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Foraminifera and A Small Molluscan Fauna from Costa Rica

By Katherine Van Winkle Palmer

June 13, 1923

Harris Co.
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FORAMINIFERA AND A SMALL MOLLUSCAN FAUNA FROM COSTA RICA

BY

KATHERINE VANWINKLE PALMER

The present paper represents a report on material sent from Costa Rica to the Cornell Paleontological Laboratory by A. C. Veatch of the Sinclair Consolidated Oil Company.

The greater portion of the fossils are of diminutive size, consisting mainly of foraminifera with associated mollusca. The material came from a portion of a well section at Cahuita, Costa Rica, in the Uscari shales of lower Miocene age, at depths of 3818 and 3861.5 ft. Since the fauna from the Uscari shales is little known and the present material represents a lower portion of the shales than heretofore described, a few illustrations seem desirable.

Mr. Axel Olsson *, who first described and named the Uscari formation of Costa Rica, has listed and described a few species. His fauna came from the upper shales. The fauna in this report occurs lower in the formation.

The following are the species which Mr. Olsson gives from the Uscari shales:

Alectrion merenda Olsson.
Cancellaria islacolonis Maury.
Chlorostoma costaricensis Olsson.
Malea elliptica Pilsbry & Johnson.
Neverita nereidis Maury.
Ptychosalpinx ? *denialis* Olsson.
Scaphella costaricensis Olsson.
Sconsia cocleana Olsson.
Sistrum nodulosum C. B. Adams (Uscari and Gatun Transitional beds)
Strombus pugiloides Guppy.

* Olsson, Axel, Bull. Amer. Pal. vol. IX, No. 39, pts. 1 and 2, 1922.

Volvula cercadensis VanWinkle (= *V. cylindrica* Gabb).
Amusium Lyonsii Gabb.
Arca dariensis Pilsbry & Johnson.
Clementia dariena Conrad.
Pteria inornata Gabb.
Dentalium uscarianum Olsson.

To which may be added from near Old Harbor in the upper shales:

Corbula vieta Guppy.
Leda davilæ Olsson.
Pecten aotus Olsson.
Sinum gatunensis (Toula).
Lævicardium serratum Linné.
Chione (*Lirophora*) *hotelensis* Olsson.
Cristellaria cultrata (Montfort).

The following is the list from the Cahuita shale:

Cristellaria cultrata (Montfort).
Frondicularia alata d'Orb.
Nodosaria sp.
Pulvinulina menardii d'Orb.
Triloculina tricarinata d'Orb.
Drillia consors Sowerby.
Drillia sp.
Terebra sp.
Crassinella cahuitensis n. sp.
? Crassinella guppyi Dall.
? Glycymeris acuticostatus Sowerby.
Phacoidcs actinus Dall.
Leda davilæ Olsson.
Pecten aotus Olsson.
Thyasira sp.

In addition to the Uscari fauna, the report includes some species of Foraminifera from a dark gray, calcareous, volcanic compact sand from MacDonald and Nigua Creeks. A species of *Nummulites* was found to be fairly abundant indicating

the age to be Eocene or Oligocene. A single, poor specimen, which is with little doubt a small species of *Lepidocyclina* was found, which tends to affirm more strongly the Oligocene age of the sediments.

The localities referred to in the text are as follows:

1. Cahuita well, about 22 miles southeast of Limon, 82° 50′ West, 9° 45′ North, Costa Rica. At depth of 3818 and 3861.5 ft.

2. MacDonald Creek, 7 miles south of Guabilo, 82° 40′ West and 9° 25′ North, Costa Rica.

3. Nigua Creek, 5 miles west of Alamirante, 82° 27′ West and 9° 20′ North, Costa Rica.

PROTOZOA

Order FORAMINIFERA

Family LAGENIDAE

Genus **NODOSARIA** Lamarck

Nodosaria sp. Plate 1, Figures 1, 6, 11

Cf. Nodosaria lamellosa d'Orb. 1826 Ann. des Sci. Nat. Ser. I, 7, p. 253, pl. 10, figs. 4, 5, 6.

Cf. Nodosaria sp. Cushman 1922 U. S. G. S., Prof. Paper 129-E, p. 93, pl. XVI, fig. 5.

