. subtrigonalis* of Evans and Shumard is a Cretaceous species. Varieties of *O. compressirostra* approach very closely to this species.

Ostrea vicksburgensis Conrad.

O. vicksburgensis Conrad, Proc. Acad. Nat. Sci. Phila., iii., p. 296, 1848; Journ. Acad. Nat. Sci., 2d Ser., i., p. 126. pl. 13, figs. 5, 37, 1848.

O. panda Morton, Syn. Org. Rem., p. 51 (*ex parte*), pl. 19, fig. 10, 1834.

O. Mortoni Gabb, Proc. Acad. Nat. Sci. Phila., p. 329, 1861.

Jacksonian Eocene of Fail Post-Office and Cocoa Post-Office, Choctaw County, Alabama; Eocene of South Carolina and Clarksville, Alabama; Vicksburgian Oligocene of Vicksburg, Mississippi; Burns and Johnson.

As previously noted, this species is probably an offshoot of *O. trigonalis*. The Vicksburg type differs from the Jacksonian only in having the ribs less imbricated and more rounded, a distinction which is not constant.

Ostrea falco Dall.

Plate 30, Figures 4, 11.

O. falco Dall, Proc. U. S. Nat. Mus., xviii., p. 22, 1895.

Jacksonian Eocene of Cocoa Post-Office, Choctaw County, Alabama, in the Zeuglodon bed; Burns and Schuchert.

This remarkably distinct species is well characterized by its cellular lower valve, radiately striate, flat, arcuate, and hooked upper valve, and the strong denticulations of the submargin. Held horizontally, the profile of the upper valve is remarkably like that of the head of a raptorial bird, and this form is exceptionally constant.

Ostrea podagrina Dall.

Plate 30, Figures 5, 6.

O. podagrina Dall, Proc. U. S. Nat. Mus., xviii., p. 22, 1895.

Upper Eocene of the west bank of the Suwanee River, near the Sulphur Spring, Florida; Eldridge.

This singular species differs from *O. percrassa* and heavy specimens of *O. trigonalis* in its few strong plications and the rounded lateral portions of the hinge-area, which in the above-mentioned species are conspicuously flat.

Ostrea percrassa Conrad.

O. percrassa Conr., Fos. Med. Tert., p. 50, pl. 25, fig. 1, 1840; Proc. Acad. Nat. Sci. Phila., xiv., p. 582.

? Eocene of Wood's Bluff, Alabama, and near Lawrence, Mississippi; L. C. Johnson (var. *sylværupis* Harr.).

Miocene of Stow Creek, Cumberland County, New Jersey, Conrad; of Shiloh and Jericho, New Jersey, Burns; of Magnesia Spring, Alachua County, Florida, Burns.

This species in its typical form is of a porous and vesicular texture, giving the extremely thick shell a surprisingly light weight.

Specimens from the southern Eocene cited above have the same form and characteristics, but the usual dense and heavy shell of other oysters. These latter might be taken for exceptionally thick and senile specimens of *O. trigonalis*, which in that case would figure as the original stock of *O. percrassa*.

This completes the list of positively Eocene species; the *O. panzana* Conrad (P. R. R. Rep., vii., pt. 1, p. 193, pl. 2, fig. 4, 1857 + *O. pansa* Conr. (err. typ.), 1866), which was doubtfully referred to the Eocene by Conrad, is a perfectly unidentifiable species described from a worn and extremely obscure type now in the National Collection, but which probably belongs to a horizon later than the Eocene.

Ostrea georgiana Conrad.

O. georgiana Conr., Journ. Acad. Nat. Sci. Phila., 1st Ser., vii., p. 156, 1834; Dana, Man. Geol., 1st ed., p. 519, fig. 811, 1863.

O. contracta Conr., Rep. Mex. Bound., vol. i., pt. ii., p. 160, pl. 18, fig. 1, 1857.

O. titan Conr., Proc. Acad. Nat. Sci. Phila., vi., p. 199, 1854; Pacific R. R. Rep., vi., p. 72, pl. iv., fig. 17 *a*, pl. v., fig. 17 *a*, 1857.

Oligocene of the lower bed at Vicksburg, Mississippi, and Choctaw Bluff on the Alabama River, Alabama; also at Clarksville, Alabama, and Shell Bluff, Savannah River, Georgia; Miocene of Oyster Point, upper Rio Grande, near Roma, Mexico; Martinez, California; Roberts Ferry, near New Berne, North Carolina.

The different names under which this gigantic oyster has been known are seen to be founded chiefly on geographical reasons as soon as the types are compared. The characters of the shell are all explainable by the effect of age and situs, so far as they differ from one another. The figuring of a typical specimen in Dana's Manual has generally been overlooked. The typical *O. georgiana* are the enormous senile specimens with shells ranging to two feet long and three or four inches thick. The young and really more normal specimens have been overlooked, though much more abundant, or referred to other species, chiefly *O. virginica*, from which they differ by their more elongated, usually straight, deeply excavated cardinal area and the absence of ribbing on the lower valve in most specimens.

Ostrea georgiana, forma normalis.

O. mauricensis Gabb (*ex parte*), Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 376, pl. 67, fig. 26, 1860.

O. Bourgeoisii Rémond, Proc. Cal. Acad. Sci., p. 13, 1863; Gabb, Pal. Cal., ii., p. 33, pl. 11, fig. 57, 1869.

O. Tayloriana Gabb, Pal. Cal., ii., p. 34, pl. 12, fig. 60, 1869.

Oligocene of Shell Bluff, Savannah River, Georgia; of Martin Station, Florida; White Sulphur Spring, Suwanee River, Hamilton County, Florida; six miles southwest of Gainesville, Alachua County, Florida; La Penotiere's hammock, near Orient, Tampa, Florida; Nigger Sink, Newnansville; Devil's Millhopper, near Hawthorne; Sullivan's old field, Levy County; Johnson's Sink, Levy County; Magg's Springs, Alachua County; silex beds of Ballast Point, Tampa Bay; Rock Bluff, Appalachicola River, Calhoun County; red clay (so called Lafayette formation) over the Oak Grove marl, Santa Rosa County, Florida, and lower bed at House Creek, Georgia.

Lower Miocene marl of Shiloh and Jericho, Cumberland County, New Jersey, and near Wilmington, North Carolina; Miocene of California and New Mexico.

It is not unlikely that to the above synonymy should be added *O. veleniana* Conrad (a typographical error for *heleniana*) of the Mexican Boundary Report, 1857, and the unrecognizable *O. panzana* and *O. robusta* Conrad, 1857.

The *O. Tryoni* Gabb (1881), from the Miocene of Costa Rica, appears to be a well-characterized species.

The young *O. georgiana* Conrad is the characteristic fossil of the Upper Oligocene of the Gulf States often found in northern Florida scattered over the surface of the Vicksburg limestone from which the Upper Oligocene marl has been dissolved away. It is the "leit fossil" of the Grand Gulf beds, though not confined to them, and occurs in the single meagerly fossiliferous bed below the Altamaha grits. The specimens are usually in poor condition superficially, having the exterior and often the interior vermiculately eroded. It occurs but rarely in the true Miocene, where it seems to become modified into the early type of *O. virginica*, which is not improbably its direct descendant. In old Post-Pliocene beds or oyster reefs it is not uncommon to find enormously thickened senile specimens of *O. virginica* which present many of the features of the Oligocene *O. georgiana*.

Ostrea haitensis Sowerby.

O. haitensis Sby., Quart. Journ. Geol. Soc., vi., p. 53, 1850.
O. haytensis Gabb, Trans. Am. Phil. Soc., 1873, p. 257.
O. Veatchii Gabb, Pal. Cal., ii., p. 34, pl. 11, fig. 59, pl. 17, fig. 21, 1869.
O. Heermanni Conr., Proc. Acad. Nat. Sci. Phila., v., p. 267, 1853; Pac. R. R. Rep., v., p. 326, 1855.
O. vespertina Conr., Pac. R. R. Rep., v., p. 325, pl. 5, figs. 36–8, 1855; Gabb, Pal. Cal., ii., p. 107, 1869. (Young shell.)
O. virginica Guppy, Quart. Journ. Geol. Soc., xxii., p. 577; not of Gmelin.
O. virginica var. *californica* Marcou, Geol. N. Am., 1858.

Oligocene of Haiti, of the Bowden marl of Jamaica, of the Chipola beds of Calhoun County, Florida, and of the Oak Grove marl, Santa Rosa County, Florida.

Miocene (?) of Carrizo Creek, Colorado Desert, California, and of various other localities in California.

Gabb recognized the identity of his *O. Veatchii* with the St. Domingo species, and a comparison of Carrizo Creek specimens adds the unfigured *O. Heermanni* to the list of synonyms. The *O. vespertina* was described from young shells from the types in the National Museum, and there can be no question of their identity. It is to be discriminated from its associated *O. Attwoodi*, which has a smooth upper valve, by the fact that both valves are similarly plicated.

Ostrea megodon Hanley.

O. megodon Hanley, P. Z. S., 1845, p. 106; Reeve, Conch. Icon., *Ostrea*, pl. xii., fig. 24 *a–b*, 1871.
O. gallus Val., Plates of the Voy. Venus, Coq., pl. 21 (no text), 1846.
O. cerrosensis Gabb, Pal. Cal., ii., p. 35, pl. 11, fig. 61, 1869.

Oligocene of St. Domingo and of the Bowden marl, Jamaica; Miocene (?) of Cerros Island, off Lower California; Post Pliocene of Lower California. Recent in the Gulf of California at Acapulco and southward.

This is one of the types which were exterminated on the east coast of America by the disturbances which united the two continents and cut off access to both oceans, and which survived to the present fauna on the western side of the continent as united. It appears to be rare in the Oligocene, but the type is much older and is represented in the Cretaceous by *O. falcata* Morton.

Ostrea carolinensis Conrad.

O. carolinensis Conr., Fos. Tert. Form., p. 27, pl. 14, fig. 1, 1832.

Eocene of South Carolina?

Miocene of the Santee Canal, South Carolina, Ravenel; and of the Choptank River, Maryland, Burns and Harris.

The original reference of this species to the Eocene is probably erroneous. The species, represented by some of the original Santee specimens in the National Collection, has only been definitely recognized from the Lower Miocene.

It appears to be a sufficiently distinct species, nearly related to *O. trigonalis.*

Ostrea sculpturata Conrad.

O. sculpturata Conr., Medial Tert., p. 50, pl. 25, fig. 3, 1840.

O. virginiana Conr., Fos. Tert. Form., p. 28, pl. 14, fig. 2, 1832; not of Lamarck.

O. subfalcata Conr., Medial Tert., p. 50, pl. 25, fig. 2, 1840.

O. virginiana Tuomey and Holmes, Pleioc. Fos. S. Car., p. 20, pl. 5, figs. 7–9 (fig. 6 excl.).

O. perlirata Conr., Kerr, Geol. Rep. N. Car., App., p. 18, 1875.

O. meridionalis Heilprin, Trans. Wagner Free Inst. Sci., i., p. 100, pl. 14, fig. 35, 35 *a*, 1887.

Miocene of Coggins Point, Petersburg, Nansemond River near Suffolk, York River near Yorktown, and the north end of the Dismal Swamp, Virginia; of Wilmington, Snow Hill, the Natural Well of Duplin County, Magnolia, Duplin County, and the Neuse River ten miles above New Berne, North Carolina; of Darlington, South Carolina, and De Leon Springs, Florida.

Pliocene of the Waccamaw beds, South Carolina, and the marls of the Caloosahatchie, Shell Creek, and Alligator Creek, Florida.

Ostrea virginica Gmelin.

O. virginiana of Lister and other nonbinomial writers.
O. virginica Gmelin, Syst. Nat., p. 3336, 1792; Dillwyn, Descr. Cat., i., p. 277, 1817; Lam., An. s. Vert., vi., p. 207, 1819.
O. edulis Akerly, Am. Monthly Mag., ii., p. 296, 1818; not Linné.
O. virginiana Sby., Genera, *Ostrea*, f. 2, 1822.
O. borealis Lam., An. s. Vert., vi., p. 204, 1819.
O. canadensis Lam., *op. cit.*, p. 207, 1819.
O. triangularis Holmes, Proc. Elliott Soc., i., p. 29, 1856.
O. fundata Holmes, Post-Pl. Fos. S. Car., p. 11, pl. 2, fig. 10, 1858.
? *O. semicylindrica* Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., ii., p. 258, 1822.

Miocene of Cumberland County, New Jersey?

Pliocene of the Caloosahatchie and Myakka Rivers, Florida; Post Pliocene of the Atlantic and Gulf coasts from Prince Edward's Island to Florida, Texas, and California. Recent from Prince Edward's Island south to Florida and west to Mexico, and on the west coast of Mexico near the head of the Gulf of California.

This well-known species occurs positively in the Pliocene of Florida, but the Miocene citations require revision. Specimens from the New Jersey marls received from Professor Whitfield under this name were either *O. georgiana* mut. *mauricensis* or the young of *O. percrassa*. Most of the southern species thus named are better placed elsewhere. Say does not appear to have published any *Ostrea fundata*, though the name has been used on his authority by Ravenel and Holmes. The long current-bred specimens, by confusion with those which have become elongated by mutual compression, have received the varietal name of *procyon* from Holmes. The same shell appears to be the *O. rhizophoræ* of Guilding and Reeve, though not *O. rhizophora* of Dillwyn.

The *O. lurida* Cpr. (1863) and *O. palmula* Cpr. (1857) with its variety *conchaphila* Cpr. (1857) are known from the Post Pliocene of the Pacific coast. I have not yet seen *O. folium* Linné or *O. equestris* Say, in the fossil state, on the east American coast.

O. solea Conrad appears to be a mere list-name, never figured or described. *O. Tuomeyi* Coquand (Mon. Ostrea Terr. Crét., p. 68, 1869) was proposed for the preoccupied name of *crenulata* Tuomey, but Conrad had already used the specific name of *Tuomeyi* (1865) for a fossil oyster from Mississippi, so if the Coquandian fossil is a good species it will require a new name.

O. pandæformis Gabb, 1862, an unfigured, supposedly Cretaceous, species, is regarded as unidentifiable by Dr. C. A. White, but is considered by Aldrich to be Jacksonian and identical with *O. Tuomeyi* Conrad. It is, perhaps, from Aldrich's remarks, a form of *trigonalis.*

Gryphæa athyroidea Guppy (1866), from the Tertiary of Trinidad, appears to be a true *Ostrea* and distinct from any of the continental species.

I have not attempted to make comparisons with the European species, as that would require a series of the latter, which is not accessible, but a casual inspection of the figures does not give the impression that there are many of them which might be identical with American forms.

Superfamily NAIADACEA.

Family UNIONIDÆ.

Genus UNIO Retzius.

Unio (Unio) caloosaënsis n. s.

Plate 25, Figures 6, 12 *a*.

Pliocene marls of the Caloosahatchie River, Florida; Dall.

Shell oblong-ovate, rounded in front, somewhat pointed at the ventral angle behind, umbonal region only moderately prominent, sculptured with numerous fine concentric wrinkles and seven or eight wavy, sharply elevated, narrow, concentric ripples; the latter are most prominent on the line of the posterior angle of the valves, on each side of which the ripple recedes, perceptibly making a small sinus, more conspicuous than any of the small fluctuations of the rest of the ripple; sides moderately compressed; ventral margin gently arcuate, straight, or slightly incurved just in front of the posterior angle which forms the ventral boundary of the posterior dorsal area; posterior end rounded above, slightly rostrate ventrally; valves solid, nearly smooth, or with more or less irregular incremental sculpture and faint traces in some specimens of obscure radial lines near the posterior ventral angle; interior with strongly impressed pallial line and muscular impressions; "cardinal" teeth short, the ventral one usually stouter in the right and the dorsal in the left valve; laterals low, solid. Lon. 57, diam. 20, alt. 32 mm.

This species, though usually defective, is not uncommon in the marls and sometimes with the valves in their natural position. The species belongs to the group of *Unio Buckleyi* of the recent fauna, which is abundantly represented in the Floridian lakes. Having submitted it to Mr. Charles T. Simpson, who has made a specialty of these mollusks, he has expressed the opinion that it is undescribed. It is somewhat singular that this is the only Tertiary species of *Unio* known from east of the Mississippi in the United States. There are a number of Post-Pliocene species, including those from the New Jersey clays, which were long regarded as Cretaceous.

Superfamily PECTINACEA.

Family PECTINIDÆ.

Genus PECTEN Müller.

Pecten (Klein, 1753) Müller, Prodr. Zool. Dan., p. 248, 1776; Da Costa, Brit. Conch., p. 140, 1778; Bolten, Mus. Bolt., p. 165, 1798; Lamarck, Prodr. d'un Nouv. Class. Coq., p. 88, 1799. Type *Ostrea maxima* Linné.

The name *Pecten* is very ancient, and appears in the prelinnéan literature colloquially. Although Linné himself did not formally adopt it as a genus, he has used the term casually in some of his minor papers. It was first introduced into binomial literature by Müller. An excellent discussion of the characters of the group by Verrill appears in the Trans. Conn. Acad. Sci., vol. x., pp. 41–57, 1897. The genus has been repeatedly subdivided and the number of groups which have been named, chiefly on the shell characters of recent species, is very large. As might be expected, when the fossil forms are taken into consideration, the groups merge into one another by insensible gradations, and so far as I have been able to examine the anatomy the same is true of it also, while the minor differences of the gross anatomy do not appear to be at all strictly correlated with the superficial modifications of the shell. Like *Conus*, as demonstrated by Bergh, the Pectens seem to form a natural genus with a profusion of minor modifications, which may be separated for convenience into sections and subgenera, but possesses within certain general limits very uniform characters. The value of the named groups will differ with the personal equation of those who deal with them, but it appears impossible, when the fossils are included, to draw lines of generic demarcation which shall be clear-cut yet not in violation of nature.

In various geological horizons, as well as in the existing fauna, certain species of *Pecten* assume a sessile habit, involving an irregular subsequent growth of the valves after attachment to other objects, as in *Hinnites*. These species have no necessary genetic connection with one another except what they gain from their relations to the *Pectinidæ* as a group, and must be regarded as purely sporadic adjustments of individual forms to a particular environment.

The shell of *Pecten* comprises two generally more or less discrepant valves, united along a long, straight hinge-line by an inconspicuous ligament and a central strong resilium. A single rounded adductor leaves its impression pretty high up, a little before the mesial line of the valves, and the pedal retractors are usually attached to the left valve above it, being often obsolete on the right side. The ends of the resilium are received by subtriangular or oval pits in the umbonal region. These pits may be shallow or deep; their basal margin sometimes projects slightly into the cavity of the valves; their apex is always nearly coincident with the umbonal point of the valve. In a few species, in the right valve, the lateral margins of the pit are raised into tooth-like processes, which fit into corresponding depressions in the opposite valve (*e. g.*, *P. Swiftii* Bernh.), but these are not homologous with the so-called teeth of *Plicatula* and *Spondylus*. Outside of these, radiating fan-like from the apex of the valve, are frequently found one to three pairs of more or less prominent laminæ, which I call the cardinal crura, and further away and below, on the ridges which mark the lower boundary of the ears, will sometimes be found another pair, only distally conspicuous, which I have named the auricular crura. The cardinal crura are most conspicuous in heavy shells, especially such as *Pecten* proper and *Lyropecten*, and serve to adjust the closing of the valves, as does the hinge armature of the Teleodonts. In a few species the crura are sufficiently prominent to actually interlock with the valves half open; in many others hardly any trace of them is visible. Almost all species possess in the nepionic stage a well-marked provinculum, formed by an elongated area on each side of the pit, covered by long, narrow, close-set taxodont teeth, separated by narrow grooved interspaces. In most species the provinculum is evanescent or represented in the adult only by faint vertical striæ, which cross the cardinal crura. In a few small, thin-shelled, mostly deep-water species, the provinculum is persistent and functional (*e. g.*, *P. thalassinum* Dall), forming an interlocking hinge. In *Pecten* proper, *Chlamys*, and some other groups, the upper cardinal margin of the right valve is bent over that of the left valve. There are occasional species in which the adult valves have each a flat area along the whole cardinal margin, covered by the ligament and forming a V-shaped groove between the upper margins of the valves, as in *P. Swiftii*. The disk of the valve is usually rounded or oblique below and at the sides, but above continued on each side in a straight line to the umbo. The shell adjacent to these straight lines is frequently slightly different in sculpture from the rest of the disk, forming narrow areas, which were called by Conrad the "submargins." Above the submargins the auricles, or ears, project, usually differentiated by a linear depression ending in a sinus below. This sinus is sometimes absent in the posterior ears, as it is in the very young stages of the shell, but it is not an important systematic character, since the same species (*e. g.*, *P. latiauritus* Conr.) may exhibit varieties some of which have a well-developed posterior sinus while others are without it. The right anterior sinus is usually emphasized by a flexuosity in the lower edge of the ear above it for the accommodation of the byssus, and on the upper part of the submargin are usually found a number of small, regularly spaced spines, which in life separate the threads of the byssus and thus keep it from twisting with the motion of the water. The growth of the margin of the valve and ear does not always march with the development of these spines, so that a species which normally has them may exhibit stages when the valve margin has grown over the old set and the new set has not been formed, much like the inequalities of growth shown by the margin of the aperture and the internal liræ of some Gastropods. This set of spines, resembling a short comb with curved teeth, has been called ctenolium, pectineum, and pectinidium. In old very heavy shells, which are held in place more by their own weight than by the formation of a byssus, they are often absent, but may usually be traced in the groove corresponding to the younger stages, or fasciole, of the sinus.

The swimming habit of *Pecten* is well known. It is more commonly exercised by the thin-shelled light or young individuals than by the heavier or adult specimens. The lateral ends of the ears do not close tightly. The valves being open, a quantity of water is retained between the inner laminæ or "curtains" of the mantle, and the contraction of the adductor forces this water out between the submargins and through the cavity of the auricles, which impels the animal forward, the ventral margin of the valves being in advance as it moves. In this way the *Pecten* moves quite rapidly with a jerking motion.

In proportion to its surface the shell of *Pecten* is thin, and in the adult is usually ribbed or fluted, a condition brought about, doubtless, by natural selection and serving to strengthen the valves, which in swimming and falling on the bottom are subjected to rude shocks. When these flutings are formed in a thin shell, the interior is usually grooved in harmony with the ribbing of the exterior. To still further strengthen the shell at its weakest point, when the flutings are of angular section, a linear deposit of shelly matter is often deposited on the angle internally, forming liræ, coincident with the angle of the shell between the ribs and interspaces. This liration becomes habitual in some species. If then in the evolutionary progress of these forms it happens that the external ribbing becomes obsolete, the liræ may be retained by natural selection, as useful in strengthening the flattened disk, and thus we have the internal liræ of *Amusium* accounted for. It is not at all uncommon for ribbed species to have a smooth or obsoletely ribbed variety, and among the Eocene species here described is one which, within the species, shows every stage of the transition between a ribbed *Pecten* and an internally lirate *Amusium*, thus rendering it impracticable to assign the latter group a systematic value greater than that of a subgenus. The same thing may be observed in a good series of the recent *P. hyalinus* Poli. While the liræ may appear without relation to any external sculpture in their final stage, there seems to be no doubt that, at the time of their inception, they were absolutely dependent upon a particular kind of external ribbing or fluting.

In the obsolescence of ribbing the right anterior ear, probably because of strains resulting from the adjacent byssus making special strength necessary, usually is the last to lose its radial ribbing, and often retains it after the rest of the shell is practically smooth.

Apart from the ribs or riblets, which usually cover the surface of the disk and ears, there are two other forms of external sculpture to be noted. One of these, originally supposed to be exclusively characteristic of the genus *Camptonectes*, is composed of fine, almost microscopic, more or less vermicular groovings, which radiate from the umbo and are deflected laterally from a mesial line of the disk. This is commonly known as the *Camptonectes* striation or sculpture, and is common to many recent forms, both ribbed and smooth. It is usually most conspicuous on the submargins, but often plainly visible in the smoother species (such as *P. grönlandicus*) over the whole disk.

The other type of sculpture, which may coëxist with any or all of the others, is a product of the minute concentric sculpture due to imbricated incremental lines. In *Pecten* proper the concentric sculpture is usually simple and sometimes (as in *P. ziczac*) almost absent.

In *P. maximus* it takes the shape of minute regularly spaced concentric lamellæ on the disk, but on the submargins and part of the ears this sculpture is often crowded and the distal edges of the lamellæ more or less concrescent. In *Chlamys*, however, the most beautiful and complex surface-sculpture of this sort is found. The lamellæ are elevated, and at points corresponding to a minute radial line give out little linguiform projections. Often these alternate on adjacent radials and, their distal edges being concrescent, a reticulated cellular sculpture results. This may be still further modified by minute differences of the radials, and finally the distal edges may become completely concrescent, hiding all the cellularity below. By erosion, when still alive, the last stage may be and usually is lost almost completely; it is more commonly preserved in fossil than in recent specimens. The paleontologist may find, according to the vicissitudes his specimen has undergone, (1) the concrescent surface alluded to; (2) the reticular cellularity of the lamellæ which have lost their upper surface; (3) the mere tracery of the bases of the lamellæ, the walls of the cells being gone; or (4) the surface completely smooth from wear and yet not obviously eroded. Great care is necessary, therefore, not to be misled into describing as different structures which originally were identical.

The original prototype of *Pecten*, judging from the stages of recent shells and the succession of the fossils, was a thin, nearly smooth shell, with a taxodont provinculum and the posterior ears ill-defined. Many sculptured Pectens begin their career in this form. Subsequently the ribbed species with cardinal crura were developed. Next ribbing became obsolete in more sedentary species. The left valve, being that most in contact with other objects, retained the radial sculpture longest. Species inhabiting soft ooze and depths where motion of the water is feeble and infrequent, or defended by a situs among the arborescent corals or other safe nooks, finally lost the radial sculpture altogether or only retained the internal liræ. The disparity of sculpture between the two valves observable in many deep-water Pectens is perhaps accounted for by the fact above mentioned that the left valve retained the ribs longer than the right valve, and, secondly, that flexibility in the ventral edge of the right valve (incompatible with radial ribbing) became useful in excluding the impalpable mud of great depths by its more hermetic sealing of the valves. Consequently, the concentric sculpture of this valve, which is inherent in its mode of growth, alone survived.

The most modern type of *Pecten* is doubtless *Amusium*. That it is derived from a ribbed form is shown by some of the Oligocene species which have (like *A. Lyoni* Gabb) a nepionic ribbed stage. I believe this group of forms is chiefly sedentary, as the shell and relatively feeble adductor are not suited to rapid motion and the violent shocks involved in this mode of progression. The peculiar hood-shaped form of the distal part of the foot is better suited to act as a sucker or scoop-anchor, by which the animal might drag itself about, than as a stilt or vaulting-pole, as in some of the shallow-water species.

The discrepancy in size of the valves appears to be more or less related to the activity of the animal. The species in which the difference is greatest are probably the more sedentary. In nearly all sessile Pelecypods the lower valve is deeper, and the differences in the Pectens are probably due to the same factors of the environment.

In nearly all the species the right valve is the least inflated. In a few, which are among the most active swimmers (like *P. irradians* Lam.), the right valve is more convex than the left. It does not seem to be a feature of systematic importance, as species otherwise apparently nearly allied differ in this respect.

The influence of the environment is very marked among the Pectens. As in mammals and birds, the same species in the northern part of its range is larger than in the south, unless it is a distinctively tropical species. But in color the rule is reversed, the southern specimens being lighter and more brightly tinted than the northern ones in the same species. The specimens which live in deep water and swim actively are usually thinner-shelled and smoother, while those which inhabit the lagoons are heavier, have more conspicuous concentric sculpture, and more solid shells. These differences are very marked in our common east coast *P. irradians*, of which *P. dislocatus* Say is the southern lagoon form; and parallel differences appear in the similarly related *P. ventricosus* and its variety *æquisulcatus*, on the Pacific coast, and in the fossil *P. eboreus* and *comparilis* of the Carolina Tertiaries.

Whatever might be advisable were our knowledge of the *Pectinidæ* confined to the recent species, any paleontological division of them cannot ignore the intergradation which is so obvious between the different types, of which the extremes appear so unlike.

For this reason the subdivisions adopted here will be comparatively few, and their rank such as belongs to groups obviously connected by intimate intergradations of peripheral species. They may be arranged as follows:

Subgenus *Pecten* s. s. Type *P. maximus* L.

Left valve moderately inflated, right valve flattish; sculpture of strong ribs with radial striation, more or less roughened by simple concentric lamellation or incremental sculpture; ears subequal.

Section *Euvola* Dall, 1897. Type *P. ziczac* L.

Left valve extremely inflated, surface polished, ribs moderate or obsolete, without radial striation, concentric sculpture inconspicuous; right valve with or without conspicuous radial and concentric sculpture, flat or concave.

Subgenus *Chlamys* Bolten, 1798. Type *P. islandicus* Müll.

Valves moderately inflated, subequal, in general similar (except in color); sculpture of radial ribbing with or without *Camptonectes* striation, with or without an imbricate surface layer; frequently spinose on the ridges; ears often discrepant, the posterior smaller.

Section *Lyropecten* Conrad, 1862. Type *P. estrellanus* Conr.

Shell resembling *Pecten* s. s., but with both valves convex; usually of large size, heavy, and with radial striation and minute concentric imbrication; ribs entire and not dichotomous; valves equilateral.

Section *Placopecten* Verrill, 1897. Type *P. Clintonius* Say.

Valves without ribs, the right smoother, the radial and concentric minor sculpture of *Lyropecten* persisting; ears subequal; valves equilateral.

Section *Patinopecten* Dall, 1898. Type *P. caurinus* Gld.

Valves with small ribs, flat on the right valve and sometimes dichotomous; smaller and more rounded on the left valve; concentric sculpture inconspicuous; radial striæ absent or obsolete; ears subequal; valves nearly equilateral.

To this group belong such fossil species as *P. Meekii* Conrad and *P. expansus* Dall.

Section *Nodipecten* Dall, 1898. Type *P. nodosus* L.

Shell like *Lyropecten*, but the ribs intermittently nodose, with more or less prominent hollow nodes or bullæ; radial striation pronounced; ears unequal, the posterior smaller, the valves often more or less oblique; imbricate surface layer sometimes very marked.

Section *Chlamys* s. s. Type *P. islandicus* Müller.

Ribs small and numerous, imbricate or spinose; valves subequal, similar, oblique, or with unequal ears, the posterior smaller; Camptonectes striation and imbricate surface layer usually present; shell usually solid and opaque; byssal notch and ctenolium present.

Section *Æquipecten* Fischer, 1887. Type *P. opercularis* L.

Shell thin, orbicular, with subequal inflated valves, usually equilateral, with uniform, well-marked radial, not dichotomous, ribs and finely imbricate radial striation; ears subequal; valves internally lirate on the edges of the grooves corresponding to the external ribs; Camptonectes striation present, but usually obscured by the radial sculpture; ctenolium and byssal notch obvious.

Section *Plagioctenium* Dall, 1898. Type *P. ventricosus* Sby.

Resembling *Æquipecten* but without radial striation; the concentric sculpture in looped lamellæ; the ribs strong, frequently smooth above; the submargins impressed below the subequal auricles; the valves well inflated with a tendency to oblique growth in the adult.

To this very natural group belong nearly all the shallow-water Pectens of our own coasts, such as *P. irradians* Lam., *P. gibbus* L., *P. dislocatus* Say, *P. ventricosus* Sby., *P. nucleus* L., *P. purpuratus* Lam., *P. eboreus* Conrad, *P. comparilis* T. and H., and numerous other fossil species.

Section *Pallium* Schum., 1817. Type *P. plica* Lam.

Shell with the disk high and narrow above, ears small; valves moderately inflated, nearly similar, the basal margin in the adult contracted, so that the edges meet each other nearly vertically; ribs few, large, widening distally, entire; surface radiately imbricately striate, frequently with Camptonectes striation and imbricate external layer; the cardinal crura usually well developed, often irregular.

The developed cardinal crura are a function of the short hinge-line and of little systematic importance; their regularity is usually exaggerated in the figures. *Pecten pallium* L. is more appropriately placed in the *Chlamys* section. In the typical species of this group the most peculiar features are the perfectly closed valves, the margins meeting all around the shell, the absence of a byssal notch or fasciole, and the obvious tendency of the irregular cardinal crura to be discrepant on the two sides of the resilial pit. Some specimens have very regular laminæ like those of most laminate species, in others the anterior laminæ show a tendency to break up into nearly vertical narrow folds. These features are apparently confined to the less normal specimens of this species and should hardly form the basis for systematic rank. *Pecten panamensis* Dall, which has in most respects an unusually close resemblance to *P. plica*, differs by having the cardinal laminæ obsolete and in the presence of a byssal sinus and ctenolium. In fact, the interchange of characters is so multifarious that one must, to be consistent, either propose a genus for every two or three species of *Pecten* or include all the species in one generic group. Locard, who adopts the former method, has proposed the name *Felipes* for a closely allied group with *P. pesfelis* L. as the type; and Bucquoy, Dautzenberg, and Dollfus (1889) propose *Peplum*, with *P. clavatus* Poli as type, which would include such species as *P. panamensis;* and Sacco adds *Flexopecten* (1897) for *P. flexuosus* Poli, which differs by having larger ears.

Subgenus *Pseudamusium* H. and A. Adams, 1858. Type *Pecten exoticus* Chemn., = *P. pseudamusium* (Klein) Sby.

Shells small, thin, more or less translucent; the sculpture, if any, feeble; inner face of the disk without liræ; disk with or without Camptonectes striation, frequently with concentric imbrication.

Section *Pseudamusium* s. s. Type *P. pseudamusium* Sby. (= *exoticus* Chemn., etc.).

Sculpture discrepant on the two valves, the right valve having the concentric, and the left valve the radial elements most pronounced; valves usually flattish or compressed. The type is a shallow-water species and shows bright colors; the species from deep water are frequently pale or whitish. The latter have been separated as *Cyclopecten* by Verrill.

Section *Camptonectes* (Agassiz MS.) Meek, 1864. Type *P. lens* Sby.

Shell similarly sculptured on both valves, more or less inflated; smooth, concentrically more or less undulated, divaricately striate, or delicately imbricated.

The minute features of surface sculpture are so interchangeable and so variable that I cannot regard them as having sectional, much less generic, value, at least in the sense in which the term is used in this work.*

Though *Camptonectes* was originally based on the character of the divaricate striæ, the species in which this character is obsolete must be included, unless violence is to be done to what seems close relationship. *Syncyclonema* Meek, if correctly made out by that careful author, has a completely closed shell without a byssal notch, the ears subequal, the left valve smooth, the right concentrically striated.

* Professor Verrill proposes for the smooth form *Pectinella;* for the undulated form *Hyalopecten;* the divaricately sculptured shells would then be typical *Camptonectes;* the imbricated ones like *P. vitreus* [(Gmelin, 1792) Dillwyn, 1817 (+ *aculeatus* Jeffr., 1843, + *abyssorum* Lovèn, + *gemellaro-filii* Biondi) not *P. vitreus* Gray, 1824 (= *P. gronlandicus* Sby., 1843); *P. vitreus* Risso, 1826; *P. vitreus* King, 1831 (= *P. corneus* Sby., 1843), nor *P. vitreus* Sby., 1843] would be *Palliolum* Monts. (restr.), 1884. *Eburneopecten* Conrad, 1865, based on *P. scintillatus* Conr., is an exact synonyme of *Camptonectes. Lissochlamis* Sacco (1897) is founded on *P. excisus* Bronn (non Pusch), a species unknown to me.

Until more is known, this section would best be retained. It is doubtful how important the characters of *Entolium* Meek (1864) may prove to be. *Lissopecten* Verrill (1897) based on *P. hyalinus* Poli seems to me merely a somewhat degenerate *Æquipecten*. *Leptopecten* of the same author is based on the kelp-inhabiting variety of *P.* (*Chlamys*) *latiauritus* Conrad; its peculiarities result directly from its special situs; the shells intergrade perfectly with the other chlamydoid forms.

Subgenus *Amusium* Bolten, 1798. Type *P. pleuronectes* L.

Valves flattish, internally lirate, externally usually smooth or faintly striated; ears subequal; the ctenolium absent and the byssal notch obsolete. *Pleuronectia* Swainson, 1840, is synonymous.

Section *Amusium* s. s. Type *P. pleuronectes* L.

Valves about equally convex, gaping at the sides, nearly similar in sculpture, the recent forms having the left valve darkly colored and the right valve pale or albescent.

Amusium Lyoni Gabb in the youthful condition has a sculptured left valve like *Propeamusium*.

Section *Propeamusium* Gregorio, 1883. Type *P. inequisculptus* Tiberi (= *fenestratus* Forbes).

Right valve impressed about the distal margin, which is not fully calcified, partially concave, the sides partially closed, away from the ears; the liræ shorter; the external sculpture chiefly concentric, while on the left valve, if present, it is radial; the recent forms usually glassy or pale colored in both valves.

On anatomical grounds Professor Verrill separates, as *Paramusium*, *Amusium Dalli* Smith; but there are no distinctive conchological characters.

In the Bulletin of the Zoological Museum of the University of Turin, No. 298, pp. 101–2, June 11, 1897, Sacco has given a list of subdivisions of *Pecten*, without definition, but referring to the species he regards as types, or includes under the several subgenera. Among those not above mentioned are the following: Under the genus *Amusium*, of which *P. cristatus* Bronn is regarded as typical, *Parviamussium* Sacco (1897) is typified by *P. duodecimlamellatus* Bronn, and *Variamussium* Sacco (1897) by *P. cancellatus* "Schmidt" (? Goldfuss, not Bean and Phillips or McCoy), while *P. fenestratus* Forbes is included. This section is therefore a synonyme of *Propeamusium* de Gregorio, 1883.

Pecten burdigalensis Lam. (regarded by Deshayes as a variety of the species *cristatus* Bronn, referred to *Amusium* by Sacco) is made type of a subgenus of typical *Pecten* called *Amussiopecten* by Sacco, and the subgenera *Oöpecten* Sacco, based on *Pecten rotundatus* Lam., and *Flabellipecten* Sacco, on *P. flabelliformis* Brocchi, are also referred to typical *Pecten*. If differential descriptions of new groups were imperative, probably some of the above might never have seen the light, but, with present methods, the flood of new names is likely to continue unchecked by any considerations drawn from a serious study of nature.

Subgenus *Hinnites* Defrance, 1821. Type *H. Cortezi* Defr.

Shell (up to advanced youth) a typical *Chlamys*, later becoming sessile and irregular, in which stage the resilial pit is elongated and the cardinal margin develops an obscure area. *Hinnita* Gray is synonymous.

There are several groups of *Pectinidæ* in Paleozoic and Mesozoic horizons, as well as one or two exotic recent types, which do not need to be considered here.

FOSSIL PECTENS OF THE PACIFIC COAST.

Since it became absolutely necessary to review the Pacific coast and Antillean *Pectinidæ* in order to settle the status of those of the Atlantic coast, and as this review has necessitated a good deal of hard work, and the results may be useful to the student, a synopsis of them is offered here.

Pecten (Patinopecten) propatulus Conrad.

Pecten propatulus Conrad, Geol. Wilkes Expl. Exped., App. 1, p. 726, pl. 18, figs. 13, 13*a*, 1849.

Pecten caurinus of various authors, but not of Gould.

Astoria Miocene of the Columbia River; Dana.

The types of this species are in the National Museum. It has been regarded as identical with *P. caurinus* Gould by Carpenter, Cooper, and others, but, as pointed out by Meek (Miocene Checklist, S. I. Misc. Coll., p. 26, 1864), while the recent shell has from twenty to twenty-six ribs and a minutely concentrically striated surface, the *P. propatulus* rarely has more than sixteen ribs, and when perfect has the surface microscopically tessellated. The latter is also a generally smaller and more convex species.

Pecten (Patinopecten) Meekii Conrad.

Pecten Meekii Conr., Pac. R. R. Rep., vii., p. 190, pl. 1, fig. 1, 1857.

Miocene of San Rafael, California; Conrad.

The type specimen of this species is also in the National Museum, and it is much closer to *P. caurinus* than the last species. It has twenty ribs and, except that it is somewhat more convex, closely resembles *P. caurinus* in every respect when of the same size. The latter, however, has not yet been found in the succeeding Pliocene deposits, though present in the fauna of Puget Sound. Conrad's figure is a mere caricature.

Pecten (Patinopecten) coosensis Shumard.

PLATE 26, FIGURE 2.

Pecten coosensis Shumard, Trans. St. Louis Acad. Sci., i., pt. 2, p. 122, 1858.
P. coosaënsis Meek (err. typ.), S. I. Mioc. Checkl., p. 3, 1864.

Miocene of the Empire beds (Astoria horizon) at Coos Bay, Oregon; Shumard and Dall.

This species is large, compressed, with twenty-nine to thirty-one squarish prominent ribs, and on the upper valve much wider interspaces crossed by fine incremental lines. The ribs are sometimes longitudinally grooved towards the base. Specimens are in the National Museum and measure in alt. 120, lat. 113, and diam. 27 mm. This fine species is very abundant in the locality indicated. It is nearest to the Pliocene *P. expansus* Dall, in which the ribs are dichotomous.

Pecten (Chlamys) altiplicatus Conrad.

Pecten altiplicatus Conr., Pac. R. R. Rep., vii., p. 191, pl. 3, fig. 2, 1857.
Pecten altiplectus Conr. (err. typ.), Proc. Acad. Nat. Sci. Phila. for 1856, p. 313, 1857.
Pecten hericeus Carpenter, Cooper; not of Gould.

Miocene of the San Rafael hills near Santa Barbara, California; W. P. Blake.

This species, which is wretchedly figured by Conrad, is represented by the type in the National Museum. It has ten or eleven high, sharp spinulose ribs alternated with an equal number of low, small imbricate riblets, the interspaces sculptured with elevated radial scabrous threads. The beak and ears are defective, but the typical specimen is characteristic enough to show that it is entirely distinct from the recent *Pecten hericeus* Gould, with which it has often been doubtfully united.

P. catilliformis Conrad (*op. cit.*, v., p. 329, pl. 9, fig. 83, 1856), which resembles in the figure a flattened valve of *P. Heermanni* seen from within, and *P. nevadanus* Conrad (*op. cit.*, p. 329, pl. 8, fig. 77) were described from drawings made by Professor W. P. Blake from internal or external casts in the sandstones of Ocoya Creek. No types of them exist, and the figures are so bad that it is to be feared they will remain for a long time unrecognized.

Section *Lyropecten* Conrad.

Lyropecten Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 291; Meek, Smithsonian Checkl. Mio. Fos., pp. 5, 27, 1864. Type *Pallium estrellanum* Conr., Pac. R. R. Rep., vi., Geol., p. 71, pl. iii., fig. 15, 1856; Proc. Acad. Nat. Sci. Phila., viii., p. 313, 1857; *Liropecten estrellanum* Cooper, Bull. State Mining Bur. Cala., No. 4, pl. 6, figs. 65–67, 1884 (text excl.). Not *P. estrellanum* Conr. of Pac. R. R. Rep., vii., p. 191, pl. 3, figs. 3–4, = *P. volæformis* Conr., Proc. Acad. Nat. Sci. for 1862, p. 291.

Liropecten Gabb, Pal. Cal., ii., p. 105, 1869.

Not *Lyropecten* Conrad, Am. Journ. Conch., iii., p. 6, 1867. Type *P. crassicardo* Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 291.

Not *Liropecten* Fischer, Man. de. Conchyl., p. 944, 1887. Type *P. nodosus* Linné.

Not *Lyropecten* Verrill, Trans. Conn. Acad. Sci., x., p. 63, 1897. Type *P. nodosus* Linné (following Fischer).

Not *Lyriopecten* Hall, 1883, = section of *Aviculopecten*.

Among the types of the Pacific Railway explorations is a fossil Pecten with a label "Estrella Valley" in Conrad's handwriting. The ears have been broken off, but in other respects it agrees well with the description and figure of *Pallium estrellanum*. The ribs are worn flat, and the undulations mentioned in the description are due to erosion. It is the only specimen agreeing at all closely with the requirements, and I have no doubt it is one of the specimens from which Conrad's description was prepared. Better preserved fragments show the intercalary line clearly, and also that the ribs were imbricated, as in *P. Jeffersonius*, by minute elevated scales. It is, in short, a *Pecten* belonging to the same group as *P. Jeffersonius*, *Madisonius*, *crassicardo*, etc. Curiously enough, the same specimen served as the subject for Conrad's *P. Heermanni* (Proc. Acad. Nat. Sci. Phila., vii., p. 267, 1855), described in a line and a half and never figured. The two were identified by Conrad as the same species on the National Museum labels. In the confusion that surrounds the specific name *estrellanum* (three species of *Pecten* from the same region having been so named by Conrad), it is probably better to revert to the earlier name of *Heermanni*. A fair figure, cited above, has been given by Cooper.

The type of the second form, named *estrellanum*, is lost. It appears to have been a shell resembling *Pecten dentatus* Sby. in outline, but the sculpture and number of ribs agree with the original *estrellanus*. Conrad renamed it *L. volæformis*, but the difference of shape may be due to crushing, as the fossils of this horizon are all more or less distorted, and the shell may be the same, as he originally thought it to be. The dentition of the hinge is similar to that of many Pectens, such as *P. Swiftii* Bernhardi, *P. ventricosus* Sby., and *P. purpuratus* Lam.

The third species referred by Conrad to this group is *P. magnolia* Conr. (Pac. R. R. Rep., vii., p. 191, pl. 1, fig. 2, 1857), of which the very imperfect fragments which served as types are in the National Museum. The figure is a very erroneous diagram compounded from the characters of these fragments. A better specimen of the same species was later described by Conrad under the name of *L. crassicardo* (Proc. Acad. Nat. Sci. Phila. for 1862, p. 291) but has not been figured. The types are in the Academy's collection. Both valves are convex and have the hinge-teeth moderately developed. The shell has from eleven to fourteen ribs and much resembles *P. Jeffersonius*, except in the greater development of the hinge-teeth and the radial ribbing of the ears.

It grows even larger than the average *Jeffersonius* and belongs to the Miocene of the Santa Inez Mountains, Santa Barbara County, California. According to Gabb (Pal. Cal., ii., p. 105) a broken specimen of this species served as the original for the figure of *Spondylus estrellanus* Conr. (Pac. R. R. Rep., vii., pl. 1, fig. 3, 1857), an opinion which the figure, poor as it is, offers much to confirm.

The genus established by Conrad was based on the heavy cardinal laminæ which compose a distinctly dentiferous hinge; this feature, however, varies in the different species and is insufficient as a basis for a group of such value in view of its inconstancy. The group name, whatever rank is assigned to it, must depend upon the type. This, as already pointed out, belongs among those species which unite with sculpture similar to that of *P. maximus* the character of having both valves more or less convex, instead of having the right valve flattened or even subconcave. Such shells are more or less intermediate between *Æquipecten* Fischer and *Pecten* proper.

In 1867 Conrad, with the forgetfulness which marked his later work, produced the genus *Lyropecten* again, as if it was not already described, and offers as a type *L. crassicardo*, one of his original species but not that originally indicated as the type. *L. crassicardo*, however, is a true member of the group. But to this species he adds *Pecten nodosus* and its allies, which are not entitled to be admitted. Fischer, in citing Conrad, ignores the original description and mentions *P. nodosus* as the type, which it never was, and thus subsequent writers were led into error. The modification of the original orthography by Gabb and Fischer is unnecessary and contrary to the rules of nomenclature followed in this volume.

Notwithstanding the fact that the real type is intermediate in form between the *P. ventricosus* group and that of *P. Jeffersonius*, the balance of characters is decidedly in favor of the latter, and, thus restricted, it forms a fairly natural and recognizable assembly which will contain, besides the type, such forms as *P. crassicardo* Conr., *P. Jeffersonius* Say, *P. Madisonius* Say, *P. edgecombensis* Conr., *P. septenarius* Say,—all large species, with conspicuous ribbing, radially squamose-striate surface, convex and nearly equilateral valves, and more or less developed cardinal laminæ. The group is chiefly Miocene.

In *Pecten Clintonius* we have a species which appears to differ remarkably from such forms as *Jeffersonius*, and yet the most essential distinction is the absence of ribbing. If we were to imagine a specimen of *P. Jeffersonius* with the ribs flattened out, the distinction between it and *P. Clintonius* would be almost imperceptible. In recent Pectens the group is only represented by such forms as *P. fuscopurpureus* Conrad, which never attain a large size but resemble in their sculpture the young shell of *P. Madisonius* and its allies. They can hardly be accommodated in the group as here restricted.

Pecten (Plagioctenium) deserti Conrad.

Pecten deserti Conr., Pac. R. R. Rep., v., p. 329, pl. 8, fig. 77, 1856; Descr. Fos. and Shells, House Reps. Doc. 129, p. 15, July, 1855.

Pecten discus Cooper, Cal. State Min. Bur. Bull., No. 4, p. 57, pl. 4, figs. 55, 56, 1894; not *P. discus* Conrad, 1857.

Miocene (?) of Carrizo Creek, Colorado Desert.

This appears to be a well-defined species resembling *P. turgidus* Lamarck, having twenty-three close-set, smooth, rounded, prominent ribs, and both valves moderately convex; the specimens are usually crushed. This has been confounded by Cooper with *P. discus* Conrad, his remarks showing that Dr. Cooper is unacquainted with the true *P. discus*.

Pecten (? Plagioctenium) pabloënsis Conrad.

Pecten pabloënsis Conr., Pac. R. R. Reps., vi., p. 71, pl. 3, fig. 14, 1857.

Miocene of San Pablo Bay, California; Merriam.

This species is represented by a better figure than some of the others, and has been collected from the original locality by Dr. John C. Merriam, of the University of California. It has been erroneously referred to the young of *P. estrellanum* (= *Heermanni* Conr.) by Dr. Cooper. It is small, with feeble sculpture like a young, pressed-out *Pecten propatulus*, with eighteen to twenty major ribs alternated with smaller intercalary riblets. The ears are discrepant, the right anterior one radially ribbed. The shell measured about thirty millimetres in height and length.

Pecten (Pecten) bellus Conrad.

Janira bella Conrad, Pac. R. R. Rep., vi., p. 71, pl. 3, fig. 16, 1857.
Not *Janira bella* Gabb, Pal. Cal., ii., p. 105, pl. 16, fig. 20, 1868.
Not *Pecten bellus* Sby. (*ubi ?*), nor *P. bellis* McCoy.

Tertiary of Santa Barbara, California.

Neither the description nor the figure are sufficient to positively identify this shell, of which no authentic specimen is known. Such information as is given does not agree with either of the recognized species.

Pecten (Chlamys) fucanus n. s.

Plate 26, Figure 7.

Found in concretions from the Miocene sandstones of Clallam Bay, twenty-five miles eastward from Cape Flattery, on the south shore of Fuca Strait, Washington, by Mr. J. S. Diller, of the United States Geological Survey. Another specimen was received from J. G. Swan, collected in the same vicinity.

This is a rather large species of the type of *P. Hindsii* var. *strategus*, both valves moderately convex and with a fine subsidiary surface tessellation; sixteen squarish ribs, of which the median one in the left valve is stronger than the rest and surmounted by prominent imbricated scales; the others are simply radially striated, as are the interspaces, which carry a mesial elevated thread; the submargins are radially threaded, as are the subequal ears, which also bear marked concentric lamellæ; the resilial pit is of moderate size and the cardinal edge is deeply grooved parallel to and just below the margin; the interior reflects the external ribbing. Alt. 85, lat. 80, convexity of left valve 16 mm. Types in the National Museum.

This interesting form is represented by very perfect internal and external casts of the left valve and other less perfect examples. It is doubtless the precursor of the recent *P. hericeus* group.

Pecten (Chlamys ?) discus Conrad.

Pecten discus Conrad, Pac. R. R. Rep., vii., p. 190, pl. 3, fig. 1, 1857; not of Cooper, Cal. State Min. Bur. Bull., No. 4, p. 57, pl. 4, figs. 55, 56, 1894.

From the fine-grained Miocene shales of Santa Barbara County, California.

This is a beautiful thin, flat species, resembling a young *Patinopecten*, but more oblique and oval, the left valve showing nine or more low, wide, smooth ribs in the middle of the disk, with wider smooth interspaces, and the sculpture obsolete towards the ends and base of the valve; the right valve has narrower, sharper, smaller, and more numerous riblets; the left valve measures about forty-seven millimetres in height and width, and the shell was apparently about ten millimetres in diameter; the ears are plain and unequal. Conrad's figure is very poor and gives little idea of the shell. This may belong to the section *Æquipecten*.

Species which may be of Miocene or Pliocene age and were collected on Cerros Island, Lower California, were described by Gabb (Pal. Cal., ii., p. 32, 1866). *P. cerrosensis* Gabb (*op. cit.*, p. 32, pl. 9, figs. 55, 55 *a*) has eighteen to twenty flattish, entire ribs, with about equal interspaces. It is of the type of *P. eboreus* Conr., but much larger. *P. Veatchii* Gabb (*op. cit.*, p. 32, pl. 10, fig. 56) is of the general type of *P. nodosus*, and has about fourteen feebly nodose broad ribs, striated, reticulated, and minutely squamose. The little, smooth *P. Peckhami* Gabb with Camptonectes striation (Pal. Cal., ii., p. 59, pl. 16, figs. 19, 19 *a*, 1866) and the concentrically undulated *P. pedroanus* (Trask) Gabb (*Plagiostoma pedroäna* Trask, Proc. Cal. Acad. Sci., i., p. 86, pl. iii., fig. 1, 1856; + *P. annulatus* Trask, *loc. cit.*, fig. 2, and *P. truncata* Trask, fig. 3; Gabb, Pal. Cal., ii., p. 60, 1866) comprise the remaining species of the Pacific coast, which are supposed to be of Miocene age. Some of them may also prove of Pliocene age.

The following undetermined forms have been observed in the collection of the State University at Berkeley, California:

Pecten sp. A species in the State University collection at Berkeley, California, which had been marked *P. pabloënsis* by Dr. Cooper is evidently distinct; it has fifteen primary ribs on the left valve, many of them unevenly divided near the basal margin by a shallow sulcus; in the interspaces are low, rounded riblets, extending about half way up the disk; right valve somewhat more convex; the ears subequal and vertically striated. Alt. 85, lat. 90 mm. Found in the Miocene of Foxin's Ranch, California.

Pecten Heermanni Conr. var.? A large species from Santa Inez Cañon, Santa Barbara County, California, is biconvex, with sixteen large, nearly smooth ribs in the right valve, with subequal interspaces, in the middle of each of which is a single small raised thread; ears subequal, the posterior radially and the others concentrically threaded; the left valve somewhat less convex. Alt. 145, lat. 147, extreme length of hinge-line 80 mm.

Pecten sp. San Pablo formation, Mount Diablo, Contra Costa County, California, has fourteen to sixteen ribs, strong and simple, with narrower channelled interspaces, which, as well as the ribs in some cases, are radially striated; ears subequal, somewhat impressed, with a few rather coarse radial riblets and concentric striation. Alt. 127, lat. 137, hinge-line 70 mm.

Pecten sp. A small species recalling *P. deserti* was collected near Mount Diablo; it is rounded, moderately convex, with eighteen to twenty slightly nodulous subequal ribs, with channelled equal interspaces crossed by fine looped concentric sculpture; the shell is like a small *æquisulcatus* in general form, with small subequal ears. Alt. 28, lat. 28, hinge-line 18 mm.

Pecten sp. indet. The flat valve of a species, in poor condition, but recalling *P. dentatus* Sby., has been received from Miocene beds near San Diego.

The following are of Pliocene age:

Pecten (Patinopecten) expansus Dall.

Plate 26, Figure 1.

Pecten expansus Dall, Proc. U. S. Nat. Mus., i., p. 14, 1878.

Pliocene of Pacific Beach (lower horizon), near San Diego, California; Hemphill, Dall, and Hamlin.

Shell large, flattish, with, on the right valve, twenty-five to thirty flat dichotomous ribs, which differentiate it from the other species of this group.

Pecten (Pecten) Stearnsii Dall.

Plate 26, Figure 5.

Pecten Stearnsii Dall, *op. cit.*, p. 15, 1878.

Found with *P. expansus.*

This is the Pliocene precursor of *Pecten diegensis* Dall, from which it differs by having five or six more ribs, which, in the adult, have a conspicuous median sulcus.

Pecten laqueatus Sby., a Japanese species, has been erroneously cited by Reeve from California.

Pecten (Pecten) Hemphillii Dall.

Pecten Hemphillii Dall, *op. cit.*, p. 15, 1878.

Janira bella Gabb (non Conrad), Pal. Cal., ii., pl. 16, fig. 20, 1869; not *P. bella* Sby., nor *P. bellis* McCoy.

Found with *P. expansus.*

This shell is probably identical with the *Janira bella* of Gabb, but it differs from the original *J. bella* Conrad by its entire ribs, rounded above instead of square, with extremely fine concentric lamellation.

Pecten (Pecten) compactus n. s.

PLATE 34, FIGURE 5.

Pliocene of Ventura County, California, at an elevation of two hundred feet and eight miles inland from the sea; U. S. Nat. Mus., No. 61,246.

Shell having a general resemblance to *Pecten dentatus* Sby. and *P. Poulsoni* Morton, being slightly larger than the latter and sculptured more like the former. Right valve with twenty flat-topped, entire, smooth, squarish ribs, separated by much narrower channelled interspaces, crossed by faint incremental lines; submargins smooth except for incremental lines; posterior ear with six or seven faint minute radials crossed by elevated lines of growth; byssal ear small, with three or four conspicuous subimbricate radials and a rather small notch and ctenolium; internal basal margin fluted; hinge-teeth rather strong. Alt. 27, lat. 27, diam. of left valve 8 mm.

Pecten (Plagioctenium) subventricosus n. s.

PLATE 29, FIGURE 8.

Pliocene of Ventura County, California, Bowers; and of Pacific Beach at San Diego, Stearns and Hemphill.

Shell of the type of *P. ventricosus* Sby., from which it differs by being smaller and less tumid, less expanded laterally, with the ribs rounded, instead of flattened, above, and with narrower interspaces; the tops of the ribs smooth, the sides with a dense fringe of concentric lamellæ, much as in *comparilis* T. and H. Alt. and lat. 65, diam. 24 mm.

Pecten (Chlamys) opuntia n. s.

PLATE 29, FIGURE 6.

Pliocene of San Diego, California; Hemphill and Hamlin.

Allied to *P. hericeus* var. *navarchus* Dall, from which it differs by its smaller and not fasciculated radial ribs, more elongated anterior ear, more densely radially costate posterior ear, small size when adult, and by a tendency to be suddenly contracted at the basal margin on the completion of growth, somewhat as in *P. pesfelis.* Alt. 35, lat. 32.5 mm.

Pecten (Chlamys) Parmeleei n. s.

PLATE 37, FIGURES 14, 14*a*.

Pliocene of San Diego, California; Parmelee.

This species is close to *P. Swiftii* Bernhardi of Japan (J. de Conchyl., vii., plates 1 and 2, 1858) but smaller, and differs by the smooth top surface of the ribs, which in *P. Swiftii* are more or less striated or coarsely threaded, and by the not alternated radial riblets on the right posterior ear; also, especially, by the profuse coalescent microscopically checkered squamation, which makes a complete external coating to the valve. Alt. 45, lat. 38 mm.

The *Pecten* fauna changes almost completely with the Pleistocene, all the species being known as recent and generally of the same climatic groups as those at present living in the most adjacent waters.

The following species have been noted:

Pecten (Chlamys) islandicus Müller.

Pecten islandicus Müll., Prodr. Zool. Danica, p. 248, 1776.

Pecten cinnabarina Born, 1778, + *P. rubidus* Martyn, 1784, + *Ostrea demissa* Solander, 1797, + *Pecten Pealeii* Conrad, 1831, + *P. Fabricii* Philippi, 1844.

Bowlder clays of the northwest coast, also living in Bering Sea; Dall.

Ribs numerous, subequal, rounded, small, scaly on both valves, with channelled minutely reticulate interspaces.

Pecten (Chlamys) hericeus Gould.

Pecten hericeus Gould, Proc. Bost. Soc. Nat. Hist., p. 236, 1850.

Pecten hastatus Cpr., 1863; not of Sowerby, 1843.

? = *Pecten rastellinum* Val., Voy. Venus, pl. 19, fig. 4, 1835.

Pleistocene of San Diego, California; Hemphill.

Middle ribs of the fasciculi on the left valve high, spiny, the rest merely scaly. This is entirely distinct from the true *P. hastatus* Sby., with which Carpenter confused it. The latter is a smaller, quite rare shell, with entirely different sculpture, and has not yet been found in the fossil state.

I have taken the name of Gould, as the oldest, for the specific designation of a group of forms of which the original *hericeus* is only a special development, the prevalent and normal form of the species being the following shell:

Pecten hericeus var. **navarchus** Dall.

Pecten rubidus Hinds, Zool, Sulph. Voy., p. 61, pl. 17, fig. 5, 1844; not *P. rubidus* Martyn, 1784, Bowlder clay of Comox, Vancouver Island, Newcombe; Pleistocene of San Pedro, Dall and Stearns; of San Diego, California, at Pacific Beach, Hamlin.

Smaller than *P. islandicus;* ribs small, obscurely fasciculated, dichotomous, and imbricated on both valves. Living from the Aleutian Islands southward to Lower California.

Pecten hericeus var. **Hindsii** Carpenter.

Pecten (? var.) *Hindsii* Cpr., Suppl. Rep. Brit. Assoc., p. 645, 1863.

Pleistocene of Sucia Island, Fuca Strait, Newcombe; recent from Bering Sea to Monterey, California.

Ribs on the right valve smooth, not fasciculated, sometimes wide, flattish, usually dichotomous; left valve as in var. *navarchus.* The typical specimens seem remarkably distinct from *navarchus*, but in a large series intergradation is obvious.

Pecten hericeus var. **strategus** Dall.

Pleistocene of Alaska and recent at Unalashka; Dall.

The fasciculi of the left valve, to the number of five to seven, with the riblets coalescent, forming large, smooth-backed, turgid ribs, with smaller imbricate intercalary threads. The large ribs sometimes break up suddenly into the usual small riblets near the base. The recent specimens are bright scarlet.

Pecten (Chlamys) latiauritus Conrad.

Pecten latiauritus Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 238, pl. 18, fig. 9, 1838.
Pecten tunica Phil., 1844 + *P. mesotimeris* Sowerby, 1847.
Pecten tumbezensis Orbigny, 1847, + *P. aspersus* Sby., 1843, non Lam., 1819, + *P. Sowerbii* Reeve, 1852 (non Guilding), is very closely related.

Pleistocene of San Pedro Hill and San Diego at Coronado Beach; very abundant. Also living.

Hinge-line wide; the ears acutely pointed above; ribs distinct, squarish, often mesially grooved; shell wide. This is the type, which varies widely.

Pecten latiauritus var. **monotimeris** Conrad.

P. monotimeris Conrad, *op. cit.*, p. 238, pl. 18, fig. 10, 1838.

Shell more oblique, inflated, and markedly shorter, with smaller ears. Found with the last, with which many specimens intergrade.

Pecten latiauritus var. **fucicolus** Dall.

With the last, and living on fuci, south to Cape St. Lucas.

Shell moderately compressed, smooth, concentric, sculpture obsolete; ribs low, rounded, wide, entire; hinge-line shorter than in the type, and without any sinus between the posterior ears and the disk. Alt. 30, lat. 31 mm.

This form lives attached by the byssus to the giant kelp of the Californian coast, and the absence of shock, due to the floating situs, is probably correlated with the obsolescence of the ribs and posterior sinus. Intergradations with the type are not at all rare.

Pecten (Patinopecten) caurinus Gould.

Pecten caurinus Gould, Proc. Boston Soc. Nat. Hist., p. 236, 1850.

Pecten yessoensis Cpr., 1863, non Jay, Perry's Voy., 1856, + *P. propatulus* Carpenter, 1863, non Conrad, 1849.

? *Pecten Meekii* Conrad, Pac. R. R. Rep., vii., p. 190, pl. 1, fig. 1, 1857.

? Miocene of California, Blake; not yet reported from the Pleistocene of California, but will probably be found in later beds of Puget Sound and vicinity when fully explored. Living about Puget Sound. The Japanese species is constantly distinguished by its smaller and lower ears and deeper byssal sinus.

Pecten (Nodipecten) subnodosus Sowerby.

Pecten subnodosus Sby., P. Z. S., 1835, p. 109.

Pecten intermedius Conrad, Am. Journ. Conch., iii., p. 7, 1867.

Pleistocene of Cerros Island and other points on the Lower Californian coast. Living in the adjacent waters.

There seems to be little reason for separating this form from the *P. nodosus* of the Antilles. Both vary through a strictly analogous series of mutations.

Pecten (Pecten) diegensis Dall.

Pecten floridus Hinds, Zool. Sulph. Voy., p. 60, pl. 17, fig. 6, 1844; not *Ostrea* (= *Pecten*) *florida* Gmelin, 1792.

Pleistocene of San Diego; Hemphill. Living on the adjacent shores from Monterey, California, southward.

Pecten (Plagioctenium) ventricosus Sowerby.

Pecten ventricosus Sby., Thes. Conch., *Pecten*, p. 51, pl. 12, figs. 18, 19, 1843.

Pecten tumidus Sby., P. Z. S., 1835, p. 109; not *P. tumidus* Turt, 1822, nor of Zieten, 1830.

Pecten circularis Sby., *ex parte*, 1835; + *P. inca* Orb., 1847.

? = *Pecten pomatia* Val., Voy. Venus, pl. 19, fig. 3, 1835.

Pleistocene of San Pedro, San Diego, and Lower California; Hemphill, Stearns, and Orcutt. Living from Santa Barbara southward.

This species is the Pacific coast analogue of *P. dislocatus* Say.

Pecten (ventricosus var.?) æquisulcatus Cpr.

Pecten æquisulcatus n. s.? Carpenter, Suppl. Rep. Brit. As., 1863, p. 645; Ann. Mag. Nat. Hist. Mar., 1865, p. 179.

Found with the preceding.

This form bears to *ventricosus* precisely the relation which *P. irradians* Lamarck, on the Atlantic coast, bears to *P. dislocatus* Say.

Pecten (Propeamusium) alaskensis Dall.

Pecten alaskensis Dall, Am. Journ. Conch., vii., p. 155, pl. 16, fig. 4, 1871.

Pleistocene of Vancouver Island, near Esquimalt, and at various points in Alaska. Living from Bering Sea to Panama Bay, usually in deep water.

This species has twenty to twenty-two internal rib-like liræ.

There is a small species of *Propeamusium* resembling *P. squamula* Lam. in the Arago beds of Oregon, but the exterior is not yet known. It is probable that a fair number of additions to this list may be made when the different horizons of the Pacific coast are sufficiently explored.

Pecten pyxidatus, which has been listed from the Pacific coast, is apparently a Chinese species. *P. subcrenatus* Carpenter and *P. Townsendi* Gould seem to be list-names, cited in Carpenter's supplementary report to the British Association in 1865, but never characterized and now unidentifiable.

Subgenus HINNITES Defrance.

Hinnites Defr., Dict. Sci. Nat., xxi., p. 169, 1821. Type *H. Cortezi* Defr.
Hinnita Ferussac, Tabl. Syst., p. xl., 1822.
Hinnus Wood, Ann. Mag. Nat. Hist., xxxvii., p. 253, 1841.

Hinnites crassus Conrad.

Hinnites crassa Conr., Pac. R. R. Rep., vii., p. 190, pl. 2, figs. 1, 2, 1857.
? = *Hinnites giganteus* Gray, Ann. Phil., p. 103, 1826.
Cf. *Pecten comatus* Val., Voy. Venus, pl. 18, fig. 2, 1835.

Miocene of Santa Margarita, Salinas Valley, California.

It should be mentioned that *Hinnites giganteus* Gray (Ann. Phil., 1826, + *H. Poulsoni* Conr., 1834) is not uncommon in the Pleistocene, and the young shells, which sometimes reach the length of thirty millimetres before becoming attached to other bodies, are in fact Pectens, and very liable to be taken for an undescribed species of that genus. They are variable in the amount of spinose sculpture, and the more spiny ones often closely resemble the young of the true *Pecten hastatus* Sby. In the recent specimens a character by which they can usually be discriminated is a suffusion of purple color on the hinge-line near the cartilage-pits.

FOSSIL PECTENS OF THE ANTILLEAN AND CENTRAL AMERICAN REGION.

Nearly all of these species are Oligocene; a few are referable to the Pliocene; but the typical Miocene or Chesapeake fauna has not been identified anywhere south of Florida. The first species described from this region appear in the paper by Sowerby on the Bowden fauna in 1849. As a number of these were very briefly described and never figured, I sent a series of the Bowden Pectens in the National Museum to Mr. Clement Reid, of the British Geological Survey, who very kindly compared them with Sowerby's types and furnished me with valuable annotations upon them. In the small series available for study the range of variation necessarily remains doubtful in some cases, though I have had the advantage of comparing with the series of types in the Guppy collection of Antillean fossils now the property of the United States National Museum.

It appears from Mr. Reid's examination that the type specimens are not segregated in the Sowerby-Heniker collection, that the fossils are loose in trays, and these trays sometimes contain more than one species. The confusion has probably occurred since Sowerby's time, as he was a very careful worker. Under these circumstances the reviser can only take the form which is best in accordance with the original diagnosis and restrict Sowerby's name to it.

Pecten (Pecten) soror Gabb.

Janira soror Gabb, Trans. Am. Phil. Soc., xv., p. 257, 1873.

Oligocene of St. Domingo, Gabb; of Jamaica and Cumana, Guppy.

A large species with twenty rounded, strong ribs, separated by flattish interspaces, with fine concentric elevated lines, the flat valve also strongly ribbed, the right valve very convex, and the shell a little inequilateral.

Pecten (Pecten) eugrammatus n. s.

PLATE 34, FIGURE 22.

Oligocene of Haiti and St. Domingo, Guppy.

Shell suborbicular, convex, with twenty-one high, sharp ribs separated by V-shaped narrower interspaces, the ribs with a sharp but shallow mesial sulcus and the outer edges of the sulcus sharp and flaring; submargins smooth, ears radially threaded, inner margin deeply fluted; surface with fine, low, sharp concentric lamellæ when perfect; notch small, narrow, sharp, with no ctenolium; cardinal crura well developed, sharply cross-striated; ears small. Alt. 23, lat. 24, diam. 8 mm.

This species may possibly belong to *Æquipecten*, but its aspect is that of *Pecten*. I have not seen the left valve. There is an unnamed valve of this species in the Heniker collection.

Pecten (Euvola) bowdenensis n. s.

PLATE 29, FIGURE 1.

Oligocene of the Bowden beds, Jamaica; Henderson and Simpson.

Shell resembling *P. ziczac* L. in the right valve, with about twenty-three obsolete smooth ribs separated by impressed lines; right valve very convex; ears subequal, smooth, notch narrow, deep; left valve with seventeen low, rounded ribs separated by wider, squarely impressed interspaces; submargins wide, smooth; disk moderately concave; ears subequal, smooth, concavely arched; interior margin of the base with paired liræ, the pairs separated by deeper channels; cardinal crura obvious. Alt. 43, lat. 44.5 mm.

The sculpture of the left valve definitely separates this species from the young of *P. ziczac*, *P. medius*, and allied forms known from this region.

Pecten (Euvola) limonensis Dall.

Janira lævigata Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 379, 1881; not *Pecten lævigatus* Goldfuss, Petref., ii., p. 68, pl. 97, fig. 6, 1835.

Pliocene clays of Limon, Costa Rica; Gabb.

Pecten (Æquipecten) oxygonum Sowerby.

Pecten oxygonum Sby., Quart. Journ. Geol. Soc., vi., p. 52, 1849.
Pecten angusticostatus Gabb, Geol. St. Dom., p. 256, 1873.
Pecten exasperatus Guppy, Geol. Journ., xxii., p. 294, 1866.

Oligocene of St. Domingo, Gabb; and Jamaica at Bowden, Henderson and Simpson.

Shell small, suborbicular, with nineteen to twenty-one sharply keeled ribs separated by V-shaped interspaces, with little-elevated, sharp, thin, concentric linear imbrication; form tumid, cardinal crura well marked; left valve less convex than the other. Alt. and lat. about 15 mm.

The above diagnosis is from the type of *P. angusticostatus*, and agrees with Sowerby's diagnosis. The shells which are now found under the name of Sowerby in the Heniker collection are, according to Mr. Reid, a pair (A) which are orbicular, suboblique, not tumid, with a well-marked small rib in each furrow, coarsely squamose sculpture, and a height of forty-seven and a half millimetres. The other specimen (B) is a single valve with the rib in the furrow obsolete or absent, the shell oblique, surface coarsely squamose. The two are not certainly the same species, and both of them conflict in character with Sowerby's diagnosis. I cannot accept them, therefore, without further evidence, as being the originals. Specimen A recalls strongly the shell here named *P. Gabbi*, and may be a specimen of that species which has been accidentally labelled with a name not belonging to it. In case this view is not accepted, in spite of the discrepancies between the specimen and Sowerby's description, the present form will take Gabb's name.

Pecten (Æquipecten) inæqualis Sowerby.

Pecten inæqualis Sby., *op. cit.*, p. 52, 1849; Guppy, Geol. Journ., xxii., p. 294, pl. 18, fig. 6, 1866.

Oligocene of St. Domingo and Haiti, Gabb; Jamaica, Bland; Curaçao, United States Fish Commission; Isthmus of Darien, Hill.

This much resembles *P. angusticostatus* Gabb in form and size, but the ribs are rounded and the interspaces roundly concave. It is the most common and widely distributed of the Antillean Oligocene Pectens.

Pecten (Æquipecten) thetidis Sowerby.

Pecten thetidis Sby., *op. cit.*, p. 52, 1849.

Oligocene of St. Domingo, Heniker; Bowden, Jamaica, Henderson and Simpson; Curaçao, United States Fish Commission.

This is a shell much resembling the recent Florida shell which Conrad named *fuscopurpureus*, but the latter is larger and less solid. The specimens in the Heniker collection include two indeterminable valves: (A) four tumid, inequilateral, equivalve, with nineteen sharp ribs and sharp furrows, sculpture squamose; (B) one orbicular compressed valve with nineteen ribs which are markedly quadrate at the margin, squamose and wrinkled, but scarcely spiny, the ribs of the disk and those of the wing forming a nearly continuous series.

Mr. Reid remarks that Sowerby's description was apparently mainly drawn from B, and that the two forms are so distinct that it is difficult to believe that Sowerby can have referred them to the same species. In the absence of a figure we may adopt B as representing the name, which would agree with usage as seen in the Guppy and other collections. The other specimens (A) seem from the remarks cited to be nearest to some varieties of *oxygonum* or *inæqualis*.

Pecten (Æquipecten) scissuratus n. s.

PLATE 34, FIGURE 4.

Oligocene of Ponton, St. Domingo, and ten and a half kilometres west of Colon, Isthmus of Darien; Hill.

Shell moderately compressed, with sixteen well-marked ribs; valves nearly equilateral, the right one less flat than the other; disk suborbicular, with small subequal ears; left valve with the ribs smooth and rounded on top, separated by subequal, slightly channelled, smooth interspaces; the ribs on each side just below the top are incised by a sharp, narrow groove, in which are closely set small imbricated scales, which seem easily detached, so that in the worn specimens the sulcus alone remains, ending in a narrow, sharp slit at the distal end of the rib; the ears are flat, with sparse radial threads; in the right valve the ribs are squarish and smooth, the sulci are absent, and the surface sculpture confined to faint incremental lines; the ears have a few imbricate radii, and the notch is shallow; the submargins are narrow and young shells have a polished surface; the internal surface is channelled in harmony with the external ribbing; the auricular and cardinal crura moderately developed. Alt. 31, lat. 30, diam. about 6 mm.

In young shells the sulci on the ribs are not conspicuous, and in perfect ones the scales must more or less completely hide the grooves.

Pecten (Chlamys) anguillensis Guppy.

Pecten anguillensis Guppy, Proc. Sci. Soc. Trinidad, Dec., 1867, p. 175.

Oligocene of Anguilla and Antigua; Guppy and Spencer.

This is quite closely related to the recent *P. antillarum* Recluz, of which it is evidently the precursor, and also resembles *P. luculentus* Reeve.

Pecten (Chlamys) ornatus Lamarck? var. **vaginulus** Dall.

Oligocene of the Bowden beds, Jamaica; Henderson and Simpson.

Seven small valves of a species closely resembling *P. ornatus* were obtained at Bowden; the form and sculpture are practically the same, but the ribs (twenty-one to twenty-five) are single, subequal, and not fasciculated, and are separated by simple narrower interspaces not radially threaded. The young of *ornatus*, as far as observed, seem to always have one or more interstitial riblets. I therefore propose for the present form the varietal name of *vaginulus*, which may be raised to specific rank if the difference is confirmed by the characters of adult specimens.

Pecten (Chlamys) interlineatus Gabb.

Pecten interlineatus Gabb, Geol. St. Dom., p. 256, 1873.

Oligocene of St. Domingo; Gabb.

Shell close to *P. anguillensis* Guppy, with about sixteen flattish, eroded ribs, with narrower interspaces containing a single thread; the surface sculptured with fine, wavy, concentric lamellæ; posterior two or three ribs under the byssal notch are corrugated on the anterior edge; submargins narrow, the anterior smooth; ears subequal, radially sculptured, notch deep.

These notes are taken from the types of this unfigured species in the collection of the Academy of Natural Sciences, Philadelphia. This may prove to be identical with the specimen now standing as the type of *P. oxygonum* Sby. in the Heniker collection.

Pecten (Chlamys ?) sp. indet.

Pecten opercularis Gabb, Geol. St. Domingo, p. 256, 1873; not of Linné.

Oligocene of St. Domingo; Gabb.

This is a nearly smooth, ovate-oblong shell, with twenty-two nearly obsolete ribs, fading out at the submargins; ears small, low, subequal. Alt. 70, lat. 58 mm. It is obviously not the European species with which Gabb too hastily identified it.

Pecten (Chlamys) cactaceus n. s.

PLATE 34, FIGURE 2.

Tertiary of St. Domingo, Gabb; Pliocene of Tehuantepec, seventy kilometres west of eastern terminus of the railway, near the foot-hills of the elevated country, Spencer.

Shell thin, fragile, compressed, nearly equilateral and equivalve, with ten to twelve sharp, narrow-keeled ribs, with much wider shallow interspaces, in which there are five or six fine, sharp radial threads; whole surface, when perfect, covered with imbricating scales, those on the ribs triangular, apices basally directed, and similarly on a smaller scale, on the threads, between the keels and threads the imbrication is looped in an umbonal direction, sharp and rasp-like; ears subequal, with close, sharp, concentric, elevated lines and a few subspinose radial threads; interior grooved in harmony with the external ribs, the margins of the channels reinforced by liræ in the adult; crura developed, notch shallow. Alt. 47, lat. 46, diam. about 8 mm.

This is quite a distinct species, not particularly like any other described from this region and apparently a deep-water shell. The specimens in Gabb's collection are mixed with others identified by him as *oxygonum* Sby., and their horizon is not definitely settled.

Pecten (Nodipecten) nodosus Linné.

Pecten nodosus Linné (as *Ostrea*), Syst. Nat., No. 164, 1758.

Pecten magnificus Gabb, Geol. St. Dom., p. 256, 1873; from type, not of Sowerby, 1835.

Oligocene of St. Domingo, Gabb (? Pliocene); Pliocene of Florida and the Antilles, Willcox. Living in the Antillean region.

The shell named *magnificus* by Gabb is merely one of the less nodose mutations of this well-known and variable species.

Pecten (Plagioctenium) excentricus Gabb.

Pecten excentricus Gabb, Geol. St. Dom., p. 256, 1873.

Oligocene of St. Domingo; Gabb and Bland.

Shell small, oblique, with about twenty-one low ribs, narrow and flattened on top, with subequal interspaces, both crossed by sharp, looped concentric lamellæ; submargins smooth, ears small, with sparse radial lines; auricular crura pronounced, cardinal crura strong, with sharply incised cross-striation.

This recalls a young specimen of *subventricosus*.

Pecten (Plagioctenium) Gabbi Dall.

PLATE 29, FIGURE 3.

Pecten paranensis Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 347, pl. 45, fig. 24, 1881; not of Orb., Voy. Am. Mer. Pal., p. 135, pl. vii., figs. 5–9, 1849.

Oligocene of Antigua, Spencer; and of St. Domingo, Gabb.

Shell broad, compressed, oblique, inequilateral, with nearly equal valves and about nineteen concentrically scabrous, longitudinally striated ribs, with narrower interspaces, each filled with one imbricated riblet. Alt. 48, lat. 52, diam. 13 mm.

The Antillean species is quite distinct from that figured by Orbigny, and more nearly resembles his *P. tehuelchus*, which has a more inflated and rounder shell, with a much larger and less oblique posterior ear. (Cf. Voy. Am. Mer., Mollusques, pl. 85, figs. 21 to 24.)

Pecten (Plagioctenium) demiurgus n. s.

PLATE 26, FIGURE 3.

Pecten comparilis Guppy, Geol. Mag., Dec. ii., vol. i., p. 451, 1874; not of Tuomey and Holmes, 1855. (From types.)

From the Caroni Series of Trinidad at Savanetta; Guppy.

This species, which is closely related to the Pacific coast *P. ventricosus* Sowerby, differs by its rounded and minutely squamose ribs, narrower umbones, wider and less inflated shell, with the anterior ears more deeply inset. It has twenty ribs, smooth submargins, and a rather deep notch. Alt. 70, lat. 72, max. diam. 36 mm. The left valve is a little less inflated than the other.

Pecten rudis Gabb, as of Sowerby, from the Tertiary of Costa Rica, appears to be indeterminable.

Pecten (Pseudamusium) Guppyi n. s.

PLATE 34, FIGURES 12, 13.

Oligocene of the Bowden marl, Jamaica, and of the Alum Bluff sand at Oak Grove, Santa Rosa County, Florida, Burns; and in the Pliocene marl of Port Limon, Costa Rica, Hill.

Shell small, suborbicular, moderately convex, smooth, with the surface covered with microscopic Camptonectes striation; ears small, the anterior slightly larger, all with very minute radiation and concentric lines; notch narrow, small, with no ctenolium; interior smooth, without liræ or developed crura; traces of the auricular crura alone perceptible; cardinal margin bearing a sharply cross-striated, very distinct provinculum; basal margins flattened, posterior margin slightly compressed. Alt. 6, lat. 6 mm.

The abundance and uniformity of this little shell testify to its adult character. Occasional individuals show a thickened line internally on each side, on the lower edges of the submargins, like some recent species, and also traces of coloration in blotches.

Amusium papyraceum Gabb.

Pleuronectia papyracea Gabb, Geol. St. Dom., p. 257, 1873.

? = *Amusium Mortoni* Ravenel, 1844.

Oligocene of Bowden, Jamaica, Henderson; and of St. Domingo, Gabb.

This species when young is more ovate, when adult orbicular. The umbones are smooth, by which it may be instantly distinguished from *P.* (*Amusium*) *Lyoni.* Whether it can be separated from *Amusium Mortoni* Rav. or not will depend upon comparisons for which the material at my command is as yet insufficient. The species is still living in Antillean and Gulf waters. Alt. 50, lat. 55 mm.

Amusium Lyoni Gabb.

Pleuronectia Lyoni Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 347, pl. 45, fig. 25 *a–b*, 1881.

Pecten Mortoni Guppy, *op. cit.*, p. 451, 1874.

Oligocene of Anguilla, Guppy; of Bowden, Jamaica, Guppy; Pliocene of Tehuantepec, Spencer; and of Costa Rica, Gabb.

This form, otherwise very similar, is immediately distinguishable from *P.* (*A.*) *papyraceus* by the nepionic sculpture of the umbonal region.

Most of the recent *Pectinidæ* of the Gulf and Antillean region are found associated with other recent shells in the raised beaches and reefs so numerous on the islands. It is not necessary to enumerate them here, but I may mention that *Pecten* (*Euvola*) *ziczac* L. is quite abundant in the Pleistocene of Barbados.

FOSSIL PECTENS OF THE FLORIDIAN REGION.

The environs being now cleared, we may proceed to consider the species represented in the Floridian horizons and the adjacent portions of the southeastern United States.

Pecten (Pecten) Poulsoni Morton.

Pecten sp. Lesueur, Walnut Hills Fos., pl. 5, figs. 3, 4, 1829.

Pecten Poulsoni Morton, Syn. Org. Rem., p. 59, pl. xix., fig. 2, 1834.

Pecten elixatus Conrad, Proc. Acad. Nat. Sci., ii., p. 174, 1846.

Janira promens de Gregorio, Mon. Claib., p. 181, pl. 21, figs. 17–25, 1890.

Oligocene (Vicksburgian) at Vicksburg, Carson's Creek, Wayne County, and Shubuta, Mississippi; near Rosefield, Louisiana, Vaughan; near Archer, Florida, Dall; at Jarves Spring, Florida, Willcox. Abundant in the Vicksburgian beds generally, but hitherto frequently confused with *P. perplanus* Morton.

This is a very solid and characteristic little shell. The ribs in young specimens are often simple; in adults they are apt to take on two or three longitudinal grooves. The crura are strong and well developed.

Pecten (Pecten) biformis Conrad.

Pecten biformis Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 306, 1843; Fos. Med. Tert., p. 73, pl. 42, fig. 1, 1845.

Eocene (?) of the Pamunkey River, Virginia; Conrad.

This rare and little-known species has the nepionic part smooth, or obsoletely radially striated. There are five or six original ribs; the succeeding riblets are numerous, rough, irregular, and minutely imbricated; the left valve is concave, otherwise like the other. Alt. 26, lat. 25 mm. The type specimens, which are all I have seen, have a somewhat abnormal aspect, and it would not be surprising if the sudden change in the sculpture should prove to be an exceptional feature. The horizon is also a little doubtful, and the species may turn out to be Miocene when its true situs is identified.

Pecten (Pecten) Burnsii n. s.

PLATE 34, FIGURE 8.

Oligocene of the Chipola marls, Chipola River, Florida; Burns.

Shell resembling *P. Poulsoni* Morton, but smaller, less inflated, and with larger ears; ribs fourteen, on the right valve strong, each divided by two grooves so as to be tricarinate, the minor keels scabrous, the interspaces narrower, with fine concentric sculpture; ears and submargins radially threaded, the ears large, subequal, the notch shallow; left valve flat, the ribs angular, simple, strong, with fine concentric sculpture; ears large, radially finely threaded; interior fluted. Alt. 18, lat. 19, diam. 6 mm.

In specimens of *P. Poulsoni* of the size of this species the scabrous tricarination of the ribs has not yet appeared; they are quite simple, and number seventeen to twenty. This is probably one of those cases where a lineal descendant takes on the adult character of the ancestor at an earlier period in its life than the ancestor did, a character often indicating senility in the life of the species. *P. Burnsii* appears to be rare, and the type disappears entirely from the succeeding horizons, as far as known, being replaced in the Miocene by large species such as *P. hemicyclicus.*

Pecten (Pecten) Humphreysii Conrad.

Pecten Humphreysii Conr., Bull. Nat. Inst., ii., p. 94, pl. 2, fig. 2, 1842.

Pecten Humphreysii var. *Woolmani* Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, p. 405.

Miocene of the Plum Point horizon, at Plum Point, Centreville, Burch, and other localities in Maryland; older Miocene of Cumberland County, New Jersey, at Shiloh and Jericho, and of Virginia and South Carolina.

This fine and rare species is somewhat widely distributed. The variety *Woolmani*, which differs from the type by its more sharply striated surface and pronounced sculpture, is chiefly known from the New Jersey localities.

Pecten (Pecten) hemicyclicus Ravenel.

Janira hemicyclica Ravenel, Tuomey and Holmes, Pleioc. Fos. S. Car., p. 25, pl. 8, figs. 1–4, 1855.

Pecten hemicyclus Meek, S. I. Checkl. Mioc. Fos., p. 4, 1864 (err. typ.).

Newer Miocene of Cooper River, South Carolina, at the Grove, and on Goose Creek at Smith's; Ravenel and Holmes.

This fine species differs from the other American forms in its size and close, coarse concentric sculpture, recalling *P. maximus* of Europe, but of a more inflated form.

Pecten (Pecten) Raveneli n. s.

PLATE 29, FIGURE 10.

Rare in the Pliocene of the Caloosahatchie marls, Florida, Dall; dredged, with other fossils, off Cape Fear, North Carolina, in fifteen fathoms by the United States Fish Commission.

Shell much of the size and form of *P. medius* Lam., but with twenty-one or twenty-two strong ribs; dichotomous in the right valve but rounded and simple in the left, with three or four finer threads on the submargins; interspaces on the right valve smaller than the squarish ribs, on the left subequal; right valve with subequal ears, each with three or four strong, rounded riblets; notch shallow; ears of the left valve concave, two-ribbed, with less pronounced sculpture; surface of both valves covered with close-set, concentric, elevated lines; interior fluted, crura moderately developed. Alt. 42, lat. 47, diam. 13 mm.

This neat little species differs from *P. medius* in its coarser sculpture, and from the young of *P. hemicyclicus* by its more numerous ribs and details of surface.

Pecten (Euvola) Holmesii Dall.

Janira affinis T. and H., Pleioc. Fos. S. Car., p. 26, pl. 8, figs. 5, 6, 1855; not of Reuss, 1846, nor Risso, 1826.

Miocene of South Carolina, on Goose Creek, at Smith's.

This fine species is only known by the author's types now in the American Museum of Natural History, New York City. The name employed was already in use for a Cretaceous species of Europe by Reuss, and for a recent species from the Mediterranean by Risso, so I have substituted another.

Pecten (Lyropecten) Jeffersonius Say.

Pecten Jeffersonius Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 133, pl. 9, fig. 1, 1824; Conrad, Fos. Medial Tert., p. 46, pl. 22, fig. 1, 1840.

Miocene of the Nansemond, James, and York Rivers, Virginia, at Suffolk, City Point, Coggins Point, Bellefield, and Grove Wharf; also in the Miocene of North Carolina.

Pecten Jeffersonius var. **edgecombensis** Conrad.

Pecten edgecombensis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, pp. 291, 581, 1863.
Liropecten carolinensis Conrad, in Kerr, Geol. N. Car., App., p. 18, 1875 (from type).

Miocene of Coggins Point, Petersburg, Grove Wharf and Gaskins Wharf, York River, and Suffolk, Virginia; Langley's Bluff, Maryland, and near Tarboro', Edgecombe County, North Carolina.

Pecten Jeffersonius var. **septenarius** Say.

Pecten septenarius Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 136, pl. ix., fig. 3, 1824.
Pecten septemnarius Conrad, Med. Tert., p. 47, pl. 22, fig. 2, 1840.

Miocene of St. Mary's River, Maryland; Petersburg, Virginia; Duplin County, North Carolina, and the Peedee River, South Carolina. Rather rare.

It is probable that no group of Pectens shows more interestingly the factors of variation in sculpture than that comprising the east American Lyropectens.

These shells (*L. Jeffersonius* and *Madisonius*) illustrate the different mutations in the most instructive way. They are ribbed shells, nearly equilateral and equivalve, with a surface sculpture of fine radial scabrous threads. It is probable—since the range of *Jeffersonius* is more restricted and its earliest appearance in the Miocene, while *Madisonius* is represented by precursors in the Oligocene—that *Jeffersonius* is an offshoot from *Madisonius* and that *P. Clintonius*, even, may be another. To determine the range of variation in the matter of the primary ribs, I have counted them on all the specimens in the collection, nearly one hundred, with the following result:

A. Variety *septenarius*. Three with seven, eleven with eight ribs.

B. Variety *Jeffersonius* s.s. Eighteen with nine, twenty-eight with ten, thirteen with eleven ribs.

C. Variety *edgecombensis*. Seven with twelve, one with thirteen, five with fourteen, two with fifteen, two with sixteen, one with seventeen, and one with twenty ribs.

The typical number for the species, therefore, would seem to be nine or ten primary ribs.

The surface is covered with fine radial threads, and in this species they are very close together, even in size, closely set with small raised scales. The fact that these scales are so close to one another makes the transverse lines pretty even. In *Madisonius* the threads are larger, the scales larger and more sparsely distributed on the threads, so that they frequently have an alternated aspect.

The threads are usually very uniform in size in *Jeffersonius*, but it frequently happens in the specimens with more numerous primary ribs that the middle threads in the interspaces will be somewhat larger than the others. This is not very apparent in the specimens which retain the scales perfect, but in those which are worn the interspaces seem to have a distinct mesial thread. It was to this kind of mutation that Conrad gave the name of *edgecombensis*, the type-specimens of which are in the National Museum. When there are fewer primary ribs, as in the type of the species or the variety *septenarius*, the threads are more uniform over the wider ribs and interspaces.

The most conspicuous character by which the peripheral specimens of *Jeffersonius* can be discriminated from those of *Madisonius* is comprised in the sculpture and form of the byssal ear. In *Jeffersonius* it is sculptured with fine, uniform, numerous threads, and the notch is shallow and leaves an inconspicuous fasciole. In *Madisonius* the upper part of the ear is provided with comparatively few and coarse threads, and the notch is wide and deep, with a broad and well-marked fasciole. Counting the ribs of seventy adult specimens of *Madisonius* in the collection, the following result was obtained:

A. Variety *Madisonius* s. s. Four with twelve, five with thirteen, eight with fourteen, twenty-three with fifteen, fifteen with sixteen, nine with seventeen, and two with eighteen ribs.

B. Variety *Sayanus*. One with thirteen and four with fifteen ribs.

It would seem, therefore, that the normal number of ribs in *Madisonius* is fourteen to seventeen.

The two species usually, but not invariably, differ in convexity, *Jeffer-*

sonius being the more inflated. The two valves are usually nearly equal in this respect.

As there are more ribs in *Madisonius*, they are necessarily narrower, and as the threads are coarser, there are fewer of them on top of the ribs. From this it results that the ribs, as noted by Say, often bear three scabrous threads, sometimes five, young specimens occasionally only two, and similarly in the interspaces, whereas on the backs of the ribs the mesial thread is often more prominent than the others. The three-threaded form was called *tricarinatus* by Conrad, though it appears to have been the original type of Say. The young two-threaded form at first appears very distinct, but such shells acquired the third thread with growth. Rarely in this species the threads are fine and uniform, as in *Jeffersonius*, but the byssal ear will enable the specimen to be rightly identified. On the whole, it seems as if in Southern specimens the tendency of *Jeffersonius* was to be flatter and have more ribs, and in the Maryland and Virginia form to have fewer ribs and more convex shells. Still, the variety *septenarius* is reported from South Carolina, and a larger series of specimens from Southern localities might show this generalization does not hold uniformly. The young shells of this group would be naturally placed in the section *Chlamys*, and the peripheral species in time, such as those of the Eocene and Pliocene, though obviously related to the Miocene type, are perhaps best placed there also. Except in the absence of nodes they are equally close to *Nodipecten*. Even in the Miocene we have species which are strictly intermediate between *Placopecten*, *Lyropecten*, and *Chlamys* s. s. Hence, no one who carefully studies the various types can feel that a multiplication of genera faithfully represents the facts of nature.

Pecten (Lyropecten) Madisonius Say.

Pecten Madisonius Say, Journ. Acad. Nat. Sci., 1st Ser., iv., p. 134, 1824; Conrad, Fos. Medial Tert., p. 48, pl. 24, fig. 1, 1840.

Pecten tricarinatus Conrad, Am. Journ. Conch., iii., p. 189, 1867.

Pecten fraternus Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, pp. 291, 581, 1863.

Miocene of New Jersey at Shiloh and Jericho, Cumberland County; of Maryland at St. Mary's River, Greensboro', Choptank River, Langley's Bluff, near Skipton, Barker's Landing, Plum Point, and Calvert Cliffs; of Virginia at Coggins Point, Temple Place on the York River, Jones's Wharf and Grove Wharf, Suffolk, and Petersburg, and of North Carolina at Snow Hill.

Pecten Madisonius var. **Sayanus** n. var.
PLATE 26, FIGURE 6.

Upper Oligocene (Alum Bluff beds) of Oak Grove, Santa Rosa County, Florida; on the Chattahoochee River at Old Chattahoochee Landing, at Rock Bluff, and on the Chipola River in the Chipola beds.

This form is the percursor in the Upper Oligocene of the typical *Madisonius* of the Miocene. It differs from the latter in its extreme compression, the ribs, except in the umbonal region, being almost obsolete. Alt. 120, lat. 135, diam. about 16 mm. This is what has been referred to *Jeffersonius* and *Madisonius* by L. C. Johnson, Foerste, and other observers in the Floridian Oligocene.

The characteristics of *P. Madisonius* have been pointed out under *P. Jeffersonius*, from which it differs by its more compressed shell, more numerous ribs, and coarser and more scabrous sculpture, as well as the deeper and wider byssal notch. The young rarely have the scales continuous across the tops of the ribs.

Pecten (Lyropecten) sp. indet. *a*.

Lower Oligocene at Sulphur Springs ferry, Suwanee River, Suwanee County, Florida (Vicksburg horizon?).

Shell small, thin, flattish, with eleven strong, rounded ribs, separated by slightly wider interspaces; submargins narrow, radially striated; surface probably with concentric elevated and faint radial sculpture when perfect. Alt. 30, lat. 37, diam. about 7 mm.

I have noted this species, as nothing like it has been described from the Vicksburgian, and it has every appearance of being a precursor of the Miocene Lyropectens. The fossil is a silicified pseudomorph, with the surface worn and the ears defective. It is possible that the bed from which it came is the upper Ocala or Nummulitic part of the Vicksburgian, though the rock shows no Nummulites.

Several closely allied species on the border line between the sections, and which, except for their more delicate shells and smaller size, might equally well be placed with the Lyropectens, will be found under the head of *Nodipecten*, *Chlamys*, and *Placopecten*.

Pecten (Placopecten) Clintonius Say.

Pecten Clintonius Say, Journ. Acad. Nat. Sci. Phila., 1st Ser., iv., p. 135, pl. ix., fig. 2, 1824.
Pecten magellanicus Conrad, Journ. Acad. Nat. Sci. Phila., 1st Ser., vii., p. 153; not of Gmelin, 1792.

Pecten principoides Emmons, Geol. N. Car., p. 280, fig. 198, 1858.
Pecten clintonensis Meek, S. I. Checkl. Mioc. Fos., p. 5, 1864.
Chlamys (*Placopecten*) *Clintonius* Verrill, Trans. Conn. Acad., x., p. 78, 1897, in part.
Pecten princeps Verrill, *op. cit.*, in syn., non Emmons.
Pecten Mulleri Verrill, *op. cit.*, in syn., not of Dall.

Miocene of Coggins Point, Grove Wharf, York River, and James River, Virginia, Rogers, Conrad, Lea, and Harris; and of Maryland, Dr. Foreman; and of North Carolina at Murfreesboro, Meherrin River, Emmons.

This remarkable shell appears to be quite limited in its range, and is only known in the Miocene of Maryland, Virginia, and North Carolina. It presents at a first glance a remarkable resemblance to the recent *Pecten magellanicus* (Ch.) Gmelin, which is doubtless its descendant. The latter can, however, be at once discriminated from the fossil by the shorter hinge-line, higher auricles, much narrower resiliary pit, and, usually, the smaller and less central adductor scar of the recent shell. A very large series of both recent and fossil specimens which I have carefully studied confirms the uniformity of the abovementioned characters. As a rule the radiating threads in the fossil are markedly coarser than those of the living species. In both the byssal notch of the adult is represented by a shallow sinuation, and the ctenolium, present in the immature stages, is usually buried in shelly matter in the adult.

Since so much confusion has occurred between these two species, a statement of the synonymy of the living form may be useful.

Pecten (Placopecten) magellanicus Gmelin.

Amusium magnum magellanicum, etc., Chemnitz, Conchyl. Cab., vii., p. 290, pl. 62, fig. 597, 1784; Schröter, Einl. Conch., iii., p. 323, 1786; Favanne, pl. 55, fig. e, 2.
Ostrea magellanica Gmelin, Syst. Nat., vi., p. 3317, 1792 (not 1788, as frequently quoted); Dillwyn, Descr. Cat. Rec. Sh., i., p. 250, 1817.
Ostrea grandis Solander, Portland Cat., 1786 (*fide* Humphrey).
Pecten grandis Humphrey, Mus. Cal., p. 51, No. 969, 1797.
? *Amusium testudinarium* Bolten, Mus. Bolt., p. 165 (name only), 1798; 2te Ausg., p. 115, 1819.
Pecten magellanicus Lam., An. s. Vert., vi., p. 165, 1819; ed. Desh., vii., p. 134, 1834; Gould, Inv. Mass., p. 132, 1842; ed. Binney, p. 196, fig. 494, 1870; Conr., Am. Mar. Conch., i., p. 6, pl. i., fig. 1, 1831; Stm., Sh. N. Engl., p. 8, 1851.
Pecten fuscus Linsley, Am. Journ. Sci., 1st Ser., xlviii., p. 278, 1845 (name only); Gould, Am. Journ. Sci., 2d Ser., vi., p. 235, fig. 6, 1848; Stm., Sh. N. Engl., p. 8, 1851. (Young shell.)
Pecten brunneus, Stm., Sh. N. Engl., p. 58, in errata, 1851. (Young.)

Pecten tenuicostatus Mighels and Adams, Proc. Bost. Soc. N. Hist., i., p. 49, 1841; Bost. Journ. Nat. Hist., iv., p. 41, pl. 4, fig. 7, 1842. (Young.)

Pecten tenuicostatus Verrill, Rep. U. S. Fish. Com., 1871–2, pp. 509, 696, 1873. (Adult.)

Chlamys (*Placopecten*) *Clintonius* Verrill (*ex parte*), Trans. Conn. Acad. Sci., x., pp. 69, 78, pl. xvii., figs. 1–7; pl. xx., figs. 7, 8, 8 *a*; pl. xxi., figs. 1, 1 *a*, 2, 2 *a*, 1897.

Pecten (*Pseudamusium*) *Mulleri* Verrill, *op. cit.*, p. 78, not of Dall.

Pecten (*Pseudamusium*) *striatus* Dall, Bull. U. S. Nat. Mus., No. 37, p. 34, No. 40, 1889 (not of Müller, *fide* Verrill), young shell; Verrill, *op. cit.*, p. 96, in errata, 1897.

Pleistocene of St. John, New Brunswick, and Gardiner's Island, New York; living from Labrador southward, in increasing depths of water, to Cape Hatteras, North Carolina.

The sculpture of the more northern specimens is less strong than in those from more southern habitat, and for the former Professor Verrill suggests the retention of Mighels's name *tenuicostatus* (originally given to the young shell) in a varietal sense. This is not *P. tenuicostatus* Hupé, in Gay's Chile, 1854. As previously noted, the writer sees no reason why Gmelin's name, given in error as to the true habitat of this species, but universally familiar, should not continue to be used. If, however, an exaggerated purism demands a change the next most appropriate name is that of Solander, given without description in the Portland Catalogue, described in the Banksian MSS., and cited by Humphrey as the Great Compass shell from Newfoundland, with nearly equal valves, remarks which cannot possibly apply to any other species. He not unnaturally places it after the species of *Amusium*, as H. and A. Adams did in their Genera of Recent Mollusca (ii., p. 55) sixty years later.

Pecten (Placopecten) virginianus Conrad.

Pecten virginianus Conr., Fos. Medial Tert., p. 46, pl. xxi., fig. 10, 1840.

Miocene of City Point, Virginia; E. Ruffin.

This is a puzzling shell, of which only the type specimen (a right valve) and one other valve are known. It appears like a young shell of *P. Clintonius* in all essentials, except that it is more convex and has the byssal ear separated by a broad fasciole and deep notch from the submargin and is provided with a strong and conspicuous ctenolium. The young shells of *P. Clintonius* of the same size (altitude fifty-eight millimetres) as the type of *virginianus* have not these characters, as an examination of a large number has shown. A specimen of the same valve from Coggins Point, Virginia, identified by Conrad as *virginianus*, seems to me merely a young *P. Clintonius* with a somewhat deeper notch than usual, but the original type specimen differs more markedly, and until intermediate specimens are obtained I should not feel justified in suppressing the species.

Pecten (Placopecten ?) marylandicus Wagner.

Pecten marylandicus Wagner, Journ. Acad Nat. Sci. Phila., viii., p. 51, pl. 2, fig. 1, 1838.
Pecten tenuis H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 246, pl. 35, fig. 33, 1845.

Miocene of the Patuxent River, at Jones's Wharf, Maryland, Wagner; of Petersburg, Virginia, Lea; and the Meherrin River, North Carolina.

I have examined the types of *P. marylandicus* in the Academy's collection, and the type of Lea's species is in the collection of the National Museum.

It is difficult to say to which section the species should be referred, as in the typical *P. marylandicus* the radiating threads often are gathered into fascicles (fifteen to seventeen) which crenulate the valve margin, while in *P. tenuis* the threads are not fasciculated and the margin is entire. In the former the interior is fluted, in harmony with the external sculpture, while in the type of *tenuis* the fluting is quite obsolete, though there are faint radial striations near the margin. In *marylandicus* the radial sculpture averages coarser than in *tenuis.* Yet these differences march closely with those observed in a large series of *P. hericeus* Gould from the northwest coast, and the other characters are so similar that I feel indisposed to assign specific rank to the differences.

In the largest and finest specimens of *P. marylandicus* there are fluctuated scales concentrically arranged on each side of a mesial thread, in the interspaces between the principal ribs. The shell attains an altitude of ninety and a width of ninety-five millimetres, and the byssal notch is deep and conspicuous. The species forms a transitional link between *Placopecten* and *Chlamys* s. s.

Pecten (Nodipecten) nodosus Linné.

Ostrea nodosa L., Syst. Nat., Ed. x., p. 697, No. 164, 1758; Ed. xii., p. 1145, 1767.
Pecten corallinus Chemn., Conch. Cab., vii., p. 306, pl. 64, figs. 609–11, 1784.
Pecten nodosus Lam., An. s. Vert., vi., p. 170, 1819; d'Orb., Moll. Cuba, ii., p. 353, 1845.
Pecten pernodosus Heilprin, Trans. Wagner Inst., i., p. 131, pl. 16 *b*, figs. 69, 69 *a*, 1887.
Pecten nodosus Heilprin, *op. cit.*, p. 100, 1887.
Pecten fragosus Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., 1, p. 214, pl. 39, fig. 11, 1849.
Pecten magnificus Gabb, Geol. St. Dom., p. 256, 1873; not of Sowerby, P. Z. S., 1835, p. 109.
Lyropecten nodosus Verrill, Trans. Conn. Acad., x., p. 91, 1897.

Pliocene of the Caloosahatchie marls, Florida, Willcox; Pleistocene of the Antilles and the north coast of South America; living in the Gulf of Mexico and the Antilles, and probably also (as *P. subnodosus*) on the Pacific shores of middle America. (Cf. remarks under *Lyropecten* and *P. subnodosus* Sby., pp. 701, 710.)

This species is the type of the section *Nodipecten*. It varies in the number of ribs (seven to ten) and extremely in its amount of nodulation. Some specimens have merely turgid undulations of the ribs, as in the form first described of the Pacific *subnodosus*. Others bear subglobular bullæ on the ribs at short intervals. Others begin without nodes and after half their growth is accomplished suddenly become nodulous. *P. subnodosus* varies in the same way. The deeper the water, apparently, in which the individual lives, the thinner and more nodose the shell. Mr. Willcox found some remarkably fine specimens in the marls of the Caloosahatchie.

Pecten (Nodipecten ?) peedeënsis Tuomey and Holmes.

Pecten peedeënsis T. and H., Pleioc. Fos. S. Car., p. 30, pl. 12, figs. 1–5, 1855.

Miocene of the Peedee River, Darlington District, South Carolina, and of Virginia.

This fine species frequently has the younger part of the shell nodose and the distal portions of the ribs wider, feebler, and less nodose. It has eight or nine ribs and conspicuous concentric lamellation. It seems nearly intermediate between the *Lyropecten* and *Nodipecten* types, and may belong to the section *Macrochlamis* Sacco (Bull. Mus. Zool. Torino, xii., No. 298, p. 101, June, 1897, type *P. latissimus* Brocchi).

Pecten (Nodipecten) condylomatus n. s.

Plate 34, Figures 14, 15.

Oligocene of White Beach, Osprey, Florida, and of the Chipola River at Bailey's Ferry, Florida, Burns and Dall; lower bed at Hawkinsville, Georgia, Burns.

Shell small for the group, subequilateral, slightly inequivalve, the right valve more convex with nine to thirteen strong, undulated, rounded, more or less nodulous, finely radially striated ribs, the undulations affecting the whole of the disk, sudden and very pronounced, giving a side view of the valve somewhat the aspect of a clenched fist; interspaces narrower radially, finely threaded, the whole valve with fine concentric lamellation somewhat prickly or limose at the intersections; submargins rather wide, radially finely striate; ears small, subequal, the surface coarsely radially threaded, the byssal ear produced with a conspicuous sinus and fasciole; ctenolium well marked; inner basal margin fluted by the ribs; cardinal margin with two or three strong crural ridges. Alt. 40, lat. 45, diam. about 22 mm.

This is an interesting species, peculiar from its small size and the abruptness of its knuckle-like undulations. Some specimens, however, are but little undulated, and the mutations are much the same as occur in other species of the section.

The following species, while they are related by sculpture, form, and conchological character to the *Nodipecten* type, are not known to form nodules; the ribs may be slightly tumid at intervals or periodically undulated, but there are no hollow bullæ, as in the more typical forms. But these characters are precisely those of the non-nodulous varieties of the nodulous species, and so I feel justified in including them in this section.

Pecten (Nodipecten) anatipes Morton.

Pecten anatipes Morton, Am. Journ. Sci., xxiii., p. 293, pl. 5, fig. 4, 1833; Syn. Org. Rem., p. 58, 1834.

Oligocene of Mississippi, Vicksburgian horizon, at Heidelberg and in Jasper County; Johnson.

The shell is small, with five or six ribs and narrower feebly striated interspaces; cardinal crura well developed.

Pecten (Nodipecten) pulchricosta Meyer and Aldrich.

Pecten pulchricosta M. and A., Journ. Cin. Soc. N. H., ix., p. 45, pl. 2, figs. 23, 23 *a*, 1886.

Jacksonian Eocene of Wahtubbee Hills, Clarke County, Mississippi; Aldrich and Burns.

Shell small, thin, with eight large ribs, which near the umbo are divided by one or two well-marked sulci, which soon become obsolete, after which the ribs are simple; the surface sculpture is of even, uniform, crowded, concentric elevated lines. The ears are subequal, the byssal notch well marked. Neither in Meyer's figure nor in the specimens do I find the ribs dividing near the basal margin, as stated in his diagnosis.

Pecten (Nodipecten) Rogersi Conrad.

Pecten Rogersi Conrad, Journ. Acad. Nat. Sci., 1st Ser., vii., p. 151, 1834; Medial Tert., p. 45, pl. 21, fig. 9, 1840.

Miocene of the James River, near Smithfield, Virginia, and of Maryland, near Skipton; Conrad and Harris.

Shell with four large and two smaller lateral simple ribs, internally lirate; submargins narrow, minutely scabrous, not radiated; the rest of the disk entirely covered with fine, squared, elevated, minutely scaly radial threads; ears subequal, finely radiated; sinus well-marked; ctenolium and cardinal crura developed. Alt. of type 20, lat. 19 mm.

This is not the *Pecten* (*Pseudamusium?*) *Rogersi* Clark, Bull. U. S. Geol. Surv., No. 141, p. 85, pl. 34, figs. 2 *a–b*, 1896, from the Eocene of Potomac Creek, Front Royal, Virginia. For the latter the specific name of *frontalis* is suggested, since there is already a species named for Professor Clark.

Pecten (Nodipecten) caloosaënsis n. s.

PLATE 29, FIGURE 12.

Caloosahatchie Pliocene marl of the Caloosahatchie River and Shell Creek; Willcox and Dall.

Shell moderately large, with four principal ribs and sometimes a subsidiary, much smaller, rib at the inner edge of the submargins; backs of the ribs strongly radially striated or even threaded, the interspaces smooth or with only obsolete traces of striation, equal to or wider than the ribs; concentric sculpture usually weak, of close-set concentric elevated or incremental lines; submargins wide, the outer margins smooth, the inner threaded like the backs of the ribs; ears large, triangular, widest at the cardinal margin and pointed at the distal cardinal angle, their sculpture radial, not crowded; feeble, except upon the byssal ear, where the threads are strong and concentrically scabrous; byssal notch wide, shallow, the fasciole conspicuous; ctenolium distinct; interior reflecting the external ribs; hinge with the crura present but feeble in the young; the old specimens have them obsolete, but on the cardinal margin a relatively broad ligamentary area is formed. Alt. 83, lat. 80, diam. 30 mm.

This is one of the finest and most characteristic species of the Pliocene, remarkable for its wide, acute ears, and for having the interspaces of the ribs nearly smooth, although the ribs are striated.

Pecten (Nodipecten) antillarum Recluz.

Pecten antillarum Recluz, Journ. de Conchyl., iv., p. 153, pl. 5, fig. 1, 1853 (May); Beau, Cat. Coq. Guadelupe, p. 21; Arango, Fauna Mal. Cubana, ii., p. 209, 1878.

Pecten fucatus Reeve, Conch. Icon., *Pecten*, pl. xxxi., fig. 139 *a–b*, 1853 (June); Krebs, W. I. Mar. Shells, p. 134, 1864.

Pecten (*Pseudamussium*) *argenteus* Marrat, Argo Exped., p. 7, 1876; not of Reeve. (An immature specimen.)

Pecten sulcatus Krebs, W. I. Mar. Shells, p. 134; not of Lam.

Pliocene and Pleistocene of the Antillean region; living in Cuba, Guadelupe, the Bahamas, and the Florida Keys.

This species is often destitute of the nodosities, and in that condition is referable to *Chlamys*. The very young shell is thin and glistening, in which state it has been mistaken for the Chinese *P. argenteus* Reeve. Old and worn specimens have been taken for *P. sulcatus* Lam. Its analogue and precursor in the Antillean Oligocene is the *P. anguillensis* Guppy.

Pecten (Æquipecten) perplanus Morton.

Pecten sp. Lesueur, Walnut Hills Fos., pl. 5, fig. 2, 1829.

Pecten perplanus Morton, Am. Journ. Sci., xxiii., p. 293, 1833; Org. Rem., p. 58, pl. 5, fig. 5, and pl. 15, fig. 8, 1834.

Pecten Spillmani Gabb, Journ. Acad. Nat. Sci., 2d Ser., iv., p. 402, pl. 68, fig. 3, 1860.

Eocene of St. Stephen's, Alabama, Morton; of the Jacksonian at Jackson, at Turk's Cave, Cocoa Post-Office, Choctaw County, and Fair Post-Office, near Claiborne, Alabama; at Pachula Creek and Shubuta, Clarke County, Mississippi; in the Vickburgian or Lower Oligocene, near Gainesville, Alachua County, at various localities in Levy County, and in the Nummulitic horizon at Ocala, Florida, Dall, Burns, and Johnson; Grant Parish, Louisiana, Johnson.

Shell with twenty-three to twenty-five subangular ribs with sloping sides and equally wide shallow interspaces, an obsolete thread on each side of the median keel of each rib, stronger on the side away from the middle of the valve; in large ones another thread begins near the basal margin; whole shell covered by regularly spaced low, thin concentric lamellæ, not crowded, which are slightly produced as a little linguiform process over each rib and thread, more prominent on the right valve, which has rather small, short ears, with three to five spinose or imbricate radii, and a conspicuous but not deep byssal notch; left valve with sharper keels, feebler concentric lamellæ, subequal ears, with five or six low beaded radii; shell plump in both valves, internal margin strongly fluted; hinge with the cardinal crura strongly developed and cross-striated. Alt. 34, lat. 35 mm.

A full description is given, as I have found this shell much confused in nearly all the collections with *P. Poulsoni*, *P. nuperus*, and others. The types of *P. perplanus* and *P. Spillmani* have been compared and their identity fully confirmed. *P. nuperus* belongs to the section *Chlamys* and, though with very similar sculpture, is a more elevated and less rotund species. Worn specimens of *perplanus* which have lost the scaly sculpture have a very different aspect and are often puzzling. A variety has the threads with minute crowded scales, while the tops of the ribs are smooth, giving them a laterally fringed appearance; these specimens have twenty-two ribs only. This form was obtained at the Natural Bridge, Alachua County, Florida, and in the lower bed (Hawthorne horizon) at Hawkinsville, Georgia, by Burns.

Pecten (**perplanus** var. ?) **centrotus** Dall.

PLATE 34, FIGURE 21.

Eocene (Vicksburgian?) of the Ponce de Leon artesian well, St. Augustine, Florida, at a depth of two hundred and twenty-five feet; Willcox.

Shell like the preceding, with twenty-three flat-topped smooth ribs with lateral fringes which wholly fill the interspaces but do not unite in the middle of the channel. Two or three of the ribs near the middle of the disk show six to eight distant, regularly spaced short spines projecting from their tops; the other ribs are destitute of spines. Interior sharply and deeply grooved to correspond with the external ribs. Alt. 20, lat. 18.5 mm.

The single valve obtained is somewhat defective, but its sculpture is so different from any of the other forms that it seemed best to describe it.

Pecten (**Æquipecten**?) **choctavensis** Aldrich.

Pecten choctavensis Aldrich, Harr. Bull. Pal., ii., p. 68, pl. 5, fig. 7, 1895.

Eocene of Wood's Bluff, Choctaw County, Alabama; Aldrich.

This shell when not worn has a very flat imbricated sculpture over all, pointed on the backs of ribs and riblets, the surface on the interspaces being quincuncially microscopically punctate. It is rather flat for an *Æquipecten*, and is one of the many peripheral species uniting the different sections.

Pecten (**Æquipecten**) **chipolanus** n. s.

PLATE 29, FIGURE 9.

Upper Oligocene of the Chipola marls, lower bed at Alum Bluff, and the silex beds at Ballast Point, Tampa Bay, Florida; Dall and Burns.

Shell solid, rounded, plump, with fifteen to seventeen strong, rounded ribs with narrower interspaces which are almost channelled, both ribs and channels with continuous fluctuated, sometimes crowded, low concentric lamellæ;

the ribs faintly grooved distally on top; the concentric sculpture sometimes strong on three or more ribs and almost absent on the intervening ones; hinge-line wide, ears large, with conspicuous but not deep notch, with six or seven coarsely imbricated, close-set radial threads on the byssal ear and more numerous threads on the others; submargins nearly smooth; cardinal crura strong; inner basal margin with strong, short flutings, obsolete above. Alt. 25, lat. 25, length of hinge-line 18 mm.

Pecten (Æquipecten) suwaneënsis n. s.

Vicksburgian of Suwanee County, Florida; Johnson.

Shell with twenty-two entire, rounded ribs, with narrower, rather shallow interspaces crossed by little raised, concentric, not crowded, more or less fluctuated laminæ continuous over ribs and spaces, with lateral grooves on the ribs near the basal margin; submargins narrow, smooth; ears subequal, moderate, with fine, close, concentric sculpture and four or five distant fine imbricated radii; notch distinct, rather deep. Alt. 20, lat. 20 mm.

This form differs from *P. Kneiskerni* by its unchannelled interspaces, continuous concentric lamellæ, and subequal ears; from *P. chipolanus* by feebler and more numerous ribs, shorter ears, and less conspicuous sculpture. It is flatter, thinner, and smaller than the weakest specimens of *P. perplanus*, and while its characters are not marked, does not seem to be unitable with any of the others of its section. *P. nuperus*, which is the nearest to it among the species of *Chlamys*, has a more solid shell, more sharply keeled ribs, and differently sculptured ears, while its form is decidedly more ovoid.

Pecten (Æquipecten) glyptus Verrill.

Pecten glyptus Verrill, Trans. Conn. Acad., v., p. 580, 1882; Dall, Proc. U. S. Nat. Mus., xii., p. 248, pl. 8, figs. 2 and 3, 1889.

Pecten Tryoni Dall, Bull. Mus. Comp. Zool., xviii., p. 438, 1887.

Chlamys (Æquipecten) glypta Verrill, Trans. Conn. Acad., x., p. 76, 1897; in part.

This species is cited here as the only true living representative on our coast of the section *Æquipecten*, and it is rather more inequilateral than typical species of that group. It has been found from the vicinity of Cape Hatteras to the continental bench off Martha's Vineyard. Professor Verrill's specimens were very imperfect, and some worn fragments of another species, *P. phrygium* Dall, were confused with those belonging to *P. glyptus* in Professor Verrill's cited paper. Of his figures on plate xvi., 7, 10, and perhaps 11 represent badly worn *P. phrygium,* while figs. 8 and 9 are taken from the worn type of *P. glyptus.* Perfect specimens of the latter are in the National Museum and were figured as above cited in its Proceedings. It is not yet known in the fossil state.

Pecten (Chlamys) islandicus Müller.

Pecten islandicus Müller, Prodr. Zool. Dan., p. 248, 1776.
Ostrea cinnabarina Born, Test. Mus. Vind., p. 103, 1780.
Pecten rubidus Martyn, Univ. Conch., No. 153, pl. 53, fig. 1, 1784.
Ostrea demissa Solander, Mus. Calonn., p. 52, 1797.
Pecten Pealeii Conr., Am. Mar. Conch., 1, p. 12, pl. 2, fig. 2, 1831.
Pecten Fabricii Phil., Abb. und Beschr., iv., p. 3, pl. 1, fig. 5, 1844.
Chlamys costellata Verr. and Bush, Trans. Conn. Acad., x., p. 75, 1897. (Very young shell.)

Pleistocene of New England and New Brunswick and northward in the bowlder clays, also on the North Pacific coasts in deposits of the same age; living from the Arctic waters southward to Chesapeake Bay.

The minute shell described by Professor Verrill under the name of *costellata* is less than five millimetres long and has not assumed the adult characteristics. From an examination of the type I see no reason to doubt that it is a very young specimen of the present species. This shell is the type of the subgenus *Chlamys.*

Pecten (Chlamys) Kneiskerni Conrad.

Pecten Kneiskerni Conr., Am. Journ. Conch., v., p. 40, pl. 1, fig. 18, 1869.
Pecten Kneiskerni Whitfield, Lam., N. J., p. 224, pl. 29, fig. 5, 1885; in part.

Eocene marl of Shark River, New Jersey, Conrad; Jacksonian Eocene of Claiborne, Alabama, and Enterprise, Mississippi, Johnson; Oligocene of the Chipola beds, Monroe County, Florida (?), Burns.

In Professor Whitfield's attempt to identify the cast of an immature shell named as above by Conrad, the former has evidently brought together the young, uncharacteristic shells of several species of *Chlamys.* Conrad's shell was described as having thirteen ribs and none on the submargins; Whitfield gives the species fifteen to fifty ribs and radiated submargins. This is a range altogether too great for a single species. Probably some of Professor Whitfield's specimens were young *choctavensis,* which has an unusually large number of ribs. I have supposed a shell from the Jacksonian might represent the unidentifiable species of Conrad. This has twenty-five ribs, divaricating near the base with rather sparse concentric imbrications; ribs wider than the interspaces, entire in the young; valves rounded; ears rather small with concentric imbricated radii and rather deep byssal sulcus.

Another form, which apparently has not yet taken on its adult characteristics, has been described from the same beds by Whitfield under the name of *P. Rigbyi.* It is said to have from twenty-two to twenty-six ribs with strong, close concentric scales. It differs from *Kneiskerni,* according to Whitfield, by its wider and stronger ribs with closer and more prominent imbrication. (Whitfield, *op. cit.*, p. 226, pl. 29, fig. 6, 1885.)

Pecten (Chlamys) membranosus Morton.

Pecten membranosus Morton, Org. Rem., p. 59, pl. 10, fig. 4, 1834.

Pecten carolinensis Conr., Kerr, Rep. Geol. N. Car., App., p. 18, pl. 3, fig. 2, 1875; not *Lyropecten carolinensis* Conr., 1875.

Eocene of Jones County, Haldeman; of Rocky Point and Wilmington, North Carolina, Stanton; Eutaw Springs, South Carolina, Conrad.

This somewhat resembles the recent *P. ornatus* Lam., but is shorter and more orbicular. There is no question of the identity of Mr. Conrad's *P. carolinensis* with Morton's species; I have compared the types.

Pecten (Chlamys) wahtubbeanus n. s.

PLATE 34, FIGURE 9.

Claibornian and Jacksonian Eocene of Louisiana, Alabama, and Mississippi; abundant at Wahtubbee; Burns.

Shell small, flattish, with small, unequal ears and rounded disk; fourteen or fifteen ribs carrying basally three densely finely imbricated, rounded threads, the interspaces narrower with two crenulate threads; submargins with close, fine, imbricate threads; ears prominent, with a deep, wide byssal notch, radiately imbricate with coarse, elevated radial threads; interior with shallow sulci, the cardinal crura developed but no liræ on the disk. Alt. 22, lat. 22 mm.

This species differs from the Claibornian *P. Deshayesii* Lea by its threaded and less individualized ribs, its similarly sculptured valves, more conspicuous notch, and concentric sculpture and smaller size when adult. *P. Johnsoni* Clark, from the Maryland Eocene, has more numerous ribs with simpler sculpture, and which increase by intercalation instead of dichotomy. A shell which I suppose to be the same as Clark's was obtained from the Jacksonian of Clarke County, Mississippi, by Johnson.

Pecten Johnsoni Clark (Bull. U. S. Geol. Surv., No. 141, p. 85, fig. 3 *a*, 3 *b*, 1896), from the Eocene of Maryland, is a young shell, not fully exhibiting the adult characters, and of which the type specimen seems worn. It belongs in this vicinity, but has twenty ribs, with single short intercalary threads, crossed only by fine lines of growth. The specimens were obtained from Potomac Creek, Va.

Pecten (wahtubbeanus var. ?) **Willcoxii** n. s.

PLATE 29, FIGURE 4.

Eocene of Clarke County, Mississippi, and of the Wahtubbee hills (Claibornian); Johnson and Burns.

Shell small, broad, flattish, thin; left valve with about sixteen narrow, rounded, elevated ribs, with somewhat sparse, regularly spaced prickles on their tops; between the ribs are similar, but lower and smaller, non-dichotomous radial threads; submargins very narrow, nearly plain, with faint *Camptonectes* striation; ears small, subequal, except the byssal ear, which is longer, narrow, with a deep sinus and conspicuous fasciole, and about six scabrous radii, the right posterior ear with concentric striæ and only faint traces of a few radii; the ears on the left valve similar, with five or six strong scabrous threads; internal basal margin of left valve with short flutings in harmony with the radial sculpture; the disk not grooved; in the right valve the internal channels are more pronounced; the right hinge-line has a single crural ridge parallel with the margin on each side of the pit. Alt. 23, lat. 24 mm.

This form is closely related to *P. wahtubbeanus*, from which it differs by the isolated character of the prickles on the ribs, which are replaced in *wahtubbeanus* by more or less continuous concentric lamellation, while the ribs of the right valve of the latter are more or less split up, but in *P. Willcoxii* present the appearance of a fascicle of separate threads. In worn specimens of *wahtubbeanus* the ribs appear rounded and plain after the removal of the scales; in *Willcoxii* the division into threads is distinct. Nevertheless it is possible that a larger series may show the two forms to be merely the extremes of a single species. From *P. membranosus* the present form is easily distinguished by wider hinge-line, larger ears, thinner shell, and by its radial threads fasciculated rather than subequally level. It is named in honor of Mr. Joseph Willcox, to whom our Tertiary Paleontology is so much indebted.

Pecten (Chlamys) Deshayesii Lea.

Pecten Deshayesii Lea, Contr. Geol., p. 87, pl. 3, fig. 66, 1833.
Pecten Lyelli Lea, *op. cit.*, p. 88, pl. 3, fig. 67. (Young.)

Pecten Deshayesii var. *tirmus* Gregorio, Claib. Mon., p. 181, pl. 21, fig. 15, 1890.
? *Pecten minutus* Lea, *op. cit.*, p. 88, 1833.
Not *P. Deshayesii* Nyst, Coq. et Polyp. Fos., p. 288, 1845.

Jacksonian of St. Stephen's Bluff, Tombigbee River, Alabama, of Claiborne, Mississippi, and four miles west of Live Oak, Florida; Burns and Stanton.

This species is positively known to occur in the Jacksonian at Claiborne and elsewhere, but I have obtained no specimens from the vast amount of marl belonging to the true Claibornian sands horizon which has come under my notice.

The shell is rather variable, losing the concentric sculpture when worn. It has fifteen to twenty-one ribs; the byssal notch is inconspicuous; in the right valve the ribs are strong and rounded on top with the concentric sculpture chiefly evident at their sides, the interspaces sparsely imbricated with one or two interstitial divaricate threads near the base; ears flattish, slightly scaly, with radial grooves, notch very shallow; left valve with the sculpture like that of *P. wahtubbeanus* but much less dense. Altitude and latitude forty-eight millimetres. There is hardly any room for doubt that Lea's other species are merely the immature stages of this same shell.

Pecten (Chlamys) cocoanus n. s.

PLATE 34, FIGURE 23.

Jacksonian Eocene of Red Bluff, Mississippi, and Cocoa Post-Office, Choctaw County, Alabama; Burns.

Shell small, thin, flattish, oblique, produced behind, with about twenty-five small, low, entire ribs, rounded above, and about fourteen interstitial single smaller threads, the tops of all of which are somewhat sparsely concentrically imbricated, the interspaces showing only incremental lines; ears quite unequal, small, the posterior smaller, each with five or six low, hardly scaly radii; inside of the valve obsoletely channelled, the cardinal crura developed. Alt. 23, lat. 23 mm.

This shell differs from *P. membranosus* by its entire and less numerous ribs, and from *P. wahtubbeanus* by its greater obliquity, its entire, less conspicuous, and less densely imbricated ribs.

Pecten (Chlamys) Greggi Harris.

Pecten Greggi Harris, Bull. Pal., ix., p. 45, pl. vii., figs. 4–5, 1897.

Lignitic or Chickasawan Eocene at Bell's, Greggs's, and Peach Tree Landings, Alabama, and Fort Gaines, Georgia.

This species is well distinguished by its narrow, simple, often distally obsolete ribs, usually about twenty-four in number, with wider interspaces, thin shell, small ears, and ovate form.

Pecten (Chlamys) clarkeanus Aldrich.

Pecten clarkeanus Aldr., Harr., Bull. Pal., 2, p. 68, pl. 5, fig. 11, 1895.

Eocene of the Lisbon horizon, Sowilpa Creek, Alabama, Aldrich; and at Black Bluff Shoals, Brazos River, Texas, Lea collection.

This species resembles worn specimens of *P. wahtubbeanus*, from which it differs by its more numerous (thirty to thirty-eight) ribs and its singular habit of intermitting the production of ribs altogether at times, so that the beak will show well-defined ribbing and a part of the disk be perfectly ribless, while later on the ribs may appear again. It should be noted, however, that only about three out of ten valves show the latter feature, the others having continuous plain ribs from beak to margin. Some of the forms included by Whitfield under *P. Kneiskerni* may belong here.

Pecten (Chlamys) nuperus Conrad.

Pecten nuperus Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 259, 1854.
Pecten nuperum Conrad in Wailes, Geol. Miss., p. 289, pl. xiv., fig. 11, 1854.

Jacksonian Eocene of Jackson, Mississippi, Conrad and L. C. Johnson; Montgomery, Grant Parish, Louisiana, Vaughan; Russell's Springs, Decatur County, Georgia, Pumpelly; also in the Vicksburgian at Arredondo, Florida, Johnson.

This species has been very generally confounded with *P. perplanus* Morton, from which to a casual glance it chiefly differs by its chlamydoid form. On more careful inspection, however, it will be observed that *P. nuperus* has fewer ribs (*circa* twenty-two), which, though somewhat similarly scabrous, are not accompanied by beaded lateral threads; the ears are higher and larger, the submargins wider, longer, and more conspicuous, and the radii of the ears are formed by rows of sparse, fluctuated, little-elevated scales, rather than by threads. The ribs of the disk in adults are keeled, with V-shaped narrower interspaces, the whole sculptured with continuous, fluctuated, concentric, rather close-set, little-elevated, very thin lamellæ, which are usually worn off more or less. In the right valve, as well as in young or worn speci-

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mens, the ribs are more rounded. On the whole, the species appears to be sufficiently well discriminated.

The only other described Eocene species from the Atlantic coast is *P. anisopleura* Conrad (Kerr, Geol. N. Car., App., p. 18, 1875), the type of which is a large, heavy shell which has lost its hinge, and was collected by Dr. Yarrow "forty miles south of Beaufort, North Carolina," which would put its locality near New River, Onslow County. It is of ovate shape, with large, squarish ears, and very irregular, large, radial, strongly but sparsely scabrous ribs, rounded above with two or three smaller riblets on each side more depressed than the centre of the rib. Alt. 85, lat. 70 mm. The shell is much bored by pholads and badly wormeaten and worn. It looks like a dilapidated valve of *Hinnites* or *Spondylus*, and its horizon is entirely uncertain.

Pecten (Chlamys) alumensis n. s.

PLATE 34, FIGURES 10, 11.

Oligocene of the Chipola horizon, in the lower bed at Alum Bluff, Chattahoochee River, Florida; Dall.

Shell small, thin, with compressed, flattish umbones and fourteen or fifteen feeble, obsolete ribs on the lower part of the disk separated by equal shallow interspaces; the whole surface marked with fine concentric lines; ears subequal, concentrically striate, not radiated, except the byssal ear, which has five scabrous riblets and a well-marked notch; interior fluted to correspond with the external ribs; the cardinal crura developed. Alt. reaching 15–18 mm. in fully adult shells; figured specimen 8, lat. 7.5 mm.

This small shell is sufficiently distinct in its characters to indicate its specific rank, though it may be that it attains a larger size when adult than any of the specimens obtained. One or two of the specimens have the ribs more rounded and prominent than the majority.

Pecten (Chlamys) tricenarius Conrad.

Pecten tricenarius Conr., Proc. Acad. Nat. Sci. Phila., i., p. 306, 1843; Fos. Medial Tert., p. 74, pl. 42, fig. 2.

(Miocene?) Pamunkey River, Virginia; Tuomey.

Of this species only the type is known, and the horizon is uncertain. It has somewhat of the outline of *P. perplanus*, but has a smaller shell and larger ears. The disk shows thirty-five rounded, nearly smooth, not dichotomous ribs, somewhat irregular in size, with equal interspaces, smooth and uniform. The ears are radially threaded, the byssal ear with four riblets over a rather wide and deep notch. The submargins are short and small, with traces of Camptonectes striation but no radial sculpture. The type is in the Academy's collection.

Pecten (Chlamys) decemnarius Conrad.

Pecten decemnarius Conr., Journ. Acad. Nat. Sci. Phila., vii., p. 151, 1834; Fos. Med. Tert., p. 49, pl. 24, fig. 2, 1840.

Pecten dispalatus Conr., Fos. Med. Tert., p. 74, pl. 42, fig. 3, 1845.

Miocene of City Point, Coggins Point, and York River, Virginia, Burns and Harris; Pamunkey River, Virginia, Conrad; also in the Ashley River phosphate rock, of South Carolina, Dall.

This species is notably irregular in its sculpture, the disk being sculptured either by numerous more or less distinctly fasciculated, small, radial threads, or the fasciculi may be replaced partially by stout, elevated, rounded ribs, with wide, radially threaded interspaces. The radial sculpture may be nearly smooth or covered with a conspicuous, dense, concentric lamellation. Three or four of the ribs may be more prominent than the others, and the smaller ones uneven in size and rugose, forming the variety *dispalatus*. When the fasciculi are rib-like they are usually dichotomous. The umbonal region in typical *decemnarius* is usually feebly sculptured, but in the variety *dispalatus* the ribbing approaches the beaks more nearly. The type of the latter has been carefully compared, and the ears and surface agree exactly with those of the *decemnarius* form. Large valves of the latter attain a height and width of sixty-eight millimetres; the type of *dispalatus* measures twenty-four millimetres. The cardinal crura are parallel with the hinge-line and moderately developed. The byssal notch is wide and conspicuous, the posterior ears small.

In sculpture this form almost exactly parallels the recent northwest American *P. hericeus* in its mutations.

Pecten (Chlamys) coccymelus n. s.

PLATE 34, FIGURE 1.

Miocene of Plum Point, Maryland; Clark.

Shell small, ovate, inflated, strongly sculptured, with unequal ears; disk with eighteen narrow, high, compressed ribs, with wider interspaces, which near the basal margin carry one or two very small radial threads; the backs of the ribs support numerous high, evenly spaced, distally guttered, small spines; in the interspaces only transverse sculpture of wavy incremental lines;

submargins small, narrow, with fine, beaded radial threads, which in the left valve also extend over the ears; hinge-line short, the cardinal crura developed, sharply cross-striated; auricular crura present; interior of the disk fluted in harmony with the external ribs. Alt. 30, lat. 25, semidiam. 5 mm.

A single left valve of this elegant species was obtained. From the young of *P. Madisonius*, which sometimes approach it, it is easily distinguished by its more oval and inflated form, nearly smooth interspaces, and compressed ribs.

Pecten (Chlamys) Harrisii n. s.

PLATE 34, FIGURE 24.

Pliocene marls of the Caloosahatchie River; Dall and Willcox.

Shell strong, rounded, with seventeen coarse, rounded ribs with narrower interspaces, overrun by close-set, prominent, slightly wavy, strong concentric lamellation; near the basal margin the ribs and interspaces are marked with a few sharp radial striæ; submargins and ears with smaller radial threads similarly lamellose; notch narrow, deep; ctenolium present, short; interior of the disk strongly fluted, lirate; cardinal crura strong, auricular crura feeble. Alt. and lat. 31, semidiam. 7 mm.

A single adult right valve and numerous immature ones were obtained.

The valve figured is a little irregular. The young shells are proportionately flatter and with wider ears. They have, as often observed in the young of *P. exasperatus*, in some cases three or four of the ribs more prominent than the rest, and the lamellation worn off from the tops of the ribs or incomplete there. The species is named in honor of Professor G. D. Harris, of Cornell University, whose work on the Eocene fossils of the Southern States is well known.

Pecten (Chlamys) exasperatus Sowerby.

? *Pecten muscosus* Gray, Wood's Ind. Test. Suppl., pl. 2, fig. 2, 1828; Sby., Thesaur. Conch., *Pecten*, p. 66, pl. xix., fig. 225, 1843; Reeve, Conch. Icon., viii., pl. 16, fig. 60, 1853. "South Seas."

Pecten exasperatus Sby., Thesaur. Conch, i., p. 54, pl. 18, figs. 183, 184, 186, 1843; Reeve, Conch. Icon., viii., pl. 2, figs. 7, 8 *a–b*, 1852; Dall, Bull. U. S. Nat. Mus., No. 37, p. 34, 1889. "Mediterranean."

Pecten triradiatus Reeve, Conch. Icon., viii., pl. 28, fig. 120, 1853; not of Müller, Zool. Dan., ii., p. 25, 1788.

Pecten cretatus Reeve, *op. cit.*, pl. 29, figs. 129 *a–b*, 1853.

Pecten fuscopurpureus Conr., Journ. Acad. Nat. Sci. Phila., N. S., i., pp. 209, 280, pl. 39, fig. 10, 1849. Tampa, Fla.

Pliocene of Costa Rica, Gabb, and of the Caloosahatchie marl at Shell Creek, Willcox; Pleistocene of Florida, South Carolina (Simmons Bluff), and of the Antilles; living from Cape Hatteras, North Carolina, to Guadelupe Island, West Indies.

The figures given of *muscosus* disclose no differences in the minor sculpture or the number of ribs, and there are no discrepancies in the description, compared with that of *exasperatus*. The locality originally given for the latter has not been confirmed, and that given for *muscosus* may prove erroneous. In this case, the latter name would take precedence. I have little doubt of their identity, but do not unite them because I have seen no authentic specimens of *muscosus*.

The present species is moderately tumid, and has a scabrous sculpture besides traces of the Camptonectes striation. The backs of the ribs are set, in perfect specimens, with small, sometimes clavate spines, and there are from one to four fine threads on each side of the main keel which are usually more or less prickly. The middle of the interspaces is, however, usually free from the radial sculpture. Adult specimens with the spines considerably worn are such as Conrad called *fuscopurpureus*. The colors of the shell are very varied, including brown, white, yellow, pink, and various shades of red, either simply unicolored or mottled. In the mottled brown ones it is common to see from three to five of the ribs uniformly white from end to end, or of a lighter color than the rest; this forms the *triradiatus* type. I have examined sixty-nine adult valves, of which ten had seventeen ribs, thirty-three had eighteen ribs, twenty-three had nineteen ribs, and three had twenty ribs; the normal number, therefore, being eighteen to nineteen. The young shells are more rotund than the adults, and their ears are proportionately more conspicuous. Guppy (Geol. Journ., xxii., p. 294) cites this species as occurring in the Oligocene of Jamaica, but the specimens he refers to present certain differences and are probably distinct.

Pecten (Chlamys) ornatus Lamarck.

Pecten ornatus Lam., An. s. Vert., vi., p. 176, 1819; Reeve, Conch. Iconica, xix., fig. 68, 1853.

? *Ostrea sauciata* Gmelin, Syst. Nat., vi., p. 3328, 1792; Chemn., Conch. Cab., vii., p. 345, pl. 69, fig. H.

? *Chlamys Benedicti* Verrill and Bush, Trans. Conn. Acad., x., p. 74, 1897.

Pleistocene of the Florida Keys and the raised reefs of the Antilles;

living throughout the West Indies at depths of one hundred fathoms or less, and extending from Bahia, Brazil, to the shores of the Gulf of Mexico, and north to the vicinity of Cape Lookout, North Carolina, in from fifteen to fifty-two fathoms. Also (*P. Benedicti*), dead, off shore in lat. 40° 9′ N., lon. 67° 9′ W., in thirteen hundred and fifty-six fathoms (?). Also in the Red Sea (?).

This elegant species (to which *P. multisquamatus* Dunker, of Cuba, seems closely allied) is extremely variable in color and surface sculpture, and has some relations to *P. membranosus*. The shell which has received the name of *Benedicti* is only six millimetres in height and possesses no adult characters. Similar shells are, however, rather common in places in the Gulf of Mexico and West Indies, where *P. ornatus* abounds, and, after comparison with the umbones of half-grown *ornatus*, I am disposed to think the two should be united.

Pecten (Chlamys) indecisus n. s.

PLATE 34, FIGURE 3.

Vicksburgian Oligocene at Archer and vicinity, Alachua County; as silicious pseudomorphs at Martin Station, Marion County; at a depth of two hundred and twenty-five feet in the artesian well, Ponce de Leon Hotel, St. Augustine; and in the Tampa limestone of the Hillsborough River, near Tampa, Florida; Dall and Willcox.

Shell thin, moderately convex, ovate, with twenty-six to thirty-four small, low, simple, entire ribs separated by about equal interspaces and having a tendency, especially in the left valve (which is slightly more convex than the other), to become obsolete distally; transverse sculpture only of lines of growth, Camptonectes striation present, more conspicuous in the smoother specimens; ears small, unequal, the posterior smaller; byssal ear with a well-marked notch and conspicuous fasciole, above which are about six partly scabrous riblets, becoming stronger dorsally; interior lirate, the liræ stronger near the margin; ctenolium present; cardinal crura well developed, cross-striated. Alt. of figured specimen 16, of adult 31, lat. of adult 28 mm.

This is a very interesting species which retains the outline of *Chlamys* while at times it assumes the characters of *Amusium*. Some specimens are almost ribless, except on the umbones, and in this state the species would belong to the "subgenus" *Lissopecten* Verrill; in others the ribs are well developed and continuous down to the very margin, which they then crenulate; in which state the shell is a typical *Chlamys*. In most of its shell characters it is intermediate between the two subgenera, *Chlamys* and *Amusium*. Just over the line, and separated from the present species more by its outline than by any other important character, is the shell I have called *Amusium ocalanum*, all of which, with the aid of *A. Lyoni* Gabb, form a complete connecting series between the most typical *Amusium* and undoubted *Chlamys*.

Pecten (Plagioctenium) gibbus Linné.

Ostrea gibba L., Syst. Nat., Ed. x., No. 172, p. 698, 1758; Ed. xii., No. 203, p. 1147, 1767. Jamaica.

Not *Ostrea gibba* Born, Test. Vindo., p. 107, 1780; nor

Pecten rubicundus gibbosus Ch., Conch. Cab., vii., p. 321, pl. 65, figs. 619–20, 1784; nor of Dillwyn, Cat. Rec. Sh., i., p. 267, 1817 (in part).

Ostrea lutea Gmelin, Syst. Nat., vi., p. 3320; + *O plana* Gmelin, *l. c.*; + *O. flabellum* Gmel., *op. cit.*, p. 3321.

Pecten gibbus Sowerby, Thes. Conch., i., fig. 17 (only), 1843.

Pecten gibbus Reeve, Conch. Icon., pl. 9, figs. 37 *b*, 37 *c*, not fig. 37 *a*, 1852.

Pecten Soverbii Guilding, 1826, not of Reeve, 1852.

Pecten dislocatus Say, Journ. Acad. Nat. Sci. Phila., ii., p. 260, 1822; Am. Conch., lvi., fig. 2, 2 *a*, 1834.

Pecten purpuratus Conrad, Am. Mar. Conch., p. 10, pl. ii., fig. 1, 1831; DeKay, Zool. N. Y., v., p. 174, 1843; not of Lamarck.

Pecten dislocatus Holmes, Post-Pl. Fos. S. Car., p. 13, pl. ii., fig. 13, 1858.

Pecten circularis Guppy, Paria Fauna, p. 155, 1877; not of Sowerby.

Pecten gibbus Orb., Moll. Cuba, ii., p. 352, 1845; Krebs, W. I. Mar. Sh., p. 134, 1864; Arango, Fauna Mal. Cubana, ii., p. 270, 1878.

Pecten irradians var. *dislocatus* Dall, Bull. U. S. Nat. Mus., No. 37, p. 34, No. 24, 1889.

Pecten nucleus Heilprin, Trans. Wagner Inst., i., p. 102, 1886.

Fossil in the later Miocene of the Nansemond River, Suffolk, Virginia, Burns; in the Pliocene of Florida, in the Caloosahatchie marls on the Caloosahatchie, Shell Creek, Myakka River, and Alligator Creek, Willcox and Dall; in the Pleistocene of North Creek, Osprey, Florida, Dall, and of the Carolinas; also in the raised coral reefs of the Antilles. The Miocene specimens are of the typical variety *gibbus;* the Caloosahatchie marls contain var. *gibbus* and var. *amplicostatus* in about equal numbers; the Pleistocene of North Creek has var. *gibbus* and var. *borealis*, an indication of the more southerly extension of the latter during the low temperatures of that epoch.

This species is at present widely distributed, and is found living from Cape Hatteras south to the Greater Antilles and Brazil, and on the continental shore to Vera Cruz and the Bay of Campeachy; also on the northwest coast of Africa, according to various authors.

Since the original description of Linné was based on Jamaican specimens figured by Browne,* there can be no question as to the proper application of the specific name. The matter has been confused (in spite of Linné's statement that the ribs are smooth) by the inclusion of a distinct form with striated ribs—figured by Born and Chemnitz and identified by Hanley with *P. gibbus*, but more recently described by Fischer—from Guadelupe, under the name of *P. Schrammi*. It is true that there are occasional microscopic radial striæ on the ribs of *P. dislocatus* or *gibbus*, but these do not amount to the strong striation indicated by the figures of Sowerby and Fischer. The specific name *gibbus*, being the oldest, must be adopted for the species. Its identity was recognized by both Gould and Stimpson, and cannot be doubted by any one who has the privilege of studying a large geographical series. Several fairly recognizable varieties exist, and for convenience will retain their familiar names. The differences appear to be due partly to *habitat* and partly to *situs*. In order to test the range of variation in sculpture, I have counted the ribs on two hundred and thirty-five specimens, carefully segregating the varieties, though, necessarily, there was a marked proportion which might have been referred to either of two varieties with equal propriety. In order that the test might be as exact as practicable, the ribs on the left valve, when both were present, were selected for counting; the ridges marking the borders of the submargins were counted as ribs, the riblets of the submargins were not counted, and no specimens less than twenty millimetres in height were used.

Pecten gibbus var. **dislocatus** Say (=*gibbus* s. s.).

Miocene to recent.

The variety *dislocatus* should be called variety *gibbus*, since it is the typical form described by Linné, but I retain in this place the more familiar name for temporary convenience. Its range extends from Cape Hatteras to Cape St. Roque in northeastern Brazil, and probably to the Amazon, and it occurs also, if the dealers' labels can be trusted, on the west coast of Africa. A specimen said to be African is variegated with gray and white, and has twenty ribs; of one hundred and fifty-one American and Antillean specimens three had eighteen ribs; thirty-six, nineteen ribs; fifty-five, twenty ribs; thirty-two, twenty-one ribs; ten, twenty-two ribs; and one, twenty-three ribs. It may be said, therefore, that the normal number of ribs for this variety is from

* P. Browne, Civil and Nat. Hist. Jamaica, p. 41, pl. 40, fig. 10, 1756.

nineteen to twenty-two. It has a preference for quiet water, and generally attaches itself to hard substances,—coral, vermetus rock, and stones,—and has a wide range of coloration, usually bright. Of the fossil specimens nine had seventeen ribs; fifteen, eighteen ribs; seven, nineteen ribs; four, twenty ribs; four, twenty-one ribs; and one, twenty-two ribs; thus showing a slight tendency towards fewer ribs than in the recent specimens.

Pecten gibbus var. **amplicostatus** Dall.

Pliocene to recent.

This differs from the typical *gibbus* by its fewer and broader ribs. It is about the same size as the type, and occurs chiefly west of the Mississippi, on the Texas coast, and south to Carthagena. It is usually white or nearly white on the right valve, and grayish with mottlings of white on the left valve. Of fourteen specimens, one had twelve; two, fourteen; four, fifteen; and seven, sixteen ribs. It is quite tumid and very solid, and probably inhabits coral or rocky bottom. Of the fossils one had fourteen; ten, fifteen; and sixteen, sixteen ribs.

Pecten gibbus var. **nucleus** Born.

Ostrea nucleus Born, Test. Vind., p. 107, pl. 7, fig. 2, 1780.

Pecten gibbosus variegatus, etc., Chemn., Conch. Cab., vii., p. 323, pl. 65, figs. 621 *a–b*, 1784.

Ostrea turgida Gmelin, Syst. Nat., vi., p. 3327, 1792; Lam., An. s. Vert., vi., p. 167, 1819; *fide* Hanley.

? *Ostrea conspersa* Gmelin, p. 3320, + *O. florida* Gmelin, p. 3330, + *O. guttata* Gmelin, p. 3330, 1792.

Recent.

This is a small, thin, polished form, usually variegated with gray, white, and dark brown, and having twenty-one to twenty-three ribs. Its peculiarities are due to the fact that it attaches itself to fuci rather than hard objects. Its range extends from the Florida Keys through the Antilles. This form was not found in the Caloosahatchie marls.

Pecten gibbus var. **borealis** Say.

Pecten borealis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 260, 1822.

Pleistocene and recent.

This is the large, thin, dark-colored form of the New England coast, ordinarily known as *irradians* Lamarck. It usually has fewer ribs than the typical *irradians*, a thinner shell, and more conspicuous concentric lamellæ. It is also rather more compressed. Of seventeen specimens two had sixteen, eleven seventeen, and the remainder eighteen ribs. It may be variegated with orange, gray, dark brown, or olive and white, but on the whole constantly averages darker than the southern specimens. It lives in the open bays on weedy or pebbly bottom. A Pleistocene specimen had nineteen ribs.

Pecten gibbus var. **irradians** Lamarck.

Pecten irradians Lam., An. s. Vert., vi., p. 173, 1819.
Pecten concentricus Say, Journ. Acad. Nat. Sci. Phila., p. 259, 1822.
Pecten turgidus Sowerby, Gen., xxxi., fig. 1, 1829; not of Lamarck.

Pleistocene and recent.

This is the southern and typical form of which *borealis* is the northern geographical race. It extends from New Jersey, which is Say's typical locality, south to Georgia and Texas. It lives in open water and usually at a greater depth than the typical *dislocatus* (= *gibbus*), and never assumes the bright colors of that shallow-water form, though occasionally variegated in the same manner with dull red. In general its colors are those of the variety *borealis*.

Twenty-two specimens had eighteen ribs; twenty-four, nineteen ribs; twelve, twenty ribs; three, twenty-one ribs; and four, twenty-two ribs. There is some variation in the roundness or angulation of the sides of the ribs, and there are rarely fine longitudinal striæ on the backs of the ribs. The normal number of ribs may be regarded as eighteen to twenty in this variety. The fossils showed nineteen to twenty-two ribs.

