

NEW YORK ACADEMY OF SCIENCES

SCIENTIFIC SURVEY
OF
Porto Rico and the Virgin Islands

VOLUME III—Part 1
Tertiary Mollusca from Porto Rico—*C. J. Maury*



NEW YORK:
PUBLISHED BY THE ACADEMY
1920

TERTIARY MOLLUSCA FROM PORTO RICO AND THEIR ZONAL RELATIONS

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INTRODUCTION

The collection of Porto Rican fossil mollusca upon which the results embodied in this paper are based, was made by Dr. Chester A. Reeds of The American Museum of Natural History, during the summer of 1915, under the auspices of the New York Academy of Sciences and the Porto Rican Government, The American Museum coöoperating.

Unlike the beautifully preserved fossils in the northern part of the neighboring island of Santo Domingo, where the shells in the Miocene blue clays of the Yaqui Valley are as perfect as those on the recent beaches, the fossils from Porto Rico are nearly all in the form of external or internal molds. The majority have been preserved in a creamy or light buff limestone from which all the substance of the shells has been removed by leaching, leaving merely either the imprint of the exterior impressed upon the stone, or else the hardened mud which filled the internal spaces of the shell. Add to this the fragmentary state of the material, and the difficulty of correct determination can be imagined. By making artificial casts of the external molds and comparing them very carefully with actual shells from Santo Domingo, Jamaica and elsewhere, I could confront myself with undoubtedly true identities.

The internal molds were very unsatisfactory and the majority were simply left untouched. But in a few cases where these molds showed the exact form and peculiarities of muscle scars, or columella plications in reverse, or other internal features, one could feel reasonably sure they were the internal casts of certain shells. Sometimes the situation was saved by finding among a great many internal molds a single imprint of the exterior which clinched the identification.

I beg to offer my sincerest thanks to Dr. W. H. Dall, Honorary Curator of the Department of Molluses, United States National Museum, and to Professor G. D. Harris, Department of Paleontology, Cornell University, for their valuable suggestions as to the stratigraphic age of the faunas from the Collazo shales and the

Campanile Zone. I am also indebted to Dr. Dall for his help on certain very puzzling identifications of some unfigured species by comparisons with types at the National Museum.

CHARACTERISTICS OF THE FAUNAS

DISAPPEARANCE OF GENERA, AND PACIFIC AFFINITIES

As in other Antillean Tertiary collections one notes in this from Porto Rico two striking peculiarities; first, the presence of certain genera which have now entirely vanished from the whole Caribbean region, and second, the singular fact that in some cases the recent species most like the fossil form is not now living in the surrounding seas but is in the distant waters of the Pacific. This is due to migration through the Isthmus; the establishment of West Coast and Pacific colonies; and the extinction of the ancestral Antillean stock. The cause of this extinction is a complete mystery, for the larger portion of analogous recent species are Atlantic and West Indian, and are evidently descendants of Oligocene and Miocene forms which have continued on unchanged in the Antillean seas. This fact prevents our calling upon any violent or profound changes to explain the annihilation of the genera and species concerned, and the question remains open.

RANGE OF SPECIES

In brief, the vertical range of molluscan species through the generalized Porto Rican section is short and limited. Only three percent of those I studied are common to the green shales and the limestone. Of these the omnipresent form is *Teredo incrassata* (Gabb) which ranges throughout the section and is extremely abundant. From the distribution of this species in the type region, Santo Domingo, I had thought of it as a Miocene form only; but Dr. T. W. Vaughan now lists it from the Upper Oligocene of the Emperador limestone, in the Panama Canal Zone. So it is not surprising to find these *Teredo* tubes also in the Porto Rican Oligocene horizons.

Arca umbonata Lamarek occurs in the Collazo green shales and in the Quebradillas and Ponce limestones. This is in harmony with the wide range of this species from the Upper Oligocene of the Tampa formation to the recent fauna, although I have carried it down lower by placing the shales tentatively in the Middle

Oligocene. *Ostrea collazica*, new species, is the third case common to the green shales and the limestone. This finely fluted oyster is highly characteristic of and abundant in the green shales, but at one locality Dr. Reeds found it extending up into the limestone.

Doubtless more complete collections would give a few other species in common between the shales and limestones, but in any case I am sure they will be found to be exceptional.

SIGNIFICANCE OF THE FAUNAL CHANGE

The striking change in the molluscan life at the close of the deposition of the Collazo shales clearly marks an important interval of time and change. If the Collazo shales are correctly referred to the Middle Oligocene, this interval would mark the transition from Middle to Upper Oligocene time.

CORRELATION OF THE FAUNAL ZONES

As a brief review of the conclusions of recent authors on Porto Rican paleontology and stratigraphy has already been given in an earlier paper¹ the matter need now only be summarized by saying that the Collazo green shales were generally referred to the Eocene and the Arecibo limestone to the Oligocene period. In 1917 I suggested, reasoning merely from analogies between Berkey's description of the Porto Rican beds² and my Santo Domingan sections³ that the Collazo (Lares) shales might go with the *Orthaulax* zone, or with the probably older Monte Cristi range limestone, and be included in the Oligocene, while the limestones about the shales might correspond to my Dominican *Aphera* and *Sconsia* formations and be of Miocene age.

The present detailed study corroborates this hypothesis, and indicates furthermore the presence of a number of distinct faunal zones to be interpolated between the Collazo shales and the highest beds of the Arecibo limestone. In determining these zones a hundred and one species and varieties have been worked out, of which fifty-two are known and forty-nine are new. These are discussed in the systematic part of this paper.

¹C. J. Maury—On the Correlation of Porto Rican Tertiary Formations with Other Antillean and Mainland Horizons. Amer. Jour. Sci., XLVIII, pp. 209-215, September, 1919.

²C. P. Berkey—Ann. New York Acad. Sci., XXVI, pp. 1-70, Pls. I-III, 1915.

³C. J. Maury—Bull. Amer. Paleontology, No. 30, pp. 1-43, Pls. I-III, and Correlation Table, 1917.

A description of the faunal zones was also published in my earlier paper. On the north side of Porto Rico they consist of the following groups placed in descending geological order: (1) Quebradillas limestone with many Bowden and Dominican Miocene forms; (2) Aguadilla limestone with *Orthaulax aguadillensis*; (3) Lares limestone with *Campanile (Portoricia) laricum*; (4) Collazo shales with *Clementia rabelli*. On the south side are (a) the Ponce limestone with *Ostrea cahobasensis* Pilsbry and Brown; (b) Guanica limestone with *Ostrea antiquensis* and (c) Juana Diaz shales. The true time relation between the beds on the north and south sides of the island is very difficult to determine and is only tentatively expressed. The correlation also of the Collazo shales with the Lower Culebra formation is suggested but awaits further knowledge for proof.

In my report, On the Correlation of Porto Rican Tertiary Formations with Other Antillean and Mainland Horizons (Maury, 1919), I followed Dr. Dall in correlating the Flint River beds near Bainbridge with the Tampa formation of Florida. The molluscan evidence would seem to justify this relationship of these horizons especially since they both contain the striking forms, *Orthaulax inornatus* and *O. pugnax*.

Vaughan, however, believes that the Flint River beds are older than the Tampa formation and that they are stratigraphically equivalent to the Antigua formation. His conclusion is based on field sections and on evidence derived from the corals and foraminifera. In the letter dated October 7, 1919, Dr. Vaughan writes: "My stratigraphic placing of the Flint River coraliferous chert is based on several different kinds of evidence. One is the comparison of numbers of sections made along Flint River from Bainbridge down stream to below River Junction, Florida, and stratigraphic studies across Florida eastward from Apalachicola River. With regard to the coral fauna in the Flint River chert, there is very little in common with the coral fauna of Tampa—*Orthaulax inornatus* and *Orthaulax pugnax* are both species of considerable stratigraphic range and neither one of them can be used as a basis for close geologic correlation."

Now, if we lower the Flint River beds to the Antiguan, should we also drop the Lares limestone with *Campanile laricum* down to the same level? This would in turn suggest dropping the Collazo shales into Lower instead of Middle Oligocene. Beds of Lower

TENTATIVE CORRELATION OF THE PORTO RICAN TERTIARY FORMATIONS

| | | Porto Rico | | Santo Domingo | Haiti | Jamaica | Anguilla | Antigua | Panama | Florida | Georgia | Cuba |
|-----------|--------|--|---|--|-------------------------------|---|--------------------|-------------------|--|-------------------------------|-----------------------------------|--------------|
| OLIGOCENE | Middle | Upper | Lower | Subdivisions of the Arecibo Formation | | | | | | | | |
| MIOCENE | Middle | North Side | South Side | Quebradillas limestone with bowden Fauna and <u>Metia trinitaria</u> | Upper or Sconsia formation | Mais-sade beds | Bowden marl | - | Gatun beda with Sconsia | Oak Grove sands Chipola marls | Marl at Baracoa | La Cruz marl |
| | | | | | | | | | ?Lower Gatun horizon | | | |
| OLIGOGENE | Middle | San Sebastian Lares, or Collazo shales | Rio Collazo Shales with <u>Clementina rabelii</u> | Guanica gahly limestone with <u>Ostrea antiguenensis</u> | ?Monte Cristi range limestone | Las Cahobes beds and Thomond beds with <u>Ostrea cahobasensis</u> | Anguilla formation | Emperor limestone | Tampa formation with Orthaulax <u>Inornatus</u> and <u>O. pugnax</u> | Various localities of Cuba | Coral reef at Guantnamo (Vaughan) | |
| | | | | | | | | | Upper part of Culebra formation | | | |

Oligocene age are represented by Hill's Montpelier white limestone and synchronous formations which are thought to be present in Cuba and Haiti.

There is a structural argument for postulating a Lower Oligocene age for the Collazo shales in that they show evidence of disturbance which has greatly deformed the fossils they contain. This might well have taken place during the period of Antillean diastrophism between the deposition of the Upper Eocene and the Middle Oligocene.

On the other hand, the paleontological evidence suggests a younger age since the most abundant fossil is a *Clementia* like *C. dariena* from Gatun. According to the field observations, however, of Berkey and of Reeds, the shales must be much older than the Gatun Formation, which is about equivalent to the Quebradillas limestone, for they underlie the limestone series. The genus *Clementia* is generally thought to have originated in the Oligocene, but Professor Harris⁴, has lately referred a St. Maurice Eocene shell, *Dosinia mercenaroidea* Aldrich, to *Clementia*. This, however, was a primitive form just differentiating from its relatives, while the shell from the Collazo shales is a typical, well defined *Clementia*, certainly of the same group as *Clementia dariena* and possibly identical, though more likely ancestral. Two of the Areas in the shales are forms which might run back even into Early Oligocene time; but one species is a later type resembling a Culebra shell. In view of these faunal relations, I do not think that the Collazo shales will prove older than Middle Oligocene.

The purely paleontological results given herein must be weighed by other investigators and harmonized with the actual succession showed by the field sections. It will very likely then be found that certain of the faunal zones in my correlation table should be somewhat raised or lowered.

Vaughan's recent geological survey of the island of Santo Domingo will doubtless reveal the presence there of new faunal horizons some of which may bring out more clearly the interrelation of the Porto Rican horizons. Meantime the following correlation table is suggested as an approximation towards the true sequences and relationships of the Tertiary molluscan zones of Porto Rico.

⁴Bull Amer. Paleontology, No. 31, p. 151. 1919.

SYSTEMATIC DESCRIPTION OF SPECIES
CLASS PELECYPODA
ORDER PRIONODESMACEA
Genus **Arca** Linnaeus

We are much indebted to Dr. Pearl Sheldon of Cornell University for critically examining and sending us valuable notes upon the Areas. In a letter, dated June 27th, 1919, Dr. Sheldon writes:

There are at least fourteen different species, many of them new, in the Porto Rican collection, but only a few of them can be described (owing to their very imperfect state), and only one certainly identified as an old species, *A. umbonata*. The single valve of *Arca* cf. *cumanensis* is the best preserved specimen in the collection, but one of the hardest to identify, because the two valves would be discrepant, and it might be *A. cumanensis* which is unfigured and only briefly described.

The collection seems to be very different from the Santo Domingan Areas. . . . There are no species in common that can be identified except *A. umbonata*, and *Barbatia reticulata*. . . . The comparisons are chiefly from Panama or other distant localities.

Concerning this striking difference between the Porto Rican and Dominican Areas, as observed by Dr. Sheldon, it is important to note that the specimens were sent to her with station numbers only, and that very few happened to be from the horizon I had identified, unknown to her, as equivalent to the Dominican and Bowden Miocene. Of these latter she refers one to *A. umbonata* and the other to a new species nearest a Dominican shell that I described as *A. cibaoica*. Dr. Sheldon's results from the Areas thus strengthen the evidence I have gathered from the other molluscan genera, namely that in the Porto Rican collection we have to do with several distinct faunas, only one of which is like that of Bowden.

Arca umbonata Lamarck

- Arca umbonata* Lamarck, 1819, Anim. s. Vert., VI, p. 37.
Arca umbonata Philippi, 1847, Abbild. u. Beschr., III, p. 13, Pl. XVII, b.
 figs. 3 a-c.
Arca imbricata (Bruguière) Gabb (in part) 1873, Trans. Amer. Phil. Soc.,
 XV, p. 254.
Arca umbonata Arango, 1879, Fauna Malacologica Cubana, p. 261.
Arca umbonata Dall, 1898, Trans. Wagner Inst. Sel., III, pt. 4, pp. 620, 659;
 1900, *Idem* pt. 5, Pl. XXXVIII, figs. 4, 4 a.
Arca umbonata Sheldon, 1916, Paleontographica Americana I, p. 8, Pl. I,
 figs. 12-17.
Arca umbonata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 164, Pl. XXX,
 fig. 11.
Arca umbonata Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 564.

Lamarek described the type of this species from a recent shell from Jamaica. Yet, curiously, it has not turned up in the Miocene (Bowden) beds of that island, although I collected it from synchronous deposits in Santo Domingo on the Rio Cana, and now it appears in Reeds's collection from Porto Rico.

Arca umbonata has a wide geological and geographical range. It is found in the upper Oligocene of the Tampa formation; the lower Miocene of the Chipola marls, Pleistocene of the Florida Keys and the Antilles, and is living from Cape Hatteras to Santa Caterina, Brazil, and also in the Antilles. The Porto Rican molds of this ark-shell are readily distinguished from the other Areas by the sharp umbonal ridge characteristic of this species. Because of its nestling habit the form of the shell varies considerably. This species is one of the best represented Areas in Porto Rico, and the localities show its presence in both the green shales and the limestones, and on the northern and southern sides of the Island. Apparently the shell was comparatively common as contrasted with its presence in the Dominican blue clays in which we found but a single valve, although other Areas were wonderfully abundant and varied.

*Localities**.—Rio Collazo, near San Sebastian, Stations 35, 60; near Quebradillas, Station 134; near Ponce, Station 292.

Also a mold from Station 111 of which Dr. Sheldon notes "I am sure this is the young of *A. umbonata* but cannot entirely prove it." The others were all identified as unquestionably this species. Of the specimen from Station 35 Dr. Sheldon writes "Besides the general form this specimen has the coarse ribs on the posterior slope and the conspicuously finer, cancellated ribs anterior to the ridge which characterize *A. umbonata* and its Pacific allies."

Subgenus **Barbatia** Gray

Barbatia (Acar) reticulata Gmelin

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

Arca reticulata Chemnitz, Conch. Cab., VII, p. 193, Pl. LIV, fig. 540.

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

Arca (Barbatia) reticulata Dall and Simpson, Bull. U. S. Fish Comm. XX, pt. 1, p. 460.

*The locality numbers mentioned in this paper are those assigned in the field by Dr. Reeds. Their exact position will be recorded by him in a forthcoming report. The American Museum accession number, 440, is understood to precede all the Station numbers.

Arca (Barbatia) reticulata Sheldon, 1916, *Paleontographica Americana*, I, p. 20, Pl. IV, figs. 8-12.

Barbatia (Acar) reticulata Maury, 1917, *Bull. Amer. Paleont.*, No. 29, p. 166, Pl. XXX, fig. 16.

There is a fragmentary imprint in a limestone block apparently made by a valve of *Barbatia reticulata*, since a cast from it agrees well with shells of this species.

This richly and deeply sculptured ark-shell was first developed in the Jacksonian Eocene of Mississippi. It continued on in the Oligocene of Tampa, Miocene of Bowden, of Matura, Trinidad, and of the Chipola River, Florida; Pliocene of Florida; Pleistocene of the Antilles; Recent from Cape Hatteras to the Gulf of Campeche. It is one of the very few fossil species still living on the Porto Rican shores and is reported by Dall and Simpson from the reefs at Ponce, from Mayaguez, Guanica, San Juan Harbor and Hucares. In 1917 I found a single valve in the Miocene bluffs of Cercado de Mao, Santo Domingo. The single external mold in the present series shows that the species was also present in Porto Rico, but seems then to have been a rare shell.

Locality.—Near Ponce, Station 288.

***Arca (Scapharca) guajatica* Sheldon and Maury, new species**

Plate I, Figure 3

Shell very small, oblong, much inflated, marked by a shallow sulcus ending at about the middle of the ventral margin. The sculpture consists of twenty-seven or twenty-eight narrow, rounded ribs, widely spaced over the anterior and posterior parts of the valve, but finer and closer in the sulcus. Cardinal area partly concealed by the limestone matrix, but probably narrow. Margin of valve crenulate. Length of shell 7 mm., height 4 mm., semi-diameter 3 mm.

Five examples of this little form show that it is not the young of any other Ark in the collection, and it appears to be a new species. Its most conspicuous feature is the convexity in the umbonal region. This species recalls *Scapharca cibaoica* Maury from the Yaqui Valley, Santo Domingo, but it has a broadly inflated umbo instead of the small pointed beaks of that shell; the beaks are less anterior (at about two-fifths the length of the shell), the direction of the sinus is less oblique, so too is the general aspect of the shell, and finally the number of ribs is greater in the Porto Rican species. From Bowden also a small species, though larger than either of our Domin-

ican or Porto Rican little Arcas, has been described by Dall as *A. bowdeniana*, but its general appearance is not like this Porto Rican shell.

Localities.—Four specimens from near Quebradillas, Station 130, and a mold, probably this species, from Station 128, same region.

Arca (Scapharca) aguadica Sheldon and Maury, new species

Plate I, Figure 2

Shell small, flattened, umbo not much inflated; beaks at the anterior third; cardinal area long and narrow; ribs about twenty-seven or twenty-eight, those on the posterior third appearing as low, narrow, rounded ridges on the mold, anterior ribs probably more closely spaced, ornamentation unknown. The outline of the shell is oblong, the base being nearly parallel to the hinge which is almost as long as the shell. The posterior margin of the best preserved specimen is straight, nearly at right angles to the hinge and basal margin, and curved only at the corners. More worn specimens have an elliptical posterior margin, yet the outline remains almost bilaterally symmetrical, instead of the usual produced and pointed *Arca* form. Length 17 mm., height 9.5 mm., diameter 7 mm.

This species may be distinguished from the young of the group to which *Arca septicostata* Reeve and *A. henekeni* Maury belong, and from the *Arca transversa* group, by its smaller and less inflated umbo, and especially by its flat, high, oblong and symmetrical posterior end. The collection affords five internal molds, showing both valves in place. Although the exterior has been dissolved away, the form of the mold is so characteristic as to be recognizable, because the species does not closely resemble any described from the Antillean region.

Locality.—Near Aguada in the northwestern part of the island, Station 124.

Arca (Scapharca) collazica Sheldon and Maury, new species

Plate I, Figure 4

Shell oblong, closely-ribbed, the ribs numbering thirty-two to thirty-six, simple, as wide as, or wider than the interspaces, and of almost the same size and spacing over the entire shell; anterior ribs beaded; cardinal area long and narrow, beaks at the anterior two-sevenths. Length of shell 28 mm., height 15 mm., semi-diameter 4 mm.

The green shales of Rio Collazo yielded several valves of a small *Scapharca* of common form, but with distinctive ribbing, unlike

that of related species. Like other specimens from these shales they have suffered distortion from pressure. Because of the distortion of the valves it is uncertain whether the posterior end is more like that of *Arca oronlensis* Gabb (Journ. Acad. Nat. Sci. Phila., (2), VIII, p. 346, Pl. XLIV, fig. 21) from the Miocene of Panama and Costa Rica, and like *Arca dariensis* Brown and Pilsbry (Proc. Acad. Nat. Sci. Phila., LXIII, p. 362, Pl. XXII, fig. 10, 1911) from the Miocene of Panama, or like that of *A. gutunensis* Toula (Jahrb. der k. k. Geol. Reichsanstalt, Wien, LXI, p. 493, Pl. XXX, fig. 4, 1911), also from the Gatun Miocene. Of Antillean species it resembles *Arca inaequilateralis* Guppy (Quart. Jour. Geol. Soc. London, XXII, p. 293, Pl. XVIII, figs. 2a, 2b, 1866) from the Miocene of Bowden, which more nearly agrees in size, and *Arca losquemadica* Maury (Bull. Amer. Paleont., No. 29, p. 172, Pl. XXX, fig. 1, April, 1917) from the Dominican Miocene.

All these Isthmian and Antillean species, however, except *Arca oronlensis*, have ribs which are narrower on the central part of the shell and wider and divided by a groove on the anterior and posterior areas of the valve, while in the Porto Rican species the ribs are entire and nearly the same size over the entire shell. From *Arca oronlensis* the fossil differs in its smaller size, more numerous, and probably less beaded ribs.

Localities.—Rio Collazo near San Sebastian, Stations, 53, 54, 60.

Arca (Scapharca) sansebastiana Sheldon and Maury, new species

Plate I, Figure 5

Shell small, oblong, rather inflated, with the umbonal ridge very sharply defined; beak full, incurved; hinge-line rather short, its characters concealed by the matrix. The entire surface of the valve is sculptured with about twenty-five, apparently uniform ribs. No beading is shown on the ribs, but this may be due to the imperfect preservation of the shell. Length of right valve 18 mm., height 12 mm., semi-diameter 5 mm.

This species is most nearly akin to *Arca balboai* Sheldon (Palaeontographica Americana I, p. 69, 1917= *Arca dalli* Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., LXIV, p. 510, Pl. XXIV, fig. 4, January, 1913, name preoccupied), from the Isthmus of Panama. But the Porto Rican shell is smaller, longer in proportion to its height, much less inflated, and with the umbonal ridge much more sharply angled. The ribs also are fewer, numbering twenty against

twenty-eight. Clearly, however, the affinities of this Porto Rican species are with the Isthmian shell, which was obtained from a lignitic clay at the bottom of the Culebra Cut, Las Cascades.

The new species is founded upon a single specimen of entirely different aspect from *Scapharca collazica*, with which it was associated.

Locality.—Rio Collazo near San Sebastian, Station 53.

Arca (Scapharca) cf. actinophora Dall

Arca (Scapharca) actinophora Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 647, Pl. XXXIII, fig. 26, 1898.

There are in the collection two specimens, probably belonging to the same species, one being the internal mold of both valves with broken posterior margin, the other the worn exterior of the umbonal region. The latter recalls *Arca auriculata* Lamarck, but the ribs are wider and the form of the mold is different. The ribs are wider than the interspaces, varying but little over the shell and entire as far as the fragment indicates.

This species is most like *Scapharca actinophora* Dall from Panama, but is smaller and is less attenuated posteriorly. It bears some resemblance also to *A. galunensis* Toula, but is larger, the beaks higher, and more anterior, and the ribbing seemingly was different. This is probably a new species, but too poorly preserved to warrant specific description.

Localities.—Near Aguada, in the northwest part of the island, Station 117 (internal mold); near Ponce, in the south central part of the island, Station 293 (exterior, probably the same).

Arca (Cuneearca) cf. cumanensis Dall

Arca (Cuneearca) cumanensis Dall, Trans. Wagner Inst. Sci., III, pt. 4, pp. 633, 634, 1898.

There is a single right valve of a small *Cuneearca* intermediate between the recent *A. incongrua* Say and *A. chemnitzi* Philippi, but nearer the former species. This Porto Rican shell answers the description of *Arca cumanensis* from the Miocene of Cumana, Venezuela, excepting that the posterior ribs near the hinge are nodulose. It is allied also to *Arca chemnitzoides* Maury from Trinidad (Jour. Acad. Nat. Sci. Phila., (2), XV, p. 44, Pl. VI, figs. 13, 14, 15, Pl. VIII, fig. 1, 1912), which is nearer *A. chem-*

nitzi. Probably this species is identical with *A. cumanensis* which has never been figured.

Locality.—Near Aguada, Station 123.