Several fragments of a *Nodosaria* were found which do not give the characters of a complete specimen but which show the ornamentation over the chambers present, beautifully preserved; the chambers are well-defined and the larger are subglobular. One fragment of three chambers shows the contour of each successive, indivual chamber, away from the largest, decreasing in convexity; surface ornamented with stout, longitudinal costæ of which there are from ten to twelve in number. The number and character of the costæ may be compared with *N. lamellosa* d'Orb. and a *Nodosaria* sp. of Cushman; the figure of d'Orbigny however shows all of the chambers of nearly

equal convexity. The *Nodosaria* sp. which Dr. Cushman found and figured a single broken specimen from the Oligocene Byram calcareous marl at Byram, Miss., appears very much like the specimens in our material.

A broken specimen of two chambers, shows on the larger one a series of intermediate costæ as on some Lagenas. See figs. 1, 11, plate 1. There are eight primary costæ, with five, secondary ribs, the secondary costæ do not occur between all of the primaries and are not present on the succeeding chamber.

Occurrence: Lower Miocene, Uscari shale from Cahuita well, Costa Rica.

Nodosaria soluta (Reuss) Plate 1, Figure 5

Dentalina soluta Reuss 1851 Zeitschr. d. deutsch. geol. Gesell. vol. 3, p. 60, pl. III, fig. 4, a, b.

Nodosaria soluta Bornemann 1855 Zeit. d. deutschen geol. Gesell., 7, p. 322, taf. XII, fig. 12; Brady 1884 Rep. Voy. Challenger Zoology vol. 9, p. 503, pl. 62, figs. 13-16; pl. 64, fig. 28; Flint 1899 Recent Foram. U. S. Nat. Mus. p. 310, pl. 56, fig. 3.

Test nearly straight, stout; chambers globular; the collection contains one specimen with six chambers present; aperture protruding with faint, radiating fissures about the exterior; surface of chambers smooth with faint, longitudinal striations at the sutures, extending shortly above and below the sutural line.

Length, 5 mm. (Incomplete specimen).

Occurrence: Nigua Creek, Costa Rica.

Genus **VAGINULINA** d'Orbigny

Vaginulina legumen (Linnæus) Plate 1, Figure 2

Nautilus legumen Linnæus 1758 Syst. Nat. 10th ed., p. 711, No. 248; 1767, 12th ed., p. 1164, No. 288.

Vaginulina legumen Brady 1874 Rep. Voy. Challenger, Zoology vol. 9, p. 530, pl. 66, figs. 13-15.

Test linear, sides nearly straight, only very slightly irregular, gradually tapering to the anterior end although the difference in width is only slight between the two ends; smooth; initial chamber large and round occupying the whole of the posterior tip; sutures oblique, thick, distinct; aperture marginal, slightly pouting.

Dimensions: 5 x 1 mm.

Occurrence: Specimen figured, MacDonald Creek; Nigua Creek, Costa Rica.

Genus **CRISTELLARIA** Lamarck

Cristellaria cultrata (Montfort) Plate 1, Figure 8

Robulus cultratus Montfort, 1808, Conch. Syst. vol. 1, p. 214, 54 genre.

Cristellaria cultrata Brady 1884 Rep. Voy. Challenger, Zoology, vol. 9, p. 550, pl. 70, figs. 4, 5, 6, 7, 8; Bagg 1898 U. S. G. S. Bull. 88, p. 55, pl. VI, fig. 1; Flint 1899 Recent Foram. U. S. Nat. Mus., p. 318, pl. 65, fig. 2.

Test round, biconvex and smooth; margin sharp with a wide keel; chamber walls distinct, strong and thick; aperture slightly protruding, marginal.

The specimen figured is the largest of all the material, measuring 5 mm. in diameter and it shows the characters beautifully and distinctly. The species is apparently the most common of all the species found, as numerous specimens from various localities, although the characters are not as clearly shown, appear to be this species. The smallest is from the Cahuita well, measuring 1 mm. in diameter.

Occurrence. Specimen figured, MacDonald Creek, Costa Rica; Nigua Creek, Cahuita well, Costa Rica.

Cristellaria *cf.* **reniformis** d'Orbigny Plate 1, Figure 10

Cristellaria reniformis d'Orbigny 1846 For. Foss. Vien. p. 88, pl. III, figs. 39, 40; Brady 1884 Rep. Vol. Challenger Zool-

ogy, vol. 9, p. 539, pl. 70, fig. 3; Flint 1899 Recent Foram. U S. Nat. Mus., p. 315, pl. 62, fig. 2.

Test sub-elongate, compressed, smooth; margin with a wide, sharp keel; chamber walls strong and thick, exteriorly raised above the surface of chambers, some inconspicuously nodose; aperture marginal.