Taking all the varieties together, the generalization may be fairly made that in the Pliocene the proportion of specimens with less than nineteen ribs is decidedly larger than among the recent shells. The variations in the fossils parallel those of the living forms; the concentric sculpture may be weaker or stronger, may be visible on the backs of the ribs or only in the interspaces. The ribs may be more or less emphatic, rounded or flat-topped with lateral angles. In the latter case the concentric sculpture sometimes stops short at the angle, leaving the unworn back of the rib smooth, as if the concentric lamellæ had been worn off. In this case, which is the most conspicuous of the various mutations, the ribs appear laterally fringed. All the species of this group, recent or fossil, show this mutation occasionally, though it is rarer among the recent shells than among the fossils.

Pecten (Plagioctenium) eboreus Conrad.

Pecten eboreus Conr., Am. Journ. Sci., xxiii., p. 341, 1833; Fos. Med. Tert., p. 48, pl. xxiii., fig. 2, and xxiv., fig. 3, 1840.

Pecten vicenarius Conr., Proc. Acad. Nat. Sci. Phila., i., p. 306, 1843. (Immature shell.)

Pecten Holbrookii Ravenel, Proc. Acad. Nat. Sci., ii., p. 96, 1844.

? *Pecten micropleura* H. C. Lea, Trans. Am. Phil. Soc., ix., p. 245, pl. 35, fig. 32, 1846. (Young shell.)

Pecten comparilis Tuomey and Holmes, Pleioc. Fos. S. Car., p. 29, pl. 11, figs. 6–10, 1855.

Pecten yorkensis Conr., Am. Journ. Conch., iii., p. 189–90, 1867.

Pecten solarioides Heilprin, Trans. Wagner Inst., i., pp. 99, 103, 1887.

Fossil in the Miocene of Virginia near Suffolk (type), at the north end of the Dismal Swamp, at Snow Hill, at City Point, at Petersburg, in Prince George County, etc.; of North Carolina at Wilmington, and in Duplin County, near and at the Natural Well; of South Carolina at Darlington (*comparilis*) and Smith's on Goose Creek; and at Alum Bluff and De Land, Florida. Also in the Pliocene of South Carolina on the Waccamaw River (Johnson) and in the Caloosahatchie marls of Florida on Shell Creek and the Caloosa River; Willcox and Dall.

Pecten micropleura Lea may be the young of *P. marylandicus* Wagner, rather than of *eboreus*. It is an immature shell, as is *vicenarius;* neither has assumed adult characters.

The rise and progress of this type affords an interesting paleontologic study.

The young always have the ribs clean cut and squarely channelled and more or less rectangular in section. They also usually have more ribs than the adult, as some one or two on the border of the submargins are apt to become obsolete with growth, though distinct in the young.

The usual phases noted under *P. gibbus* (of which this form is a precursor) are equally characteristic of *eboreus*. In the adult the ribs may be low or high, rounded or squarish, with the concentric sculpture equally strong over the whole surface or obsolete on the backs of the ribs, the lamellæ feeble and distinct or close and prominent, or the surface sculpture may be almost wholly obsolete. The right valve usually shows one more rib than the left. The radial sculpture on the ears and submargins varies in strength. An examination of eighty-seven specimens resulted in showing that one had seventeen ribs, one eighteen, two nineteen, four twenty, fourteen twenty-one, nineteen twenty-two, eighteen twenty-three, fifteen twenty-four, seven twenty-five, three twenty-six, and three twenty-seven ribs. The normal number of ribs for this species would therefore seem to be twenty-one to twenty-five.

In the basal Miocene, as at Darlington, South Carolina, the adults of this species show radial threads towards the margin, which, reticulating with the concentric sculpture, give the shell a little the look of *Lyropecten*, like *edgecombensis*, and, in fact, the shells are intermediate between the Lyropectens and *Plagioctenium*. The latter section has its characters well in equilibrium hardly before the recent fauna, though in this series they can be seen in the making.

The different mutations, though intergrading considerably, may, for convenience, be distributed as follows:

Pecten eboreus var. **darlingtonensis** Dall.

Miocene of Darlington, South Carolina.

Shell large, radially striate on the disk near the margin; the ribs angular, well marked, twenty-one to twenty-four; the concentric sculpture fine.

Pecten eboreus var. **eboreus** Conrad.

Miocene of Suffolk, Nansemond River, Virginia.

Shell large, with no radial striæ on the disk; ribs low, rounded, with shallow interspaces, twenty-three to twenty-seven; concentric sculpture distant, feeble.

Pecten eboreus var. **yorkensis** Conrad.

Miocene of York River, Virginia.

Like variety *eboreus*, but with the ribs more rectangular in section, twenty-one to twenty-five.

Pecten eboreus var. **comparilis** Tuomey and Holmes.

Miocene of South Carolina.

Shell stunted, rather convex; the backs of the strong rectangular ribs bare, the interspaces and sides of the ribs with strong, crowded, concentric lamellæ; twenty-three ribs, the interspaces deeply notched at the margin.

This form bears to the typical *eboreus* much such a relation as, in *P. gibbus*, variety *dislocatus* does to variety *irradians*.

Pecten eboreus var. **solarioides** Heilprin.

Pliocene marls of Florida.

Shell large, like variety *eboreus*, but the ribs squarish and distant, nineteen or twenty.

Pecten eboreus var. **senescens** Dall.

Plate 29, Figure 5.

Pliocene of the Waccamaw beds, South Carolina; Johnson.

Shell of moderate size, rather convex; ribs (twenty-three) obsolete externally, their liræ strong within; the concentric sculpture fine, chiefly visible in the interspaces. Alt. 60, lat. 62, diam. 15 mm.

The posterior ear is a little more oblique in my specimen than in any of the typical *eboreus* I have noticed, but the characters in general are so close that I hesitate to regard the form as of specific rank.

Subgenus **PSEUDAMUSIUM** H. and A. Adams.

Pseudamusium H. and A. Adams (after Klein), Gen. Rec. Moll., ii., p. 553, 1858. (Type *P. hybridus* Gmelin.)

Pseudamusium Klein, Tent. Ostr., p. 134, pl. ix., fig. 11, 1753. Sole species. *Pecten lævis, variegatus*, etc., of Lister, pl. 173, fig. 10; Verrill, Trans. Conn. Acad., x., p. 60, 1897.

Camptonectes (Agassiz) Meek, S. I. Checkl. Jur. Fos., p. 39, 1864.

Eburneopecten Conrad, Am. Journ. Conch., i., pp. 140, 190*b*, 1865.

The type of this group is a very rare shell, which is chiefly found in old collections, and was figured by Lister, from whom Klein copied his figure. Since H. and A. Adams accorded Klein a place as a binomial author and cited the genus as his, it follows that Klein's type and sole example was for them necessarily the type of *Pseudamusium*, though they did not cite a type, and included in their list several incongruous species. But as the evidence is conclusive that Klein did not adopt the binomial system of his rival Linné, the subgenus can only date from H. and A. Adams's habilitation of it in 1858. The Listerian shell on which Klein based his name is identified by the elder Sowerby and by Hanley with *P. exoticus* Chemnitz (Conch. Cab., xi., pl. 207, figs. 2037–8) and was named binomially by Gmelin, who called it *P. hybridus* in 1792, which is cited in their list by the brothers Adams. There is little doubt that it is also the *P. dispar* of Lamarck.

As the shell is rare in collections, a summary of its characters may be useful.

The surface is nearly smooth in the adult, the left valve being radially and the right valve concentrically feebly sculptured. The latter is nearly flat, with a well-developed ctenolium and byssal notch; the ears in both valves are small and have stronger sculpture than the disk. The surface has the Camptonectes striation, most evident on the submargins. The hinge is simple, with traces of the provinculum; the cardinal crura in the left valve feeble and close to and nearly parallel with the cardinal margin; the auricular crura are present, but there are no liræ. The margin of the valves is entire. The colors are variegated and bright, recalling those of some deep-water species. The form of the shell is nearly orbicular, moderately convex, and the height and width of the disk is about an inch (twenty-five millimetres) in the largest valves I have seen. It is supposed to come from the west coast of Africa. The characteristics which separate this type from the deep-water forms for which Verrill has proposed the name *Cyclopecten* are the direct result of the environment, producing a thinner and less calcareous shell, more delicate sculpture, and, as a rule, paler coloration. Those species of *Cyclopecten* which range from comparatively shallow to very deep water, like *P. alaskensis* Dall, have, in the shallow-water specimens, the margin of the right valve solid, meeting the left valve evenly; while those from very deep water have it less calcified and consequently flexible. Otherwise the shells do not differ at all, and the character not being of specific rank, it would seem is hardly available for subgeneric distinctions. *Camptonectes* and its synonyme, *Eburneopecten* Conrad, are simply unribbed species of this group.

Pecten (Pseudamusium) calvatus Morton.

Pecten calvatus Morton, Syn. Org. Rem., p. 58, pl. x., fig. 3, 1834.

Original locality Eutaw Springs, South Carolina, Conrad; also in the Jacksonian of Alabama and at Hatchetigbee Bluff in the Chickasawan, Burns.

There are two extremely similar species of *Pseudamusium* in the southern Eocene; both are smooth except for Camptonectes striation, both are nearly orbicular when adult and more ovoid when young, both have the byssal ear more or less radiated. They have been more or less confused, and the original type of *calvatus* appears to be lost. However, there is one character by which they may be distinguished: the present species has equal or almost equal ears, and the distal cardinal angle of the posterior ear is nearly a right angle, agreeing with Morton's figure; the other species, *P. scintillatus* Conr., has the ears distinctly unequal and the posterior ear obliquely truncated. It is also, in most cases, a little more elongated.

Pecten (Pseudamusium) scintillatus Conrad.

Pecten (*Eburneopecten*) *scintillatus* Conrad, Am. Journ. Conch., i., p. 140, pl. 10, fig. 4, 1865. (Young shell.)

Camptonectes scintillatus Conr., S. I. Checkl. Eoc. Fos., p. 23, 1866.

Camptonectes claibornensis Conr., *op. cit.*, p. 23, 1866 (name only).

Pecten claibornensis Harris, Rep. Geol. Surv. Ark., 1892, ii., p. 145.; Proc. Acad. Nat. Sci. Phila. for 1896, p. 470 (name only), pl. xviii., figs. 1, 2, 1896.
Pseudamusium claibornense Harris, Bull. Pal., 9, p. 43, pl. 7, fig. 1, 1897.

Chickasawan (or Lignitic) Eocene of Hachetigbee Bluff, Alabama, of the Wahtubbee hills, Clarke County, Mississippi, and at Enterprise, Mississippi; Clairbornian of St. Maurice, Louisiana, and of the bluff at Claiborne, Alabama; Jacksonian (green marl bed), Jackson, Mississippi, and Clarke County, Mississippi; Burns and L. C. Johnson.

The specimen described as *scintillatus* by Conrad is very young and more oval, and with the discrepancies of the ears less marked, than in adult specimens such as were figured by Harris, who also suggests the relationship, which a large series of different ages enables me to confirm. The distinctions between this species and *P. calvatus* are mentioned in the remarks under the head of that species. The Camptonectes striation is more marked in the young, but rather variable as between individuals. This species is the type of Conrad's subgenus *Eburneopecten*, which he afterwards regarded as a synonyme of *Camptonectes*. *P. claibornensis*, as such, has never received a formal diagnosis, though it has been referred to and figured several times on the strength of Conrad's manuscript label in the Academy's collection.

Pecten (Pseudamusium) frontalis Dall.

Pecten Rogersi Clark, Bull. U. S. Geol. Surv., No. 141, p. 85, pl. 34, figs. 2*a*, *b*, *c*, 1896; Johns Hopkins Un. Circ., xv., p. 5, 1895.
Not *P. Rogersi* Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 151, 1834.

Eocene of Potomac Creek, Front Royal, Virginia, Clark; Jacksonian of Garland's Creek, Clarke County, near Shubuta, Mississippi, Burns.

The specimen described by Clark is young, only eighteen millimetres in height, but Burns obtained specimens twenty-nine millimetres high by twenty-eight wide in Mississippi. The radial sculpture is obsolete near the centre of the disk and on the beaks, but well marked near the margin. There are about seventy small, low, flattened riblets separated by narrower grooves. The ears are small and the posterior ear smaller and obliquely truncate. The shell is moderately convex and recalls *P. choctavensis* Aldr., but with much feebler sculpture.

Pecten (Pseudamusium) cerinus Conrad.

Pecten cerinus Conr., Am. Journ. Conch., v., p. 39, pl. 2, fig. 2, 1869.

Miocene of Charles County, Maryland, Cope; Ashley River phosphate rock, South Carolina, Dall.

Shell small, thin, polished, compressed; left valve more convex, with about twenty faint, flat, rather irregular obsolete ribs, separated by narrower, shallow sulci, the whole surface with minute Camptonectes striation; right valve with concentric incremental lines and a few faint threads near the beaks and anterior submargin; ears small, subequal; ctenolium present; cardinal and auricular crura developed; interior of left valve faintly fluted, but without liræ. Alt. 19, lat. 18 mm.

In some of the specimens there are a few feeble concentric undulations near the beak of the left valve.

? Section *Hyalopecten* Verrill.

Hyalopecten Verrill, Trans. Conn. Acad., x., p. 71, 1897. Type *P. undatus* Verrill, *op. cit.*, vi., p. 444, 1885; = *P. fragilis* Jeffreys, Ann. Mag. Nat. Hist., p. 424, 1876; + *Hyalopecten dilectus* Verr. and Bush, Trans. Conn. Acad., x., p. 80, 1897.

This section differs from the ordinary abyssal *Pseudamusium* in being concentrically undulated, and from the thin, smooth, shallow-water forms like *P. grönlandicus* in the absence of the Camptonectes striation. These features are barely of more than specific value, as they appear to be generally interchangeable, like other surface characters in this genus. The types of Jeffreys's *P. fragilis* are in part in the United States National Museum. They agree perfectly with his description and figures (P. Z. S., 1879, p. 561, pl. xlv., fig. 1 [inner and outer views]). The first specimens obtained were fragmentary, as was the case with *P. undatus* Verrill. I have compared the specimens received from both authors with care, and consider them conspecific. *P. dilectus* is complete, and, except that it is a younger and smaller shell, I have been unable to detect any differences, even of a varietal nature. On the other hand, the specimen to which Professor Verrill has given the name *fragilis* Jeffreys is a perfectly distinct species with marked characters, as noted by Professor Verrill (*op. cit.*, p. 81). Jeffreys in his original description describes his shell (left valve) as having "numerous fine and raised striæ" which "radiate from the beak and cover the whole surface." How, then, Professor Verrill should come to regard a shell "distinctly undulated but not otherwise sculptured" as the species of Jeffreys is a mystery which I cannot solve. At all events, they are perfectly distinct, and the *P. fragilis* Verrill, non Jeffreys, may take the specific name of *eucymatus*. It should be observed that the "raised striæ," or threads, described by Jeffreys, are more abundant and more constant on the left valve; on the right valve they are often nearly obsolete, and on the left valve the different individuals differ in the amount of their radiation.

Pecten (Hyalopecten) sp. indet.

Lower Miocene of the Ashley River, South Carolina, in the so-called "phosphate rock."

Valves of a species too imperfect for satisfactory description, yet showing distinctly a thin, undulated, and probably radially striate shell, of about the size of half-grown *P. fragilis* (*circa* eight millimetres in altitude), were found in the rock above mentioned. The shells were crushed and their undulations flattened down during fossilization, and the chief character which appears to have distinguished them from *P. fragilis* is that the undulations were higher and sharper and the form perhaps more ovate. Still, this group is so singular, and its discovery in a fossil state so interesting, that I feel it should be recorded.

Pecten (Pseudamusium) Guppyi Dall.

Plate 34, Figures 12, 13.

This species has already been cited (p. 718) as occurring in the Alum Bluff beds at Oak Grove, Santa Rosa County, Florida, as well as in the Oligocene and later formations of the Antilles and Costa Rica.

Subgenus AMUSIUM (Bolten) Schumacher.

Amusium (Rumphius, 1705) Bolten, Mus. Bolt., 1st ed., p. 165, 1798 (no description); Schum., Essai, p. 117, 1817; Dall, Bull. Mus. Comp. Zool., xii., No. 6, p. 207, 1886.
Pleuronectia Swainson, Malac., p. 388, 1840.
Type *Ostrea pleuronectes* Linné.

Pecten (Amusium) precursor n. s.

Oligocene of the Chipola beds at Alum Bluff and on the Chipola River and elsewhere in these beds; Burns and Dall.

There are several species of *Amusium* ranging from the Oligocene to the recent fauna in this region. In general they appear extremely similar, so much so that such figures as are ordinarily given would show no differential characters. By careful and repeated study I find myself able to separate them by the umbonal sculpture, which differs in the different forms as follows:

Nepionic shell perfectly smooth externally.

1. Shell more or less ovate: *P. papyraceus* Gabb.
2. Shell very large, orbicular: *P. Mortoni* Rav.

Nepionic left valve with obsolete radii and often feeble concentric undulations: *P. precursor* Dall.

Nepionic left valve with distinct flattened ribs with shallow channelled interspaces crossed by concentric, evenly spaced, not crowded, elevated lines: *P. Lyoni* Gabb.

Left valve of the adult with obsolete rounded ribs extending, in the adult, well over the middle of the disk: *P. ocalanus* Dall.

P. precursor is nearly as large as *P. Mortoni*, but slightly rougher and more convex when adult, the young are nearly orbicular; a distinct trace of Camptonectes striation, near the beak and submargins, may be discerned with a magnifier in a good light. Alt. 110, lat. 123, diam. 20 mm. The right valve is much flatter than the other. As the material is much broken up, it seemed hardly worth while to figure it.

Pecten (Amusium) ocalanus n. s.

Plate 29, Figure 2.

Oligocene of the Vicksburgian at Natural Bridge, Alachua County; at various localities in Levy County; at Arredonda and Archer; Newnansville and Johnson's lime sink; and in the Nummulitic horizon at Ocala and Martin Station, Marion County, Florida; also in the Vicksburgian of Alabama; Dall, Burns, and Willcox.

Shell of moderate size, nearly equivalve, quite inequilateral, moderately convex; right valve with the disk nearly smooth, posterior margin produced; ears subequal, nearly smooth, their outer angles a little raised, so that the cardinal margins form a very obtuse angle at the beak; byssal sinus represented by a marked flexure but not a distinct notch; left valve similar, slightly more convex, with about eighteen obsolete rounded ribs, separated by narrow, shallow grooves, sharpest near the beak, radiating nearly to the basal margin but becoming less visible there and at the submargins; ears vertically striated, subequal; interior of the disk with about twenty-one pairs of well-marked liræ similar in each valve; hinge with developed cross-striated cardinal crura, auricular crura present; margins of the valves smooth, not crenulated. Alt. of figured shell 35, lat. 35; alt. of largest specimen 43 mm.

The fossils vary from nearly smooth to obviously ribbed; the byssal sinus is more distinct than in the other species and sometimes verges on a notch, and there is a perceptible byssal fasciole.

Pecten (Amusium) papyraceus Gabb.

This species, described from the Tertiary of St. Domingo, appears to be identical with the recent species of the Gulf of Mexico and the Antilles. I formerly referred it to *P. Mortoni*, to which it is closely related, but it is generally less orbicular and smaller than the typical *P. Mortoni*, and in default of a full and completely intergrading series it is probably better to retain Gabb's name.

Pecten (Amusium) Mortoni Ravenel.

Pecten Mortoni Rav., Proc. Acad. Nat. Sci. Phila., ii., p. 96, 1844; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 27, pl. 10, figs. 1,2, 1855; Emmons, Geol. N. Car., p. 281, 1858.

Miocene of Fairhaven and Drum Point, Maryland; Duplin County, North Carolina; Cooper River and Goose Creek, South Carolina, and in the upper bed at Alum Bluff, Chattahoochee River, Florida; Pliocene of the Caloosahatchie marls on the Caloosahatchie and Shell Creek, Florida; Burns, Willcox, and Dall.

Pecten (Propeamusium) alabamensis Aldrich.

Pecten (*Pleuronectia*) *alabamensis* Aldr., Bull. Geol. Surv. Ala., p. 40, pl. 4, fig. 8, 1886; Harris, Bull. Pal., iv., p. 162, pl. 2, fig. 3, 1896.

Pecten alabamensis Harris, Geol. Surv. Ark., Rep. for 1892, ii., p. 41.

Pecten (*Amussium*) *alabamensis* de Gregorio, Mon. Claib. Fauna, p. 183, pl. 21, fig. 26, 1890.

Basal or Midwayan Eocene of Dale's Branch, Matthews Landing, and Naheola, Alabama, and of Marshall's Well, Little Rock, Arkansas.

This interesting little species reaches less than five millimetres in extreme height, has the right valve concentrically striated or nearly smooth, the left with sparse, partly obsolete radial threads crossed by elevated, concentric, distant lines, with a tendency to nodulation at the intersections. Internally there are about eight or ten well-developed liræ and the auricular crura. The byssal ear has sparse radii and a distinct byssal notch.

Pecten (Propeamusium) squamula Lamarck?

? *Pecten squamula* Lam., Ann. du Mus., viii., p. 354, No. 3, 1806; Hist. An. s. Vert., vi., p. 183, 1819; Desh., Descr. Coq. Fos. Env. Paris, i., p. 304, pl. xlv., figs. 16–18, 1824.

? *Amussium squamula* Cossm., Ann. Soc. Roy. Mal. de Belg., xxii., p. 188, 1887.

Amussium squamulum Harris, Bull. Pal., ix., p. 44, pl. 7, figs. 2, 3, 1897.

Chickasawan (or Lignitic) Eocene of Wood's Bluff, Alabama; Harris.

This small species is destitute of the reticulate sculpture on the left valve which characterizes *P. alabamensis*, and is doubtless distinct. It has been referred by Professor Harris to Lamarck's species. On comparing the figures of Harris and of Deshayes, the latter seem to represent a species broader and more orbicular than Professor Harris's figures of the Wood's Bluff shell. I have, however, not seen specimens of either. There are several closely related recent species in the deep waters of the Atlantic off the American coast and among the West Indian islands.

FAMILY SPONDYLIDÆ.

Genus **SPONDYLUS** Linné.

Spondylus Linné, Syst. Nat., Ed. x., p. 610, 1758. Type *S. gæderopus* L. Mediterranean.

The species of this genus are not numerous in the American Tertiary or the recent fauna.

Spondylus dumosus Morton.

Plagiostoma dumosum Mort., Org. Rem., p. 59, pl. 16, fig. 8, and fig. in text, 1834.
Spondylus dumosus Conr., Cat. Eoc. Fos., Am. Journ. Conch., i., p. 14, 1865.

Eocene of the Jacksonian horizon, St. Stephens, Clarke County, Cocoa Post-Office, Choctaw County, etc., in Alabama; Red Bluff, Wayne County, Carson's Creek near Shubuta, and Chickasawha River, Wayne County, Mississippi; Winchell, Burns, and Johnson.

This well-defined species is unusually uniform in its characters and may be easily discriminated from the next species by its longer and more conspicuous submargins. It also seems never to reach so large a size.

Spondylus bostrychites Guppy.

Spondylus bifrons Sowerby, Quart. Journ. Geol. Soc., vi., p. 53, 1849; not of Goldfuss, Petref., ii., p. 99, pl. 106, figs. 10 *a–c*, 1835.
Spondylus bostrychites Guppy, Proc. Sci. Soc. Trinidad, p. 176, 1867; Gabb, Geol. St. Domingo, p. 257, 1873.

Oligocene of St. Domingo, at Ponton; of the Bowden marl, Jamaica; of Anguilla; of White Beach, near Osprey, Florida, and in the Ballast Point silex beds, Tampa Bay, Florida.

Variety *chipolanus:* Chipola beds on the Chipola River; lower bed at Alum Bluff, Chattahoochee River; Alum Bluff beds at Oak Grove, Santa Rosa County, and the Ballast Point silex beds, Tampa Bay, Florida.

The type form of this species has a relatively small number of spinose ribs, the intervening ones being free from spines, longitudinally finely striate, and show when very perfect minute scales. The adult shell is rather short and rounded and less inflated than usual in the genus. The species is remarkable for its small hinge-area.

In the variety *chipolanus* Dall there is no radial striation on the interspatial ribs, but rather a concentric sculpture; there are many more spinose ribs, the shell is more oval and more inflated, and, as far as the material goes, seems to attain a larger size. It may prove distinct with more perfect specimens, in which case the varietal name may be taken as specific.

Spondylus rotundatus Heilprin.

PLATE 35, FIGURES 25, 25 *a*.

Spondylus rotundatus Heilprin, Trans. Wagner Inst., i., pp. 99, 103, pl. 14, fig. 33, 1887.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida; Willcox and Dall.

This fine species was represented in the original publication by a very poor figure drawn from a very imperfect lower valve, so I have had another figure prepared showing the characters. It is characterized by the presence of eight or ten primary ribs with longer spines, which are broad, spathulate, and longitudinally ridged; at the end, when perfect, the spine is decurved like a half-shut hand. Between the primaries are two or three smaller ribs densely clothed with similar but smaller and shorter spines whose backs are so close together as to almost conceal the whole surface. The cardinal area is of moderate size, triangular and twisted. The lower valve is similarly sculptured, but with less regularity. Traces of coloration indicate that the shell originally was of deep red or purple color. *S. rotundatus* is less similar to the recent most foliaceous specimens of *S. echinatus* than is the Oligocene *bostrychites.*

Spondylus echinatus Martyn.

Ostræa echinata Martyn, Univ. Conch., ii., fig. 154, 1784.

Spondylus armatus Humphrey, Mus. Calon., p. 54, No. 1021, 1797.

Spondylus croceus Humphrey, Mus. Calon., p. 55, No. 1022, 1797; Arango, Moll. Cubana, p. 271, 1880.

Spondylus dominicensis Bolten, Mus. Bolt., 1st ed., p. 193, 1798; 2d ed., p. 135, 1819; (Chemn., vii., p. 79, pl. 45, fig. 465.)

Spondylus aurantiacus Bolten, *op. cit.*, p. 195, 1798.

Spondylus americanus Lam., An. s. Vert., vi., p. 188, 1819; (Enc. Méth., pl. 195, figs. 1, 2;) Reeve, Conch. Icon., pl. 4, fig. 17, 1856.

Spondylus longitudinalis Lam., An. s. Vert., vi., p. 191, 1819; (Chemn., vii., p. 81, pl. 45, fig. 466;) Reeve, pl. 13, fig. 46, 1856.

Spondylus spathuliferus Lam., *op. cit.*, p. 191; (Enc. Méth., pl. 191, figs. 4, 6, 7;) Dall, Bull. U. S. Nat. Mus., No. 37, p. 32, 1889.

Spondylus crassisquama Lam., *op. cit.*, p. 191, *ex parte.*

Spondylus arachnoides Lam., *op. cit.*, p. 188.

Spondylus longispina Lam., *op. cit.*, p. 189.

Spondylus avicularis Lam., *op. cit.*, p. 190.

Spondylus gilvus Reeve, Conch. Icon., pl. 11, fig. 38, 1856.

Spondylus erinaceus Reeve, *op. cit.*, fig. 39.

Spondylus ictericus Reeve, *op. cit.*, fig. 40.

Spondylus ramosus Reeve, *op. cit.*, pl. 14, fig. 51.

Spondylus imbutus Reeve, *op. cit.*, pl. 15, fig. 55.

Spondylus ustulatus Reeve, *op. cit.*, pl. 16, fig. 58.

Spondylus vexillum Reeve, *op. cit.*, pl. 16, fig. 59.

Spondylus nux Reeve, *op. cit.*, pl. 18, fig. 64, 1856.

Spondylus digitatus Reeve, *op. cit.*, fig. 68.

Spondylus echinatus Orbigny, Moll. Cuba, ii., p. 359, 1846.

Spondylus folia-brassicæ Orbigny, *op. cit.*, p. 358, 1846.

Fossil in the Pleistocene elevated reefs of the West Indian Islands and of the continent from southeastern Florida to Brazil; and recent over the same general region, extending as far north as Cape Hatteras, North Carolina.

This species has the irregularities of sculpture due to, or usually associated with, the sessile habit, and the mutations of color characteristic of many Pectinidæ. To these and to the exigencies of trade imposed by dealers upon Reeve is due the multiplication of merely nominal species indicated in the preceding synonymy.

The normal or most ordinary type of sculpture comprises from four to eight radial ridges from which project spines, either narrow and almost pointed, or wide and crumpled or digitate, separated by wider interspaces with smaller, sometimes spinulose, radii, to which is added a series of still finer threads, chiefly indicated by rows of small, short scales. By the continuity and regularity of the radial lines the species is separated from the otherwise quite similar *S. gæderopus* Linné of the Mediterranean. Specimens which have been cleaned with acid have usually lost the tertiary rows of minute scales, but they seem to be absent naturally from some specimens which have only two series of radials, the secondary ones but little spiny, and the spines comparatively sparse, long, and narrow on the primary ribs. This type forms the variety *americanus.* The sculpture on the fixed valve is more foliaceous and less spiny than on the other. The spinosity varies greatly; some individuals have almost none, others are profusely spiny, and others, again, have the spines limited almost entirely to the major ribs, which vary greatly in number. There is occasionally a distinct ctenolium in adult specimens. The colors and their distribution vary as in many Pectens.

I have seen from the West Indian region but one species of large foliaceous *Spondylus* (with one well-marked variety),—the present species. There is one deep-water species, common to the Mediterranean,—the *Spondylus Gussoni* of Costa, which is small, with acicular spines, and colorless.

The Eocene *S. amussiopse* de Gregorio is the young of *Plicatula filamentosa* Conrad. *S. inornatus* Whitfield, from the Miocene of New Jersey, is based on a smooth specimen of *Plicatula densata* Conrad. *S. estrallensis* Conrad, 1857, afterwards altered to *S. estrellanus*, from the Miocene of the Estrella valley, California, was based on a much-mutilated specimen of *Lyropecten*. The very imperfect type of *Pecten anisopleura* Conrad from North Carolina strongly resembles a *Spondylus*, but is too incomplete to permit of positive determination. A species doubtfully referred to this genus is mentioned by Heilprin in his paper on the Eocene Mollusca of Texas (Proc. Acad. Nat. Sci. Phila. for 1890, p. 404).

Professor Harris has figured a valve of a *Spondylus* from the Chickasawan or Lignitic beds of Hatchetigbee Bluff, which he doubtfully refers as a variety to *S. dumosus* Morton. The specimen is too imperfect to afford definite evidence, but may probably turn out to be a distinct species (cf. Bull Pal., No. 9, p. 42, pl. 6, fig. 11, 1897).

Genus **PLICATULA** Lamarck.

Plicatula Lam., Syst. An. s. Vert., p. 132, 1801. Type *P. gibbosa* Lam., *l. c.* = *P. ramosa* Lam., 1819.

Harpax Parkinson, Org. Rem., 3, pl. 12, 1811; Brookes, Intr. Conch., p. 83, 1815. Type *H. Parkinsonii* Bronn.

Ostrenomia Conrad, Proc. Acad. Nat. Sci. Phila. for 1872, p. 216. Type *O. carolinensis* Conr.

The only established species mentioned by Lamarck in the Système, where he described the genus, is the West Indian form, which he at first named *P. gibbosa* and wrongly identified with the Chinese *Spondylus plicatus* of Linné. In 1819 he arbitrarily changed the name to *ramosa*. Linné's still preserved type specimen and designated habitat show that his species was not the same as that of Lamarck. The latter, and not *P. plicata*, must therefore be cited as the type of the genus. The original specific name must, of course, be retained.

The genus is easily separated from the Spondyli by the character of its hinge. It may attach itself by either valve; there is no regularity in this respect within the species. An important memoir by Deslongchamps on this group is to be found in the Trans. Soc. Linn. de Normandie, ii., 1860.

Plicatula arose in the Trias and reached its maximum in the later Mesozoic. It is doubtless an offshoot from the *Pectinidæ*, with which the characters of the hinge, the occasional auriculation, and the presence in some species of internal liræ, appear to connect it.

Plicatula filamentosa Conrad.

Plicatula filamentosa Conrad, Fos. Tert. Form., p. 38, 1833.

Plicatula Mantilli Lea, Contr. Geol., pp. 89, 90, pl. 3, fig. 68, 1833.

Plicatula planata Aldrich, Journ. Nat. Hist. Soc. Cin., ix., p. 45, pl. ii., fig. 20, 1866. (Young shell.)

Spondylus amussiopsc Gregorio, Claib. Mon., p. 179, pl. 20, figs. 11–13, 1890. (Young shell.)

Eocene of the Chickasawan or Lignitic at Hachetigbee, and of the Claiborne sands at Claiborne, Alabama, also at Newton and Wahtubbee, Mississippi, and in corresponding beds in Louisiana, Burns, Johnson, Aldrich, Harris, and others; and in Lee County, Texas, Singley.

This species is peculiar in its characters. When young it has fine radial striation on both valves, which may sometimes be wholly or partly spiny (mut. *planata*), and the shell is flattish; this sculpture changes rather suddenly by an appearance of the large plications, of which the lateral ones rarely bear a few coarse spines. The radial striation continues through life in well-developed specimens, and may be recognized in unworn shells. There are sometimes well-marked auricles developed near the beaks. The interior of the young, as noted by Gregorio, presents a few strong liræ resembling those of *Propeamusium;* these persist until middle age, especially distally, but on the disk are gradually buried in shelly matter. The thickened ends of the liræ are visible longer, but gradually disappear, their position in the adult being marked by small pits.

Plicatula filamentosa var. **concentrica.**

Wahtubbee Hills, Clarke County, Mississippi; Burns.

This form is marked by a total disappearance of the radial striæ and the development of fine, even, regularly spaced, concentric, elevated sculpture all over the shell. I should have regarded it as a distinct species had it not been for a few intergrading specimens.

A fossil which may be a *Plicatula*, but of which the hinge is not accessible, is figured from the Midwayan Eocene by Harris, Bull. Pal. No. 4, p. 47, pl. 2, figs. 2, 2 *a*, 1896.

Plicatula densata Conrad.

Plicatula densata Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 311, 1843; Medial Tert., p. 75, pl. 43, fig. 6, 1845; Proc. Acad. Nat. Sci. Phila., xiv., p. 582, 1863.
Spondylus inornatus Whitfield, Mioc. Pal. N. J., p. 34, pl. 5, figs. 1, 2, 1895.

In the Oligocene Vicksburg limestone at Archer, Florida, and the Nummulitic horizon at Ocala, Florida, Dall and Willcox; also in the Guallava beds of Costa Rica, Hill; in the Chipola beds on the Chipola River, and in the lower bed at Alum Bluff; in the silex beds of Ballast Point, Tampa Bay, and in the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida, and the Bowden marl, Bowden, Jamaica; in the Miocene marls of Cumberland County, New Jersey, at Shiloh and Jericho.

This species is distinguished from the later *marginata* of Say by its usually rounder form and more numerous, less prominent plications. Occasional specimens attached to a smooth surface by a considerable area do not develop the plications, and one such has served as the type of Whitfield's species.

Plicatula gibbosa Lamarck.

Plicatula gibbosa Lam., Syst. An. s. Vert., p. 132, 1801.
Plicatula ramosa Lam., An. s. Vert., vi., p. 184, 1819; ? Heilprin, Trans. Wagner Inst., i., p. 102, 1887.
Plicatula cristata Gabb, Geol. St. Dom., p. 257, 1873.
Plicatula vexillata Guppy, Geol. Mag., Dec. ii., vol. i., p. 444, pl. xvii., fig. 7, 1874.

? Oligocene of Jamaica, Guppy; recent in the Atlantic from Cape Hatteras, North Carolina, south to the West Indies and Rio de la Plata, Brazil.

This species is contained in the Guppy collection from Jamaica, the specimens showing the dark lines belonging to the species, but I suspect that they were obtained from a later, perhaps a Pleistocene, deposit, as the explorations of the Bowden marl by Messrs. Henderson and Simpson have produced only specimens of the *P. densata* from the Bowden horizon.

Plicatula marginata Say.

Plicatula marginata Say, Journ. Acad. Nat. Sci. Phila., iv., pp. 136–7, pl. 9, fig. 4, 1824; Conrad, Fos. Med. Tert, p. 75, pl. 43, fig. 5, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 24, pl. 7, figs. 11–14, 1855.

Plicatula rudis H. C. Lea, Trans. Am. Phil. Soc., N. S., ix., p. 246, pl. 35, fig. 34, 1845.

Miocene of Petersburg, Virginia, Lea; of Coggins Point, Virginia, E. Ruffin; of York River, Virginia, Harris; of Duplin County, North Carolina, Murfreesborough and Wilmington, North Carolina, Haldeman and Stanton; of Darlington, South Carolina, Burns; Pliocene of De Leon Springs (Wright), and of the Caloosahatchie marls on the Caloosahatchie, Shell Creek, and Alligator Creek, Dall and Willcox; of the Waccamaw River, South Carolina, Johnson; and of Cape Fear, North Carolina, Dr. Yarrow.

So far as the form of the shell is concerned, this species cannot be discriminated from *P. gibbosa*, but none of the specimens show any trace of the dark venous lines which are so characteristic of both recent and fossil specimens of *gibbosa*. In a very large series of the recent shell a few specimens will usually be found which have a diffused brownish blush instead of the brown lines; but these are so exceptional that I have felt the present species might be separated with propriety. In both the differences of sculpture due to *situs* pass through a parallel series of mutations.

The genus *Ostrenomia* Conrad, referred to in the synonymy, is in my opinion based on a specimen of *Plicatula* which incidentally grew around the stem of a Gorgonian or other round object, as there is no byssal scar. The specimens were from the Eocene of North Carolina.

There are a number of Cretaceous species of *Plicatula*, but I have been unable to find any other Tertiary forms from America cited in the literature besides those above mentioned.

Family DIMYACIDÆ.

Genus **DIMYA** Rouault.

Dimya grandis Dall.

Plate 35, Figure 8.

Dimya grandis Dall, Proc. U. S. Nat. Mus., xix., No. 1110, p. 328, 1896.

Oligocene of St. Domingo, at the Potrero, Rio Amina; Bland.

The recent *D. argentea* Dall has not been found fossil. The present species may not improbably hereafter be found in the Chipola beds.

Family LIMIDÆ.

Genus LIMA (Bruguière) Cuvier.

Lima Bruguière, Enc. Méth., pl. 206, 1792; name only, no type; Cuvier, Tabl. Elém., p. 421, 1798: type *Ostrea lima* L., Lam. Prodr., p. 88, 1799.

Mantellum Bolten, Mus. Bolt., p. 160, 1798.

Limaria Link, Beschr. Rostock Samml., p. 157.

Glaucion a Oken, Zool., 1815, *fide* Herrmannsen.

Radula H. and A. Adams, Gen. Rec. Moll., ii., p. 556, 1858; not *Radula* Gray, Syn. Br. Mus., p. 60, 1844.

Ctenoides H. and A. Adams, *op. cit.*, p. 557, 1858; *L. scabra* Born.

Acesta H. and A. Adams, *op. cit.*, p. 558, 1858; *L. excavata* Chemn.

This very natural group indicated by Bruguière derived its name from the nonbinomial writers, but was first defined and a type mentioned by Cuvier. Bolten named it without a diagnosis in the same year, and Link a few years later corrected the form of the name, after his habit. The nonbinomial names of Klein were habilitated by H. and A. Adams, but take date only from their work.

The group is divisible as follows:

Subgenus *Lima* s. s. Hinge edentulous; valves gaping, inequilateral.

Section *Lima* s. s. Sculpture radial, submargins impressed. *L. lima* Linné.

Section *Ctenoides* Ads. Sculpture divaricate, submargins impressed. *L. scabra* Born.

Section *Plagiostoma* Sowerby, 1814. Sculpture feeble, radial; valves subtriangular, with a deep resiliary pit. *L. gigantea* Sowerby.

Section *Mantellum* Ads. Submargins not impressed. *L. hians* Gmel.

Subgenus *Limatula* Searles Wood, 1839. Valves closed, equilateral, more or less distinctly mesially sulcate; sculpture radial. *L. subauriculata* Mtg.

The group is quite ancient, and attained its climax in the Mesozoic; the Tertiary species are relatively few and rare. I have omitted some of the older forms from the list as hardly in place here.

Lima (Lima) vicksburgiana n. s.

Plate 35, Figure 20.

Vicksburgian Oligocene, at Johnson's lime-sink, Levy County, and at La Penotière's hammock, near Orient, Florida; Dall.

Shell of moderate size, hardly oblique, moderately gaping, elongate, radially sculptured, with thirty-five or more nearly simple radial ribs, separated by slightly wider interspaces, which cover the whole surface; submargins slightly impressed; ears small, unequal; hinge-margin straight, basal margin slightly indented by the ribs; a slight nodulation is perceptible on the backs of the ribs. Alt. 30, lat. 23 mm.

This differs from *L. staminea* Conrad (Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 126, pl. 13, fig. 30, 1848) in its less angular and oblique outline, more prominent ears, and stronger and more regular sculpture.

Lima (Lima) tampaënsis n. s.

PLATE 35, FIGURE 18.

Chipolan Oligocene, near Bartow, and on the shores of Hillsborough Bay, near Tampa, Florida; Dall.

Shell very inequilateral, the anterior side short, moderately gaping; the posterior side long, straight, with a wide impressed submargin; base expanded and rounded; hinge-line very short, with very small ears, the anterior larger; pit large, triangular, not oblique; exterior with about twenty-seven narrow, smooth, rounded radial ribs separated by wider channelled interspaces; the basal margin is serrated by the sculpture; the submargins are finely striated. Alt. 35, lat. 27, diam. 14 mm.

The chief characteristics of this species lie in its simple, distant, rounded ribs and the great obliquity of the valves.

Lima (tampaënsis var.?) **costulata** n. s.

PLATE 35, FIGURE 24.

An imperfect valve was obtained from the Oligocene of Hillsborough Bay, near Tampa, Florida.

Shell like the preceding but broader, with more numerous (thirty-five) ribs, which are separated by very narrow interspaces and in perfect specimens are probably minutely nodulous; the posterior submargin is also more deeply impressed.

This is probably a distinct species, but the material is insufficient to fully define its characters, and I mention it as a variety merely in order that it may not be lost sight of.

Lima (Lima) smirna n. s.

PLATE 30, FIGURE 3.

Chipolan Oligocene of Hillsborough Bay, near Tampa, Florida; Dall.

Shell ovate, slightly inequilateral, smooth, except for incremental lines;

submargins narrow, concentrically striated, the anterior longer, with a moderate gape, the posterior shorter, hardly differentiated from the disk; ears small, hinge-line short, shell very thin. Alt. 31, lat. 23, diam. 10 mm.

The perfectly smooth surface of this species differentiates it from any other of our Tertiary species.

Lima (Mantellum) carolinensis n. s.

PLATE 35, FIGURE 21.

Oligocene of the Oak Grove sands, Santa Rosa County, Florida, Burns; Miocene of Darlington, South Carolina, and the Duplin Natural Well, Duplin County, North Carolina, Burns.

Shell small, thin, inflated, oblique, with a moderate gape, sculptured with concentric lines of growth and rather sharp, fine, numerous, somewhat irregular radial threads, obsolete on the beaks, absent from the posterior submargin and the anterior ears; submargins not impressed, beak prominent, ears small, the margin of the gape forming a concave sinuosity in front of and below the anterior beak; hinge-line short, with a very wide pit, its lower margin projecting from the cardinal plate; interior radially striate, the basal margin slightly crenulate. Alt. 16, lat. 12, diam. 7 mm.

This differs from *L. papyria* Conrad, from the Maryland Miocene, in the absence of the angle which in the latter species modifies the margin just below the anterior ear, and in the presence of dense radial striation on the anterior submargin, while in *L. papyria* this region is smooth.

Lima lima Linné.

Ostrea lima L., Syst. Nat., Ed. x., p. 699, 1758.

Pecten radula Chemnitz, Conch. Cab., vii., p. 349, pl. 68, fig. 651, 1784.

Lima squamosa Lam., Syst. An. s. Vert., p. 136, 1801; An. s. Vert., vi., p. 156, 1819; Dall, Bull. U. S. Nat. Mus., No. 37, p. 36, No. 46, 1889.

Pliocene of the Caloosahatchie marls, Florida, Dall; Pleistocene of the West Indies; recent on the American coast from Sarasota Bay, Florida, to Brazil, and widely distributed in foreign seas. Type of the genus.

This shell seems rare in the Pliocene. Only a few small specimens were obtained.

Lima (Mantellum) caloosana n. s.

PLATE 28, FIGURE 3.

Pliocene of the Caloosahatchie; Dall and Willcox.

Shell inflated, oblique, strong, with a large anterior gape, the posterior margins not excavated; incremental lines strong; radial sculpture of about forty rather sharp, minutely nodulous, narrow threads, with usually wider but often somewhat irregular interspaces, sometimes carrying a slender intercalary thread or faint traces of radial striation; submargins almost free from radial sculpture, not impressed; hinge-margin short, pit large, wide, with a projecting lower margin; basal margin of the valve rounded, hardly crenulated by the sculpture. Alt. 37, lat. 35, diam. 24 mm.

This shell is much like the recent *L. inflata* Gmelin, but is constantly wider, less oblique, and differs in minor details. It appears to be one of the characteristic species of the Caloosahatchie marls.

Lima (Ctenoides) scabra Born.

Ostrea scabra Born, Test. Mus. Vind., p. 110, 1780.

Ostrea glacialis Gmelin, Syst. Nat., vi., p. 3332, 1792, *ex parte*.

Lima aspera Chemnitz, Conch. Cab., vii., p. 352, pl. 68, fig. 652, 1784.

Ostrea sagrinata (Solander MS.), Mus. Calonnianum, p. 52, 1797.

Lima glacialis Lamarck, An. s. Vert., vi., p. 157, 1819; Holmes, P.-Pl. Fos. S. Car., p. 13, 1860.

Lima scabra Heilprin, Trans. Wagner Inst., i., p. 120, 1887; Dall, Bull. U. S. Nat. Mus., No. 37, p. 36, No. 48, 1889.

Pliocene of the Caloosahatchie, Monroe County, Florida, Heilprin, Willcox, and Dall; Pleistocene of South Carolina and the West Indies; recent from Cape Hatteras, North Carolina, to the island of Trinidad, West Indies.

This well-known species occurs in excellent condition in the Pliocene marls.

Lima (Ctenoides) tenera Sowerby.

Lima tenera Sby., Thes. Conch., p. 84, No. 2, pl. xxi., figs. 10, 11, 1847; Dall, Bull. U. S. Nat. Mus., No. 37, p. 36, No. 47, 1889.

Pliocene of the Caloosahatchie, Monroe County, Florida; Pleistocene of the West Indies; recent from Cedar Keys, Florida, south to Barbados, West Indies.

A single valve of this form, which is, perhaps, little more than a variety of *L. scabra*, was obtained from the marls.

Genus **LIMÆA** Bronn, em.

Limea Bronn, Ital. Tert., p. 115, 1831. *Ostrea strigillata* Broc.

Limoarca Münster, Leonh. u. Bronn, Jahrb., p. 421, 1832.

Limæa Gray, P. Z. S., 1847, p. 201.

This genus differs from *Lima* by having on each side of the resilium a number of taxodont teeth on the cardinal margin.

Limæa solida n. s.

PLATE 35, FIGURES 4, 5.

Oligocene of the Bowden beds at Bowden, Jamaica; Henderson and Simpson.

Shell minute, solid, rounded triangular, with about twelve rounded, strong, slightly granular radial ribs, separated by narrower interspaces crossed by lines of growth; submargins without radial sculpture; hinge-line short, with a small central pit, on each side of which are about eight teeth; interior radially feebly grooved, the basal margin crenulated by the ribs; shell moderately inflated. Alt. 3.5, lat. 3.3, diam. 2.5 mm.

This little shell is related to the *L. Bronniana* Dall of the recent fauna, but is distinguished from it by its narrower and more solid hinge, with a distinctly smaller resiliary pit and heavier and more solid shell.

Besides the species above discussed, the following members of this family have been reported from our Tertiaries.

From the Chickasawan or Lignitic Harris has described *L.* (*Mantellum*) *ozarkana*, from Ozark, Alabama (Bull. Pal., ix., p. 43, pl. 6, fig. 12, 1897).

Gabb has described a *Lima multiradiata* from the California Eocene, between the Tejon and Martinez groups at Lower Lake, Lake County (Pal. Cal., ii., p. 261, pl. 33, fig. 101, 1868), which Cooper also reports from Santiago Cañon, Santa Anna Mountains, Los Angeles County.

From the Miocene of Costa Rica Gabb described (Journ. Acad. Nat. Sci. Phila., 2d. Ser., viii., p. 348, pl. 45, fig. 26, 1875) *L.* (*Mantellum*) *papyracea*, and Cooper cites the recent *L.* (*Mantellum*) *dehiscens* Conrad, from the Pliocene of Santa Barbara, California.

Superfamily ANOMIACEA.

FAMILY ANOMIIDÆ.

In *Ephippium sella* Gmel., while the nepionic shell is doubtless (as in *Anomia*) essentially symmetrical and without any byssal notch or foramen, it very early initiates one, with a distinct plug, and then again discards it, so that in the adolescent or adult shell the traces of the process are frequently obliterated. We have in this case the singularity of a shell taking on a very radical modification and then reverting to what is, in the main, its earlier condition. The hinge-margin in *Ephippium* is usually much worn and has lost its original characters, but sometimes we find them preserved. They comprise an umbonal area covered with a thin ligamentary tissue and presenting, under the umbo, an elevated subtriangular swelling recalling the deltidium in some Brachiopods. The inner margins of the cardinal border in the right valve are, as it were, detached, except at the umbonal end, and bent downward into the cavity of the shell, carrying with them on their external edges a portion of the ligament which, like the shelly crests upon which it is seated, still remains continuous with the original ligament and cardinal border under the umbo, though in the opposite (left or convex) valve it is mainly accommodated in a pair of grooves corresponding to the crests. In addition to this, the ligament *senso stricto*, there is also a small and feeble resilium situated in the angle between the divaricating crests. Whether this is caused by an advance with the growth of the shell of the external ligament over the angle formed by the crests under the umbones, or is an original structure, the material at my disposal is insufficient to decide. At all events, the sinus and subsequent perforation is situated anteriorly to the anterior of the two chondrophores, or crests, as, according to the anatomical structure, is inevitable.

In *Placenta* (*P. placenta* L.), however, we have a different state of things. Here the cardinal margin is so narrow that the external ligament, if any, has disappeared at an early age, leaving the two unequal chondrophores more nearly parallel than occurs in *Ephippium* and not united in an angle at their upper ends. The anterior cardinal margin is compressed into a narrow wing with a groove for a byssus, as in some species of *Pecten*. The groove has its edges reflected and thickened, and in most cabinet specimens, unless eroded, is represented externally by a thread-like elevated ray.

Pododesmus Philippi (Wiegm. Arch., 1837, p. 385) was founded on *Placunanomia rudis* Brod. from Cuba, a species which differs from *Monia* Gray in having a small, solidly soldered-up byssal foramen and a single muscular impression (*fide* Philippi); the latter character would be true if the impression were regarded as additional to the byssal scar, but it is probable that Philippi took the latter for the adductor scar and did not see the true muscular impression at all. However, it is likely that *Monia*, at best, can form no more than a section of *Pododesmus*, which is long prior to Gray's subgenus. From *Carolia* to *Pododesmus* is a short step; another step, somewhat shorter, brings us to *Monia*.

The genus *Placunanomia* Broderip was founded on a remarkable and still very rare shell, the *P. Cumingii* of west Central America. It is, in some respects, intermediate between *Ephippium* and *Monia* Gray, but presents additional characteristics of its own.

The shell is strongly plicated with a few folds; is attached when very young, but may be free in the adult state. In the right valve the cardinal margin is broad and strongly rugose with interlocking rugosities of both valves. Though deep, they are too irregular in form to be called teeth. In the right valve two strong elevated crests—the auricular crura—meet above at a very acute angle, and are received into sockets in the opposite valve, separated by a space bearing a strong median ridge. The ligament connects the outside of the crests with the sockets, but is continuous with a resilium occupying the upper third of the space between the crests. The adductor leaves a large subcentral, nearly circular, impression on both valves. The byssal foramen is closed at an early age, leaving a round scar between that of the adductor and the end of the anterior crest, which scar is joined to the beak by a linear, solidly cemented suture. The byssal muscle persists as an accessory adductor in function. There is no perforation of the shell nor any necessary connection with external objects, in the adult state, any more than in *Ephippium* or *Carolia*. None of the other genera of the group exhibit the interlocking rugose cardinal area.

The species by which the genus *Placunanomia* is usually judged belong to a group, properly separated by Gray in 1849 (P. Z. S., p. 121) under the name of *Monia*, with *P. macroschisma* Deshayes as the type. In *Monia* there is a very large, partly shelly, partly corneous, byssal plug, embraced by the right valve (but with the suture always unsoldered, though close fitting), by which the animal is attached at all stages of its existence, unless in the larval condition. There is no cardinal area, no interlocking teeth or rugosities, or paired, elevated internal crests or median internal resilium connecting the valves below the chondrophoric arch.

In *Monia macroschisma* as compared with *Placenta* we have a condition more like that of *Ephippium*, but with a large notch and byssal plug, while the chondrophoric margin is arched and not angulated, being represented by a single pedunculated wide mass with a resilium under the arch. That portion of the ligament attached to the chondrophore has become so large and massive that it has supplanted entirely the remnant on the cardinal margin, and the latter, at least in adults, is non-existent. In the left valve the margins of the ligamentary scar are sometimes moderately thickened, but the process has not been carried so far as to form crura. Coincidently with the existence of the enormous plug in this group, the byssal muscle has been enlarged until it exceeds in section the size of the adductor, above which it is inserted on the surface of the left valve. In *Anomia* proper and *Ænigma*, the other features not being greatly modified, we have the byssal muscle divided into several bundles, each producing its separate scar on the upper valve.

In the form of *Carolia*, which we are about to describe, we have combined with the single chondrophore of *Monia* the obsolescent notch and plug, together with the simple adductor scar of *Ephippium*. The sensible but narrow cardinal area of the latter is represented by a broad and conspicuous margin. The lateral edges of the ligamentary scar in the left valve form narrow elevated crura, while the exterior is free from the radiating striæ common to all the other forms and resembles that of the smooth Anomias. If these differences be taken as sufficient for establishing a section of the subgenus, the name *Wakullina* will be used, from Wakulla County, Florida, in which the type specimens were collected.

The synonymy of this group is in an unsatisfactory condition. The genus *Placenta* was first named by Da Costa in his Conchology (p. 271, 1776), though, unfortunately, this author not having consistently adopted in this work the Linnean nomenclature, it is not entitled to be cited in synonymy. The name *Placenta* had been used by Klein in 1734 to designate an Echinoderm, but this author is absolutely without a binomial nomenclature and not entitled to any consideration in discussing systematic questions. Da Costa's name became current among students and was adopted in proper binomial form by Retzius in his well-known dissertation on new genera of shells, published by his pupil, Phillipson, at Lund in 1788.

Meanwhile Linné had referred the species to *Anomia* under the name of *Anomia placenta*. In an unpublished description of the shells in the ducal cabinet of Portland, Dr. Solander had proposed the name *Placuna* for the same type, and this was used by Bruguiére on the plates of the unfinished Encyc. Méthodique (174, 175, 1792), though with the genuine *Placuna* he united certain species of *Plicatula*. Solander's name was also quoted by Humphrey in his Catalogue of the Museum of Calonne (p. 45, 1797), which contained a number of specimens derived from the Portland cabinet. A year or two later Bolten revived the hitherto nonbinomial name of *Ephippium* employed by Chemnitz to designate (Conch. Cab., viii., p. 116, 1785) the saddle-oyster,—he included that as well as *Anomia placenta* in his genus

(Mus. Boltenianum, p. 166, 1798),—while in 1799 Lamarck (Prodrome, p. 82) adopted Solander's name with the original type. In 1817 Schumacher used Retzius's name and correctly placed *Placuna* in its synonymy. Since that time, however, as was natural, the name adopted by Lamarck has had the wider currency, perhaps partly on account of the erroneous statement by Herrmannsen (Ind. Gen. Mal., ii., p. 277) that Chemnitz refers to Solander's manuscript name in the volume of the Conchylien Cabinet published in 1785, three years before Retzius gave Da Costa's name a binomial standing. A careful search of Chemnitz in the place indicated shows no reference whatever to Solander or his name, as has already been pointed out by Deshayes. In 1848 Gray enumerated the species of *Placenta* Retz. (P. Z. S., 1848, p. 114) and divided the genus into two sections or subgenera, 1, *Placenta* s. s., typified by *P. placenta* Lin., and 2, *Ephippium* (Chemn.), after Bolten (+ *Sellaria* Link, 1807), comprising the saddle-oysters. The name *Ephippium* (Bolten) antedates by four years its use in Entomology, even if we do not go back to the non-binomial Chemnitz, and though part of the species were referable to *Placenta* Retz., the remainder, belonging to an unnamed group, were entitled to retain Bolten's name. If Bolten's name had been entirely new the absence of a diagnosis might militate against its acceptance, but as it is really a revival of a well-known but not binomially established name, with proper references to Chemnitz's and other figures and to Gmelin's synonymes, while there can be no possible doubt as to the species included, it would seem that no question need arise on this account.

In 1864 Deshayes referred a problematical fossil (*Placuna solida* Desh.) to this group under the name of *Hemiplicatula*, for which in 1886 Fischer proposed the emended form of *Semiplicatula*. Its true relations can only be determined by a more critical examination than it seems yet to have received.

In 1867 Conrad described a genus *Paranomia*, from the Ripley group (Upper Cretaceous) of Alabama, to which he referred his *Placunanomia Saffordi* (Journ. Acad. Nat. Sci., 2d Ser., iv., p. 290, pl. 46, fig. 21) and the *Placuna scabra* of Morton. The typical species is ill preserved, and the beaks almost always wanting, but, from the examination of a large number of specimens, it seems probable that the genus resembles *Monia* in its external characters; the presence of a triangular chondrophore recalls *Anomia*, but there is not sufficient evidence of a permanent foramen, the muscular impressions are not preserved, and there is in the right valve, associated with the single chondrophore, a pair of low, narrow crests, recalling those of *Placenta*, but obviously of different function. The genus is a puzzle and cannot as yet be safely united with any other. *Diploschiza* Conrad, however, appears to be founded on a broken valve of an ordinary *Anomia.* It is impracticable to attempt here a revision or discussion of the names which have been applied to exotic fossils apparently related to this group, as the material is wanting, and few of them have been intelligently studied in the light of the anatomical relations of the recent forms.

In 1870 Stoliczka (Cret. Pelec. India, p. 451), misled by an imperfect knowledge of its synonymic status, proposed for *Ephippium* (Bolt.) Gray the name *Placunema,* which falls into synonymy.

It seems to the writer that the absence of any foramen and the permanently byssiferous habit of *Placenta* generically distinguish it from all the foraminiferous *Anomiidæ.* Its arenaceous habitat is also different from all the rest.

Placunanomia as typified by *P. Cumingii* seems also a good genus.

The list, omitting doubtful forms and unstudied exotics, will stand about as follows:

1. Byssal scars absent or obsolete.

Genus *Placenta.* Type *P. orbicularis* Retzius.
Genus *Ephippium.* Type *E. sella* Gmelin.
Genus *Carolia.* Type *C. placunoides* Cantraine.
Section *Wakullina.* Type *C. floridana* Dall.

2. A single conspicuous byssal scar on the disk.

A. Adult foramen closed; hinge armate.
Genus *Placunanomia.* Type *P. Cumingii* Broderip.
B. Adult foramen small; hinge unarmed.
Genus *Pododesmus.* Type *P. rudis* Broderip.
C. Adult foramen large; hinge unarmed.
Section *Monia.* Type *P. macroschisma* Deshayes.

3. Two byssal scars on the disk; hinge unarmed; foramen open.

A. Main byssal scar largest; foramen ample.
Genus *Anomia.* Type *A. ephippium* Linné.
B. Adductor scar larger than those of the byssus; foramen small.
? Section *Patro.* Type *A. elyros* Gray.
C. Main byssal scar distant from the two others.
Section *Ænigma.* Type *A. ænigmatica* Jonas.

In addition to the major and minor byssal scars on the disk, there is a small semilunar scar near the resiliary pit, due to a branch of the byssal muscular system. The "*Placuna papyracea*," of which the nepionic foramen is figured by Fischer (Man. Conch., p. 953, fig. 701), belongs to the genus *Ephippium*. The dynamic relation between the size and position of the byssal foramen and the byssal scars is sufficiently obvious. The only American fossil referred to *Placuna*,—*P. scabra* Morton,—as already indicated, belongs to the Cretaceous, and is placed by Conrad in his genus *Paranomia*.

Genus **CAROLIA** Cantraine.

Carolia Cantraine, Bull. Acad. Sci. Brux., 1838, p. 111. Type *C. placunoides* Cantraine; Fischer, J. de Conchyl., xxviii., p. 345, pl. xii., 1880; Man., p. 932, fig. 700, pl. xvi., fig. 7, 1886. Lower Eocene of Egypt.

Hemiplacuna (Sby. MS.) Gray, P. Z. S., 1849, p. 123. Type *H. Rozièri* Sby. Cf. Rozière in Descr. de l'Egypte, Mineralogie, pl. xi., fig. 6.

Shell thin, nacreous, with radiating striæ, the right valve flattened; resilium rounded-triangular, internal, large, attached in the right valve to a pedunculate chondrophore seated on the anal side of the umbo and extended adorally so as to bring the middle of the resilium in the median line of the valve; in the left valve the resilium is attached in the cavity of the umbo, leaving a broad, fan-shaped, thickened scar of attachment, of which the anterior and posterior margins are elevated into diverging lamellæ. In the young stage the right valve is perforate for the passage of a byssus or byssal plug, which gradually atrophies, so that in the full-grown shell the sinus and perforation are closed with shelly matter and so overshadowed by the heavy chondrophore as to be hardly perceptible even as a scar. It should be observed that the attachment of the resilium is wholly posterior, and not the result of the merging of an anterior and posterior chondrophore. The scar of the adductor in each valve is single, orbicular, and nearly central, with two very minute accessory pedal or byssal muscular scars above it in the left valve.

This genus has been discussed by Gray and Fischer, the latter giving some instructive figures of the gradual obliteration of the sinus and of the analogous early sinus in *Ephippium papyraceum*.

For a fine specimen of the *Carolia* figured by Rozière in Savigny's Egypte I am indebted to Lieutenant S. M. Ackley, U. S. N., who obtained it from the Eocene Tertiary bed underlying the desert, about five miles west from the bed of the ancient Lake Mœris, in the Fayoum. It measures thirteen by fifteen centimetres, being somewhat wider than high. The chondrophore is almost sessile, so short is the peduncle; the scar of the byssal foramen is very distinct, about two millimetres in diameter and ten millimetres below the base of the chondrophore. So small is the play of the valves that the cardinal border, *senso stricto*, has ceased to exist, and the convex valve has that margin flattened and produced dorsally, taking on a patelliform character. The elevated lateral margins of the ligamentary scar are clearly of dynamic origin and not developed crura.

A singular fact is that the convex valve retains several of the sessile plugs of a large *Anomia* and adherent portions of their valves.

This species has no cardinal area, the surface is radiately striate and of that talcose aspect proper to *Placenta* and *Ephippium;* the distal portion of the chondrophore bears traces of a reflexed lamina like that we figure for our Floridian form (pl. 24, fig. 6 *b*). This character again is obviously dynamic, and is probably absent in young and perhaps some adult specimens.

Carolia (Carolia) jamaicensis n. s.

Plate 33, Figure 21.

Eocene (?) of the Cambridge beds, Cambridge, Jamaica; R. T. Hill.

Shell of moderate size and irregular growth, extremely compressed, thin, normally suborbicular; upper valve slightly convex, with inconspicuous beak and no clearly defined cardinal area; surface of both valves covered with fine, vermicular, close-set radial striæ and threads; lower valve flat, the foramen indicated by a small tubercle which in the course of growth comes to lie almost directly under the wide, little-elevated chondrophore; adductor scar subcentral, rounded; shell silvery, subnacreous. Alt. of portion figured (broken) 40, lat. 47, diam. 5 mm.

These shells were found mixed in with the remains of *Barrettia* and Rudistes of several species which appear to be standing in the limestone in the position in which they grew, in what Professor Hill calls the Cambridge formation and refers to the Upper Cretaceous. Considering the relations of the genus, I cannot regard the *Carolia* as Cretaceous, and prefer to look at it as either a subsequent deposition, or as possibly having grown upon previously fossilized Cretaceous Rudistes upon which an Eocene sea had encroached. This view is supported by the presence of other fossils of unmistakably Eocene facies in the limestone in which the *Carolia* occurs.

Carolia (Wakullina) floridana Dall.

PLATE 24, FIGURES 5, 6, 6 *b*, 7, 7 *b*.

C. (*Wakullina*) *floridana* Dall, Proc. U. S. Nat. Mus., xviii., p. 21, 1895.

From the Oligocene of Florida in the Sopchoppy limestone on the banks of Deep Creek near the Sopchoppy River, Section 13, Township 4, Range 3, Wakulla County, Florida; collected by L. C. Johnson, of the United States Geological Survey; also in the "Fuller's earth" bed by Dr. D. T. Day, at Quincy, Florida.

Shell thin, not sculptured, nacreous, suborbicular, and adherent, somewhat irregular; right valve flattened or concave, especially at the umbo; left valve convex with a moderately prominent umbo near the cardinal margin; hinge-margin variable, but always with a transverse flattish area arched in the middle over the attachment of the internal ligament; exterior irregularly imbricated by the scaly nacreous layers; interior smooth, with a large subcentral nearly orbicular adductor scar; right valve with the minute sealed byssal foramen under the middle of the chondrophore connected by a soldered linear suture with the upper anterior margin of the valve; chondrophore rounded triangular, broad, radiately rugose above, recurved as a thin lamina from the umbo in fully adult specimens (see figure), rather closely sessile and fitting into the umbonal cavity of the opposite or convex valve; left valve with the ligamentary attachment broadly triangular, marginated by a thin lamellar deposit of shell substance on each side and arched over by the elevated portion of the cardinal area. There is no trace of a scar corresponding to the byssal muscle of youth in adult specimens. Antero-posterior diameter 110, dorso-ventral height 110, maximum thickness of the closed valves 9 mm.

This fine shell, curiously enough, is, so far as known, the only species in the Sopchoppy limestone which retains its shell-structure, all the other mollusks, so far as observed, being represented only by their impressions in the soft limestone. It is interesting to find an Egyptian type in our southern fauna, though the only relation between them is, in the writer's opinion, that which both bear to the *Anomiidæ* which preceded them, and the analogous recent forms which have succeeded to them. The characters upon which *Carolia* is based are purely dynamic and might be expected to occur in a long succession of *Anomiidæ* of any region, the several Carolias having no genetic connection with each other, as such, any more than the Oregonian *Batissa* has with those of other continents now living.

Genus **PLACUNANOMIA** Broderip.

Placunanomia Brod., P. Z. S., 1832, p. 28. Type *P. Cumingii* Brod.
Placunomia Swainson, Malac., p. 390, 1840; Gray., P. Z. S., 1849, p. 120.

Placunanomia plicata Tuomey and Holmes.

P. plicata T. and H., Pleioc. Fos. S. Car., p. 19, pl. 6, figs. 4–6, 1855.

Newer Miocene of Duplin County, North Carolina, at the Natural Well, Burns; and at Smith's on Goose Creek, South Carolina, Tuomey and Holmes; living in Charleston Harbor, South Carolina? Ravenel.

Tuomey and Holmes state that Dr. Ravenel had in his collection a recent specimen of this species obtained from Charleston Harbor, but the absence of any confirmatory evidence for more than forty years leaves the accuracy of this determination in doubt. The fossil much resembles *P. Cumingii*, but is less deeply plicated, more delicate, with the rugosities of the cardinal border more feeble, and the byssal scar nearly equal in size to that of the adductor, in the right valve, while in *P. Cumingii* the adductor scar is conspicuously the larger of the two. If the present species be extinct, as seems likely, it is one of several instances where peculiar forms which were common to both coasts of America before the Pliocene survive the separation of the two oceans only on the Pacific side, a result which I believe to be due to the much steeper slope of the Pacific shores, which enabled many species of mollusks or their embryos to migrate seaward as the land rose and thus survive the change, while the more level margin of the Atlantic resulted in the total desiccation of a wide strip of sea-bottom in a relatively short space of time, thus exterminating a large proportion of the less active littoral fauna simultaneously over the whole of the elevated border of the coast.

Conrad has briefly described (Kerr, Geol. Rep. N. Car., App., p. 19, 1875) an unfigured Miocene species from North Carolina under the name of *P. fragosa*. The type is lost and the generic place of the species is doubtful.

Placunanomia lithobleta n. s.

Rare in the Oligocene of Bowden, Jamaica; Henderson and Simpson.

Shell resembling *P. plicata*, but flatter; not plicate, but gently waved distally; surface radially sculptured with minute, almost microscopic, threads, which are frequently interrupted, when the termination of the proximal part of the thread is swollen, resembling a minute head or pustule; interior resembling *P. plicata*, but the hinge weaker, the amorphous irregularities confined to a very small space near the umbo, and inconspicuous; crura of the lower valve small, forming an acute angle, well elevated, the socket for their reception on the opposite valve shallow. Alt. about 50, lat. 50, diam. about 8 mm.

This form is distinguishable at once from the Pliocene and recent species by its peculiar surface sculpture.

Genus **PODODESMUS** Philippi.

Pododesmus Phil., Wiegm. Archiv., i., p. 385, 1837; Handb. der Conch., p. 380, 1853. Type *P. decipiens* Phil. = *P. rudis* Brod.

? *Tedinia* Gray, P. Z. S., 1851, p. 197; Cpr., Maz. Cat., p. 165, 1857.

Placunanomia pars, Broderip, Gray, Carpenter, Reeve, *et al.*

Pododesmus rudis Broderip.

Placunanomia rudis Brod., P. Z. S., 1834, p. 2; Reeve, Conch. Icon., pl. 1, fig. 2, 1859.

Pododesmus decipiens Phil., Wiegm. Archiv., i., p. 387, pl. 9, fig. 1, 1837.

Placunanomia echinata Brod., *l. c.*; Reeve, Conch. Icon., pl. 1, fig. 1, 1859.

Placunanomia abnormalis Gray, P. Z. S., 1849, p. 121; Reeve, Conch. Icon., pl. 3, fig. 14 *a–b*.

Placunanomia (*Pododesmus*) *rudis* Gray, P. Z. S., 1849, p. 120.

Placunanomia Harfordi Reeve, Conch. Icon., pl. 2, figs. 8 *a*, 8 *b*, 1859.

? *Placunanomia Gouldii* Reeve, *op. cit.*, pl. 3, fig. 10 *a*, *b*, 1859.

? Chipola Oligocene of the Chipola River, Florida; Dall. Recent from Cedar Keys, Florida, through the West Indies, and south to the mouth of the La Plata River, South America.

This shell resembles *Anomia aculeata* externally, from which it is distinguished by its small, often obsolete, byssal foramen, and by having only two muscular impressions,—one large and conspicuous, which is the mark of the modified byssal muscle, and another below it, smaller and hardly distinguishable on a fresh polished specimen, which is due to the adductor. It is likely that the Chipola species is distinct and could be properly characterized when adult, but the two upper valves obtained are quite young, and offer absolutely no characters by which they can be differentiated from *P. rudis* of the same size. I have therefore thought it best to refer the form to *P. rudis* until more material is available. The relative position of the scars in the *Anomiidæ* changes with age.

Pododesmus scopelus n. s.

Plate 30, Figure 8.

Uppermost Oligocene of the Alum Bluff beds, at Rock Bluff, Chattahoochee River, Florida; Dall.

Shell large, irregular, taking the form of the object to which it adheres, the upper valve convex, with rude, irregular radial threads or unequal riblets, close-set and frequently broken up so as to appear vermicular; interior smooth, with two muscular impressions rather feebly impressed, the site of the resilium deeply impressed and extending behind the cardinal margin; attached valve concave, irregular, the foramen small and elongate, probably eventually closed, the chondrophore projecting partly over it in our specimens; space between the valves very small. Alt. 44, lat. 58, diam. 7 mm.

This species is one of the few characteristic fossils which are preserved at Rock Bluff, and has not occurred at Oak Grove or Alum Bluff in the same horizon, which may be explained by the fact that the bed at Rock Bluff is an old oyster reef, in which only *Ostrea*, *Turritella*, the present species, and fragments of *Pecten* and *Balanus* are preserved. The matrix is ill adapted to conserve fossils in their perfection, and the specimens of *Pododesmus* are very irregular and mostly shattered by internal movements of the marl.

Section *Monia* Gray.

Pododesmus (Monia) macroschisma Deshayes.

Anomia macroschisma Desh., Rev. Zool. Soc. Cuvierienne, p. 359, 1839; Mag. Zool., 1841, pl. 34; Middendorf, Beitr. Mal. Ross., iii., p. 6, 1849; Phil., Abbild. beschr. Conch., p. 132, pl. 1, fig. 4, 1850.

Placunanomia macroschisma Gray, P. Z. S., 1849, p. 121; Cat. Anom. Brit. Mus., p. 12, 1850; Cpr., Rep. Brit. As., 1863, p. 646.

Placunanomia cepio Gray, P. Z. S., 1849, p. 121; Cat. Anom. Brit. Mus., p. 11, 1850; Reeve, Conch. Icon., pl. 3, fig. 12, 1859.

Placunanomia alope Gray, *op. cit.*, p. 122, 1849; Reeve, Conch. Icon., pl. 3, fig. 11.

Upper Miocene of Sooke, Vancouver Island, C. F. Newcombe; Pliocene of San Diego, California, Hemphill; Pleistocene of California, Oregon, and Alaska, Dall; recent from North Japan to Kamchatka, the Aleutian district and southeastern Alaskan coasts south to Lower California in shallow water.

This species is abundant in the Pleistocene and occurs in the Californian Pliocene of the San Diego well. It is a very large, solid, and characteristic species. Carpenter referred a fossil of the Carrizo Creek Miocene, *Anomia subcostata*, to this species, but the *subcostata* is a true *Anomia*. It is possible that *Placunanomia inornata* Gabb, referred by him to the Cretaceous and by Conrad to the Tejon Eocene, may belong in this section, and it even greatly resembles this species externally (cf. Pal. Cal., p. 217, pl. 32, figs. 288, 288 *a*, 1868). *Placunanomia fragosa* Conrad, from North Carolina, from the description may be referred to this group, but in the absence of any type or figure, or even any exact locality for the species, it is impossible to be certain. An unnamed species of the Chickasawan (Harris, Bull. Pal. No. 9, p. 42, pl. 6, fig. 10), if the scars are completely figured, should belong in this group.

Genus **ANOMIA** (Linné) Müller.

Anomia (pars) Linné, Syst. Nat., Ed. x., p. 700, 1758.
Anomia Müller, Prodr. Zool. Dan., pp. xxx., 248, 1776; Retzius, Diss., p. 9, 1788.
Echion + *Echionoderma* Poli, Test. Utr. Sicil., i., p. 34, and ii., p. 255, 1791.
Cepa (Hwass) Humphrey, Mus. Calon., p. 45, 1797.
Fenestella Bolten, Mus. Boltenianum, p. 193, 1798; Ed. ii., p. 134, 1819.
Anomya Agassiz, Moules des Moll., i., p. 23, 1839.
Diploschiza Conrad, Am. Journ. Conch., ii., pp. 77, 105, 1866.
Not *Anomia* Da Costa, Elem. Conch., p. 292, pl. vi., figs. 3, 10, 1776; nor of Bolten, Mus. Bolt., p. 134, 1798 (Brachiopoda).

The fossil species of this group are very difficult things to study, since the lower valve is seldom preserved and the muscular impressions can seldom be made out. I shall therefore refrain from consolidating doubtful species in the absence of a sufficiency of material for thorough study. To the natural difficulties is added that due to the fact that the sculpture in this genus is very variable in perfectly normal specimens and is further complicated by the differences of form and surface due to the object upon which they are sessile. I have satisfied myself by the examination of a large number of recent specimens belonging to a single species from a single locality that the relative positions of the adductor and byssal scars on the left valve are not constant in the same individual at all ages, and consequently that small differences of this kind cannot safely be used as specific distinctions. The best character seems to be the more minute surface sculpture when fully developed in normal specimens.

Anomia lisbonensis Aldrich.

Anomia ephippioides Gabb, var. *lisbonensis* Aldr., Bull. Geol. Surv. Ala., i., p. 41, pl. 4, fig. 6, 1886.

Claibornian Eocene at Lisbon Bluff, Alabama, Aldrich; and in similar horizons in Webster and Bienville Parishes and near Nachitoches and Mt. Lebanon in Louisiana, Vaughan; near Wheelock and in Lee County, Texas, Singley and Johnson.

This is a normally smooth, large species, with radiating bands of color on a lighter ground. It is clearly distinct from the species to which it was originally referred as a variety.

Anomia ephippioides Gabb.

Anomia ephippioides Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 388, pl. 67, fig. 59, 1860.

Claibornian Eocene of Texas, Gabb; near Laredo and Wheelock, Texas, Johnson and Singley.

This species was originally very imperfectly described and figured from worn specimens. The chief specific character is not alluded to. The young when in perfect condition are covered with minute pustules; as the shell approaches maturity these elongate and become close-set, rather coarse threads, separated by narrower grooves. In perfect condition it cannot be mistaken for any other American species. This sculpture, it should be clearly understood, is normal to the species and entirely independent of irregularities due to *situs*.

Anomia Ruffini Conrad.

Anomia Ruffini Conr., Proc. Acad. Nat. Sci. Phila., i., p. 323, 1843; Medial Tert. Fos., p. 74, pl. 42, fig. 6, 1845; S. I. Checkl. Eoc. Fos., p. 3, 1866.

Anomia McGeei Clark, Bull. U. S. Geol. Surv., No. 141, p. 86, pl. 34, fig. 5 *a–b*, 1895.

Eocene, Waterloo, Pamunkey River, New Kent County, Virginia, E. Ruffin; Hanover County, Virginia, and various localities in Maryland, Clark and Whitfield. (Miocene of ?)

Specimens collected by Ruffin, in the National Museum, from Shell Bank and Waterloo, leave little doubt that Clark's species, from the same region, is identical with that of Conrad. The characteristics of the species are its large size and the irregular fluting of the shell, especially near the margins. The muscular scars are usually difficult to make out, but the species is an *Anomia* and not a *Pododesmus*, as might be suspected from Clark's figure. The species is not found in the Caloosahatchie beds, though included by an error of identification in Heilprin's list.

The other Eocene species referred to in the literature, but which I have not identified, are *Anomia jugosa* Conrad (Proc. Acad. Nat. Sci. Phila., i., p. 310, 1843; iii., p. 22, pl. 1, fig. 15) from the Jacksonian of South Carolina,—a species of which neither the description nor the figure affords sufficient information to enable one to identify it,—and *A. navicelloides* Aldrich (Nautilus, xi., p. 97, Jan., 1898) from the Wood's Bluff horizon at Choctaw Corner, Alabama, which is still unfigured.

Anomia microgrammata n. s.

PLATE 35, FIGURE 11.

Oligocene of the Chipola beds at the Chipola River and the lower bed at Alum Bluff, Florida; also at Ballast Point, Tampa Bay, Dall, Burns, and Willcox; and at Bowden, Jamaica, Henderson and Simpson.

Shell small, irregular, characterized by a fine, almost microscopic, close-set radial striation covering the whole surface and flaring away from the medial line of the valve in a somewhat wavy manner; the two lower scars on the left valve are subequal and side by side, the major byssal scar larger, opposite the medial line between them; the beak of the left valve is some distance within the margin, and the surface where worn appears smooth; the striation is only visible under a lens in most cases. Alt. 17, lat. 25 mm.

This species is recognizable by its fine, almost divaricate striation, which does not break into pustules near the beaks, as in the larger and more coarsely sculptured *A. ephippioides.*

The specimens from Bowden have a still finer and often partially obsolete striation. They form the variety *indecisa* (Guppy, MS.).

Anomia floridana n. s.

PLATE 35, FIGURE 7.

Oligocene of Oak Grove, Santa Rosa County, Florida; Burns.

Shell of moderate size, usually rather convex, the surface irregular, obsoletely microscopically radially striated, more or less irregularly feebly pustular and with obsolete, broken, feeble radial plications; the minor byssal scar is above and slightly further back (about half its own width) than the adductor scar of the same size; the major byssal scar is rounded and much larger, situated directly above the minor one, so that the three scars are nearly in one dorso-ventral line; the beak of the left valve is at the cardinal margin. Alt. of largest specimen 35, lat. 39 mm.

This species is intermediate in size and character between *A. microgrammata* Dall and *A. Ruffini* Conrad. It is smaller and less sculptured than the latter, which also wants the microscopic striation; it is larger, less sharply striated, and has the beak and scars situated differently from the former. Many of the specimens still retain some of the original greenish coloration.

The only other Oligocene species described from the North American and Antillean regions is the *A. umbonata* Guppy, from Trinidad (Proc. U. S. Nat. Mus., xix., No. 1110, p. 235, pl. 30, fig. 6, 1896), which is small, with minute pustulation but no radial striation.

Anomia simplex Orbigny.

Anomia ephippium Conrad, Medial Tert. Fos., p. 75, pl. 43, fig. 4, 1845.

Anomia simplex Orb., Moll. Cubana, ii., p. 367, pl. 38, figs. 31–3 (1845, Spanish edition), 1853; Dall, Bull. U. S. Nat. Mus., No. 37, p. 32, pl. 53, figs. 1, 2, 1889.

Anomia acontes Gray, P. Z. S., 1849, p. 116.

Anomia Conradi Orb., Prodr. Pal., iii., p. 134, pl. 25, fig. 30, 1852; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 582, 1863.

Anomia ephippium Tuomey and Holmes, Pleioc. Fos. S. Car., p. 18, pl. 5, fig. 4, 1855; Holmes, P.-Pl. Fos. S. Car., p. 11, pl. 2, fig. 11, 1858; Emmons, Geol. N. Car., p. 277, 1858; Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 380, 1881.

Anomia glabra Verrill, Am. Journ. Sci., 3d Ser., iii., p. 213, 1872; x., p. 372, 1875.

Anomia electrica Gould, Inv. Mass., p. 140, 1841; Binney's Gould, p. 205, fig. 499, 1870; not of Linné.

Anomia squamula Gould, Inv. Mass., p. 140, 1841; Binney's Gould, p. 206 (young), 1870; non Linné.

Anomia Ruffini Heilprin, Trans. Wagner Inst., i., p. 102, 1887; not of Conrad.

? *Anomia ephippium* Gabb, Geol. St. Domingo, p. 257, 1873.

? Oligocene of St. Domingo, Gabb; Upper Miocene of Duplin County, North Carolina, at the Natural Well, Conrad; of York and Nansemond Rivers, Virginia, Burns; Pliocene of the Waccamaw beds, South Carolina, Tuomey and Johnson; of the Caloosahatchie beds, Florida, Dall; of Limon, Costa Rica, Gabb; Pleistocene of the Atlantic and Gulf coasts from the Carolinas southward, Holmes and Burns; recent from Cape Sable, Nova Scotia, southward to Martinique.

I am unable to find any distinctive characters separating the Upper Miocene from the recent shells. The surface is normally smooth, and the variations of position in the scars of the left valve are remarkable. In the young the lower pair of scars are usually equal and side by side; as the shell grows older their positions change, and the minor byssal scar is no longer on the same level with that of the adductor. Shells which by some accident of position are forced to grow in elongated form usually have the scars more strung out and more nearly in a single line than the individuals which maintain a normal suborbicular growth.

Anomia aculeata Gmelin.

Anomia aculeata Gmelin, Syst. Nat., vi., p. 3346, 1792; Gould, Inv. Mass., p. 139, fig. 90, 1841; Binney's Gould, p. 204, fig. 498, 1870; Verrill, Rep. U. S. Fish Com. for 1871–2, p. 697, pl. 32, figs. 239, 240, 240*a*, 1873; Dall, Bull. U. S. Nat. Mus., No. 37, p. 32, pl. 53, figs. 5–8, 1889.

Upper Miocene of York River, Virginia, Harris; Pleistocene of Sankoty Head, Massachusetts, Verrill; recent from the Arctic Ocean south to Cape Fear, North Carolina, on the Atlantic coast; also on the northern coasts of Europe.

The presence of this species in the Virginia Miocene is established by some beautifully preserved small valves with the characteristic sculpture obtained by Mr. Harris.

The *A. delumbis* Conrad (Proc. Acad. Nat. Sci. Phila. for 1862, p. 582) is a mere list-name, never described or referred to a locality. A well-defined species is the *A. subcostata* Conrad, from the Miocene of the Carrizo Creek beds, Colorado Desert, California. (Pac. R. R. Reps., v., p. 325, pl. 5, fig. 34, 1855.) It is strongly radially plicated.

Anomia limatula Dall.

PLATE 35, FIGURE 19.

Anomia limatula Dall, Proc. U. S. Nat. Mus., i., p. 15, 1878.

Pliocene of Ventura County, California, eight miles inland and two hundred feet above the sea level, Bowers; of Coronado beach, San Diego, California, Hemphill; and of Pacific beach, near San Diego, Stearns; Pleistocene of Spanish Bight, Coronado beach, San Diego, and of San Pedro Hill, Los Angeles County, California, Stearns.

A fine, large species, which is characterized by its peculiar, finely granulose surface, devoid of all normal radial sculpture, and which still retains on its yellowish valves traces of dark purple, irregularly radial blotches. The calcareous plug of this species is peculiar, being hollow, and the cylinder incomplete on one side.

From the Pleistocene of San Pedro Hill, California, has been obtained *A. lampe* Gray, the common *Anomia* of the recent fauna of the coast (Gabb, Pal. Cal., ii., p. 106, 1868). This is almost invariably radially ribbed and often concentrically grooved, and has a polished surface quite unlike that of *A. limatula*. It has also been obtained by Stearns at Spanish Bight, Coronado beach, San Diego, California.

Superfamily MYTILACEA.

FAMILY MYTILIDÆ.

Genus MYTILUS (L.) Bolten.

< *Mytilus* Lin., Syst. Nat., Ed. x., p. 704, 1758; Müller, Zool. Dan. Prodr., p. 249, 1776; Da Costa, Brit. Conch., p. 214, 1778; Bruguière, Encyc. Méth., i., xiii., 1789; Humphrey, Mus. Calon., pp. 42, 43, 1797.

< *Mytilus* + *Volsella* Scopoli, Intr. Hist. Nat., pp. 396–7, 1777; Modeer, K. vet. Acad. Handl., xiv., pp. 179, 181, 1793.

< *Mytulus* + *Perna* Retzius, Dissert., p. 20, 1778.

= *Mytilus* Bolten, Mus. Bolt., p. 157, 1798; Ed. ii., p. 110, 1819.

< *Mytulus* Cuvier, Tabl. Elem., p. 423, 1798.

= *Mytilus* Lamarck, Prodr. Nour. Class. Coq., p. 88, 1799. Type *M. edulis* L.; Link, Beschr. Rostock Samml., p. 158, 1807.

? *Arcomytilus* Agassiz, 1840. Type *Mytilus pectinatus* Sby. (? = *Septifer* Recluz, 1848).

The name *Mytilus* for the mussels is of very ancient date, and in adopting it for his heterogeneous genus Linné merely followed classical usage. If we ascribe the genus to Linné we are obliged to seek the type by his method of taking the most common species, and while this might be done under stress of circumstances, it is better, if practicable, to follow the regular rule.

The naturalists who followed Linné did not grasp the characters which separate the groups of the Linnean Mytili, and after eliminating the fresh-water species, they seemed to fall back on the dentiferous or edentulous character of the hinge in their divisions of the group. Thus Scopoli divided the Linnean *Mytilus* into an edentulous group, for which he preserved the name without citing any examples, and *Volsella*, which included species with one or more teeth. It was by some misidentification, therefore, that *Mytilus modiolus* was included in Scopoli's *Volsella* and defined as having one tooth. Modeer followed Scopoli, and Retzius did the same, except that he proposed a genus *Perna* for the forms Scopoli had named *Volsella*. Even Cuvier included both *Mytilus* and *Modiola* in his *Mytulus*.

The first author who seems to have had clear and what may be termed modern views on the subject was Bolten, who divided his *Mytilus* into a smooth and a sulcate group and excluded nearly all the species not Mytiloid, as now understood. He did not name a type, but this deficiency was supplied by Lamarck a year later.

A consideration of these facts shows that the course of some writers who would substitute *Volsella* or *Perna* for *Modiolus* Lamarck is unwarranted by the history of these names. The quadrinomials of Poli (*Callitriche* + *Callitrichoderma*, 1791) have no place in our nomenclature. The names which are entitled to adoption are all comparatively modern. The curious twisted subgenus *Stavelia* Gray, which is usually placed with *Mytilus*, should be removed to *Modiolus*. *Mytilaster* Monterosato has vermiculate sculpture.

The *Mytili* occurring in the North American Tertiary are divisible by their sculpture into two sections:

Genus *Mytilus* (L.) Bolten.

Section *Mytilus* s. s. Surface with chiefly concentric sculpture or smooth. Type *M. edulis* L.

Section *Hormomya** Mörch (Cat. Yoldi, p. 53, 1853). Shell radially sculptured. Type *Mytilus exustus* Linné.

To these may be added:

Subgenus *Mytiloconcha* Conrad. Apical region of the shell much thickened and produced, with longitudinal grooves. Type *M. incurva* Conrad.

The number of species of *Mytilus* in the Tertiary of the Eastern United States is very small, but the Pacific coast offers a larger number.

Mytilus Conradinus Orbigny.

Mytilus incrassatus Conr., Am. Journ. Sci., xli., p. 347, 1841; Fos. Medial Tert., p. 74, pl. 42, fig. 4, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 32, pl. 14, figs. 1, 2, 1855; Harris, Bull. Pal., 3, p. 5, 1895; not of Deshayes, 1830.

Mytilus Conradinus Orbigny, Prodr. Pal., iii., p. 127, 1852.

Mytiloconcha incrassata Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 291, 1862.

Mytiliconcha incrassata Conr., *op. cit.*, p. 579, 1863.

Lower Miocene of Cumberland County, at Shiloh and Jericho, New Jersey, Conrad and Burns; Miocene of the artesian well at Galveston, Texas, between two thousand three hundred and eighty-four and two thousand eight hundred and seventy-one feet below the surface, Singley; Upper Miocene of the Natural Well, Duplin County, North Carolina, Burns; two and one-half miles below Governor's Run, Chesapeake Bay, Maryland, Burns; Miocene of South Carolina, in the Darlington District and on the Waccamaw River, Tuomey and Holmes.

This species does not differ from the true *Mytilus* except in being a little heavier than is usual in this genus. It has not the produced cardinal area of *Mytiloconcha*, with imperfect specimens of which it has sometimes been confused.

Mytilus pandionis n. s.

Plate 30, Figures 9, 10.

Oligocene of White Beach, near Osprey, Little Sarasota Bay, west Florida; Dall.

* *Arcomytilus* Agassiz. (Sowb. Min. Conch., French ed., 1840) is prior in point of time, but the type has the aspect of a *Septifer* and the interior is not described or figured.

Shell large, somewhat compressed behind, wide, with the posterior cardinal angle in the anterior third; cardinal line short, an impressed narrow area in front of the beaks nearly half as long as the shell; surface apparently smooth (the type is an internal cast), umbones acute. Alt. 122, lat. 60, diam. 36 mm.

This is the only large *Mytilus* of the *M. edulis* type in the east American Pre-Miocene Tertiary. It somewhat recalls very large specimens of *M. galloprovincialis* Lam.

Mytilus edulis Linné.

Mytilus edulis L., Syst. Nat., Ed. x., p. 705, 1758; Dall, Bull. U. S. Nat. Mus., 37, p. 38, pl. 54, fig. 3, pl. 71, fig. 2, 1889.

Mytilus borealis Lam., An. s. Vert., vi., p. 126, 1819; DeKay, Nat. Hist. N. Y., Moll., p. 182, pl. 13, fig. 222, pl. 24, fig. 256.

Mytilus pellucidus Pennant, Brit. Zool., iv., p. 237, pl. 66, fig. 3.

Modiola pulex H. C. Lea, Am. Journ. Sci., xlii., p. 107, pl. 1, fig. 3, 1842 (young shell); not of Lam., An. s. Vert, vi., p. 112, 1819.

Mytilus minganensis Mighels, Proc. Bost. Soc. Nat. Hist., i., p. 188, 1844.

Mytilus notatus DeKay, *op. cit.*, p. 182, pl. 13, fig. 223, 1843.

Pliocene of Great Britain (Red Crag).

Post Pliocene of the American coast from Labrador south to St. John's River, Florida (Verrill), also in northern Europe and on the northwest coast of America; recent from the Arctic Seas south to Fort Macon, North Carolina; Coues.

The writer has never observed this species in the Pleistocene of Florida and the Carolinas; the statement of its occurrence there is inserted on the authority of Professor Verrill (Inv. An. Vineyard Sound, p. 693, 1873).

Mytilus (Hormomya) exustus Linné.

Mytilus exustus L., Syst. Nat., Ed. x., p. 705, 1758; Lam., An. s. Vert., vi., p. 121, 1819?

Mytilus bidens L., Syst. Nat., Ed. xii., p. 1157, 1767.

Mytilus domingensis Lam., An. s. Vert., vi., p. 121, 1819; Orbigny, Moll. Cubana, ii., p. 328, 1845.

Mytilus striatulus Schröter, Einl., iii., p. 449, pl. ix., fig. 16.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; Pleistocene of Simmons Bluff, South Carolina, Burns; and of the West Indies; recent from Charleston, South Carolina, south to Bahia, Brazil.

This well-known species is rare in the marls, and not especially abundant in the Pleistocene.

Mytilus (Hormomya) hamatus Say.

? *Mytilus recurvus* Raf., Mon. Coq. Biv. Ohio, p. 55, 1820; New Orleans.

Mytilus hamatus Say, Journ. Acad. Nat. Sci. Phila., ii., p. 265, 1822; Binney's reprint of Say, pp. 91, 204, pl. 50; Dall, Bull. U. S. Nat. Mus. No. 37, p. 38, 1889.

Brachydontes hamatus Perkins, Proc. Bost. Soc. Nat. Hist., xiii., p. 156, 1869.

? *Dreissena recurva* Fischer, Journ. de Conchyl., vii., p. 130, 1858.

Mytillus striatus Barnes, Am. Journ. Sci., vi., p. 364, 1823; Say, Am. Conch., v., pl. 50, 1832.

Modiola hamatus Verrill, Am. Journ. Sci., 3d Ser., iii., p. 211, pl. 7, fig. 3, 1872; Inv. An. Vineyard Sound, p. 693, 1873.

Mytilus carolinensis Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 244, pl. 20, fig. 6, 1837; Tryon, Am. Mar. Conch., p. 187, fig. 513, 1874.

Pliocene of the Caloosahatchie, Dall; Pleistocene of Wailes Bluff, St. Mary's County, Maryland, Burns; recent from Long Island Sound south to Costa Rica.

On the Pacific coast, besides *M. edulis*, the Pleistocene affords the great *M. californianus* Conrad, which even, according to Cooper, is found in the Pliocene, and *M. pedroanus* Conrad, which is perhaps identical with *M. edulis*. The Pliocene affords *M. Middendorfii* Grewingk (Beitr. Kenntn. N. W. Kuste Am., p. 360, pl. vii., figs. 3 *a–c*, 1850) and *M. Condoni* Dall (Nautilus, iv., p. 87, Dec., 1890), peculiar species with a few broad plications posteriorly, from Alaska and Oregon respectively. In the Miocene are the large *M. Mathewsoni* Gabb and the *M. inezensis* of Conrad, which may prove to be the same as *Modiola multiradiata* Gabb; both are radiately sculptured and of rather uncertain outline. In the Eocene (Tejon) are *M. ascia* Gabb and *M. humerus* Conrad, both rather obscure, smooth species, and *M.* (*Hormomya*) *dichotomus* Cooper (Bull. Cal. State Mining Bureau, No. 4, p. 49, pl. v., fig. 64, 1894), of which the characters, even the genus, are imperfectly known. Its relations to *Septifer dichotomus* Gabb and *S. bifurcatus* Reeve, as well as *Mytilus bifurcatus* (Conr.) Stearns, remain to be clearly made out.

Subgenus MYTILOCONCHA Conrad.

Myoconcha Conrad, Medial Tert., p. 52, 1840.

Mytiloconcha Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 290, 1862.

Mytiliconcha Conrad, *op. cit.*, p. 578, 1863.

Mytilus (Mytiloconcha) incurvus Conrad.

Myoconcha incurva Conrad, Medial Tert., No. 1, p. 3 of cover, 1839; No. 2, p. 52, pl. 28, fig. 1, 1840.

Mytilus incurvus Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854.
Mytilus (*Myoconcha*) *incurvus* Conrad, Medial Tert., p. 88, 1861.
Mytiloconcha incurva Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 291, 1862.
Mytiliconcha incurva Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 579, 1863.
Mytiloconcha incrassata Whitfield, Mio. Moll. N. J., p. 38, pl. 5, figs. 10, 11, 1894; not of Conrad.

Oligocene of Sopchoppy Creek, Wakulla County, Florida, Hodge; Lower Miocene of Cumberland County, New Jersey, at Shiloh and Jericho; of Maryland, near Skipton, on the Choptank, near Easton, Talbot County, and in Calvert County, Harris and Burns; Miocene of South Carolina, Whitfield.

The specimens found in New Jersey are very badly worn and young, hence Professor Whitfield's identification of them, which I believe erroneous. I have never seen a perfect specimen of this singular shell, but the external casts from the Upper Oligocene of Florida show its characters admirably. The *M. incrassata* Conrad is only a rather heavy *Mytilus*. The hinge of the present species has two strong teeth in the left and one in the right valve, which are obsolete in senile specimens. These teeth are produced over the cardinal area as ridges, extending to the apex of the valve, with a furrow on each side of each ridge, a single furrow between the two ridges of the left valve. Apart from the furrows and ridges the area is flattened. Close to the posterior margin the groove of the ligament is continued along the edge of the area to the apex. In a specimen one hundred and twenty millimetres long the area is twenty millimetres long and about the same in greatest width. The characters are those of ordinary *Mytilus*, but curiously exaggerated. *Mytilus hesperianus* Lam., of the Red Crag of Britain, would seem to belong in this group.

Genus **MODIOLUS** Lamarck.

Modiolus Lam., Prodr. Nouv. Clas. Coq., p. 87, 1799. Type *Mytilus modiolus* L.; Bosc, Hist. Coq., iii., p. 158, 1802; Link, Beschr. Rostock Samml., iii., p. 146, 1807; Cuvier, Règne Anim., ii., p. 471, 1817; Goldfuss, Zool., p. 611, 1820; Risso, Hist., iv., p. 323, 1826; Fleming, Hist. Brit. An., p. 408, 1828; Forbes, Malac. Monensis, p. 43, 1838; Herrmannsen, Ind. Gen. Mal. Suppl., p. 84, 1852.

Modiola Lam., Syst. des An. s. Vert., p. 113, 1801. Type *M. papuana* Lam. (Encyc. Méth., pl. 219, fig. 1); Roissy, Moll., vi., p. 273, 1805; Lam., An. s. Vert., vi., p. 119, 1819; Fischer, Man. de Conch., p. 968, 1886; Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

Amygdalum Megerle, Mag. Ges. Naturf. Fr., v., p. 69, 1811. Type *A. dendriticum* Meg. (Chemn., xi., p. 198, fig. 2016–7).

Brachidontes Swainson, Malac., p. 384, 1840. Type *Modiola sulcata* Lam.
Modiella Monterosato, Nom. Con. Medit., p. 12, 1884 (not of Hall, 1883). Type *Modiola polita* Verrill.
Gregariella Monterosato, *op. cit.*, p. 11, 1884. Type *Mytilus petagnæ* Scacchi.
Brachydontes Fischer, Man. de Conch., p. 968, 1886; Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

The main conchological characters which separate this genus from *Mytilus* are the non-terminal umbones, the tendency to hirsuteness in the epidermis, the absence of developed teeth at the beaks, and the habit of nestling in a mass of byssal fibres with extraneous entangled material which is more or less characteristic of all true *Modioli*, though less conspicuous and complete in the larger species. In some deep-water species a real nest is spun, like that of *Lima*, but more dense. A more efficient protective device could hardly be imagined than the byssal nest of *M. politus*, which completely conceals the occupant from predacious marine carnivora. In the matter of sculpture these shells resemble *Mytilus*, and have a distinct tendency to a medial unsculptured area in the radially sculptured species. Although true teeth are not found in this group, the provinculum is often present and permanent, while its origin is obviously indicated by the secondary denticulations due to the impinging of the radial sculpture upon the margin.

I believe hinge-teeth were thus originally initiated, while the secondary denticulations alluded to repeat in the descendants the process by which their remote ancestors acquired an interlocking hinge.

The genus *Modiolus*, like *Mytilus*, may be divided into natural groups by the sculpture of the surface.

Genus *Modiolus* Lam.

Section *Modiolus* s. s. Surface smooth, shell inflated, edentulous, epidermis more or less hirsute. Type *M. modiolus* Linné.

Section *Amygdalum* Megerle. Surface smooth, shell compressed, epidermis polished, not hirsute. Type *M. pictus* Lam. (Syn. *Modiella* Mts., not Hall.)

Section *Gregariella* Mts. Surface decussate with a central smooth area; shell plump, epidermis hirsute. Type *M. petagnæ* Scacchi. (Syn. *Botulina* Dall, 1889.)

Section *Brachydontes* Swainson. Surface more or less radially sulcate; epidermis not hirsute. Type *M. sulcatus* Lam. (1819, not 1807). *Semimodiola* and *Planimodiola* Cossmann seem to belong to this section rather than to *Modiolaria*.

Section *Botula* Mörch. Surface deeply concentrically sulcate, shell inflated, with conspicuously spiral umbones, the epidermis polished. Type *M. cinnamomeus* Lam.

This section, if it were not for its peculiar muscular scars, might perhaps equally well be placed under *Lithophaga,* as has been done by Fischer. It is intermediate, conchologically, between the boring *Lithophagi* and the nestlers, as regards externals.

Section *Arcoperna* Conrad (Am. Journ. Conch., i., p. 140, pl. 10, fig. 14, 1865). Shell oval, general form like *Botula,* but the surface finely striated or reticulated and the margin, except over the ligament, crenulated. Type *M.* (*A.*) *filosus* Conr., *l. c.* Jacksonian and Parisian Eocene.

This section resembles *Modiolaria,* except in the absence of the medial unstriated impressed area, and the more oval outline of many of the species. The umbones are swollen and conspicuous.

Modiolus cretaceus Conrad.

Modiola cretacea Conrad, Trans. Geol. Soc. Penna., i., p. 340, pl. 13, fig. 2, 1835.
Perna cretacea Conrad, Am. Journ. Conch., i., p. 10, 1865.

Jacksonian Eocene of Clarke and Choctaw Counties, Alabama, Conrad; near Fail Post-Office, Alabama, in the Zeuglodon bed, Schuchert; ? Oligocene of western Florida, Eldridge; ? Upper Oligocene of Oak Grove, Santa Rosa County, Florida, Burns.

This is a large species resembling *M. modiolus* L. A few young shells represented by internal casts and a lot of fragments from Oak Grove, collected by Eldridge and Burns, may belong to this species, but are insufficient for a positive decision.

Modiolus pugetensis n. s.

PLATE 35, FIGURE 17.

Eocene of the Puget group in the State of Washington, from the old Renton coal mine, near Seattle; Willis.

Shell small, short in front, arched and produced behind; concavely impressed in front, with a rounded ridge extending from the beaks to the lower posterior margin; surface polished, with concentric lines of growth. Alt. 17.7, max. lat. 9.5, diam. 5 mm. A larger specimen measures 25 mm. from end to end, but is imperfect.

This is a very simple little species, but unlike any other in our Tertiary.

Modiolus silicatus n. s.

PLATE 27, FIGURE 28.

Upper Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida; Willcox and Dall.

Shell small, smooth, short, broad, moderately convex, with a few incremental striæ; beaks low, anterior end very short, posterior margin elevated, rounded, anterior margin slightly impressed; basal end rounded; inner margin smooth, with an unusually deep ligamental sulcus. Alt. 22, max. lat. 16, diam. 9 mm.

This is somewhat like the Miocene *M. inflatus* T. and H., but a much smaller shell, with a less impressed lateral area and less sinuous anterior margin.

Modiolus inflatus Tuomey and Holmes.

Mytilus inflatus T. and H., Pleioc. Fos. S. Car., p. 33, pl. 14, fig. 3, 1855.

Perna inflata Conrad, Proc. Acad. Nat. Sci. for 1862, p. 579, 1863.

Modiola inflata Whitfield, Mioc. Moll. N. J., p. 39, pl. 6, figs. 3, 4, 1895 (not *Modiola inflata* Whitf., Lam. Rar. Clays, p. 197, pl. 26, figs. 1, 2, 1885).

Lower Miocene of Shiloh and Bridgeton, Cumberland County, New Jersey, Burns; Miocene of South Carolina at Giles Bluff, Peedee River, Tuomey.

This species is closely related to the recent *M. tulipus* Lam.

Modiolus Ducatelii Conrad.

Modiola ducatelii Conrad, Medial Tert., p. 53, pl. 28, fig. 2, 1840.

Miocene of Calvert Cliffs, Maryland, Professor Ducatel; of Jericho, New Jersey, Burns; of York River, Virginia, Harris; of the Natural Well, Duplin County, North Carolina, Burns.

This large species is rather abundant in the Maryland Miocene, but rarely perfect. The *M. gigas* Wagner (Trans. Wagner Inst., iv., p. 10, pl. 2, fig. 3, *a–b*, 1897) differs by its much wider posterior part and attenuated anterior end. It is also Miocene.

The other valid species, belonging to the section *Modiolus* as restricted, found in our Tertiary except *M. tulipus* Lam., which occurs in the later rocks of the West Indies, are all Californian and include *M. capax* Conrad, Pliocene and Pleistocene (as well as recent); *M. flabellatus* Gld., Pliocene and recent; *M. rectus* Conrad, Miocene and recent; while the *M. modiolus* L., which is said to go back to the Miocene (?) in California, is known from Pleistocene deposits on both sides of the continent as well as the shores of Europe.

Modiolus (Brachydontes) grammatus n. s.

Plate 30, Figure 2.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida, Dall; and (var. *curtulus* Dall) of the lower bed at Alum Bluff, Chattahoochee River, Florida, Burns.

Shell small, thin, slender, delicately dichotomously radially ribbed; anterior end extremely short, barely exceeding the beaks; posterior margin angulated; front margin nearly straight, basal end rounded; inner margin delicately crenulate. Alt. 20, max. lat. 8.5, diam. 6.5 mm.

This is closely related to the recent *M. citrinus* Bolt., but is more attenuated towards the beaks, and has the dorsal angulation and crenulations of the margin less pronounced. The variety, which more abundant material might show to be a distinct species, is stouter, more triangular, with coarser and more nodulous ribs and stronger crenulations of the margin. Alt. 12, max. lat. 7, diam. 6 mm.

Modiolus (Brachydontes) Guppyi n. s.

Plate 35, Figure 16.

Oligocene of the Bowden beds, Jamaica; Henderson and Simpson.

Shell small, thin, delicate, radiately numerously ribbed, the ribs but seldom dichotomous, general form as in *M. grammatus*, but shorter and more rounded, the surface frequently concentrically faintly undulated, inner dorsal margin sharply crenulate, the rest of the shell margin almost smooth; basal end of valve rounded, dorsal angle obsolete. Alt. 8.5, max. lat. 4.7, diam. 2.5 mm.

This differs from the last in its more delicate and less dichotomous ribbing, its more rounded, thinner, and less angular shell, and in the absence of crenulations over most of the margin, due to the feebleness of the sculpture.

Modiolus (Brachydontes) demissus Dillwyn.

Mytilus demissus (Solander MS.) Dillwyn, Descr. Cat. Rec. Shells, i., p. 314, 1817; Say, Journ. Acad. Nat. Sci. Phila., ii., p. 265, 1822; Wood, Ind. Test., p. 25, pl. 12, fig. 30, 1825; Greene, Mass. Cat., 1833; Ravenel, Cat., p. 7, 1837.

Modiola plicatula Lam., An. s. Vert., vi., p. 113, 1819; ed. Desh., vii., p. 22, 1835; Totten, N. Engl. Cat., 1833; Gould, 1st Rep. Geol. Me., p. 119, 1837; Inv. Mass., p. 125, fig. 81, 1841; De Kay, Nat. Hist. N. Y., Moll., p. 184, pl. 24, fig. 258, 1843; Verrill, Inv. An. Vineyard Sound, p. 693, pl. 31, fig. 238, 1873; Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, pl. 54, fig. 1, 1889.

Mytilus plicatulus Sby., Genera, Myt., pl. vii., 1822; Deshayes, Enc. Méth., ii., p. 568, pl. 220, fig. 5, 1830; Stimpson, Sh. N. Engl., p. 12, 1851.

Modiola semicostata Conr., Journ. Acad. Nat. Sci. Phila., vii., p. 244, pl. 20, fig. 7, 1837. (Not of Dall, Bull. 37, 1889.)

Modiola semicosta Verrill (as of Conrad), Inv. An. Vineyard Sound, p. 693, 1873.

(?) *Mytilus clava* Meuschen, Mus. Gronov., 1778 (*fide* Mörch, Cat. Yoldi, ii., p. 54, 1853).

(?) *Mytilus magellanus* Meuschen, Mus. Gevers, 1787 (*fide* Mörch, *op. cit.*, p. 54, 1853).

Brachydontes clava Mörch, Cat. Yoldi, ii., p. 54, 1853.

Perna (*Brachydontes*) *plicatula* H. and A. Adams, ii., p. 517, 1857.

Modiola demissa Conrad, Am. Journ. Sci., 2d Ser., ii., p. 44, 1846.

Pliocene marls of the Caloosahatchie River, Florida, rare, Dall; Post Pliocene of Massachusetts Bay; recent from Nova Scotia to Georgia, west Florida, and Texas; locally restricted towards the extremes of its distribution.

There is no doubt of the applicability of Dillwyn's name to our common plicate mussel. The two names of Meuschen are doubtful, and probably cover a confusion of our species with the *Mytilus magellanicus* of authors. I have not been able to consult Meuschen's works, but believe the names are not accompanied by any description or figure, and are identified chiefly by means of the alleged localities. At all events, until the information is fuller and more satisfactory, it seems inadvisable to use Meuschen's earlier name, while his later one is inapplicable. There are two distinguishable geographical races of this species, the form found north of New York, and figured in the Encyclopédie Méthodique, which Lamarck called *plicatulus* and Conrad *semicostatus;* and the southern form, which is more attenuated behind, has a more delicate and elegant sculpture, the ribs being minutely granulose, and the color lighter and of a less intense purple. Dillwyn's name included both, and may be specially centred on the southern form, while that of Massachusetts Bay may be regarded as forming a variety *plicatulus.* In my Bulletin 37, United States National Museum, the two names were accidentally transposed.

Modiolus (Brachydontes) citrinus Bolten.

Arca modiolus Linné, Syst. Nat., Ed. xii., p. 1141, 1767.

Mytilus citrinus polydentatus, etc., Chemn., Conch. Cab., viii., p. 175, pl. 84, fig. 754, 1785.

Mytilus flavicans (Sol. MS.) Humphrey, Mus. Calon., p. 43, 1797 (no description or figure).

Mytilus citrinus Bolten, Mus. Bolt., p. 157, 1798; Ed. ii., p. 111, No. 45, 1819.

Mytilus exustus Gmelin, Syst. Nat., vi., p. 3352, 1792; not of Linné.

Modiola sulcata Lam., An. s. Vert., vi., p. 113, 1819 (not of Lam., Ann. du. Mus., 1807); Reeve, Conch. Icon., x., pl. 10, fig. 74, 1858.

Modiola Chemnitzii Potiez and Michaud, Gal. Moll., 1838; *fide* Mörch.

Brachydontes modiolus Mörch, Cat. Yoldi, ii., p. 54, 1853.

Mytilus cubitus Say, Journ. Acad. Nat. Sci. Phila., ii., p. 263, 1822; De Kay, Nat. Hist. N. Y., Moll., v., p. 183, 1843; Gibbes, Cat. S. Car., p. xxii., 1848; Binney's Say, p. 90, 1858.

Perna (*Brachydontes*) *modiola* H. and A. Adams, Gen. Rec. Moll., ii., p. 517, 1857.

Pleistocene of south Florida and the Antilles; recent from South Carolina (Gibbes) south to the Antilles and Rio Grande do Sul, Brazil (Ihering).

This species, which is excessively abundant where it flourishes at all, is commonly known under Lamarck's name of *sulcatus*. It is very similar to several of the nominal Tertiary species, and a full and good series of both will be required to determine how far the older forms can be discriminated.

The absence of a really good series of the fossils of this group makes it impracticable to suggest any synonymy here, though probably some reduction in the number of species will be demanded with further study and material.

The following list includes the species hitherto named.

M. (*B.*) *texanus* Gabb, Proc. Acad. Nat. Sci. Phila. for 1861, p. 371; Harris, *op. cit.* for 1895, p. 46, pl. 1, fig. 2. This was originally described as *Perna texana*, and is from the Lower Claibornian and Midway Eocene.

M. (*B.*) *Saffordi* Gabb, Journ. Acad Nat. Sci. Phila., 2d Ser., iv., p. 395, pl. 68, fig. 30, 1860; Harris, Bull. Pal., iv., p. 49, pl. 3, figs. 4, 5, 1896. Midway Eocene.

M. (*B.*) *potomacensis* Clark, Bull. U. S Geol. Surv., No. 141, p. 85, pl. 34, figs. 1 *a*–1 *c*, 1896. Mideocene of Maryland.

M. (*B.*) *alabamensis* Aldrich, Bull. Pal., ii., p. 16, pl. 5, fig. 13, 1895; Harris, *op. cit.*, ix., p. 47, pl. 7, fig. 9, 1897. Wood's Bluff horizon, Chickasawan Eocene.

M. (*B.*) *mississippiensis* Conrad, Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 126, pl. 12, fig. 19, 1848. Lower Oligocene of Vicksburg, Mississippi.

M. (*B.*) *contractus* Conrad, Pac. R. R. Rep., v., Geol., p. 325, pl. v., fig. 35, 1855. Pacific coast Tertiary. Eocene?

M. (*B.*) *ornatus* Gabb, Pal. Cal., i., p. 184, pl. 24, fig. 166, 1865. Tejon Eocene of California.

M. (*B.*) *multiradiatus* Gabb, Pal. Cal., ii., p. 30, pl. 8, fig. 52, 1866. Miocene of California. (*Volsella striata* "Gabb," Meek, S. I. Checkl. Mio. Fos., p. 7, 1864, is probably a provisional manuscript name for this species.)

There is a fine species in the Arago beds (Claibornian) of Oregon, which is probably identical with one of the above; and I have another, as yet unidentified, from the Oligocene limestone of Jacksonborough, Georgia.

In the absence of authentic specimens of several of the above-mentioned nominal species it would be imprudent to attempt to describe either of these as new, while the wretched quality of a number of the figures renders an identification from them impossible.

Modiolus (Gregariella) minimus n. s.

PLATE 35, FIGURE 26.

Shell small, broad, with turgid umbones in front, more or less attenuated behind; hinge-line arcuate, convex, the opposite margin nearly parallel and concave, surface as in *M. opifex* Say. Alt. 8, lat. 3.5, diam. 4 mm.

This little shell is represented by a silicious pseudomorph, retaining but little of the external surface, from the Oligocene silex beds of Ballast Point, Tampa Bay, Florida; the form is, however, unmistakable, and affords the opportunity of recording this group from that horizon.

Modiolus (Botula) cinnamomeus Lamarck.

Mytilus cinnamominus, etc., Chemn., Conch. Cab., viii., p. 152, pl. 82, fig. 731, 1785.
Modiola cinnamomea Lam., An. s. Vert., vi., p. 114, 1819; ed. Desh., vii., p. 25, 1835.

Oligocene of the Chipola marl, Chipola River, Monroe County, Burns; of the silex beds at Ballast Point, Tampa Bay, Dall, and of Trinidad, West Indies; Pliocene marl of the Caloosahatchie, Dall; recent, nestling or boring into soft limestone rock or shell, from the vicinity of Cape Fear, North Carolina, to the West Indies. A valve from coral at Belize measures thirty-four millimetres in length, but it is usually smaller.

I am not able to determine whether the East Indian shell usually called *M. fuscus* Gmelin is the same or distinct specifically. The distribution of boring species is often very wide. It is certain, however, that Chemnitz's specimens, on which Lamarck founded the species, were West Indian. It seems remarkable that this species should be found in the Oligocene, but I am not, from my present material, able to find any differential characters whatever from recent specimens of the same size.

This form differs from *Lithophaga* especially by the presence of a row of small but well-defined scars, extending in a radial manner towards the lower posterior basal angle of the shell, within the pallial line. These almost give the impression, when observed casually, of the presence of a pallial sinus. In the absence of fresh specimens of the animal I am unable to determine the function of these scars.

There are a few species of *Modiolus* named in the literature which belong elsewhere. *M. spiniger* H. C. Lea (Trans. Am. Phil. Soc., ix., p. 244, pl. 35, fig. 30, 1845) is perhaps a *Crenella;* the spines are probably due to some extraneous organism; it is from the Miocene of Petersburg, Virginia. *M. subpontis* Harris (Bull. Pal., iv., p. 49, pl. 3, fig. 6*a*, 1896), from the Midway Eocene of Georgia, has the aspect of a *Modiolaria. M. houstonia* Harris (Proc. Acad. Nat. Sci. Phila. for 1895, p. 46, pl. 1, fig. 1), from the lower Claibornian of Texas, is probably a *Lithophaga*, and specimens from the Orangeburg District of South Carolina, referred to his species by Harris, are certainly so. It should be carefully compared with *L. subalveata* Conrad, from the Lower Miocene of Cumberland County, New Jersey. *M. tenuis* Meyer (Ber. Senckenb. nat. Ges., 1886, p. 10, pl. ii., fig. 7) is a *Crenella*, and identical with *C. latifrons* Conrad (1860), from the Claibornian and Jacksonian Eocene of Alabama.

Genus **LITHOPHAGA** Bolten.

Lithophaga Bolten, Mus. Bolt., p. 156, 1798; Ed. ii., p. 109, 1819; Mörch, Cat. Yoldi, p. 55, 1853.

Lithophagus Megerle, Entwurf., p. 69, 1811; Dall, Bull. 37, p. 58, 1889.

Lithodomus Cuvier, Regne An., ii., p. 471, 1871.

Lithotomus Nitsch, Ersch et Grub. Encycl., Sect. 1, p. 175, 1825; Voigt, Cuv. Thierr., iii., p. 616, 1834.

Lithodoma Verany, Cat. An. Invert., p. 13, 1846.

Lithodomus Fischer, Man. Conch., p. 969, 1886.

Leiosolenus Cpr., Mazatlan Cat., p. 130, 1856.

Myoforceps Fischer, Man. Conch., p. 969, 1886.

The type in each of the first three cases cited is *Mytilus lithophagus* Linné. This was a compound of two species, the most common and best known of which was the Mediterranean form, which received the specific name of *dactylus* from Sowerby.

The genus may be divided into sections as follows:

Lithophaga Bolten, s. s. Shell subcylindric, with nearly terminal beaks; surface polished, with no calcareous incrustation. Type *L. dactylus* Sby.

Adula H. and A. Adams, 1857. Shell rhombic, with subcentral beaks; surface polished, clean. Type *L. soleniformis* Orbigny.

Leiosolenus Carpenter, 1856. Shell like *Lithophaga*, but building a doubly tubular spout to the aperture of its burrow, and therefore probably furnished with elongated tubular siphons. Type *L. spatiosus* Cpr.

Myoforceps Fischer, 1886. Shell as in *Lithophaga*, but the animal has the habit of depositing a calcareous crust on the exterior of the valves, which covers them smoothly and projects in a twisted process from the posterior end of each valve. Type *L. caudigera* Lamarck.

Diberus Dall, 1898. Resembling *Myoforceps*, but with two or more radial sulci extending backward from the beaks, with the incrustation plume like, arranged in a distinct pattern on the areas between the sulci, and, when projecting beyond the ends of the valves, apposited symmetrically, not alternate and twisted as in the last section. Type *L. plumula* Hanley.

The genus is commonly represented in the Tertiary rocks by casts of its burrows, but the shells are so thin and fragile as to be rarely preserved. Most of those here mentioned are silicious pseudomorphs which preserve the form and markings of the original shell.

Lithophaga antillarum Orbigny.

Lithodomus antillarum Orb., Moll. Cubana, ii., p. 332, pl. 28, figs. 12, 13, 1847 (Spanish edition and atlas, 1845).

Modiola corrugata Phil., Abbild. und Beschr., ii., 147, pl. 1, fig. 1, 1846.

Lithodomus corrugatus Reeve, Conch. Icon., x., pl. 1, fig. 1, 1858.

Lithophagus dactylus Mörch, Cat. Yoldi, ii., p. 55, 1853; not of Sowerby, 1824.

Lithophagus caribæus Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, No. 81, 1889; not of Philippi.

Oligocene silex beds at Ballast Point, Tampa Bay, Florida, Willcox and Dall; recent from Florida southward through the Antilles.

The reason why this species has not turned up in later formations is probably the extreme fragility of the shell and the less favorable opportunities for preservation. It would naturally have been absent through the colder period of the Miocene. It is among the St. Domingo fossils collected by Gabb.

Lithophaga nigra Orbigny.

Lithodomus niger Orb., Moll. Cubana, ii., p. 331, pl. 28, figs. 10, 11, 1847 (Spanish edition and atlas, 1845).

Modiola caribæa Phil., Abbild. und Beschr., iii., p. 20, pl. 2, fig. 5, 1847; Zeitschr. für Mal. for 1847, p. 116.

Modiola antillarum Phil., *op. cit.*, p. 20, pl. 2, fig. 4, 1847; Zeitschr., p. 116 (not of Orbigny; young shell).

Mytilus lithophagus Gibbes, S. Car. Cat., p. xxii., 1848; not of Linné.

Lithophagus nigra Mörch, Cat. Yoldi, ii., p. 56, 1853.

Lithodomus antillarum Reeve, Conch. Icon., x., pl. 2, fig. 7, 1857.

Oligocene silex beds of Ballast Point, Tampa Bay, Florida, Dall; recent at Bermuda, and from South Carolina southward through the West Indies to Rio Janeiro, Brazil.

Lithophaga nuda n. s.

Plate 11, Figure 7; Plate 35, Figure 27.

Oligocene silex beds at Ballast Point, Tampa Bay, Florida, where it is the most common species, and its burrows, or their casts, very numerous.

Shell large, thin, closely resembling *L. nigra*, but from which it may be instantly discriminated by the absence of all transverse or radial striation. Alt. 17 (?), lat. 50, diam. 15.7 mm.

Few of the specimens retain the outer markings of the shell, but those that do are easily recognized by the smooth surface, only sculptured by incremental lines. From the *Diberus* group, which also have unstriated shells, it is distinguished by its cylindrical form, large size, absence of sulcations and of the calcareous mantle.

Lithophaga (Myoforceps) aristata Dillwyn.

Mytilus aristatus (Solander MS.) Dillwyn, Cat. Rec. Sh., i., p. 303, 1817.

Modiola caudigera Lam., An. s. Vert., vi., p. 116, 1819; (after Enc. Méth., pl. 201, fig. 8) Phil., Abb., ii., p. 149, pl. 1, fig. 5, 1846.

Mytilus caudigerus Gibbes, Cat. S. Car., p. xxii., 1848.

Lithodomus aristatus Forbes and Hanley, Brit. Moll., ii., p. 212, 1851.

Lithodomus caudigerus Sby., Genera, Lith., fig. 4, 1824; Reeve, Conch. Icon., x., pl. iii., fig. 16, 1857.

Lithophagus aristatus Stimpson, Checkl. Rec. Sh., p. 2, 1860.

Lithophagus forficatus Ravenel, Proc. Acad. Nat. Sci. Phila. for 1861, p. 44; Tryon, Am. Mar. Conch., p. 188, 1873; Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida; recent from Cape Fear, North Carolina, south to the West Indies, east to the Red Sea, west to Mazatlan on the Pacific coast of Mexico.

Only fragments probably referable to this form were obtained at Ballast

Point, but its wide distribution, evidently antedating the present conformation of Central American and Mediterranean lands, is much in favor of its antiquity.

Lithophaga (Diberus) bisulcata Orbigny.

Lithodomus bisulcatus Orb., Moll. Cubana, ii., p. 333, pl. 28, figs. 14–16, 1847 (Spanish edition and atlas, 1845).

Modiola appendiculata, Phil., Abbild. und Beschr., ii., p. 150, pl. 1, fig. 4, 1846.

Mytilus attenuatus Gibbes, Cat. S. Car., p. xxii., 1848; not of Deshayes.

Lithophagus appendiculatus Mörch., Cat. Yoldi, ii., p. 56, 1853.

Lithodomus appendiculatus Reeve, Conch. Icon., x., pl. 4, fig. 21, 1857.

Lithodomus biexcavatus Reeve, *op. cit.*, fig. 22, *a–b*.

Lithophagus bisulcatus Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida, Dall; recent from South Carolina southward to the Gulf of Mexico, West Indies, and Rio Janeiro, Brazil.

This species was found in the silex beds not only with the shell preserved or reproduced, but with a complete pseudomorph of the calcareous mantle in which the lime was replaced by silica.

Among the species reported in the literature of the American Tertiary is *L. claibornensis* Conrad (Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 131, pl. 14, fig. 27, 1848; Aldr., Bull. Pal., 2, p. 17, pl. 5, fig. 14, 1895), from the Claibornian; *L. gainesensis* Harris (Bull. Pal., 4, p. 50, pl. 3, fig. 7 *a*, 1896), from the Upper Midway Eocene of Georgia, which may be referable to *Botula; L. incurva* Gabb (Journ. Acad. Nat. Sci., 2d Ser., viii., p. 377, pl. 47, fig. 80, 1881), from the Pliocene of Costa Rica, which is certainly a *Botula* and very close to *B. cinnamomea* Lam.; and *L. subalveata* Conrad (Am. Journ. of Conch., ii., p. 73, pl. 4, fig. 4, 1866), from the lowest Miocene of New Jersey, a peculiar species with which *Modiola houstonia* Harris (1895) should be carefully compared. *L. dactylus* Sby. is reported by Conrad (Am. Journ. Sci., 2d Ser., 1, p. 210) as having been found by Lyell in Georgia, but this is perhaps a misidentification; the species may have been *L. nuda*. The figure of *Byssomia petricoloides* Lea (Contr. Geol., p. 48, pl. 1, fig. 16, 1833) much resembles a chipped *Lithophaga*, and the suggestion of Gregorio that it is identical with *L. claibornensis* Conrad is plausible.

Genus **CRENELLA** Brown.

Crenella Brown, Ill. Conch. Gt. Brit., pl. 31, figs. 12–14, 1827; 2d edition, p. 75, pl. 23, figs. 12–14, 1844. Type *Mytilus decussatus* Montagu, 1808.

Stalagmium Conrad, Fos. Tert. Form., p. 39, Oct., 1833. Type *S. margaritaceum* Conrad, *l. c.*

Hippagus Lea, Contr. Geol., p. 72, Dec., 1833. Type *N. isocardioides* Lea, *l. c.*, pl. 2, fig. 50.

Myoparo Lea, Contr. Geol., p. 73, Dec., 1833. Type *M. costatus* Lea, *l. c.*, pl. 2, fig. 51.

Nuculocardia Orbigny, Moll. Cubana, ii., p. 310, 1847 (Spanish edition and atlas, 1845). Type *N. divaricata* Orb., *l. c.*, p. 311, pl. xxvii., figs. 56–59.

Crenellodon Edwards, MS. Syst. List., Edw. Coll. B. M., p. 14, 1891. Type *Crenella pulcherrima* Edw., MS. Oligocene, Brit.

Not *Crenella* Sowerby, Conch. Man., p. 297, fig. 136, 1842.

This interesting little group extends through the Tertiary and, owing to the little study given to its characters, has received many names. The shell is usually convex and ovoid, with more or less incurved beaks, a nacreous inner layer, thin epidermis which adheres closely to the shell, and a fine radial, often crossed by a concentric, striation. In young shells the provinculum is exceptionally well developed, sometimes recalling the hinge of *Nucula* by its strong and projecting denticulations. If the shell is thin, these become obsolete with growth, but in some species are replaced by a series of denticulations directly consequent on the impingement of the external sculpture on the cardinal margin, thus repeating a second time in the same individual the process by which the provinculum was originally initiated in its ancestors. At least that is the way in which the writer interprets the facts. When the shell is thick, or when the external sculpture is very delicate, no secondary denticulations appear in the adult, which is then left with a practically unarmed hinge-line. The appearance of the provinculum is not dependent on the existence of external sculpture, but the secondary denticulations are so dependent. The exterior may be almost perfectly smooth and polished with only microscopic striation; finely radially striate without decussation (like *C. sericea*), decussate, or with the radial sculpture strong and divaricate. Usually the sculpture is uniformly distributed over the surface, but occasionally there will be an area of unstriated separating two of striated surface, as in *Modiolaria*, but without the impressed boundaries of the latter genus.

The form of the foot and the short siphons separate *Crenella* generically from *Modiolaria*, as far as yet shown, but the modifications of the surface upon which the former has been divided into genera are, in the writer's opinion, of little more than specific value. *Hippagus* is a thick shell with feeble sculpture, and therefore the provinculum is not succeeded by a series of secondary denticulations. Otherwise it is an ordinary rather obese *Crenella*. *Stalagmium* is a typical *Crenella*, and *Myoparo* is, of course, a synonyme specifically and generically of Conrad's form. *Nuculocardia* is only a well-observed, strongly crenulate *Crenella*, and what else, if anything, the undescribed *Crenellodon* may be is unknown.

Crenella margaritacea Conrad has for a synonyme *C. costata* Lea; *C. isocardioidea* Lea (as *Hippagus*) and *C. latifrons* Conrad (+ *Modiola tenuis* Meyer, 1887) are Claibornian. The last mentioned is a large, oblique, thin species, and extends into the Jacksonian.

C. concentrica Gabb (Pal. Cal., i., p. 186, pl. 24, fig. 169) is extremely similar to *C. margaritacea* and is found in the Martinez Eocene of California. A shell which is perhaps a *Crenella* (or a *Limæa*) was described from the Miocene of Petersburg, Virginia, by H. C. Lea under the name of *Nucula æquilatera*.

Crenella divaricata Orbigny.

Nuculocardia divaricata Orb., Moll. Cubana, ii., p. 311, pl. 27, figs. 56–59, 1847 (Spanish edition and atlas 1845); Gabb, Geol. St. Domingo, p. 252, 1873.
Crenella decussata Dall, Blake Pelecypoda, p. 235, 1886.

Oligocene of St. Domingo and Pliocene of Costa Rica, Gabb; Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; recent from Cape Hatteras to the West Indies (one hundred fathoms off Barbados), and also on the Pacific coast at Panama and in the Gulf of California.

This little shell is not to be distinguished, except by its nearly white color, from the young of *C. decussata* of the same size. The examination of a much larger series of specimens than was at my disposal when preparing the Blake report shows that the size when fully adult is uniform and always smaller than the adult *C. decussata*. The young *divaricata* is proportionately less inflated and has a more circular outline than the full-grown shell. The color is yellowish or nearly white in all the specimens I have seen, and the epidermis hardly perceptible.

Crenella minuscula n. s.

PLATE 35, FIGURE 22.

Oligocene of the lower bed at Alum Bluff, Chattahoochee River, Florida; Burns.

Shell minute, thin, inflated, elongate ovate, feebly radially striated, the striations apparently diverging from a medial line on the disk; not dichotomous; the beaks smooth; inner margins crenulate; valves nearly equilateral. Alt. 1.75, lat. 1.25, diam. 1 mm.

This little shell is rare in the marl, and resembles in a general way *C. divaricata* Orb., of which it is the precursor, but has fainter sculpture and smooth beaks, besides being constantly of smaller size, and is more narrow in form than the young of *C. divaricata* of the same length.

Crenella duplinensis n. s.

PLATE 35, FIGURE 6.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, thin, rounded ovate, delicately radially sculptured, with fine, rounded ribs crossed by delicate incremental lines; smoother towards the beaks; valves moderately inflated; beaks recurved, striæ diverging from a line near the anterior third; inner margin crenulated, the crenulæ extending well up into the valve; the hinge with its crenulations short and delicate. Alt. 2.9, lat. 2.4, diam. 1.5 mm.

This species is proportionally wider and less inflated than *C. minuscula*, attains a larger size, and has more recurved beaks. From *C. divaricata* it differs by its feebler sculpture, somewhat smaller shell, and especially by its much weaker hinge, with less conspicuous and strong crenulations. The line of divarication of the sculpture is also more anterior and the beaks more recurved.

The recent *Crenella glandula* Totten is reported as fossil in the Pleistocene beds at Montreal by Dawson (Geol. Rep. Can., 1863, p. 927), and at Sankoty Head, Massachusetts, by Verrill, but Dr. Dawson is now disposed to refer his specimens to *C. faba* Fabr.

Genus **MODIOLARIA** Beck.

Modiolaria Beck, in E. Robert, Zool. Voy. Récherche en Isl. et en Grönl., pl. 17, figs. 1–4, 1840; Lovèn, Ind. Moll. Scand., p. 33, 1846. Type *Mytilus discors* Linné.

Lanistes Swainson (as of Humphrey), Malac., p. 385, 1840; not of Montfort, 1810. Type *Mytilus impactus* Herrmann.

Lanistina Gray, P. Z. S., 1847, p. 199 (in place of *Lanistes* Sw.).

Modiolacra Gray, in Dieffenbach, N. Zeal., ii., p. 259, 1843; *fide* Hutton, Cat. Mar. Moll. N. Zeal., p. 78, 1873; (a typographical error for *Modiolaria?*) sole ex. *M. impacta* Gray.

Swainson quotes *Lanistes* as of Humphrey, but there is no such genus in the Museum Calonnianum, where the *Mytilus discors* Lam. (not of Linné), otherwise *M. impactus* Herrmann (1776), is given the specific name of

"*Lanatus*." By some confusion of this with Montfort's *Lanistes* (which is cited by Swainson, p. 387, as *Lanites*) this error probably arose.

I have not access to Dieffenbach's New Zealand at this writing, but if the *Modiolacra* cited from it by Hutton is correct, it is probably a typographical error for *Modiolaria*, and an earlier citation of Beck's name than is usually known.

This genus is distinguished from *Crenella* by its elongated siphons, the branchial one being usually shorter and not closed along its lower side, but merely with apposited free edges; the foot also differs, being long and tapering to a point, instead of clavate as in *Crenella*. It is somewhat difficult to apportion the fossil species, but they are perhaps best separated from *Crenella* by the impressed mid-lateral area which, in the typical *Modiolaria*, is usually smooth or not radially sculptured.

The genus may be divided as follows:

Modiolaria s. s. Shell with three areas on the disk, the central with feeble or entirely without radial sculpture, the others radially sculptured. Branchial siphon considerably shorter than the anal. Type *Mytilus discors* L. = *M. discrepans* Mont.

Lioberus Dall. Shell with the radial sculpture obsolete or absent; branchial siphon equal or nearly equal to the anal, both much elongated. Type *Modiola castanea* Say, Journ. Acad. Nat. Sci. Phila., ii., 266, 1822.*

Rhomboidella Monterosato (1884). Shell rhomboid, the surface entirely covered with sharp radial striations. Type *Modiola rhombea* Berkeley.

? *Planimodiola* Cossmann (1887). Shell modioliform rather than rhomboid, with the anterior radiated area very small and the valves rather compressed. Type *Modiola sulcata* Lam. (Parisian Eocene.)

This section might quite as well be placed in *Modiolus*, from which it differs by no very important characters. It is very doubtful if it is a *Modiolaria*. The type is not the same as the recent *Modiola sulcata* of Lamarck (= *M.* (*Brachydentes*) *citrinus* Bolten).

The earliest species in our Tertiary is probably *M. subpontis* Harris, from the Upper Midway, though its generic position is not positively determined.

* This is probably the same as *M. lignea* Reeve, Conch. Icon., x., *Modiola*, pl. 10, fig. 71, 1858. *M. castanea* Say was mistakenly referred by Tryon to the young of *M. tulipa* Lam. in Am. Mar. Conch., p. 187, 1874.

M. alabamensis O. Meyer, from the Claibornian, is, however, a well-characterized species.

Modiolaria sp. indet.

Oligocene of the Chipola River, Monroe County, Florida; Dall.

A single broken valve belonging to this genus was obtained from the Chipola marl. It is a species similar to *M. lateralis* Say, but marked especially by well-developed latticed sculpture in the interspaces of the radii.

Modiolaria virginica Conrad.

Modiolaria virginica Conrad, Am. Journ. Conch., iii., p. 267, pl. 22, fig. 3, 1867.

Yorktown, Virginia, Conrad; from the Miocene beds along the York River, Virginia, Harris.

This small species is well-characterized by its rather angular shape, the reticulated sculpture of the posterior area, and the feeble sculpture of the anterior area. It recalls *Gregariella*, and perhaps should rightly be referred to that section of *Modiolus* rather than be placed in *Modiolaria*.

Modiolaria carolinensis n. s.?

PLATE 35, FIGURE 12.

Upper Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, plump, rather elongate, with a shallow but well-marked radial furrow at the posterior edge of the medial smooth area; terminal areas radiately sculptured with small, radial, rounded threads, those on the anterior area fine and simple, those on the ridge of the posterior slope more or less reticulated by concentric elevated lines and distally dichotomous, divergent from the summit of the ridge and stronger dorsally; hinge-line straight, the margin above it angulated at its posterior termination; the beaks nearly anterior, the posterior ventral termination of the valve rounded and produced; inner margin crenulated; on the hinge-line the crenulæ are almost like teeth, and increase in strength backward, distally being disproportionately large at the end of the series. Alt. 4.5, lat. 6.5, diam. 3.5 mm.

This shell is very like *M. virginica*, which, however, is arched instead of angulated near the distal end of the hinge-line, and, in the specimens I have been able to examine, is more rounded and less produced behind and has a less conspicuous medial furrow. It may, however, prove, when a sufficiently large number of specimens are brought together, that these characters fall within the limits of varietal rather than specific distinction. The specimen figured is somewhat blunted by fracture or other accidental causes at the lower posterior end, so that it does not show as much of the produced character as the other smaller and less developed specimens which were collected with it.

Modiolaria lateralis Say.

Mytillus lateralis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 264, 1822; Binney's Say, p. 91, 1858.

Crenella lateralis Tryon, Am. Mar. Conch., p. 190, pl. 40, fig. 523, 1874.

Modiolaria lateralis Dall, Bull. U. S. Nat. Mus., No. 37, p. 40, pl. 6, figs. 7, 8, 1889.

Modiola elliptica H. C. Lea, Am. Journ. Sci., xliii., p. 106, pl. 1, fig. 2, 1842.

Pliocene of the Caloosahatchie and Shell Creek marls, Florida, Dall and Willcox; Pleistocene of Simmons Bluff, South Carolina, Burns; recent at Portland, Maine (Fuller); Delaware Bay, Lea; North Carolina, United States Fish Commission; South Carolina, Gibbes; and southward through the Antilles to Venezuela; situs on oysters and sponges (*Tethya*).

This pretty little species is much like *M. marmorata* Forbes of the British fauna. It is probable that specimens obtained north of Chesapeake Bay have been transported with "seed" oysters. *Modiolaria translucida* Gabb (Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 377, pl. 47, fig. 81, 1881) from the Pliocene of Costa Rica is a very similar species.

The recent northern species, *M. nigra* Gray and *M. discors* L., are reported by Dawson (Can. Nat., 2, p. 419, and Geol. Rep. Can. for 1863, p. 927) from the Pleistocene glacial beds of the Province of Quebec, near Montreal.

Family DREISSENSIIDÆ.

The systematic position of this family cannot yet be said to be definitely fixed, and is not likely to be finally decided until careful anatomical and embryological investigations of such forms as *Septifer*, *Mytilopsis*, etc., are available.

The nomenclature of this group has, so far as I know, never been published in the full and precise shape demanded by systematists of the present day; those who have referred to it seem to vie with each other in omitting dates, references, and essential facts. To make such a review here is not called for by present necessities, and is impracticable for want of part of the literature. The earliest name appears to be *Enocephalus* (Münster MS., 1828) Keferstein (Geogn. Geol. Zeitschr., ix., p. 92, 1831), but it would seem as if the genus had not been specifically characterized, though two species were described under this generic name, and it was cited by Deshayes (Bull. soc. géol. de Paris, t. iii.) in 1833. In 1836 Goldfuss fully characterized the genus, which was founded on two fossil species. In 1835 the recent *Mytilus fluviatilis* of Pallas (*M. wolgæ*, Chemn., xi., p. 256, fig. 2028) was almost simultaneously named *Dreissena* (mel. *Dreissensia*) by Van Beneden and *Tichogonia* by Rossmässler, the former having a few weeks' precedence. In 1837 appeared the names *Mytilina* and *Mytilomia* Cantraine. Jay, in 1836, used for the Danubian shell the name *Dythalmia danubii* (Cat. Coll., p. 25) but without description. There is also a large number of variants due to misprints or errors of the pen.

The species *D. fluviatilis* (or *polymorphus* of many authors) differs from most of the fossils and from our American shells by the absence of the secondary myophore, and is doubtless generically distinct. Being unable to determine the status of *Enocephalus*, the nomenclature of the American type may be provisionally stated as follows:

Genus **CONGERIA** Partsch.

Congeria Partsch, Ann. Wiener Mus., i., p. 93, 1835.

Mytilopsis Conrad, Proc. Acad. Nat. Sci. Phila. for June, 1857, p. 167. Type *M. leucophæatus* Conr., 1831.

Mytilus sp. Reeve, Conch. Icon., x., pl. x., 1858.

Praxis H. and A. Adams, Gen. Rec. Moll., ii., p. 522, Dec., 1857.

Mytiloides Conrad (*lapsus*), Proc. Acad. Nat. Sci. Phila. for 1874, p. 29; not of Brogniart, 1822.

Partsch specifically mentions the myophore in his diagnosis, and an examination of a number of his species shows that they agree in all essential systematic characters with the American shells.

Congeria leucophæata Conrad.

Mytilus leucophæatus Conrad, Journ. Acad. Nat. Sci. Phila., vi., p. 263, pl. 11, fig. 13, 1831; Ravenel, Cat., p. 7, 1834; De Kay, New York Fauna, Zool., v., p. 184, 1843.

Mytilopsis leucophæatus Conr., Proc. Acad. Nat. Sci. Phila. for 1857, p. 167; Dall, Bull. U. S. Nat. Mus., No. 37, p. 40, 1889.

Dreissena americana (Recluz MS.), in Reeve, Conch. Icon., x., pl. x. (*Mytilus*), fig. 43, Jan., 1858; Fischer, J. de Conchyl., vii., p. 131, 1858.

Dreissena Riisii (Dkr. MS.) Fischer, Journ. de Conchyl., vii., p. 133, 1858.

Dreissena leucophæta Tryon, Am. Mar. Conch., p. 190, pl. 40, fig. 424, 1874.

Pleistocene of North Beach, Osprey, Florida, Dall; recent, especially about oyster beds, from Maryland to Florida, Nicaragua (Richmond), New Grenada (Totten), St. Thomas (Dunker), and Vieque, West Indies.

A review of the American Congerias in the National Museum shows that besides the above-mentioned species there is found in the United States the *C. Rossmässleri* Dunker (1858, Rve., fig. 45, + *C. Sallei* Reeve, fig. 44, 1858, not of Recluz, 1852), which occurs near Tampa, Florida, and is said to extend to Brazil. It is distinguishable from the common *leucophæata* by its more triangular, anteriorly flattened, heavier shell. The *C. Gundlachi* Dunker (1858), which has a more conspicuous myophore, is found in Cuba, while the *C. cochleata* is common at Colon, on the Isthmus of Darien. There may be one or two more identifiable forms in the West Indies, but the shell is variable, passing through about such a set of mutations as does *Mytilus edulis*, and too much stress should not be laid on slight differences. None of the other species mentioned has yet been found fossil, but a species is not uncommon in the Florida Pliocene which is obviously different from any of them. It is notable that the European type, *Dreissensia*, does not occur in Africa or America, though it is represented by a species (*D. Massiei* L. Morlet) in Cochin China. In Africa, America, China, and the Viti Islands *Congeria* is present.

Congeria lamellata n. s.

PLATE 35, FIGURES 13, 14, 15.

Pliocene marls of the Caloosahatchie and Shell Creek, Monroe County, Florida; Dall and Willcox.

Shell subtrigonal, externally smooth, except for concentric undulations due to irregularities of growth; anterior side flattened below the beaks, the periphery of the flattened area rounding over towards the disk; beaks subacute and slightly twisted outward, byssal gape very narrow; dorsal slope subarcuate with no pronounced angle at the distal end of the hinge-line, in the vicinity of which the valves are somewhat compressed; internal margins smooth; cardinal border with a wide groove for the reception of the ligament, this groove being continuous to the beaks; septum small, separated from the groove by a Λ-shaped lamella which on the anterior side is conspicuously produced and extends along the anterior margin about twice the length of the septum beyond the septum; myophore small, entirely hidden below the septum and formed by a callous eminence bearing the scar of the retractor muscle of the foot upon which the strain from the byssus comes; adductor scars ovoid, elongate, and partly in contact, with a slight insinuation of the pallial line in front of them; margin of the right valve somewhat impressed below the beak so as to pass behind the prominence on the margin of the opposite valve when closed. Alt. 17, lat. 10, diam. 10 mm.

This is a much heavier and more triangular shell than *C. leucophæata* and more elongate than *C. Rossmässleri*, with a different hinge from either. Some very similar but not conspecific forms occur in the Vienna basin.

Harris mentions the occurrence of a *Dreissensia* (= *Congeria*) in the Galveston artesian well, between the levels of two thousand one hundred and twenty-three and two thousand eight hundred and seventy-three feet below the surface. The horizon here is Upper Miocene.

There are no species of *Septifer* determined from the Tertiary rocks of eastern North America, but, as elsewhere noted, Cooper has described a species from the Californian Tertiary.

Family JULIIDÆ.

(*Prasinidæ*, p. 529.)

This family has not been hitherto represented in the faunal lists of American mollusks, recent or fossil, except through the inclusion of forms such as *Phascolicama* and certain Paleozoic fossils, which in all probability belong elsewhere. Semper showed many years ago that the typical genus, *Prasina*, was suspiciously close to the older genus, *Julia*, of Gould. Fischer, in his manual, unites them as subdivisions of one genus. They are really identical, and the consolidated genus must take the older name of Gould and *Prasina* be relegated to synonymy, according to the rules of nomenclature. To *Prasina* and *Julia* Cossmann has added a shell from the Parisian Eocene, named by him *Anomalomya*, and Fischer has suggested that *Berthelinia* Crosse may perhaps find a place in the same vicinity.

Genus **JULIA** Gould.

Julia Gould, Proc. Bost. Soc. Nat. Hist., viii., p. 284, Feb., 1862; Otia, Conch., p. 241, 1862. Type *J. exquisita* Gould, *l. c.*

Prasina Deshayes, Cat. Moll. Isle de Réunion, p. 25, 1863. Type *P. borbonica* Desh., *op. cit.*, p. 29, pl. iv., figs. 4–8.

Prasinia Cossmann, Cat. Ill. Eoc. Paris, p. 174, 1887.

Fischer (Man., p. 950) separates *Prasina* from *Julia* on the ground that the latter is nacreous and has the borders finely crenulated, but both these characters are non-existent in the one as much as in the other. Gould probably used the word "margaritacea" to express the lustre often seen on polished porcellanous shells, and the "crenulations" are merely the faint incremental radiations common to all bivalves. The examination of authentic specimens of Gould's species (for which I am indebted to the authorities of Cornell University) enables me to make a positive statement in regard to these facts. The shell is *not* pearly and the margin is *not* crenulated in the strict sense of those words. The adductor scar is precisely as figured by Fischer for *Prasina borbonica*, and I can find no trace of any other scar, though the interior is so polished that this would be hardly visible at any rate if present.

Julia floridana n. s.

Plate 35, Figures 1, 2, 3.

Oligocene marl of the Chipola River, Florida; Burns.

Shell small, inflated, smooth, arched above, rounded behind, the base nearly straight; the beaks prominent with a small impressed lunule immediately under them; below this lunule the valve projects forward to a rather acute point; with the exception of the groove for the ligament the hinge-line is perfectly simple without teeth or crenulations of any kind; the edge of the impressed lunule in the right valve is produced into a lamella which fits behind a less prominent extension of the corresponding margin in the opposite valve; interior of the valves smooth, with no trace of muscular or other scars; exterior sculptured only by faint incremental lines; inner margin of the valves simple, not crenulated; shell substance showing no traces of nacreous structure, but rather porcellanous. Alt. 4.5, lat. 6.5, diam. 2 mm.

This species evidently belongs to the same restricted group as the original *Prasina borbonica* of Deshayes. The chief difference is that the impressed lunule is smaller and not so deep, and that its margin in the left valve is not elevated into so evident a tubercle. Careful scrutiny of more than twenty valves collected failed to show any satisfactory muscular or pallial scars.

This is the only species known from American deposits and, as far as I have been able to discover, the only fossil species known of the restricted group from any horizon.

Order TELEODESMACEA.

For reasons of convenience, some groups of this order having been completed in manuscript as much as two years ago, and it being desirable to print them as early as practicable, the series of families is here begun with the *Teredinidæ*, an order the reverse of that appearing in the list of families on page 484 of this volume.

Superfamily ADESMACEA.

Family TEREDINIDÆ.

Genus TEREDO Linné.

Teredo Linné, Syst. Nat., Ed. x., p. 651, 1758. Type *T. navalis* Linné.
Xylophagus Meuschen, Zooph. Gronovianum, p. 258, 1781. Same type.

The tubes of *Teredo* and its allies appear in all the Tertiary horizons of North America which have been well searched, and a number of names have been applied to them, but so far, I believe (unless *Pholas rhomboidea* Lea, from the Miocene of Petersburg, Virginia, be founded on a valve of *Teredo*), the valves of none of the species have been described or figured. This leaves the species of the genus in our Tertiary in a very unsatisfactory state, and it has even been suspected that some of the tubes described as teredine are really the shelly retreats of *Serpulidæ* or other tubicolous worms. In this uncertainty, I shall content myself with giving a list of the names which have been proposed, with references, leaving to a more propitious time the task of examining into their validity or determining their synonomy.

Eocene.

1. *Teredo emacerata* Whitfield, Lam. N. J., p. 242, pl. xxx., fig. 25, 1885. Eocene marl of New Jersey.
2. *Teredo mississippiensis* Conrad, Wailes, Geol. Miss., p. 289, 1854; Eoc. Checkl. S. I., p. 24, 1866 (name only). Upper Eocene of Jackson, Mississippi.
3. *Teredo pugetensis* White, Bull. U. S. Geol. Surv., No. 51, p. 62, pl. 8, fig. 1, 1889. Eocene of the Puget Group, Puget Sound, Washington, from Carbonado, Washington.
4. *Teredo simplex* Lea, Contr. Geol., p. 38, pl. 1, fig. 6, 1833. Claiborne sands at Claiborne, Alabama.

This species is represented by a short piece of tube, apparently teredine, among Lea's types. De Gregorio, however (Mon. Claib., p. 10, pl. 1, figs. 30–33), has identified what he regards as a *Serpula* tube from Claiborne with Lea's species, and for the true *Teredo* tubes which occur in the Claiborne sands has proposed the name of *Teredo simplexopsis* (*op. cit.*, p. 236, pl. 38, figs. 26 *a–b*, 1890), which probably may have to be regarded as a synonyme of *T. simplex*, while the *Serpula* will need a new name.

5. *Teredo substriata* Conrad, Geol. U. S. Expl. Exp., p. 728, pl. 20, figs. 7 *a–b*, 1849. Tertiary of Astoria, Oregon.

6. *Teredo virginiana* Clark, Bull. U. S. Geol. Surv., No. 141, p. 72, pl. 15, figs. 5 *a–c*, 1896. Eocene of Virginia and Maryland.

Oligocene.