Genus **Glycymeris** Da Costa
Glycymeris acuticostata Sowerby

Pectunculus acuticostatus Sowerby, 1850; Quart. Jour. Geol. Soc. London, VI, p. 53, Pl. X, fig. 13.

Pectunculus acuticostatus Guppy, 1866, Quart. Jour. Geol. Soc., London, XXII, p. 293; 1867, Proc. Sci. Assoc. Trinidad, p. 164.

Axinea acuticostata Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 255.

Pectunculus acuticostatus Guppy, 1874, Geol. Mag. London, p. 443; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 532.

Glycymeris acuticostata Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 608.

Glycymeris acuticostata Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 364.

Glycymeris acuticostata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 180, Pl. XXVI, fig. 12; *Idem*, No. 30, pp. 10, 11, 20, 23.

Glycymeris acuticostata Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

In the collection is a single internal mold probably of *Glycymeris acuticostata*, because artificial casts made from the interior of a valve of similar size of this species from Santo Domingo show the same angle of slope of the hinge teeth and bear the same general aspect.

This species was originally described from the Yaqui Valley, Santo Domingo, where Colonel Heneken first collected it. The Maury expedition, 1916, found it quite common in the *Scoriae laevigata* formation of the Mao and Gurabo rivers, Santo Domingo, but did not obtain any specimen from the *Aphera* formation. The species is also known from Cumana, Bowden and Gatun, but is now for the first time found in Porto Rico.

Locality.—Near Quebradillas, Station 130.

Glycymeris cf. jamaicensis Dall

Pectunculus pennaceus Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 293. Not of Lamarck.

Axinea pennacea Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 255.

Pectunculus decussatus Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 532. Not of Hanley.

Glycymeris jamaicensis Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 608; 1903, *Idem*, III, pt. 6, p. 1586.

Glycymeris jamaicensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 181, Pl. XXVI, fig. 13; *Idem*, No. 30, pp. 24, 27.

Partly imbedded in the limestone matrix is a *Glycymeris* which is sculptured with fine, impressed, radiating lines, giving under the lens the effect of obsolete ribs. This sculpture is characteristic of *Glycymeris jamaicensis* Dall from Bowden, which we also found in the Dominican Miocene, *Aphera* formation. It is quite probable that the Porto Rican shell is a young specimen of *G. jamaicensis* but it is too imperfect to identify decisively. The recent analogue of this species is *Glycymeris pennacea* Lamarck, while the corresponding Gatun species is *G. carbasina* Brown and Pilsbry.

Locality.—Near Aguada, Station 117.

Genus *Pteria* Scopoli
Pteria inornata (Gabb)

Avicula inornata Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 253.

Pteria inornata Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 669.

Pteria inornata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 181, Pl. XXVI, fig. 14; *Idem*, No. 30, pp. 11, 13.

Two internal molds of a *Pteria* match very well with shells of *P. inornata* Gabb obtained by the writer on Santo Domingo. This attractive little shell is somewhat variable in form, just as these two molds are not quite alike, but Dominican specimens can be chosen that conform very exactly to each. Well preserved shells are marked with concentric wavy lines of chestnut brown, otherwise the surface is quite smooth. Usually one finds them without the outer layer and then they justify Gabb's name *inornata*. The substance of the shell has been entirely dissolved away from the Porto Rican specimens. This is the first time that this species has been reported from outside of the Dominican Republic.

The recent Porto Rican shell, *Pteria radiata* Leach, is larger and is ornamented with radiating rows of scales; but d'Orbigny's *Pteria candeana* is of much the same general aspect as the fossil.

Locality.—Señor Rabell's Ranch on Rio Guajataca, Station 110.

Genus *Ostrea* (Linnaeus) Lamarck
Ostrea collazica, new species

Plate I, Figure 7; Plate II, Figure 1

Shell irregularly oval, valves very dissimilar in form and sculpture. The lower valve is very convex and irregularly ridged and deformed because of the large area of attachment usually in front of and below the beak. Some specimens show internal marginal crenulations anterior and posterior to the

ligamental area. The beak is recurved. The convex valve is sculptured with close, somewhat regular, wrinkled flattings, in younger shells about five to a space of ten millimeters, in old valves about three to the same distance. On young valves this radial sculpture is very noticeable, in old valves it becomes more or less obscured but traces can be seen on some areas. Some convex valves are greatly thickened, one measuring 65 mm. along the ligament area. The close, radial, wrinkled flattings, convex, irregularly ridged form, and large, deforming attachment area at once distinguish these valves from those of any other species in Porto Rico. The flat valve is marked only with exceedingly close, fine, wrinkled, concentric growth lamellæ. Beak very curving, often with a strong spiral twist as in *Exogyra*. Marginal crenulations are usually in front of and behind the beak. A medium-sized shell with both valves in place measures 70 mm. in height, 55 mm. in width and 40 mm. in thickness. Estimated length of an old valve 160 mm., width 105 mm.

Although extremely characteristic of and common in the green Collazo shales, this species was found also at one locality (Station 56), in the Arecibo limestone.

Localities.—Rio Collazo near San Sebastian, Stations 22, 24, 25, 26, 27, 28, 36, 38, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 62, 63, 95, 107; near Lares, Station 56. Near Arecibo, Station 452. Dr. Reeds collected an enormously heavy *Ostrea*, possibly this species.

Ostrea berkeyi, new species

Plate I, Figure 6

Shell radially sculptured with smooth, well defined divaricating, radial ribs, divided into two unequal series by a main primary rib.

The shell differs from *Ostrea collazica* in being smaller and in having no wrinkled and irregular flattings. In its size and type of sculpture this *Ostrea* recalls the Claibornian Eocene species, *Ostrea divaricata* Lea. Height of shell 40 mm., greatest width 25 mm., greatest thickness of convex valve 15 mm. This species is named in honor of Professor C. P. Berkey of Columbia University, in recognition of his valuable contributions to the geology of Porto Rico.

Locality.—Rio Collazo near San Sebastian, Station 107.

Ostrea sansebastiana, new species

Plate I, Figure 1

Shell nearly circular in outline, concave. Beak incurved. Exterior marked by fine, irregularly wrinkled lamelle not unlike those of a flat valve of *Ostrea collazica*. Practically entire internal margin conspicuously crenulate. Height of valve 65 mm., breadth 65 mm., semi-diameter 15 mm.

I should consider this shell to be a specimen of *Ostrea collazica* that had through some accident of growth assumed a rounded and concave form, were it not for the strong marginal crenulations which lead me to differentiate it under a special name.

Locality.—Rio Collazo near San Sebastian, Station 23.

***Ostrea cahobasensis* Pilsbry and Brown**

Ostrea cahobasensis Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Phila., LXIX, p. 40, Pl. VI, fig. 8.

Many specimens of a very heavy, thick oyster, of crude aspect, and in nearly every case badly broken, were collected on the south side of the island. The shells were much like the description and figure of *Ostrea cahobasensis* Pilsbry and Brown, the type of which is from Haiti, in the mountains north of Lake Assnei, on the trail to Las Cahobas, and the species is also found south of Thomonde. In both these Haitian localities the valves of this *Ostrea* form extensive beds.

Because of its very evident importance in correlation, Dr. H. A. Pilsbry by request compared one of the Porto Rican shells with the Haitian type, which is at the Philadelphia Academy, and stated that the Porto Rican shell, "shows no characters differentiating it from *Ostrea cahobasensis* Pilsbry and Brown. I am disposed to identify it provisionally with that Haitian species; yet the condition of your specimen does not admit of positive identification." There are, however, among the number some valves precisely like the figure of the type. Dr. Dall also remarked of our shell: "We have fragments of this from the mountains between Haiti and San Domingo." In Porto Rico this oyster is very abundant in and characteristic of the Ponce chalky beds.

The affinities of *Ostrea cahobasensis* seem to be with *O. vaughani* Dall, from the Tampa silex beds or the limestone immediately above them.

Localities.—Near Ponce, Stations 292, 293, 295.

***Ostrea antiquensis* Brown**

Ostrea antiquensis Brown, 1913, Proc. Acad. Nat. Sci. Phila., LXV, pp. 603, 614, 615, Pl. XIX, fig. 7, Pl. XX, figs. 1, 5, 6.

On the island of Antigua Dr. A. P. Brown found in the hard limestone along the sea shore at Hodge's Bay, High Point and

Wetherill's Bay, many isolated oyster shells which he first referred to *Ostrea gatunensis* Brown and Pilsbry, but on further examination decided were new and named *Ostrea antiquensis*. On the south side of Porto Rico, east shore of Guanica Harbor, Dr. Reeds collected a quantity of beautifully preserved oyster shells from a shaly foraminiferal limestone. I was at first disposed to refer these specimens provisionally to *Ostrea gatunensis*, as a few valves bear considerable resemblance to the figure of the Gatun oyster, but the majority are broader and of a different aspect, so that I have concluded that the two species are distinct.

Dr. Brown's figures of the type of *Ostrea antiquensis* are of specimens so worn as to be hardly recognizable. Hence a specimen of the Guanica shell was sent to Dr. Pilsbry, who compared it with the type which is at the Philadelphia Academy. In a letter dated July 7th, 1919, Dr. Pilsbry writes:

Your oyster is in my opinion, *Ostrea antiquensis* A. P. Brown. The original specimens are poorly preserved, being in hard rock. In the type there are indications of some ribs additional to the 7 mentioned by Brown. The wide depression, mentioned as characteristic of *antiquensis* (convex valve), is well marked in your shell, which is far better preserved than the type. I have no doubt of the identity.

The relationships of this oyster are with *Ostrea haitensis* Sowerby from the Miocene of Santo Domingo, *O. gatunensis* Brown and Pilsbry from Panama and *O. veatchi* Gabb from California. In addition to the strong, radiating, radial ribs of *O. haitensis* and *O. veatchi* there are upon the ribs of the Guanica oyster spinose flutings, formed by the raised concentric lamellæ. The sculpture of the flat valve is similar to that of the convex but is less bold.

Localities.—Guanica Harbor, Stations, 368, 369, 370, 371, 373, 374, 375, 376, 381.

Genus *Pecten* Müller *Pecten thetidis* Sowerby

- Pecten thetidis* Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 52.
Pecten thetidis Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 256.
Pecten thetidis Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 532.
Pecten (Aequipecten) thetidis Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 714; 1903, *Idem*, pt. 6, p. 1586.
Pecten (Aequipecten) thetidis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 185, Pl. XXXIV, fig. 6; *Idem*, No. 30, p. 27.

In the Porto Rican collection are several Pectens which correspond to specimens of *Pecten thetidis* Sowerby that my party collected from the type region in the Yaqui Valley, Santo Domingo. Dr. Dall compared our Dominican shells with his Bowden shells, which in turn had been compared with Sowerby's type in the British Museum. This species bears very small spiny scales, visible only under a lens. These decorate the ribs and the radiating threads on the ears. The interspaces also are squamose in older shells.

Pecten thetidis has been recorded from Curaçao and Jamaica as well as Santo Domingo. Its range is now extended into northern Porto Rico.

Locality.—Near Aguada, Station 122.

***Pecten inæqualis* Sowerby**

- Pecten inæqualis* Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 52.
Pecten inæqualis Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 294,
Pl. XVIII, fig. 6; 1867, Proc. Sci. Assoc. Trinidad, p. 164.
Pecten inæqualis Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 256.
Pecten inæqualis Guppy, 1874, Geol. Mag. London, p. 443; 1876, Quart. Jour.
Geol. Soc. London, XXXII, p. 532.
Pecten inæqualis Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 714; 1903,
Idem, pt. 6, p. 1586.

Dr. Dall has identified one of the specimens in this collection as probably *Pecten inæqualis* Sowerby. The shell is incomplete but agrees well with Sowerby's description of the type, which was collected by Heneken in the Yaqui Valley, seventy years ago. Guppy later identified the species in Jamaica and figured a shell from that island. Gabb remarked that *Pecten inæqualis* was common in the Cibao (south of the Yaqui River in the northern part of Santo Domingo) and had been found by Bonaczy, one of his assistants, at Loma Cristina on the south side of the island, near San Cristobal. Dall notes that *Pecten inæqualis* is the most common and widely distributed of the Antillean Miocene Pectens. It is recorded, in addition to the Dominican type locality, from Jamaica by Guppy and Bland, from Curaçao by the United States Fish Commission, and from the Isthmus of Panama by R. T. Hill.

The mollusca associated with this specimen in Porto Rico so strengthen Dall's probable identification as to leave very little doubt that we can now extend the range eastward to Porto Rico.

Locality.—Near Aguada, Station 124.

Pecten guanicus, new species

Plate IV, Figure 4

Shell rather small, obliquely fan-shaped; right valve with about nineteen ribs. On the upper part of the valve towards the beaks, the ribs are carinated by a single radial thread and the narrow interspaces are smooth. Somewhat further down the single radial thread on each rib becomes accompanied by a second, this by a third and a fourth. About the same time that the tertiary radials appear on the ribs one or two radials develop on the interspaces. Hence on the ventral margin of the shell each rib is ornamented with four radial threads and each interspace with two. Anteriorly the ribs tend to become flatter than on the posterior part of the valve. Approximate altitude 24 mm., breadth 26 mm. The single specimen is partly concealed by the matrix but the characteristics of sculpture are well preserved.

In general form and in the sudden development of more ornate sculpture this species resembles *Pecten hatoriejonis* Maury from the trail between Hato Viejo and Potrero, Santo Domingo, but that shell is decidedly squamose whereas this is entirely without scales.

Brown's⁵ figure 6 of *Pecten anguillensis* Guppy bears a slight resemblance to the Porto Rican shell, but his figures 4, 7, 8 of *P. anguillensis* are quite unlike our specimen. The Antigua shell like ours has secondary ribbing but the ribs are far broader and much less numerous. The Porto Rican shell is decidedly more like the Dominican species.

Dr. Dall has examined this Pecten and he notes that the National Museum has it from Santo Domingo but not named.

Locality.—East shore Guánica Harbor, Station 369.

Pecten meseticus, new species

Plate III, Figure 2

Operculate valve perfectly flat and nearly circular in outline. The ribs number about twenty-five and the perfect ear shows six sharply defined radiating threads. In the umbonal region and upper part of the shell, the ribs are almost linear and very sharply carinated by a radial thread. Less than half way to the ventral margin two more radial threads develop, one on either side of the carinating thread, so that the rib becomes ornamented on top with the three radials. The interspaces are deep set with perpendicular margins and have no radial threads. They are, however, ornamented with sharp, very delicate raised growth lines hardly visible without a lens and as fine as spider webs. These also pass over the ribs but are most apparent in the interspaces. Altitude of shell 35 mm., breadth the same.

⁵Proc. Acad. Nat. Sci. Phil., 1913, Pl. XVIII.

We are much indebted to Dr. Dall for comparing this shell with *Pecten soror* Gabb. The latter species has never been figured, but Dall places this Porto Rican shell close to *P. soror* as identified by Guppy. According to Gabb's description the left valve of his type was concave, but our operculate valve is perfectly flat. The ribs of *P. soror* are fewer, nor does Gabb mention any radiating threads upon them. Doubtless, however, though not identical, the affinities of this Porto Rican Pecten are with the Dominican *P. soror*.

This is the most exquisite of the Porto Rican Pectens.

Locality.—East shore of Guanica Harbor, Station 375.

Pecten camuyencis, new species

Plate IV, Figure 5

Shell rather small, subcircular with nearly equal ears. The ribs, omitting the very small anterior and posterior ones, number twenty. Towards the umbonal region the ribs are entire and rather rounded, then about half way towards the ventral margin those on the central part of the valve become medially grooved while those near the anterior and posterior margins remain entire. An exceedingly delicate radial thread develops in the interspaces. It is visible only with a lens and then chiefly because it is accentuated by fine, sharp, V-shaped growth lines, the apices pointing forwards. These growth lines also swing over the ribs and form in the medial grooves U-shaped arches directed slightly backwards. The ears are marked by radial threads, roughened by the fine growth lines which cross over them. Altitude of shell 25 mm., width 26 mm.

Dr. Dall has compared this shell with the Pectens in the National Museum and says that it is not represented in the collection there. In its sculpture *Pecten camuyensis* is of the same general type as *Pecten gabbi* Dall (= *paranensis* Gabb, 1881, not of d'Orbigny, 1849) from Santo Domingo and Antigua, but that shell is larger and of a much less symmetrical and elegant form than the Porto Rican shell.

Locality.—Near Arecibo, Station 511.

Pecten sansebastianus, new species

Plate III, Figure 1

Shell of medium size, oblique, ovate, somewhat inflated. The sculpture consists of about twenty-four ribs which do not extend quite to the anterior and posterior margins. Over the anterior region of the valve each rib bears on either side of its keel a radial thread, but posteriorly the ribs may

have four of these radii. Interspaces each with one radial thread. Ears of about the same size. The anterior rather coarsely radially striated, the posterior more finely so. Greatest height of shell, measured obliquely, 35 mm., width 32 mm.

Dr. Dall on comparing this Pecten with the collection in the National Museum says it is not represented there. In sculpture it resembles our Porto Rican species *P. guanicus* but otherwise is quite different. The type showed no scales or nodules upon the ribs but other specimens show microscopic spines, and it may be that these have been abraded from the type. The species is common and variable.

Localities.—Rio Collazo, near San Sebastian, Stations 49, 63. Specimens, probably this species, were also found at nearby Stations 27, 38, 47, 107 and a doubtful shell from 105.

Pecten sansebastianus laresianus, new variety

Plate IV, Figure 3

Shell with sculpture of the same general plan as that of *Pecten sansebastianus*, but the central keel of the ribs bears minute tear-like nodules. On either side is a radial thread and one also occupies every interspace. The ear is handsomely ornamented with well-defined nodose radii. Altitude 31 mm.

This appears to be a variety of *Pecten sansebastianus*, but more material may prove it distinct.

Locality.—Near Lares, Station 59.

Pecten guajatacus, new species

Plate IV, Figures 1, 2

Shell rather large, suborbicular, very inequivalve; ribs thirteen to sixteen, tending to become obsolete near the anterior and posterior margins of the shell. The convex valve is moderately inflated but not extremely convex. The opposite valve is operculate in form. Altitude of largest specimen 55 mm., width approximately 53 mm.

Dr. Dall after examination notes that these shells are identical with specimens named *Pecten heermannii* Conrad in the National Museum collection. He did not mention where the latter specimens had been collected, but I presume from the Antillean region. If so, the label would seem to have been a provisional one, for a comparison of our specimens with Conrad's description of the type

indicates that the Antillean and Californian fossils are of the same *P. eboreus* group, but specifically distinct. The true, western *P. heermannii* has twenty-one square ribs, and, judging from the description, is more compressed than the Porto Rican shell. For these reasons I would suggest that the latter should be differentiated by the name *P. guajatacus*.

Locality.—Señor Rabell's Ranch on Rio Guajataca, Station 113.

Genus **Amusium** Bolten
Amusium papyraceum (Gabb)

Pleuronectia papyracea Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 257; 1881, Jour. Acad. Nat. Sci. Phil., (2) VIII, p. 347.

Amusium papyraceum Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 718; 1903, *Idem*, pt. 6, p. 1586.

Amusium papyraceum Maury, 1917, Bull. Amer. Paleont., No. 29, p. 190, Pl. XXVI, fig. 22; *Idem*, No. 30, pp. 23, 28.

A single fragment of an *Amusium* evidently when complete about the size of *A. papyraceum* is in the Porto Rican collection. The substance of the shell is preserved and the internal surface, showing the characteristically paired ribs of *Amusium papyraceum*, lies upward in the matrix so that the ribs are clearly seen. They are spaced so as to allow two pairs to ten millimeters. Each pair occupies about four and each interspace about three millimeters. Gabb's type of this species measured about two inches. The probabilities are very strongly in favor of the fragment being identical with Gabb's shell, since the other Miocene form, *Amusium lyoni* Gabb has the internal ribs solitary, not paired.

Amusium papyraceum was first described by Gabb from Santo Domingo. It also occurs at Bowden. The shell is very closely related to, and perhaps identical with, *Amusium mortoni* Ravenel, living in the Antillean and Gulf waters.

Locality.—Near Arecibo, Station 475.

Section **Propeamusium** De Gregorio
Propeamusium hollicki, new species

Plate III, Figures 3, 4

Shell rather small, suborbicular, thin and semi-transparent, valves dissimilar, the lower gently convex, the upper flat and operculate, ears nearly equal. Outer surface of both valves smooth, but prettily diversified by the

shining through of the delicate, internal, radiating riblets. These riblets occur in pairs which near the basal margin of the valve measure about one millimeter across, and are separated by interspaces about two and a half millimeters wide. Towards the beak the riblets converge. Each valve has usually eight pairs of riblets which are distributed over the central part of the shell, the anterior and posterior areas being smooth. The most perfect flat valve measures 16 mm. in altitude and 17 mm. in width. A small convex valve is 12 x 12.5 mm., and the largest 20 x 21 mm. This seems to be the maximum size attained, as we have a number of specimens from various localities.

No species resembling this has ever been recorded from the Antillean Miocene. It has somewhat the general aspect of *Propeamuseum pourtalasianum marmoratum* Dall⁶, a living form but differs among other respects in the lower valve being smooth, not concentrically sculptured, and the riblets being paired, not club-shaped. The Porto Rican shell is referred tentatively to the section *Propeamuseum*. It appears most closely allied to this group, yet all of the characters are not revealed. According to Dall, the living members of this section are in deep waters in temperate and tropic seas, from 805 to 13 fathoms and at bottom temperatures of 39° F. to 82° F. which is a very unusual range. This, the most fragile and exquisite member of the genus *Amusium* yet discovered in the Antillean Miocene, is named in honor of Dr. Arthur Hollick.

Localities.—Rio Collazo near San Sebastian, Stations, 27, 36, 53, 54, 60, 63, 107.

Genus *Spondylus* Linnaeus *Spondylus bostrychites* Guppy

- Spondylus bifrons* Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 53.
Not of Goldfuss, 1835
- Spondylus bostrychites* Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 176.
- Spondylus bostrychites* Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 257.
- Spondylus bostrychites* Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 758; 1903, *Idem*, pt. 6, p. 1586; 1916, Proc. U. S. Nat. Mus., LI, 1917, p. 493.
- Spondylus bostrychites* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 190, Pl. XXXII, fig. 4; *Idem*, No. 30, pp. 10, 20, 23.

Professor Gabb remarked of this shell: "A beautiful convex, almost equivalve Pecteniform species with remarkably narrow areas and a thin shell." This is a welcome addition to Sowerby's laconic, Latin, three-line description of the type, *Spondylus bifrons*, re-

⁶Bull. 37, U. S. Nat. Mus., Pl. IV, Fig. 3.

named, because preoccupied, by Guppy. Dall also adds a short description of this Antillean Miocene species in describing his variety *chipolanus* from Florida. Later he referred this to the typical species.

In 1874, Guppy listed *Spondylus bostrychites* from Jamaica, Anguilla and Haiti. By Haiti he really meant the Yaqui Valley, Santo Domingo, where Henneken obtained the type. The Porto Rican specimens are nearly all poorly preserved molds but several seem undoubtedly identical with shells my party collected in Santo Domingo and figured as this species.

Localities.—Señor Rabell's Ranch, Station 113; near Aguada, Station 117; near Arecibo, Station 499; near Ciales, Station 500.

Spondylus gumanomocon Brown and Pilsbry

Spondylus americanus Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 257. Not
S. americanus Lamarck.

Spondylus gumanomocon Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., p. 514 (Footnote).

Spondylus gumanomocon Maury, 1917, Bull. Amer. Paleont., No. 23, p. 191;
Idem, No. 30, p. 22.

This Dominican Miocene species has never been figured, but when adult is easily known by its very large and heavy valves. A specimen collected by Gabb weighed over thirty-two ounces. Unfortunately, one does not always find these ponderous examples and one is perplexed by variations of form and growth stages. We have from Porto Rico some internal molds showing that the cavities of the two valves were nearly equal, while others show the typically flatter and the more convex valve, and finally, some of the specimens have the convex valve somewhat twisted. Similar variations of form appear in a series of recent *Spondylus americanus* in the American Museum and suggest that the same took place in the Miocene member of this group, *Spondylus gumanomocon*.

Localities.—Near Arecibo, Stations 463, 471; near Ciales, Stations 492, 493, 495, 496, 501, 502, 505.