Dimensions: 4 x 3 mm.

Occurrence: Specimen figured, MacDonald Creek; Nigua Creek, Costa Rica.

Genus **FRONDICULARIA** Defrance

Frondicularia alata d'Orbigny Plate 1, Figure 13

Frondicularia alata d'Orb. 1826 Ann. des Sc. Nat. Ser. I, 7, p. 256; Parker, Jones & Brady 1871 Ann. Nat. His. VIII, p. 161, pl. X, fig. 66; Brady 1884 Rep. Voy. Challenger Zoology, vol. 9, p. 522, pl. 65, figs. 20-23, pl. 66, figs. 3-5; Flint 1899 Recent Foram. U. S. Nat. Mus., p. 313, pl. 59, fig. 1.

Triangular, compressed, smooth and transparent; initial chamber distinct, globular, slightly raised beyond the surface of the remainder of the test; succeeding chambers V-shaped, the point of the V directed away from the initial chamber; the mid-line appearing like a series of vertebræ; aperture terminal; the line of the free end of the chambers is partially broken so that the true nature is not known; free end of early chambers slightly projecting.

Length: 4.5 mm.

Occurrence: Lower Miocene, Uscari shale from Cahuita well, Costa Rica.

Frondicularia sp. Plate 2, Figure 5

A large weathered specimen of *Frondicularia* was found in the MacDonald Creek material which is not *F. alata*. It measures 9 mm. in length. The specimen has been figured for future comparison, on plate 2.

Genus **PULVINULINA** Parker & Jones

Pulvinulina menardii (d'Orbigny) Plate 1, Figure 7

Rotalia menardii d'Orbigny 1826 Ann. Sci. Nat. vol. 7, p. 273.

Pulvinulina menardii Brady 1884 Rep. Voy. Challenger, Zoology, vol. 9, p. 690, pl. 103, figs. 1, 2; Cushman 1918 U. S. Nat. Mus. Bull. 103, p. 70, pl. 25, figs 2, 3,

Test plano-convex, thin and smooth except for dense and fine punctations; outer margin and line between the chambers distinct, raised and rounded; six chambers in the last-formed whorl.

Diameter: .5 mm.

Ocurrence: Lower Miocene, Uscari shale from Cahuita well, Costa Rica.

Genus **NUMMULITES** Lamarck

Nummulites costaricensis, n. sp. Plate 1, Figures 9, 12

Test small, thin, complanate; exterior smooth, slightly irregular; convolutions five; segments strongly arcuate; alar prolongations of the segments regular, sinuo-radiate; chambers numerous about twice as high as long, 32 in next to the last convolution; central convolution small, height of chambers increasing outwardly; aperture and canal system unknown. Small specimens 1.5 mm. in diameter which we take to be young, are very much thicker than the larger specimens.

This species is of the size of *N. davidensis* Cushman and the characters of the chambers are the same. This species however would have more than twice the number of chambers in the last convolution. In the larger number of chambers it is more like *N. panamensis* Cushman and yet has as a greater number than that species. There are 32 chambers in the convolution next to the last in *costaricensis*. The last whorl in our sections is too badly destroyed to determine the number of

chambers. It would probably have a number approaching that of *N. willcoxi* Heilprin of the Ocala limestone of Florida. The number in that species is given as 35-45. The young specimens of *costaricensis* are like *N. willcoxi* in thickness and shape but the larger specimens are compressed, thin and more or less irregular. Since the septal prolongations have not been described for the Panama species and a systematic study made of all the North American species of *Nummulities* we feel it best to give the Costa Rican species a distinct name for the present.

Dimension: 3.5 mm. in diameter.

Occurrence: Nigua Creek and MacDonald Creek, Costa Rica. Fairly abundant.

Genus **TRILOCULINA** d'Orbigny

Triloculina tricarinata d'Orbigny Plate 1, Figures 3, 4

Triloculina tricarinata d'Orbigny 1826 Ann. Sci. Nat. vol. 7, p. 299.

Miliolina tricarinata Brady 1884 Rep. Voy. Challenger, Zoology, vol. 9, p. 165, pl. 3, figs. 17a, b.

Triloculina tricarinata Cushman 1918 U. S. Nat. Mus. Bull. 103, p. 82, pl. 32, fig. 2.

Test minute, oval and smooth; apertural view triangular, sides convex, slightly concave towards the borders, angles acute; aperture round, tooth absent.

Length: .75 mm.