1. *Teredo incrassata* Gabb (as *Kuphus*), Geol. St. Domingo, p. 249, 1873; Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 342, pl. 44, figs. 12 *a–c*, 1881. Oligocene of St. Domingo, Haiti, and Costa Rica, Gabb; and of the Bowden marls, Jamaica, Henderson and Simpson. *T. fistula* Guppy (*non* H. C. Lea), from the Oligocene of Trinidad, is probably the same.

2. *Teredo circula* Aldrich, Bull. Ala. Geol. Surv., i., p. 36, 1886. Vicksburgian.

Miocene.

1. *Teredo calamus* H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 234, pl. 34, fig. 4, 1845. Petersburg, Virginia. *T. fistula* of the same author (*op. cit.*, fig. 5) is probably identical, being from the same locality and differing in little but size.

2. *Teredo* (sp.) Conrad, Am. Journ. Conch., v., p. 101, 1870, is cited from the Miocene of New Jersey.

3. *Teredo* (sp.) Merriam, Bull. Univ. Cal., ii., No. 3, p. 104, 1896. Miocene of Vancouver Island; should be compared with *T. substriata* Conrad. A species of *Teredo* or some allied genus is abundant in the fossil wood of the Miocene at Unga Island, Alaska.

Pleistocene.

1. *Xylotrya palmulata* Leach is reported by Holmes (Post-Pleioc. Fos. S. Car., p. 60, pl. 9, fig. 5, 1858) from the Pleistocene of South Carolina.

Family PHOLADIDÆ.

This family is in much the same condition as regards the Tertiary American species as the preceding, except that the shells are better known. They are as a rule rare, the specimens more or less imperfect, and often unique, and widely scattered in different collections. Only a few can be considered in detail here, but they will be followed by a list of the species mentioned in the literature. The most thorough revision of the species of the group as regards synonymy is to be found in Tryon's Monograph of the *Pholadacea*, a reprint of papers extracted from the Proceedings of the Academy of Natural Sciences, Philadelphia, 1861–62, though some shifting of generic names would be necessary to bring the work up to date.

Subfamily PHOLADINÆ Tryon.

Anterior hiatus permanently open, with no callum.

Genus PHOLAS (Linné) Lamarck.

Pholas Linné, Systema Nat., Ed. x., p. 669, 1758 (*ex parte*); Lam., Prodrome, p. 90, 1799. Type *P. dactylus* L.

Dactylina Gray, P. Z. S., 1847, p. 187; Tryon, Mon. Pholad., p. 75, 1862.

Phragmopholas Fisher, Man. de Conchyl., p. 1133, 1887.

Thovana (Leach MS.) Gray, P. Z. S., 1847, p. 187.

Valves with an umbonal reflection, the space beneath it divided into cellular cavities by supporting radial septa.

Subgenus PHOLAS s. s.

Shell with an accessory protoplax, a mesoplax with the nucleus at the outer margin over each umbo, and a narrow elongate hypoplax. Valves emarginate in front. Type *P. dactylus* L.

Subgenus THOVANA Gray, 1847.

Like *Pholas*, but with the mesoplax nucleus near the inner margin and the valves regularly rounded in front. Type *P. oblongata* Say. This is *Gitocentrum* Tryon, 1862, and based on the same type.

Subgenus MONOTHYRA Tryon, 1862.

The shell with a single mesoplax over both umbones with a subcentral nucleus, the anterior hiatus narrow. Type *P. orientalis* Gmelin.

Pholas (Thovana) campechiensis Gmelin.

Pholas campechiensis Gmelin, Syst. Nat., vi., p. 3216, 1792; Hanley, Descr. Cat. Rec. Sh., p. 6, pl. 9, fig. 44, 1842.

Pholas oblongata Say, Journ. Acad. Nat. Sci., ii., p. 320, 1822; not of Tuomey and Holmes, Pleioc. Fos. S. Car., p. 103, pl. 24, fig. 5, 1858.

Pholas candeana Orbigny, Moll. Cubana, p. 215, pl. 25, figs. 18–19, 1845. (Young shell.)

Pleistocene of South Carolina and Florida; recent from Cape Hatteras, North Carolina, to Brazil.

This species is distinguished from the following one by the proportions and extent of the umbonal processes, which differ markedly in the two forms.

Pholas (Thovana) producta Conrad.

Pholas oblongata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 103, pl. 24, fig. 5, 1858; not of Say.

Pholas producta Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863.

Miocene of the Sumter District and Peedee River, South Carolina; Pliocene of the Waccamaw River, South Carolina; Holmes and Johnson.

In this species the umbonal reflection is considerably longer in proportion than in the Pleistocene shell, and the anterior space between the reflected edge and the exterior of the valve in front of the umbo and below the level of the septa is much smaller and less conspicuous. The ribbing of the present species is less sharp and continuous.

Pholas (Thovana?) Memmingeri Tuomey and Holmes.

Pholas Memmingeri T. and H., Pleioc. Fos. S. Car., p. 104, pl. 24, fig. 6, 1858.

Miocene of the Sumter District, South Carolina; Tuomey and Holmes.

This species recalls *Zirfæa*, but is said by the authors cited to have a septate umbonal reflection. It is subtruncate behind and differs widely from any of the other species, but has been unaccountably omitted from all the checklists.

Genus **BARNEA** (Leach MS.) Risso.

Barnea Risso., Hist. Eur. Mer., iv., p. 376, 1826. Type *B. spinosa* Risso (= *P. candida* Linné).

Holopholas Fischer, Man. de Conchyl., p. 1133, 1887.

Pholas Lamarck, 1801; Tryon, 1862; not Lamarck, 1799.

Cyrtopleura Tryon, Mon. Pholadacea, p. 73, 1862.

Shell with the space below the umbonal reflection not septate; accessory plates not exceeding two in number.

Subgenus BARNEA s. s.

Shell with only one accessory plate (protoplax); anterior gape small. Type *Pholas candida* Linné.

Subgenus SCOBINA Bayle, 1880.

Shell with a transverse mesoplax and a lanceolate protoplax. Type *P. costata* Linné.

Barnea (Scobina) costata Linné.

Pholas costatus Linné, Syst. Nat., Ed. x., p. 669, 1758; Lam., An. s. Vert., v., p. 445, 1818; Sby., Gen., No. 23, pl. 1, 1824; Holmes, Post-Pleioc. Fos. S. Car., p. 58, pl. 9, figs. 1, 1 *a*, 1858; Tryon, Mon. Pholad., p. 73, 1862.

Pholas virginianus Lister, Hist. Conch., Ed. ii., pl. 5, fig. 434, 1770.

Pliocene of the Caloosahatchie marls, Florida, Dall; Pleistocene of Massachusetts, at New Bedford; of Maryland, at Cornfield Harbor; of South Carolina, at Simmons Bluff; of Florida, at Osprey; recent from Massachusetts south to Mexico and Brazil.

The recent shell is identical with that of the Pliocene, but differs from the Miocene form by its uniformly thinner texture, resulting in a sort of punctate pattern on the interior of the valves, its larger size, and the different proportions of its umbonal reflection, much as *P. campechiensis* differs from the Miocene *P. producta*.

Barnea (Scobina) arcuata Conrad.

Pholas arcuata Conr., Medial Tert., cover of No. 2, p. 3, 1841; Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863.

Pholas acuminata Conr., Medial Tert., p. 77, pl. 44, fig. 2, 1845.

Pholas costata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 102, pl. 24, fig. 4, 1857; not of Linné.

Miocene of Nansemond River, near Suffolk, Virginia, Burns; of Maryland, Conrad; of South Carolina, in the Waccamaw district, Tuomey.

This species is known from *B. costata* by its longer umbonal reflection and smaller size. It is usually more solid and thick, with more numerous and finer radial ribs. Fragments from the Galveston artesian well may belong to it, but have not been accessible to me for critical comparison with *B. costata*.

Barnea truncata Say.

Pholas truncata Say, Journ. Acad. Nat. Sci. Phila., ii., p. 321, 1822; Sby., Thes. Conch., i., p. 488, pl. 104, figs. 29, 30, 1849; De Kay, Zool. N. Y., Moll., p. 248, pl. 34, fig. 323 *a–b*, 1843; Holmes, Post-Pleioc. Fos. S. Car., p. 57, pl. 9, fig. 4, 1858.

Pholas (*Cyrtopleura*) *truncata* Tryon, Mon. Pholad., p. 74, 1862; Cat. Pholadacea, p. 2, 1867.

Pleistocene of South Carolina, Holmes; recent at New Bedford Harbor, Massachusetts, and southward to South Carolina, Ravenel; Chili and Peru, Ruschenberger (?) *fide* Tryon.

This species (to which the figure of *P. Memmingeri* T. and H. has a suspicious resemblance) usually has a tolerably wide anterior gape, and a single accessory valve extending forward from behind the umbones with the nucleus posterior; but in one specimen in the National Museum the plate is divided into two, the anterior elongate and narrow, the posterior (behind the umbones) small and round, and this is the condition figured by De Kay. There seems to be no doubt as to the specific identity of the two variations, which leads to a query as to the systematic value of the characters upon which the name *Scobina* is based.

The identity of the form from the west coast of South America with Say's *truncata* is doubtful. Perhaps it should rather be united with the Californian type named by Stearns *Pholas pacifica.*

Barnea alatoidea Aldrich.

Pholas alatoidea Aldr., Bull. Ala. Geol. Surv., No. 1, p. 36, pl. 4, figs. 9 *a–c*, 1886.
Pholas Roperiana Tuomey MS.
Barnea alatoidea Cossmann, Notes Compl. Eoc. Ala., p. 5, 1894.

Chickasawan Eocene of Bell's and Gregg's Landings, Alabama; Aldrich.

De Gregorio has given the varietal name of *Aldrichi* to the figure 9*b* of Aldrich. The species strongly recalls *B. Levesquei* Watelet of the Parisian Eocene.

Genus **ZIRFÆA** (Leach) Gray.

Zirfæa "Leach, 1817," Gray, P. Z. L., 1847, p. 188; Ann. Mag. N. Hist., 2d Ser., viii., p. 385, 1851.
Zirphæa Leach, Moll. Gt. Brit., pp. 250, 252, 1852. Type *Pholas crispata* Linné.
Thurlosia "Leach, Conch. Nomen., 1845," *fide* Agassiz in Scudder's Nomenclator, 1882; (not found.)

Shell with a radial sulcus dividing the valves into two areas; accessory plates rudimentary or wanting; anterior gape large.

Zirfæa crispata Linné.

Mya crispata Linné, Syst. Nat., Ed. x., p. 670, 1758.
Pholas crispata Linné, Syst. Nat., Ed. xii., p. 1111, 1767.
Pholas bifrons Da Costa, Brit. Conch., p. 242, pl. 16, fig. 4, 1778.
Pholas parva Da Costa, Brit. Conch., p. 247, 1778. (Young shell.)
Solen crispus Gmelin, Syst. Nat., vi., p. 3228, 1792.

Pholas lamellata Russell, Essex Journ., i., p. 50, 1839 (not Turton).
Zirfæa crispata Gray, Ann. Mag. Nat. Hist., 2d Ser., viii., p. 385, 1851.
Zirphæa crispata (Gray) Leach, Moll. Gt. Brit., p. 252, 1852.
Thurlosia crispata Tryon, Mon. Pholadacea, p. 83, 1862; (not in Leach as cited by Tryon !)

Miocene (?) of New Jersey near the mouth of Shark River, Whitfield (in United States National Museum); Pleistocene of Labrador and boreal eastern America; recent in northeastern America from the Arctic Seas south to New York and possibly to North Carolina.

I have been unable to trace the *Thurlosia* synonyme further than Tryon. It does not occur in the Mollusca of Great Britain, from which he cites it. If Agassiz's reference be correct it would antedate *Zirphæa* and *Zirfæa*, but I cannot discover the publication to which he alludes, and therefore retain what appears to be the earliest identifiable name. There is some doubt as to the age of the New Jersey fossil; at least it has the appearance to me of being newer than the Miocene.

The *Pholas semicostata* H. C. Lea, which in 1889 I referred with doubt to *Zirfæa*, probably belongs with *Teredina*. It is a very peculiar form, and the species has not yet been found in a fossil state. The *Zirfæa* from the northwest coast of America, referred by Carpenter to *Z. crispata*, is a distinct though allied species, called *Z. Gabbii* by Tryon, and found fossil in the Pleistocene of California as well as living, there and northward. Another species, *Z. dentata* Gabb (Pal. Cal., ii., p. 18, pl. 3, figs. 31–31 *a*, 1866), is found in the Californian Pliocene. *Z. plana* White (Bull. U. S. Geol. Surv., No. 51, p. 15, pl. iv., fig. 22, 1889) is from the Tejon Eocene near Martinez, California.

Subfamily JOUANNETINÆ Tryon.

Anterior gape closed in the adult by a calcareous deposit, or "callum," attached to either valve and the edges of which meet in the middle line below; valves with one or more radial sulci, and with one or more accessory plates.

Genus PHOLADIDEA Goodall.

Pholadidea Goodall, in Turton, Conch. Dict., p. 147, 1819. Type *P. Loscombiana* Goodall (= *Pholas papyraceus* Turton, Dith. Brit., p. 2, 1822, + (?) *Pholas papyraceus* Solander MS., 1788).
Cadmusia Leach, Moll. Gt. Brit., p. 254, 1852; same type.

Shell with a double anterior accessory plate (protoplax), the other plates present or absent, the valves prolonged behind into leathery or testaceous cups or a tube (siphonoplax) for the protection of the siphons.

Subgenus **PHOLADIDEA** s. s.

Shell with a double, rather small, protoplax, the siphonoplax cup-like, the other accessory plates wanting; a single radial sulcus. Type *P. Loscombiana* Goodall.

Section *Penitella* Val., 1846.

Like *Pholadidea*, but with a small mesoplax, the two parts of the protoplax confluent. Type *Pholas penita* Conrad, 1838 (+ *P. concamerata* Desh., 1840, + *P. Conradi*, Val., 1846). *Pholameria* Conrad, 1865, is probably synonymous.

Section *Nettastomella* Carpenter, 1865.

Like *Pholadidea*, but small, with the siphonoplax prolonged as diverging flaps. Type *P. Darwini* Sowerby (= *P. penita* Tryon, not Conrad).

Section *Hatasia* Gray, 1851.

Like *Pholadidea*, but with the siphonoplax prolonged into a shelly tube. Type *P. melanura* Sowerby (= *P. Wilsoni* Conrad, 1849).

Genus **PARAPHOLAS** Conrad, 1849.

Shell with a single large protoplax, the mesoplax and metaplax present, double but confluent; a double hypoplax present; valves with two radial sulci, the posterior becoming obsolete with age; the siphonal prolongations thin and horny, not attached to a heavy calcareous tube, which is formed from débris by the animal around the siphonal opening of its excavation; this differs from the siphonoplax of *Pholadidea* in not being an original secretion of the animal. Type *P. californica* Conrad (+ *P. Janellii* Desh.).

Genus **MARTESIA** Leach.

Martesia Leach, in Blainville, Man. de Mal., i., p. 632, 1825. Type *P. clavata* Lam. = *Pholas striata* Linné.

Shell with a large protoplax, elongated metaplax, and a double confluent narrow hypoplax; mesoplax and siphonoplax wanting; valves with a single radial sulcus.

This is one of the oldest and most prolific groups of Pholads, both in the Tertiary and existing faunas.

The mutations which occur between youth and the adult condition in Pholads are so great that the young shell may sometimes be referred with equal plausibility to several genera, hence the references of our Tertiary forms following must be taken as merely provisional.

These species appear to be referable to *Pholadidea: P.* (*Pholameria*) *triquetra* Conrad (1848) is a young shell from the Vicksburgian Oligocene and resembles a young *Pholadidea.* It has no characters upon which the undefined genus *Pholameria* Conrad (1865) can be maintained. *Pholadidea* (*Penitella*) *penita* Conrad, 1838 (+ *P. spelæa* Conr., 1855), and *P.* (*P.*) *ovoidea* Gould, 1853, are known from the Pleistocene of California and may turn up in older horizons. *Zirfæa plana* White, which is a young shell, may eventually find a place hereabouts.

Parapholas is represented in the Eocene marls of New Jersey by *P. Kneiskerni* Whitfield (Lam., Eo. N. J., p. 241, pl. 30, figs. 22–24, 1885); and in the later Tertiaries of California by *P. californica* Conrad, also found recent on the same coast.

The genus *Martesia* includes *M. elongata* Aldrich, 1886, from the Chickasawan Eocene of Bell's Landing, Alabama; *M. texana* Harris, 1895, from the Claibornian of Texas; *M. clausa* Gabb, 1866, from the Tejon Eocene of California; *M. striata* Linné is reported by Guppy and Gabb from the Pliocene of Trinidad and Costa Rica; *M. cuneiformis* Say, 1822, from the Miocene of Yorktown, Virginia, and the Pleistocene of South Carolina; and *M. intercalata* Cpr., 1857, from the same horizon in California. *Martesia Dalli* Harris, 1895, from the Midway Eocene of Georgia, appears from the figure to be more like a *Gastrochæna;* it is certainly not a *Martesia. M. sphæroidalis* Guppy, from Bowden, is probably referable to another group.

The following species may be a *Martesia*, though there is no trace of any accessory valves except the protoplax.

Martesia ? ovalis n. s.

Plate 36, Figure 5.

Miocene of Maryland, at Plum Point; Harris.

Shell small, short; valves somewhat lozenge-shaped with a single, nearly median, radial furrow; in front of the furrow the valve is covered with crowded, fine, somewhat pectinated lamellæ; behind, sculptured only with rather coarse concentric incremental lines; the posterior termination bluntly rounded; umbonal reflection small, solid, standing up vertically from the shell with a thickened edge; callum smooth, meeting that of the opposite valve without overlapping; protoplax enormous, extending nearly as far back as the ends of the valves and similarly forward to the anterior ends, but broken here so that it is not certain how far it may have curved anteriorly; the lateral edges are not complete, but the general form seems to have been oval or rounded, with no signs of segmentation, furrows, or additional accessory plates, which, indeed, would be quite needless. Lon. 12, lat. 8.5, diam. 7 mm.

This singular shell recalls *Martesia obtecta* Sby. in its enormous protoplax. Say's description of his *Pholas ovalis* is insufficient to identify his shell without a figure or typical specimen. I have wondered if it could be possible that the "tube" in which his shell is said to have been enclosed could by any chance have been a poorly observed or imperfect protoplax of this kind. It is, of course, impossible to decide without further information, but Say's descriptions are usually so clear and good, and his observing powers were so keen, that I can hardly suppose him to have used the word "tube" for an appendage of this kind without some explanation or modification.

This species appears to be related to the *Pholas scutata* Deshayes (An. s. Vert. Bassin de Paris, i., p. 137, pl. vi., figs. 5, 6, 1860), for which and similar species he proposed the sectional name *Scutigera*. This name being preoccupied since 1802 for a genus of *Myriapods*, Fischer proposed to replace it by *Aspidopholas* (Man., p. 1137, 1887). The French species secretes a calcareous tube or siphonoplax, though none such was found with the present shell. This may be due to immaturity or other accidental circumstance, and the adults may possess such a tube, which may be what Say referred to.

Genus **XYLOPHAGA** Turton.

Xylophaga Turton, Dithyra Brit., p. 527, 1822. Type *X. dorsalis* Turton. (Not *Xylophagus* Meuschen, 1788.)

Shell like that of *Teredo*, but with a double protoplax and the internal apophyses obsolete; soft parts contained within the shell, without callum, siphonoplax, or calcareous tube. There is sometimes a calcareous lining to the excavation made by the animal, according to Fischer, but none of the borings I have seen from this animal exhibit it.

If, according to the very obnoxious practice of some authors, the name *Xylophaga* must be rejected on account of the existence of the ancient synonyme *Xylophagus*, the name might be changed to *Xylotomea*, but our own opinion is strongly adverse to such changes.

Xylophaga mississippiensis Aldrich, 1886, has been described from the Eocene of Newton, Mississippi, but from the figure it is somewhat doubtful if the species is really a member of this genus. *Pholas rhomboidea* H. C. Lea, 1845, from the Miocene of Petersburg, Virginia, is probably a *Xylophaga*.

A species of *Xylophaga* too imperfect for description was obtained by Henderson and Simpson from the Oligocene marl of Bowden, Jamaica.

Subfamily TEREDININÆ Tryon.

Shell forming an undivided callum and tube continuous with the valves when adult, thus enclosing the animal completely, as in *Fistulana*, with the external surface of the valves visible on the outside of the tube.

Genus SCYPHOMYA Dall.

Shell resembling that of *Pholadidea* s. s., and with similar dorsal plates; callum voluminous, tube short, subconical, irregular, simple. Type *Pholas semicostata* H. C. Lea (Bost. Journ. Nat. Hist., v., pl. 24, fig. 1, 1844). Coast of the Carolinas.

The shell differs entirely from that of *Teredina*, but the manner of forming a tube is much the same. It is probable that there is a pedal fissure in the callum, but the specimens studied did not have this part intact. Lea describes apophyses, but they are no longer present on my specimens, in which the cardinal margin recalls that of *Xylophaga*.

Genus TEREDINA Lamarck.

Teredina Lamarck, An. s. Vert., v., p. 438, 1818. Type *T. personata* Lam., from the Lower Eocene of Paris.

Shell like that of *Xylophaga*, with a pedal fissure in the middle line of the callum, the tube elongate, subcylindric, sometimes distally bifid or partially septate; umbones covered by four accessory valves soldered to the dorsal extension of the callum, probably representing a double protoplax and mesoplax.

This group differs from *Teredo* by the inclusion of the valves in the tube and the absence of siphonal "pallets," as well as the presence of dorsal accessory plates.

Teredina bowdeniana n. s.

PLATE 36, FIGURE 4.

Oligocene marl of Bowden, Jamaica; Henderson and Simpson.

The specimen obtained is the portion of a tube containing most of the left valve of a *Teredina*, with very marked sculpture. The anterior border is formed by a narrow, irregularly broken strip of the shelly matter belonging to the missing tube. The thin posterior border of the valve is not intact, though enough remains to show the character of the sculpture. The sculpture of the anterior part of the valve is composed of small, four-sided lozenges, separated by sharp, narrow, arcuate grooves in such a way as to produce the effect of a parting on the periphery of the valve. This grooved and faceted sculpture ceases abruptly behind, but the rows of facets are continued as wider longitudinal riblets posteriorly. The umbonal reflection is heavy and radially striate; the apophysis seems to have been obsolete and its remains appressed to the internal arch of the umbo. The whole is rather thick and solid, and the antero-posterior length of the fragment is six and a half millimetres.

The very distinct sculpture of this shell instantly distinguishes it from any other known *Teredina*.

The only other Pholads of which I find any mention in our Tertiary literature are *P. ovalis* Say, which may be a *Fistulana*, and will be later referred to under that head; and *Pholas petrosa* Conrad (Bull. Nat'l Inst., ii., p. 193, pl. 2, fig. 4, 1842; and Am. Journ. Sci., 2d Ser., i., p. 213, pl. 2, fig. 1, 1846), which is not a Pholad,* though externally much like one.

Superfamily MYACEA.

Family GASTROCHÆNIDÆ.

Genus **GASTROCHÆNA** (Spengler) Cuvier.

< *Gastrochæna* Spengler, Nova Acta Soc. Sci. Hafn., ii., p. 174, 1783; Desh., Traite de Conchyl., i., p. 26, 1844.

< *Chæna* Retzius, Nov. Test. Gen., p. 19, 1788; Schum., Essai, p. 94, 1817.

< *Mytilus* Bruguière, Encyc. Méth., pl. 219, 1792.

< *Fistulana* Bosc, Hist. Nat. Coq., ii., p. 208, 1802.

Trapezium β, Megerle, Entw., Neuen Syst. Schal., p. 69, 1811.

Gastrochæna Cuvier, Regne An., ii., p. 490, 1817; Lam., An. s. Vert., v., p. 446, 1818.

Rocellaria (Fleuriau MS.) Blainv., Dict. Sci. Nat., vol. 57, p. 244, 1828 (*G. modiolina* Lam.); Tryon, Mon. Pholad., p. 39, 1862.

Roxellaria Menke, Syn., p. 121, 1830; Agassiz, Nom. Zool., 1845.

Gastrochæna Fischer, Man. de Conchyl., p. 1128, 1887.

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* *Phenacomya* n. g. Shell thin, feebly radially sculptured, pholadiform; more or less expanded and truncate anteriorly, adult with a narrow dorsal gape in front of the beaks, shell closed below, equivalve; young with a wide anterior gape which is gradually closed with growth as shown by the incremental lines; shell attenuated and smoother posteriorly. Type *Pholadomya cuneata* Sowerby, Desh., An. s. Vert. Bassin de Paris, i., p. 277, pl. ix., fig. 6–8, 1868.

It is very doubtful if the group represented by this type has any very close relation to *Pholadomya*.

The American representatives are *Pholas petrosa* Conrad, above cited, and *Pholadomya Mauryi* Harris, Bull. Pal., iv., p. 71, pl. 6, fig. 17 *a*, 1896. All are Eocene and, so far as known, the genus is Eocene only.

Shell regular, equivalve, inequilateral, ovoid, widely gaping, with the umbones anterior; sculpture concentric, feeble, forming flask-shaped excavations (chiefly in shells and corals) which are lined with calcareous matter, or when not protected by the burrow, forming a partial or complete shelly tube to which extraneous matter is attached. Type of the restricted group *G. dubia* Don. (+ *G. modiolina* Lam.).

Subgenus SPENGLERIA Tryon, 1862.

Valves truncated behind, the beaks not so near the anterior end, with an elevated area triangular and transversely lamellose, radiating from the beak to the truncation on each valve.

Type *G. rostrata* Spengler (+ *mytiloides* Lam.).

Under the impression that the adventitious tube was a constant character Gould separated *G. lagenula* (= *G. cymbia* Spengler) as a genus under the name of *Cucurbitula* (Proc. Boston Soc. N. Hist., viii., p. 22, 1861), but later writers regard the formation of this sort of tube as accidental and possible with any of the species.

Chæna Retzius is a complete synonyme of *Gastrochæna* Spengler. Cuvier was the first to restrict the genus and to discriminate between *Gastrochæna* proper and *Spengleria*. *Rocellaria* Fleuriau was founded on the type of Cuvier, ten years later, and *Rupellaria* Fleuriau was confused by Tryon with *Rocellaria*, probably by heterophemy.

This genus extends well into the Mesozoic, and in the basal Eocene is represented by *G. gainesensis* Harris (Bull. Pal., iv., p. 70, pl. 6, figs. 12, 12 *a*, 1896), from the Midway horizon of Georgia, *G. Dalli* Harris (as *Martesia*, *op. cit.*, p. 71, pl. 6, fig. 15), and *G.* (*Spengleria ?*) *cimitariopsis* Harris (*op. cit.*, p. 70, pl. 6, fig. 13), from the same horizon. From the Claibornian come *G. larva* Conrad (Am. Journ. Sci., 2d Ser., i., p. 212, pl. 2, fig. 5, 1846; Aldr., Bull. Pal., ii., p. 71, pl. 5, fig. 12, 1895) and *G. subbipartita* O. Meyer, which has neither been described nor figured (cf. Ber. Senck. Ges., 1887, p. 12). Burrows are not uncommon, and have been described by Meyer from Claiborne and by Clark from the Eocene of Maryland and Virginia.

Gastrochæna ovata Sowerby.

Gastrochæna ovata Sowerby, P. Z. S., 1834, p. 21; Hanley, Descr. Cat. Rec. Sh., p. 10, pl. ix., fig. 42, 1842; Cpr. Mazatlan Shells, p. 15, 1857.

Rocellaria ovata Tryon, Mon. Pholad, p. 49, 1862.

Recent from the Carolinas to the West Indies, and on the west coast of America at Mazatlan.

Variety **rotunda** Dall.

Oligocene of the Chipola marls, Chipola River, Florida, Burns; of the silex beds at Ballast Point, Tampa Bay, Florida, Dall; of the Bowden marl, at Bowden, Jamaica, Henderson.

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. Lon. 7, lat. 3.5, diam. 2.8 mm.

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.

Gastrochæna ligula H. C. Lea.

Gastrochæna ligula H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 234, pl. 34, fig. 6, 1845; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863.

Oligocene of the Oak Grove sand at Oak Grove, Santa Rosa County, Florida, Burns; Miocene of the Natural Well, Duplin County, North Carolina, Burns; and of Virginia, at Petersburg, Lea.

This shell is distinguishable from the others by its narrow and slender form and feeble concentric striation.

Gastrochæna cuneiformis Spengler.

Gastrochæna cuneiformis Spgl., Nova Acta Soc. Hafn., ii., p. 179, figs. 8–11, 1788; Lam., An. s. Vert., v., p. 447, 1818; Sby., Gen., figs. 3–5, 1820; Orbigny, Moll. Cubana, ii., p. 228, 1845.

Pholas hians Gmelin, Syst. Nat., vi., p. 3217, 1792.

Chæna cuneiformis Retzius, Diss. Nov. Test., p. 19, 1788.

Fistulana rupestris Bosc, Hist. Nat. Coq., ii., p. 205, 1802.

Rocellaria hians H. and A. Ads., Gen. Rec. Moll., ii., p. 336, 1856; Tryon, Mon. Pholad., p. 47, 1862.

Pliocene marl of the Croatan beds, North Carolina, Johnson; of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; of Trinidad, Guppy; Pleistocene of South Carolina, Florida, and the West Indies; recent from Cape Fear, North Carolina, southward to the West Indies.

This species can be readily recognized by its vast hiatus, nearly as long as the shell, and the rather blunt and wide posterior termination of the valves. *Rocellaria antiqua* Gabb from the Miocene of James River, Virginia, has not been figured, but the description (Proc. Acad. Nat. Sci. Phila., 2d Ser., v., p. 368, 1861) reads very much like the present species.

Genus **FISTULANA** (Bruguière) Cuvier.

Fistulana Bruguière, Enc. Méth., i., p. xii., 1789; *ib.*, pl. 167, 1792; name only, no species cited; Cuvier, Tabl. Elém. Hist. Nat., p. 432, 1798; (*Teredo clava* Linné;) Lam., Prodrome, p. 90, 1799 (same type).

Chæna Gray, P. Z. S., 1858, p. 315; (not of Retzius, 1788.)

Gastrochæna Tryon, Man. Pholad., p. 38, 1862; (not of Cuvier;) Cossmann, Eoc. Bassin de Paris, i., p. 9, 1886.

Bruguière was the first to name *Fistulana*, though he did not describe it or cite any species. Cuvier supplied a type, and this was adopted by Lamarck. For some time later, however, Fistulanas and Gastrochænas were confounded in lists of the genus, while Gray injudiciously endeavored to utilize *Chæna* as a name for this group. Tryon became badly confused on the generic nomenclature of this group, which was rectified by Fischer in 1866.

Conrad (Fos. Tert. Form., p. 34, 1835) enumerates *Fistulana elongata* Deshayes as a member of the Claiborne fauna, but it does not appear in his later lists, and may very possibly be the shell he called *F. larva*, which is a *Gastrochæna*. The only possible *Fistulana*, as here restricted, which appears to have been reported from the American Tertiaries, is *F.? ovalis* Say (as *Pholas*), 1820, from the Miocene of Maryland, which has never been figured, and of which the type specimen seems to be lost. It is represented as being contained in a tube, yet also as boring into *Perna torta*, which suggests *Gastrochæna*. I am now able to include the genus in our fauna from an earlier horizon.

Fistulana ocalana n. s.

PLATE 35, FIGURE 23.

Oligocene of the Ocala or nummulitic limestone, Ocala, Florida; Willcox.

Tube straight, claviform, with slight indications of annulation and adherent extraneous matter; anterior end larger, anterior disk convex, subcircular. Lon. (incomplete) 55, lat. (ant.) 12.5, (post.) 9 mm.

Though the specimen is merely a limestone cast of an external mold of the tube, there can be no question as to the generic place of the species.

The little irregularities, especially notable near the anterior end, are probably due to attached particles of gravel on the original tube.

Family SAXICAVIDÆ.

Genus PANOPEA Ménard.

Panopea Ménard, Annales du Mus. Paris, ix., p. 135, 1807; Goldf., Handb. d. Zool., p. 677, 1820.

Glycimeris Lamarck, Prodrome, p. 83, 1799. Type *Mya glycymeris* Born. (Not *Glycymeris* Da Costa, 1778, nor *Glycimeris* Lam., 1801, nor Schumacher, 1817.)

Panopæa Lam., Extr. d'un Cours., p. 108, 1812; An. s. Vert., v., p. 456, 1818; Valenciennes, Arch. du Mus. Paris, 1, p. 3, 1838.

Panopia Swainson, Malac., p. 367, 1840.

Glycimeris H. and A. Adams, Gen. Rec. Moll., ii., p. 350, 1856; Gray, Fig. Moll. An., v., p. 30, 1857.

This well-known genus, after the exclusion of the Saxicavoid species, forms a very natural group, related to the *Myacidæ* on the one hand and to *Saxicava* on the other. Some pearly forms formerly confounded with it have long been eliminated, and have relations, no doubt, with *Anatinacea*.

I have had the advantage of an opportunity to study several Pacific coast forms in life and in their natural surroundings, as well as a very large series of our Tertiary species, and also a fair series of most of the recent exotic species. For that reason, perhaps, the following conclusions will have a certain value, which is only derived from a somewhat extended range of observation of the animals themselves.

All boring mollusks in which the shell has so degenerated that it no longer covers the whole adult animal when retracted are more liable to variation in minor details than those in which the valves meet distally, and dynamically influence their own development by fixing for it certain definite limits. This is markedly the case in the present genus. Those shells which live in an easily movable medium, such as sand or fine, soft mud, are thinner, better developed, more elongated, and less distorted than their congeners who are obliged to confine themselves to a gravelly or stony *situs*. So marked is the difference that I have several times been presented with supposed new species based on these dynamic characters, and, by a curious reversal of logic, have been assured that the differences must be specific, because the animals inhabited, respectively, the different kinds of ground alluded to.

I have observed, also, that where the ground into which the burrowers retire is a comparatively thin coating over a stony or rocky layer which they cannot pierce, the tendency in *Panopea*, *Mya*, etc., is for relatively short and broad shells, with shorter siphons, to survive; which naturally have a wider, shorter, and more rounded pallial sinus, and shorter and more incurved nymphs. I believe the influence of the environment is direct and not selective; at all events, the association of *situs* and specimens so characterized is, as far as I have been able to determine, quite uniform, whether selective or not.

It is extremely puzzling to endeavor to determine, out of a very large series of specimens from one locality, how far the interchangeable variations which present themselves can be regarded as differential in a systematic sense; and, in the end, one has to rely more on a general habit of growth recognizable with experience, but difficult to diagnose in language which shall not be more prescriptive than the actuality. There is no difficulty in making a description; the trouble is, as in so many other cases, to make a differential yet just and impartial diagnosis.

In addition to the differences more or less evidently due to *situs* there are a series of differences which occur among specimens of a single species from apparently the same *situs*, both in the fossil and recent forms. These include a nearly rectilinear as compared with an arcuate hinge-line, and a short as opposed to a long insertion of the ligament. The length of the ligament is perhaps coördinated with the heaviness of the valves, but the differences alluded to occur so constantly that I have been led to suspect that they might be due in part to differences correlated with sex in this genus.

From the Chickasawan Eocene Harris has described (as *Glycymeris*, Bull. Pal., ix., p. 69, pl. 13, fig. 16, 1897) *P. alabama*, a species which he had previously (Proc. Acad. Nat. Sci. Phila. for 1896, p. 475, pl. 22, fig. 4) regarded as a variety of *P. porrectoides* Aldrich (Bull. Ala. Geol. Surv., i., p. 37, pl. 4, fig. 3, 1886), which was described from nearly the same horizon. Conrad (Proc. Acad. Nat. Sci. Phila., iii., p. 290, 1848, and Journ. Acad. Nat. Sci., 2d Ser., i., p. 121, pl. 13, fig. 12) has described *P. oblongata* from the Vicksburgian. This is distinguished from the similar *P. elongata* Conrad (Trans. Geol. Soc. Penna., i., p. 339, pl. 13, fig. 1, 1835; and Am. Journ. Sci, 2d Ser., i., p. 214, pl. ii., fig. 2, 1846; not of Roemer, Verst. Oolith., p. 126, pl. 8, fig. 1, 1836) of the Eocene of Maryland, Virginia, and the District of Columbia by its more anterior and prominent umbones. The former also occurs in the Jacksonian.

Panopea Whitfieldi Dall.

Panopea Goldfussii Whitfield, Mio. Marls N. J., p. 89, pl. 16, figs. 9–13, 1895; not of Wagner, 1838.

Oligocene of the silex beds at Ballast Point, Tampa Bay; of the Chipola River and Oak Grove, Santa Rosa County, Florida, Burns; and mixed with Miocene species in the rehandled marl of Jericho, Cumberland County, New Jersey, Burns.

This species differs from the typical Miocene *P. Goldfussii* Wagner in its smaller size, more equilateral valves, and less expanded anterior region.

Panopea Goldfussii Wagner.

P. Goldfussii Wagner, Journ. Acad. Nat. Sci. Phila., viii., p. 52, pl. 1, fig. 3, 1838; Trans. Wagner Inst., v., p. 8, 1897.

P. porrecta Conrad, Fos. Medial Tert., p. 71, pl. 41, fig. 2, 1842.

Miocene of Maryland at Jones's Wharf, Plum Point, Langley's Bluff, St. Mary's, Calvert Cliffs, and on the Choptank River; of Virginia at Suffolk and on the Nansemond River, Nomini Cliffs, and Grove Wharf, Burns and Harris; and in the upper bed at Alum Bluff, Chattahoochee River, Florida, Burns.

This species, though varying like the others, may almost always be distinguished by its expanded anterior end, and elongated and attenuated posterior part. It is very close to the European *P. Rudolphii* Eichwald, *P. Basteroti* Valenciennes, and *P. Menardi* Deshayes, which, from the figures, appear to be pretty much one and the same species. The last two are united by Deshayes himself in manuscripts in my possession, Deshayes's name being the prior one.

P. porrecta Conrad is identical with this species.

Panopea reflexa Say.

P. reflexa Say, Journ. Acad. Nat. Sci., iv., p. 153, pl. 13, fig. 4, 1824; Conrad., Med. Tert., p. 5, pl. 3, fig. 4, 1838.

P. Faujasi Conrad, in Morton, Syn. Org. Rem., p. 3, 1834; not of Ménard.

P. cymbula Heilprin, Trans. Wagner Inst., i., p. 91, pl. 9, fig. 20, 1887.

P. reflexa Emmons, Geol. Rep. N. Car., p. 300, fig. 299, 1858.

Miocene of Gay Head, Martha's Vineyard, Massachusetts; of Grove Wharf and Suffolk, Petersburg, and York River, Virginia; of Wilmington, Magnolia, and the Duplin County Natural Well, North Carolina; of the Peedee River and Darlington, South Carolina.

This species is characterized by the swollen and rounded anterior end, without pedal truncation, and the attenuated posterior end, with the dorsal margin more or less reflected. It is a smaller shell and less equilateral than the Pliocene form confused with it by Heilprin. The distinctions he mentions between it and the original *reflexa*, as figured by Say, are inconstant, and if the number of specimens had been as large as that at my disposal, doubtless he never would have separated them. The *P. Menardi* of Deshayes is related to *P. Goldfussii*, and much less so to this species. Stunted specimens of *P. reflexa* are often quite broad and very puzzling. The depth of the pallial sinus differs quite markedly between individuals, and also its width, the shorter specimens, as usual, having the wider sinus.

Panopea americana Conrad.

P. americana Conr., Fos. Medial Tert., p. 4, pl. 2, fig. 1, 1838.

Miocene of Calvert Cliffs, and very abundantly at Jones's wharf, also on the Patuxent and St. Mary's River, Maryland, and at Coggins Point, Virginia.

This fine species is the American analogue of the European *P. glycymeris* Born (1780), from which it differs by its smaller and heavier shell and deeper and narrower pallial sinus. It is immediately recognizable by its pedal truncation and oblique posterior margin. The European shell is more generally known by the later name of *P. Aldrovandi* Menard, 1807.

Panopea generosa Gould.

P. generosa Gould, Proc. B. Soc. Nat. Hist., iii., p. 215, 1850; Moll. Wilkes Expl. Exp., p. 385, pl. 34, fig. 507.

Glycimeris generosa Carpenter, Suppl. Rep. Brit. Assoc., 1863, p. 637; Cooper, Cat. Cal. Fos., 7th Ann. Rep. State Mineralogist, California, p. 241, 1888.

Miocene of Contra Costa and Santa Barbara Counties, California; Pliocene of Santa Barbara and San Fernando, California; Pleistocene of Santa Barbara and San Pedro, California, Cooper; recent from Puget Sound south to the Gulf of California, Gould, Stearns, and Palmer.

This fine species is widespread and variable. Gabb unites to it the *Mya* (= *Panopea*) *abrupta* of Conrad (Wilkes Expl. Exp., Geol., p. 723, pl. 17, fig. 5, 1849) and the *Glycimeris estrellana* Conrad (Pac. R. R. Reps., vii., p. 194, pl. 7, figs. 5, 5 *a*, 1857). After a comparison of the figures and specimens I conclude that Conrad's two species are identical, and as Deshayes used the name *abrupta* for a *Panopea* in 1843, the specific name of *estrellana* would best be retained for this Miocene fossil of Oregon and California. The latter, however, seems entirely distinct from the *P. generosa*, being a smaller, more slender, and more equilateral species. The latter has several varieties which are so marked in form that it is perhaps best to assign them varietal names.

Panopea generosa Gould, typical form.

Shell rather thin, nearly equilateral, the beaks slightly anterior, the dorsal and ventral margins in the full-grown shell parallel and nearly straight, the pedal margin evenly rounded, the nymph narrow, and the attached edge of the ligament very short, the pallial sinus wide and shallow. Lon. 182, alt. 110, diam. 60 mm. Puget Sound.

Panopea (var.) *solida* Dall.

Shell heavy, somewhat arcuate, the pedal region slightly obliquely truncated, the nymph strong, and the ligamentary attachment twice as long as in the typical form, the pallial sinus deeper. Lon. 177, alt. 97, diam. 62 mm. San Francisco, California.

Panopea (var.) *globosa* Dall.

Shell thin, short, inflated, the beaks nearer the anterior end, which is expanded and rounded in the pedal region; posterior end narrower, opposite margins not parallel; posterior hiatus smaller than in the type and somewhat recurved; nymph narrow, slender, somewhat longer than in the type; pallial sinus small, wide. Lon. 160, alt. 120, diam. 80 mm. Head of the Gulf of California; Palmer.

The last variety is only known from the locality cited, the other two are found from Puget Sound to San Diego, California.

Panopea floridana Heilprin.

P. floridana Heilprin, Trans. Wagner Inst., i., p. 91, pl. 10, fig. 21, 1887.
P. Menardi Heilprin, *op. cit.*, p. 90, pl. 9, fig. 19, 1887; not of Deshayes.
P. navicula Heilprin, *op. cit.*, p. 91, pl. 10, fig. 22, 1887.

Pliocene of the Caloosahatchie beds, on the Caloosahatchie, Shell Creek, and Alligator Creek, Florida; Dall and Willcox. Recent at Cape Lookout, North Carolina, Bickmore; and at Mobile Point, Mississippi, Conrad.

The form referred to *Menardi* by Heilprin is a distinct species from that and from the American Miocene forms usually called *reflexa* Say. In the writer's opinion there is but one species of *Panopea* in the Florida Pliocene, so far as yet described, and its mutations are analogous to those observed in *P. generosa* and other species of which a large series has been studied. If a varietal name be thought advisable for the arcuate form, *navicula* might be used in this sense. The form called by Heilprin *floridana* corresponds to the variety *solida* of *P. generosa*, and the form he referred to *Menardi* to the typical *generosa*.

Panopea dubia H. C. Lea (1845), probably a *Sphenia*, is not a *Panopea*, as it has a chondrophore like *Mya*. It is from the Miocene of Petersburg, Virginia. The various synonymes of the so-called *Panopea norvegica* will be found under *Panomya*. *P. bitruncata* Conrad (Proc. Acad. Nat. Sci. Phila. for 1872, p. 216, pl. 7, fig. 1) has not yet been found in a definitely fossil state, but is known as recent from North Carolina to Tampa, Florida. The *Pholadomya abrupta* Conrad (Fos. Tert. Form, p. 26, 1832) was wrongly referred to *Panopea* by Deshayes and others; it appears to be allied to *Pholadomya*, is a pearly shell and the type of the genus *Margaritaria* Conrad (Mio. Checkl., 1863, + *Actinomya* C. Mayer, Mus. Zurich, 1870), and which may perhaps include subgenerically *Argyromya* Fischer (Man., 1887), founded on the *Panopea margaritacea* Deshayes, from the Parisian Eocene.

Genus **PANOMYA** Gray.

Panomya Gray, Figs. Moll. An., v., p. 29, 1857; H. and A. Ads., Gen. Rec. Moll., ii., p. 659, 1858. Type *Panopea* (*Mya*) *norvegica* Spengler.

Chenopea C. Mayer, Tert. Moll. Mus. Zurich, iv., 1885.

Panopea and *Saxicava* of authors.

Shell solid, large, irregular, with a single cardinal tooth under the beak in each valve; the pallial line of unconnected rounded impressions; the animal larger than the shell, with large, united siphons, diverging slightly at the tips and covered with a wrinkled coriaceous epidermis; a burrower in mud and gravel, never perforating stones. Type

Panomya norvegica Spengler.

Mya norvegica Spgl., Acta Soc. Hist. Nat. Hafn., iii., p. 46, pl. 2, fig. 18, 1793.

Glycimeris arctica Lam., An. s. Vert., vi., p. 458, 1819; Gould, Inv. Mass., p. 37, fig. 27, 1841.

Panopæa Spengleri Val., Arch. du Mus. Paris, 1, p. 15, pl. 5, fig. 3, 1838; Chemn., Ill. Conch., pl. 4, fig. 4.

Panopæa Bivonæ Philippi, Moll. Sicil., i., p. 8, pl. 2, fig. 1, 1836; Smith, Wern. Soc. Mem., viii., p. 107, pl. 2, fig. 4.

Panopea glycimeris Bean, Ann. Nat. Hist., viii., p. 562, pl. 50, 51, 1835.

Panopæa arctica Hanley, Ill. Cat. Rec. Sh., p. 18, pl. 10, fig. 43.

Panopæa norvegica var. *nana*, Sby., Min. Conch., vii., p. 1, pl. 610, fig. 2, and 611, figs. 1, 2, 1829.

Panopæa Middendorffii A. Adams, P. Z. S., 1854, p. 137; *fide* Woodward, P. Z. S., 1855, p. 221; Reeve, Conch. Icon., xix., pl. vi., fig. 8, 1873.

Pliocene of Italy and France; Pleistocene of the boreal North Atlantic and Pacific coasts; recent in the Arctic and boreal seas of both hemispheres, on the Pacific south to the Aleutians, and on the Atlantic in cold, deep water to the Mediterranean.

Panomya ampla Dall.

Panopæa norvegica Midd. (pars), Mal. Ross., iii., p. 78, pl. xx., fig. 11, 1849; not of Spengler.

Pleistocene of the North Pacific, Bering, and Okhotsk Seas, and recent in the same region.

This differs from *P. norvegica* by its much more heavy and rude shell, with a more expanded posterior region, and flatter, more irregular valves.

Genus SAXICAVA Fleuriau de Bellevue.

Hiatella Daudin, in Bosc, Conchyl., iii., p. 120, 1802; Roissy, Man., vi., p. 385, 1805; Lam., Hist. An. s. Vert., vi., p. 29, 1819; Gray, List of Brit. Moll., Brit. Mus., p. 88, 1851.

Saxicava Fleuriau, Bull. Soc. Philom., No. 62, pp. 5, 10, 1802; Lam., An. s. Vert., v., p. 501, 1818.

Shell small, irregular, very inequilateral, the young with a cardinal tooth like *Panomya*, the adult with the teeth obsolete; pallial line discontinuous, siphons naked, slightly separated at the tips and in normal specimens completely retractile, shell burrowing, or nestling in gravel or broken shell, or perforating rocks, corallines, or dead shells like pholads. Type, *Mya arctica* Linné.

It is unnecessary to repeat the formidable list of generic and specific synonymes which the curious may find in Gray's List of British Animals, vii., Mollusca, pp. 87–89, 1851. In this synonymy, which Dr. Gray separates into two parts, allotting *Saxicava* to *S. rugosa* and *Hiatella* to *S. arctica* (which is the young of *rugosa*), he cites a rare memoir of Daudin's for the genus *Hiatella* dating two years before the proposal of *Saxicava* by Fleuriau. Bosc and Roissy do not refer to this memoir, but mention two species from Tranquebar in Favanne's collection, both of which are figured in the atlas to Bosc's work. Lamarck without ceremony refers Bosc's figures to *Mya arctica* Linné, and cites but that single species under the genus. Dr. Gray cites *Hiatella arctica* from Daudin's memoir of 1800, but without mentioning page or figure for it, which leads to the suspicion that he may not have actually seen the paper himself. If his citations be correct, there would seem to be no doubt that *Hiatella* should be adopted in place of the later *Saxicava*, but in the doubt that remains I hesitate to make the change, and would prefer to leave it to some one who can consult the original memoir.* Brown in 1827 (Ill. Conch. Gt. Brit.) takes the same course that Gray did later with regard to the two names, but the *Hiatella* of Costa, 1828, is the same as *Galeomma* Turton, 1822.

Saxicava arctica Linné.

Mya arctica Linné, Syst. Nat., Ed. xii., p. 1113, 1767; O. Fabr. Fauna Grönl., p. 407, 1780.
Solen minutus Linné, *op. cit.*, p. 1115, 1767.
Mya byssifera O. Fabr. Fauna Grönl., p. 408, 1780.
Mytilus pholadis Mohr, Osl. Naturh., p. 135, 1786.
Saxicava striata Fleuriau, Mém. sur les Vers lith., p. 10, 1802.
Glycimeris byssifera Schum., Essai, p. 106, 1817.
Saxicava rugosa Lam., An. s. Vert, v., p. 501, 1818.
Saxicava gallicana Lam., An. s. Vert, v., p. 501, 1818.
Agina purpurea Turton, Dith. Brit., p. 54, pl. 4, fig. 9, 1822.
Hiatella oblonga Turton, Dith. Brit., p. 25, pl. 2, fig. 13, 1822.
Pholeobia præcisa Brown, Ill. Conch. Gt. Brit., pl. ix., fig. 6, 1827.
Saxicava distorta Say, Journ. Acad. Nat. Sci. Phila., ii., p. 318, 1822; Gould, Inv. Mass., p. 61, fig. 40, 1841.
Saxicava bilineata Conrad, Medial Tert., p. 18, pl. 10, fig. 4, 1838.
Saxicava grönlandica Potiez et Mich., Gal. ii., p. 266, pl. 69, figs. 1, 2, 1844.
Saxicava rhomboides Wheatley, Cat., 2d ed., p. 4, 1844.
Saxicava rubra Desh., Expl. Algeria, Moll., pl. 66, fig. 72, 1848.
Saxicava ungana Grewingk, Verh. Russ. Kais. Min. Ges., 1848–9, p. 354, pl. 6, figs. 1 *a*–1 *c*, 1850.
Saxicava insita Conr., Am. Journ. Conch., v., p. 40, 1869.
Saxicava incita Conr., *op. cit.*, p. 101, 1869.
Saxicava protexta Conr., Kerr, Geol. Rep. N. Car., p. 22, pl. 4, fig. 6, 1875.

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* Since this was written I have learned, through the kindness of Mr. Edgar A. Smith, of the British Museum, that there is no mention of *Hiatella* in Daudin's Memoir of 1800.

Miocene of Maryland; of Duplin County, North Carolina; Shiloh, New Jersey; and Alaska; Pliocene of the Caloosahatchie beds, Florida, and of the California coast at San Pedro and Santa Barbara; Pleistocene of northern North America and Europe; recent, almost universally distributed in the temperate and colder seas.

Saxicava abrupta Conrad (Pac. R. R. Reps., v., p. 324, pl. 3, figs. 25, 25 *a*, 1856), from the Pleistocene of San Pedro, California, is indeterminable, but probably not a *Saxicava;* the same may be said of *S. parilis* Conr. (Am. Journ. Conch., ii., p. 70, pl. 4, fig. 6, 1866), from the Miocene marl of Shiloh, New Jersey. *S. pectorosa* Conr. (1834, Medial Tert., p. 18, pl. 10, fig. 3, 1838), from the Miocene of Virginia, is probably a *Petricola,* as is *S. legumen* Deshayes, from the Pleistocene of San Pedro, California. The latter may be identical with *P. carditoides* Conr. *S. myæformis* Conr. (Am. Journ. Conch., ii., p. 70, pl. 4, fig. 6, 1866) is a *Thracia. S. lancea* H. C. Lea (1845) is not a *Saxicava*, but belongs in a group closely related to, or the same as, *Sportella.* The genus *Saxicavella* Fischer (*Arcinella* Phil., 1844, not Oken, 1815, nor Schum., 1817), founded on the little *Mya plicata* Montagu, though present in the European Pliocene, has not been detected in America.

Genus **CYRTODARIA** Daudin.

Cyrtodaire Daudin, Bull. Soc. Philom., xxii., p. 170, 1799.
Cyrtodaria Reuss, Repertor. Comm., p. 351, 1800.
Glycimeris Lam., An. s. Vert., v., p. 457, 1818; not Lam., 1799.
Glycimera Blainv. Malac., p. 571, pl. 80, fig. 3, 1825.

Type *Cyrtodaria siliqua* Daudin.

Cyrtodaria siliqua Daudin.

C. siliqua Daudin, *op. cit.*, 1799.
Mya siliqua Chemn., Conch. Cab., xi., p. 192, pl. 198, fig. 1934, 1795.
Glycimeris incrassata Lam., Syst. An. s. Vert., p. 126, 1801.
Mya picea Wood, Gen. Conch., p. 96, pl. 22, fig. 5, 1815.

Pleistocene of the Arctic and boreal Atlantic coasts; recent from Cape Cod northward to the Arctic coast, and west on the Arctic coast to the mouth of the Mackenzie River; Richardson.

This well-known shell does not seem to have penetrated to the region of Bering Strait, and is only represented in Bering Sea by a diminutive recent analogue, the *C. Kurriana* Dunker.

Family CORBULIDÆ.

Genus **CORBULA** (Bruguière) Lamarck.

< *Corbula* Brug., Encycl. Méth., pl. 230, 1797 (not in Table, 1792); Lam., Prodr., p. 89, 1799; Syst. An. s. Vert., p. 137, 1801; Cuvier, Regne An., ii., p. 486, 1817; Lam., An. s. Vert., v., p. 494, 1818; Turton, Dithyra Brit., p. 38, 1822.

Aloidis Muhlfeldt, Entw., p. 67, 1811. Sole ex. *C. sulcata* Lam.

Lentidium Cristofori et Jan., Catal., p. 8, 1832, and Mantissa, p. 4, 1832; Villa, Disp. Syst., p. 45, 1841; Isis, 1842, p. 473. Type *Corbula mediterranea* Costa (+ *maculatum* Jan.).

Erodona Daudin, Mém. Moll. Vers et Zooph.? 1800; Bosc, Hist. Nat. Coq., ii., p. 329, 1802. Type *E. mactroides* Daudin, Bosc, *l. c.* (but named on pl. 6, fig. 1, *Mya erodona*).

Azara Orbigny, Voy. Am. Mér., Pal., pl. vii., 1839, text, p. 161, 1842; Voy. Am. Mér., Moll., p. 572, 1846. Type *Mya labiata* Maton.

Potamomya Sowerby, Min. Conch., vi., Index, p. 1, 1835; Man. Conch., p. 88, 1839; (not of Orbigny, Voy. Am. Mér., Moll., p. 573.)

Corbulomya Nyst., Coq. Tert. Belg., p. 59, 1846. Type *C. complanata* Sby.

? *Harlea* Gray, Synops. Brit. Mus., pp. 78–91, 1842 (*nom. nudum*).

? *Raleta* Gray, *op. cit.*, p. 91, 1842 (*nom. nudum*); *ibid.*, p. 78, 1844.

? *Tomala* Gray, *op. cit.*, p. 91, 1842; *ibid.*, p. 78, 1844 (*nom. nudum*).

Erodina Gray, P. Z. S., 1847, p. 191.

Pachydon Gabb, Am. Journ. Conch., iv., p. 198, 1868. Type *P. obliqua* Gabb; not *Pacyodon* (Beck MS.) Gray, P. Z. S., 1847, p. 191, nor *Pachyodon* Stutchbury, 1842.

Agina Gray, P. Z. S., 1847, p. 191; Conrad, Am. Journ. Conch., iv., App., p. 63, 1868; Cossmann, Fos. Paris, i., p. 34, 1886; not of Turton, 1822.

Anisothyris Conrad, Am. Journ. Conch., vi., p. 196, 1870 (Oct.).

Anisorhynchus (Conrad MS.) Meek, 2d Prel. Rep. U. S. Geol. Surv. Terr., p. 293, 1872. Type *Corbula pyriformis* Meek.

Cuneocorbula Cossmann, Cat. Coq. Fos. Bassin de Paris, i., p. 37, 1886. Type *C. biangulata* Deshayes.

Bothrocorbula Gabb, Proc. Acad. Nat. Sci. Phila. for 1872, p. 274. Type *Corbula viminea* Guppy.

Bicorbula Fischer, Man. de Conchyl., p. 1125, 1887. Type *C. gallica* Lamarck.

Himella H. Adams, Ann. Nat. Hist., vi., p. 455, 1860; type *H. fluviatilis* Ads. Not of Dallas, 1854.

Not *Corbula* Bolten, Mus. Boltenianum, p. 174, 1798; Ed. ii., p. 128, 1819 (= *Asaphis* Modeer, etc.).

The synonymy of this genus is quite involved. The several valid sections are chiefly separated from each other by differences of form, which intergrade distally, and for convenience in bringing together the various names and references they are included in the above synonymy. The original publication of Bruguière's name is to be found on Plate 230 of the Encyclopédie Méthodique, and not in the earlier printed table of genera. There is, of course, no diagnosis; no species are named, and no references given; merely the name at the top of the plate, upon which the shells figured are not all Corbulas. Authors who accept a name on such a basis have no right, logically, to take exception to any of Bolten's names. Lamarck cited no example in the Prodrome, and the list of specific names in the Système, beginning with *C. sulcata*, appears to be the first occasion when the requirements of nomenclature were complied with. No type was cited even at that time, or for much later, and, curiously enough, the shell figured by Bowdich to illustrate the genus in 1822 is probably not a *Corbula*. Megerle's name was the first applied to *C. sulcata* exclusively, and must be retained for the section of the genus typified by that species. The typical section of *Corbula* will necessarily be reserved for some one of the other forms included in the list of 1801, which are also figured on the above-mentioned plate. This leaves only a choice between *C. margaritacea* and *C. gallica* Lam., and, as the former seems to be some kind of an *Anatina*, we are obliged to fall back upon *C. gallica* as the type of *Corbula* in the stricter sense. This agrees with the arrangement of Nyst, whose first species of true *Corbula*, after segregating *Corbulomya*, is *C. gallica*. The *C. sulcata* group is not sharply separated from the typical *Corbula*, and the peripheral species merge.

Azara and *Potamomya* are exact synonyms of *Erodona*. *Corbulomya* is identical with the earlier *Lentidium*. Gray has contributed a group of *nomina nuda*, based on undescribed species supposed to be *Corbulæ*. An error of Gray, by which *Agina* Turton (based on *Saxicava arctica*) was referred to the *Corbulidæ*, has been widely copied. The supposed type, *Corbula gibba* Olivi, is a true *Corbula*. A group of very remarkable and very variable brackish-water Pliocene species is comprised under the name of *Anisothyris* Conrad (+ *Pachydon* Gabb). The other names stand for fairly distinct sections of the genus.

The following arrangement of the group is proposed:

Genus **CORBULA** senso lato.

Valves unequal, the right usually larger, both more or less rostrate; hinge of (in the right valve) a single large tooth below the beak with a deep resiliary pit behind it and no lateral laminæ; the left valve without laterals, with a more or less prominent process upon which the resilium and ligament are inserted, in front of a socket into which the cardinal tooth of the right valve fits; the posterior margin of this socket is sometimes elevated like an indistinct tooth; beaks prominent, prosogyrate or erect, the right one usually superior to the left; sculpture variable, often discrepant on the two valves, rarely reticulate, and never strongly radial; pallial line with a small sinus or none; lunule and escutcheon usually absent; ligament chiefly internal; siphons complete, usually short, and fringed distally; mantle with a pedal opening but mostly closed ventrally. Chiefly marine.

Section *Corbula* s. s.

Shell subtrigonal, ligament internal; globose; valves feebly concentrically sculptured with no rostral keels, sculpture discrepant on the two valves. Type *C. gallica* Lam. *Bicorbula* Fisher is identical.

Section *Aloidis* Megerle.

Like *Corbula*, but with strong concentric sculpture and keeled rostrum. Type *C. sulcata* Lam. (+ *A. guineënsis* Meg.).

Section *Lentidium* C. and J.

Shell compressed, trapezoid, feebly concentrically sculptured; the ligament appearing externally through a fissure in the right umbo. Type *C. mediterranea* Costa. *Corbulomya* Nyst is identical. Recent and Tertiary.

Section *Cuneocorbula* Cossmann.

Shell elongate ovoid, with two elevated radial keels on the rostrum, which is distally truncate; the valves similarly sculptured. Type *C. biangulata* Deshayes. Recent and Tertiary.

This group may be extended to cover the American species with similarly sculptured valves, like *C. contracta* Say, in which the keels are less pronounced and the dorsal one sometimes obsolete.

Section *Tiza* de Gregorio, 1890.

Shell very inequilateral, twisted, and produced behind, the right valve convex, the left flattened or even concave, pointed behind; surface smooth, valves similarly sculptured, pallial sinus obsolete. Type *C. alta* Conrad, Journ. Acad. Nat. Sci. Phila., 2d Ser., ii., pl. 1, fig. 3, 1850 (not i., pl. 12, figs.

33–35, 1848); = *C. aliformis* Conrad, Am. Journ. Conch., ii., p. 76, 1866; Shell Bluff group, Vicksburg, Mississippi; + *C.* (*Tiza*) *amara* de Greg., Mon. Claib., p. 234, pl. 37, figs. 12–14.

Section *Anisothyris* Conrad.

Like *Corbula*, but larger, with heavy, smooth shells, the beaks strongly prosogyrate, thus twisting the plane of the ligament out of the vertical into an oblique or nearly horizontal direction; form very variable; inhabiting fresh or brackish water. Type *A. obliqua* Gabb. Fresh-water Tertiaries of the Amazon.

Section *Anticorbula* Dall.

Shell thin, the left valve larger, the hinge reversed; the ligament external; resilium as in *Anisothyris*. Type *A.* (*Himella*) *fluviatilis* H. Adams. (*Himella* Ads., 1860, not Dallas, 1854.) Recent, Amazon River.

Section *Anisorhynchus* Conrad.

Valves subequal, smooth or concentrically undulated, the shell rounded and inflated in front, prolonged into a long rostrum behind, with an escutcheon-like area defined by two dorsal keels behind the beaks; hinge and other characters like *Corbula*. Type *Corbula pyriformis* Meek. Brackish-water Tertiaries of Montana.

Section *Erodona* Daudin.

Shell elongate triangular, feebly concentrically sculptured with a conspicuous epidermis, the left umbo superior, though the left valve is not the larger; hinge of a strong, nearly vertical process supporting the resilium, with a small socket on each side in the left valve; in the right valve a deep central pit for the resilium, the edges of the hinge-plate bordering it turned up on each side as a narrow projection fitting into the sockets opposite, but no well-defined cardinal tooth or laterals; the ligament is obsolete. Type *Mya labiata* Maton, from Brazilian estuaries. *Potamomya* Sby., 1835, and *Azara* Orbigny, 1839, are synonymes.

Section *Bothrocorbula* Gabb.

Shell ovate, solid, pointed behind; valves similarly sculptured with strong concentric ridges; lunular region impressed, sometimes forming a globular cavity in the hinge-margin; shell otherwise like *Cuneocorbula*. Type *Corbula viminea* Guppy. Oligocene to recent in the Antillean region.

Subgenus **CORBULAMELLA** Meek and Hayden.

Proc. Acad. Nat. Sci. Phila. for 1857, p. 143.

Shell subglobular, inflated, like *Corbula* s. s., except that the posterior adductor is inserted in each valve on a raised lamella, recalling that of *Cucullæa*. Type *C. gregaria* Meek and Hayden. Cretaceous of Nebraska.

I have examined a very large number of adult Corbulas, and in none of them have I found any traces of lateral teeth or any more than a single cardinal tooth, well developed, in the right valve. When not erect the beaks are invariably prosogyrate; but Bernard has shown that in the nepionic young there are traces of an anterior and posterior left cardinal and two left anterior lamellæ, and similarly in the opposite valve are traces of denticulation, which become obsolete in the adult, but which tend to show the relations of the group to the *Myacea*.

In the Eocene of the Pacific coast are found *Corbula* (*Anisorhynchus*) *alæformis* Gabb, 1868, and *C.* (*A.*) *cultriformis* Gabb, from the Tejon and the Martinez group respectively. If the name of the former be regarded as insufficiently distinguished from *C. aliformis* Conrad, 1866, it might be changed to *C. Gabbii*. *C.* (*Cuneocorbula*) *Evansana* Shumard, 1858, from the Port Orford coal measures (Arago beds), *C.* (*C.*) *Hornii*, *C.* (*C.*) *parilis*, and *C.* (?) *primorsa* Gabb, 1868, from the Tejon of California, complete the list of Pacific coast Eocene species so far recorded.

From the brackish-water Tertiaries of the West, Meek (1877) has described *Corbula* (*Anisorhynchus*) *pyriformis*, for which *C. concentrica* Meek (1861) was an earlier but preoccupied specific name. With it in Utah was found *C.* (*Cuneocorbula*) *Engelmannii* Meek (1877). From Nebraska *Corbulamella gregaria* and *Corbula* (*Aloidis?*) *perundata*, *C.* (*Erodona*) *mactriformis*, and *C.* (*E.*) *subtrigonalis* Meek and Hayden were described in 1857.

The peculiar and polymorphous section *Anisothyris* from the Pebas clays of the upper Amazon is represented by the following species: *C.* (*A.*) *amazonensis* (Gabb as *Tellina*), *C.* (*A.*) *tenuis* Gabb (+ *Hauxwelli* Woodward, + *ovata* Conrad), *C.* (*A.*) *erecta* Conrad, *C.* (*A.*) *obliqua* Gabb, *C.* (*A.*) *armifera* Dall (+ *carinata* Conrad non Phillips), *C.* (*A.*) *spheniella* Dall (+ *cuneata* Conrad non Say), and *C.* (*A.*) *ledæformis* Dall.

Species of the Eastern Eocene.

Turning now to the eastern Tertiary of the United States, the earliest species is *C.* (*Cuneocorbula*) *subcompressa* Gabb (1860) from the Midway of Tennessee, Alabama, and Arkansas.

From the Chickasawan (or Lignitic) we have the following:

1. *Corbula concha* Aldrich, Bull. Pal., ii., p. 7, pl. 5, fig. 6, 1895; Harris, Bull. Pal., ix., p. 66, pl. 13, fig. 11, 1897.
2. *Corbula Aldrichi* Meyer, Am. Journ. Sci., xxx., 1885, p. 67; Bull. Ala. Geol. Surv., i., p. 83, pl. 1, fig. 21, 1886; Harris, Bull. Pal., ix., p. 67, pl. 13, figs. 12, 13*a*, 1897.
3. *Corbula subengonata* Dall, Harris, Bull. Pal., ix., p. 68, pl. 13, fig. 14*a*, 1897 (as *alabamiensis* Lea, var.); Aldrich., Bull. Ala. Geol. Surv., i., p. 58, 1886 (as *C. engonata* Conrad).

This form is smaller, less inflated, thinner, and with more nearly parallel dorsal and ventral borders than *C. alabamiensis.* The sculpture is finer than in *C. engonata*, which is a more elongated species.

4. *Corbula Gregorioi* Cossmann, Ann. Géol. et Pal., No. 12, p. 6, pl. 1, figs. 4, 5, 1894.

The first is a typical *Corbula* with nearly smooth surface; the others belong to *Cuneocorbula.* The last is abundant in the Claibornian, where it has generally been mistaken for the young of *C. nasuta* Conrad. The Claibornian contains a number of species some of which are restricted to this horizon, but others are found in the beds below or continue into the Jacksonian.

Corbula (Cuneocorbula) alabamiensis Lea.

Corbula alabamiensis Lea, Contr. Geol., p. 45, pl. 1, fig. 12, Dec., 1833.

Corbula nasuta Conrad, Fos. Tert. Form., p. 38, Sept., 1833; Am. Journ. Sci., N. S., i., p. 398, pl. 4, fig. 4, May, 1846; Harris, Reprint Fos. Tert. Form., pl. 19, fig. 4; not of Sby., P. Z. S., 1833, p. 35.

Corbula (*Neæra*) *nasuta* de Gregorio, Mon. Claib., p. 231, pl. 36, figs. 36–50, 1890.

Corbula subnasuta Orbigny, Prodr. Pal., p. 382, 1850.

? *Corbula nasuta* var. *ima* de Greg., *op. cit.*, p. 231, pl. 37, figs. 5–8, 1890.

Claibornian Eocene of Orangeburg, South Carolina; Clarksville and Claiborne, Alabama; White Bluff, Arkansas, and the Gatun beds of the Isthmus of Panama. Also, according to Clark, in the Eocene of Virginia and Maryland.

The *C. nasuta* of Sowerby is a recent species from the west coast of Central America, described in March, 1833. It is somewhat difficult to discriminate the young of *alabamiensis* from the young of *C. densata*, which is often mixed with it, and which Gregorio has described as a variety *tecla* of this species. I am unable to identify his variety *ima* from the figures; it much resembles some of the forms of *Gregorioi* Cossmann. The *C. nasuta* Conrad of the Mex. Boundary Rep., i., p. 161, pl. xix., fig. 4, 1857, from western Texas, is obviously a distinct species, which may take the name of *C. Conradi*.

Corbula (Cuneocorbula) densata Conrad.

Corbula densata Conr., Proc. Acad. Nat. Sci. Phila., vii., p. 258, 1855; Wailes, Rep. Geol. Miss., p. 289, pl. 14, fig. 9, 1854.

Corbula nasuta var. *tecla* Gregorio, Mon. Claib., p. 231, pl. 37, figs. 9–11, 1890. (Young shell.)

Claibornian Eocene of Orangeburg, South Carolina; Clarksville and Claiborne, Alabama, and Carson's Creek, Mississippi; Jacksonian Eocene at Jackson, Mississippi; Wailes.

This is a large, irregular, coarse, and strong species, more common in the Claiborne sands than in the Jacksonian, from which it was first described. It is more coarsely sulcate and much more trapezoidal than *C. alabamiensis*, with which it is usually associated.

Corbula (Cuneocorbula) compressa Lea.

Corbula compressa Lea, Contr. Geol., p. 47, pl. 1, fig. 15, 1833; Gregorio, Mon. Claib., p. 233, pl. 36, figs. 34, 35 (not fig. 33 *a–c*), 1890; Cossmann, Ann. de Géol. et Pal., 12, p. 6, 1894.

Claibornian of Claiborne, Mississippi, and Jacksonian of Clarke County, Mississippi; L. C. Johnson.

This small species is not very well represented by Lea's figure, which is too long, and his type specimen is defective just in front of the beak, where some boring animal has made a hole. It is a recognizable form, however, best recognized by its compression, and most likely to be confounded with the young of *densata*.

Corbula (Cuneocorbula) Aldrichi Meyer.

Corbula Aldrichi Meyer, Bull. Ala. Geol. Surv., i., p. 83, pl. 1, fig. 21, 1886.

Chickasawan Eocene of Wood's Bluff, Alabama.

This form is best recognized by its feeble umbonal sculpture and the radial sculpture, which is quite exceptional in this genus.

Corbula (Cuneocorbula) Gregorioi Cossmann.

Corbula compressa var. *Gregorioi* Cossm., Ann. Géol. et Pal., 12, p. 6, pl. 1, figs. 4, 5, 1894.

Corbula Aldrichi var. *smithvillensis* Harris, Proc. Acad. Nat. Sci. Phila. for 1895, p. 52, pl. 3, fig. 5 *a*, 1895.

Eocene of Prairie Creek and Coffeeville, Alabama; of Newton and Wahtubbee and Clarke County, Mississippi; of Meridian and Claiborne, Alabama; Mount Lebanon and Montgomery, Louisiana; Lee County, Texas; the Gatun beds of the Isthmus of Darien, and in the Jacksonian of Clarke County, Mississippi.

This small and rather variable form seems to me specifically distinct from either of the species to which it has been referred as a variety.

Corbula (Aloidis) oniscus Conrad.

Corbula oniscus Conr., Am. Journ. Sci., xxiii., p. 341, Jan., 1833; and same, N. S., i., p. 219, pl. 4, fig. 13, 1846.

Corbula Murchisonii Lea, Contr. Geol., p. 46, pl. 1, fig. 13, Dec., 1833; Gregorio, Mon. Claib., p. 231, pl. 37, figs. 22–39, pl. 38, figs. 1–13, 1890.

Corbula gibbosa Conr., Am. Journ. Conch., 1, p. 3, 1865; not of Lea.

Corbula rugosa Heilprin, Proc. Acad. Nat. Sci. Phila. for 1890, p. 401; not of Lamarck.

Corbula Churchisonii Gregorio, Mon. Claib., p. 233, 1890.

Corbula (*Neæra*) *ignota* Gregorio, *op. cit.*, p. 232, pl. 37, figs. 15–18, 1890 (smooth valve).

Corbula nasuta Gregorio, *op. cit.*, p. 232 (in synonymy, not of Conrad, 1833).

Eocene of the Chickasawan stage at Wood's Bluff, Alabama; of the Claibornian at Claiborne and Clarksville, Alabama; and of the Jacksonian at Jackson, Mississippi.

This species is subject to a scaling off of the outer sculptured layer of the shell, leaving the latter in an apparently perfect condition, nearly smooth, and with sundry sulci on the dorsal side of the rostrum which do not appear on the uninjured shell. In this state it has every aspect of a distinct species. The left valve has apparently been described by de Gregorio as a distinct species, the sculpture and form being quite different from that of the right valve.

This species belongs to a group of closely related forms which appear to be distinct, though the characters might be regarded at first as varietal. They appear in different horizons, and they do not seem to grade into one another, so I have regarded them as species.

Corbula (Aloidis) fossata Aldrich.

Corbula Murchisoni Lea var. *fossata* Aldr., Journ. Cin. Soc. Nat. Hist., ix., p. 45, pl. 2, fig. 22, 1886.

Eocene of Newton and Wahtubbee, Mississippi, and of Mt. Lebanon, Bienville Parish, Louisiana (Vaughan).

This form is very abundant in the Wahtubbee Hills and very constant in its characters. It differs from *oniscus* in having a furrow before the rostral carina, behind which the concentric ribs are doubled in number and halved in size, while the carina is more prominent than in *oniscus*, though the general form is the same.

Corbula (fossata var. ?) **extenuata** Dall.

Plate 36, Figure 6.

Eocene of the Orangeburg District, South Carolina; Burns.

This differs from *fossata* by being less high and more elongated, with two very strong keels on the rostrum, the end of which is emarginate between them; the anterior keel projects below the ventral margin of the rest of the valve, with an emargination in front of it; the rostrum is produced, recurved, and sculptured as in *fossata;* the beaks are small, pointed, and incurved; the left valve is smooth and very turgid. Lon. 8, alt. 6, diam of right valve 3.3 mm.

Corbula (Aloidis) perdubia de Gregorio.

——— Lesueur, Walnut Hills Fossils, pl. v., fig. 16, 1829.

Corbula (Neæra) perdubia Greg., Mon. Claib., p. 233, pl. 36, figs. 31, 32, 1890.

Corbula laqueata Conr., Am. Journ. Conch., I, p. 3, 1865; Checkl. Eoc. Fos. N. Am., p. 28, 1866. (Name only.)

Corbula filosa Conrad, Am. Journ. Conch., I, p. 145, 1865; not page 137, plate 10, fig. 7.

Jacksonian Eocene at Jackson, Red Bluff, and near Enterprise, Mississippi; Natchitoches, Louisiana, and Rust County, Texas; in the Vicksburgian at Vicksburg, Mississippi.

This species has had some vicissitudes. Conrad named it in manuscript *laqueata* and included the name in his check-lists, but when he wrote a description he headed it "*filosa*," a name he had used for another species only a few pages earlier in the Journal. Moreover, in the reference to the figure of the original *filosa* on page 212 he refers not to the original description, but to the second one.

The species is notable for the absence of rostral keels, and is usually small, but some of the specimens attain nearly the full size of *C. oniscus*. I have not seen it from the Claibornian. Gregorio's specimens were not located, but probably are Jacksonian.

Corbula (Aloidis) gibbosa Lea.

Corbula gibbosa Lea, Contr. Geol., p. 46, pl. 1, fig. 14, 1833.

Corbula (*Neæra*) *gibbosa* de Greg., Mon. Claib., p. 233, pl. 36, figs. 26–30, 1890; Cossmann, p. 6, 1894.

Claibornian Eocene of Claiborne, Alabama, and near Meridian, Mississippi; at White Bluff and other localities in Arkansas.

As shown by Cossmann, this is an excellent species which has frequently been confounded with *C. oniscus.*

Corbula (Aloidis) milium n. s.

PLATE 36, FIGURE 19.

Chickasawan Eocene, Wood's Bluff horizon at Thomasville, Clarke County, Alabama; Burns.

Shell minute, rounded, inflated, with prominent beaks a little in advance of the middle line of the valves; right valve larger, sculptured with fine, even, concentric threads separated by narrower interspaces; there is no radial striation, but near the posterior cardinal margin a well-marked sulcus extends from the beak to the upper posterior margin, the surface above it and next to the cardinal margin turgid; in front of the strongly prosocœlous beaks the valve is impressed, though without any defined lunule; left valve smaller, less inflated, nearly smooth or with faint incremental lines; a strong radial rib close to the posterior hinge-margin; interior and internal margins of the valves polished; a small ridge near the hinge reflects the posterior external sulcus of the right valve; cardinal tooth small, conical, rather prominent, the chondrophore hidden under the cardinal margin; left valve with the chondrophore flat, squarish, projecting, and a socket for the point of the right cardinal. Lon. 2.2, alt. 2.3, diam. 1.6 mm.

This interesting little species recalls *C. laqueata* Conrad on a smaller scale and with proportionately finer sculpture. Though so small, there is no reason to doubt that it is an adult form.

Corbula (Aloidis) texana Gabb.

Corbula texana Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 387, pl. 67, fig. 54, 1860.

Eocene of Lee County, Texas; Singley in United States National Museum.

This appears to be distinct from any of the others, being flatter, less involved, and more distinctly triangular. It is a peculiarly solid shell.

Corbula (Aloidis) Wailesiana Harris.

Corbula Wailesiana Harris (MS. in Coll. U. S. Nat. Mus.).

Corbula bicarinata Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 258, 1855; Wailes, Rep. Geol. Miss., p. 289, pl. 14, fig. 3, 1854; not of Sby., P. Z. S., 1833, p. 35.

Jacksonian Eocene of Jackson, Mississippi; Drew and Cleveland Counties, Arkansas, and Montgomery, Louisiana.

This is a fine species, closely resembling the *C. oniscus*, but separable by minor details.

The other species which have been referred to the Eocene are: *C. filosa* Conrad (Am. Journ. Conch., i., p. 137, pl. 10, fig. 7, not p. 145, 1865), from the Jacksonian of Mississippi; *C. nasutoides* Whitfield (Lam., Raritan Clays, p. 239, pl. 30, figs. 18, 19, 1885), from the Eocene marl of New Jersey, which is possibly not a *Corbula*, and *C. pearlensis* Meyer (Bull. Ala. Geol. Surv., i., p. 83, pl. 3, figs. 16, 16*a*, 1886), from Jackson, Mississippi, which may prove to belong to some other genus, as the figure certainly has not the aspect of a *Corbula*. *Corbula prima* de Gregorio was correctly described originally by Aldrich as a *Neæra* (= *Cuspidaria*).

Oligocene Species.—In the Lower Oligocene, or Vicksburgian, besides those forms which have been mentioned as coming up from the Eocene, there are two species which have been called *alta* by Conrad. The first (Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 124, pl. 12, figs. 33–35, 1848) I have not seen, but, from the figures, should conclude it to be different from the shell figured in 1850 (*op. cit.*, ii., pl. i., fig. 3) under the same name, and for which Conrad in 1866 (Am. Journ. Conch., ii., p. 76) proposed the name of *aliformis*. This is a very singular shell, for which de Gregorio has very properly proposed a subgeneric name (*Tiza*, q. v., p. 838), and it is said by Conrad to come from a horizon above the typical Vicksburgian, which he correlates with the Shell Bluff group of Georgia. *C. intastriata* Conr. (1848), later called *interstriata* (Eoc. Checkl., 1866), appears to be a *Cuspidaria*.

Including those previously mentioned under the Eocene, the following species completes the list of known Vicksburgian Corbulas.

Corbula (Cuneocorbula) engonata Conrad.

——— Lesueur, Walnut Hills Fossils, pl. 5, fig. 18, 1829.

Corbula engonata Conr., Proc. Acad. Nat. Sci. Phila., iii., p. 294, 1848; Journ. do., 2d Ser., i., p. 124, pl. 12, fig. 30, 1848; not of Aldrich, Bull. Ala. Geol. Surv., i., p. 58, 1886.

Eocene of Carson's Creek, Wahtubbee, Meridian, and Heidelberg, Mississippi; Vicksburgian of Vicksburg and Red Bluff, Mississippi.

Corbula engonata var. **Burnsii** Dall.

Upper Oligocene of the Chipola beds, on the Chipola River and at Ballast Point, Tampa Bay, and in the lower bed at Alum Bluff, Chattahoochee River, Florida; Burns and Dall.

This form, doubtless a direct descendant of the earlier one, differs from it in its larger size and more prominently arcuate base. The form and sculpture otherwise is essentially similar. Lon. 11, alt. 7, diam. 6 mm. The measurements of the largest *C. engonata* in the collection are: lon. 8.5, alt. 5.5, diam. 4 mm.

The Upper or Chipolan Oligocene is either better explored or more prolific in forms of this family.

Corbula (Cuneocorbula) sphenia n. s.

PLATE 36, FIGURE 10.

Chipola beds, at the typical locality on the Chipola River, Florida; Burns.

Shell solid, somewhat inequivalve, the posterior ventral margin of the right valve folded in; beaks moderately prominent, somewhat anterior; anterior end of shell evenly rounded, base somewhat prominent under the beaks, posterior end sharply pointed with a well-marked keel on the rostrum; surface showing (about eighteen) narrow concentric ribs, with the steeper slope upward, and somewhat wider interspaces, feebler on the beaks and similar on both valves; there is no radial sculpture, the cardinal tooth is strong, and in the left valve behind the socket there is a small tubercle on the margin of the valve. Lon. 17, alt. 10, diam. 7.5 mm.

This species recalls *C. (Cuneocorbula) dominicensis* Gabb (Geol. St. Domingo, p. 247, 1873), which is a larger shell, from the Oligocene of St. Domingo.

Corbula (Cuneocorbula) sarda n. s.

PLATE 36, FIGURE 14.

Chipola Oligocene of the lower bed at Alum Bluff, Chattahoochee River, Florida, and in the silex beds at Ballast Point, Tampa Bay, Florida; Dall and Burns.

Shell subequilateral, thin, slender, inequivalve, the right valve higher and less strongly sculptured; anterior end rounded; base arcuate, prominently so in the right valve; posterior end obliquely and narrowly truncate, with two low rostral keels, the dorsal one close to the dorsal margin of the valve; sculpture of concentric ribs like the lap-streaking of a boat, the short slope above on each rib, about twenty-five in all, feebler on the rather low umbones, and unequally developed on different specimens; cardinal tooth stout, recurved; in the left valve a narrow lamella projects from the margin behind the socket. Lon. 10, alt. 6 (left valve) or 7 (right valve), diam. about 5 mm.

This species, though more delicate, recalls *C. alabamiensis* Lea, but is less twisted and pointed behind.

Corbula (Cuneocorbula) seminella n. s.

PLATE 36, FIGURE 11.

Chipolan Oligocene of the Chipola River, Florida, Dall and Burns; Alum Bluff beds at Oak Grove, Santa Rosa County, Florida, Burns; Pliocene (?) of Port Limon, Costa Rica, R. T. Hill.

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. Lon. 4.5, alt. 3, diam. 2 mm.

This is a very compact, solid, seed-like little shell, recalling *C. Aldrichi* Meyer on a smaller scale.

Corbula (Cuneocorbula) sericea n. s.

PLATE 36, FIGURE 8.

Corbula cubaniana Guppy, Geol. Mag., Dec. ii., vol. 1, p. 449, 1874; not of Orbigny, Moll. Cubana, 1853.

? Corbula Lavalleana Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 371, 1881.

Oligocene marl of Bowden, Jamaica; Pliocene (?) of Port Limon, Costa Rica; Hill.

Shell much like the preceding species in general form, but slightly larger and with less emargination beneath the rostrum; the sculpture, however, is quite different, being of very numerous, equal, fine, sharp, close-set ribs, the interspaces crossed by fine, close, sharp radial striation, which at once distinguishes it from any of the allied species. Both valves are similarly sculptured, the sculpture becoming obsolete on the beaks. Lon. 4.5, alt. 3.5, diam. 2.3 mm. The largest valve measures 5.4 by 4 mm.

As the ribs are not overrun by the radial sculpture, the effect is not reticulate. *C. Lavalleana* Orbigny, of the recent Antillean fauna, is said to be radially striated, but I have not been able to obtain specimens of it for comparison.

Corbula (Cuneocorbula) Whitfieldi n. s.

PLATE 36, FIGURE 18.

Uppermost Oligocene of the Alum Bluff beds at Oak Grove, Santa Rosa County, Florida; Burns.

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. Lon. 7, alt. 4.5, diam. 3.4 mm. 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, 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.

Corbula (Aloidis) vieta Guppy.

Corbula vieta Guppy, Quart. Journ. Geol. Soc. Lond., xxii., p. 580, pl. 26, fig. 8, 1866. (Right valve.)

Erycina tensa Guppy, *op. cit.*, p. 582, pl. 26, fig. 6. (Left valve.)

Corbula disparilis Dall, Proc. U. S. Nat. Mus., xix., No. 1110, pp. 327, 329, 1896. (Not of Orbigny.)

Oligocene of Manzanilla and other localities in Trinidad; Pliocene of Matura, Trinidad, Guppy; and of Port Limon, Costa Rica, Hill.

In my review of Mr. Guppy's fossils above cited this form was referred to *C. disparilis* Orbigny, to which it is nearly related. A more thorough study of a large amount of material of this puzzling group has shown, however, that there are constant, if not very conspicuous, differences between them, and I have, accordingly, restored the form to specific rank. The recent shell is larger, less compact, less regularly sculptured, and decidedly more rostrate.

Corbula (Aloidis) heterogenea Guppy.

PLATE 36, FIGURE 15.

Corbula heterogenea Guppy (MS. in Coll. U. S. Nat. Mus.).

Eocene of Vamos-vamos Station on the Panama Canal and at Gatun, Isthmus of Darien; Oligocene of the Bowden beds, Jamaica, the Chipola River, and the lower bed at Alum Bluff, Chattahoochee River, Florida; Upper Oligocene of Oak Grove, Santa Rosa County, Florida; Miocene of the upper bed at Alum Bluff, and of Magnolia, Duplin County, North Carolina; Pliocene of Walton County, Florida, and of the marls of the Caloosahatchie and Shell Creek, Florida; Willcox, Dall, and Burns.

This form is very close to *C. vieta*, but differs from it in having the beaks narrower, less elevated, and less prominent, and the posterior part of the shell more produced. Lon. 9.5, alt. 8, diam. 5 mm.

After examining many hundred specimens and finding the above differences constant, I have considered them to be of specific value. In other respects the shells are practically identical.

Corbula (Bothrocorbula) viminea Guppy.

Corbula viminea Guppy, Quart. Journ. Geol. Soc. Lond., xxii., p. 293, pl. 18, fig. 11, 1866.

? *Corbula Bradleyi* Nelson, Trans. Conn. Acad. Sci., ii., p. 17, 1870.

Bothrocorbula viminea Gabb, Proc. Acad. Nat. Sci. Phila. for 1872, p. 274, pl. 10, figs. 3, 3 *a*; Geol. St. Domingo, p. 247, 1873.

Eocene of Vamos-vamos Station, Panama Canal, Isthmus of Darien; Oligocene of St. Domingo (Gabb) and Bowden, Jamaica; Henderson and Guppy.

This is a large and solid species in which the lunular depression is deep and subspherical; if the other species possessed this character to an equal degree the group would undoubtedly be of generic value, but, as will be seen, they vary in the amount of depression, so that a connecting series of species leads to *Cuneocorbula* without any marked break. For this reason I have not considered the group as possessing generic value.

Corbula (Bothrocorbula) synarmostes n. s.

PLATE 36, FIGURES 12, 13.

Oligocene of the Chipola beds, Chipola River, Florida; Dall and Burns.

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. Lon. 15, alt. 10, diam. 7.6 mm.

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.

Corbula (Bothrocorbula) radiatula n. s.

Plate 36, Figures 1–3.

Upper Oligocene of Oak Grove, Santa Rosa County, Florida; Burns.

Shell resembling the last species, 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. Lon. 13, alt. 8.6, diam. 6.2 mm.

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 and *C. viminea.*

To complete the account of this group, the following Pliocene species is brought in here, somewhat out of its geological associations:

Corbula (Bothrocorbula) Willcoxii n. s.

Plate 36, Figure 9.

This species has the form of *C. viminea,* but is materially smaller; it has a deep hemispherical lunular depression unequally divided between the two valves, much the larger part being excavated from the margin of the left valve; the surface is sculptured like that of *C. synarmostes,* the radial threads being rather more numerous and the lunule quite different; in other respects the hinge is similar to that of that species, and the general appearance of the shell, except of the lunule, is much the same. Lon. 16, alt. 10, diam. 8 mm.

This species is rather common in the Pliocene marls of the Caloosahatchie and Shell Creek. Stimpson reports having dredged a living *Bothrocorbula* in the deep water of Florida Strait; he referred it to *C. viminea*, but it was probably this species. As the specimens were lost in the Chicago fire, a positive identification must be delayed until the shell can be re-collected.

C. contracta Say and *C. disparilis* Orb. have been mistakenly included among Antillean Oligocene species.

Miocene and Pliocene Species.

The cooler waters of the Miocene epoch were less favorable to mollusks of this genus than those of the Oligocene, and the species are not so numerous. The warm water of the Pliocene induced some of the subtropical types to return, but the relatively short duration of this epoch may explain why but a few species came in while it lasted.

Corbula (Corbula) idonea Conrad.

Corbula idonea Conrad, Am. Journ. Sci., xxiii., p. 341, 1833; Fos. Medial Tert., p. 6, pl. 10, fig. 6, 1840.

Miocene marl of New Jersey, Whitfield; Calvert Cliffs, Choptank River, St. Mary's River, Jones's Wharf, and Plum Point, Maryland.

This, the finest of our Tertiary Corbulas, belongs to the typical section.

Corbula (Aloidis) elevata Conrad.

Corbula elevata Conrad, Fos. Medial Tert., p. 7, pl. 4, fig. 3, 1840; Whitfield, Miocene N. J., p. 86, pl. 15, figs. 15–19, 1895.

Corbula levata Meek, Geol. N. J., p. 297, 1863. (Typographical error.)

Corbula curta Conrad, Am. Journ. Conch., iii., p. 269, pl. 21, figs. 6–8, 1867. (Decorticated shell.)

Miocene marl of Shiloh, New Jersey, Burns; Plum Point, Patuxent River, and other localities in Maryland, Burns and Harris.

This is a rather large and tall shell, usually in poor preservation and frequently entirely stripped of its outer coat, as mentioned in connection with *C. oniscus*. In this latter state it is the *curta* of Conrad.

C. (*Aloidis*) *galvestonensis* Harris (Bull. Pal., iii., p. 94, pl. 2, figs. 5, 5 *a*, 1895), from the Upper Miocene of the Galveston artesian well, between the two thousand four hundred and forty-three and two thousand six hundred and fifty foot levels below the surface, is a small shell, recalling *perdubia* Gregorio or *laqueata* Conrad.

Corbula (Aloidis) caloosæ n. s.

PLATE 36, FIGURE 16.

Pliocene marls of the Caloosahatchie, Shell Creek, and Myakka Rivers, south Florida; Dall and Willcox.

Shell inflated, very inequivalve, nearly inequilateral; within the right valve a high, prominent, incurved beak; in the left valve the beak is much lower and less curved; the general form is ovate, hardly truncate behind, with no differentiated rostrum or rostrum keels; in some specimens the latter are represented by obsolete rounded ridges which fail towards maturity; sculpture of fine incremental lines, and on the right valve strong concentric undulations which cover the shell as far back as the margin of the posterior dorsal area, but are not absolutely in harmony with the lines of growth; the left valve has no undulations, but shows sparse, irregularly distributed radial threads; cardinal tooth strong, chondrophore in the left valve lamelliform and rather long. Lon. 12.5, alt. right valve 10, left valve 7.5, diam. 6.5 mm.

This species is more elongated, less triangular, and less distinctly rostrate than the recent *C.* (*A.*) *disparilis* Orbigny of the Antillean region. In the latter there is a distinct recurvature of the posterior dorsal slope, while in the former there is under the posterior dorsal margin a ledge or ridge against which the edge of the left valve fits, and which is quite absent in the recent shell.

Corbula (*Erodona?*) *priscopsis* Harris (Bull. Pal., iii., p. 94, pl. 2, figs. 5, 5 *a*, 1895), from two thousand four hundred and forty-five feet below the surface in the Galveston, Texas, artesian well, belonging to the Upper Miocene, if really an *Erodona* is the only North American species from any of the marine Tertiary beds of the coastal region.

Corbula (Cuneocorbula) inæqualis Say.

Corbula inæquale Say, Journ. Acad. Nat. Sci. Phila., iv., p. 153, pl. 13, fig. 2, 1824; not of Conrad, Med. Tert., p. 6; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 76, pl. 20, fig. 12.

Corbula cuneata Conrad, Fos. Medial Tert., p. 5 (excl. diag.), pl. 3, fig. 2, 1840; Harris, Bull. Pal., v., pp. 329, 346, pl. 13, fig. 2, 1896; not of Say, 1824.

Corbula inæqualis Meek, Checkl. Inv. Fos. N. Am. Miocene, p. 12, 1864.

Miocene of Maryland at Calvert Cliffs, Jones's Wharf, Fairhaven, Plum Point, Greensborough, St. Mary's, the Choptank and Patuxent Rivers; of Virginia, at Suffolk, on the Nansemond and York Rivers; at Magnolia and Wilmington, North Carolina; Turkey Creek, South Carolina; and in the upper bed at Alum Bluff, Chattahoochee River, Florida; also in the Pliocene of the Waccamaw River, South Carolina, at Tilly's Lake.

In describing this species, by a typographical error it was referred to figure 3, plate 13, which represents *C. cuneata.* Conrad, with his usual carelessness, not only did not detect this error, but figured in the Medial Tertiary by the side of a copy of Say's figure of *cuneata* what seems to be the left view of a specimen of *inæqualis*, and connected them by a dotted line, as if they were the same species. It is only necessary to read the descriptions carefully in connection with a series of the shells to see the blunder.

This is the commonest of our Miocene species, identifiable by its short, high form, unequal valves, and coarse, irregular undulations. It is rather variable, and the undulations sometimes become obsolete, leaving only the incremental striæ, but the totality of characters will usually leave little difficulty in identifying it.

Corbula (Cuneocorbula) cuneata Say.

Corbula cuneata Say, Journ. Acad. Nat. Sci., iv., p. 152, pl. 13, fig. 3, 1824.

Corbula inæquale Conrad, Fos. Med. Tert., p. 6, pl. 3, fig. 3 (left hand one), 1840 (diagn. and remarks excluded).

Not *C. cuneata* Tuomey and Holmes, Pleioc. Fos. S. Car., p. 75, pl. 20, fig. 11, 1855; nor of Emmons, Geol. N. Car., p. 290, fig. 215 *B*, 1858; nor of Hinds, 1844; nor Conrad (*Anisothyris*), 1870.

Miocene of Maryland, on the Choptank River; of Virginia, on the York River; of the Natural Well and Magnolia, Duplin County, North Carolina; of Darlington, South Carolina; Pliocene of the Caloosahatchie River, Florida (rare).

In this case, as in the preceding, Conrad, while copying the diagnosis, transposed the figures. Emmons's figure represents a different species, more like *C. nasuta* Conrad, and the figure of Tuomey and Holmes is probably intended to represent *C. contracta.*

C. cuneata Say has not been found in the recent state, and seems rather rare everywhere. It is at once separable from the varieties of *inæqualis* by its nearly straight basal margin, its fine, even, concentric sculpture, and its sharp rostral keel.

Corbula (Cuneocorbula) subcontracta Whitfield.

Corbula subcontracta Whitf., Fos. Mioc. Marls N. J., p. 88, pl. 15, figs. 11–14, 1895.

Miocene marl of Shiloh, Cumberland County, New Jersey; Burns.

This is a small, cuneate species, with coarse, irregular undulations, quite distinct from any of the other Miocene species.

Corbula (Cuneocorbula) Swiftiana C. B. Adams.

Corbula Swiftiana Adams, Contr. Conch., xii., p. 236, 1852; Dall, Bull. Mus. Comp. Zool., ix., p. 114, 1881; xii., p. 314, pl. 2, figs. 5 *a–c*, 1886; Bull. U. S. Nat. Mus., No. 37, p. 70, pl. 2, figs. 5 *a–c*, 1889; Harris, Bull. Pal., iii., p. 94, pl. 2, fig. 6, 1895.

Typical form, recent from Cape Hatteras, North Carolina, to Venezuela.

Variety *nucleata* Dall. Plate 36, figure 17.

Miocene of the upper bed at Alum Bluff, Chattahoochee River, Florida; Pliocene of Walton County, Florida, and Mrs. Guion's marl bed, on the Waccamaw River, South Carolina.

Variety *Harrisii* Dall.

Upper Miocene of the Galveston artesian well, from a depth of two thousand nine hundred and twenty feet upward.

The typical form of this species has rather irregular, sometimes rather coarse, concentric sculpture, fainter near the beaks with faint traces of radiating striæ. When adult the rostrum, though small and narrow, projects prominently and is squarely truncate; the basal margin of the right valve is very flexuous.

In the variety *nucleata* the shell is shorter, more globose; the concentric sculpture is nearly uniform and equally fine over the whole shell except the extreme point of the beaks; the rostrum is but little differentiated, short and very obliquely, if at all, truncate.

In the variety (?) *Harrisii* (Harris, *op. cit.*, pl. 2, fig. 6) the shell is stated to be fifteen millimetres long, which is nearly twice the size of the typical *Swiftiana*, the rostral keel is much straighter, and the border less emarginate below it than in the typical *Swiftiana*. It should be noted that specimens closely agreeing with the recent shells, and some which resemble the variety *nucleata*, were also obtained from the well at various depths.

The *C. caribæa* Orbigny is very close to *C. Swiftiana*, and is found recent in the Antilles and has been reported by Guppy (1874) from the Pliocene of Trinidad. If the two, on comparison of authentic examples, should prove to be identical, Orbigny's name has seven years' precedence.

Corbula (Cuneocorbula) contracta Say.

Corbula contracta Say, Journ. Acad. Nat. Sci. Phila., ii., p. 312, 1822; Conrad, *op. cit.*, vii., p. 153, 1834; Gould, Inv. Mass., p. 43, fig. 37, 1841; Reeve, Conch. Icon., *Corbula*, pl. iv., fig. 27, 1844.

Corbula ferruginosa Greene, Mass. Cat., 1833; not of Wood.

Azara contracta H. and A. Ads., Gen. Rec. Moll., ii., p. 357, 1856.

Corbula cuneata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 75, pl. 20, fig. 11, 1855; not of Say or Conrad.

Corbula contracta Holmes, P.-Pleioc. Fos. S. Car., p. 56, pl. 8, fig. 17, 1858; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, pl. 1, fig. 6 *a–b*, pl. 59, fig. 10, 1889.

Pliocene of the Croatan beds, North Carolina, and of the Caloosahatchie marls in south Florida; Pleistocene of Heislerville, New Jersey, and Simmons Bluff, South Carolina, and Sankoty Head, Massachusetts.

Recent from Cape Cod, Massachusetts, to Jamaica.

This species has been reported from the Oligocene of St. Domingo and the Pliocene of Costa Rica by Gabb, but it is probable that some of the allied species were confounded with it. I have seen no specimens from beds older than the Pliocene.

Corbula (Cuneocorbula) Barrattiana C. B. Adams.

Corbula Barrattiana Adams, Contr. Conch., xii., p. 237, 1852; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, pl. 2, fig. 7 *a–c*, 1889.

Pliocene of the Waccamaw beds at Tilly's Lake, South Carolina, and in the marls of the Caloosahatchie and Shell Creek, Florida; Dall and Willcox.

This shell resembles somewhat *C. engonata* Conrad, but has finer, closer, and more even sculpture, and a strongly marked rostral area, on which, when perfect, fine radial lines can be made out which do not occur on the disk of the shell.

Corbula (Cuneocorbula) Dietziana C. B. Adams.

Corbula Dietziana Adams, Contr. Conch., xii., p. 235, 1852; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, pl. 1, fig. 5 *a–b*, 1889.

Pliocene clays of Port Limon, Costa Rica; Hill.

Recent, from Cape Hatteras, North Carolina, to Barbados.

This strongly marked species is rare in the fossil state, but not uncommon in the recent fauna.

Corbula diegoana Conr. (P. R. R. Rep., v., p. 322, pl. 3, fig. 16, 1855) and *Corbula luteola* Cpr. (1863) have been reported from the Pleistocene of the Pacific coast; *C. carinifera* Gabb (Geol. St. Dom., p. 258, 1873) from that of St. Domingo.

Family MYACIDÆ.

Genus MYA (Linné) Lamarck.

< *Mya* Linné, Syst. Nat., Ed. x., p. 670, 1758.

< *Hiatula* (auct.) Schröter, Einl. Conch., ii., p. 599, 1784; Modeer, K. Vetensk. Handl., xiv., pp. 178, 182, 1793.

= *Mya* Lam., Prodr., p. 83, 1799. Type *Mya truncata* L.

Not *Mya* Modeer, *op. cit.*, 1793, nor *Mya* Humphrey, Mus. Calonnianum, p. 59, 1797; = *Unio* Retzius, 1788.

Mya truncata Linné.

Mya truncata L., Syst. Nat., Ed. x., p. 670, 1758; Gould, Inv. Mass., p. 42, 1841; Jeffreys, Brit. Conch., iii., p. 66, pl. 3, fig. 1, 1865.

Mya ovalis (young) and *Sphenia Swainsoni* Turton, 1822.

Mya præcisa Gould, Proc. Bost. Soc. Nat. Hist., iii., p. 215, 1850; Moll. U. S. Expl. Exp., p. 585, fig. 498.

Pleistocene of the Arctic and boreal shores of the North Atlantic and Bering Seas; at Portland, Maine; in the Leda clays of the St. Lawrence River, at Quebec, Montreal, and Beauport; Polaris Bay, Greenland; Bessels; and south to Massachusetts, and in Alaska to the Sitkan region.

Mya arenaria Linné.

Mya arenaria L., Syst. Nat., Ed. x., p. 670, 1758; Gould, Inv. Mass., p. 40, 1841; Verrill, Inv. An. Vineyard Sound, p. 672, 1873; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, pl. 49, fig. 9; pl. 55, fig. 2; pl. 69, fig. 2, 1889.

Mya mercenaria Say, Journ. Acad. Nat. Sci. Phila., ii., p. 313, 1822.

Mya acuta Say, *op. cit.*, p. 313, 1822.

Mya alba Agassiz, Mém. Soc. Sci. Nat. Neuchâtel, ii., p. 1, pl. 1, fig.2–8, 1839.

Mya Hemphillii Newcomb, Proc. Cala. Acad. Nat. Sci., v., p. 415, 1874.

Mya corpulenta Conrad, Fos. Medial Tert., p. 68, pl. 39, fig. 1, 1845.

Miocene of York River and Petersburg, Virginia, Burns; of Gay Head, Massachusetts, Dall; Pleistocene of the Atlantic coast from Labrador to South Carolina; recent from Nova Scotia southward to North Carolina. Introduced with seed oysters on the Pacific coast, and erroneously attributed to Porto Rico (Agassiz).

This well-known and widely distributed species was not originally a native of the Pacific coast, where it was represented by a form which may be called *Mya intermedia*, which is intermediate in character between *M. arenaria* and *M. truncata*, strongly recalling the glacial *M. uddevallensis* of Sweden. This shell grows to a very large size on the Alaskan Peninsula and is very puzzling.

Carpenter referred it to *M. truncata* as a variety, and Grewingk figures an unusually pointed specimen as *M. arenaria.*

It occurs recent and in the Miocene of Unga Island, Alaska, and also in the Alaskan Pleistocene. Since *M. arenaria* was accidentally introduced into Californian waters it has spread remarkably and is reported to have reached the coast of Oregon.

Mya producta Conrad.

Mya producta Conr., Fos. Medial Tert., p. 1, pl. 1, fig. 1, 1838; Proc. Acad. Nat. Sci. Phila. for 1862, p. 572, 1863.

Mya prælonga Conr., Bull. Nat. Inst., ii., p. 185, 1842; name only.

Miocene of Yorktown, York River, Virginia, Wagner; Patuxent River, St. Mary's County, Maryland, Conrad and Burns.

This is a very distinct species, and seems to be very restricted in its distribution.

Mya montereyana and *subsinuata* Conrad, from the Miocene of Monterey, California, are poorly described, badly figured, and have not since been identified (cf. Pac. R. R. Reps., vi., p. 70, pl. 2, figs. 4, 5, 1857). *Mya crassa* Grewingk (Verh. Rus. Min. Ges. für 1848–9, p. 355, pl. 5, fig. 1 *a–d*, 1850), from the Miocene of Alaska, appears from the figures to be distinct from *M. intermedia.* *Mya bilirata* Gabb, from the Miocene of California, is said to be a *Sphenia.* *Mya abrupta* Conrad (1849, not 1856) is a *Panopea* from the Miocene of Astoria, Oregon. *Mya reflexa* H. C. Lea, from the Miocene of Petersburg, Virginia, is a doubtful species, the description and figure being insufficient to determine its generic place. (See Trans. Am. Phil. Soc., ix., p. 236, pl. 34, fig. 10, 1845.) *Mya simplex* Holmes, from the Pleistocene of South Carolina, is a synonyme of *Fulcrella simplex.*

Genus **PLATYODON** Conrad.

Platyodon Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 235, 1837; Carpenter, Suppl. Rep. Brit. As., p. 637, 1863.

Differs from *Mya* by its sculpture, irregular pallial line, and the presence on the distal end of the siphons of valvular horny appendages which sometimes are more or less testaceous. These appendages are analogous to those of *Tresus* and some *Pholadacea*, and are doubtless due in all cases to the same dynamic and selective influences. There is but one species known, *P. cancellatus* Conrad (*op. cit.*, p. 236, pl. 18, fig. 2), which is found recent and in the Californian Pleistocene.

Genus CRYPTOMYA Conrad.

Sphænia Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 234, 1837.
Cryptomya Conrad, Proc. Acad. Nat. Sci. Phila., iv., p. 121, 1848.

Shell like a small *Mya*, but the pallial sinus absent or obsolete. Type:

Cryptomya californica Conrad.

Sphænia californica Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 234, pl. 17, fig. 11, 1837.
Cryptomya californica Conrad, Proc. Acad. Nat. Sci. Phila., iv., p. 121, 1848; viii., p. 314, 1857.
Cryptomya ovalis Conrad, Pac. R. R. Reps., vi., p. 69, pl. 2, fig. 2, 1856.

Miocene of California in many localities, also Pliocene and Pleistocene, and recent from British Columbia to Lower California.

Genus SPHENIA Turton.

Sphenia Turton, Dithyr. Brit., p. 37, 1822. Type *S. Binghami* Turton.
Sphænia Conrad, 1837; *Sphæna* Defrance, Tabl., p. 105, 1824; *Sphena* Deshayes, Enc. Méth., iii., p. 965, 1832; and *Sphænia* Gabb, Pal. Cal., ii., p. 90, 1869.

Shell small, irregular, nestling, with an irregular pallial line and deep sinus, short siphons, and the chondrophore narrow and very oblique.

Most of the diagnoses of *Sphenia* are faulty; there are no teeth, the chondrophore is very narrow and oblique, borne by the smaller left valve as in *Mya*, from which the genus is barely separate.

The only species recorded in our Tertiary are *Sphenia californica* Conrad, which is the type of *Cryptomya*, and *S. bilirata* Gabb (Proc. Acad. Nat. Sci. Phila., xiii., p. 369, 1862), from the Tertiary of Santa Barbara, California, which seems to have been omitted from Gabb's Paleontology of California. *S. ornatissima* and *alternata* Orb., reported by Gabb from the Tertiary of St. Domingo, are species of *Cuspidaria.*

Sphenia dubia H. C. Lea.

Panopea dubia H. C. Lea, Trans. Am. Phil. Soc., ix., p. 236, pl. 34, fig. 9, 1845 (extra copies p. 10).

Miocene of Petersburg, Virginia, Lea; of York River, Virginia, Harris; of North Carolina, at Magnolia and the Natural Well, Duplin County, Burns.

This is a small, irregular little shell which is found sparsely at the localities indicated.

Sphenia attenuata n. s.

PLATE 35, FIGURE 9.

Pliocene marl of the Caloosahatchie River, Florida; Dall.

Shell small, irregular, solid, wider, and rounded in front, attenuated behind; nearly equilateral, moderately inflated; exterior with small, irregular, concentric ridges and radial wrinkles due to irregularities of situs; adductor impressions large, especially the posterior ones; pallial sinus moderately deep. Lon. 9.5, alt. 6, diam. about 4 mm.

The most conspicuous feature of this irregular little shell is the attenuation of the rather pointed posterior end. It is a decidedly heavier and larger shell than *S. dubia.*

Genus **TUGONIA** Gray.

Tugonia Gray, Synops. Brit. Mus., p. 91, 1842; name only. Type *Pholas tugon* Adanson, = *Mya anatina* Ch.

Tugonia Récluz, Revue zoologique, p. 168, 1846. Type *Mya anatina* (Chemnitz) Gmelin.

This genus has a reticulated sculpture and a globose shell, short behind, with a posterior truncation forming a somewhat contracted hiatus, the beaks quite posterior and the chondrophores subequal in the two valves; pallial sinus shallow; shell of moderate size.

(? Subgenus) **TUGONIOPSIS** Dall.

Shell minute, externally with concentric sculpture or none, plump, irregular, when normal very inequilateral; beaks very posterior; valves truncate behind and gaping; chondrophore of the left valve as in *Mya*; in the right valve subumbonal, but becoming more prominent with age, as if seated on a shelly callus; the hinge-margin grooved on each side of the beak, in the right valve in the adult, with a dentiform projection behind the chondrophore and unconnected with it, seated on the cardinal margin and recalling the tooth in *Corbula*, but less prominent, and in the young hardly developed; posterior adductor scar very conspicuous and deeply impressed; pallial sinus moderate. Type:

Tugoniopsis compacta n. s.

PLATE 35, FIGURE 10.

Miocene of Magnolia, Duplin County, North Carolina; Burns.

Shell small, plump, usually more or less irregular, and evidently a nestler; surface finely concentrically wrinkled; beaks nearer the posterior end, small and pointed; general form rounded ovoid; other characters as in the subgeneric diagnosis. Lon. 6, alt. 5, diam. about 4 mm.

This is an interesting little shell, intermediate between *Tugonia* proper, *Sphenia*, and *Mya*.

Genus PARAMYA Conrad.

Paramya Conrad, Proc. Acad. Nat. Sci. Phila. for 1860, p. 232; for 1862, p. 572, 1863; Meek, Checkl. Inv. Fos. N. Am., Miocene, p. 12, 1864; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, 1889.

Myalina Conrad, Fos. Medial Tert., p. 65, pl. 36, fig 4, 1845; not of De Koninck, 1842.

Shell subquadrate, small, concentrically striated (equivalve?), inequilateral, with beaks anterior to the middle line; hinge with a triangular vertically directed pit for the resilium, the lateral borders of the pit sometimes carinated, the basal margin depressed; no hinge-teeth or external ligament; the pallial line more or less broken up, as in *Saxicava*, a feature more prominent in the young; pallial sinus none in a strict sense, the pallial line slopes forward from the posterior adductor scar in a right line, joining the basal portion at an obtuse angle without any curve or insinuation; this part of the pallial line is notably distant from the posterior end of the shell. Type *P. subovata* Conrad.

This curious little shell was referred to the *Saxicavidæ* by Conrad, Meek, and Tryon, and to the *Corbulidæ* by the present writer, but its true place seems still uncertain and is likely to remain so until the anatomy is made known. In quite young shells the pallial line is distinctly broken up, in old specimens the original patches have become confluent. If the chondrophore of *Mya* was turned down into the vertical plane of the valves and the surface of attachment in the opposite valve elevated into the same plane, the result would be analogous to the hinge of *Paramya*. There are analogies to be traced in *Basterotia* and *Fabagella*. On the whole, I am disposed to think that *Paramya* should be referred to the *Myacidæ*, subject to future correction. I have never seen an indubitable pair of valves, and it is uncertain whether the valves are equal or not, but I am inclined to suspect that they are somewhat unequal.

Paramya subovata Conrad.

Myalina subovata Conrad, Fos. Medial Tert., p. 65, pl. 36, fig. 4, 1845.

Paramya subovata Conrad, Proc. Acad. Nat. Sci. Phila. for 1860, p. 232; for 1862, p. 572, 1863; Meek, Checkl. Inv. Fos. N. Am., Miocene, p. 12, 1864; Dall, Bull. U. S. Nat. Mus., No. 37, p. 70, 1889.

Miocene of the York River, Virginia, Harris; and of the Natural Well, Duplin County, North Carolina; Pliocene of South Carolina, on the Waccamaw River; Pleistocene of South Carolina, and living, in from twelve to thirty fathoms, from the vicinity of Beaufort, North Carolina (Stimpson), southward to Florida; Dall and Rush.

The recent shell does not appear to differ in any respect from the Miocene fossil. Stimpson was of the opinion that *Mya simplex* Holmes (P.-Pl. Fos. S. Car., p. 55, pl. 8, fig. 16, 1858), from the Pleistocene of Simmons Bluff, South Carolina, is identical with *Paramya*, but Holmes's species has a narrow chondrophore, much as in *Sphenia*, but smaller, with a prominent tooth in front of it, and, as far as one can judge from the shell alone, belongs in the vicinity of *Basterotia*, probably in the subgenus *Fulcrella*.

Superfamily MACTRACEA.

With the exception of Neumayr's and Bittner's investigations, the Mactroid hinge appears to have been studied without reference to large series of specimens of a single species, and with little consideration of evolutionary progress or dynamic modification.* In order to discuss it properly it is necessary to pay much more minute attention to its details and the relations of its parts than has hitherto been thought required.

To make these details clear and avoid excessive verbiage, it becomes necessary to name the parts of the hinge, and for clearness I prefer to use, for the most part, plain English terms, applied for the occasion in a particular and exclusive sense. The memory is thus not burdened with the task of learning a wholly new vocabulary, and can devote its energy solely to following the description.

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 laminæ, 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

* The excellent studies of Bernard, Bull. Soc. Géol. de France, 3me Sér., t. xxiii., pp. 141–144, 1895, appeared after the preparation of this part of my manuscript.—W. H. D.

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 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, as I have elsewhere shown.* 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 *Mactridæ* 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.

The shelly portions of the hinge arise from a shelly basis stretched antero-posteriorly between the limbs of the arch forming the cardinal margin. This basis is called the *hinge-plate*, and it may have its surface "*flat*,"

* Am. Journ. Sci. and Arts, vol. xxxviii., Art. 55, Dec., 1889.

i.e., nearly parallel to a vertical plane between the closed valve-margins, or "*oblique*," that is, inclined at an angle so that its dorsal edge starts from the valve within the dorsal margin of the latter. When the hinge-plate forms a marked angle with the valve, the space between the ventral edge of the plate and the dorsal margin of the valve is said to be "*excavated*," forming a V-shaped valley on each side of the chondrophore, a state of things which some of the older writers tried to indicate by the objectionable expression that the hinge was "*double-edged*." In *Mactra* the hinge-plate is never perfectly flat (such as we find, for instance, in *Astarte*), and in some of the thin-shelled forms, like *Pteropsis* or *Labiosa*, the excavation is deep and sharp, and is indicated on internal casts of the fossils by two areas set off from the general mass by deeply incised lines parallel with the dorsal margin. A hinge-plate is always present, however, and we never find a Mactroid hinge set directly upon the cardinal margin, as in *Arca*.

As the shelly projections usually called lateral teeth are very variable and often ill-defined compared with the cardinal teeth, I have found it conducive to clearness to term them "laminæ" rather than "teeth." The cardinal teeth are essentially in origin like the teeth of *Cyrena*, but in the process of evolution the two outside teeth have gained strength by retaining a union at the angle where they join, and the inner bifid tooth (that of the left valve) has become more triangular, in harmony with the bearing surfaces of its neighbors. That this is not merely a speculation may be seen by comparing a regular *Mactra* with *Rangia* or some of the Mulinias which do not continue to unite the outside cardinals, and it will be seen that the form of the inner cardinal is much more triangular and constant in its shape in the first mentioned. The study of very young shells has shown in every case that the arms of the cardinal tooth of the right valve in *Mactra*, after separating from the inner ends of the laminæ, are distinct teeth, and in *Mulinia* and some species of *Mactra*, as well as *Rangia*, they remain separated, more or less completely, even in the adult. The diverging branches of this compound tooth I call its anterior and posterior "arms." The single tooth in the opposite valve is sometimes excavated in the middle line and curved upward like the petal of a lily; such teeth I name "petaloid." The angular space between the anterior arm of the cardinal tooth and the dorsal margin of the valve I call the "anterior sinus" of the hinge; the other one, behind the cartilage-pit, the "posterior sinus." The space between the arms of the cardinal tooth is the "ventral sinus." There are some parts of the nepionic laminæ which become obsolete in the adult, or are represented only by frail remnants. One such is between the side of the cardinal tooth and the surface of the resilium in the left valve (4 *b* of Bernard's notation); others are parallel to the arms of the cardinal teeth in the right valve. These thin sheets of shelly matter in the adult I call "accessory lamellæ." As might be expected, they are very inconstant and excessively fragile if well developed; usually, whether by breakage or otherwise, they appear merely as low ridges parallel to the normal teeth and laminæ. These lamellæ are often referred to as "teeth" in descriptions of species, and, to the rather frequent presence of the accessory lamella (4 *b*) of the posterior arm of the left cardinal tooth is probably due the ascription by the older authors of three cardinal teeth to the valve in the genus *Mactra*.

When the hinge-plate is excessively oblique, as in *Mactra alata* Spengler, the thin and slender teeth are sometimes reinforced by horizontal or vertical *buttresses*, which extend from the teeth to the hinge-margin. In using adjectives denoting the direction of plane surfaces in this paper the shell is conceived of as suspended by the umbones with its longest antero-posterior line in a horizontal plane. When, therefore, a buttress extends in a plane substantially parallel with the plane including the margin of the valve, it may cover part of the sinus so that the portion covered is either wholly filled with shelly matter or is merely *roofed over* by a shelly plate. The former condition is more common. In other cases the buttresses may extend in a plane at right angles to the plane of the valves and inclined at any angle to the plane of their transverse diameter which will give the greatest strength with the least expenditure of material. Such buttresses cut the sinus into two or more cavities, those nearer the beaks being cellular. This variety of buttress I call a "*septum*." (See pl. 27, fig. 14 *c*.) It is somewhat rare, and when present curiously complicates the hinge. The initiation of hinge-teeth is illustrated in a curious way in *Schizodesma Spengleri*, where the ridge supporting the ligament is produced at the margin of the valve into an obscure prominence, which is partly received by a slight depression in the opposite valve. This requires very little encouragement to develop into an entirely new type of tooth, at least compared with the primitive teeth of the hinge of *Mactra*.

In the situation and form of the different teeth upon the hinge-plate the influence of the different strains and stresses involved in the mechanical action of the hinge are clearly discernible if intelligently looked for. A study of the hinge taken in connection with its secreting surfaces shows that the different shelly parts of the two valves which combine to form the hinge rarely touch each other. No matter how close the hinge may fit, there is an intervening space between the most approximated surfaces, into which a delicate secretive film, a portion of the dorsal mantle margin, extends, and probably, during life, permanently remains. It is true that this membrane may contract more or less at times, leaving the space between two surfaces unoccupied, but an examination of many specimens, which have been put into alcohol while still alive, leads me to conclude that normally the whole hinge-surface is in contact with the secretive film. It is known to all close students of the mollusks that the mantle possesses the faculty of absorbing shell-substance inconvenient to the animal, as well as of secreting that which is needed. The method of operation is still not understood, but the process is perhaps connected with ciliary action. At all events, the operation takes place; consequently the stresses upon the parts of the hinge act first by being communicated to the soft tissues between them and not necessarily by direct friction or pressure. Intermittent pressure appears to produce increased secretion, and thus thickening of the shelly surfaces concerned; continuous pressure leads to absorption by the tissues in self defence; the marks of it are often clearly visible in old shells on the posterior face of the anterior arm of the left cardinal tooth, where the most continuous and direct pressure felt by any part of the hinge is most constantly applied. (See pl. 27, fig. 16 *s*.) It is to be noted that the growth of the hinge does not always march uniformly with the growth of the valves, though discrepancies here are much less marked than in the structures of Gastropods, which are superimposed upon the oral surface of their shells.

With the separation of the ligament and resilium a space more or less marked intervened between their adjacent parallel sides. In one group, the typical Mactras, this space has become more or less occupied by a shelly ridge, which, when the valves are closed, more or less completely cuts off the ligament from the resilium, partition-wise. This ridge or shelly wall naturally belongs to the posterior slope of the shell, and may become coalescent, over the apex of the resiliary pit, with the spur. In a small antipodean group of species the partition is accomplished in another way,—the spur projects and is continued in a more or less irregular shelly rod, which is laid close to the ventral border of the ligament, and is attached to the shell, though not heartily coalescent. *Mactra ovata* Gray offers a good example of this formation. In a single species the ligament, while quite separate from the pit, has itself sunken below the dorsal shell margin, only its most anterior point remaining at the surface. (*M. tristis* Reeve, Conch. Icon.)

Having indicated and named the characteristic portions of the hinge-armature, it remains to say a few words as to the relative attitude of the different parts. It must be borne in mind that the proliferations of the mantle, which supply the exudations from which the shell-substance is crystallized out, are delicate and filmy, unable to "stand alone." If, by some accident, the beginning of the hinge or any part of it is abnormally shaped, subsequent depositions must be laid down upon the abnormal basis and correspondingly modified. In short, as soon as the shelly valves are formed they represent, in relation to the soft parts they enclose, an extraneous rigid mold or body composed of two parts which react dynamically upon each other through the intermediation of the soft parts contained between them. The initiatory form of the shell is as purely genetic as any portion of the animal can be; the subsequent development must be largely guided by it. Mutations foreign to this plan can only be brought about by environmental forces still more energetic.

The distribution of the parts of the hinge in single species is remarkably uniform, but if groups of species are considered, the types are seen to gradually approach and almost merge, one in another. Sharp generic distinctions can seldom be drawn, and there are many groups named, sectionally or even generically, which owe their verbal distinctness to wilful or unconscious ignoring of the details of structure in other parts of the family.

The lateral laminæ were originally determined from the umbones as a focus, but this was an ancient event and, for practical purposes, is much obscured in the existing conditions of the hinge. The distance to which they extend on either side of the beaks, and their greater or less continuity between the beaks and the distal portions of the teeth, are variable dynamic functions depending upon the form of the dorsal arch of the valves and the strains to which the valves are subjected in the station preferred by each particular species. In general, the geologically more ancient forms have the lateral laminæ more adjacent than in their modern descendants, other things being equal, which is what might be expected theoretically. Taking the different species in one contemporaneous group, much variation may be found in the distance of the laterals from the beak, as well as in their form, but these features do not seem to possess any very great systematic importance.

The lateral laminæ may be set frankly on the hinge-plate, or more or less confluent with its ventral margin; usually long, slender, and simple, they are sometimes fluted longitudinally with the distal angle recurved. The paired laminæ are more variable than the single ones. The former vary from little elevated ridges on either side of an indentation in the substance of the hinge-plate, to thin, sharply defined lamellæ; the dorsal one of the pair may be nearly confluent with the dorsal margin of the valve, or it may be a clean-cut, independent lamina rising sharply from the hinge-plate. In the more triangular species the laterals are shorter and closer to the beaks, and in some of the very thin-shelled forms (such as *Pteropsis* or *Labiosa*), where no great strain is ever brought upon them, they are always imperfectly developed. In *Harvella*, however, we find them clearly defined, notwithstanding the thinness of the shell. In some groups (such as that typified by *Spisula solidissima*) the tendency of the valves to rotation on the resilium as an axis is opposed by the development of transverse grooves on the opposed surfaces of the laterals, and in a few species this grooving has become so pronounced that the valves can hardly be separated without the use of force sufficient to fracture the laterals. It is an illustration of the same principle which developed the hinge of *Arca*, but applied secondarily upon a type of hinge which, when adult, is the exact antithesis to that of the Prionodont.

In studying the development and mutations of the cardinal teeth, besides the changes which result from the dorsal coalescence of previously distinct parts, another set of variations present themselves which a complete series of the stages of growth in any single type would doubtless show to be dynamic. It is obvious, in species with sagittate ligaments, that the sinus between the barbs of the ligament is filled by a pointed process of each valve, forming part of the dorsal margin, which extends backward, and in a single valve is seen to be situated over the resiliary pit, or partially so. This may be called the cardinal *spur*. Its tip is sometimes slightly recurved or callous. The cardinal teeth are situated under the anterior part of the spur, and in mature specimens the posterior arm of the cardinal tooth in the right valve is often coalescent with the spur. In that group which has the ligament partly or wholly walled off from the cartilage-pit by a shelly ridge, this ridge unites the spur with the dorsal shell margin, between the scar of the ligament and the pit, or chondrophore, properly so called.

Now the dynamical feature to which I would direct attention in connection with the cardinal teeth, especially in the right valve, is that the two arms of the cardinal seem (when different sections of the genus are compared) to rotate, as it were, on an imaginary axis nearly coincident with the angle at which the two teeth are soldered together. From this it results that the anterior arm of the consolidated cardinal may be coalescent with the dorsal shell margin (in which case the anterior laminæ will radiate from the ventral sinus), or may be superimposed exactly upon one of the laminæ (usually the ventral one, when the hinge appears to have lost one of its anterior laminæ), or may rise from the hinge-plate on a radial line behind that of the ventral anterior lamina. Concurrently the posterior arm of the tooth may be directed vertically downward with an empty triangular space between it and the anterior verge of the pit (in which case there is often an accessory lamella at the verge), or it may rise directly from the verge like a wall, or it may project out over the pit supported only by its attachment to the cardinal spur. The angle at which the two arms of the cardinal tooth unite is usually quite constant in the same species, and the triangle or ventral sinus enclosed between them is therefore quite uniform in shape.

By following this rather long but necessary dissertation upon the examples of the hinge, which have been figured and lettered for the purpose, it will be found comparatively easy to apply the terms used to the description of particular hinges and to comprehend the relations of the several parts.

The earliest *Mactridæ* yet recognized are Mesozoic. In the Chico beds of California, now thought to represent the lower part of the Upper Cretaceous, are several genuine Mactras, described by Gabb under the name of *Cymbophora*. In the early Eocene *Pteropsis* Conrad hardly differs from *Raëta*. In the Middle Tertiary a very large number of species are said to occur, exceeding the recent forms in abundance; many of these, however, are probably synonymes and should not be counted. The group is an essentially modern one, and is probably represented to-day by as many living species as were present in any antecedent fauna.

A number of groups which should properly belong to the family have been scattered in different families, or even orders, by systematists devoted to single characters or morphologists having little acquaintance with the details of character. A number of groups which have closely related shells present marked differences of superficial anatomy, as, for instance, the *Mesodesmatidæ*, which have Mactroid shells and Tellinoid free siphons; others defy final classification, owing to our ignorance of their anatomy. The place of various fossils, such as *Mactropsis* Conrad, must be governed by the general habit of the shell, since no other means is left us to decide by.

Mactra is, on the whole, a somewhat active animal, and seems to prefer clean sand, through which it ploughs at times with its strong *Cardium*-like foot, leaving long furrows behind it. Certain forms seem to favor a sedentary life, many of the Mulinias and *Rangia*, and in these the foot has become smaller, and the hinge more amorphous in appearance. In a still more modified division, which has, to all intents and purposes, become absolutely sedentary, and which inhabits deeper water than the above-mentioned Mulinias, the dynamic modifications characteristic of this class of vertical borers have been more or less fully adopted. The body has become elongated, the siphons lengthened, the epidermal sheath necessary for protection to the permanently extruded siphons is continued to their ends, the mantle has become soldered ventrally as closely as the use of the foot for boring will permit, the shell has become more asymmetrical relative to the hinge. The mollusk, which has really made of its permanent tunnel an artificial shell, does not materially suffer by the exposure within that tunnel of a greater proportion of shell-less surface, and from the gradual degradation of a hinge which has become no longer of vital importance. All these modifications are of the kind I class as "dynamical," and though, by heredity, they may eventually be permanently impressed on the organism, yet it will hardly be claimed that they have as great a value for the higher systematic divisions as those characters which, derived from unknown antiquity, we are able to recognize as genetic. Yet it is found in one of the latest morphological essays at a systematic arrangement of the Pelecypods that *Lutraria* is put in a different *Order* from *Mactra* because of the closure of the ventral opening of the mantle in part of the species! Such characters are common to forms as fundamentally divergent as *Solemya*, *Solen*, *Glycimeris*, *Tagelus*, *Mya*, and *Cyrtodaria*, and indicate nothing more than a common (and inevitable) response to common dynamic conditions of life. Such conditions have existed, it is true, from the beginning, and *Solemya* is witness to a very ancient response; nevertheless, there is nothing in any of the mutations which is indicated as a permanent necessary part of the organism, or which might not pass away with ease under a prolonged change of conditions.

Before proceeding to discuss the various groups of *Mactracea*, it is desirable to refer more particularly to the views of the late Professor Neumayr, to whom we owe such a stimulating and important discussion of the morphology of the hinge of bivalves.* Having independently arrived at conclusions in regard to many points in this connection agreeing with those deduced by Professor Neumayr, it will not be due to any want of appreciation of his talents that I find myself in some particulars unable to follow him as regards details. In accepting most of his views in regard to the initiation of the various types of dental armature,—and, among others, that which derives some part of his so-called Desmodont type of tooth from plications correlated with the submergence of the protoligament, a view independently proposed by me in 1889,—I cannot accept his homologies of the parts of the Mactroid hinge considered in detail, nor do I believe that his Desmodonta form a valid group. In fact, a fuller consideration of the types of hinge displayed by recent Pelecypods has shown the distinguished and lamented Austrian the fallacy of this earlier conclusion.† The secondary submergence of the ligament is a dynamic process which might be looked for and does occur in all the groups of bivalves to which I have attached an ordinal significance, including the Neumayrian *Desmodonta*, *Taxodonta*, *Heterodonta*, and *Dysodonta;* and the association with this submergence of plications which give rise to teeth is a dynamic result which depends solely upon the efficiency of the hinge through which the submergence takes place.‡ When, as in the case of the *Prionodonta* (*Taxodonta*), the rigidity of the valves is sufficiently provided for by a long series of interlocking processes, there is no demand for the development of additional guards to the desired stability of motion in a transverse vertical plane, and hence their development in such forms as the taxodonts is not to be expected. But where the hinge is imperfectly provided with dental leaders, and their place is not supplied by the presence of an

* Sitzb. Kais. Acad. Wiss. Wien., lxxxviii., p. 385, 1883.

† Cf. Morph. der Biv. Schal.

‡ Bernard has shown, in his interesting and important studies of the development of the hinge of bivalves, that the nepionic ligament lies between the thin edges of the valves and more or less obliquely across them, so that it is both internal and partly external. The changes by which the ligament and resilium become wholly external in many bivalves must involve an elevation of the organs mentioned. The paleontological history of such forms as *Crassatellites* shows that their precursors had an external, or nearly external, ligament; and, as we follow the members of the group in time, the ligament and resilium become larger and more internal in the successive species, until the modern type is reached. Therefore the internal position in such cases is properly referred to as the result of submergence, notwithstanding the fact that it is partly a return to a state originally normal and universal. *Crassatellites*, *Mactra*, etc., are not forms in which the originally sunken ligament has specially developed in place, but in which it has risen to the exterior and been again submerged.

exceptional adductor muscle sufficient for the purpose, then, in time, other teeth will appear and contribute their quota to the dental armature.

Specifically, in the case of *Mactra*, Neumayr (*op. cit.*, ¶ 4) homologizes, first, the nymphæ of *Glycimeris* (*Aldrovandi*) and *Mya truncata*, showing their intimate relationship. He does not mention the fact that the ligament in both these forms is composed of an outer, posterior, slightly greenish, ligamentary portion, and an inner, more ferruginous part, set off by a calcareous unconsolidated layer from the former. The latter is really an internal "cartilage" or resilium, and the scars of insertion of the two parts are readily distinguished on careful examination. In the fresh or alcoholic specimen the distinction of color enables one to recognize the parts at a glance. He proceeds to compare *Mya* with *Thracia* (*phaseolina*), and here again the homology is readily recognized. But when he continues by homologizing the cardinal teeth of *Eastonia* (*rugosa*) with the marginal ridges of the resiliary pit, and these with the stout rib below the ligamentary groove of *Panopea* or *Thracia*, a halt must be called at once. They are in no respect homologous. The *ridge* in *Panopea* is homologous with the *pit* of *Mactra*. In the former it is convex, in the latter concave; in both it is the seat and fulcrum of the resilium, whose very existence has not been recognized because it is, so to speak, wrapped in the ligament in *Panopea*. It is probable that Neumayr's observations on *Mactra* were based on fossil specimens, or recent ones which had lost their ligament and resilium in drying. Otherwise some of his remarks would be incomprehensible.

The error into which he has been led is still more obvious in the continuation, where he separates *Rangia*, as having a typically Heterodont hinge, from *Mactra*, which he regards as a true Desmodont. I have elsewhere shown that both in its gross anatomy and its hinge *Rangia* is truly Mactroid, and cannot be separated when young from a young *Mulinia*. If one is the other must also be Heterodont. The peculiarities of the sunken ligament and resilium are shared with *Mulinia*, and the deep pit to which attention was especially called by Neumayr is the dynamic result of the wide separation of the umbones and the persistency of the resilium. He would have found the same extended ligament, uncovered, in *Schizodesma*; and, in fact, in all *Mactridæ* the ligament starts at the beak of the shell or nearly so, and its termini are widely separated or close together according as the beaks are far from or near to each other.

In *Mactra* the cardinals represent radiating arms of a bent lamina primitively coalescent above. The anterior edge of the cartilage-pit is not concerned with any of the teeth of *Mactra* except when they are accidentally superposed upon it. The laterals also are not related to any part of the pit, as such, though possibly they may have originated through plications not unconnected with the ancestral proto-ligament. In short, Neumayr was mistaken in supposing *Mactra* to be a Desmodont, as sufficient material will show any one.

Family MACTRIDÆ.

The family *Mactridæ*, when divested of some extraneous matter, is divisible into several groups from our present knowledge. These groups will be regarded here as subfamilies, though, as in many other cases, it is by no means determined whether their systematic value is precisely equivalent to other groups of the same nominal rank. It suffices that they seem to be natural groups, within the family, of higher than generic value.

Subfamily MACTRINÆ.

Shell subequilateral, nearly closed; hinge normal (as previously described, p. 862), fully developed; siphons partially or wholly naked, wholly retractile within the shell; mantle, between siphons and anterior adductor, chiefly open ventrally.

Subfamily PTEROPSIDINÆ.

Shell subequilateral, nearly closed, thin; hinge feeble, concentrated, the laterals partly obsolete or much reduced; siphons wholly retractile, naked; mantle partially closed ventrally.

Subfamily LUTRARIINÆ.

Shell inequilateral, widely gaping; hinge tending to be irregular, the laterals partly reduced or obsolete; the chondrophore free, in the plane of the hinge-plate; siphons contractile, not retractile within the shell, clothed with a horny epidermis to their tips; ventral opening of the mantle short, and the foot correspondingly reduced in size. An opisthopodial orifice sometimes present.

Subfamily ZENATIINÆ.

Shell inequilateral, compressed, thin; hinge concentrated, irregular, the laterals tending to become obsolete or absent; chondrophore bent out of the plane of the hinge-plate and more or less adherent to the valve; siphons contractile, naked; ventral opening of the mantle and foot variable.

? Subfamily ANATINELLINÆ.

Shell inflated, gaping, radiately striate; hinge with a prominent large, narrow chondrophore, a short external ligament, a narrow cardinal tooth, and accessory lamella in each valve without laterals. The pallial line distinct without a sinus. Soft parts unknown.

In order to classify our Tertiary *Mactridæ* it became necessary, owing to the confused state of the group, to go over and revise the whole of it, and this investigation has resulted in numerous rectifications and changes, since no revision of the group has been made in many years. With the idea that these results may be useful for paleontologists, the subjoined synopsis of the different groups is presented.*

Subfamily MACTRINÆ.

Genus MACTRA Linné, 1758.

Mactra (L.) Lam., 1799. Type *M. stultorum* Linné.
Trigonella Da Costa, 1778; not Walch, 1762, or Schröter, 1776.
Crassatella Lam., 1799. Type *C. cygnea* (Chemn.) Spengler.
Mactra Dall, Nautilus, viii., p. 26, July, 1894.

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.

Subgenus MACTRA s. s.

Type *M. stultorum* Lin.

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.

There was no type mentioned by Linné, but his rule of regarding the best-known, most common, or officinal species as the type would have pointed to *M. stultorum*, which was actually selected as the type by Lamarck in 1799. Da Costa was not a consistently binomial writer, except in his last work, and

* An abstract of the classification here adopted was published in the Proceedings of the Malacological Society, vol. i., pt. 5, pp. 203–213, London, March, 1895.

is therefore not entitled to be cited for earlier work in synonymy. However, if he were, the name *Trigonella*, which he applied to the Mactras, was preoccupied by other authors.

Subgenus CŒLOMACTRA Dall, 1895.

Type *M. violacea* (Ch.) Gmelin.

Shell equilaterally oval, thin, inflated, with a thin lineated epidermis; dorsal areas grooved; beaks adjacent; pallial sinus very short, high, rounded behind; valves nearly close-fitting, convex; ligament sagittate, linear, completely shut off from the chondrophore by shelly matter; dental armature not concentrated; laterals long, thin, and flexuous, distally confluent with the hinge-plate margin, as is the anterior ventral lamina; anterior sinus roofed by a buttress upon which stands the anterior arm of each cardinal, and from under which the laterals emerge; chondrophore roofed at the apex; right cardinal not coalescent above, the anterior arm adjacent to the dorsal shell-margin; hinge-plate very oblique, especially in front, forming a deep recess extending to the beaks.

This group, recognized, but not named, by Gray in 1837 (*Mactra D*), is the analogue in the *Mactra* line of *Schizodesma* in the *Spisula* line, from which it differs in its ligament, set off by a shelly floor, in its short, high, almost obsolete pallial sinus, the light, inflated valves, the remarkable anterior sinuses, and the disposition of the cardinal teeth. *Mactra turgida* Gmelin (*tumida* [Ch.] Rve.), and probably *M. Cumingii* Reeve (= *Cuvieri* Desh.), have similar features. It is a tropical old-world group of species.

Subgenus MACTRODERMA Dall.

Mactroderma Dall, Nautilus, viii., p. 39, 1894. Type *M. velata* Phil.

Shell inequilateral, rude, with a coarse epidermis, pronounced pedal gape, a lanceolate sunken ligament, an inconspicuous spur; dental armature concentrated, teeth and laminæ short, the anterior arm of the right cardinal lying in the plane of the ventral lamina; otherwise as in *Mactra*.

Section *Mactroderma* s. s.

Shell elongated. Distribution, west America. *Mactra velata* Phil., Panama.

Section *Cyclomactra* Dall, 1895.

Shell subcircular, compressed, pedal gape obsolete, ligament submerged except the tip, but wholly separated from the resilium; remainder of characters like *Mactroderma.* Distribution, Australian seas and New Zealand. *M. tristis* Gray may serve as type.

Subgenus MACTROTOMA Dall.

Mactrotoma Dall, Nautilus, viii., p. 26, 1894. Type *M. fragilis* Gmelin.

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 laminæ 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. (See pl. 27, figs. 1, 4, 8, 18.)

This group is widely distributed over the world in the tropics, usually a single species in each fauna. The type is better known as *M. brasiliana* Lam. These species have been confounded with *Standella* Gray, which was based on *M. pellucida* Chemn. (which Gray by an error referred to as *fragilis* Chemn., another species figured on the same plate of the Conch. Cabinet) and *M. ægyptiaca* Dillwyn, species belonging to the *Lutrariinæ.* Gray's error of reference is explained by manuscript notes of Deshayes in the writer's possession and by specimens identified after Gray by Cuming for the United States National Museum; but the details make too long a story to recapitulate here. The soft parts of this group (as might be anticipated from the shell characters) show modifications pointing towards *Lutraria. Standella* has a spisuloid ligament.

Section *Simomactra* Dall.

Nautilus, viii., p. 40, 1894. Type *M. dolabriformis* Conrad, Gulf of California.

Shell inequilateral, flattened cuneiform; pallial sinus smaller; siphonal gape inconspicuous; accessory lamellæ distant from the laterals; otherwise as in *Mactrotoma* s. s.

Section *Micromactra* Dall.

Nautilus, viii., p. 40, 1894. Type *M. californica* Conrad, non Deshayes.

Shell small, solid; hinge like *Mactrotoma* s. s.; beaks sulcate. (See pl. 28, fig. 12, and pl. 37, fig. 23.)

The type is found in California, and the group is represented in the Oligocene of Florida and the Eocene of Trinidad.

Subgenus **MACTRELLA** Gray, Jan., 1853.

Dall, Nautilus, viii., p. 40, Aug., 1894. Type *M. alata* Spgl. (+ *Papyrina* Mörch, April, 1853).

Shell trigonal, thin, inflated, the posterior dorsal area marked off by a keel or angle; beaks prominent; ligament narrow, sagittate; dental armature concentrated, anterior laterals short.

Section *Mactrella* s. s.

Plate 27, Figure 14.

Mactrella Dall, Nautilus, viii., p. 40, 1894.

Chondrophore small, oblique, apically roofed; the pit walled in front by the posterior cardinal arm in the right and by a well-marked accessory lamella in the left valve; anterior laterals very small and short; both ventral laminæ formed by the upturned edge of the hinge-plate; cardinal tooth in the left valve rather petaloid, the anterior arm stronger than the other, supported at the angle and at the ventral extremity by a septum extending to the dorsal margin of the valve; there is a feeble anterior accessory lamella superposed on the root of the anterior lateral lamina and a posterior ditto walling the chondrophore; in the right valve the arms of the cardinal are not coalescent above; the anterior arm is supported by a septal buttress at each end, and has a small projection below it on the edge of the hinge-plate, representing an accessory lamella; the gape is short and wide; the surface of the valves is smooth.

Section *Harvella* Gray, 1853.

Dall, Nautilus, viii., p. 40, 1894. Type *M. elegans* Sowerby.

Hinge like the typical section; surface of the valves plicate; shell extremely thin.

This group includes *M. vitrea* Ch. and *M. Reevesii* Gray.

Section *Mactrinula* Gray, 1853.

Type *M. plicataria* Lamarck.

Shell externally like *Harvella*, the dental armature less concentrated, the chondrophore large and narrow, laterals well-developed, emerging in the right valve anteriorly from a roofed sinus, on the roof of which is set the anterior cardinal arm; in the left valve the posterior cardinal arm projects over the chondrophore, while the anterior one is continued ventrally by a narrow accessory lamella; hinge-plate quite oblique, without buttresses to the cardinals.

The species of this group are rare tropical forms, a single species being found in a fauna when present at all. Geologically they go back to the Oligocene.

Genus **SPISULA** Gray, 1838.

Dall, Nautilus, viii., pp. 26, 40, 1894. Type *Mactra solida* (L.) Gray, 1847.

Shell small, subequilateral, trigonal, with a thin epidermis, adjacent beaks, and concentrically grooved dorsal areas; pallial sinus small, rounded; gape obsolete; valves convex; ligament sagittate, set in a callous area close to the dorsal margin and not set off from the chondrophore by any shelly ridge; dental armature normal, strong, not concentrated; the opposed surfaces of the laterals transversely grooved; left cardinal small, prominent, with a small posterior accessory lamella, the posterior ends of both projecting over the chondrophore; right cardinal with the arms coalescent above, the anterior arm close to the dorsal shell-margin; hinge-plate thick and flattish; exterior smooth or concentrically striated; the dorsal areas ill-defined.

Subgenus HEMIMACTRA Swainson, 1840.

Dall, Nautilus, viii., p. 26, 1894. Type *M. solidissima* Dillwyn.

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.

Section *Mactromeris* Conrad, 1868.

Dall, Nautilus, viii., p. 26, 1894. Type *M. polynyma* Stm.

Shell like *Hemimactra*, but the laterals smooth, the cardinals not compressed, and the anterior arm of the right cardinal not confluent with the ventral lamina. (See pl. 27, figs. 3, 7, 13, 16, 24.)

This type is especially characteristic of northwest America. *Mactrodesma* (*ponderosa*) Conrad is merely an extremely ponderous rotund *Mactromeris* of Miocene age; *Pseudocardium* Gabb also seems nothing more than an unusually heavy, short, and elevated species of *Mactromeris*; *Veleda* Conrad is based on *V. lintea,* a small species of the same general type, though perhaps more strictly referable to the subgenus *Cymbophora* referred to below.

Section *Oxyperas* Mörch, 1853.

Type *M. triangularis* Lam.

This section is characterized by its more crudely triangular shape and rather strong concentric sulcation of the surface of the valves. It is chiefly Indo-Pacific in its distribution.

Subgenus LEPTOSPISULA Dall, 1895.

Type *Mactra striatella* Lam.

Shell thin, inflated, with undulated beaks, the dorsal areas smooth; pallial sinus large, deep; gape well marked; valves convex; ligament sagittate, dental armature concentrated; opposed surface of the laterals smooth; anterior arm of left cardinal coalescent with the lateral; anterior arm of right cardinal coalescent with the dorsal lamina; hinge-plate thin and excavated; spur prominent, but the chondrophore not roofed at the apex.

This group in the Spisuloid division represents the *Mactrella* type in the Mactroid section. The type of the subgenus is said to come from India.

Subgenus CYMBOPHORA Gabb, 1869.

Type *Mactra Ashburneri* Gabb.

A careful study of the typical species of this group shows that it differs from *Spisula* only in the following features. The attached ends of the resilium were convex instead of flat (as is sometimes seen in recent species), and the margins of the pit are therefore elevated; while the posterior sinus, instead of being (as usually in the later types of *Spisula*) roofed over or filled up with a solid mass of callus at the apex, upon which the ligament is attached, is vacant, so that the ligament was fixed on the convex margin of the pit, or on the side of the ventral lamina, or partly on both, all being very close together. This character would seem to be trifling until it is observed that all the Mesozoic species are characterized by this feature, though, as in recent *Spisula,* the external form may vary, the dorsal areas be smooth or grooved, the teeth sulcate or smooth. As it is common to all the Cretaceous *Mactridæ* of which I have been able to examine a hinge, I have thought it best to retain the name in a subgeneric sense for that stage of development of the group. Gabb's figures are too formalized and do not bring out the features clearly.

His *Lutraria truncata* and *Schizodesma abscissa* are both referable to *Cymbophora* and differ chiefly in form.

Subgenus SCHIZODESMA Gray, 1837.

Type *Mactra Spengleri* Linné.

Scissodesma Gray (olim), 1842; *Mactra* Mörch, 1853; not Lam., 1799.

The type species of this group is a very remarkable form, which, if isolated, would deserve generic rank. The other species, however, smooth the way to the ordinary sagittate ligament, being in every way comparable in the *Spisula* series to *Mactrella* in the *Mactra* series. The hinge, apart from the purely dynamic features due to the distance between the beaks, presents an interesting illustration of the inception of teeth at points subject to percussion. The end of the strong rib which guards the ligamentary slit in either valve in one valve has developed a nascent tooth or projection, and in the other an obscure socket to receive it. This appears to be unique in the family. The species are confined to the African coasts.

Genus MULINIA Gray, 1837.

Dall, Nautilus, viii., p. 27, 1894. Type *N. typica* Gray (=*M. edulis* King).

Shell with the ligament and resilium both enclosed in a single pit and invisible externally. Laterals subequal, moderately distant; teeth normal; valves closing almost hermetically; pallial sinus short and small; siphons short; foot narrow, pointed. (See pl. 28, figs. 4, 6–9, 14.)

Widely distributed in estuaries of the tropics and temperate seas over most of the world. The most conspicuous species are from South America.

Genus RANGIA Desmoulins, 1832.

Type *R. cuneata* Gray (+ *cyrenoides* Desm., 1832).

Shell like *Mulinia*, but with the proximal end of the anterior lateral vertically hooked; laterals curved, cross-striated, more or less unequal, the posterior longer; pallial sinus small.

Subgenus RANGIANELLA Conrad, 1868.

Type *Mactra mendica* Gld., 1851 (+ *Gnath. trigonum* Petit, 1853).

Shell small, rostrate, with the laterals short, straight, and nearly smooth; pallial sinus obsolete, teeth normal.

All the recent species of the genus are from the warmer estuaries of North America.

Section *Miorangia* Dall, 1894.

Type *Gnathodon Johnsoni* Dall. Miocene of Mississippi.

Shell small, extremely inequilateral; pallial sinus obsolete; cardinals reversed from the normal, that in the left valve fitting over the other.

This a peculiar little form from the newer Miocene of the Gulf border. So far as my observations go, it is the only species in the whole family which presents us with a superior left cardinal.

Subfamily **PTEROPSIDINÆ**.

Genus **PTEROPSIS** Conrad, 1860.

Type *Lutraria papyria* Conr., 1833 (= *M. dentata* Lea).

Shell subequilateral, thin, inflated, with a more or less vermiculate surface; pallial sinus deep, narrow, pointed; siphonal gape small; ligament sagittate, not set off by a shelly lamina from the chondrophore; dental armature strong; chondrophore large, shallow; left cardinal tooth wide, the anterior arm superposed on the root of the anterior lateral, the posterior arm walling the pit; posterior lateral long and well marked; right cardinal wide, the anterior arm walling the pit, the posterior smaller, appressed upon the dorsal shell-margin; arms of the cardinal coalescent above, spur perceptible, not roofing the pit; laminæ short, smooth, the anterior emerging from the ventral sinus; hinge-plate very oblique, thin; dorsal areas obscure.

This group comes from the Lower Eocene, Lisbon or Buhrstone horizon, and the Claiborne sand, where it is represented by a single species in each horizon. The Claiborne species is the type; that from the Buhrstone is *Lutraria lapidosa* Conr. (1846), of which *Astarte Conradi* Dana (1863, Man. Geol., fig. 800) is a synonyme.

This group is, without doubt, the precursor of *Raëta*, and should be looked for in the Tertiaries of Eastern Asia. It differs from *Raëta* in the strong, not concentrated hinge, well-developed laterals, broad, rotated right cardinal, and in having no shelly lamina between the ligament and resilium. It corresponds to *Spisula*, as does *Raëta* to *Mactra* in the *Mactrinæ*.

Genus **LABIOSA** (Schmidt) Moller, 1832.

Type *Mactra anatina* Spengler, 1802.

Shell large, thin, inflated, broad and gaping behind, beaks adjacent; surface concentrically striate; dorsal areas well defined, the posterior area set off by an elevated line; pallial sinus short, rounded, wide; siphonal gape wide;

ligament marginal, set off by a prominent lamina of shell from the pit; left cardinal with a very short posterior arm projecting over the pit, with an accessory lamella above appressed to the ligamentary ridge over the apex of the chondrophore; a single obsolete and very short lateral in each valve before and behind the pit; hinge-plate flattish behind, depressed and excavated in front.