Spondylus lucasi, new species

Plate V, Figure 1

Shell oval, oblique, small for the genus. The cardinal area is defective and broken, but shows traces of the isodont hinge of *Spondylus*. The sculpture consists of stronger, low, primary, radiating, rounded threads

bearing spines at intervals, and between every two of these primaries are eight to ten or twelve much more delicate radiating lines. The central one of these is slightly stronger than the rest. It does not stand out sharply but the eye can discern that it is a shade thicker. The fine radii between the primaries nearly always alternate in strength, the finest lines of all being visible only with a lens. All of the fine radii are ornamented with minute scales, giving them a beaded appearance, especially on the anterior part of the valve. Approximate altitude of shell 33 mm., estimated breadth 28 mm.

Among the specimens of *Spondylus* were some fragmentary external molds remarkable for the extreme fineness and delicacy of their sculpture which was imprinted in reverse upon the limestone. A single shell shows the same delicate sculpture in the positive; the actual substance of the valves being retained.

The exquisite sculpture distinguishes this species from the specimens that my party collected in Santo Domingo. Our young shells of *Spondylus bostrychites* have very much coarser and less numerous radial ribs between the spinose primaries. The large shell, *Spondylus guanomocon* has the primaries but little differentiated and frequently the spines are no longer than the coarse, imbricating scales which cover all the ribs alike. Dall has lately described *Spondylus filiaris* from the Flint River, Georgia, Oligocene. His figure of the young shell (Proc. U. S. Nat. Mus. LI, Pl. LXXXIII, fig. 5) bears at first glance quite a resemblance to the Porto Rican fossil, but the Georgian species has no spinose processes, the radii are quite smooth, and the sculpture not so delicate.

There is, however, a very beautiful *Spondylus* in the Calcaire grossier of Grignon, France. It is Lamarck's *S. radula*. In form it is quite unlike *Spondylus lucasi*, but its sculpture is so strikingly like as to be almost exactly parallel. The European Eocene shell is more sharply spinose and more prickly. This shell is named in honor of Dr. Frederic A. Lueas.

Localities.—Señor Rabell's Ranch, Rio Guajataca, Station 110; East Shore of Guanica Harbor, Station 370; near Arecibo, Station 509.

Genus *Lithophaga* Bolten
Lithophaga nigra (d'Orbigny)

Lithodomus niger d'Orbigny, 1845, In De la Sagra's Hist. Pol. y. Nat. Isla de Cuba, V. pt. 2, p. 351; 1855, *Idem*, Atlas, VIII, Pl. XXVIII, figs. 10, 11.
Modiola caribaea Philippi, 1847, Abbild. u. Beschr., III, p. 20, Pl. II, fig. 5.

Lithophaga nigra Dall, 1898, Trans. Wagner Inst. Sci., III, pt. 4, p. 799; 1915,
Bull. 90 U. S. Nat. Mus., p. 129.

Lithophaga nigra Maury, 1917, Bull. Amer. Paleont., No. 29, p. 194; *Idem*,
No. 30, p. 26.

A single specimen of this shell is present in this series. It is fragmentary but unquestionably this species, since it shows the entire anterior part of the two valves, which have remained in place, and the characteristic cross striations ending abruptly along an oblique line. In size it corresponds almost perfectly to d'Orbigny's figure of the type which was a recent specimen.

The earliest recorded appearance of this species is in the Upper Oligocene, Dall having identified it in the Tampa formation. My party found it in the Lower Miocene of the Yaqui Valley, Santo Domingo and it is now living from Florida to St. Thomas, West Indies. The fossil shells in all respects except color are like the recent specimens.

Locality.—Near Lares, Station 56.

ORDER ANOMALODESMACEA

Genus **Thracia** Blainville

Subgenus **Cyathodonta** Conrad

Cyathodonta reedsi, new species

Plate V, Figure 2

Shell rather elongate, beaks subcentral, right valve gently convex, with its anterior end somewhat produced and rounded, posterior end broad, abruptly truncated; posterior dorsal area flattened, nearly smooth and marked off by a rounded carina passing from the beak to the base of the truncation; dorsal line in front of the beak very sloping, but behind nearly straight; beak low, acute, curving over the hinge and evidently in life very close to, or touching, the opposite beak, its apex appears perforated but this may be due to an accident and not to contact with the opposite beak. Surface of valve anterior to the carina ornamented with close-set, nearly uniform, slightly wavy, concentric ripples, about four to every five millimeters. These ripples near the center of the disc are often broken off and then continued as though unskillfully spliced, and sometimes they anastomose with adjacent ripples. Nevertheless, their appearance is rather regular and elegant. In front of the carina is a shallow broad, inconspicuous sulcation. Hinge entirely concealed by the limestone matrix. Length of shell 32 mm., altitude 20 mm., thickness of one valve 7.5 mm.

The genus *Thracia* has never before been recorded from the Miocene of the Greater Antilles. Heneken, Guppy, Gabb and the writer

all failed to find a *Thracia* in Santo Domingo or Jamaica, nor does Dall list this genus in the Henderson-Simpson collection from the Bowden beds of Jamaica. Dr. J. W. Spencer, however, collected two species from the Lesser Antilles, both on the Island of Guadeloupe. These were described by Dall as *Cyathodonta guadalupensis* and *C. spenceri*, and were referred to an Oligocene horizon.

Singularly enough, the Porto Rican *Thracia* is not like either of the Guadeloupe species, but resembles far more the older shell, *Cyathodonta ricksburgiana* Dall, from the Oligocene of Vicksburg, Mississippi. In general aspect it corresponds strikingly with *C. ricksburgiana*, but is proportionally higher, more convex, with beaks subcentral, instead of at the posterior third, and the ripples are less crowded, there being four instead of five to every five millimeters. To a less extent our fossil recalls Toula's Isthmian *Cyathodonta galunensis*, which among other respects differs in its broader anterior end, less elongate form, and its crude aspect. This rare and more delicate shell is dedicated to Dr. Chester A. Reeds, by whom it was discovered.

Localities.—Near Quebradillas, Stations 126, 129, 131; near Ponce, Station 293.

Genus **Cuspidaria** Nardo
Cuspidaria islahispaniolæ Maury

Plate V, Figure 3

Neara alternata Gabb, 1873, Trans. Amer. Phil. Soc., XV., p. 248. Not *Sphena alternata* d'Orbigny, 1845.

Neara ornatissima Guppy, 1876, (in part), Quart. Jour. Geol. Soc. London, XXXII, p. 530. Not *Sphena ornatissima* d'Orbigny, 1845.

Cuspidaria islahispaniolar Manry, April 29, 1917, Bull. Amer. Paleont., No. 29, p. 196, Pl. XXVI, fig. 20; *Idem*, No. 30, p. 13.

Cuspidaria gabbi Johnson and Pilsbry, May 5, 1917, Proc. Acad. Nat. Sci. Phil., LXIX, p. 195.

A specimen in the collection matches so perfectly with shells of my Dominican *Cuspidaria islahispaniolar* from Bluff 3, Cercado de Maó, that there seems to be no doubt of their complete identity. Gabb and Guppy both referred the Miocene *Cuspidarias* from Santo Domingo to the recent species *C. alternata* and *C. ornatissima* of d'Orbigny. These they considered identical with each other and with the fossils.

Johnson and Pilsbry's revision of the Gabb collection in the Philadelphia Academy differentiated two species of *Cuspidaria* as *C. ornatior* (like *ornatissima*) and *C. gabbi* (like *alternata*). This harmonizes with Gabb's remark in 1873 that he had specimens grading into the two species. Johnson and Pilsbry unfortunately gave no figures, but judging from their description, *C. gabbi* is synonymous with *C. islahispaniolæ*. We have no representatives of *C. ornatior*.

Locality.—Near Juana Diaz, Station 178.

***Cuspidaria juanadiazæ*, new species**

Plate V, Figure 4

Shell small, plump, with full beaks and a long rostrum. Surface marked by rather coarse concentric growth lines as in some small Ledas. Exfoliated over central part of valve and under layers cracked and veined, but along the base and at the anterior and posterior ends the outer layer is preserved and shows no radial ribbing whatever. There is only a weak radial thread defining the rostrum. Hinge characters concealed. Length of shell 10 mm., height 6 mm.

This species is about the same size as *Cuspidaria islahispaniolæ*, but is at once differentiated by the absence of all radial ribbing. This feature also separates it from Dall's two Bowden species *C. craspedonia* and *C. distira* and also from *C. costellata* Deshayes. It is evidently a shell of the same type as the recent *Cuspidaria lamellosa* Sars, which lives in fifty to five hundred and fifty-two fathoms off the Norwegian and Rhode Island coasts. This is the first Cuspidarian of this group ever found in the Antillean Miocene.

Locality.—Near Juana Diaz, Station 176.

ORDER TELEODESMACEA

Genus **Crassatellites** Krüger

***Crassatellites juanadiazæ*, new species**

Plate IV, Figures 6, 7

Shell elongated, anterior end rounded, posterior end produced and bluntly pointed. The substance of the shell was thin and this has been increased by exfoliation. The original form has been altered by pressure which apparently has greatly increased the inequality of the valves giving the shell a *Corbula*-like form, with one valve very gibbous and incurving

at its base, and the other valve flattened and seeming to fit into the larger. This appears to be due to distortion. On the convex valve a pronounced carina passes from the beak to the posterior angle; beak anterior to the center; neponic shell, as far as can be seen, with very close, sharp, concentric ridges. With age these become progressively rounder and somewhat more distant and ornament the entire shell. Hinge concealed by the matrix. Length of shell 28 mm., height 16 mm., thickness of convex valve 7 mm.

Gabb's *Crassatellites reevei* from the Miocene of Santo Domingo is a very much larger shell, fifty-six millimeters in length, and more coarsely sculptured. I do not think this Porto Rican shell could be the young of that species as it has a very much more delicate and different aspect and appears adult. The Bowden species, *Crassatellites jamaicensis* Dall, is wholly unlike this fossil in both form and sculpture. The convex valve of the Porto Rican shell is, however, strikingly like *Crassatellites flexurus* (Conrad) from the Jacksonian Eocene of Jackson, Mississippi, but the latter shows no noticeable inequality of its valves, while the Porto Rican shell even before distortion would seem to have had discrepant valves.

A single specimen only was found.

Locality.—Near Juana Diaz, Station 182.

Genus *Venericardia* Lamarck

Venericardia collazica, new species

Plate VI, Figure 6

Shell elongate, very inequilateral, much inflated in the umbonal region, beaks very near the anterior end, very high, acute, curving over the hinge line. Ribs thirteen or fourteen showing traces on the mold of crenulations. The ribs are simple without secondary threads nor are there interstitial riblets in the interspaces. The interspaces are about as wide as or a little narrower than the ribs which are broadest and more distant on the central portion of the valves and become suddenly finer and closer on the posterior dorsal areas. Length of shell approximately 34 mm., height 20 mm., diameter 21 mm.

In general form this species resembles *Venericardia nasuta* Dall from the Eocene of Alabama (Trans. Wagner Inst. Sci., III, pt. 6, p. 1425, Pl. LIII, fig. 9, 1903), but that shell has lateral threads accompanying the anterior and medial ribs, and the ribs number twenty-five against fourteen in the Porto Rican shell. The species is founded on a single internal mold from the Collazo shales, still retaining in places a coating of the shell substance, which shows

both valves together of a shell resembling *Carditamera* in its elongated form, but with the prominent, prosogyrate beaks characteristic of *Venericardia*.

Locality.—Rio Collazo near San Sebastian, Station 53.

Venericardia rabelli, new species

Plate VI, Figure 7

Shell rather small, sub-circular with low, acute beaks, strongly prosogyrate. Surface ornamented with many close-set ribs, numbering about twenty-one, and separated by narrower interspaces. The ribs of the anterior and central portion of the valve develop on either side of their central keels, fine threadlike secondary riblets which are just visible without a lens. On the posterior part of the valve these secondary threads become weaker and finally disappear. Traces yet remain of nodules on the anterior ribs. The characters of the hinge are concealed by the matrix. Length of shell 20 mm., height 17 mm., semi-diameter 10.5 mm.

This pretty little *Venericardia* recalls in some respects *V. cerrogordensis* Maury, from Santo Domingo. That shell is of similar form and size, and its anterior and central ribs also have two accompanying lateral, threadlike riblets, but there are only seventeen ribs in the Dominican species and they are far more distantly spaced. This *Venericardia* is dedicated to Señor Narciso Rabell of San Sebastian.

Locality.—Weathered green shale, which has become reddish, in a roadside cut, Rio Collazo near San Sebastian, Station 62. Also a fragment, probably this same species from the nearby Station 54.

Venericardia juncalensis, new species

Plate VI, Figure 5

Shell when complete ovate-cordate in form moderately convex, compressed by pressure to which the Collazo shales were subjected. Substance rather thin; beaks low, acute; ribs fourteen when perfect strongly nodular. All the ribs except those of the posterior area are accompanied on either side by a radiating thread; at the base of the shell a medial rib with its two radiating threads measures about three millimeters across. Length of shell approximately 30 mm., height 29 mm., diameter of crushed shell 11 mm.

Although this species has the same general type of sculpture as the preceding shell and as *V. cerrogordensis* Maury, yet its aspect is unlike those two species.

Locality.—Rio Collazo near San Sebastian, region of Juncal, Station 94.

Genus *Echinochama* Fischer
***Echinochama antiquata* Dall**

- Chama arcinella* Moore, 1853, Quart. Jour. Geol. Soc. London, IX, p. 130.
 Not *C. arcinella* Linnæus, 1767.
- Chama arcinella* Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 294; 1867, Proc. Sci. Assoc. Trinidad, p. 163.
- Chama arcinella* Gabb, 1873, Trans. Amer. Phil. Soc. XV, p. 251.
- Chama arcinella* Guppy, 1874, Geol. Mag. London, p. 442; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 531.
- Echinochama antiquata* Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, pp. 1404, 1586, Pl. LIV, fig. 9.
- Echinochama antiquata* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 201, Pl. XXXIII, fig. 10; *Idem*, No. 30, p. 10.
- Echinochama antiquata* Jones, 1918, Jour. Geol., XXVI, p. 738.

This Miocene species was recorded from the Yaqui Valley, Santo Domingo and the Bowden beds of Jamaica by Guppy and Gabb as the recent shell *Chama arcinella* which has much more prominent and spiny ribs. Dall first discriminated the fossil and referred it to Fischer's genus *Echinochama*. The closest recent ally of *Echinochama antiquata* is a Pacific shell and not *Echinochama arcinella* which Dall and Simpson record from Mayaguez Harbor, Porto Rico and is abundant elsewhere in the Antilles.

The type of *Echinochama antiquata* is a Bowden shell. My party collected fine specimens from Cercado de Mao, Santo Domingo, and Jones has now found it in the Las Cahobas beds, south of Thomonde, Haiti.

From Porto Rico Reeds collected a single internal mold which fits very perfectly into a fine shell of *Echinochama antiquata* in this Museum collected by F. C. Nicholas from Bowden. The only other *Echinochama* which it might be is *E. yaquensis* Maury, but that tends to be smaller. It is almost certainly the internal mold of *Echinochama antiquata*.

Locality.—Near Arecibo, Station 445.

Genus *Lucina* Bruguière
***Lucina chrysostoma* (Meuschen) Philippi**

- Tellina crysostoma* Meuschen, 1787, Mus. Gevers., p. 482. (Typographical error.)
- Lucina chrysostoma* Philippi, 1847, Abbh. und Beschr. Conchy., II, p. 206, Pl. I, fig. 3.

Venus edentula Chemnitz, 1784, Conch. Cab., VII, Pl. XL, figs. 427-429. Not of Linnæus, 1758.

Lucina edentula Reeve, 1850, Conch. Icon., *Lucina*, Pl. II, fig. 9.

Lucina edentula Heilprin, 1886, Trans. Wagner Inst. Sci., I, pp. 102-103.

Lucina chrysostoma Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1354.

Lucina chrysostoma Maury, 1917, Bull. Amer. Paleont., No. 29, p. 202, Pl. XXXV, fig. 2; *Idem*, No. 30, pp. 13, 26.

Lucina chrysostoma Jones, 1918, Jour. Geol. XXVI, pp. 740, 742.

This is one of the most abundant species in the Porto Rican collection. Among a great number of internal molds which show the plump form, elongated adductor scar and variable radial lines characteristic of the interior of shells of *Lucina chrysostoma*, are several very perfect impressions of the exterior of the shell, showing also the edentulous hinge. Artificial casts of these when compared with recent and Pleistocene specimens of *Lucina chrysostoma* showed no points of difference. This is the apricot shell of collectors,—so named because the interior of living shells has a fine apricot blush. Dall does not record this species from beds earlier than Pliocene; but it seems that it extended into the Miocene since both these Porto Rican specimens and mine from the Yaqui Valley, Santo Domingo, appear in all respects like the recent. Jones also reports it from the Maissade beds of Haiti.

Localities.—Near Juana Diaz, Station 174; near Ponce, Stations 285, 287, 288, 289, 290, 291, 292, 293, 297, 298, 299, 301; near Guayanilla, Station 320.

Genus **Phacoides** Blainville

There are several varied forms of this genus in the collection, but nearly all are internal molds, upon which no specific determinations can be based.

Subgenus **Here** Gabb

Phacoides (Here) quebradillicus, new species

Plate VI, Figure 8

Shell moderate in size, convex, with the posterior and anterior dorsal areas very sharply marked off by narrow, deep sulci. The beak is full, acute and strongly turned forwards. The entire surface of the valve is sculptured with very close-set, nearly uniform and equidistant concentric ridges, so fine as to be hardly visible without a lens. Characters of the hinge unknown. Length of shell 24 mm., approximate altitude 21 mm., semi-diameter 7 mm.

This species is much less convex than the subglobular Bowden shell, *Phacoides podagrinus* Dall, which is also a member of the Pliocene to recent, *P. pennsylvanicus* group. *Phacoides dominicensis* Dall is flatter with less fine and regular, concentric sculpture, and is of the *Phacoides pectinatus* stock.

The Porto Rican shell, which is represented by a single, nearly perfect external mold of the left valve, is so finely sculptured that the east of its imprint appears almost smooth to the eye. The delicate, nearly regular, concentric ridges stand out only with a lens. In its general aspect this species resembles *Phacoides (Here) wacissanus* Dall, from the Tampa silex beds more than any with which I am acquainted.

Locality.—Near Quebradillas, Station 126.

Subgenus **Lucinisca** Dall
Lucinisca hoveyi, new species

Plate VII, Figure 2

Shell small, rather plump, suborbicular, with an acute, strongly prosogyrate beak. Valve very beautifully latticed by the intersection of fine, sharp, close-set concentric ridges, with the somewhat stronger radial ribs. Ribs thread-like, nearly equidistant and about uniform in strength with no secondary riblets intervening. Anterior dorsal area marked by a change in sculpture as the ribs are obsolete and only the concentric ridges are present. Posterior dorsal area defined by a slight umbonal ridge beyond which the area is a little compressed. Hinge characters unknown, but the shell is referred tentatively to the subgenus *Lucinisca* because of its form and sculpture. Length of most perfect external mold 11 mm., height 10.5 mm., semi-diameter 4.5 mm.

This species is at once differentiated from the Santo Domingan Miocene shells, *Lucinisca hispaniolana* Maury and *L. cercudica* Maury, by its lack of secondary riblets. It is closer to Dall's Floridian *Lucinisca calhounensis* from the Tampa and Chipola horizons, for that has all the ribs subequal; but the Porto Rican shell is less compressed and differs in form, being plumper and more cordate. The external molds retain every detail of sculpture in reverse in the limestone rock, and show that this shell was one of the most exquisite on the Miocene beaches of Porto Rico. It is dedicated to Dr. E. O. Hovey.

Localities.—Near Quebradillas, Stations 126, 129, 131, 133, 136; near Ponce, Station 292.

Subgenus **Miltha** H. and A. Adams**Miltha** cf. **smithwoodwardi** Maury

Phacoides (Miltha) smithwoodwardi Maury, April, 1917, Bull. Amer. Paleont., No. 29, p. 204, Pl. XXXV, fig. 6.

As in the Dominican Miocene waters, so in the Porto Rican, two species of *Miltha* were represented. Unfortunately, the collection affords only internal molds of the Porto Rican shells.

One of these molds has the very striking subquadrilateral and flattened form of *Miltha smithwoodwardi* Maury, from Bluff 2, Cercado de Mao, Santo Domingo. The mold is somewhat larger, measuring 53 mm. in length, 60 mm. in height and 18 mm. in diameter, while the corresponding measurements of the type were 45 x 50 x 12 mm. Nevertheless it was clearly either identical with or very closely akin to *Miltha smithwoodwardi*, for the striking posterior truncation, and the angles of the ventral margin are exactly parallel to the outlines of the Dominican shell. The beak also was markedly prosogyrate. The main difference in form is that the anterior dorsal margin of the mold is sloping and not angulated as in the Dominican shell. This species is represented in the living fauna by *Miltha childreni* Gray, in the Gulf of California. The only other living *Miltha* is found off Mozambique. The subgenus was at its maximum during the Eocene and has since declined. Dall calls attention to the interesting fact that in most horizons down to the Pliocene, species representing three groups occur—namely the group of *M. hillsboroënsis* Heilprin, that of *M. childreni* Gray, and that of *M. pandatus* Conrad. The first two groups are represented in the Porto Rican Miocene.

Localities.—Near Quebradillas, Station 137. A smaller, broken internal mold, probably the same species, from Señor Rabell's Ranch, Station 112.

Miltha cf. **hillsboroënsis** (Heilprin)

Lucina hillsboroënsis Heilprin, 1887, Trans. Wagner Inst. Sci., I, pp. 117, 120, Pl. XVI, fig. 62.

The other internal mold of *Miltha* under consideration has the general form of the Floridian species *M. hillsboroënsis* Heilprin from the Oligocene and Miocene, and of the related Pliocene shell, *M. disciformis* Heilprin. It also resembles the Santo Domingan mem-

ber of this group, *Miltha riocanensis* Maury. Of all these, the mold corresponds in size best with *M. disciformis*, but that is a much later species. As the surface characters of the Porto Rican shell are quite unknown no specific identification is possible. We know, however, that a member of the *M. hillsboroënsis* group was living in the Miocene of Porto Rico.

Localities.—Near Ponce, Station 289. Also a larger, fragmentary mold 60 mm. in width, probably the same species, from Station 292.

Genus **Divaricella** von Martens
Divaricella prevaricata Guppy

Divaricella prevaricata Guppy, 1896, Proc. U. S. Nat. Mus., XIX (1897), No. 1110, p. 327, Pl. XXX, fig. 6.

Divaricella prevaricata Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, pp. 1389, 1587.

Divaricella prevaricata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 207, Pl. XXXV, fig. 10; *Idem*, No. 30, pp. 13, 24, 28.

The type of this Miocene species was described by Guppy from Bowden, Jamaica. My party collected shells corresponding to Guppy's description and figure in the Miocene of Santo Domingo, in the *Aphera islacolonis* formation in the bluffs of the Rios Mao, Gurabo and Cana. In the present collection there is a single, but very perfect, imprint of this shell in the limestone so that the species has now been found on three of the Greater Antilles. *Divaricella prevaricata* is smaller and more delicately sculptured than the recent representative, *Divaricella quadrisulcata* d'Orbigny, recorded by Dall and Simpson from Hucares, Porto Rico.

Locality.—Near Quebradillas, Station 125.

Genus **Cardium** (Linnaeus) Bruguière

This genus is represented in the collection by a considerable number of specimens, but nearly all in the form of poorly preserved molds. Probably several correspond to Jamaican and Santo Domingan Miocene species.

Section **Trigoniocardia** Dall
Cardium (Trigoniocardia) sancti-sebastiani, new species
 Plate VI, Figure 4

Shell sub-trigonal, exceedingly oblique, anterior end very short, posterior end produced and roundly pointed; beak very anteriorly placed, high, acute.

curving forwards; posterior slope from the umbonal region to the posterior basal margin not carinated, but gently and evenly rounded, so that the posterior area is not well defined. On the body are ten radial ribs which show traces of having been crenulated, on the posterior area are five ribs closer, and finer than those on the body of the shell. Length 12 mm., altitude from beak to anterior basal angle 6 mm., semi-diameter 5 mm.

The Antillean Tertiary has yielded the following Cardiums of the section *Trigoniocardia*: *C. castum* Guppy (Quart. Jour. Geol. Soc. Lond., XXII, pl. XXVI, fig. 4, 1866) from the older Tertiary of Manzanilla, Trinidad, a small subovate shell with twenty-two ribs and beak nearly central; *C. haitense* Sowerby, from the Miocene of Santo Domingo and Bowden and its more oblique, more strongly carinated variety, *C. cercadica* Maury, both have fourteen ribs on the body and ten on the truncation; *C. aminense* Dall from Rio Amina, Santo Domingo, is a strongly carinate, very convex shell, with ten ribs on the body and ten also on the truncation, and *C. maturense* Dall from the later Tertiary of Matura, Trinidad, is not carinate, but is only slightly oblique and has twelve body and eight posterior ribs. The Porto Rican shell is clearly specifically distinct from any of these forms.

Locality.—Rio Collazo near San Sebastian, Station 53.

Cardium (Trigoniocardia) haitense Sowerby

Cardium haitense Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 52,
Pl. 10, fig. 11.

Cardium haitense Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 293;
1867, Proc. Sci. Assoc. Trinidad, p. 163.

Cardium (Fragum) haitense Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 251.
Cardium haitense Guppy, 1874, Geol. Mag. London, p. 442; 1876, Quart. Jour.

Geol. Soc. London, XXXII, p. 531.

Cardium (Trigoniocardia) haitense Dall, 1900, Trans. Wagner Inst., Sci., III,
pt. 5, pp. 1103, 1105.

Cardium (Trigoniocardia) haitense Maury, 1917, Bull. Amer. Paleont., No. 29,
p. 211, Pl. XXXVI, figs. 5, 5a.

In 1917 I noted that Sowerby's figures of the type of *Cardium haitense* included two forms; the upper representing a subquadrate shell with roundly angulated umbonal slope, the lower a trigonal shell, posteriorly produced with a sharp umbonal ridge. As the description fitted the first figure I suggested restricting the name *haitense* to that form and differentiating the second by the varietal name *cercadicum*. An external mold in this collection shows the same form and number of ribs as American Museum specimens of

C. haitense from Bowden, Jamaica, and mine from the Yaqui Valley, Santo Domingo. As long ago as 1867, Guppy recorded this shell from Jamaica and Cumana, Venezuela, as well as from the type locality which was the Yaqui Valley. To this distribution we may now add Porto Rico.

Localities.—Near Quebradillas, Station 133; near Arecibo, Station 476. Specimen from Station 476 poor and identification uncertain.

Cardium (Trigoniocardia) haitense cercadicum Maury

Cardium (Trigoniocardia) haitense variety *cercadicum* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 212, Pl. XXXVI, fig. 6; *Idem*, No. 30, p. 11.

Several internal molds of what appear to be this variety are in the Porto Rican collection. Traces of about fourteen ribs on the body and of about ten on the truneation still remain. The umbonal ridge is sharply angulated and the outline of the shell is trigonal.

Localities.—Near Quebradillas, Station 131; near Ponce, Stations 288, 289, 291.

Subgenus *Lævicardium* Swainson

Cardium (*Lævicardium*) *serratum* Linnaeus

Cardium serratum Linnaeus, 1758, Systema Naturæ, ed. X, p. 680; 1767, ed. XII, p. 1123.

Cardium levigatum Lamarck, 1819, Anim. sans Vert., VI, pt. 1, p. 11. Not of Born, 1780, nor of Linnaeus 1758.

Cardium (Lævicardium) serratum Dall, 1900, Trans. Wagner Inst. Sci., III, pt. 5, p. 1110; 1903, *Idem*, pt. 6, p. 1587.

Cardium (Lævicardium) serratum Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 367.

Cardium (Lævicardium) serratum Maury, 1917, Bull. Amer. Paleont., No. 29, p. 212, Pl. XXXVI, fig. 8; *Idem*, No. 30, pp. 10, 22, 23, 24.

Cardium (Lævicardium) serratum Vaughan, 1919, Bull. U. S. Nat. Mus. No. 103, p. 562.

My party found in the Miocene Bluffs of the Gurabo and Mao Rivers, Santo Domingo, fossil shells of *Lævicardium serratum* precisely like recent specimens on the beach at Monte Cristi. Dall records this species from Bowden, Jamaica, and Alum Bluff, Florida; the Pliocene of Florida and South Carolina; Pleistocene of Florida and the Antilles, and living from Cape Hatteras to Bahia, Brazil.

Among the molds of *Cardium* from Porto Rico collected by Reeds are some which seem undoubtedly to represent this species. We may thus extend its range eastward to Porto Rico.

Localities.—Near Quebradillas, Stations 126, 131; near Ponce, Station 291.

Genus **Clementia** Gray

This tropical genus is now reduced to some half dozen species living chiefly on the Philippine, Korean, and Australian coasts, the genotype being *Clementia papyracea* Gray. A single authentic recent species *C. solida* Dall, is on the West coast of Mexico. It is the only living member of the genus in American waters. During the Tertiary, however, *Clementia* lived on the East coast of America. Professor G. D. Harris has lately referred *Dosinia mercenaroidea* Aldrich, from the St. Maurice Eocene beds at the base of the Clairborne bluff, to *Clementia*. During the Miocene *Clementia inoceriformis* inhabited the Maryland shores and probably ranged north to Martha's Vineyard, Mass., since a mold like it has been found in the Gay Head Miocene clays. *Clementia grayi* Dall lived during the deposition of the Oak Grove sands, Florida, and *C. tenuiosa* Guppy has been preserved in the Savaneta beds of Trinidad Island. The Isthmian species was *C. dariena* of which we have now found an ancestral form in the Middle Oligocene of Porto Rico.

This genus has never before been recorded from the Greater Antilles. The Trinidad species, *C. tenuiosa* is subtriangular with the beaks nearly central.

Clementia rabelli, new species

Plate VI, Figures 2, 3

Shell closely resembling *Clementia dariena* Conrad, but far less ventricose and smaller than this later, Isthmian species. Original substances of shell very delicate and papery, handsomely sculptured with wave-like, concentric, rounded ridges, resembling the undulating sculpture of the modern genus *Ræta* and its Eocene precursor, *Pteropsis*. Older shells of the Clementia lose this sculpture and near their ventral margins show only close, concentric growth lines just as in aged specimens of *C. dariena*.

Dr. Reeds collected many molds of this common and very characteristic fossil of the Collazo shales. The molds are greatly deformed by disturbances of the strata in which they were deposited.

Many are flattened, while in others the pressure has acted on the anterior-posterior axis, fracturing the shell medially and compressing it into an oblong triangular form with a false, superficial aspect of *Inoceramus*. Measurements of various shells are as follows: Oval specimens—altitude 40 mm., length 45 mm., diameter 15 mm.; 33 x 38 x 12; 34 x 45 mm. Triangular compressed shell—38 x 24 x 20 mm.

This *Clementia* is an ancestral Oligocene precursor of the Miocene Gatun *C. dariena*. The affinity is so close that, had there been a less distant stratigraphic relationship, I would have called the Porto Rican shell a variety of the Gatun. But the Porto Rican *Clementia*, according to Dr. Reeds, underlies the *Orthaulax* zone. Apropos of this Vaughan's recent listing of an unidentified *Clementia* in the Culebra formation at Panama is interesting. This shell would be far more nearly synchronous with the Porto Rican *Clementia*.

Of recent shells, *Clementia rabelli* is most like specimens in the American Museum of *C. papyracea* from New Holland. This species is dedicated to Señor Narciso Rabell Cabrero, the scientist and naturalist of San Sebastian, who most generously showed his collections to Dr. Reeds and pointed out the rich fossiliferous localities along Rio Collazo. The *Clementia* and its associated fauna were obtained from the green shales outerropping on the Collazo in the vicinity of the beautiful waterfalls on Señor Rabell's property.

Localities.—Rio Collazo near San Sebastian, Stations 23, 53, 54, 60, 61, 62.

Genus **Antigona** Schumacher

Antigona tarquinia Dall

Venus magnifica Heilprin, 1886, Trans. Wagner Inst. Sci., I, p. 116. Not
V. magnifica Sowerby, 1853.

Venus tarquinia Dall, 1900, Trans. Wagner Inst. Sci., III, pt. 5, p. 1194, Pl. XXXVIII, figs. 2, 2a. Figure only.

Cytherea tarquinia Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1274.

Antigona tarquinia Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 147, Pl. XXVI, figs. 1, 2.

From the Collazo shales come two imperfect specimens which have the striking and very characteristic sculpture of *Antigona tarquinia*, described by Dall from the Tampa formation, and listed by him also from Santo Domingo. The species is remarkable for its very handsome sculpture which is *Corbis*-like, and consists of

uniform, close-set, radial threads interrupted by regularly-spaced, concentric ridges.

One of the shells has been crushed into an elliptical form by pressure acting on the dorsal region. This enhances its false resemblance to a *Corbis*. The other is not distorted but is broken at the ends. Yet the shell shows a decided likeness in form, sculpture, and size to the Floridian type and the posterior dorsal margin also is nearly straight. The altitude is 40 mm. and diameter 25 mm., the corresponding measurements of the type were 41 x 26 mm.

Localities.—Rio Collazo near San Sebastian, Station 46. A crushed shell, probably this species from Station 63, same locality. From the limestone near Aguada, Station 117, is an internal mold, retaining traces of sculpture, which may be this species.

Antigona tarquinia antillica, new variety

Antigona tarquinia Maury, 1917, Bull. Amer. Paleont., No. 29, p. 217, Pl. XXXVII, fig. 4; *Idem*, No. 30, p. 27. Not *A. tarquinia* Dall, 1900.

Shell of medium size, roundly trigonal, with the posterior dorsal margin sloping rapidly; beaks low; surface sculptured with narrow, concentric ridges between which are conspicuous radial threads. Length of shell 36 mm., altitude 33 mm., semi-diameter 10 mm. Collected by my party at Zone H, Rio Cana, Santo Domingo, in 1916.

In describing this Dominican shell I noted that more material might prove it worthy of varietal rank.

The Porto Rican collection made by Dr. Reeds includes a single external mold in the limestone which strikingly resembles the Dominican valve. The umbo is broken away, but the mold agrees in its sloping posterior margin and in size and general aspect with the valve from the neighboring island.

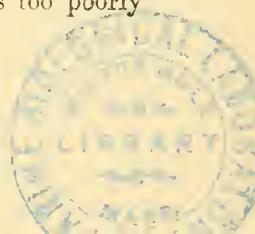
This form appears to constitute a variety.

Locality.—Near Quebradillas, Station 130.

Antigona, species indet.

A very imperfectly preserved shell shows that a large *Antigona* was present resembling somewhat in form and sculpture *A. willcoxi* Dall from the Florida Pliocene, but smaller. In size the shell resembled the Miocene *A. caesarina* Dall from the Chipola marls, but in outline it is nearer *A. willcoxi*. Unfortunately it is too poorly preserved to describe.

Locality.—Near Ciales, Station 504.



Genus **Callocardia** A. Adams
Callocardia riocollazica, new species

Plate VI, Figure 9

Shell rather small, cordate, moderately convex, beaks rather low and curving forward over the small lunule. Hinge characters concealed by the matrix, hence the reference of the shell to this genus is tentative. Surface sculpture of very fine, even ridges barely seen without a lens. Length of shell 28 mm., altitude 20 mm., semi-diameter 8 mm.

Callocardia gatunensis Dall from the Miocene of the Isthmus and of Santo Domingo, is larger and the curve of the anterior basal margin is quite unlike that of the Porto Rican shell.

Locality.—Rio Collazo near San Sebastian, Station 53.

Genus **Chione** Mergele von Mühlfeldt
Chione woodwardi (Guppy)

Venus woodwardi Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 292, Pl. XVIII, fig. 1; 1867, Proc. Sci. Assoc. Trinidad, p. 162.

Chione woodwardi Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 249.

Venus woodwardi Guppy, 1874, Geol. Mag. London, p. 442; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 536.

Chione woodwardi Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, pp. 1291, 1587.

Chione woodwardi Maury, April, 1917, Bull. Amer. Paleont., No. 29, p. 218, Pl. XXXVII, fig. 6.

Chione woodwardi Pilsbry and Johnson, May, 1917, Proc. Acad. Nat. Sci. Phila., p. 199.

Guppy first described this species from a Jamaican shell, later he identified it at Cumana, Venezuela, and in 1876 found it among the left over specimens of the Heneken Collection from the Yaqui Valley, Santo Domingo. Dall also cites it from Bowden, Jamaica and Santo Domingo. In 1916, my party collected *Chione woodwardi* in abundance in Santo Domingo. The specimens correspond in all respects to casts made from many external molds in the Porto Rican limestone. These molds show the characteristic single radial riblets of *C. woodwardi* which are never paired, nor split into smaller ribs, as in related species. Curiously, Gabb failed to find *C. woodwardi* in Santo Domingo, and that is doubtless why Pilsbry and Johnson remark that it does not appear to occur there,—as it is not in the Gabb collection at Philadelphia. But Guppy, Dall, and the

writer have all noted its presence in Santo Domingo. This pretty shell was evidently quite widespread in Porto Rico.

Localities.—Near Quebradillas, Stations 125, 129, 136; near Ponce, Station 299; near Ensenada, Stations 392, 393, 394; near Manati, not *in situ*, from boulders, Station 474.

Chione quebradillensis, new species

Plate VII, Figure 4

Shell subtrigonal, anterior end rounded, posterior end somewhat pointed. The surface is handsomely sculptured by about fifteen concentric, crenulated ridges which are cut by the deeply impressed lines defining the lunule, and then continue on over the lunule itself. Over the anterior and posterior areas of the valve the radial sculpture consists of very fine and close-set riblets more or less uniform, only the posterior are somewhat finer and closer. Upon the central portion of the valve the radial ribs are less crowded, although still close, and usually show a definite alternation of a comparatively broad, unpaired, rib with a very fine, linear rib. Length of shell 21 mm., height 16 mm., semi-diameter 9 mm.

This species is related to *Chione walli* Guppy, from the Manzanilla beds of Trinidad and also recorded from Bowden, Jamaica; but that shell has a great many more concentric ridges, and the central riblets alternating with the small intermediate ribs are paired. Lately Pilsbry and Johnson have briefly described, but not figured, a Dominican shell, *Chione santodomingensis*, which is apparently of the same group. The Floridian analogue is *C. chipolana* Dall. The Porto Rican collection afforded a single but very perfect external mold of this shell imprinted in the limestone.

Locality.—Near Quebradillas on Rio Guajataca, Station 134.

Chione quebradillensis guajatica, new variety

Plate VII, Figure 5

A fragmentary external mold was collected by Reeds which resembles the species described as *Chione quebradillensis*, but the ribs over the central area of the valve are paired and alternate with the fine, intermediate rib. This character is as in Guppy's *Chione walli*, but in the Porto Rican shell the concentric crenulated ridges are distant, while in *C. walli* they are very close, almost crowded.

Locality.—Near Quebradillas, Station 133.

Genus ***tellina*** (Linnaeus) Lamarck

This genus is well represented in the collection, but nearly all the specimens are internal molds, too imperfect for specific identification. From the Quebradillas limestone comes a fragmentary imprint of a *Scissula* near *S. cercadica* Maury but probably not that species.

Subgenus ***Angulus*** (Mergele) Dall

***Tellina (Angulus) disparoides*, new species**

Plate VI, Figure 1

Internal mold with short elliptical form; comparatively straight dorsal margin on either side of the low, acute beaks. Hinge characters and surface markings unknown.

On comparing this mold with recent species in the American Museum it was found to be strikingly like specimens labelled *Tellina* (*Tellinula*) *dispar* Conrad from California and from the Hawaiian Islands. When a shell of similar size of *Tellina dispar* was placed upon the mold it coincided at nearly every point.

Failing any evidence regarding the surface characters of the Porto Rican fossil, we can only say that judging from the form alone its relationship is seemingly with this recent Pacific species. Length of fossil 25 mm., altitude 18 mm., semi-diameter 6 mm.

Localities.—Rio Collazo near San Sebastian, Station 60. Imperfect mold, probably the same species, from Station 57. A smaller mold, perhaps identical, from Station 62.

Genus ***Metis*** H. and A. Adams

***Metis trinitaria* Dall**

Tellina biplicata Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 588; 1867, Proc. Sci. Assoc. Trinidad, p. 161; 1874, Geol. Mag. London, p. 441; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 530. Not *Tellina biplicata* Conrad, 1834, Jour. Acad. Nat. Sci. Phila., VII, p. 152.

Tellina sagra Guppy and Dall, 1896, Proc. U. S. Nat. Mus., XIX, p. 329. Not *Tellina sagra* d'Orbigny.

Metis trinitaria Dall, 1900, Trans. Wagner Inst. Sci., III, pt. 5, p. 1041, Pl. XLVI, fig. 24.

Metis trinitaria Maury, 1917, Bull. Amer. Paleont., No. 29, p. 226.

Internal molds of *Metis* are very abundant. Three external molds occur, casts of which correspond with Dall's figure of *Metis trinitaria*, except they are less truncate posteriorly. Still they vary in this respect, some being less produced than others. In one case

the internal mold still rested within the external, thus removing all possible doubt as to whether the internal molds were of the same species.

This shell is easily known by its striking form, the right valve being medially constricted as though pressed in by the thumb, while the left valve is convex. This gives a peculiar aspect, different from any of the other Porto Rican fossils. The internal molds show an immense, rounded pallial sinus, which is slightly larger and higher in the left than in the right valve. The posterior end of both valves is sulcated, that of the right being noticeably bisulcate. Surface smooth except for concentric lines of growth.

Dr. Guppy referred this Antillean shell to *Tellina biplicata* Conrad from the Miocene of Maryland, and in 1874 listed it from the Miocene of Barbuda, and Santo Domingo, from the Caroni Series of Trinidad, and the Tertiary of Cuba.

In 1900, Dall differentiated the Antillean fossil by the name *M. trinitaria* and recorded it from near Santiago de Cuba, at about two hundred and fifty feet above sea level along the ore railway.

A specimen was seen by Guppy in the Heneken collection from the Yaqui Valley, Santo Domingo, but both Gabb and the writer failed to collect it there. It has not been reported from Jamaica, but it ranged from Trinidad north to Barbuda and thence west to Porto Rico, Santo Domingo and southeastern Cuba. The number of specimens indicate very favorable conditions in Porto Rico.

On the one hand *Metis trinitaria* resembles the Chesapeake Miocene *M. biplicata* and on the other the Pleistocene and recent *M. intastriata* Say. The *Tellina sagræ* of Orbigny's unpublished Paleontologica Cubana pl. IV, figs. 8, 9, was an internal cast, according to Dall probably of *M. intastriata*.

Localities.—Rabell's Ranch, on Guajataca River, Station 110; near Quebradillas, Stations 125, 127, 128, 129, 130, 131, 133, 135, 136, 137, 138, 144.

Also a very poor internal mold possibly this species from near Guayanilla, Station 320.

Genus **Semele** Schumacher

Semele, species indet.

A number of distorted specimens of a *Semele* somewhat resembling *Semele chipolana* Dall come from the Collazo shales, but the shells

are too deformed and imperfect for specific description. Attention is simply called to the presence of the genus in this formation.

Localities.—Rio Collazo near San Sebastian, Stations 36, 53, 54.

Genus **Tagelus** Gray

Section **Mesopleura** Conrad

Mesopleura hubbardi, new species

Plate VII, Figure 3

Shell transversely oblong-elliptical, compressed; anterior and posterior ends evenly rounded; basal margin gently arched; beaks very low, almost exactly central; muscle scar prominent; the most conspicuous character is the very strong, nearly straight, internal rib which is directed downward from the beak a varying distance towards the ventral margin. In the internal molds this rib appears in reverse as a strongly-marked groove. Length of shell 35 mm., altitude 14 mm. The thickness varies with the pressure to which the specimens have been subjected after deposition in the shales.

A number of specimens of a *Tagelus* somewhat resembling *Tagelus (Mesopleura) divisus* Spengler, and probably an ancestral form of that Pliocene to recent species were found in the Collazo shales. This species is named in honor of Mr. Bela Hubbard, as a token of appreciation of his very accurate and valuable paleontological work in northwestern Porto Rico and on Mona Island.

Localities.—Rio Collazo near San Sebastian, Stations 53, 62.

Genus **Psammosolen** Risso

Psammosolen cf. sancti-dominici Maury

Psammosolen sancti-dominici Maury, 1917, Bull. Amer. Paleont., No. 29, p. 228, Pl. XXXVII, fig. 13; *Idem.*, No. 30, p. 14.

A very imperfect mold shows the general characters of *Psammosolen*, and retains very clearly the characteristic, oblique surface markings of this genus. The shell may have been identical with the form we collected at Bluff 3, Cercado de Mao, Santo Domingo, and named *Psammosolen sancti-dominici*, as it is about the size, but it is too poorly preserved for specific identification.

Locality.—Near Quebradillas, Station 131.

Genus **Corbula** (Bruguière) Lamarck

Corbula collazica, new species

Plate VI, Figures 10, 11

Shell ovate-triangular, of medium size for the genus, anterior end rounded, posterior end produced, right valve somewhat larger than the

left, its posterior end obliquely truncate, its surface sculptured with about twenty-five to thirty fine, close-set, even, subequal concentric ridges, alternating with linear interspaces; left valve somewhat smaller and pointed posteriorly to fit within the truncated end of the right valve. Concentric sculpture of both valves similar. Length of shell 13 mm., height 8 mm., semi-diameter 3.5 mm.

This *Corbula* is one of the commonest and most characteristic shells in the Collazo shales. Fossil species of this genus already described from the Greater Antilles are the following: *Corbula sericea* Dall, *C. heterogenea* Guppy, *C. vieta* Guppy, *C. viminea* Guppy, *C. dominicensis* Gabb, *C. cercadica* and *C. caimitica* Maury. From all of these the present species differs.

Owing to pressure resulting from the disturbance of the shales, the shells are more or less deformed, and at first it seemed as if two forms might be present, one more triangular, the other more nasute. But this difference seems due rather to accidents, as the sculpture and general aspect of all are similar, and I have selected as the type a specimen that seems to have suffered least from pressure and to represent what appears to have been the normal form.

Localities.—Rio Collazo near San Sebastian, Stations 23, 49, 53, 54.

Genus **Panopea** Ménard
Panopea, species indet.

An imperfect internal mold of what appears to represent a very large and extremely obese *Panopea* was found in the collection. The mold measures 90 mm. in length, 70 mm. in altitude and 76 mm. in diameter.

Locality.—Near Arecibo, Station 459.

Genus **Teredo** Linnaeus
Teredo incrassata (Gabb)

Kuphus incrassatus Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 246; 1881, Jour. Acad. Nat. Sci. Phil., (2), VIII, p. 342, Pl. XLIV, figs. 12a-e.

Teredo fistula? Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 529.

Teredo incrassata Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1587.

Teredo incrassata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 235, Pl. XXXIX, fig. 24; *Idem*, No. 30, p. 25.

Kuphus incrassatus Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 558.

Gabb first described the tubes of this *Teredo* from Guayubin, Santo Domingo. Later he found it was abundant and widespread in the Miocene of that island, throughout the Samba Hills and also south of Samaná Bay. He states that, "it is a very common

and characteristic fossil of the upper part of the Dominican Miocene." The writer's party in Santo Domingo also collected *Teredo incrassata* in abundance. The tubes were seen loose along the roadside from Los Quemados to Caimito. They were several feet long and resembled the roots of trees. At Caimito they were present in the Teredo limestone and occurred at Cereado in Bluff 3. Thus this species ran through both the *Sconsia laevigata* and *Aphera islacoloniis* formations.

Dall lists *Teredo incrassata* from Bowden, Jamaica, in the Simpson and Henderson collection. Its range is now extended to Porto Rico, where Reeds found it in great quantities and, as the list of localities shows, extremely wide spread.

Besides its distribution in the Miocene of these three islands of the Greater Antilles, *Teredo incrassata* was also identified by Gabb at Sapote on Rio Reventazon, Costa Rica.

It is of interest that although such large numbers of the tubes have been found, no valves have yet been discovered. The shell therefore remains unknown. The descriptions and identifications rest entirely upon the tubes. These are wrinkled with annular growth lines, often somewhat gnarled and may attain several feet in length and an inch and a quarter in diameter. Smaller portions of the tubes are frequently divided into two by an internal septum.

Localities.—Rio Collazo near San Sebastian, Stations 24, 25, 33, 35, 36, 38, 39, 44, 45, 46, 48, 49, 51, 52, 54, 57, 58, 59, 61, 63; near Lares, Stations 82, 92; Rio Collazo, Station 95; Señor Rabell's Ranch, Rio Guajataca, Stations 110, 111, 112; near Aguada, Stations 117, 119, 122, 123; near Quebradillas, Station 126; near Juana Diaz, Stations 160, 163, 184, 189; near Ponce, Stations 288, 292, 299, 300; East Shore of Guánica Harbor, Stations 368, 373, 374, 375; near Guánica Central, Station 392; near Arecibo, Stations 441, 469; near Manati, Stations 474, 477, 478, 479, 480, 481, 482, 483; near Ciales, Stations 495, 498, 500, 502; near Arecibo, Station 509.