A single species on each shore of America inhabiting the warmer regions. Geologically the group goes back to the Pliocene.

Subgenus RAËTA Gray, 1853.

Type *Lutraria canaliculata* Say, 1822.

Shell large, inequilateral, thin, inflated, acutely rostrate behind, concentrically plicate; dorsal areas obscure, the surface of the valves more or less vermiculate; pallial sinus deep, narrow, pointed; siphonal gape small; ligament submerged except at the anterior end, set of by a shelly ridge which roofs the apex of the pit and partially supports the posterior arm of the cardinal tooth; dental armature concentrated; chondrophore large; left cardinal small, its posterior arm shorter, with a small accessory lamella above, both projecting over the pit; right cardinal with the arms coalescent above, the anterior larger, superposed on a feeble anterior lateral, the posterior arm much shorter, projecting over the pit; a single anterior and posterior lateral in each valve but no paired laminæ.

Distribution the same as *Labiosa*. Geologically the group goes back to the Miocene.

Section *Raëtina* Dall, 1894.

Type *R. indica* Dall n. s.

Shell like *Raëta* but small, with the posterior laterals wholly wanting; the hinge-plate normal, its ventral margin not upturned; the anterior sinus excavated, and roofed at the apex.*

Subgenus RAËTELLA Dall, 1894.

Type *R. tenuis* Dall.†

Shell very small and thin, surface concentrically plicate, not vermiculate, polished; dorsal areas well defined; sinus short and rounded; valves inflated,

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* *R. indica* n. s. Shell white, elongate, concentrically finely plicate, very thin; pallial sinus very deep and narrow; beaks small, inflated, nearer the anterior end, which is full and rounded, the posterior end being produced, attenuated, and laterally compressed, forming a bluntly pointed rostrum. Alt. of shell 28.5, lon. 43, diam. 20 mm.

Bombay, U. S. Nat. Mus., No. 90,276.

This species resembles *R. rostralis* Deshayes (= *pulchella* Ad. and Rve.) but is larger, while in suborbicular, subequilateral, with a short, pointed rostrum; no lateral laminæ in either valve, the edge of the very oblique hinge-plate being produced on each side in each valve, near the chondrophore, to perform the office of laterals; ligament very short, external; the cardinals and chondrophore well-developed, normal.

The genus *Blainvillia* Hupé, 1854 (not Rob. Desv., 1830), has been referred to this vicinity by authors. It doubtless is identical with *Clementia* Gray and belongs elsewhere. Gray's name must be retained.

Subfamily LUTRARIINÆ.

Genus LUTRARIA Lamarck, 1799.

Type L. *oblonga* Gmelin.

+ *Lutricola* Blainville, 1825; + *Psammophila* (Leach) Brown, 1827; + *Lutaria* Philippi, 1853 (+ *Cacophonia* Gistel, 1848, *fide* Herrmannsen).

Shell inequilateral, thin, compressed, siliquiform; dorsal areas ill-defined; surface smooth or concentrically striated; beaks anterior, adjacent; pallial sinus deep; siphonal and pedal gapes well-marked; ligament short, feeble, not separated from the chondrophore by a shelly lamina; dental armature concentrated; chondrophore large, oblique; resilium continuous and homogeneous between the valves; left cardinal compressed, prominent, with an

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rostralis the anterior end is longer than the posterior. The latter is a Chinese species. *R. indica* differs in form and proportions from *R. Abercrombiei* Melvill, also a Bombay species.

In the absence of specimens it is impossible to speak positively, but it is probable that several other forms described from the China Seas and Indo-Pacific region should be grouped in this section. This and the following recent form are included here in order to complete the revision of the group.

† *R. tenuis* "Hinds," in Ads. Gen. Rec. Moll. The shell is excessively thin, yellowish, polished, with a nacreous sheen of much brilliancy, but internally pale straw color without nacre; the beaks are small and prominent, the surface regularly plicate with concentric waves, increasing in breadth as they approach the margin, about forty in all, the small rostrum remaining, as well as the anterior dorsal area, nearly smooth; the cardinal teeth are well developed and prominent, the cartilage pit small and nearly vertical. Alt. 10, lon. 13, diam. 6 mm.

This elegant little shell does not appear to have been described, though the name has been in the catalogues for a long time. The specimen described here was dredged in Hong Kong harbor in about eight feet of water, muddy bottom, by Stimpson, in 1853. It has been compared with a specimen, bearing the same name, in the British Museum, by Dr. P. P. Carpenter, and is No. 519 on the Museum Register. *R. pulchella* Ads. and Rve. (*rostralis* Desh.) has the same pseudo-nacreous surface, probably due to some peculiarity of structure in the epidermis, and in its general characters differs only by the presence of a trace of dorsal lamina anteriorly in the right valve, and in having the hinge-margin somewhat more effectively modified into laterals. It should doubtless be comprised in the same group. Our specimens were dredged at Hakodadi in six fathoms by Stimpson.

accessory posterior lamella; laterals very short and feeble, the posterior one obsolete or even absent. Right cardinal with the arms not coalescent above, the anterior arm adjacent to or superposed upon the ventral lamina; dorsal laminæ and the posterior ventral lamina frequently absent or obsolete; hinge-plate strong, narrow, and flattish.

This group is not represented in America, but has representatives in Europe, the China Seas, and part of the Indo-Pacific region. Species described as *Lutraria*, from American beds (such as *Traskii* and *transmontana* Conrad), belong to other genera.

Section *Goniomactra* C. Mayer, 1867.

Type *Lutraria impar* Deshayes, 1854. Australia.

Shell having much the form of *Tagelus;* dorsal areas strongly plicate above an obscure ray on each side radiating from the beak, the space between the rays ventrally smooth or concentrically striate; form subquadrangular.

I know this form only from Reeve's figure, which does not show the hinge, of which Deshayes says the cardinal tooth is prominent and the posterior lateral short and lamelliform. The pallial sinus is extremely deep. A single valve from Moreton Bay seems to be all that is recorded of this peculiar species.

Section *Lutrophora* Dall, 1894.

Type *Lutraria complanata* Gmelin (= *planata* Chemn. + *costata* Tryon).

Shell inequilateral, ovate, thin, compressed, concentrically waved or plicate; dorsal areas not differentiated; beaks anterior, adjacent; pallial sinus very deep; gapes large; left cardinal with the anterior arm adjacent to the rudimental lateral, prominent, wide, the posterior arm walling the pit, without an accessory lamella; posterior lateral small but distinct; right cardinal wide, the lamellæ not coalescent above, the anterior arm closely appressed to the dorsal shell-margin at the root of the ventral laminæ, posterior arm walling and even overshadowing the pit; posterior ventral lamina developed; dorsal laminæ absent; posterior sinus in both valves roofed at the apex; hinge-plate long, somewhat excavated, otherwise as in *Lutraria* s. s.

The rare and beautiful species which serves as type for this section bears somewhat such a relation to the ordinary Lutrarias as Raëta does to *Mactrella*. It is poorly figured by Chemnitz, but not referred to by Reeve, in the Iconica. Chemnitz refers it to the Nicobar Islands, and the specimens in the National

Museum were obtained at Bombay. They are evenly rounded at both ends and have the texture and surface of Raëta.

Genus **TRESUS** Gray, Jan. 1, 1853.

Type *T. Nuttallii* Conrad, 1837.

= *Cryptodon* Conrad, 1837, not Turton, 1822; + *Schizothærus* Conrad, Jan. 31, 1853; + *Tresus* Dall, Naut., viii., 42, 1894.

Shell large, inequilateral, thin, inflated; siphonal gape very large, pedal gape narrow; ligament minutely sagittate, separated by a shelly lamina from the pit, which lamina is often recurved and patulous; resilium homogeneously continuous between the valves; left cardinal high, compressed, with a strong posterior accessory lamella roofing the apex of and projecting over the pit; laterals small, but distinct in both valves; right cardinal feeble, not coalescent above, the anterior arm superposed upon the ventral lamina, posterior arm walling and overhanging the pit. Gills, foot, palpi, and mantle-margin not differing in any essential particular from those of *Spisula similis* Say.

The siphons are large, united to the tips, firmly clothed with a coarse epidermis; siphonal orifices papillose; the end of the united siphons when the papillose tips are retracted shuts like a book instead of contracting circularly, and the horny epidermis accumulates with growth on the flat lateral portions which correspond to the covers of the book and forms flattish masses which sometimes resemble "horny valves," as described by Conrad, but which are a purely mechanical product not comparable to the "pallets" of *Teredo*. Northern specimens have the siphonal tunic more rugose and the siphonal "valves" less clearly formed than in the southern ones. Something of the same sort can be observed at the ends of the siphons in *Mya truncata*, *Platyodon cancellatus*, and, doubtless, in other burrowers with long tunicated siphons.

The chief feature in which *Tresus* differs from the *Spisula* referred to, apart from its permanently exserted siphons and slightly less open mantle, is the great development of a thin membrane behind and extending from the siphonal septum towards the gills, to which it is attached. In *Spisula* the edges of the gills are closely adjacent to the siphonal septum with little membrane intervening. The gills in *Tresus* are more coarsely plicate than in *Spisula* and proportionately somewhat smaller. The osphradial raphe which bisects the current from the branchial siphon in *Spisula* is less prominent and more ventrally situated in *Tresus*. In other respects the gross anatomy did not differ more than one would expect to find in two species of the same genus.

In order to compare *Tresus* with another group to which it has been affiliated, a specimen of *Mya truncata* from Bering Sea was examined. The difference here was more decided; so far as general appearances go the two animals looked very different, but an analysis of the differences does not reveal anything very striking. The gills in *Mya* were smoother than in either of the Mactroids, and their anchorage to the siphonal septum was more like that of *Spisula* than *Tresus*. The foot in *Mya* is much reduced. The palpi are smaller and much less adherent to the mantle; the mantle is much more closed ventrally and the gills are more posterior as a whole than in either of the Mactroids. There is no elevated osphradial raphe apparent in the *Mya*. In other features all three genera seemed pretty much alike.

Through the kindness of Dr. Nolan, secretary of the Philadelphia Academy, I have received information showing that the signature of the Academy's Proceedings which contained the description of *Schizothærus* by Conrad was published about the end of January, 1853, while Gray's *Tresus* appeared in the January number of the Annals of Natural History, which was doubtless issued in the first days of the month. *Tresus* will therefore take precedence. The distinction attempted to be drawn between *Tresus* and *Schizothærus* by Conrad in his Catalogue of *Mactridæ* is without sufficient basis in fact. There is but one species, which varies (like *Mya*) considerably in form and proportions. It is found on both sides of the North Pacific and fossil in California.

Genus **STANDELLA** Gray, 1853.

Type *Mactra fragilis* Gray non Chemnitz = *M. pellucida* (Ch.) Gmelin, 1788; not *Standella* H. and A. Adams, 1856.

Shell short, subequilateral, thin, compressed, dorsal areas obscure; surface striated or vermiculate; beaks low, adjacent; pallial sinus deep; siphonal gape moderate; ligament not set off from the chondrophore by a shelly septum; dental armature concentrated; chondrophore moderate, oblique; resilium homogeneously continuous between the valves; left cardinal wide, prominent, with a very small posterior accessory lamella; anterior lateral short, high, adjacent to the cardinal; posterior lateral longer, both well developed and partly confluent with the ventral edge of the hinge-plate; right cardinal wide, the posterior arm walling the pit, the anterior arm superposed on the ventral lamina; both laminæ present before and behind the pit; the posterior sinus in the right valve distinctly roofed.

Owing to a confusion between two of Chemnitz's figures, by which his *pellucida* was identified as *fragilis* by Gray, most of those who have used the name *Standella* have applied it to shells resembling *M. fragilis* Gmelin, better known as *M. brasiliana* Lamarck. The ligament in *Standella* is Spisuloid while in *M.* (*Mactrotoma*) *fragilis* it is distinctly Mactroid. The true *Standella* was called *Spissula* by Mörch, but it is not *Spisula* of Gray. The species have much the same distribution in the old world as *Lutraria*. None is known from North America, but a west African species is found on the coast of southern Brazil. The genus is found in the French Miocene (Helvetien of Pontlevoy).

Subgenus EASTONIA Gray, 1853.

Type *Mactra rugosa* Gmelin.

This form is like *Standella*, but has the surface radiately striate. The type has the shell less compressed; the left cardinal narrow, compressed, with a very small, thin accessory posterior lamella (usually lost), and the anterior lateral well separated from the cardinal. Other characters as in *Standella*.

Eastonia nicobarica Gmelin (*ægyptiaca* Reeve non Chemnitz) has a hinge like *Standella pellucida*. *E. Stimpsoni* Dall, a species with finer sculpture, from the China Seas, has the hinge similar, but depauperate. This group is *Lutricola* Blainville, *ex parte*, 1825, and *Merope* H. and A. Adams, 1856. The distribution of *Eastonia* is confined to the warmer seas of the old world.

Genus **HETEROCARDIA** Deshayes, 1854.

Type *H. gibbosula* (Desh.) H. and A. Adams, Gen. Rec. Moll., ii., p. 387, 1856.

Shell subequilateral, short, with an arched posterior dorsal slope, and finely vermiculate surface concentrically striated; hinge-plate produced behind and excavated; pallial sinus deep; ligament short, external, set off by a shelly lamina; chondrophore moderate, roofed at the apex; left cardinal wide, small, its posterior arm walling the pit, the anterior arm short, inclined dorsally, crossing the root of a short, high anterior lateral; posterior laterals short, strong, as in *Standella;* right cardinal wide, posterior arm walling the pit, and the anterior appressed to the dorsal hinge-margin over a buttress roofing the anterior sinus; anterior dorsal lamina short, small; the ventral high and spur-like; the posterior laminæ longer, subequal, rather short.

This genus bears to *Standella* the relation which *Mactra* bears to *Spisula*, and is especially characterized by its very short, high anterior ventral lamina, and the manner in which the anterior arms of the cardinals are inclined towards the dorsal shell-margin. The long, excavated backward extension of the hinge-plate is noteworthy. The genus was named by Deshayes, but defined by Adams, who selected the type. Not having access to that species, the characters have been taken from *H. Denisoniana* H. Ads. It is an Indo-Pacific genus.

Subfamily ZENATIINÆ.

Genus ZENATIA Gray, 1853.

Type *Z. acinaces* Quoy and Gaim. (+ *Z. zelandica* Gray).
Metabola C. Mayer, 1867 ; same type.

Shell inequilateral, thin, compressed, siliquiform, smooth, with a conspicuous epidermis; dorsal area obscure; beaks inconspicuous, adjacent, very anterior; lunular area encroaching on the inner dorsal margin, hardly visible externally; pallial sinus very deep, gapes conspicuous, the valves hardly touching, except at the hinge and on the ventral margin; ligament lanceolate, short, somewhat sunken, not set off by any shelly barrier from the pit; chondrophore oblique, large, posteriorly depressed below the hinge-plate, resilium homogeneous and continuous between the valves; dental armature concentrated; left cardinal large, with an obscure accessory lamella between it and the ligament; a short, high anterior lateral parallel with the anterior arm of the cardinal, above which descends the lunular area; behind the ligament a very small, narrow posterior lateral (often lost) lies adjacent to the dorsal margin; valves below the cardinals reinforced by an obscure, thickened ray of shell-substance, but which does not support the chondrophore; upon this ray, behind the adductors and below the ventral sinus of the cardinal, are the scars of the pedal retractors; right valve with the cardinal wide, hardly coalescent above, with two very small posterior but no anterior laminæ; both the cardinals are wholly exterior to the pit.

The species of this genus are confined to New Zealand. The above description is taken from *Z. Deshayesii* Reeve (*Lutraria solenoides* Desh. non Lam. + *L. acinaces* Rve. non Quoy and Gaimard). The type of the genus (*Z. acinaces* Quoy and Gaim., 1834 + *Z. zelandica* Gray, 1837 + *L. Cumingiana* Desh., 1854) differs from *Z. Deshayesii* by the total absence of lateral teeth or laminæ, but these are so feeble when present, even in the large *Z. Deshayesii*, that it would seem inadvisable to divide the genus, even sectionally, on that account. The lunular area is obsolete in *Z. acinaces*. The siphons are naked and wholly united, the gills continuous, and the mantle edges united behind the foot in this genus.

Genus **RESANIA** Gray, Jan., 1853.

Type *R. lanceolata* Gray + *Vanganella* (*Taylori*) Gray, June, 1853 + *Myomactra* C. Mayer, 1867 + *Laminaria* C. Mayer, 1867.

Shell inequilateral, thin, compressed, lanceolate, smooth, with a conspicuous epidermis; dorsal areas obscure; beaks very low, adjacent, somewhat posterior; pallial sinus short, broad, gapes conspicuous; ligament small, short, lanceolate, not set off from the pit by a shelly ridge; chondrophore large, oblique, posteriorly depressed below the hinge-plate and resting on a radial thickened rib, which extends from the beaks towards the base behind the posterior adductor; a second rib of the same sort reinforces the valve behind the anterior adductor; resilium homogeneous, dental armature concentrated; left cardinal strong, prominent, petaloid, with a thin posterior accessory lamella, which, with posterior arm of the tooth, projects slightly over the pit; a short, thin, well-elevated lateral tooth on each side of the beak; a small but deep lunular inflection of the anterior dorsal margin; right cardinal low, wide, the anterior arm superposed on the ventral lamina; the anterior dorsal lamina very small between the arm of the cardinal and the lunular inflection; posterior arm of the cardinal projecting a little over the pit; the posterior laminæ small but distinct. The gills are discontinuous on one side, and the whole mantle edge free between the adductors. A single species is known from New Zealand.

Genus **DARINA** Gray, 1853.

Type *D. solenoides* King (not *Lutraria solenoides* Lam.) + *D. Kingii* Fischer.

Shell inequilateral, thin, siliquiform, smooth, with a conspicuous epidermis; dorsal areas not differentiated; beaks posterior, adjacent, inconspicuous; pallial sinus deep; shell gaping at both ends; ligament lanceolate, very short and narrow but deep, not separated from the pit by any lamina; chondrophore large, nearly vertical, depressed below the hinge-plate, and resting on a thickened, obscurely ray-like portion of the valve; resilium composed of two lateral horny parts, adherent to a medial calcified layer, which separates them like an ossiculum; dental armature feeble, concentrated; left cardinal petaloid, small; the posterior arm projecting entirely across the upper part of the pit, attended by a posterior accessory lamella, nearly of equal size, which overhangs the hinder border of the pit; anterior arm of the left cardinal larger, walling the anterior border of the pit; a low, obscure lateral tooth on each side of the beak in this valve; right cardinal obscure, the anterior arm coalescent with the anterior ventral lamina, the posterior excessively thin and fragile, overhanging the pit almost in the plane of the valve margins, floor-like; there are two short but distinct, low posterior laminæ but no anterior dorsal lamina; the scar of the retractor of the foot nearly marginal behind the adductor.

One recent species, the type, is known from the Straits of Magellan (Gregory Bay, U. S. Fish Com.), and another has been reported from the Straits of Fuca (*D. declivis* Cpr.); but the latter may be a Patagonian specimen with erroneous locality.

The genera *Cardilia* and *Anatinella* I have not had a sufficient opportunity of studying. Their pertinence to this family is, to say the least, not yet assured. The former I have not examined. The following notes were taken from *Anatinella dilatata* Rve. It should be mentioned that while H. and A. Adams correctly figure the hinge of this genus, their description of it as containing "two small teeth on each side in the right valve" is erroneous.

? Subfamily ANATINELLINÆ.

Genus ANATINELLA Sowerby, 1834.

Shell thin, porcellanous, finely radiated externally, with low adjacent beaks, posterior gape well marked; chondrophore large, narrow, projecting obliquely backward; resilium large, narrow, with calcareous median layer; ligament short, sunken, submarginal, strong; left cardinal narrow, the posterior arm wider below, long, strong, with a low accessory lamella between it and the margin of the pit; anterior arm short; right cardinal short, small, distinctly deltoid, with long, high accessory lamina walling the pit; lateral teeth entirely absent; pallial line somewhat irregular, but without any sinus.

It is somewhat doubtful whether there is more than one species of *Anatinella*,—the *A. nicobarica* Gmelin or *Sibbaldii* Sowerby. The nominal species are Indo-Pacific in distribution. Gray, in 1853, erected a family on this problematical shell. It has a good deal the aspect of *Tugonia*, but the hinges are not comparable.

There are some curious parallelisms in the characters of the different groups above mentioned. They cannot all be tabulated in one scheme, but offer some points worthy of investigation.

The order of modification, theoretically, after the submergence and division of the original ligament into ligament and resilium, should have followed two lines, one in which the parts, though separated, are not walled apart by a shelly septum and the process of modification is still left unlimited in its possibilities; and the other where the separation, being complete, is made final by the development of a septum. In accordance with this hypothesis we find the oldest fossil *Mactridæ* spisuloid and even without a base of attachment for the ligament proper; later this base is supplied and certain forms took on the Mactroid type. *Pteropsis* is the earliest known genus of its subfamily and is spisuloid, while the recent *Raëta* is Mactroid. The older *Lutraria* and the newer *Tresus*, the older *Standella* and newer *Heterocardia*, offer parallel cases. The *Zenatiinæ* appear to be a relatively modern type and they are all spisuloid, as is *Anatinella*. In each case the Mactroid features belong to the modern or later stage of each group when they are present at all, some groups not having yet acquired the requisite equilibrium. The Mesozoic forms so far known have the *Cymbophora* hinge, the Eocene ones in America are spisuloid; total submergence in *Mulinia* and *Rangia* (derivatives from the spisuloid type) comes later on in the Miocene, while none of the aberrant latest developments has reached a Mactroid stage. These features may be tabulated as follows:

Ligament.	Spisuloid.	Submerged.	Mactroid.
Mactrinæ	Spisula.	Mulinia.	Mactra.
	Spisula.	Rangia.	Mactroderma.
	Hemimactra.	Rangianella.	Mactrotoma.
	Cymbophora.	Miorangia.	Cœlomactra.
	Schizodesma,		Mactrella.
	Leptospisula.		
Pteropsidinæ	Pteropsis.		Labiosa.
			Raëta.
			Raëtella.
Lutrariinæ	Lutraria.		Tresus.
	Standella.		Heterocardia.
	Eastonia.		
Zenatiinæ	Zenatia.		
	Resania.		
	Darina.		
Anatinellinæ	Anatinella.		

Subfamily MACTRINÆ.

Genus MACTRA (L.) Lamarck.

Typical Mactras, as might be expected from their position in the line of evolution, are relatively modern and are not yet known in America from earlier than Oligocene rocks. Only one small recent species is known from the Atlantic coast, while in the old world the group is numerously represented in the recent fauna.

Mactra chipolana n. s.

PLATE 27, FIGURE 19.

Oligocene of the Chipola beds, Calhoun County, Florida; Burns.

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. Lon. of a well-grown specimen about 45, alt. 35, semidiam. 12 mm.

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.*

Mactra clathrodon Lea.

Mactra clathrodon I. Lea, Contr. to Geol., p. 212, pl. 6, fig. 223, 1833.

St. Mary's City, Maryland, Finch; in the Chesapeake Miocene.

This small species, from an examination of Mr. Lea's types, appears to be a *Mactra* and not the young of any of the Miocene Spisulas or the *S. modicella* in particular, to which Conrad referred it. Of the known St. Mary's species it could only be the young of *S. ponderosa* Conrad, from which it is separated by a delicate but distinct lamella walling off the ligament from the pit. *M. alabamiensis* "Lea," which Conrad referred at one time to *S. modicella* and another to his *M. prætenuis*, appears nowhere in Dr. Lea's writings, and there seems to be no evidence that such a name was ever proposed by him.

Subgenus MACTROTOMA Dall.

Section *Micromactra* Dall.

Mactra (Mactrotoma) cymata n. s.

PLATE 33, FIGURE 23.

Oligocene marl of Oak Grove, Florida; Burns.

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. Lon. 31.5, alt. 20, diam. 10 mm.

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

Mactra (Mactrotoma) undula n. s.

PLATE 28, FIGURE 12.

Pliocene of Darlington, South Carolina, Burns; of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox.

Shell small, moderately thick, ovate-oblong, externally nearly smooth or marked with feeble concentric lines of growth and, near the ventral edge, with fine, somewhat irregular wrinkles; beaks small, adjacent, not prominent, concentrically undulated with rounded ripples, becoming rapidly obsolete but varying in strength in different individuals; dorsal areas smoother, impressed, long and narrow, with a single narrow, slightly elevated line extending from the beak to the posterior ventral margin in each valve; posterior extreme usually rounded, more slender than the anterior, or slightly rostrate; anterior end somewhat shorter than the posterior, rounding into the arcuate base; pallial sinus rounded in front, not quite reaching the vertical from the beaks; muscular impressions large; hinge well developed, normal to the subgenus. Lon. 42, alt. 26, diam. 14 mm.

This interesting species is closely allied to the recent *M. californica* Conrad of the Californian coast, and is one of the rather numerous instances where forms now living in the Pacific and formerly common to both coasts have become extinct in the Mexican Gulf and Antillean region. "*Mactrinula*" *macescens* Guppy, from his types found in the Manzanilla Eocene beds of Trinidad, is also a *Micromactra* and related to the present species, but more strongly undulated.

Section *Mactrotoma* s. s.

Mactra (Mactrotoma) fragilis Gmelin.

PLATE 27, FIGURES 1, 4, 8, 18.

Mactra fragilis Gmelin (after Chemnitz), Syst. Nat., p. 3261, No. 22, 1792.
M. brasiliana Lam., An. s. Vert., v., p. 478, 1818.
M. oblonga Say, Journ. Acad. N. Sci. Phila., ii., p. 310, 1822.
M. anserina Guppy, Ann. Mag. N. Hist., xv., 1875, p. 50, pl. vii., fig. 1.

Pliocene of the Caloosahatchie beds, Dall and Willcox; Post Pliocene of Simmons Bluff, South Carolina, Burns; living from Cape Hatteras, North Carolina, to Rio Janeiro, Brazil, and probably on the west African coast, in moderate depths of water.

This species, the type of the subgenus, is widely distributed and represented in eastern seas by very similar though generally smaller species. It was erroneously referred to the Nicobar Islands by Chemnitz, but his figure enables us to correctly identify his species with the American shell. It is the *M. dealbata* Pult., 1803; the *oblongata* of Ravenel, 1834; the *bilineata* (C. B. Ad. MS.) of Reeve, 1854, and probably the *ovalina* of Lamarck, the *silicula* and the *ambigua* of Weinkauff. Owing to the fragility of the shell, large specimens are usually broken before being thrown up on the beach, and cabinet specimens are apt to be small. The fossil specimens sometimes attain a length of eleven or twelve centimetres, which is larger than any of the recent shells I have been able to examine, but the differences, which I was at first inclined to think were varietal, on the examination of a large series of the recent shells proved to be fully within the range of individual variation in the species. The *Spisula fragilis* of Gray in his review of the *Mactridæ* of 1838 is not this species, but a *Standella* from the East Indies.

Mactrotoma fragilis is represented in the Pacific coast fauna by the *M. nasuta* of Gould, a distinct but allied species which was referred to by Carpenter under the name of *fragilis*.

Mactra (Mactrotoma) Willcoxii n. s.

PLATE 28, FIGURES 10, 11.

Pliocene of the Myakka River, Florida; Willcox.

Shell small, solid, inequilateral, subovate, externally marked by lines of growth and fine, slightly oblique, irregular wrinkles; the fossil shows distinct traces of radial bands of color; anterior end shorter, rounded, the dorsal area faintly impressed; posterior end longer, somewhat recurved, the dorsal area narrow, excavated, elongated, bordered by a broad, impressed fasciole bounded on each side by an elevated line, and extending backward from the umbo; base of the shell markedly arcuate; valves rather convex; the pallial sinus broad, rounded, not reaching the middle of the valve; hinge normal, the ventral border of the chondrophore projecting, the teeth short and strong; the dentate appearance caused by the fusion of the anterior arm of the cardinal teeth with the ventral lamina is very marked. Lon. 44.5, alt. 30, diam. 17 mm. The posterior end has a pronounced gape.

A single specimen of this well-marked species was found among the fossils presented by Mr. Willcox to the National Museum. It is heavier, more inequilateral, and more arcuate than specimens of *M. fragilis* of the same length.

Subgenus MACTRELLA Gray.

Mactra (Mactrella ?) darienensis n. s.

Shell small, short, inflated, trigonal, thin, with very high and prominent beaks; surface smooth or minutely undulated, angulated posteriorly by the line bounding the dorsal area; anterior dorsal area impressed, with the dorsal shell margin reflected upward; both the anterior and posterior areas are broad, and distinctly, regularly, sharply, concentrically grooved; posterior end shorter than the anterior, obtusely angular below; anterior end produced and rounded, depressed above.. Lon. 22, alt. 18, semidiam. 5.5 mm.

This species is represented by a right valve, partially lost from the cast, in a grayish marly rock, which does not disclose the hinge, and therefore it cannot be positively stated to be a *Mactrella*, but the form of the shell and all the attendant circumstances leave little doubt in my mind that it is correctly placed in that group.

It is found with *Turritella gatunensis*, *Cytherea dariena* Conr., and *Glyptostyla panamensis* Dall, in the Eocene Gatun beds, corresponding to the Claibornian, at Vamos-vamos Station on the line of the Panama Canal, Isthmus of Darien.

Genus SPISULA Gray.

Spisula Gray, Mag. Nat. Hist., i., N. S., p. 372, 1838.

Spissula Phil. non Mörch; *Spizula pars* Mörch, and *Spisulina* Fischer, 1887.

This group being anterior on the line of evolution to the typical Mactroids is much better represented in the fossil state, and, in the form of its subgenus, *Cymbophora* Gabb, recedes to the middle of the Cretaceous at least. With these older forms we are not at present concerned, but it may be useful to refer to a group of small Eocene species which were among the first to be described of American fossil species. Omitting *Mactra æquorea* and *rectilinearis*, which seem to belong in the *Mesodesmatidæ*, the following species were described at an early date from the Claibornian. *M. parilis* Conr. (+ *pygmæa* Lea), *M. decisa*, and *prætenuis* Conr., all of which belong to the genus *Spisula*, and even to its typical section, as I have determined by an examination of the type specimens. In other Eocene beds are *Spisula albirupiana* Harris from White Bluff, Arkansas; *Spisula mississippiensis* Conr. and *S. funerata* Conr. from Vicksburg, Mississippi, a variety of the latter having been named *inequilateralis* by O. Meyer. There is another form which differs barely, if at all, from *funerata*, in the Jacksonian. *M. dentata* Lea was founded on the hinge-plate of *Pteropsis papyria* Conr. of the Claibornian.

In the Miocene we find a more numerous and richer development of the genus.

Subgenus HEMIMACTRA Swainson.

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 laminæ cross-striated, while in the section *Mactromeris* Conrad they are smooth, though this character is not one to which I attach any great importance.

The following species have smooth laminæ, and the large recent *S. ovalis* Gould also retains this character.

Section *Mactromeris* Conrad.

Spisula (Hemimactra) dodona n. s.

PLATE 27, FIGURES 7, 13, 25.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

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. Lon. 50, alt. 34, diam. 15 mm.

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

Spisula (Hemimactra) delumbis Conrad.

Plate 27, Figure 26.

Mactra delumbis Conr., Fos. Sh., p. 26, pl. 11, 1832; Tert. Fos., p. 27, pl. 15, fig. 1, 1838; Proc. Acad. Nat. Sci. Phila. 1862, p. 572, 1863.

Mactra virginiana Conr., Am. Journ. Conch., iii., pp. 188, 269, pl. 22, fig. 4, 1867.

Chesapeake Miocene of the James River, Virginia, at Smithfield and Suffolk; of the York River, at Yorktown, Virginia, and in Maryland, at St. Mary's City; Burns and Harris.

This fine species was early described by Conrad, who, many years after, obtaining specimens of *S. marylandica*, perpetrated one of his characteristic blunders by re-describing the old species and leaving the new one still nameless, his intention, of course, being to do just the reverse.

Spisula (Hemimactra) marylandica n. s.

Plate 28, Figure 5.

Chesapeake Miocene of Jones's Wharf, Patuxent River, Maryland, of St. Mary's River, Maryland, Burns; and of Walton County, Florida, L. C. Johnson.

Shell large, subovate, thin, inflated, with a nearly smooth surface, marked chiefly by incremental and obsolete radiating lines; beaks high, subcentral, adjacent; anterior end excavated above, rounded in front, posterior sloping to a bluntly pointed end behind; anterior dorsal area rather smooth and deeply impressed; posterior area somewhat depressed, striated, flexuous, with three obscure, elevated lines, extending from the umbo to the margin outside of the area; base arcuate; pallial sinus rather narrow, extending nearly to the middle of the shell, bluntly pointed in front; hinge strong, with a large oblique chondrophore, very short, smooth lateral laminæ, and the anterior arm of the right cardinal tooth coalescent with the ventral lamina. Lon. 90, alt. 67, diam. 40 mm.

This fine species is at once differentiated from *S. delumbis* by its more equilateral and inflated shell, and by having instead of only one three elevated lines radiating backward from the beak.

Spisula (Hemimactra) duplinensis n. s.

Plate 30, Figure 1.

Chesapeake Miocene of Duplin County, North Carolina; Willcox.

Shell subovate, thin, moderately inflated, beaks subcentral, not prominent, adjacent; surface smooth, except for incremental lines, which are most prominent towards the ends; the middle of the valve is more or less polished, anterior end somewhat shorter than the posterior, both moderately rounded; dorsal slope nearly equal on both sides of the beak; dorsal areas obscure, the posterior smoother and more impressed; hinge much as in *S. marylandica*, but the pit larger and with a more projecting ventral margin; pallial sinus reaching forward more than half the length of the shell, pointed in front; basal margin curved but not arcuate. Lon. 58, alt. 42, diam. 22 mm.

This species at first sight looks very close to *S. marylandica*, but has a longer pallial sinus, less prominent beaks, more equal dorsal slopes, and less arcuate basal margin. The lateral laminæ are finely granulated, and not striated, which separates it at once from the *similis* group, and the proportions are quite different from those of the young *S. polynyma* Stm. of the same size. It is probably the shell referred to *S. similis* Say by Tuomey and Holmes (Pleioc. Fos., p. 97, pl. 23, fig. 8) and Emmons.

Spisula (Hemimactra) curtidens n. s.

Plate 27, Figures 2, 24.

Chesapeake Miocene of Burch, on the Patuxent, and near Easton, on the Choptank River, Maryland; of Magnolia, Duplin County, North Carolina; Burns.

Shell large, not heavy, subtrigonal, with low, narrow, rather pointed beaks, the anterior being markedly longer than the posterior end; surface smooth or striated by incremental lines, and near the base by fine, obscure, irregular longitudinal wrinkles; valves moderated, inflated; anterior end produced, depressed above, rounded in front; posterior end short, flattened in front of the beaks, posterior dorsal area impressed and bounded by a rounded ridge which extends from the beak to the margin; anterior dorsal area impressed, with a somewhat flexuous surface; hinge with a large but not projecting chondrophore; in the right valve the dorsal laminæ are very short and smooth, the cardinal tooth quite compressed. Lon. (of young shell) 22, alt. 17, diam. about 9 mm.; but judging from the fragments found, the species reaches when adult a height and length of 90 mm.

This fine *Spisula* is sharply distinguished from any other American species by its high and triangular form, short, excavated hinge-plate, and the inequilaterality of the shell.

Spisula (Hemimactra?) magnoliana n. s.

PLATE 27, FIGURE 29.

Chesapeake Miocene of Magnolia, Duplin County, North Carolina; Burns.

Shell small, equilateral, somewhat compressed, with small, little-elevated, pointed, adjacent beaks; surface smooth except for lines of growth and a feeble angulation extending backward from the umbo to the lower posterior margin; ends nearly equally rounded, the posterior slightly more pointed, the base moderately and evenly curved; pallial sinus small, angular, very short; hinge normal, feeble, with short granulose laterals. Lon. 17, alt. 10, diam. 7 mm.

A single left valve was obtained by Burns, which much resembles a *Mulinia* except in the character of the ligamentary attachment. It differs from the other species of the formation by its rounded ends and subcylindric form.

Spisula (Hemimactra) subponderosa Orbigny.

PLATE 27, FIGURES 3, 16.

Mactra ponderosa Conr., Journ. Acad. Nat. Sci. Phila., vi., p. 228, 1830; Medial Tert., p. 25, pl. 14, fig. 1, 1838; not of Eichwald, Nat. Skizze von Lith., p. 207, 1830, nor of Philippi.

Mactra subponderosa Orb., Prodr. Pal., iii., p. 100.

Mactrodesma ponderosa Conr., Am. Journ. Conch., iv., p. 247, 1869.

Chesapeake Miocene of St. Mary's, Maryland; Burns.

This fine shell differs from the typical *Mactromeris* of Conrad only in its shorter and more inflated shell and thicker valves, features which can hardly be claimed to have more than a specific value. If *S. marylandica* had a thick shell it would closely resemble the present species. But *Mactromeris* differs only from *Hemimactra* in having the laterals smooth or granular without cross-striation, and very little study will convince anyone that this character has very slight systematic value. Conrad's name having been used previously by Eichwald, Orbigny substituted for it in the same year the term *subponderosa*, which should be adopted under the rule that such rectifications are not to be disturbed by subsequent generic references of the species to which they refer.

Other species of *Spisula* in the Miocene of the eastern United States (chiefly *Hemimactra*) are *S. confragosa* Conrad (= *Mesodesma confragosa* Conr., Am. Journ. Sci., xxiii., p. 340, July, 1833; + *Mactra fragosa* Conr., Medial Tert., p. 26, pl. 14, fig. 2, 1838; + *Mactra incrassata* Conr., Medial Tert., p. 24, pl. 13, fig. 2, 1838; + *Mesodesma confraga* Conr., Proc. Acad. Nat. Sci., 1862, p. 574, 1863) from Maryland, Virginia, and North Carolina; *S.* (*Mactromeris*) *subparilis* Conr., 1841, from Wilmington, North Carolina; *S. modicella* Conr., 1833, York River, Virginia; this last is not the same as *Mactra clathrodonta* Lea, as supposed by Conrad; *S. subcuneata* Conr., 1838, Maryland; and *S. medialis* Conr., 1863, which is probably from North Carolina, though the provenance of the types is not precisely known.

Section *Hemimactra* s. s.

Spisula (Hemimactra) densa n. s.

PLATE 27, FIGURE 22.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, solid, smooth, or concentrically scuptured, with fine incremental lines, and sometimes obscure radial striæ near the margin; subtriangular, subequilateral; beaks small and low, hinge strong, the laminæ sharply cross-striated; pallial sinus rounded, small, and very short; lon. 14, alt. 9.5, diam. 6 mm.

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.

Genus **MULINIA** Gray.

This form presents the last term in the submergence of the ligament, and does not appear in the older Tertiary or even in the Oligocene, but in the Miocene and subsequently it has attained a profuse development. The student should bear in mind that much variation of outline exists within specific limits in this genus and a new species should be founded in general on a large number of specimens, otherwise the estimate of its characters is sure to be defective.

Mulinia congesta Conrad.

Mactra congesta Conr., Am. Journ. Sci., xxiii., p. 340, 1833; Medial Tert., p. 27, pl. xv., fig. 2, 1838.

Mactra crassidens Conr., Medial Tert., p. 69, pl. xxxix, fig. 5, 1840; Am. Journn. Sci., xli., p. 347, pl. 2, fig. 11, 1841.

Mactra triquetra Conr., Medial Tert., p. 69, pl. xxxix., fig. 3, 1840; Proc. Acad. Nat. Sci. Phila., i., p. 324, 1843.

Mactra (Spisula) trigonalis Conr., MS.

Hemimactra congesta Conr., Proc. Acad. Nat. Sci., 1862, p. 572, 1863.

Mulinia crassidens et triquetra Conr., *ibid.*, p. 573.

Standella congesta Conr., *ibid.*, p. 573.

Chesapeake Miocene of Maryland, Virginia, the Carolinas, and of Florida at Alum Bluff (upper bed), De Leon Springs, and other localities near Tallahassee and along the Chipola River; Pliocene of the Croatan beds, North Carolina, and some localities in South Carolina.

This well-known and variable species is of wide distribution. Short, high specimens form the variety *triquetra* of which *crassidens* is a young shell. Conrad, by the extraordinary carelessness which was normal to him, placed the two latter names under *Mulinia*, while *congesta* appears both as *Hemimactra* and as *Standella* in different places in the same list of Miocene fossils printed in 1863!

Mulinia lateralis Say.

Mactra lateralis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 309, 1821.

Mactra rostrata Phil., Abbild. und Beschr., iii., p. 138, pl. 3, fig. 6, 1845; not of Spengler, 1802.

Mactra corbuloides (Deshayes), P. Z. S., 1854, p. 63; Reeve, Conch. Icon., *Mactra*, fig. 103, 1854.

Standella lateralis Conr., Proc. Acad. Nat. Sci. Phila. 1862, p. 573, 1863.

Mulinea lateralis Conr., Am. Journ. Conch., iii., Suppl., p. 31, 1868.

Chesapeake Miocene of Duplin County, North Carolina, and the Pascagoula clays of Mississippi; Pliocene of the Waccamaw beds of South Carolina, the Caloosahatchie River and Shell Creek in Florida; the Pleistocene from Maine to Texas, and the recent fauna from Massachusetts Bay southward.

This species shows the same variations in form as the preceding. The shells are smoother and less rude in the southern portion of their range, and the variety *corbuloides* is relatively more abundant in the south, but may be found represented wherever the species is distributed. It bears to the typical form a relation analogous to that which *M. triquetra* bears to the typical *M. congesta* or *Spisula Raveneli* to *S. similis* Say.

Mulinia Milesii Holmes.

Mulinia Milesii Holmes, P.-Pl. Fos. S. Car., p. 42, pl. vii., fig. 11, 1859.
Mulinia parilis Conr., Am. Journ. Conch., iii., p. 269, pl. 22, fig. 5, 1868; not *Mactra parilis* Conrad.
Mulinia caroliniana Conr., MS. label Coll. Acad. Nat. Sci.
Mactra contracta Conr., Am. Journ. Conch., iii., p. 268, pl. 22, fig. 6, 1868.

Uppermost Chesapeake Miocene of Virginia, North and South Carolina, and Florida; Holmes, Johnson, Burns, *et al.*

This form is probably an extremely elongate variety of *congesta*, of which *parilis* is the young. The reference of the type of *contracta* to *Mactra* by Conrad was an error due to the breaking away of the thin roof of the cartilage-pit and subsequent wear on the broken edges.

Mulinia caloosaënsis n. s.

PLATE 28, FIGURES 4, 6.

Pliocene of the Caloosahatchie beds on the Caloosahatchie and Shell Creek, Florida; Dall and Willcox.

Shell small, solid, thick, elongate ovate, subequilateral, sculptured chiefly by concentric lines of growth; form somewhat variable, but in general with the anterior side shorter, rounded, the posterior longer, narrower, the dorsal slope descending more rapidly than in front, and terminating in a more or less distinct, somewhat oblique truncation, with its basal angle almost pointed; dorsal areas polished, with obscure boundaries; beaks small, pointed, distant, with a keel or angular line extended from the umbo to the posterior basal angle of the shell; interior smooth; pallial sinus small, pointed in front; hinge normal, solid, strong, the laterals short, finely granular, not cross-striated; the chondrophore completely roofed in, but frequently showing a fissure above due to erosion. Lon. 22, alt. 15, diam. 12 mm.

Larger specimens than the one above described are not uncommon; the most characteristic features are the broad area set off by the posterior keels, and the somewhat quadrate general form.

Mulinia sapotilla n. s.

PLATE 28, FIGURES 7, 8, 9, 14.

Pliocene of the Caloosahatchie beds; Dall and Willcox.

Shell small, solid, compressed, very inequilateral, varying in form like the rest of the genus, but in general with the beaks at the anterior third of the length; umbones small, low, pointed, adjacent; surface marked only with lines of growth; anterior end short, evenly rounded from the beaks to the base; posterior end long, dorsal slope nearly rectilinear, ending in a rounded point; base rather arcuate; dorsal areas and umbonal angle obscure or undefined; pallial sinus very wide and short; hinge feeble, the lateral laminæ finely granulose or smooth, the posterior markedly longer than the anterior; left cardinal with a well-marked posterior accessory lamella; chondrophore small and inconspicuous; hinge-plate very narrow. Lon. 27, alt. 14, diam. 10 mm.

This is a very interesting and peculiar species. The figured specimen is rather shorter and higher than that of which the dimensions are given above. The young vary considerably in form from subtrigonal to quite elongate, but these differences become less marked in the adult, though not wholly eliminated. It is one of the most characteristic species of the Caloosahatchie beds.

Genus **RANGIA** Desmoulins.

Gnathodon (Gray) Sowerby, Gen. Shells No. 36, Dec., 1831. (Type *G. cuneatus* Gray) Dall, Mon. Gnath., Proc. U. S. Nat. Mus., xvii., p. 85, 1894.
Rangia Desmoulins, Actes Soc. Lin. de Bordeaux, v., No. 25, p. 50, Feb. 15, 1832.
Gnatodon Rang, Nouv. Ann. du Mus., iii., p. 217, 1834.
Columbia Blainville MS., Rang, *op. cit.*, p. 217.
Clathrodon (as of Gray MS.) Conrad, Am. Journ. Sci., xxiii., p. 340, 1833.
Perissodon Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 573.
Not *Gnathodon* Goldfuss, Man. Zool., 1820.

The reader is referred to the writer's monograph above mentioned for all details. Its Mactroid character and close relationship to *Mulinia* is there fully established. The synonymy is here finally rectified by the rejection of *Gnathodon*, which turns out to have been used by Goldfuss for a genus of fishes in 1820.

In the monograph I mentioned that Gray received his specimens from Canada, which he described (as stated by Conrad) under the name of *Clathrodon*, and sent the MSS. to the American Journal of Science to be published in America about 1830; also that the publication was not made. It is a singular circumstance that immediately after reading the last proofs of my paper on *Gnathodon*, while engaged in examining a miscellaneous lot of papers from the library of the late Dr. Isaac Lea, presented to the Smithsonian Institution by his son-in-law, Dr. L. T. Chamberlain, I came upon a sheet of manuscript with a drawing attached, which proved to be the original MS. of Dr. J. E. Gray above alluded to. It is in Mrs. Gray's handwriting, with the specific and generic names inserted in Dr. Gray's hand. It seems that he received the specimens from Mrs. Mauger, who obtained them from Canada. The first name inserted was not *Clathrodon*, but *Cladodon*, which is crossed out and *Gnathodon* substituted for it. The drawing, exquisitely made, is by E. I. Gray. Dr. Lea has endorsed on the envelope: "Wrote Mar. 6, 1832, a second time for instructions respecting this." As the genus had, several months earlier, been published by Sowerby, it is probable that Dr. Gray paid no further attention to the matter.

Rangia cuneata Gray.

Gnathodon cuneatus (Gray) Sowerby, Gen. Shells, No. 36, figs. 1–7, 1831; Dall, Mon. Gnath., Proc. U. S. Nat. Mus., xvii., p. 93, pl. vii., figs. 1 and 10, 1894.

Rangia cyrenoides Desm., Actes Soc. Lin. de Bordeaux, v., p. 57, figs. 1–3, 1832.

Gnathodon Grayi Tuomey and Holmes, Pleioc. Fos. S. Car., p. 99, pl. 23, fig. 11, 1857; not of Conrad.

Gnathodon minor Holmes, Post-Pleioc. Fos. S. Car., p. 41, 1860.

Pliocene of the Carolinas and of Florida, rather abundant in the Caloosahatchie beds; Pleistocene of Cornfield Harbor, Chesapeake Bay, and Wailes's Bluff, Potomac River; of South Carolina, Florida, and the whole north coast of the Gulf of Mexico, and of Matamoras, Mexico; living in Mobile Bay, Alabama, and westward to Vera Cruz, Mexico, in shallow, especially brackish, water.

The shell is variable in form, and very abundant when it occurs at all.

Rangia clathrodonta Conrad.

Mactra clathrodonta Conrad, Am. Journ. Sci., 1st Ser., xxiii., p. 340, 1833.

Gnathodon Grayi Conr., Medial Tert., p. 23, pl. 13, fig. 1, 1838; Emmons, Geol. N. Car., p. 298, fig. 226*a*, 1858.

Gnathodon minor Conr. (young shell), Medial Tert., p. 69, pl. 39, fig. 6, 1840; not of Whitfield.

Rangia (*Perissodon*) *clathrodonta* Conr., Proc. Acad. Nat. Sci. Phila. 1862, p. 573, 1863.

Gnathodon clathrodon Dall, Mon. Gnath. Proc. U. S. Nat. Mus., xvii., p. 95, pl. vii., fig. 9, 1894.

Chesapeake Miocene of James and York Rivers, Virginia, and North Carolina, Conrad, Ruffin, and Yarrow; Pliocene of the Croatan beds in North Carolina, Johnson.

This is the oldest species of the genus, but seems to be quite limited in its distribution. I have seen no specimens from south of North Carolina. The subgenus *Perissodon* of Conrad was never defined, and rests upon purely specific characters. His *G. minor* is merely a young shell of the same species.

Section *Miorangia* Dall.

Rangia Johnsoni Dall.

Plate 22, Figure 18.

Gnathodon Johnsoni Dall, Trans. Wagner Inst., iii., p. 337, pl. 22, fig. 18, 1892; Proc. U. S. Nat. Mus., xvii., p. 96, pl. vii., fig. 7, 1894.

Chesapeake Miocene of the Pascagoula clays, at Shell Bluff, Pascagoula River, Greene County, Mississippi; also at a depth of seven hundred feet in the artesian well at Biloxi, Mississippi, and seven hundred and thirty-five feet in the artesian well at Mobile, Alabama; L. C. Johnson.

This species is smaller and more peculiar in form than any of the others, and presents the peculiarity (extremely rare in this family) of having the superior cardinal tooth in the right instead of the left valve. The anterior lateral tooth is shorter relatively than in any other species, and the shell is more drawn out behind the beaks.

In the Miocene (?) of Carrizo Creek, Colorado Desert, California, Dr. Leconte found a fossil species of *Gnathodon*, which was named *G. Lecontei* by Conrad. It is nearest related to *R. cuneata*. A curious little shell is described and figured by Harris in the Fifth Annual Report of the State Geological Survey of Texas under the name of *G. quadricentennialis*. A careful examination of specimens submitted by Mr. Harris leads me to believe that the species may best be referred to *Spisula*, as the cartilage-pit is not closed above. It is found at a depth of twenty-one hundred to twenty-two hundred and fifty feet in the Galveston artesian well, and belongs to the Upper Miocene. *Rangia? minor* (Conr.) Whitfield, from the Miocene marl of Shiloh, New Jersey, is founded on a young *Mulinia* in the collection of the U. S. Nat. Museum, and is probably not identical with Conrad's species. *Gnathodon? tenuidens* Whitfield, based on an internal cast from the Cretaceous "Plastic Clays" of New Jersey, is probably referable to *Isocardia* or some analogous form, and has nothing but the prominent and distant beaks to connect it with *Rangia*. Several foreign species referred by authors to *Rangia* are with little doubt more correctly placed in other genera. No undisputed species of *Rangia* has been found earlier than the Middle Miocene, or in any region exterior to the North American continent.

Subfamily PTEROPSIDINÆ.

Genus PTEROPSIS Conrad.

I have chosen this genus from which to form the subfamily name, as it is the prototype of the more modern *Labiosa* and *Raëta*. The typical species was described by Conrad under the name of *Lutraria papyria* (Fos. Sh. Tert., p. 41, Oct., 1833), while two months later Dr. Lea gave the name of *Mactra dentata* to a perfectly recognizable fragment of the same species.

Genus LABIOSA (Schmidt) Moller.

The name *Labiosa* proposed in MS. by Schmidt for the *Anatina* of Schumacher (1817, non Lam., 1809) was printed in an abstract of this MS. after Schmidt's death by Moller in 1832, though without any diagnosis. As it is perfectly identifiable it must be allowed to stand. It is the *Cypricia* of Gray (1840) and the *Leucoparia* of Ch. Mayer in 1867. The typical form does not seem to antedate the Pliocene in America, though in the later Miocene the subgenus *Raëta* is fully developed.

Labiosa lineata Say.

Lutraria lineata Say, Journ. Acad. Nat. Sci. Phila., ii., p. 310, 1821.
Mactra Nuttallii Rve., Conch. Icon., *Mactra*, fig. 125, 1854; not *Lutraria Nuttallii* Conr.
Mactra recurva Gray, Wood's Ind. Test., Suppl., fig. 2, 1828.
Mactra papyracea Auct., non Lam.

Pliocene of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox; Pleistocene of the southeastern United States; living from the coast of New Jersey to San Paulo, Brazil.

The fossil specimens do not seem to differ at all from the recent ones and run through a parallel series of variations chiefly in the outline and inflation of the valves. The only other typical *Labiosa* is found on the Pacific coast of middle America, the *L. anatina* Spengler (1802), also named *pellucida* by Schumacher (1817), *L. papyracea* by Lam. (1818), and *L.* (*Cypricia*) *cyprinus* by Gray (1828). It is not known to occur in a fossil state.

Subgenus RAËTA Gray.

Raëta Gray, Ann. Nat. Hist., ii., p. 43, 1853.
Cryptodon H. and A. Adams; not of Conrad or Turton.
Lovellia C. Mayer, 1867.
Type *L.* (*Raëta*) *canaliculata* Say.

Labiosa (Raëta) canaliculata Say.

Lutraria canaliculata Say, Journ. Acad. Nat. Sci. Phila., ii., p. 310, 1821.
Mactra canaliculata Reeve, Conch. Icon., *Mactra*, fig. 122, 1854.
Mactra campechensis Gray, Wood's Ind. Test. Suppl., fig. 3, 1828.

Post Pliocene of South Carolina, Burns; and of North Creek, Little Sarasota Bay, Florida, Dall; living from New Jersey southward to southern Brazil, United States National Museum.

I have not yet seen this species from the Pliocene, though it may very likely be found in that formation in the future. The variations in outline and especially in the recurvature of the rostrate end of the shell in the living form are very remarkable. They seem to be purely individual. Notwithstanding the fact that dead valves of this shell are found in windrows on the beaches at some points of the southern coast, the character of the soft parts is unknown, and I shall be very greatly obliged to any one who can furnish me with a specimen of the animal in spirits in order that its systematic position may be positively settled.

Labiosa (Raëta) alta Conrad.

PLATE 27, FIGURES 20, 23.

Raëta alta Conr., Kerr's Geol. Rep. N. Car., App., p. 19, pl. 3, fig. 3, 1875.
Raëta erecta Conr., *ibid.*, p. 19, 1875.

Newer Miocene of Goldsborough, North Carolina, Kerr; and of the York River, Virginia, near Yorktown, Harris and C. W. Johnson.

This species is shorter and higher, with the beaks more erect and the concentric undulations more feeble than in *L. canaliculata*. The chondrophore is frequently quite large and in general proportionately larger than in the recent species, but this character is variable and the two species founded by Conrad on specimens of this shell from North Carolina and based on differences in the size of the cartilage-pit must be united under the name which precedes the other and is illustrated by a figure. Figure 23, plate 27, represents the variation which received the name of *erecta* from Conrad.

FAMILY MESODESMATIDÆ.

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.

The nomenclature of the genera comprised in this family has always been more or less confused. In 1799 Lamarck proposed a genus *Paphia*, without naming any type. The diagnosis comprised no characters which would differentiate the genus from *Mactra*. Moreover, the name had been proposed for a group of *Veneridæ* during the previous year by Bolten. In 1801 Lamarck repeated his diagnosis, and cites as examples a small, short species of *Crassatella* and *Paphia glabrata* Lam. (not *Mactra glabrata* [L.] Gmelin). The latter of the two has commonly been regarded as the type of *Paphia*, the *Crassatella* being referred to its own genus. Subsequently, Lamarck abandoned the genus *Paphia* and referred *P. glabrata* to the genus *Crassatella* without remark (An. s. Vert., 5, p. 482, Ann. du Mus., 6, p. 408). The name *Paphia* being preoccupied, another name is necessary. Sowerby had referred species of this type to *Erycina* Lam. (though they were not the typical *Erycina*), and Swainson, on the ground that *Erycina* was preoccupied by Fabricius, proposed *Eryx* in 1840 for the group of which *P. glabrata* is the type. This name, also, is unfortunately preoccupied in entomology.

In 1812 Lamarck used the name *Donacille* for a shell described by Poli under the name of *Mactra cornea*. But, as printed, *Donacille* was a vernacular *nomen nudum*, without diagnosis or type, and, in 1818, Lamarck described a genus *Amphidesma*, in which he combined much heterogeneous material, including his earlier *Donacille*, which he states is synonymous with *Amphidesma* and had been based on Poli's *Mactra cornea*. In 1830 Lesson proposed for the *Mya novæzelandiæ* of Chemnitz the name of *Paphies* (Duperrey, Voy. Aut. du Monde, ii., p. 424) to indicate the affinity which it seemed to show to the suppressed *Paphia* of Lamarck. In the same year Deshayes brought together, under the name of *Mesodesma*, Lamarck's *Paphia*, some of Lamarck's Crassatellas, Amphidesmas, and his uncharacterized *Donacille*, but without naming a type. His first species was *M. donacia*, a large Chilian form. The species from which he obtained the anatomical data, mentioned in his diagnosis under the name of *Mesodesma Quoyi*, does not appear to have been described under that name, but was one of the large donaciform species of New Zealand, perhaps *M. ventricosa* Gray. I have not found any positive identification of it, and it is not in Deshayes's own manuscript list of Mesodesmas in my possession. *M. novæzelandiæ* Chemnitz is the second species of Deshayes, and is not mentioned as the type, as mistakenly stated by Herrmannsen. The fundamental feature of *Mesodesma*, indicated in the name, was regarded as the presence of the cartilage *between* the hinge-teeth as opposed to its situation *behind* them in the *Crassatella* of authors. The difference is apparent and not real, being due to the obsolescence of the posterior laterals in *Crassatella*, but it seems to have impressed forcibly the writers anterior to Deshayes.

Gray in the Synopsis of the Contents of the British Museum as early as 1840 printed a list of names without diagnosis or types, many of which he afterwards introduced into nomenclature. In 1847, in his list of genera (P. Z. S., pp. 129–219), he seems to have included under *Paphia* the *Mesodesma* of Deshayes, to which he does not give an independent standing. He mentions as a synonyme, under number 572, *Paphia*, "*Mesodesma*, sp. Desh., 1835, *Mya novæzelandiæ*;" and cites as a distinct genus 573, "*Anapa* Gray," with *Erycina Petitiana* Récluz as the type. *Ervilia* Turton is also included in the family. The next publication by Gray on this subject was his important summary of 1853 (Ann. Nat. Hist., p. 44) in which the "*Paphiadæ*" are divided, by the presence or absence of a pallial sinus, into two groups. In the first, with "a siphonal inflection," are put *Mesodesma* Desh., with *M. novæzelandiæ* as type; *Taria* n. g., with *T. Stokesii* n. s. as type; *Donacilla* Lam., with *D. cornea* as type; *Paphia* Lam., with *P. glabrata* and *ventricosa;* and *Ceronia*, with *C. denticulata.*

In the group without a sinus are included *Anapa* Gray (1842 and 1847) with an entirely different type from that of 1847, namely *A. Smithii* of Tasmania; and *Davila* Gray, n. g., based on *D. polita.*

The above arrangement is good, but the nomenclature is very faulty, as will shortly appear.

It should be mentioned that in the synonymy of *Mesodesma novæzelandiæ* in a catalogue of New Zealand shells, published in Dieffenbach's New Zealand, 1843, Gray had noted that Leach had used the name *Machæna* for that species in some of his manuscripts, doubtless in allusion to its solen-like form. In the same year d'Orbigny would adopt *Donacilla* in place of *Mesodesma*, a course which is impracticable, because *Donacille* was never Latinized, described, or typified in a sufficient manner by its author. It would have been better, doubtless, if Deshayes had adopted and established this name instead of proposing a new one, but he was quite within his rights in doing what he did.

The Adams brothers, Woodward, and others followed Gray in essentials, while the last reviser, Fischer, would restrict *Mesodesma* s. s. to the *Donacilla* type, use *Machæna* for *M. novæzelandiæ*, *Eryx* Swainson for *M. glabratum*, in other respects following Gray.

Lastly, to close the record of the nomenclature of this group, *Ervilia* Turton (1822) and *Cæcella* Gray, 1853, may be mentioned, and Conrad's *Triquetra*, 1846, for which he substituted *Mactropsis* in 1854, a genus based on two Claibornian species in which the first stages of submergence of the ligament are well exemplified.

A number of the names above cited are not available for reasons which may be stated. *Paphia* is preoccupied by Bolten, who has precedence of one year. *Donacilla* was not characterized, but if we adopt *M. donacium* Lam. (*chilensis* Orb.), Deshayes's first species, as the type of *Mesodesma*, *Donacilla* can be revived in a sectional sense for the smooth-toothed cuneate species, as was done by Gray; in which case *Ceronia* Gray becomes an exact synonyme of *Mesodesma*. *Paphies* Lesson has precedence of *Machæna* for *M. novæzelandiæ* (= *M. australis* Gmelin). The original *Anapa* Gray is a synonyme of *Lasæa* (Leach) Brown, and cannot be used for the Tasmanian genus to which Gray later applied it. The family will then stand as follows:

Subfamily MESODESMATINÆ.

Shells heavy, with a pallial sinus more or less developed; siphons separate from their bases; shell substance porcellanous, epidermis conspicuous; ligament inconspicuous, generally inserted on the upper part of the posterior border of the "cartilage-pit," if wholly external more or less obsolete; resilium narrow, oblique; hinge with an anterior and posterior lateral in the left valve, fitting between laminæ in the right valve; recent species with a single narrow, long left cardinal tooth, with a short posterior arm which crosses the apex of the cartilage-pit; right cardinal lamellar feeble, obsolete; Eocene species have the cardinals normal.

Genus MACTROPSIS Conrad.

Mactropsis Conrad, Proc. Acad. Nat. Sci., vii., p. 30, 1854.
Triquetra Conrad, Am. Journ. Sci., 2d Ser., i., p. 217, 1846; not Blainville, 1818.

This differs from all the recent forms in that the combined ligament and resilium are very near the dorsal border, and the cardinal teeth are distinct, with subequal arms. The laterals are striated transversely. As the submergence of the resilium progressed in later species, it gradually encroached upon and nearly destroyed the posterior arm of the cardinals; but in the two Eocene species upon which this genus was founded the pit does not descend more than half way from the dorsal border to the ventral margin of the hinge-plate. The pallial sinus is small but well marked. The type is *M. æquorea* Conrad, Tert. Fos., p. 42, 1833 (= *Mactra Grayi* Lea). *M. rectilinearis* Conrad is a somewhat larger species from the same horizon. The intermediate state in which the hinge is found in this genus is good evidence that in America, at least, this family is not likely to be found in earlier than Eocene rocks.

Genus ATACTODEA Dall.

Paphia Lam., 1801 (*ex parte*), not Bolten, 1798; *Erycina* Sby., 1822, not Lam., 1804; *Mesodesma* sp. Desh., 1835; *Eryx* Swainson, Malacol., p. 370, 1840, not Daudin nor Stephens, 1832.

Atactodea Dall., Proc. Mal. Soc. Lond., i., p. 213, 1895.

Type *Paphia glabrata* Lam.; Indo-Pacific region.

Shell subtrigonal, strong, concentrically sculptured or smooth; pallial line with a short, well-marked sinus; hinge strong, ligament submarginal, obsolete; cartilage narrow, strong; dorsal areas not differentiated.

The group is exclusively old world and especially tropical, extending from the Red Sea to Japan and south to Mauritius. The species are few and mostly very similar in appearance; the soft parts are unknown.

Genus MESODESMA Deshayes.

Mesodesma Desh., 1830, Enc. Méth., Vers, ii., p. 442.

Type *M. donacium* Lam. (+ *M. chilense* Orb.); Chile.

Subgenus MESODESMA s. s.

Shell donaciform or subtrigonal, inequilateral, solid, with a thick epidermis, smooth or concentrically striated, posterior end subtruncated, shorter; dorsal areas not differentiated; hinge strong, resiliary pit large, deep, with raised margins; ligament short, chiefly internal; lateral teeth transversely sulcate, strong, the anterior elongated; pallial sinus well marked.

Ceronia Gray, 1853, is a synonyme. The species are found in temperate waters of both shores of South America, New Zealand, and the northeastern shore of North America. *M. arctatum* Conrad and *M. deauratum* Turton are known from the Pleistocene of eastern North America, north of Cape Cod, and *M. Bishopi* White (Powell, Rep. Geol. Uinta Mts., p. 128, 1876) has been described from the western brackish-water Tertiary, but the exact locality and age are uncertain. Harris has described a *Ceronia Singleyi* (Proc. Acad. Nat. Sci. Phila. for 1895, p. 52, pl. 3, fig. 3) from the Lower Claibornian of Lee County, Texas, but the interior is still unknown and the generic position somewhat dubious.

Subgenus DONACILLA (Lam.) Philippi.

Donacille Lam., Extr. d'un Cours., p. 107, 1812; *Donacilla* Phil. Moll. Sicil., p. 37, 1836; *Amphidesma* sp. Lam., 1818; *Mesodesma* sp. Desh., 1830; *Erycina* sp. Sby., 1822.

Type *M. corneum* Poli; Mediterranean.

Ligament marginal, obsolete; laterals not sulcate, the anterior lateral long, the posterior short, stout, triangular, with the posterior margin of the cartilage-pit raised and thickened like a second tooth; posterior ventral lamina in the right valve triangular, stout, elevated, vertically directed, the dorsal lamina obsolete, the anterior laminæ normal.

The group is represented in Europe, Australia, and New Zealand. The shells are mostly small with a horny, often colored epidermis. The Mediterranean species is the only member of the subfamily which displays color markings on the shell not pertaining solely to the epidermis.

Subgenus TARIA Gray.

Taria Gray, Ann. Mag. Nat. Hist., 1853, p. 44. *Mesodesma* sp. Desh.

Type *M. Stokesii* Gray (MS. ?) = *M. latum* Desh., N. Zealand.

Shell subtrigonal, subequilateral; the hinge concentrated; the laterals smooth, subequal, short; the ligament short, strong, mostly internal; the resilium narrow; the chondrophore depressed, projecting prominently downward; pallial sinus well marked, sometimes deep.

The species occur in New Zealand and on the eastern coast of South America.

Subgenus PAPHIES Lesson.

Paphies Lesson, Duperrey, Voy. Coq., ii., pt. i., p. 424, 1830; *Machæna* (Leach MS.) Gray, Dieff. N. Zeal., ii., p. 252, No. 174, 1843; *Mesodesma* Auct.; *Paphia* Hutton, Proc. Lin. Soc. N. S. Wales, x., p. 519, 1884; not of Lam.

Type *M. australis* Gmel., (= *Mya novæzelandiæ* Chemnitz, *Paphies Roissyana* Lesson *et Mesodesma Chemnitzii* Deshayes); New Zealand.

Shell elongated, subequilateral, subsoleniform, solid; hinge concentrated, heavy; laterals smooth or finely granulose, short; ligament short, mostly internal, small; resilium narrow, vertical; the chondrophore projecting; pallial sinus very small, angular.

Two species are known, from New Zealand.

Subfamily DAVILINÆ.

Pallial line simple.

Genus DAVILA Gray.

Davila Gray, Ann. Mag. N. Hist., 1853, p. 44.
Type *D. polita* Gray (MS. ?) = *D. plana* Hanley, Philippines.

Shell compressed, rounded, smooth, with a thin epidermis and simple pallial line; laterals as in *Donacilla;* left cardinal very large and prominent, right cardinal obsolete; ligament small, nearly marginal; cartilage narrow, elongated.

There are three or four species, all Indo-Pacific. They are all small and much alike. *D. crassula* Desh. (*Mesodesma mundum* Gld.) has color markings near the umbones.

Genus ANAPELLA Dall.

Anapella Dall, Proc. Mal. Soc. Lond., I, p. 213, 1895.
Anapa Gray, 1853; not Gray, 1847. (The latter was based upon *Lasæa rubra*, otherwise *Erycina Petitiana* Récluz.)
Type *Anapa Smithii* Gray, = *A. triquetra* Hanley, Tasmania.

Shell subtrigonal, solid, inflated, concentrically sculptured; dorsal areas obscure; beaks moderate, adjacent, somewhat anterior; valves close fitting; pallial sinus absent, the pallial line presenting a projecting angle below the posterior adductor; ligament short, partly external between the beaks, partly sunken and attached in a short sinus over the chondrophore, not set off from the resilium by any shelly ridge; chondrophore somewhat below the level of the hinge-plate, strong, its ventral margin somewhat projecting, directed backward; left cardinal strong, narrow, grooved at the apex, with a small obscure accessory lamella; laterals strong, rather irregular and distant; right cardinal small, rude, its posterior arm walling the pit, its anterior arm short, more prominent, coalescent above; laminæ rude, normal, the ventrals most prominent; resilium strong, with its anterior face calcareous.

A few species range from Tasmania to the Philippine Islands. They resemble *Atactodea* except in the absence of a pallial sinus and in having a ruder hinge.

Subfamily ERVILIINÆ.

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 Indo-Pacific region.

Genus **CÆCELLA** Gray.

Cæcella Gray, 1853, Ann. Mag. N. Hist., p. 43.

Type *C. Horsfieldii* Gray (MS.?); China.

Shell large, concentrically striate, white, with a thick brown epidermis, well marked pallial sinus, obsolete marginal ligament, and fluviatile or brackish-water habitat.

This genus was referred to the *Mactridæ* by Gray, but a careful study has convinced me that it stands nearest to *Ervilia*, and if that genus belongs in the *Mesodesmatidæ* so does *Cæcella;* the soft parts of neither being known, their place is not decisively settled. Its distribution is confined, as far as known, to the Indo-Pacific and Austral region.

Genus **ERVILIA** Turton.

Ervilia Turton, 1822, Brit. Biv., p. 56.

Type *Mya nitens* Montagu; Britain, South Europe.

Shell small, concentrically striate, sometimes brightly colored; pallial sinus well marked; ligament obsolete; epidermis inconspicuous; habitat marine.

Ervilia chipolana n. s.

PLATE 33, FIGURE 10.

Oligocene of the lower bed at Alum Bluff and the equivalent marl at McClellan's marl bed, Chipola River, Calhoun County, Florida; Dall and Burns.

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. Lon. 4.5, alt. 3, diam. 2 mm.

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.

Ervilia triangularis n. s.

Plate 33, Figure 19.

Oligocene of the Chipola beds, at McClellan's marl bed.

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. Lon. 5.5, alt. 4, diam. 2.5 mm.

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.

Ervilia lata n. s.

Plate 33, Figure 20.

Newer Miocene of the Natural Well and at Magnolia, Duplin County, North Carolina, Burns; and of Walton County, Florida, L. C. Johnson.

Small, very similar to *E. concentrica*, from which it differs by being broader between the beak and the basal margin, with the beaks slightly more equilateral and the dorsal margin behind the umbo usually more impressed; the surface is usually covered with concentric ridges, which are flattened and coarser and less regular than those of *E. concentrica;* the hinge-teeth also are less strong than the latter species. Lon. 4.5; alt. 3.5; diam. 2.2 mm.

This form on casual inspection would be referred to *E. concentrica* as a mere variety, but when a large number of specimens are examined and the characters above mentioned seem to be fairly constant, I believe it is best to recognize the average differences by a name, than to overlook them by consolidation with what I regard as probably a distinct species. The Floridian specimens are particularly triangular and small.

Ervilia planata n. s.

Oligocene sand (Alum Bluff beds) of Oak Grove, Yellow River, Santa Rosa County, Florida; F. Burns.

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. Lon. 3.25, alt. 2.25, diam. 1.5 mm.

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*. The horizon is younger than the Chipola marl, but carries, with some peculiar forms, a number of Chipola species.

Ervilia polita n. s.

PLATE 33, FIGURE 17.

Pliocene of the Caloosahatchie and Shell Creek; Dall and Willcox.

Shell inequilateral, moderately full, the anterior end shorter, the ends evenly rounded, the base gently curved; dorsal slopes gentle, dorsal margins nearly straight, the posterior a little depressed; surface smooth, polished, marked only by feeble incremental lines; hinge normal, delicate; pallial sinus rounded in front, reaching forward of the vertical from the beaks. Lon. 6.25, alt. 3.75, diam. 2.3 mm.

It is somewhat odd that the Pliocene species, which is very abundant in the Caloosahatchie marl, should be more unlike either of the recent species than the forms here made known from the Oligocene. *E. polita* appears to be a very well-characterized and distinct species.

Ervilia oregonensis n. s.

PLATE 33, FIGURE 16.

Eocene (?) of the Nehalem River, Columbia County, Oregon; J. S. Diller.

Shell small, oval, moderately inflated, smooth and more or less polished; inequilateral, the beaks low, small, closely adjacent; the anterior end slightly more acute than the posterior end; interior unknown. Lon. 7.5, alt. 5, diam. 3.25 mm.

Although this shell is detached from hard rock and the interior cannot be examined, I feel no doubt that it is correctly referred to this genus, and have included it here to complete the list of our fossil species.

PLATE XXIII.

Fig. 1. *Solariella louisiana* Dall ; alt. 5.5 mm. ; p. 407.

Fig. 1 a. The same, from below ; max. diam. 7 mm. ; p. 407.

Fig. 2. *Solariella turritella* Dall ; alt. 5.6 mm. ; p. 408.

Fig. 3. *Liotia agenea* Dall ; diam. 2.5 mm. ; p. 410.

Fig. 3 a. The same, from below ; p. 410.

Fig. 4. *Vaginella chipolana* Dall, ventral view ; 5.5 mm. ; p. 431.

Fig. 5. The same, in profile ; p. 431.

Fig. 6. *Teinostoma chipolanum* Dall, from below ; 2.3 mm. ; p. 413.

Fig. 7. The same, from above ; p. 413.

Fig. 8. *Teinostoma caloosaënse* Dall, from below ; 2 mm. ; p. 413.

Fig. 9. *Teinostoma microforatis* Dall, from above ; 4.7 mm. ; p. 415.

Fig. 10. The same, from below ; 4.7 mm. ; p. 415.

Fig. 11. *Teinostoma steiratum* Dall ; 2.6 mm. ; p. 415.

Fig. 12. *Teinostoma pseudadeorbis* Dall, from below ; 5.5 mm. ; p. 417.

Fig. 13. The same, in profile ; p. 417.

Fig. 14. *Teinostoma collinus* Dall ; 2 mm. ; p. 416.

Fig. 15. *Teinostoma funiculus* Dall, from below ; 2.4 mm. ; p. 417.

Fig. 16. *Cochliolepis striata* Stimpson, basal view ; 6 mm. ; p. 419.

Fig. 17. The same, from above ; p. 419.

Fig. 18. *Mölleria duplinensis* Dall ; 2 mm. ; p. 421.

Fig. 19. *Neritina chipolana* Dall ; 5 mm. ; p. 422.

Fig. 20. *Calliostoma cyclus* Dall, from below ; 5.2 mm. ; p. 403.

Fig. 20 b. The same, in profile ; p. 403.

Fig. 21. *Fissuridea chipolana* Dall ; 15 mm. ; p. 426.

Fig. 22. *Lucapina* (*Foraminella*) *suffusa* Reeve ; 14.75 mm. ; p. 424.

Fig. 23 a. *Ischnochiton tampaënsis* Dall, central valve, from above ; the fine granulation is not indicated ; lat. 4 mm. ; p. 434.

Fig. 23 b. The same valve, from below ; p. 434.

Fig. 24. *Dentalium caloosaënse* Dall ; 50 mm. ; the dorsoventral line in the accompanying view of the anterior orifice would be horizontal or parallel to the base of the plate, p. 441.

Fig. 25. *Dentalium caduloide* Dall ; the same remark applies to the figure of the aperture ; 10 mm. ; p. 442.

Fig. 26. *Cadulus floridanus* Dall ; 9.25 mm. ; p. 446.

NOTE.—As it was necessary to assign numbers to these figures before they could be assembled on the plate, the sequence of the numbers has been broken up.

As the figures are of different degrees of magnification, the longest dimension of the specimen—viewed as in the figure—follows the name in the references to this and the other plates, except where otherwise stated.

PLATE XXIII.

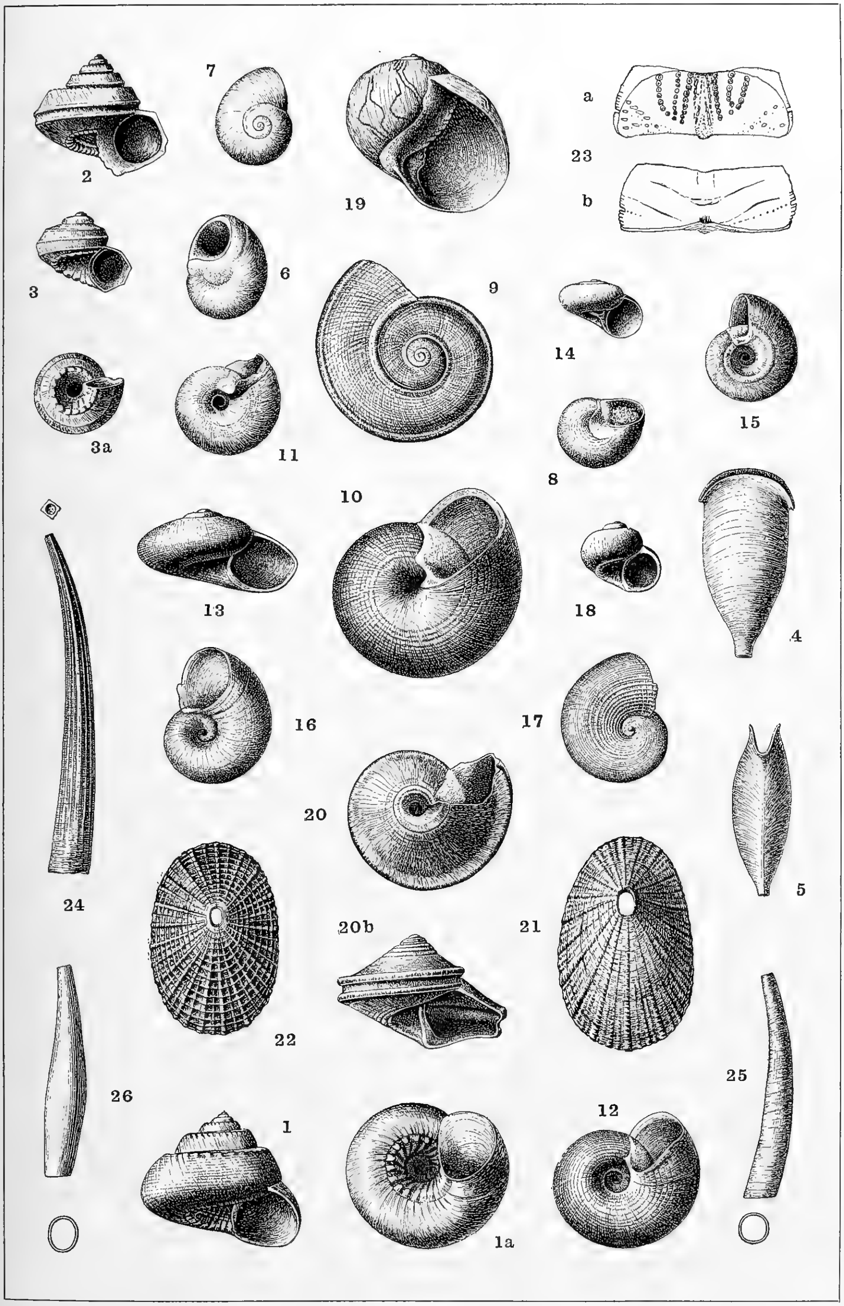
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PLATE XXIV.

Fig. 1. *Gemma purpurea* var. *Totteni* Stm., from above ; 3.5 mm.

Fig. 2. *Gemma purpurea* Lea, right valve, from above ; 2.8 mm.

Fig. 3. *Gemma purpurea* var. *Totteni* Stm., side view ; 3.5 mm.

Fig. 4. *Gemma purpurea* Lea, side view ; 2.8 mm.

Fig. 4 b. *Gemma purpurea* Lea, interior of right valve ; 2.8 mm.

Fig. 5. *Carolia floridana* Dall, view of the cardinal region showing valves in juxtaposition ; p. 777.

Fig. 6. *Carolia floridana* Dall, from above ; 110 mm. ; p. 777.

Fig. 6 b. *Carolia floridana* Dall, profile of part of the lower valve showing scar of foramen and profile of chondrophorus ; p. 777.

Fig. 7. *Carolia floridana* Dall, view of the same from above.

Fig. 7 b. *Carolia floridana* Dall, showing interior of upper valve, cardinal areas, ligamentary and adductor scars ; 110 mm. ; p. 777.

Fig. 8. *Aligena æquata* Conrad, sp., Miocene of Virginia ; interior of the left valve ; 5 mm.

Fig. 8 a. *Aligena æquata* Conrad, sp., showing exterior of left valve ; 5 mm.

Fig. 8 b. *Aligena æquata* Conrad, sp., showing interior of right valve ; 7 mm.

Fig. 9. *Pleurodon Adamsii* Dall, interior of right valve ; 3.25 mm. ; Florida Strait ; figured for comparison ; p. 601.

Fig. 10. *Pleurodon Woodii* Dall ; 2.75 mm. ; p. 600.

PLATE XXIV.

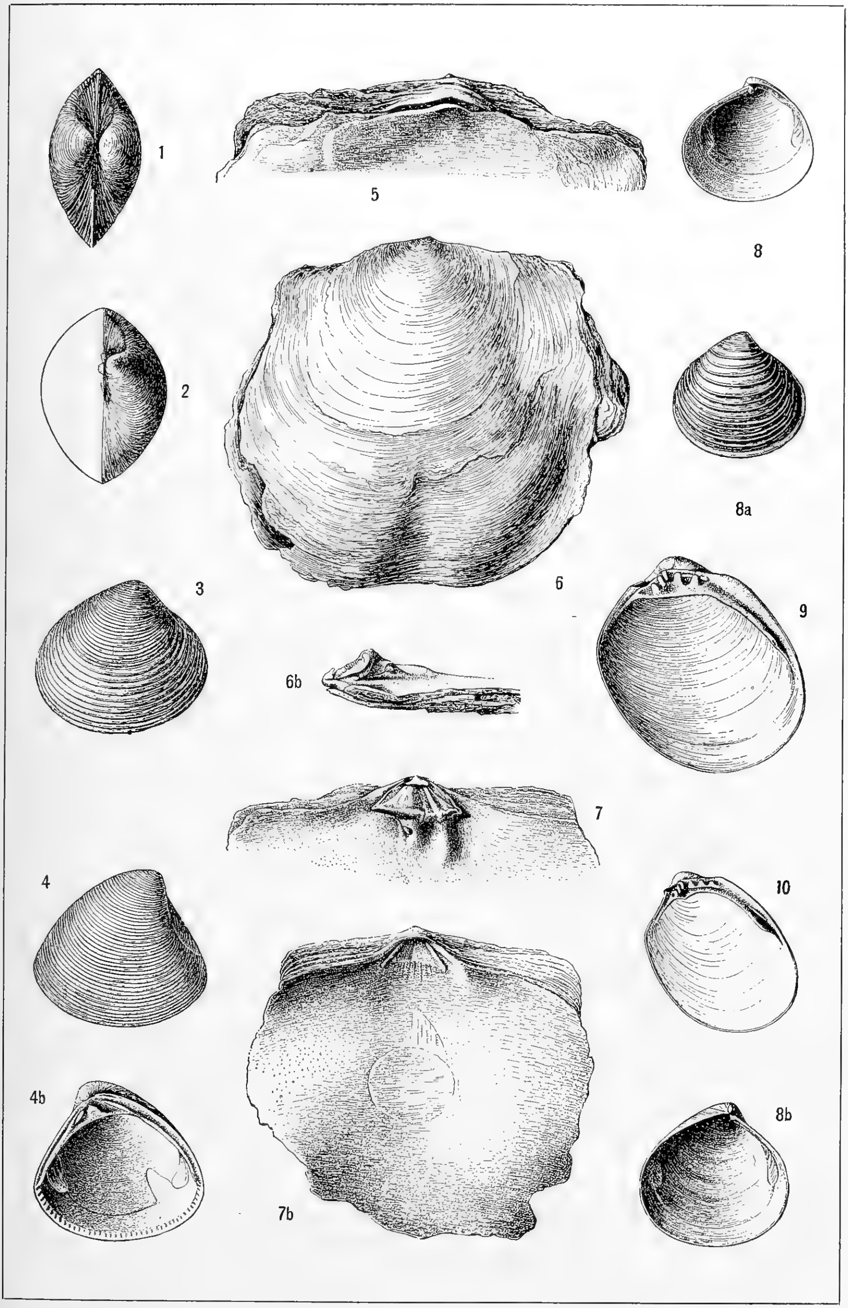

PLATE XXV.

Fig. 1. } *Arca* (*Cucullaria*) *tæniata* Dall, inner and outer view of left valve; lon. 52
Fig. 1 a. } mm.; p. 631.

Fig. 2. } *Coralliophaga elegans* Dall; Ballast Point silex beds; lon. 19 mm.
Fig. 2 a. }

Fig. 3. *Sportella lancea* H. C. Lea; Caloosahatchie beds; lon. 10 mm.

Fig. 3 a. *Sportella compressa* H. C. Lea; Caloosahatchie beds; 7.2 mm.

Fig. 4. *Sportella constricta* Conrad; Caloosahatchie beds; right valve; 9 mm.

Fig. 4 a. *Sportella constricta* Conrad, left valve; 9 mm.

Fig. 5. *Unio caloosaënsis* Dall, profile; 45 mm.; p. 688.

Fig. 6. *Bornia lioica* Dall; Caloosahatchie beds; lon. 9.5 mm.

Fig. 7. *Leda multilineata* Conrad, valve in profile showing teeth; 20 mm.; p. 588.

Fig. 8. *Bornia Mazyckii* Dall; Caloosahatchie beds; 11.5 mm.

Fig. 9. *Lucina* (*Here*) *amabilis* Dall; Caloosahatchie beds; interior of right valve showing sunken lunule; alt. 15.5 mm.

Fig. 9 a. *Lucina* (*Here*) *amabilis* Dall, front view; alt. 15.5 mm.

Fig. 10. *Psammobia* (*Gobræus*) *Wagneri* Dall; Caloosahatchie beds; 77 mm.

Fig. 11. *Leda multilineata* Conrad; 20 mm; p. 588.

Fig. 11 b. *Leda multilineata* Conrad, from above, in profile; 20 mm.; p. 588.

Fig. 12. *Scintilla Kurtzii* Dall; Caloosahatchie beds; lon. 8.25 mm.

Fig. 12 b. *Unio caloosaënsis* Dall, viewed from above; 57 mm.; p. 688.

PLATE XXV.

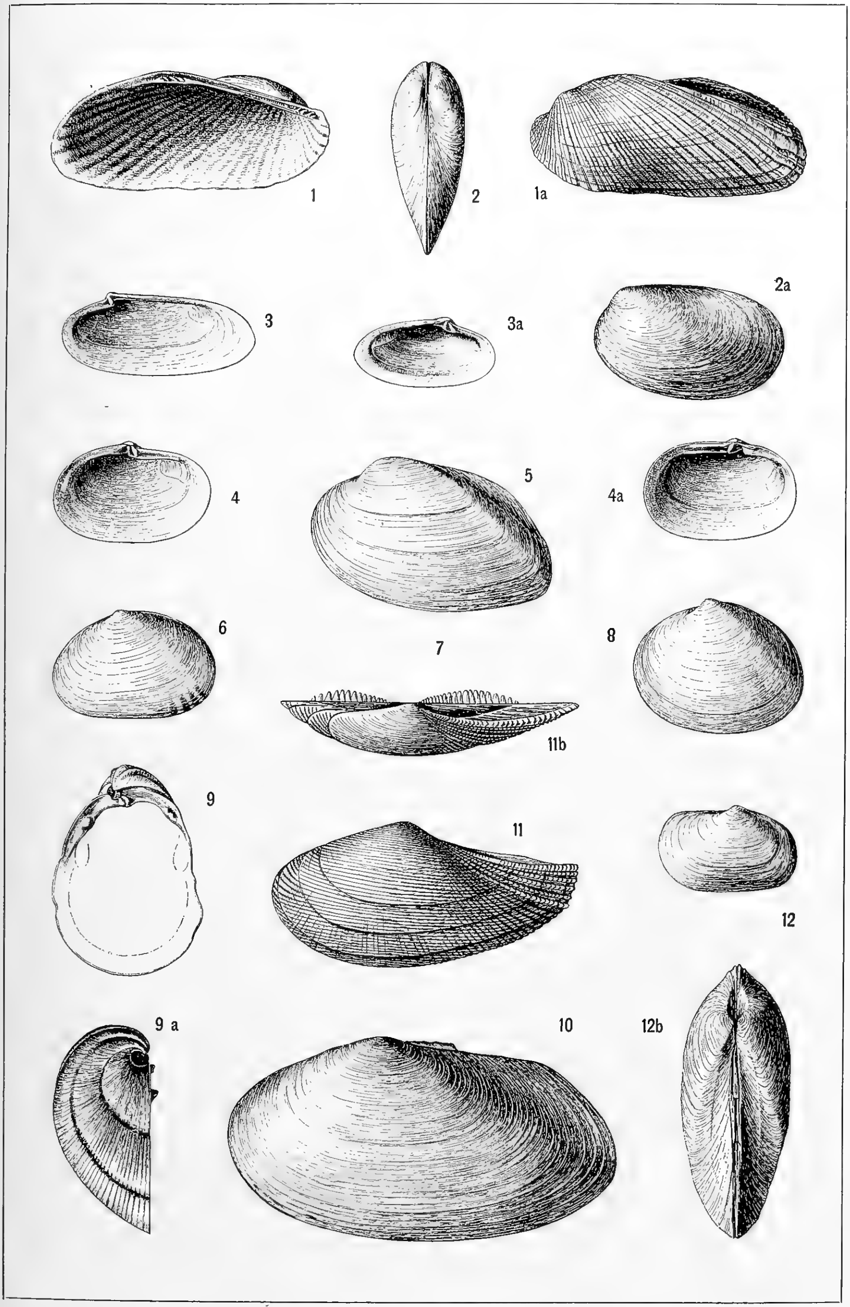

PLATE XXVI.

Fig. 1. *Pecten expansus* Dall, view of right valve ; lat. 147 mm. ; p. 706.

Fig. 2. *Pecten coosensis* Shumard, view of right valve ; alt. 100 mm. ; p. 700.

Fig. 3. *Pecten demiurgus* Dall, view of right valve ; alt. 71 mm. ; p. 718.

Fig. 4. *Pinna caloosaënsis* Dall, interior view of part of left valve near apex ; lon. 120 mm. ; p. 660.

Fig. 5. *Pecten Stearnsii* Dall, view of right valve ; alt. 71 mm. ; p. 706.

Fig. 6. *Pecten Madisonius* var. *Sayanus* Dall, view of right valve ; lat. 135 mm. ; p. 725.

Fig. 7. *Pecten fucanus* Dall, view of mold of left valve ; alt. 85 mm. ; p. 704.

PLATE XXVI.

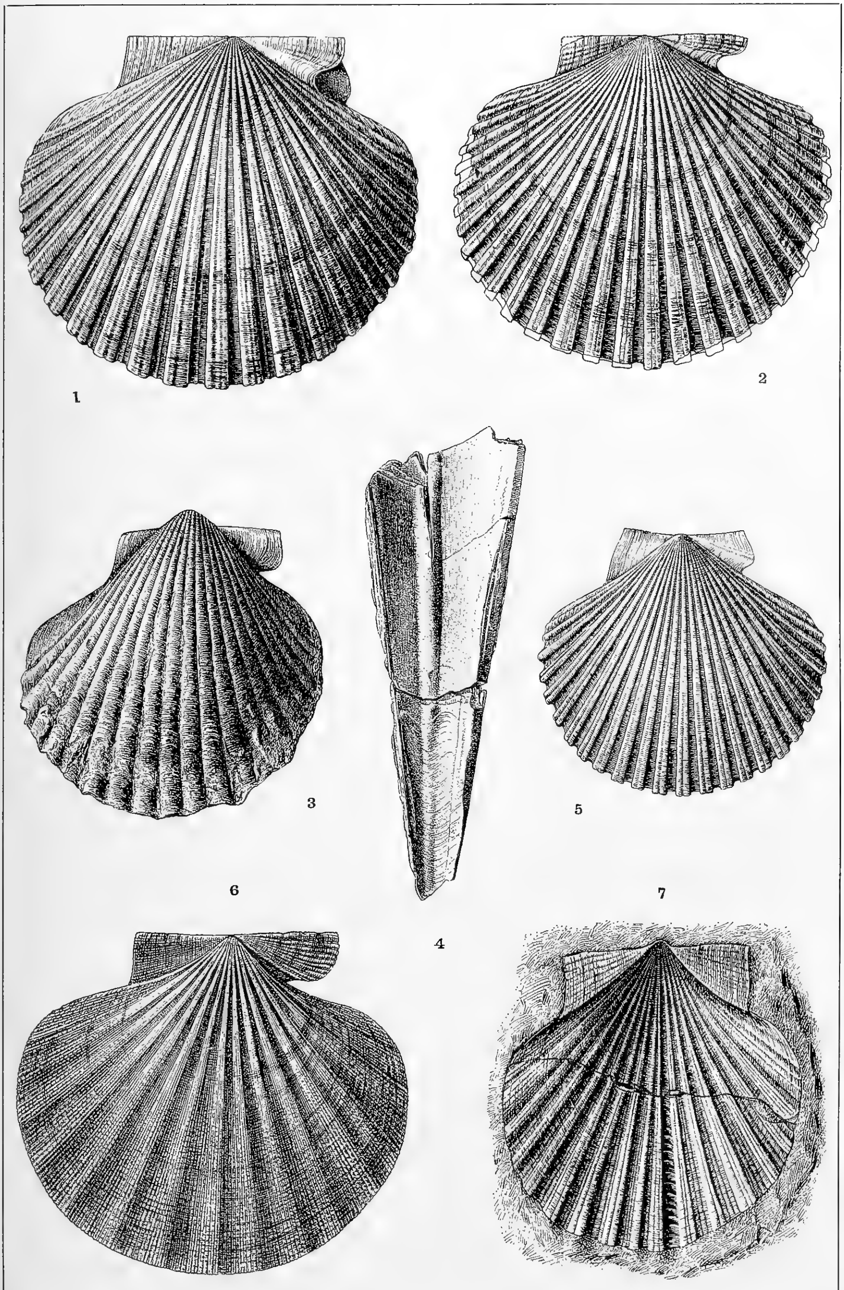

PLATE XXVII.

Fig. 1. *Mactra* (*Mactrotoma*) *fragilis* Gmelin, right valve from below, showing the profile of the hinge-teeth: *a*, anterior ventral, and *b*, anterior dorsal lamina; *c*, accessory lamella of, *d*, anterior arm of the right cardinal tooth, and *e*, posterior arm of the same; the space between the teeth *a*, *c*, *d*, *e* and the edge of the chondrophore is the ventral sinus, that between *a* and *b* is the anterior sinus; *f*, septum between the ligament (attached to the shell at *g*) and the resilium; *h* and *i* are the ventral and dorsal posterior laminæ respectively; about 60 mm.; p. 876.

Fig. 2. *Spisula* (*Hemimactra*) *curtidens* Dall, outline of young shell traced from incremental lines on broken larger valve; 35 mm.; p. 898.

Fig. 3. *Spisula* (*Hemimactra*) *subponderosa* Orbigny, profile of hinge from above, left valve: *a*, anterior lateral; *b*, cardinal tooth; *c*, accessory lamella; *d*, spur with part of the cavity for the sagittate ligament below it; *e*, scar of attachment of ligament; *f*, posterior lateral lamina; 70 mm.; p. 878.

Fig. 4. *Mactra* (*Mactrotoma*) *fragilis* Gmel., part of right valve showing hinge: *a*, anterior dorsal lamina; *f*, anterior ventral lamina; *b*, accessory lamella of, *c*, anterior arm (*i*, posterior arm) of the right cardinal; *d*, septum between the resilium and ligament; *e*, ligamentary scar; p. 876.

Fig. 5. *Teinostoma* (*Solariorbis*) *floridanum* Dall, 1895, upper surface; 1.6 mm.

Fig. 6. The same, lower surface; Pliocene of the Caloosahatchie beds.

Fig. 7. *Spisula* (*Mactromeris*) *dodona* Dall, exterior of right valve; Oak Grove, Florida; 50 mm.; p. 896.

Fig. 8. *Mactra* (*Mactrotoma*) *fragilis* Gmel., left valve, profile of hinge-plate: *a*, anterior lamina; *b*, accessory lamella; *c*, cardinal tooth; *d*, septum; *e*, posterior lamina; p. 876.

Fig. 9. *Teinostoma* (*Solariorbis*) *floridanum* Dall; 1.6 mm.

Fig. 10. *Teinostoma* (*Solariorbis*) *undula* Dall, 1895; from Natural Well of Duplin County, North Carolina; 2.5 mm.

Fig. 11. The same, from above; Miocene.

Fig. 12. *Teinostoma* (*Solariorbis*) *duplinense* Dall, 1895; Miocene; from below; 2 mm.

Fig. 13. *Spisula* (*Mactromeris*) *dodona* Dall, hinge-plate of left valve; 30 mm.; p. 878.

Fig. 14. *Mactrella alata* Spengler, hinge-plate of left valve: *a* and *b*, posterior laminæ; *c*, scar of ligament above septum; *d*, spur; posterior and anterior sides of cardinal tooth are supported by, *e*, septal buttresses; *s*, anterior sinus; *i*, anterior lamina; 57 mm.; p. 877.

Fig. 15. *Teinostoma* (*Solariorbis*) *duplinense* Dall, from above; diam. 2 mm.

Fig. 16. *Spisula* (*Hemimactra*) *subponderosa* Orbigny, hinge-plate of left valve: *a*, dorsal, and *e*, ventral posterior laminæ; *b*, ligamentary scar not separated from the pit below by a septum; *c*, spur; *f*, accessory lamella; *i*, petaloid cardinal tooth; *d*, anterior lamina with *s*, absorption scar, from ventral lamina of opposite valve; 70 mm.; pp. 878, 899.

Fig. 17. *Teinostoma* (*Solariorbis*) *undula* Dall, from below; 2.5 mm.

Fig. 18. *Mactra* (*Mactrotoma*) *fragilis* Gmelin, hinge-plate of left valve: *a*, posterior lamina; *b*, ligamentary scar with septum below it; *c*, spur, roofing the pit; *d*, cardinal tooth with *e*, accessory lamella, and *f*, anterior lamina; p. 876.

Fig. 19. *Mactra chipolana* Dall, hinge-plate of left valve: *a*, dorsal, and *c*, ventral posterior lamina; *b*, ligamentary scar; *c*, spur; *f*, anterior arm of cardinal tooth; *d*, anterior lamina; the septum is not shown very clearly, being seen on edge; p. 892.

Fig. 20. *Labiosa* (*Raëta*) *alta* Conrad, exterior of right valve; 65 mm.; p. 907.

Fig. 21. *Teinostoma* (*Solariorbis*) *duplinense* Dall; 2 mm.

Fig. 22. *Spisula* (*Hemimactra*) *densa* Dall, exterior of left valve; Oak Grove, Florida; 14 mm.; p. 900.

Fig. 23. *Labiosa* (*Raëta*) *alta* Conrad, hinge-plate of left valve: *f*, anterior lamina; *c*, ligament scar with septum below it; *b*, cardinal tooth with one arm projecting over the chondrophore; *a*, anterior lamina; 33 mm.; p. 907.

Fig. 24. *Spisula* (*Hemimactra*) *curtidens* Dall, hinge-plate of right valve: *a*, dorsal, and *e*, ventral anterior laminæ; *b*, anterior arm of cardinal tooth; *c*, ligament scar, without septum below it; *d* and *f*, posterior laminæ; 44 mm.; p. 878.

Fig. 25. *Spisula* (*Mactromeris*) *dodona* Dall, hinge-plate of right valve; 30 mm.; p. 896.

Fig. 26. *Spisula delumbis* Conrad; Suffolk, Virginia; interior of right valve; 96 mm.; p. 897.

Fig. 27. *Gyrodisca duplinensis* Dall, 1895; Upper Miocene; 3.6 mm.

Fig. 28. *Modiolus tampaënsis* Dall; from Ballast Point silex beds; interior of right valve; 22.5 mm.; p. 793.

Fig. 29. *Spisula magnoliana* Dall, interior of left valve; 19 mm.; p. 899.

PLATE XXVII.

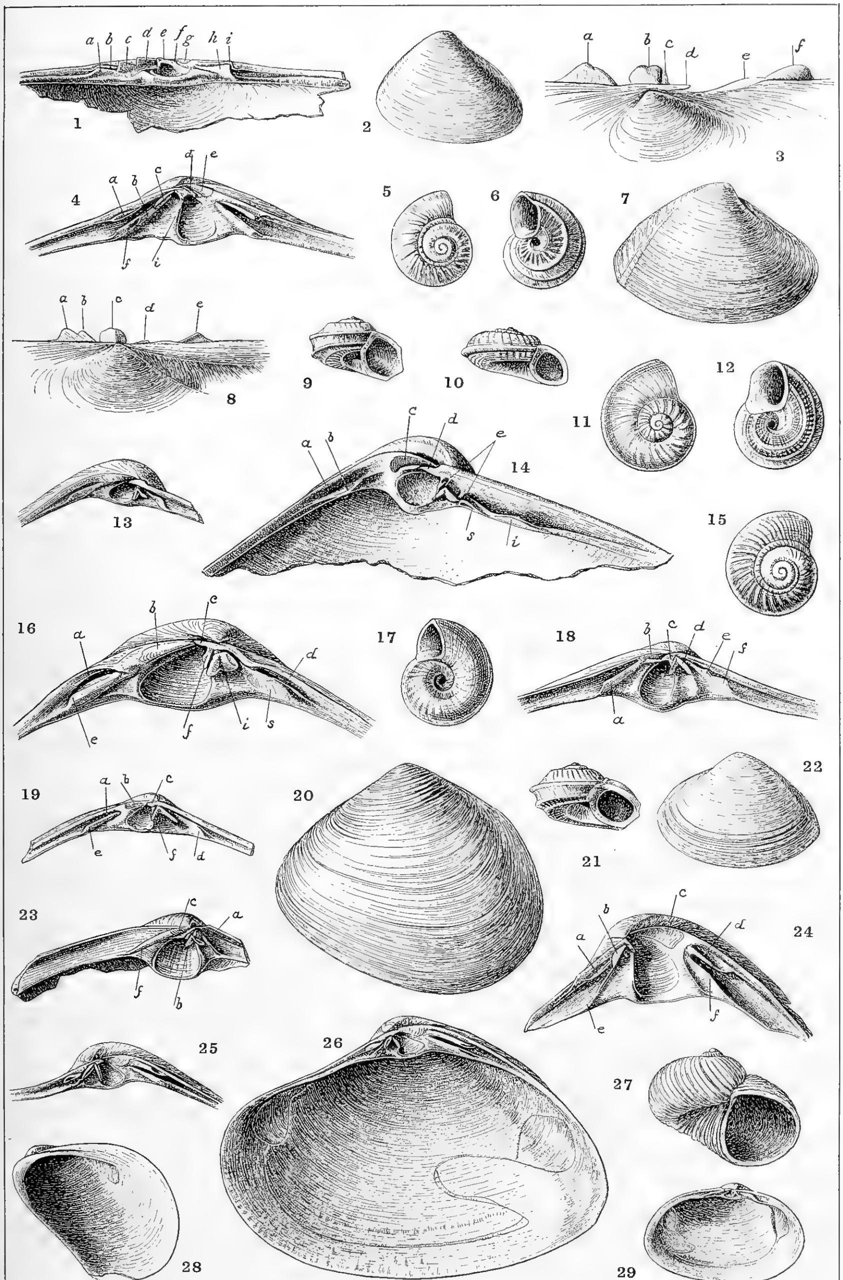
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PLATE XXVIII.

Fig. 1. *Lucina* (*Miltha*) *caloosaënsis* Dall, right valve ; 55 mm. ; Pliocene.

Fig. 2. *Diplodonta acclinis* Conrad, interior of right valve ; from the Caloosahatchie beds ; 23 mm.

Fig. 3. *Lima caloosana* Dall ; 33 mm. ; p. 767.

Fig. 4. *Mulinia caloosaënsis* Dall, profile ; 22 mm. ; p. 902.

Fig. 5. *Spisula marylandica* Dall, interior of right valve ; 92 mm. ; p. 897.

Fig. 6. *Mulinia caloosaënsis* Dall, dorsal aspect ; 22 mm. ; p. 902.

Fig. 7. *Mulinia sapotilla* Dall, interior of an elevated young right valve ; 18 mm. ; p. 880.

Fig. 8. *Mulinia sapotilla* Dall, dorsal aspect ; 12 mm. ; p. 902.

Fig. 9. *Mulinia sapotilla* Dall, interior of adult left valve, showing elongation ; 29 mm. ; p. 880.

Fig. 10. *Mactra* (*Mactrotoma*) *Willcoxii* Dall, interior of right valve ; 45 mm. ; p. 894.

Fig. 11. *Mactra* (*Mactrotoma*) *Willcoxii* Dall, exterior of left valve ; 45 mm. ; p. 894.

Fig. 12. *Mactra* (*Micromactra*) *undula* Dall, interior of left valve ; 42.5 mm. ; p. 893.

Fig. 13. *Diplodonta acclinis* Conrad, exterior of right valve ; 23 mm.

Fig. 14. *Mulinia sapotilla* Dall, exterior of valve figured above at fig. 7 ; 18 mm. ; p. 902.

Fig. 15. *Mactra multilineata* Dall, exterior of left valve ; from the Caloosahatchie beds ; 49 mm.

Fig. 16. *Donax Emmonsi* Dall, 1892 ; Miocene of North Carolina ; profile ; 10 mm.

Fig. 17. *Donax æquilibrata* Dall, 1892 ; Miocene of North Carolina ; profile ; 18 mm.

PLATE XXVIII.

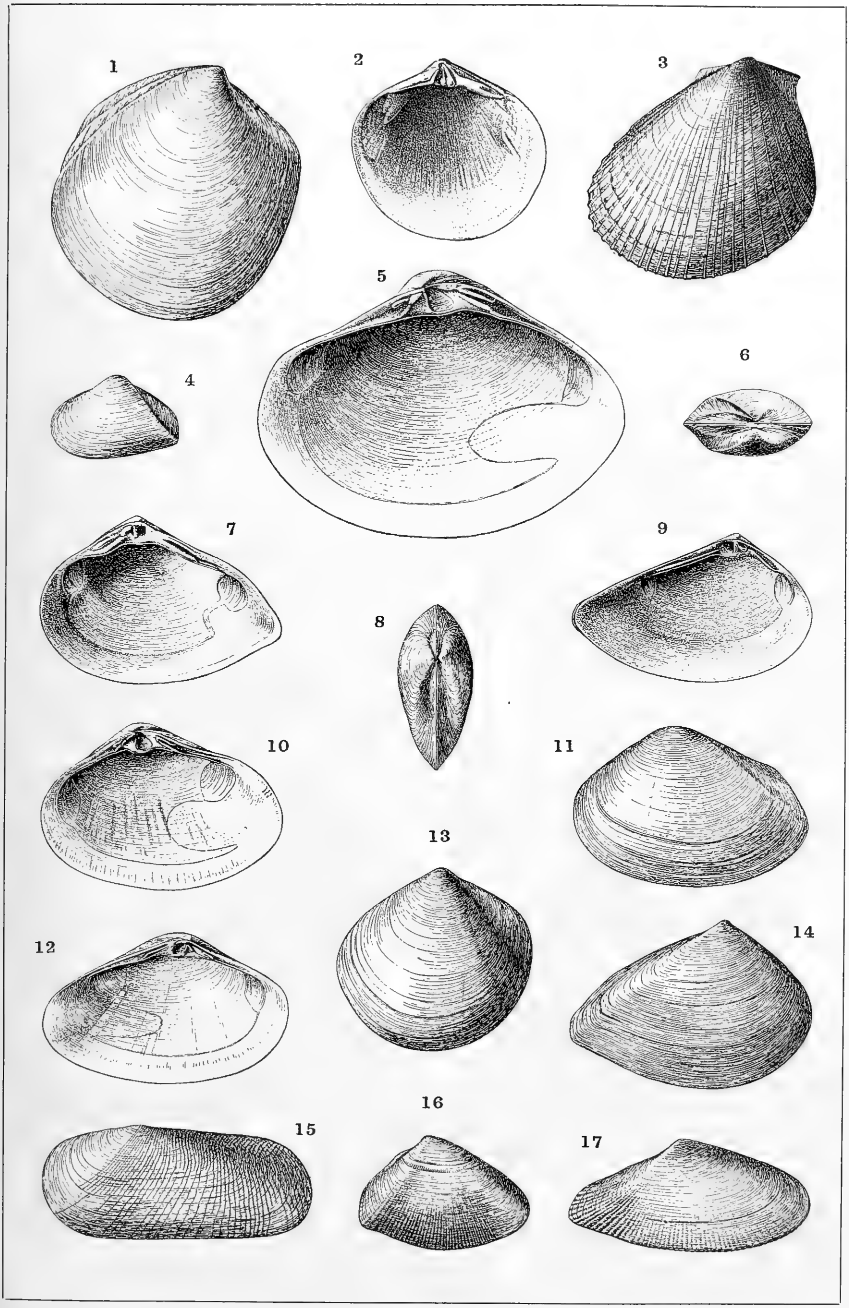

PLATE XXIX.

Fig. 1. *Pecten bowdenensis* Dall, exterior of left or flat valve ; lat. 36 mm. ; p. 713.

Fig. 2. *Pecten ocalanus* Dall, left valve ; lat. 36 mm. ; p. 756.

Fig. 3. *Pecten Gabbi* Dall, right valve ; lat. 53 mm. ; p. 717.

Fig. 4. *Pecten Willcoxii* Dall, right valve ; alt. 19 mm. ; p. 737.

Fig. 5. *Pecten eboreus* var. *senescens* Dall, left valve ; lat. 63 mm. ; p. 751.

Fig. 6. *Pecten opuntia* Dall, left valve ; alt. 33 mm. ; p. 707.

Fig. 7. *Pinna quadrata* Dall, external view of anterior portion of internal cast ; lon. 56 mm. ; p. 660.

Fig. 8. *Pecten subventricosus* Dall, left valve ; lat. 63 mm. ; p. 707.

Fig. 9. *Pecten chipolanus* Dall ; lat. 25.5 mm. ; left valve ; p. 733.

Fig. 10. *Pecten Raveneli* Dall, right or convex valve ; lat. 48 mm. ; p. 721.

Fig. 11. *Atrina Harrisii* Dall, exterior of decorticated right valve ; alt. 150 mm. ; p. 663.

Fig. 12. *Pecten caloosaënsis* Dall, right valve ; alt. 64 mm. ; p. 731.

PLATE XXIX.

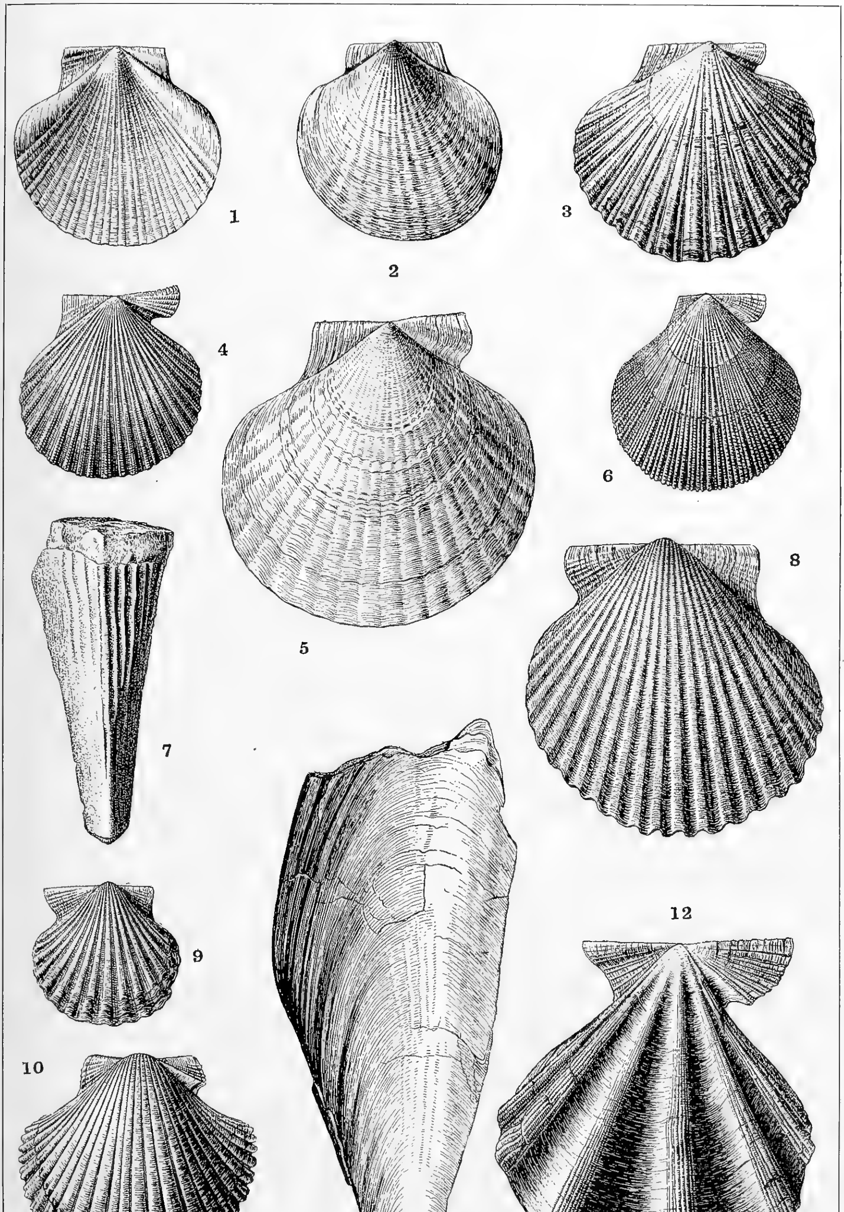

PLATE XXX.

Fig. 1. *Spisula duplinensis* Dall, interior of right valve; Miocene, Duplin County, North Carolina; lon. 58 mm.; p. 898.

Fig. 2. *Modiolus grammatus* Dall; Ballast Point silex beds; lon. 20 mm.; p. 794.

Fig. 3. *Lima smirna* Dall; Oligocene; Ballast Point silex beds; alt. 31 mm.; p. 766.

Fig. 4. *Ostrea falco* Dall, inner face of upper valve; Zeuglodon bed; alt. 55 mm.; p. 682.

Fig. 5. *Ostrea podagrina* Dall; Oligocene of Suwanee River, Florida; interior of upper valve; alt. 110 mm.; p. 682.

Fig. 6. The same, external view; p. 682.

Fig. 7. *Tellina dodona* Dall; Oligocene, Oak Grove marl; lon. 16 mm.

Fig. 8. *Pododesmus scopelus* Dall; Rock Bluff marl; inner face of attached valve; lat. 57 mm.; p. 779.

Fig. 9. *Mytilus pandionis* Dall; umbonal view; p. 787.

Fig. 10. *Mytilus pandionis* Dall; White Beach, Osprey, Florida; internal cast of right valve; lon. 122 mm.; p. 787.

Fig. 11. *Ostrea falco* Dall; alt. 55 mm.; external view; p. 682.

PLATE XXX.

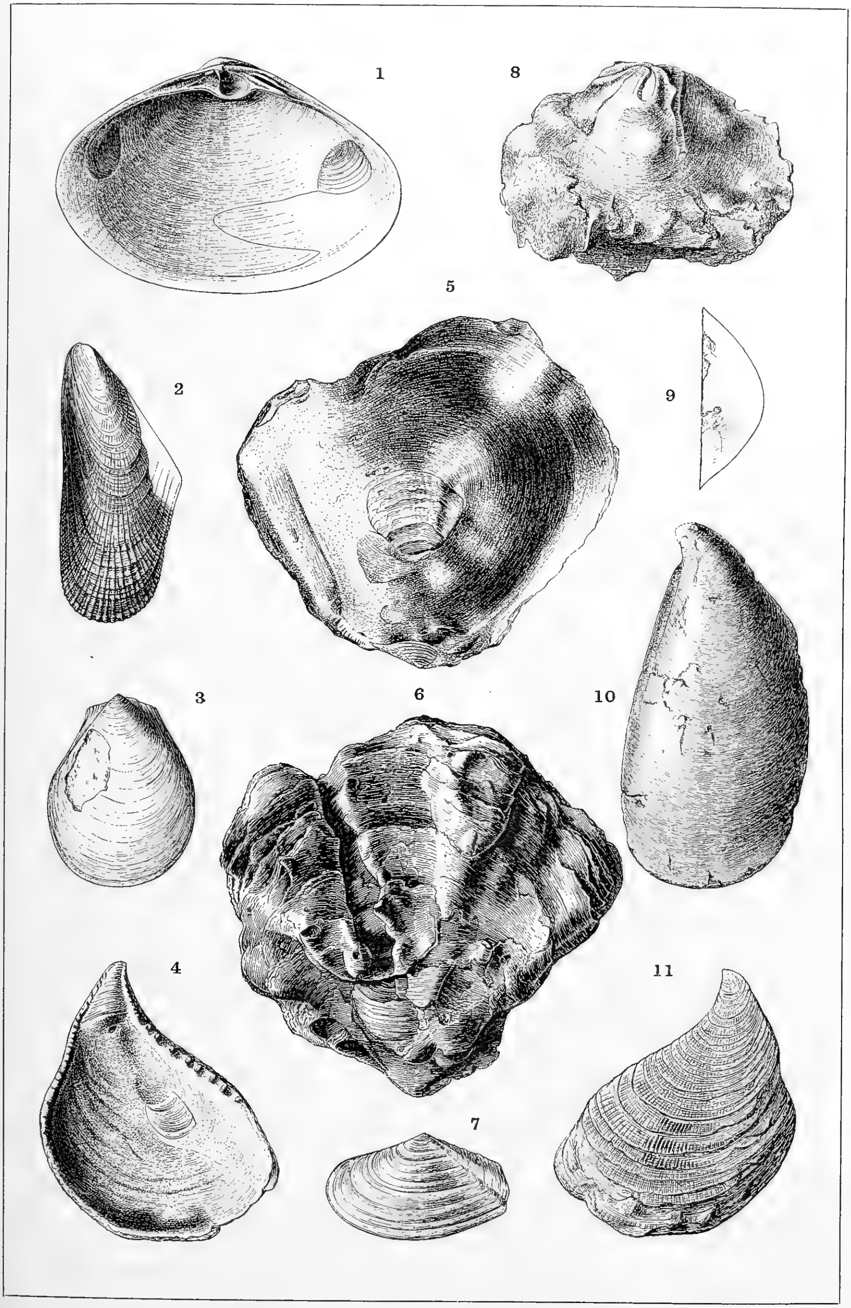

PLATE XXXI.

Fig. 1. *Arca* (*Scapharca*) *dodona* Dall; Oak Grove marl; umbonal view; lon. 40 mm.; p. 640.

Fig. 2. *Arca* (*Scapharca*) *santarosana* Dall; Oak Grove marl; umbonal view; lon. 37 mm.; p. 641.

Fig. 3. *Arca* (*Scapharca*) *campyla* Dall; Caloosahatchie beds; side view; lon. 37 mm.; p. 644.

Fig. 4. *Arca* (*Scapharca*) *campyla* Dall, umbonal view, showing tortuosity of the valves; lon. 37 mm.; p. 644.

Fig. 5. *Arca* (*Anadara*) *alcima* Dall; Caloosahatchie beds; lon. 30 mm.; p. 625.

Fig. 6. *Arca* (*Anadara*) *rustica* Tuomey and Holmes; Caloosahatchie beds; lon. 54 mm.; p. 653.

Fig. 7. *Arca* (*Anadara*) *alcima* Dall; Caloosahatchie beds; view of interior of left valve; lon. 30 mm.; p. 635.

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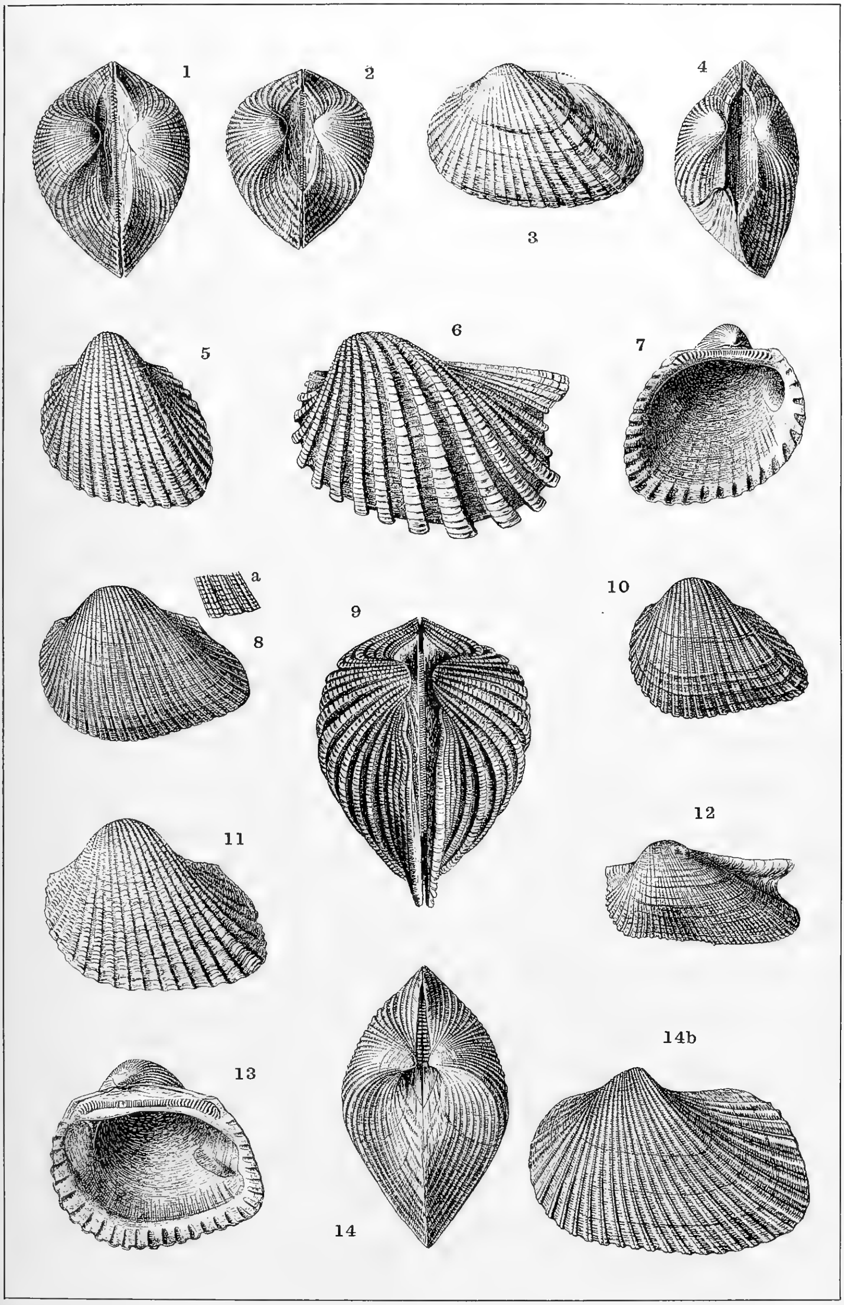

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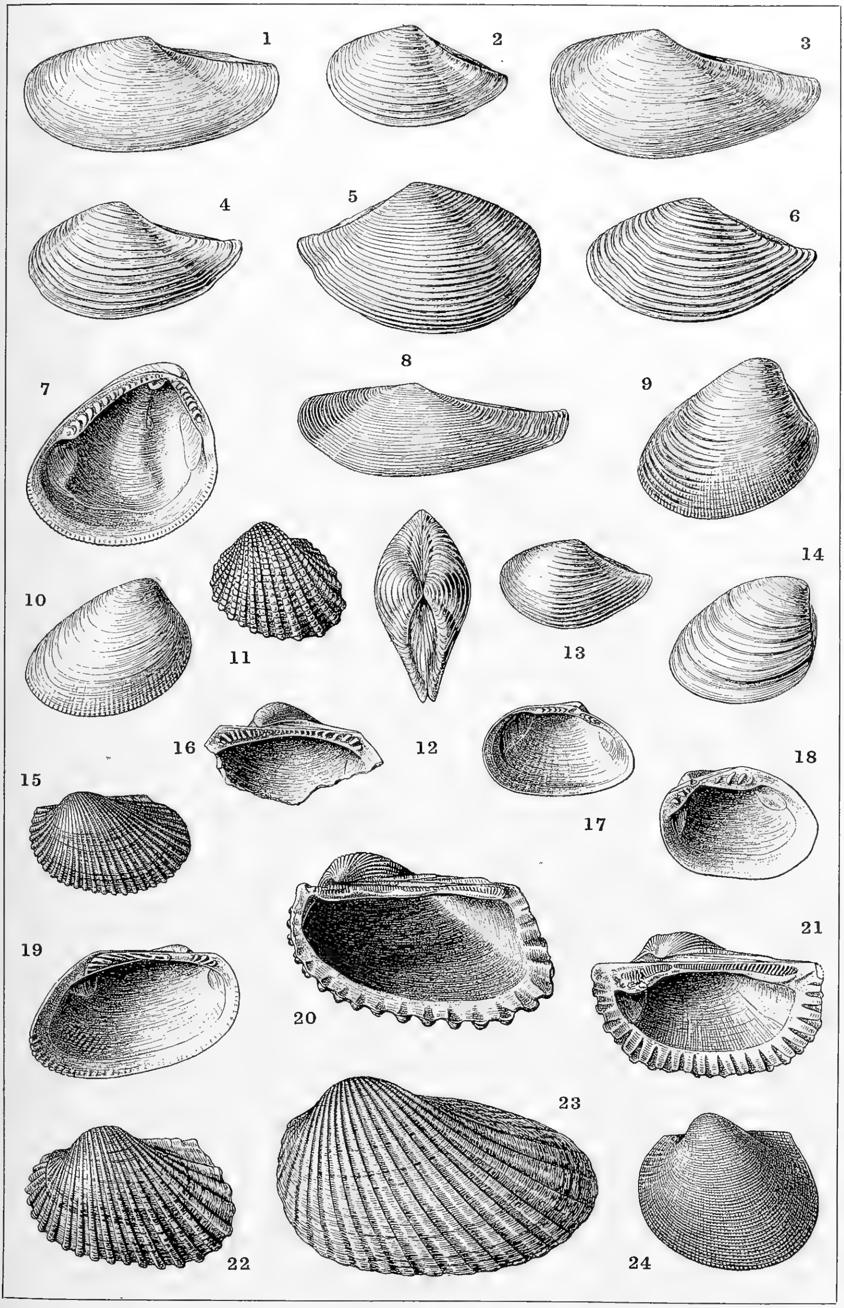
PLATE XXXII.



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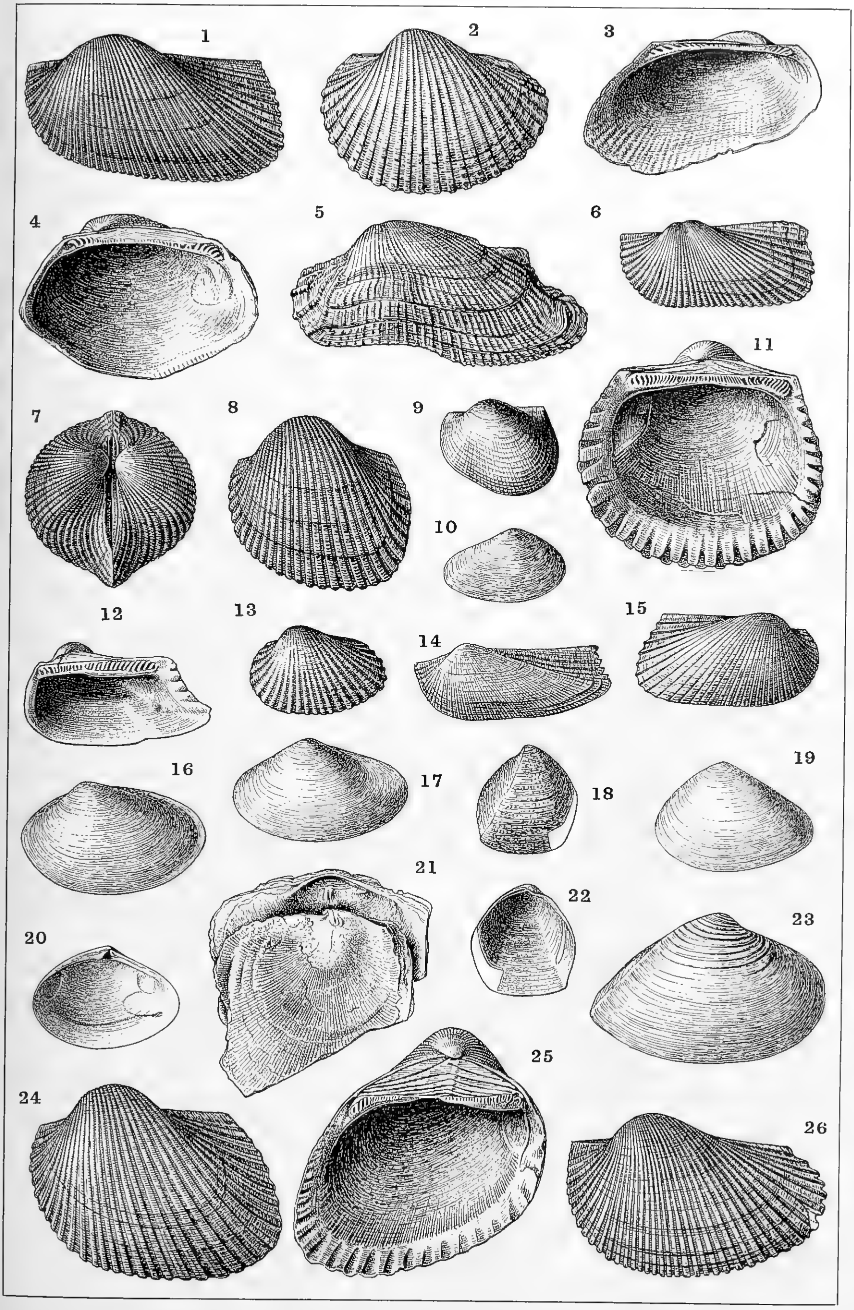

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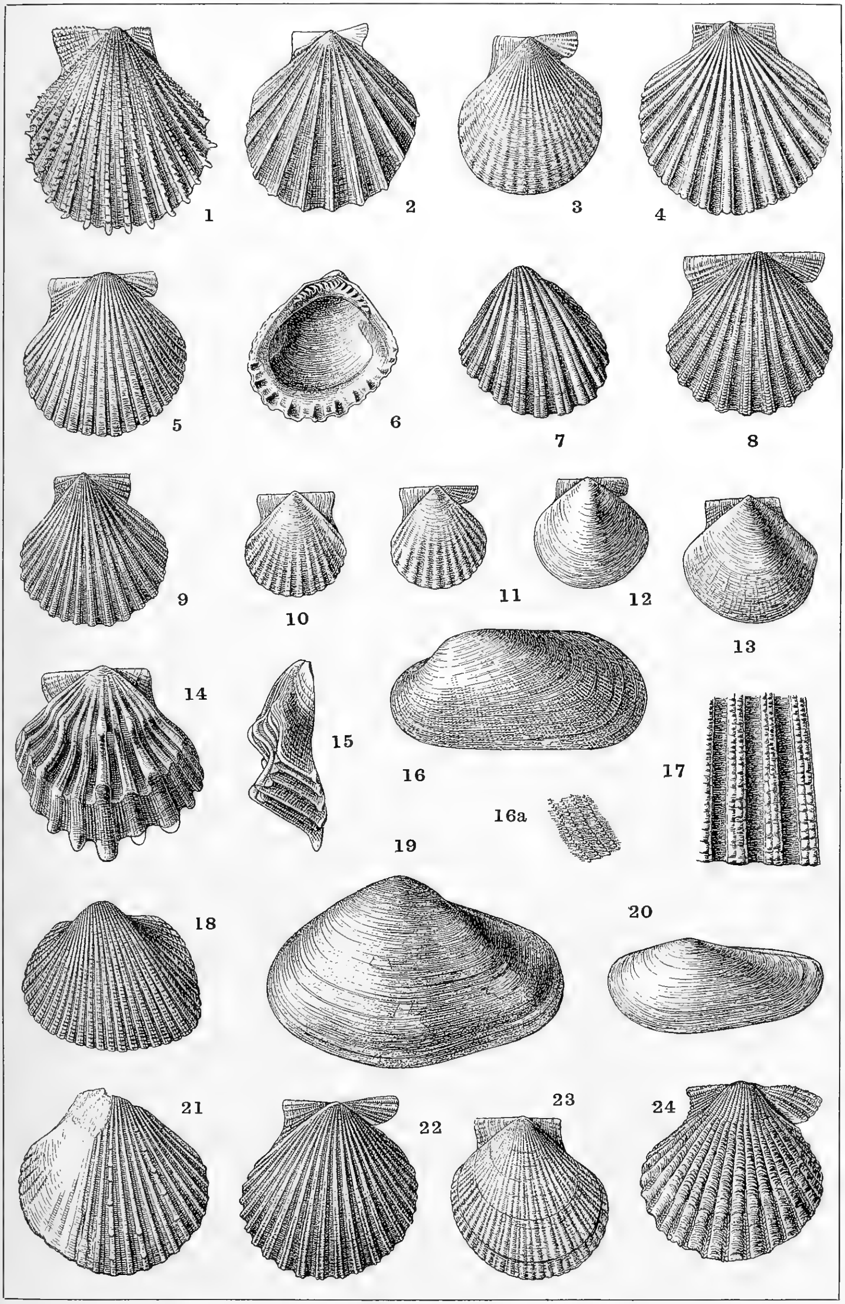
PLATE XXXIV.



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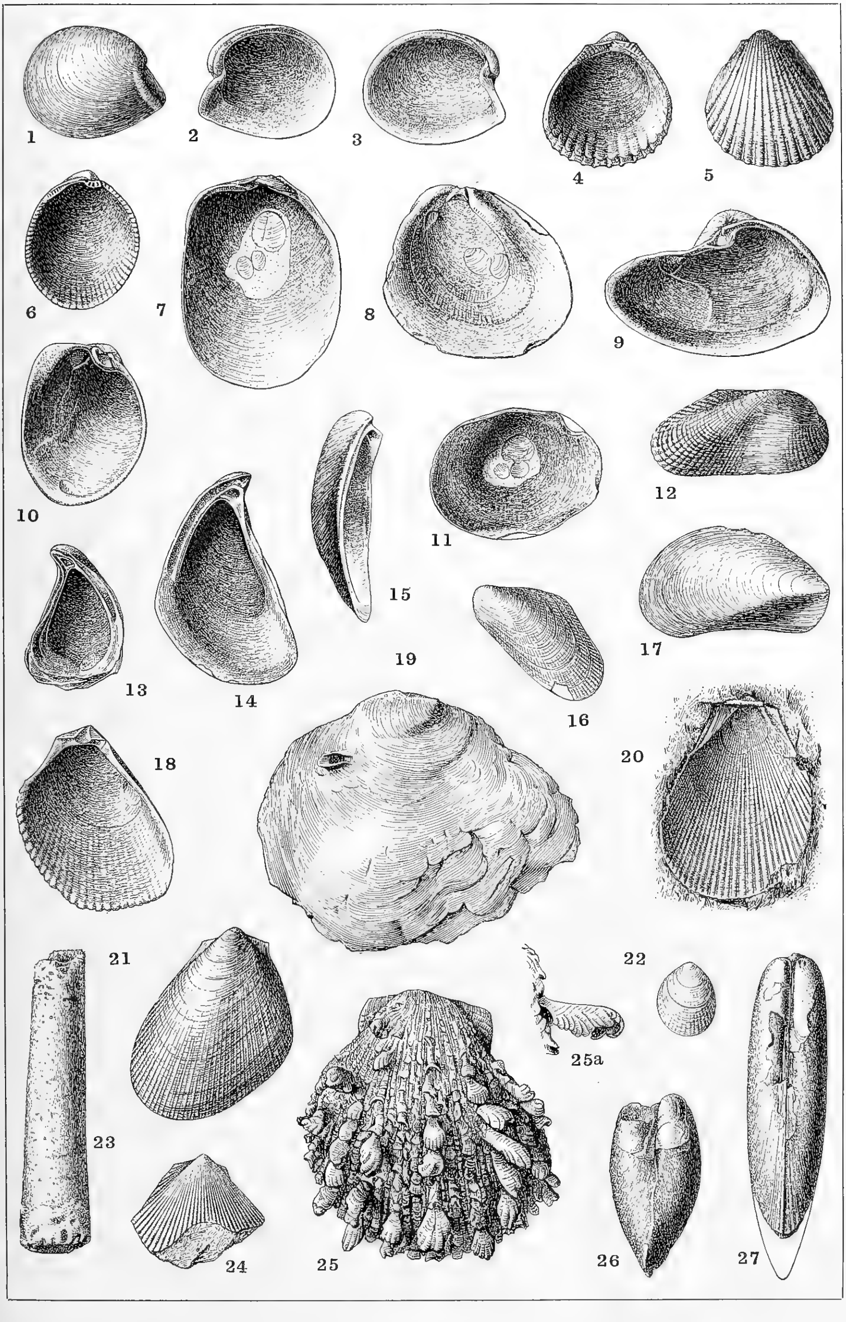

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FINAL NOTE.

The manuscript of this paper was sent in for publication April 3, 1898, and the printing completed October 15, 1898. The plates of higher number than Plate XXXV., to which a few references appear in the text, will be issued with Part V.

ERRATA.

Page 571, line 13, for "Colonnianum" read Calonnianum.
Page 638, line 5, for "Plate 36" read Plate 32.
Page 688, line 15, for "Figures 6, 12*a*" read Figures 5, 12*b*.

TRANSACTIONS OF THE WAGNER FREE INSTITUTE OF SCIENCE OF PHILADELPHIA

VOL. III.

PART V.

DECEMBER, 1900

WAGNER FREE INSTITUTE OF SCIENCE
MONTGOMERY AVE. AND SEVENTEENTH ST.
PHILADELPHIA

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PHILADELPHIA

VOL. III.

PART V.

DECEMBER, 1900

WAGNER FREE INSTITUTE OF SCIENCE
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PHILADELPHIA

CONTRIBUTIONS

TO THE

TERTIARY FAUNA OF FLORIDA

WITH ESPECIAL REFERENCE TO THE

SILEX BEDS OF TAMPA AND THE PLIOCENE BEDS OF THE CALOOSAHATCHIE RIVER

INCLUDING IN MANY CASES

A COMPLETE REVISION OF THE GENERIC GROUPS TREATED OF AND THEIR AMERICAN TERTIARY SPECIES

BY

WILLIAM HEALEY DALL, A.M.

PALEONTOLOGIST TO THE UNITED STATES GEOLOGICAL SURVEY; HONORARY PROFESSOR OF INVERTEBRATE PALEONTOLOGY IN WAGNER FREE INSTITUTE OF SCIENCE

PART V.

TELEODESMACEA: SOLEN TO DIPLODONTA

WAGNER FREE INSTITUTE OF SCIENCE OF PHILADELPHIA

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PREFACE

THE present continuation of the work on our Southeastern Tertiary fauna carries the text so far that it seems certain that another part will conclude the work. It includes a large part of the Teleodesmacea, but it was found that the family Veneridæ was too extensive to be finished without unduly delaying the publication of the manuscript already completed, and the discussion of that group is therefore deferred until the next instalment is printed.

The present part reviews the nomenclature of several groups in which great confusion had reigned, and their revision, it is hoped, will be useful to students both of fossil and recent shells. A very large number of hitherto unrecognized species are here first described and figured.

I have been, as heretofore, under obligations to the authorities of the Smithsonian Institution, the National Museum, and the Director of the United States Geological Survey for essential facilities for study and research without which this work could not have been carried on; to Mr. Joseph Willcox and other officers of the Wagner Free Institute of Science for the most liberal encouragement and assistance in the gathering and illustration of material; and to Dr. H. A. Pilsbry and the authorities of the Academy of Natural Sciences of Philadelphia for courtesies which they have freely rendered. To numerous correspondents I am also under serious obligations for information furnished and specimens submitted for comparison and study, among whom I cannot refrain from mentioning Mr. E. A. Smith, of the British Museum, and M. Maurice Cossmann, of Paris, France, whose courtesy has been unfailing and unlimited.

WILLIAM H. DALL.

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TERTIARY FAUNA OF FLORIDA.

Superfamily SOLENACEA.

Family SOLENIDÆ.

THIS group is quite ancient if we assume that the Paleozoic *Paleosolen* is a member of it, which seems likely from the perfect correspondence of the exterior form, though the hinge of *Paleosolen* is unknown. Want of sufficient material obliges me to refrain from attempting any revision of the groups older than the Tertiary, among which *Solenaria* Stoliczka (1870), from the Turonian of Europe, and *Legumen* Conrad (1867), *Legumenaia* Conrad (1858), and *Solyma* Conrad (1870), from the Cretaceous, may be mentioned.

The *Solenidæ* form a compact group after the elimination of the soleniform *Psammobiidæ,* such as *Novaculina* and *Tagelus.* In the flattened species with thin shells the valve is usually strengthened by a dorsoventral rib or clavicle; in the strong cylindrical forms this is not needed and is not developed. The foot is strong, extensile, and larger distally, where usually it can be expanded laterally into a sort of disk by which the animal can pull itself rapidly into its burrow as if by a mushroom anchor. Perhaps the security against enemies which this arrangement gives is responsible for the great persistence of this type in time. The siphons are short, more or less papillose or filamented externally, and are more or less united, in those with long siphons only the tips are separated. The beaks vary from subcentral to anterior; the deep burrowers have them most anterior for obvious dynamical reasons.

The following arrangement is adopted:

Genus *Solen* (L.) Scopoli, 1777. Type *S. marginatus* Pulteney.

Hinge with one cardinal in each valve; beaks nearly anterior; external surface polished; valves usually straight.

Section *Solena* Mörch, 1853. Type *S. obliquus* Spengler.

Beaks subanterior; no anterior furrows; periostracum rude, unpolished.

Section *Plectosolen* Conrad, 1867. *P. protextus* Conrad.

Like *Solena,* with a furrow extending ventrally from the beaks.

Genus *Leptosolen* Conrad (Am. Journ. Conch., iii., p. 15, 1867). Type *Siliquaria biplicata* Conr., Journ. Acad. Nat. Sci., 2d Ser., iii., p. 324, pl. 34, fig. 17 (bad), 1858. Middle and Upper Cretaceous.

Shell like a small, thin *Solena,* but with a strong clavicular rib directed vertically from the beaks towards the ventral margin; the proximal portion of this rib in the type species is united with the hinge margin behind by a wing, between which and the valve is a deep recess. This genus has shell characters nearly intermediate between *Solen* and *Siliqua.* The nymphs are long and the pallial sinus very shallow.

Genus *Ensis* Schumacher, 1817. Type *S. magnus* Schumacher.

Like *Solen,* but with one right and two left vertical cardinals, and in each valve a posterior horizontal tooth; the valves usually more or less curved.

Genus *Siliqua* Megerle, 1811. Type *S. radiatus* Linné.

Shell ovate, flattened, straight, with a rib or clavicle ventrally directed; hinge like *Ensis,* but more feeble.

Genus *Cultellus* Schumacher, 1817. Type *S. lacteus* Spengler.

Shell more elongate and often arcuate, the beaks more anterior, the clavicle absent.

Genus *Solecurtus* (Blainville), 1824. Type *Solen legumen* Linné.

Shell more soleniform, ends rounded, beaks subanterior; a short clavicle below the beaks and another, less evident, passing obliquely forward; pallial sinus well marked; surface polished.

Subgenus *Pharella* Gray, 1854. Type *Solen javanicus* Lamarck.

Beaks central; teeth small, slender; surface rude; clavicle absent.

? Genus *Tanysiphon* Benson, 1858. Type *T. rivalis* Benson.

Shell resembling *Pharella,* but short, the anterior end shorter, ligament external, with a shorter broad internal resilium set on a short projecting nymph recalling that of *Sphenia;* pallial sinus deep, siphons long, with a tunic, but retractile; valves very slightly unequal.*

* This fresh-water shell was very naturally referred to the vicinity of *Mya,* but the teeth, when present, agree with those of *Pharella,* and I think it merely a somewhat peculiarly specialized solenoid.

Genus *Psammosolen* Risso, 1826. Type *S. strigilatus* Linné.

Shell subcylindric, short, not fully covering the retracted animal; beaks subcentral, ends subtruncate; teeth in each valve two, but no clavicle is present; typical section with incised oblique or divergent sculpture.

Section *Azor* (Leach), 1844. Type *S. antiquatus* Pulteney.

Sculpture concentric only.

Genus **SOLEN** Linné.

Solen Linné, Syst. Nat., ed. x., p. 672, 1758, *ex parte*.

Solen Scopoli, Intr. ad Hist. Nat., p. 397, 1777; Lamarck, Prodr., p. 83, 1799. Type *S. vagina* Lam., not Linné, = *S. marginatus* Pulteney.

> *Solenarius* Duméril, Zool. Anal., p. 168, 1811; not of Mörch, 1853.

Vagina Megerle, Mag. Ges. Nat. Fr., 1811, p. 44. Type *S. recta* Megerle = *S. vagina* L.

Solen Schumacher, Essai, p. 124, pl. vi., fig. 3, 1817; not of Megerle, *op. cit.*, p. 45, 1811.

Fistula Mörch, Cat. Yoldi, ii., p. 6, 1853 (after Martini, Conch. Cab., 1774, non-binomial).

Solenarius Mörch, Cat. Yoldi, ii., p. 6, 1853.

Hypogæa + *Hypogæoderma* (sp.) Poli, Test. Utr. Sicil., 1791-5.

Listera Leach (Gray), Synops. Moll. Gt. Brit., p. 261, 1852; sole ex. *Solen marginatus* Pulteney.

Solen Fischer, Man. de Conchyl., p. 1110, 1887; Newton, Syst. List Brit. Olig. and Eoc. Moll., p. 78, 1891.

Solena Mörch, Cat. Yoldi, ii., p. 7, 1853. Type *Solen obliquus* Spengler, not Sowerby, 1844; H. and A. Adams, Gen. Rec. Moll., ii., p. 342, 1856; Conrad, Am. Journ. Conch., iii., Supplem., p. 27, 1867; Fischer, Man. Conchyl., p. 1110, 1887 (after Browne, 1756, non-binomial; no type).

Hypogella Gray, Ann. Mag. Nat. Hist., xiv., p. 23, 1854. Type *Solen ambiguus* Lam. (= *S. obliquus* Spengler); Fischer, Man. de Conchyl., p. 1111, 1887.

Plectosolen Conrad, Am. Journ. Conch., ii., p. 103, 1866. Type (selected by Fischer, Man. de Conchyl., p. 1111, 1887) *Solen angustus* Desh.

Ensatella (*rudis*) Carpenter, Suppl. Rep. Brit. As., 1863, p. 39; not of Swainson.

The genus *Solen* as originally used by Linné was heterogeneous, but the diagnosis of Scopoli fixes the name on the species of the type of *S. marginatus*. Browne, of Jamaica, was not a binomial writer, and applied the classical name *Solena* indiscriminately to all soleniform bivalves. Mörch reintroduced the word to apply to the rude brackish-water forms like *S. obliquus* Spengler, while *Plectosolen* Conrad may be retained sectionally for the earlier fossils of the Tertiary, which differ from *Solena* by having a well-marked furrow externally from the beaks to the anterior ventral angle. There are several of these in the American Tertiaries.

Solen amphistemma n. sp.

PLATE 39, FIGURE 8.

Oligocene of the Chipola beds at Alum Bluff and on the Chipola River, Florida, and of the Oak Grove sands, Santa Rosa County, Florida.

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. Lon. of shell 112, alt. 27.5, diam. 18 mm.

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

Solen sicarius Gould.

Solen sicarius Gould, Shells of the Wilkes Exploring Exped., p. 387, fig. 501, 1852.

Miocene (Cooper) to recent on the Californian coast; not uncommon in the Pleistocene sands of San Pedro Hill. The living shell ranges from Vancouver Island to San Pedro, California, and is said to occur in Japan.

Solen rosaceus Carpenter.

Solen (*sicarius* var. ?) *rosaceus* Cpr., Suppl. Rep. Brit. As., 1863, p. 638; Ann. Mag Nat. Hist., 3d Ser., xv., p. 177, 1865.

Miocene (Cooper) and Pliocene of California; Pleistocene of San Diego; recent from Santa Barbara south to the Gulf of California.

Solen viridis Say.

Solen viridis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 316, 1821; Conrad, Am. Mar. Conch., ii., p. 28, pl. 5, fig. 2, 1831.

Pleistocene of South Carolina at Simmons Bluff; recent from Rhode Island (Totten) to Georgia (Postell).

This appears to be a rather rare species, of which the largest and finest specimens I have seen are those obtained by General Totten in Narragansett Bay, and which passed with his collection into the possession of the National Museum.

Solen Conradi Dall.

Solen curtus Conrad, Am. Journ. Sci., 2d Ser., v., p. 432, fig. 14, 1848; not of Desmoulins, 1832.

Plectosolen curtus Conrad, S. I. Eocene Checkl., p. 8, 1866.

Ensis curtus Meek, S. I. Miocene Checkl., p. 12, 1864.

Oligocene? or Miocene of Astoria, Oregon; Conrad.

The type of this species appears to be lost, but it is certainly not a *Plectosolen*, and the figure looks more like a true *Solen* than an *Ensis*. It is of the general form of *S. sicarius*, but smaller. I have collected what I suppose to be this species from the Empire beds at Coos Bay.

Solen (Plectosolen) protextus Conrad.

Donax? protextus Conrad, Geol. Wilkes' Expl. Exp., p. 723, pl. 17, fig. 9, 1849.

Solena protexta Conrad, Am. Journ. Conch., i., p. 152, 1865.

Plectosolen protextus Conrad, Am. Journ. Conch., ii., p. 103, 1866; S. I. Eocene Checkl., p. 9, 1866.

Hypogella protexta Gabb, Pal. Cal., ii., p. 89, 1869.

Upper Eocene (?) or Miocene of Oregon, near Astoria, and at Coos Bay.

This species was badly figured from a poor cast. It is a member of the section *Plectosolen*, which is easily distinguished from *Solena* by the deep furrow in the anterior part of the valves. The type specimen is lost, but a similar shell is not uncommon in the Miocene of the Empire beds at Coos Bay, which are practically of the same horizon as the Miocene of Astoria, and the same or a very similar form is found in transitional (Oligocene?) beds above the Eocene of Cape Arago.

Solen (Plectosolen) lisbonensis Aldrich.

Solen lisbonensis Aldrich, Bull. Ala. Geol. Survey, i., p. 37, pl. 4, fig. 4, 1886.

Eocene of the Chickasawan horizon at Lisbon, Alabama; Aldrich.

Variety **abruptus** Dall.

Claibornian Eocene of Clarke County, Mississippi; Burns.

This form, represented by numerous fragments, differs from Aldrich's figure by its more abrupt anterior truncation and relatively wider valves. It will probably, when more complete specimens are obtained, prove to belong to a distinct species.

Other forms in our Tertiary belonging to the true Solens are *Solena diegoensis* Gabb (Pal. Cal., i., p. 213, pl. 32, fig. 280, 1866; ii., p. 176, 1868) and a species reported by Conrad from Ocoya Creek (H. Ex. Doc. 129, p. 8, 1855). *Hypogella cuneata* Gabb (Pal. Cal., ii., p. 175, pl. 29, fig. 61, 1868) from the Eocene of Martinez, California, may prove to be a *Modiolus* or allied form; and his figure of *H. parallela* (*op. cit.*, ii., p. 233, 1869) looks more like a *Solecurtus*. It may be Cretaceous and not Eocene, as he supposed. A fragment figured by Harris (Bull. Pal., ii., p. 258, pl. 13, fig. 9, 1897) may belong to *S. lisbonensis* Aldrich. *Solen obliquus* Sowerby, 1844, of the Parisian Eocene, is a typical *Plectosolen*, but appears to be distinct from the *Solen* (*Solena*) *obliquus* Spengler, 1794, and should receive a new name.