CLASS SCAPHOPODA
Genus **Dentalium** Linnaeus
Dentalium diazicum, new species

Plate VII, Figure 1

Shell with no longitudinal sculpture, polished and entirely smooth except for faint microscopic, annular growth lines, tube curving, tapering con-

siderably, circular in cross section. Length of fragment 19 mm., diameter of larger end 2.75 mm., of smaller end 1.50 mm.

This species is about the size and has the same curvature as apical fragments of *Dentalium dissimile* Guppy from the Miocene of Jamaica and Santo Domingo but is at once differentiated by its absence of longitudinal sculpture. *Dentalium haytense* Gabb from Santo Domingo is smooth and circular in cross section, but the tube is nearly straight. *Dentalium pyrum* Pilsbry and Sharp is ovate in section, while *D. precursor*, another smooth form described by the same authors is oval in cross section. Among other Miocene Antillean *Dentalia* may be mentioned *D. calliglyptum*, *D. tryoni* and *D. cossmannianum* of Pilsbry and Sharp, and *D. glaucoterrarium* Maury which are all sculptured species.

Locality.—Near Juana Diaz, Station 185.

Genus **Cadulus** Philippi

Cadulus poncensis, new species

Plate VII, Figure 13

Shell small, curving, not very slender, circular in cross-section, slightly constricted at the larger extremity, evenly convex up to about two millimeters from the apex when it rather suddenly tapers. Just at the apex the shell seems very slightly swollen. The surface apparently was perfectly smooth. Length of shell 7 mm., greatest diameter 1.50 mm.

From a chalky phase of the limestone near Ponce comes a single specimen of a *Cadulus*. The shell substance appears to have been replaced, but the original form is well preserved. The small Dominican species, *Cadulus phenax* Pilsbry and Sharp (Proc. Acad. Nat. Sci. Phila., XLIX, p. 472, Pl. XI, figs. 23, 24, 1897) of which we collected hundreds of shells in the bluffs of Rio Mao, is about this length, but is a very much more slender and delicate shell. The Bowden form *C. dentalinus* Guppy, is characterized by circular rings around the smaller part of the tube. *Cadulus denticulus-tigris* Maury from Rio Gurabo, Santo Domingo, is about the length of the Ponce shell, but is much more inflated centrally.

Locality.—Near Ponce, Station 283.

CLASS GASTROPODA

ORDER CTENOBANCHIATA

Genus **Calyptreæ** Lamarck**Calyptreæ centralis** (Conrad)

Infundibulum centralis Conrad, 1841, Amer. Jour. Sci., XLI, p. 348; 1845,
Foss. Medial Tert., p. 80, Pl. XLV, fig. 5.

Trochita centralis Emmons, 1858, Geol. N. Car., p. 276, fig. 193.

Trochita collinsii Gabb, 1875, Jour. Acad. Nat. Sci. Phila., (2), VIII, p. 342,
Pl. XLIV, figs. 11, 11a.

Calyptreæ centralis Dall, 1892, Trans. Wagner Inst. Sci., III, pt. 2, p. 353.

This widespread Miocene species is represented by a single internal mold, but the characters of the pillar are concealed by the matrix. The recent analogue and probable descendant of *C. centralis* is *Calyptreæ candeana* d'Orbigny, of which Dall and Simpson report finding a great number of dead shells at Mayaguez. *Calyptreæ centralis* occurs according to Dall in the Chipola Miocene of Florida and in the Miocene of North and South Carolina, Virginia, Maryland and Sapota, Costa Rica.

Locality.—Near Quebradillas, Station 130.

Genus **Natica** Scopoli

There are many internal molds of Naticoid shells in the collection. They are evidently of various species but scarcely any can be specifically determined.

Natica cf. canrena (Linnæus) Moerch

Nerita camerna (Linnæus in part) Auct., Mærch, 1877, Malak. Blatt., 24.
p. 62.

Natica canrena Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 223.

Natica canrena Guppy, 1876, Quart. Jour. Geol. Soc., XXXII, p. 518.

Natica canrena Dall, 1892, Trans. Wagner Inst. Sci., III, pt. 2, pp. 364-365.

Natica canrena Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., p. 508.

Natica canrena Maury, 1917, Bull. Amer. Paleont., No. 29, p. 134, Pl. XXIII,
fig. 10; *Idem*, No. 30, pp. 10-27.

Natica canrena Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

One specimen agrees well in form with *Natica canrena* and is probably that species, but since it is an internal mold, it cannot show the characteristic, tangential surface plicæ which would definitely determine the identification. *Natica canrena* is an ancient,

static form ranging from the Tertiary to the recent. It is found as a fossil in Trinidad, Santo Domingo, Gatun, Costa Rica, and Florida. Its present range is from the Antilles to Pernambuco, Brazil.

Locality.—East shore of Guanica Harbor, Station 373.

Section **Stigmaulax** Moerch

Natica (Stigmaulax) sulcata (Born)

Nerita sulcata Born, 1780, Mus. Cæs. Vindobonensis, p. 400, Pl. XVII, figs. 5, 6.

Natica sulcata Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 290, Pl. 18, figs. 14, 15; 1867, Proc. Sci. Assoc. Trinidad, p. 157.

Natica sulcata Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 223.

Natica sulcata Guppy, 1874, Geol. Mag. London, p. 437; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 518.

Natica (Stigmaulax) sulcata Dall, 1892, Trans. Wagner Inst. Sci., III, pt. 2, p. 366.

Natica sulcata Dall and Simpson, 1902, Bull. U. S. Fish Comm., XX, pt. 1, p. 438.

Natica (Stigmaulax) sulcata Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1585.

Natica (Stigmaulax) sulcata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 135, Pl. XXIII, fig. 13; *Idem*, No. 30, pp. 11, 22, 24, 27.

Natica (Stigmaulax) sulcata Jones, 1918, Jour. Geol. XXVI, p. 742.

As early as 1867, Guppy, the pioneer and indefatigable paleontologist of the West Indies, had listed this species from the Miocene of Cumana, Venezuela, and from Jamaica and Santo Domingo. Dall has also recorded it from Bowden, and Jones lately found it in the Maissade beds, Rivière L'Ayaye, Haiti. My Dominican expedition found it in abundance in the Miocene blue clays, the specimens from Bluff 3, Cercado de Mao, being particularly large and fine. Reeds obtained a single much broken shell from Porto Rico which though so imperfect has the groovings and form characteristic of this widespread species. This is one of the few cases where the Miocene shell has lived on unchanged to the present time. It is still found on the Porto Rican shores. *Natica sulcata* is easily recognized by its ornamentation of uniform groovings which traverse the entire surface, keeping parallel to the margin of the outer lip.

Locality.—Rabell's Ranch on Rio Guajataca, Station 110.

Genus *Amauropsis* Moerch

Amauropsis guppyi gurabensis Maury

Amauropsis guppyi gurabensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 138, Pl. XXIII, fig. 20; *Idem*, No. 30, p. 24.

Amauropsis guppyi gurabensis Jones, 1918, Jour. Geol. XXVI, p. 742.

An internal mold in the collection shows the broad form, short, acute spire, and broadly shouldered whorls that characterize this variety of Gabb's *Amauropsis guppyi* (*Aaura Guppyi* Gabb, Trans. Amer. Phil. Soc., XV, p. 224, 1873). The typical form has a more evenly sloping spire and proportionally longer body whorl.

My party found the variety, *gurabensis* rather commonly in the bluffs of Rio Gurabo, Los Quemados, Santo Domingo. Jones later obtained it from the Maissade beds, Rivière L'Ayaye, Haiti. The Porto Rican mold agrees well in form with our Dominican shells.

Locality.—Near Aguada, Station 123.

Genus *Xenophora* Fischer de Waldheim

Xenophora conchyliophora (Born)

Trochus conchyliophorus Born, 1778, Mus. Cæs. Vind., Index, p. 333.

Phorus reclusus Conrad, 1855, Proc. Acad. Nat. Sci. Phil., VII, p. 262.

Phorus agglutinans Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 241.

Xenophora agglutinans De Gregorio, 1890; Mon. Eocene Ala., p. 144. Not of Lamarck.

Xenophora conchyliophora Dall, 1892, Trans. Wagner Inst. Sci., III, pt. 2, pp. 360-362; 1915, Bull. 90, U. S. Nat. Mus., p. 105, Pl. XV, figs. 1, 3.

Xenophora conchyliophora Dall, 1916, Proc. U. S. Nat. Mus., LI, p. 518, Pl. LXXXVI, fig. 10.

Xenophora conchyliophora Maury, 1917, Bull. Amer. Paleont., No. 29, p. 133, Pl. XXIII, fig. 7; *Idem*, No. 30, pp. 22, 23.

The Porto Rican representatives of *Xenophora* are all internal molds; but almost undoubtedly they are the fillings of shells of *X. conchyliophora*. This ancient, static species dates from the Ripley Cretaceous of Alabama through Eocene, Oligocene, Miocene and Pliocene times down to the recent fauna. It is living in 14 to 250 fathoms from Hatteras to Guadeloupe and in the West Indies generally. The Dominican Miocene shells that my party gathered from the bluffs of Rio Gurabo were in all respects like those on the beaches of that island so it is no surprise to find this species in synchronous, Porto Rican deposits.

Localities.—Near Quebradillas, Stations 126, 128, 129.

Genus **Turritella** Lamarck
Turritella altilira culebrina, new variety

Plate VIII, Figure 4

Shell with uniform spirals in the concave central part of the whorls; two raised spiral ridges one near the proximal and one near the distal suture. The lower may have been slightly beaded, the upper is crested with a double row of beads. Grooved area between ridges sculptured with five or six uniform spiral threads. Altitude of most complete specimen 50 mm. greatest diameter (increased by flattening from pressure) 12 mm.

There are several *Turritellas* from the Collazo shales, which though flattened by pressure have retained the shell substance and sculpture. They are remarkably like the Gatun species *T. altilira* Conrad (*T. gabbi* Toula). It may seem strange to refer this species to the Gatun shell rather than to Guppy's *Turritella tornata* described from Cumana, Venezuela, and listed also from Jamaica. But these shells are so much more like Toula's, and Brown and Pilsbry's figures of the Gatun species than like Guppy's figure of the Cumana type that without a series of the actual fossils this identification seems truer.

Localities.—Rio Collazo near San Sebastian, Stations 54, 60, 61, 94.

Turritella collazica, new species

Plate VIII, Figure 5

Shell large and heavy, flattened by pressure but still retaining its characteristic and very striking sculpture. The unique fragment consists of four whorls each with a very heavy and prominent broad swollen band encircling the base just above the proximal suture. This band occupies about one-third of the whorl. The remaining portion is flat and shows traces of having been ornamented with about six coarse spirals. Height of four whorls 65 mm., greatest diameter (increased by flattening of the shell) 35 mm., least diameter 20 mm.

This species is at once recognized by the very heavy rounded ridge defining the base of each volution. The species with which it seems to be most closely related is the North American Eocene shell, *Turritella mortoni* Conrad. I know of no Antillean species at all resembling it. The fossil would seem to be a descendant of Conrad's shell with the ridge not sharp and carinate as in that species but broad, round and swollen.

Locality.—Rio Collazo near San Sebastian, Station 64.

Turritella poncensis, new species

Plate VII, Figure 6

Shell of medium size, tapering rather gradually from the base towards the apex. Whorls flattish, each usually marked by six stronger primary spiral threads between which are a varying number of fine secondary spirals visible only with a lens. Anteriorly the whorls are roundly carinated and project so as to partly overhang the suture immediately beneath them. This overhanging of the basal part of the volutions is the most conspicuous character of the shell and differentiates it at once from the common West Indian Miocene species, *Turritella planigyrata* Guppy. A fragment of about four whorls measures 28 mm. in length and 14 mm. in greatest diameter.

This species seems nearest akin to the larger Gatun shell, *Turritella mimetes* Brown and Pilsbry.

Locality.—Near Ponce, Station 285.

Turritella guanicensis, new species

Plate VII, Figure 7

Shell was fairly large, tapering rather rapidly towards the apex. The sculpture of the two whorls that precede the last volution consists on each of an anterior and a posterior pair of spiral, beaded ridges separated by a narrow groove. Between the whorls is a concave space in the center of which lies the suture. On the last shorl, in addition to the two pairs of beaded, spiral ridges, there is a somewhat smaller, basal carina, just beneath the anterior pair making them appear like three ridges and forming in all five instead of four ridges on the body whorl. On this whorl also there is a threadlike secondary spiral in the groove between the two pairs of beaded ridges. A fragment of about four volutions measures 22 mm. in length and 12 mm. in greatest diameter.

On the one hand, this species bears some resemblance to *Turritella forresti* Brown from Willoughby Bay, Antigua, but that shell is much smaller, about half the diameter of the Porto Rican, and has three major spiral ridges, beaded and paired, and between these three groups of major ridges are clusters of five, finer, secondary spirals. On the other hand, the aforementioned Ponce shell recalls in quite a striking manner the sculpture of the much later Floridian *Turritella apicalis tensa* Dall, which has also two pairs of beaded ridges to every whorl and seems to be the Pliocene analogue of the Porto Rican species.

Locality.—Guanica Harbor, Station 374.

Genus **Cerithium** Bruguière**Cerithium russelli arecibense**, new variety

Plate VII. Figure 9

Each whorl ornamented with a row of small, nearly uniform beads, about eight to a half volution. Beneath this beaded row a series of rounded, not perfectly regular longitudinal ribs, about twelve to a volution. Entire surface marked by fine incised spirals, visible without the lens; on last whorl tending to alternate with secondary, microscopic spirals. Last two whorls measure 15 mm., in height and 11 mm., in greatest diameter.

This variety is founded upon a fragmentary external mold of a *Cerithium* resembling *C. russelli* Maury, from Los Quemados, Rio Gurabo, Santo Domingo. It differs notably in its smaller size and details of ornamentation. The sculpture of the Porto Rican shell is rather bolder, the ribs few, stronger and more regular than in the Dominican type.

Locality.—Near Arecibo, Station 471.

Cerithium utuadicum, new species

Plate VII. Figure 8

Whorls, three of which show in the rock imprint, slightly convex and ornamented with arching, rounded, longitudinal ribs, about nine to half a volution, separated by narrower interspaces. A few of the ribs can be traced from suture to suture across the whorl, but the majority are so interrupted posteriorly by an abrupt change of sculpture as to lose their identity. This change consists in the development of a band bearing, regular, uniform, bead-like nodules, twelve or more to half a volution. This beaded row comes out well in the artificial cast. Beneath it is a very fine row of nodules, best seen in the external mold, as it is too delicate to form a good impression. Beneath the row of fine nodules are about seven primary spiral threads, usually alternating with finer, secondary spirals. Height of fragment 16 mm., greatest diameter approximately 10 mm.

The specimen consists of the fragmentary mold of a richly-sculptured, turreted shell which at first glance one would think a *Terebra*, but on examination under a lens the ornamentation appears more like that of certain unusual *Cerithia*. This species has a decided general resemblance to the figure of *Cerithium corallicolum* Dall from the Upper Flint River beds, Georgia (Proc. U. S. Nat. Mus., LI, Pl. LXXXVII, fig. 6, 1917). But the Porto Rican shell is smaller, slenderer, with finer, more numerous ribs, a minor beaded

row beneath the major, and is a more elegantly sculptured shell than the earlier Georgian form.

A recent specimen in the American Museum labelled *Vertagus faciatus* Bruguière, Jay Collection, from Ceylon, resembles the fossil in having a nodose band, giving the shell a *Terebra*-like aspect, but the ribs are lower, straighter, closer and more numerous and the spirals fewer than in the fossil species.

Locality.—About midway between Arecibo and Utuado, Station 471.

Subgenus **Campanile** Bayle

Section **portoricia**, new section

Shell large, many-whorled, turreted, very elongate-conic, tapering gradually from a comparatively narrow base to the apex. Suture very profoundly excavated. Whorls rounded, each showing distinct traces of a narrow, deep medial groove, perhaps representing surface sculpture.

The specimens are all in the form of internal molds. The cylindrical axial perforation represents the space occupied by the dissolved columella. The interior surface of this perforation has a coating of calcite crystals which obscures to some extent the structure, but there is no indication of any grooves representing in reverse columella plications. The pillar apparently was smooth.

Although so imperfect, the suggestion of a new section for these singular molds seems justified by their unique characters. In the very deep sutures, rounded whorls and curious Pleurotomarian-like groove they differ from such forms as *Campanile claytonense* Aldrich from the Midwayan Eocene of the Gulf States and also from the great *Cerithium giganteum* of the Paris basin Eocene. In a superficial way they bear more resemblance to *Halloysia biplicata* Briart and Cornet from the lower Eocene of Mons, but that has a plicate columella and its affinities are with *Nerinea*.

The presence in North America of large *Cerithiums* recalling those of the Paris basin Eocene was first noted by Dall in a letter⁷ to Dr. Fischer regarding the basal Eocene beds of the Gulf States. He remarked: "Dans ces calcaires du Tertiaire inférieur se montrent des fragments d'un *Cerithium* de très grande taille, paraissant voisin du *C. giganteum* de l'Eocène du Bassin de Paris. Or, ce type est trouvé pour la première fois en Amerique." In 1894, Aldrich

⁷Published in Bull. Soc. Géol. de France, XVIII, (3) 1890, p. 327.

described *Cerithium (Campanile) claytonense* from the Midwayan Eocene of Alabama. This attains 125 mm., and has flattened whorls with the suture not excavated.

In a discussion of the Oligocene fauna of Bainbridge, Georgia, Dall remarks:⁸ "A feature of somewhat unusual interest paleontologically is the presence in the upper bed of a relatively large number of species of the Cerithiidae, several of them of unusual size, recalling the analogous group in the Parisian Eocene of France, and not paralleled in any of the other Tertiary horizons of the United States as far as known."

These Porto Rican specimens are, however, very much larger than any *Cerithiums* from the Flint River Oligocene, nor are they like Dall's species. I know of no North American or Antillean fossil resembling these Porto Rican molds. I believe they represent a unique fauna having affinities with European Eocene forms, but of a younger geological period.

Campanile (Portoricia) laricum, new species

Plate VIII, Figures 1, 2

At the base of the Arecibo limestone a number of internal molds were collected for which I have suggested the above described new section *Portoricia*. The largest fragment consists of six whorls and shows evidences of pressure, resulting in distortion. The six volutions of this mold measure 80 mm., in height. Another fragment of three whorls is 33 mm. in height and 45 mm. in greatest diameter. All the fragments appear to have been the same species and all show interrupted traces of the medial groove, which looks like the markings on internal molds of Pleurotomarian shells, but was probably some surface sculpture that grooved the internal wall of the volution.

Localities.—Near Lares, Stations 57, 58, 59.

Genus *Strombus* Linnaeus

***Strombus* cf. *haitensis* Sowerby**

Strombus haitensis Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 48,
Pl. IX, fig. 7.

Strombus haitensis Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 157.

Strombus bituberculatus Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 233.
Not of Lamarck.

⁸Proc. U. S. Nat. Mus., LI, 1917, p. 487; Pls. LXXXIII to LXXXVIII.

Strombus haitensis Guppy, 1874, Geol. Mag. London, p. 438; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 521.

Strombus haitensis Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1584.

Strombus haitensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 118, Pl. XX, fig. 1; *Idem*, No. 30, pp. 10, 18, 22, 23, 24.

Several internal molds probably represent fillings of *Strombus haitensis*. When compared with shells of this species collected by the writer from the type region in the Yaqui Valley, Santo Domingo, the molds are seen to correspond to the interior of the shell. They also show traces of the stronger, upper row of spiny prongs. Absolute certainty is not possible, but in all probability the molds are those of *S. haitensis*. First described by Sowerby from Heneken's Dominican shells, this species has been later found in the Yaqui Valley by Gabb and the writer. Gabb referred his specimens to the living *Strombus bituberculatus*. The differences between the Miocene and the recent species are noted in my descriptions of Dominican fossils. Dall lists *S. haitensis* from Henderson's and Simpson's collection of Bowden fossils. The species thus seems to have lived on the Miocene shores of the adjacent islands of Santo Domingo, Jamaica and Porto Rico.

Localities.—Señor Rabell's Ranch, Rio Guajataca, Station 112; near Aguada, Station 117.

***Strombus cf. bifrons* Sowerby**

Strombus bifrons Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 48, Pl. IX, fig. 9.

Strombus bifrons Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 287; 1867, Proc. Sci. Assoc. Trinidad, p. 157.

Strombus pugilis Gabb (in part) 1873, Trans. Amer. Phil. Soc., XV, p. 233. Not of Linnaeus.

Strombus bifrons Guppy, 1874, Geol. Mag. London, p. 438.

Strombus bifrons Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 521.

Strombus bifrons Dall, 1890, Trans. Wagner Inst. Sci., III, pt. 1, pp. 176, 177; 1903, *Idem*, pt. 6, p. 1584.

Strombus bifrons Maury, 1917, Bull. Amer. Paleont., No. 29, p. 119, Pl. XX, figs. 2, 3; *Idem*, No. 30, pp. 10, 13, 18, 22, 23, 27.

In the collection is an internal mold which probably represents *Strombus bifrons* Sowerby. When compared with Dominican shells of that species, it corresponds in size and form to the interior; but no positive identification is possible because of the very imperfect preservation of the Porto Rican specimen. The type locality of

Strombus bifrons is the Yaqui Valley, Santo Domingo where it was first found by Colonel Heneken and described by Sowerby. Guppy and Dall have recorded its presence in the Bowden beds, Jamaica.

This very pretty and graceful shell of the Miocene shores of the Greater Antilles had for its analogues in Florida *Strombus aldrichi* Dall and *S. chipolanus* Dall. The Isthmian *S. gatunensis* Toula resembled it to a less degree as it lacked the shoulder spines. The living representative of this type of *Strombus* is *S. columba* of the oriental seas.

Locality.—Señor Rabell's Ranch, Rio Guajataca, Station 110.

***Strombus cf. proximus* Sowerby**

Strombus proximus Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 48, pl. IX, fig. 8.

Strombus proximus Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 157.

Strombus pugilis Gabb (in part) 1873, Trans. Amer. Phil. Soc., XV, p. 233.

Not *S. pugilis* Linnæus. Exclude Gabb's other synonyms.

Strombus proximus Guppy, 1874, Geol. Mag. London, p. 438; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 521.

Strombus pugilis Dall (in part) 1890, Trans. Wagner Inst. Sci., III, pt. 1, p. 177. Not *pugilis* Linnæus.

Strombus proximus Maury, 1917, Bull. Amer. Paleont. No. 29, p. 119, Pl. XX, figs. 4, 5; *Idem*, No. 30, pp. 10, 13, 22, 27.

Strombus proximus Jones, 1918, Jour. Geol. XXVI, p. 741.

The type of *S. proximus* was collected by Colonel Heneken in the Yaqui Valley, Santo Domingo, seventy years ago. Twenty years and more later Gabb found it there also, but referred it erroneously to *Strombus pugilis*. Jones lately reports finding *S. proximus* in the Maissade beds, Riviere L'Ayaye, Haiti.

Several internal molds in the collection are probably of this species as they correspond to the form of the Dominican shells. Positive identification is not possible, but as far as the material at hand permits one to form an opinion, the three very characteristic Dominican Miocene species, *S. haitensis*, *S. bifrons* and *S. proximus* were also living in Porto Rico. The nearest living analogue of *Strombus proximus* seems to be *S. gracilior* Sowerby, from Panama.

Localities.—Near Ponce, Stations 289, 292.



Genus ***Orthaulax*** Gabb
***Orthaulax aguadillensis*, new species**

Plate IX, Figure 4

Shell large and heavy, form of spire short and blunt, like that of *Orthaulax pugnax*. This at once distinguishes the shell from the Dominican species, *O. inornatus* Gabb, which is high-spired. A further characteristic of the shell is the evenly rounded form of the shoulder, which in cross-section would be almost perfectly circular. This marks it off very decisively from the Floridian, Chipolan species, *Orthaulax gabbi* Dall, which is markedly triangular at the shoulder. The spire measures 45 mm., in diameter.

A single specimen of this *Orthaulax* was collected by Reeds at Aguadilla. It is imperfect, but undoubtedly a typical member of this very important index genus.

The shell was submitted to Dall who compared it with the types of the various known species in the National Museum. He replied that "The *Orthaulax* is nearest to *O. pugnax* but as the margin of the spire is gone it is impossible to be certain. I think it is new."

One might be criticized for describing so incomplete a specimen as new were this a less rare and less stratigraphically important genus. Moreover, no complete adult shell of either *O. inornatus* or *O. pugnax* has ever been found. Though heavy and apparently strong the shells seem to go to pieces very easily and usually one finds only heads, as in this case or fragments of the heavy pillars.

No other mollusean shells were found associated with this *Orthaulax*, but an Echinoderm occurred.

It is a little surprising that the nearest ally of this Porto Rican *Orthaulax* should be not Gabb's *O. inornatus*,—from the adjacent island of Santo Domingo and in the Tampa and White Beach beds, Florida, but *O. pugnax*. The latter ranges geographically from the Tampa, Florida beds and those of Bainbridge, on the Flint River, Georgia to Cuba, Antigua and the Canal Zone, and geologically from the Middle Oligocene of Antigua to the Upper Oligocene of the Tampa and Flint River formations.

Locality.—Aguadilla, Station 3.

Genus ***Cypræa*** Linnaeus
***Cypræa sancti-sebastiani*, new species**

Plate VII, Figure 12

Molds of the usual oval-cylindrical *Cypræa*-shape, the outer lip extending considerably above the spire; exterior characters unknown. Length of

smaller mold 18 mm., width 11 mm., thickness 9 mm.; corresponding measurements of the larger mold, which is figured, 29 x 17 x 12 mm.

A number of molds of *Cypraea* varying in size were obtained from the Collazo shales. The large specimens are so deformed that it is impossible to say whether they are identical with the less distorted smaller molds or not. Of the smaller specimens, described above, the first is about the size of the Miocene to recent species, *Cypraea spurca* Linnaeus, but is less contracted basally and more cylindrical. The other is in size like *C. spurcoides* Gabb, but less inflated and appears to be specifically the same as the smaller specimen.

Localities.—Rio Collazo near San Sebastian, Stations 24, 36.

Genus **Dolium** Lamarck

Subgenus **Malea** Valenciennes

Malea camura Guppy

Malea camura Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 287, Pl. XVII, fig. 9; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158.

Malea ringens Gabb (in part), 1873, Trans. Amer. Phil. Soc., XV, p. 223. Not *M. ringens* Swainson.

Malea camura Guppy, 1874, Geol. Mag. London, new ser., decade 2, I. p. 439; 1876, Quart. Jour. Geol. Soc., London, XXXII, p. 525.

Malea camura Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1584.

Malea camura Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phil., p. 356.

Malea camura Maury, 1917, Bull. Amer. Paleont., No. 29, p. 112, Pl. XIX, fig. 3; *Idem*, No. 30, pp. 11, 13, 23, 24.

Malea camura Jones, 1918, Jour. Geol. XXVI, p. 741.

Malea camura Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

This species was first described by Guppy from an immature Jamaican shell. Later he identified it from Santo Domingo and Panama. Gabb referred his Dominican specimens to the recent West coast species, *Malea ringens* Swainson. Dall lists *M. camura* from the Henderson and Simpson collection of Bowden, Jamaica fossils; Pilsbry and Brown record it from Gatun; Jones has lately found it in the Maissade beds, Rivière L'Ayaye, Haiti. The writer has obtained it in abundance from Cercado de Mao and Los Que-mados, Santo Domingo.

On comparing an external mold and its artificial cast from Porto Rico with Dominican specimens the agreement is almost line for line with some of our younger shells of *Malea camura*, leaving no doubt of complete identity. The closest ally and probable descend-

ant of *Malea camura* is *M. ringens* Swainson living on the West Coast. Zetek in Los Moluscos de la Republica de Panama, p. 29, 1918, lists the latter shell from Panama.

The present distribution of the subgenus *Malea* is restricted to the West Coast of Central and South America to Polynesia and the Philippines. It has become strictly Pacific, while in Tertiary times it was abundant in the Antillean and Isthmian Atlantic waters.

Locality.—Near Quebradillas, Station 131.

Genus **Pyrula** Lamarck
Pyrula hoveyi, new species

Plate VIII, Figure 3; Plate IX, Figure 7

Shell fig-shaped, spire unusually high for the genus; entire surface reticulated by very close-set, sharply defined longitudinal ridges crossing the spiral sculpture and equalling in thickness the series of primary spirals. The spiral ornamentation consists of delicate, but sharp, primary spirals at intervals of two and a half to three millimeters apart, and between each pair of primaries are three much finer subequal threads. Thus the secondary thread which occupies the center of each interspace is only very slightly more pronounced than the two tertiaries which lie on either side of the secondary. The earliest whorls are not shown in the rock imprint of the shell, but the third from the body whorl shows the point at which the longitudinal ridges suddenly begin. The primary spirals clearly precede them, but how far back towards the apex they extended is unknown. Length of incomplete internal mold 42 mm., greatest width 26 mm. Very likely the shell when adult attained a much larger size.

From the above description it is clear that this Porto Rican shell is not of the Antillean and East Coast *Pyrula papyratia* stock, of which Burnett Smith has described an ancestral Bowden form as *Pyrula pilsbryi*. The *P. papyratia* race have pronounced secondary spirals, very much stronger than the tertiaries, resulting in a very different type of sculpture from our fossil, and the longitudinal lines are so inconspicuous that the surface is not reticulated. Nor is the Porto Rican fossil like Guppy's *Pyrula carbarea* from the Caroni series of Trinidad. That species has very characteristic sunken interspaces between the primaries, and appears to be an aberrant form.

Two molds of the *Pyrula*, one being a nearly complete internal mold and the other an impression in the rock, are present showing most of the spire and the upper part of the body whorl. The sculp-

ture is perfectly preserved and an artificial cast of the external mold reveals every detail of the exquisitely fine ornamentation of the original.

This fossil is closer to the Isthmian species *Pyrula micronematica* Brown and Pilsbry from the Pecten bed in the Culebra Cut, but was larger, with a much higher spire and with very close-set longitudinal ridges instead of the wide-spaced axial threads of that species. Nor is there any knotting at the points of intersection of spirals and axials as noted in *P. micronematica*. Nevertheless, the kinship of the Porto Rican shell is with this species, because like it, its relationship is to the West Coast and not to the East Coast group of Pyrulas.

In the unusual prominence of the spire the Porto Rican fossil resembles recent specimens in the American Museum of *Pyrula dussumieri* Valenciennes, living in the China seas. In its sculpture it is almost precisely like a specimen of *Pyrula reticulata* Lamarck from Japan. Its affinities are very clearly with the recent Pacific fauna. The shell is named in honor of Dr. E. O. Hovey.

Localities.—Near Arecibo, Stations 468, 470.

Genus **Tritonium** Link
Subgenus **Colubraria** Schumacher
Colubraria juanica, new species

Plate IX, Figures 2, 3

Shell of medium size, broadly fusiform, somewhat flattened on the oral and aboral faces; suture distinct, whorls very slightly convex; outer lip bordered with a heavy, marginal varix, and within bearing about sixteen short, sharp liræ; body whorl with an obsolete varix on the center of the oral side; aperture elliptical; anterior canal short, strongly recurved; entire surface of shell sculptured with a very fine, even reticulation formed by the intersections of longitudinal and spiral ridges. Length of decollate shell 23 mm., greatest width 9 mm.

Dall mentions *Colubraria lanceolata* Menke from the Pliocene marl of the Caloosahatchie, a species which is also living in the Antilles. But that shell is much slenderer than the Porto Rican fossil.

Locality.—Near Juana Diaz, Station 185.

Genus *Phos* Montfort
***Phos costatus* Gabb**

Phos costatus Gabb, 1873, Trans. Amer. Phil. Soc. XV, pp. 212, 213.

Phos costatus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 88, Pl. XIV, figs. 13, 14; *Idem*, No. 30, p. 13.

Phos costatus Jones, 1918, Jour. Geol. XXVI, p. 740.

Among the fossils is an external mold of a *Phos* which shows the robust form, deep suture, and strong, rather distant, rounded longitudinal ribs, characteristic of Gabb's Dominican species, *Phos costatus*. The type, which Gabb never figured, is with the main Gabb collection in the Philadelphia Academy; but the writer in 1916, obtained specimens of the shell from Cercado de Mao, Santo Domingo, and identified them by comparison with metatypes of Gabb's at Cornell University.

The Porto Rican rock imprint does not reveal the aperture as it is more a side view of the shell; but the form, sculpture, and ribbing are so evidently that of this rugged *Phos* that there seems no doubt of its complete identity with the Dominican species.

W. F. Jones reports *Phos costatus* from the Maissade beds on Rio Blanco, north of Maissade, and also in the same formation on Rivière L'Ayaye, Haiti. Until then it had never been identified outside of the Dominican Republic. Its Miocene range is now extended to the neighboring island of Porto Rico.

Like the following species this *Phos* is referable to the section *Strongylocera* Moerch which Dall has suggested might well be revived for these and kindred species.

Locality.—Near Quebradillas, Station 129.

***Phos fasciolatus* Dall**

Phos (Strongylocera) fasciolatus, Dall, 1897, Proc. U. S. Nat. Mus. XIX, No. 1110, p. 311, Pl. XXVIII, fig. 12.

Phos fasciolatus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 88, Pl. XIV, figs. 15, 16; *Idem*, No. 30, pp. 13, 27.

Phos fasciolatus Jones, 1918, Jour. Geol. XXVI, p. 741.

The type of *Phos fasciolatus* was collected by Bland at Potrero, on the Rio Amina, Santo Domingo, and described by Dall. The writer obtained this species in abundance at Caimito, Rio Cana, and it was also present at Cercado, Rio Mao, Santo Domingo,—occurring at both localities in the *Aphera islacoloni*s formation. At

Cereado it was associated with *Phos costatus*, and it is interesting to note that Jones has since found these two species associated in the Maissade beds, Rivière L'Ayaye, Haiti.

Among the Porto Rican fossils is a single external mold of a *Phos* apparently this species. The impression in the rock is very clear and sharp and represents the dorsal side of the shell. The whorls are convex, suture deep and the imprinted portion of the last whorl shows six even, rounded ribs. The ribs are closer than in *Phos costatus* and the shell is more regular and less rugged and robust. The characters of the aperture of the Porto Rican shell are not shown by the material in hand, but judging from the dorsal aspect of the mold and its artificial cast, it is the same as the Dominican shells I referred to *Phos fasciolatus* Dall.

This species is now reported for the first time beyond the limits of Santo Domingo and Haiti. In Porto Rico also it is found associated with *Phos costatus*.

Locality.—Near Quebradillas, Station 131.

Genus **Alectrion** Montfort

External molds of two species of *Alectrion* from the Quebradillas limestone are perhaps identical with the Dominican Miocene forms, but they are too imperfect for definite determination.

Genus **Murex** Linnaeus

Murex messorius Sowerby

Murex messorius Sowerby, 1840, Proc. Zool. Soc., p. 137.

Murex messorius Reeve, 1845, Conch. Icon., *Murex*, fig. 90.

Murex recurvirostris Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 201. Not *M. recurvirostris* Broderip.

Murex messorius Dall, 1890, Trans. Wagner Inst. Sci., III, pt. 1, p. 139.

Murex messorius Dall and Simpson, 1902, Bull. U. S. Fish Comm., XX, pt. 1, p. 407.

Murex messorius Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci., Phila., p. 353.

Murex messorius Maury, 1917, Bull. Amer. Paleont., No. 29, p. 101, Pl. XVI, figs. 1, 2; *Idem*, No. 30, pp. 13, 21.

Murex messorius Zetek, 1918, Los Moluscos de la Republica de Panama, p. 23.

Murex messorius Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

This is a typically static species of wide geographic and geologic range. Abundant in the Antillean Miocene, it is still living on unchanged in the West Indies, and extends from Cedar Keys west

to Texas and south to Colón, Panama. Recent shells differ in no respect from the fossil. The latter have been identified in the Gatun beds by Brown and Pilsbry; in the Dominican Miocene by Gabb (as *M. recurvirostris*); the writer has obtained them from Cercado and Los Quemados, Santo Domingo; and Jones has listed the species from the Maissade beds, Rivière L'Ayaye, Haiti. The range is now extended eastward to Porto Rico. The Porto Rican representatives are fragmentary imprints of the exterior of the shell; but the sculpture is so perfectly preserved and accords so exactly in every detail with that of Dominican Miocene specimens that the identification is conclusive.

Murex messorius has been found by Dall and Simpson living at Mayaguez, Porto Rico. Other recent species of this island's fauna are *Murex antillarum* Hinds, *M. rufus* Lamarck, *M. brevifrons* Lamarck, *M. pomum* Gmelin, *M. micromeris* Dall, *M. cellulosus* Conrad, and *M. intermedius* Adams.

Localities.—Near Quebradillas, Stations 130, 134, 135.

Genus **Marginella** Lamarck

Marginella coniformis Sowerby

Marginella coniformis Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 45.

Marginella coniformis Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 288, Pl. XVII, fig. 2.

Marginella coniformis Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 221.

Marginella coniformis Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 528.

Marginella coniformis Guppy and Dall, 1896, Proc. P. S. Nat. Mus., XIX, No. 1110, p. 309.

Not *Marginella coniformis* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 348, Pl. XXIV, fig. 12.

Marginella coniformis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 70, Pl. XI, figs. 5, 5a.

Marginella coniformis Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

Several external molds of a *Marginella* show the characters of the Santo Domingan Miocene species, *M. coniformis* Sowerby. On comparison with specimens of this species they are seen to agree in size, form, number and direction of the columellar plaits, and in the extension of the aperture to the apex of the spire.

This species has been erroneously reported from Cumana, Venezuela. The specimen Guppy listed from there he later found to be

M. cincta Kiener, while that from the Caroni Series of Trinidad is a *Persicula* near *obesa*. Its occurrence at Gatun also appears very doubtful, because the figure Pilsbry and Brown give of a Gatun specimen is very unlike Guppy's illustration of the Bowden shell, and unlike our specimens from the type locality, which was the Yaqui Valley, Santo Domingo. Moreover the figure of the Gatun shell distinctly shows that its aperture does not continue to the spire, whereas Sowerby says of the type of *M. coniformis*, "labii externi margine inflexo, lato, crasso, depresso, ad apicem continuo." Whether Vaughan records this species in his 1919 list from an actual Gatun shell or from the Gatun report of Pilsbry and Brown I do not know. But it would seem that, as far as now known, *Marginella coniformis* was limited to the three neighboring Greater Antilles,—Santo Domingo, Jamaica, and Porto Rico.

Localities.—Señor Rabell's Ranch on Rio Guajataca, Station 112; near Quebradillas, Stations 131 and 134.

Genus **Mitra** Martyn
Mitra henekeni Sowerby

Mitra henekeni Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 46, Pl. IX, fig. 5.

Mitra henekeni Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160.

Mitra henekeni Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 219.

Mitra henekeni Guppy, 1874, Geol. Mag. London, new ser., decade 2, I, p. 440.

Mitra henekeni Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 528.

Mitra henekeni Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1583.

Mitra henekeni Maury, 1917, Bull. Amer. Paleont., No. 29, p. 74, Pl. XII, figs. 5, 5a; *Idem*, No. 30, pp. 10, 19, 22, 26.

Mitra henekeni Jones, 1918, Jour. Geol. XXVI, p. 741.

The collection of Porto Rico fossils made by Dr. Reeds affords several incomplete external molds showing the characteristic sculpture of this handsome shell which is so common in the Miocene of Santo Domingo. One of the molds shows distinctly the three columella plaits, the posterior two being well defined and sharp, the anterior nearly obsolete as described by Sowerby in 1850. The type was collected in Santo Domingo by Colonel Heneken. Later this species was identified by Guppy in the Caroni Series of Trinidad and the Jamaican Miocene. Dall lists it from Bowden, Jamaica; it was obtained by the writer from Los Quemados, Caimito and Cerredo de Mao, Santo Domingo; Jones has lately found it in the

Maissade beds, Rivière L'Ayaye, Haiti, and its range is now extended eastward to Porto Rico.

Adult examples of *Mitra henkeni* show a marked general resemblance to the figure of *M. antillensis* Dall of the living fauna, extending from Cape Lookout to the Island of Grenada. The recent shell is, however, much larger, attaining a length of 80 mm. against about 55 mm. in the fossil, and the living species has four strong columellar plications.

The genus *Mitra* is well represented in the recent Porto Rican fauna and includes *Mitra barbadensis* Gmelin, *M. nodulosa* Gmelin, *M. hanleyi gemmata* Sowerby, *M. straminea* Adams, and *M. microzonias* Lamarck.

Localities—Near Quebradillas, Stations 125, 130, 133.

Genus *Lyria* Gray

Lyria cf. *musicina* (Heilprin)

Voluta musicina Heilprin, 1887, Trans. Wagner Inst. Sci., I, p. 109, Pl. XV,
fig. 45.

Lyria musicina Dall, 1890, Trans. Wagner Inst. Sci., III, pt. 1, p. 85.

Lyria musicina Dall, 1915, Bull. 90 U. S. Nat. Mus., p. 59, Pl. IX, figs. 1, 4.

A single imperfect internal mold of a *Lyria* in the collection shows traces of about five broad, longitudinal ribs on half of the last volution and a suggestion of a constricting band below the suture. On breaking away the part of the mold which filled the shell's aperture one sees very distinctly five or six very strong anterior grooves, the first two oblique, and a group of about the same number of faint, posterior grooves. These grooves show where the mud filling the aperture pressed against the folds on the columella of the shell which has since been wholly dissolved away. The evidence gathered from the mold proves that it is not a filling of the very common Dominican Miocene shell, *Lyria pulchella* Sowerby. That has far more numerous and narrow ribs and the anterior plaits are not so heavy and are transverse. Obviously, this is a member of the Eocene *Lyria costata* Sowerby group, which in the American Oligocene to Miocene was followed by the Floridian species, *Lyria musicina* Heilprin. The last whorl of *L. costata* is much more elongated in proportion to its width than that of the Porto Rican mold. It could not be that species, but it corresponds very well with the form of *Lyria musicina*. Very probably the mold is identical with that shell, but an exact identification is not possible.

Lyria musicina is recorded from the Upper Eocene (Jacksonian) of Ocala, Florida. The upper Oligocene of Tampa Bay, and the lower Miocene of the Chipola marls, Florida. With it Dall found *Lyria pulchella* in the Tampa formation. Now it appears that just as the latter Antillean Miocene species had emigrated to Florida, so the Florida species had established an exchange colony in Porto Rico.

Locality.—Near Aguada, Station 117.

Genus **Oliva** Martyn
Oliva cf. brevispira Gabb

Oliva brevispira Gabb, 1873, Trans Amer. Phil. Soc., XV, p. 215.
cf. *Oliva giraudi* Cossmann, 1913, Journ. de Conchyliologie, LXI, p. 56, Pl. V,
figs. 1, 4-8.
Oliva brevispira Maury, 1917, Bull. Amer. Paleont., No. 29, p. 68, Pl. X, figs
16, 17; *Idem*, No. 30, pp. 11, 13, 24, 26.

Several internal molds of a medium-sized, very short-spired Olive, on comparison with shells of *Oliva brevispira* Gabb, are seen to have the same general form that a filling of one of these shells would possess. No positive identification can be made with the material in hand; but the probabilities strongly suggest the identity of the Porto Rican molds with this Santo Domingan species.

Oliva brevispira was obtained in great abundance on the writer's Dominican expedition at Cercado, Los Queinados and Caimito, and was identified by comparisons with Gabb's metatypes at Cornell University. A very similar and seemingly identical form has been described by Cossmann as *Oliva giraudi* from Martinique. Otherwise this very common Dominican shell has not heretofore been found outside of that island.

This contrasts with the wide distribution of the much larger species, *Oliva cylindrica* described in 1850 by Sowerby from Hennen's Dominican collection, and closely allied to the recent *Oliva recticularis* Lamarck. Sowerby's species is found in the Isthmian deposits and those of Cumana, Venezuela, and in the insular Tertiary beds of Trinidad (Caroni series), Barbuda and Jamaica (Bowden). Jones has also lately found it in the Maissade beds, Rivière L'Ayaye, Haiti. It has not yet turned up in the Porto Rican collection, but is to be expected in this fauna.

The recent Olives living on the Porto Rican shores are *Oliva recticularis* Lamarck and *Oliva caribaeensis* Dall and Simpson.

Localities.—Near Ponce, Station 285; near Guayanilla, Station 321.

Genus **Olivella** Swainson

Olivella muticoides (Gabb)

Oliva muticoides Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 215.

Olivella mutica variety *muticoides* Dall, 1890, Trans. Wagner Inst. Sci., III, pt. 1, p. 45.

Olivella muticoides Cossmann, 1913, Journ. de Conchyliologie, LXI, p. 60.

Olivella muticoides Maury, 1917, Bull. Amer. Paleont., No. 29, p. 68, Pl. XI, fig. 1; *Idem*, No. 30, pp. 24, 26.

Olivella muticoides Jones, 1918, Jour. Geol. XXVI, p. 741.

In the collection of Porto Rican fossils are a number of internal and external molds of a species of *Olivella*. Fortunately one of the latter is so oriented in the rock as to show the characters of the aperture. An artificial cast of this mold accords perfectly with shells of *Olivella muticoides* collected on my expedition to Santo Domingo at Los Quemados, Cercado de Mao and Caimito and identified by comparisons with Gabb's metatypes at Cornell University. The Porto Rican imprints show perhaps a slightly more deeply channelled suture, but in his original description Gabb mentions this deep channelling as a characteristic. It is carried to an extreme in the form *O. canaliculata* Gabb which is a broader variety as Gabb's metatypes show. *Olivella muticoides* is closely allied and probably ancestral to the recent *O. mutica* Say, in Mayaguez Harbor, Porto Rico, and elsewhere in the Antilles and ranging along the mainland from Cape Hatteras to Trinidad and from Florida west along the Gulf coast to Texas. But the fossil shell is slenderer than the recent and shows a series of plications on the columella which are not concealed by the callus. A related fossil species is *Olivella duplicata* Conrad. *Olivella boussaci* Cossmann, fossil, from Martinique, has somewhat the general aspect of the Dominican shell but the aperture is lower. Jones has lately identified *Olivella muticoides* in the Maissade beds, Rivière L'Ayaye, Haiti. It is now for the first time recorded outside of the Dominican and Haitian Republics.

Localities.—Near Quebradillas, Stations, 126, 135, 144; near Ponce, Station 299.

Genus *Cancellaria* Lamarek***Cancellaria lævescens* Guppy**

Cancellaria lævescens Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 289, Pl. XVII, fig. 12; 1867, Proc. Sci. Assoc. Trinidad, p. 157.

Cancellaria lævescens Gabb, 1873, Trans. Amer. Phil. Soc. XV, p. 239.

Cancellaria lævescens Guppy, 1874, Geol. Mag. London, p. 438; 1876, Quart. Jour. Geol. Soc., XXXII, p. 520.

Cancellaria lævescens Maury, 1917, Bull. Amer. Paleont., No. 29, p. 64, Pl. X, fig. 6.

In the fossil Gastropod exhibit in the American Museum are specimens of *Cancellaria lævescens* Guppy, collected by Thomas Bland from the Bowden beds of Plantain Garden, St. Thomas, Jamaica. One of these is so like the figure of Guppy's type, which was also Jamaican, that it might pass for the original. The others show interesting variations in degrees of loss of sculpture on the body whorl. The shells are large and solid, the largest being 40 mm. x 21 mm. while the type was 45 mm. x 28 mm.

Gabb identified shells which he collected over forty-five years ago in Santo Domingo. My party did not find this species there, but I figured one of Gabb's shells. It was only 25 mm. in height but otherwise bore considerable resemblance to Guppy's shell.

Cancellaria lævescens portoricensis*, new variety*Plate VII, Figure 10**

Mold with finely cancellated spire and body whorl smooth, except for a few spirals at the base. It appears to be a dwarfed variety of *Cancellaria lævescens*. It resembles Gabb's Dominican specimen of *C. lævescens* but is still smaller and is only a third the size of Guppy's type.

Locality.—Near Quebradillas, Station 130.

***Cancellaria*, species indet.**

There are several fragmentary internal molds apparently of the later volutions of several species of *Cancellaria*. The molds show grooves representing in reverse the columella plaits, and the lirations marking the interior of the outer lip of this genus.

Localities.—Near Quebradillas, Stations 126, 128.

Genus **Terebra** Bruguière
Terebra cirrus Dall

Terebra (Acus) bipartita Sowerby variety *cirrus* Dall, 1895, Proc. U. S. Nat. Mus., XVIII, p. 38.

Terebra (Oxymeris) bipartita variety *cirrus* Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, Pl. LIX, fig. 28.

Terebra cirrus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 25, Pl. III, fig. 17; *Idem*, No. 30, pp. 12, 24, 27.