Genus **ENSIS** Schumacher.

Solen (sp.) Linné, Syst. Nat., ed. x., p. 672, 1758.

Ensis Schumacher, Essai, p. 143, 1817. Type *E. magnus* Schum., pl. xiv., fig. 4 (Chemn. Conch. Cab., vi., p. 44, pl. 4, fig. 29, 1782).

Ensatella Swainson, Treatise Mal., p. 365, 1840. Type *Solen ensis* L.; Verrill, Inv. An. Vineyard Sound, p. 674, 1873.

Ensis Gray, P. Z. S., 1847, p. 189; List Brit. An., vii., p. 58, 1851; Ann. Mag. N. Hist., xiv., p. 24, 1854; Conrad, Cat. *Solenidæ*, Am. Journ. Conch., iii., p. 26 (Suppl.), 1867; Fischer, Man. Conch., p. 1110, 1887.

Solen Leach, Synops. Brit. Moll., p. 260, 1852.

This genus is well defined by its hinge, perfectly distinct from that of *Solen*. The name is masculine. Each north and south coast appears to have a large northern form (*E. magnus*, Europe, *E. directus*, eastern America) and a smaller similar southern form (*E. ensis*, Europe, and *E. minor*, southern American coast). *E. magnus* Schum. differs from our American form by being straighter and more slender; on the Pacific coast the large northern form is wanting and the small southern one represented by *E. californicus* Dall. A somewhat similar parallelism is found in the species of *Siliqua*.

Ensis directus Conrad.

Solen ensis Conrad, Bull. Nat. Inst., ii., p. 191, 1842; not of Linné.

Solen directus Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 325, 1843.

Solen magnodentatus H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 236, pl. 34, fig. 8, 1845.

? *Ensis* "*americana* Beck," H. and A. Adams, Gen. Rec. Moll., ii., p. 342, 1856.

Solen ensis Tuomey and Holmes, Pleioc. Fos. S. Car., p. 101, pl. 24, fig. 3, 1856; not of Linné.

Solen americanus Gould, Inv. Mass., 2d ed., p. 42, 1870.

Ensatella americana Verrill, Inv. An. Vineyard Sound, p. 674, pl. 32, fig. 245, 1873; Am. Journ. Sci., iii., pp. 212, 284, 1872.

Ensis americana Dall, Bull. 37, U. S. Nat. Mus., p. 72, pl. 53, fig. 4, pl. 55, figs. 4, 5, 1889.

Oligocene of the Oak Grove sands, Santa Rosa County, Florida. Miocene of Maryland (Conrad); of Virginia at Petersburg; of North Carolina at the Duplin County Natural Well; of Darlington, South Carolina; of Florida in the upper bed at Alum Bluff; Pliocene of South Carolina; Pleistocene of Heislerville, New Jersey; Cornfield Harbor, Maryland; Nantucket at Sankoty Head and Point Shirley, Massachusetts, and Portland, Maine; recent from Labrador to Indian Key, Florida.

I began the examination of the fossil material supposing that the Miocene form might be distinct from the recent shell, but after a series of careful comparisons I am unable to find any constant character by which they can be discriminated. From *E. ensiformis* the present species is distinguished by its larger size and more squarely truncated posterior end.

Ensis minor Dall.

Pleistocene of Simmons Bluff, South Carolina, Burns; recent from Cape May to Florida and Texas.

This form is the "small variety" of "*Solen ensis*" described by Conrad as long ago as 1831, and referred to by some authors as var. *minor*. It is constantly smaller and more slender than *E. directus*, and has a tendency to be wider at the posterior than at the anterior end. It is proportionately longer than *E. ensiformis*, and is wider instead of attenuated and rounded behind. It bears to the large *E. directus* the same relation that the true *E. ensis* of Europe bears to the north European *E. magnus* Schum.

Ensis ensiformis Conrad.

Solen ensiformis Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 326, 1843; Fos. Medial Tert., p. 76, pl. 43, fig. 8, 1845.

Miocene of Maryland at St. Mary's River (type locality), Choptank River, and Cove Point; of Virginia on the York and Nansemond Rivers; the Natural Well and Magnolia, Duplin County, North Carolina; of Florida in the rock excavated from the city reservoir at Jacksonville. Distinguished by its straight, rather short, and posteriorly tapered and rounded form.

Genus **SILIQUA** Megerle.

Siliqua Megerle, Mag. d. ges. Naturf. Fr., 1811, p. 44. Type *Solen radiatus* Linné; Philippi, Handb. Conch., p. 331, 1853; H. and A. Adams, Gen. Rec. Moll., ii., p. 345, 1856; Fischer, Man. de Conchyl., p. 1109, 1887.

Aulus Oken, Allgem. Naturg., v., i., pp. iv., 297, 1835; sole ex. *Solen radiatus* Linné; not of Oken, Lehrb., p. 225, 1815.

Aulus Agassiz, Moules d'Aceph. Viv., p. 42, 1839, Oken, 1835. Type *Solen radiatus* Linné; not of Oken, 1815, type *S. diphos* L.

Leguminaria Schumacher, Essai, p. 126, 1817. Type *S. radiatus* Linné (L. *costata* Schum., pl. 7, fig. 1).

Solecurtus A, Blainville, Man. Mal., p. 568, 1825. Type *S. radiatus* Linné.

Solecurtoides Desmoulins, Actes Soc. Lin. de Bordeaux, v., p. 108, 1832. Type *S. radiatus* Linné.

Machæra Gould, Inv. Mass., p. 32, 1841. Type *Solen costatus* Say; not *Machæra* Cuvier, 1832.

Solenocurtus Sowerby, Man., p. 99, 1839; ed. ii., p. 262, 1842.

This genus is chiefly American and Oriental in its distribution. Megerle's name antedates all others. *Aulus* Oken, as originally proposed without a diagnosis, contained two species, both belonging to the older genus *Sanguinolaria* Lamarck. Subsequently Oken tried to transfer the name to *Siliqua radiata* and its congeners, which, of course, is inadmissible.

This genus was fully differentiated before the beginning of the Tertiary, and a thorough examination of the Eocene faunas will doubtless reveal several species, but hitherto the material collected has been sparse and fragmentary. One species, *S. Simondsi* Harris (Proc. Acad. Nat. Sci., 1895, p. 51, pl. 3, fig. 2), has been described from the Claibornian of Texas, another from the Oligocene of St. Domingo.

Siliqua subequalis Gabb.

Siliqua subequalis Gabb, Geol. St. Dom., p. 247, 1873.

Oligocene of St. Domingo, Gabb; and of the Chipola beds of Calhoun County, Florida, at Alum Bluff and on the Chipola River (?); Burns.

This species is smaller than *S. costata* and has centrally situated beaks. The specimens from Florida are fragmentary, but the beaks were evidently nearly central, and until better material is at hand I prefer to refer it to Gabb's species, which came from nearly the same horizon.

Siliqua Nuttallii Conrad.

Solecurtus Nuttallii Conrad, Journ. Acad. Nat. Sci. Phila., 1st Ser., vii., p. 232, pl. 17, fig. 9, 1838.

Siliqua californica Conrad, Am. Journ. Conch., iii., p. 193, 1867.

Siliqua patula auct. *ex parte.*

Machæra patula Gabb, Pal. Cal., ii., p. 89, 1869, in part, synonymy excluded.

Miocene of Santa Clara County, California; Pliocene, Santa Rosa County; Pleistocene of San Diego, California; recent from Lituya Bay, Alaska, to Monterey, California.

The nomenclature of this form has been much confused. Mr. Gabb wrongly united with it *S. lucida* Conrad, which is a distinct and good species; *Solemya ventricosa* Conrad, which is a fine, large Miocene species of *Solemya*; and *Solen patulus* Dixon, which is a much larger, coarser form, with a broader shell and straight clavicle, and is not authoritatively known from south of Alaska. The present species is longer, more slender, with a more oblique clavicle and more parallel dorsal and ventral margins. If it is merely a geographical race of *patula* it deserves a name on account of the differences of form.

Siliqua (**patula** Dixon var?) **oregonia** Dall.

Miocene of Astoria (?) and of Two-Mile Creek, near Coos Bay, Oregon (Diller).

A somewhat imperfect specimen from the Miocene shales collected by Mr. Diller; differs from *S. Nuttallii* by its strong and straight clavicle, its proportionately wider shell, and its somewhat rostrate posterior extremity. It appears to be adult, and if so is much smaller than *S. patula*, which also has a more rounded posterior end. I await better material before figuring this interesting form, which is probably the same as that referred to by Gabb as *S. patula* from the Astoria Miocene. The shell measures about 65 mm. long and 25 wide. The pallial sinus appears to be decidedly deeper and narrower than in *S. Nuttallii*.

Siliquaria edentula Gabb, from the Pliocene of California, is a *Psammobia* and will be found referred to under that genus.

The very young shells of *Siliqua* are donaciform and hardly recognizable as belonging to the same group as the adults.

Genus **CULTELLUS** Schumacher.

Cultellus Schumacher, Essai, p. 130, 1817. Type *Solen lacteus* Spengler, pl. 7, fig. 4 (Chemn. Conch. Cab., vi., p. 51, pl. 5, fig. 35) = *Solen maximus* Gmelin non Wood (cf. Dunker, Novit. Conch. Moll. Marina, p. 11, pl. iii., fig. 4, 1858) but not *Cultellus lacteus* and *maximus* of Sowerby, Conch. Icon., *Cultellus*, pl. 1, 1874.

Not *Cultellus* Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 232, 1838 (= *Tagelus* Gray); nor of G. B. Sowerby, Conch. Man., ed. ii., p. 129, 1842 (= *Lutraria* sp.).

Cultellus Gray, Ann. Mag. N. Hist., xiv., p. 24, 1854; *C. lacteus* Spgl., 1794, = *Solen magnus* Wood, Gen. Conch., p. 130, 1815, not *Ensis magnus* Schumacher, 1817.

Cultellus H. and A. Adams, Gen. Rec. Moll., ii., p. 344, 1856; Fischer, Man. de Conchyl., p. 1109, 1887.

Phaxas Leach, Synops. Moll. Gt. Brit., p. 262, 1852. Sole ex. *Solen pellucidus* Donovan.

Ensiculus Adams, P. Z. S., 1860, p. 369. Type *Solen cultellus* L.

In this group there is an ill-defined ridge which strengthens the shell in front of the narrow and elongate anterior adductor scar. In some of the more curved and rounded species (*Ensiculus*) this ridge is more curved downward, while in the typical species it is straight. In the absence of weightier characters this feature can hardly be held of even sectional value. The group is represented in the Parisian Eocene, and there is a single American species of the section *Ensiculus*.

Cultellus (**Ensiculus**) **Conradi** Cossmann.

Ensiculus Conradi Cossmann, Notes Compl., p. 5, pl. 1, fig. 1, 1894.

Eocene of the Claiborne sands at Claiborne, Alabama.

Specimens of this small species have been obtained by Burns and Johnson, but mostly in a fragmentary condition. It is easily recognized by the curved ridge in front of the adductor scar.

Genus **Solecurtus** (Blainville).

$<$ *Solecurtus* Blainville, Dict. Sci. Nat., xxxii., p. 351, 1824; Man. de Mal., p. 568, 1825.

$=$ *Solecurtus* C, Blainville, Man. de Mal., p. 568, 1825. Type *Solen legumen* L., pl. 80, fig. 1.

Solenocurtus Brown, Rec. Conch. Gt. Brit., ed. ii., p. 113, 1844; not of Sowerby, 1839.

Pharus (Leach MS.) Brown, *op. cit.*, p. 113, in synonymy, 1844; Gray, P. Z. S., 1847, p. 189; Fischer, Man. de Conchyl., p. 1108, 1887.

Artusius Leach, Synops. Moll. Gt. Brit., p. 263, 1852. Sole ex. *Solen legumen* L.

Polia Orbigny, Pal. Franc. Terr. Cret., iii., p. 390, 1843; Hoernes, Foss. Moll. Wiener beck., ii., p. 16, 1870; not of Ochsenhausen, 1816.

Ceratisolen Forbes and Hanley, Hist. Brit. Moll., i., p. 255, 1848. Type *S. legumen* L.

Solecurtoides (sp.) Desmoulins, Actes Soc. Lin. de Bordeaux, v., p. 102, 1832.

Pharella Gray, Ann. Mag. Nat. Hist., xiv., p. 24, 1854. Type *Solen javanicus* Lamarck.

Blainville described his genus *Solecurtus* as consisting of three lettered sections (not otherwise named by him), a single example being cited under each. Section A had already been named *Siliqua* by Megerle von Muhlfeld; Section B was separated as *Psammosolen* by Risso the following year, leaving to bear the original name of Blainville only Section C, typified by *Solen legumen.* The subsequently proposed names above enumerated must therefore fall into synonymy. A slight difference in the hinge-teeth enables us to retain

Pharella (*javanica*) Gray with one or two other tropical species as a section under *Solecurtus*. The original Greek as shown by Herrmannsen would have been more appropriately Latinized as *Cyrtosolen*, which, however, comes too late, while the efforts of several emendators, who assumed a non-existent Græco-Latin compound in *Solecurtus*, have resulted in several unnecessary synonyms.

Solen parallelus Gabb (Pal. Cal., i., p. 146, pl. 22, fig. 117, 1864; *Plectosolen parallelus* Conrad, S. I. Eocene Checkl., p. 9, 1866) has the aspect of a *Solecurtus*, but I know it only from the figure. It is said to be from the Tejon Eocene of California by Gabb, but Dr. Boyle in his bibliography of American mesozoic fossils states that it is really Cretaceous.

Pharella alta Gabb (*op. cit.*, p. 147, pl. 22, fig. 118, 1864) appears to belong to the subgenus or section so named, and there are at least two other species, all of which are now regarded as Cretaceous. Neither *Solecurtus* proper nor *Pharella* have been identified from the American Tertiary. *Solecurtus Blainvillei* Lea (Contr. Geol., p. 39, pl. 1, fig. 7, 1833) is a *Psammobia*, and most of the other species cited under this generic name from our Tertiary belong to *Psammosolen*.

Genus **Psammosolen** Risso.

Psammobia Risso, Hist. Nat. Eur. Mer., iv., p. 375 (not p. 350), 1826 (err. typog.).

Psammosolen Risso, *op. cit.*, v., index, 1826 (corrig.). Type *Solen strigilatus* L.; Philippi, Handb. Conch., p. 331, 1853; Hörnes, Foss. Moll. Wiener beck., ii., p. 18, 1870.

Tellina (sp.) Oken, Lehrb. Naturg. Zoologie, p. 224, 1815.

Macha Oken, Allgem. Naturg., v., 1, p. 298, 1835. Type *Solen strigilatus* L.; Gray, P. Z. S., 1847, p. 189; List Brit. An., Moll., p. 61, 1851; Mörch, Yoldi Cat., ii., p. 8, 1853; H. and A. Adams, Gen. Rec. Moll., ii., p. 346, 1856; Fischer, Man. Conchyl., p. 1107, 1887.

Solecurtus β, Blainville, Dict. Sci. Nat., xxxii., p. 351, 1824; Man. Malac., p. 568, 1825.

Solecurtus Des Moulins, Actes Soc. Lin. de Bord., v., p. 100, 1832; Deshayes, in Lam., An. s. Vert., ed. ii., vi., p. 61, 1835; Traité élém., p. 113, 1840; An. s. Vert. bass. Paris, i., 158; not of Blainville, 1824.

< *Solenocurtus* Fischer, Man. de Conchyl., p. 1107, 1887.

< *Solenocurtis* Swainson, Treatise Mal., p. 366, 1840.

< *Cyrtosolen* Herrmannsen, Ind. Gen. Mal., ii., p. 468, 1848; corrig.

Adasius Leach, Syn. Moll. Gt. Brit., p. 266, 1852. Type *Solen strigilatus* Linné.

Not *Macha* Philippi, Handb. Conch., p. 331, 1853.

Not *Psammosolen* Hupé, Gay's Hist. de Chile, viii., p. 365, 1854.

Subgenus AZOR Leach.

Azor Leach (MS.), Brown, Rec. Conch. Gt. Brit., ed. ii., p. 113, 1844. Sole ex. *Solen antiquatus* Pulteney; Gray, P. Z. S., 1847, p. 189; List Brit. An., Moll., p. 62 (not p. 35), 1851; Leach, Synops. Brit. Moll., p. 264, 1852; Mörch, Cat. Yoldi, ii., p. 8, 1853; Fischer, Man. de Conchyl., p. 1107, 1887.

The genus *Psammosolen* was proposed by Risso, but the name by some accident of proof-reading was printed as *Psammobia,* an error corrected in the index of the next volume, printed during the same year. *Macha* Oken is frequently quoted as printed in his Lehrbuch der Zoologie in 1815, but the name does not appear in that work and I have not been able to trace it earlier than 1835. It formed one of the sections of Blainville's *Solecurtus,* and appears under the name of *Adasius* in Gray's edition of Leach's Synopsis. It is a *Solen* with short shell, with subcentral umbones, partially naked soft parts and, in the typical section, a curious oblique or angular surface sculpture superimposed upon the concentric incremental lines and not in harmony with them. In the group typified by *Solen antiquatus,* the shell, otherwise very similar, has only the incremental sculpture. In some of the species of *Psammosolen* the angular sculpture is obsolete, and these could hardly be separated from *Azor* except for certain differences alleged to exist in the soft parts. The name *Azor* was first published by Brown in his synonymy in 1844, in 1847 and 1851 was used by Gray for a species of *Psammobia,* but appeared with its original significance in Gray's edition of Leach's Synopsis in 1852.

Psammosolen vicksburgensis Aldrich.

Solecurtus vicksburgensis Aldrich, Cincinnati Journ. Nat. Hist., July, 1885, p. 145, pl. 2, fig. 1.

Macha vicksburgensis Aldrich, Bull. Ala. Geol. Surv., No. 1, p. 37, pl. 2, fig. 1, 1886.

Oligocene of the Vicksburgian horizon at Vicksburg, Mississippi; of the Chipolan on the Chipola River, Florida, and of the Bowden beds, Jamaica.

The species of this group are variable and all very similar in general appearance. The incised lines vary in strength with the individual, and are sharper and closer together in the young than in the adult. While I cannot be absolutely certain that the specimens from the Chipolan horizon are specifically identical with those from the Vicksburgian, I cannot, in the material before me, find characters by which to separate them. The best preserved specimens from Bowden are nearer the European *P. strigilatus* than to the existing recent American species.

Psammosolen Cumingianus Dunker.

Plate 28, Figure 15.

Macha Cumingiana Dunker, P. Z. S., 1861, p. 425.

Tagelus lineatus Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 370, pl. 47, fig. 71, 1881.

Macha multilineata Dall, Trans. Wagner Inst., vol. iii., part iv., p. 938, pl. 28, fig. 15, 1898 (p. 923, *Mactra m.* by typographical error).

Pliocene clays of Costa Rica, near Port Limon, Gabb; Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; recent from North Carolina to Texas and south to São Paulo, Brazil.

At first I supposed that the extent of the incised markings over the surface of the shell was a constant character and, as the material then in hand was very different in this respect from Gabb's figures, I named the Caloosahatchie form *multilineatus*. After more thorough study of a larger amount of material I have come to the conclusion that this view is erroneous, and that the differences referred to come within the range of individual variation. The drawing of the anterior adductor scar in Gabb's figure is obviously erroneous. This form is differentiated from *Psammosolen sanctæ-marthæ,* the other east American recent species, by its slenderness and greater relative length and size. Both species range through about the same geographical area, but only the former has yet been found fossil.

Superfamily TELLINACEA.

Family DONACIDÆ.

This group is very compact and simple in its characters, though requiring more close examination than has usually been given to it. I have not, so far, found in any of the manuals a description of the shell characters, and especially the hinge, which is accurate and complete.

In the genus *Donax* the hinge comprises an external ligament, short, convex, usually amphidetic, set in a deep groove which is often bordered by a rib externally. Below this is a small opisthodetic resilium, seated on a pair of small, short, usually excavated nymphs. The adult teeth comprise normally two cardinals, very discrepant in size in each valve; the major cardinal is frequently bifid, but may be bifid or simple in different individuals of the same species; there are two laterals normally on the left valve, which are received by sockets in the valve opposite; but the laterals are not always both in one valve, and in some of the peripheral forms of the family one or both of the laterals may be obsolete or practically absent. The anterior right dorsal margin is often distinctly grooved in front of the laterals, to receive the edge of the opposite valve. The posterior end of the shell is shorter than the anterior; there is no distinct lunule; the limits of the posterior truncation are often sharply angular and carinate, the sculpture of this part of the shell is generally more emphatic than that of the anterior region. There is sometimes a well-defined escutcheon, limited by a rib or ridge. In such cases the sculpture on the escutcheon differs more or less from that outside of it, and the limiting rib may appear on the distal margin as a prominent tooth or projection. The ventral and distal shell margins are usually sharply fluted; even those species which are said to have entire margins will show under magnification, in well-developed specimens, a fine serration on at least part of the edge. The nepionic shell of *Donax* exhibits a provinculum and three primary cardinal lamellæ in each valve, of which one eventually is smothered by the growth of the resiliar nymphs, except in *Machærodonax*. It is doubtful whether those forms like *D. ovalinus* Lamarck, which have been referred to *Heterodonax,* are congeneric with *H. bimaculatus,* the type of that genus. They have much more resemblance to the section *Latona,* but doubtless the question can be decided only by a comparison of the anatomical features.

The group may be arranged as follows:

Genus *Iphigenia* Schumacher, 1817 (*Donacina* Fér., 1821, and *Procos* Gistel, 1848). Type *Donax lævigata* Ch.

Shell large, subtriangular, subequilateral, without radial sculpture; thick, with entire ventral margins; two cardinals, the larger bifid, in each valve and two obsolete laterals in the right valve.

Genus *Egerella* Stoliczka, 1870 (*Egeria* Lea, 1833, not Roissy, 1806). Type *E. subtrigonia* Lea. Eocene.

Shell small, of variable form, with faint radial sculpture, thin, with serrate ventral margins; cardinals as in *Iphigenia,* but the laterals absent.

Genus *Donax* (L.) Lamarck, 1799. Type *D. trunculus* L.

Section *Donax* s. s.

Shell elongate, smooth, with no posterior carination; ventral margins with obsolete serration; cardinal teeth two in each valve, the larger often bifid; laterals both in the left valve, the anterior hardly distinguishable from the margin, of which it is a sort of modification.

Section *Chion* Scopoli, 1777. Type *D. denticulata* L.

Shell more solid and triangular, sharply truncated, the truncation sculptured; the ventral margins sharply fluted. Teeth as in *Donax* s. s., but the laterals distinct; the shell radially sculptured with the grooves punctate.

Section *Hecuba* Schumacher, 1817. Type *D. scortum* L.

Shell large, conspicuously carinate behind, with marked longitudinal sculpture in front of the carina. Teeth as in *Donax* s. s., with a sharp groove on the right dorsal margin in front of the socket for the anterior lateral.

Section *Machærodonax* Römer, 1870. Type *D. scalpellum* Gray.

Shell brilliantly polished, thin, smooth, elongated; with a sharp carina behind but no marked truncation; ventral margins serrate. Teeth as in *Donax* s. s., but a feeble posterior right cardinal present in addition to the usual two; the anterior right dorsal margin grooved for the edge of the opposite valve.

Section *Platydonax* Dall. Type *D. Finchii* Sby.

Shell like *Machærodonax* but compressed, with the carina obsolete; marginal serration feeble; cardinals as in *Donax* s. s. but laterals absent.

Section *Grammatodonax* Dall. Type *Donax madagascariensis* Lam.

Shell short, triangular, compressed; the surface of the valves deeply obliquely furrowed; the margins finely serrate; the right valve with a single bifid cardinal; the left with two simple cardinals, an anterior and a posterior lateral.

Section *Latona* Schumacher, 1817. Type *D. cuneata* L.

Shell compressed, rounded triangular, solid, the valves subequilateral, concentric sculpture more conspicuous and frequently rugose behind; there is no distinct truncation or posterior carination; right valve with a deep socket, its ventral edge conspicuous, for the posterior lateral of the opposite valve; a stout bifid and an obsolete anterior cardinal, and a feeble anterior lateral; left valve with a posterior lateral and two small simple cardinals; the ventral margins feebly radially striated. This section is intermediate between the true Donaces and *Heterodonax* in the characters of its shell.

Genus *Hemidonax* Mörch, 1870. Type *Cardium donaciforme* Spengler (+ *Donax pictus* Tryon).

Shell resembling *Chion,* but the laterals elongated and the pallial line unsinuated.

Donacicardium Vest, 1875, is synonymous.

Genus **EGERELLA** Stoliczka.

Egerella Stoliczka, Cret. Pel. India, p. 133, 1870. Type *Egeria subtrigonia* Lea.
Egeria (pars) Lea, Contr. Geol., p. 49, 1833; not of Roissy, 1806.

Lea named no type, and his genus included species of *Diplodonta, Angulus* or *Mœra,* and *Abra,* as well as Donaces of the type of *E. subtrigonia,* for which Stoliczka proposed the name *Egerella.*

Egerella subtrigonia (Lea).

Egeria subtrigonia Lea, Contr. Geol., p. 53, pl. 1, fig. 22, 1833.
Egeria veneriformis Lea, *op. cit.,* p. 53, pl. 1, fig. 23, 1833.
Egeria donacea Conrad, Am. Journ. Conch., i., p. 146, pl. 11, fig. 12, 1865.

Eocene of the Claiborne sands, at Claiborne, Alabama.

This is an extremely common fossil at Claiborne, of variable outline but always tolerably plump.

Egerella triangulata (Lea).

Egeria triangulata Lea, Contr. Geol., p. 51, pl. 1, fig. 20, 1833.
Egeria Bucklandii Lea, *op. cit.,* p. 52, pl. 1, fig. 21, 1833.
Donax limatula Conrad, Fos. Tert. Form., p. 42, 1833; *fide* Conrad in Morton, App., p. 7, 1834.

Eocene of the Claiborne sands, at Claiborne, Alabama.

I have retained Lea's name for this species because Conrad's brief diagnosis without a figure does not contain data sufficient for discriminating the species from any of the others, and we know that his subsequent identifications in Morton's appendix are frequently only plausible guesses. On the other hand, there can be no doubt as to the shell which Lea described and figured in a perfectly satisfactory manner.

This species is comparatively rare, but the young of the same size as *E. subtrigonia* are much more compressed and triangular than the latter. *E. Bucklandii* Lea is merely one of the individual mutations of a rather variable species. *E. fragilis* Conrad (in Mort. App.) is a nude list-name and was perhaps based on the young of this species. It has never been described.

Genus **DONAX** (Linné).

< *Donax* Linné, Syst. Nat., ed. x., p. 686, 1758; Bruguière, Enc. Méth., i., p. xiv., pl. 260, 1797.
< *Cuneus* Da Costa, Brit. Conch., p. 202, 1778.
> *Donax* Scopoli, Intr. ad Hist. Nat., p. 398, 1777.

> *Chion* Scopoli, *op. cit.*, p. 398, 1777. Type *Donax denticulata* L.

Donax Bolten, Mus. Bolt., p. 173, 1798; ed. ii., p. 128, 1819.

Donax Lamarck, Prodrome, p. 85, 1799. Type *D. trunculus* L.

> *Capisteria* Meuschen, Mus. Gevers., p. 462, 1787.

Donax Megerle, Entw. Neuen Syst., pp. 49, 50, 1811.

> *Donax* Schumacher, Essai, p. 144, 1817. Type *D. rugosa* L.

> *Hecuba* Schumacher, Essai, p. 157, 1817. Type *D. scortum* L.

> *Latona* Schumacher, Essai, p. 156, 1817. Type *D. cuneata* L.

> *Serrula* Mörch, Cat. Yoldi, ii., p. 18, 1853. Type *D. trunculus* (L.) Hanley.

> *Cuneus* Gray, List Brit. An., Moll., p. 46, 1851. Type *C. vittatus* Da Costa.

> *Capsella* Gray, *op. cit.*, p. 47, 1851. Type *Donax politus* F. and H. = *Tellina violacea* Meuschen.

> *Capisteria* Gray, P. Z. S., 1847, p. 187; after Meuschen.

> *Machærodonax* Roemer, Conchyl. Cab., x., p. 77, 1870. Type *D. scalpellum* Gray; Zool. Rec., 1870, p. 172.

> *Liodonax* Fischer, Man. de Conchyl., p. 1102, 1887.

> *Peronæoderma* Mörch, Cat. Yoldi., ii., p. 12, 1853 (*T. polita Poli*).

Though so simple and compact a genus, an unusual number of names have been applied to different members of it, and the disentanglement of the synonymy is not without difficulty.

The original *Donax* of Linné was heterogeneous, containing a *Sunetta* and a *Venerupis* among the six identifiable species. Da Costa's *Cuneus* was a similar assembly, a substitution for rather than a dismemberment of the Linnean group, and may be regarded as a strict synonym of *Donax* L. Scopoli was the first to divide the genus, but unfortunately named no type for his restricted *Donax*. Bolten's *Donax* was purged of extraneous forms. Lamarck was the first to name a type, *D. trunculus,* in 1799, and in his selection he followed the Linnean rule of taking the "commonest, best known, or officinal species."

The name *Serrula,* applied by Chemnitz to *D. rugosa* and *D. trunculus,* was not used in a generic sense, but was merely a translation of the vernacular name of "Saw-shell" applied by some collectors to these species on account of their serrate margin. Megerle, in 1811, followed Bolten, but named no type. Duméril (Zool. Anal., p. 335, 1806) changed *Donax* into *Donaciarius* in pursuance of his fad for terminations in *us;* but Schumacher was the first, after Scopoli, to attempt a subdivision of the true Donaces, which was, unfortunately, chiefly based on trivial or misinterpreted characters. Fischer in 1887 violated the rules of nomenclature by proposing to include a number of groups already named under a wholly new designation. I have not been able to get any data or specimens to elucidate the standing of the brackish-water fossil, *Oncophora,* said by Tryon to be allied to *Donax,* nor of the Jurassic genus *Delia* De Loriol, 1891 (not of Robineau Desvoidy, 1830), which is said to belong to this family.

Donax funerata Conrad.

Donax funerata Conrad, Proc. Acad. Nat. Sci. Phila., iii., p. 292, 1848; Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 123, pl. 13, fig. 9, 1848; S. I. Eoc. Checkl., p. 28, 1866.
Egeria funerata Conrad, Am. Journ. Conch., i., p. 5, 1865.

Four miles northwest of Vicksburg, Mississippi, Conrad; in the Vicksburgian Oligocene at Vicksburg, C. W. Johnson.

This is the earliest true *Donax* yet identified from our Tertiaries.

Donax æqualis Gabb.

Donax æqualis Gabb, Geol. St. Dom., p. 249, 1873.

Later Tertiary of Santo Domingo, Gabb; Bowden beds Oligocene at Bowden, Jamaica, Henderson and Simpson.

Small, faintly striated, and nearly equilaterally triangular, and moderately convex.

Donax chipolana n. sp.

PLATE 44, FIGURE 20.

Oligocene of the Chipola River, Calhoun County, Florida; Burns.

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. Lon. 9.5, alt. 5.5, diam. 3 mm.

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. With it was another valve of smaller size which may represent a distinct species or an extreme variation 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.*

Doubtless a more thorough search of the Oligocene beds would reveal additional species of this family.

Donax Emmonsi Dall.

PLATE 28, FIGURE 16.

Donax Emmonsi Dall, Nautilus, v., No. 11, p. 126, March, 1892; Emmons, Geol. N. Car., p. 298, fig. 227, 1858; Dall, Trans. Wagner Inst., iii., p. 923, pl. 28, fig. 16, 1898.

Miocene of North Carolina, in Duplin County, at the Natural Well and Magnolia, Burns; Pliocene of the Cape Fear River, at Mrs. Guion's marl bed, C. W. Johnson.

This species is more triangular than any of the recent forms of the coast, faintly radially striate, ventrally somewhat flexuous, and with a sharply serrate margin. The teeth are normal and strong, especially the sockets for the laterals. Lon. 10, alt. 7, diam. 4 mm.

Donax fossor Say.

Donax fossor Say, Journ. Acad. Nat. Sci. Phila., ii., p. 306, 1822; Tryon, Am. Mar. Conch., p. 153, pl. 27, figs. 376, 377, 1873.

Donax variabilis Tuomey and Holmes, Pleioc. Fos. S. Car., p. 95, pl. 23, fig. 6, 1857; not of Say.

Donax angustatus Sowerby, Thes. Conch., iii., p. 309, pl. 281, fig. 44, 1866.

Donax protractus Conrad, Journ. Acad. Nat. Sci. Phila., 2d Ser., 1, p. 208, pl. 39, fig. 8, 1849 (senile stage).

Donax parvula Phil., Zeitschr. Mal., p. 146, 1845 (young shell).

Miocene of Duplin County, North Carolina, at Magnolia, Burns; Pliocene of the Waccamaw beds, South Carolina; of the Cape Fear River, North Carolina; and of the Caloosahatchie beds of Florida; Pleistocene of Simmons Bluff, South Carolina, Burns; recent, from New Jersey to the Florida Keys.

Although *Donax variabilis* Say has several times been reported from the Miocene and Pliocene, the specimens when critically studied have so far turned out to be *D. fossor*.

Other Miocene forms are *D. idonea* Conrad (Proc. Acad. Nat. Sci. Phila., xxiv., p. 216, pl. 7, fig. 2, 1872), a large form supposed to have been washed out of submarine Miocene beds on the coast of North Carolina; *Donax tumida* Philippi (Zeitschr. Mal., p. 147, 1848), a recent Texan species, identified by Harris from the fossils of the Galveston artesian well, supposed to be Upper Miocene; and *D.* (*Machærodonax*) *galvestonensis* Harris, from the same source, described by Harris (Bull. Pal., ii., p. 92, 1895) as a variety of the Pacific coast recent *D.* (*Machærodonax*) *carinata* Hanley.

Donax æquilibrata Dall.

PLATE 28, FIGURE 17.

Donax æquilibrata Dall, Nautilus, v., No. 11, p. 126, 1892; Trans. Wagner Inst., iii., p. 923, pl. 28, fig. 17, 1898.

Pliocene of the Cape Fear River, North Carolina, at Mrs. Guion's marl bed; C. W. Johnson.

This species is not unlike *D. fabagelloides* Guppy (Proc. Sci. Assoc. Trinidad, Dec., 1867, pp. 62, 173), from the Pliocene of Matura, Trinidad, West Indies, but is more angular and attenuated behind.

Donax striata Linné.

Donax striata Linné, Syst. Nat., ed. xii., p. 1127, 1767; Guppy, Proc. Sci. Assoc. Trinidad, Dec., 1867, p. 162.

Donax flexuosus Gould, Bost. Journ. Nat. Hist., vi., p. 395, pl. xv., fig. 8, 1853; not of Cooper, Cat. Cala. Fos., p. 238, 1888.

Donax Lamarckii Deshayes, Reeve, Conch. Icon., viii., pl. 5, fig. 37, 1855.

Pliocene of Matura, Trinidad; Guppy.

It has long been a source of surprise that the *Donax flexuosa* described from specimens collected at Santa Barbara, California, by Colonel E. Jewett, has never turned up since, as the species of this genus are known to be very abundant when occurring at all. On a recent review of the recent Donaces in the collection of the National Museum a comparison of one of Jewett's specimens with specimens of *Donax striata* from the Antilles shows that the two are identical. Several of Colonel Jewett's species are known to have been confused as to locality, and there can be little doubt that this is another instance where shells from some West Indian locality were mixed with Pacific coast shells by some accident and described with an erroneous habitat. The shell referred to by Cooper under the name of *flexuosus,* from the Pliocene of San Diego, California, is the original *D. californica* of Conrad.

Donax californica Conrad.

Donax californica Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 254, pl. 19, fig. 21, 1838; not of Carpenter and the majority of Californian authors, nor of Deshayes.

Donax navicula Hanley, P. Z. S., 1845, p. 15; Reeve, Conch. Icon., viii., pl. 4, fig. 18, 1855.

Pliocene of the San Diego, California, Well; Pleistocene of San Pedro Hill and San Diego, Stearns and Dall; recent from San Pedro, California, south to Panama.

This species grows slightly larger and has more tendency to radiating coloration in tropical waters, but cannot be subdivided naturally. It is this shell which is usually referred to by Cooper and others when they cite *D. flexuosa* Gld. from various Californian horizons.

The only other unmentioned Pliocene species is *D. moenensis* Gabb (Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 371, pl. 47, fig. 72, 1881) from the Pliocene of Costa Rica near Port Limon. It is a small shell and may prove immature.

D. californica Deshayes was founded on pale specimens of *D. culter* Hanley, and has not yet been reported in the fossil state.

Donax lævigata Deshayes.

Donax lævigata Deshayes, P. Z. S., 1854, p. 352; Reeve, Conch. Icon., viii., pl. 5, fig. 31.

Donax obesus Gould, Proc. B. Soc. N. Hist., iv., p. 90, Nov., 1851; Boston Journ. Nat. Hist., vi., p. 395, pl. 15, fig. 9, Oct., 1853; Philippi, Zeitschr. Mal., 1851, p. 75; not of D'Orbigny, 1843.

Donax californica of several Californian authors (not of Conrad or Deshayes) and of Carpenter, Maz. Cat., p. 47, 1857.

Pleistocene of San Pedro Hill and of San Diego, California, Stearns and Dall; recent, from Santa Barbara southward.

This is the common species of California, used for food, and the west coast analogue in the fauna of the east coast *D. variabilis.* It varies, like all the other species, in outline, but in general has very uniform characters. Remarkably fine specimens of it are abundant in the Pleistocene of San Pedro Hill.

Donax variabilis Say.

Donax variabilis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 305, 1822; Tryon, Am. Mar. Conch., p. 154, pl. 27, figs. 378-9, 1873; not of Tuomey and Holmes, 1857.

Pleistocene of Florida in many localities; recent from Cape Hatteras, North Carolina, to St. Thomas, West Indies.

This, the most abundant species of the eastern coast, has not turned up in any beds older than the Pleistocene, and of those, so far, only in Florida. Associated with the recent shells from South Carolina to Texas and usually confounded with *variabilis* is a form nearly intermediate between the latter and the Texan *D. Rœmeri* Phil., but this has not yet been found fossil.

In California the southern *D. culter* Hanley (1845, + *D. californica* Desh. *non* Conr., + *D. Conradi* Desh., 1854; + *D. contusus* Reeve) reaches to San Diego, but this also is not yet known as a fossil.

Family PSAMMOBIIDÆ.

The species belonging to this group were referred to *Tellina, Solen,* etc., by the earlier writers. A smooth, rather inflated species (referred by Hanley to *Psammotæa serotina* Lam.) was described by Rumphius in 1704 under the name of *Tellina gari.* The specific name here is the genitive case of a Latin noun of the second declension, *Garum,* meaning a sauce or pickle made of shell-fish. As the Amboyna species was used in a similar way (the recipe for the method is given by Rumphius) he very appropriately used the classical word, properly inflected, for his *nomen triviale.* The name was accepted without change by Linnæus in 1758, and the species placed in his genus *Tellina.* Linnæus, as was his habit when he did not possess a type of one of his species, referred to several figures in illustration of *Tellina gari,* and, as frequently happened, these figures did not both represent the same species. That of Rumphius must obviously be taken as typical, while another, in a plate of Argenville (pl. 26, fig. 1), also represents a smooth species, but is hardly identifiable. Later, in the Museum Ulricæ, in 1762, Linnæus described a common north European shell, *Ps. feroënsis* * of authors, under the name of *Tellina gari,* though he had a year previously named the former *Tellina incarnata;* notwithstanding it was not his *Tellina incarnata* of 1758, named in the *Systema Naturæ.*

In 1817 Schumacher subdivided the Linnæan Tellinas and erected, upon the *Tellina gari* (Linné, 1762; not of 1758, or of Rumphius) and another shell, the *Tellina papyracea* of Spengler, 1798, a genus which he called *Gari,* apparently not recognizing the Latinity of this word and without correcting the inflection. As he figures for his "Section α" of this new genus the *Ps. feroënsis,* it must be taken as his type. The other species is the *Tellina planata* (L.) of authors, figured by Lister. The name *gari* in this form is plainly inadmissible for a generic name. Before any one corrected the erroneous inflection, Lamarck proposed the name *Psammobia* for a mixed group, including species related to the original *Tellina gari* (but not including *gari* itself) and others now referred to *Macoma,* but without indicating a type. For the true *gari* (under the names of *violacea* and *serotina*) and others he proposed the genus *Psammotæa* at the same time. In 1822 Bowdich, a pupil of Lamarck, published his "Elements of Conchology," in which the genus *Psammobia* is illustrated by a figure of *P. feroënsis,* which may be regarded as fixing the type.

* Misprinted *fervensis* in Gmelin, and sometimes so quoted by authors. It is *feroënsis,* from the Færoe Islands, not from Ferro Island.

The difficulty of allotting the synonymy and fixing the names of the subdivisions of this family is greatly aggravated by the errors and uncertainties of the earlier authors in regard to species, and by the excessive and obscure subdivisions proposed by them, including Lamarck himself. To discuss the whole subject would occupy too much space and time, and therefore I shall content myself with stating the results of a long-continued and laborious investigation of perhaps as confused a lot of nomenclature as exists in the literature of the subject.

Hiatula Modeer, 1793.

The name *Hiatula* is an ancient synonym of *Mya* Linné, indicating the gaping species, and is so cited by Schroeter as early as 1784. It was revived by Modeer for a group containing *Mya arenaria* and *truncata, Saxicava,* and *Sanguinolaria diphos.* He used *Mya* for the group named *Unio* by Retzius some years earlier. *Hiatula* should therefore be regarded as a synonym of the heterogeneous *Mya* of Linné, and the use of the name is barred by its previous synonymic character, as pointed out by Fischer.

Asaphis Modeer, 1793.

This genus is founded upon a single type, the *Venus deflorata* of Linné, and is generally accepted. The synonyms include *Capsa* (sp.) of Bruguière, 1792; *Capsa* Lamarck, 1801, but not of 1799 or 1818; *Corbula* (sp.) Bolten, 1798, not of Bruguière, 1792; *Psammocola* (pars) Blainville, 1824; *Capsula* Schumacher, 1817; *Sanguinolaria* Deshayes, 1835, not of Lamarck, 1799; *Pliorhytis* Conrad, 1863, and probably *Heteroglypta* von Martens, 1880. The last-mentioned will probably form a distinct section by itself, as restricted to its typical species, though its author intended to include all the diversely sculptured Psammobias.

Capsa (Bruguière, 1797) Lamarck, 1799.

Lamarck selected as an example of the genus *Capsa* in 1799 the *Tellina angulata* of Linné. This Mörch identifies (J. de C., vii., p. 134, 1858) with figure 1 of Bruguière's plate 231. But Lamarck does not refer to that plate, his diagnosis is not distinctive, and Hanley identifies the *T. angulata* of Linné, not with the *Gastrana* figured by Bruguière, but with the *Tellina* (*Arcopagia*) *plicata* Valenciennes, of which a specimen still remains in the Linnæan cabinet. Owing to this fact and the extraordinary confusion which has always attended this generic name, it would best be dropped altogether, especially as its original status merely depends on a name at the head of a plate of heterogeneous unnamed bivalves.

Gastrana Schumacher, 1817.

Though not a member of this family, this genus is mentioned here because of the entanglement of its synonymy with the others. The type is *Tellina fragilis* L. The synonyms are *Diodonta* Deshayes, 1846 (not *Diodon* Linné, 1766, nor *Didonta* Schumacher, 1817); *Fragilia* Deshayes, 1848; and *Capsa* Mörch, 1858, not Lamarck, 1799.

Sanguinolaria Lamarck, 1799.

Sole example *S. sanguinolentus* Gmelin, the *S. rosea* of Lamarck and many later authors. This is very closely related to *S. diphos* Gmelin, but they will be kept in separate sections here for clearness in the synonymy. This is exactly *Aulus* Oken, 1815, not *Aulus* Oken, 1821 or 1835, *Lobaria* Schumacher, 1817, not Muller, 1776, and *Isarcha* Gistel, 1848. It is not *Sanguinolaria* Blainville, 1825, nor of Deshayes, 1835.

Soletellina Blainville, 1824.

Sole example figured in Blainville's Manual is *S. diphos* Gmelin, called *radiata* by Blainville. Synonyms: *Aulus* (sp.) Oken, 1815; *Hiatula* (sp.) Modeer, 1793; *Solenotellina* Mörch, 1853. The group will probably only form a section of *Sanguinolaria.* It is not *Soletellina* Cossmann, 1886, whose use of the name seems due to a confusion of species called *radiata* by the early authors.

Asaphinella Cossmann, 1886.

Founded on *Capsa minima* Deshayes. This seems, from the figures, to be but doubtfully established in its relations, and may possibly belong in another family, though some of the species associated with it by Cossmann are minute Psammobias, others he has since (1891) removed to the *Tellinidæ* under the name of *Herouvalia* (*semitexta*).

Psammobia (Lamarck, 1818) Bowdich, 1822.

Type *P. feroënsis* Gmelin, = *T. gari* L., 1762, not of L., 1758; this is not *Psammobia* Cossmann, 1886. Synonyms: *Gari,* pars, Schumacher, 1817; *Haplomochlia* Gistel, 1848.

Psammotœa (Lamarck, 1818) Bowdich, 1822.

Example cited, *P. serotina* Lam.; identified by Hanley (Ips. Lin. Conch.) with *Tellina gari* of Rumphius and Linné in 1758. The type is fixed by Bowdich, as Lamarck selects none. Blainville endeavored in 1824 to bring together a group which he realized was closely related, though previously divided into several genera. To do this, instead of consolidating the unnecessary genera under the prior name of those already given, he made the mistake of giving a wholly new name, *Psammocola,* and arranging the others under it as sections. The name *Psammocola* is therefore inadmissible. He cites under it *P. vespertina* Gmelin (as *vespertinalis*) and an *Asaphis,* but the genus must be regarded as void. Subsequently Deshayes applied the name of *Capsella* (1854, not *Capsella* Gray, 1851; *Capsula* Reeve, on plates, 1857, not *Capsula* Schumacher, 1817) to Lamarck's group, which is almost exactly intermediate between *Gobræus* and *Asaphis.*

Gobræus (Leach) Gray, 1852.

Type *Psammobia vespertina* Lam. Synonyms: *Solen* Megerle, 1811, not Linné, 1758; *Psammobia* Blainville, 1825, not (Lamarck, 1818) Bowdich, 1822; *Sanguinolaria* Blainville, 1825, not Lamarck, 1799; *Azor* Gray, 1851 (Brit. An., p. 51, not p. 62), *?Psammobella* Gray, 1851; *Psammocola* (sp.) Blainville, 1825.

For convenience may be mentioned here also:

Psammotellina Fischer, 1887. Type *Psammotella ambigua* Desh. Synonyms: *Psammotella* Deshayes, 1856, and Reeve, 1857; not of Blainville, 1826 (Hermannsen, 1852). This will form merely a section under *Sanguinolaria.*

Psammotella (Blainville, 1826, as *Psammotelle*) Hermannsen, 1852. Type *Tellina rufescens* Chemn., not *Psammotella* Deshayes in H. and A. Adams, 1856, and Reeve, 1857. *Peronæa* sp. H. and A. Adams, 1856. The correct name of the type is *Tellina operculata* Gmelin; it is also the *Tellina semiplanata* of Spengler. It will form a section of *Sanguinolaria,* having nothing in common, conchologically, with the Tellinas, among which it is usually classed. It is not the *Tellina rufescens* of Hanley from Peru, = *T. Hanleyi* V. Bertin.

Elizia Gray, 1854. Type *E. orbiculata* Wood (sp.). This shell, except in its excessive inequilaterality and free pallial sinus, does not appear to differ much from the orbicular species heretofore referred to *Sanguinolaria* or *Soletellina.*

Amphichæna Philippi, 1847. Sole example *A. Kindermannii* Phil. ?*Amphidona* Mörch, 1858 (*lapsus ?*); not *Amphichæna* H. and A. Adams, 1856. This very remarkable shell should not be associated with such forms as *Psammobella* Gray.

Heterodonax Mörch, 1853. Type *Tellina bimaculata* Linné. Synonyms: *Arcopagia* Orb., 1853, not of (Leach MS.) Brown, 1827; *Liodonax* (pars) Fischer, 1887. The anatomy, shell, coloration, and habit of this form are conclusive as to its relations with *Psammobia* rather than the Donaces.

Genus **PSAMMOBIA** (Lam.) Bowdich.

Psammobia Lam., An. s. Vert., v., p. 511, 1818; Bowdich, Elem. Conch., ii., p. 6, pl. 1, fig. 10, 1822. Type *P. feroënsis* Gmelin.

The fossil species in the Paris Basin Eocene appear to show a transition towards *Tellina* both in general form and in the tendency for the line marking the pallial sinus to be free from the line due to the attachment of the mantle below it. This is true of the species which in general form are nearest to *Psammotæa* as well as those more like the typical *Psammobia*. The specialization of form thus increases with the progress of the group in geological time, as ought, on the theory of evolution, to be the case. A careful scrutiny of a large number of recent species shows that the majority of the typical *Psammobia* have the lower line of the sinus nearly or quite coalescent with the main pallial line; most of the species of *Gobræus* show a little more of the sinus free, anteriorly; some (ex. *P. occidens*) have a considerable part of it free; and in some individuals there is more of it free in one valve than in the other. It appears to be a variable character of very little physiological importance; nevertheless, the generalization holds good that the Eocene species, as a whole, have the sinus less coalescent than the more recent or the living forms. There does not seem to be any marked difference between the recent and fossil American forms in this respect, but it is obvious in the French fossils. Owing to the variations observed, I am able to regard this character as at most of only subordinate value, though taken into account with other differences it may be recognized as sectional or subgeneric. The hinge-teeth in this group are also rather variable, which is probably due to the fact that these animals are more sedentary than their allies the Tellens, and more given to burrowing. All burrowers, if sedentary, tend to degeneration in such features as hinge-teeth. Throughout the groups the normal formula for the teeth is, $\frac{\text{L. } 10101}{\text{R. } 01010}$, but this is almost always reduced until the left valve may have but two and the right one tooth. It sometimes happens also that the angle of the cardinal margin in front of the socket for the left anterior tooth may be perceptibly thickened, or even project as a toothlike mass of considerable prominence. In one species I have noticed a projection of the cardinal margin itself before the hinge on one side which is received by a shallow groove on the edge of the valve opposite and behind the hinge, the same in reversed position, which may be regarded as a reminiscence of the lateral teeth of the original *Tellina* stock. In the very small species the teeth are most reduced, both in size and number. The bifurcation or grooving of the distal end of the chief teeth, though sometimes present, is a rare and uncertain character in the recent species I have examined. The posterior tooth which lies on the anterior end of the nymph is usually very slender or obsolete, and often only slight if any traces of it remain. In the small species the posterior tooth of the right valve is usually entirely absent. The genus *Psammobia* will fall naturally into two subgenera and several sections, as follows:

Subgenus *Psammobia* s. s. Type *S. feroënsis* Gmel.

Shell elongated, more or less pointed behind, compressed, somewhat rudely concentrically sculptured, the posterior dorsal area frequently sculptured diversely from the disk, the pallial sinus elongated and, for the most part, coalescent below with the pallial line.

Section *Garum* Dall (*Gari* Cossmann non Schum.).

Shell telliniform, concentrically grooved, the pallial sinus short, detached from the pallial line for about half its length or more, not deeper than the vertical of the beaks.

As Cossmann has named no type, *Psammobia Dutemplei* Desh. of the Parisian Eocene may be selected.

Section *Psammoica Dall* (*Soletellina* Cossmann, not Blainville).

Shell small, *Angulus*-like, smooth, flattish, and pointed behind; the hinge with two teeth in each valve, the pallial sinus elongated and coalescent below with the pallial line.

This differs from *Psammobella* most obviously in its compressed and more tellinoid form. Type *P. appendiculata* Desh. of the Parisian Eocene.

Section *Psammodonax* Cossmann. Type *P. caillati* Desh.

Shell small, compressed, short, and often angular behind with radial striæ on the posterior dorsal area, the left valve with two teeth, the posterior feeble or obsolete, pallial sinus short, oval, and wholly free from the pallial line.

The striæ are found in many species of different sections; most recent ones show traces of them.

Section *Grammatomya* Dall, 1898. Type *P. squamosa* Lam.

Shell with strong oblique sculpture, not interrupted at the borders of the posterior dorsal area; two teeth in each valve; sinus rounded, short, and more or less detached in front from the pallial line. This is *Gari* Fischer, 1887, not Schum., 1817.

Subgenus *Gobræus* Leach, Moll. Gt. Brit., 1852, p. 265. Type *G. variabilis* Leach = *Solen vespertinus* Gmel.

Shell inflated, more or less truncate behind; concentrically striate or nearly smooth, often with fine radial striæ, especially evident on the posterior dorsal region; teeth variable, not more than three in the right and two in the left valve; sinus rounded in front, rarely shorter than the vertical of the beaks, and often more or less detached from the pallial line.

This group has no circumscription of the dorsal areas, and differs from *Psammobia* most obviously in its blunt and inflated form, with a distinct posterior gape. Chiefly recent.

? Section *Psammobella* Gray, 1851. Type *P. tellinella* Lam.

Shell small, with feeble hinge, the sinus coalescent below.

Section *Psammotæna* Dall. Type *P. effusa* Lam., Parisian Eocene.

Shell resembling *Psammobella,* but with the sinus largely free from the pallial line.

The Psammobias begin in the Cretaceous of America (*P. cancellato-sculpta* Roemer, Texas, and *P. obscura* White, Washington), and so far all known North American species belong to the subgenus *Gobræus,* except two in the Claibornian.

In the Lignitic or Chickasawan stage of the Eocene is found *P. ozarkana* Harris; in the Claibornian *P. Blainvillei* Lea (as *Solecurtus*), *P. eborea* and *P. filosa* Conrad, and on the Pacific *P. Hornii* Gabb (as *Tellina*), of the Tejon, and *P. obscura* White, of the Puget Group. In the Jacksonian appear *P. eborea* Conrad and *P. papyria* Conrad, which seems to extend through the Vicksburgian (which also has *P. lintea* Conrad) to the Chipolan Oligocene. The cold water of the Miocene seems to have excluded the genus on our southeastern coast, but with the warmer temperatures of the Pliocene came *P. Wagneri* Dall in Florida and *P. edentula* Gabb (as *Siliquaria*) on the Pacific. The latter has persisted in deep water to the recent stage, being joined in the Pleistocene by *P. californica* Conrad (+ *rubroradiata* Carpenter), also found recent. The genus has retreated from the North American Atlantic shores in the present epoch, though a single species, *P. vaginata* Reeve, is doubtfully reported from Charlotte Harbor on the Gulf coast. *P. circe* Mörch and another unnamed species are extremely rare in the Antilles, while two or three very rare forms, such as *P. maxima* Deshayes, *P. fucata* Hinds, and *P. regularis* Carpenter, are found between California and Panama on the Pacific coast.

Psammobia (Gobræus) Wagneri Dall.

Plate 25, Figure 10.

Psammobia (Gobræus) Wagneri Dall, Trans. Wagner Inst., iii., part iv., p. 920, pl. 25, fig. 10, 1898.

Shell moderately elongated, thin, somewhat compressed, the anterior end shorter, both ends rounded; posterior dorsal margin straight, with an almost linear escutcheon; surface concentrically sculptured in harmony with the lines of growth, middle of the disk almost smooth, the lines a little stronger anteriorly, on the posterior end periodical, rising in subequally spaced sharp, thin, low lamellæ; nymphs about half the length of the posterior dorsal margin; hinge $\frac{\text{L. 0101}}{\text{R. 1010}}$, the anterior teeth stronger; pallial sinus not reaching the vertical of the beaks, round in front, rather narrow, and partly free from the pallial line below; valves gaping slightly at both ends. Lon. 77, alt. 40, diam. 20 mm.

Pliocene marls of the Caloosahatchie, Florida, and the Waccamaw River, South Carolina; Dall and Johnson.

This fine species is similar to, but smaller than, the Pliocene *P. edentula* Gabb of California, which reaches a length of one hundred and twenty-five millimetres.

A number of species have been referred, chiefly by the earlier authors, to *Psammobia* which do not belong to that genus as now understood. Of these *Gari texta* Gabb, of the Tejon, and *Gari alata* Gabb, from the Pliocene of California, appear to belong to *Sanguinolaria; P. lusoria* Say is a *Macoma; P. mississippiensis* Conrad, of the Vicksburgian, is probably an *Abra* or a *Semele; Psammocola regia* H. C. Lea, of the Miocene, is an Asaphis, while *P. lucinoides,* of the same author and locality, is perhaps a *Diplodonta; Psammocola pliocena* of Tuomey and Holmes is a mere individual mutation of *P. regia* Lea, and both are referable to *Asaphis centenaria* Conrad; *Psammobia perovata* Conrad, of the Vicksburgian, is an *Abra.*

With the exception of *P. Blainvillei* Lea, the Claibornian species are unfigured and the descriptions very inadequate. *P. eborea* Conrad is a *Gobræus,* not unlike *P. papyria* Conrad. It is thirty-five millimetres long and nineteen high. Though Conrad describes the posterior end as the longer, the type is almost exactly equilateral, and the truncation of the posterior end is not more evident than in *P. Wagneri.* It has been referred to *P. Blainvillei* Lea by Heilprin, probably through some inadvertence, since the outlines are not at all similar. *P. filosa* Conrad belongs to the section *Garum* of the typical Psammobias. It is elongated and somewhat arcuate; the concentric sculpture pretty close and uniform on the disk, but elevated into low, somewhat broken small laminæ on the posterior dorsal slope; the type is forty-two millimetres long and about fifteen millimetres high. The teeth and pallial sinus are as in *Garum*.

On the same card with Conrad's type in the collection of the Academy of Natural Sciences is another shell thirty-nine millimetres long and seventeen millimetres high, more equilateral, less arcuate, with a blunter and less decurved posterior end and generally straighter dorsal margin. This is probably a distinct species for which I would propose the name of *Psammobia* (*Garum*) *clabornensis*. It, with the other Eocene species, will be illustrated elsewhere. In the Gregg's Landing beds of Clabornian age Mr. Aldrich has found a specimen of a species having almost exactly the outline of *P. eborea* Conrad, but which differs from that form by having conspicuous radiating striæ on the dorsal slopes, especially distally, which granulate the incremental ridges. The latter often form in *P. eborea* small, sharp, concentric waves dorsally, but not raised laminæ, as in *P. filosa*. Aldrich's species is hardly perfect enough to receive a name.

Genus **SANGUINOLARIA** Lamarck.

Sanguinolaria Lam., Prodr., p. 84, 1799, and Syst. des An. s. Vert., p. 125, 1801. Type *Solen sanguinolentus* Gmelin (= *S. rosea* Gmelin and Lamarck).

This group may be subdivided as follows:

Section *Sanguinolaria* s. s.

Shell moderately large, thin, equivalve, short, rose-colored or white, with short, inconspicuous nymphs, two bifid cardinal teeth in each valve; pallial sinus deep, widest in front, confluent with the pallial line below, the epidermis thin, dehiscent.

Section *Psammotella* (Blainville, 1826) Herrmannsen, 1852. Type *P. operculata* Gmelin (= *Tellina rufescens* Chemn.).

Shell elongate, rostrate, inequivalve, the left valve flattened; pallial sinus discrepant in the two valves, narrower in front, partly confluent with the pallial line, otherwise like *Sanguinolaria*.

Section *Soletellina* Blainville, 1824. Type *Solen diphos* Gmelin.

Shell large, equivalve, with a conspicuous, dark epidermis and more or less bluish purple coloration, hinge as in *Sanguinolaria;* sinus narrowing to a point in front, below wholly confluent with the pallial line; pallial impressions rude and irregular.

From the elongate, rostrate form of the type the species vary to broad and truncate, forming a transition towards the next section.

Section *Nuttallia* Dall, 1898. Type *S. Nuttallii* Conrad.

Shell large, suborbicular, inequivalve, more or less twisted, the right valve slightly flatter, the posterior cardinal in the left valve obsolete; the pallial sinus narrower in front and somewhat detached from the pallial line.

This group comprises a few species from California and Japan.

Section *Psammotellina* Fischer, 1887. Type *Psammotella ambigua* Desh.

Shell like *Sanguinolaria* but more compressed, with the pallial sinus long and narrow, confluent with the pallial line below; the callosities of the nymphs wide and more or less excavated, as if for an internal ligament, below; hinge as in *Nuttallia.*

Section *Elizia* Gray, 1854. Type *Solen orbiculatus* Wood.

Shell very inequilateral, equivalve, with the anterior side reduced; suborbicular; the pallial sinus free from the pallial line and ascending; otherwise as in *Nuttallia,* except that a third cardinal is persistent in the right valve.

There are several species in the American Cretaceous which have been referred to *Sanguinolaria,* but the Tertiary species are few and all more or less doubtful in their generic relations. *S. unioides* Guppy is from the Tertiary (Oligocene?) of Trinidad. The following are tellinoid and probably Macomas: *S. Whitneyi* Gabb, *S. californica* Conrad, *S. fusca* Say, and *S. lusoria* (Say) Conrad. *S. miniata* Gould and *S. purpurea* Deshayes, of the Gulf and Central American Pacific coast, are synonyms of *S. tellinoides* A. Adams. *S. decora* Hinds is a synonym of *S.* (*Nuttallia*) *Nuttallii* Conrad. *Sanguinolaria? caudata* White, from the basal Eocene beds of Puget Sound, at Carbonado, Washington, is a remarkable shell, like a greatly prolonged *Unio,* of which the hinge and systematic relations are not yet known.

The superficial appearance of *Gari alata* Gabb is that of a *Sanguinolaria.* The *Gari texta* of the same author recalls *Psammotella,* but of neither is the hinge or interior known. The former is said to be Pliocene, and the latter is referred to the Tejon Eocene of Martinez, California, by Gabb.

Genus **AMPHICHÆNA** Philippi.

Amphichæna Philippi, Arch. f. Naturg., xiii., p. 61, 1847; Fischer, Man. Conchyl., p. 1104, 1887. Type *A. Kindermannii* Phil., *loc. cit.,* pl. iii., fig. 7; Mazatlan.

Amphidona "Phil.," Mörch, Journ. de Conchyl., vii., p. 137, 1858 (? lapsus calami).

Not *Amphichæna* H. and A. Adams, Gen. Rec. Moll., ii., p. 391, 1856.

It is probable that to the rarity of this very remarkable shell is due the little attention which it has attracted, and the incongruous species which have been associated with it. It has the form of *Tagelus divisus*, with the color, texture, solidity, and strong internal marginal grooving of *Donax*. The surface is smooth, with the caducous periostracum and suppressed radial sculpture of such species as *Donax variabilis*. The nymphs are slender and short, the pallial sinus short, rounded in front, and partially free below. There are two cardinals on the right and three on the left valve, the posterior tooth in the latter being more or less merged with the nymph. It is perhaps nearest in the family to some of the species of *Psammotæa*. It occurs recent and in the quaternary of the west American coast near Mazatlan, Mexico.

Genus **HETERODONAX** Mörch.

Heterodonax Mörch, Yoldi Cat., ii., p. 15, 1853.

Arcopagia Orbigny, 1853, not of Brown, 1827. Type *H. bimaculata* L.

This is one of the few species which are abundant unmodified on both sides of the isthmus connecting the two Americas, extending on the Atlantic side from Fernandina, Florida, to Brazil, and on the Pacific from Southern California to Panama. It is found in the Pleistocene of south Florida, the Antilles, and both shores of Central America and Mexico. The typical species was described by Conrad from San Diego as *Psammobia pacifica*, and occurs in the Pleistocene of Southern California.

Genus **ASAPHIS** Modeer.

Asaphis Modeer, K. vetensk. Acad. nya Handl., xiv., pp. 176, 182, 1793. Type *Venus deflorata* L.

Capsa (sp.) Bruguière, Enc. Méth., 1792.

Capsa Lamarck, Syst. An. s. Vert., p. 125, 1801; not of Prodrome, p. 84, 1799, or An. s. Vert., v., p. 553, 1818.

Corbula (sp.) Bolten, 1798; not of Bruguière, 1792.

Capsula Schumacher, Essai, pp. 130-31, 1817.

Psammocola (pars) Blainville, Man. Conch., p. 567, 1825.

Sanguinolaria Deshayes, 1835; not Lamarck, 1799.

Pleiorhytis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 286, 1863.

Pliorytis Conrad, *ibid.*, p. 576.

Heteroglypta Martens, Meeresf. von Mauritius, p. 331, 1880 (*ex parte*).

This group, which is rather closely allied to the typical *Psammotæa*, may be divided as follows:

Section *Asaphis* s. s.

Shell large, thin, gaping behind, with rather uniform radial sculpture; two prominent cardinal teeth in each valve, the larger bifid; the pallial sinus moderate, rounded in front, partly confluent with the pallial line below.

A. undulata and *multicostata* are described by Gabb from the Cretaceous of California, but neither has the aspect of genuine *Asaphis*.

Section *Heteroglypta* von Martens, 1880. Type *Psammobia contraria* Deshayes. Isle Bourbon.

Shell with diverse sculpture converging in angles like that of *Goniomya*, otherwise like *Asaphis*. The original use of the term by von Martens was more inclusive, but I have preserved the name for the typical species.

Asaphis centenaria Conrad.

Petricola centenaria Conrad, Am. Journ. Sci., xxiii., p. 341, 1833; Fos. Medial Tert., p. 17, pl. x., fig. 1, 1838.

Pliorhytis centenaria Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 576, 1863.

Psammocola regia H. C. Lea, Trans. Am. Phil. Soc., ix., p. 234, pl. 34, fig. 17, 1845.

Psammocola pliocena Tuomey and Holmes, Pleioc. Fos. S. Car., p. 91, pl. 22, fig. 8, 1857 (var.).

Capsa centenaria Orbigny, Prodr. Pal., iii., p. 103, 1852.

Pleiorytis ovata Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 286, 1863.

Miocene of Charles County, Virginia, of Magnolia, Duplin County, North Carolina, and of Peedee, Waccamaw, and Black Rivers, South Carolina. The reference to the Pliocene is unconfirmed.

Genus **TAGELUS** Gray.

Tagelus Gray, P. Z. S., 1847, p. 189. Type *Solen gibbus* Spengler.

Siliquaria Schumacher, Essai, Nouv. Syst., p. 129, 1817; Conrad, Cat. *Solenidæ,* p. 22, 1867.

Not *Siliquaria* Bruguière, Encyc. Méth., 1789 (*Vermetidæ*), nor Lam. Syst., p. 98, 1801.

Solecurtus Orbigny, Moll. Cuba, ii., p. 230, 1853.

Not *Solecurtus* Blainville, Man. Conchyl., pp. 568-9, 1825.

Psammosolen Hupé, Moll. Chile, p. 365, 1848; not of Risso, 1826.

Cultellus Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 232, 1837; Medial Tert., p. 75, 1845; not of Schumacher, 1817.

Mesopleura Conrad, Cat. *Solenidæ,* App., p. 23, Am. Journ. Conch., 1867.

Silicaria Mörch, Mal. Blatt., 1861, p. 185; as of Blainville, 1827; not of Daudin, 1800.

Tagalus Fischer, Man. de Conchyl., p. 1107, 1887.

The genus *Tagelus* is distinguished from any of the *Solenidæ* by its long and distinct siphons. In its other characters it approaches closely to *Psammotæa.* Adanson in describing his *Solen tagal* has given it the siphons of a true *Solen,* which is doubtless erroneous, since if his figure and description were correct the species would belong not only to a distinct species, but to a different family from the American shells, which have usually been specifically united with it on conchological grounds.

The group to which this genus belongs may include the following divisions, all of which are more closely related to *Psammobia* than to the *Solenidæ,* among which they were formerly placed.

Genus *Novaculina* Benson, 1830. Type *N. gangetica* Benson.

Beaks subanterior; teeth (when fully developed), three in the left and two in the right valve; the anterior left tooth often obsolete or wanting, the anterior right tooth bifid; valves without a median constriction or clavicular internal rib; pallial sinus short, not reaching the beaks; posterior adductor scar rounded; the ventral portion of the pallial sinus distinct from the pallial line below it; *situs* in fresh water of Indian rivers.

Loncosilla Rafinesque, 1820, as pointed out by Stoliczka, was probably founded on a defective specimen of *Novaculina,* but is unidentifiable.

Section *Clunaculum* Dall. Type *Solecurtus mollis* (Gould MS.) Sowerby, Conch. Icon., pl. vi., fig. 26, 1874. Coasts of Brazil and Uruguay.

Beaks subanterior; teeth two in each valve, the posterior left tooth bifid (with in some species an obsolete tooth behind it); valves obliquely constricted, the constriction reflected by an internal thickened elevation (not a rib or clavicle); the pallial sinus not reaching the beaks; posterior adductor scar triangular; the ventral part of the pallial sinus wholly coalescent with the pallial line; *situs* estuarine or marine.

Genus *Tagelus* Gray, 1847. Type *Solen gibbus* Spengler. West Africa and East America.

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 shell figured by H. and A. Adams to illustrate *Tagelus* is a *Novaculina,* and their diagnosis is a mixture of the characters of *Novaculina* and *Tagelus.*

Tagelus gibbus Spengler.

Solen gibbus Spgl., Skrift. Nat. Selsk., iii., p. 304, 1794.

Solen guineensis Chemn., Conch. Cab., xi., p. 202, pl. 198, fig. 1937, 1795; Dillwyn, Descr. Cat., i., p. 62, 1817; Wood, Gen. Conch., p. 129, 1835.

Solen declivis Turton, Conch. Dict., p. 164, fig. 80, 1819.

Psammobia declivis Turton, Dithyra Brit., p. 91, 1822.

Solen caribæus Lam., An. s. Vert., v., p. 454, 1818.

Siliquaria notata Schum., Essai, p. 129, pl. vii., figs. 2-3, 1817.

Solecurtus caribæus, Blainv., Dict. Sci. Nat., xxix., p. 240, 1825; Conrad, Am. Mar. Conch., p. 22, pl. 4, fig. 3, 1831; Gould, Inv. Mass., p. 30, 1841; Mighels, Bost. Journ. Nat. Hist., iv., p. 312, 1843; Sowerby, Conch. Icon., *Solecurtus,* fig. 21 *a-b,* 1874.

Solen Adansonii Bosc, Hist. Nat. Coq., iii., p. 12, 1802.

Cultellus caribæus Conrad, Am. Journ. Sci., 2d Ser., i., p. 404, 1846; not of Medial Tert., pl. 43, fig. 1, 1845.

Siliquaria gibba H. and A. Adams, Gen. Rec. Moll., ii., p. 347; not pl. 93, figs. 5, 5a, 1856.

Siliquaria caribæa Holmes, Post-Pleioc. Fos. S. Car., p. 54, pl. viii., fig. 14, 1858.

Siliquaria carolinensis Conrad (*ex parte*), Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863.

? Solecurtus angulatus Sowerby, Conch. Icon. *Solecurtus,* pl. viii., fig. 23, 1874.

Solecurtus centralis Sowerby, Conch. Icon., fig. 18, 1874; not of Say.

Tagelus gibbus Dall, Proc. Bost. Soc. Nat. Hist., xiii., p. 251, 1870.

Fossil in the Miocene of York River, Virginia, near Yorktown (Harris), in the Pliocene of the Caloosahatchie marls, Florida, and the Waccamaw district, South Carolina, and in the Pleistocene from New Bedford, Massachusetts, to Florida and the Gulf Coast. Recent from Cape Cod south to Brazil and on the west coast of Northern Africa. Adventitious on the British coast.

All the specimens collected from the Caloosahatchie marls appear to be young, at which stage they much resemble the adults of *T. divisus,* which, however, has longer nymphs, a shorter pallial sinus, and a median clavicle.

Tagelus gibbus var. **carolinensis** Conrad.

Siliquaria carolinensis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863; *ex parte.*

Miocene of Wilmington, North Carolina; Emmons and Stanton.

This form differs from the typical *gibbus* in being somewhat shorter and stouter and with a shorter pallial sinus. The differences are, however, little greater than appear between specimens of the recent shell from different localities.

Tagelus californianus Conrad.

Cultellus californianus Conrad, Journ. Acad. Nat. Sci. Phila., 1st Ser., vii., p. 233, pl. 18, fig. 3, 1838.

Solecurtus californianus Carpenter, Suppl. Rep. Brit. As., p. 638, 1863.

Pliocene of the San Diego well, Hemphill; Pleistocene of San Pedro and San Diego, California, and San Ignacio Lagoon, Lower California, Hemphill; recent from San Pedro to Lower California.

This species is extremely abundant in the Pleistocene sands of San Pedro Hill.

Section *Mesopleura* Conrad.

Mesopleura Conrad, Cat. *Solenidæ,* Am. Journ. Conch., iii., App., p. 23, 1867. Type *Solen divisus* Spengler.

Shell with an internal radial rib, ventrally directed from the submedian beaks; ends of the valves rounded, and the form of the shell usually more or less arcuate; otherwise like *Tagelus.*

Tagelus divisus Spengler.

Solen divisus Spengler, Skrift. Nat. Selsk., iii., p. 96, 1794.

Solen bidens (etc.) Chemnitz, Conch. Cab., xi., p. 203, pl. 198, fig. 1939, 1795; Dillwyn, Cat. Rec. Sh., p. 65, 1817.

Solen bidentatus Spengler, *op. cit.,* iii., part 2, p. 104, 1794.

Solen fragilis Pulteney, Hist. Dorset, p. 28, pl. 4, fig. 5, 1799.

Psammobia tæniata Turton, Dithyra Brit., p. 85, pl. 8, fig. 3, 1822.

Solen centralis Say, Journ. Acad. Nat. Sci. Phila., ii., p. 316, 1822; Binney's Say, p. 104, 1858; not of Sowerby.

Solecurtus fragilis Conrad, Am. Mar. Conch., p. 19, pl. 4, fig. 1, 1831; Proc. Acad. Nat. Sci., iii., p. 24, 1846.

Solecurtus bidens Forbes and Hanley, Brit. Moll., i., p. 266, 1850.

Leguminaria floridana Conrad, Proc. Acad. Nat. Sci. Phila., iv., p. 121, 1848.

Solecurtus Carpenteri Dunker, P. Z. S., 1861, p. 426.

Mesopleura bidentata Conrad, Am. Journ. Conch., iii., App., p. 26, 1867.

Solecurtus subteres Emmons, Geol. N. Car., p. 299, fig. 228, 1858; not of Conrad, 1838.

Solecurtus equalis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 571, 1863.

Tagelus divisus Dall, Proc. Bost. Soc. N. Hist., xiii., p. 251, 1870.

Machæra pellucida (de Gerville MS.) *et M. fragilis* Dautzenberg, Nantes et la Loire inf., Moll., p. 15, 1898.

Not *Solecurtus centralis* Sowerby, Conch. Icon., fig. 18, 1874.

Fossil in the Pliocene of the Carolinas and in the Caloosahatchie marls, Shell Creek, the Myakka River, etc., south Florida; in the Pleistocene of North Carolina and of North Beach, near Osprey, Florida. Recent from New Bedford, Massachusetts, to St. Thomas, West Indies. Adventitious on the British coast and elsewhere.

The radial rib always perceptible in normal species, in others is distinct in the young, but gradually becomes obsolete in the mature shell, showing that *Mesopleura* is the older type. When the rib is imperceptible the most obvious distinguishing characters of this species are the long nymphs and short pallial sinus. I have seen nothing older than the Pliocene, which seems referable to this species. Emmons' figure is very poor but distinctly different from *T. divisus* and, if not a young *gibbus,* may prove to be a distinct species as assumed by Conrad.

Tagelus (*Mesopleura*) *subteres* Conrad (1838), from the Pacific coast (not *subteres* Emmons), is larger than the east coast species and has the same range as *T. californianus.* The rib is entirely obsolete in the fully matured adults. It is found in the Pleistocene and also living.

Tagelus lineatus Gabb, 1881, from the Pliocene of Costa Rica, is a *Psammosolen.* There are several species of true *Tagelus* in the West Indies and southward, which should be compared with any supposed new species which may turn up.

Family SEMELIDÆ.

Genus **SEMELE** Schumacher.

Semele Schumacher, Essai, p. 165, 1817. Type *Tellina reticulata* Spengler, Fischer, Man., p. 1153, 1887, = *T. proficua* Pult.

Amphidesma Lamarck, An. s. Vert., v., p. 489, 1818; Bowdich, Elem. Conch., ii., p. 8, pl. 2, fig. 18, 1822. Type *A. variegata* Lam., = *Venus purpurascens* Gmelin.

The *Amphidesma* of Lamarck was a heterogeneous assembly with no type cited, the first species being *A. variegata,* which was taken to illustrate the genus by Bowdich four years later. Fortunately Schumacher had proposed *Semele* a year earlier than Lamarck with a single type, about which there is no uncertainty. The genus makes its appearance in the Eocene and is well represented subsequently up to the present fauna. It differs from *Scrobicularia,* which has a very similar hinge, by the characters of its ctenidia, which are like those of *Tellina.* The genus is divisible into two sections.

Section *Semele* s. s. Type *S. proficua* Pulteney.

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

Section *Semelina* Dall. Type *S. nuculoides* Conrad.

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.

The Eocene species are *S. linosa* Conrad, a fine, large, thin, concentrically sculptured species very much like some recent ones, but very rare at Claiborne; and *S. profunda* Conrad, also from the Claibornian, which is a small, smooth species, conchologically near to *Abra* but having the characteristic *Semele* outline. Both these species are figured on supplementary plate 19 of Harris's reprint of Conrad's "Fossils of the Tertiary Formations," but *S. profunda* has never been described.

In the Lower Oligocene (Vicksburgian) are known *S. mississippiensis* Conrad,* a smooth, very equilateral shell; and perhaps another described by Conrad from the same horizon at Vicksburg under the name of *Corbis staminea.* The fauna of the Upper Oligocene is better explored or richer in species of this group.

Semele chipolana n. sp.

PLATE 37, FIGURE 3.

Upper or Chipolan Oligocene at the base of Alum Bluff, Florida, also at Bailey's Ferry (now the county bridge) and McClellan's farm, on the Chipola River, Calhoun County, and in the Oak Grove sands at Oak Grove, Santa Rosa County, Florida.

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

* A specimen, apparently of this species, with the manuscript name of *S. perovata* Conrad, is in the collection of the Academy of Natural Sciences, Philadelphia.

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 lamellæ, with wider, microscopically radially striate interspaces; there are about fifteen lamellæ to the centimeter; hinge and other internal characters normal. Alt. 46, lat. 54, diam. 21 mm.

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.

Semele silicata n. sp.

Plate 38, Figure 6.

Oligocene silex beds at Ballast Point, Tampa Bay, Florida; Dall.

Shell small, moderately convex, inequilateral, with low beaks; anterior end longer, evenly rounded from the lunular slope; posterior end shorter, higher, hardly folded; sculpture of numerous close-set, rounded, little elevated, concentric threads, separated by narrower grooves with no indication of radial striation; lunule and escutcheon very narrow, teeth rather strong. Alt. 20, lat. 23, diam. 8 mm.

The figure was taken from a siliceous pseudo-morph on which the sculpture was indistinct. Subsequently other specimens showing the sculpture better were obtained. It is not unlike that of *S. subovata* Say, var. *duplinensis,* but the threads are finer, closer, and more numerous.

Semele Smithii n. sp.

Plate 43, Figure 6.

Upper Oligocene of the Chipola horizon at McClellan's farm, Calhoun County, Florida; Burns.

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. Alt. 19, lat. 23, diam. 7 mm.

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

Semele mutica n. sp.

PLATE 43, FIGURES 2, 12, 16.

Upper Oligocene of the Chipola River, at McClellan's farm, Calhoun County, Florida; Burns.

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 variable, as follows:

Variety *Stearnsii* Dall; 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. (Fig. 16.)

Variety *mutica* Dall; with the waves numerous, compressed, elevated into narrow, somewhat irregular lamellæ, with wider interspaces over the whole, sharper and more crowded near the posterior dorsal slope; no radial sculpture. (Fig. 12.)

Variety *scintillata* Dall; with sculpture like either of the preceding, to which is added radial threading visible first towards 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 towards the ends of the shell at the intersections. (Fig. 2.)

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. Alt. 7.5, lat. 11.5, diam. 3.0 mm.

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.

Semele carinata Conrad.

PLATE 36, FIGURES 23, 26.

Amphidesma carinata Conrad, Journ. Acad. Nat. Sci. Phila., vi., p. 229, pl. 9, fig. 23, 1830; Fos. Medial Tert., p. 37, pl. 19, fig. 7, 1838.

Smodesmia carinata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 93, pl. 23, fig. 2, 1856.

Abra Holmesii Conrad, in App. Kerr, Geol. Rep. N. Car., p. 19, pl. 3, fig. 8, 1875.

Abra carinata Conrad, Proc. Acad. Nat. Sci. Phila., xiv., p. 574, 1863.

Uppermost Oligocene of Oak Grove, Santa Rosa County, and Shoal River, Walton County, Florida (var. *compacta*); Miocene of St. Mary's County, Maryland, of the Natural Well and Magnolia, Duplin County, North Carolina, of Darlington District, South Carolina; Pliocene of the Waccamaw River, South Carolina, at Mrs. Purdy's marl bed; C. W. Johnson.

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 concentric 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*.

Besides the above, the following species are known from the Miocene and later horizons.

Semele Burnsii Whitfield.

Amphidesma Burnsii Whitfield, Mio. Moll. N. J., p. 79, pl. xiv., figs. 16-18, 1894.
Abra æqualis Whitfield, *op. cit.*, p. 80, pl. xiv., figs. 11-15, 1894; not of Say.

Miocene marl of Cumberland County, New Jersey, at Shiloh and Jericho; Burns.

This is a small, nearly smooth species, with irregular incremental lines. It has a rather inflated shell. An examination of Whitfield's types in the National Museum shows that his *Amphidesma Burnsii* was founded on an imperfect specimen of the same species as that which he had identified as *Abra æqualis* Say, but which is not Say's shell, nor an *Abra*. The other specific name must therefore be retained for this shell, which is clearly distinct from the other Miocene Semeles.

Semele alumensis n. sp.

Plate 43, Figure 4.

Miocene of the upper bed at Alum Bluff, Calhoun County, Florida; Dall and Burns.

Shell small, moderately convex, but more compressed near the posterior end; anterior end slightly longer, rounded; posterior end sloping above, with a well-marked radial fold, especially in the left valve, subtruncate obliquely, near the base, behind; sculpture of ten or twelve prominent, rounded concentric riblets separated by equal or wider interspaces, not very regularly disposed; the ribs tend to be especially prominent in the middle of the disk and to be obsolete behind the posterior fold; the surface is also concentrically striated; hinge strong, normal; beaks not prominent; pallial sinus short, rounded, ascending towards the umbo and not extending behind a vertical therefrom. Alt. 6.5, lat. 8.0, diam. 3.5 mm.

This stout, strongly sculptured little shell recalls the young of *carinata,* but is much more inflated, solid, and more coarsely sculptured.

Semele subovata Say.

Amphidesma subovata Say, Journ. Acad. Nat. Sci. Phila., iv., p. 152, pl. 10, fig. 10, 1824; Conrad, Fos. Medial Tert., p. 36, 1840.

Syndosmya subobliqua Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854 (lapsus for *subovata*).

Abra ovalis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 288, 1863.

Miocene of the Choptank River, Maryland; of Petersburg, Virginia; of the Yorktown beds along the York River, Virginia; and of the artesian well at Galveston, Texas, between two thousand five hundred and fifty-two and two thousand six hundred feet below the surface.

This is a common species of the Virginia Miocene, separable from the *S. carinata*, which is almost equally common, by its more oval and thinner shell, and finer, sharper, and closer concentric sculpture. The posterior dorsal area is usually conspicuously sculptured, while in *S. carinata* the tendency of the sculpture on this area is to become obsolete.

Semele bella Conrad.

Abra bella Conrad, Kerr, Geol. N. Car., App., p. 19, pl. 3, figs. 4, 6, 1875.

Miocene of North Carolina at Wilmington, and in Duplin County, at and near the Natural Well; Conrad and Burns.

This species exhibits much such a series of mutations as *S. mutica* of the Oligocene. It is nearly the shape of *S. subovata* and may be separated into three principal varieties by its sculpture:

Variety *duplinensis* Dall. This form has close set, elevated, concentric, sharp lamellæ, with no radial sculpture. Duplin County, North Carolina.

Variety *appressa* Dall. In this the concentric lamellæ are appressed to the surface, forming narrow, flattish waves, much as in *S. carinata* var. *compacta,* but more distinct, narrow, and clear cut. Duplin County, also in the Waccamaw beds, South Carolina.

Variety *bella* Conrad, s. s. In this, which (though not common, compared with the other varieties) was the form figured by Conrad, to the other sculpture is added more or less distinct radial striation or threading, as in *S. mutica* var. *scintillata,* but finer and less distinct. The concentric sculpture is sharper and more elevated than in var. *appressa,* but not lamellose, as in var. *duplinensis,* and the radial sculpture is confined almost entirely to the interspaces. This type was described from Wilmington, but occurs occasionally with the others with which it intergrades. The reticulation is feebler than in *S. bellastriata* Conr., to which it bears some resemblance.

Semele proficua Pulteney.

?*Tellina reticulata* Linné, Syst. Nat., ed. xii., p. 1119, 1767.

Tellina proficua Pulteney, Hutch. Dorset., p. 29, pl. v., fig. 4, 1799; Mont. Test. Brit., p. 66, 1803.

Tellina decussata Wood, Gen. Conch., p. 190, pl. 43, figs. 2, 3, 1815.

Amphidesma orbiculata Say, Journ. Acad. Nat. Sci. Phila., ii., p. 307, 1822; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 94, pl. 23, fig. 4, 1856.

Amphidesma radiata Say, Journ. Acad. Nat. Sci. Phila., v., p. 230, 1826; Hanley, Rec. Shells, p. 342, pl. 12, fig. 8, 1856; not of Reeve, 1853.

Amphidesma jayanum C. B. Adams, Proc. Boston Soc. Nat. Hist., ii., p. 10, 1845.

Amphidesma reticulata (Chemn.) Orbigny, Moll. Cuba, ii., p. 240, 1846; Reeve, Conch. Icon. *Amphidesma,* pl. v., fig. 29, 1853.

Amphidesma subtruncatum (Sby.) Reeve, Conch. Icon. *Amphidesma,* fig. 11, 1853; Sowerby, Spec. Conch., pt. 2, *Amphidesma,* fig. 3, 1855.

Amphidesma decussata Reeve, Conch. Icon. *Amphidesma,* pl. iv., fig. 23, 1853.

Semele orbiculata Holmes, Post-Pl. Fos. S. Car., p. 51, pl. viii., fig. 9, 1858.

? *Semele radiata* Holmes, Post-Pl. Fos. S. Car., pl. viii., fig. 11, 1858; young shell.

Semele carolinensis Conrad, Am. Journ. Conch., iii., p. 14, 1867.

Semele reticulata Arango, Moll. Cubana, p. 247, 1880.

Pliocene of the Caloosahatchie River, Florida, and of the Waccamaw beds, South Carolina; Pleistocene of Simmons Bluff, South Carolina; living on the coast of the eastern United States south to the Antilles and Brazil.

This is the species which was referred to the Linnæan *Tellina reticulata* by Spengler, Schumacher, Wood, and other early writers. Linné, however, states that his species was brought from India by Tesdorf, and refers to a figure of an Amboyna species in Rumphius to illustrate it. In the absence of definite types, which do not exist, we must therefore regard Linné's species as Oriental. The next name in point of date is that of Pulteney and Montagu, who erroneously supposed the shell to be British. Say's names are later, being subsequent to that of Wood. Conrad named the figures of Tuomey and Holmes which represent the pit of the resilium as unusually large. This is a somewhat variable character in this group, and in the large series of recent specimens in the National Collection there are several undoubted examples of this species in which the pit is nearly as large as figured by Holmes. The color is also variable and northern specimens, as usual, are less brilliant and have a thicker periostracum. Quite young specimens are more transverse than those which are older, and the adults differ somewhat in outline among themselves.

Semele perlamellosa Heilprin.

PLATE 37, FIGURES 4, 5.

Semele perlamellosa Heilprin, Trans. Wagner Inst., i., pp. 92, 102, pl. 11, fig. 23, 1887.

Pliocene of the Caloosahatchie and Shell Creek, Florida; Willcox and Heilprin.

The original figure of this elegant species was taken from an imperfect specimen, and at Mr. Willcox's suggestion it has been refigured here from a more perfect example. The dimensions of a well-preserved pair are: alt. 40, lon. 55, diam. 14 mm.

Semele Leana n. sp.

PLATE 37, FIGURES 1, 2.

Pliocene of the Caloosahatchie River and Shell Creek, Florida; Dall and Willcox.

Shell large, moderately inflated, somewhat inequilateral, the anterior end longer, nearly equivalve; anterior end evenly rounded, base evenly arcuate, posterior end blunt, subtruncate, short; lunule narrow, longer on the left valve, the right valve-margin encroaching on the hinge-line in the lunular region; sculpture of feeble, flattened, small radial threads and numerous evenly distributed, rather high, concentric lamellæ, those on the posterior dorsal areas lower and forming an obtuse angle where they pass on to the disk; the edges of the lamellæ are more or less minutely crenulated by the radial sculpture; hinge normal, pit rather large, pallial sinus large, rounded, ascending, free from the pallial line except at junction. Lon. of average specimen 54, alt. 44, diam. 18 mm. An exceptionally large valve measures lon. 63, alt. 52, diam. (double) 22 mm.

This extremely fine shell is of the same general type as *S. perlamellosa,* but of different outline and proportions, as the figures show very well. It is one of the most characteristic shells of the Florida Pliocene and is not exactly represented by any of the recent species of the coast so far discovered. It is named in honor of the late Dr. Isaac Lea, one of the earliest, most careful and thorough workers on our Tertiary Paleontology.

Semele purpurascens Gmelin.

Venus purpurascens Gmelin, Syst. Nat., vi., p. 3288, No. 91, 1792; Mörch, Cat. Yoldi, ii., p. 16, 1853 (after Lister, pl. 303-304, figs. 144, 145, and Klein, Tent. Ostr., p. 157, pl. ii., fig. 57).

Tellina obliqua Wood, Gen. Conch., p. 152, pl. 41, figs. 4, 5, 1815; Dillwyn, Descr. Cat. Rec. Shells, i., p. 78, 1817.

Amphidesma variegata Lamarck, An. s. Vert., v., p. 490, 1818; Sowerby, Gen. Sh., pt. 9, fig. 1, 1821; Orbigny, Moll. Cuba, ii., p. 239, 1853.

Amphidesma obliqua Reeve, Conch. Icon. *Amphidesma,* pl. i., figs. 5 *a, b,* 1853.

Semele purpurascens Mörch, Cat. Yoldi, ii., p. 16, 1853; Krebs, Cat., p. 106, 1864; Arango, Moll. Cuba, p. 246, 1878; Mörch, Poulsen Cat. W. I. Shells, p. 14, 1878; Krebs, Cat., p. 106, 1864; not of Sowerby, Reeve, or Lamarck.

Semele ornata Gould, Otia Conch., p. 239, 1862; Tryon, Am. Mar. Conch., p. 155, 1874 (young shell).

? Semele formosum Krebs (as of Sowerby), Cat., p. 106, 1864; not of Sowerby.

Pliocene of the Caloosahatchie beds, Florida, Dall; of Costa Rica, Gabb; Pleistocene of Santo Domingo, Gabb; living in the Western Atlantic from North Carolina to Rio Janeiro.

This fine species has had a variety of names, but Mörch's identification of it with Gmelin's *Venus purpurascens* appears to be correct. The *Amphidesma purpurascens* of Lamarck, however, was founded on *Ervilia nitens* and the species so named by Reeve in the Iconica is distinct from the present one.

Semele bellastriata Conrad.

Amphidesma bellastriata Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 239, pl. xx., fig. 4, 1837; Bull. Nat. Inst., ii., p. 192, 1842.

Amphidesma cancellata Orbigny, Moll. Cuba., ii., p. 241, pl. 25, figs. 42-44, 1853 (? not of Sowerby, 1853).

Semele nexilis Gould, Otia Conch., p. 238, 1862; Tryon, Am. Mar. Conch., p. 155, 1874; Dall, Proc. U. S. Nat. Mus., vi., p. 338, 1883.

Semele cancellata Dall, Bull. No. 37, U. S. Nat. Mus., p. 62, 1889.

Semele lata Adams, Bush, Trans. Conn. Acad., vi., part 2, p. 476, 1885.

Pliocene of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox; living in the Western Atlantic and Antillean region from Câpe Hatteras, North Carolina, south to Cape San Roque, Brazil, in moderate depths of water.

This elegant little shell was described by Conrad among Nuttall's Californian shells, and consequently the name has been overlooked. A careful comparison of Pliocene and recent specimens shows a practical identity of character, the only difference observable being that the recent shells would average slightly heavier. The latter are very variable in color and sculpture. There does not seem to be any *Semele lata* of Adams, and the name used by Miss Bush for this species is apparently an error of labelling.

Section *Semelina* Dall.

Semele nuculoidea Conrad.

Amphidesma nuculoides Conr., Am. Journ. Sci., vol. xli., p. 347, Oct., 1841; Fos. Medial Tert., p. 73, pl. 41, fig. 6, 1845.

Abra nuculoides Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863; Meek, S. I. Checkl. Mio. Fos. N. Am., p. 11, 1864.

Semele nuculoides Dall, Bull. 37, U. S. Nat. Mus., p. 62, 1889.

Oligocene of Oak Grove, Santa Rosa County, Florida, Burns; also in the Miocene of North Carolina at Wilmington, and at Magnolia and the Natural Well, Duplin County; of Virginia in the Yorktown beds of the York River; Pliocene of the Caloosahatchie beds, Florida; living from North Carolina, near Cape Hatteras, southward to the West Indies and west to Pensacola, Florida.

The variety *striulata* Dall, from the uppermost Oligocene of Oak Grove, Florida, 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. The variety *lirulata* Dall, which is chiefly found among the recent specimens, has faint radial striation distally. The recent shells are usually whitish, but the color varies and may be yellow, red, or rayed with red; the variations of the outline are proportionately about the same as in the larger species of the genus. The remark that the lateral teeth of the hinge are obsolete shows that Conrad had only a left valve to study, as in the right valve they are strong. The pit for the reception of the resilium is not conspicuous and in slightly worn specimens it is difficult to make out. The concentric striation is somewhat sharper, and the interspaces are more elevated over the posterior dorsal slope, as usual in the genus. The largest of the Duplin County specimens measures 7 mm. long by 5 mm. high; no recent specimens have come to hand as large as this.

Semele cythereoidea n. sp.

Plate 44, Figure 5.

Upper Oligocene of the Chipola River, Calhoun County, Florida; Dall.

This species, which is abundant in the Chipola marl, is much like the preceding, 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 five millimetres long by 3.75 high and having a diameter of 1.7 mm. 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.*

The *Syndosmya nuculoides* of Whitfield (Mon. Mio. N. J., p. 81, pl. xv., figs. 7-9, 1894) is not Conrad's species, nor does it belong to this genus; the specimen is an undoubted *Sportella* of the section *Fabella* Conrad.

The *Amphidesma transversa* of Say (Am. Conch., iii., 28, 1831) is not an American shell, the species being based on a specimen of *Scrobicularia piperita* which Mr. Say had been led to suppose indigenous. What the species described by Holmes under the same name (Post-Pl. Fos. S. Car., p. 52, pl. viii., fig. 10) may be, neither his description nor his figure is sufficient to determine. The *Amphidesma lepida* Say is a *Lepton* and his *A. punctata* is a *Diplodonta. A. constricta* Conrad is a *Fabella,* as is his *A. protexta. A. inequale* "Say" Conrad (Journ. Acad. Nat. Sci. Phila., vii., 153, 1834) is a lapsus for *A.* (*Abra*) *æqualis* Say.

On the Pacific coast *Semele decisa* Conrad, and *S. pulchra* Sowerby, are reported by Gabb from the Pleistocene of California (Pal. Cal., ii., p. 94, 1869).

Genus **ABRA** (Leach) Lamarck.

Abra (Leach MS.) Lam., An. s. Vert., v., p. 492 (in synonymy), 1818. First species *Mactra tenuis* Mont.

Amphidesma (sp.) Lam., *op. cit.,* p. 492, 1818; Leach, Moll. Gt. Brit., p. 278, 1852.

Ligula (sp.) Montagu, Test. Brit., Suppl., p. 96, 1808; not of Humphrey, 1797, nor Bloch, 1782.

Abra Gray, Ann. Mag. N. Hist., xx., p. 272, 1847.

Syndosmya Récluz, Rev. Zool., 1843, pp. 292, 359. Type *Amphidesma Boysii* Lam., = *Mactra alba* Wood.

Syndesmia (corr.) Chenu, Agassiz, 1846.

Orixa Leach, Moll. Gt. Brit., p. 280, 1852. Type *Mactra tenuis* Montagu; Fischer, Man. de Conchyl., p. 1152, 1887.

Dorvillea Leach, Moll. Gt. Brit., p. 286, 1852; sole ex. *D. anglica* Leach, *loc. cit.;* Jeffreys, Brit. Conch., ii., p. 444, 1863.

Scrobicularia (pars) Jeffreys, Brit. Conch., ii., p. 435, 1863.

Lutricularia Monterosato, Nom. Conch. Med., p. 28, 1884; *Erycina ovata* Phil., and *Mactra tenuis* Montagu, are cited.

Abra Risso, Hist., p. 370, 1826; *A. fragilis* and *sinuosa* Risso, cited; Monterosato, Nom. Conch., Med., p. 29, 1884.

Syndesmya Fischer, Man., p. 1151, 1887 (*S. alba* Wood).

Iacra H. and A. Adams, Gen. Rec. Moll., ii., p. 409, 1856; sole ex. *I. seychellarum* A. Adams.

Erycina (sp.) Lam., Ann. du Mus., vi., 1804; Philippi, Moll. Sicil., i., p. 12, 1836.

Shell tellinoid, with an external ligament and stronger internal resilium; one or two, often bifid, cardinal teeth in each valve, and feebly developed lateral laminæ in the right valve, sometimes obsolete; surface usually smooth, and with the periostracum often faintly iridescent, as in some Tellinas; pallial sinus discrepant in the two valves. The teeth are feeble, often more or less variable in the same species; in the trigonal species the laterals are frequently, but not always, obsolete. There seems to be insufficient ground for more than one sectional division of the genus, as follows:

Abra s. s. Type *A. tenuis* (Mtg.). Exterior smooth or faintly concentrically sculptured.

Iacra Adams. Type *A. seychellarum* Adams. Surface divaricately sculptured.

Strigillina Dunker, Mal. Bl. viii., p. 43, 1861, of which the type is *S. lactea* Dunker (*loc. cit.*) is identical with and must be regarded as an exact synonym of *Iacra*. Externally this group closely resembles *Strigilla*.

Abra nitens Lea.

Egeria nitens Lea, Contr. Geol., p. 51, pl. 1, fig. 19, 1833.

Mysia nitens Conrad, in Mort. Syn. Org. Rem., App., p. 7, 1834.

Amphidesma tellinula Conrad, Am. Journ. Sci., N. S., i., p. 397, pl. 4, fig. 5, 1846; Harris Reprint, Fos. Tert., p. 115, pl. 19, fig. 12, 1893.

Abra nitens Conrad, Am. Journ. Conch., i., p. 5, 1865; Checkl. Eoc. Olig. Foss., p. 7, 1866; Harris, Bull. Pal., i., p. 30.

Abra tellinula Conrad, Am. Journ. Conch., i., p. 5, 1865; Checkl. Eoc. Olig. Foss., p. 7, 1866.

Tellina nitens Gregorio, Mon. Claib., p. 223 (*ex parte*), pl. 35, fig. 17, 1890.

Syndesmya tellinula Cossmann, Notes Compl., p. 8, pl. 1, figs. 7-8, 1894.

Claiborne sands, at Claiborne, Alabama; Burns and others.

This little shell is a typical *Abra*, with which Conrad's *Amphidesma tellinula* is synonymous. A small species of *Tellina* of almost identical form is figured by de Gregorio under this name (pl. 35, figs. 13-16) and Cossmann has supposed that this might have been Lea's species. Lea's specimens, however, are of the *Abra,* and the *Tellina,* requiring a new name, might be called *T. Cossmanni.* Gregorio's figures erroneously represent the pallial line as entire. Conrad's second figure of his *tellinula* in Harris's reprint (pl. 19, fig. 12) is different from his original figure and is either very bad or represents some other shell.

A. nitens is the only Eocene species yet made known from the eastern United States. From the Oligocene of Vicksburg, Mississippi, Conrad has described *A. perovata* and *A. protexta.* Two others referred by him to the same genus are probably referable to *Semele* (*A. mississippiensis* and *A. staminea* Conrad); both are Vicksburgian. The following species is derived from the Upper Oligocene:

Abra triangulata n. sp.

Plate 49, Figure 4.

Oligocene marl of Bowden, Jamaica; Henderson and Simpson (rare).

Shell small, thin, polished, subtrigonal, nearly equilateral, wider than high, moderately inflated; beaks pointed, not much elevated, the dorsal margins straight, diverging at the umbo in an angle of somewhat over ninety degrees; base arcuate; anterior end slightly longer, rounded; posterior end shorter, more pointed; exterior polished; anterior dorsal margin in the right valve with a lateral tooth at some distance from the hinge-plate; on the posterior margin is a short fold not elevated to become a tooth; the left valve shows no laterals. Alt. 5.5, lat. 6.25, diam. 3.0 mm.

This species is not unlike *A. lioica* Dall, of the recent fauna, but of a more evenly trigonal outline and with the anterior part less produced.

Abra subreflexa Conrad.

Amphidesma subreflexa Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 133, 1834; Fos. Med. Tert., p. 37, pl. 19 (1st ed.), fig. 6, 1845.

Abra subreflexa Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863.

Miocene of the York River, Virginia, Conrad and Harris; Petersburg, Virginia, Burns.

This is an elongated species, with feeble lateral teeth.

Abra æqualis Say.

Amphidesma æqualis Say, Journ. Acad. Nat. Sci., ii., p. 307, 1822; Am. Conch., iii., pl. 28, 1831; Conrad, Fos. Med. Tert., p. 76, pl. 43, fig. 9, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 93, pl. 23, fig. 3, 1856.

Abra æqualis Holmes, Post-Pl. Fos. S. Car., p. 50, pl. 8, fig. 7, 1859; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863.

Abra nuculiformis Conrad, Am. Journ. Conch., iii., p. 14, 1867.

Not *Abra æqualis* Whitfield, Mio. Moll. N. J., p. 80, pl. 14, figs. 11-15, 1894; = *Semele* sp.

Miocene of North Carolina, near Wilmington, Stanton; of South Carolina at Goose Creek and Smith's, Tuomey; Pliocene of the Waccamaw district, South Carolina, and of the Caloosahatchie River, Florida. Living from Cape Hatteras, North Carolina, to the Gulf of Mexico in moderate depths of water.

This species varies a good deal in outline in the same locality, but southern specimens of the recent shells, especially those from Florida, have the anterior dorsal slope less rounded and the umbonal angle smaller than those from more northern localities. The fossils are generally of this type rather than like the more rounded northern recent specimens. From *A. angulata* Holmes, of the Post Pliocene of the Carolinas, *A. æqualis* is separated by the same characteristics, only more pronounced. This would indicate that the larger rounded form is correlated with water of a lower temperature. From *A. lioica* Dall, of the recent fauna, *A. æqualis* is distinguished by its less transverse and quadrate form, and also by having on the anterior right dorsal margin a long groove continuous with the hinge-plate, bordered by a ridge below, while *A. lioica* has a short, developed lateral tooth separated by a wide gap from the hinge-plate.

Abra or *Amphidesma subobliqua* Conrad (Proc. Acad. Nat. Sci. Phila., vii., p. 29) is apparently an undescribed form, or a *lapsus pennæ*. Other species in the literature which have been referred to *Abra*, especially those of Conrad (1863 and 1865), will be found treated of under the genera to which they really belong, such as *Semele, Aligena,* and *Fabella* or *Sportella.*

Genus **CUMINGIA** Sowerby.

Cumingia Sowerby, P. Z. S., 1833, p. 34. Type *C. mutica* Sby.

Mactra (sp.) Conrad, 1831.

Anatina (sp.) H. C. Lea, 1845.

Harpax Gistel, Naturg. Thierr., p. viii., 1848; not of Parkinson, 1811.

Lavignon (sp.) Orbigny, 1846, and Tuomey and Holmes, 1856.

Mikrola O. Meyer, Proc. Acad. Nat. Sci. Phila. for 1887, p. 53.

This is a well characterized genus, though intimately related to *Scrobicu-*

laria, which it seems to represent on the American coasts. It differs from the type of *Scrobicularia,* which lives in sandy places, by being found as a nestler; though never excavating burrows in hard substances, it often occupies those made by true borers, and in this way exhibits a great diversity of outline within the species, as usual with nestlers. The surface is usually fine, radially striate or sagrinate, with concentric sculpture which may be in one and the same species mere lineation or elevated lamellæ, the different mutations of sculpture frequently occurring, at different stages of growth, on the same specimen. The right valve exhibits two strong lateral teeth, the anterior one distally being often subspinose, the dorsal margins of the left valve are extended to fit in the channels above the laterals of the opposite valve, the outer surface of these extensions forming a lunule and escutcheon almost wholly confined to the left valve. There is an external ligament and strong internal, posteriorly directed resilium. The pallial sinus is deep and well marked, the siphons separate and naked, the gills as in *Scrobicularia.* The genus has its emporium on the two coasts of middle America and extends in the Pacific to Simoda, Japan. A subgenus, *Thyella* H. Adams, 1865 (not R. Desvoidy, 1863), is represented by its type, *T. elegans* Sby., in the Philippines, and a fine species, *T. Stimpsoni* Dall, in the Loochoo Islands. It differs from *Cumingia* in the absence of lateral teeth in the right valve. The genus *Montrouzieria* Souverbie has somewhat analogous hinge characters, but is not a nestler and may not be closely related to *Cumingia.* It is represented by a single species in New Caledonia. The number of species of *Cumingia* has been overestimated, owing to the variability of its characters due to the nestling habit. In the northern range of the common species of the United States on both the Pacific and Atlantic we find the shells larger and the sculpture less sparse and irregular. As we follow the species south the shells seem to diminish in average size and the lamellation becomes relatively more prominent. Thus, south of Florida the specimens never attain the size of those of the Carolinas and Massachusetts, and on the Pacific the northern specimens of *C. californica* are twice as large as those of the Gulf of California and Panama. Though the change is gradual, and I am inclined to believe all the mutations should be referred to one species, I have kept them separate here for convenience, as the extremes differ considerably.

Cumingia medialis Conrad.

Cumingia tellinoides Conrad, Fos. Med. Tert., p. 28, pl. 15, fig. 4, 1838; not of Conrad, 1831.

Anatina tellinoides H. C. Lea, Trans. Am. Phil. Soc., 3d Ser., ix., p. 237, pl. 34, fig. 12, 1845.
Lavignon tellinoides Orbigny, Prodr. Pal., iii., p. 101, 1852.
Lavignon tellinoides Tuomey and Holmes, Pleioc. Fos. S. Car., p. 92, pl. 23, fig. 1, 1856.
Cumingia medialis Conrad, Am. Journ. Conch., ii., p. 106, 1866.

Miocene of the James River, Virginia, Conrad; Petersburg, Virginia, H. C. Lea; York River, Virginia, Harris; of Duplin County, North Carolina, at the Natural Well and Magnolia, Burns; of South Carolina on the Peedee River, Tuomey.

This species is very similar to some varieties of the recent *C. tellinoides,* but differs in general in its larger size, more conspicuous socket for the resilium, less elongation and less prominent surface sculpture. The genus is said to go back to the Cretaceous, but in the American beds the only species older than the *C. medialis* is a small shell described from the Red Bluff Eocene of Mississippi by Otto Meyer (Proc. Acad. Nat. Sci. Phila. for 1887, p. 53, pl. iii., figs. 16, *a-b*) under the name of *Mikrola mississippiensis.* An examination of the type specimens of this species led to the discovery that, contrary to Dr. Meyer's diagnosis, there are well developed lateral teeth in the right valve on each side of the fossette; and the appearance of the shell confirmed the opinion that it is only a very young specimen of a species of *Cumingia* which would therefore carry the specific name of *mississippiensis.*

Cumingia tellinoides Conrad.

Mactra tellinoides Conrad, Journ. Acad. Nat. Sci. Phila., vi., p. 258, pl. xi., figs. 2-3, 1831; Am. Mar. Conch., pl. 14, fig. 2, 1831; not of Conrad, 1838, ex Miocene.
Cumingia borealis Conrad, Am. Journ. Conch., ii., p. 76, 1866.
Cumingia tellinoides Holmes, Post-Pl. Fos. S. Car., p. 53, pl. 8, fig. 12, 1859; Verrill, Am. Journ. Sci., 3d Ser., x., p. 371, 1875; Dall, Bull. U. S. Nat. Mus., No. 37, p. 62, pl. 56, fig. 14, 1889.

Pleistocene of Sankoty Head, Massachusetts, Verrill, and of Simmons Bluff, South Carolina, Holmes and Burns. Recent from Prince Edward Island south to Florida and, if the following form be regarded as conspecific, to Northern Brazil.

Cumingia coarctata Sowerby.

Cumingia coarctata Sby., P. Z. S., 1833, p. 34 (not of Cpr.).
Lavignon antillarum Orbigny, Moll. Cubana, ii., p. 236, pl. 25, figs. 36-38, 1846.
Lavignon Petitiana Orbigny, *op. cit.,* p. 236, pl. 25, figs. 33-35.
Cumingia antillarum A. Adams, P. Z. S., 1850, p. 24.
Cumingia fragilis A. Adams, P. Z. S., 1850, p. 25, pl. 8, fig. 7.

Cumingia sinuosa A. Adams, P. Z. S., 1850, p. 25, pl. 8, fig. 6 (*sinuata* in legend to plate).
Cumingia tenuis H. and A. Adams, Gen. Rec. Moll., ii., p. 412, 1854.

Pliocene of the Caloosahatchie beds, Florida; Dall. Recent from the Florida Keys throughout the Antilles to the Bay of Caraccas, and probably to northern Brazil.

This form appears to grade into *C. tellinoides,* from some of the young of which it cannot be distinguished by shell characters. It is also essentially like the Pacific coast *C. lamellosa* Sby., with which Carpenter even united it. *C. lamellosa* bears to *C. californica* Conr. the same relation which *C. coarctata* does to *C. tellinoides*. The fact remains, however, that, notwithstanding the northern specimens of *coarctata* appear to merge into the southern type of *tellinoides,* no specimens of typical *tellinoides* have been seen from the West Indian region; just as on the Pacific side no specimens of typical *C. californica* are known from the region east and south of Cape St. Lucas. The two forms in each case are perhaps to be regarded as subspecies of a common descent, modified by differences of temperature and food, or, as we formerly expressed it, "geographical races."

Cumingia californica Conrad.

Cumingia californica Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 234, pl. 17, fig. 12, 1837.
Cumingia similis A. Adams, P. Z. S., 1850, p. 24, pl. viii., fig. 4; Sby. in Reeve, Conch. Icon. *Cumingia,* pl. 2, fig. 13, 1873.

Pliocene of San Diego (?); Hemphill. Pleistocene of California at Santa Barbara and San Diego. Recent from Crescent City, California, south to Cape St. Lucas. Also received from Simoda, Japan, collected by W. Stimpson.

Cumingia lamellosa Sowerby.

Cumingia lamellosa Sby., P. Z. S., 1833, p. 34.
Cumingia trigonularis Sby., P. Z. S., 1833, p. 34.
Cumingia coarctata Cpr., P. Z. S., 1863, p. 367; not of Sby.

Pleistocene of Lower California, at Todos Santos Bay. Recent, from the Gulf of California south to Payta, Peru.

The other west coast species of Cumingia which are recognizable as such are: *C. mutica* Sby. (1833, + *C. grandis* Desh. 1856, + *C. ventricosa* Sby., 1873), the largest species and type of the genus, from Chile and Peru; *C. Cleryi* A. Adams (1850), a species said to be smooth and polished, from Chile; and *C. striata* A. Adams (1850, + *C. Adamsi* Cpr., 1863), from Chile to the Gulf of California, a small, arcuate species with fine, crowded sculpture.

Family TELLINIDÆ.

Having eliminated *Sanguinolaria* and its allies from this family, and omitting a discussion of the ill-known groups referred here by Conrad from among his Cretaceous types, the remainder forms a very compact and natural group, in which the following genera may be recognized:

A. with lateral teeth.

Genus *Tellina* (Linné) Lamarck, 1799. Type *T. virgata* Linné.
Genus *Tellidora* (Mörch MS.) H. and A. Adams, 1856. Type *T. Burneti* Broderip and Sowerby.
Genus *Strigilla* Turton, 1822. Type *T. carnaria* Linné.
Genus *Metis* H. and A. Adams, 1858. Type *T. Meyeri* Dunker.

B. without lateral teeth.

Genus *Gastrana* Schumacher, 1817. Type *T. fragilis* Linné.
Genus *Macoma* Leach, 1819. Type (*M. tenera* Leach, =) *T. calcarea* Gmelin.

All the above have two cardinal teeth in each valve when perfect. The posterior left cardinal in *Phylloda, Tellidora,* and *Strigilla* is an extremely thin lamina, attached to the anterior face of the nymphal callosity, above which it rises. In opening the valves the free part of this lamina—which fits into an extremely narrow chink in the right valve between the large bifid cardinal and the nymph—is in *Strigilla* usually broken off even with the top of the callosity, leaving no traces of its existence except a slight roughness which disappears entirely in slightly worn valves. By careful search I have never failed to find it. In *Metis* (*alta* Conr.), usually described as without laterals, I have found a minute distant posterior left lateral, though in most of the species there is no trace of this lamina, unless in the young shells.

With a view of testing the constancy of the various characters which have been used as a basis for sectional divisions in the *Tellinidæ,* I went over all the recent species in the Museum and tabulated the features of each species as regards lateral teeth, coalescence or freedom of the ventral part of the pallial sinus, thickened radii internally, etc. The only differences found throughout the family in the cardinal teeth, of which the number is invariable, were those of size and in the grooving of the central cardinals. A very few species after careful inspection showed no grooving, but in nearly all cases unworn specimens indicate a perceptible groove. I have been forced to the conclusion that the amount or absence of coalescence with the pallial line of the ventral part of the pallial sinus is a character of minor value. Even within the species it is not absolutely constant, though mainly so. Physiologically, as I have already pointed out, it has very little significance. In general the tendency to coalescence increases with the progress of geological time, but even in the Eocene there are species with wholly coalescent scars. In a general way species which would be placed together on other grounds have similar sinus characters, but there are so many exceptions to this that no rule can be said to be established.

In this group, as in the gastropods, singular as it may appear, the characters of the external sculpture seem to be among the most permanent features in an evolutionary series from the Eocene to recent times. All of the groups approach each other closely, through peripheral species, in this as in other features.

A careful examination of the hinges of a large number of species indicates that the lateral laminæ are prone to become obsolete in all the forms where they are not actively functional. The right anterior lateral when adjacent to the cardinals is invariably functional, which may account for its exceptional constancy. In species where a lateral is represented only by an almost microscopic ridge or pustule it becomes difficult to decide on its diagnostic use. One cannot say the species has no laterals, although they are obsolete, and it sometimes happens that species, closely allied by other characters, differ in the state of the laminæ, so that if these organs were functional the discrepancy is such as ordinarily would be taken to be of sectional or subgeneric value.

In my diagnoses of groups I have described as carefully as I could the characters of the type species, but it will frequently happen that the forms which it seems necessary to associate with the type do not correspond in all minor details with the diagnosis. I cannot bring myself to think that a named subdivision for each of these fluctuations would correspond to any important series of facts or be of real service to students; indeed, I have found the multiplication of ill-defined and insufficiently compared subgenera, sections, etc., in much of the later literature a real impediment to study.

Realizing the difficulties, and that I can hardly hope to surmount all of them to the satisfaction of everybody, I have tried at least to make my statements correspond with what I have seen in the specimens, and have not troubled myself overmuch as to whether this agreed with antecedent literature or not; except that, when I found a disagreement, I have taken the precaution to review my work at intervals and again compare with the specimens. If any reader feels disposed to criticise the result, my only request is that before formulating his dissent he should carefully investigate, not manuals and text-books, but a good series of correctly identified specimens.

I may add that while certain Tellinas have all their lateral laminæ nearly or quite obsolete, they do not thereby become Macomas. *Macoma* seems to be a very natural group in which there never were any laterals developed, and not one which has possessed and subsequently lost them.

Genus **TELLINA** (Linné) Lamarck.

< *Tellina* Linné, Syst. Nat., ed. x., p. 674, 1758; ed. xii., p. 1116, 1767; Gmelin, Syst. Nat., p. 3228, 1792; Cuvier, Tabl. élém., p. 426, 1798.

Tellina Lamarck, Prodrome, p. 84, 1799; *Tellina virgata* L.; Syst. An. s. Vert., p. 124, 1801; *T. radiata* L.

< *Angulus* Muhlfeldt, Mag. d. Ges. Naturf. freunde zu Berlin, v., p. 47, 1811; *T. lanceolata* L. and *T. virgata* L.

> *Tellinella* "Gray, 1852," Mörch, Yoldi Cat., ii., p. 13, 1853; H. and A. Adams, Gen. Rec. Moll., ii., p. 394, 1856; Stoliczka, Cret. Pel. India, p. 116, 1871.

> *Musculus* Mörch, Yoldi Cat., ii., p. 13, 1853; not Raf., 1818.

> *Liotellina* Fischer, Man. de Conchyl., p. 1147, 1887; *T. radiata* L.

> *Peronæoderma* Mörch, Yoldi Cat., ii., p. 12, 1853; not of Poli, 1795; *T. polita* Poli.

Eutellina Fischer, Man. de Conchyl., p. 1147, 1887.

> *Arcopagia* Leach, in Brown, Ill. Conch. Gt. Brit., p. ii., pl. 16, fig. 8, 1827; *Tellina crassa* Mont.

> *Cydippe* Leach, Moll. Gt. Brit., p. 314, 1852; *Tellina crassa* Mont.

> *Omala* Schumacher, Essai, p. 128, 1817; *Tellina hyalina* Gmelin.

> *Homala* Agassiz, Nomenclator, Index, p. 744, 1848; Mörch, Cat. Yoldi, ii., p. 11, 1853; *Tellina triangularis* Dillwyn.

> *Phylloda* Schumacher, Essai, p. 148, 1817; *Tellina foliacea* Linné.

> *Tellinides* Lamarck, An. s. Vert., v., p. 535, 1818; *Tellina timorensis* Lam.

> *Eurytellina* Fischer, Man. de Conchyl., p. 1147, 1887; *T. punicea* Born.

> *Homalina* Stoliczka, Cret. Pelec. India, p. 118, 1871; *Tellina triangularis* Dillwyn; Cossmann, Cat. Illustr. Eoc. Paris, p. 74, 1886.

> *Quadrans* Bertin, Nouv. Arch. du Mus., 2me Sér., i., pp. 229, 266, 1878; *Tellina gargadia* Linné.

> *Peronæa* Stoliczka, Cret. Pelec. India, p. 119, 1871; *Tellina planata* (Linné) Poli; not *Peronæa* Poli, 1791, = *Psammotella* Lamarck.

> *Palæomoera* Stoliczka, Cret. Pelec. India, p. 116, 1870; *Tellina strigata* Goldfuss.

> *Fabulina* Gray, Brit. Moll. and Brach., p. 40, 1851; *Tellina fabula* Gron.

> *Moera* H. and A. Adams, Gen. Rec. Moll., ii., p. 396, 1856 (= *Donacilla* Gray, 1851; not of Lam., 1812, or Philippi, 1836); not *Moera* Leach, Crust., 1815.

?*Linearia* Conrad, Journ. Acad. Nat. Sci. Phila., iv., p. 279, 1860; *L. metastriata* Conr.

> *Moerella* Fischer, Man. Conchyl., p. 1147, 1887; *T. donacina* Linné.

> *Homala* Fischer, Man. Conchyl., p. 1148, 1887; *T. hyalina* Gmel. (= *Omala* Schum.); not *Homala* Mörch, 1853.

> *Pseudarcopagia* Bertin, Nouv. Arch. du Mus., Paris, 2me Sér., i., pp. 229, 264, 1878; *Tellina decussata* Lamarck.

?*Liothyris* Conrad in Kerr, Geol. Rep. N. Car., App., p. 9, 1873, not of Douvillé, 1880.

> *Donacilla* Gray, List Brit. An., Moll., p. 39, 1851; *Tellina donacina* Linné; not *Donacilla* (Lam.) Philippi, 1836.

> *Maera* H. and A. Adams, Gen. Rec. Moll., i., index, p. xxvii., 1856; not *Maera* Leach, *Crust.*, 1813.

> *Elliptotellina* Cossmann, Cat. Illustr. Eoc. Paris, p. 58, 1886. Type *Tellina tellinella* Lamarck.

> *Macaliopsis* Cossmann, Cat. Illustr. Eoc. Paris, p. 63, 1886; *Tellina Barrandei* Desh.

> *Cyclotellina* Cossmann, Cat. Illustr. Eoc. Paris, p. 67, 1886; *Tellina lunulata* Lamarck.

> *Arcopagiopsis* Cossmann, Cat. Illustr. Eoc. Paris, p. 69, 1886; *Tellina pustula* Deshayes.

> *Oudardia* Monterosato, Nom. Conch. Medit., p. 22, 1884; *T. compressa* Brocchi; Cossmann, Cat. Ill., p. 75, 1886.

> *Tellinula* Auct., Bucquoy, Dautz, et Dollf. Moll. Mar. Roussillon, ii., p. 654, 1898. Type *Tellina fabula* Gronovius.

In discussing the synonymy of this genus it is first of all necessary to eliminate from consideration the authors who were not consistently Linnean in their nomenclature, such as Chemnitz, who was frankly polynomial, and Poli, who organized for himself a unique quadrinomial system in which the shell and animal had each a separate generic and specific name. Thus simplified, the genus *Tellina* of Linné is recognizable as obviously heterogeneous according to modern ideas. The first author to name a type for it was Lamarck in 1799. The species selected by him was *T. virgata* Linné. The first author to subdivide the genus was Megerle von Mühlfeldt, in 1811, who divided the Linnean Tellens into two groups, one containing all the elongated and rostrate species, and the other the suborbicular species. His genus *Angulus,* proposed for the former group, is thus synonymous with the group indicated as typical *Tellina* by Lamarck. Megerle's first species was a peculiar compressed and acute form, *T. lanceolata,* for which, with its allies, his name has been retained in an amended and restricted sense. In 1817 Schumacher proposed *Omala, Phylloda,* and *Gastrana* for peculiar forms of *Tellina,* and Lamarck proposed *Tellinides* in the following year for a form with a single adjacent lateral which he took for a third cardinal tooth. Leach followed with *Arcopagia* and *Macoma,* and subsequent authors have proposed numerous subdivisions, chiefly on characters of very small physiological importance. A favorite basis has been the coalescence of the siphonal retractor scars with the basal part of the pallial impression. Such characters, convenient for sections when constant, in a genus containing numerous species, should not be taken too seriously; as the moving of the ventral part of the retractile apparatus a fraction of an inch with respect to the points of attachment of the pallial margins is surely not of much weight. A matter which has greatly added to the difficulty of clearing up the synonymy is the reckless manner in which authors who in other respects have done excellent work have disregarded all rules of nomenclature and have altered, consolidated, and proposed new names with apparently no consideration of the mischief they were doing or the difficulties created for other workers by such conduct.

The hinge of *Tellina* in the broad sense, when developed to the fullest extent, comprises on each valve an anterior and posterior lateral and two cardinals, of which one is grooved or bifid on its distal edge. When the valves are closed the two bifid teeth are central and the simple teeth are respectively anterior and posterior to them. Normally the teeth of the right valve close in in advance of the teeth of the left valve, and in the obsolescence of the laterals those of the left valve disappear first. The simple cardinal of the left valve is often very close to and hardly distinguishable from the anterior part of the nymphal callosity, and, owing to its fragility, is often broken off at the base, leaving hardly a trace, from which circumstances proceed the erroneous diagnoses so common in the literature which ascribe a single left cardinal to sundry species or groups of Tellinas. No *Tellina* is without two cardinal teeth in each valve and at least one (anterior) lateral tooth in the right valve, unless it has been deprived of these parts by erosion, fracture, senility, or abnormal growth.

It occasionally happens that the hinge of an individual will be reversed with respect to the valves of normal specimens, but I have found no species in which the hinge is habitually reversed. The laterals are stated by Bernard to appear independently of and later than the cardinals, and in those species where the laterals are distant from the cardinals they do not develop from the shank of a Λ-shaped nepionic tooth, as do the laterals of many Teleodont bivalves. I am inclined to believe, however, that the so-called "adjacent" laterals may arise in the above-mentioned manner, as they often appear to retain some connection with the anterior cardinal, and, in fact, have been described by several authors as cardinals. In the subgenus *Omala* the adjacent lateral is so close to the cardinals and so like them that it is not surprising that it has been taken to belong to the cardinal series.

The distant laterals, as in *Cardium* and *Lucina,* arise independently and later. They are often not functional and naturally become obscure and sometimes obsolete. It is often difficult to say whether the projecting callosity at the distal end of a nymph should be regarded as a lateral or not, and it often happens in inequivalve species that the functions of a lateral lamina are performed by an evenly callous projecting portion of the valve margin, not differentiated into a recognizable lamina. I have regarded such hinge margins as not constituting laminæ in making up my formulæ. It often happens that the non-functional laminæ are reduced to very small dimensions only visible on close study and easily overlooked, whence such cases arise as in the genus *Metis,* of which some species still retain (as in *M. alta* Conr.) a minute obsolete lateral under the nymph, while others (*M. interstriata* Say) have entirely lost it. I have not found in the literature a single case where the diagnostic characters given for the various groups are uniformly correct in describing the hinges. The teeth are subject to differences correlated with age. To obtain an accurate idea of the cardinals it is often necessary to examine specimens in the adolescent stages, as the teeth become in some cases crude and irregular in adults, besides suffering from erosion. The bifid teeth are not, as Noëtling has apparently assumed, due to the coalescence of two originally distinct lamellæ, but the accretions to the teeth, being deposited by distinct proliferations of the dorsal mantle-border, are naturally less profuse along the line where two adjacent proliferations meet each other, and a groove results. The lateral laminæ, on the other hand, are usually better developed in the older individuals and sometimes wanting in the young.

The ligament varies from extremely long and narrow, as in *Phylloda,* to short and high, as in some species of *Angulus.* The nymphs are usually larger and more prominent in thin shells with short ligaments; subcircular species always have a short ligament. The resilium is usually enclosed in the hemicylindric ligament. In some forms, however, as *Metis* and *Tellidora,* the resilium is much shorter than the ligament and evinces a tendency to become internal, as in the *Semelidæ.* In such instances it is notably thicker, especially towards the beaks. There is in a few forms, like *Macalia,* a tendency towards an amphidetic area, and over this is frequently concentrated a certain amount of dark periostracum, presenting an appearance as if the ligament proper extended in front of the beaks. Mr. E. A. Smith called attention to this in his report on the Challenger *Pelecypoda,* instancing *T. donacina* as an example. I have not, however, been able to satisfy myself in any instance that any portion of the true ligament extends forward of the beaks in *Tellina,* except in cases where erosion has set up a diseased condition, nor that the resilium has become separated from the ligament to form an internal and distinct bond between the valves, as in *Semele* or *Abra.*

The valves of many species, especially compressed and thin forms, are often strengthened by a deposit of shell-material in radial lines, which generally pass from the beaks towards the margin behind the anterior adductor scars, and less frequently in front of the posterior scars. In the cases I have noted of the latter kind there is a tendency to form two adjacent small rays (as in *T. fabula* Gronovius), while the anterior radii are usually single and stronger (*T. compressa* Brocchi). The radii are sometimes well defined (as in the species last mentioned), but quite frequently they have only one well-defined margin. All stages intermediate may be observed in a large collection of species.

The posterior adductor scars in *Tellina* are generally rounded, the anterior ones longer and narrower. The scar of the mantle attachment is usually parallel to the margin of the valves. The scar of the sinus or impression of the siphonal retractors is quite variable. In some species the sinus is quite free, ventrally, from the pallial line; in the majority the two are more or less coalescent, and in still others the dorsal portion of the line extends from one adductor scar to the other. These may have the ventral portion absolutely coalescent with the pallial line throughout, as in *Strigilla* (*sincera,* Hanl.), or from the adductor scar the siphonal line may run downward and backward, enclosing a small triangular space between the pallial and siphonal lines and the scar of the anterior adductor. Still another state occurs in which the sinus may not reach forward, even near to the adductor, but from the latter to the anterior part of the bight of the sinus a line of attachment extends (as in *T. scobinata* L.), leaving a distinct scar. This is probably connected with some reinforcement of the retractor muscles of the siphons. It is not common to all the species of *Arcopagia,* does not occur in *T. crassa,* for instance, which is much the same shape as *T. scobinata,* nor is it confined to rounded species, since the elongated *T. Antoni* Phil. exhibits it. I have called this a case where the sinus is "linked" to the adductor.

I have not found the details of the disposition of the scar of the sinus very constantly correlated with the other characters of the shell, and in the Macomas a notable amount of variation may occur within the species. As I have elsewhere observed, its physiological importance cannot be very great and caution should be used in basing systematic subdivisions on this character alone.

The exterior sculpture of the Tellinas is emphatically concentric. Though fine radial sculpture often exists, it does not, except in the section *Pseudarcopagia,* rival the concentric sculpture in strength. There is no known species with only radial sculpture. Oblique or angular sculpture is rare. The posterior end of the shell is usually flexed to the right and exhibits one or more folds of greater or less prominence. Occasional marked inequality of the valves is observable, and the culmination of the surface sculpture as it passes over the ridges which radiate from the beaks towards the end of the valves sometimes results in elegant lamelliform prominences.

The characteristics of the soft parts have been already mentioned (p. 553), the foot is sometimes (*Psammacoma*) modified to serve as a stilt or anchor, much as in Yoldia, and the siphonal tubes are long and naked. The supposition of Fischer, that in *Macoma* the branchial siphon is much shorter than the anal one, is incorrect. Deshayes has indeed figured a species with this character (which was perhaps due to mutilation), but the common typical Macomas do not show any such feature; in them, as in most bivalves, the anal siphon is shorter. If we symbolize the left valve by L, the right by R, the laterals by l, the simple cardinals by 1, the bifid cardinals by ½, the resilium by c, and indicate distance from or adjacency to the cardinals by the signs — and + respectively, the normal formula for the hinge of a fully developed *Tellina* will be $\frac{\mathrm{L}\ \mathrm{l} - 10\frac{1}{2}0 - \mathrm{l}}{\mathrm{R}\ \mathrm{l} - 0\frac{1}{2}01 - \mathrm{l}}$, the ciphers standing for the gaps into which the teeth enter when the valves are closed. In the subgenus *Angulus,* which has a single adjacent lateral in the right valve, possibly of different origin from the distant laterals of typical *Tellina,* the formula will be $\frac{\mathrm{L}\ \ 10\frac{1}{2}0}{\mathrm{R}\ 0\frac{1}{2}01 + \mathrm{l}}$, the right hand end of the formula in all cases corresponding to the anterior end of the hinge. I insert the symbol for the resilium only when it is subinternal.

The following subdivisions are recognizable in the genus *Tellina:*

A. With two lateral laminæ in each valve, those in the left valve always less strong.

Subgenus *Tellina* (Lam.) s. s. Type *T. virgata* Linné.

Valves sculptured externally, the concentric sculpture stronger; somewhat compressed, ovate trigonal, subequivalve, with a more or less distinct ridge from the beaks towards the lower posterior angle; subequilateral, porcellanous, often elegantly colored, the periostracum hardly visible; the umbonal radii internally inconspicuous or absent, the shell margin entire, the siphonal sinus more or less coalescent below with the pallial line.

Angulus Megerle, 1811, *Tellinella* "Gray" Mörch, 1852, and *Eutellina* Fischer, 1887, are synonymous. The group is a denizen of the warmer seas. The following groups may for convenience be regarded as of sectional rank:

Section *Liotellina* Fischer, 1887 (*Musculus* Mörch, 1853, non Rafinesque, 1818). Type *T. radiata* Linné.

Valves externally smooth, elongated, and convex, the left lateral laminæ feeble or obsolete. Tropical.

Section *Macaliopsis* Cossmann, 1886. Type *T. Barrandei* Desh. of the Parisian Eocene.

Shell resembling *Tellina* proper, but usually smaller, more compressed, and not brightly painted, most of the species being nearly white, with no color pattern, but only a delicate suffusion, when colored at all; hinge and sinus as in *Tellina;* external sculpture concentric, frequently sharp and with a fine radial striation. Eocene to recent seas, especially of the warm temperate region.

This group presents little in the way of salient diagnostic characters, but is a very natural one, ancient geologically and widespread. Species with rounded form and obsolete fold form the section *Arcopagiopsis* Cossmann.

Section *Arcopagella* Meek, 1871. Type *A. mactroides* Meek, Upper Cretaceous of Dakota.

This form has the form and sculpture of *Moerella,* and the sinus of *Arcopagia.*

Section *Herouvalia* Cossmann, 1892. Type *H. semitexta* Cossmann. Parisian Eocene.

Shell small, subequilateral, moderately convex, with a posterior truncation but no fold; hinge as in *Tellina;* sinus squarish in front, partly confluent below; the nymphs short and the bifid cardinals rather long and thin; the lunule and escutcheon very narrow, well marked, and deeply impressed; the external sculpture is mainly concentric with rays towards the ends which reticulate the former.

This little shell is very close to *Linearia,* a subgenus of *Tellinidæ* described by Conrad from the Upper Cretaceous in 1875. The type of *Linearia* externally resembles *Semele cancellata,* the hinge has a well-marked nymph, and its chief peculiarity is in the lengthening of the bifid cardinals. The present section differs by its greater convexity, more marked posterior truncation, and shorter cardinals. *Herouvalia* is also very close to *Elliptotellina,* which has less developed laterals and an evenly rounded posterior end. I may add that *Liothyris* Conrad (not Douvillé), described as a subgenus of *Linearia,* is quite distinct, and its connection with any of the *Tellinidæ* is very doubtful.

B. With two lateral laminæ in the right valve, one or both of those of the left valve absent or obsolete.

Subgenus *Elliptotellina* Cossmann, 1886. Type *Tellina tellinella* Lamarck.

Shell small, subequilateral, convex, with the extremities rounded, the posterior not compressed or folded; hinge with a moderate nymph and ligament, two laterals in the right valve, none in the left; sinus free, short, rising obliquely from the pallial line; external sculpture concentric with a tendency to reticulation near the ends by radii from the umbones. Lower Eocene of Paris to recent fauna.

This remarkable little shell resembles an *Ervilia* externally, and is quite destitute of some of the most characteristic features of *Tellina,* to which it is linked by *Herouvalia,* which has a more fully developed hinge and posterior truncation. Recent species occur in the warm temperate waters of both coasts of North America.

Subgenus *Pseudarcopagia* Bertin, 1878. Type *Tellina decussata* Lamarck.

Shell subequilateral, moderately convex or somewhat compressed; the extremities rounded, with no flexure; hinge with two right but no left laterals; valves rounded or ovate; sinus high, partly confluent below; external sculpture reticulate. Tropical, especially Austral seas.

These forms make a strong contrast with the other Tellinas, owing to their conspicuously reticulate sculpture, in which the radial element is not markedly feebler than the concentric and may be even stronger. Such species as *T. pretiosa* Deshayes recall Conrad's *Linearia,* from which they differ in their normal cardinals.

Subgenus *Arcopagia* (Leach), 1827 (+ *Cydippe* Leach, 1852), 1827. Type *Tellina crassa* Pennant.

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 *Cyclotellina* Cossmann, 1886. Type *Tellina lunulata* Deshayes.

Shell with the shape and sculpture of *Arcopagia,* the anterior left lateral sometimes present (as in the type), the sinus more or less confluent below, anterior and posterior radii more or less developed. Lower Parisian Eocene to recent in the warmer seas.

This group may perhaps be extended to include most of the large rotund species which have erroneously been referred to *Arcopagia,* such as *T. fausta, remies,* and *discus,* which have a partially confluent sinus, often linked to the anterior adductor scar by a linear scar, but in other respects agreeing with *Arcopagia. Arcopagiopsis* Cossmann has the fully developed hinge of *Tellina* and sharp sculpture, allying it more closely to the section *Macaliopsis,* from which it can hardly be separated.

Section *Merisca* Dall, 1900.

This group comprises more or less trigonal, usually rather convex shells, of small or moderate size, with lamellose concentric sculpture, and often fine radial striæ 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.

These shells are related to *Macaliopsis,* from which they differ by the absence of lateral teeth in the left valve; to *Moerella,* from which their sculpture and posterior fold separate them; and to *Pseudarcopagia,* which is not rostrate and has no fold, while its radial sculpture is more conspicuous. The recent species are usually pale, without color markings, or white, and inhabit the warmer seas.

Section *Phyllodina* Dall, 1900. Type *Tellina squamifera* Deshayes.

Shell elongate, inequivalve, with a sharp concentric sculpture rising into leaflets along the dorsal border; fold conspicuous; hinge with well-marked right laterals and a feeble anterior left lateral, distant from the cardinals; sinus short, ascending, blunt behind and free below from the pallial line as in *Arcopagia;* interior without thickened radii. Oligocene to recent.

This elegant shell, described from a single specimen of unknown habitat, has erroneously been referred to Chinese seas, but is now known to be American. Its characters recall *Phylloda* and it can hardly find a place in other sections, especially as it has several fossil representatives.

Section *Eurytellina* Fischer, 1887 (*Peronæoderma* Mörch, 1853, non Poli, 1795). Type *T. punicea* Born.

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.

Section *Scrobiculina* Dall, 1900. Type *Scrobicularia viridotincta* Carpenter.

Valves thin, flexuous behind, feebly sculptured; hinge with the anterior right lateral subapproximate, the other laterals feebly developed; resilium short, deep, internal on the excavated hinge-plate; radii feeble or absent, the sinus moderate, confluent below.

Differs from *Metis* by its regular Tellinoid shape and better developed hinge.

Section *Quadrans* Bertin, 1878. Type *T. gargadia* Linné.

Valves as in *Eurytellina,* but bluntly truncate behind, externally sculptured with oblique grooving; sinus as in *Eurytellina,* hinge with the left laterals both obsolete. Recent warmer seas.

Section *Tellinides* Lamarck, 1818. Type *T. timorensis* Lamarck.

Shell compressed, equivalve, with no flexure or sharp truncation, a single approximate anterior lateral, no internal thickened radii, the sinus coalescent below, the external sculpture feeble.

This group was proposed with generic rank by Lamarck owing to his misinterpreting the adjacent small lateral as a third cardinal tooth. It differs from *Quadrans* by the absence of the posterior right lateral and of the external oblique grooving. Recent warm seas.

Subgenus *Phylloda* Schumacher, 1817. Type *Tellina foliacea* Linné.

Shell large, compressed, with a very long ligament, the nepionic valves undulate, the adults delicately, chiefly concentrically, sculptured; posterior dorsal margin convex and more or less dentate; hinge with the laterals very small or obsolete; a minute right anterior and usually a feeble left anterior may be traced close to the cardinals; sinus, more than half free from the pallial line below, linked by a lineal scar to the anterior adductor scar. Tropical.

Subgenus *Moerella* Fischer, 1887. (+ *Moera* Adams, 1856, non Leach, 1815; + *Maera* Adams, 1856, non Leach, 1813; + *Donacilla* Gray, 1851, non Lamarck, 1812). Type *Tellina donacina* Linné.

Shell small, compressed, hardly folded, acute behind, rounded in front, with feeble concentric sculpture; left laterals obsolete; no interior radii; the sinus long, coalescent with the pallial line below. Eocene to recent seas.

This little group is closely related to the smaller forms of *Angulus,* but has the laterals better developed and is without internal radii. It forms the transition from the forms previously considered towards *Angulus.* There is a distinct posterior lateral in the right valve, and an obsolete anterior lateral may sometimes be detected in the left valve.

C. Hinge with a strong right anterior lateral, closely adjacent to the cardinals, the left laterals absent, the posterior right lateral obsolete.

Subgenus *Angulus* Megerle (em.), 1811. (+ *Fabulina* Gray, 1851, + *Tellinula* (sp.) auct.). Type *Tellina lanceolata* Linné.

Shells elongated, variable in size but chiefly small, compressed, with the posterior end angularly pointed and not twisted, the surface smooth or with fine concentric sculpture; nymphs short and prominent, the ligament short; hinge with a single adjacent lateral well developed in the right valve anteriorly; internally a thickened ray passes from the umbo just behind the anterior adductor scars and one or two narrower similar rays in front of the posterior adductors, often stronger in the left valve, the posterior rays sometimes obsolete; sinus largely or wholly coalescent with the pallial line below. Eocene to recent.

Section *Angulus* s. s. Surface smooth or finely concentrically striated, internal radii ill defined.

Section *Scissula* Dall, 1900. Surface with fine oblique grooving, not in harmony with the incremental lines. Type *Tellina decora* Say.

These forms constitute a well-defined and perfectly recognizable group.

Section *Oudardia* Monterosato, 1885. Type *Tellina compressa* Brocchi.

This group differs from *Angulus* s. s. only in having the anterior radii internally, strong and well defined. The type has oblique external grooving which is wanting in other species.

Section *Peronidia* Dall, 1900 (*Peronæa* Mörch, 1853; not *Peronea* Curtis, 1824, nor *Peronia* Blainville, 1824). Type *Tellina albicans* Gmelin (*nitida* auct.).

Shell without laterals, having the internal characters of *Angulus* s. s. and the external appearance of *Eurytellina*. Tertiary and recent.

Subgenus *Omala* Schumacher, 1817 (+ *Homala* Agassiz, 1848, and Fischer, 1887; non Mörch, 1853). Type *Tellina hyalina* Gmelin.

Shell mesodesmatiform, inequilateral, compressed, with narrow and pronounced lunule and escutcheon. Anterior laterals small and approximate, posterior laterals absent; no internal radii, sinus short, coalescent with the pallial line below; surface smooth or feebly concentrically sculptured. Eocene to recent.

The inequilaterality and compression of these species give them a very characteristic look, but the distinctions are not very important.

Section *Homalina* Stoliczka, 1871 (+ *Homala* Mörch, 1853; not Agassiz, 1848). Type *Tellina triangularis* Dillwyn.

Shell resembling *Omala*, but (according to the literature) without any lateral teeth. Recent. This species requires further examination and may prove to belong to *Omala* proper. It is smaller than *T. hyalina*, and the laterals if present may have been overlooked. Stoliczka separated this form from Omala under a mistaken impression as to the type of that group, but if there is a real difference the name can be retained, as he specifies *T. triangularis* as the type of *Homalina*. The Parisian Eocene form, *T. Lamarckii* Deshayes, belongs to *Omala* in the strict sense, at least if one may judge from figures and descriptions.

The following Eocene species have been described from the region under consideration; the sections under which they would probably rank are inserted in parentheses: *T.* (*Arcopagia?*) *Spillmani* Dall = *T. albaria* Conrad, Am. Journn. Conch., i., p. 138, pl. xi., fig. 7, 1865; not *T. albaria* Conrad, Geology Wilkes Expl. Exp., p. 725, App., pl. 18, fig. 5, 1849, which is probably an *Angulus*. *T. Spillmani* is from the Jacksonian of Mississippi; *T.* (*Arcopagia*) *alta* Conrad, 1833, Claibornian, not *T.* (*Metis*) *alta* Conrad, 1837; *T.* (*Arcopagia*) *eburneopsis* Conrad, 1865, Jacksonian; *T.* (*Moerella*) *Greggi* Harris, 1896 (+ *T. lignitica* Harris, 1896, but not *virginiana* Clark, 1895), Chickasawan; *Tellina linifera* Conrad, 1865, Jacksonian; "*T.*" *nitens* Lea, 1833 (= *Abra nitens* Conrad, not *T. nitens* Gregorio, which is founded on *Diplodonta ungulina* in a very young state), Claibornian; *T.* (*Moerella*) *ovalis* Lea, 1833 (= *T. Leana* Dall, not *T. ovalis* Sowerby, 1825), Claibornian; *T.* (*Peronidia?*) *papyria* Conrad, 1833 (+ *T. mooreana* Gabb, 1860), Lower

Claibornian; *T.* (*Angulus*) *plana* Lea, 1833 (+ *Donax plana* Gregorio). The numbers of the figures of this species and *T. ovalis,* both in text and on the plate, in Lea's "Contributions to Geology" *are reversed; Egeria plana* is represented by figure 24, and *E. ovalis* by figure 25, as clearly denoted by their respective descriptions. As there was already a *Tellina plana,* d'Orbigny changed this specific name to *subplana* in 1850, Claibornian; *T.* (*Arcopagia*) *Raveneli* Conrad, 1846 (a fine and typical *Arcopagia,* externally recalling *Semele linosa;* Conrad refers to a figure on Plate v., but I have never found a copy of this plate, though the description is quite recognizable), Claibornian; *Macoma scandula* Conrad, 1834, Claibornian; *T.* (*Metis?*) *Sillimani* Conrad, 1846, Claibornian; *T.* (*Angulus*) *subtriangularis* Aldrich, June, 1895 (not *T. Williamsi* Clark), Chickasawan; *T.* (*Arcopagia*) *tallicheti* Harris, 1895 (compare *T. papyria* Conr.), Claibornian; *T.* (*Arcopagia*) *Trumani* Harris, 1897, Chickasawan; *T.* (*Peronidia?*) *Williamsi* Clark, 1895, Maryland; and *T.* (*Angulus*) *virginiana* Clark, 1895 (not identical with *subtriangularis* Aldrich), Maryland; *T. subequalis* Conrad, 1848, unfigured and described from a cast, is unrecognizable. To this list a few species can now be added from the collections of the United States Geological Survey.

Tellina (Angulus) entaenia n. sp.

PLATE 46, FIGURE 2.

Eocene of the Claiborne sands at Claiborne, Alabama; Frank Burns.

Shell small, rather compressed, solid, elongate, very inequilateral; beaks low, surface polished, sculptured with faint, little elevated, somewhat irregular concentric lines, which at about the posterior third become suddenly stronger and more prominent, and on the posterior dorsal slope become about half as numerous, somewhat irregular, and still more elevated; hinge normal, nymph for the ligament short and prominent; pallial sinus short, rounded in front, reaching a little before the middle of the valve and below about half confluent with the pallial line; a faint ray behind the anterior adductor scar. Lon. 9, alt. 4, semidiam. 0.8 mm.

Nothing like this interesting little shell has been described from this horizon. Two left valves were obtained. The prominence of the nymph is a general characteristic of the subgenus *Angulus,* though I note in several European publications this feature does not appear to be understood, and there has been a tendency to refer such forms to *Psammobia,* apparently on this character alone.

Tellina cynoglossa n. sp.

PLATE 46, FIGURE 27.

Chickasawan Eocene of Wood's Bluff, Alabama; Choctaw Corners and near Meridian, Mississippi; Burns and Johnson.

Shell small, moderately convex, subovate, slightly inequilateral, with a moderate posterior fold; beaks little elevated; surface polished, sculptured with numerous even, regular concentric riblets with narrower interspaces, flattish in the middle of the disk, sharper and more elevated towards the ends of the valve, especially over the fold; lunule smooth, depressed, long, and narrow; hinge normal, right laterals distant, strong; left laterals obscure; pallial sinus small, oblong, obliquely ascending, confluent for a short distance below with the pallial line; interior with a few obscure radii. Lon. 16.5, alt. 10.5, diam. 4.8 mm.

This species is quite abundant at Wood's Bluff and has very much the external characters of *T. linifera* Conrad, which is larger, more elongated, and more pointed behind.

The species from the Pacific coast described at an early date by Conrad, and referred by him first to the Miocene and later to the Eocene, will be considered under the head of the Oligocene, though it is probable that some of them may be Miocene. Most of the types are in the National Museum.

Tellina (Moerella?) Aldrichi n. sp.

PLATE 46, FIGURE 9.

Chickasawan Eocene of Lisbon, Alabama; Aldrich. Also of Bell's and Gregg's Landings, Alabama.

Shell large for a *Moerella,* elongate, with very straight dorsal slopes, rounded in front, arcuate below, and bluntly pointed behind; beaks incurved, pointed, not prominent, posterior end hardly folded; surface smooth, with obsolete concentric undulations and rare radial striulations; lunular region deeply impressed; hinge normal. Lon. 20, alt. 10, semidiam. 2.5 mm.

A single left valve, with the interior inaccessible except the hinge, was sent by Aldrich with specimens of *T. papyria,* from which it differs by its elongated slender form, smaller size, and less convex valves. Better specimens from Bell's Landing show a nearly normal hinge with long, low laterals, and an ovate pallial sinus about half confluent below. It is perhaps nearest to *T. Greggi* Harris, but that species seems to be smaller, more rounded behind, with the pallial sinus free from the pallial line below.

Comparatively few species have been described from the Oligocene, though it is well supplied with *Tellinidæ*. Gabb cites *T. cuneata* Orbigny, 1853 (= *Moerella Gouldii* Hanley, 1847, not *Tellina cuneata* Chemnitz or *T.* (*Macoma*) *cuneata* Sowerby, 1867), from Santo Domingo, an identification which needs to be confirmed; *T.* (*Peronidia?*) *dariena* Conrad (+*T. semilævis* Gabb, 1861) is from the Oligocene sandstones of the Isthmus of Darien above the Eocene shales; *T.* (*Eurytellina?*) *serica* Conrad (+ *T. euryterma* Gabb), Vicksburgian; *T.* (*Moerella*) *minuta* Gabb, 1873, Santo Domingo; *T.* (*Elliptotellina?*) *perovata* Conrad, 1848, Vicksburgian; *T.* (*Moerella*) *pectorosa* Conrad, 1848, Vicksburgian; *Macoma sublintea* Conrad, 1871, a doubtful species from the Vicksburgian, and *T.* (*Moerella*) *vicksburgensis* Conrad, 1848, Vicksburgian, are all the east American species I have found recorded. From the Pacific coast there are a few species, poorly described and figured, but of which the types in some cases exist, from the Astoria region in Oregon, but it is uncertain whether the horizon be Oligocene or Miocene, the fauna of these shales having been but little investigated with reference to their stratigraphy. The species are *T.* (*Peronidia?*) *emacerata* Conrad; *T.* (*Moerella?*) *obruta* Conrad; *T.* (*Peronidia?*) *oregonensis* Conrad, and two indeterminate forms, *T. bitruncata* and *subnasuta* Conrad, described in the geological report of the Wilkes Exploring Expedition in 1849. None of them appears to be definitely identifiable with any recent species.

Tellina chipolana n. sp.

Plate 47, Figure 6.

Oligocene of the Chipola beds at Alum Bluff and on the Chipola River, Florida; Burns.

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 lamellæ; 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. Lon. 38, alt. 23, diam. 11 mm.

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.

Tellina strophia n. sp.

PLATE 47, FIGURE 11.

Oligocene of the Chipola River, at Macdonald's farm, Calhoun County, Florida; Burns.

Shell elongate, subequilateral, slender, with inconspicuous beaks, rostrate, and sharply sculptured, with low, elevated, close-set concentric lamellæ, 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. Lon. 27, alt. 11, diam. 5 mm., but probably reaching a size one-third greater, judging by fragments collected.

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

Tellina segregata n. sp.

PLATE 37, FIGURES 7, 8.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida; Dall.

Shell small, subovate, subequilateral, beaks low; anterior end rounded, base evenly arched, posterior end feebly rostrate, obliquely truncate with two radial folds separated by a sulcus; lunule extremely narrow, impressed, smooth, the escutcheon slightly larger, similar but represented only on the left valve; disk almost compressed, surface finely radially striated, the concentric sculpture of fine, elevated threads, which on the anterior half have a tendency to segregate themselves in groups of four, separated by wider interspaces; near the base, however, the threads become crowded; as the threads pass backward one after another in each group fails, and the posterior half therefore shows much sparser threading and wider interspaces, while the persistent threads tend to become lamellose; the interior of the silicified type of this species is inaccessible. Lon. 17, alt. 10, diam. 4 mm.