The type of *Terebra cirrus* was described by Dall from Rio Amina, Santo Domingo, and in 1916 specimens were collected on the writer's expedition to that island at Caimito, Los Quemados and Cercado de Mao,—being in all cases from the *Aphera islacolonis* formation. In ornamentation *Terebra cirrus* resembles the Isthmian species *T. gatunensis* Toula but is easily distinguished from that shell by its biplicate columella which allies it to the Dominican group of *Terebra bipartita* Sowerby. *Terebra gatunensis* has a single, nearly obsolete plait on its pillar.

A fragmentary imprint of a fossil *Terebra* was found by Reeds in Porto Rico. An artificial cast of this shows the ornamentation very perfectly and is an excellent match of Dominican specimens of *Terebra cirrus*. This appears to be the first fossil *Terebra* recorded from Porto Rico. The scarcity of the genus there contrasts with the rich variety in the Miocene of the Yaqui Valley on the neighboring island of Santo Domingo where the writer obtained sixteen distinct specific forms. The recent fauna of Porto Rico comprises half a dozen Terebras of which Simpson has given brief descriptions in Mollusca of Porto Rico.

Locality.—Near Ponce, Station 285.

***Terebra sansebastiana*, new species**

Plate VII, Figure 11

Specimen incomplete. Last whorl shows traces of about 15 longitudinal, nearly straight ribs, wider than their interspaces, surmounted by ribbed band about 2 mm., wide. Main ribs become slightly arched on penultimate whorl. Indistinct traces of spiral sculpture over entire surface. Height of fragment 23 mm., greatest diameter of flattened mold 16 mm., least diameter 6 mm.

This species is founded upon a distorted internal mold from the Collazo shales of what seems to be a *Terebra*, perhaps allied to

T. dislocata Say. The fact that this shell is a member of the odd fauna of the Collazo shales seems to be sufficient excuse for naming such an imperfect specimen a new species.

Locality.—Rio Collazo, near San Sebastian, Station 54.

Genus **Drillia** Gray
Drillia consors (Sowerby)

Pleurotoma consors Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 50.

Pleurotoma consors Guppy, 1866, Quart. Jour. Geol. Soc. London, XXII, p. 280; 1867, Proc. Sci. Assoc. Trinidad, p. 159.

Turris (Drillia) militaris Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 207. Not *Drillia militaris* Hinds, 1843, Proc. Zool. Soc., p. 38.

Pleurotoma consors Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 527.

Pleurotoma sp. aff. Pl. alesidota (Dall) var. *macilenta* Toula, 1911, Jahrb. der k. k. Geol. Reichsanstalt Wien, LXI, p. 506, Pl. XXX, fig. 11. Not *alesidota* var. *macilenta* Dall, 1889.

Drillia consors Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 345.

Drillia consors Cossmann, 1913, Journ. de Conchyliologie, LXI, pp. 20-22, Pl. II, figs. 8-14.

Drillia consors Maury, 1917, Bull. Amer. Paleont., No. 29, p. 53, Pl. VIII, figs. 15, 16; *Idem*, No. 30, p. 18.

Drillia consors Jones, 1918, Jour. Geol. XXVI, p. 741.

Drillia consors Vaughan, 1919, Bull. 103 U. S. Nat. Mus., p. 561.

Several blocks of limestone contain fragmentary imprints which unquestionably represent the very beautiful and unmistakable form and sculpture of *Drillia consors*. The type of this fine species was collected seventy years ago by Colonel Heneken in the Yaqui Valley, Santo Domingo, and described by Sowerby; it is now in the British Museum. Guppy identified this species in 1866, in the Bowden beds of Jamaica, and later it has been recorded by various authors from Gatun, Mindi, and Martinique. Gabb referred his Dominican specimens to the recent West Coast species, *Drillia militaris* Hinds, but the resemblance is only a very general one. The fossil is very much more like the recent, deep sea, Barbadian shell, *Drillia alesi-dota macilenta* Dall, which may be its descendant. Toula first called attention to this interesting affinity. It is not surprising to find that *Drillia consors* was also living in Miocene times on the Porto Rican shores.

Localities.—Señor Rabell's Ranch, Rio Guajataca, Station 112; near Quebradillas, Stations 126, 131.

Drillia diazica, new species

Plate IX, Figure 1

Shell elongate, turreted, very slenderly fusiform, the last whorl extending into a very long, straight, anterior canal; aperture narrow; suture linear, wavy; sub-sutural channel smooth to the eye, but with six to eight extremely fine, microscopic spirals, and with delicate but sharp, microscopic, deeply arcuate growth-lines. Beneath the sub-sutural channel the whorls are sculptured with sharply defined, regular, evenly spaced, rounded, longitudinal ribs, numbering five to half a volution on the ultimate and the same on the penultimate whorl. On each of the later volutions are four major spiral threads which are strongest on crossing the crests of the ribs. Between every two major spirals are three, very fine, minor spirals, visible only with a lens. The longitudinal ribs terminate abruptly where the last whorl narrows to form the canal, but the two sets of spirals continue to the end of the canal although they become less regular and weaker. Estimated length of shell with tip of spire complete 37 mm., greatest width 11 mm.

The affinities of this species are clearly with the two Miocene Dominican forms, *Drillia fusiformis* (Gabb) and *D. cercadonis* Maury, and with the Gatun Miocene form *Drillia fusinus* Brown and Pilsbry. *Drillia fusiformis* (*Defrancia fusiformis* Gabb, Trans. Amer. Phil. Soc., XV, p. 209, 1873) has only about eight ribs, crossed by three major spirals. *Drillia cercadonis* has nine ribs, uniform spirals, and a smooth subsutural channel. The anterior canal of the Porto Rican fossil is also longer than that of these Dominican shells. The Gatun analogue, *Drillia fusinus* has a very long canal, but the ribs are feeble, and appear obsolete on the later whorls.

Locality.—Near Juana Diaz, Station 175.

Genus *Conus* Linnæus

Cone-shells are present from several of the Porto Rican horizons, but all are in the form of internal molds and usually very imperfect. With the exception of two, it would be unwise to hazard even a comparison.

***Conus recognitus* Guppy**

Conus solidus Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 45. Not *C. solidus* Sowerby, 1841, Proc. Zool. Soc., Conch. Illust., *Conus* No. 76, Pl. LVI, fig. 56.

Consus solidus Guppy, 1866, Quart. Jour. Geol. Soc., XXII, p. 287, Pl. XVI, fig. 1.

Conus recognitus Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 171.

- Conus pyriformis* Gabb, 1873, Trans. Amer. Phil. Soc., XV, p. 229. Not *C. pyriformis* Reeve, 1843, Conch. Icon. I, Pl. XIII, fig. 70.
Conus recognitus Guppy, 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 527.
Conus recognitus Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1583.
Conus recognitus Maury, 1917, Bull. Amer. Paleont. No. 29, p. 45, Pl. VII, fig. 9; *Idem*, No. 30, pp. 12, 21, 26, 27.

In the collection is an internal mold of a *Conus* of the same size as Dominican shells of *C. recognitus* Guppy, and showing the very characteristic pear-shaped or fig-shaped contours of that species. In all probability the mold is the filling of *C. recognitus*. My party found this species in the lower, or *Aphera* horizon in the Yaqui Valley, Santo Domingo. It is also at Bowden. The recent West Coast, *Conus pyriformis* Reeve is the descendant of migrants through the Isthmus.

Locality.—Near Aguada, Station 122.

Conus cf. tortuosostriatus Toula

- Conus (Chelyconus) tortuosostriatus* Toula, 1911, Jahrb. der k. k. Geol. Reichsanstalt Wien, LXI, p. 508, Pl. XXXI, fig. 22.
Conus (Hemiconus) tortuosostriatus Cossmann, 1913, Journ. de Conchyliologie, LXI, p. 40, Pl. III, figs. 28, 29.
Conus tortuosostriatus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 41, Pl. VI, fig. 9; *Idem*, No. 30, pp. 22, 24.

Another internal mold from Aguada resembles in form the slender, high-spired, delicate, Isthmian shell, *Conus tortuosostriatus* Toula, and the Dominican forms that I collected and referred to that species. No positive identification is possible, but the Porto Rican mold is very probably of the same shell.

Locality.—Near Aguada, Station 122.

ORDER OPISTHOBRANCHIA

Genus **Haminea** Leach **Haminea granosa** (Sowerby)

- Bulla granosa* Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 51, Pl. X, fig. 10.
Bulla granosa Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 155.
Bulla granosa Gabb, 1873, Trans. Amer. Phil. Soc. XV, p. 246.
Bulla granosa Guppy, 1874, Geol. Mag. London, p. 437; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 518.
Bullaria granosa Maury, 1917, Bull. Amer. Paleont., No. 29, p. 20, Pl. III, fig. 10; *Idem*, No. 30, p. 27.

Sowerby, in his description of the type of this species, which Heneken had collected in the Yaqui Valley, Santo Domingo, re-

marks on its resemblance in form to the recent *Bulla hydatis*, since made the geno-type of *Haminea* Leach.

Recent specimens labelled *Haminea hydatis* in the American Museum, from the Mediterranean are certainly very like in form and size to the fossil species. These recent shells are the *H. hydatis*, of most authors, but really *H. navicula* Da Costa. The true *hydatis* of Linnaeus is oblong-oval and smaller while *navicula* is ventricose like the fossil species. But the resemblance there ceases. For the living shells are nearly or perfectly smooth while the most striking feature of the fossil is its strongly cancellated sculpture, which becomes granose at the points of intersection of the subequal spiral and longitudinal ridges.

Internal molds representing this species are common in the collection under examination. A number correspond perfectly in size and form to Sowerby's figured type. These molds retain the cancellation of the original surface and some even show the granular points of intersection. There seems no doubt of their complete identity with the Dominican species. These measure about 18 mm. in length; but there are some larger molds, about 25 mm. in length, which show the cancellated surface and seem to be only larger specimens. Possibly more material will show them worthy of varietal rank.

Many authors have quoted *Haminea granosa* from Santo Domingo, but the only definite locality known is Zone I at Caimito, Rio Cana, where they were collected by the Maury expedition in 1916. The species has not been found heretofore outside of the Dominican Republic, but the present collection shows it was also a common Porto Rican Miocene shell. Recent species of *Haminea* in Porto Rican waters are *H. elegans* Gray and *H. succinea* Conrad. These are both spirally striated, but have no longitudinal sculpture and are quite unlike the fossil species.

Localities.—Near Aguada, Station 117, near Quebradillas, Stations 126, 128, 129, 130, 131, 133, 135, 136; near Guayanilla, Station 321.

***Haminea quebradillica*, new species**

Plate IX, Figure 5

External mold, ornamentation spiral but not cancellate, spirals sharply incised lines of uniform strength, almost microscopic, about nine lines to

5 mm. These alternate with perfectly flat bands. Occasionally, however, there is a wider band as if one line has been omitted. Altitude of incomplete mold 18 mm., diameter 13 mm.

As far as the dorsal aspect of the mold and its artificial cast permits one to judge, this pretty and delicate species must have been most nearly akin to the recent *Haminea elegans* Gray, living in the Antilles and from Florida to Rio de Janeiro. Dall and Simpson record one specimen taken at Mayaguez Harbor, Porto Rico. In this recent species the entire surface is also ornamented with incised lines, but they are not uniform as in the fossil, and very fine lines are mingled with coarser, unequally spaced grooves. The even, delicate uniform lines distinguish the Miocene from the living shell. The other living Porto Rican species of this genus is the smaller, cylindrical shell, *H. succinea* Conrad.

Of fossil Hamineas a Martinique Miocene species has been described by Cossmann as *Haminea ventripotens* (Journ. de Conchyliologie, LXI, p. 8, Pl. I, figs. 8-11, 1913) which he likens in some respects to *H. elegans*. But the Martinique shell has a perfectly smooth surface so that its resemblance to *H. elegans* and to this fossil is only one of general form. It is distinguished from *H. granosa* Sowerby by its different sculpture and absence of raised cords.

Locality.—Near Quebradillas, Station 125.

Genus **Bullaria** Rafinesque

Bullaria paupercula Sowerby

Bulla paupercula Sowerby, 1850, Quart. Jour. Geol. Soc. London, VI, p. 52.

Bulla paupercula Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 155.

Bulla paupercula Gabb, 1873, Trans. Amer. Phil. Soc. XV, p. 246.

Bulla paupercula Guppy, 1874, Geol. Mag. London, p. 437; 1876, Quart. Jour. Geol. Soc. London, XXXII, p. 518.

Bulla paupercula Dall, 1890, Trans. Wagner Inst. Sci., III, pt. 1, p. 18.

Bulla striata Dall, 1903, Trans. Wagner Inst. Sci., III, pt. 6, p. 1583.

Bullaria paupercula Maury, 1917, Bull. Amer. Paleont., No. 29, pp. 18-19, Pl. III, fig. 8; *Idem*, No. 30, pp. 12, 24, 26, 27.

Bullaria paupercula Jones, 1918, Jour. Geol. XXVI, p. 741.

From Ponce comes an internal mold of a *Bullaria* slightly larger than shells of *B. paupercula* Sowerby from the Yaqui Valley Miocene, Santo Domingo. In its form and size it is almost exactly like specimens in the American Museum labelled *B. occidentalis* Adams from the Pleistocene of North Creek, Florida; but its spire is much

more deeply sunken. In this very deeply involute spire it resembles *B. paupercula* and although a trifle larger, it is really akin to it rather than to the recent Antillean *B. occidentalis*. The Miocene species, *B. paupercula* and *B. vendreyesiana* Guppy, the recent *B. occidentalis* and the Pliocene to recent *B. amygdala* Dillwyn are all members of the group of *B. striata* Bruguière and are often recorded as the latter species.

The true *Bullaria striata* is now restricted to the Mediterranean and Southern Europe, but during the Pliocene it had a much wider geographic range, as it has been found by Dall in deposits of that age in Florida and has also been recorded from synchronous beds in West Africa. This species has a characteristically somewhat hump-backed form due to its tapering at the upper end. *Bulla amygdala* is the recent American analogue of *striata* but the body is more cylindrical. It is living throughout the West Indies. Typical specimens are much larger, heavier and more solid than the Miocene ancestral shell, *B. paupercula*. The latter species is abundant along the bluffs of the upper Rio Cana and in general in the *Aphera islacolonis* formation, Santo Domingo. Dall lists *Bulla striata* from Bowden, Jamaica, which is probably the same as these. Jones has recorded *B. paupercula* from the Maissade beds, Rivière L'Ayaye, Haiti. Its Miocene range is now extended to Porto Rico.

Locality.—Near Ponce, Station 299.

Genus **Scaphander** Montfort

Section **Bucconia** Dall

Bucconia reedsi, new species

Plate IX, Figure 6

Internal mold distinctly and regularly spirally striated. On the dorsal side the striations are crossed by longitudinal ridges, more or less uniform and equidistant, but weaker than the spirals. Mold somewhat flattened in median dorsal region. Length of incomplete mold 34 mm., estimated complete length approximately 40 mm., greatest width 28 mm.

The species which seems most like this fossil is *Scaphander (Bucconia) grandis* Aldrich from the Jacksonian of Bunker Hill, Louisiana, and the Ocala beds of Central Florida. This mold especially resembles Dall's figure⁹ of the Ocala shell and is less like Aldrich's illustration of the type¹⁰. *Bucconia grandis* attained a

⁹Trans. Wagner Inst. Sci., 1890, III, pt. 1, Pl. X, fig. 9.

¹⁰Geol. Survey Ala., 1886, Bull. No. 1, p. 35, Pl. III, fig. 1.

length of 66 mm. against about 40 mm. in the Porto Rican shell. Moreover, both Aldrich's and Dall's figures represent *grandis* with very close-set transverse striae, about 10 to a distance of 5 mm., while this mold shows only 6 to an equal distance.

The ornamentation of the dorsal side suggests the sculpture of *Haminea granosa* Sowerby, but that is more decidedly cancellated and the shell typically is only one-third the size of the form now described.

The imperfect state of preservation renders it impossible to determine positively the generic position of this shell; but it is tentatively referred to Dall's section *Bucconia*, which he describes as a thin-shelled *Sabatia* without the body-callus. This harmonizes with the globose form, thin shell, and distinct spiral striation which distinguish the Porto Rican species. As far as I am aware, this shell is wholly unique among Antillean fossils. Its unusual size and spiral sculpture at once differentiate it. The species is named in honor of Dr. Chester A. Reeds by whom it was discovered in 1915.

There is a very rare living deep sea species, dredged by the Challenger at 500 fathoms, off the Philippines, and described by Watson as *Scaphander niveus*. This is somewhat smaller and has more distant and weaker spirals than the Porto Rican fossil, but in its *Bullaria*-like form and large size it bears more resemblance to our species than any recent shell I know.

Locality.—Near Ponce, Station 285.

PLATE I

- Fig. 1. *Ostrea sansebastiana*, new species; height 66 mm.
- Fig. 2. *Arca (Scapharca) aguadica*, new species; length 17 mm.
- Fig. 3. *Arca (Scapharca) guajatica*, new species; length 7 mm.
- Fig. 4. *Arca (Scapharca) collazica*, new species; length 28 mm.
- Fig. 5. *Arca (Scapharca) sansebastiana*, new species; length
18 mm.
- Fig. 6. *Ostrea berkeyi*, new species; height 36 mm.
- Fig. 7. *Ostrea collazica*, new species; flat valve; height 79 mm.

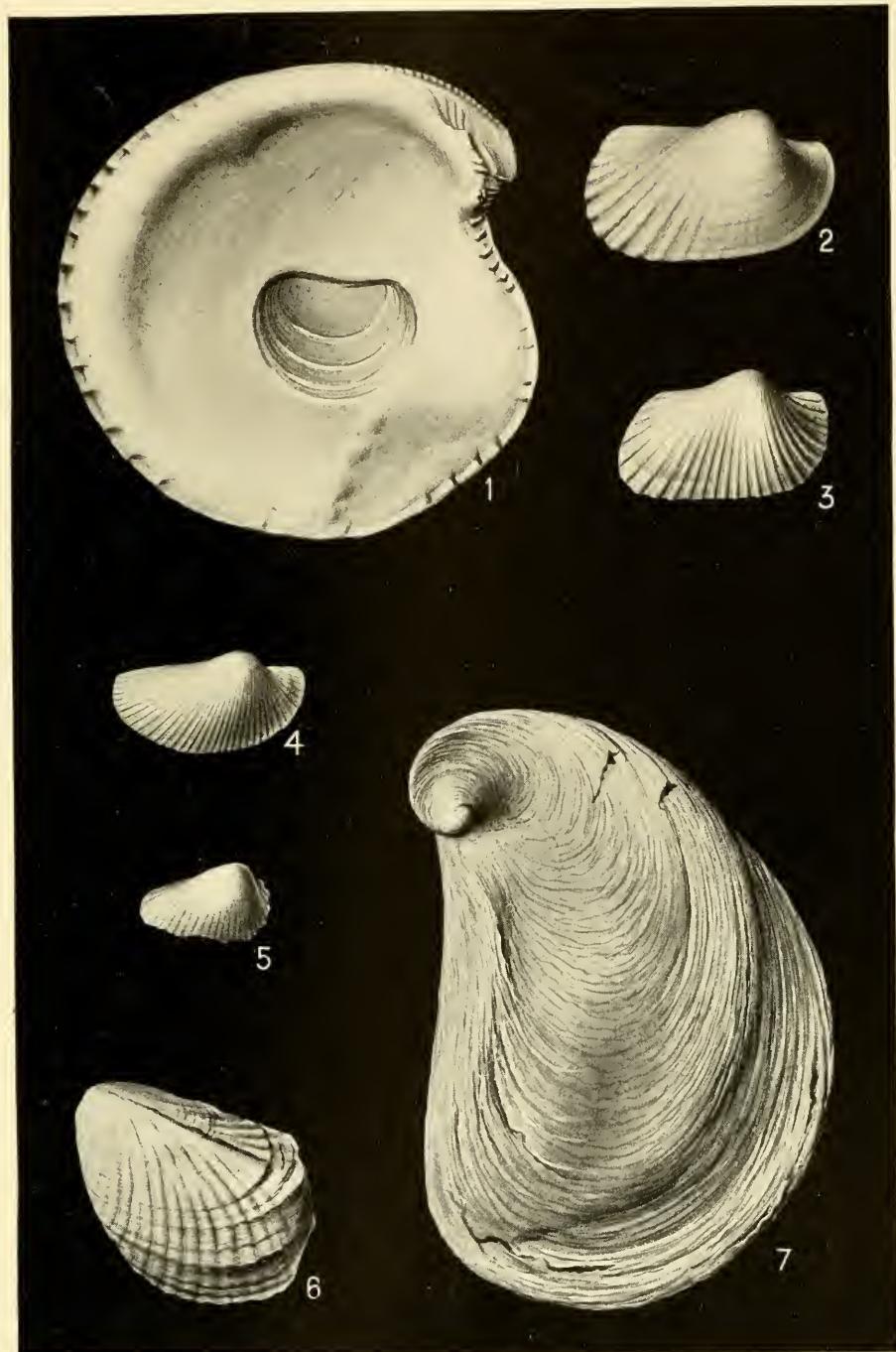


PLATE II

Fig. 1. *Ostrea collazica*, new species; convex valve of a large individual; width 95 mm.

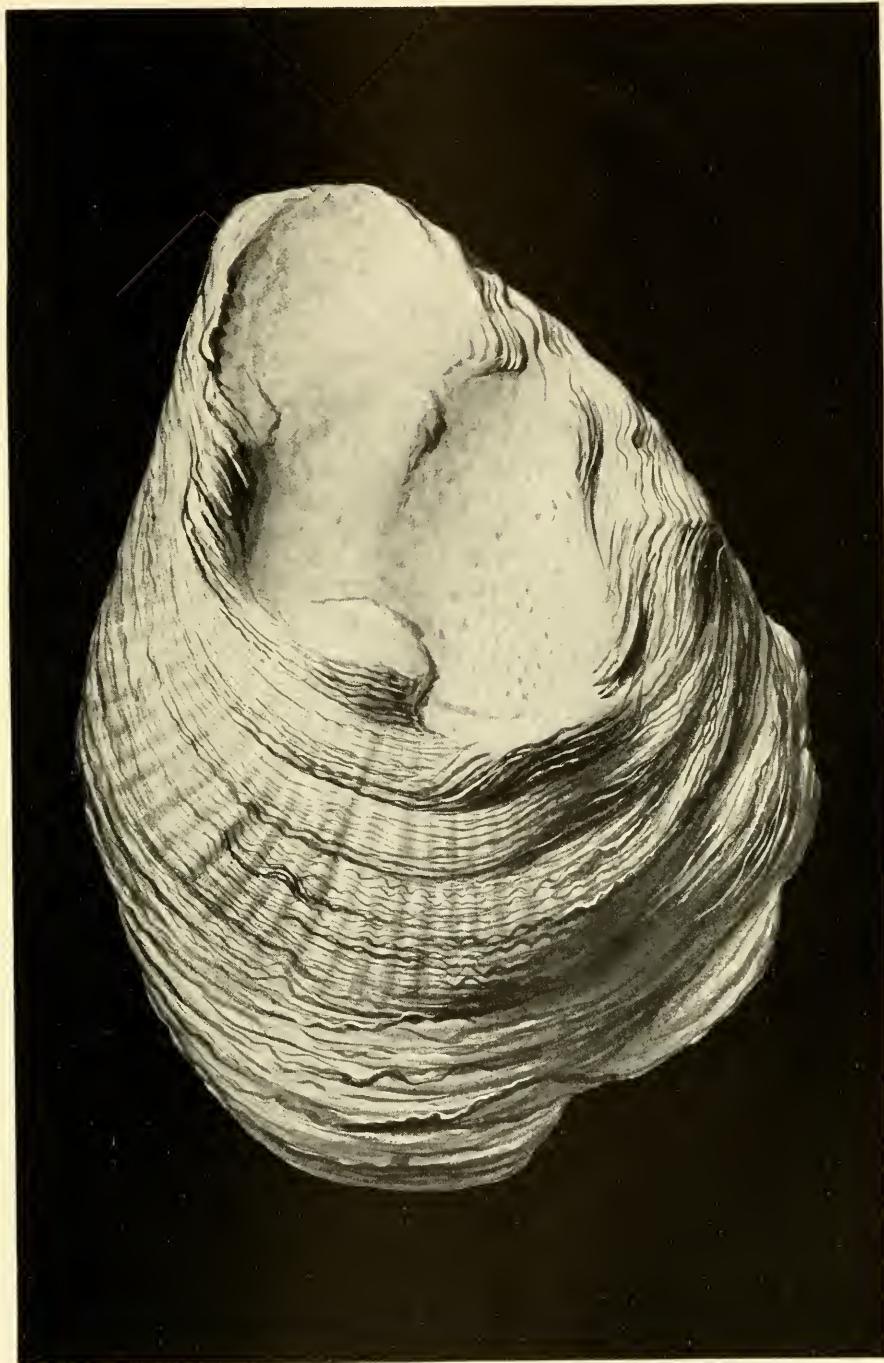


PLATE III

- Fig. 1. *Pecten sansebastianus*, new species; height of shell 35 mm.
Fig. 2. *Pecten mesenticus*, new species; height of shell 35 mm.
Fig. 3. *Amusium (Propeamusium) hollicki*, new species; convex valve; height 12 mm.
Fig. 4. *Amusium (Propeamusium) hollicki*; flat valve of another individual; height 16 mm.