This species appears to belong to the same group as *T. chipolana,* but the character of the sculpture is quite different.

Tellina (Macaliopsis?) merula n. sp.

PLATE 46, FIGURE 4.

Oligocene of the Tampa silex beds at Ballast Point.

Shell small, plump, subovate, anterior end longer, evenly rounded, base convexly arcuate, posterior end slightly flexed, hardly folded; obliquely bluntly pointed; beaks inconspicuous, lunule obscure; surface nearly smooth, with irregular concentric striation at intervals and sparse elevated concentric threads or lamellæ, usually worn off, and when present low and delicate; hinge normal, in the left valve feeble; pallial sinus large, subovate, largely confluent below. Lon. 16, alt. 12.2, diam. 8 mm.

Shell recalling *T. mera* Say but of different form.

Tellina (Macaliopsis) cloneta n. sp.

PLATE 46, FIGURE 8.

Oligocene of the Chipola River, Calhoun County, Florida.

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 striæ, but with very thin, regular, rather distant concentric, elevated lamellæ, 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. Lon. 13.5, alt. 8.5, diam. 4 mm.

Much more delicate and of a different form from the preceding species.

Tellina (Merisca) æquistriata Say.

Tellina æquistriata Say, Journ. Acad. Nat. Sci. Phila., iv., p. 145, pl. x., fig. 7, 1824; Harris, Bull. Am. Pal., i., p. 321, pl. 29, fig. 7, 1896.

Oligocene of Alum Bluff, Calhoun County, Florida; of the Bowden marl, Jamaica; Miocene of Maryland and the York River, Virginia; Pliocene of the Croatan and Waccamaw beds, North and South Carolina; recent, from North Carolina to Brazil, in moderate depths of water.

This species is closely related to the recent *T. lintea* Conrad, 1837, but when adult is more triangular and equilateral. The fossil specimens reach a size considerably in excess of any that I have hitherto examined among recent shells. Between those of equal size I have not observed any differences which might serve as a basis for even a varietal name, but the differences of the adults, above noted, probably render it desirable to keep the two forms separate until more is known about them. A single valve of the recent type was found in the Caloosahatchie marl.

Tellina (Merisca?) acrocosmia n. sp.

PLATE 46, FIGURE 10.

Oligocene of the Bowden beds of Jamaica, West Indies.

Shell small, rounded, triangular, with nearly central, inconspicuous beaks, and hardly pointed, slightly flexed, posterior end, the anterior end evenly rounded, base convexly arched; lunule obsolete; disk covered with a fine radial threading, more or less concealed by fine, elevated, concentric sharp lamellæ; hinge normal, teeth large and strong for the size of the shell; pallial sinus large, nearly reaching the anterior adductor scar, largely confluent below; above rising above the level of the posterior adductor. Lon. 7, alt. 5.5, diam. 3 mm.

This very compact and sharply sculptured little shell is very distinct from any of the other local or any American species.

Tellina (Merisca?) halidona n. sp.

PLATE 38, FIGURES 3, *3a*.

Oligocene of the Tampa silex beds at Ballast Point, Tampa Bay, Florida; Dall.

Shell small, solid, inflated, very inequilateral, elongate and rounded in front, obliquely subtruncate in front; beaks full, low, not conspicuous, base convexly arcuate; lunule and escutcheon obsolete; surface smooth or with incremental lines, not polished; hinge normal, pallial sinus high, short, mostly confluent below. Lon. 14.5, alt. 11.5, diam. 6.5 mm.

This species rests upon a single left valve of which a very perfect silicious pseudomorph was collected, consequently the hinge characters of the right valve are unknown. It seems highly probable, however, that it is referable to *Merisca*. *T.* (*Macaliopsis*) *merula* Dall is the most similar species of this horizon, but has a better developed hinge and different outline.

Tellina (Merisca) sclera n. sp.

PLATE 49, FIGURE 5.

Oligocene of the Bowden marls, Jamaica, West Indies.

Shell minute, short, plump, with low inflated beaks, rounded in front and below, shorter and blunt behind; slightly flexed, not rostrate, but with an obsolete posterior radial sulcus in the right valve; sculpture of elevated crowded concentric threads, becoming alternately obsolete towards the ends of the shell where the persistent threads are more elevated and tend to become lamellose; hinge normal, strong for the size of the shell; pallial sinus short, round, confluent below. Lon. 4.2, alt. 3.2, diam. 2 mm.

This little shell is not unlike *T. acrocosmia* Dall, but smaller and without the strong radial sculpture.

Tellina (Merisca) hypolispa n. sp.

Plate 46, Figure 23.

Oligocene of the Chipola horizon at Alum Bluff and on the Chipola River, Calhoun County, Florida, and of the Oak Grove sands at Oak Grove, Santa Rosa County, Florida.

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*. Lon. 13.5, alt. 8.5, diam. 5 mm.

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.

Tellina (Phyllodina) lepidota n. sp.

Plate 46, Figure 18.

Shell nearly flat, elongated, subequilateral; beak small, low, pustular; nepionic shell distinct, smooth, polished; profile of the dorsal slopes near the beaks rectilinear; anterior end rounded, posterior subrostrate, with, in the right valve, a single elevated ray extending to the posterior basal angle from the umbo; an extremely narrow lunule deeply impressed; margin of dorsal slopes close-set with oblique scales; surface of the disk with low, distant, concentric lamellæ with much wider, slightly excavated interspaces showing microscopic concentric striæ; interior showing the reflection of the surface undulations, polished; laterals long and slender, cardinals very small; pallial sinus obliquely ascending, narrow, free. Lon. 7.5, alt. 4 mm., taken from lines of growth on fragment 8.5 mm. long.

This fragment is from the Oligocene sandstones above the Eocene shales of Gatun on the line of the Panama Canal, and is so remarkable that I have thought it best to include it, since the species may turn up at any time in the equivalent beds of the Antilles or the Gulf States. The figure does not show the scales with sufficient distinctness.

Tellina (**Phyllodina**) **halistrepta** n. sp.

Plate 47, Figure 17.

Oligocene of the Bowden marl on the island of Jamaica; Henderson and Simpson.

Shell compressed, flattish, subequilateral, longer than high; beak small, low, resembling a pustule on the summit of the broad, smooth nepionic shell; surface marked anteriorly with rather close, low, elevated, concentric threads with about equal interspaces; near the posterior third of the disk these threads become less numerous by the cessation of alternate threads, making the interspaces wider, while the persistent threads become lamellose; in the type, which is a young shell, the dorsal margin is not coronate, but in an adult there are probably dorsal scales corresponding to the later lamellæ; hinge normal for the section, pallial line obscure. Lon. 9, alt. 5.5, diam. 1.2 mm.

Although this specimen is young, it is sufficiently characteristic and distinct to be recognized, though the adult very likely reaches twice or thrice the size of the one described.

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

Plate 30, Figure 7.

Tellina dodona Dall, this work, part iv., p. 925, pl. 30, fig. 7, 1898.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

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 ten) 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. Lon. 34, alt. 21, diam. 6 mm. Lon. of figured specimen, 16 mm.

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.

Tellina (Eurytellina) sp.

Oligocene of the Bowden marl, Jamaica, West Indies.

Fragments of quite a distinct species of *Eurytellina* were found in the marl, but I prefer to merely announce its presence until material fit for figuring is obtained.

Tellina (Eurytellina) roburina n.sp.

PLATE 47, FIGURE 9.

Oligocene of the Oak Grove sands, Santa Rosa County, Florida; Burns.

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, sublamellose 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. Lon. 39, alt. 22.5, diam. 8 mm.

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

Tellina (Moerella) Simpsoni n. sp.

PLATE 46, FIGURE 12.

Oligocene of the Bowden marl of Jamaica; Henderson and Simpson.

Shell small, inflated, equivalve, very inequilateral, polished; anterior dorsal slope rectilinear, anterior end rounded, base convexly arcuate; posterior end very short with a sudden constriction, slightly flexed, with the extremity bluntly pointed; beaks low, somewhat opisthogyrous, with a perceptible lunule; hinge normal, pallial sinus extending nearly to the anterior adductor scar, mostly confluent below. Lon. 7, alt. 5, diam. 4 mm.

This form is what Gabb identified as *T. cuneata* d'Orbigny, but the latter is less inflated and less flexuous behind. *T. Simpsoni* sometimes appears perfectly smooth, but other specimens show incremental sculpture.

Tellina (Moerella) Hendersoni n. sp.

PLATE 46, FIGURE 5.

Oligocene of the Bowden marl of Jamaica; Henderson and Simpson.

Shell small, moderately convex, very inequilateral; form resembling the preceding species but less inflated, more regular, with the posterior end not constricted or markedly flexed; surface polished, with, except near the beaks, fine, rather distant, concentric threads, which on the basal half of the posterior end rise into extremely delicate low lamellæ; hinge normal, strong; pallial sinus connecting the adductor scars and confluent below; there is a slightly impressed narrow lunule. Lon. 7.5, alt. 5, diam. 3 mm.

This species differs in sculpture, form of the pallial sinus, and other details from the other allied forms.

Tellina (Moerella) acloneta n. sp.

Plate 46, Figure 16.

Oligocene beds of the Chipola River, Calhoun County, Florida; Burns.

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. Lon. 4.7, alt. 3.0, diam. 1.5 mm.

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.

Tellina (Angulus) pharcida n. sp.

Plate 46, Figure 7.

Oligocene of Bowden, Jamaica; Henderson and Simpson.

Shell small, elongate, very inequilateral, moderately convex; anterior end produced, rounded; posterior end short, roundly pointed, with a slight flexure; beaks in the posterior third; surface covered with extremely fine close-set grooves; sculpture as usual a little stronger near the posterior end; beaks low, pointed; lunule obsolete; hinge normal, pallial sinus obscure in the polish of the interior but probably normal; no thickened rays. Lon. 5.5, alt. 3, diam. 1.5 mm.

This small form recalls *T. sybaritica* Dall, which is a larger, more solid, and more flexuous shell. It may not be fully adult, but is not the young of any of the other species which were obtained from the Bowden marl at the same time.

Tellina (Moerella) nucinella n. sp.

Plate 46, Figure 19.

Oligocene sands of Oak Grove, Santa Rosa County, Florida.

Shell minute, ovate, equivalve, very inequilateral; beaks pointed, low; anterior end produced, rounded; posterior end much shorter, wider, and bluntly rounded; sculpture of uniform, close-set, rounded threads which in the posterior third become alternately higher and here cross minute close radial striæ; lunule and escutcheon absent; hinge normal, strong, ligament very short; pallial sinus obliquely ascending, rounded, short, free from the pallial line below. Lon. 3.5, alt. 2.3, diam. 1.0 mm.

A single right valve of this little species was obtained from the marl. It recalls *T. ovalis* Lea from the Claibornian, but is proportionately shorter.

Tellina (Angulus) pressa n. sp.

Plate 47, Figure 5.

Oligocene marl of Bowden, Jamaica, and of the Chipola River, Calhoun County, Florida.

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 lamellæ; 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. Lon. 12.5, alt. 7.5, diam. 2 mm.

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.

Tellina (Angulus) acosmita n. sp.

Plate 46, Figure 1.

Oligocene of the Chipola beds, Chipola River, Calhoun County, Florida; Dall and Burns.

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. Lon. 10.5, alt. 5, diam. 2.5 mm.

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

Tellina (**Angulus**) **agria** n. sp.

PLATE 46, FIGURE 11.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell resembling the preceding species, 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*. Lon. 6.7, alt. 3.5, diam. 2 mm.

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

Tellina (**Angulus**) **acalypta** n. sp.

PLATE 47, FIGURE 12.

Oligocene of the Chipola horizon at Alum Bluff, Calhoun County, and in Walton County, Florida; also in the Oak Grove sands, Santa Rosa County, Florida; Burns.

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 towards 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. Lon. 10.5, lat. 5.5, diam. 2.5 mm.

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

Tellina (Scissula) scitula n. sp.

PLATE 47, FIGURE 15.

Oligocene of Santo Domingo and of Bowden, Jamaica.

Shell small, thin, elongate-ovate, polished, inequilateral; rounded in front, moderately pointed behind; beaks low; surface with fine, regular, rather close striæ extending obliquely backward towards the base, with more or less evident microscopic radial striulation; posterior dorsal areas minutely concentrically waved; interior with no thickened rays; hinge normal, very delicate; pallial sinus long, high, normal. Lon. 8, alt. 4.2, diam. 1.5 mm.

From the young of *T. iris* Say of the same size it is at once distinguishable by the much finer and closer and more oblique striation and the more pointed posterior end.

Tellina (Scissula) lampra n. sp.

PLATE 46, FIGURE 14.

Oligocene of the Chipola horizon at Alum Bluff, and on the Chipola River, Calhoun County, Florida.

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 towards 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. Lon. 8.6, alt. 7.3, diam. 4 mm.

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.

This completes the list of species belonging to the various subdivisions of the genus *Tellina* known from the Oligocene of North America and the West Indies. The Eocene and Oligocene of middle America, judging by material in my possession, will eventually add very largely to this number. Omitting those species of doubtful horizon from Oregon and California which have already been referred to, we may now conveniently consider the Neocene species in one list, not forgetting that some of them which reach the Oligocene have already been referred to. *Tellina* (*Eurytellina*) *appressa* Gabb, 1881, from the Pliocene of Costa Rica, is unfigured, but is said to resemble *T. rufescens* Chemnitz; *T.* (*Peronidia?*) *arctata* Conrad, 1843 (not *T. arctata* Conrad, Wilkes Exped., 1849, from Oregon = *Macoma arctata* Dall), from the Upper Miocene of North Carolina; *T. abrupta* Conrad (in Meek's Miocene Checklist, 1864), from the Miocene of Oregon, seems to be a mere list name, as I have been unable to find any other reference to it; *T.* (*Peronidia*) *bodegensis* Hinds, 1844 (not the same as *emacerata* Conrad, 1849, as suspected by Gabb), is abundant in the Pleistocene of San Diego and San Pedro, California; the specimens cited under this name from lower horizons require further examination; *T.* (*Angulus*) *capillifera* Conrad, 1866 (+ *T. shilohensis* Heilprin, 1887, list name), Lower Miocene of Shiloh, New Jersey; *T.* (*Angulus*) *declivis* Conrad, 1834, Lower Miocene of Shiloh, New Jersey, of Plum Point and Jones Wharf, Maryland, of Petersburg, Virginia, Upper Miocene of York River and Suffolk, Virginia, Pliocene of Shell Creek, Florida, and Pleistocene of North Creek, Osprey, Florida; this species is very close to *T.* (*Angulus*) *polita* Say, of the recent fauna, but the latter is a more ventricose shell and the right anterior lateral is longer than in the fossil; *T.* (*Peronidia?*) *egena* Conrad, 1834, Miocene of James River, Virginia; *T.* (*Merisca*) *lintea* Conrad, 1837 (not *T. lintea* Conrad, Vicksburgian, 1848, which is a *Psammobia*), Upper Miocene or Pliocene of New Berne, North Carolina, a species very near *T. æquistriata* but larger and more produced; *T.* (*Angulus?*) *peracuta* Conrad, 1866, a somewhat dubious species from the Lower Miocene marls of Cumberland County, New Jersey; *T.* (*Angulus*) *producta* Conrad, 1840, Miocene of Plum Point and Blake's Cliffs, Maryland, of Petersburg, Virginia, and the Pliocene or transition beds at the northern end of the Dismal Swamp, Virginia. For other species refer to the genus *Macoma* and the following descriptions.

Tellina (Eurytellina) alternata Say.

Tellina alternata Say, Journ. Acad. Nat. Sci. Phila., iv., p. 275, 1822; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 89, pl. 22, fig. 4, 1857; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 573, 1863; Gabb, Geol. St. Domingo, p. 248, 1873; Plioc. Fos. Costa Rica, p. 371, 1881.

Pliocene of the Caloosahatchie beds, on Shell Creek and the Caloosahatchie River, Florida; of South Carolina (Haldeman); of the Croatan beds and the Neuse River below New Berne, North Carolina; Pleistocene of Simmons Bluff, South Carolina; and recent from Cape Hatteras, North Carolina, south to Belize and St. Domingo.

I have not found any satisfactory evidence of the presence of this species in beds earlier than the Pliocene, the references to the Miocene being due to a confusion of Miocene and Pliocene deposits or misidentification with other species. It is certain at least that the assertion that it is found in Miocene beds requires confirmation. This species is said by Dunker and Krebs to be synonymous with *Tellina subradiata* Schumacher, but I have been unable to find the place of publication of Schumacher's name, if it has been published.

An allied species, *T.* (*Eurytellina*) *rubescens* Hanley, now living in West Mexican waters, occurs in the Pleistocene of San Pedro, California.

Tellina (Eurytellina) scapha n. sp.

Plate 47, Figure 16.

Upper Miocene at Lee's wharf, Nansemond River, near Suffolk, Virginia; Burns.

Shell thin, light, moderately convex, inequilateral, the anterior end longer, higher, evenly rounded; the posterior end short, attenuated, with an obsolete fold, vertically rounded-truncate; beaks low, lunule and escutcheon obsolete; surface smooth or marked only with incremental lines a little stronger on the posterior dorsal area; hinge normal, hinge-line thin, pallial impressions obscure, the sinus probably falling short of the anterior adductor scar. Lon. 30, alt. 16.5, diam. 7 mm.

A single left valve was obtained by Burns which has the aspect of a *Eurytellina*. In form it resembles Conrad's dubious *Tellina arctata,* but wants the broad hinge-plate and concentric elevated lines.

Tellina (Merisca) caloosana n. sp.

Plate 47, Figure 2.

Pliocene marls of the Caloosahatchie River, Florida, near the site of Fort Thompson; Dall.

Shell small, plump, ovate, slightly inequivalve, nearly equilateral, slightly flexuous behind, but hardly rostrate, posterior dorsal area marked by a shallow sulcus; beaks pointed, conspicuous, a well-marked lunular impression in front of and escutcheon behind them; surface covered with small, sharp, regularly spaced elevated concentric lamellæ; upper part of the pallial sinus connecting the adductor scars, the lower part wholly confluent with the pallial line. Lon. 8, alt. 6, diam. 3 mm.

This little shell differs from the young of *æquistriata* by its inflation; from *T. martinicensis* d'Orbigny, its nearest ally, by its more crowded surface lamellation and the form of the pallial sinus, the latter in the recent shell failing to reach the anterior adductor scar and running for some distance, after turning, nearly parallel with the pallial line below, before becoming confluent with it.

With it was found a single valve which could only be referred, after careful comparisons, to the recent *T. mera* Say, still abundant in the Antillean region, Bermuda, and on our southern coast.

Tellina (Merisca) dinomera n. sp.

PLATE 47, FIGURE 19.

Pliocene marls of the Caloosahatchie River, Florida; Dall.

Shell solid, rotund, rather convex, nearly equilateral; beaks pointed, with a small narrow lunule impressed before them; surface faintly concentrically striate with no radial lines, and with numerous, regularly spaced, elevated, concentric lamellæ; a well-marked radial fold borders the dorsal area below; hinge normal, strong, sinus gibbous, not attaining the anterior adductor and about half confluent below. Lon. 18, alt. 15, diam. 8 mm.

This differs from the closely allied *T. mera* Say, also found in the same marls, by being much heavier and more strongly sculptured and with the dorsal slope more abruptly descending behind; *T. promera* Dall, also very similar, has the lateral teeth nearer the cardinals and a larger and more gibbous pallial sinus, free from the adductors in both valves.

Tellina (Cyclotellina) fausta Donovan.

Tellina fausta Donovan, Nat. Hist. Brit. Shells, iii., pl. 98, 1801; Dillwyn, Descr. Cat. Rec. Shells, i., p. 94, 1817; Wood, Gen. Conch., p. 185, 1815; Pulteney, Dorset Cat., p. 29; Montagu, Test. Brit., i., p. 64, 1803.

Tellina remies Born, Mus. Test. Vind., p. 36, pl. 2, fig. 11, 1780; not of Linné, 1768.

Tellina lævis Wood, Gen. Conch., p. 181, pl. 37, fig. 1, 1815.

A single young valve, agreeing perfectly with the young of the recent shell now inhabiting the same region, was found in the Pliocene marl of the Caloosahatchie. This species was originally described as British from adventitious specimens, but is an inhabitant of south Florida and the Antilles.

Tellina (Moerella) suberis n. sp.

PLATE 46, FIGURE 25.

Pliocene of the Caloosahatchie marls.

Shell small, solid, inflated, polished, very inequilateral, produced and rounded in front; short, distinctly folded, and slightly flexed behind; beaks small, high, with a deeply impressed lunule in front of them; hinge normal, teeth strong; surface mostly smooth or showing faint incremental lines, but towards the basal margin and on the posterior dorsal area exhibiting a few distant rather irregular elevated lines; interior with the upper part of the pallial sinus connecting the adductors and wholly confluent in the pallial line below. Lon. 7, alt. 5, diam. 3 mm.

This little shell differs from *T. Gouldii* Hanley by its flexuous posterior end and less regular form. From *T. martinicensis* d'Orbigny, which is nearly allied, *T. suberis* differs by its blunter posterior end, less sculptured surface, and wholly confluent pallial sinus below.

The species associated under the name of *Angulus* in our later Tertiary are very puzzling. There are about as many forms in the Miocene and Pliocene as there are in the recent fauna of the coast, and in most cases it may be surmised that the recent forms are the descendants of the fossil ones. The resemblance in many cases is so close that a hasty examination would result in their being united under one name, as I myself did when making provisional identification of part of the material here treated. More thorough study has shown that a certain amount of constant difference separates a number of the older forms from their recent representatives, and these have been consequently regarded as distinct in the final arrangement.

Tellina (Angulus) dupliniana n. sp.

Plate 46, Figure 17.

Miocene of Wilmington, of the Natural Well and Magnolia, Duplin County, North Carolina; of Plum Point, Maryland; and of York River, Virginia; Pliocene of the Waccamaw beds at Mrs. Guion's marl pit, Waccamaw River, South Carolina; Burns, Harris, and C. W. Johnson.

Shell small, solid, rather convex, inequilateral, dorsal margins rectilinear, diverging at an angle of about one hundred and eight degrees, anterior end longer, rounded evenly into the base, which is nearly parallel with the anterior dorsal margin; posterior end much shorter, pointed, the terminal angle slightly decumbent and the basal margin in front of it slightly incurved; beaks inconspicuous, hinge normal, the right adjacent lateral short and the anterior hinge-margin in front of it grooved for the edge of the opposite valve; middle of the disk smooth, the beaks, posterior dorsal area, and the portions of the disk near the basal margin more or less concentrically striated; interior with the pallial sinus rising to a small angle under the umbo, then descending in a somewhat wavy line to a point on the pallial line considerably short of the anterior adductor scar; in the left valve the sinus is not angulated above and extends somewhat nearer the adductor; the interior is marked with some faint radiations near the adductors, but no thickened ray appears. Lon. 12.5, alt. 8, diam. 4 mm.

There is some little difference in the proportional height in different individuals, in the amount of inflation, and in the arcuation of the posterior dorsal margin; the posterior fold, or ridge bounding the posterior dorsal area, is not strongly marked. Compared with *T. tenella* Verrill, this species is a heavier and higher shell, with the posterior end more pointed and decurved. The dorsal margin of the right valve is not grooved in *T. tenella,* and the adjacent lateral is longer than in *T. dupliniana* of the same size.

Tellina (Angulus) umbra n. sp.

PLATE 46, FIGURE 13.

Upper Miocene of North Carolina, at Wilmington, and in Duplin County, at the Natural Well, and Magnolia; and of St. Mary's, Maryland; Pliocene of the Waccamaw district, South Carolina, at Mrs. Guion's marl-pit, and of the Caloosahatchie River, Florida; Pleistocene of North Creek, Osprey, Florida.

Shell small, solid, markedly flexuous, moderately convex, inequilateral, nearly equivalve; anterior end longer, rounded; posterior end shorter, attenuated, bluntly pointed; beaks inconspicuous; whole surface covered with close-set, regular, even, concentric threads; hinge normal, right anterior lateral short and stout, posterior lateral small but prominent; pallial sinus long, slightly convex above, reaching to the anterior ray (which is obviously thickened), nearly similar in both valves, and wholly confluent below. Lon. 12.5, alt. 6.5, diam. 3.5 mm.

This species is nearest to *T. sybaritica* Dall, but is a larger and less slender shell, with a less angular posterior end. It is doubtless the precursor of that species.

Tellina (Angulus) propetenella n. sp.

PLATE 46, FIGURE 6.

Upper Miocene of York River, Virginia, and Wilmington, North Carolina; Pliocene of the Caloosahatchie River, Florida, and of the Waccamaw beds at Tilly's Lake, South Carolina.

Shell small, solid, hardly convex, subequivalve, inequilateral, with rather high beaks at about the posterior third; dorsal slopes rectilinear; anterior end rounded, posterior bluntly pointed, hardly flexed, with the umbo-basal ridge hardly marked; posterior angle nearly basal with the basal margin slightly incurved in front of it; surface with irregular, feeble, concentric incremental lines; hinge normal, teeth small, hinge-margin grooved in front of and behind them; pallial sinus rather shorter than usual and more arched above; the internal ray feeble. Lon. 10, alt. 6.25, diam. 3 mm.

This species approaches *T. tenella* Verrill, but is less arcuate, blunter behind, and with the sculpture less sharp, regular, and close. The left valve is usually a little flatter than the right, and there is a notable difference in individuals in the amount of arcuation, just as in *T. tenella*.

Tellina (Angulus) macilenta n. sp.

Plate 46, Figure 20.

Miocene of the Natural Well, Duplin County, North Carolina.

Shell solid, subtrigonal, moderately convex, equivalve; inequilateral; anterior end longer, rounded, posterior roundly pointed near the base; beaks pointed, dorsal margins slightly arched; surface polished, faintly distantly concentrically striated; near the basal margin the striæ become regular and more sharp and conspicuous; posterior dorsal area nearly smooth, posterior end not folded, but slightly flexed; hinge normal, adjacent lateral short, strong, and prominent; pallial sinus somewhat arched above, long, wholly confluent below; interior more or less radially striate; in the left valve the thickened rays inside the adductor scars are obvious. Lon. 16.5, alt. 10.5, diam. 5.5 mm.

This form is not intimately related to any of the recent species, and is easily discriminated by its solid, subtrigonal valves, size, and shortness from any of the Miocene species.

Tellina (Angulus) Sayi Deshayes.

Tellina polita Say, Journ. Acad. Nat. Sci. Phila., ii., p. 276, 1822; Am. Conch., pl. lxv., fig. 2, 1834; Hanley, Thes. Conch., i., p. 282, pl. 57, fig. 60, 1847; Philippi, Abb. und Beschr., ii., p. 27, pl. 3, fig. 10, 1846.

Angulus polita (*sic*) Holmes, P.-Pl. Fos. S. Car., p. 45, pl. 8, fig. 2, 1858; H. and A. Adams, Gen. Rec. Moll., ii., p. 398, 1856.

Not *Tellina polita* Spengler, Nat. Selsk., iv., pt. 2, p. 107, No. 38, 1798; nor of Pulteney, Dorset Cat., p. 29, 1813; nor of Sowerby, Tankerville Cat., App., p. iv., 1825; nor of Poli, Risso, Blainville, etc., 1795-1825.

Tellina Sayi Desh., MS.

Pliocene of the Caloosahatchie River, Florida, of South Carolina, of the Croatan beds, North Carolina; Dall and Johnson; recent from North Carolina to Yucatan.

The well-known name of this species must be changed, as it had been used for a *Tellina* three or four times before Say so applied it, and one of the prior attempts, at least, was made on a species of *Angulus*. The name of Deshayes is suggested in one of his manuscripts in my possession.

Tellina (Angulus) propetenera n. sp.

Plate 47, Figure 7.

Pliocene of the Caloosahatchie River, Florida; Dall.

Shell moderately convex, equivalve, subequilateral; beaks rather prominent, anterior end rounded, posterior dorsal slope convex, the end slightly decumbent, the basal margin in front of it slightly incurved; surface polished, with concentric striæ and somewhat irregular, sharp, elevated lines, not always in harmony with the lines of growth, and which become more numerous and crowded near the basal margin; pallial sinus high, rising to an angle above the level of the posterior adductor scar in the left valve, and then descending to the pallial line at the distal end of the anterior thickened ray, and wholly confluent with the pallial line below; hinge normal, shell moderately thick, with some internal radial lines. Lon. 16, alt. 10, diam. 4.5 mm.

This shell is nearest *T. tenera* Say, but larger and more solid, with a strong thickened internal ray, its posterior dorsal margin more arched, and the valves more nearly equilateral.

T. (Angulus) mera Say and *T. (Angulus) tampaensis* Conrad are also found in the Pliocene marls of the Caloosahatchie River.

Tellina (Scissula) similis Sowerby.

Tellina similis Sby., British Misc., pl. 75, 1806; Turton, Conch. Dict., p. 170, 1819; Hanley, Thes. Conch., p. 285, pl. 57, fig. 65, 1846; D'Orbigny, Moll. Cubana, ii., p. 249, 1853.

Tellina decora Say, Journ. Acad. Nat. Sci. Phila., v., p. 219, 1827; De Kay, Zool. N. Y., v., p. 211, 1843; Hanley, Thes. Conch., i., p. 285, pl. 56, fig. 27, 1846 (not pl. 59, fig. 127, nor pl. 66, fig. 260); Binney's Say, p. 126, 1858.

Tellina iris Philippi (non Say), Abb. und Beschr., ii., p. 25, pl. iii., fig. 5, 1845.

Tellina (Angulus) decora H. and A. Adams, Gen. Rec. Moll., ii., p. 397, 1856.

Pliocene of the Caloosahatchie River, Florida, Dall; recent from Florida and Bermuda, south to Venezuela.

There can be no reasonable doubt that Sowerby's *Tellina similis* was founded upon a large white specimen of Say's *Tellina decora*, and the latter name, familiar and appropriate as it is, will have to be dropped.

Tellina (Scissula) calliglypta n. sp.

PLATE 47, FIGURE 1.

Pliocene of Shell Creek, Florida; Willcox.

Shell small, solid, subtrigonal, moderately convex, nearly equilateral, equivalve; beaks high, dorsal slopes rapidly descending; anterior end rounded, posterior end slightly decumbent and sharply pointed, basal margin sinuous; rostrum with a feeble ridge bordering the dorsal area, hardly flexed; surface polished, with faint incremental lines, obliquely, finely, closely grooved over the entire disk from the anterior end to the borders of the posterior dorsal area, which shows only sharp concentric grooving, most obvious in the right valve; pallial sinus slightly angular above, not reaching the anterior adductor, wholly confluent below, similar in both valves; interior with a few radial striæ, the ray obsolete. Lon. 13.5, alt. 9, diam. 4.5 mm., some specimens reaching a length of 18.5 and a height of 11.5 mm.

This fine species in combination of form and sculpture is unlike any other recent or fossil known from the region.

Tellina (Oudardia) Buttoni Dall.

PLATE 47, FIGURE 18.

Angulus modestus of California collectors, not of Carpenter.
Angulus? var. *obtusus* Carpenter, Suppl. Rep. Brit. Assoc. for 1863, p. 639, 1864.
Tellina (*Angulus*) var. *obtusus* Carpenter, Proc. Acad. Nat. Sci. Phila., p. 56, 1865.
Not *Tellina obtusa* Sowerby, Min. Conch., ii., p. 175, pl. 179, fig. 4, 1818.

Pleistocene of San Diego, California, Hemphill and Stearns; recent from Lituya Bay, Alaska, south to the Gulf of California.

The specific name of this species being preoccupied in the genus, I propose that above mentioned in honor of Mr. F. L. Button, an enthusiastic student and collector of Pacific coast shells.

The species is milk white, polished, with faint incremental lines, subequivalve, and slightly flexed; the pallial sinus is angular above and behind in the right valve and elongate oval in the left, in both reaching to the anterior ray, which is well defined and strong. Below the sinus is wholly confluent with the pallial line; there are two minor posterior rays in front of the posterior adductor. Lon. 20, alt. 12, diam. 3.5 mm.

The original *T.* (*Angulus*) *modesta* Carpenter is a distinct species, as the type in the National Museum indicates.

This concludes the list of species belonging to the genus *Tellina* so far known from the Tertiary of the United States.

Genus **TELLIDORA** Mörch.

Tellidora Mörch, in Adams, Gen. Rec. Moll., ii., p. 401, 1856. Type *T. Burneti* Brod. and Sby.

Lucina (sp.) Récluz, Rév. Cuv., p. 270, 1842, Mag. de Zool., pl. 60, 1843.

Tellina (sp.) Brod. and Sby., Zool. Journ., iv., p. 362, pl. ix., fig. 2, 1839.

This fine genus is often quoted as of Mörch, "1851," but Dr. Mörch published nothing in 1851 and his publications of 1850 and 1853 contain no reference to this genus. I have not been able to find any earlier citation of it than that given in the "Genera of Recent Mollusca" cited above, though it is possible the name may have been mentioned by some correspondent of Mörch in some anterior publication which I have not discovered.

The group is linked to *Tellina* by such forms as *Phyllodina.*

Tellidora cristata Récluz.

Lucina cristata Récluz, Révue Cuvier., p. 270, 1742; Guérin, Mag. de Zool., pl. 60, 1843.

Tellina lunulata (Holmes MS.) Adams, Genera of Rec. Moll., ii., p. 401, 1856.

Tellidora lunulata H. and A. Adams, Genera Rec. Moll., ii., p. 401, 1856; Holmes, P.-Pl. Fos. S. Car., p. 47, pl. ix., fig. 7, *a-b,* 1858.

Tellidora cristata Dall, Bull. 37, U. S. Nat. Mus., p. 62, 1889.

Pliocene of the Caloosahatchie and Shell Creek, Florida; Pleistocene of the Carolinas; recent from North Carolina southward to Campeche and Trinidad Island.

This is closely related to the *T. Burneti,* but is less compressed and the flatter valve is the left one, while in *T. Burneti* it is the right.

Tellidora Burneti Broderip and Sowerby.

Tellina Burneti Brod. and Sby., Zool. Journ., iv., p. 362, pl. ix., fig. 2, 1839; Cpr. Maz. Cat., p. 39, 1857.

Tellidora Burneti H. and A. Adams, Gen. Rec. Moll., ii., pl. 104, fig. 3, p. 401, 1856; Holmes, P.-Pl. Fos. S. Car., p. 48, pl. ix., fig. 6, *a-b,* 1858.

Pleistocene of Lower California (Hemphill); recent in the Gulf of California and southward to Panama.

Carpenter states, on the authority of Woodward, that "a species of similar form is found fossil in the Palæozoic rocks, agreeing more with the Atlantic shell" (Maz. Cat., p. 39), but this must refer to some Pelecypod not congeneric, since the oldest *Tellinidæ* do not pass below the Lower Cretaceous, and *Tellidora* is not known in any beds older than the Pliocene.

Genus **STRIGILLA** Turton.

Strigilla Turton, Dithyra Brit., p. 117, 1822; *Tellina carnaria* Linné, non Pennant.
Strigella Gray, Synops. Brit. Mus., p. 91, 1842 (err. typ. for *Strigilla*).
Strigillina Stoliczka, Cret. Pel. India, p. 120, 1870; not of Dunker, 1862.
Limicola (Leach) Fischer, Man. de Conchyl., p. 1149, 1887; not of Leach, 1852.
Strigula Pfeiffer, Malacozoologische Blätter für 1861, vii., Index; not of Perry, 1811.

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 chiselled 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 (*S. senegalensis*); 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. Ignorance of these facts is responsible for a long list of synonyms among the recent species, especially on the Pacific coast.

Strigilla pisiformis Linné.

Tellina pisiformis Linné, Syst. Naturæ, ed. x., p. 677, 1758; Hanley, Thes. Conch., *Tellina,* p. 261, pl. lvi., fig. 30, 1847.
Cardium discors Montagu, Test. Brit., p. 84, 1803.
Strigilla pisiformis H. and A. Adams, Gen. Rec. Moll., ii., p. 399, 1856.

Oligocene of Bowden, Jamaica, Henderson and Simpson; Pliocene of Trinidad, Guppy; Pleistocene of the Antillean region generally, and recent throughout the West Indies and as far north as Cape Hatteras.

Guppy cites *S. carnaria* L. from the Bowden beds, but his specimens and all the specimens I have seen from the Bowden marl are identical, so far as I can judge, with the present species.

Strigilla flexuosa Say.

Tellina flexuosa Say, Journ. Acad. Nat. Sci. Phila., ii., p. 303, 1822; Hanley, Thes. Conch., p. 261, pl. lvi., figs. 28, 29, 1847; Holmes, P.-Pl. Fos. S. Car., p. 44, pl. vii., fig. 14, 1858.

Tellina mirabilis Philippi, Arch. für Naturg., 1841, i., p. 260.

Strigilla flexuosa H. and A. Adams, Gen. Rec. Moll., ii., p. 399, 1856.

Strigilla carolinensis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 573.

Oligocene of the lower bed at Alum Bluff, Florida; Miocene of the Natural Well and at Magnolia, Duplin County, North Carolina; Pliocene of the Caloosahatchie and Shell Creek, Florida; Post-Pliocene of North and South Carolina; and recent from Cape Hatteras, North Carolina, southward to Bermuda and the Antilles.

Holmes's figure, cited above, is poor; the artist has drawn the teeth in the reversed position, probably by inadvertence. Conrad's name is based on the figure in the "Pliocene Fossils of South Carolina," pl. xxii., fig. 7, which is an excellent representation of the recent *S. flexuosa,* though derived from the Miocene of Peedee River, South Carolina.

Strigilla prora Gabb (Am. Journ. Conch., v., p. 30, 1870), from the Tertiary of Payta, Peru, is not a *Strigilla.* The species described by Hanley under the name of *prora* and cited by Gabb is a *Eurytellina.*

Genus **METIS** H. and A. Adams.

?Capsa (sp.) Bruguière, Encycl. Méth., i., pl. 231, figs. 1 *a-c?* 1797; species undeterminable *fide* Bory St. Vincent, 1827.

Capsa Lamarck, Prodrome Nouv. Class. Coq., p. 84, 1799; sole ex. *Tellina angulata* Linné.

Caspa Bosc, Hist. Nat. Coq., p. 18, 1802 (err. typ. for *Capsa*).

Not *Capsa* Humphrey, Mus. Calon., p. 59, May, 1797 (= *Cyrena Keraudrenii fide* Mörch); nor *Capsa* Lamarck, Systeme d'un Nouv. class., p. 126, 1801 (= *Asaphis* Modeer, 1793); nor *Capsa* Lam., An. s. Vert., v., 553, 1818 (= *Iphigenia* Schum., 1817).

Tellina (sp.) Bruguière, Encycl. Méth., ii., pl. 287, fig. 3, pl. 290, fig. 14, 1797; Lamarck, An. s. Vert., v., pp. 530, 531, 1818.

Lutricola Cpr., Suppl. Rep. Brit. As., p. 639, 1863; sole ex. *L. alta* Conr. Not *Lutricola* Blainv., Man. Mal., i., p. 566, 1825 (= *Thracia* + *Scrobicularia* + *Eastonia*).

Metis H. and A. Adams, Gen. Rec. Moll., ii., p. 399 (sole ex. *T. Meyeri* Phil.) + *Capsa* H. and A. Adams, *op. cit.*, p. 409, 1856; not *Capsa* Leach, Moll. Gt. Brit., p. 298, 1852, = *Venerupis;* nor Tryon, Cat. Tell., p. 99, 1869, = *Macalia* Adams.

The generic name *Capsa* has been more ill used than almost any other in our nomenclature. The first use of it probably was by Humphrey in May, 1797, for a fresh-water shell from New South Wales said to be the *Venus erosa* of Solander in the Portland Catalogue (No. 3961). A manuscript note by Mörch in his copy of Humphrey states that this was *Cyrena Keraudreni,* but neither the species nor the genus was described in either the Calonne or the Portland Catalogue. The volume of the plates of the Encyclopédie Méthodique, in which plate 231 appears, has the date 1797 on its title-page, and no text appeared until 1827 owing to the death of Bruguière. There are no specific names on the plates, only the generic name above the neat-line of the engraving. Three types are represented on the plate labelled *Capsa.* Figure 1 may perhaps be a *Metis,* but is represented with an entire pallial line. Figure 2 is *Tellina Bruguièri* Hanley, 1846, for which H. Adams in 1860 proposed the generic name of *Macalia* (not, as indicated by Fischer, Man., p. 1150, typified by *Macoma inquinata* Desh.). Figures 3 and 4 are species of *Asaphis* (Modeer, 1793). If Humphrey's name is the earliest, it is indeterminable and must be dropped from nomenclature. If Bruguière came first, then the type of *Capsa* must be either *Tellina Bruguièri,* which was adopted by Tryon in 1869, or the indeterminable possible *Metis* at the top of the plate, since the type must, according to modern rules, be taken from among those species associated with a generic name by its author at the time of its first publication. Lamarck named *Tellina angulata* L. as his sole example of *Capsa* in the Prodrome of 1799. This is a somewhat doubtful species, but probably the shell Lamarck had in mind was *T. Bruguièri* Hanley,* and if so the same as Bruguière's Figure 2. The second attempt of Lamarck exemplified *Capsa* †

* Schumacher in 1817 (Essai, p. 130) applies the name *Capsula* to *Asaphis,* and credits its authorship to Hwass, who prepared the manuscript of the Museum Calonnianum.

† A shell extremely similar to this figure 2 of Bruguière is figured by Chemnitz, Conch. Cab., vi., p. 89, pl. 9, figs. 74-75, under the name of *Tellina angulata* of Linné, and it is entirely probable that Lamarck had this in mind, though Hanley has shown that it is probably not the original *T. angulata* of Linné. This was also Tryon's opinion.

by *Asaphis,* which is prior; and the third by *Iphigenia,* which is not among Bruguière's figures and cannot be accepted. Bosc, in adopting Lamarck's genus and type of 1799, misspelled the name "*Caspa.*" Under the circumstances it is probably best to assume that Humphrey (as is entirely probable) preceded Bruguière and expel the term *Capsa* from accepted nomenclature. H. and A. Adams, curiously enough, proposed the name *Metis* for one species of the group which they placed under *Tellina* as a subgenus, while they gathered the other species of the same group as a subgenus of *Scrobicularia,* which they called *Capsa.* In 1825 Blainville consolidated several older genera into one, and instead of utilizing the oldest name for this group, proposed a new one, *Lutricola,* in violation of the rules of nomenclature; and in 1863 Carpenter revived this rejected name for the species properly belonging under *Metis,* an inadmissible proceeding.

This group, extending, with its characteristics well developed, far back into the Tertiary, seems entitled to generic rank, on the same grounds as *Strigilla,* etc. The type is *Tellina Meyeri* Dunker (in Phil.), a recent species from the East Indies.

Metis trinitaria n. sp.

PLATE 46, FIGURE 24.

Tellina biplicata Guppy, Proc. Geol. Soc., v., 22, p. 588, 1866 (not of Conrad); Proc. Sci. Assoc. Trinidad, p. 161, 1867, etc.

Tellina sagræ Guppy, Quart. Journ. Geol. Soc. Lond., Nov., 1876, p. 530; Dall and Guppy, Proc. U. S. Nat. Mus., xix., p. 329, 1896; not of d'Orbigny.

Oligocene of the West Indies, in the "Caroni series" of Trinidad, and near Santiago de Cuba at about two hundred and fifty feet elevation on the line of the ore railway; Guppy and King.

Shell anteriorly elongated and dorso-ventrally attenuated, the anterior dorsal slope rapid, the anterior end rounded; the disk mesially constricted, the posterior end short, high, blunt, strongly folded; beaks high, surface sculptured with numerous small, sharp, slightly elevated concentric lamellæ, which are closer towards the ends of the shell; interior with the pallial sinus larger and higher in the left valve, about half confluent below, deep and rounded in front. Lon. 52, alt. 41, diam. 19 mm., but reaching twice this size.

The peculiar anterior elongation and arcuate form of this species distinguish it clearly from the other American species. Guppy erroneously identified it with a Miocene and also with a Pleistocene species, from both of which comparison shows it perfectly distinct.

Metis chipolana n. sp.

Plate 47, Figure 21.

Oligocene of the Chipola horizon, at Alum Bluff and the Chipola River, Florida; Burns.

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 towards the base and over the fold; pallial sinus obliquely ascending, free from the pallial line below, as in *Arcopagia*. Lon. 44, alt. 36, diam. 16 mm.

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.

Metis biplicata Conrad.

Tellina biplicata Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 152, 1834; Fos. Medial Tert., p. 36, pl. xix., fig. 4, 1840; not of Tuomey and Holmes, Guppy, or Emmons.

Metis biplicata Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 573 (in part), 1863; Am. Journ. Conch., v., p. 99, 1869.

Lower Miocene of Maryland, on the Choptank River, the Patuxent, Plum Point, etc.; Pliocene of the Caloosahatchie River, Florida (?).

The Caloosahatchie specimen is quite imperfect and requires confirmation by better material, but as far as it goes it resembles this species more than any of the others. *M. biplicata* has been confused with several other species which are discriminated in this memoir, but which seem quite recognizable. The pallial sinus is low, subequal in the two valves, and partly confluent below.

Metis magnoliana n. sp.

Plate 49, Figure 6.

Tellina biplicata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 88, pl. xxii., fig. 3, 1856; Emmons, Geol. Rep. N. Car., p. 296, fig. 225, 1858; not of Conrad, 1834.

Upper Miocene of the Peedee River, South Carolina, and of the Natural Well and Magnolia, Duplin County, North Carolina; Tuomey and Burns.

Shell subquadrate, subequilateral, rounded in front, with the posterior dorsal area compressed and elevated, extending backward beyond the posterior basal angle as a rounded winglike extension of the shell; posterior end strongly folded, middle of the disk nearly smooth except for fine radial striæ and incremental lines, which towards the ends of the shell are reinforced by elevated concentric lamellation, especially strong on the wing; beaks rather low; interior with large adductor scars, the pallial sinus low, not reaching the anterior scar, but more than half confluent below; lunule and escutcheon narrow, deeply impressed. Lon. 71, alt. 60, diam. 22 mm.

This species is readily recognized by its dorsal posterior "wing," which none of the other species exhibits, and which is discernible in a young specimen less than fifteen millimetres long. It seems to be characteristic of the Upper as *M. biplicata* is of the Lower Miocene of the Atlantic coast.

Metis intastriata Say.

Tellina intastriata Say, Journ. Acad. Nat. Sci. Phila., v., p. 218, 1827; De Kay, Zool. N. York, p. 211, 1843; Binney's Say, p. 125, 1858.

Tellina Grüneri Philippi, Zeitschr. für Mal., ii., p. 150, 1845.

Tellina inornata Adams, *fide* Krebs, Cat., p. 101, 1864.

Lutricola interstriata Dall, Bull. U. S. Nat. Mus., No. 37, p. 62, 1889.

Tellina ephippium Gregory, Quart. Journ. Geol. Soc. Lond., Fifth Ser., vol. li., p. 293, 1895; not of Spengler, 1793.

Tellina sagræ Orbigny, Paleontologia Cubana, pl. iv., figs. 8, 9 (1853 ?); not of Guppy, 1876.

Pleistocene of the Antillean region; recent, from the Florida Keys and Bermuda west to Texas and south to Guadelupe in thirty fathoms or less.

This species was confounded by Holmes with *Macoma constricta,* by Gregory with an Oriental species, and by Guppy with the Oligocene type. Say's original name is probably a misprint for *interstriata,* as observed by Krebs and others. On the plates of the unpublished Cuban Paleontology of Sagra's "Natural History of Cuba," d'Orbigny has named an internal cast, probably of this species, *Tellina sagræ.* I know several sets of these plates are in circulation, and the names have been cited in the literature, but as far as I can discover no text or Atlas were ever published and the date is very uncertain, though probably about 1853.

The species can be recognized by its very sharp and narrow posterior fold, its obsolete lunule and escutcheon, its extremely strong flexure, its small adductor scars, and its exceptionally large and high pallial sinus more than half confluent below. Lon. 50, alt. 41, diam. 21.5 mm.

Metis alta Conrad.

Tellina alta Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 258, 1837 (not *Tellina alta* Conrad, Fos. Tert. Form., i., No. 4, p. 41, Oct., 1833; Claibornian).

Tellina alta Hanley, Thes. Conch., i., p. 332, pl. 62, fig. 200, 1847.

Scrobicularia biangulata Carpenter, P. Z. S., 1855, p. 230.

Lutricola alta Cpr., Suppl. Rep. Brit. Assoc., 1863, p. 639; Journ. de Conchyl., xii., p. 133, 1865; Cooper, Geogr. Cat., p. 6, 1867.

Pleistocene of San Diego and San Pedro, California. Recent from Santa Barbara south to San Diego.

This species is close to but distinguishable from *M. excavata* Sowerby of the Panamic fauna. Both of them are nearer the Upper Miocene *M. magnoliana* than they are to the recent *M. interstriata* of the present Antillean fauna. Perhaps, strictly speaking, Conrad's name should be rejected for that of Carpenter, as he had already described a *Tellina alta* (now placed in *Arcopagia*) from the Claibornian Eocene, but as the two were placed in separate genera before attention was called to this fact, I have concluded to let the name remain. This is probably the largest species of the genus, one valve from the Pleistocene of San Diego in the National Collection measures in lon. 110, alt. 100, diam. (half that of the pair?) 27 mm.

Conrad described from the Pleistocene of Santa Barbara, California, an *Arcopagia unda* (Pacific R. R. Rep., vii., p. 192, pl. iv., figs. 3, 4, 1857) which may be referable to this species but is practically unrecognizable.

A Miocene species from Monterey County, California, which is probably distinct from *M. alta,* though united with the latter by Gabb, was described by Conrad (Pacific R. R. Rep., vi., pt. 2, p. 70, pl. 2, fig. 6, 1857) under the name of *Arcopagia* (=*Metis*) *medialis*. *M. Dombeyi* Hanley (not Carpenter) and *M. excavata* Sowerby are recent species from the west coast of Middle America which have not yet been reported in a fossil state.

Genus **MACOMA** Leach.

Macoma Leach, App. ii., Ross's Voy., p. lxii., 1819 (*M. tenera* Leach); Journ. de Physique, lxxxviii., p. 465, 1819 (June).

Limicola Leach, Moll. Gt. Brit., p. 296, 1852; *Tellina carnaria* Penn. non Linné; not *Limicola* Koch, *Aves*, 1816; nor Fischer, Man. Conchyl., p. 1149, 1887.

> *Macalia* H. Adams, P. Z. S., 1860, p. 369; *Tellina Bruguièri* Hanley.

> *Tellinungula* Roemer, Conchyl. Cab., ed. ii., Mon. *Tellina,* p. 268, 1872; *Tellina Bruguièri* Hanley.

> *Capsa* Tryon, Cat. *Tellinidæ*, p. 99, 1869; *Tellina Bruguièri* Hanley.

Macroma Gray, Ann. Phil., xxv., p. 136, 1825; P. Z. S., 1847, p. 186; err. typ. for *Macoma* Leach.

Psammobia (sp.) Turton, Dithyra Brit., p. 95, 1822; *Tellina solidula* Mtg.; Lam., An. s. Vert., v., p. 514, 1818; Say, Journ. Acad. Nat. Sci. Phila., v., 219, 1827.

Psammotea Gray, P. Z. S., 1847, p. 186; not Turton, 1822, nor Lam.

Sanguinolaria (sp.) Conrad, Am. Mar. Conch., p. 34, 1831; Gould, Inv. Mass., p. 66, 1841.

Rexithærus Conrad, in Tryon, Cat. Tell., p. 104, 1869; *Macoma secta* Conrad.

Shell without lateral teeth, usually subtrigonal and with a marked posterior flexure, the surface feebly sculptured concentrically or smooth; the siphons naked. Type *M. tenera* Leach (= *Tellina calcarea* Gmelin).

Subgenus *Macoma* s. s. Shell subtrigonal, the periostracum conspicuous; usually colorless, or, if colored, without a color pattern; flexure well marked; the pallial sinus coalescent with the pallial line below and often discrepant in the two valves; inhabiting the cooler seas and especially boreal waters.

Section *Macalia* Adams. Shell rounded, with a wide hinge-plate and exceptionally large teeth. Subtropical.

Section *Rexithærus* Conrad. Shell large, inequivalve, with a smooth surface, a large and strong deep-set ligament, behind which the dorsal margin is conspicuously produced upward.

Subgenus *Psammacoma* Dall, 1900. 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.*

Section *Psammacoma* s. s. Type *T. candida* Bertin. Shell elongate, ligament and resilium slender and wholly external.

Section *Psammotreta* Dall, 1900.

Like *Psammacoma* but shorter, with the resilium internal, shorter than and partly separated from the ligament. Type *Macoma aurora* Hanley.

This section bears to *Psammacoma* the same relation that *Scrobiculina* does to *Angulus* in the genus *Tellina.*

Subgenus *Cymatoica* Dall, 1889.

Shell small, thin, concentrically undulate, strongly flexed behind and elongated and inflated anteriorly. Type *Tellina undulata* Hanley (+ *occidentalis* Dall).

This very peculiar little type appears as early as the Oligocene and has persisted in the Antillean and Middle American region until the present time.

Macoma calcarea Gmelin.

Tellina calcarea, testa ovata, etc., Chemnitz, Conch. Cab., vi., p. 140, pl. 13, fig. 136, 1782.

Tellina calcarea Gmelin, Syst. Nat., vi., p. 3236, No. 38, 1792.

Tellina lata Gmelin, Syst. Nat., vi., p. 3237, No. 48, 1792.

Tellina sabulosa Spengler, Skrift. Naturh. Selsk., iv., p. 114, 1794; Mörch, Fort., Gronl. Blod., p. 18, 1877.

Macoma tenera Leach, App. to Ross's Voy., p. 62, 1819; Journ. de Phys., vol. 88, p. 465, 1819.

Tellina proxima (Brown MS.) Sowerby, Zool. Beechey's Voy., p. 154, pl. 44, fig. 4, 1839; Smith, Wern. Mem., viii., p. 105, pl. 1, fig. 21, 1839; Hanley, Thes. Conch., *Tellina*, p. 313, pl. 66, fig. 264 and pl. 59, fig. 115, 1847; Forbes and Hanley, Brit. Moll., i., p. 307, pl. 21, fig. 1, 1850; iv., p. 251, pl. 133, fig. 3, 1853; Stimpson, Shells of N. Engl., p. 21, 1851.

Tellina sordida Couthouy, Boston Journ. Nat. Hist., ii., p. 59, pl. 3, fig. 11, 1838.

Sanguinolaria sordida Gould, Inv. Mass., p. 67, 1841.

Pleistocene of Scandinavia, Scotland, Greenland, Siberia, and Alaska; living in the Arctic and boreal seas in two to one hundred fathoms, extending southward on the Atlantic coast to Long Island Sound, and on the Pacific to the coast of Oregon and Northern Japan, in the southern part of its range only in deep water.

The National Museum possesses specimens which appear to be Macomas from the Eocene of Prairie Creek, Wilcox County, Alabama; Caton's Bluff, Conecuh River, Alabama; White Bluff, Arkansas, and elsewhere, but not in satisfactory condition for description. The genus appears to be represented also in the Oligocene sandstone of the Isthmus of Panama, near Gatun, by *M.* (*Psammacoma*) *dariena* Conrad (1855, + *Tellina semilævis* Gabb, 1861). The Oligocene and later species will be treated in the order of their place in the genus.

Macoma? calhounensis n. sp.

PLATE 47, FIGURE 10.

Oligocene of the Chipola marl, Chipola River near Bailey's Ferry, Calhoun County, Florida; Burns.

Shell small, thin, moderately inflated, ovate trigonal with prominent pointed beaks; anterior end slightly longer, rounded, base arcuate, posterior end attenuated with a small truncation at the tip; surface polished, with rather distant, very delicate, concentric, elevated lines; interior with the pallial sinus high, long, nearly reaching the anterior adductor scar, wholly confluent with the pallial line below. Lon. 10.5, alt. 6.25, diam. 3 mm.

The single perfect specimen is a left valve and has only the cardinal teeth, but the margins on each side of them project in a way unusual in this genus, yet the associated fragments include hinges of both right and left valves of undoubted *Macoma* which appear to be the same as the complete valve. It may be a young shell of a species which reaches a considerably larger size.

Macoma irma n. sp.

PLATE 46, FIGURE 15.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida; Dall.

Shell ovate, moderately convex, short, with a marked posterior flexure, nearly equilateral; beaks not conspicuous, anterior end broad, rounded, posterior attenuated, bluntly pointed, flexed to the right; surface marked only by rather rude incremental lines; hinge-plate strong, teeth normal; pallial sinus obscure but apparently connecting the adductor scars, and wholly confluent with the pallial line below. Lon. 28, alt. 20, diam. 10 mm.

The specimens are rather poor pseudomorphs in silica, but evidently belong to the genus *Macoma* and to a species distinct from any of the others listed from this horizon.

Macoma lenis Conrad.

Tellina lenis Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 306, 1843; Fos. Medial Tert., p. 72, pl. 41, fig. 9, 1845.

Tellina lens Meek, S. I. Miocene Checklist, p. 10, 1864; err. typ. for *lenis.*

Oligocene of the Oak Grove sands, at Oak Grove, Santa Rosa County, Florida, Burns; Miocene of Calvert Cliff, Maryland, Conrad; of Jones Wharf and Plum Point Landing, Maryland Geological Survey.

The pallial sinus is rather short and wholly confluent below. The hinge-teeth are very small and feeble, but the ligament long. A strong thickened ray proceeds from the umbo radially behind the anterior adductor scar, and the shell has the anterior end markedly shorter than the posterior, which is not flexed and is lanceolately pointed, giving the shell the aspect of a *Gastrana,* but the surface sculpture is without radial striation. The presence of the species in the Oak Grove sands is one of those items which illustrate the transitional character of these sands and their faunal modification by the influx of northern species of a type belonging to colder water than that of the earlier Oligocene in Florida.

Macoma Conradi n. sp.

PLATE 47, FIGURE 3.

Miocene of Darlington, South Carolina; of the Natural Well and Magnolia, Duplin County, North Carolina, and York River, Virginia; Burns and Harris.

Shell thin, inflated, ovate, broad and rounded in front, rapidly attenuated, roundly pointed and somewhat flexuous behind; beaks low, pointed, near the posterior third; surface smooth or marked only with fine incremental lines; hinge normal, feeble, teeth small; adductor scars large, pallial sinus short, rounded, and curved (in the right valve) well backward below before coalescing with the pallial line. Lon. 22, alt. 14, diam. 7 mm.

This is a shorter and broader and less flexuous shell than *M. virginiana* Conrad, some of the varieties of which somewhat approach it.

Macoma virginiana Conrad.

Tellina lusoria Conrad, Fos. Medial Tert., p. 35, pl. 19, fig. 3, 1840; Proc. Acad. Nat. Sci. Phila. for 1863, p. 573, 1864; Emmons, Geol. N. Car., p. 297, fig. 225*a*, 1858; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 89, pl. 22, fig. 5, 1858; not of Say, 1822.

Tellina virginiana Conrad, Am. Journ. Conch., ii., p. 76, 1866; not of Clark, Bull. 141, U. S. Geol. Surv., p. 76, pl. 15, fig. 4, 1897.

Miocene of York River, Petersburg, and the Nansemond River, near Suffolk, Virginia; Pliocene of the Caloosahatchie River, Florida; of Mrs. Guion's marl-pit, Waccamaw River, South Carolina; and the north end of the Great Dismal Swamp, Virginia.

After repeated studies of the subject I have come to the conclusion that Say's *Psammobia lusoria* was probably based on a large specimen of the shell which he afterwards described under the name of *Tellina tenta*. From that species the present shell differs, as Conrad states it does from *lusoria*, by being higher, more arcuate below, and less compressed and flexuous behind; it also averages considerably larger. The pallial sinus is low, rather short, rounded in front, and about half confluent with the pallial line below. There is some doubt as to whether the shell figured by Emmons is the same, as he speaks especially of sharp, elevated lines on the surface, which I have not observed on any of the Virginia shells.

Macoma alumensis n. sp.

PLATE 47, FIGURE 8.

Miocene of Alum Bluff, Calhoun County, Florida; Burns.

Shell solid, inequivalve, inequilateral; beaks inconspicuous, pointed; left valve more convex and flexuous, right valve flatter and less flexuous; anterior end longer, the dorsal margin nearly parallel with the base in the left valve, the end evenly rounded into the base, which towards the posterior end is a little sinuated; posterior dorsal margin rapidly descending; a keel near it rises above the line of the margin to the strongly flexed point, which is near the base; surface smooth except for incremental lines; right also with a strong keel, so that the margins of the valves meet at the bottom of a deep sulcus behind the beaks when closed; hinge-teeth normal; hinge-plate solid and heavy, especially in the right valve; pallial sinus discrepant in the two valves, but in both low, rather short, rounded behind, and about half confluent with the pallial line below. Lon. 20, alt. 12, diam. 8 mm.

Macoma Lyelli Dall.

PLATE 37, FIGURES 9, 10, 11.

Macoma Lyelli Dall, Am. Journ. Sci., xlviii., p. 298, Oct., 1894.

Miocene (and Pliocene?) of Gay Head, Martha's Vineyard, Massachusetts; Dall and Woodworth.

This is the shell alluded to by Sir Charles Lyell in his account of his visit to Gay Head as "a *Tellina* resembling *T. biplicata.*" It is closely related to *Macoma obliqua* J. Sowerby, of the English Crag, but is less produced in front and more excavated on the posterior dorsal margin. It occurs only in the form of very perfect internal casts in the Miocene clay of Gay Head, where it is the most abundant molluscan fossil. In the sands unconformably superposed on the clays fragments supposed to belong to this species were collected which may perhaps be Pliocene.

Macoma tenta Say.

?*Psammobia lusoria* Say, Journ. Acad. Nat. Sci. Phila., ii., p. 304, 1822; not of Conrad, 1840.

Tellina tenta Say, Am. Conch., plate 65, fig. 3, 1834.

Macoma tenta Dall, Bull. 37, U. S. Nat. Mus., p. 60, pl. 56, fig. 10, 1889.

Tellina Souleyetiana Récluz, Journ. de Conchyl., iii., p. 253, pl. 10, fig. 5, 5′, 1852; not *T. Souleyeti* Hanley, 1844, P. Z. S., p. 71.

Tellina (*Peronæa*) *Récluziana* Tryon, Cat. Tell., p. 98, 1869.

Pliocene marls of the Caloosahatchie River, Florida; Dall. Recent from Cape Cod southward to Rio Janeiro.

T. Souleyetiana differs from the northern specimens of *T. tenta* only by the warmer flush of yellow or orange which suffuses the umbonal region of the valves, and perhaps in having a little smoother periostracum. As these differences are obviously such as are correlated with a more southern habitat, the forms can hardly be separated specifically. *M. virginiana* Conrad is their Miocene precursor.

Macoma constricta Bruguière.

Solen constrictus Brug., Mém. Soc. Hist. Nat., i., p. 126, No. 3, 1799.
Psammobia cayennensis Lamarck, An. s. Vert., v., p. 514, 1818.
Tellina cayennensis Deshayes, An. s. Vert., ed. ii., vi., p. 177, 1835; Hanley, Thes. Conch., p. 312, pl. 62. fig. 190, 1846.
Tellina constricta Philippi, Abb. und Beschr., i., p. 9, pl. 1, fig. 5, 1843.
Tellina lateralis Say, Journ. Acad. Nat. Sci. Phila., v., p. 218, 1827.
Tellina cayennensis Holmes, P.-Pl. Fos. S. Car., p. 47, pl. 8, fig. 4, 1859.
Macoma constricta Dall, Bull. U. S. Nat. Mus., No. 37, p. 60, 1889.

Pliocene of the Caloosahatchie River, Florida, Dall; Pleistocene of South Carolina, Holmes; recent from the coast of New Jersey south to Brazil.

This species appears to be rare in the Pliocene, as only a single valve was obtained, but it is unmistakably conspecific with the recent shell.

Macoma laxa n. sp.

PLATE 47, FIGURE 14.

Pliocene marl of the Caloosahatchie River, Florida; Dall.

Shell thin, nearly equilateral, elongate, moderately convex, with inconspicuous beaks; anterior end a little longer, higher, and rounded, posterior attenuated, compressed, pointed; not obviously flexuous; surface sculptured only with rather rude, somewhat irregular incremental lines; posterior termination near the base, posterior dorsal margin moderately arched; hinge normal, with minute feeble teeth; pallial sinus discrepant in the two valves, elongate but not quite reaching the anterior adductor, in the right valve slightly angular above under the umbo, in the left valve only slightly sinuous there, in both wholly confluent below with the pallial line; interior of the valves faintly radially striated, especially near the base. Lon. 23, alt. 13, diam. 6 mm.

This species has a peculiar outline and does not closely approach any of the other species of *Macoma* from the region.

Macoma balthica Linné.

Tellina balthica Linné, Syst. Nat., ed. x., p. 677, No. 53, 1758; Fauna Suecica, ed. ii., p. 517, 1761; Syst. Nat., ed. xii., p. 1120, 1768; Meyer and Möbius, Fauna der Kielerb., ii., p. 101, f. 14-19, 1872.

Venus fragilis O. Fabr., Fauna Grönl., p. 413, 1780; not of Linné.

Tellina gröndlandica (Beck MS.) Lyell, Geol. Trans., 2d Ser., vi., p. 137, pl. 16, f. 8, 8*a*, 1839; Mörch in Rink's Grönl., App., p. 90, 1857.

Psammobia fusca Say, Journ. Acad. Nat. Sci. Phila., v., p. 219, 1827; Binney's Say, p. 126, 1858.

Sanguinolaria fusca Conrad, Am. Mar. Conch., p. 34, pl. vii., fig. 1, 1831; Gould, Inv. Mass., p. 66, fig. 42, 1841; Mighels, Bost. Journ. N. Hist., iv., p. 317, 1843; DeKay, Nat. Hist. N. Y., v., p. 212, pl. xxxii., fig. 304, 1843.

Tellina inconspicua Brod. and Sowerby, Zool. Journ., iv., p. 363, 1829; Zool. Beechey's Voy., p. 153, pl. xli., fig. 6, 1839; Hanley, Thes. Conch., i., p. 317, pl. lix., fig. 120, 1847.

Tellina fusca Hanley, Thes. Conch., i., p. 316, pl. lix., fig. 117, 1847; Philippi, Abb. und Beschr., ii., p. 24; *Tellina,* pl. iii., fig. 3, 1845; Stimpson, Sh. of N. E., p. 20, 1851.

Tellina (Macoma) tenera Mörch, Prodr. Faun. Moll. Grönl., p. 18, 1857; Admiralty Man. Nat. Hist. Greenl., p. 131, 1875; not of Leach, 1819.

Tellina Fabricii Hanley, Thes. Conch., i., p. 318, pl. lix., fig. 112, 1847.

Tellina fragilis Möller, Ind. Moll. Grönl., p. 20, 1842; not of Linné; + *T. Molleri* Desh. MS.

Macoma fragilis Stimpson, Proc. Acad. Nat. Sci. Phila. for 1861, p. 97; H. and A. Adams, Gen. Rec. Moll., ii., p. 400, 1856; Verrill, Inv. An. Vineyard Sound, p. 676, pl. xxx., fig. 222, 1873.

Macoma Fabricii H. and A. Adams, Gen. Rec. Moll., ii., p. 400, 1856.

Macoma grönlandica Packard, Mem. Boston Soc. N. Hist., i., pp. 235, 243, etc., 1866.

Macoma fusca H. and A. Adams, Gen. Rec. Moll., ii., p. 400, 1856; Holmes, P.-Plioc. Fos. S. Car., p. 48, pl. viii., fig. 5, 1858.

Tellina moesta Deshayes, P. Z. S., 1854, p. 361.

Fossil in the Pleistocene of Northern Europe, the northeastern coast of America, and Alaska; living in all arctic and boreal seas, and, on the east coast of America, south to Georgia; in Europe to the Mediterranean.

The original *Tellina balthica* was the thin form of the brackish waters of the Baltic, and not the solid, heavy, smooth shell known as *Macoma solidula* Pulteney, which is the variety of *balthica* best known among collectors. It is probably because comparisons of the American shells have usually been made with British specimens of *balthica* var. *solidula* that American authors have been disposed to separate the two and give the American shell a different name.

Macoma Kelseyi n. sp.

Plate 49, Figure 7.

Pleistocene of San Diego, California, obtained in the City Park by Dr. R. E. C. Stearns.

Shell large, solid, heavy, compressed, slightly flexed; beaks subcentral, prominent, pointed; anterior end evenly rounded into an arcuate base and dorsal margin; posterior end lanceolate, the dorsal margin nearly rectilinear; surface sculptured only by strong, rather irregular lines of growth; hinge-plate short, broad, and strong; teeth normal, elongated, large; pallial sinus discrepant in the two valves; left valve with the upper part of the sinus sinuous, extending from the posterior to the anterior adductor, behind which is a thickened obscure ray; right valve with the sinus short, gibbous, the anterior end rounded, thence the line curves backward before coalescing with the pallial line below; in the left valve the sinus is coincident with the whole of the pallial line below. Lon. 86, alt. 56, diam. 20 mm.

This fine, large species is closely related to the recent and Pleistocene *M. nasuta* Conrad, from which it differs as follows: it is larger, heavier, and flatter than any specimens of *M. nasuta* yet recorded; the ridge bounding the posterior dorsal area is less prominent, and in all the specimens of *M. nasuta* examined the line of the sinus joins the pallial line below at a right angle without previously curving backward. The most obvious external character is the comparative flatness of the posterior part of the right valve and its narrower dorsal area in *M. Kelseyi.* The latter is named in honor of Professor F. W. Kelsey of San Diego, who has given much attention to the local shell fauna.

Other species of typical *Macoma* which have been reported from the post-Eocene beds of the Pacific coast are *Macoma arctata* Conrad (1849, as *Tellina,* not *Tellina arctata* Conrad, 1843, from North Carolina) from the Miocene of Oregon; *M. congesta* Conrad (as *Tellina* in P. R. R. Rep., 1855, v., App., p. 323, pl. iii., figs. 14, 18, 21, 21*a*) from the white shales of Monterey County, California, Miocene; *T. diegoana* and *pedroana* Conrad (*op. cit.*) appear to be unrecognizable; *T. eborea* Conrad (in Meek's Miocene Checklist, 1864) seems to be merely a list name never figured or described; *T. ocoyana* Conrad (1855, P. R. R. Rep., v., p. 329, pl. viii., fig. 75) is referred to *Macoma* by Gabb, but has not been recognized since it was figured by Conrad from Blake's Ocoya Creek collection; *M. indentata* Carpenter, *M. expansa* Carpenter, and *M. nasuta* Conrad have all been cited from the Miocene of California or

Oregon, but should be carefully compared with the recent types before these identifications are accepted, since in many cases the fossils prove to be representative and not identical. Conrad described (without a figure) a *Tellina nasuta* from Oregon in the " Geology of the Wilkes Exploring Expedition" in 1849, apparently quite forgetting a recent species, to which he gave the same name, from Nuttall's Californian collection in 1837. The Pliocene species are better preserved and identified, and here *M. inquinata* Deshayes and *M. nasuta* Conrad, 1837, have been recognized. The Pleistocene has yielded *M. calcarea* Gmelin, *M. nasuta* Conrad, 1837, *M. inquinata* Deshayes, *M. balthica* Linné (+ *californica* Conrad and *inconspicua* Brod. and Sby.), and *M. yoldiformis* Carpenter, all known in the recent state from the Pacific coast.

From the Atlantic coast Pleistocene the number of names is even larger, including all or nearly all of the recent species, which I will not enumerate here, as nearly all of them have been referred to already in this work.

Macoma (Rexithaerus) secta Conrad.

Tellina secta Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 257, 1837; Hanley, Thes Conch., p. 327, pl. 65, figs. 245, 248, 1847.

Tellina ligamentina Deshayes, Mag. de Zool., 1843, pl. 8.

Macoma secta H. and A. Adams, Gen. Rec. Moll., ii., p. 401, 1858.

Macoma var. *edulis* (Nutt. MS.) Carpenter, Rep. Brit. Assoc. for 1863, p. 639.

Macoma (Rexithærus) secta Tryon, Cat. Tellinidæ, p. 104, 1869.

Pleistocene of San Diego, California, Stearns; recent from Puget Sound to Lower California.

To the same group belongs *Macoma indentata* Cpr., which also occurs in the Pleistocene of San Diego, and recent in the adjacent region.

Macoma (Psammacoma) tracta n. sp.

Plate 47, Figure 13.

Oligocene of the Chipola horizon on Shoal River, Walton County, Florida, and of the Bowden beds, Jamaica.

Shell small, thin, rather compressed, elongated, inequilateral, the anterior end longer; beaks low, not conspicuous; posterior end slightly flexed to the right; anterior end higher, rounded, posterior attenuated, bluntly terminated; surface smooth except for faint incremental lines; interior (inaccessible in the specimens). Lon. 12.7, alt. 5, diam. 2 mm.

This small species differs from the young of the next in its more attenuated posterior end and slight flexure.

Macoma (Psammacoma) olivella n. sp.

PLATE 47, FIGURE 20.

Oligocene marl of Bowden, Jamaica.

Shell large, solid, moderately convex, with rather full, conspicuous beaks, equivalve, very inequilateral; anterior dorsal slope rectilinear, anterior end rounded; posterior dorsal slope slightly concave, posterior end much shorter, rounded below, blunt terminally and subangulate at its junction with the dorsal line; an elongated lunule and escutcheon, moderately impressed and not very definitely limited, are present; surface smooth, except for lines of growth and on the ridge bounding the lunule, which is slightly undulated, especially near the beaks; hinge normal, teeth rather small, pallial sinus gibbous, short, partly free below. Lon. 23, alt. 13, diam. 5 mm.

This species recalls *M. (Psammacoma) elongata* Hanley of the recent Panama fauna.

Macoma (Psammacoma?) producta Conrad.

Tellina producta Conrad, Fos. Medial Tert., p. 36, pl. 19, fig. 5, 1840.

Tellina (Peronæoderma) producta Conrad, Proc. Acad. Nat. Sci. Phila. for 1863, p. 573, 1864.

Miocene of St. Mary's River, Maryland; Meek.

This approximates to *M. tenta* by the figure, and may not belong here.

Macoma (Psammacoma?) Holmesii n. sp.

PLATE 47, FIGURE 4.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell large, solid, equivalve, inequilateral, with low beaks, moderately convex, elongated; anterior end longer, the dorsal slope rectilinear, the end rounded, the base nearly straight; the posterior end shorter, the anterior vertically subtruncate, but not angular; a feeble sulcus in the left valve extending from the umbo to the posterior end of the base; a faint, narrow escutcheon but no lunule visible; surface smooth except for incremental lines, which show a little stronger on the posterior dorsal area; hinge short, teeth small, resilium verging on *Psammotreta,* to which this species may eventually, with more material, prove to belong; pallial sinus long but not reaching the anterior adductor, sinuous above; posterior dorsal ridge of the right valve insinuated at the margin of the valve. Lon. 32, alt. 17, diam. 8 mm.

The species is named in honor of Professor J. A. Holmes, State Geologist of North Carolina.

Macoma (Psammacoma) brevifrons Say.

Tellina brevifrons Say, Am. Conch., pl. lxiv., fig. 1, 1834; Binney's Say, p. 227, 1858; Hanley, Thes. Conch., i., p. 329, 1846; Tryon, Am. Mar. Conch., p. 149, pl. 26, figs. 355-7 (bad), 1874.

?*Tellina oblonga* Gmelin, Syst. Nat., p. 3234, 1792, after Chemnitz, Conch. Cab., vi., pl. 10, fig. 87.

Pliocene of the Caloosahatchie marls, Monroe County, Florida; Dall; recent from South Carolina to Brazil.

This species, having been badly figured and the figures very erroneously colored (having appeared after Mr. Say's death), seems to have been a good deal confused. It resembles the preceding species a good deal, but is a shorter and broader shell, usually small towards the northern extreme of its range but attaining a considerable size (lon. 39, alt. 23.5, diam. 13 mm.) in the warmer waters southward and in the Pliocene. The recent specimens have usually a blush of orange color in the central and umbonal region. *T. lusoria,* which has been more or less confused with this species, I suspect to have been founded on a large specimen of *Macoma tenta.*

Macoma (Psammacoma) tageliformis n. sp.

Pleistocene of Texas coast at Corpus Christi, and recent in the same region but apparently rare.

Shell rather thin, elongate, slightly flexuous, similar to the preceding species in general form but more elongated, more rudely striated, more equilateral, and, when living, without the orange suffusion; pallial sinus discrepant in the two valves; in the left valve short, high, rounded above and behind, half confluent with the pallial line below; in *M. brevifrons* this sinus is angular above and reaches nearer to the anterior adductor in front; in the right valve the sinus rises to a blunted angle in front of the posterior adductor scar and close to it, then descends obliquely, and then returns to the pallial line, with which it is less than half confluent; this sinus is even shorter than that in the opposite valve, while the same in *brevifrons* is one-fourth longer. Lon. of shell 45, alt. 25, diam. 12.5 mm.

This species, which, by its larger size, more elongate and flexuous form, its absence of color, and its different pallial sinus, is well distinguished from *M. brevifrons,* will be figured from the recent specimens in a forthcoming report on the Mollusks of Porto Rico.

Macoma (Psammotreta) aurora Hanley.

Tellina aurora Hanley, P. Z. S., 1844, p. 147; Thes. Conch., p. 301, No. 153, pl. lviii., fig. 76, 1846.

Pleistocene of San Diego, California; Stearns (abundant); recent, from the Panamic region to the Gulf of California.

This form is in a general way similar to *M. brevifrons* Say, and probably for that reason was identified with *Tellina oblonga* Gmelin by Deshayes. As Chemnitz, upon whose figure Gmelin's species was based, distinctly says his species is not European, but from Guinea and the West Indies, it cannot be assumed to be the Panama shell when one equally near Chemnitz's figure is found in the West Indies, namely, *M. brevifrons.*

Macoma (Cymatoica) Vendryesi n. sp.

Plate 46, Figure 3.

Oligocene of the Bowden marls, Jamaica; Henderson and Simpson.

Shell minute, thin, flexuous, rostrate, inequivalve, inequilateral, gaping behind, moderately inflated; anterior end full, rounded, shorter; posterior end longer, rectilinear above, sinuous below, produced into an obliquely truncate rostrum; beaks low, pustular, left valve slightly less convex than the right and a little longer; surface concentrically irregularly undulated except on the posterior dorsal area, which is transversely striated; pallial sinus small, short, partly confluent below with the pallial line. Lon. 7, alt. 4, diam. 2 mm.

This species is considerably smaller than the recent *M. orientalis* Dall, the concentric wave-like sculpture is finer and less broken, and the shell is relatively more inflated. The teeth are quite feeble and minute.

The presence of this type so long ago as the Oligocene, with its characteristics fully developed, lends plausibility to the assumption upon which its separation from the typical Macomas was based. The genus *Strigilla,* the section *Phyllodina,* etc., are analogous cases.

The present species is named in honor of Henry Vendryes, Esquire, of Kingston, Jamaica, who has given many years to the investigation of the Tertiary and recent Mollusks of Jamaica.

Superfamily VENERACEA.

Family PETRICOLIDÆ.

Genus **PETRICOLA** Lamarck.

Petricola Lamarck, Syst. An. s. Vert., p. 121, 1801.

Rupellaria Fleuriau de Bellevue, Mém. s. les vers lithoph., p. 3, 1802. Type *Venus lithophaga* Retzius.

Choristodon Jonas, Zeitschr. Mal., i., p. 185; Molluskolog. Beitr., p. 1, 1844. Type *C. typicum* Jonas, *op. cit.*, p. 185; Beitr., pl. 7, fig. 3.

Naranio Gray, Ann. Mag. N. H., 2d Ser., xi., p. 38, 1853. Type *N. costata* Gray = *Venus lapicida* Gmelin; Deshayes, Biv. Shells Brit. Mus., p. 215, 1853.

Lajonkairia Deshayes, Biv. Sh. Brit. Mus., p. 217, 1854; 1st sp. *Venerupis decussata* Philippi.

Petricolaria Stoliczka, Cret. Pel. India, p. 139, 1870. Type *Petricola pholadiformis* Lam.

Claudiconcha Fischer, Man., p. 1087, 1887. Type *Venerupis monstrosa* (Chemn.) Gray.

Gastranella Verrill, Am. Journ. Sci., iii., p. 286, 1872; Rep. U. S. Fish Com., 1871-72, p. 678, 1873 (Nepionic stage). Type *G. tumida* Verr., *op. cit.*, p. 286, pl. 6, figs. 3, 3*a*.

In describing the genus *Petricola,* Lamarck mentions two described species, one of which was actually known to him from a specimen in his collection, the other he cites from a publication of Retzius. The following year Fleuriau, with the approbation of Lamarck, separated the latter as a new genus, *Rupellaria.* The type of the Lamarckian *Petricola* is therefore the *Venus lapicida* of Chemnitz and Gmelin, renamed *Petricola costata* by Lamarck, which subsequently received the name of *Naranio* from Gray. It differs from *Rupellaria* only in having a more rotund form and zigzag surface striation. *Lajonkairia* of Deshayes is close to *Rupellaria,* differing chiefly by more regular radial striation, absence of strong concentric sculpture, and rounded rather than pyriform outline. *Choristodon* Jonas is a rude *Rupellaria,* the original characters upon which it was based being pathological. Jonas supposed that the anterior cardinal in the left or the posterior in the right valve was separated from its base by a layer of cartilage, and in a certain proportion of the specimens this state of affairs really seems to exist more or less completely developed. A careful study of a large series, however, shows that this condition is not normal. The only explanation of its occurrence at all which suggests itself to me is that the tooth in question, from having a sort of pedicillate or constricted base, is very liable to fracture at that point and, if this occurs while the animal is living, the break is repaired, not by the deposition of shelly matter but by the secretion of conchioline, which serves to hold the fractured tip in place. At all events I find some specimens in which the shelly matter is perfectly continuous, others in which a circular fracture, not entirely decapitating the tooth, is filled with conchioline, and still others where the entirely detached tip is soldered to the base by a layer of conchioline cement. The anatomical characters of *Choristodon* do not differ from those of *Rupellaria* sufficiently to authorize its separation; indeed, not more than might be expected between distinct species. Certain species which burrow in sand have the shell elongated, and this elongation, varying in amount in different species, is accompanied, as usual in such cases, by an antero-posterior protraction of the soft parts. For these species Stoliczka has proposed the name *Petricolaria.* Lastly we have boring species, in which the natural inequality of the valves is exaggerated and the margin of the right valve in full-grown specimens is irregularly expanded, overlapping that of the left valve, which remains normal, and frequently forming channels in which the siphons lie or may be extruded. For these forms, erroneously referred to *Venerupis,* Fischer has proposed the subgeneric name of *Claudiconcha.* These also sometimes have broken teeth cemented. *Petricola* in the wide sense and adult state has no lateral teeth; in the left valve there are three radial cardinals, the middle one larger, higher, and bifid, or with several grooves; in the right valve there are two cardinals, the anterior simple, arcuate, and often very prominent, the posterior lower, oblique, and grooved or bifid. The resilium and ligament are coincident and external on nymphs; the lunule is absent or ill-defined; the pallial sinus small or large, the siphons separate, elongated, and naked.

From the often very similar *Venerupis* the species of this group may be separated by the hinge-teeth and generally by the absence of regular and elevated concentric lamellæ. *Venerupis* has three subequal, usually bifid teeth in each valve, and the margin of the shell is very commonly serrate or denticulate, which is not the case in *Petricola.* It should be borne in mind that in these more or less distorted borers or nestlers the hinge in fully grown shells is almost always more or less distorted and defective; only the examination of a large series, especially of the young shells, can give an adequate idea of the normal dentition.

The genus appears to be divisible into sections as follows:

Section *Petricola* Lamarck, s. s. Type *P. lapicida* (Gmelin).

Shell ovate, with a short or moderate wide pallial sinus, the radial sculpture more or less divaricate or zigzag. *Naranio* is synonymous.

Section *Rupellaria* Fleuriau. Type *P. lithophaga* (Retzius).

Shell inflated and rounded in front, attenuated and more compressed behind; sculpture chiefly radial, stronger anteriorly. *Lajonkairia* and *Choristodon* are synonymous.

Section *Claudiconcha* Fischer. Type *P. monstrosa* (Gmelin).

Margin of the right valve irregularly expanded, pallial sinus shallow, form like *Petricola.*

Section *Petricolaria* Stoliczka. Type *P. pholadiformis* Lam.

Shell elongated, pholadiform, thin; hinge-teeth protracted, slender; pallial sinus deep.

Bernard is of the opinion that the nepionic shell in this group possesses rudiments of three cardinals in both valves, but, in adolescent examples, I have not been able to discover any trace of the supposed posterior right cardinal.

Petricola centenaria Conrad is an *Asaphis; P. compressa* H. C. Lea is a *Fabella* or *Sportella.* It is stated that the *P. carditoides* Conrad of the Californian recent fauna is also found in the Californian Pleistocene, but its presence in earlier beds is yet to be established.

Petricola lapicida Gmelin.

Venus lapicida Gmelin, Syst. Nat., vi., p. 3269, 1792 (after Chemn. Conch. Cab., x., p. 356, pl. 172, figs. 1664-1665, 1788); Wood, Ind. Test., pl. 8, fig. 72, 1825.

Venus divergens Gmelin, Syst. Nat., vi., p. 3269, 1792 (after Chemn. Conch. Cab., x., p. 357, pl. 172, figs. 1665-1666).

Petricola costata Lam., Syst. An. s. Vert., p. 121, 1801; Hanley, Descr. Cat. Rec. Sh., p. 53, 1843.

Naranio costata Gray, Ann. Mag. Nat. Hist., xi., p. 38, 1853.

Naranio lapicida Deshayes, Cat. Conch. B. M., i., p. 216, 1853.

Petricola divaricata Orbigny, Moll. Cubana, ii., p. 265, 1853.

Pliocene of the Caloosahatchie beds, Florida; Dall. Recent from South Carolina southward throughout the Antilles and Caribbean region, boring in coral.

Immediately recognizable by the zigzag striation in the younger stages, to which in the adult are added, on the posterior end, coarse radial ridges.

Petricola (Rupellaria) typica Jonas.

Choristodon typicum Jonas, Zeitschr. Mal., i., p. 185; Beitr. Molluskol., p. 1, pl. 7, fig. 3, 1844.

Petricola lithophaga Arango, Moll. Cuba, p. 248, 1880; not of Retzius and Lamarck.

Choristodon robusta Dall, Bull. U. S. Nat. Mus., No. 37, p. 58, 1889; not of Sowerby.

Pliocene of the Caloosahatchie beds, Florida; Dall. Recent in the Antillean region from Cape Florida southward.

Shell radially ridged, the sculpture coarser behind.

This and the preceding species appear to be rare in the Pliocene beds.

Petricola (Rupellaria) Harrisii n. sp.

PLATE 43, FIGURE 1.

Miocene of the York River, Virginia, from the bluff at Bellefield, four and a half miles above Yorktown; G. D. Harris.

Shell solid, ovate, distorted more or less by the irregularities of its *situs;* posterior end blunt, longer; anterior end shorter, rounded; sculpture of fine, nearly uniform radial rounded threads with wider interspaces, crossed by fine, rounded, slightly elevated incremental lines; beak moderately elevated, hinge short, with, in the left valve, one strong, apically grooved cardinal between two simple narrow diverging teeth; ligamentary nymph short, strong, deeply grooved; basal margin feebly crenulated by the external sculpture; pallial sinus wide, shallow. Alt. 20, lat. 23, semidiam. 7 mm.

Only one valve of this species was obtained by Professor Harris, in whose honor it is named. This species recalls the *P. decussata* Phil. of the recent Mediterranean fauna, but has no analogue in our own present fauna.

Petricola (Petricolaria) carolinensis Conrad.

Petricola carolinensis Conrad, Proc. Acad. Nat. Sci. Phila., xiv., p. 576, 1863.

Petricola pholadiformis Tuomey and Holmes, Pleioc. Fos. S. Car., p. 87, pl. 21, fig. 5, 1856; not of Lamarck, 1818.

Upper Miocene of Magnolia, Duplin County, North Carolina, Burns; Peedee River and Goose Creek, South Carolina, Tuomey.

This shell is more equilateral and has the radial sculpture more uniform, and consequently stronger over the posterior portion than *P. pholadiformis.* It does not seem to reach so large a size as the latter.

Petricola (Petricolaria) calvertensis n. sp.

PLATE 44, FIGURE 14.

Miocene of Calvert Cliffs, Maryland; Burns and Harris.

Shell elongate-oval, with the beaks near the anterior third, solid, closely regularly sculptured with fine radiating threads, the interspaces wider, the threads a little stronger towards the ends of the shell, concentric sculpture only of fine somewhat irregular incremental lines; beaks rather elevated; shell moderately inflated, more or less irregular from nestling among rocks, sculpture near the beaks quite faint; hinge short, a spur from the lunular region extending over and past the cardinal teeth behind the beaks; hinge normal; margins entire; pallial sinus deep and rounded. Alt. 9, lat. 17, semidiam. 3.5 mm.

A single valve of this species was obtained by Messrs. Burns and Harris. It is readily discriminated from the other American species by its *Callista*-like form and very fine, even radial sculpture.

Petricola (**Petricolaria**) **pholadiformis** Lamarck.

Petricola pholadiformis Lam., An. s. Vert., v., p. 505, 1818; Conrad, Am. Mar. Conch., p. 37, pl. 7, fig. 3, 1831; Say, Am. Conch., pl. 60, fig. 1, 1834; Gould, Inv. Mass., p. 63, 1841; Sowerby, Thes. Conch., ii., p. 771, pl. 166, fig. 1, 1854; Dall, Bull. U. S. Nat. Mus., No. 37, p. 58, pl. 59, fig. 15, pl. 64, fig. 140*a*, 1889.

Petricola fornicata Say, Journ. Acad. Nat. Sci. Phila., ii., p. 319, 1822.

Pleistocene of Simmons Bluff, South Carolina; Burns. Living from Prince Edward Island south to St. Thomas, West Indies; Greytown, Nicaragua, and other portions of the Antillean region. Var. *dactylus* Sby. Post-pliocene of South Carolina according to Holmes.

It is probable that the *P. dactylus* Sowerby, though closely related to *P. pholadiformis*, may be regarded as specifically distinct. Both forms occur together from Maine to Florida, but on the South American coast the typical *pholadiformis* does not seem to have been found, though several other varieties, some of which have been named, have been reported by observers near the southern extreme of South America in what was formerly Patagonia.

The curious little shell named in 1872 by Verrill *Gastranella tumida* is certainly a *Petricolaria*, and I suspect it to be the young of *P. dactylus*, which has when very young and fresh a purplish tinge on the umbones in some individuals. The hinge is precisely the same in both. Carpenter similarly took the nepionic young of *P. denticulata* Sowerby for a *Psephis* and described it under the specific name of *tellimyalis*. This was the more excusable since the fry are brightly colored with orange and purple, while the adult and adolescent stages of the *Petricolaria* are pure white. I have a series showing the latter with its purple umbones strongly contrasting with the white valves, but this condition lasts only a short time, the color fading entirely out in most specimens before they attain full growth.

Family COOPERELLIDÆ.

Genus **COOPERELLA** Cpr. (em).

> *Oedalia* Carpenter, Rep. Brit. Assoc. for 1863, pp. 611, 639. Type named, *Oe. subdiaphana* Cpr., p. 639, Aug., 1864; Journ. de Conchyl., xii., p. 134, Apr., 1865 (same type); Smiths. Misc. Coll., No. 252, Moll. W. N. Am., pp. 97, 125, 302, Dec., 1872.

> *Cooperella* Carpenter, Rep. Brit. Assoc. for 1863, pp. 611, 639, 1864; Proc. Cal. Acad. Sci., iii., p. 208, 1866.

> *Oedalina* Carpenter, Proc. Cal. Acad. Sci., iii., p. 208, 1866 (as a substitute for *Oedalia* Cpr., 1864; not Meig., 1830).

In 1864 Carpenter described the type of this genus and the genus itself in three lines as two species of two subgenera, both of which were regarded as new, and the types of which are in the National Museum. One of the names used was preoccupied and, as both applied to the same species, the second name must be adopted. A year later Carpenter gave full diagnoses of genus and species under the preoccupied name, and in 1866, still regarding them as distinct, he gave a full diagnosis for the supposed subgenus and substituted *Oedalina* for the preoccupied *Oedalia*. The supposed subgeneric difference was based on the assumed (but not real) absence of an internal ligament in the type and its less bifid cardinal teeth. The latter character is shown by material in the collection to differ among adult individuals and probably in the same individual at different ages. The specific name under which the species was first fully described is here adopted for the type. The characters of the genus are as follows:

Shell small, thin, smooth, or concentrically striate or undulate, equivalve, nearly equilateral, with entire margins; ligament long, feeble, profuse, amphidetic; resilium short, stout, opisthodetic, immersed behind the cardinals on an oblique thickening of the hinge-plate, not excavated to form a pit or produced into a chondrophore; hinge-plate narrow, carrying two right and three left subumbonal divaricating short cardinal teeth, of which the left central tooth is always, and the others frequently, bifid; laterals none; muscular impressions small, oval; pallial line narrow with an ample sinus; siphons long, slender, separate, the branchial fringed at its orifice; mantle margins simple, free, for about half the length of the shell, gills rather small, free, with direct and reflected inner and outer laminæ, palpi very small, foot compressed, quadrate, without any byssal groove or obvious gland.

I give the anatomical characteristics from the typical species because they have not been recorded anywhere and have an important bearing on the relationship of the genus. Excepting the large sinus the shell strongly recalls *Psathura* Deshayes.

The type *Cooperella subdiaphana* (+ *scintilliformis*) Cpr. is not uncommon, living on the Pacific coast between Vancouver Island, Monterey, and Todos Santos Bay, but owing to the extreme fragility of the shell is difficult to preserve intact. It was with peculiar interest, therefore, that I noted the existence of the following species in our Miocene, the genus not being known from Atlantic waters and hitherto represented only by its type, which occurs in the Pleistocene of San Pedro, California.

Cooperella Carpenteri n. sp.

Plate 49, Figure 8.

Miocene of Petersburg, Virginia, and of the Natural Well, Duplin County, North Carolina; Pliocene(?) of the north end of the Dismal Swamp, Virginia; Burns and Shaler.

Shell smooth or slightly concentrically undulate, and with faint incremental lines; ovate, nearly equilateral, the beaks moderately elevated; hinge delicate, hinge-plate narrow, excavated; pallial sinus deep but only moderately high; base arcuate, ends rounded. Lon. 14, alt. 11.5, diam, 7.50 mm.

This species bears a very marked resemblance to *C. subdiaphana* Cpr., and differs from it chiefly in being more equilateral and with more nearly equally rounded ends, and in having the area occupied by the pallial sinus proportionately less high.

The following genus is anatomically unknown, but its hinge is remarkably like that of *Cooperella,* and the habit of the shell is much the same in spite of the almost unsinuate pallial line.

Genus **CYAMIUM** Philippi.

Cyamium Phil., Arch. f. Naturg., i., p. 50, 1845. Type *C. antarcticum* Phil., *loc. cit.;* not *Cyamea* Kroyer, Crustacea, 1843, nor *Cyamium* H. and A. Adams, 1857 (ii., p. 476), nor Jeffreys, Brit. Conch., ii., p. 237, 1863.

Shell small, thin, smooth, ovate, with an obsolete amphidetic ligament externally, and a short, strong, oblique internal resilium; hinge-plate narrow with, in the right valve, two subumbonal divaricating bifid cardinals, and, in the left valve, three more slender, not obviously bifid, cardinals; laterals, none in either valve; pallial line narrow except near the posterior muscular impression, where it is irregularly wider or slightly insinuated; adductor scars narrow, elongate; margin of the valves entire.

This shell is perfectly distinct from the *Turtonia* of the northern hemisphere, with which it has been most unaccountably confounded. The type of dentition and aspect of the shell are entirely different. The characters of the hinge recall *Cooperella,* which has, however, a deep pallial sinus. The exact place of this genus can only be settled when the anatomical characters are known, but the appearance of the pallial line in the adult leads me to suspect it is siphonate. The *Cyamium elevatum* "Stimpson" cited by H. and A. Adams belongs to the genus *Aligena.* Philippi's genus contains only the original type, a young specimen of which in the National Museum was labelled by Dr. Philip Carpenter *Kellia declivis* Cpr., but I do not know if this name has been published.

This genus has been mentioned under the *Leptonacea,* where it may be that it will eventually remain.

Family VENERIDÆ.

The enormous group belonging to this family will be treated later, as it has been found impracticable to prepare the discussion of it in time for the publication of this division of the volume.

Superfamily Isocardiacea.

Family ISOCARDIIDÆ.

Genus **ISOCARDIA** Lamarck.

Isocardia humana Linné.

Bucardia dalmatica Klein, Meth. Ostr., p. 140, 1753 (non-binomial).

Cardium humanum Linné, Syst. Nat., ed. x., p. 682, 1758.

Chama cordiformis Linné, Mus. Lud. Ulricæ, p. 516, 1764.

Chama cor Linné, Syst. Nat., ed. xii., p. 1137, 1767; Born, Mus. Cæs. Vindob., p. 80, 1780; Chemnitz, Conch. Cab., vii., p. 103, pl. 48, fig. 483, 1784; Gmelin, Syst. Nat., vi., p. 3299, 1792; Donovan, Brit. Shells, iv., pl. 134, 1802.

Hippopodes. H. cor Meuschen, Mus. Gevers, p. 423, 1787.

Glossus + *Glossoderma rubicundus* Poli, Test. Utr. Siciliæ, ii., p. 253, 1791 (non-binomial).

Cardita cor Bruguière, Encycl. Méth. Vers., i., p. 403, 1792; Bosc, Hist. Nat. Coq., iii., p. 87, tab. 21, fig. 4, 1802; Encycl. Méth., ii., pl. 232, 1797.

Trapezium cor Humphrey, Mus. Calonnianum, p. 50, 1797.

Cardium cor auritum Bolten, Mus. Boltenianum, p. 192, 1798; 2d ed., p. 134, 1819.

Isocardia cor Lamarck, Prodr. Nouv. Class. Coq., p. 86, 1799; An. s. Vert., vi., p. 31, 1819; Sowerby, Gen. Rec. and Fos. Sh., vii., 1822; Fischer, Man. de Conchyl., p. 1074, 1887.

Isocardia globosa Lamarck, Syst. des An. s. Vert., p. 118, 1801.

Isocardium cor Link, Beschr. Rostock Samml., 2, p. 153, 1807; Blainville, Man. Mal., ii., p. 545, pl. 69, fig. 2, 1825.

Bucardium communis Megerle v. Mühlfeldt, Entw., Neues Syst. der Schalthierhause, Mag. Ges. Naturf. Fr., v., p. 52, 1811.

Glossus cor Oken, Lehrb. der Naturg., iii., Zoologie, pt. 1, pp. viii., 235, 1815; Gray, Brit. An., vii., p. 95, 1851; Stoliczka, Cret. Pel. of India, p. 188, 1871.

Bucardia communis Schumacher, Essai, p. 146, 1817.

Cardita humana Mörch, Yoldi Cat., ii., p. 38, 1853 (not *Isocardia* Mörch, *loc. cit.*, = *Meiocardia* H. and A. Adams, 1857).

Bucardia cor H. and A. Adams, Gen. Rec. Moll., ii., p. 461, 1857.

Tychocardia cor Roemer, Conchyl. Cab., Neue Ausg., x., pt. 3, p. 5, 1869.

To make clearer the history of this genus I have prefixed the synonymy of its type species so far as it bears on the subject. The "heartshells" of the older conchologists included most of the species with conspicuously cordiform profiles, compressed or cyclodont teeth, or involute umbones. *Bucardia* of the pre-Linnean writers comprised such forms as *Cypricardia, Hippopus, Cardium, Cardita,* etc., and in the *Isocardia* of Klein we find such an assembly.

In early attempts to segregate the members of this heterogeneous group it was inevitable that the first subdivisions, according to modern ideas, should still be composed of more than one generic group.

Linné placed the type of this genus first in *Cardium* and subsequently in *Chama,* and gave it three specific names before suiting himself. The oldest of these, according to the rules of nomenclature, must take the place of the latest, which is in almost universal use.

Poli seems to have been the first to separate the group from the Chamas, but his quadrinomial nomenclature forbids us to utilize his names.

Bruguière separated under the name of *Cardita* a group which included the type of *Isocardia,* as well as a large number of Carditas in the modern sense.

Humphrey under the name of *Trapezium* separated *Cypricardia* + *Isocardia* of Lamarck, and the former having been selected by Megerle to carry the generic name, the name applied by Lamarck to the latter can be retained. The plural name *Hippopodes* proposed by Meuschen for *Isocardia* and *Hippopus* is not in accordance with the Linnéan nomenclature and must be rejected, though it might fairly be claimed that it was embodied in Lamarck's *Hippopus* to an extent which left *Isocardia* free. *Isocardium* and *Bucardium* are variants of philologic trifling. Why the name *Tychocardia* of Roemer should have been proposed, as observed by Stoliczka, is incomprehensible.

So far as the Tertiary and recent fauna of North America and the Antilles are concerned the genus is divided into two groups, *Isocardia* proper, typified by *I. humana* L., and the subgenus *Meiocardia* H. and A. Adams, typified by *I. Moltkeana* Chemnitz. These groups are feebly separated in the recent fauna, and among the fossils their characters seem indefinitely interchangeable. The group of which *Callocardia* is the most conspicuous member is widely separated from *Isocardia* by anatomical characters. None of its members have yet been reported as American Tertiary fossils.

There are very few species of *Isocardia* in our Tertiary. "*Bucardia*" *veta,* described by Conrad from the Shark River, New Jersey, Eocene, is referred to the *Veneridæ* by Whitfield and regarded as a Cretaceous species. Harris (Bull. Am. Pal., i., p. 180, pl. 16, fig. 5, 1896) has described *I. mediavia* from the Midway Eocene of Alabama and Texas; *Glossus filosus* Conrad (in Wailes, Geol. Miss., p. 289, pl. 14, fig. 8, 1854) is a *Glycymeris*. The following species are all the others yet discovered:

Isocardia floridana n. sp.

PLATE 46, FIGURES 21, 26.

Vicksburgian Oligocene of Arredondo, Florida.

Shell short, high, with strongly involute beaks, solid, strongly and sharply unicarinate; inequilateral, the anterior end shorter, hardly extending farther than the vertical of the beaks; base rounded from the anterior end to the end of the carina, which extends from the beaks to the posterior basal angle; posterior dorsal margin gently arcuate, posterior end truncate from the end of the hinge-line to the basal end of the carina; teeth of the hinge normal, much compressed, the lateral low and distant; posterior dorsal slope excavated. Lon. 30, alt. 25, diam. 30 mm.

A single cast of the inside of a right valve of this species is all that was obtained, but the characters are well exhibited, except the external sculpture, which may have been somewhat undulated. It cannot be any of the described species.

Isocardia fraterna Say.

Isocardia fraterna Say, Journ. Acad. Nat. Sci. Phila., iv., p. 143, pl. xi., fig. 1 *a-b,* 1824.

< *Isocardia rustica* Conrad, Fos. Medial Tert., p. 20, pl. xi., fig. 1, 1838; not *Venus* (=*Arctica*) *rustica* Sowerby, 1818.

Glossus rusticus Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854.

Isocardia Conradi Orbigny, Prodr. Pal., iii., p. 121, 1852.

Glossus fraterna Meek, S. I. Miocene Checkl., p. 8, 1864.

Bucardia fraterna Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 576, 1863.

Miocene of Maryland at Plum Point (Burns, lower bed), Charlotte Hall, and St. Mary's on the Patuxent; City Point, James River, and near

Yorktown on the York River, and at Williamsburg, Virginia; also at Murfreesboro, Hartford County, North Carolina, according to Conrad.

This species was confounded with the *Venus rustica* of Sowerby, a British Crag fossil belonging to the genus *Cyprina* of Lamarck (=*Arctica* Schum.), and Orbigny, on the ground that they were not identical, and probably overlooking Say's previous description, renamed the shell *I. Conradi.* This of course is not identical with the *Isocardia Conradi* Gabb (Journ. Acad. Nat. Sci., 2d Ser., iv., p. 392, pl. 68, figs. 21, 21*a*, 1860) from the Cretaceous marl of Timber Creek, New Jersey (described and figured also by Whitfield, Mon. U. S. Geol. Surv., ix., p. 200, pl. 25, figs. 3, 4, 1885) and Prairie Bluff, Alabama. The Cretaceous species may take the name of *Isocardia Gabbi,* since the present name is untenable.

The *I. fraterna* seems to have but a limited distribution in the Miocene. The young are rather more elongated than the adult proportionately and senile specimens again become drawn out so that the outline of the shell, as well as the undulation of its surface, are exceedingly variable. The striation of the lateral tooth, mentioned by Conrad, is not a constant feature, as this tooth is often smooth. Nevertheless, it is quite a characteristic shell. An internal cast, probably of this species, was collected in the Miocene clays of Chilmark, Martha's Vineyard, Massachusetts, by J. B. Woodworth.

This species has been united with the *Isocardia humana* of Europe by Deshayes, Hoernes, and others, but this appears to me quite inadmissible.

Isocardia Markoei Conrad.

Isocardia Markoei Conrad, Bull. Nat. Inst., ii., p. 193, pl. 2, fig. 1, 1842.
Glossus Markoei Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854; Meek, Mioc. Checkl., p. 8, 1864.
Bucardia Markoei Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 576, 1863.

Miocene of Calvert Cliffs, Maryland, Markoe, Foreman, and O'Brien; Plum Point, Maryland, Burns (upper bed).

This well-characterized and compact species has not been, so far as I have heard, discovered anywhere outside of Maryland.

Isocardia carolina n. sp.

Plate 46, Figure 22.

Miocene of Edgecombe County, North Carolina, J. E. Bridges; Grove Wharf, James River, Virginia, Burns.

Shell large, solid, rotund, rather thin for its size, with involute beaks, inflated and inequilateral valves; anterior end short, subangular above, rounding evenly into the base below; hinge-line forming a segment of a circle, and except the anterior angle the outline of the valve is nearly suborbicular; near the umbo behind are traces of two radial ridges separated by a shallow sulcus, but these rapidly become obsolete, and the surface of the valves smooth except for incremental lines, which become stronger and more disposed in undulations near the anterior base in senile specimens; hinge normal, strong, the lateral smooth and well developed, the left cardinal duplex, compressed, with a small deep pit for the opposite cardinal below the junction; anterior adductor scar small, impressed, posterior scar much larger. Lon. 95, alt. 92, diam. 74 mm.

This species is represented by two left valves in the National Collection, obtained from North Carolina and Virginia. It forms a marked contrast to *I. fraterna* in its nearly smooth subglobular form and greater size. It may be that to specimens of this species Conrad referred when in his description of *I. rustica* (= *fraterna*) he said that it "attains in North Carolina a larger size than the *I. cor* with which Deshayes considers it identical." If Deshayes had specimens of this sort his conclusion would not seem so unreasonable as it does when one compares a good series of *I. fraterna* with *I. cor* (= *humana*). The present species, though very much less ponderous than *I. fraterna,* is thicker than *I. humana* and has its hinge less compressed, especially the cardinals, of which the profile forms a broad M with a conical pit below it; the lateral is also stronger and proportionately more distant from the cardinals; the posterior adductor scar is larger than in *humana* of the same dimensions, while the umbo of *I. carolina* is smaller, more pointed, less involute, and is distant 6.5 millimetres from the hinge margin, while, in a specimen of *I. humana,* slightly larger than that of *I. carolina,* the umbo of the same valve is eighteen millimetres from the margin. Correlatively, the excavation in front of the beaks is considerably smaller in *I. carolina.* The largest senile specimens of *I. humana* are higher and less orbicular than the types of *I. carolina,* which are evidently senile specimens also.

On the whole, in spite of the fact that the material is scanty, there seems to be reason to think that in the Upper Miocene there is a type of *Isocardia* leading from the older Miocene forms of Maryland in the direction of the *I. humana* of the European fauna. The form figured by Hoernes from the Vienna Miocene under the name of *Isocardia cor* (Moll., Wiener Beckens, pl. 20, fig. 2 *a-d,* 1870) is in my opinion distinct from the recent shell, from which it differs by its more produced and involute beaks, its much greater transverse diameter as compared with its height, its broader and heavier hinge-plate, and its less angular or rather totally rounded anterior end. I give the dimensions for comparison:

I. humana L.,	alt. 70,	lon. 76,	diam.	55.0	mm.
Hoernes's figure,	" 70,	" 70,	"	71.5	mm.
Height from hinge-line to base, *I. humana*, ...				65	mm.
" " " " " Hoernes's figure, . .				60	mm.
" " " top of beaks, *I. humana*, . .				5	mm.
" " " " " Hoernes's figure,				10	mm.

Hoernes states, and his figures support the statement, that the Vienna shell is more ponderous than the recent one, and I may say that the comparison of a large series of the latter from various localities shows nothing comparable with the characters of the former. I would therefore propose the name of *Isocardia Hoernesi* for the type from Gainfahren, Vienna Miocene.

Superfamily CARDIACEA.

Family CARDIIDÆ.

Genus **CARDIUM** Linné.

< *Cardium* Linné, Syst. Nat., ed. x., p. 678, No. 272, 1758; Mus. Lud. Ulricæ, p. 483, 1764; Syst. Nat., ed. xii., p. 1121, 1767. First species *C. costatum* L.

Cordiformes Da Costa, Elem. Conch., pp. 267-68, 1776; ex. fig'd. *C. unedo* L. (work not strictly binomial in nomenclature).

Cardium Muller, Zool. Dan. Prodr., p. 246, 1776; *C. echinatum et edule* L.; Humphrey, Mus. Calonnianum, p. 49, 1797; Bolten, Mus. Boltenianum, ed. i., p. 189, 1798; ed. ii., pp. 132-34, 1819; Bruguière, Encycl. Méth., i., pp. 203-235, 1789; Lamarck, Prodrome, p. 86, 1799; sole ex. *Cardium aculeatum* L.

The genus Cardium as originally proposed by Linné was nearly homogeneous. He named no type, and Bruguière was the first to eliminate *Isocardia* (which he placed with *Cardita*), but he also contented himself with saying that the spiny species were originally typical, and named none of them as an exemplar. Hwass (in Humphrey) seems to have followed Bruguière, and Bolten was the first to make a formal division of the genus. He separated the species into three genera, *Corculum*, containing shells of the *C. cardissa* type; *Fragum*, with the "strawberry heartcockles" like *C. unedo;* and *Cardium* proper, which was also divided into lamellate, costate, imbricate, dentate, or spiny, and glabrous groups, the latter being equivalent to *Isocardia*. The following year Lamarck, in his Prodromus, selected *C. aculeatum* Linné as an exemplar of the genus.

From that time the work of systematists has been confined chiefly to naming minor groups characterized by peculiarities of sculpture, many of which are of little structural importance and chiefly convenient as a means of assorting a rather uncomfortably numerous assembly of species.

The genus *Cardium* in the wider sense is very homogeneous compared with most large groups. The differences are of comparatively minor importance if judged by the standard of many other analogous groups.

The sculpture is predominantly radial, only in very exceptional cases does concentric or oblique sculpture or marked reticulation appear.

The hinge throughout the typical portion of the group is very uniform, comprising lateral lamellæ in both valves and two cardinals in each valve, of which, when interlocked, the inner pair are more robust and the outer pair feeble, so as to be liable to be overlooked or to become obsolete in worn or senile specimens. A more important character is that brought about by "torsion," or a process of twisting, which results in many species in bringing the two cardinals of one valve one above another, vertically, while in the opposite valve the cardinals will follow each other in a horizontal line. The teeth often, especially in thin species, seem to spring from the umbonal cavity rather than from a hinge-plate, a feature which I have tried to indicate by the term Cyclodont. Another feature, perhaps connected with the apparent rotation of the cardinals, is the tendency of the dorsal margin, just in front of the umbones, to be pouted and thickened.

In all the typical Cardiums there is neither lunule nor escutcheon, though a space between the terminal ribs and the shell margin may be smoother and simulate a lunular area. The lateral teeth are present in all groups except the subgenus *Lophocardium*. In *Serripes* alone the cardinals are obsolete. All the species, especially those of tropical waters, tend to have the ends of the shell, especially the posterior end, slightly different in sculpture from the middle of the disk. Thus in *Lævicardium* the ends are smooth and the disk obsoletely radially grooved, in *Serripes* the exact reverse is the case. Whether the surface be smooth or not, there is always some serration of the internal basal margins. In *Protocardia* a strongly differentiated posterior area is developed, the sculpture of which is doubtless correlated with the structure of the mantle edge around the siphonal apertures. In *Tropidocardium* there are several channels (corresponding, not to elevations of sculpture, but to the interspaces of the ribs externally) internally radiating from near the umbones, where at their terminations they are, as it were, roofed over; these channels are differently colored from the rest of the interior. Somewhat analogous is the case of *Ethmocardium,* an Upper Cretaceous type, in which the region within the pallial line is deeply pitted, the apices of the conical pits being covered with an extremely thin layer of shelly matter, so that the least exfoliation or erosion results in the appearance of a row of perforations in the channels between the external ribs over a large part of the disk. In most *Cardiacea* the pallial line is more distant from the distal margin of the valves than is usual in Pelecypoda, and it is frequently subtruncate behind. In *Leptocardia,* a small Cretaceous type, there is a double sinuation of the posterior part of the pallial line, almost suggesting a pallial sinus, and in *Serripes* it is truncate.

The periostracum in most species is thin and obscure, but in the boreal species, except *Serripes,* it becomes more conspicuous, coarse, and even tufted. A few tropical forms, notably *C. latum* Reeve, also show a pubescent periostracum.

The ligament, which encloses an obscure resilium, is usually short, strong, and seated in a deep groove, forming short, often thickened, nymphs. I have not found any species with an amphidetic ligament or any tendency to a sinking in of the ligament. The activity of these animals is such that the valves must be pretty flexible in their motions not to put their owner to a disadvantage among its kind, and this condition is correlated with the feebleness of the cardinals, the strong, short ligament, and the constant presence of serrations to hold the valves in place when closed.

Nearly all Cardia have two forms, one more equilateral and globose, the other more oblique and elongated, but whether these differences can be correlated with sex is at present unknown.

The shell of *Cardium,* especially the tropical species, is frequently furnished with an external shelly layer from which most of the spinose, nodose, or other superficial sculpture is wholly formed. This layer is very feebly attached to the next inward layer of shell and may be easily scaled off, taking with it the sculpture. The surface below it is usually polished, and in fossils, especially of the subgenus *Fragum,* the ribs will then appear polished and perhaps flat, when they were originally keeled or nodose, and show no evidences of erosion. This deceptive habit should be borne in mind by workers on this group.

The distribution of the genus in time among our Tertiaries has some points of interest. The Eocene forms are much more like European recent species, as regards the sections of the genus to which they belong, than later American forms. There are at present no species of typical *Cardium* in the American fauna, but in the Eocene and up to the end of the Oligocene such forms were not uncommon.

The curious subgenus *Ethmocardium* of the Cretaceous, the section *Dinocardium* from the Oligocene to the present fauna, and the elegantly sculptured *Trigoniocardia* are of strictly American distribution both recent and fossil as far as I have been able to ascertain.* *Cardium* and *Trachycardium* are represented in America only as fossils. We have no representatives of *Tropidocardium, Hemicardium, Fulvia, Discors, Corculum, Ctenocardia, Lunulicardia,* or *Aviculariim. Cerastoderma* and *Serripes* are circumboreal; *Ringicardium, Fragum, Papyridea, Lævicardium,* and *Protocardia* are circumtropical. Unless the internal cast from the (Eocene?) Puget group of Washington, figured by White (U. S. Geol. Surv., Bull. No. 51, plate ix., fig. 4, 1889), be an exception, we have on this side of the world no examples of that curious group of modified fluviatile cockles, typified by *Adacna,* so abundant in the brackish water beds of southeastern Europe and the Caspian.

The synonymy and subdivisions of this group are as follows:

Genus **CARDIUM** (L.) Lamarck.

Cardium Lam., Prodr., p. 86, 1799; Poli, Test. Utr. Sicil., iii., pp. 50, 258, 1795; Megerle, Entw., p. 53, 1811.

Cerastes + *Cerastoderma* Poli, *op. cit.,* p. 258, 1795; not *Cerastes* Laur., 1768 (*Reptilia*).

Acanthocardia Gray, List of Brit. An., p. 23, 1851; H. and A. Adams, Gen. Rec. Moll., ii., p. 455, 1857.

Acanthocardium Roemer, Conch. Cab. (*Cardium*), ed. ii., p. 17, 1869; Monterosato, Conch. Medit., p. 18, 1884.

Cardea Conrad (MS.) Whitfield, Lam. Raritan Clays, p. 134, 1885 (*C. dumosum* Conrad).

Criocardium Conrad, Am. Journ. Conch., vi., p. 75, 1870 (*C. dumosum* Conrad).

Eucardium Fischer, Man. Conch., p. 1037, 1887.

Plagiocardium Cossmann, Cat. Illustr., p. 156, 1887.

Shell variably sculptured, usually with predominantly radial ornamentation, usually closed or gaping but slightly, with no lunule or escutcheon; foot

* Since this was written I find *Cardium alternatum* Orbigny, from the Turonian of Sainte Maure, is an *Ethmocardium.*

geniculate, smooth, the pallial line rather distant from the margin of the valves. Hinge $\frac{L.\ 010.0101.010}{R.\ 101.1010.101}$.

Subgenus CARDIUM s.s.

Shell rotund, closed, with spinose ribs and granulose or cross-striated channels; left cardinals anterior when interlocked.

Subgenus TRACHYCARDIUM Mörch.

Trachycardium Mörch, Yoldi Cat., ii., p. 34, 1853 (*C. isocardia* L.).
Granocardium Gabb, Pal. Cala., ii., p. 266, 1868 (*C. sabulosum* Gabb).

Shell like *Cardium* s. s., but with the ribs imbricate or granulose; the channels also sometimes granulose.

Section *Acrosterigma* Dall, 1900.

Shell with an elevated mesial rib internally, radiating from the umbonal cavity. Type *Cardium Dalli* Heilprin.

Subgenus RINGICARDIUM Fisher.

Ringicardium Fischer, Man. Conch., p. 1037, 1887 (*C. ringens* Gmelin).
Bucardium Gray, Ann. Mag. N. Hist., 1853, p. 40 (*ex parte,* not of Megerle, Entw., p. 52, 1811).
Pectunculus (*Adanson*) Mörch, Yoldi Cat., ii., p. 33, 1853 (not of Lamarck, 1799).

Shell rotund, gaping, with flat ribs and channels, the posterior area with granulose channels; posterior margin sharply spinose, the spines crossing each other over the gape; left cardinals when interlocked posterior to the right ones.

Subgenus CERASTODERMA Mörch.

Cerastoderma Mörch, Cat. Yoldi, ii., p. 34, 1853; Roemer, Conch. Cab., 2d ed. (*Cardium*), p. 40, 1868; Meek, Pal. Upper Missouri, p. 166, 1876; *C. edule* L.
Cardium Gray, List Brit. An., p. 25, 1851; not of Lamarck.
Parvicardium Monterosato, Sin. Conch. Medit., p. 19, 1884.

Shell rotund or obovate, closed; with strong ribs obsoletely granulose or imbricate or smooth; no posterior or anterior area, channels simple; hinge normal.

Section *Cerastoderma* s. s.

Shell white, with coarse or tufted periostracum, the ribs similar, and usually obscurely nodulose; inhabiting boreal seas or comparatively deep water.

Section *Dinocardium* Dall, 1900.

Shell with more or less coloration, periostracum thin, polished, and inconspicuous; ribs with, anteriorly, arcuate hardly raised imbrications; mesially, flattened and nearly smooth; posteriorly, depressed and polished. Type *Cardium magnum* Born, = *C. ventricosum* Brug.

This group is notable for its elegant sculpture, from which spines, pustules, and elevated scales are absent. It replaces in warmer waters of America the Cerastodermas of the North, and goes back in geological time, with its characters well marked, as far as the Oligocene.

Subgenus ETHMOCARDIUM White.

Ethmocardium White, Proc. U. S. Nat. Mus., ii., p. 291, 1880. Type *Cardium speciosum* Meek and Hayden, Proc. Acad. Nat. Sci. Phila. for 1856, p. 274, 1857; not *Cardium speciosum* Adams and Reeve, Voy. Samarang, p. 77, pl. 22, fig. 9, 1850.

Shell ovate, closed, usually with plain ribs and channels, internally with the pallial area deeply pitted in lines corresponding to the external channels, the pits nearly reaching the external surface.

This type is believed to be characteristic of the Upper Cretaceous. The specific name of the typical species is preoccupied and I would propose for it the new name of *Cardium* (*Ethmocardium*) *Whitei.*

Subgenus TROPIDOCARDIUM Roemer.

Tropidocardium Roemer, Conch. Cab., 2d ed. (*Cardium*), p. 13, 1869 (*C. costatum* L.); Meek, Pal. Upper Missouri, p. 166, 1876.

Shell with a straight hinge-line, subauriculate, inflated, rotund, gaping behind, with ribs bearing hollow keels or spines; interior with excavated radial channels behind the middle line; hinge normal.

Subgenus FRAGUM Bolten.

Fragum Bolten, Mus. Boltenianum, p. 189, 1798; ed. ii., p. 131, 1819 (*C. unedo* L.); Mörch, Cat. Yoldi, ii., p. 35, 1853.

Isocardia Oken, Lehrb. Naturg., pp. viii., 234, 1815 (*ex parte,* not of Lamarck, 1799).

Hemicardium Swainson, Mal., p. 373, 1840; Roemer, Conch. Cab., 2d ed., p. 100, 1869; Cuvier, Regne An., ii., p. 479, 1817, *ex parte*.
Bucardium Gray, Ann. Mag. Nat. Hist., 1853, p. 40; not of Megerle, Entw., p. 52, 1811.
Loxocardium Cossmann, Cat. Illustr., p. 160, 1887.

Shell subtruncate behind, inflated, with strong ribs, no lunule or escutcheon, the channels simple, hinge normal, pallial line nearer the basal margin than in most Cardia.

Section *Fragum* s.s.

Valves obtusely angular in front of the truncation, ribs numerous, strong, pustular, or imbricate throughout. Type *C. unedo* L.

Section *Hemicardium* (Cuvier em.) Dall.

Valves more or less keeled behind the truncation, ribs comparatively few, low, flattish, only those near the middle of the shell pustular; channels concentrically sculptured. Type *C. hemicardium* L.

Section *Trigoniocardia* Dall.

Shell small, few ribbed, medial ribs very strong; posterior end subtruncate with smaller closer ribs; channels strongly concentrically sculptured; shell colorless, periostracum smooth. Type *Cardium graniferum* Sowerby.

Section *Ctenocardia* H. and A. Adams.

Ctenocardia H. and A. Adams, Gen. Rec. Moll., ii., p. 459, 1857; Fischer, Man. Conch., p. 1139, 1887. Type *C. hystrix* Reeve.

Like *Fragum* s. s., but the ribs profusely spinose, the truncated area destitute of spines, or with much smaller ones.

Subgenus PAPYRIDEA Swainson.

Papyridea Swainson, Mal., p. 374, 1840 (*C. soleniforme* Brug. = *C. spinosum* Meuschen).

Valves elongate oval, gaping, with numerous narrow ribs more or less tuberculose or spiny.

Section *Papyridea* s.s.

Shell thin, gaping at both ends, subcompressed, the posterior margin around the gape deeply serrate; periostracum inconspicuous.

Section *Fulvia* Gray.

Fulvia Gray, Ann. Mag. N. Hist., 1853, p. 40. Type *C. apertum* Bruguière; not *Fulvia* H. and A. Adams, Fischer, etc.

Shell globose, very thin, gaping behind, with fine radial threading; anterior part of shell minutely pustulate; the right anterior laterals start from the umbonal cavity, not from the hinge-plate, and the left cardinals, as in *Papyridea,* are posterior to the right ones when interlocked; the margin of the gape is not serrate.

The type of this section has been erroneously cited as *C. bullatum* L., causing confusion.

Subgenus LÆVICARDIUM Swainson.

Lævicardium Swainson, Mal., p. 373, 1840; H. and A. Adams, Gen. Rec. Moll., ii., p. 457, 1857; Roemer, Conch. Cab., 2d ed. (*Cardium*), p. 80, 1869.

Liocardium Mörch, Yoldi Cat., ii., p. 35, 1853. Type *Cardium norvegicum* Spengler.

Shell thin, oval, closed, middle of the valves smooth or feebly radially sculptured, ends with a smooth area, hinge normal, but with the anterior laterals springing from the umbonal cavity; periostracum smooth.

Section *Pachycardium* Conrad.

Pachycardium Conrad, Am. Journ. Conch., v., p. 96, 1870. Type *C. Spillmani* Conrad.

Shell resembling *Lævicardium* but very ponderous and with obsolete radial sculpture on the posterior fourth of the shell, visible chiefly as serrations on that part of the margin; the remainder of the shell smooth, or in certain abnormal specimens with irregular concentric wrinkles on the anterior aspect. Cretaceous.

Another Cretaceous form from Texas (Tucumcari) has the posterior end of the shell truncate and somewhat impressed, as in *Fragum medium* L., but shows the other characteristics of *Pachycardium.*

Subgenus DISCORS Deshayes.

Discors Deshayes, An. s. Vert. basin de Paris, i., pp. 553, 569, 1858. Type *C. subdiscors* Orbigny.

Lyrocardium Meek, Pal. Upper Missouri, p. 173, 1876. Type *C. lyratum* Sowerby.

Amphicardium von Martens, 1880, *fide* Fischer.

Divaricardium Dollfus and Dautzenberg, Feuille des Jeunes Nat., p. 95, 1886; *C. discrepans* Basterot.

Shell like *Lævicardium* but with the anterior half finely radially striate, over which pass sharp, elevated, oblique lamellations; posterior half with sharp, elevated, radial ribs.

Genus **SERRIPES** Beck.

Serripes (Beck MS.) Gould, Inv. Mass., p. 93, 1841; *C. grönlandicum* Gmelin.

Aphrodite Lea, Trans. Am. Phil. Soc., v., p. 111, 1834; obs. genus *Unio,* i., p. 223; sole ex. *A. columba* Lea, *op. cit.;* not *Aphrodite* Hübner, 1816 (Lepidoptera).

Acardo Swainson, Mal., p. 374, 1840; *C. edentulum* auct.; not *Acardo* Bruguière, or Lamarck, 1799, or Oken, 1815.

Valves smooth mesially, radially striate towards the ends, cardinal teeth obsolete; pallial line truncate behind; foot geniculate, compressed, serrate on the edge below.

This genus is confined to boreal seas and includes only two species in the present fauna.

Genus **CORCULUM** Bolten.

Corculum Bolten, Mus. Boltenianum, p. 188, 1798; ed. ii., p. 131, 1819. *Cardium cardissa* L. Roemer, Conch. Cab., 2d ed. (*Cardium*), p. 113, 1869.

Cardissa Megerle von Muhlfeldt, Entw., p. 52, No. 19, 1811; Swainson, Mal., p. 373, 1840; Gray, Ann. Mag. N. Hist., 1853, p. 41 (not of Oken, Lehrb. d. Naturg., pp. viii., 232, 234, 1815, = *Venericardia* Lam.).

Isocardia Oken, Lehrb. d. Naturg., pp. viii., 234, 1815 (not of Lamarck, 1799).

< *Hemicardes* Cuvier, Regne An., ii., p. 479, 1817.

Hemicardium Fèrussac, Fabl. Syst., p. xliii., 1822; Gistel, Naturg., p. 172, 1848.

Hemicardia Mörch, Yoldi Cat., ii., p. 36, 1853; H. and A. Adams, Gen. Rec. Moll., ii., p. 458, 1857.

Shell antero-posteriorly compressed, mesially keeled, closed, with a moderately impressed escutcheon but no lunule, feeble radial sculpture and normal hinge. In adults of the larger forms of this genus the umbones pass by each other like the blades of a pair of scissors and the ligament is very short.

Genus **LUNULICARDIA** Gray.

Lunulicardia Gray, Ann. Mag. N. Hist., 1853, p. 41 (*C. retusum* L.); H. and A. Adams, Gen. Rec. Moll., ii., p. 459, 1857; Roemer, Conch. Cab., 2d ed. (*Cardium*), p. 116, 1869; not *Lunulicardium* Münster, 1840.

Opisocardium Bayle, Journ. de Conchyl., xxvii., p. 35, 1879.

Shell truncate in front with a deeply impressed lunule, but no escutcheon, the flap of the dorsal anterior margin projecting into the cavity of the lunule, hinge pressed out of shape by the lunular depression but otherwise normal; sculpture feeble.

Genus **AVICULARIUM** Gray.

Avicularium Gray, Ann. Mag. N. Hist., xi., p. 41, 1853. Type *Cardium aviculare* Lam.
Lithocardium Woodward, Man. Rec. and Fossil Shells, p. 291, 1854.

Shell keeled laterally, subtrigonal, the hinge-line long, straight, mostly in front of the umbones, and the hinge produced anteriorly.

Section *Avicularium* s. s.

Valves closed.

Section *Byssocardium* Munier Chalmas, 1882.

Valves with a byssal foramen on the anterior margin. Type *Cardium emarginatum* Deshayes.

Pterocardia (Agassiz) Bayan, 1874, founded on *C. striatum* Buvignier, Mém. Soc. phil. de Verdun, ii., p. 5, pl. 3, figs. 20-21, 1843 (*C. Buvignieri* Deshayes), I have not seen, but from Fischer's description it must be allied to *Avicularium* if not identical.

Goniocardium Vasseur, Journ. de Conchyl., xxviii., p. 182, 1880, has not been well figured and is founded on *G. Heberti* Vasseur and *Cardium rhachitis* of Deshayes. Cossmann refers it to *Fragum*, but from the description given by Vasseur it would seem to resemble *Avicularium*.

Genus **PROTOCARDIA** Beyrich.

Protocardia Beyrich, Zeitschr. für Malak., p. 17, 1845. Type *Cardium hillanum* Sowerby. Cretaceous.

Protocardium Meek and Hayden, Proc. Acad. Nat. Sci. Phila., xii., p. 418, 1860; Cossmann, Cat. Illustr., p. 163, 1887.

Nemocardium Meek, Pal. Upper Missouri, p. 172, 1876; *C. semiasperum* Deshayes.

Shell globose with a posterior area sharply distinguished by sculpture from the rest of the surface; closed; hinge normal, with no lunule or escutcheon.

Section *Protocardia* s.s.

Posterior area sculptured with smooth radial ribs, the remainder of the surface with concentric striation.

Section *Nemocardium* Meek.

The posterior area spinose or tuberculate, the remainder of the surface finely radially striate, or finely reticulate; the anterior laterals springing from the umbonal cavity.

Section *Leptocardia* Meek.

Leptocardia Meek, Pal. Upper Missouri, p. 172, 1876; *C. subquadratum* Evans and Shumard. Cretaceous.

Shell small, thin, with the form of *Protocardia* s. s. with the sculpture obsolete, and the pallial line doubly sinuous near the anterior adductor scar.

I have cited the above sections indicated by Meek, though I am very doubtful of their value. I find the minute tuberculations, which sometimes are seated on the ribs and sometimes spring from the channels, are extremely fugitive, and it is often difficult to decide even in recent specimens whether they have been provided with tubercles or not. Consequently I am disposed to unite *Nemocardium* with *Protocardia* s. s. Moreover, I find, in examining many specimens of recent *Protocardia*, that in a large proportion of them an irregular sinuosity appears in the posterior part of the pallial line, as figured by Meek for *Leptocardia,* but it is not constant in the same species, and is probably one of those individual irregularities which have no systematic value. Therefore I should let *Leptocardia* share the fate of *Nemocardium.* All the Protocardias have on the anterior part of the shell both concentric and radial sculpture, though, as in *Lævicardium,* it may be almost imperceptible. The slight variations which will result in radial, concentric, or reticulate sculpture on this part of the shell can therefore be held to have hardly more than specific importance. The anterior laterals in *Protocardia* invariably spring from the umbonal cavity; in many forms the posterior laterals, especially in the left valve, show signs of obsolescence; and the dorsal margin of the right valve exhibits a tendency to overlap the corresponding margin of the opposite valve, as often occurs in *Chlamys. Pachycardium* should be transferred to the vicinity of *Lævicardium.* The spinules next the anterior border of the posterior area in *Protocardia* often fuse together to form a low crest or keel, much as in *Lophocardium,* but this formation is so excessively fragile that even in living specimens it is only represented by fragmentary portions of the original.

Subgenus **LOPHOCARDIUM** (Fischer).

Lophocardium Fischer (as section of *Papyridea*), Man. de Conchyl., p. 1038, 1887; *C. Cumingi* Broderip.

Lophocardium Dall, Nautilus, June, 1889, p. 13; Proc. U. S. Nat. Mus., xii., No. 773, p. 264, 1889.

Shell resembling *Protocardia* but gaping behind, with the keel bordering the posterior area more prominent and less fugacious, and with the lateral teeth entirely obsolete. An examination of a recent specimen shows marked anatomical differences also.

The species of typical *Cardium* in our Tertiaries are few and do not survive the Oligocene. *C. hatchetigbeënse* Aldrich, 1886, from the Lower Claibornian and *C. Tuomeyi* Aldrich, 1886, from the Chickasawan are the only well-established species in the literature. Gabb described a *C. multiradiatum* (1860, not *C. multiradiatum* Sowerby, 1846) which Whitfield identifies with a fossil from the Raritan clays of New Jersey, which is a *Cardium* s. s., but its name must be changed, as it has been used in the genus before. *C. vicksburgense* Conrad, from the Vicksburgian, may belong to this section or to *Cerastoderma,* I have not examined it. The "*Cardium*" *aleuticum* of Girard, 1850, from the Alaskan Eocene, is perhaps an internal cast of a *Glycymeris.* "*C.*" *subtentum* Conrad, 1849, from Oregon, appears to be a *Venericardia.* *Cardium globosum* Conrad (1848, printed *glebosum* by a typographical error afterwards corrected by Conrad, but not *Cardium globosum* Bean, 1839, from the Cornbrash of Scarborough, England; nor *C. globosum* d'Orbigny, 1849), from the Jacksonian and Red Bluff beds, is perhaps to be placed in this section, though its Λ-shaped spines recall *Trachycardium.* As *glebosum* is a Latin word, it may best be retained as the name of the species, though in no wise appropriate to the shell in question.

Cardium propeciliare n. sp.

Plate 48, Figure 12.

Oligocene marl of the Chipola River, Calhoun County, Florida; Burns.

Shell small, thin, inflated, slightly oblique and inequilateral, with high, well-rounded beaks, anterior end slightly shorter, general outline suborbicular; sculptured with nineteen elevated ribs of triangular section separated by narrow, cross-striated channelled interspaces, each rib surmounted by a low keel the edge of which is periodically produced into short spines each ending in a knob, sides of the ribs finely concentrically striate; near the posterior end the whole surface shows a microscopic granulation; internal margins deeply fluted; hinge normal, delicate. Alt. 20, lon. 20, diam. 15.5 mm.

This elegant little shell is close to the young of the *C. echinatum* L. of Europe, in which, however, the ribs are lower, the interspaces wider and less sharply cross-striated, the keel less elevated and continuous, and the spines long and sharp. The European shell is more equilateral, with a longer hinge-line and not oblique. However, they are so similar as to be very interesting. According to Turton and Hanley, the young *C. echinatum* is probably the *C. ciliare* of Linné.

Cardium ctenolium n. sp.

PLATE 40, FIGURE 13.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell rounded, a little produced behind, with inflated beaks, subequilateral; sculptured with eighteen broad, rounded ribs separated by narrower flat interspaces sharply defined; there are posteriorly some fine radial striations and over the whole shell fine concentric sculpture which seems stronger where it passes over the ribs, especially distally, and in some places approaches imbrication; there is a small smooth area above the outermost anterior rib, but none behind the beaks; internal margins deeply fluted and radially striate; hinge normal. Lon. 19.5, alt. 18.5, diam. 14 mm.

Although not spiny I have placed this species in the typical section, as in all other characters this seems closely related to the true *Cardia,* and the latest representative of that group known from our Tertiaries.

Cardium acrocome n. sp.

PLATE 48, FIGURE 2.

Oligocene marl of the Chipola River, Calhoun County, Florida; Burns.

Shell small, rotund, plump, nearly equilateral, with moderately full umbones; sculpture of about forty-five close-set, low, nearly flat radial ribs separated by very narrow channelled interspaces; the alternate ribs anteriorly surmounted with prominent hollow spines usually truncate at the ends, their alternates showing low $\wedge$-shaped spines; behind the middle of the shell the long-spined ribs are less numerous and on the posterior area nearly all the ribs have low spines; there is no smooth area near the hinge-margin; internally the margins are fluted or serrate minutely, and the shell radially sulcate near the margin; hinge normal, delicate. Alt. 7.5, lon. 7.5, diam. 6 mm.

Only a single valve of this very distinct little species was obtained. Owing to the alternation in the sculpture it has somewhat the aspect of *Criocardium.*

Subgenus **TRACHYCARDIUM** Mörch.

The only Eocene representative of this group is *C. bellum* Conrad (1875, in Kerr, N. Car. Rep., App.), which has not been figured or sufficiently described. From the description it would appear to resemble *C. isocardia.* In the Oligocene the fauna is much richer. We have *C.* (*T.*) *dominicense* Gabb, 1873, from St. Domingo, easily known by its sixty ribs; *C.* (*T.*) *lingualeonis* Guppy, 1866, from Bowden, Jamaica, a species allied to the recent *C. Belcheri* of the Gulf of California, but with more numerous and less elevated ribs, *C.* (*T.*) *inconspicuum* Guppy, and a number of undescribed species. The National Collection contains fragments of a large flat-ribbed species with narrow wrinkled interspaces, not unlike *C. marmoreum* Lam., and of another species also large and strong with narrower, keeled-muricate ribs, both from Bowden, which may furnish better specimens later on. From the Chipola horizon at Alum Bluff, Chattahoochee River, Florida, comes another species with very narrow imbricate ribs and much wider wrinkled interspaces, only represented in the collection by a fragment.

Cardium (Trachycardium) inconspicuum Guppy.

Cardium inconspicuum Guppy, Quart. Journ. Geol. Soc., London, vol. xxii., p. 293, pl. xviii., fig. 12, 1866.

Oligocene of the Bowden, Jamaica, marl, and of the Chipola marl, Calhoun County, Florida.

This species really has a little resemblance to *C. subelongatum* Sowerby, and probably Gabb confused this with *C. lingualeonis* Guppy when he placed (wrongly) the latter name as a synonym under *C. subelongatum.* The species actually labelled by the last-mentioned name in Gabb's collection are quite a different thing again, as will shortly be shown.

The present species has from thirty-six to forty-two ribs, which, when they preserve their outer coat, have a beautiful close concentric threading over the whole shell, except the ribs of the posterior area, which are smooth and polished; the loops of the threads as they pass over the body ribs (as usual in *Cardium*) are convex towards the umbones. When this coating is removed by wear the tops of the ribs will be flat and polished while their sides show fringing wrinkles. If erosion attack the second surface, the structure of the shell will reproduce pretty faithfully the reversed loops of the original outer coat.

Cardium (Trachycardium) dominicanum n. sp.

Plate 48, Figure 16.

Cardium subelongatum Gabb, Geol. St. Dom., p. 250, 1873 (syn. exclus.); not of Sowerby, P. Z. S., 1840.

Oligocene shales near Gatun, on the line of the Panama Canal, Rowell; Oligocene of St. Domingo, Gabb.

Shell ovate, solid, heavy, inflated, with high, conspicuous prosogyrate beaks, and a very short and heavy hinge; sculpture of twenty-seven similar, subequal, strong ribs, subtriangular in section, the longer side of the rib in each case inclining towards the middle line of the shell; interspaces very narrow, not regularly channelled, but rather formed by the sides of the ribs; the whole shell is covered with fine concentric lineation, and the summit of each rib when perfect carries a line of small nodules, usually rounded or oblong and transverse, and on a few of the ribs near the posterior end more or less $\wedge$-shaped; shell nearly equilateral, internal margin fluted, upper part of the posterior margin serrate. Alt. 28, lon. 20.5, diam. 23 mm.

This shell has obviously little resemblance to *C. subelongatum,* and Gabb's statement that it resembles perfectly the recent specimens of that species from the same region is one of those puzzles which are inexplicable.

(Group of *C. isocardia* Linné.)

Cardium (Trachycardium) cestum n. sp.

Plate 48, Figure 14.

Oligocene marl of the Chipola River, Calhoun County, Florida; Burns.

Shell moderately large, solid, inflated, slightly oblique, subequilateral; beaks high and rounded; sculpture of thirty-four triangular radial ribs, on the summit of which is developed a thin elevated keel of which the summit is somewhat like the top of a T-rail, overhanging at the sides, when intact, and flattened and smooth on top; the sides of the keels and ribs, up to the twenty-second, are vertically striated and sparsely sprinkled with minute granules; the posterior twelve ribs are asymmetrical, the keels being placed behind the summits of their sustaining ribs and crenulate or surmounted by obliquely set transverse nodules; the first nine ribs are somewhat similarly imbricate or nodulous, and ventrally in adults near the margin are often pressed over backward and strongly transversely wrinkled with their interspaces flat and rather wide, while over the disk the interspaces are chiefly narrow and V-shaped; different individuals show minor modifications of these details of ornament; interior with the margins fluted, the posterior margin deeply serrate, the internal face with shallow grooves extending upward from the flutings; hinge normal. Alt. 50, lon. 40, diam. 36 mm.

This profusely ornamented species is naturally usually more or less defective, but under all conditions is a remarkable shell.

Cardium (Trachycardium) lingualeonis Guppy.

Cardium lingualeonis Guppy, Quart. Journ. Geol. Soc. London, vol. xxii., p. 293, pl. xviii., fig. 7, 1866.

< *Cardium subelongatum* Gabb, Geol. St. Domingo, p. 250, 1873; not of Sowerby, 1840.

Oligocene marl of the Chipola horizon on Shoal River, Walton County, Florida; and of Bowden, Jamaica.

This species has thirty-two ribs, which are closer together than in the preceding species, while the edges of the surmounting keels are undulated, twisted, and rippled as confectioners do with ribbons of pulled candy. The shell is narrower and less oblique than *C. cestum*.

Cardium (Trachycardium) delphicum n. sp.

PLATE 48, FIGURE 18.

Oligocene of the Ballast Point, Tampa, silex beds, and of the Oak Grove sands, Florida.

Shell small, solid, thick, subovate, with high beaks, nearly equilateral; sculptured with twenty-eight to thirty-one strong, high, triangular ribs, with much narrower, hardly channelled interspaces, both longitudinally and concentrically feebly striated; the first six or seven ribs are furnished with the usual cup-like projections, but succeeding ones show the cups narrowing and compressed above so as to form strong $\wedge$-shaped imbrications; at about the nineteenth rib the anterior wing of the $\wedge$ seems to become obsolete and the posterior wing, persisting on the posterior side of the ribs, more and more oblique and nodulous; interior margin with rather small flutings continued as sulci nearly to the middle of the shell; posterior margin feebly serrate; hinge short, strong. Alt. 33, lon. 28, diam. 24 mm.

This represents in the Oak Grove fauna the *C. isocardia* type. The Ballast Point specimens have only twenty-eight ribs and may belong to another species; as they are rather poor silicious pseudomorphs I have preferred to class them here, at least temporarily.

Cardium (Trachycardium) Emmonsi Conrad.

Cardium muricatum Emmons, Geol. Rep. N. Car., p. 301, figs. 232-233, 1858; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 576, 1863; not of Linné, 1758, nor Tuomey and Holmes, 1856.

Cardium Emmonsi Conrad, Am. Journ. Conch., iii., p. 13, 1867.
Cardium floridanum Heilprin, Trans. Wagner Inst., vol. i., pp. 92, 103, pl. xi., fig. 25, 1887.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Willcox; of North Carolina, at Walker's Bluff, Cape Fear River, Emmons.

This form has nine ribs on the posterior with hood-like imbrications; ten on the disk with high, arching imbrications continuous on the posterior side; and ten anterior, with cup-like ornaments like strung convolvulus flowers. The nearest recent relative is *C. consors* Broderip, of the Pacific coast. It is rather rare in the marls.

Cardium (Trachycardium) isocardia Conrad.

< *Cardium isocardia* Linné, Syst. Nat., ed. x., p. 679, 1758; ed. xii., p. 1122, 1767; Dillwyn, i., p. 118.
Cardium isocardia Chemnitz, Conch. Cab., vi., p. 182, pl. 17, figs. 174-176, 1782; Reeve, Conch. Icon., ii., *Cardium*, pl. 17, fig. 84, 1845.
Cardium Egmontianum Shuttleworth, Journ. de Conchyl., v., p. 472, 1856.
?*Cardium eburniferum* Guppy, Ann. Mag. N. Hist., 4th Ser., xv., p. 51, pl. vii., fig. 3, 1875.

Miocene of North Carolina at Wilmington; Pliocene of the Caloosahatchie and Myakka Rivers, Florida; Pleistocene of North Creek, Osprey, Florida; recent from off-shore near Cape Hatteras, North Carolina, southward through the West Indies to Trinidad.

This is the type of the subgenus, and has about twenty-seven to thirty-three ribs, with comparatively low and distant arcuate imbricating scales; the ribs are squarish and the interspaces channelled, the scales tend to be seated on the posterior side of the ribs; on the anterior face of the shell the imbrications are closer, lower, and heavier, but these ornaments change their form very gradually from one end of the shell to the other.

Linné and the earlier writers confounded this shell with a similar form from the East Indies which was afterwards named *C. squamosum* by Gmelin. A specimen of the West Indian shell was in the Linnean cabinet and serves to hold the name, though among the figures cited by him several referred to the Oriental shell. Guppy has described a shell from the Gulf of Paria which appears to be this species, though with rather more ribs than usual, but I know it only from his figure.

The spines are sometimes more distant and are then usually longer than common.

(Group of *C. muricatum* Linné.)

Cardium (Trachycardium) precursor n. sp.

Plate 48, Figure 10.

Oligocene of Vicksburg, Mississippi; L. C. Johnson.

Shell small, moderately inflated, rather thin, nearly equilateral, the beaks small and slightly prosogyrate; sculpture of thirty-seven to thirty-eight strong, well-defined ribs, mostly of triangular section, with narrower channelled interspaces; the ribs on the anterior face minutely nodulous, the posterior ten flattened and more or less spinose with minute prickles; the whole shell finely concentrically striated, so that in perfect specimens the summit of the ribs on the disk is probably minutely crenate; internal margin sharply fluted; hinge normal, strong. Alt. 22.5, lon. 22, diam. 14.5 mm.

The single valve of this species in the National Collection appears distinct from any of those heretofore described from the Vicksburgian, and by its sculpture foreshadows the type to become so well-developed.

Cardium (Trachycardium) virile n. sp.

Plate 48, Figure 1.

Oligocene of the Chipola marl, Calhoun County, Florida; Dall and Burns.

Shell small, solid, strong, rounded, subovate, with about thirty-eight rather close-set ribs, with narrower channelled interspaces; the anterior ribs to the number of about fourteen exhibit the strung and flattened cup-imbrication like *Cardium consors* in miniature; the posterior fourteen are asymmetrical, with an undulate or irregularly twisted serrate keel on the anterior side of the rib; those in the middle of the disk have a similar keel on the posterior side of the rib; the outer posterior ribs are more or less muricate or spinulose, and the posterior margin is serrate, the rest merely fluted internally; exceptionally perfect small specimens show small and extremely delicate spines on the medial ribs. Alt. 27, lon. 25.5, diam. 18 mm.

The delicacy and fragility of the ornamentation of this little shell are such that not a single specimen of many preserved its sculpture intact.

Cardium (Trachycardium) parile n. sp.

Plate 48, Figure 17.

Oligocene of the lower bed at Alum Bluff and on the Chipola River, Calhoun County, Florida.

Shell small, suborbicular, inflated, nearly equilateral, the posterior end slightly more attenuated and produced; beaks full but not high; sculptured with twenty-five ribs having in section the form of a truncated pyramid, separated by narrower channelled interspaces, elegantly concentrically closely striated; the anterior ten ribs bear ∧-shaped projections, the anterior wing of the ∧ being broad and produced, the posterior narrow and appressed; the four ribs next posterior have on their tops slender arcuate transverse rather sparse imbrications; behind these the projections shift to the posterior side of the summits of the ribs, gradually becoming more oblique, losing the anterior wing of the arch, and finally appearing as delicate spinules nearly parallel with the ribs; interior margin behind strongly serrate, below and in front fluted, the flutings continued to the umbonal cavity as shallow sulci; hinge normal, delicate; a narrow, smooth area between the most anterior rib and the hinge-margin. Alt. 15, lon. 15.5, diam. 10 mm.

This little species appears to be rather abundant in the sands.

Cardium (**Trachycardium**) **malacum** n. sp.

PLATE 48, FIGURE 4.

Oligocene sands of Oak Grove, Santa Rosa County, Florida.

Shell small, solid, somewhat oblique, the upper anterior and lower posterior margins produced, beaks small and low; sculpture of thirty-two rounded-triangular rather high ribs with very narrow channelled interspaces, which, with the sides of the ribs, are concentrically striated; the first twelve ribs have cup-like imbrications of the strung-convolvulus type, behind which they change by the modification of the anterior part to 7-shaped, and finally to the usual transverse oblique nodulous type; interior margin sharply and deeply fluted, the channels continued half-way up the disk, the upper posterior margin with seven or eight serrations. Alt. 24, lon. 24, diam. 16 mm.

This species has a peculiar obliquity that I have not elsewhere noticed, otherwise its characters are not striking.

Cardium (**Trachycardium**) var? **bowdenense** Dall.

Cardium muricatum Guppy, Geol. Mag., Dec. ii., vol. i., p. 450, 1874; not of Linné, 1758.

This species from the Bowden marl and from the silex beds at Ballast Point, Tampa Bay, Florida, was identified with the recent *muricatum* by Guppy. It has about the same number of ribs (thirty-seven to forty-one) and the sculpture is much the same in character, but the similarities are all in miniature; the shell is always small (alt. 15.5, lon. 15.5, diam. 9 mm. for the largest seen), less inflated proportionately than *C. muricatum* of the same size, with the ribs more compressed and crowded. *C. muricatum* has not been found in any horizon between Bowden and the Pleistocene, which is in itself a strong reason for doubting whether the older shell is identical with the newer. I therefore propose for it the name of *bowdenense,* which, if connecting links should hereafter be found, may be regarded as of varietal value.

Cardium (Trachycardium) oedalium Dall.

Cardium muricatum Tuomey and Holmes, Pleioc. Fos. S. Car., p. 64, pl. 19, fig. 2, 1856; not of Linné, 1758.

Cardium carolinensis (*sic*) Conrad, Am. Journ. Conch., iii., p. 13, 1867; not of Conrad, 1862.

Pliocene of Florida, on the Caloosahatchie, Alligator, and Shell Creeks, Dall and Willcox; of South Carolina, near Darlington, Burns and Holmes.

Shell suborbicular, moderately inflated, nearly equilateral, with low beaks and a narrow smooth space above the upper anterior rib in each valve; sculpture of twenty-seven to thirty-one rounded triangular ribs, separated by narrow, finely cross-striated channels; the anterior nine ribs bear on their anterior edge small ovate or reniform disks with convex lower surfaces, on each rib connected together by a raised line; the nine ribs next posterior bear on their summits a similar series of half funicular projections, which become more and more indented in the median line until on the last of the nine ribs the series is composed of double leaflets instead of a single arch; on the remaining ribs the projections are laid on the posterior side as a single series (on each rib) of subtriangular leaflets oblique or nearly parallel with the rib on which they stand; internal margin deeply fluted, disk sulcate, posterior margin feebly serrate, hinge normal, delicate, shell not very heavy. Alt. of type 30, lon. 31, diam. 19 mm. Some specimens reach an altitude of 46 mm.

This is the Pliocene representative of *Cardium muricatum,* which has not been found in the marls so far, but a close examination will show the very different and much more developed character of the murication. This, however, is found occasionally more or less dwindled; a variety *depauperatum* has the ornaments represented only by sparse and feeble spinules, which, however, preserve their original form whenever intact. This shows much less variation than *C. muricatum* in the number of ribs, of which there are almost always thirty-one. In studying the sculpture of this and allied species it is very necessary to select perfectly preserved examples, as in the great majority the minor characteristics have been lost.