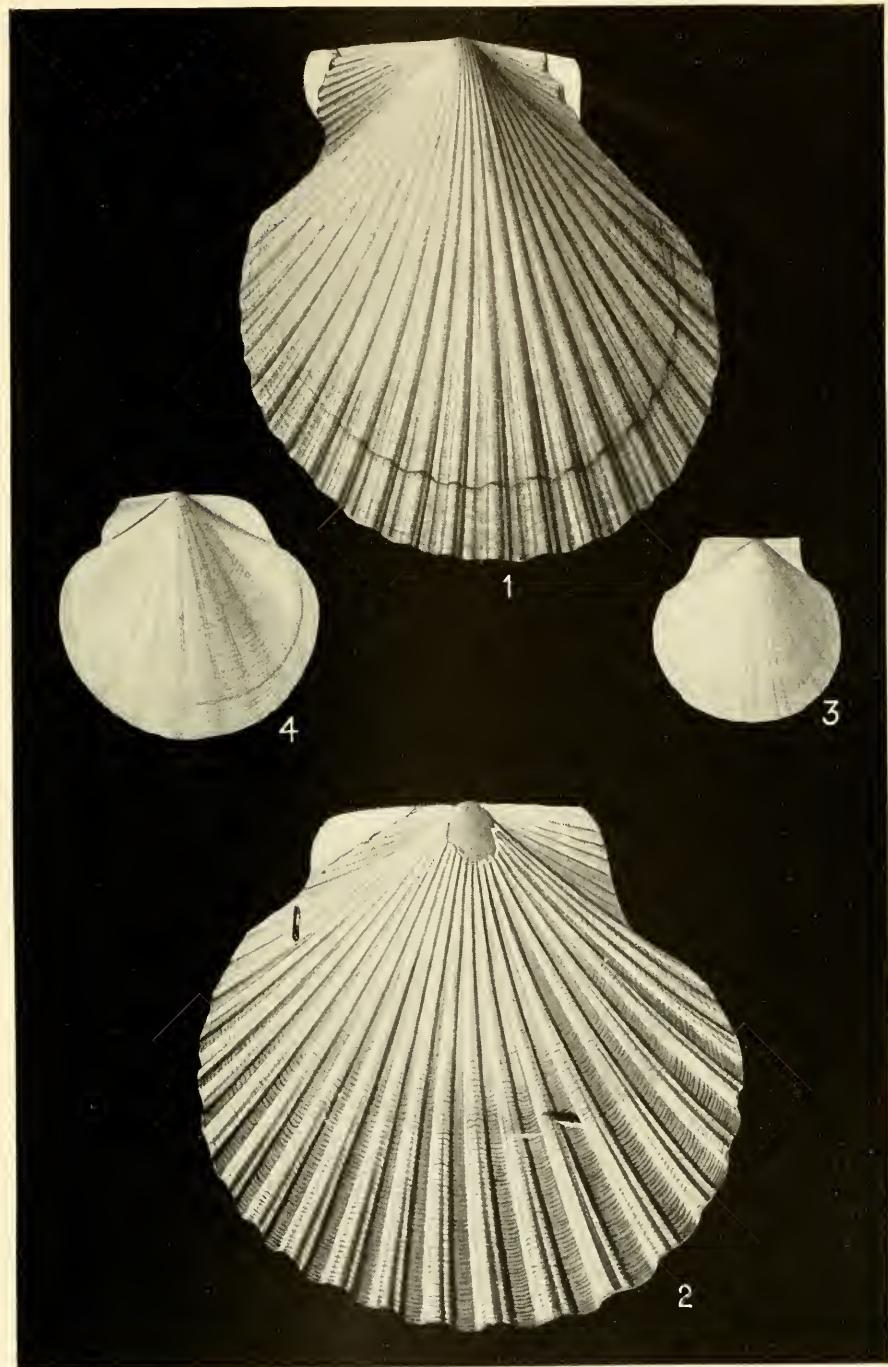


PLATE IV

- Fig. 1. *Pecten guajatacus*, new species; operculate valve; approximate length 45 mm.
- Fig. 2. *Pecten guajatacus*, new species; convex valve; height 55 mm.
- Fig. 3. *Pecten sansebastianus laresianus*, new variety; height 31 mm.
- Fig. 4. *Pecten guanicus*, new species; height 24 mm.
- Fig. 5. *Pecten camuyicensis*, new species; height 25 mm.
- Fig. 6. *Crassatellites juanadiazus*, new species; length 28 mm.
- Fig. 7. *Crassatellites juanadiazus*, new species; viewed from anterior end; height 16 mm.

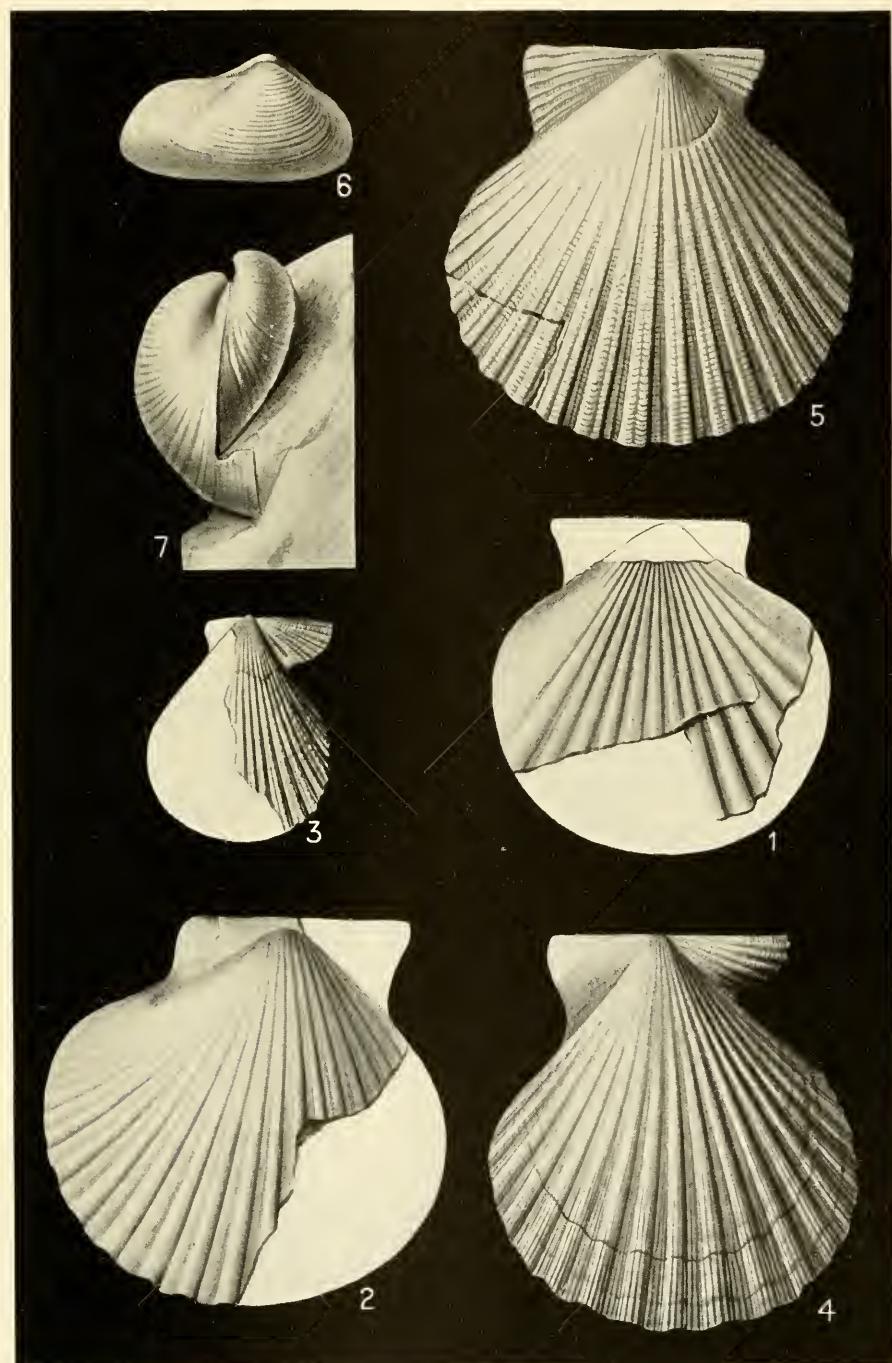


PLATE V

- Fig. 1. *Spondylus lucasi*, new species; height approximately 33 mm.
- Fig. 2. *Thracia (Cyathodonta) reedsi*, new species; height 20 mm.
- Fig. 3. *Cuspidaria islahispaniolæ* Maury, length 8 mm.
- Fig. 4. *Cuspidaria juanadiaza*, new species; length 10 mm.



PLATE VI

- Fig. 1. *Tellina disparoides*, new species; length 25 mm.
- Fig. 2. *Clementia rabelli*, new species; normal form; height 39 mm., length 40 mm.
- Fig. 3. *Clementia rabelli*, new species; crushed into triangular form by pressure and made more ventricose; height 43 mm., length 33 mm.
- Fig. 4. *Cardium (Trigoniocardia) sancti-sebastiana*, new species; length 12 mm.
- Fig. 5. *Venericardia juncalensis*, new species; height 29 mm.
- Fig. 6. *Venericardia collazica*, new species; length 34 mm.
- Fig. 7. *Venericardia rabelli*, new species; length 20 mm.
- Fig. 8. *Phacoides (Here) quebradillicus*, new species; height 21 mm.
- Fig. 9. *Callocardia riocollazica*, new species; length 28 mm.
- Fig. 10. *Corbula collazica*, new species; right valve; length 13 mm.
- Fig. 11. *Corbula collazica*, new species; another individual; left valve 12.5 mm.

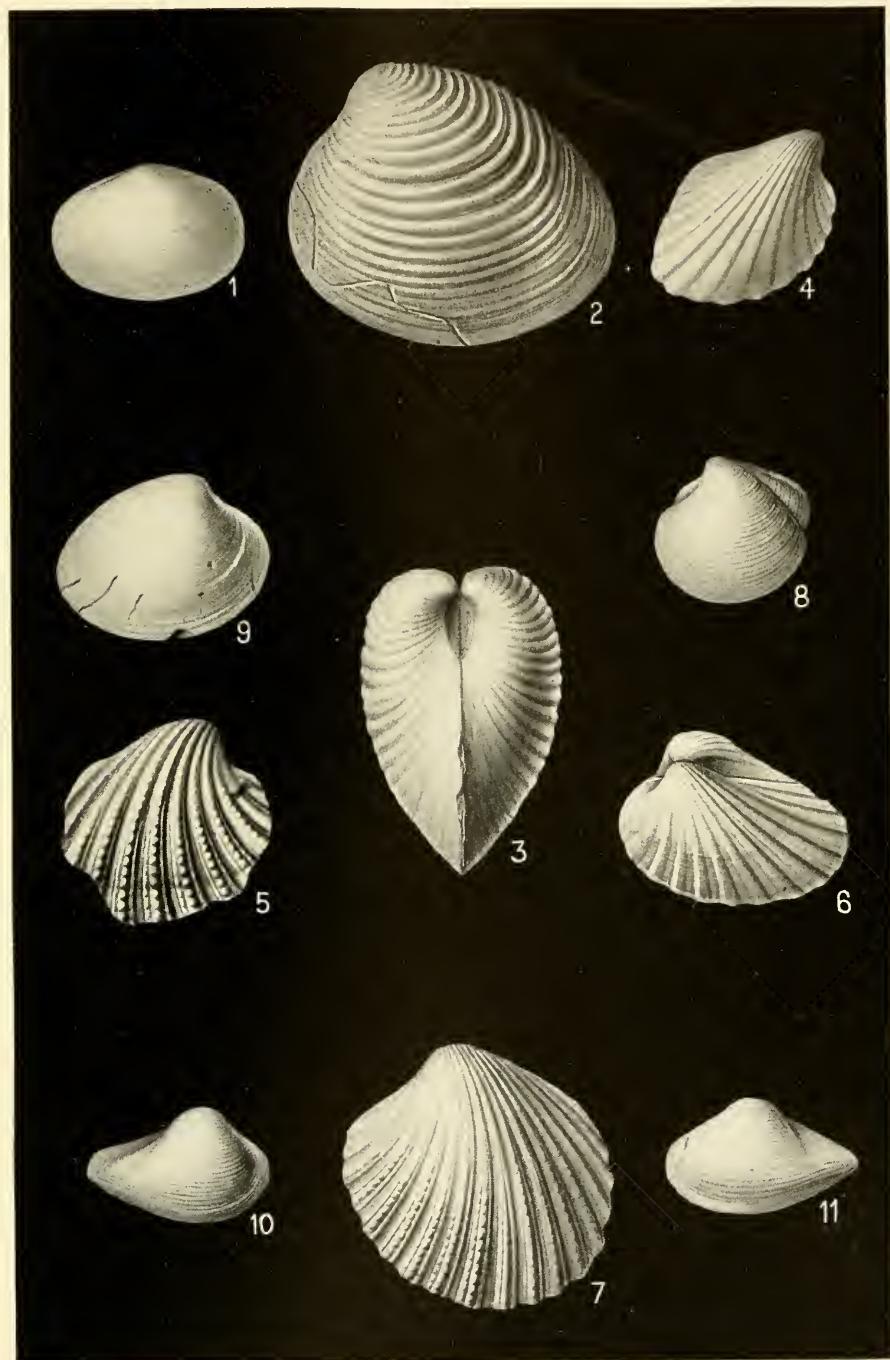


PLATE VII

- Fig. 1. *Dentalium diazicum*, new species; length 19 mm.
Fig. 2. *Lucinisca hoveyi*, new species; from artificial cast of external mold; length 11 mm.
Fig. 3. *Tagelus (Mesopleura) hubbardi*, new species; internal mold; length 35 mm.
Fig. 4. *Chione quebradillensis*, new species; from artificial cast of external mold; length 21 mm.
Fig. 5. *Chione quebradillensis guajatica*, new variety; from artificial cast of external mold; length 20 mm.
Fig. 6. *Turritella poncensis*, new species; from artificial cast of external mold; height of fragment 28 mm.
Fig. 7. *Turritella guanicensis*, new species; height of fragment 22 mm.
Fig. 8. *Cerithium utuadicum*, new species; height of fragment 16 mm.
Fig. 9. *Cerithium russelli arecibense*, new variety; from artificial cast of external mold; greatest diameter 11 mm.
Fig. 10. *Cancellaria lavescens portoricensis*, new variety; from artificial cast of external mold; greatest diameter 11 mm.
Fig. 11. *Terebra sansebastiana*, new species; height of fragment 22 mm.
Fig. 12. *Cypræa sancti-sebastiani*, new species; height 29 mm.
Fig. 13. *Cadulus poncensis*, new species; length 7 mm.

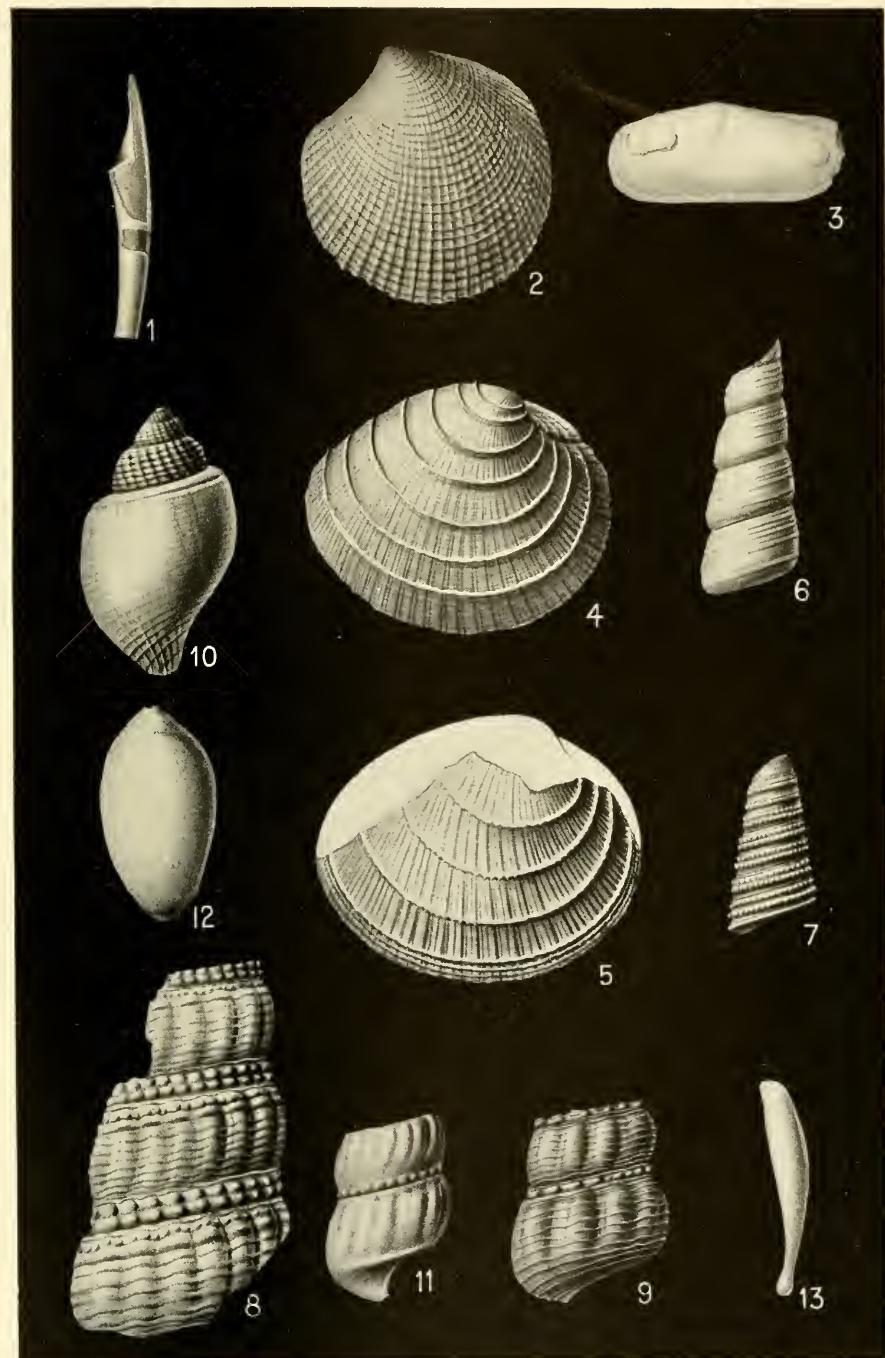


PLATE VIII

- Fig. 1. *Campanile (Portoricia) laricum*, new species; internal mold; height 33 mm., greatest diameter 45 mm.
- Fig. 2. *Campanile (Portoricia) laricum*, new species; largest internal mold, somewhat flattened by pressure: height 80 mm.
- Fig. 3. *Pyrula hoveyi*, new species; incomplete internal mold of a young shell; height 42 mm.
- Fig. 4. *Turritella altilira culebrina*, new variety; drawn from the actual shell with fine details of sculpture restored from its external mold; length of fragment 39 mm.
- Fig. 5. *Turritella collazica*, new species; incomplete internal mold; height 65 mm.

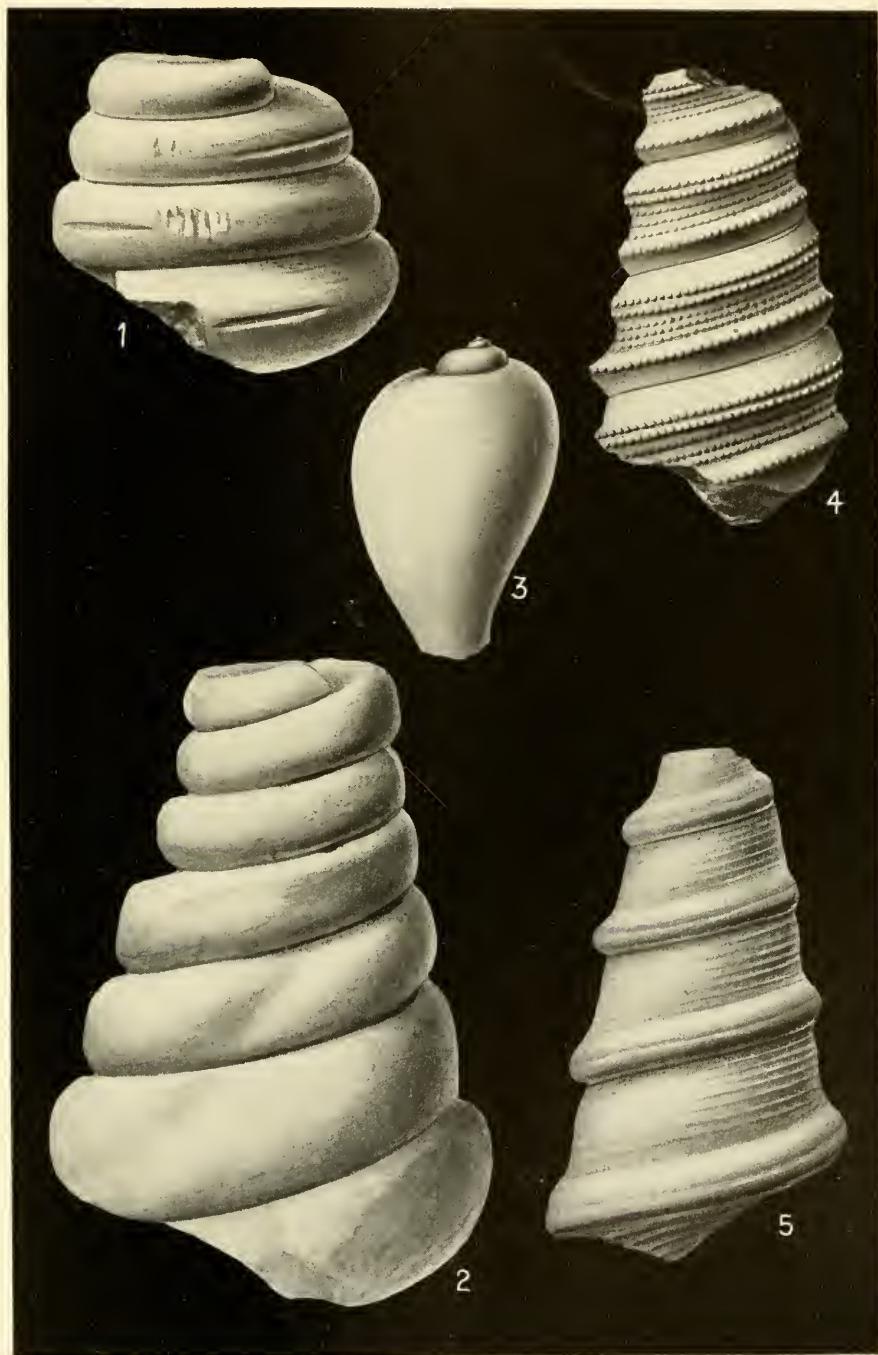


PLATE IX

- Fig. 1. *Drillia diazica*, new species; height of decollate shell 33 mm.
- Fig. 2. *Colubraria juanica*, new species; aboral aspect of shell; height 23 mm.
- Fig. 3. *Colubraria juanica*, new species; oral aspect of the same shell; height 23 mm.
- Fig. 4. *Orthaulax aguadillensis*, new species; view showing the extreme shortness of the spire and the circular outline of the shell at the shoulder. Unique specimen, mineralized; greatest diameter 45 mm.
- Fig. 5. *Haminea quebradillica*, new species; from artificial cast of external mold; height 18 mm.
- Fig. 6. *Scaphander (Bucconia) reedsi*, new species; incomplete internal mold; greatest diameter 28 mm.; estimated length when complete 40 mm.
- Fig. 7. *Pyrula hoveyi*, new species; fragment of spire and of body whorl. From an artificial cost of an external mold; height 23 mm.