This species is the subject of one of Conrad's perennial blunders. In 1862 he proposed the name of *C. carolinensis* (*sic*) for the *C. magnum* of Tuomey and Holmes, which he supposed not to be *C. magnum* of Born. Again in 1867 he proposes the same name for the *C. muricatum* of Tuomey and Holmes. In 1875 he again uses the name for a supposed new species of *Trachycardium* from the Cretaceous of North Carolina, making three distinct species to which he has applied the specific name *carolinensis* in the genus *Cardium*, besides his *Protocardia carolinensis* of 1875, also from the North Carolinian Cretaceous.

Cardium (Trachycardium) muricatum Linné.

Cardium muricatum Linné, Syst. Nat., ed. x., p. 680, No. 69, 1758 (not p. 679, No. 62, = *aculeatum* in errata, p. 824). Not of Emmons, 1858, Tuomey and Holmes, 1856, or Guppy, in part, 1874.

Cardium campechiense Bolten, Mus. Boltenianum, p. 191, No. 407, 1798.

Cardium muricatum Reeve, Conch. Icon., ii., *Cardium*, pl. vi., fig. 33, 1844.

Cardium Gossei Deshayes, P. Z. S., 1854, p. 330.

Pleistocene of Florida, the Atlantic coast of Middle America, and the West Indies; recent from the coast of North Carolina near Cape Hatteras southward to Santa Caterina, Brazil; among seaweeds in one to four feet of water, Krebs, but in deeper water towards the extremes of its range.

The typical locality for this species is Campeche, and considering its variability in some particulars it is curious that the species has but two synonyms. The species has from thirty to forty-one ribs, the first twelve of which have seated on the anterior side of their flattened summits pedunculated nodules in a single, not crowded series, resembling little incisor teeth pointing with their broad edges towards the umbo of the valve; the next posterior pair of ribs have a double series, one on each side of the top of the rib, alternating, and not unlike the cusps of little canine teeth, also pointing upward; the number of ribs with this double series varies from one to four, but is usually two; about fourteen ribs next posterior have only a single series set obliquely on the posterior side of the ribs; then follow about six with similar processes but more blade-like and twisted, then one with a double set of blades, and three or four with a single set rather longer and more crowded; the interspaces are narrow and hardly channelled; the inner margin has short serrations all round and radial sulci extend over the inner disk to the umbonal cavity.

There is practically no smooth area between the most antérior ribs and the hinge-margin in a typical specimen. The details of the ornament vary more or less but are more constant than one would expect in structures whose minute details can hardly affect the economy of their builder, but are the result of minute modifications of the mantle margin.

I have been at the trouble to count the ribs of fifty-five specimens of this species from all parts of its range and record the result, the figures representing the number of ribs and those following in parentheses the number of specimens having the number of ribs indicated by the units preceding the parenthesis:

30 (2), 31 (9), 32 (5), 33 (8), 34 (7), 35 (8), 36 (6), 37 (5), 39 (3), 40 (1), 41 (1).

The only generalization that seemed authorized is that the ribs are less numerous in specimens from near the northern border of the range of the species, and also in the fossils; the specimens with thirty-seven to forty-one ribs are nearly all from the southern half of the area inhabited. There was no diminution of ribs towards the southern extreme of the range and no regularity in the variations of the murication which could be correlated with difference of habitat.

(Species of the group of *C. elongatum.*)

Of this group, which resembles species of the *C. isocardia* type with the ornament removed from the tops of the ribs, and existing, if at all, only on their sides in the interspaces, we have two unidentified species indicated by fragments in the Bowden Oligocene marl of Jamaica; one, *C. declive* Gabb (1881, very similar to *C. inconspicuum* Guppy), from the Pliocene of Costa Rica, and the following species:

Section *Acrosterigma* Dall.

Cardium (Trachycardium) Dalli Heilprin.

Cardium Dalli Heilprin, Trans. Wagner Inst., vol. i., p. 131, pl. 16*a*, fig. 70, 1887.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida; Willcox and Dall.

This magnificent species has thirty-five ribs, of which seven belong to the posterior area and are flattened and grooved, with traces of minute spinules in the interspaces near the hinge; the other ribs are broadly arched, almost flat, nearly smooth, with faint longitudinal and concentric striæ; the edges of these ribs overhang so much as to nearly roof over the narrow channelled interspaces; on the upper fifth of the shell the sides of the ribs, and on the umbo their tops, are gently crenulated. Internally the margins in front and below are fluted, the sulci extending half-way up the shell; the posterior margin is distantly denticulated by the ends of the ribs of the posterior area.

A singular feature, and one which seems to be worthy of sectional discrimination, is presented by this species, though not mentioned in the original description. Internally, from the umbo, nearly in the middle of the shell a stout, elevated, solid rib is given off and extends downward on the shell wall to about the level of the lower end of the posterior lateral tooth. An examination of *C. elongatum* and many other exotic species of *Cardium* revealed no such feature in any, though *C. pseudolima* and a few other species have the thickened ridge in the wake of the posterior adductor scar common to so many bivalves.

While this rib is conspicuous only in full-grown shells, it exists in the youngest hitherto examined.

The measurements of the largest pair of *C. Dalli* in the National Collection are: Alt. 136.0, lon. 93.0, diam. 51.0 mm.

In concluding this review of the *Trachycardia* it may be mentioned that the enormous *C. quadragenarium* Conrad, 1838, is reported by Cooper to occur in the Pliocene and Pleistocene beds of California as well as in the existing fauna from San Pedro southward. It is the *C. luteolabrum* of Gould, 1851, and *C. xanthocheilum* (Gld. MS.) Carpenter, 1856.

Subgenus RINGICARDIUM Fischer.

Cardium procerum Sowerby (1833, of which *C. laticostatum* Sowerby is said to be the young, and *C. panamense* Sowerby, 1843, very closely allied) is known from the Pliocene of the well in the City Park at San Diego, California, and also from the Pleistocene of the coast. In the recent fauna it ranges from Lower California and the Gulf to Panama.

Subgenus CERASTODERMA Mörch.

This group contains the greater number of our Neocene cockles and is by far the most imposing in point of size. Of its two sections, one, the typical group, is circumboreal in distribution; the other, *Dinocardium*, is, so far as I know, exclusively American and confined to the warmer waters of the coast, where it takes the place in faunal economy occupied by the typical group in the more northern waters.

The Eocene species, which might be, perhaps, included in this group and are excluded by their characters from any of the other groups of the genus, are few in number. *C. Harrisi* Vaughan, 1896, from the Lower Claibornian of Louisiana, which, except that the shell does not gape, might be supposed to belong to *Tropidocardium* and is believed to have large, flat spines externally, and *C. Cooperi* Gabb,* of California. There is a poorly preserved species with numerous rounded ribs found in the lower marls at Shiloh, New Jersey, which was referred by Whitfield in his description of the marl fauna to *C. craticuloide* Conrad. A comparison with the true *craticuloide,* which is a Plum Point Miocene shell with thirty very elevated narrow ribs, shows that this identification is incorrect. The Shiloh species, in the absence of better material, does not seem to differ from casts in the limestone of Jacksonboro', Georgia, referred by Conrad to his ill-defined Shell Bluff group, and both appear extremely close to, and possibly identical with, *C. eversum* Conrad, described from the Vicksburgian Oligocene in 1848. Another species, *C. vicksburgense,* was described by Conrad from the same horizon at the same time.

In the Miocene there is a fine showing of these shells. *C. acutilaqueatum* Conrad (Medial Tert., p. 34, pl. xviii., fig. 2, 1839) has been obtained from the Miocene of Alum Bluff, Florida; from that of the Natural Well and Magnolia, Duplin County, North Carolina; Suffolk, on the Nansemond River, Grove Wharf, on the James River, and Petersburg, Virginia. It is somewhat compressed, elevated, and has about forty ribs. *C. laqueatum* Conrad, 1831 (*op. cit.*, p. 31, pl. xvii., fig. 1), is a somewhat similar but more inflated and trigonal species with thirty-four to forty-one ribs, and is usually found in a very decayed state. It is known from the Natural Well and Magnolia, North Carolina; from the north end of the Dismal Swamp, from Cove Point and Petersburg, Virginia, Jones Wharf and St. Mary's, Maryland. It is the *C. ingens* Wagner, 1839. *C. leptopleura* Conrad, 1841, from Calvert Cliffs, Maryland, is a rare species, notable for its relative width and thirty-one distant, angular, carinated ribs. I have not succeeded in collecting this species in its typical form, and specimens which have been referred to it from Plum Point seem to differ more or less from Conrad's figure. A *Cardium modestum* Conrad (1855, Pacific R. R. Reports, vol. v., p. 322, plate iii., fig. 15) is de-

* This is, however, claimed to be really a Cretaceous species.

scribed as having twenty-two ribs and being subtruncate behind, but has not been recognized since, and may be a young *Fragum* or a small species of the present group. It is said to have been collected from the Miocene of the San Diego Mission, though no Miocene is known at present in this vicinity. It is not the *Cardium modestum* of Adams and Reeve, "Zoology of the Samarang," 1850.

On the Pacific coast in the Pliocene and later we have several fine species. Chief among these is *Cardium corbis,* Martyn, 1784 (*C. Nuttallii* Conrad, 1838, + *C. californianum* Conrad, 1838, + *C. Nuttallianum* Carpenter, 1864). This species ranges from the Pliocene to recent seas in time, and at present from Bering Sea to Monterey and from California to Kamchatka. Another is *C. californiense* Deshayes, 1839 (+ *C. pseudofossile* Reeve, 1844, + *C. blandum* Gould, 1850), a more triangular and less inflated species with forty to forty-eight rounded, nearly smooth ribs, which is recorded from the Pliocene and Pleistocene of California and ranges in the recent state from North Japan to Bering Sea and south to Monterey, California. In the bowlder clays of Vancouver Island a variety of this species has been found by Dr. Newcombe in which the ribs are much depressed and flattened, and the interspaces reduced to narrow, shallow grooves. This may take the name of var. *comoxense* Dall. It reaches about forty millimetres in length.

Cardium (Cerastoderma) waltonianum n. sp.

PLATE 48, FIGURE 19.

Oligocene (?) of Flournoy's mill-race at Summerville, two miles east of Argyle Post-Office, Walton County, Florida; L. C. Johnson.

Shell solid, coarse, strong, elevated, short, with about forty narrow, flat-topped radial ribs separated by subequal channelled interspaces crossed by lines of growth; a narrow, smooth area on the hinge-margin on each side of the high, rather pointed beaks; hinge very strong; internal basal and anterior margins with short flutings. Lon. 45, alt. 45, diam. 28 mm.

This shell is more trigonal than *C. craticuloide* and has less elevated ribs; it is not so produced at the ends as *C. leptopleura* Conrad, has narrower and more crowded ribs and a different outline.

Cardium (Cerastoderma) pansatrum n. sp.

PLATE 40, FIGURE 14.

Oligocene of Walton County and of the Oak Grove sands, Santa Rosa County, Florida; Johnson and Burns.

Shell small, solid, plump, slightly oblique and inequilateral, suborbicular, with moderately prominent beaks; sculptured with twenty-one strong, rounded ribs (of which six are smaller and on the posterior area) separated by narrower, sharply channelled interspaces; concentric sculpture irregular but rather marked, cross-striating the channels and forming thickened loops over the backs of the ribs; surface polished, a small, smooth, pseudo-lunule in front of the beaks, hinge normal, strong for the size of the shell, the internal margins deeply channelled, the sulci reaching well up on the disk. Alt. 11, lon. 11, diam. 9 mm.

It is possible that this species should be placed next to *C. ctenolium* among the typical *Cardia,* but the sculpture is more like that of *Cerastoderma.*

Cardium (Cerastoderma) druidicum n. sp.

PLATE 40, FIGURE 7.

Oligocene of the Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, rather thin, with moderately high beaks; produced and pointed behind, rounded below and in front; sculptured with about sixteen strong, rounded ribs with narrower channelled interspaces; on the posterior area are five flattened, smooth ribs separated by narrow sulci; the anterior ribs, especially towards the margin, show low transverse ridges rather regularly and distantly arranged, as in *Dinocardium,* the anterior four or five ribs, however, are smaller and smooth; transverse sculpture, except that just mentioned, only of incremental lines; a small, smooth pseudolunule; hinge small, delicate, normal; anterior and basal margins fluted, the sulci ascending as high as the lower edges of the adductor scars. Lon. 25, alt. 22.5, diam. 15 mm.

This is an elegant little shell foreshadowing the characters of *Dinocardium,* but also related intimately to *Cerastoderma.*

Cardium (Cerastoderma) virginianum Conrad.

Cardium virginianum Conrad, Fos. Medial Tert., Cover of No. 1, and p. 33 (No. 2), pl. 18, fig. 1, April, 1839; not *Protocardia virginiana* Conrad, 1864.

Cardium ingens Conrad, as of Wagner, *op. cit.,* p. 33, 1840; not of Wagner (MS. 1839), Trans. Wagner Inst., v., p. 10, pl. 3, fig. 2, 1897.

Cardium quadrans Rogers, Trans. Am. Phil. Soc., 2d Ser., vol. v., p. 375, pl. xxx., fig. 1, Dec., 1839.

Miocene of Virginia at Suffolk and Grove Wharf; of Alum Bluff, Florida; and of Gay Head, Martha's Vineyard, Massachusetts.

This very rare and remarkable shell is almost invariably so eroded and decayed as to obscure its characters. It is very oblique, flattened, angular in front, with twenty-four flattened, longitudinally striate ribs separated by shallow channels on the disk, with the posterior area smooth and sculptured by about eight radial very narrow grooves. Near the beaks the channels are cross-striated. The hinge is strong, with the anterior minor cardinal unusually well developed, and an oblong pseudolunule on the hinge-margin externally above it. The characteristics of this shell, except its compression and anterior wing, ally it to *Dinocardium*, but it is almost worthy of a section to itself.

Cardium (Cerastoderma) leptopleura Conrad.

Cardium leptopleura Conrad, Fos. Medial Tert., p. 66, pl. 37, fig. 5, 1845; Proc. Acad. Nat. Sci. Phila., i., p. 29, 1841.

Miocene of Plum Point, Maryland; Burns.

Shell resembling the *C. waltonianum*, but thinner, less inflated, with the anterior part of the basal margin less rounded and produced; ribs lower than in *C. craticuloide* and the shell more triangular and oblique; the tops of the ribs are keeled, but the keel is not sharp or angular, but squarely flattened like the edge of a board; the ribs number from thirty-one to thirty-seven in different individuals,—thirty-three appears to be the most common number,—but the shells are very poorly preserved and always more or less eroded.

I have identified these Plum Point shells with Conrad's *C. leptopleura*, although their correspondence with his figure left something to be desired, because in a general way his description fits them as far as it goes, and no shell agreeing perfectly with his figure has been collected even in his original locality after careful search. Should the present form be found to be separable I would suggest for it the name of *Cardium leptopleura* variety *marylandicum*.

Cardium (Cerastoderma) tæniopleura n. sp.

PLATE 49, FIGURES 1, 2.

Miocene of Yorktown, York River, and Suffolk, Nansemond River, Virginia; Burns and Harris.

Shell thin, oblique-ovate, inequilateral, with moderately elevated beaks; sculptured, with thirty-one to thirty-four narrow, elevated ribs with the section of a T-rail, separated by wider, not channelled interspaces; the rounded-flattened overhanging tops of these ribs are crossed by concentric sculpture which is obscure on the summits but on their edges stands out at regular intervals at right angles to the ribs, giving a remarkable articulated appearance to them; the six ribs of the posterior area are asymmetrically appressed and are exempt from the tænia-like structure; hinge normal, strong, with a well-marked pseudolunule above the anterior part of it. Lon. 35, alt. 30, diam. 23 mm.

The very remarkable sculpture of this species would enable one to recognize even a small fragment of it, but the ribs are hollow and the substance of the shell of a spongy character, lending itself to solution or erosion, and the specimens obtained are all extremely dilapidated.

Cardium (Cerastoderma) ciliatum Fabricius.

Cardium ciliatum O. Fabricius, Fauna Grönl., p. 410, 1780.

Cardium islandicum Chemnitz, Conch. Cab., vi., pp. 146, 200, pl. 19, figs. 195, 196, 1782; Spengler, Mag. Ges. Naturf. Freunde zu Berlin, ii., p. 121, 1808; Wood, Gen. Conch., p. 225, pl. lv., figs. 2, 3, 1815; Index Test., p. 26, pl. v., fig. 27, 1825; Gould, Rep. Inv. Mass., p. 89, fig. 58, 1841; De Kay, Zool. N. York, v., p. 206, pl. xxiii., fig. 252, 1843; Mighels, Boston Journ. Nat. Hist., iv., p. 321, 1843; Reeve, Conch. Icon., ii., *Cardium*, pl. xi., fig. 54, 1844; Stimpson, Shells of N. Eng., p. 19, 1851.

Cardium edule Mohr, Isl. Naturh., p. 128, 1786; not of Linné.

Cardium pubescens Couthouy, Boston Journ. Nat. Hist., ii., p. 61, pl. iii., fig. 6, 1838.

Cardium arcticum Sowerby, P. Z. S., 1840, p. 106; Conch. Ill., i., pl. 51, fig. 26, 1841.

Cardium Dawsoni Stimpson, Proc. Acad. Nat. Sci. Phila. for 1862, p. 58, figure.

Cardium Hayesii Stimpson, Proc. Acad. Nat. Sci. Phila. for 1863, p. 142, 1863.

Cardium (Cerastoderma) ciliatum Mörch, Yoldi Cat., ii., p. 34, 1853.

Cardium (Serripes) islandicum H. and A. Adams, Gen. Rec. Moll., ii., p. 456, 1857.

?*Cardium boreale* Broderip and Sowerby, Zool. Journ., iv., p. 368, 1829.

Pleistocene of the post-glacial silts and bowlder clays of the entire boreal region; recent, from the Arctic seas southward to Cape Cod on the Atlantic and to Puget Sound on the Pacific coast.

This well-known species is one of the most characteristic shells of the cold-water Pleistocene throughout the northern hemisphere. It is curious that the typical form figured by Chemnitz should have been the one Stimpson was led to separate from the other varieties as a distinct species under the name of *Hayesii*. The *C. boreale* of Broderip and Sowerby is perhaps the same as *C. blandum* Gould, but it has not been figured and the description is insufficient to certainly identify the shell. It is certainly either *blandum* or the present species.

Tryon, curiously enough, refers this species to Linné under the name *islandicum* (which does not occur in the Syst. Nat.), and gives for it the reference to *C. pectinatum* Linné (cf. Am. Marine Conch., p. 175).

Like most northern shells this is very variable, but the differences are inconstant. The law that the greater the number of serial parts the greater the range of variation of that number in different individuals holds good in this case, as usual. The original description of Fabricius calls for thirty-two to thirty-eight ribs. Chemnitz allows from twenty-six to thirty-six; *C. Hayesii*, thirty-three to thirty-five, and *C. arcticum* is figured as having about twenty-nine ribs. The most usual number is thirty-five, always well separated from one another, and having a tendency to angularity, most marked in the adult.

Cardium (Cerastoderma) decoratum Grewingk.

Cardium decoratum Grewingk., Verh. Min. Ges. St. Peters. for 1848-49, p. 274, pl. iv., figs. 3 *a-g;* 1850.

Pliocene? of St. Paul Island, Unga Island, and Aliaska Peninsula, Alaska; Pleistocene of Kadiak and Atka Islands and Pavloff Bay, Alaska, and in the bowlder clay deposits south and east to Comox and Victoria, Vancouver Island.

This is a very characteristic species of the bowlder clays of the northwest coast, narrower and proportionately heavier than *C. ciliatum,* showing usually concentric color zones when well preserved; twenty-five to thirty-one ribs, frequently reticulated by concentric elevated lines.

Section *Dinocardium* Dall.

Cardium (Cerastoderma) phlyctaena n. sp.

Plate 48, Figure 13.

Oligocene of the silex beds at Ballast Point, Tampa Bay, Florida; Willcox and Dall.

Shell solid, squarish, with rather elevated beaks and convex valves; sculptured with thirty-one flattish, narrow radial ribs, the anterior half of which have the usual lepidote sculpture of this group, the posterior half being nearly smooth and all separated by somewhat narrower channelled interspaces; posterior area large, nearly smooth, with sparse radial grooves along which are set minute distant pustular spines; a small pseudolunule is present; hinge normal, solid, internal margin in front and below with very short flutings. Alt. 27, lon. 25.5, diam. 18 mm.

The specimens are silicious pseudomorphs and may be defective, yet, except in respect of the almost microscopic pustules on the grooves of the posterior area, it seems to have all the characteristics of *Dinocardium.*

Cardium (Cerastoderma) chipolanum n. sp.

Plate 40, Figure 8.

Oligocene of Alum Bluff and the Chipola beds of the Chipola River, Florida, Burns; and of Roberts, Escambia County, Alabama, E. A. Smith.

Shell thin, polished, with large, full beaks; subequilateral, rounded in front and below, obliquely subtruncate behind; sculptured with about twenty-four strong ribs, of which the anterior five or six are smooth, thence to the middle of the shell with thickened adherent scale-like ornaments (which I call lepidote for short) especially near the margin, the remainder of the ribs smooth, except on their sides, where they are cross-striated, as are the narrow channelled interspaces; posterior area smooth with obsolete radial grooves, one or two near the hinge stronger; no pseudolunule; hinge normal, strong; internal margins sharply fluted, sulci reaching well up on the disk. Lon. 34, alt. 36, diam. 24 mm.

This shell in its general characters is a miniature *Cardium robustum,* and is especially characteristic of the Chipola horizon.

Cardium (Cerastoderma) taphrium n. sp.

Plate 40, Figure 9.

Oligocene of the Ballast Point silex beds, Tampa Bay (?), and of the Oak Grove sands, Santa Rosa County, Florida; Dall and Burns.

This at first sight might be taken for the preceding species, but an examination shows that the ribs are one-third more numerous, being usually thirty-three or thirty-four; there is a rather large pseudolunule, the shell is proportionately more produced behind and below and actually larger when mature. The specimen figured is 35 mm. long, but a full-grown one, obtained later, measures lon. 48, alt. 47, diam. 34 mm.

The radial grooves on the posterior area are usually sharper and stronger than in the preceding species. The types come from Oak Grove, where the shell seems characteristic of that horizon. A very poor pseudomorph from Ballast Point is temporarily placed here, though probably more perfect specimens would show it belonged elsewhere. It has thirty-two ribs and is apparently of squarer form than *C. taphrium.*

Cardium (Cerastoderma) robustum Solander.

Cardium robustum Solander, Portland Catalogue, p. 58, 1786, after Lister, Hist. Conch, pl. 328, fig. 165, 1770.

Cardium ventricosum Bruguière, Enc. Méth., i., p. 228, 1789; plates vol. i., pl. 299, fig. 1, 1792; Wood, Gen. Conch., p. 220, 1815.

Cardium magnum Born, Ind. Mus. Vind., p. 34; Test. Mus. Vind., p. 46, pl. 3, fig. 5, 1780; not of Linné, Syst. Nat., ed. x., p. 680, 1758.

Cardium magnum Reeve, Conch. Icon., ii., *Cardium*, pl. iv., fig. 20, 1844; and of the majority of American authors, but not of Linné.

Cardium maculatum Gmelin, Syst. Nat., vi., p. 3255, No. 38, 1792; Dillwyn, Cat. Rec. Shells, i., p. 121, 1817; Ravenel, Cat., p. 5, 1834; not of Reeve, 1844.

Cardium robustum Solander, Dillwyn, *op. cit.*, i., p. 121, 1817.

Cardium carolinensis (*sic*) Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 576, 1863; not of Conrad, in Kerr, Rep. Geol. N. Car., App., p. 15, 1875.

Cardium magnum Tuomey and Holmes, Pleioc. Fos. S. Car., p. 63, pl. 19, fig. 1, 1856; Heilprin, Trans. Wagner Inst., i., p. 103, 1887.

Upper Miocene of Wilmington, North Carolina, Stanton; Pliocene of Darlington, South Carolina, of the Croatan beds of North Carolina, of the Caloosahatchie and Shell Creek, Florida; Pleistocene of Simmons Bluff, South Carolina, of the Brunswick Canal, Georgia (Couper), and of many localities in the Floridian, Gulf, and Antillean region; recent from Cape May, New Jersey, south to Cuba, Jamaica, and Campeche.

As Solander gives a reference to Lister's perfectly recognizable figure (the same upon which Gmelin's name of *maculatum* was afterwards founded), there can be no doubt his name should be adopted.

As regards the ribs, the fossil species vary in having from twenty to twenty-eight, the majority in the list having between twenty and twenty-four. The recent ones vary between twenty-two and thirty, the majority having twenty-three to twenty-seven. These figures are exclusive of the flattened rays on the posterior area, which are invariably seven or eight, there being one more on one valve than on the other. The total rays or ribs would then amount to from thirty to thirty-five in the great majority of specimens. There is in the list as I have recorded it for my own study a slight apparent tendency to a less number of ribs in the fossils than in the recent shells, and in the northern compared with the southern specimens, as has been observed heretofore with ribbed pelecypods considered by me in this memoir. The number of specimens of which the ribs were counted was forty-five. The Miocene specimens examined had twenty-seven and twenty-three ribs, and those with fewer ribs than this were only four in number, of which one was a recent shell from Yucatan and the others from the Pliocene of Florida. The two specimens with twenty-nine and thirty ribs came from Florida and Vera Cruz, Mexico, but a valve from Cape May, New Jersey, had twenty-eight ribs, and so did one from the Pliocene of the Caloosahatchie. Thirty-one of the forty-five specimens had between twenty-three and twenty-six ribs. The species is very uniform in its general character, becoming more oblique and elongated with age, and having the two forms common to all species of *Cardium*, one more elongated and oblique, and one more quadrate and equilateral.

There is no living member of *Dinocardium* on the Pacific coast, but *C. Meekianum* Gabb, 1869, from the Pliocene of California is related to *C. robustum.*

Roemer described a *Cardium elegantulum* in 1849 from the American Cretaceous, but as this was transferred to the genus *Liopistha* before its conflict with *C. elegantulum* Beck, 1842, was noticed, there will be no occasion for any change now.

There is a *Cardium multisulcatum* from the South American Tertiary described from Darwin's collections in 1846, but this name had previously been used by Sowerby (P. Z. S., 1833) and the former species (cf. Philippi, Tert Verst. Chile, p. 178, 1887) may take the name of *C. Darwini.*

Subgenus FRAGUM Bolten.

Section *Fragum* s. s.

Cardium (Fragum) gatunense n. sp.

Black Eocene shales of Gatun, Isthmus of Darien; R. T. Hill.

Shell solid, high, truncate behind, rounded in front, nearly equilateral, radiately ribbed with flattened ribs separated by narrower channelled interspaces; there are sixteen ribs in front of the truncation, which is bordered by a single rib more prominent than the others, behind which are about ten others; the truncation is bordered by an obtuse margin and the edges of the ribs in the channels are, as it were, fringed by small imbrications; on the body and posterior truncation the ribs are dotted sparsely with small globular tubercles, generally worn off; in front of the somewhat anteriorly gyrate umbones and also behind them near the margin are spaces where the ribbing is obsolete, but not defined as lunule or escutcheon by any boundary; the margins are serrate or squarely notched, and the internal flutings run well up on the disk; the hinge and scars are normal. Lon. 23, alt. 28, diam. circa 23 mm.

This well-marked species is abundant in the shales, but the matrix is so much tougher than the remains of the shell that the characters have to be determined from a large number of imperfect specimens.

Cardium (**Fragum**) sp. indet.

Oligocene marl of Bowden, Jamaica; Henderson and Simpson.

A fragment of a *Cardium* resembling *C. medium* was obtained from the marl but is too imperfect for description and is noted here to avoid the omission of this element in the Bowden fauna. It may be the same as the following species, but is very much larger than any of the Chipola specimens.

Cardium (**Fragum**) **Burnsii** n. sp.

PLATE 48, FIGURE 15.

Oligocene of the Chipola River, Calhoun County, Florida; Burns.

Shell small, subquadrate, moderately inflated, truncate behind, rounded in front, with rather low beaks; sculpture of on the body twenty-two to twenty-four subequal rounded ribs with narrower channelled interspaces, sharply cross-striated between the ribs; on the posterior truncation twelve to fourteen similar but smaller ribs, a few near the hinge-margin wider than the rest, with no marked smooth area between them and the margin either in front of or behind the umbones; an easily detachable outer layer covers the ribs with fine concentric threading, rising at intervals into semilunar small nodules, all of which is frequently worn off when the ribs appear polished; internally, the margin is strongly fluted; hinge normal, strong. Lon. 6.5, alt. 7.0, diam. 6.0 mm. A single broken valve reaches 10 mm. in height.

This little shell stands almost midway between typical *Fragum* and *Trigoniocardia,* having the striated interspaces of the latter and the numerous similar subequal ribs of the former. It seems abundant in the marls.

Cardium (**Fragum**) **medium** Linné.

Cardium medium Linné, Syst. Nat., ed. x., p. 678, 1758; ed. xii., p. 1122, 1768; Reeve, Conch. Icon., ii., *Cardium,* pl. vi., fig. 30, 1844; Roemer, Conch. Cab. Neue Ausg., p. 102, pl. iv., figs. 5-7, 1869.

Cardium venustum Dunker, Mal. Blätt., viii., p. 37, 1861.

Hemicardium columba Heilprin, Trans. Wagner Inst., i., p. 93, pl. xi., fig. 26, 1886.

Miocene of St. Mary's River, Maryland, W. B. Clark; of the Natural Well, Duplin County, North Carolina; Pliocene of the Caloosahatchie River, of Shell Creek, and of Alligator Creek, south Florida; recent in two to fifteen fathoms from Cape Lookout, North Carolina, to the West Indies and south to Santa Marta, Brazil.

This species is abundant in the West Indies and differs especially in the amount of impression of the posterior area and the elevation of the upper part of the posterior margin projecting from the central part of the depression when the valves are closed. Some specimens have only a slight depression, others have it very marked, and the intermediate stages are so common that it is evident they are of little systematic value. Professor Heilprin compared, as it happened, extreme specimens, which have a very different aspect without the connecting gradations.

Cardium (Fragum) arestum n. sp.

PLATE 40, FIGURE 10.

Pliocene of the Caloosahatchie River, Florida.

Shell solid, thick, elevated, rather oblique, with the anterior region very short; beaks high, involute; sculpture of on the body thirty and on the posterior truncation fourteen flattened ribs with very narrow channelled interspaces, the whole crossed by extremely fine, close, concentric threads, and on the body supplemented by sparse imbricating arched nodules, low and distant, which towards the middle of the shell tend to stand on the posterior half rather than in the middle of the ribs; posterior truncation well marked, bordered near the beaks by a sharp keel which lower down becomes obtuse; interior normal, the margins fluted below the hinge. Alt. 24, lon. 19, diam. 21 mm.

This species in its form and sculpture appears to be the Pliocene representative of the Pacific *C. planicostatum* Sowerby, but differs from that species in the unusual brevity and obliquity of the anterior end of the shell. In a large number of specimens of *C. medium* both recent and fossil I have seen nothing approaching it at all closely.

Cardium (Fragum) biangulatum Sowerby.

Cardium biangulatum Sowerby, Zool. Journ., iv., p. 367, 1829; Conch. Ill., *Cardium,* p. 7, pl. 46, fig. 2, 1841.

Pliocene of San Quentin Bay, Lower California; Pleistocene of Santa Barbara, California; recent in ten to twenty fathoms, Catalina Island, California, and south to Panama.

This seems to be the Pacific coast representative of *C. medium,* but has much wider ribs.

Section *Trigoniocardia* Dall.

This group seems especially characteristic of the Middle American and Antillean region to which it is, so far as known, confined. It is an offshoot of the *Fragum* group starting in the Eocene and more or less abundantly represented to the recent fauna, which contains, on the Atlantic side, *C. antillarum* Orbigny (1845, + *C. ceramidum* Dall, Blake Rep., i., p. 269, pl. 4, fig. 6, 1886) and on the Pacific side *C. graniferum* Broderip and Sowerby, 1829; *C. alabastrum* Carpenter, 1857, and *C. obovale* Sowerby, 1833.

Of species belonging to this group which have been described from the Tertiary there are *C. castum* Guppy, 1866, of the Eocene of Manzanilla, Trinidad; *C. haitense,* Sowerby, 1849, of the St. Domingo, Curaçao, and Jamaica Oligocene; *C. galvestonense* Harris, 1895, from the Upper Miocene of the deep well at Galveston, Texas; and *C. callopleurum* Gabb, 1881, from the Pliocene of Costa Rica. These appear to be well-founded species, and it is now practicable to add materially to the list. *Hemicardia affinis* Nelson, 1870, from the Tertiary of Peru, is compared by the author to *C. obovale,* but is unfigured and insufficiently described.

Cardium (Trigoniocardia) alicula n. sp.

PLATE 40, FIGURE 12; PLATE 48, FIGURE 5.

Oligocene of the Ballast Point silex beds, Tampa, Florida, Dall; of the lower bed at Alum Bluff; and the marls of the Chipola River, Calhoun County, Florida, Burns.

Shell obliquely subtriangular, elevated, narrow, truncate behind the beaks, rounded above in front and pointed below; beaks high, carinated behind the keel defining the posterior area; posterior area with eight low, flat ribs, the upper ones broader; body with twelve similar but larger ribs separated by narrow cross-striated channels deeper near the keel and almost obsolete in front; on top of the ribs when perfect are rounded pustules, sparse, very fragile, and usually worn off; the pustules on the ribs of the posterior area are more elongate, oblique, and rarely arcuate; margin fluted internally, hinge strong. Alt. when fully mature, 19, lon. 14, diam. 14 mm.

The specimen first figured (pl. 40, fig. 12) is worn and has lost its pustules, being only a pseudomorph in silica; the subsequent figure (pl. 48, fig. 5) illustrates the unworn sculpture.

This species has much of the aspect of the Oriental forms of the section for which I have revived the name of *Hemicardium,* but this is probably merely an adaptive resemblance, as it is not likely to be genetically connected with them.

Cardium (Trigoniocardia) Simrothi n. sp.

Plate 48, Figure 8.

Oligocene marls of the Chipola River, Calhoun County, Florida; Dall and Burns.

Shell small, oblique quadrate, plump, rounded in front and especially on the anterior basal margin, truncate and slightly alate behind; beaks high, involute and prosogyrate; body with eleven broad, flat, rapidly widening low ribs separated by narrow interspaces in which the cross-grooves are so wide that their interspaces appear as narrow, elevated, concentric threads; ribs on the truncation seven or eight, smaller and more crowded; when perfect the ribs are surmounted by small pustules, oblong in a transverse sense on the body and drop-like in a vertical sense on the truncation; internal margin fluted, hinge normal, strong, with very deep sockets and conical teeth. Alt. 13, lon. 9.5, diam. 10 mm.

In measuring these oblique species the altitude is taken from the point of the valve below to the top of the umbo. This shell much resembles the Caloosahatchie species, but is squarer, with the hinge-margin more produced behind and with pustules of a more transverse and different shape.

Cardium (Trigoniocardia) aminense n. sp.

Plate 48, Figure 11.

Oligocene of the Potrero, Rio Amina, St. Domingo.

Shell elongate, narrow, carinate, very convex; beaks high and narrow; body with ten or eleven high flat ribs, the margins overhanging the narrower cross-threaded channels; truncation with ten lower and narrower but very similar riblets; when perfect the ribs carry a series of, on the body, transverse wedge-shaped nodules with the long slope of the wedge pointing downward; the nodules on the truncation are smaller and connected, resembling a string of tear-shaped beads with the small end of the drop upward; internal margin with rather long flutings, hinge normal, shell rather thick. Alt. 14, lon. 9.5, diam. 12 mm.

This is the longest and narrowest species, but somewhat more ovate and less pointed than *C. aliculum.*

Cardium (Trigoniocardia) maturense n. sp.

PLATE 48, FIGURE 7.

Cardium haitense Guppy, *pro parte,* Geol. Mag., Dec., ii., vol. i., p. 450, 1874; Geol. Mag., vol. ii., 1865, p. 256; not of Sowerby, 1849.

"Pliocene" of Matura, Trinidad; Guppy.

The National Museum contains among the types of Mr. Guppy's West Indian fossils some specimens of a *Cardium* which was identified and listed as above, under the name of *C. haitense,* by Mr. Guppy. The appearance of the fossils differs from any Pliocene fossils I have seen from Middle or South America or the Antilles, and I should judge them, from their aspect, to be of greater age. However this may be, the shell in question is undoubtedly quite distinct from *C. haitense* and offers the following characters:

Shell small, obovate, not carinate, short, elevated, somewhat oblique; posterior area with eight or nine ribs, body with twelve or thirteen; ribs rounded, low, those before the middle having a long slope anteriorly and a row of very small, bead-like nodules near the summit which is close to the short slope; all the ribs have this disproportionately small nodulation; the interspaces are narrow but not channelled, at the bottom is a cross-striation in arcuate lines; beaks not elevated for this group, shell with no sharp angles anywhere. Lon. 6.6, alt. 9, diam. 7 mm.

C. haitense has ten ribs on the truncation and fourteen on the body; they are narrower, much higher, and of different form from those of *C. maturense;* the nodulation of the former species is as broad as the rib it stands on and of a wholly different shape from that of the latter.

Cardium (Trigoniocardia) apateticum n. sp.

PLATE 48, FIGURE 6.

Uppermost Oligocene of the Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, oblique, produced behind at the hinge-line, obliquely truncate, evenly rounded from in front into the base; beaks rather high, carinate behind, and prosogyrate; truncation with nine and body with thirteen ribs, low, flat, wide on the body and rapidly broadening with very narrow interspaces squarely channelled; on the truncation the ribs, as usual, are smaller and more crowded and decrease in size from within outward; the channels are crossed by fine, sharp, evenly spaced elevated lamellæ which have a punctate appearance in the narrower interspaces; these threads rise on the sides of the ribs and pass over them as fine concentric threads; internal margin fluted, hinge strong, with a small, smooth space on each side of the umbones simulating lunule and escutcheon. Alt. 11.5, lon. 8, diam. 7 mm.

This is the only species which when perfectly intact is without nodules.

Cardium (Trigoniocardia) Willcoxi n. sp.

PLATE 48, FIGURE 9.

Pliocene marls of the Caloosahatchie and Shell Creeks, Florida; Willcox and Dall.

Shell small, plump, oblique, ovate triangular, obtusely carinate behind, with high involute, prosogyrate beaks; body with nine, truncation with eight ribs; on the body the ribs are high, flat-topped, with channelled, cross-striated interspaces narrower than the ribs; on the truncation the ribs are smaller and lower; when intact the ribs carry a row of nodules (rounded in the young, more or less transverse in the adult) which do not extend quite to the sides of the top of the rib on which they are seated; on the truncation the nodules appear to remain hemispherical at all ages; the cross-striation of the channels is close and very elegant; there is a small, smooth space in front of the most anterior rib; the inner margins are fluted and the hinge strong, but more transverse than in many of the species. Alt. 11, lon. 8, diam. 9 mm.

This elegant little shell is very abundant in the Caloosahatchie marl. It most resembles *C. Simrothi* Dall, and the Pacific coast recent *C. alabastrum* Carpenter, but is more elongate, more pointed below, and has no backward wing to the hinge-margin. The large ribs are proportionately smaller and less elevated than in *C. alabastrum.*

Subgenus PAPYRIDEA Swainson.

Cardium (Papyridea) spinosum Meuschen.

?Cardium rugatum Gronovius, Zoophyl., p. 278, pl. 18, fig. 5, 1781.

Cardia spinosum Meuschen, Mus. Gevers., p. 442, No. 1637, 1787 (after Lister, pl. 342, fig. 179, Jamaica, and Knorr, vi., pl. 7, fig. 6).

?Cardia hiatus Meuschen, *op. cit.,* p. 442 (after Gualtieri, pl. 85, fig. H).

Solen bullatus Chemnitz, Conch. Cab., vi., p. 65, pl. 6, figs. 49, 50, 1782; not of Linné, Syst. Nat., ed. x., p. 673, 1758 (=*Arca* sp., Rumphius, pl. 44, fig. N, Amboyna).

Cardium bullatum of Authors, as of Linné, not of Mörch, 1853.

Cardium soleniforme Bruguière, Enc. Méth., Vers., i., p. 235, 1789; Wood, Gen. Conch., p. 233, pl. 56, fig. 3, 1815.

?Cardium latum Born, Index Mus. Vind., p. 67, 1778; Test. Mus. Vind., p. 48, pl. iii.,

fig. 9, 1780 (in text wrongly as fig. 8), after Knorr, Vergn., vi., pl. 7, fig. 6; ?not *C. latum* "Borne" Reeve, Conch. Icon., fig. 21.

Cardium hiulcum Reeve, Conch. Icon., *Cardium*, pl. xxi., fig. 123, 1845 (*fide* E. A. Smith).

> *Cardium aspersum* Sowerby, P. Z. S., 1833, p. 85; Conchological Ill., fig. 15, 1841.

> *Cardium asperum* Roemer, Conch. Cab., Neue Ausg., *Cardium*, pp. 76, 122, 1869.

Papyridea soleniforme Swainson, Malac., p. 374, 1840.

This species has a confused synonymy, owing to the fact that the earlier writers confused several distinct shells under one name, and applied a Linnean name (*Solen bullatus*) based on a figure, supposed to represent an *Arca*, in Rumphius's work on Amboyna shells to the present species. I have not access to Gronovius's work, and his species by many authors is cited as identical with *C. apertum* L., while other authorities refer it to the shell now under consideration. The name *C. latum* was given by Born to a shell figured by him which closely resembles worn specimens of *C. latum* Reeve in the Conchologia Iconica, figure 41. The description, however, as pointed out by Smith (Challenger bivalves, p. 158) might serve very well for the present species, and if identical the name would be prior. I hesitate to accept it, however, on account of the uncertainty referred to and the fact that authors most nearly contemporaneous and their successors for more than a century have identified the name with the Chinese shell. The earliest unquestionable name is *C. spinosum* Meuschen, based on a figure of Lister representing a Jamaican specimen of the present species. Meuschen, by the way, also cites Knorr (to which I have not access) for an illustration of his shell, which reference is also given by Born under *C. latum*.

A careful study of a large number of specimens shows that there are several nearly related forms of this shell, which are possibly specific, but which in the absence of a fuller series from the far East I prefer to rank as varieties.

Cardium (Papyridea) spinosum var. **spinosum** s. s.

Cardium soleniforme Bruguière, *ex parte*.

Pleistocene of Florida and the Antilles; recent in the West Indies and from Cape Hatteras, North Carolina, south to Santa Marta, Brazil.

Shell with about forty-six ribs separated by narrower interspaces, in each of which runs a little, elevated narrow thread; the anterior ribs ($\pm$ 16) show low arched imbrications, especially towards the margin; the central ribs ($\pm$ 18) are low and rounded, becoming flatter and wider posteriorly, and are more or less sprinkled with very dehiscent microscopic granulations usually worn off even in living specimens, and more abundant behind the middle part of the shell; the posterior ribs (± 12) have the long slope forward and an abrupt slope on the posterior side, and are surmounted on the posterior side by a supplementary costa from which spring obliquely set spinules; the posterior ribs near the hinder margin are again more crowded.

Cardium (Papyridea) spinosum var. **aspersum** Sowerby.

Cardium aspersum Sowerby, P. Z. S., 1833, p. 85.

Recent on the Pacific coast of America from the Gulf of California south to Panama and Santa Elena.

Shell with about the same number of ribs as the preceding and having them similarly divided into groups, but with the bottoms of the channels flattish rather than filiform, the ribs themselves more elevated, rounded and strong, and the imbrications and spinules coarser and more distant; the microscopic granulations irregularly distributed, very sparse and distant, often wholly absent.

Cardium (Papyridea) spinosum var. **Turtoni** Dall.

Cardium bullatum E. A. Smith, Marine Moll. of St. Helena, P. Z. S., 1890, p. 302.

Pliocene of the Caloosahatchie River, Florida; recent at St. Vincent, Cape Verde Islands, and St. Helena (Turton).

Shell with about fourteen anterior, sixteen to twenty-three medial, and eight to eleven posterior ribs, the interspaces with a well-marked flattish thread between two sharp grooves; the spinules and imbrications as in var. *spinosum;* the medial ribs triangular in section, the apex of the triangle inclining for the most part slightly towards the anterior end of the valve and surmounted by a single row of close-set minute granules, giving it a serrate appearance, and elsewhere polished and destitute of granulation; the form and serration of the ribs obvious to the naked eye; concentric striation regular and fine.

It is a singular thing that the Pliocene fossil should be of the type now confined to the eastern Atlantic; the well-known fact that many of the living deep-water mollusks of the Antillean area are represented in the Italian Pliocene and not in our own may be, in some manner to be determined later, of an analogous nature.

Cardium (Papyridea) semisulcatum Gray.

Cardium semisulcatum Gray, Ann. Phil., ix., p. 137, 1825; E. A. Smith, Challenger Biv., p. 162, 1885.

Cardium ringiculum Sowerby, P. Z. S., 1840, p. 106; Conch. Ill. *Cardium*, p. 2, pl. 48, fig. 11, 1841.

Cardium Petitianum Orbigny, Moll. Cubana, ii., p. 309, pl. 27, figs. 50-52, 1853.
Papyridea Petitiana Dall, Bull. U. S. Nat. Mus., No. 37, p. 54, 1889.

Miocene of the Natural Well, Duplin County, North Carolina; Pliocene of the Caloosahatchie River at Fort Thompson, Dall; recent from Turtle Harbor, south Florida, south to the West Indies and the east coast of Brazil ninety miles southeast of Cape San Roque; in the eastern Atlantic on the coast of Liberia and at Simon's Bay, Cape of Good Hope, in fifteen to twenty fathoms.

Mr. Smith has pointed out the earliest name for this interesting little shell. The single specimen from the North Carolina Miocene exhibits no differences of character from the recent shells.

Cardium (Papyridea) bulbosum n. sp.

Plate 48, Figure 20.

Oligocene marl of the Chipola River, Florida; Burns.

Shell ovate, moderately inflated, with about thirty-eight ribs, nine anterior with minute spines on the anterior side of each rib near the margin; sixteen medial, low and rounded, with narrower channelled interspaces; thirteen posterior, low and obliquely flattened, with their highest part on the posterior side, the last three or four bearing minute spiny pustules; beaks low, pointed, smooth, margin crenulate, serrate above behind; hinge normal. Lon. 27, alt. 23.5, diam. 10 mm.

This species is notably shorter and with fewer ribs than the forms preceding, and is especially notable for the small number of anterior ribs and the very sparse muricate sculpture.

Subgenus **LÆVICARDIUM** Swainson.

This group is well established in the Cretaceous, where we have such species as *C. annulatum* Gabb and *C. linteum* Conrad, from the Chico series of California. No species, however, have been reported from the Eocene, though doubtless the group will eventually be found represented there. In the Oligocene the Vicksburg so far has furnished nothing in this line.

Cardium (Lævicardium) compressum n. sp.

Plate 48, Figure 21.

Oligocene of the Chipola beds at Alum Bluff and on the Chipola River, and of the Oak Grove sands on the Yellow River, Florida; Burns.

Shell small, plump, inequilateral, with convex beaks nearer the anterior end;

surface smooth over a small anterior area, and over the posterior area which is compressed so that the pinch gives to the lower posterior margin a distinct insinuation; between these the disk is covered by minute radii which, though conspicuous in eroded shells, hardly interrupt the smoothness of the surface when perfect; the outline is rounded in front and below and slightly oblique; interior polished, with the adductor scars impressed; the margin, except of the anterior and posterior areas, finely serrate. Lon. 24, alt. 26, diam. 14 mm.

All the species of *Lævicardium* are very similar shells, especially when they have lost color by fossilization, but this species is readily recognizable by the small size of the smooth areas and the peculiar pinching of the posterior area.

Cardium (Lævicardium) serratum Linné.

Cardium serratum L., Syst. Nat., ed. x., p. 680, 1758; ed. xii., p. 1123, 1767; Chemnitz, Conch. Cab., vi., p. 193, pl. 18, fig. 189, 1782.

Cardium lævigatum Lamarck, An. s. Vert., vi., part i., p. 11, 1819 (not of Born, Mus. Vind. Test., p. 47, 1780; nor of Linné, Syst. Nat., x., p. 680, 1758).

Cardium citrinum Wood, Gen. Conch., p. 223, pl. 54, fig. 3, 1815.

Liocardium pictum Ravenel, Proc. Acad. Nat. Sci. Phila. for 1861, p. 44, 1862 (*pullus*).

Cardium hiatus "Meuschen" *fide* Krebs, W. I. Cat. Sh., p. 115, 1864.

Cardium lineatum Krebs, *op. cit.*, not of Gmelin, 1792.

Cardium pristis Valenciennes, *fide* Krebs, *op. cit.*

Cardium oviputamen Reeve, Conch. Icon., *Cardium*, pl. vii., fig. 36, 1844.

Cardium venustum Gabb, Geol. St. Domingo, p. 251, 1873.

Cardium serratum Dall, Proc. U. S. Nat. Mus., xix., No. 1110, p. 327, 1896 (not *serratum* of Pennant, 1778).

Oligocene of Bowden, Jamaica; Miocene of Alum Bluff, Florida; Pliocene of the Caloosahatchie and Myakka Rivers, Florida, and Tilly's Lake in the Waccamaw District, South Carolina; Pleistocene of south Florida and the Antilles; recent from Cape Hatteras, South Carolina, to Bahia, Brazil, in water from a few feet to one hundred fathoms in depth.

After a good deal of study and thought upon the subject with a large series of specimens I have been led to the conclusion that the differences between the shells commonly known as *serratum, lævigatum,* and *oviputamen* are not of specific value. I am unable to specify any distinctive characters between the Bowden fossil and recent specimens of "*serratum*" of the same size. All the fossils observed are of the *serratum* type. I have seen none of the squarish form usually called *lævigatum* Lamarck, which is not the original *lævigatum* of Linné. Small specimens from Bowden, to which a correspondent attached a manuscript name, are apparently not to be distinguished in form from the deep-water variety named by me, in the Blake Report, *sybariticum*, and perhaps Ravenel's *pictum*.

Cardium (**Lævicardium**) **sublineatum** Conrad.

Cardium sublineatum Conrad, Trans. Am. Geol. and Nat., p. 110, pl. v., fig. 13, 1842; Am. Journ. Sci., xli., p. 347, pl. ii., fig. 13, 1842; Medial Tert., p. 66, pl. 37, fig. 4, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 64, pl. 19, fig. 3, 1856.

Miocene of Wilmington, of the Natural Well and Magnolia, Duplin County, North Carolina; Pliocene of the Waccamaw beds, Tilly's Lake, and Darlington, South Carolina; Holmes and Burns.

This species is easily recognized by its heavy shell, often with a marked furrow, internally, from the centre of the umbonal cavity towards the base midway between the adductor scars. It is also more compressed than any of the other species.

Cardium (**Lævicardium**) **Mortoni** Conrad.

Cardium Mortoni Conrad, Journ. Acad. Nat. Sci. Phila., vi., p. 259, pl. 10, figs. 5, 6, 7, 1830; Gould, Inv. Mass., p. 91, 1841.

Liocardium Mortoni Stimpson, Checkl. E. Coast Shells, p. 2, 1860; Dall, Bull. 37, U. S. Nat. Mus., p. 54, pl. 58, fig. 8, 1889.

Lævicardium Mortoni Perkins, Proc. Bost. Soc. Nat. Hist., xiii., p. 150, 1869.

Miocene of Jones Wharf, Maryland; Pliocene of the Caloosahatchie and Shell Creek, Florida; Pleistocene of South Carolina, and of Osprey, Florida, at North Creek; recent from Nova Scotia south to Santa Marta, Brazil.

The material in hand considerably extends the range, both in time and space, of this well-known species.

Other fossil American species are *C.* (*L.*) *bulla* Gabb (described as a *Serripes*), 1873, from the Tertiary of Santo Domingo; *C.* (*L.*) *substriatum* Conrad, 1838, from the Pleistocene of San Pedro, California; the great *C.* (*L.*) *elatum* Sowerby, 1833, from the Pleistocene of San Diego, California; and *C.* (*L.*) *Milleri* Gabb, 1881, described from an internal cast of a Miocene fossil from Costa Rica which may prove to belong to the genus *Protocardia*.

Genus **SERRIPES** Beck.

Serripes grönlandicus Beck.

Venus islandica O. Fabricius, Fauna Grönl., p. 411, 1780; not of Linné.

Cardium grönlandicum Chemnitz, Conch. Cab., vi., pp. 146, 202, pl. xix., fig. 198, 1782;

Mohr, Isl. Naturh., p. 129, 1786; Gmelin, Syst. Nat., p. 3252, 1792; Spengler, Mag. Ges. Naturf. Freunde zu Berlin, ii., p. 126, 1808; Wood, Gen. Conch., p. 227, 1815; Dillwyn, Cat. Rec. Sh., i., p. 129, 1817; Lamarck, An. s. Vert., vi., i., p. 13, 1819; Gould, Inv. Mass., p. 92, 1841; Moller, Ind. Moll. Grönl., p. 20, 1842; Mörch, Fort. Grönl. Blöddyr, p. 20, 1857.

Mactra radiata Donovan, Brit. Sh., v., p. clxi., 1799; Turton, Conch. Dict., p. 80, 1819.

Cardium edentulum Montagu, Test. Brit. Suppl., p. 29, 1808; Sowerby, Genera Sh., pt. 34, fig. 2, 1831.

Cardium radiatum Gray, App. Parry's Voy., p. 244, 1824.

Aphrodite columba Lea, Trans. Am. Phil. Soc., N. S., v., p. 111, pl. xviii., fig. 54, 1834; Obs. Gen. Unio, i., p. 223, 1837.

Cardium boreale Reeve, Conch. Icon., ii., *Cardium*, pl. xxii., fig. 131, 1845; not of Broderip and Sowerby, 1829.

Cardium Fabricii Deshayes, P. Z. S., 1854, p. 333.

Cardium grönlandicum Middendorff, Mal. Ross., iv., p. 41, pl. 16, figs. 6, 7 (not figs. 8, 9), 1849.

Acardo edentulum Swainson, Malac., p. 374, 1840.

Serripes grönlandicus Beck, in Gould, Inv. Mass., p. 93, 1841; Mörch, Yoldi Cat., ii., p. 35, 1853; H. and A. Adams, Gen. Rec. Moll., ii., p. 456, 1857; Dawson, Notes on Post-Pl. of Canada, p. 77, 1872.

Pleistocene of Quebec and along the St. Lawrence River; Lawlor's Lake, New Brunswick; Labrador; Cape Elizabeth and Portland, Maine; the coast of Alaska and southward to the vicinity of Puget Sound; recent throughout the Arctic seas and south to Cape Cod on the Atlantic and to Puget Sound on the Pacific side.

This species occurs in a recent state in vast numbers on muddy bottom and is one of the species most consumed by the walrus in boreal seas. It varies considerably in relative length and height, and in the extension of the radial sulcations, which are almost always absent from the middle of the disk. The name *Fabricii* was given to a short, heavy mutation of the typical shell, while the more elongate variety was left nameless by Deshayes, who probably had the facts reversed in his mind by some accident. The elongate variety might be called var. *protractus*.

Serripes Laperousii Deshayes.

Cardium Laperousii Deshayes, Révue Zool. Soc. Cuv., p. 360, 1839; Mag. Zool., pl. 48, 1841; Carpenter, Rep. Brit. Assoc., 1856, pp. 203, 207; Suppl. Rep. Brit. Assoc., 1863, p. 528; Moll. West. N. Am., p. 14, 1872.

Cardium (?Serripes) Laperousii Dall, Am. Journ. Conch., vii., p. 148, 1871.

Pleistocene of the Aleutian Islands and bowlder clay of southeastern Alaska near Juneau; recent from the Kamchatkan coast at Avatcha Bay, eastward through the Aleutians, the southern part of Bering Sea, and southeastward to Sitka, Alaska.

This fine form is not to be confounded with *S. grönlandicus* var. *protractus*, which occurs wherever *S. grönlandicus* extends, though rare. The present shell far exceeds *S. grönlandicus* in size and is restricted to the range above mentioned.

I have already mentioned that *Serripes bulla* Gabb (Santo Domingo, 1873) should be referred to *Lævicardium;* and *Cardium centifilosum* Cpr., which has been referred to *Serripes* by some authors, is a *Protocardia.* In this group the teeth are often strongly developed in young specimens, but the cardinals, and much more rarely the laterals, become more or less obsolete in the adult or senile specimens.

Genus **PROTOCARDIA** Beyrich.

The Eocene species of *Protocardia* known in our Tertiary are as follows: *P. curta* Conrad (1870, not *Cardium curtum* Meek and Hayden, 1861), from the Eocene marls of New Jersey, a doubtful species founded on an internal cast which does not admit of an exact determination of the species; *P. lenis* Conrad (1855, unfigured, + *P. virginiana* Conrad, 1864; not *P. lenis* var. Harris, 1897), from the Eocene of Pamunkey River, Virginia; *P. Harrisi* Dall (1900, = *P. virginiana* Harris, Proc. Acad. Nat. Sci. Phila. for 1896, p. 475, pl. 20, figs. 7, 8), from the Chickasawan of Alabama; *P. Nicoleti* Conrad (1841, + *P. lima* Conrad, 1865, which is merely the shell retaining its posterior tubercles which are frequently lost), Jacksonian, and *P. virginiana* Conrad (1864, = *P. lenis* Conrad, 1855), from the Eocene of Virginia.

The young of *P. diversa* shows the interspaces of the ribs crossed by somewhat irregular elevated lamellæ (often worn away); the young of *P. Nicoleti* has, when perfect, strawberry-shaped pustules on top of the ribs, the channels smooth or nearly so; specimens of *P. Harrisi* Dall show minute tubercles on the anterior sides of the ribs in the channels, but the tops of the ribs are smooth; this species is more quadrate, with less produced terminal margins. It is a smaller shell and more glistening and with more conspicuous anterior sculpture than the others. Sundry large specimens in somewhat imperfect condition, from Naheola Bluff, are in the National Collection. They may be an undescribed species, or possibly the adults of *P. Harrisi.*

The Oligocene has the well-known *P. diversa* Conrad, 1848, for the more sinuous specimens of which Gregorio (Mon. Claib., 215, 1890) has proposed the varietal name of *mittens*. His magnified figure of the posterior sculpture is quite inadequate. *P. gambrina* Gabb, from the Texas Oligocene, is the young of *P. diversa,* as Gabb suspected. *P. Newberryana* Gabb, 1881, from the Oligocene sandstones of Gatun, on the Panama Canal, has the appearance of a cast of *P. diversa,* but is really unrecognizable.

There is a small species in the Bowden marl of Jamaica which much resembles the recent *P. peramabilis* Dall, but on the Pacific coast the Tertiary has not yet furnished any species, though there is a recent species, *Cardium centifilosum* Cpr., 1863 (+ *C. Richardsoni* Whiteaves, 1878), as well as the lovely *P.* (*Lophocardium*) *Annettæ* Dall, 1889, and *P.* (*L.*) *Cumingi* Sowerby, 1833.

Protocardia jamaicensis n. sp.

Plate 48, Figure 3.

Oligocene of the Bowden marl, Jamaica; Henderson and Simpson.

Shell small, plump, subquadrate, with rather high subcentral umbones; anterior end evenly rounded, posterior very slightly rounded truncate; surface with very numerous radiating threads crossed by concentric lines evenly disposed, which at the intersections reveal themselves by rendering the radii beaded; this sculpture covers a little less than the anterior half of the disk, behind which the radials are narrower and not beaded, separated by still narrower channels; in the channel separating the anterior from the posterior type of sculpture rises a low crest like a string of small beads, behind which in each second or third channel rises a row of small, stout, very caducous spines, those on the posterior area smaller and shorter than those on the disk; internally the margin is minutely serrate; the hinge is normal. Lon. 6.2, alt. 6.0, diam. 4.5 mm.

This species is nearest *Protocardia peramabilis* Dall, a recent deep-water species of the Antilles, but differs by its smaller size, more delicate sculpture, and less numerous rows of spines. It is also differentiated from the other living Antillean species, *P. tincta* Dall, by its sculpture and much smaller size.

Superfamily LEPTONACEA.

The *Leptonacea* form a very interesting and puzzling group. Their characters combine features characteristic in other Teleodonts of immaturity, with such as are more probably due to environmental modifications. Without being in themselves prototypes, they exhibit features which we may readily suppose might have been characteristic of prototypic Teleodonts. Groups which are really starting-points for numerous subsequently developed genera are usually notable for their tendency to vary and interchange characters. In the present case perhaps the very general habit of commensalism, or parasitism, has produced degeneration or afforded an excessive protection, inducing or accompanied by a revival of atavistic primary characters. The fact that authors, struck by similarity of dental features to those of immature specimens of genera of widely different origin, have too hastily referred species of *Leptonacea* to such families as the *Mactridæ* or *Cyrenidæ* is significant in this connection.

It must be confessed at the outset that our knowledge of the anatomy of recent *Leptonacea* is lamentably deficient. We have to assume (which is never safe) that forms with similar shell characters are generally similar in other points of structure, except where we know to the contrary. We find, moreover, that the dentition is frequently indistinctly developed or somewhat amorphous, rendering it difficult to make out the homologies of the different parts of the hinge. It is certainly unsafe to assume, as Bernard has sometimes done, that the position of a dental lamina is sufficient to settle its homology. The dynamic reactions of teeth upon each other are, I am confident, of the utmost importance in the development of the hinge. As in the vertebrate skeleton, pressure and friction in localized areas will produce directly a response in facets and buttresses. In fact, to the eye trained to take such matters into account, every hinge shows more or less evidence of the mutability of hinge-structure and its responses to stress, as well as inherited tendencies of form. In no group are these more obvious than in the *Leptonacea*.

The prototypic hinge of the group,—or that which with slight modifications will exhibit any of the various types of hinge-structure found in the group,—is very simple and has been figured by Bernard in his illustrations of a minute form which he has named *Pachykellya*. His invaluable researches upon the early features of the hinge have shown that among the *Teleodesmacea* the so-called laterals and cardinals are dissevered parts of an originally single lamina sharply bent at its proximal, or umbonal, end and having somewhat the form of a figure seven (7). In *Pachykellia* the hinge is composed of an internal resilium not obviously separated from the ligament and inclined obliquely backward, as in many nepionic Teleodonts. On each side of this in each valve is a pair of the ⌐ -shaped lamellæ, of which most have developed more or less distinctly the proximal or cardinal "hook." The lower ones are less engaged in the various stresses to which the laminæ are subjected in use, and hence, as might be expected, the hook is less evident or even undeveloped.

From this type of hinge all the others can be developed by trifling modifications. The laminæ may be long or short; when the outer limb is short we have a Λ-shaped tooth; if the angle proceeds to that stage of development when its continuity is lost, we may have a hinge like that of *Cyamiomactra;* the severed hook may be modified by pressure to a petaloid shape, which again by degeneration may be reduced to two obscure minute conical projections, as in some species of *Galeomma.* Any part or the whole of the hinge may become obsolete; the resilium and ligament may separate or continue in connection; the latter frequently becomes external and often obsolete, though traces of it almost always exist.

The arrangement of the groups must, in our present state of knowledge, be provisional. No linear arrangement will show the exact inter-relations of the different genera, and yet we are confined to a linear arrangement. The present tentative scheme is based on our present insufficient information, and, where only shell characters are known, chiefly on those of the hinge. It is difficult at present to say what should be done with *Montacuta.* According to the literature, it has Lucinoid gills and Thyasiroid hepatic digitations, while the shell is obviously Leptonoid. The anatomical combinations that the other groups would exhibit are at present unknown in many cases. It may be for the present most convenient to place the Montacutas and Aligenas at the end of the list with an unassigned value, as they certainly seem to lead up to the *Thyasiridæ,* in spite of the differences of the gills.

It does not seem practicable to associate *Sportella, Anisodonta,* and other genera in which the soft parts are permanently retained within the shell, with forms like *Galeomma,* in which they are exserted, covering a large part of the valves. The only data we have on *Anisodonta* (*quadrata*) would indicate that the mantle edges are largely united, the gills as in *Thyasira* (*Cryptodon*), but united behind the foot, and, contrary to the rule in the *Leptonacea,* the incurrent orifice, though not developed into a siphon, is complete and posterior. Yet the shell characters merge so gradually into those of typical *Anisodonta,* and these into those of *Sportella,* that one feels that without more definite information they can hardly be separated. The interchanges of characters, and the multiplicity of forms separated by apparently trifling details of structure, make this group one of the most perplexing I have ever tried to review.

It should not be forgotten that in certain groups, such as *Galeomma* and *Lasæa,* individual variation among the teeth is very prevalent within the species. Features which in some other genera might be important are here often of no systematic importance whatever, and are liable to lead the "closet naturalist" into serious error.

In connection with these studies I have repeatedly met with the difficulty so commonly encountered when one begins to take up a group which has obscure characters and inconspicuous minute shells. The descriptions and figures of authors, whose attention has not been especially directed to these troublesome little species, are frequently inaccurate and misleading to a degree which can hardly be realized until one comes to deal with them. I have, therefore, discarded literature whenever it was possible to obtain a specimen of the shell in question or a magnified drawing of an author's type by a trusty hand. My descriptions, identifications, and consolidations are based on specimens in nearly every case; I have not worried myself about the conflicting statements of authors; and this has been, as far as possible, my method of procedure throughout this work. I need hardly say I have depended freely upon the excellent figures of Bernard and Verrill, and am under great obligations to the unfailing courtesy of Mr. E. A. Smith, of the British Museum.

The following scheme is provisionally adopted. The name of the typical species follows the date of the genus. The series commences with the most specialized forms:

Family CHLAMYDOCONCHIDÆ.

Chlamydoconcha Dall, 1884. *C. Orcutti* Dall.

Family GALEOMMATIDÆ.

Ephippodonta Tate, 1889. *E. Macdougalli* Tate.
Galeomma Turton, 1825. *G. Turtoni* Broderip and Sowerby.
Sections: *Amphilepida* Dall, 1899. *G. polita* Deshayes.
Paralepida Dall, 1899. *G. formosa* Deshayes.
Libratula Pease, 1865. *L. plana* Pease.
Solecardia Conrad, 1849. *S. eburnea* Conrad.
Subgenera: *Scintilla* Deshayes, 1855. *S. philippinensis* Deshayes.
Spaniorinus Dall, 1899. *S. Cossmanni* Dall.
Scintillorbis Dall, 1899. *S. crispata* Fischer.
Vasconiella Dall, 1899. *Vasconia Jeffreysiana* Fischer.

Family SPORTELLIDÆ.

Sportella Deshayes, 1858. *Psammobia dubia* Deshayes.
Section? *Fabella* Conrad, 1863. *F. constricta* Conrad.
Anisodonta Deshayes, 1858. *A. complanata* Deshayes.

Sections: *Fulcrella* Cossmann, 1886. *Poromya paradoxa* Deshayes.
? *Basterotia* Mayer, 1870. *Corbula quadrata* Hinds.
?*Hindsiella* Stoliczka, 1871. *Modiola arcuata* Defrance.

Family LEPTONIDÆ.

Entovalva Voeltzkow, 1890. *E. mirabilis* Voeltzkow.
Lepton Turton, 1822. *Solen squamosa* Montagu.
Subgenera: *Neolepton* Monterosato, 1875. *L. sulcatulum* Jeffreys.
Lutetina Velain, 1876. *L. antarctica* Velain.
Epilepton Dall, 1899. *Lepton Clarkiæ* Clark.
Planikellia Cossmann, 1887. *Erycina radiolata* Lamarck.
Erycina (Lamarck, 1806) Récluz, 1844. *Erycina pellucida* Lamarck.
Subgenera: *Scacchia* Philippi, 1844. *Tellina elliptica* Scacchi.
Anomalokellia Cossmann, 1887. *A. catalaunensis* Cossm.
Pseudopythina Fischer, 1884. *P. macandrewi* Fischer.
Bornia Philippi, 1836. *Erycina corbuloides* Bivona.
Section: *Ceratobornia* Dall, 1899. *Lepton longipes* Stimpson.
Subgenus: *Pythina* Hinds, 1844. *P. Deshayesiana* Hinds.
Kellia Turton, 1822. *Mya suborbicularis* Montagu.
Sections: *Mancikellia* Dall, 1899. *Zoë pumila* Monterosato.
Kelliola Dall, 1899. *Kellia symmetros* Jeffreys.
Divarikellia Cossmann, 1887. *K. nitida* Caillat.
Thecodonta A. Adams, 1864. *T. Sieboldii* Adams.
?Subgenera: *Serridens* Dall, 1899. *Pristiphora oblonga,* Cpr.
Dicranodesma Dall, 1899. *Mysella calvertensis* Glenn.
Rochefortia Vélain, 1876. *R. australis* Vélain.
Subgenera: *Pythinella* Dall, 1899. *Montacuta cuneata* Verrill.
? *Sphenalia* S. Wood, 1874. *Montacuta donacina* S. Wood.
Pachykellya Bernard, 1897. *P. Edwardsi* Bernard.

* * *

Lasæa Leach, 1827. *Cardium rubrum* Montagu.
Myllita Orbigny, 1850. *M. Deshayesii* Récluz.
Perrierina Bernard, 1897. *P. taxodonta* Bernard.

Family KELLIELLIDÆ.

Kelliella Sars, 1870. *K. abyssicola* Sars.
Lutetia Deshayes, 1860. *L. parisiensis* Deshayes.
Alveinus Conrad, 1865. *A. parvus* Conrad.

Pauliella Munier Chalmas, 1895. *P. Bernardi* M. C.
Cyamiomactra Bernard, 1897. *C. problematica* Bernard.
?*Turtonia* Alder, 1848. *Venus minuta* Fabricius.

INCERTÆ SEDIS.

Cyamium Philippi, 1845. *C. antarcticum* Philippi.
Scioberetia Bernard, 1896. *S. australis* Bernard.
Montacuta Turton, 1822. *Ligula substriata* Montagu.
Sections: *Decipula* Jeffreys, 1875. *D. ovata* Jeffreys.
Orobitella Dall, 1900. *Montacuta floridana* Dall.
Aligena H. C. Lea, 1845. *Abra æquata* Conrad.
?Section: *Spaniodon* Reuss, 1867. *S. nitidus* Reuss.
Cycladella Carpenter, 1865. *C. papyracea* Carpenter.
Asbiornsenia Friele, 1886. *A. striata* Friele.*

FAMILY GALEOMMATIDÆ.

Genus **GALEOMMA** Turton.

Galeomma Turton, Zool. Journ., ii., p. 361, 1825. Type *G. Turtoni* Brod. and Sby., *loc. cit.*, p. 362, pl. 13, fig. 1.
Parthenope Scacchi, Oss. Zool., pp. 8, 19, 1833. Type *P. formosa* Scacchi (= *G. Turtoni* Brod.); not *Parthenope* Fabr., 1798.
Galeomna Hanley, Ill. Cat. Rec. Sh., p. 59, 1844 (err. typ.).
Thyreopsis H. Adams, P. Z. S., 1868, p. 14. Type *G. coralliophila* H. Adams, *loc. cit.*
Lepirodes Fischer, Man. de Conchyl., p. 1031, 1887. Type *G. formosum* Desh. (not *Lepyrodes* Guen., 1854; Lepid.).
Libratula Pease, P. Z. S., 1865, p. 512, sole ex. *L. plana* Pse., *loc. cit.*
Psammobia (sp.) Lamarck; Quoy and Gaimard.
Hiatella (sp.) Costa, Ann. Sci. Nat., viii., p. 169.
Galeomma Deshayes, Expl. Algérie, Moll., i., Atlas, pl. 81-82; Mittré, Ann. Sci. Nat., 3d Ser., vii., p. 169, pl. 5, figs. 1-8.

This remarkable genus is represented by a type which has the mantle covering a large part of the valves, a thin amphidetic ligament, and a short, stout resilium with the hinge-margin smooth or retaining traces of the provinculum. The resilium is seated in a small chondrophoric pit, shallow or having its anterior and posterior margins somewhat projecting. In typical *Galeomma* the shell has sharp radial sculpture; in *Libratula* it is smooth and the valves are

* Referred by Friele to *Tellinidæ* following Jeffreys's advice, but possibly related to *Montacuta*.

held nearly in the same horizontal plane, being very flat. *Ephippodonta* Tate (Trans. Roy. Soc. S. Austr., xi., p. 63, 1889, and xiv., p. 267, type *E. Macdonaldi* Tate, *loc. cit.*) is closely related to *Galeomma* and *Libratula.*

In the absence of anatomical details *Galeomma* may be divided as follows:

Section *Galeomma* s. s. (Type *G. Turtoni* Brod.)

Valves radially ribbed, hinge edentulous. Gape moderate.

Section *Amphilepida* Dall. (Type *G. polita* Desh.)

Valves smooth or concentrically faintly striated, hinge with a small dentiform process on each side of the resiliary pit; gape moderate.

Section *Paralepida* Dall. (Type *G. formosa* Desh.)

Valves radially sculptured, hinge with a dentiform process on each side of the pit; widely gaping.

Subgenus *Libratula* Pease. (Type *L. plana* Pse.)

Valves flat and smooth, carried horizontally both in the same plane, hinge as in *Galeomma.*

The summary of this group is added for completeness. No species are known from the American Tertiary or recent fauna.

Genus **SOLECARDIA** Conrad.

Solecardia Conrad, Proc. Acad. Nat. Sci. Phila., iv., p. 155, 1849; Journ., 2d Ser., i., p. 278, pl. 39, fig. 1, 1850. Type *S. eburnea* Conr., *loc. cit.,* Lower California.

> *Scintilla* Deshayes, P. Z. S., 1855, p. 171; 1st sp. *S. Cumingi* Desh., *loc. cit.,* p. 173 (Panama), which is selected as type by Woodward, Man. Rec. and Fos. Shells, Suppl., p. 470, 1856; H. and A. Adams, Gen. Rec. Moll., ii., p. 480, 1857; Desh., An. s. Vert. bas Paris, i., p. 697, 1858; Fischer, Man. Conchyl., p. 1031 (fig. 775 exclus.), 1887; Cossmann, Cat. Ill. Fos. Paris., ii., p. 50, 1887.

Barclayia H. Adams, P. Z. S., 1874, p. 585; sole ex. *Scintilla incerta* Desh., Moll. Reunion, p. 18, pl. 2, figs. 16-18, 1863.

Barclaya, Zool. Record for 1874, p. 184; Fischer, Man. de Conchyl., p. 1032, 1887.

Lionelita Jousseaume, Mém. Soc. Zool. de France, i., p. 204, 1888.

Sportella sp., Deshayes; *Psammobia* sp., Quoy, etc.

The genus *Solecardia* Conrad was well defined and based upon a single species, which, six years later, was redescribed by Deshayes under the name of *Scintilla Cumingi.* In his account of the genus *Scintilla* Deshayes mentioned no type, but his first species was *S. Cumingi,* which was named as type by Woodward in the Supplement to his Manual published in the following year. There is no doubt, as suggested by Fischer (Man., p. 1032), that the original list of *Scintilla* contained a partly heterogeneous assembly, but, until something is known of the anatomy it will be difficult to divide them accurately. To determine which portion of the group shall retain the name *Scintilla* it is necessary to proceed by the method of elimination. *S. Cumingi* (= *S. eburnea* Conrad non Mörch) cannot be selected as the type because it was already the type of *Solecardia.*

The next work treating of *Scintilla* is H. and A. Adams's "Genera of Recent Mollusca," in which *S. philippinensis* Desh. is named and figured as an example in 1857, a course followed by Chenu (ii., p. 128) in 1862. This is one of the rather short species, but its hinge agrees with the original diagnosis, though the exterior seems devoid of punctations. It is probable that it will be best to adopt this species as the type.

In his Manual Fischer figures (after Mœbius) *Scintilla aurantia* (Lamarck as *Psammobia,* = *S. mauritiana* Sby., not *S. aurantiaca* Desh.) and gives as an example of the genus *S. vitrea* Quoy and Gaimard (as *Psammobia,* = *S. aurantiaca* Desh. but not *S. vitrea* Desh.), but as far as the shells go, the latter of these agrees with *S. philippinensis* and therefore presents no advantages as type over that species.

Henry Adams has proposed a genus *Barclayia* for a species of *Scintilla* with faintly reticulate surface sculpture, or, rather, a granular surface resulting from the intersection of radial and incremental lines, but, as this feature is suggested by the surface of *S. Cumingi* (= *eburnea*) when unworn, it is probable that the differential value of this character is not very great.

The surface of *S. eburnea* (Conrad non Mörch) when worn is polished, with minute punctate and divaricate sculpture, but when fresh a large part of the surface is covered with a finely granular calcareous layer which is raised into elevated concentric lines along the incremental sculpture. From this it seems probable that the reflection of the border of the mantle over the valve does not extend so far towards the umbones as in *Galeomma.* There are also radial impressed lines, especially towards the posterior end, which result in faint serrations of the basal margins of the valves and probably correspond to appendages of the mantle. The cardinal teeth are small and rather variable in form, the ligament elongate and obsolete, the resilium wholly internal, and the hinge-plate deeply excavated. A marked peculiarity is the situation of the subcircular adductor scars entirely within the pallial line, a situation which is probably correlated with the extension of the mantle edge externally. As far as can be judged from separated valves, the ventral gape, when the valves are closed, must be very narrow and mostly posterior.

In typical *Solecardia* there is a narrow, external ligament, which leaves very little trace of its insertion on the shell, and a strong internal resilium with a good deal of calcareous matter ventrally distributed in its substance but not consolidated into an ossiculum. The external ligament is usually ignored in descriptions of *Scintilla,* but it exists more or less developed in all the fresh specimens of this genus which I have been able to examine. It is stronger in the type mentioned than in some of the others, but in all there seem to be some traces of it.

It does not seem advisable, in the absence of anatomical data and authoritative material, to attempt at present any subdivision of the recent Scintillas, although it is quite possible that the group as it remains is not thoroughly homogeneous. The fossil forms of the Paris basin, however, do not seem to agree in character with the typical *Scintilla* and, with a number of American Tertiary species, require to be eliminated from the subgenus.

The essential characters of the several groups are as follows:

Genus *Solecardia* Conrad.

Shell partially covered by the mantle with an amphidetic obsolete external ligament and an oblique internal resilium, without a lithodesma; right valve with two divaricating, well-defined lamellæ on each side of the resilium; left valve with a single lamella on each side fitting between those of the opposite valve; hinge-plate excavated; adductor scars rounded, small, situated within and distinct from the pallial line; valves subequilateral, with low beaks, the surface more or less punctate. Type *S. eburnea* Conrad, 1849.

?Subgenus *Scintilla* Deshayes (em.).

Shell almost wholly covered by the mantle, with an amphidetic obsolete external ligament and an oblique internal resilium, without a lithodesma; right valve with one or two short anterior and one or rarely two feeble posterior lamellæ on the hinge-plate; left valve with two (rarely one) anterior lamellæ and one, or rarely two, behind the resilium; hinge-plate flat or excavated; adductor scars ovate, continuous with the pallial line; valves subequilateral with low beaks, the surface polished, smooth, radiately striate, or punctate. Type *S. philippinensis* Deshayes, 1855. *Scintillula* Jousseaume, 1888, belongs hereabouts. The teeth in *Solecardia* are clean cut and strong; in *Scintilla,* being practically functionless, they appear obsolete and rather shapeless; as a rule, only one is at all distinct. In *Solecardia* the valves appear to close all round, in *Scintilla* there is more or less of a gap between them, sometimes even dorsally. Arranged according to their dental formulæ * some of the species of *Scintilla* fall into the following groups, but so amorphous are the feebly developed teeth that I feel some suspicion that these differences may prove somewhat inconstant even within the species.

$\frac{\text{L. 1 r 2.}}{\text{R. 1 r 1}}$ *S. philippinensis* Desh., *S. ambigua* Desh., *S. Forbesii* Desh., *S. timorensis* Desh., *S. semiclausa* Sby., *S. Hanleyi* Desh., *S. Deshayesii* Sby., *?S. crenulata* Cpr.; $\frac{\text{L. 1 r 2}}{\text{R. 2 r 1}}$ *S. faba* Desh.; $\frac{\text{L. 1 r 1}}{\text{R. 2 r 1}}$ *S. Strangei* Desh.; $\frac{\text{L. 1 r 2}}{\text{R. 1 r 2}}$ *S. vitrea* Quoy and Gaimard, *S. aurantiaca* Desh., *S. candida* Desh., and *S. pellucida* Desh.; $\frac{\text{L. 1 1 r}}{\text{R. 1 1 1}}$ *S. rosea* Desh.; $\frac{\text{L. 0 r 2}}{\text{R. 0 r 1}}$ *S. crispata* Jeffreys; $\frac{\text{L. 2 r 2}}{\text{R. 2 r 2}}$ *S. aurantia* Lam., *S. mauritiana* Sby.; $\frac{\text{L. 1 r 1}}{\text{R. 2 r 2}}$ *S. angusta* Desh.,† *S. Cumingi* Desh. (=*Solecardia*).

Subgenus *Spaniorinus* Dall.

Shell with an oblique internal resilium in front of which, in each valve, is a prominent tooth, that in the right valve stronger, conical, and sometimes with traces of a minute obsolete lamella behind it, while in front and above the dorsal margin of the valve is produced laterally, forming a small rounded projection which fits under the dorsal margin of the opposite valve; left valve with the tooth horizontally flattened and triangular; the hinge-plate is flattened, rounded, or slightly excavated, but behind the resilium carries no distinct

* In the formula L stands for left and R for right valve, 1 or 2 for lamellæ, and r for resilium. The formula reads from behind forward.

† As *Galeomma*, 1855. In this connection some confusion of names may be referred to. The names *ambigua, anomala,* and *angusta* have been used by Deshayes more than once for species of *Scintilla.* In 1855 (P. Z. S., p. 170) he described a *Galeomma angusta* which has since been referred to *Scintilla.* In 1858 he described a *Sportella angusta* (Bas. Paris, p. 598) which is now referred by M. Cossmann to *Scintilla.* In 1855 Deshayes described as *Galeomma ambigua* another species of *Scintilla,* and also a *Scintilla anomala.* In 1858 he used the name *ambigua* for a Parisian fossil, which in the explanation of the plates in the Atlas is called *S. anomala.* Reeve's *Scintilla ambigua* is intended for Deshayes's *Galeomma ambigua* and, as this antedates the Parisian fossil, it is the latter which should have a new name. M. Cossmann has proposed for the former the name of *S. Reevei,* which, unfortunately, cannot stand for the above reasons. The name *anomala,* being earlier in use, is unavailable, but I prefer to leave it to the French naturalists to rename their fossil. S. V. Wood in the Crag Moll. (ii., p. 120) identified with *Erycina ambigua* Nyst a Crag shell which turns out to be a *Scintilla* according to M. Cossmann, who has named it *Scintilla Woodi* (Cat. Illustr., App., ii., p. 9, 1896). It has the hinge of *Spaniorinus.* *S. eburnea* Mörch, 1874, not Conrad, 1849, from the Antilles, has been named *S. Mörchii* in my recent synopsis.

posterior lamella in either valve; adductor scars as in *Solecardia;* exterior concentrically or radially striate; form variable but resembling *Scintilla* and approaching *Fulcrella.* Type *Scintilla Cossmanni* Dall, Miocene of Virginia.

This group is intermediate between *Fulcrella, Sportella,* and *Scintilla,* but most nearly related to the latter. It is often difficult to say whether one of the smaller more inequilateral forms is a *Montacuta* or should be placed here. Nearly all the species I have been able to examine have a single tooth in each valve and no trace of a posterior lamella. The difference in form between the right and the left tooth is very marked. As far as I can judge from figures all the species from the Parisian Eocene referred by M. Cossmann to *Scintilla* will find a place in this group, together with all the American Tertiary forms. The obsolete amphidetic external ligament of the recent Scintillas leaves little or no trace of its existence on the shell; I believe it likely that *Spaniorinus* had a similar ligament, but this must remain in doubt for most of the species. In allotting the species of these puzzling shells to a genus I have placed those with a coarse hinge, double anterior cardinals, and which show a distinct scar of the external ligament in *Sportella;* those very inequilateral, with delicate hinge and no external ligament, in *Montacuta,** and, in *Scintilla,* those with the hinge above described, with nearly equilateral shells, no external ligament scar, and frequently with radial sculpture of fine, sharp striæ.

Scintilla recondita Fischer would probably belong in *Spaniorinus.* In spite of Jeffreys's opinion, I do not think it identical with the Eocene *S. Caillati* Desh. But specimens from Monte Mario, distributed under Deshayes's name by Rigacci, belong to Fischer's species.

Subgenus *Scintillorbis* Dall.

Shell compressed, orbicular, extremely thin, with radial and concentric sculpture, an obsolete external ligament, a stronger internal resilium; dental formula $\frac{\text{L. r 2}}{\text{R. r 1}}$. Type *S. crispata* Fischer, 1872.

This is entirely unlike the typical *Scintilla,* and, except for the hinge, resembles an orbicular *Lepton.* It does not appear that any of the so-called *Scintillas* of Europe or America, recent or fossil, closely resemble the tropical and chiefly Oriental typical forms.

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* *Sportella corbulina* Deshayes, from his figure, would be placed in this paper under *Montacuta.*

Solecardia (Spaniorinus) Cossmanni n. sp.

Plate 45, Figures 27, 27*a*.

Miocene of Petersburg, Virginia; Burns.

Shell thin, nearly equilateral, rounded at both ends, the posterior end blunter, shorter, and higher than the anterior; surface with rather irregular obvious incremental lines, smoother near the beaks; base nearly straight, posterior dorsal slope arcuate, descending; anterior arcuate, beaks low, inconspicuous; right valve with the tooth narrow, slender, in a transverse vertical plane, the anterior dorsal margin expanded slightly just in front of it, the scar of the resilium strong, narrow, oblique; left valve with the tooth flattened in a horizontal plane, the anterior part longer; interior with faint, obsolete radiations; adductor scars rather large, ovate; margins entire. Lon. 8, alt. 5.2, diam. 3.5 mm.

This species has also been found in the Miocene of Maryland at various points by the State Geological Survey, and some of their specimens exceed ten millimetres in length. A single valve was also found at Petersburg which differs from *S. Cossmanni* by having a somewhat proportionately longer shell, the two ends being practically equal in height and rotundity, while the interior shows distinct radiations. This may be a variety of *S. Cossmanni*, of which more material is required to decide the range of variation.

A *Scintilla alabamiensis* has been described by Cossmann from Claiborne. The Chickasawan supplies a species which has been named by Aldrich *Scintilla Clarkeana*. In the Vicksburgian Conrad has named a *Scintilla oblonga* which belongs in the group I have called *Spaniorinus*. Only one left valve is known. A fragment of a species, different from any of the above, but too imperfect to name, was collected by Burns from the Chipola marl.

Family SPORTELLIDÆ Dall.

Genus **SPORTELLA** Deshayes.

Sportella Deshayes, An. s. Vert. bas. Paris, i., p. 593, 1858. Type *Psammotea dubia* Desh., Coq. Fos. bas. Paris, i., p. 76, pl. 10, figs. 13-14, 1824.

Fabella Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, pp. 574, 586, 1863. Type *Amphidesma constricta* Conr., Med. Tert., p. 76, pl. 43, fig. 10, 1845.

Angusticardo Cossmann, Cat. Illustr., ii., p. 17, 1887; section of *Sportella*. Type *Poromya rotundata* Desh., Cossmann, *op. cit.*, pl. 1, fig. 9.

This genus, though sometimes cited as of 1852, was proposed by Deshayes in 1858. Both Deshayes and Conrad seem to have recognized its characters only in part. Deshayes describes the ligament as external, seated on a nymph, but says nothing of the resilium; Conrad mentions the cartilage pit, but mistakes the nymphæ for lateral teeth and says nothing of an external ligament. The type of *Fabella* undoubtedly possessed both, somewhat more strongly developed than in the French fossil. The dentition of the two is identical, and after a careful study of several species of *Sportella,* including the typical species, for which I am indebted to the courtesy of M. Cossmann, I am of the opinion that *Sportella* also possessed an internal resilium. The scar is faint and if at all worn not visible in *S. dubia,* but in *S. gibbosula* Deshayes I find it well defined, though in any case less impressed than in the American species. The surface of *S. dubia* is sculptured with faint, almost microscopic radial scratches, traces of which may be found in most of the species, though obsolete in some of them. The pallial area of the inner surface of the shell is sometimes punctate. All these features tend to unite it with the other Leptonacea. *Myllita* has a similar duplex ligament; some of the Kellias and *Cyamium* have both separately developed. The differences between the American *Fabella* and the European *Sportella* are trifling and only of degree, but for those who prefer very minute subdivision in such groups I suppose the name *Fabella* might be kept in a sectional sense for the American species.

The earliest *Sportella* recorded in our Tertiary is the *Fabella oblonga* Aldrich (Bull. Am. Pal., ii., No. 8, p. 182, pl. 5, fig. 2*a*, 1897; Harris, Bull. Am. Pal., ii., No. 9, p. 250, pl. 2, figs. 7-8, 1897) from the Lignitic or Chickasawan at Wood's Bluff, Alabama. The Claibornian offers *S. Gregorioi* Cossmann (Notes Compl., p. 11, pl. 1, figs. 11-12, 1894, Ald. Bull. Am. Pal., No. 8, p. 173, pl. 5, fig. 4, 1897) and Aldrich's *Lepton? alabamense* (*op. cit.,* p. 182, pl. 5, fig. 9) has, though obscure, the aspect of *Sportella.* The hinge is certainly not that of *Lepton.* I have examined the type specimen. It is Claibornian.

Curiously enough the Upper Eocene and the Oligocene up to the Oak Grove sands have not afforded any species of *Sportella* so far, unless some of the species we have included under *Montacuta* would more properly find a place here. In the sands, however, the genus seems to reappear as follows:

Sportella obolus n. sp.

PLATE 44, FIGURE 18.

Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, solid, subcircular and flattish; interior polished, the cicatrices feeble; exterior smooth or faintly marked with incremental lines, and, in very perfect specimens, microscopic radiating striæ; umbones small, polished, conspicuous; dorsal margins of the hinge-plate inflected in the right valve; hinge-plate strong; right cardinal stout; prominent; left valve with the dorsal margins of the hinge-plate slightly bevelled, cardinal teeth subequal, small. Alt. 4, lon. 4.5, diam. 1.0 mm.

This is a peculiar little shell whose rounded form does not suggest the genus, but it has the typical hinge. The radial striæ are extremely fine and visible only under magnification in perfect specimens.

Sportella unicarinata n. sp.

PLATE 44, FIGURE 13.

Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, solid, compressed, ovate, with the anterior part somewhat more produced and attenuated, interior polished, scars distinct; exterior divided into two areas by a single sharply defined small thread extending obliquely from the beak to the posterior part of the base, the area behind the thread depressed, surface smooth or faintly microscopically radially striate, with faint irregularly distributed incremental lines; nepionic shell smooth, conspicuous; hinge normal, the hinge-plate thickened in front of the conspicuous right cardinal tooth; left cardinals unequal, the anterior most elevated, the left hinge-plate with the posterior dorsal margin slightly inflected. Alt. 4, lon. 5.5, diam. 1.5 mm.

This species is notable for its depressed posterior areas, which distinguish it from any of our other species. It and the following were found with *S. obolus*.

? Sportella lubrica n. sp.

PLATE 44, FIGURE 9.

Oak Grove sands, Santa Rosa County, Florida; Burns.

Shell small, thin, polished, ovate-trigonal, sculptured only by incremental lines, which are feeble generally but at intervals strong; beak low, decurved; hinge-plate narrow, right cardinal slender, prominent, with a small prominent callus in front of it on the dorsal margin; shell moderately convex. Alt. 4, lon. 5, diam. 2 mm.

A single right valve, somewhat broken, is all that is known of this species. It has not exactly the aspect of *Sportella,* though nearest to that genus, to which until more material is received it is provisionally referred.

Sportella lioconcha n. sp.

PLATE 44, FIGURE 24.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell oblong, moderately inflated, evenly rounded, the ends subequal in outline; surface smooth or with some incremental irregularities, sculptured with very fine concentric and obsolete, microscopic, radial striæ; interior polished, with faint radial striations; beaks low, inconspicuous, with a minute, brilliantly polished prodissoconch; hinge narrow, cardinals more or less duplex in the young, single, straight and prominent in the adult; pit for the resilium distinct, triangular, short; ridge for the ligament small, short but obvious. Lon. 14, alt. 9.5, diam. 6 mm.

This is a very elegant species with somewhat the aspect of a *Scintilla* but the typical hinge of *Sportella.*

Sportella Whitfieldi Dall.

Abra nuculoides Whitfield, Mio. Moll. N. J., p. 81, pl. 15, figs. 7-9, 1894; not of Conrad.

Lowermost Miocene marl at Jericho, Cumberland County, New Jersey, and uppermost Oligocene of the Oak Grove sands, Santa Rosa County, Florida; Burns, Miocene of Maryland, State Geological Survey.

Professor Whitfield's type is in the National Collection, together with a fragment, apparently of the same species, from the Oak Grove sands. This species resembles some of the species we have referred to *Montacuta,* but has a coarser and heavier hinge. It recalls *S. corbulina* Desh. In some respects it foreshadows the *S. constricta*, but is more inflated and much more inequilateral, the anterior side produced, the posterior very short, blunt, and almost truncate.

Sportella constricta Conrad.

PLATE 25, FIGURE 4, 4*a*.

Amphidesma constricta Conrad, Am. Journ. Sci., xli., p. 347, pl. 2, fig. 15, 1841; Trans. Am. Assoc. Nat. and Geol., i., p. 110, pl. 5, fig. 15, 1842; Fos. Med. Tert., p. 76, pl. 43, fig. 10, 1845.

Syndosmya constricta Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854.

Fabella constricta Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, pp. 574, 586, 1863; Meek. S. I. Checkl. Mio. Fos. N. Am., p. 11, 1864; Dall, Bull. 37, U. S. Nat. Mus., p. 48, 1889.

Sportella constricta Dall, Trans. Wagner Inst. Sci., p. 920, pl. 25, figs. 4, 4*a*, 1898.

Miocene of Petersburg, Virginia, of North Carolina at Magnolia and the

Natural Well, Duplin County, and on the Cape Fear River; Pliocene of the Waccamaw beds, South Carolina, and of the Caloosahatchie and Shell Creek, Florida.

This very characteristic little shell has the hinge more robustly developed than in most of the species, though its teeth, etc., are otherwise precisely similar. This may account for the fact that Conrad referred two of the closely allied species to *Abra* while erecting a genus for this one. The outer surface is sculptured mainly by rather prominent incremental lines, but occasionally shows a fine shagreening or minutely pustular sculpture. This character is not constant in most but is occasional or habitual in nearly all the American species as well as some European ones. The living shell, which in my "Mollusks of the Southeastern Coast of the United States" I too hastily referred to this species, has with further study proved to be the *Eucharis* (=*Anisodonta*) *elliptica* of Récluz. The resemblances, however, suggest that the latter genus may eventually find a place in the vicinity of *Sportella*. The form and muscular scars, the tendency to pustulation of the surface, and to a less extent the characters of the hinge point in this direction. Up to the present time, though not intrinsically improbable, there is no conclusive evidence of the survival of *Sportella constricta* in the recent fauna.

Sportella protexta Conrad.

Plate 25, Figure 3.

Amphidesma protexta Conrad, Am. Journ. Sci., xli., p. 347, 1841; Trans. Am. Assoc. Geol., i., p. 110, 1842; Fos. Med. Tert., p. 73, pl. 41, fig. 7, 1845.

Hiatella lancea H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 242, pl. 34, fig. 24, 1845.

Syndosmya protexta Conrad, Proc. Acad. Nat. Sci. Phila., vii., p. 29, 1854.

Saxicava fragilis Holmes, Post-Pl. Fos. S. Car., p. 57, pl. 8, fig. 18, 1859.

Abra protexta Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863; Meek, S. I. Checkl. Mio. Fos. N. Am., p. 11, 1864.

Sportella lancea Dall, Trans. Wagn. Inst. Sci., iii., part iv., p. 920, pl. 25, fig. 3, 1898.

Miocene of Petersburg, Virginia, of North Carolina at Wilmington, and in Duplin County at Magnolia and the Natural Well; Pliocene of the Cape Fear River, North Carolina; of Tilly's Lake, Waccamaw River, South Carolina, and of the Caloosahatchie beds of Florida; Pleistocene of Simmons Bluff, South Carolina; living off Cape Lookout, North Carolina, in twenty-two fathoms, sand, dredged by the United States Fish Commission.

This species is notable for its solenoid form, more pronounced in the young, its conspicuous nepionic stage visible on the beaks, and its sparse pustulation, which is easily eroded and therefore apparently absent in a certain proportion of specimens. The pustulation is more conspicuous on fully grown specimens, and the adolescent sometimes do not have any. The outline varies somewhat, not only with age but also in different individuals, and has led to the suspicion that the *S. compressa* may perhaps only be an extreme variation of *S. protexta*. A single fresh valve of the latter was dredged off Cape Lookout by the United States Fish Commission.

Sportella petropolitana n. sp.

PLATE 45, FIGURE 10.

Miocene marl of Petersburg, Virginia; Burns.

Shell small, oblong, subequilateral, moderately convex, the dorsal slopes evenly arched, the base nearly straight, and the ends rounded; beaks low and inconspicuous; outer surface nearly smooth or sculptured with incremental lines; hinge with the cardinal tooth single, smooth, and conical, the pit small, triangular, and the ligamentary ridge obscure. Lon. 5.75, alt. 3.75, diam. 2 mm.

A single small valve establishes the presence of this species at this locality. From *S. constricta* of the same size it can be distinguished by the even arch of the dorsal margin, the thinner and more elegant shell, and the absence of the posterior dorsal reflection which gives this part of the shell in *S. constricta* a squarish aspect. The cardinal tooth is also smaller and more slender.

Sportella compressa H. C. Lea.

PLATE 25, FIGURE 3*a*.

Petricola compressa H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 239, pl. 34, fig. 15, 1845; Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863; Meek, S. I. Checkl. Mio. Fos. N. Am., p. 9, 1864.

Sportella compressa Dall, Trans. Wagn. Inst. Sci., iii., part iv., p. 920, pl. 25, fig. 3*a*, 1898.

Miocene of Petersburg, Virginia, Lea; Pliocene of the Caloosahatchie beds, Florida, Dall.

This species is much like *S. protexta*, but more equilateral and of more ovate form. It appears to be relatively rare.

Sportella yorkensis n. sp.

PLATE 44, FIGURE 1.

Miocene of the York River, Virginia, near Yorktown; Harris.

Shell small, subovate, slightly inequilateral, compressed; beaks moderately prominent, exterior sculptured with moderately conspicuous incremental lines or smooth; posterior end slightly shorter, both ends evenly rounded, base arcuate; hinge with a large pit for the resilium, left valve with the anterior cardinal large and prominent, the hinge-plate thickened behind the pit, narrower in the right valve. Alt. 5, lon. 7, diam. 2 mm.

This species is represented by four somewhat worn valves in the National Collection. They show no traces of pustulation, which may, however, have been worn off. It recalls *S. constricta* but is smaller, less inflated, and more compact.

Sportella pelex n. sp.

PLATE 44, FIGURE 10.

Miocene of Petersburg, Virginia, Burns; Cove Point, Maryland, Maryland Geological Survey.

Shell small, solid, compressed, inequilateral, the posterior side quite short and blunt; beaks low, surface sculptured with fine regular incremental lines, of which a few at wide intervals are more conspicuous; basal margin nearly straight, anterior end produced, rounded, posterior bluntly rounded; left valve with a strong hinge, the anterior lamella obsolete, but the one behind it prominent and strong, socket of the resilium deep, the hinge-plate above it obscurely thickened, a narrow but distinct groove for the external ligament; interior polished, the adductor scars rather high up, the disk faintly radially striated, the margin entire. Lon. 7.3, alt. 5.5, diam. 2 mm.

This species has a good deal the shape of a small *Mesodesma* and is nearest to *S. yorkensis,* compared with which it is higher and more inequilateral and with a more oblique anterior dorsal slope.

Several other species of *Sportella* as yet undescribed appear in the collections of the Maryland State Geological Survey from the Miocene, among which one from the Cove Point, Maryland, Miocene has received the manuscript name of *Sportella recessa* from Mr. L. C. Glenn of the Survey. I have included (Plate 45, Figure 13) an illustration of this species with the others.

Genus ANISODONTA Deshayes.

Eucharis Récluz, Journ. de Conchyl., i., p. 164, 1850. Type *Corbula quadrata* Hinds; Fischer, *op. cit.*, viii., p. 83, 1860; xxxiv., p. 193, 1886; not of Latreille, 1804.

Poromya Deshayes, An. s. Vert. bas. Paris, i., p. 248, 1857; not of Forbes, 1844.

Anisodonta Desh., An. s. Vert. bas. Paris, i., p. 542, 1858; Cat. Moll. Réunion, p. 15, 1863; Cossmann, Cat. Ill. bas. Paris, i., p. 136, 1886; ii., p. 204, 1887.

Basterotia C. Mayer, in Hörnes, Fos. Wiener beckens, ii., p. 40. Type *B. corbuloides*, *op. cit.*, pl. iii., fig. 11, 1870; Dall, Blake Moll., p. 316, 1886; not of Bayle (MS. *fide* Jousseaume), 1884.

This genus has been associated with the Corbulas, which are not closely related to it, with *Poromya*, and with the Cypricardians. The general features of the soft parts have been described by Fischer, but his account is not sufficiently detailed to enable us to locate it definitively. At present all that can be said is that it may belong near *Haloconcha* or in the vicinity of *Sportella*.

As far as can be judged at present the genus is divisible into the following sections, which are not separated from each other by any very distinct characters:

Section *Basterotia* Mayer, 1870.

Shell inflated, quadrate, carinated behind, more or less gaping behind and ventrally, with a granular surface sculpture, glassy texture, and simple pallial line; hinge with a single prominent denticle under the incurved beaks separated by a gap from a short dentiform nymph bearing an external ligament. Type *B. corbuloides* Hörnes.

Section *Fulcrella* Cossmann, Cat. Ill. bas. Paris, i., p. 136, 1886. Type *Poromya paradoxa* Desh.

Shell like *Basterotia* but without posterior carina, the surface usually concentrically striate and not granular; rounded quadrate, the tooth less prominent, the nymph longer, and without any conspicuous notch or gap between it and the tooth, and the valves more or less close fitting.

Section *Anisodonta* Deshayes, 1858. Type *A. complanata* Desh., *op. cit.*, pl. xxii., figs. 1-4 (bad).

Shell elongated, more or less carinate and pointed behind, beaks not conspicuous, valves gaping little if at all, surface granulose, teeth moderately developed; nymph rather elongate, not prominent.

The original type specimen was diseased and consequently the figure is very misleading. The identification has been cleared up by M. Cossmann. The distinctions between the three sections are very slight.

The relations of the genera *Passya* Desh., and *Fabagella* Cossmann (i., p. 41, 1886, type *F. faba* (Desh.), pl. ii., figs. 40-41) to *Basterotia* will bear investigation.

Anisodonta (Basterotia) bowdeniana n. sp.

Oligocene of the Bowden beds, Jamaica; Henderson.

A species of *Basterotia*, which appears to be clearly distinct from *B. quadrata* Hinds, is represented by a broken right valve in the collection made by Henderson and Simpson at Bowden. Hardly complete enough to figure, it may be described as distinguished from *B. quadrata* by the following characters. The keel, which is so prominent a feature in *B. quadrata*, in the present shell is well marked only on the beak, rapidly becoming obsolete distally and represented only by a rounded ridge, which passes imperceptibly into the general convexity of the valve. The beaks in *B. bowdeniana* are less angular and elevated, the shell thinner and more ovate, the hinge-line longer, the elevated tooth smaller in proportion to the shell and much more delicate. The surface is minutely sagrinate, the length 10.5, the diameter about five millimetres.

Anisodonta (Fulcrella) (elliptica Récluz? var.) **carolina** Dall.

Plate 45, Figure 20.

Eucharis elliptica Récluz, Journ. de Conchyl., i., p. 168, 1850.

Mya simplex Holmes, Post-Pl. Fos. S. Car., p. 55, pl. 8, fig. 16, 1858.

Miocene of Duplin County, North Carolina, at the Natural Well and Magnolia, Burns; Pleistocene of Simmons Bluff, South Carolina, Holmes; living in eighteen to twenty-two fathoms off the coast of North Carolina, United States Fish Commission.

I am somewhat in doubt as to the distinctness of the Miocene shells from *A. elliptica* Récluz, characteristic specimens of which are found associated with those, which I have named *A. corbuloides*, off the coast of North Carolina. Holmes's figure is very like the recent *A. elliptica*, and a little larger and more rounded behind than the Miocene fossils. These differences, however, appear to correspond to the differences between young and adult *A. elliptica*. Two right valves of the Miocene form were collected, and more profuse material is needed before their position with regard to *A. elliptica* can be ascertained. Should they prove distinct the Miocene species will require a new name. *A. simplex* will at any rate be annexed to *A. elliptica* as a synonym, Récluz's name having seven or eight years' priority, for the recent and Pleistocene form.

Anisdonta americana n. sp.

Plate 36, Figure 7.

Pliocene marls of the Caloosahatchie, Monroe County, Florida; Dall.

Shell small, thin, elongate, subquadrate, the anterior end shorter and rounded, the posterior longer and obliquely pointed; surface minutely granose and with concentric incremental sculpture, a rounded ridge extending from the umbo to the posterior basal angle; beaks low, rather incurved; hinge delicate, a small subconical cardinal under the umbo in the right valve and a slightly excavated nymph behind it for the reception of the ligament and resilium, which are external; base and posterior hinge-line nearly parallel, the latter terminating at an angle of the dorsal margin beyond which the margin slopes downward; the outer edges of the nymphs are incised, forming a narrow groove; interior of shell smooth, anterior muscular scar impressed, posterior and pallial line faint and obscure. Lon. 6, alt. 3.7, diam. 2.9 mm.

A single right valve was obtained. From the Miocene form of the last species this is distinguished by its greater length and more conspicuous granulation. In reality, however, the differences between *Fulcrella* and the typical *Anisodonta* are insignificant.

Genus **HINDSIELLA** Stoliczka.

Hindsia Deshayes, An. s. Vert. bas. Paris, i., p. 693, 1858; not of Adams, 1853.

Hindsiella Stol., Cret. Fauna India, Pelecypoda, p. 266, 1871 (type *Modiola arcuata* Defrance, Desh., *op. cit.*, p. 695, pl. 53, figs. 32-35, 1858); Cossmann, Cat. Ill., ii., p. 53, 1887.

Vasconia Fischer, Les fonds de la Mer, ii., p. 83, 1873.

Kellia (sp.) De Gregorio, Cossmann.

The peculiar form of the shell with its median constriction, which led to the institution of a genus for the Parisian fossil, is probably due to the commensal habit, and may therefore occur in commensal species of different genetic relations. My attention was first drawn to this explanation by the discovery of the *situs* of "*Pythina*" *rugifera* Cpr. of the Alaskan fauna. This little bivalve is byssiferous and has the same median arcuation as the *Hindsiella*. It lives attached by the byssus to one of the abdominal segments of *Gebia pugetensis* Stm., a burrowing crustacean of the northwest coast. The mollusk, by means of its arcuate medial sinus, precisely fits the convex surface, to which it is attached by its byssus, and it is difficult, after examining one *in situ*, to doubt that its location and form have not a certain relation of cause and effect. By fitting closely and thus being able to keep itself hanging symmetrically on the abdomen of the crab the mollusk avoids the shocks which it would receive if it swung to one side, and is able to maintain its position sheltered from the carnivorous gastropods always so ready to drill holes in thin-shelled bivalves. Besides this the fragments of the crab's food in the burrow probably attract many infusoria and other minute organisms which serve as food for the bivalve. Such burrows are known to be frequented by various commensal *Leptonacea.* Stoliczka supposed that it would be necessary to remove *Hindsiella* from the vicinity of the *Erycinidæ* on account of its external ligament. But the fact is that ligament and resilium are both represented in a majority of the *Leptonacea,* sometimes one is obsolete and sometimes the other, but it is doubtful whether either is absolutely deficient in any case. A careful examination of the hinge of *H. arcuata* leads to the belief that the ligament of this type was not, as Deshayes supposed, entirely external. At all events, from all the facts, it does not seem that a sufficient reason has been advanced for separating this group from the *Leptonacea.* As Smith has already shown, a variety of forms have been referred to these groups solely on account of their external form. The type of *Hindsiella* has in the right valve a single small conical tooth under the umbo, behind which the hinge-plate is wide, somewhat excavated, and exhibits what appears to be an elongated thickening upon which the resiliary part of the ligament was seated. In the left valve the hinge is similar, but there is a second small tooth behind the more prominent one in front of the resilium, the resiliary process is less prominent, and a distinct groove may be seen where the posterior part of the external ligament terminated. The ligament and resilium were in contact, but both were present. It is difficult to decide whether the elongate posterior lamina is a " tooth" or a resiliifer. Whichever is the case, it appears in the American species also. I am indebted to M. Cossmann for the opportunity of studying authentic valves of this curious little shell.

Deshayes's name being preoccupied, Stoliczka modified it to *Hindsiella,* while, a short time after, Fischer, apparently ignorant of Stoliczka's action, proposed *Vasconia* for the same reason. As he specifically states this, it is not practicable to use his name for a curious little shell described at the same time by Fischer as *Hindsia Jeffreysiana,* and which is separated from *Hindsiella* by good characters. The latter is a purely external shell, usually with a distinct unpolished periostracum, and the sinuosity in its base is merely a sinuosity without distinct boundaries. The *H. Jeffreysiana,* however, is a shell almost entirely if not wholly internal, without an epidermis, with a solely internal, small, short, subumbonal resilium and no external ligament; the sulcus in the valves is a sharp slit, leaving a fasciole with sharply defined boundaries, and the cardinal tooth, unlike those of *Hindsiella,* though similarly placed, is clean cut and sharp. These differences obviously correspond to serious anatomical characteristics of which *Hindsiella* has no trace in its shell, and therefore I have proposed for *H. Jeffreysiana* the generic name of *Vasconiella.*

Hindsiella is represented in the American Tertiaries, so far as known, by the following species:

Hindsiella faba O. Meyer.

Hindsiella faba O. Meyer, Bull. Ala. Geol. Surv., i., p. 82, pl. 1, fig. 25, 1886.

Kellia faba De Gregorio, Mon. Claib., p. 211, pl. 30, fig. 16, 1890; Cossmann, Notes compl., p. 12, 1894.

Eocene of the Claiborne sands, Claiborne, Alabama.

These small shells with their obscure cardinal characters are very puzzling and difficult to diagnose clearly. M. Cossmann expresses the opinion that this shell is a *Kellia,* but if *Kellia* is to be judged by its type, *K. suborbicularis,* the two hinges, though allied, cannot be regarded as identical. The hinge of *H. faba* seems to me to agree in all essentials with Deshayes's figure (Bas. Paris, pl. 43, fig. 33), though the posterior part of the hinge-plate in *H. faba* is proportionately narrower and does not show the minute groove for the external ligament clearly. The shades of obsolescence in the ligamentary characters among these shells are so delicately graded that I cannot regard this as a matter of importance. The dental characters of *Kellia* include one very large and one small cardinal and three distinct laterals in the two valves, and therefore it seems to me far more distinct from *H. faba* than it is from *H. arcuata.* It is not at all impossible that, as is the case in *Kellia,* different individuals have the hinge somewhat differently developed. Where the teeth are so unformed and amorphous as they are in many of the *Leptonacea* too much stress cannot prudently be laid on minute differences.

Hindsiella (**faba** var?) **donacia** Dall.

PLATE 45, FIGURE 12.

Eocene of Claiborne, in shell sand; Burns.

Shell small, donaciform, with variable outline, rather compressed, inequilateral, the posterior side shorter, anterior dorsal margin sloping to the rounded anterior end, base slightly insinuated; posterior dorsal margin with a shorter and steeper slope, the posterior end of the shell subtruncate obliquely, the basal angle rather marked; the whole shell slightly twisted; surface with concentric somewhat irregular incremental lines and microscopic partly obsolete radial striæ; interior polished, hinge like that of *H. faba* but with the right cardinal more prominent and stem-like, the left cardinal obsolete; in some specimens the resiliary insertion was directly on the surface of the valve, in others (probably more mature) there was a distinct thickening, especially about the margin of the scar. Lon. 2.2, alt. 1.7, diam. 0.6 mm.

This shell is probably distinct from *H. faba*. It is more triangular, more inequilateral, and more compressed. The sinuation of the base is much less conspicuous, the cardinal tooth is longer, and the laminæ proportionately shorter that in *H. faba*. Several specimens with the valves in the natural position indicate that there was a small external ligament in addition to the large internal resilium.

The hinge characters of both these species and the type *H. arcuata* seem to me to be most nearly allied to those of *Montacuta*, especially those *Montacuta* * which, like *M. ferruginosa* Mtg., have only the right cardinal and the left anterior lamina well developed. To these in *Hindsiella* is added a more or less developed external ligament, and if the peculiar form of the shell is due, as has been suggested, to a commensal situs on the ventral segments of crustacea it is not improbable that the animal wants the broad external frills of the mantle which have been observed in the free *Montacuta*.

Hindsiella nephritica n. sp.

Plate 45, Figure 8.

Oligocene of the lower bed at Alum Bluff, Calhoun County, Florida; Burns.

Shell small, short, inflated, subequilateral, with rather prominent umbones, near which the valves are smooth, elsewhere with irregular, more or less prominent incremental lines; centrally vertically constricted, which produces a shallow insinuation in the basal margin; umbones prosogyrate with the dorsal margin impressed in front of them; hinge narrow, in the right valve a single subumbonal short tooth, behind and below the beak a narrow elongate scar for the resilium, and farther back a slender posterior lamella separated by a groove from the dorsal margin; adductor scars narrow, rather high up; interior of the shell polished with entire margins. Lon. 4.75, alt. 3.5, diam. 3 mm.

A single right valve of this species was collected.

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* Other forms which, from their arcuate outline, have wrongly been referred to *Hindsiella* will be discussed under *Bornia, Pythinella,* and *Montacuta.*

Hindsiella carolinensis n. sp.

PLATE 45, FIGURE 4.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, rounded, moderately compressed, with low, inconspicuous beaks, subequilateral, with a feeble mesial constriction; sculpture of faint incremental lines crossed by microscopic radial striation sometimes partly obsolete; right valve with a small stout subumbonal tooth, a resiliary scar behind the umbo, and a faint groove in the posterior distal part of the narrow hinge-plate; left valve with two anterior teeth, the posterior one subumbonal and smaller, the anterior hinge-plate excavated, the posterior with a narrow elongate resiliary scar and a faint ridge representing the lamella; interior of the valve polished and faintly radially striate. Lon. 5.5, alt. 4.5, diam. 2.0 mm.

The radial striæ are only visible with a good light and strong magnification.

Hindsiella acuta n. sp.

PLATE 45, FIGURE 9.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, cuneate, inflated, subequilateral, the posterior side broader and rounded, the anterior narrower, more pointed and decurved; anterior dorsal margin declining, posterior arcuate; middle of the base conspicuously insinuate; surface sculptured with crowded, rather prominent, incremental lines, feebler towards the anterior end, which shows some faint radial markings; hinge-plate narrow, left valve with a prominent subumbonal tooth and a feeble lamella a little in front of it, a strong resiliary scar, and a minute, obsolete, very distant posterior lamella; right valve with an arcuate, short, subumbonal lamina, a deep pit for the opposite cardinal above it, and a short, distant, sharp groove corresponding to the posterior lamella of the opposite valve; interior of the valves polished, faintly radially striate, the adductor scars rather low down. Lon. 6.0, alt. 4.0, diam. 3.0 mm.

This species is especially characterized by its relatively acute anterior end, which, in all the individual variations noted, is still preserved.

It should be observed that, like nestlers in general, the species of *Hindsiella* exhibit a good deal of variation among individuals; much more than free bivalves usually show. Slight differences of outline count for little, but there is always a certain *facies* which may serve as a sufficient guide in discriminating one species from the others, provided one has a satisfactory amount of material for study.

FAMILY LEPTONIDÆ.

Genus **LEPTON** Turton.

Lepton Turton, Dithyra Brit., p. 61, 1822. Type *L. squamosum* Montagu.

Eupoleme Leach, Moll. Gt. Brit., p. 279, 1852. Same type.

Neolepton Monterosato, Nuova Revista, 1875, p. 12, *nota;* Nom. Conch. Medit., p. 15, 1884. Type *Lepton sulcatulum* Jeffreys.

In this genus we have the hinge composed in the left valve of an anterior lamella at the umbonal end of which is a nascent cardinal or "hook" which may or may not be completely detached from the lamella; behind this is a stout internal resilium, behind which is a posterior lamella which rarely becomes obsolete. In the right valve a pair of lamellæ on each side of the resilium is disposed in such a manner as to form a socket for the lamella of the opposite valve. The hinge is concentrated in comparison with that of most of the *Leptonacea,* the lamellæ are short, the resilium is short, stout, and nearly central. In the typical species there is only one cardinal "hook," and that is in the left valve. The shells are usually somewhat compressed, subquadrate, and polished, with a minute surface-sculpture, punctate or sagrinate; the beaks are nearly central and erect. The anatomical characters are remarkable, but it is only necessary to state here that the mantle is reflected over the valves which it normally covers to a greater or less extent.

The hinge of all the *Leptonacea* is fundamentally based on the same plan, the different genera merely exhibit modifications of detail. The notion that any relation to *Mactra, Cyrena,* and other alien genera is shown by these modifications is unwarranted and superficial. The apparent resemblances are not genetic, but due to convergence, except in so far as they exhibit features common to the nepionic stages of Teleodesmacea in general. The careful student will see in the hinge of *Lepton* relations to *Scintilla, Myllita, Bornia,* etc., but it is impossible to say which, if any, of these predominates. Hardly any three of the species have a precisely similar dentition, and the sections hereinafter enumerated must therefore be considered as merging peripherally into each other.

Section *Lepton* s. s. Type *L. squamosum* Mtg.

Characters mainly as given in the generic diagnosis, an anterior cardinal hook in the left valve, none in the right valve.

Section *Neolepton* Monterosato. Type *L. sulcatulum* Jeffreys.

Shell inflated, concentrically striate, more or less inequilateral, impunctate; hinge essentially the same as in *Lepton* proper.

Section *Epilepton* Dall. Type *Lepton Clarkiæ* Jeffreys.

Shell much as in *Neolepton;* hinge with a simple posterior and a hooked anterior lamella in each valve, not concentrated, the resilium in an oblique posterior furrow.

Lepton glabrum Fischer, from deep water in the Bay of Biscay, also has the typical hinge of this section, which verges on that of *Erycina.*

Section *Planikellia* Cossmann. Type *Erycina radiolata* Lam.

Shell recalling *Lepton* but with radial sculpture; hinge with a central resilium between two diverging lamellæ in the left, which are received between paired lamellæ in the right valve; there is no "hook" or cardinal in either valve.

I was enabled to study the hinge in specimens kindly sent by M. Cossmann. It differs from the hinge of *Lepton* s. s. chiefly in the absence of the cardinal hook in the left valve. There are several species in the Parisian Eocene.

The genus *Lepton* is not represented in our Tertiaries as far as explored. Only one species belonging to the genus as restricted is known from the Atlantic coast recent fauna. *Lepton alabamensis* Aldrich proves to be a *Sportella; L. mactroides* and *fabagella* Conrad are referable to *Bornia* and *Kellia.*

The genus has been considered here to make the discussion of the *Leptonacea* more complete and because the manuals are, as a rule, very defective in their treatment of this puzzling group.

Genus **ERYCINA** Lamarck.

$<$ *Scacchia* Philippi, Moll. Sicil., ii., p. 27, 1844; 1st sp. *Tellina elliptica* Scacchi, Phil.,

= *Erycina* Récluz, Revue Zool., vii., pp. 291, 325, 1844. Type *E. pellucida* Lam., Ann. du Mus., vi., p. 413; Deshayes, An. s. Vert. bas. Paris, pl. 6, figs. 19-21.

= *Erycina* Cossmann, Cat. Illus., ii., p. 50, 1887; Fischer, Man. de Conchyl., p. 1025, 1887.

Not *Erycina* Philippi, Moll. Sicil., i., p. 12, 1836, type *E. Renieri* Brown (= *Abra*); nor *Erycina* Brown, Zool. Textb., p. 461, 1833, type *E. striata* Brown, pl. 90, fig. 21 (= *Atactodea*).

$>$ *Scacchia* Philippi, Moll. Sicil., ii., p. 27, 1844; 1st sp. *Tellina elliptica* Scacchi, Phil., *op. cit.*, pl. 14, fig. 8.

= *Neæromya* Gabb, Trans. Am. Phil. Soc., xv., p. 247, 1873; Proc. Acad. Nat. Sci. Phila. for 1872, p. 274. Type *N. quadrata* Gabb, *loc. cit.*, pl. 10, figs. 4, 4*a*, 4*b*, 1872.

The genus *Erycina* as instituted by Lamarck was extremely heterogeneous, the first species being a *Cyrena,* the third a *Corbula,* the fourth a *Tellina,* the fifth a *Psathura* (only doubtfully admitted by Lamarck), and the sixth a *Diplodonta.* The essential feature of the genus as understood by Lamarck was the possession of an internal resilium situated in a fossette *between* the cardinal teeth instead of *at one side* of the cardinals, as in *Mactra.* The species enumerated (1, 4, 5, 6) which do not possess this character were, being fossils, supposed to have it by Lamarck, who mistook the triangular gap between the divergent cardinals for a fossette. The correction of this error leaves only two species corresponding to the diagnosis. *Corbula* had been instituted several years previously, so we are reduced to the single type, *Erycina pellucida,* as the exemplar of the genus.* In the absence of an exact knowledge of the facts the genus was misunderstood by many of the early writers and was only put on a sound foundation later by the researches of Récluz, Fischer, and Cossmann. It contains a large number of species, especially in the Eocene, when all incongruous elements are eliminated. *Neæromya* Gabb, as sagaciously supposed by Cossmann, is a true *Erycina.* The obsolescence of some of the elements of the hinge among the peripheral species renders some subdivision into sections necessary. The most characteristic feature of the group as a whole is the combination of the minute subumbonal cardinals with the long lateral laminæ, the latter being most prominent distally. The following arrangement is proposed:

Subgenus *Erycina* s. s. Type *E. pellucida* Lam.

Shell small, somewhat compressed or not very convex, exterior concentrically striate, smooth, or rarely with partially radial sculpture, sometimes punctate or sagrinate; hinge with an obsolete external ligament, sometimes hardly traceable, and a well-marked internal resilium which is attached to the shell in an oblique fossette behind the beaks and close to the cardinal border; teeth, normally, one or two minute cardinals and two lateral laminæ in each valve, the latter near and sometimes confounded with the dorsal margin of the valve, usually long, low proximally, more elevated distally, and often recurved upon themselves, like a segment of a cylinder; in the right valve sometimes double with the socket for the laminæ of the opposite valve between them. Pallial line with a slight insinuation.

* Froriep in his Neues Syst. Conch., p. 38, 1807, gave an outline of the Lamarckian system in which he named as type of *Erycina* Lamarck's first species; but, since this does not agree with Lamarck's diagnosis, while *E. pellucida* does, Froriep's selection cannot be accepted. This is lucky, as otherwise we should have to use the name *Erycina* for the genus *Cyrena.*

Lepton, which is closely related to *Erycina*, is distinguished from it by the greater concentration of the dentition, which is usually lower down in the valve from the dorsal margin, by the much shorter and straighter lateral laminæ, the valves flattened by compression and more equilateral and quadrate in outline, and by the greater extension of the mantle-edge over the outside of the shell.

Subgenus *Scacchia* Philippi. Type *Tellina elliptica* Scacchi.

One right and two left cardinals; laminæ obsolete; external ligament small but distinct; pallial line simple; foot compressed.

The left anterior tooth may be a concentrated lamina and not a cardinal. In the right valve the dorsal margins are extended, as if to take the place of laminæ, functioning, in connection with the dorsal margins of the opposite valve, like the grooves in *Erycina*. *S. tenera* Jeffreys has only one cardinal in each valve. This group appears to be represented by a fragment of a hinge from the Chipola beds.

Subgenus *Anomalokellia* Cossmann. Type *Erycina catalaunensis* Cossm., Cat. Illus., ii., pp. 75-76, pl. iii., figs. 29-31, 1887.

Hinge with two left and one right cardinal, the posterior laminæ developed, the anterior wanting, the resilium small, leaving a feeble pit behind the cardinals. Otherwise as in *Erycina*.

Only one species is known, a fossil of the Parisian Eocene.

Subgenus *Pseudopythina* Fischer, 1884. Type *Kellia MacAndrewi* Fischer, J. de Conch., xv., p. 194, pl. 9, fig. 1, 1867.

Shell rather large for the family, reniform, with a coarse rugose periostracum; hinge with two projections of the right dorsal margin fitting into sulci of the opposite valve, one right and one left cardinal, a strong internal resilium, sometimes with a lithodesma, and an evident but small external ligament; laminæ absent or not distinct.

The nude name without means of identification appeared in a list published by Fischer in 1878. I have not found it characterized earlier than 1887, but it was identified with its type by Monterosato (Nom. Conch. Medit., p. 17) in 1884. It is probably commensal with crustacea.

?Subgenus *Turquetia* Vélain, Comptes Rendus, July 24, 1876; Faun. St. Paul et Amst., p. 134, 1878. Type *T. fragilis* Vélain, *op. cit.*, p. 135, pl. 5, figs. 15-17, 1878.

Hinge like *Pseudopythina*, one cardinal in each valve; resilium long, narrow; valves truncate behind. This is regarded by Bernard as probably the fry of a Lucinoid shell.

Lutetina Vélain, of the same publication, is from Bernard's recent figures * referable to the vicinity of *Neolepton*, where it may perhaps form a separate section. Without his figures it could not be identified.

For the proper determination of these minute exotic forms it is generally unsafe to depend upon anything but the actual specimens, as experience has repeatedly shown the incapacity of many draughtsmen to clearly delineate objects whose characters are so minute and unfamiliar as the hinges of these little shells. I am therefore obliged to omit any characterization of several such forms.

A few American Eocene species of *Erycina* have been described. From the Claibornian are *Erycina Whitfield*i Meyer (Ala. Bull., p. 82, pl. 1, fig. 20, 1886) and a form which Cossmann (Notes Compl., p. 12, 1894) has indicated as (a flatter, more equilateral, and more oblong) variety *Meyeri*. From the Jacksonian Meyer has described *E. Zitteli* (Ber. Senckenb. Nat. Ges., 1887, p. 11, pl. 2, fig. 8) and a form which he refers to *E. Whitfieldi*, but which if his figure is reliable is more likely to be a variety of *E. Zitteli* or even a distinct species. *Neæromya quadrata* Gabb (Geol. St. Dom., p. 247, 1873, and Proc. Acad. Nat. Sci. Phila. for 1872, p. 274, pl. 10, figs. 4 *a-b*, 1873) is a typical *Erycina*, as I have determined from an examination of the types. It is found in the Oligocene of St. Domingo and Bowden, Jamaica. To these we are now enabled to add the following species: †

Erycina plicatula n. sp.

Plate 44, Figures 7, 12.

Eocene of the Claiborne sands at Claiborne, Alabama.

Shell compressed, ovate, inequilateral, the anterior side longer; beaks low, pointed, somewhat prosocœlous; surface near the beaks faintly concentrically striate or smooth; about half-way to the margin from the umbo the sculpture grows stronger, consisting of fine, low, rather sharp plications, not always continuous nor in exact harmony with the incremental lines; anterior dorsal

* Bull. Mus. d'Hist. Nat., 1898, No. 2, p. 79.

† Several undescribed species are in the collections of the Maryland Geological Survey from the Miocene.

margin depressed in front of the beaks, nearly straight for a short distance, then rounding evenly to the anterior end; base arcuate, posterior end more bluntly rounded, with the posterior dorsal margin arcuate and high; hinge-plate narrow, channelled, with a short obscure anterior lamella, whose "hook" is represented by a small pustular elevation; posterior lamella long, arcuate, almost fused with the margin but rising distally to a small elevation; interior of the valve smooth or with faint radial lines; adductor scars narrow, long, extending well down towards the base. Lon. 9.5, alt. 7, diam. 2.2 mm.

Two left valves of this well-marked species were found in the marl. The other species described from this horizon are much smaller and more inflated, and the young of *E. plicatula,* judging by the incremental lines, had a different outline from either of the others.

Erycina undosa n. sp.

PLATE 45, FIGURE 3.

Oligocene of the Chipola beds at Alum Bluff and on the Chipola River, Calhoun County, Florida; Burns and Dall.

Shell small, compressed, polished, *Semele*-form, anterior end rounded, longer; posterior end shorter and more bluntly rounded; beaks low but rather pointed; surface with equidistant concentric impressed lines separating wider, flattish interspaces; hinge strong, teeth normal; adductor scars large, the pallial impression wide and slightly irregular. Lon. 3.5, alt. 2.8, diam. 1.5 mm.

The shell varies somewhat in proportional length and some specimens may reach 4.5 mm.

Erycina chipolana n. sp.

PLATE 44, FIGURE 15; PLATE 45, FIGURE 17.

Oligocene of the Chipola marls of Alum Bluff and the Chipola River, Calhoun County, Florida; Burns and Dall.

Shell small, compressed, smooth, polished, donaciform; posterior end shorter and with more abrupt descent of the dorsal margin; beaks rather low, hinge strong, the distal portions of the laminæ prominent with a marked groove above them; posterior adductor scar larger and lower down than the anterior; basal margin arcuate. Lon. 4.1, alt. 3.0, diam. 2 mm.

The principal characteristic of this small species is its trigonal shape; the laminæ are also more prominent than usual.

Erycina fabulina n. sp.

Plate 45, Figure 1.

Upper Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, ovate, subequilateral, moderately convex, with low umbones; surface polished, with numerous faint incremental striæ; dorsal margin and base nearly equally arcuate, ends rounded, the anterior slightly longer and higher; hinge normal, the laminæ rather long and somewhat recurved; adductor scars small, subequal. Lon. 5, alt. 3.6, diam. 2 mm.

Erycina curtidens n. sp.

Plate 45, Figures 14, 15.

Upper Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns and E. A. Smith.

Shell small, thin, smooth, polished, moderately convex, with low beaks, rounded ovate varying to suborbicular, slightly inequilateral; hinge in the right valve with notably short and strong laminæ, the dorsal margin above them thickened so as almost to form a second pair in some cases; laminæ of the left valve longer and narrower; adductor scars small, subequal, and pretty high up. Lon. 3.66, alt. 3, diam. 1.2 mm.

This little species is brilliantly polished and the different valves vary considerably in rotundity, some being almost orbicular.

Erycina carolinensis n. sp.

Plate 44, Figures 3, 22.

Miocene of Duplin County, North Carolina, at the Natural Well (fig. 3) and Magnolia, at Wilmington, and on the Cape Fear River, North Carolina; Pliocene of the Waccamaw River, South Carolina (fig. 22); and the Caloosahatchie marls of Florida; Burns, Stanton, Johnson, and Dall.

Shell large for the genus, inequilateral, somewhat compressed, elongated, the anterior end produced, rounded, the posterior end shorter, downwardly arcuated; base nearly straight, slightly insinuated near the middle, corresponding to a slight mesial constriction of the shell; anterior dorsal margin nearly parallel with the base, posterior declining to a rounded point at its junction with the base; beaks small, low, pointed; surface with rather strong, irregular, concentric incremental lines but very little radial striation; hinge normal, the lamellæ rather long, and the hook (or cardinal) small; resiliary groove deep and strong, elongated; interior of the valves smooth or faintly radially striated towards the margins; adductor scars high up, the anterior larger, the pallial line rather wide, somewhat irregular. Lon. 13.25, alt. 7, diam. 4 mm.

This is the largest and apparently the most common species of *Erycina* in the later Tertiary of the Carolinas. On occasional specimens a little faint radial striation may be observed under the shelter of the concentric sculpture, but many specimens do not show it, and on none does it appear to cover the surface. From the next species, which has a somewhat similar form, this is distinguished by the well-developed lateral lamellæ.

Erycina (Pseudopythina?) americana n. sp.

PLATE 44, FIGURES 21, 25.

Miocene of the Calvert Cliffs, Maryland; Harris.

Shell large, moderately convex, inequilateral, rounded at both ends, the posterior side shorter; beaks low, surface sculptured only with rather conspicuous incremental lines; anterior dorsal margin nearly parallel with the base, posterior dorsal margin arcuate; hinge-margin narrow, feebly channelled, edentulous, adductor scars small, narrow, high up; pallial line wide and radially striated. Lon. 16, alt. 10.5, diam. 7 mm.

A single right valve was collected by Harris. The umbonal angle of the anterior dorsal margin is slightly defective, and it is uncertain whether the species had a subumbonal tooth or not. The shell might perhaps be referred to the subgenus *Pseudopythina,* but if the lateral laminæ are present it would be merely an *Erycina* with a rather obsolete hinge armature.

Erycina marylandica Glenn.

PLATE 45, FIGURE 19.

Miocene of Plum Point and three miles south of Fishing Creek; Maryland Geological Survey.

This is a small, short species, with a strongly developed hinge.

Erycina (Pseudopythina) protracta n. sp.

PLATE 45, FIGURE 22.

Pliocene of the Waccamaw River, South Carolina, Johnson; and of the Caloosahatchie marls of Florida, Dall.

Shell small, thin, almost soleniform, inequilateral; surface polished with sculpture only of incremental lines; beaks inconspicuous; anterior end longer, the anterior dorsal margin parallel with the base, the anterior end evenly rounded; posterior dorsal margin arcuate, declining, basal angle rounded; hinge feeble, the distal lamellæ weak and low, the "hook" or subumbonal lamella obscure, low, nearly parallel with the margin; anterior adductor scar high, narrow; posterior larger, lower, both with a few radial lines. Lon. 8.35, alt. 4, diam. 2.2 mm.

This is the most elongated species among those of our Tertiary and appears to be rare.

Erycina Kurtzii Dall.

PLATE 25, FIGURE 12.

Scintilla Kurtzii Dall, Trans. Wagner Inst., iii., part iv., p. 920, pl. 25, fig. 12, 1898.

Pliocene marls of the Caloosahatchie River, Florida; Dall.

Shell small, thin, subquadrate, rather compressed, polished, nearly equilateral; beak very low, inconspicuous; surface sculptured with incremental lines and fine, sharp radial striæ visible only with magnification; hinge nearly obsolete, the lamellæ nearly merged with the dorsal margin and the "hook" reduced to a minute angular projection; ends almost equal in length and rotundity; adductor scars rather large, interior smooth. Lon. 8.5, alt. 5.2, diam. 2.2 mm.

This species resembles *E. americana,* and like it might perhaps be referred to *Pseudopythina.* It retains some faint traces of the lateral teeth, which the typical *Pseudopythina* does not. Than *E. americana* it is more equilateral and differs from it and the other elongate-quadrate species in its fine radial sculpture, which led to its reference in 1898, after a hasty examination, to *Scintilla* instead of its proper genus *Erycina,* which became evident after more careful study. Only one right valve was obtained. It is named in honor of Lieutenant J. D. Kurtz, the associate of Stimpson in the investigation of the shells of the Carolina coast. The *Lepton Kurtzii* of the list of Waccamaw shells on page 210 (part ii.) is the shell above described under the name of *Erycina carolinensis,* and not the present species.

Genus **BORNIA** Philippi.

< *Bornia* Philippi, Moll. Sicil., i., p. 13, 1836. First species *B. corbuloides* Phil. (Bivona as *Erycina*), *op. cit.,* p. 14, pl. 1, fig. 15, 1836.

< *Kellia* Philippi, Moll. Sicil., ii., p. 10, 1844.

Erycina (sp.) Récluz, Revue Zool., vii., pp. 327, 333, 1844.

Bornia Stoliczka, Cret. Pel. India, p. 266, 1871. Type *B. corbuloides* Phil., Fischer, Man. de Conchyl., p. 1026, fig. 772 (wrongly named *B. complanata,* and copied from Moll. Alg. of Deshayes, who called it *Erycina Geoffroyi*), 1887.

> *Pythina* Hinds, Zool. Voy. Sulphur, ii., p. 70, 1844. Type *P. Deshayesiana* Hinds, *op. cit.,* pl. xix., figs. 8, 9; Smith, Ann. Mag. N. Hist. for Sept., 1891, p. 227.

Pythinia Deshayes, An. s. Vert. bassin de Paris, i., p. 694, 1858.

Philippi's genus was heterogeneous, including species of *Kellia* and *Lasæa,* and was afterwards regarded by him as synonymous with *Kellia,* but when the incongruous elements are eliminated there still remain several species which are shown by their anatomical characters to be distinct from *Kellia* and for which Stoliczka and Fischer have revived Philippi's name.

Shell ovate or subtrigonal, subequilateral, with a more or less flattened disk, the periostracum usually brilliant, the surface smooth or divaricately more or less plicate; an obsolete amphidetic external ligament present, a short, slightly posterior, subumbonal internal resilium without a lithodesma, the pallial line not sinuated, and the pallial area frequently punctate or radially striate; hinge with one moderately long posterior and two shorter anterior laminæ in the left valve, and in the right one anterior and one longer, sometimes remote, posterior lamina; one or both the anterior laminæ in either valve may have the aspect of cardinals; hinge-plate usually excavated.

Owing to the gradations which appear in the shells there are hardly sufficient conchological reasons for separating the group into sections, but if this be done *Bornia* must be retained for the smooth and *Pythina* for the divaricate species.

After long search, I finally obtained a specimen of *Pythina Deshayesiana* from the Bishop Museum of Honolulu. It differs from the typical *Bornia* by having the first anterior denticle in each valve strong, conical, and projecting; there are two right and one left posterior laminæ and a small, short, elevated lamina in front of the conical tooth in the left valve only.

It is of course possible that anatomical differences may eventually be found which may definitely separate *Pythina* and *Bornia,* but this remains to be determined. One of the posterior laminæ sometimes becomes duplex in well-developed individuals of *Bornia;* conchologically the flattened disk and shorter, more central resilium enable one to separate the species from the nearly related but more globose Kellias. The reniform outline of many of the species may be due to commensalism. *Ceratobornia* (see p. 1152) has anatomical peculiarities.

Bornia is represented in the Chickasawan or Lignitic Eocene of the United

States by *B. prima* Aldrich (Bull. Pal., ii., p. 181, pl. 5, figs. 3, 3*a*, 1897) of Wood's Bluff and in the Claibornian by *B. Dalli* Cossmann (as *Montacuta,* Notes Compl., p. 12, pl. 1, figs. 13-14, 1894). No species have so far been collected from the Lower Oligocene, though they will doubtless be found on further exploration of the Chipola beds.

Bornia scintillata n. sp.

Plate 49, Figure 10.

Eocene of the Claibornian sands, Claiborne, Alabama; Burns.

Shell small, subtrigonal, subequilateral, polished, finely, sharply radially grooved, the grooving of the middle of the disk finer and closer than that towards the ends; the beaks moderately elevated, nearly smooth, the larval shell small, distinct; hinge armature feeble; the left posterior lamina small, feeble, short; anteriorly the "hooks" of the two anterior laminæ distinct, simulating cardinals, the lateral portions nearly obsolete; the grooving of the exterior faintly visible interiorly towards the anterior end but not crenulating the basal margin; muscular impressions narrow, feeble; basal margin entire. Lon. 3.75, alt. 3.0, diam. 1.5 mm.

A single left valve of this very distinct species was obtained. From *B. prima* Aldrich, it differs by being grooved, not plicated, in the absence of the punctuation which covers the surface in *B. prima,* and in the much more profuse and finer sculpture.

Bornia plectopygia n. sp.

Plate 49, Figure 9.

Eocene of the Claiborne sands, Claiborne, Alabama; Burns.

Shell small, short, rounded ovate, polished, smooth to the eye, except for incremental lines and about three faint radial plications on the posterior basal half; beak low, distinct; hinge armature feeble, the distal laminæ obsolete, the hooks of the left anterior laminæ perceptible but not prominent; anterior side short, rounded, posterior side produced downward and backward, the margin indented by the radial furrows, elsewhere entire; scars obscure. Lon. 4.5, alt. 4.0, diam. 2.0 mm.

A single left valve of this species was collected which though somewhat imperfect cannot be confounded with either of the other species from this horizon. There is a faint microscopic radial striation on the surface, a sulcus for the ligament, and a faint excavation for the resilium.

Bornia dodona n. sp.

PLATE 45, FIGURE 16.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, thin, compressed, subtrigonal, smooth, brilliantly polished; anterior end slightly shorter, wider, and more rounded, posterior end longer and more pointed; beaks low, the prodissoconch distinguishable, dorsal margins sloping, basal nearly straight; right valve with two lamellæ bearing knob-like teeth on the umbonal end in front of the beak, a subumbonal obliquely directed resiliary scar, and a posterior lamella, separated by a groove from the dorsal margin; left valve with two short divaricating lamellæ under the beak and a feeble rather distant posterior lamella; adductor scars small, rather high up, interior of the valves faintly, radially striated. Lon. 5.25, alt. 3.7, diam. 1.75 mm.

Resembles *B. mactroides* Conrad, but appears to be uniformly of a very much smaller size.

Bornia floridana n. sp.

PLATE 45, FIGURE 2.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell thin, compressed, smooth, or with faint incremental lines, brilliantly polished, the prodissoconch obvious; teeth short, the anterior left lamella most prominent, the posterior lamella feeble; hinge normal, form as figured. Alt. 5, lon. 6.6, diam. 1.75 mm.

This species is more compressed, less trigonal, and more elevated in proportion than *B. dodona*, as the figure shows. The proportional elevation seems to increase with age. All the valves obtained were more or less imperfect.

Bornia mactroides Conrad.

Lepton mactroides Conrad, Journ. Acad. Nat. Sci. Phila., vii., p. 151, 1834; Fos. Medial Tert., p. 19, pl. 10, fig. 5, 1838.

Erycina mactroides Orbigny, Prodr. Pal., iii., p. 115, No. 2153.

Kellia mactroides Conrad, Proc. Acad. Nat. Sci. Phila., vol. i., p. 310, 1843.

Miocene of Maryland, near Easton, at Barker's landing, Choptank River, Dover Bridge, Governor's Run, and Peachblossom Creek; Burns, Harris, and Maryland Geological Survey.

This species differs from the next in its more triangular form, pointed ends, mesially compressed disk, and more cuneate vertical section, the shell being quite inflated dorsally and compressed towards the base.

Bornia triangula n. sp.?

Kellia triangula H. C. Lea, MSS., in Coll. Acad. Nat. Sci. Phila. (Petersburg, Va.).

Miocene of the coastal plain; three miles west of Centreville, Maryland; York River and Petersburg, Virginia; Duplin County, North Carolina; at the Natural Well and Magnolia; and at Darlington, South Carolina; Pliocene of the Caloosahatchie and Shell Creek, Florida.

This is the most common fossil species of our Tertiary. It occurs quite plentifully sometimes, and is readily distinguished from *B. mactroides,* as a rule, by its shorter, more triangular, and less flexuous shell and the other features mentioned under *B. mactroides.* The outline is quite uniform as a whole, and the shell almost always easily separated from *B. mactroides,* for which reason I have retained Lea's unpublished name, though I do not feel wholly confident that both these forms may not eventually prove to be extremes of a single species.

Bornia rota n. sp.

Plate 45, Figure 11.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, subrotund, compressed, brilliantly polished; beaks small and low but conspicuous, valves nearly equilateral, the posterior side rounded, the anterior slightly more pointed and produced; hinge normal, the teeth very small and the posterior lamella nearly obsolete; scar of the resilium elongate; adductor scars ovate, the pallial line nearly as wide as the scars where it joins them but narrower below; margin simple, entire. Lon. 4.2, alt. 3.9, diam. 1.6 mm.

This species is exceptionally small and rounded in its outline.

Bornia lioica Dall.

Plate 25, Figure 6.

Bornia lioica Dall, Trans. Wagner Inst., iii., part iv., p. 920, pl. 25, fig. 6, 1898.

Pliocene marl of the Caloosahatchie River, Florida; Dall.

Shell thin, smooth, compressed, rounded-quadrate, brilliantly polished; nearly equilateral, the posterior portion higher, more rounded, and longer, the anterior shorter and less broad; beaks low, small, and almost pointed; dorsal margins arcuate, the anterior more rapidly descending, the basal margin nearly straight, but towards its posterior end showing four or five subequal, small radial plications which extend but a little way inward over the disk; hinge narrow, teeth normal, very small; interior feebly radially striate. Lon. 9.5, alt. 6, diam. 2.5 mm.

A single valve of this beautiful species was obtained in the marl.

Bornia Mazyckii Dall.

PLATE 25, FIGURE 8.

Bornia Mazyckii Dall, Trans. Wagner Inst., iii., part iv., p. 920, pl. 25, fig. 8, 1898.

Pliocene marls of the Caloosahatchie River, Florida; Dall.

Shell ovate, compressed, subequilateral, faintly concentrically striated, brilliantly polished; beaks low, small, the prodissoconch obvious; hinge narrow, with, in the left valve, a long, narrow posterior lamella, mostly low and feeble, with a small triangular elevated part distally, below this a short resiliary scar near the umbo, and anteriorly two small, short lamellæ, one directly under the umbo, the other larger, longer, and more oblique and the hinge-plate in front of it flattish; in the right valve the teeth are similar with the hinge-plate grooved above them; posterior part of the shell slightly longer, interior faintly radially striated, margins entire. Lon. 11.5, alt. 8.7, diam. 3.8 mm.; a larger fragment was originally about 13 mm. long.

This species appears to be rare. Its outline is not unlike that of "*Montacuta*" *Bowmani* Holmes (Post-Pl. Fos. S. Car., p. 30), but that shell is described and figured as having the hinge of *Rochefortia*. The horizon to which *M. Bowmani* belongs is not mentioned by Holmes. The present species is named in honor of Mr. W. G. Mazyck, of Charleston, South Carolina.

"*Lepton*" *longipes* Stimpson (Proc. Boston Soc. Nat. Hist., v., p. 111, Feb., 1855), from South Carolina, is a *Bornia* so far as the shell is concerned, but the soft parts exhibit characters intermediate between those of *Bornia* and *Lepton*. The mantle has not the hood-like prolongation anteriorly which is found in *B. corbuloides*, though it extends beyond the borders of the shell. There are two long anterior cirrhi and one posterior, dorsally situated, in Stimpson's shell; the foot is very extensile and the posterior portion has a cylindrical extension, distally pointed, from the apex of which a byssal secretion may be ejected. For these reasons I have proposed the sectional name of *Ceratobornia* for this and other species which may eventually prove to have a similar organization.*

* Proc. U. S. Nat. Mus., xxi., No. 1177, p. 889, pl. 88, figs. 10, 11, 13, 1899.

Genus **KELLIA** Turton.

Kellia Turton, Dithyra Brit., p. 56, 1822. Sole ex. *K. suborbicularis* Mtg. (sp.), p. 57, pl. 11, figs. 5-6.

Tellimya, Sect. I., Brown, Ill. Rec. Conch. Gt. Brit., pl. 14, figs. 12-13, 1827; 2d ed., p. 106, pl. 42, figs. 12-13, 1844; sole species (under several names) *T. suborbicularis* Mtg.

Tellimya I., Brown, Zool. Textb., p. 460, 1833; ex. cited *T. suborbicularis* Mtg. (sp.), pl. 90, fig. 14.

Chironia Deshayes, Revue Zool., p. 356, 1839; Mag. de Zool., pl. 11, 1840. Type *C. Laperousii* Desh.

Oronthea Leach, Moll. Gt. Brit., p. 274, 1852.

Goodalliopsis R. and M-C., Journ. de Conchyl., xi., p. 195, 1863. Type *G. Orbignyi* R. and M-C., *loc. cit.*, p. 195, pl. 8, fig. 3; = *Erycina terminalis* Desh., An. s. Vert. bas. Paris, i., p. 713, pl. 50, figs. 38-41, 1860; Cossmann, Cat. Ill., ii., p. 80, pl. 5, figs. 12, 13, 1887.

Zoë Monterosato, Giorn. Sci. Nat. Econ. Palermo, xiii., p. 69, 1878 (not of Philippi, Crust., 1840). Type *Lasæa pumila* S. Wood.

?Divarikellia Cossmann, Cat. Illus., p. 71, 1887. Type *Kellia nitida* Caillat, Desh., An. s. Vert. bas. Paris, p. 705, pl. 50, figs. 5-7, 1868.

Kellya Fischer, Man. Conch., p. 1025, 1887.

There is no question about the type of the genus *Kellia,* which some years later served also as the type of the genus *Tellimya* Brown and *Oronthea* of Leach. *Chironia* Deshayes is based on a large Californian species of *Kellia* in which the hinge is better developed than usual in the genus, having in its best estate two short, so-called cardinals in each valve, one left and two right posterior laminæ. Poorly developed specimens of this species have a hinge exactly like the average *Kellia suborbicularis,* while the latter in exceptionally well-developed specimens shows traces of the extra laminæ referred to. As in so many others, the shells of this genus show a diminished development of the hinge correlated with reduced size and greater depth of habitat. Some of the minute abyssal species retain only one small tooth in each valve. The genus *Goodalliopsis* of de Raincourt and Munier-Chalmas has the same dental formula as *Kellia,* of which it appears to be merely a small compressed species. The gills of *Kellia* are normal; that is, they have both direct and reflected inner and outer laminæ. The viscera are contained within the body mass.

The group may be divided as follows:

Section *Kellia* Turton s. s. Type *K. suborbicularis* Mtg.

Shell rounded and inflated, concentrically striated or smooth; with an obsolete amphidetic external ligament and a large, strong internal resilium without a lithodesma; in its fullest development with two anterior and two posterior teeth in each valve, of which the anterior ones are shorter and usually regarded as "cardinals," which may be concrescent at their umbonal ends, forming a /\-shaped tooth, or may be free and pustular; the interior face of the valves commonly shows radial striation and the valves are frequently distorted through the effect of the nestling habit. The species retain the young between the valves until pretty well grown, and these young are much more compressed than the adult shells. In many species the dental formula is not fully represented by developed teeth.

Section *Mancikellia* Dall, 1899 (*Zoë* Monterosato, non Philippi). Type *K. pumila* S. Wood.

Shell minute, rounded; hinge with a minute right cardinal in line with a more distant anterior lamina, right posterior lamina distant, feeble; a feeble or obsolete anterior and posterior lamina in the left valve. The posterior laminæ are sometimes wholly absent. (See my recent "Synopsis North American Leptonacea.")

Section *Kelliola* Dall, 1899. Type *Kellia symmetros* Jeffreys.

Shell minute, oblong, turgid, posterior end short; with a strong internal resilium behind the beaks and a single relatively stout anterior tooth in each valve, that of the right valve stouter.

Section *Divarikellia* Cossmann. Type *K. nitida* Caillat.

Shell oblique, rounded; hinge-plate excavated, the edge inflected to serve as laminæ; the cardinals obsolete or absent; the interior of the valves with elevated radial liræ which hardly affect the smoothness of the outer surface.

Anomalokellia Cossmann seems to us better placed as a section of *Erycina*, and *Planikellia* is more closely related to *Lepton*. *Kelliopsis* Verrill and Bush is synonymous with *Aligena* Lea.

Kellia sp. indet.

Miocene of Barker's Landing, Choptank River, Maryland; Harris.

Shell oblong, moderately convex, equilateral, externally smooth or with feeble concentric sculpture; beaks low and inconspicuous; dorsal margins sloping, ends rounded, base arcuate. Lon. 9.5, alt. 7.5, diam. 4 mm.

A single left valve of a species singularly resembling *Kellia Laperousii* Desh. of the Pacific fauna was collected as above indicated. Unfortunately, the hinge was incrusted and worn, so that the generic characters cannot be determined in a satisfactory manner. It is noted here in order that the genus may be detected if present in these beds.

All the species of *Kellia* reported in the literature from the Tertiary of the eastern United States belong to other genera, chiefly *Bornia* and *Aligena,* under which they will be found referred to. *Kellia Laperousii* Deshayes is not uncommon in the Pleistocene of the Pacific coast, but does not seem to have been reported from the older formations. It is extremely variable in form. *Bornia luticola* Val. (Voy. Venus, pl. 24, figs. *7a-b,* 1846) is identical with it, but *Ungulina luticola* Val. (*op. cit.,* pl. 24, fig. 5) is a worn specimen of *Petricola carditoides* Conrad.

Kellia suborbicularis Montagu.

Mya suborbicularis Montagu, Test. Brit., pp. 39, 564, pl. 26, fig. 6, 1804.

Kellia suborbicularis Turton, Dithyra Brit., p. 57, pl. 11, figs. 5, 6, 1822.

?*Lepton fabagella* Conrad, Am. Mar. Conch., ii., p. 53, pl. 11, fig. 3, 1831; Tryon, Mar. Conch., p. 173, pl. 33, figs. 442-44, 1873.

?*Kellia fabagella* Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 310, 1843.

?*Montacuta Gouldii* Thomson, Am. Journ. Conch., iii., p. 33, pl. 1, fig. 15, 1867; Tryon, Mar. Conch., p. 172, pl. 33, fig. 441, 1873.

Pleistocene of California, at San Diego and San Pedro Hill; Hemphill. Recent on the European shores south to Madeira, on the coast of southern New England, and in California.

An examination of Thomson's types in the Academy of Natural Sciences shows that they belong to the genus *Kellia* and are identical with the shell identified by Verrill and others with *Kellia suborbicularis* from New England. The *Lepton fabagella* of Conrad, afterwards referred by him to *Kellia,* is probably the same species, having been obtained in Narragansett Bay only a short distance from Thomson's locality, while the figures are very similar. Conrad's type is lost, and absolute certainty about the species is, therefore, unattainable. I have not thought it worth while to give the long list of European synonyms. It is noticeable that the specimens so far obtained on the New England coast, while externally very similar to the European shell, are more delicate and decidedly smaller than the average of the latter. No specimens like the average adult British *suborbicularis* have ever been obtained on the New England coast. The hinge armature is more slender, the resilium weaker but proportionately longer and decidedly more calcareous than in the British shell. It is probably most prudent therefore for the present to treat the New England shell as a variety, for which Thomson's name may be retained in a varietal sense. The Californian specimens are more like those from Britain, though often difficult to discriminate from the young of *K. Laperousii.*

Genus **THECODONTA** A. Adams.

Thecodonta A. Adams, Ann. Mag. Nat. Hist., xiii., p. 308, 1864. Type *T. Sieboldii* A. Adams, *op. cit.*, Japan.

Shell oval, very inequilateral, the beak nearly terminal in front, hinge with an arcuate short left anterior lamella, behind which is a triangular shelf for the resilium, the posterior lamella long, narrow, separated from the dorsal margin by a narrow groove, the distal portion slightly elevated, then depressed, and rising beyond the depression in a second elevation corresponding to a posterior lateral; pallial area faintly radiated, basal margin entire; right valve unknown.

The long side in this group is posterior, while in *Rochefortia* it is anterior, and in this group the posterior and anterior teeth are very unequal in length. I am indebted to Mr. Edgar A. Smith of the British Museum for a careful drawing of the hinge of the type specimen.

?Subgenus *Serridens* Dall. (*Pristiphora* Cpr., 1866; not Blanchard, 1835.)

Shell like *Thecodonta,* but the resilium planted on the inner surface of the valve, not on a shelf, the posterior lamella simple and the teeth proximally finely cross-striated. Type *Pristiphora oblonga* Cpr., Proc. Cal. Acad. Sci., iii., p. 210, 1866. San Pedro, California.

In 1864 (Suppl. Rep. Br. Assoc. for 1863, pp. 611, 643) Carpenter used the name *Pristes* for an undescribed species of shell allied to *Rochefortia,* but when he came to describe it, regarding *Pristes* as preoccupied (Latham, 1794), he proposed the name *Pristiphora* (Proc. Cal. Acad. Sci., iii., p. 210, 1866, sole example *P. oblonga* Cpr., *loc. cit.;* not *Pristiphora* Blanchard, Hymenoptera, 1835), which was also unavailable.

?Subgenus *Dicranodesma* Dall.

Shell rounded-trigonal, in general like *Serridens,* but with the anterior tooth elevated and conical, the hinge-plate excavated, the posterior lamella smooth, stout, and elevated in the left; thin, high, and marginal below a wide groove in the right valve; muscular impressions rounded, small, dorsally situated; pallial area smooth, basal margins entire. Type *D. calvertensis* Glenn. Miocene of Maryland.

I am in some doubt as to whether this form and *Serridens* are to be referred to *Thecodonta* as subgenera, or should form a group apart. The chief difference lies in the spoon-shaped process for the resilium in the latter, while in the former two the resilium is directly applied to the valve.

Thecodonta? (Dicranodesma) calvertensis Glenn.

Plate 45, Figures 23, 24.

Miocene of Maryland at Plum Point; Maryland Geological Survey.

This is a peculiarly solid little shell, convex, polished, and unusually trigonal, with a particularly solid hinge, conical anterior, and stout lamelliform posterior teeth, and small adductor scars. It measures 4.6 mm. in length, 3.5 in height, and about 3 in diameter. It was obtained by Mr. L. C. Glenn of the Survey, who will fully describe it in a forthcoming publication of the Maryland Survey.

Genus **ROCHEFORTIA** Vélain.

Montacuta (sp.) Turton, Dithyra Brit., p. 60, 1822 (*M. bidentata* Mtg.).

Anatina (sp.) Brown, Ill. Conch. Gt. Brit., 1st ed., 1827. *A. bidentata* (Mtg. sp.) Brown, *op. cit.,* pl. 11, figs. 8, 9.

Tellimya, Sect. ii. (sp.), Brown, Ill. Conch. Gt. Brit., 2d ed., p. 107, 1844.

Rochefortia Vélain, Comptes rendus, July 24, 1876; Fauna St. Paul et Amst., p. 133, 1877. Type *R. australis* Vélain, *op. cit.,* p. 133, pl. v., figs. 9-11 (bad); Bernard, Bull. Mus. d'Hist. Nat., 1898, p. 82, fig. 4.

Tellimya H. and A. Adams, Gen. Rec. Moll., ii., p. 478, 1857, type *T. bidentata* Mtg.; not of Brown, 1827.

> *Sphenalia* S. Wood, Suppl. Crag Moll., iii., p. 126, 1874. Type *S. donacina* S. Wood, *loc. cit.,* Jeffreys, P. Z. S., 1881, p. 698; Fischer, Man. Conch., p. 1027, 1887.

Mysella Angas, P. Z. S., 1877, p. 176. Type *M. anomala* Angas, *op. cit.,* pl. xxvi., fig. 22 (very bad); Dall, Proc. U. S. Nat. Mus., xxi., pp. 876, 890, June, 1899.

The name *Tellimya,* as of Brown, has had a considerable currency, owing to Adams's use of it with *T. bidentata* as the type. But *T. bidentata* was not included among the original Tellimyas of 1827. It was referred to *Anatina* by Brown in the publication in which he first proposed the genus *Tellimya,* and consequently cannot be used as a type for that genus.

The original *Tellimya* was divided into two * sections by its author, contain-

* By a very natural mistake Miss Bush (Science, N. S., x., p. 250) has stated that Brown (in 1844) divided his genus *Tellimya* into *three* sections. The supposed third section (Brown, p. 107) is really a section of the family *Mactracea* and not of the genus *Tellimya;* and the confusion arises from the fact that Brown subdivides not only the genus but the family into groups which he calls sections, which are printed in the same type and have their Roman numerals frequently incorrect.

ing respectively short orbicular species and elongate species, and in 1833, and subsequently, Brown cited *Kellia suborbicularis* as an example of the former, making this section an exact synonym of *Kellia,* as all Brown's orbicular Tellimyas were varieties of this species. All the original species of the second section are referable to the prior genus *Montacuta,* the first one of the list being *M. ferruginosa.* *T. bidentata* was not included with them until 1844, so that the name *Tellimya* must be dropped absolutely into synonymy.

The next name which might be applied to this group is *Sphenalia* S. Wood, which was given to a very peculiar little Pliocene and recent shell which may prove to be possessed of generic rank when the soft parts come to be known.

Jeffreys, however, was in error in supposing that there is no internal resilium. It is present as in *Rochefortia,* and I am unable to make out on his unique recent specimens any evidence of an external ligament. In the uncertainty as to anatomical characters and in view of the peculiarity of the shell it seems best not to extend the scope of *Sphenalia* so as to make it cover species like *T. bidentata.*

In 1877 Angas described and figured badly two small Australian shells which he called *Mysella.* The types were presented to the British Museum and reported on by Mr. Edgar A. Smith (Ann. Mag. Nat. Hist. for Sept., 1891, p. 235), who found no characters differentiating them from the group then called *Tellimya* as represented by *T. bidentata.* I owe to the ever-ready courtesy of Mr. Smith a careful drawing of the hinge of Angas's type *Mysella anomala,* and entirely agree with his determination of its generic relations. I have also been able to study specimens of Angas's second species, *M. donaciformis,* which possesses the same type of hinge. As I have already shown, the name *Tellimya* not being available, *Mysella* might be used for the group, and in my synopsis of the recent and Tertiary Leptonacea of North America and the West Indies, above cited, I adopted it. There is, however, a name still prior to *Mysella,* but which from the figures and descriptions given by its author seemed to differ too much to be safely united with it in the absence of specimens. This is *Rochefortia* Vélain (1876). Since the publication of my synopsis I have received a copy of a paper by the late F. Bernard on the lamellibranchs of St. Paul Island, in which he gives excellent figures of *Rochefortia* from the type specimens. He points out that it is identical with the so-called *Tellimya,** a conclusion which I heartily accept.

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* Identified in Bernard's paper as *Montacuta bidentata.*

We therefore arrive at the conclusion that the name *Rochefortia* must be adopted for the genus, which may be characterized as follows:

Shell small, ovate or rounded-quadrate, anterior end longer; hinge with a short internal subumbonal resilium and traces of an amphidetic, obsolete, external ligament; on either side of the resilium the cardinal margin bears a simple oblique lamina, the pair divaricating from the umbo and without any hook at the proximal ends; they are separated usually in one valve from the dorsal margin by a groove parallel to it, and above this groove the margin in some cases is thickened so as to form another lamina; the single laminæ of the opposite valve, sometimes represented only by inflected and bevelled extensions of the valve margin, are received into the grooves above the laminæ of the first-mentioned valve, are often longer than the latter and themselves of unequal length; the double short laminæ, when both are present, are usually in the left valve, and the right anterior lamina is longer than the right posterior one. From Bernard's researches into the development of the hinge it is evident that these laminæ represent the secondary laminæ of such forms as the *Veneridæ* before the latter break up into cardinal and lateral teeth properly so called; but in rare instances the laminæ of the present group begin to show signs of a tendency to separate, so that the distal portions are more elevated than the medial part and the former might be taken for laterals and the proximal ends for obscure cardinals, which in a genetic sense they really are. The ventral portion of the resilium carries a calcareous coating which in well-developed specimens is distinguishable as a lithodesma or "ossicle." Type *R. australis* Vélain.

Subgenus *Rochefortia* s. s.

Shell ovate or rounded-trigonal, periostracum adherent, usually polished; individuals free or domiciliary in the burrows of crustaceans.

?Subgenus *Pythinella* Dall.

Shell transverse, with a basal insinuation; periostracum rude, individuals commensal with and (?) attached by a byssus to the bodies of crustacea; hinge as in *Rochefortia*. Type *Montacuta cuneata* Verrill and Bush; North Carolina.

This subdivision corresponds, in the line of *Rochefortia*, to *Pseudopythina* in the line of *Erycina*, *Pythina* in the line of *Bornia*, and *Hindsiella* in the line of *Sportella*.

?Subgenus *Sphenalia* S. Wood.

Shell minute, subquadrate, with the umbones nearly terminal, hinge disproportionately small, with two very small and short lamellæ in the left valve, a minute resilium between them (probably without a lithodesma), and in the right valve two minute inflected projections of the cardinal margin taking the place of lamellæ. Type *S. donacina* S. Wood. Pliocene and recent.

Rochefortia Stantoni n. sp.

PLATE 43, FIGURE 11.

Miocene of the Natural Well in Duplin County, North Carolina, Burns; Wilmington, North Carolina, T. W. Stanton.

Shell minute, convex, elongate-ovate, quite inequilateral, the anterior end much longer; surface with faint incremental lines, polished; dorsal margin arcuate in front, descending behind the umbo; ends rounded, an oblique nearly straight bit of margin intervenes between the posterior rounded end and the arcuate base, as if a little of the edge had been shaved off; beaks low, hinge with small lamellar teeth the anterior nearly twice as long as the posterior, resiliary notch small; adductor scars high, rather large, and distinct; margin simple, entire. Lon. 3.6, alt. 2.4, diam. 1.5 mm.

This curious little species recalls *R. Verrillii* Dall (*M. tumidula* Verrill and Bush, Proc. U. S. Nat. Mus., xx., p. 781, pl. 94, figs. 1-2, 1898; not of Jeffreys, Brit. Conch., v., p. 177, pl. 100, fig. 5, 1869), but is a much more solid shell, more cylindrical, and less tumid near the beaks.

These small shells are very puzzling, as their range of variation is for the most part unknown, and they require a good light and strong magnification to bring out their characters.

Rochefortia Stimpsoni n. sp.

PLATE 45, FIGURE 5.

Miocene of the Natural Well and Magnolia, Duplin County, North Carolina; Burns.

Shell small, somewhat compressed, thin, frequently somewhat irregular, and variable in outline; surface marked by obvious incremental lines, not polished, nearly equilateral, rounded, anterior part slightly wider, hinge narrow, resiliary pit directly under the low inconspicuous umbo, with a short recurved oblique lamella on each side of it, the lamellæ nearly equal; adductor scars rather large, the anterior smaller; pallial line simple, high up on the disk. Lon. 6, alt. 5, diam. 2 mm.

This species recalls *R. striatula* Verrill and Bush, but is larger, less distinctly truncate, less regular in form, and somewhat smoother and more convex. The specimens of *R. striatula* I have compared with it have, as a rule, smaller and less stout dental lamellæ.

Rochefortia bidentata Montagu.

Mya bidentata Montagu, Test. Brit., p. 44, pl. 26, fig. 5, 1803.

Montacuta bidentata Turton, Dithyra Brit., p. 60, 1822; Forbes and Hanley, Brit. Moll., ii., p. 75, pl. 18, figs. 6, 6*a*, 1853; Jeffreys, Brit. Conch., ii., p. 208, pl. 5, fig. 1, 1863; v., p. 177, pl. 31, fig. 8, 1869; not of Verrill and Bush, Proc. U. S. Nat. Mus., xx., p. 779, pl. 93, figs. 7, 8, pl. 94, fig. 6, 1898; not of Gould, Inv. Mass., p. 59, 1841.

Anatina bidentata Brown, Ill. Conch. Gt. Brit., 1st ed., pl. 11, figs. 8, 9, 1827.

Mesodesma exiguum Lovèn, Ind. Moll. Scand., p. 42, 1846.

Tellimya bidentata Brown, Ill. Conch. Gt. Brit., 2d ed., p. 107, 1844; H. and A. Adams, Gen. Rec. Moll., ii., p. 478, 1857.

Erycina faba Nyst + *E. nucleola* Récluz, *fide* Jeffreys.

Mysella bidentata Dall, Synopsis Lept. N. Am., p. 890, 1899.

Pliocene of Italy, Great Britain, and Ireland; Pleistocene of Norway; recent from Finmark to the Mediterranean and at Madeira.

The *Montacuta bidentata* of Gould, in 1841, is *Aligena elevata* Stimpson (sp.) non Mörch. The true *R. bidentata* is not known from America, the shell known by that name is the following species:

Rochefortia planulata Stimpson.

PLATE 45, FIGURE 7.

Kellia rubra Gould, Inv. Mass., p. 60 (*ex parte*), pl. 2, fig. 33, 1841; not of Turton, Dithyra Brit., p. 58, 1822.

Kellia planulata Stimpson, Shells of New England, p. 17, 1851; Verrill, Inv. An. Vineyard Sound, p. 688, pl. 30, fig. 6, 1873; Dall, Bull. 37, U. S. Nat. Mus., p. 48, 1889.

Lasæa planulata Jeffreys, Ann. Mag. Nat. Hist., Oct., 1872, p. 239.

Montacuta bidentata Verrill and Bush (and vars. *tenuis* and *fragilis* V. and B.), Proc. U. S. Nat. Mus., xx., p. 779, pl. 93, figs. 7, 8, pl. 94, fig. 6, 1898.

Mysella planulata Dall, Synopsis Lept. N. Am., p. 890, 1899.

Pliocene of the Caloosahatchie marls of Florida; Pleistocene of the Gulf of Maine; recent from Massachusetts Bay to Cape Hatteras and on the coast of Texas (var. *fragilis*) and from Wood's Holl, Massachusetts, to Cape Hatteras, North Carolina (var. *tenuis*).

The variety *tenuis* of Verrill and Bush is distinguished from the typical *planulata* (which is the same as their *M. bidentata* var. *fragilis*) by its larger and thicker hinge laminæ and usually more solid shell. These teeth vary, however, in different individuals so much that it is almost impossible to separate a large series without finding a fair proportion of strictly intermediate specimens, and I find the same true of the original *R. bidentata,* of which I have examined a very large series covering all parts of its geographical range.

These small shells are very puzzling and require close study to discriminate, but I think no one who had gone carefully over the series in the Jeffreys collection would hesitate to pronounce the European and American shells distinct. The former are smaller, more convex, more inequilateral, more quadrate, more elongate, and have smaller dental lamellæ than the average American specimens, and I have not found any adult specimens which could be called intermediate.

The *Kellia rubra* of Dr. Gould in 1841 was a mixture of two species, one of which was *Turtonia minuta,* and the other, which he figured, the present shell, to which Stimpson in 1851 gave the name here adopted. What Dr. Gould thought were the young and found among the roots of seaweed, as he himself informed me, were the *Turtonia.* The *Rochefortia,* when containing the dried remains of the animal, has a ruddy tinge and a pale-brown epidermis, which are lost in the washed valves found on the beach. In Binney's edition of Gould *K. planulata* is rather badly figured and no scale is given for the magnified illustration. Both the typical form and the variety *tenuis* occur in the Caloosahatchie marls. The *R. striatula* V. and B. and the *R. Molleri* Mörch (*Montacuta elevata* Mörch, 1875, not Stimpson, 1851) have also been confused by authors with *R. planulata,* from which both are easily discriminated when the characters are pointed out and carefully studied. Miss Bush states (Science, N. S., x., p. 250, Aug. 25, 1899) that the *Lasæa planulata* of Verrill's Checklist of 1870, dredged at Halifax, Nova Scotia, by the United States Fish Commission, is not Stimpson's species but *R. Molleri.*

Genus **LASÆA** Leach.

Lasæa (Leach) Brown, Ill. Con. Gt. Brit., 1st ed., pl. 20, figs. 17-18, 1827; 2d ed., p. 93. pl. 36, figs. 17-18, 1844; Zool. Textb., p. 451, 1833; Conch. Textb., p. 128, 1833. Type *Cardium rubrum* Montagu; Gray, Ann. Mag. N. Hist., xx., p. 272, 1847.

Lasea Gray, P. Z. S., 1847, p. 192; Moll. Gt. Brit., p. 289, 1852.

Autonoë Leach, Moll. Gt. Brit., p. 288, 1852; *C. rubrum* Mtg.

Cycladina Cantraine, Bull. Acad. Brux., ii., p. 399, 1846. Type *Chama poron* Adanson = *C. Adansonii* Cantr.

Poronia Récluz, Rev. Zool., p. 166, 1843 (*Chama poron* Adans.); Philippi, Zeitschr. Mal. f. 1847, p. 72.

Anapa Gray, P. Z. S., 1847, p. 186. Type *Erycina petitiana* Récluz (= *Lasæa rubra* Mtg.).

Kellia (sp.) Turton, Dithyra Brit., p. 57, 1822; Forbes and Hanley, Brit. Moll., ii., p. 94.
Bornia (sp.) Philippi, Moll. Sicil., p. 14, 1836; Deshayes, Moll. Algerie, 1, Atlas, p. 103, pl. 43, figs. 8-11 (*B. seminulum* Phil.).

The diphthong in the second syllable was used by Brown, a particular follower and friend of Leach, in the original publication, so there seems no reason to doubt that it should be retained.

Lasæa is remarkable for having gills in which the inner lamina is both direct and reflected, while the outer one is represented by the direct portion only. The hepatic and generative glands are included within the general mass of the body.

The known species are nestlers, adhering by a byssus to the rugosities of calcareous algæ, barnacles, etc., and the young are long retained within the parent shell. All the species vary from a purplish red to a pale-greenish yellow and show a coarse epidermis under the microscope. The hinge shows a great crudeness and, as it were, an amorphous constitution. Hardly any two individuals will show exactly the same development and form of the teeth. Normally there are in the left valve two laminæ diverging from the subumbonal region, where there is a minute pustular "cardinal." In the right valve a similar "cardinal" and on each side of it a pair of laminæ between which the single lamina of the opposite valve is received. The so-called cardinal exists in less than half the specimens examined, sometimes in one valve of a pair and not in the other. The laminæ are irregular, and part of them often missing. The resilium is enormous in proportion to the size of the shell, its ventral surface with, in fully developed specimens, a thick, chalky layer which might perhaps be regarded as a lithodesma. The resilium is inserted along the ventral margin of the hinge-plate or laminary platform.

The individual variation of these little shells is so great as to lend some countenance to the old supposition that there is but one widely distributed species in the genus. On the "new school" basis twenty-five or thirty species must exist in British waters alone. I am inclined to believe that there are two species, one Indo-pacific and Antarctic, the other common to the eastern North Pacific, Florida, Bermuda, and European waters. There is great difficulty in finding any constant differential characters, if they exist. *Lasæa rubra* (Mtg.) Brown is found in Southern California and Mexico, has very recently been discovered in south Florida at Fort Worth by Dr. Pilsbry, has long been known from Bermuda, and is a common European shell. The course indicated by these localities is one which might coincide with the ocean currents were the former passages across the American isthmus still open.

The Bermudian form has recently received a specific name from Miss Bush (*L. bermudensis* Bush, *Science,* Aug. 25, 1899, p. 251). After examination of some hundreds of specimens from some forty localities, and careful study of quite a number under a compound microscope, I have so far failed to find any constant differences between the Bermuda shell and the ordinary *L. rubra.* In a general way the former is a little rounder in form on the average than the average *rubra,* but no more so than many British specimens. The largest specimen I have seen, from the Channel Islands, is considerably larger than the largest *L. bermudensis* I have found. As in nearly all cases, however, the average specimens from southern waters will exceed in size specimens of the same species from the north unless the species is boreal. When we remember that southern Florida, as late as Miocene times, was an island, and that *Lasæa* is a species which does not appear to live on purely sandy shores like those of the Carolinas, we can understand why the species may have reached and flourished on the coral rocks of Bermuda while it failed to progress northward on the mainland.

In the separation of "species" much must be allowed for personal equation. Yet I cannot refrain from expressing the opinion that many of the more interesting and important interrelations of animals must be lost sight of if we subdivide beyond a certain limit. Some allowance must be made in any rational system for individual variation in any given habitat, and for the other set of variations which seem to depend upon geographical distribution.

Small shells like *Lasæa,* which attach themselves by a byssus to algæ, may be widely distributed by ocean currents. Differences of temperature and food cannot fail to make their mark upon the different colonies. When, in addition, we have a normal crudity and want of definition in the hinge characters throughout the genus, it would seem inadvisable to subdivide the type too minutely.

The species has not yet been recorded as fossil in America, though very probably it may be found hereafter in the Florida Pleistocene, as it has been already in that of Europe. The group has been included here in order that the treatment of the family may be as complete as practicable.

Lasæa rubra (Montagu) Brown.

The following measurements show the proportions of specimens from various localities; in each case the largest available specimen was measured, not an average one:

Channel Islands (Guernsey)	lon. 3.25,	alt.	2.75,	diam.	2.0	mm.
Wales (Lantivet)	" 4.00,	"	3.5,	"	2.5	mm.
Bermuda	" 3.33,	"	2.8,	"	1.5	mm.
Florida (Fort Worth inlet)	" 3.25,	"	3.0,	"	2.0	mm.
California (San Diego)	" 4.60,	"	4.0,	"	3.0	mm.
" (Monterey)	" 3.50,	"	3.5,	"	2.25	mm.

Genus **MYLLITA** d'Orbigny and Récluz.

Myllita d'Orb. and Récluz, Journ. de Conchyl., i., p. 292, 1850.

Mylitta Kobelt, Ill. Conchylienbuch, pl. 103, fig. 11, 1878.

Pythina sp. Tenison Wood, Hutton.

Type *M. Deshayesii* Récluz (as *Erycina,* 1844); D'Orb. and Récluz, *op. cit.,* pl. 11, figs. 12-14.

Shell equivalve, solid, surface punctate or sagrinate with concentric, radial, or divaricate sculpture; ligament external, obsolete, amphidetic; resilium strong, internal, seated in a conspicuous sulcus below the lower posterior lamina, the mesial portion with a calcareous coating; valves with a small anterior and posterior dorsal gape, but closed ventrally; hinge with a single left anterior and posterior lamina and a single left cardinal, right valve with a cardinal and double anterior and posterior laminæ, the cardinals often bifurcate; mantle completely open below between the adductors and probably covering more or less of the exterior of the valves; pallial line simple, with large adductor scars; foot strong with a conspicuous (byssal?) sulcus, the young incubated in the generative or peripheral atrium, small, vitreous, and numerous.

Five species from New Zealand, Australia, and Tasmania. The triangular pallial sinus of the original description is non-existent.

To make the description of the family more complete, the synonymy and characters of this genus are included as in some other cases.

Perrierina Bernard (Bull. du Mus. d'hist. Nat., 1897, p. 312) appears to belong in this vicinity, though in addition to the normal hinge characters it has, like *Woodia* and *Transennella,* supplementary lamellations on the hinge-line.

Family KELLIELLIDÆ.

Genus **ALVEINUS** Conrad.

Alveinus Conrad, Am. Journ. Conch., i., pp. 10, 138, 1865; Proc. Acad. Nat. Sci. Phila. for 1872, p. 53, pl. 1, fig. 6, 1872; Am. Journ. Sci., xxix., p. 467, 1885.

Lutetia Cossmann, Notes Compl., p. 13, 1894.

The type of this genus well illustrates the slipshod methods, or want of method, of Conrad. His first nude mention of the genus and species occurs in his list on page 10, where the species is called *parva,* though the generic name is masculine, but neither genus nor species is defined or figured. Subsequently, at the place where the genus and species are described (p. 138), the latter is called *minuta* instead of *parva* and, with all the other species described in the article, is said to come from Enterprise, Mississippi, though Dr. Spillman informed the Hon. T. H. Aldrich that he had not sent Conrad any fossils from Enterprise, but did send him some from the Jacksonian beds of Garland's Creek in Clarke County, whence these fossils are doubtless derived. As the name *parva* was never defined, it appears that *minutus* will be the first valid name applied to the type of this genus. This is misspelled *mimatur* in the synonymy of the species given by De Gregorio (Mon. Claib., p. 210).

This genus is closely related to *Lutetia* Deshayes, and they have been united by Cossmann, but a prolonged study leads me to a different conclusion. The differential characters are as follows:

Lutetia Deshayes: Hinge with a well-marked nymph for an external ligament; right valve with three laminæ, a posterior straight one nearly parallel with the hinge-margin, in front of which is a larger one bent at an obtuse angle just below the beak; and, lastly, a small tubercle immediately under the angle of the last. Between the posterior tooth and the nymph the hinge-plate is flat with no indication of an internal resilium in either valve. The left valve also has three teeth, a straight anterior and posterior lamina radiating from the beak, and between and below them a short lamina obtusely angular in the middle.

Alveinus Conrad: Hinge with a very feeble nymph only noticeable on the largest and most fully developed specimens, and under the beaks a deep, well-marked pit for an internal resilium. Right valve with two teeth, parallel with each other and with the hinge-line, proximally elevated and with the upper edges bent over and towards each other. Left valve with a single tooth bent like a figure seven, the proximal arm shorter and with a small projection or angular thickening on the ventral side at about the middle; above this tooth the subumbonal margin is sometimes thickened, with a groove between it and the lamina. The posterior shell margin for about a third of the circumference is prominent and is received in a groove in the corresponding margin of the right valve. This grooving is occasionally continued nearly round the shell both in *Lutetia* and *Alveinus,* at other times the margin is flattened or simple.

These differences seem to me sufficient to separate the groups, though perhaps of less than generic value.

A minutus ranges from the Claibornian (Alabama, Louisiana, Arkansas) into the Jacksonian, and, after an examination of a great many, only one valve, about twice the usual size, showed the groove for an external ligament.

Alveinus rotundus n. sp.

PLATE 45, FIGURES 25, 28.

Oligocene marl of the Chipola River, Calhoun County, Florida; Burns.

Shell resembling *A. minutus* Conrad, but smaller, more inflated, more elevated, more nearly equilateral, and with a proportionately heavier and more solid shell. No trace of attachment for an external ligament could be found on any of the specimens. Alt. 1.9, lon. 2, diam. 1.2 mm.

At first this species was regarded as merely a local race of *A. minutus,* but the comparison of many specimens showed the characters to be constant, and the difference of horizon in the geologic column is quite marked, so I have thought it best to treat it as a species.

The study of these minute forms is very difficult; even with a compound microscope various lights and a good series are needed to bring out the characters. A very slight amount of wear or solution suffices to materially alter the minute teeth, and the observer has to be constantly on his guard against being misled.

Genus **KELLIELLA** Sars.

This little genus is represented in the Jacksonian by *K. Boettgeri* O. Meyer, described in the Bulletin of the Alabama State Geological Survey, No. 1, p. 83, pl. 3, figs. 15, 15*a,* 1886. A recent species, *R. nitida* Verrill, is known from the Atlantic coast in deep water, and we may expect that other Tertiary horizons when thoroughly searched will prove to include this genus.

Genus **PAULIELLA** Munier Chalmas.

Pauliella (*Bernardi*) Mun. Chalm., Comptes Rendus, som., 1895, pp. liv.-lv.; Bernard, Bull. Mus. d'hist. Not., 1898, p. 84, figs. 6-7.

This remarkable little genus resembles *Lutetia* in a general way, but is characterized by having three anterior laminæ in each valve.

It was among the minute species collected by Vélain in the islands of St. Paul and Amsterdam in the Indian Ocean, but was not detected until lately, and is described as above.

Genus TURTONIA Alder.

Turtonia Alder, Cat. Moll. North. and Durham, p. 95, 1848; Forbes and Hanley, Brit. Moll., ii., p. 80, 1853; Verrill, Am. Journ. Sci., 3d Ser., iii., p. 286, pl. 7, fig. 4, 1872; Rep. U. S. Fish Com. for 1871-72, p. 687, 1873. Type *Venus minuta* Fabr., Fauna Grönl., p. 412, 1780.

Cyamium Jeffreys, Adams, and others; not of Philippi, 1845.

Shell ovate, smooth, closed, with an elongated external combined resilium and ligament; margins entire; hinge with, in the right valve, two stout cardinals, prolonged into slightly prominent laminæ anteriorly, in the left valve one stout and one slender arched laminar cardinal and an obscure lateral lamina entering a sulcus in the opposite valve; pallial line distinct, not sinuate, adductor scars ovate, distinct, surmounted by a smaller pedal scar from the retractors.

This genus is entirely distinct from Philippi's *Cyamium,* with which it has frequently been confounded. It has no internal ligament and the teeth are of a different character. The hinge is well figured by Verrill (*loc. cit.,* fig. 4, 1872), but the very large pedal scar indicated in his figure must have been abnormal, as I have not found it of any such size in a large number of specimens examined.

Cyamium Philippi (Arch. für Naturg., 1845, p. 50) is based upon a small translucent shell having somewhat the appearance of *Abra.* It has a strong internal resilium; an amphidetic, obsolete, external ligament; two strongly bifid cardinals in the right valve, and in the left three smaller simple cardinals. The pallial line is obscure but apparently simple, and the teeth recall those of *Cooperella* rather than of the *Leptonacea.*

Turtonia minuta Fabricius.

Venus minuta Fabricius, Fauna Grönl., p. 412, 1780.

Mya purpurea Montagu, Test. Brit. Suppl., p. 21, 1808; not of Turton, Dithyra Brit., p. 54, 1822.

Turtonia minuta Alder, Cat. Moll. North. and Durham, p. 95, 1848; Stm., Sh. of N. Engl., p. 16, 1851; Verrill, Rep. U. S. Fish Com. for 1871-72, p. 687, 1873; Dall, Bull. 37, U. S. Nat. Mus., p. 48, pl. 64, fig. 142*a,* pl. 68, fig. 7.

Turtonia nitida Verrill, Am. Journ. Sci., 3d Ser., iii., p. 286, pl. 7, figs. 4, 4*a,* 1872.

Cyamium minutum Jeffreys, Brit. Conch., ii., p. 260, pl. 5, fig. 8, 1863, v., pl. 33, figs. 5, 5*a,* 1869.

Pleistocene of raised beaches near Portland, Maine, Fuller; recent, Cape Cod to Greenland, " South Carolina," Kurtz (?); Atlantic and Mediterranean coasts of Europe, and the shores of southern Alaska and the Aleutian Islands from Nunivak Island south to Sitka, Dall.

A careful examination of a good many specimens shows that there is great variation in the outline of this little species, and, as in all these groups with imperfectly developed hinge-teeth, more or less discrepancy between the hinges of different individuals. There is no constant difference between specimens from Massachusetts, Britain, and Alaska, nor even a prevailing facies which would enable one to distinguish geographical races. *T. occidentalis* Dall, from eastern Siberia, near Bering Strait, has a more rounded form and is nearly twice the size of *T. minuta,* but I am by no means sure that it is not a mere local development of the typical species. Jeffreys states that the "pallial scar is deeply sinuous or indented," which is an error, probably arising from the individual mutation of some abnormal specimen. I have never seen one in which it was not perfectly simple and entire.

This species was referred to "*Lesæa*" Leach by Möller in 1842 (Ind. Moll. Grönl.), which is an obvious *lapsus* for *Lasæa.*

Genus **MONTACUTA** Turton.

Montacuta Turton, Dithyra Brit., p. 58, 1822. First sp. *M. substriata* Mtg. (as *Ligula*) Turt., *op. cit.,* p. 59, pl. 11, figs. 9, 10.

Tellimya H., Brown, Ill. Rec. Conch. Gt. Brit., 1st ed., 1827; 2d ed., p. 106, 1844 (1st sp. *Montacuta ferruginosa* Turton).

Montacuta Thorpe, Brit. Mar. Conch., p. 51, 1844; Gray, P. Z. S., 1847, p. 192. Type *M. substriata* Mtg., Herrmannsen, Ind. Gen. Mal., ii., 1847 (same type); Gray, List of Brit. An. B. M., p. 84, 1851.

< *Montacuta* Jeffreys, Brit. Conch., ii., p. 204, 1863; Fischer, Man. de Conchyl., p. 1027, 1887; Cossmann, Cat. Illustr., ii., p. 81, 1887; Verrill, Proc. U. S. Nat. Mus., xx., p. 779, 1898.

Tellimya sp. Dall, Bull. U. S. Nat. Mus., No. 37, p. 50, 1889.

> *Decipula* (Jeffreys MS.) Friele, Vid. Selsk. for., p. 57, 1875. Type *D. ovata* Jeffreys, *loc. cit.*

Montaguia Fischer, Man., p. 1027, 1886; not Desmarets, 1825.

Turton's first species of *Montacuta* * (*substriata*) has been regarded as the

* The form *Montacuta* is that proposed by Turton. Desmarets three years later used the form *Montagua* for a Crustacean. Three years later still, in 1828, Fleming named a Nudibranch *Montagua;* and in 1855 Bate applied the same name to a Crustacean. In 1882 Scudder suggested that Turton's genus should be spelled *Montaguia,* which was approved of by Fischer (1887) and acted on by Locard (1898).

The present writer can see no good reason why the word should not be retained as type for more than half a century and was specifically named as such by Gray and Herrmannsen in 1847. Its characters are as follows:

Gills on each side with only the direct and reflected inner lamina developed; hepatic glands arborescent, projecting from the ordinary body wall.

Shell small, more or less transversely ovate, posterior end usually shorter; anterior part of the hinge provided, in the right valve, with a narrow lamina having a minute cardinal hook at the proximal end; the left valve with a similar lamina on which the hook is less prominent or even absent; external ligament obsolete, amphidetic, leaving no traces on the shell; resilium strong, internal, posterior, seated on nymphs of which the right one is usually less strong; the ventral surface of the resilium, in the larger species, with a thin calcareous deposit, often wholly absent and never forming a developed lithodesma; the distal portions of the laminæ sometimes obsolete.

Sections:

I. *Montacuta* s. s. Type *M. substriata* Mtg.

II. *Decipula* Jeffreys. Type *D. ovata* Jeffreys.

Teeth obsolete in the left valve; nymphs not developed.

III. *Orobitella* Dall. Type *M. floridana* Dall.

Laminæ obsolete but cardinal hooks persistent, the sockets of the resilium elevated.

An examination of the specimens of *Decipula ovata* in the Jeffreys collection shows that they differ from typical *Montacuta* by the obsolescence of the teeth of the left valve, while the resilium is inserted directly on the shell without the intervention of a nymph. I am unable to decide whether, as Jeffreys supposed, the *Tellimya ovalis* of G. O. Sars (Moll. Reg. Arct. Norv., p. 341, pl. 34, figs. 1*a-c*, 1878) is the same shell or not, as Professor Sars's figure of the hinge of his shell is quite different from the actual hinge of Jeffreys's specimens. These are from Osterfiord, Norway, and the Fosse de Cap Breton. The great difficulty encountered in getting at the characters of the hinge in these minute shells renders it likely that the differences are due to misinterpretation, and that from its deep-water habitat *Decipula* has become somewhat degenerate and has been derived from *Montacuta*, of which it may be regarded as a section.

Turton originally wrote it, though the form is not in accord with modern methods. It is at any rate in general use, and was probably proposed by Turton from the point of view that *Montagu* is itself a corrupt derivative from *mons* and *acutus*. I find that some members of the Montagu family used the form Montacute as their surname.

Between species like *M. substriata,* in which the hinge of both valves is fully developed, and those in which the cardinal hook or lamina is obsolete, or the differentiated left lamina is represented only by a bevelled inflection of the cardinal margin, there is really only a difference of degree, and a difference which may perhaps be of only specific value, and even I am inclined to suspect sometimes exhibited by individuals within the species. After a careful study of all the material at my command, recent and fossil, I find the following species among others should be referred to *Montacuta* as restricted: *M. substriata* Mtg., *M. Vöringi* Friele (N. Atlantic), *M. ferruginosa* Mtg., *M. floridana* Dall (West Florida), *M.* (*Decipula*) *ovata* Jeffreys (not *Montacuta ovata* Jeffreys, which is a *Rochefortia*), and *M. chipolana* Dall, of the Oligocene. All the species referred by Verrill and Bush ("Revision of Deep-water Mollusks," Part i., 1898) to *Montacuta* will under the present arrangement be referred to *Rochefortia.*

Montacuta claiborniana n. sp.

Plate 45, Figure 21.

Eocene sands of Claiborne, Alabama; Burns.

Shell small, thin, polished, smooth, nearly equilateral, very slightly arcuate, moderately inflated; beaks low, dorsal margin thin, evenly arcuate, passing distally into the rounded ends, of which the anterior is shorter and less high; base slightly arcuated; in the left valve the posterior dorsal margin above the scar of the internal ligament is somewhat reflected, the single minute cardinal is under the beak with a slight fold extending forward. Lon. 1.7, alt. 1.2, diam. 1.0 mm.

A single small valve was obtained from Claiborne shell sand. Though doubtless immature, it is described as being the only representative of the genus in this horizon, *M. Dalli* Cossmann being, under the present arrangement, referred to *Bornia.*

? **Montacuta chipolana** n. sp.

Plate 44, Figure 4.

Oligocene of the Chipola beds of Calhoun County, Florida, on the Chipola River, and in the lower bed at Alum Bluff; Dall and Burns.

Shell small, very inequilateral, the posterior side very short, dorsal and ventral margins nearly parallel, straight, passing evenly into the bluntly rounded ends; the young have the posterior end proportionately less short and the anterior end narrower; external surface polished, smooth except for faint incremental lines, shell inflated; beaks low, the subtriangular prodissoconch conspicuous; hinge with a stout, conspicuous left cardinal and a more slender prominent right cardinal; thickening of the margin over the resilium feebly developed in both valves, the anterior lamina obsolete in both; scar of the resilium large, short, scars of the adductors and pallial line normal. Lon. of a medium-sized specimen 8.5, alt. 5, diam. 4 mm. A broken specimen still measures 10 mm. in length.

This species forms the next term in a series of which in *M. ferruginosa* the laminæ are partially obsolete in front, and in *M. substriata* they are distinctly developed though small. It recalls *Sportella Whitfieldi,* but has a thinner shell and much more delicate hinge. Species of this type nearly bridge the conchological gap between *Montacuta* and *Sportella.*

? **Montacuta actinophora** n. sp.

Plate 44, Figure 2.

Upper Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, rather compressed, subquadrate, the anterior end much the longer; basal and dorsal margins subparallel, anterior end evenly rounded; posterior end short, sloping above, rounded below; beaks small, low, the nepionic shell conspicuous; outer surface marked with somewhat irregular incremental lines, smooth near the beaks, elsewhere closely, evenly, sharply, radially striate, an obscure ridge extending from the beaks backward and downward; hinge-plate narrow, in the right valve with one prominent slender cardinal tooth directed obliquely forward in front of a narrow elongate sulcus for the resilium obliquely directed backward below the dorsal margin; in the left valve on each side of the sulcus is a rather obscure lamina, the anterior most prominent and longer, the posterior fitting under the posterior dorsal margin of the opposite valve, the anterior into a socket above the right cardinal; interior of the valves smooth or faintly radially striate, the muscular impressions large and rather low down, the pallial line simple and wide. Lon. 11, alt. 7.6, diam. 4.5 mm.

This is an elegant shell which has the external aspect of *Scintilla* but a different hinge. The teeth differ from those of typical *Montacuta* in the shortness of the shank of the cardinal "hook" and in the presence of a posterior lamina in the left valve, but traces of the latter may be found in several of the other species. But for the absence of any evidence of an external ligament this species might be referred to *Sportella.*

Montacuta mariana n. sp.

Plate 45, Figure 18.

Miocene of St. Mary's River and Plum Point, Maryland; Harris and the State Geological Survey.

Shell small, ovate, moderately convex, sculptured chiefly by incremental lines and faint concentric wrinkles; beaks conspicuous, showing the prodissoconch, but not high, nearly central; the dorsal margin sloping almost equally each way from the beaks, the ends rounded, the base evenly arcuate; hinge with a single small subtrigonal anterior lamina in each valve, a small oblique submarginal sulcus in each valve behind the beaks; interior of the valves smooth, muscular impressions faint but normal. Lon. 4, alt. 3.25, diam. 1.5 mm.

This species is smaller and more rounded than most of the Montacutas and is apparently rather common in the St. Mary's Miocene.

Montacuta petropolitana n. sp.

Plate 45, Figure 6.

Shell subtrigonal, rounded, moderately convex, inequilateral, the anterior side longer; external surface nearly smooth with faint incremental lines and a few minute sparsely distributed obscure granulations which may or may not be a specific characteristic; hinge with, in each valve, the anterior cardinal tooth well developed, obliquely bent forward, and the anterior lamina absent, as in the last species; the posterior thickening over the resilium is small and short, or more or less obsolete; pit for the resilium elongated, narrow, and distinct, hinge-plate flattish; surface of the shell internally smooth or faintly radially striated, the scars obscurely impressed. Lon. 5.75, alt. 4.5, diam. 2.3 mm.

Two valves were obtained by Burns in the marl at Petersburg, Virginia.

This species is puzzling and might easily be regarded as a *Sportella,* but differs by having the slender cardinal bent back obliquely instead of projecting in a straight line at right angles to the plane of the shell margin. It is also less parallel-sided than most *Sportellas,* and the general aspect is more that of *Montacuta.* From *Sportella petropolitana,* the most similar species known from Petersburg, it is distinguishable at once by its less equilateral and more trigonal shell, and the absence of the ligamentary nymphs.

Montacuta sagrinata n. sp.

PLATE 44, FIGURE 6.

Miocene of York River, Virginia; Harris.

Shell small, rounded, subequilateral, moderately inflated, thin, sculptured with incremental lines and fine broken concentric ridges more or less irregular and sometimes almost granular, with an obscure vertical constriction from the beaks (which may be an individual feature); posterior end higher and more rounded, anterior end more pointed; a single small, projecting short lamina in front of the beaks in the right valve with a rather long oblique sulcus for the resilium behind; interior mostly smooth or radially striate. Lon. 7.5, alt. 6.0, diam. 3.75 mm. A second broken valve was proportionally a good deal more elongate.

This species at first sight recalled *Aligena lineata,* which has an extremely similar surface, but the gap between the resilium and the tooth is less marked and the aspect of the shell is decidedly more like *Montacuta* than *Aligena.* If it belongs to the latter genus it is certainly not one of the described species. The beaks are decidedly lower and the shell in front of them less impressed than in any of the numerous specimens of *Aligena* I have examined.

Montacuta (Orobitella) floridana Dall.

Montacuta floridana Dall, Proc. U. S. Nat. Mus., xxi., 1899, p. 893, pl. 87, fig. 10.

Pliocene of the Caloosahatchie beds, Florida; Pleistocene of North Creek, near Osprey, Florida, Dall; living on the coast of West Florida, Simpson.

Shell subovate, inequilateral, posterior end shorter, white, inflated; beaks low, polished; sculpture of concentric lines growing gradually stronger downward and forward until on the lower anterior third they form low, stout, evenly distributed, concentrically striated lamellæ, while remaining feebler on the posterior part of the shell; base nearly straight, dorsal margin arcuated, ends evenly rounded; hinge with a prominent slender cardinal in each valve, the laminæ obsolete; sockets of the resilium thickened and raised above the inner surface of the valve. Lon. 16, alt. 10, diam. 9.5 mm.

This is probably the largest species of the genus and the anterior laminæ have entirely vanished. There is no radial sculpture visible, but under strong magnification a few fine striations can be made out on the anterior slope, which are faintly reflected on the inner anterior margin.

A broken valve of a species not unlike *M. floridana,* but less rounded and inflated, was obtained by Harris from the Miocene of the York River, Virginia, but it is too imperfect for description.

Genus **ALIGENA** H. C. Lea.

Aligena H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 238, 1845. Type *A. striata* Lea, *op. cit.*, pl. 34, fig. 13 (not *Haligenes* Guenther, *Pisces*, 1859).

Laubrièreia Cossmann, Cat. Ill. bas. Paris, ii., p. 76, 1887. Type *Erycina emarginata* (Desh.), *op. cit.*, pl. 4, fig. 13.

Kelliopsis Verrill and Bush, Proc. U. S. Nat. Mus., xx., p. 783, 1898. Type *Montacuta elevata* Stm., *op. cit.*, p. 784, pl. 93, figs. 2-4, pl. 94, figs. 7-8.

Amphidesma (sp.) Conrad, Fos. Medial Tert., p. 65, 1845.

Abra (sp.) Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863.

The genus as described by Lea included two species; the second, *A. levis* * (Lea, fig. 14), is apparently a species of *Fulcrella,* but agrees less well with Lea's generic diagnosis than the first species here cited as the type. The characteristic of this group is the possession of a rounded triangular inflated shell with only a single small anterior tooth under the beaks, separated by a gap from the surface of attachment, under the posterior dorsal margin, of an elongate internal resilium carrying a lithodesma. The pallial line is simple, and the cardinal of the left valve more feeble than the other. *Spaniodon* Reuss (Sitzb. K. K. Akad. Wien., vol. 55, p. 134, 1867, type *S. nitidus* Reuss, *loc. cit.*), from the Miocene of Galicia, must, from the figures, be closely related to *Aligena.*

Aligena æquata Conrad.

Plate 24, Figures 8, *8a, 8b.*

Amphidesma æquata Conrad, Proc. Acad. Nat. Sci. Phila., i., p. 307, 1843; Fos. Med. Tert., p. 65, pl. 36, fig. 5, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 95, pl. 23, fig. 5, 1856.

Aligena striata H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 238, pl. 34, fig. 13, 1845.

Abra æquata Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 574, 1863.

Kellia (sp.) Orbigny, Prodr., iii., p. 115, 1852.

Aligena æquata Dall, Trans. Wagner Inst., iii., p. 919, pl. 24, fig. 8, 1898.

Miocene of St. Mary's County, Maryland; Petersburg, Virginia; Natural Well and Magnolia, Duplin County, and Wilmington, North Carolina, and of the Peedee River, South Carolina; Pliocene of the Caloosahatchie beds, Florida.

This shell is quite variable in its outline, occasionally being ovate-oblong,

* This was referred to *Kellia* by d'Orbigny (Prodr., iii., p. 115, No. 2153, 1852), who, as there was already a *Kellia lævis,* changed the specific name to *sublævis.*

but the typical form is rounded triangular. When quite young it is smooth or merely concentrically striated, but later on develops the prominent concentric laminæ. Occasional specimens are found in which the laminæ fail to develop, forming the variety *nuda*, Dall.

Aligena pustulosa Dall.

PLATE 33, FIGURES 18, 22.

Aligena pustulosa Dall, Trans. Wagner Inst., iii., p. 928, pl. 33, fig. 18, 1898.

Upper Oligocene of the Chipola beds, Chipola River, and of the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, thin, subtrigonal, moderately inflated, subequilateral, with small, pointed, inconspicuous beaks; valves with a well-marked carina extending downward and forward to the anterior angle of the basal margin, in front of which keel the surface is slightly impressed; surface sculptured with feeble incremental lines, along which are irregularly distributed small, pointed pustular elevations; beaks anteriorly twisted with a minute obscure tooth below them on the cardinal margin; ligamentary sulcus long and well marked; scars and pallial line much as in *Diplodonta;* margin entire, inner surface faintly radially striated. Alt. 6, lat. 5.2, diam. 4 mm.

The peculiar surface sculpture distinguishes this species at once from the other species. The Chipola specimen is not in very good condition, but shows rather stronger and closer concentric sculpture than the Oak Grove specimens.

Aligena lineata n. sp.

PLATE 44, FIGURE 23.

Oligocene of the Alum Bluff sands at Oak Grove, Santa Rosa County, Florida; Burns.

Shell small, thin, inequilateral, moderately convex, the anterior side longer, rounded, the posterior side higher, shorter, bluntly rounded, the beaks rather elevated, the base evenly arcuate; sculpture of fine, rather irregular elevated lines, not developed into laminæ, stronger near the anterior slope and feebler near the posterior slope; hinge and other characters of the interior much as in the last species. Alt. 7, lat. 8, diam. 4 mm.

This species is distinguished by its more elongated form and less elevated concentric sculpture from *A. æquata,* to which of all the species it is most nearly allied.

Aligena minor n. sp.

PLATE 44, FIGURE 8.

Miocene of the Natural Well, Duplin County, North Carolina; Burns.

Shell small, ovate, oblique, very inequilateral, posterior end shorter and smaller, anterior end produced; beaks small; surface of the valves moderately convex, smooth except for incremental inconspicuous concentric lines; interior polished, faintly radially striate, adductor scars rather large, ligamentary sulcus short, the cardinal tooth strong and prominent. Alt. 3.2, lat. 4, diam. 3 mm.

This little shell by its oblique form and strong cardinal tooth is easily separated from the rather quadrate smooth young shells of *A. æquata* which are found in the same bed. It appears to be rather scarce, as only five valves were obtained from a large amount of the marl.

Aligena elevata Stimpson.

Montacuta bidentata Gould, Inv. Mass., p. 59, 1841; not of Turton. Wheatley, Cat., p. 5, 1842; De Kay, N. Y. Moll., p. 232, 1843.

Montacuta elevata Stimpson, Shells of N. E., p. 16, 1851; Binney's Gould's Inv. Mass., p. 86, fig. 396, 1870; Tryon, Am. Mar. Con., p. 172, pl. 33, fig. 440, 1873; Verrill, Inv. An. Vineyard Sd., pp. 394, 688, 1874.

Cyamium elevatum H. and A. Adams, Gen. Rec. Moll., ii., p. 477, 1858.

Tellimya elevata Dall, Bull. U. S. Nat. Mus., No. 37, p. 50, pl. 68, fig. 6, 1889.

Kelliopsis elevata Verrill and Bush, Proc. U. S. Nat. Mus., xx., p. 784, pl. 93, figs. 2-4; pl. 94, figs. 7, 8, 1898.

Pleistocene of Pt. Shirley, Boston Harbor, Dall; recent on the coast of New England, especially south of Cape Cod, and south to New Jersey; Wheatley.

This is a well-characterized species from which we learn that the resilium carries a lithodesma, which is lost in the fossil species. Usually the ligament is invisible externally, but in some specimens a little fissure over it allows it to be seen. The thickened edge to which the resilium is attached has been spoken of as "tooth-like," but it is only the nymph-like thickening produced where the strain requires special strength in the shell and not otherwise like a tooth.

The only other species of the group which has been described from the American Tertiary, as far as I have been able to discover, is *Aligena Sharpei* O. Meyer (Proc. Acad. Nat. Sci. Phila. for 1888, p. 171, fig'd), which came from some point on the west shore of Chesapeake Bay, not precisely determined, but probably from the Miocene.

Superfamily LUCINACEA.

Family DIPLODONTIDÆ.

Genus DIPLODONTA Brown.

Diplodonta Brown, Ital. Tertiär. geb., p. ix., 1831. Type *Venus lupinus* Brocchi; not *Diplodon* Spix, 1827.

Mysia Brown, Zool. Textb., p. 454, pl. 90, fig. 6, 1833; Sby. Man., p. 197, 1842; not of Leach in Lam., 1818, nor of Brown, Ill. Conch. Gt. Brit., 1st ed., pl. 17, figs. 1, 2, 1827; not *Mysea* Billborg, Insecta, 1820.

Mysia Conrad, Fos. Medial Tert., p. 30, 1838; not of Leach.

Egeria Lea, Contr. Geol., p. 49, 1833, *ex parte;* not of Roissy, 1805.

Sphærella Conrad, Fos. Medial Tert., p. 17, 1838. Type *S. subvexa* Conrad, *op. cit.,* pl. 10, fig. 2.

?*Felania* Récluz, Journ. de Conchyl., ii., p. 69, 1851. Type *Venus diaphana* Gmelin (*Le Felan* Adanson).

Glocomene Leach, Moll. Gt. Brit., p. 313, 1852.

Cycladicama Val., Voy. au Pôle Sud., v., p. 116, 1854; Fischer, Journ. de Conchyl., viii., p. 377, 1860. Type *C. luciniformis* Val., *op. cit.,* pl. 3, fig. 3.

Mittrea Gray, Fig. Moll. An., v., p. 35, 1857; sole ex. *Diplodonta brasiliensis* Mittre, Journ. de Conchyl., i., p. 240, 1850.

Diplodonta + *Mysia* Cossmann, Cat. Ill., ii., p. 21, 1887.

This genus dates from the Cretaceous, and, considering the simplicity of its characters, seems to have received less attention than it deserves from modern writers. I have shown elsewhere that *Mysia* Leach is based on *Lucinopsis undata,* and that to the true *Diplodonta* Leach applied the name of *Glocomene.*

Conrad, Brown, and other writers have used *Mysia* for this genus so frequently that much confusion has resulted.

Egeria Lea was preoccupied when used by him and also contained representatives of several genera, a few of which belong to *Diplodonta.* Gray (Fig. Moll. An., v., p. 18, 1857) and Woodward (Man., p. 474) figure a bivalve from the Philippines, perhaps a *Joannisiella,* which has two siphonal openings and a compressed foot of the ordinary type, under the name of *Mysia,* and therefore separated the true Diplodontas, which have only an anal siphonal aperture and long Lucinoid foot, under the name of *Mittrea,* with *Diplodonta brasiliensis* Mittré as the type. This error has been transferred to Fischer's Manual by inadvertence.

An examination of a specimen of *Felania diaphana* (Gmel.) Récluz discloses some errors in his description of its characters. There is both a ligament and a resilium present, contrary to Récluz's impression, and the statement that there is a pallial sinus is erroneous. It is true that a little behind the middle of the shell there is a roughly quadrate polished patch or area extending upward, much as figured by Récluz (J. de Conchyl., ii., pl. 2, fig. 11), but a careful examination of this area shows that it is not due to a sinus in the pallial line (which passes regularly below it, as in *Diplodonta,* without any flexuosity), but to the attachment to the shell of a localized area of the mantle above the pallial line. According to Mittré, there is a single (anal) opening, not produced into a siphon, as in *Ungulina,* and therefore nothing which would require the attachment of siphonal retractor muscles to the valve. *Felania,* however, differs from *Diplodonta* in possessing a lunule, small but sharply circumscribed, and until more is known will best be kept separate. Both *Diplodonta* and *Ungulina* agree in having usually an amphidetic extension of the ligament as well as an internal resilium, united in the former but divided in the latter. The resilium is small and nearly external in *Diplodonta,* large and internal in *Felania* and *Ungulina,* marginally in contact with the ligament in *Felania,* but subvertical and separated in *Ungulina.* The teeth are essentially the same in all three, but more rugose and irregular in *Ungulina.* Many of the species commonly referred to *Felania* do not agree in character with the type of that group, but form a section of *Diplodonta.* I have seen no species which could be referred to *Felania* in the strict sense except the two named by Récluz. It will be necessary to examine the anatomy of *Felania* before it can be definitely settled whether it will form a distinct genus or merely a subgenus of *Diplodonta.* H. and A. Adams refer to the foot of *D. lupinus* as compressed, but this is probably due to an erroneous observation of Clark on a young *D. rotunda,* since *D. lupinus* is a fossil unknown in the recent state. *Cycladicama* Val. appears to be a synonym of *Diplodonta* proper.

Sphærella Conrad is founded on a single species, *S. subvexa* Conr., from the Miocene of Virginia, which has some distinctive characters, the most important of which are, (1) the unusual position of the posterior adductor scar, which is placed low down, its upper end hardly rising above the ventral end of the anterior scar; and (2) the form of the right posterior cardinal tooth, which is much more transverse and larger than in ordinary *Diplodonta.* Conrad referred many globose species of *Diplodonta* to *Sphærella,* but I have seen but one other American species which presents the distinctive characters of *Sphærella.* Among recent forms there are a few, of which *Diplodonta senegalensis* Reeve is the most conspicuous, which have low-set posterior adductors, but this species has the ordinary teeth of *Diplodonta.* It is evident, therefore, that *Sphærella* can be regarded at most as a section of *Diplodonta,* closely allied to the typical forms of that genus.

The genus may be divided as follows:

Section *Diplodonta* s. s. Type *D. lupinus* Brocchi, Miocene of Italy.

Shell rotund, equilateral, externally concentrically striated or smooth, with inconspicuous epidermis; two cardinal teeth in each valve, of which the right posterior and left anterior are distally sulcate or bifid; no lateral teeth; the hinge-plate when developed is usually excavated distally; there is no circumscribed lunule or escutcheon; the adductor scars are subequal, continuous with the pallial line, and close to the hinge-plate; the margin is entire, the pallial line simple, the pallial area often radiately striate; anatomically the genus is separated from *Lucinidæ* by its double gills and absence of siphon, and from *Cryptodontidæ* by its generative and digestive glands being contained within the general mass of the body. The excavation of the hinge-plate by which Fischer would separate *Felania* from *Diplodonta* appears to be merely a specific character, as is the turgidity of the shell, which varies widely among the typical Diplodontas.

Glocomene, Cycladicama, and *Mittrea* are synonyms.

Section *Felaniella* Dall, 1899. Type *Felania usta* Gould, Japan.

Shell like *Diplodonta,* but heavy, compressed, externally smooth, with a conspicuous, usually dark epidermis, and less equilateral valves.

To this group belong the shells referred to *Felania* by Carpenter and others from the Pacific, *D. apicalis* Phil. from the Mediterranean, etc.

Section *Sphærella* Conrad. Type *S. subvexa* Conr.

Shell large, concentrically striate, an impressed line above the anterior cardinal suggesting a minute lunule; the right posterior cardinal wide, undulated above; the posterior adductor scar distant from the hinge-plate.

A single species known from the Miocene, and one (*D. Verrilli* Dall, = *D. turgida* V. and S., 1881, not Conrad, 1848) from the Atlantic coast in deep water.

Section *Phlyctiderma* Dall, 1899. Type *D. semiaspera* Phil., Cuba * (1836).

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* The shell from Japan, called by Dunker and others *D. semiaspera,* is a distinct species, and will probably have to take the name of *D. japonica* Pilsbry. Philippi's type was from Havana and may be the same as *D. semireticulata* Orb. (1845). All three belong to the section.

Shell like *Diplodonta,* but with the concentric sculpture more or less broken up into reticulations or pustules.

This section includes several living and some fossil species of the Western Hemisphere. The Cretaceous genus, *Tenea* Conrad, which has been referred to this family, belongs to the *Veneridæ,* and *Linearia* Conrad, also included by Zittel (Traité de Pal., p. 93) among the synonyms of *Diplodonta,* belongs in the *Tellinidæ.*

Diplodonta hopkinsensis Clark.

D. hopkinsensis Clark, Bull. U. S. Geol. Surv., No. 141, p. 79, pl. xxii., figs. 1 *a-d,* 1895.
Diplodonta sp. Harris, Bull. Pal., ii., p. 257, pl. 13, fig. 7, 1897.

Hatchetigbee Bluff, Alabama, Harris; Wood's Bluff, Alabama, L. C. Johnson; Thomasville, Alabama, Burns; Evergreen, Virginia, Clark.

This appears to be the common species of the Chickasawan (or Lignitic) Eocene, which also contains the following species:

Diplodonta ungulina Conrad.

Astarte ungulina Conr., Am. Journ. Sci., xxiii., p. 342, 1833; Proc. Acad. Nat. Sci. Phila. for 1857, p. 166, 1858.
Egeria rotunda Lea, Contr. Geol., p. 50, pl. 1, fig. 17, 1833.
Mysia astartiformis Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 296, 1860; Am. Journ. Conch., i., p. 147, pl. 11, fig. 15, 1865.
Mysia deltoidea Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 296, 1860; Am. Journ. Conch., i., p. 147, pl. 11, fig. 10, 1865.
Egeria nana Gregorio, Mon. Claib., p. 208, 1890; not of Lea.

Chickasawan Eocene of Wood's Bluff, Alabama, L. C. Johnson; Claiborne sands at Claiborne, Alabama, Clarksville and localities in Clarke County, Alabama; and Glass Bayou, lower bed, near Vicksburg, Mississippi.

This fine species is abundant at Claiborne and presents the appearance of a precursor of the Miocene *D. acclinis.* The *Egeria nana* of Lea is often represented in collections by the young of this species, but is a small species of *Felaniella,* not unlike one from the Oligocene of Bowden which will be described later. It recalls *Goodallia* in form as suggested by Cossmann, but has the dentition of *Diplodonta.*

Diplodonta turgida Conrad.

Sphærella turgida Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 124, pl. xii., fig. 23, 1848; Am. Journ. Conch., i., p. 9, 1865.
Sphærella bulla Conr., Am. Journ. Conch., i., p. 138, pl. 10, fig. 9, 1865.

Sphærella anteproducta Harris, Proc. Acad. Nat. Sci. Phila. for 1895, p. 50, pl. 2, fig. 4.
Sphærella sp. Harris, Bull. Pal., ii., p. 257, pl. 13, fig. 6, 1897.
Not *Diplodonta turgida* Verrill and Smith, 1881, = *D. Verrilli* Dall.

Lower Claibornian of Texas, Harris; Claiborne sands at Claiborne, Alabama, Johnson; Wahtubbee Hills, Clarke County, Mississippi, Burns; Red Bluff, Wayne County, Mississippi, Burns and Aldrich; Oligocene of Vicksburg, Mississippi, Conrad.

This remarkable globular species is not a *Sphærella,* but simply a turgid *Diplodonta.* It ranges from the Chickasawan upward to the Vicksburgian and without any marked change. Specimens labelled by Professor Harris do not seem to me to differ from the ordinary *turgida* except as individuals differ in any large series.

Diplodonta inflata Lea.

Egeria inflata Lea, Contr. to Geol., p. 50, pl. 1, fig. 18, 1833.
Mysia levis Conr., Am. Journ. Conch., i., p. 147, 1865.
Sphærella levis Conr., Am. Journ. Conch., i., p. 9, 1865.
Lucina (*Sphærella*) *inflata* var. *paruminflata* Gregorio, Mon. Claib., p. 207, pl. 29, figs. 15-17, 1890.

Claiborne sands of Claiborne, Alabama; Johnson.

This species is not very happily named, as it is never markedly inflated; it appears to be rather rare in the sands.

The *Sphærella oregona* Conrad of the Smithsonian Eocene Checklist, said to be from the Eocene of Oregon, appears to be undescribed or figured. The *Mysia polita* Gabb, from the Eocene of Martinez, California (Pal. Cal., i., p. 178, pl. 30, fig. 256, 1864), is probably a *Diplodonta.*

Diplodonta? eburnea Conrad (as *Loripes,* Journ. Acad. Nat. Sci. Phila., 2d Ser., i., p. 124, pl. xii., fig. 23, 1848) appears to be of doubtful affinities. It is from the Vicksburgian. There is in the National Museum a pair of valves of *Diplodonta* from the Jacksonian of Jackson, Mississippi, which are not unlike Conrad's very poor figure, though they do not nearly attain the size he assigns to it. These agree as far as can be determined with the species called *parilis* by Conrad from the basal Miocene of the New Jersey marls.

Each fauna seems to have a representative of each of the several types of *Diplodonta.* Thus in the Oligocene of Bowden we have *D. capuloides* Gabb (1873), corresponding to the *turgida* type of the Eocene; *D. subquadrata*

Gabb,* corresponding to the more compressed Eocene forms like *ungulina;* a *Felaniella* the analogue of *D. nana* of the Eocene, and a *Phlyctiderma* of which the Eocene analogue, if any, has not yet been recognized. The same is the case with the Miocene, Pliocene, and recent faunas.

Diplodonta (Felaniella) minor n. sp.

PLATE 44, FIGURE 17.

Oligocene marl of Bowden, Jamaica; Henderson and Simpson.

Shell small, moderately convex, smooth, polished, oblique, inequilateral, the lower anterior side produced, the posterior side shorter, rounded; margins simple, pallial line and adductor scars normal, the right anterior cardinal submarginal, rather long; the posterior cardinal short, vertical, deeply bifid, the beaks low and pointed, both the left cardinals short, the anterior bifid. Alt. 4.5, lat. 3.8, diam. 2.5 mm.

This is very similar to the Claibornian *D. nana* and to the young of the Mediterranean *D. apicalis* Philippi.

Diplodonta (Phlyctiderma) puncturella n. sp.

PLATE 45, FIGURE 26.

Oligocene marl of Bowden, Jamaica, Henderson and Simpson; recent, Jamaica, United States Fish Commission.

Shell small, thin, rounded, moderately convex, with inconspicuous beaks, outline nearly circular, the beaks smooth, but the rest of the external surface closely minutely punctate all over, other characters as in typical *Diplodonta,* like *D. capuloides,* but less turgid. Alt. 6.7, lat. 6.5, diam. 4.0 mm.

The punctation of the surface is very close and regular, not pustulose, like most of the species of this section.

Diplodonta alta Dall.

PLATE 11, FIGURES *9a, 9b;* PLATE 44, FIGURE 19.

Diplodonta alta Dall, Trans. Wagner Inst., iii., p. 189, pl. 11, figs. *9a-b,* 1890

Chipola Oligocene of the Chipola River, the lower bed at Alum Bluff, and the Ballast Point silex beds of Tampa, Florida; also in the Alum Bluff beds at Oak Grove, Santa Rosa County, Florida; Dall and Burns.

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* Geol. St. Domingo, 1873, p. 252; not of Carpenter, P. Z. S., 1855, p. 230. This species, since Gabb's name is preoccupied, may be called *D. Gabbi.*

Shell large, thin, concentrically striated, beaks small, not elevated; anterior end short, rounded, posterior end longer, larger, more arcuate above, the lower portion near the base produced; groove for the ligament very narrow; hinge-plate narrow, slightly excavated; teeth and adductors normal; margin simple. Alt. 27, lat. 26, diam. 12.5 mm.

The specimen figured from the silex beds being defective at the posterior margin, a much finer specimen from the Chipola beds, subsequently acquired, has been figured to show the normal form of the species. A form from the sands at Oak Grove seems to be the same, but differs by the presence of a minute lunule or incised line in front of the beaks as in *Sphærella,* the adductor scars, however, are normal. As the Oak Grove specimens are all young, I prefer to regard them as a variety of *D. alta* until more information is available.

Diplodonta radiata n. sp.

Plate 44, Figure 11.

Oligocene sands of Oak Grove, Santa Rosa County, Florida; Burns.

Shell large, very thin, finely concentrically sculptured with minutely wrinkled silky striæ; anterior end shorter and narrower, slightly produced below, posterior end wider, rounded; hinge-plate narrow, channelled in front, cardinals small, short, normal; ligamentary groove very short, beaks low, inconspicuous; adductor scars and pallial line normal; pallial area smooth, with, towards the base, numerous obscure liræ which appear on the basal margin as short elevated lines with abrupt terminations, somewhat as in *Propeamusium.* Alt. 18, lat. 20, diam. 10 mm.

This is a peculiar species and, so far as the liræ are concerned, appears to be unique. They are entirely distinct from the radiating striæ not uncommon on the pallial area of Lucinoid bivalves, being most elevated at their distal termination, and found in both the young and mature shells.

Diplodonta shilohensis Dall.

Mysia parilis Conrad, Am. Journ. Conch., ii., p. 71, pl. 4, fig. 1, 1866; Whitfield, Mio. Moll. N. J., p. 61, pl. 9, figs. 9-13, 1895.

Not *Mysia parilis* Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser., iv., p. 278, pl. 46, fig. 16, 1860; nor *Mysia parilis* Conr., Am. Journ. Conch., i., p. 153, 1865.

Basal Miocene of New Jersey, at Shiloh and Jericho, Cumberland County; Conrad and Burns.

The nomenclature of this species illustrates one of the peculiarities of Conrad's work to which I have often had occasion to refer. The first *Diplodonta* which received the name of *parilis* from Conrad was a species from the Astoria beds of Oregon which figured under the generic name of *Loripes* in 1848 and was referred first to the Miocene and afterwards to the Eocene in 1865 under the generic name of *Mysia*. In 1860, however, he had described a distinct species from the Cretaceous of Alabama as *Mysia parilis*. It turned out to belong to the *Veneridæ*, and Conrad proposed a genus *Tenea* for it in 1870, while Gabb in 1876 showed that he had described the same shell in 1860 as *Mysia gibbosa*, while Conrad as early as 1853 had named it *Lucina pinguis*. Whitfield thinks *Tenea* practically identical with *Thetis* Sowerby, but at all events it has a high angular pallial sinus and cannot be a *Diplodonta*. In addition to the above complications, in 1866 Conrad described a true *Diplodonta* from the Miocene of Shiloh, New Jersey, as *Mysia parilis*. This has no connection with the Oregon shell and requires a new name, which I have given it as above.

This species is rotund and turgid and clearly distinct from the later Miocene species about to be discussed. There is a very closely related if not identical form in the Jacksonian Eocene of Mississippi.

Diplodonta nucleiformis Wagner.

Mysia nucleiformis Wagner, Journ. Acad. Nat. Sci. Phila., viii., p. 52, pl. 1, fig. 4, 1838.

Loripes elevata Conrad, Fos. Med. Tert., p. 73, pl. 41, fig. 8, 1845.

Cytherea sphærica H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 241, pl. 34, fig. 22, 1845.

Diplodonta elevata Conrad, Proc. Acad. Nat. Sci. Phila., ix., p. 166, 1858.

Mysia carolinensis Conrad, in Kerr, Rep. Geol. N. Car., App., p. 21, pl. 4, fig. 5, 1875.

Miocene of Petersburg and York River, Virginia; of the Meherrin and Neuse River, of the Natural Well and Magnolia, Duplin County, North Carolina, and in the Oligocene Oak Grove sands, Florida; Wagner, Lea, Conrad, and Burns.

This is a smooth, moderate sized, globose species without any very distinctive characters, but smaller, less turgid, and transverse than *D. shilohensis*, and more solid and circular than the following species.

Diplodonta yorkensis n. sp.

PLATE 43, FIGURE 5.

Miocene of the York River, Virginia, near Yorktown; Harris.

Shell thin, oblong, varying to rounded, sculptured only by incremental lines, slightly varying in strength; beaks low, inconspicuous; ligament short, teeth short and small, hinge-line narrow, briefly excavated in front; muscular and pallial impressions normal. Alt. 8, lat. 10.5, diam. 5 mm.

This species differs from the preceding by its very thin shell, less turgid and globose; the shorter and most rounded specimens are considerably less inflated than in the *nucleiformis,* which does not seem to attain so large a size.

Diplodonta acclinis Conrad.

PLATE 28, FIGURES 2, 13.

Lucina acclinis Conrad, Fos. Tert. Form., p. 21, pl. 6, fig. 2, 1832; Whitfield, Mio. Moll. N. J., p. 62, pl. x., figs. 5, 6, 1895.

Mysia americana Conrad, Fos. Medial Tert., p. 30, pl. 16, f. 2, 1838 (not *Lucina americana* Defrance, 1823); Proc. Nat. Inst., ii., p. 185, 1842; Meek, Mioc. Checkl., p. 8, 1864.

Diplodonta acclinis Conrad, Proc. Acad. Nat. Sci. Phila., ix., p. 166, 1858; Dall, Trans. Wagner Inst., iii., p. 923, 1898.

Basal Miocene of Shiloh, Cumberland County, New Jersey; Miocene of Jones Wharf, Maryland, Greensboro', Maryland, York River, Virginia, Wilmington and various localities in Duplin County, North Carolina; Pliocene of Tilly's Lake, Waccamaw River, South Carolina, of Walton County, Florida, and of the Caloosahatchie River; Burns, Harris, Stanton, and Dall.

This is the finest and most conspicuous species of the Miocene; if it possessed, when living, a strong, polished epidermis it would probably have found a place in the section *Felaniella,* to which its form and minor characters show some resemblance.

Diplodonta (Sphærella) subvexa (Conrad).

Sphærella subvexa Conrad, Fos. Medial Tert., p. 18, pl. 10, fig. 2, 1838; Proc. Acad. Nat. Sci. Phila. for 1863, p. 577.

Erycina subconvexa Orbigny, Prodr., iii., p. 115, 1852.

Miocene of the James River near Smithfield, Virginia, Conrad; and of the Nansemond River near Suffolk, Virginia, Burns.

This fine species has been discussed in connection with the section *Sphærella.* It appears to be rare. Our largest specimen measures, alt. 36, lat. 40, diam. 30 mm.

The *Sphærella oregona* Conr., of the "Smithsonian Checklist of Eocene Fossils of North America" (p. 6, 1866) appears to be a nude name, at least I have not been able to find any diagnosis of it in the literature, and it has not been figured.

Diplodonta Leana Dall.

Psammocola lucinoides H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 239, pl. 34, fig. 16, 1845.

Not *Diplodonta lucinoides* Desh. (as *Venus*), Coq, Fos. de Paris, i., p. 146, pl. 23, figs. 12-13, 1824.

Miocene of Petersburg, Virginia; Lea and Burns.

This resembles *D. shilohensis* Dall, but is thinner, less inflated, with the lower posterior margin more prominently rounded. *D. caloosaënsis* when adult is much larger, and the young, when of the same length as *D. Leana*, are of a rounded triangular form, conspicuously different from the regularly subovate outline of *D. Leana*. *D. nucleiformis* is a smaller, more cup-like shell with proportionately more prominent beaks.

Diplodonta punctata Say.

Amphidesma punctata Say, Journ. Acad. Nat. Sci. Phila., i., p. 308, 1822.

Lucina venezuelensis Dunker, Zeitschr. Mal., v., p. 184, 1848.

Lucina janeirensis Reeve, Conch. Icon. *Lucina*, pl. 8, fig. 43, June, 1850.

Lucina subglobosa C. B. Adams, Proc. Boston Soc. Nat. Hist., ii., p. 298, 1847 (name only).

Diplodonta braziliensis Mittré, Journ. de Conchyl., i., p. 240, pl. xii., figs. 7-9, Aug., 1850 (not *Lucina braziliensis* Phil.).

Diplodonta venezuelensis Dunker, Novit. Conch. Moll. Mar., p. 3, pl. iv., figs. 7-9, 1858; Dall, Bull. Mus. Comp. Zool., ix., p. 136, 1881.

?*Diplodonta orbella* Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser., viii., p. 376, 1881; not of Gould.

Mysia pellucida Heilprin, The Bermuda Ids., pp. 179, 190, pl. 17, fig. 3, Oct., 1889.

Pliocene of Costa Rica? Gabb; Pleistocene of South Carolina and Florida, Burns and Dall; living from Cape Hatteras, North Carolina, south to Rio Janeiro, and at Bermuda.

This species is easily distinguished by its squarish orbicular form with somewhat attenuated anterior end, and especially by the microscopic sculpture, which exhibits short radiating striulæ, minutely punctate where well developed, and succeeding one another over a large part of the surface. This style of sculpture appears to be peculiar to this particular species, which thus tends to bridge the gap between *Diplodonta* proper and *Phlyctiderma*. It is not equally well shown, however, on all specimens.

Diplodonta (Phlyctiderma) punctulata H. C. Lea.

Lucina punctulata H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., ix., p. 240, pl. 34, fig. 18, 1845.

Miocene of Petersburg, Virginia; Lea.

I have not been able to obtain additional specimens of this species, but it undoubtedly belongs here. The punctations are microscopic, and cover the whole surface, unlike the pustules of *D. semiaspera.* The species superficially resembles *D. puncturella,* but is larger. The type specimen is still in the collection of the Academy of Natural Sciences, where I have examined it.

Diplodonta (Phlyctiderma) semiaspera Philippi.

Diplodonta semiaspera Phil., Wiegm. Arch., i., p. 225, pl. vii., fig. 2 *a-d,* 1836.

Lucina granulosa C. B. Adams, Proc. Boston Soc. Nat. Hist., ii., p. 9, 1845; Contr. Conch., p. 245, 1852.

Lucina semireticulata Orb., Voy. Am. Mér., p. 585, pl. 84, figs. 7-9, 1846.

Diplodonta semiaspera Dall, Bull. 37, U. S. Nat. Mus., p. 52, 1889.

Pliocene of the Caloosahatchie beds, Florida, Dall; living in moderate depths of water from Cape Hatteras, North Carolina, south to Rio Janeiro.

Diplodonta caloosaensis n. sp.

Plate 44, Figure 16.

Pliocene of the Caloosahatchie beds, Florida, Dall; and of the Waccamaw River, South Carolina, Johnson.

Shell large, moderately inflated, sculptured with somewhat irregularly prominent incremental lines; beaks low, pointed, inconspicuous; anterior end shorter, smaller, evenly rounded into the evenly arcuate base; posterior end squarish, longer, larger, more inflated; in the young the form is even more inequilateral and sometimes rounded trigonal with the anterior end attenuated; hinge-line short, with hardly any hinge-plate; ligamentary groove sharp, but the nymph not prominent; teeth and scars normal. Alt. 25, lat. 27, diam. 17 mm.

This species is larger and less equilateral than *D. Leana;* specimens of the same size are less inflated. It resembles *D. punctata* Say, which is a smaller shell, but has not the microscopic surface sculpture.

Diplodonta soror C. B. Adams.

Lucina soror C. B. Adams, Contr. Conch., p. 247, 1852.

Lucina kiawahensis Holmes, Post-Pl. Fos. S. Car., p. 29, pl. 6, fig. 5, 1858.

Pleistocene of the Kiahwah (Ashley) River and of Simmons Bluff, Wadmalaw Sound, South Carolina; living at Jamaica in the Antilles and on the coast of Texas.

This is a well-characterized species, notable for its microscopic shagreening on the posterior slope and the compression or subrostration of the same part of the shell. It is abundant at Simmons Bluff, and specimens of the same size are absolutely identical with specimens of *soror* named by and received from Professor Adams.

The *D. orbella* Gould, a recent species of the Pacific coast, has been erroneously referred to *Sphærella* by Conrad, and the name has been incorrectly used for a Pliocene species of Costa Rica by Gabb. *Venus ascia* H. C. Lea (1845), from the Miocene of Petersburg, Virginia, has the aspect of a much dilapidated *Felaniella,* but the type valve is so poor that its systematic position cannot be decisively fixed.

PLATE XXXVI.

Fig. 1. *Corbula (Bothrocorbula) radiatula* Dall, outside of left valve; lon. 12.5 mm.; p. 851.

Fig. 2. The same, interior of left valve; lon. 12.5 mm.; p. 851.

Fig. 3. The same, interior of right valve; lon. 12.5 mm.; p. 851.

Fig. 4. *Teredina bowdeniana* Dall, left valve with portions of tube attached; lon. 6.5 mm.; p. 822.

Fig. 5. *Martesia (Aspidopholas) ovalis* Say, with a portion (edges broken) of the enveloping protoplax; lon. 12 mm.; p. 820.

Fig. 6. *Corbula (Aloidis) extenuata* Dall; lon. 7 mm.; p. 844.

Fig. 7. *Anisodonta americana* Dall; from the Caloosahatchie Pliocene; lon. 6 mm.; p. 1133.

Fig. 8. *Corbula (Cuneocorbula) sericea* Dall; lon. 5.5 mm.; p. 848.

Fig. 9. *Corbula (Bothrocorbula) Willcoxii* Dall, interior of right valve, showing depressed lunule; lon. 16.2 mm.; p. 851.

Fig. 10. *Corbula (Cuneocorbula) sphenia* Dall; lon. 17.5 mm.; p. 847.

Fig. 11. *Corbula (Cuneocorbula) seminella* Dall; lon. 4.7 mm.; p. 848.

Fig. 12. *Corbula (Bothrocorbula) synarmostes* Dall, exterior of left valve; lon. 14 mm.; p. 850.

Fig. 13. The same, interior of right valve; lon. 12.5 mm.; p. 850.

Fig. 14. *Corbula (Cuneocorbula) sarda* Dall; lon. 12 mm.; p. 847.

Fig. 15. *Corbula (Aloidis) heterogenea* Guppy, interior of right valve; lon. 7.5 mm.; p. 850.

Fig. 16. *Corbula (Aloidis) caloosæ* Dall; lon. 11.5 mm.; p. 853.

Fig. 17. *Corbula (Cuneocorbula) nucleata* Dall; lon. 5.15 mm.; p. 855.

Fig. 18. *Corbula (Cuneocorbula) Whitfieldi* Dall; lon. 6 mm.; p. 849.

Fig. 19. *Corbula (Aloidis) milium* Dall; lon. 2.7 mm.; p. 845.

Fig. 20. *Crassatellites clarkensis* Dall; Eocene of Wahtubbee, Clarke County, Mississippi; dorsal view; lon. 29 mm.

Fig. 21. The same, showing hinge of left valve; lon. 23.5 mm.

Fig. 22. *Callista pittsburgensis* Dall; Tejon Eocene of Pittsburg, Oregon; lon. 26 mm.

Fig. 23. *Semele carinata* Conrad; Oligocene of Oak Grove, Florida; lon. 16.5 mm.; p. 988.

Fig. 24. *Crassatellites clarkensis* Dall; Eocene; hinge of right valve; lon. of fragment 17 mm.

Fig. 25. The same, side view of perfect right valve; lon. 43 mm.

Fig. 26. *Semele carinata* Conrad, exterior of valve, figured above; lon. 16.5 mm.; p. 988.

PLATE XXXVI.

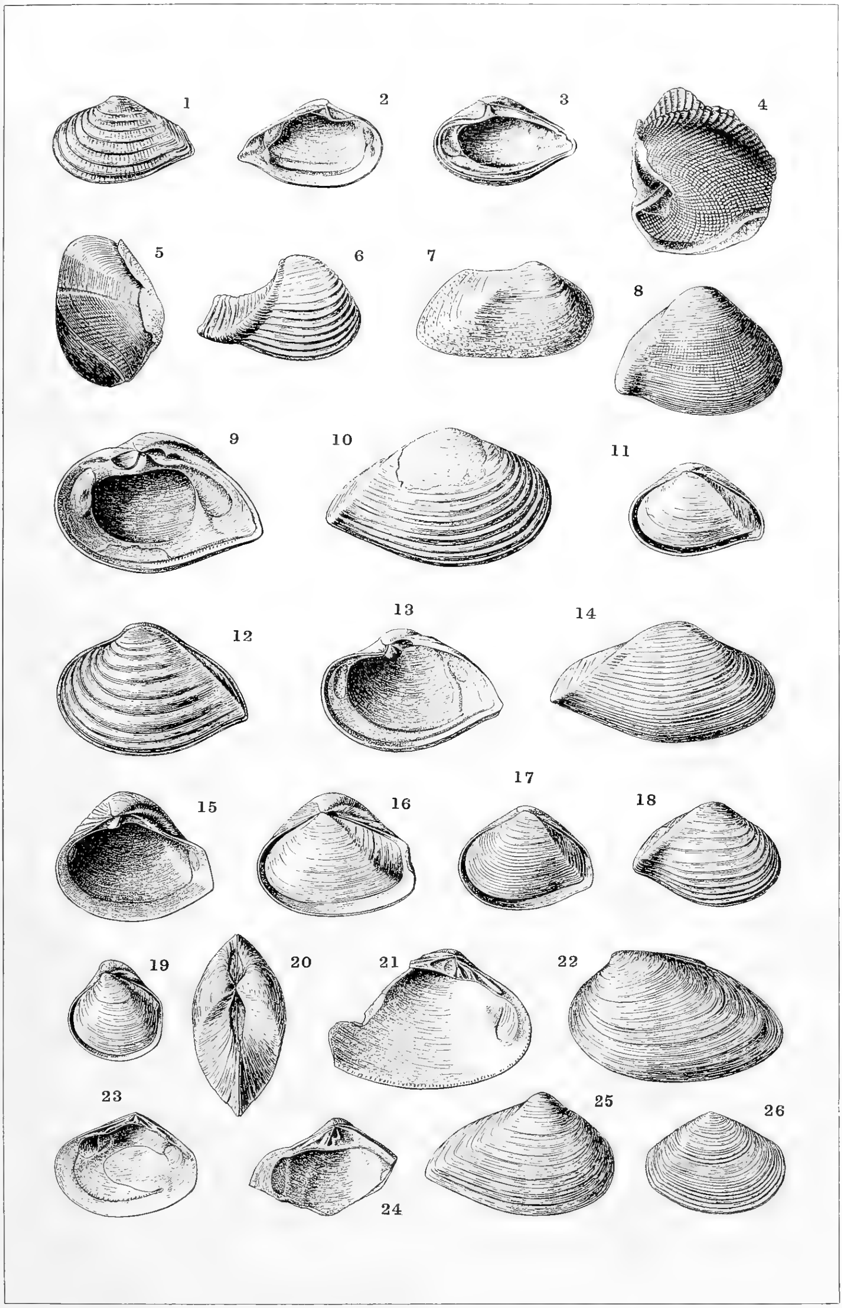


PLATE XXXVII.

Fig. 1. *Semele Leana* Dall; Caloosahatchie beds; lon. 54 mm.; p. 992.

Fig. 2. *Semele Leana* Dall, umbonal view; p. 992.

Fig. 3. *Semele chipolana* Dall, Chipola beds; lon. 54 mm.; p. 986.

Fig. 4. *Semele perlamellosa* Heilprin; Caloosahatchie Pliocene; lon. 54 mm; p. 992.

Fig. 5. The same, umbonal view; p. 992.

Fig. 6. *Crassatellites melinus* Conrad, variety *meridionalis* Dall; Miocene of Alum Bluff, Florida; lon. 69 mm.

Fig. 7. *Tellina segregata* Dall, left valve; Ballast Point, Tampa Bay, silex beds; lon. 17 mm.; p. 1019.

Fig. 8. The same, dorsal view; p. 1019.

Fig. 9. *Macoma Lyelli* Dall, internal cast, showing impression of right valve; Miocene of Gay Head, Martha's Vineyard, Massachusetts; lon. 43 mm.; p. 1049.

Fig. 10. The same, umbonal view of another internal cast; lon. 39 mm.; p. 1049.

Fig. 11. The same, internal cast showing impression of right valve of same specimen as figure 9 represents; lon. 43 mm.; p. 1049.

Fig. 12. *Clementia Grayi* Dall; Oligocene of Oak Grove sands; lon. 64 mm.

Fig. 13. *Crassatellites melinus* Conrad, variety *meridionalis* Dall; Miocene of Alum Bluff, Florida; same specimen as Figure 6, viewed dorsally; lon. 69 mm.

Fig. 14. *Pecten Parmeleei* Dall; Pliocene of San Diego, California; alt. 45 mm.; p. 708.

Fig. 14a. The same, enlarged view of secondary sculpture.

PLATE XXXVII.

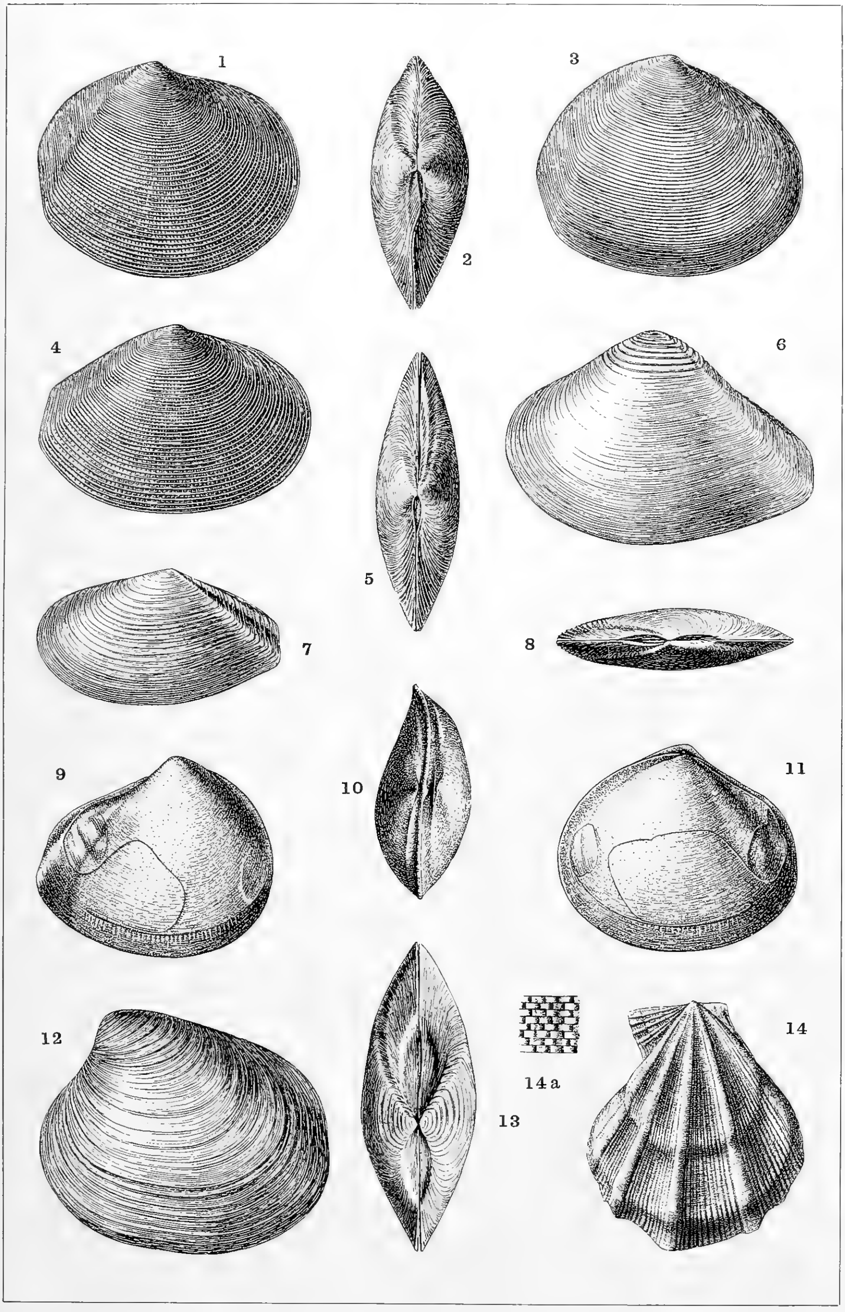


PLATE XXXVIII.

Fig. 1. *Venus halidona* Dall, right valve, enlarged to bring out sculpture; Ballast Point, Tampa Bay, Florida, silex beds; lon. 37 mm.

Fig. 1a. The same, umbonal view.

Fig. 2. *Venus tarquinia* Dall, = *V. magnifica* Heilprin non Sowerby, left valve, enlarged slightly; lon. 49 mm.; Ballast Point silex beds.

Fig. 2a. The same, umbonal view.

Fig. 3. *Tellina (Merisca) halidona* Dall; Ballast Point silex beds; lon. 14.5 mm.; p. 1021.

Fig. 3a. The same, inside view; p. 1021.

Fig. 4. *Arca umbonata* Lamarck; from above; Ballast Point silex beds; lon. 36.0 mm.; p. 620.

Fig. 4a. The same, inside view of left valve; p. 620.

Fig. 5. *Leda flexuosa* Heilprin, type specimen; lon. 14.25 mm.; p. 589.

Fig. 5a. The same, dorsal view.

Fig. 6. *Semele silicata* Dall; Ballast Point silex beds; lon. 23.0 mm.; p. 987.

Fig. 7. *Cyrena pompholyx* Dall, interior view of right valve; from the Ballast Point silex beds; lon. 43 mm.

Fig. 8. The same, external view.

Fig. 9. *Cardita serricosta* Heilprin, interior view of a silicious pseudomorph, natural size; Ballast Point silex beds.

PLATE XXXVIII.

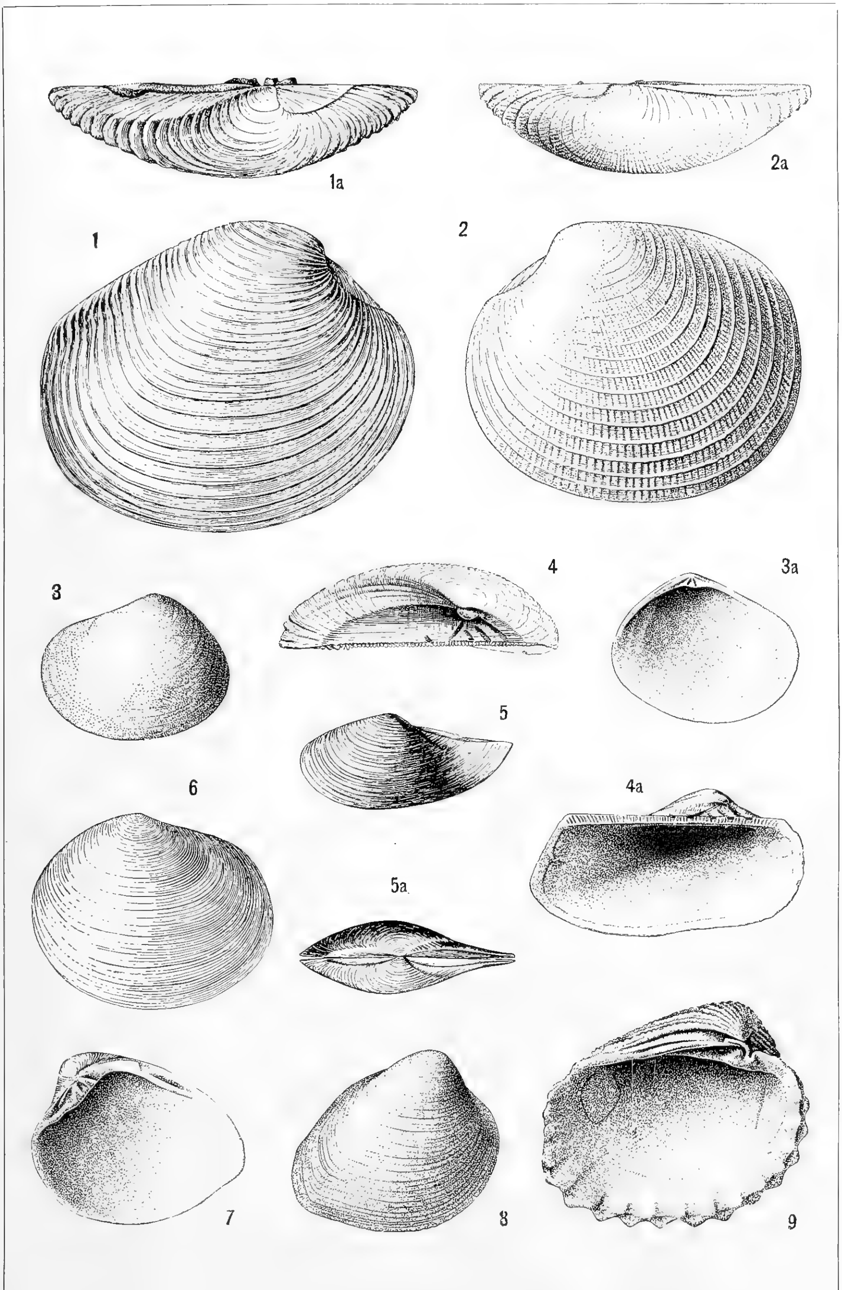


PLATE XXXIX.

Fig. 1. *Cypræa chilona* Dall, from above; Chipola horizon at Alum Bluff, Florida; lon. 50 mm.

Fig. 2. *Solarium cupola* Heilprin, basal view; Eocene of Wood's Bluff, Alabama; diam. 18 mm.; p. 326.

Fig. 3. *Cypræa chilona* Dall (Fig. 1), basal view; lon. 44 mm.; laterally defective.

Fig. 4. *Helix (Plagioptycha) direpta* Dall, basal view; diam. 15 mm.; p. 10.

Fig. 5. *Helix (Plagioptycha) direpta* Dall; Ballast Point silex beds; a perfect specimen figured to supply the deficiencies of the original figures; alt. 13 mm.; p. 10.

Fig. 6. *Arca Wagneriana* Dall; Caloosahatchie beds; a specimen with unusually produced wings; lon. 12.7 mm.; p. 619.

Fig. 7. The same, viewed from above.

Fig. 8. *Solen amphistemma* Dall; Oligocene sands of Oak Grove, Florida; interior of right valve; lon. 112 mm.; p. 952.

Fig. 9. *Crassatellites densus* Dall; Oak Grove sands; interior of right valve; lon. 59 mm.

Fig. 10. The same; another specimen viewed from above.

Fig. 11. The same; another specimen showing variation in form.

Fig. 12. The same; a specimen having what is probably the most normal form of the species.

PLATE XXXIX.

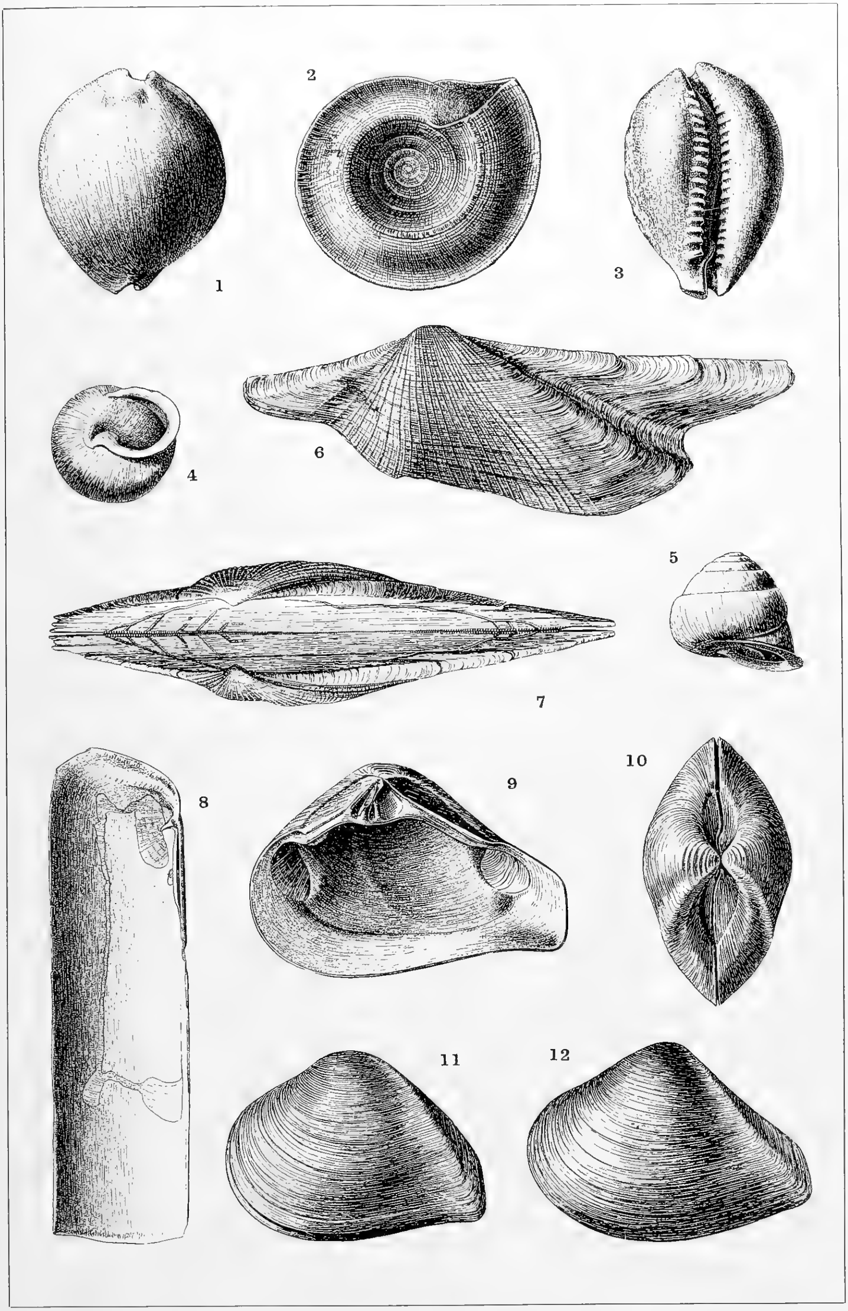


PLATE XL.

Fig. 1. *Nucula (Acila) decisa* Conrad; Pittsburg, Oregon; outside view; lon. 24.6 mm.; p. 573.

Fig. 2. *Lucina plesiolopha* Dall; Oligocene of Oak Grove, Florida; interior of left valve; alt. 15.5 mm.

Fig. 3. *Nucula (Acila) decisa* Conrad, interior; lon. 24.6 mm.; p. 573.

Fig. 4. *Nucula (Acila) cordata* Dall; Miocene of Oregon; lon. 16.0 mm.; p. 573.

Fig. 5. *Lucina plesiolopha* Dall, exterior; alt. 15.5 mm.

Fig. 6. *Nucula Shaleri* Dall; Miocene of Gay Head, Martha's Vineyard, Massachusetts; lon. 16.5 mm.; p. 575.

Fig. 7. *Cardium druidicum* Dall; Oak Grove sands; exterior of left valve; lon. 25 mm.; p. 1094.

Fig. 8. *Cardium chipolanum* Dall; Chipola marl; exterior of right valve; alt. 36 mm.; p. 1098.

Fig. 9. *Cardium taphrium* Dall, exterior of left valve; Oak Grove sands; lon. 35 mm.; p. 1098.

Fig. 10. *Cardium (Fragum) arestum* Dall; Caloosahatchie beds; alt. 27 mm.; p. 1102.

Fig. 11. The same from behind; alt. 27 mm.

Fig. 12. *Cardium (Trigoniocardia) alicula* Dall, a worn pseudomorph from the Ballast Point silex beds; alt. 13 mm.; p. 1103.

Fig. 12b. *Astyris turgidula* Dall; Ballast Point, Tampa Bay, silex beds; alt. 13 mm.

Fig. 13. *Cardium ctenolium* Dall; Oak Grove sands; alt. 20 mm.; p. 1081.

Fig. 14. *Cardium pansatrum* Dall; Oak Grove sands; lon. 12.3 mm.; p. 1093.

Fig. 15. *Cardium (Hemicardium) apateticum* Dall; Oak Grove sands; outside of left valve; alt. 10.5 mm.; p. 1105.

Fig. 16. *Cardita* sp.; Oak Grove sands; lon. 20.5 mm.; young shell.

PLATE XL.

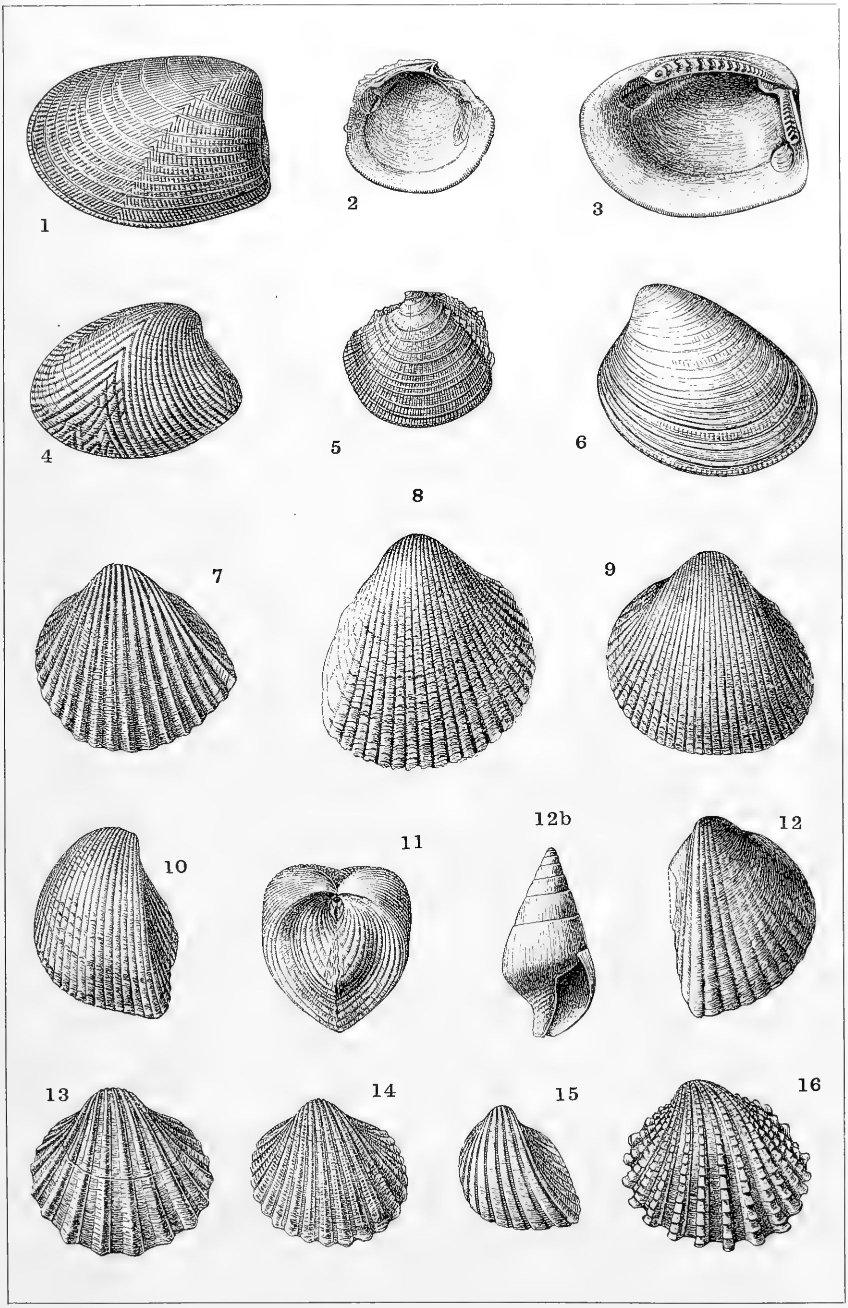


PLATE XLI.

Fig. 1. *Scala (Sthenorhytis) Mazyckii* Dall, basal view; Miocene of Cainhoy, South Carolina; diam. 28 mm. See *The Nautilus,* vol. ix., p. 111, February, 1896.

Fig. 2. The same, front view.

Fig. 3. *Ancillaria chipolana* Dall; Oligocene marl of the Chipola River, Florida; alt. 25 mm.

Fig. 4. *Pleurotoma boadicea* Dall; Oligocene sands of Oak Grove, Florida; alt. 25 mm.

Fig. 5. *Chama Willcoxi* Dall, interior of attached valve; Pliocene of Shell Creek, Florida; lon. 85 mm.

Fig. 6. The same, with both valves in place.

Fig. 7. The same, interior of upper valve; lon. 85 mm.

Fig. 8. *Scala ranellina* Dall, basal view; Eocene of the Zeuglodon bed (Jacksonian), near Cocoa P. O., Alabama; diam. 23 mm. See *The Nautilus,* vol. ix., p. 111, February, 1896.

Fig. 9. The same, front view; alt. (decollated) 33 mm.

Fig. 10. *Astyris perfervida* Dall; Oligocene sands of Oak Grove, Florida; alt. 18 mm.

Fig. 11. *Terebra psilis* Dall; Oligocene sands of Oak Grove, Florida; alt. 16.5 mm.

PLATE XLI.

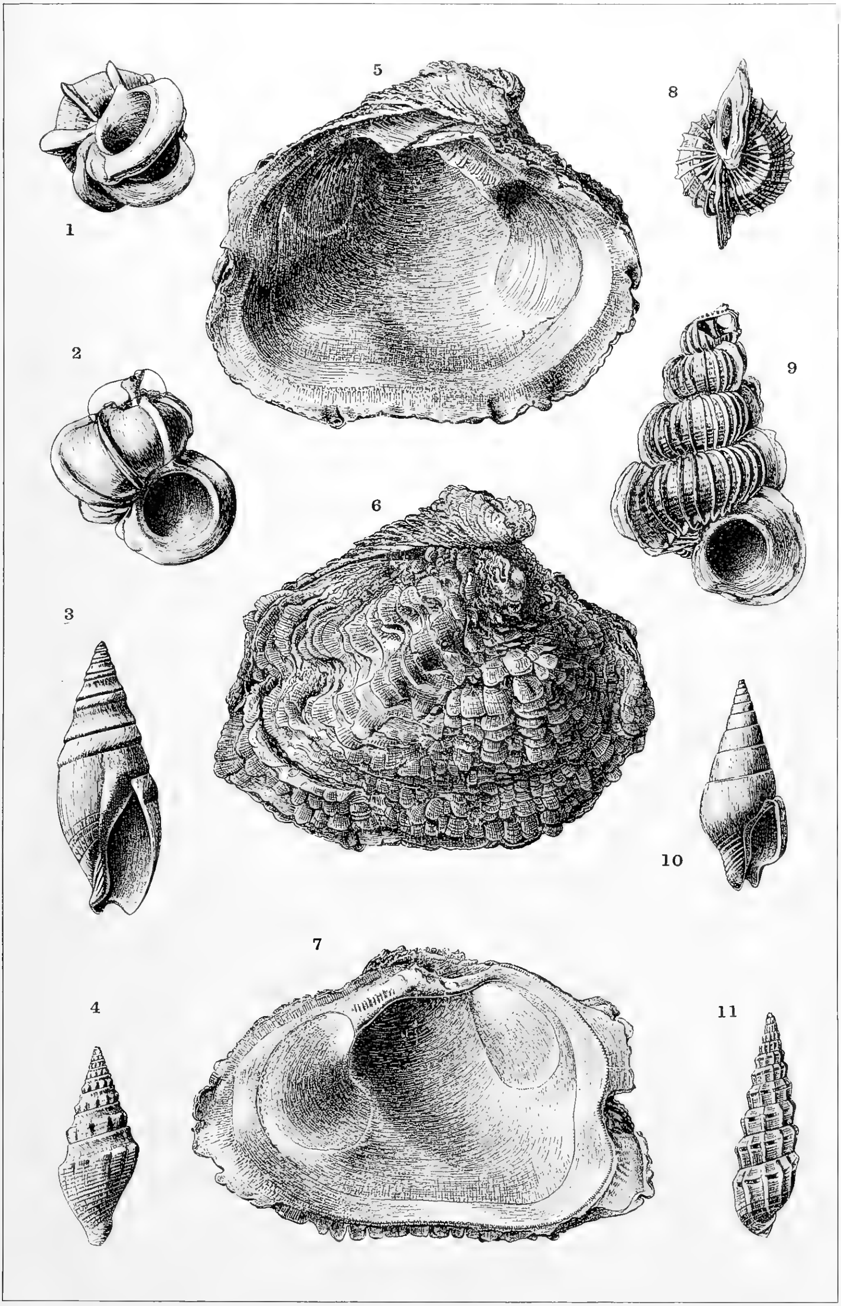


PLATE XLII.

Fig. 1. *Verticordia (Haliris) mississippiensis* Dall; Wahtubbee Eocene of Mississippi; lon. 5.6 mm.

Fig. 2. *Venus Langdoni* Dall; Chipola marl; interior of left valve; lon. 88 mm.

Fig. 3. *Venus latilirata* Conrad; Pliocene of the Waccamaw beds, South Carolina; dorsal view; lon. 34 mm.

Fig. 4. *Venus (Anaitis) Burnsii* Dall; Oligocene of the Chipola River, Florida; form with the concentric ribs confluent; lon. 34 mm.

Fig. 5. *Venus (Anaitis) ulocyma* Dall; Miocene of Alum Bluff, Florida; adult; lon. 45 mm.

Fig. 5a. The same, young shell; lon. 18 mm.

Fig. 6. *Eunaticina caractacus* Dall; Oligocene sands of Oak Grove, Florida; alt. 7.1 mm.

Fig. 7. *Venus Langdoni* Dall, dorsal view; lon. 88 mm.

Fig. 8. *Crassatellites psychopterus* Dall; Wahtubbee Eocene of Mississippi; lon. 20.2 mm.

Fig. 9. The same; external view of the same valve.

Fig. 10. *Venus (Anomalocardia) caloosana* Dall; Pliocene of the Caloosahatchie marls, Florida; lon. 21 mm.

Fig. 11. *Venus (Anaitis) Burnsii* Dall; Chipola beds; form with the concentric ribs distinct.

Fig. 12. *Venus Langdoni* Dall; Chipola beds; view of exterior of left valve; *a*, shows one of the concentric lamellæ complete, the others are more or less defective through chipping; lon. 88 mm.

Fig. 13. *Verticordia coceneusis* Langdon; Wahtubbee Eocene of Clarke County, Mississippi; internal view of left valve; lon. 4 mm.

Fig. 14. The same, external view of the same valve.

PLATE XLII.

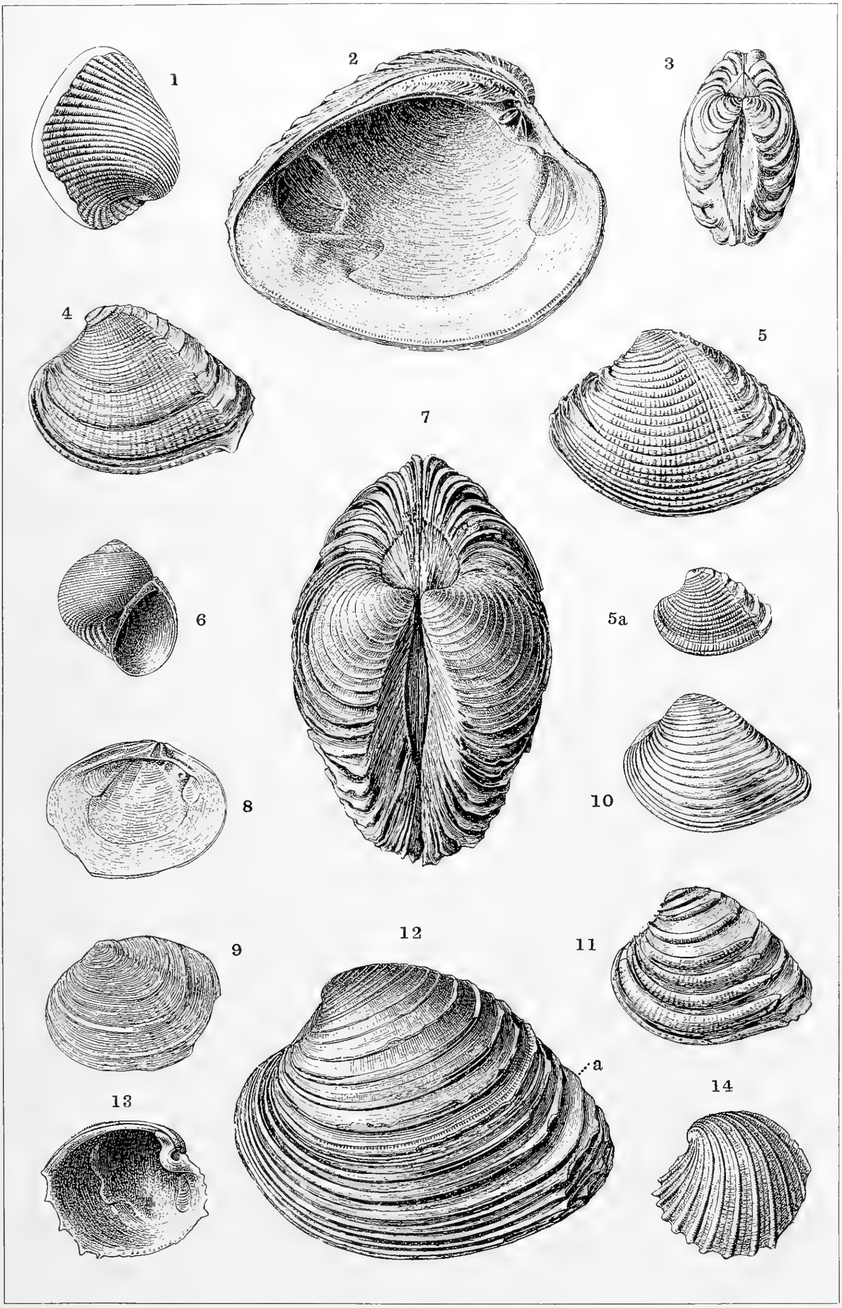


PLATE XLIII.

Fig. 1. *Petricola Harrisii* Dall; 22.5 mm.; Miocene of Virginia; p. 1060.

Fig. 2. *Semele mutica*, var. *scintillata* Dall; 8.0 mm.; Oligocene of Florida; p. 988.

Fig. 3. *Astarte protracta* O. Meyer, young; lon. 6.5 mm.; Claiborne sands, Claiborne, Alabama.

Fig. 4. *Semele alumensis* Dall; 8.5 mm.; Alum Bluff Miocene; p. 989.

Fig. 5. *Diplodonta yorkensis* Dall, view of interior and profile of teeth; 11.0 mm.; Miocene of Virginia; p. 1185.

Fig. 6. *Semele Smithii* Dall, restored from fragments; 26.0 mm.; Chipolan; p. 987.

Fig. 7. *Pteropurpura Postii* Dall, Proc. U. S. Nat. Mus., xviii., p. 44, 1895; Tampa silex beds; Oligocene; alt. 38 mm.

Fig. 8. *Velorita floridana* Dall; 80 mm.; Tampa silex beds; Oligocene; showing hinge as worked out.

Fig. 9. *Trapezium clairbornense* Dall; 7.0 mm.; Claibornian; outside view.

Fig. 10. The same, view of the interior.

Fig. 11. *Rochefortia Stantoni* Dall; 3.76 mm.; Miocene of North Carolina; p. 1160.

Fig. 12. *Semele mutica* Dall, typical form; 9.5 mm.; p. 988.

Fig. 13. *Velorita floridana* Dall, profile of type specimen; 80.0 mm.

Fig. 14. *Pleurotoma Lapenotierei* Dall; Tampa silex beds at Ballast Point; 27.0 mm.

Fig. 15. *Meretrix (Callista) pittsburgensis* Dall, view from above; 36.0 mm.; Eocene of Pittsburg, Oregon.

Fig. 16. *Semele mutica*, var. *Stearnsii* Dall; 11.0 mm.; Chipolan Oligocene; p. 988.

PLATE XLIII.

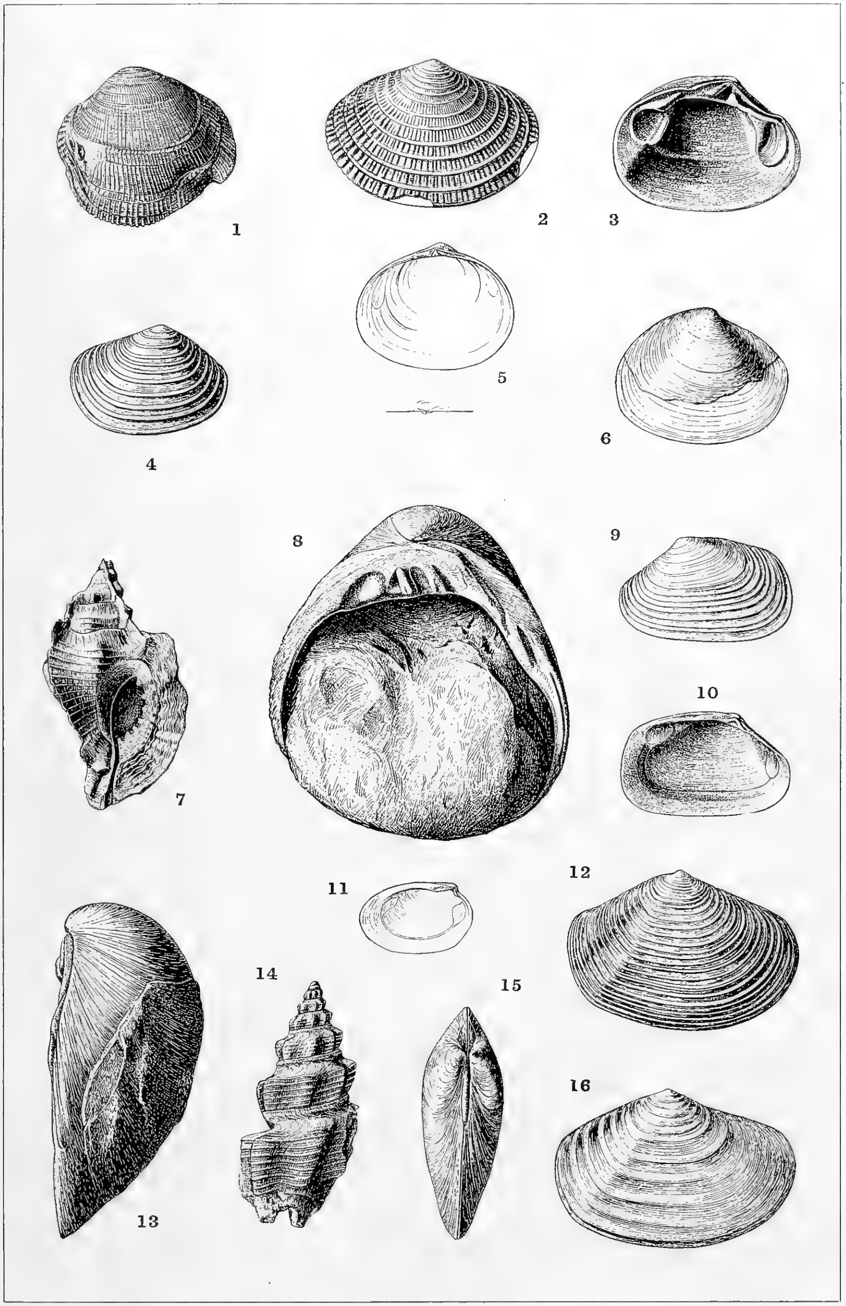


PLATE XLIV.

Fig. 1. *Sportella yorkensis* Dall; 7.0 mm.; Miocene of Virginia; p. 1130.

Fig. 2. *Montacuta actinophora* Dall; 11.0 mm.; Oligocene of Florida; p. 1172.

Fig. 3. *Erycina carolinensis* Dall; 7.0 mm.; Miocene of North Carolina; p. 1145.

Fig. 4. *Montacuta chipolana* Dall; 8.5 mm.; Oligocene of Florida; p. 1171.

Fig. 5. *Semelina cythereoidea* Dall; 5.0 mm.; Oligocene of Florida; p. 994.

Fig. 6. *Montacuta sagrinata* Dall; 7.5 mm.; Miocene of Virginia; p. 1174.

Fig. 7. *Erycina plicatula* Dall; 9.5 mm.; Claibornian; adult with feeble sculpture; p. 1143.

Fig. 8. *Aligena minor* Dall; 3.0 mm.; Miocene of North Carolina; p. 1177.

Fig. 9. *Sportella lubrica* Dall; 5.0 mm.; Oligocene of Florida; p. 1127.

Fig. 10. *Sportella pelex* Dall; 7.3 mm.; Miocene of Virginia; p. 1131.

Fig. 11. *Diplodonta radiata* Dall, interior of left valve and profile of teeth; 19.0 mm.; Oligocene of Florida; p. 1184.

Fig. 12. *Erycina plicatula* Dall; 6.0 mm.; young shell with strong sculpture; p. 1143.

Fig. 13. *Sportella unicarinata* Dall; 5.5 mm.; exterior of adolescent valve, showing carina and prominent prodissoconch; Oligocene of Florida; p. 1127.

Fig. 14. *Petricola calvertensis* Dall; 17.5 mm.; Miocene of Maryland; p. 1060.

Fig. 15. *Erycina chipolana* Dall; 4.1 mm.; Oligocene of Florida; p. 1144.

Fig. 16. *Diplodonta caloosaënsis* Dall; 27.0 mm.; Pliocene of Florida; p. 1188.

Fig. 17. *Diplodonta (Felaniella) minor* Dall, interior of right valve and profile of teeth; 4.5 mm.; Oligocene of Bowden, Jamaica; p. 1183.

Fig. 18. *Sportella obolus* Dall, interior of right valve and profile of teeth; 4.5 mm.; Oligocene of Florida; p. 1126.

Fig. 19. *Diplodonta alta* Dall; 27.0 mm.; Chipolan Oligocene; p. 1183.

Fig. 20. *Donax chipolana* Dall; 9.5 mm.; Chipolan Oligocene; p. 966.

Fig. 21. *Erycina (Pseudopythina) americana* Dall; 16.0 mm.; Miocene of Maryland; p. 1146.

Fig. 22. *Erycina carolinensis* Dall; 13.25 mm.; Pliocene of South Carolina; p. 1145.

Fig. 23. *Aligena lineata* Dall; 7.5 mm.; Oligocene of Oak Grove, Florida; p. 1176.

Fig. 24. *Sportella lioconcha* Dall; 14.0 mm.; Oligocene of Oak Grove, Florida; p. 1128.

Fig. 25. *Erycina (Pseudopythina) americana* Dall, 16.0 mm.; interior; Miocene of Maryland; p. 1146.

PLATE XLIV.

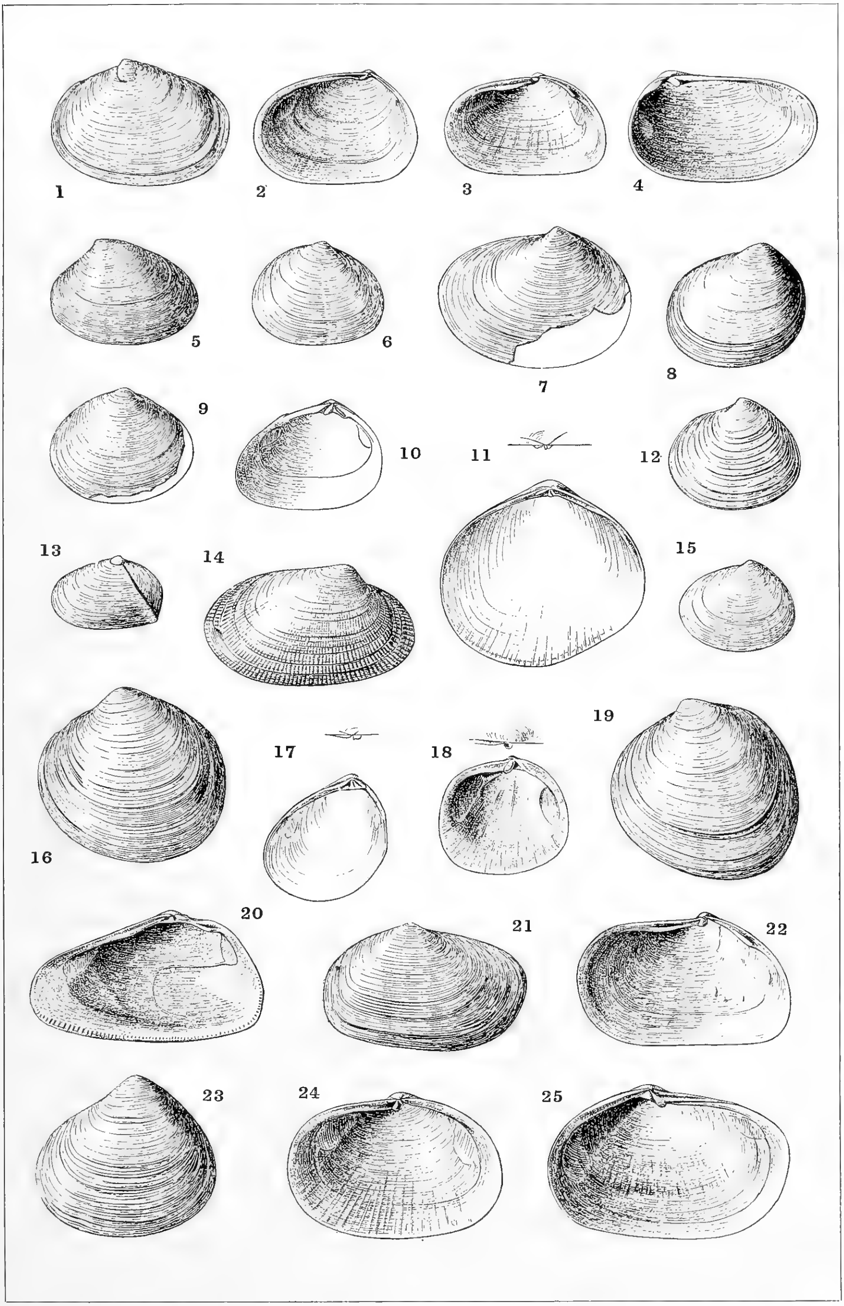


PLATE XLV.

These figures are from camera lucida drawings of the type specimens by W. H. Dall.

Fig. 1. *Erycina fabulina* Dall; 5.0 mm.; Oak Grove, Florida; Oligocene; p. 1145.

Fig. 2. *Bornia floridana* Dall; 7.3 mm.; Oak Grove, Florida; Oligocene; p. 1150.

Fig. 3. *Erycina undosa* Dall; 3.5 mm.; Chipolan Oligocene; p. 1144.

Fig. 4. *Hindsiella carolinensis* Dall; 5.5 mm.; Miocene of North Carolina; p. 1138.

Fig. 5. *Rochefortia Stimpsoni* Dall; 6.0 mm.; Miocene of North Carolina; p. 1160.

Fig. 6. *Montacuta petropolitana* Dall; 5.75 mm.; Miocene of Petersburg, Virginia; p. 1173.

Fig. 7. *Rochefortia planulata* Stimpson; 4.1 mm.; Pliocene of Florida; p. 1161.

Fig. 8. *Hindsiella nephritica* Dall; 4.75 mm.; Oligocene of Florida; p. 1137.

Fig. 9. *Hindsiella acuta* Dall; 6.0 mm.; Miocene of North Carolina; p. 1138.

Fig. 10. *Sportella petropolitana* Dall; 5.75 mm.; Miocene of Petersburg, Virginia; p. 1130.

Fig. 11. *Bornia rota* Dall; 4.2 mm.; Miocene of North Carolina; p. 1151.

Fig. 12. *Hindsiella donacia* Dall; 5.66 mm.; Claibornian; p. 1136.

Fig. 13. *Sportella recessa* Glenn; 5.0 mm.; Miocene of Maryland; p. 1131.

Fig. 14. *Erycina curtidens* Dall; 3.66 mm.; interior of right valve; Oligocene of Florida; p. 1145.

Fig. 15. The same, showing hinge of a left valve; p. 1145.

Fig. 16. *Bornia dodona* Dall; 5.25 mm.; Oligocene of Oak Grove, Florida; p. 1150.

Fig. 17. *Erycina chipolana* Dall; 4.1 mm.; Oligocene of Florida; p. 1144.

Fig. 18. *Montacuta mariana* Dall; 4.0 mm.; Miocene of Maryland; p. 1173.

Fig. 19. *Erycina marylandica* Glenn; 3.05 mm.; Miocene of Maryland; p. 1146.

Fig. 20. *Anisodonta (Fulcrella) carolina* Dall; 5.0 mm.; Miocene of North Carolina; p. 1133.

Fig. 21. *Montacuta claiborniana* Dall; 4.5 mm.; Eocene of Alabama; p. 1171.

Fig. 22. *Erycina protracta* Dall; 8.35 mm.; Pliocene of South Carolina; p. 1146.

Fig. 23. *Dicranodesma calvertensis* Glenn, interior of right valve; 4.75 mm.; Miocene of Maryland; p. 1157.

Fig. 24. The same, interior of left valve; 4.75 mm.; p. 1157.

Fig. 25. *Alveinus rotundus* Dall, interior of left valve; 1.9 mm.; Chipolan Oligocene, Florida; p. 1167.

Fig. 26. *Diplodonta puncturella* Dall, interior of left valve and profile of teeth; 6.0 mm.; Oligocene of Bowden, Jamaica; p. 1183.

Fig. 27. *Solecardia (Spaniorinus) Cossmanni* Dall, interior of right valve; 8.0 mm.; Miocene of Virginia; p. 1125.

Fig. 27a. The same, hinge of left valve; p. 1125.

Fig. 28. *Alveinus rotundus* Dall, interior of right valve, showing hinge; 1.9 mm.; Chipolan Oligocene of Florida; p. 1167.

PLATE XLV.

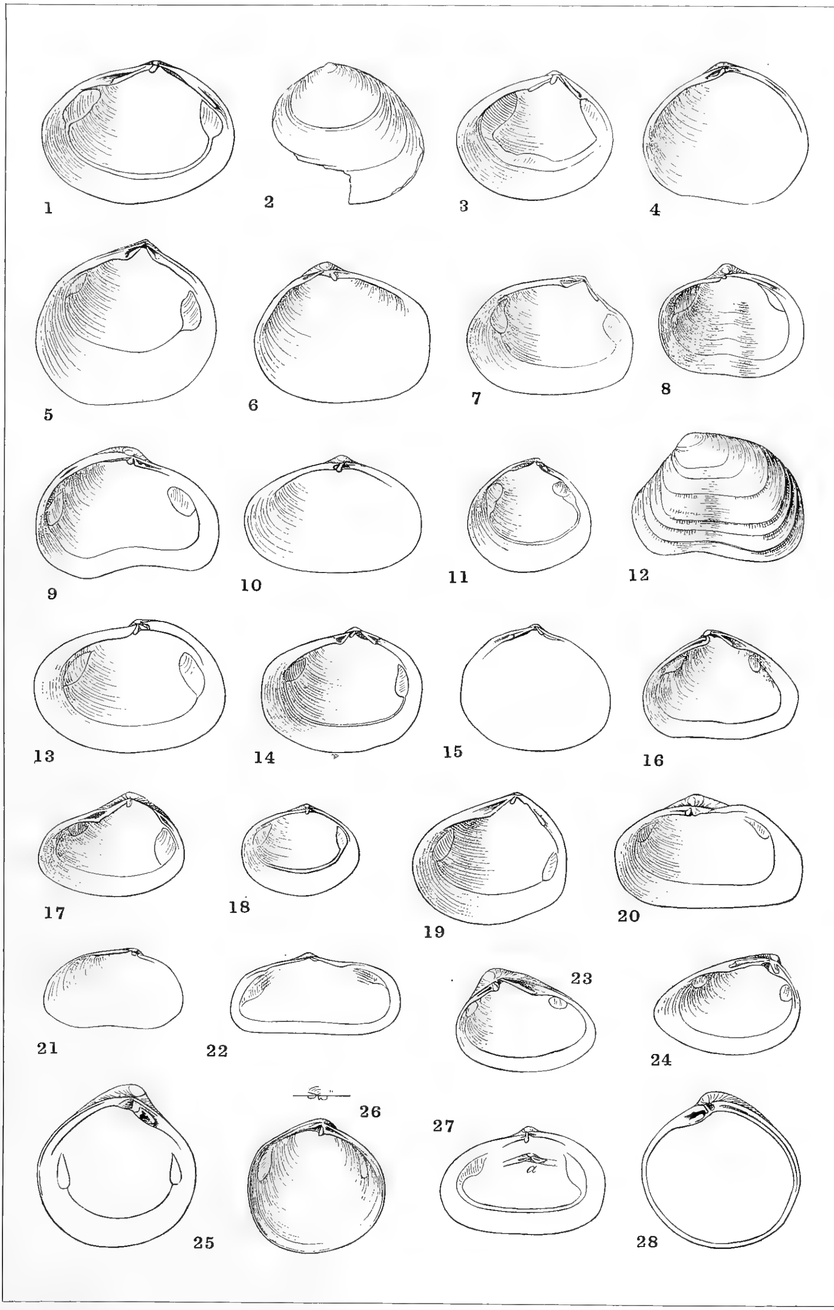


PLATE XLVI.

Fig. 1. *Tellina (Angulus) acosmita* Dall; Chipola Oligocene; lon. 10.5 mm.; p. 1026.

Fig. 2. *Tellina (Angulus) cutœnia* Dall; Claibornian; lon. 9.0 mm.; p. 1016.

Fig. 3. *Macoma (Cymatoica) Vendryesi* Dall; Oligocene of Bowden. The sculpture in the figure is too regular, the concentric waves are more broken up than the artist has indicated in this figure; lon. 7.0 mm.; p. 1056.

Fig. 4. *Tellina (Macaliopsis) merula* Dall; silex beds of Ballast Point, Florida; lon. 16.0 mm.; p. 1019.

Fig. 5. *Tellina (Moerella) Hendersoni* Dall; Oligocene of Bowden; lon. 7.5 mm.; p. 1024.

Fig. 6. *Tellina (Angulus) propetenella* Dall; Miocene of York River, Virginia; lon. 10.0 mm.; p. 1033.

Fig. 7. *Tellina (Angulus) pharcida* Dall; Oligocene of Bowden; lon. 5.5 mm.; p. 1025.

Fig. 8. *Tellina (Macaliopsis) clonecta* Dall; Chipola beds; lon. 13.5 mm.; p. 1020.

Fig. 9. *Tellina (Moerella) Aldrichi* Dall; Chickasawan Eocene of Lisbon, Alabama; lon. 20.0 mm.; p. 1017.

Fig. 10. *Tellina (Merisca) acrocosmia* Dall; Oligocene of Bowden; lon. 7.0 mm.; p. 1020.

Fig. 11. *Tellina (Angulus) agria* Dall; Oligocene of Oak Grove, Florida; lon. 6.7 mm.; p. 1027.

Fig. 12. *Tellina (Moerella) Simpsoni* Dall; Oligocene of Bowden; lon. 7.0 mm.; p. 1024.

Fig. 13. *Tellina (Angulus) umbra* Dall; Miocene of Duplin County, North Carolina; lon. 12.5 mm.; p. 1033.

Fig. 14. *Tellina (Scissula) lampra* Dall; Chipola beds; lon. 8.6 mm.; p. 1028.

Fig. 15. *Macoma irma* Dall; Ballast Point silex beds, Florida; lon. 28.0 mm.; p. 1047.

Fig. 16. *Tellina (Moerella) aclonecta* Dall; Oligocene of Bowden; lon. 4.7 mm.; p. 1025.

Fig. 17. *Tellina (Angulus) dupliniana* Dall; Miocene of Duplin County, North Carolina; lon. 12.5 mm.; p. 1032.

Fig. 18. *Tellina (Phyllodina) lepidota* Dall; Oligocene of the Gatun beds, near Panama; lon. 7.5 mm.; p. 1022.

Fig. 19. *Tellina (Moerella) nucinella* Dall; Oligocene of Oak Grove, Florida; lon. 3.5 mm.; p. 1026.

Fig. 20. *Tellina (Angulus) macilenta* Dall; Miocene of Duplin County, North Carolina; lon. 16.5 mm.; p. 1034.

Fig. 21. *Isocardia floridana* Dall; Vicksburgian of Florida; umbonal view of internal cast; lon. 25.0 mm.; p. 1066.

Fig. 22. *Isocardia carolina* Dall; Miocene of Grove Wharf, Virginia; lon. 84.0 mm.; p. 1067.

Fig. 23. *Tellina (Merisca) hypolispa* Dall; Chipola beds; lon. 13.5 mm.; p. 1022.

Fig. 24. *Metis trinitaria* Dall; Oligocene of Trinidad; lon. 52.0 mm.; p. 1041.

Fig. 25. *Tellina (Moerella) suberis* Dall; Pliocene of the Caloosahatchie marls; lon. 7.0 mm.; p. 1031.

Fig. 26. *Isocardia floridana* Dall; Vicksburgian of Florida; side view of internal cast; lon. 36.0 mm.; p. 1066.

Fig. 27. *Tellina cynoglossa* Dall; Chickasawan Eocene of Wood's Bluff, Alabama; lon. 16.5 mm.; p. 1017.

PLATE XLVI.

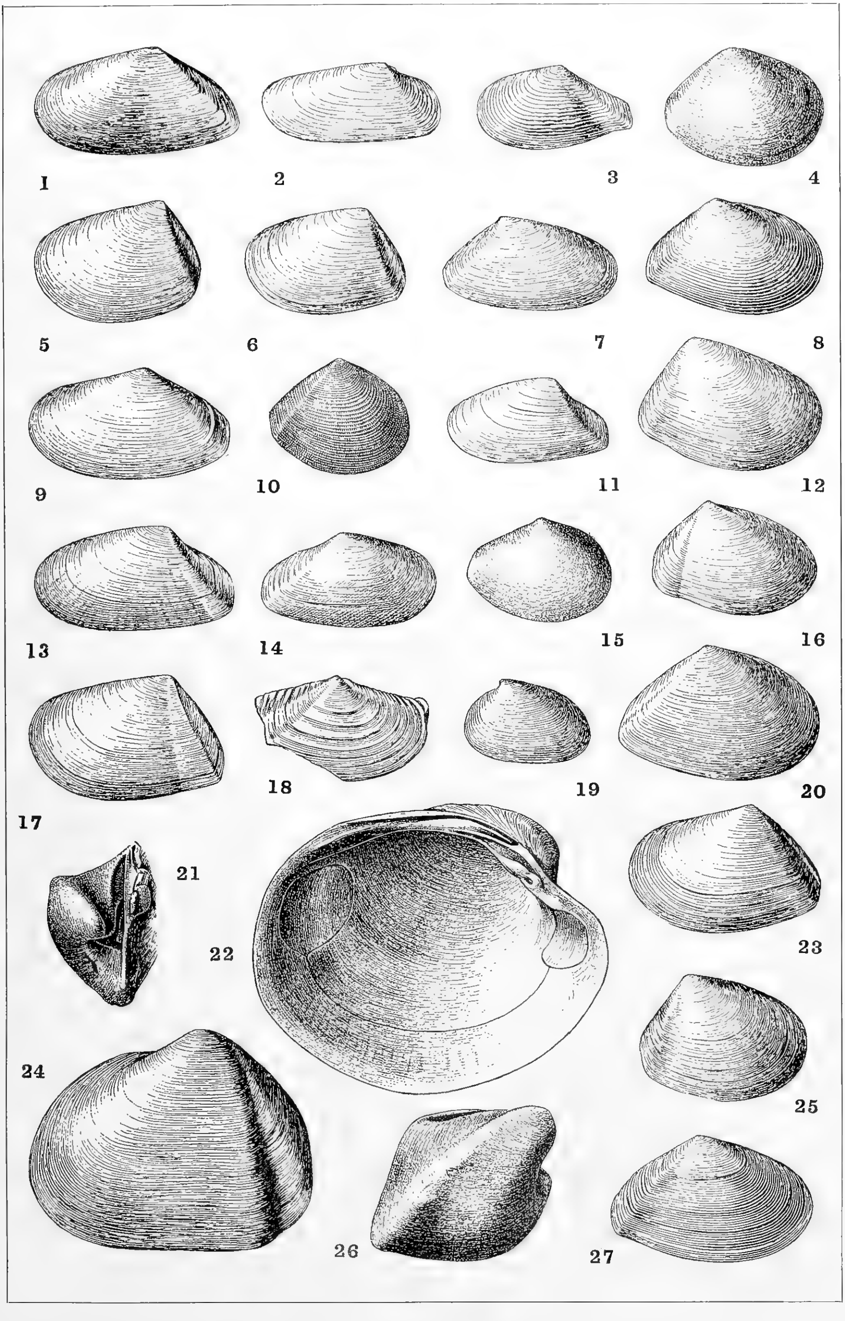


PLATE XLVII.

Fig. 1. *Tellina (Scissula) calliglypta* Dall; Pliocene of Shell Creek, Florida; lon. 13.5 mm.; p. 1036.

Fig. 2. *Tellina (Merisca) caloosana* Dall; Pliocene of the Caloosahatchie marl; lon. 8.0 mm.; p. 1030.

Fig. 3. *Macoma Conradi* Dall; Miocene of York River, Virginia; lon. 22.0 mm.; p. 1048.

Fig. 4. *Macoma Holmesii* Dall; Miocene of Duplin County, North Carolina; lon. 32.0 mm.; p. 1054.

Fig. 5. *Tellina (Angulus) pressa* Dall; Chipola beds; lon. 12.5 mm.; p. 1026.

Fig. 6. *Tellina chipolana* Dall; Chipola beds; lon. 38.0 mm.; p. 1018.

Fig. 7. *Tellina (Angulus) propetenera* Dall; Pliocene of the Caloosahatchie marls; lon. 16.0 mm.; p. 1035.

Fig. 8. *Macoma alumensis* Dall; Miocene of Alum Bluff, Florida; lon. 20.0 mm.; p. 1049.

Fig. 9. *Tellina (Eurytellina) roburina* Dall; Oligocene of Oak Grove, Florida; lon. 39.0 mm.; p. 1024.

Fig. 10. *Macoma calhounensis* Dall; Oligocene of Calhoun County, Florida (Chipola); lon. 10.5 mm.; p. 1046.

Fig. 11. *Tellina strophia* Dall; Chipola beds; lon. 27.0 mm.; p. 1019.

Fig. 12. *Tellina (Angulus) acalypta* Dall; Chipola beds; lon. 10.5 mm.; p. 1027.

Fig. 13. *Macoma (Psammacoma) tracta* Dall; Oligocene of Bowden; lon. 12.7 mm.; p. 1053.

Fig. 14. *Macoma laxa* Dall, inside view; Pliocene of the Caloosahatchie marls; lon. 23.0 mm.; p. 1050.

Fig. 15. *Tellina (Scissula) scitula* Dall; Oligocene of Bowden; lon. 8.0 mm.; p. 1028.

Fig. 16. *Tellina (Eurytellina) scapha* Dall; Miocene of Nansemond River, Virginia; lon. 30.0 mm.; p. 1030.

Fig. 17. *Tellina (Phyllodina) halistrepta* Dall; Oligocene of Bowden; lon. 9.0 mm.; p. 1023.

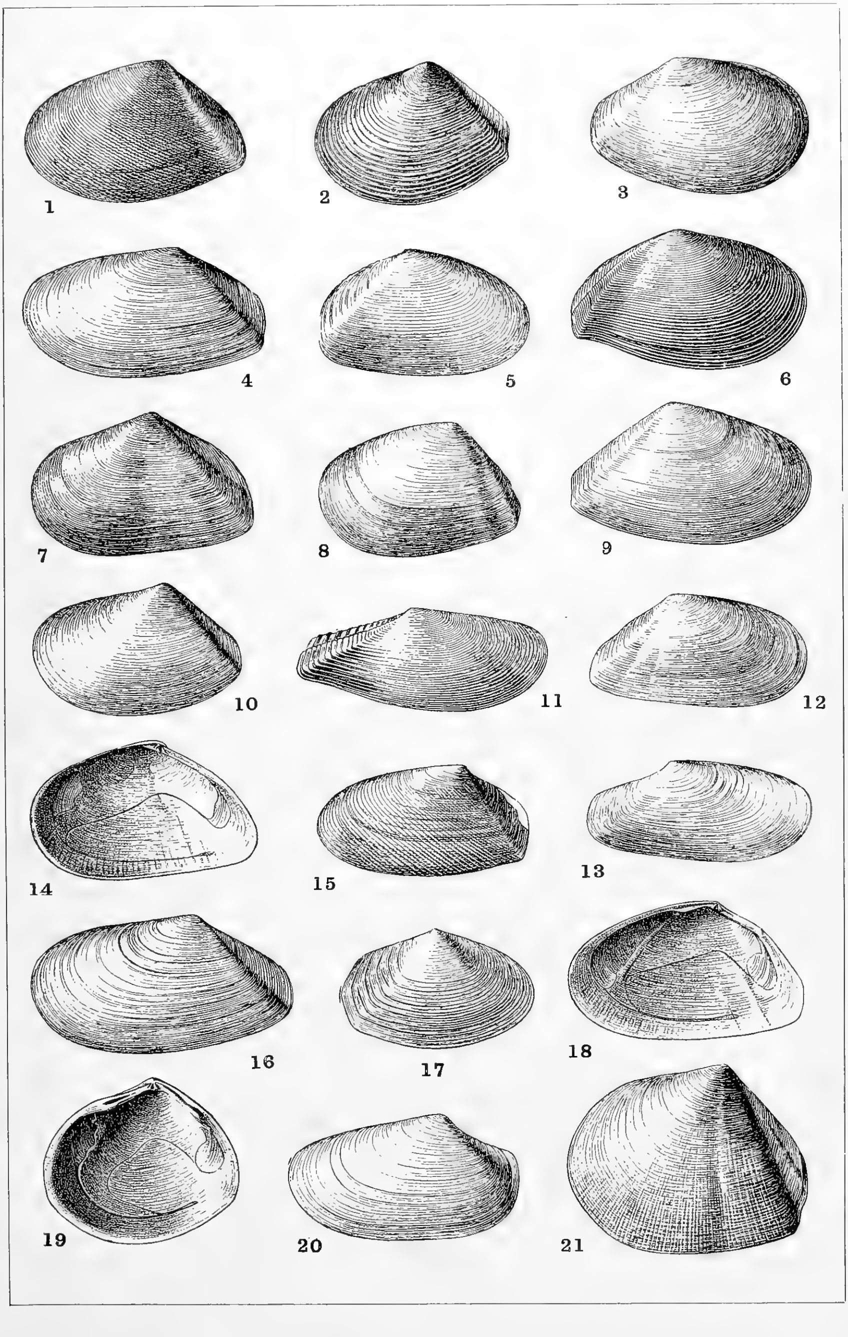
Fig. 18. *Tellina (Oudardia) Buttoni* Dall, inside view, showing radii; lon. 20.0 mm.; p. 1036.

Fig. 19. *Tellina (Merisca) dinomera* Dall, inside view; Pliocene of the Caloosahatchie; lon. 18.0 mm.; p. 1031.

Fig. 20. *Macoma (Psammacoma) olivella* Dall; Bowden Oligocene; lon. 23.0 mm.; p. 1054.

Fig. 21. *Metis chipolana* Dall; Chipola beds; lon. 44.0 mm.; p. 1042.

PLATE XLVII.



INDEX.

In this index subgenera are treated as genera and varieties treated as species. Those names now first proposed for groups or species are in italics; the numerals in italics indicate the pages where the genus or species is described or discussed at length, as contrasted with the pages where it is merely mentioned.

ADDENDUM.

To the synonymy of *Kellia,* page 1153, add:

Diplodontina Stempel, in Spengel's Zool. Jahr., Suppl. bd. iv., bd. 2, heft 1, p. 232, Dec., 1899. Type *D. tumbesiana* Stempel, *loc. cit.*, pl. 12, figs. 18, 19, 19*a*. (Chile.)

According to the figures and description, this name is an exact synonym of *Kellia.*

A *Strigilla galvestonensis* has been described by Harris from the Upper Miocene of the Galveston artesian well, in Bull. Am. Pal., i., p. 92, pl. 7, fig. 4, 1895.

FINAL NOTE.

Plates 48 and 49, to which a few references appear in the text, will be issued with Part vi. The manuscript of this memoir was submitted for publication in April, 1900, and the printing was completed November 28, 1900.