Occurrence: Lower Miocene, Uscari shale from Cahuita well, Costa Rica.

MOLLUSCA

Genus **TEREBRA** Lamarck

Terebra sp. Plate 2, Figure 4

Finding only one small specimen of *Terebra* we have included the illustration but do not attempt to determine it specifically.

Genus **DRILLIA** Gray

Drillia consors Sowerby Plate 2, Figure 7

A single specimen of *Drillia consors* was found. This practically represents the only large or moderately large species found in the Cahuita material. A specimen of *D. consors* from Santo Domingo has been figured for comparison.

Drillia sp. Plate 2, Figure 6

A broken specimen of a *Drilla* from the Cahuita material is figured. It is not perfect enough to compare with known species but is figured for future comparison.

Genus **GLYCYMERIS** Da Costa

Glycymeris cf. acuticostatus (Sowerby) Plate 2, Figure 9

Pectunculus acuticostatus Sowerby, 1849 Quart. Jour. Geol. Soc. Lon. V, p. 53, pl. X, fig. 13.

A small, single specimen of *Glycymeris* was found in the Uscari shale material which has the ribs perfect, fully preserved. The specimen is 6 mm. in height and 6.5 mm. in width. It may represent an adult shell or the young of some species. Having only one specimen we can not definitely say and have only compared it with *G. acuticostatus* Sowerby because in shape, character and number of the ribs it is like young specimens of *G. acuticostatus* Maury in the Santo Domingo collection. There are twenty-six, radiating ribs which are pronounced, V-shaped or rounded and have very narrow interspaces.

The shell is from the Uscari shale of the Cahuita well, Costa Rica.

Genus **CRASSINELLA** Guppy

Crassinella cahuitensis, n. sp. Plate 2, Figure 2

Description: Shell small, equilateral; beaks pointed, minute; anterior end high and convex; moderately concave beneath the beaks posteriorly; surface with fifteen, rounded, concentric ribs with interspaces equal to the width of the rib. In shape this species is like *C. martinicensis* d'Orbigny but it has a greater number of concentric ribs which are not as sharp but are more rounded than *martinicensis*.

Dimensions: Height 3 mm.; width 3 mm.

Occurrence: Lower Miocene, Uscari shale from Cahuita well, Costa Rica.

Genus **PHACOIDES** Blainvile

Section Bellucina

Phacoides actinus Dall, var. **uscarensis**, n. var. Plate 2, Figures 1, 3

Several specimens of a small *Phacoides* which bears a resemblance to *P. actinus* Dall (Trans. Wag. Inst. Sci. III, pt. 6, p. 1385, pl. 52, fig. 3) occur well preserved. They are larger than *actinus* with a greater number of radiating ribs, there being twenty-two on the Uscari specimens. In other respects the shells have the characters of typical *actinus*. The specimens of this species which Mr. Olsson records from the Gatun beds of Bocas del Toro, Costa Rica have been compared. They are very small and do not have the radiatiug ribs developed to the extent of *uscarensis*. The Santo Domingo specimens reported by Dr. Maury also have a smaller number of ribs.

Dimensions: Height 6 mm.; width 5.5 mm.; semidiameter 2 mm.

Occurrence: Lower Miocene, Uscari shale fron Cahuita well, Costa Rica.

ORBITOLITES FROM THE EOCENE OF OREGON

As a result of a collecting trip from the Eocene of Western Oregon in the summer of 1919, a large amount of fossil material was obtained from old and new localities. At one locality in Coos County a moderately large species of foraminifera was very numerous. This form was very noticeable, particularly as it was not found at other localities. An examination of the specimens shows the form to be a species of *Orbitolites* which we take occasion to describe in the present paper. Not only is the form of interest in its occurrence but in the character of the associated mollusca as well. The fauna is of the same horizon as that at Glide and vicinity, on the Little River, in the Roseburg Quadrangle, Oregon and certain localities in California which are of Meganos, Mid-Eocene age. This fact is of considerable interest as it means the further extension in Oregon of the middle Eocene horizon heretofore found only at the one region in Douglas County.

Orbitolites is a beach foraminifera occurring abundantly in shallow water sands. This accounts for its association with the shallow to moderate depth molluscan fauna. Three other species of foraminifera were found: *Cristellaria crepidula* (Fichtel and Moll.), *Cristellaria rotulata* (Lamarck) and *Nodosaria obliqua* (Linnæus). The first species was also abundant. It is a typical shallow water form. *C. rotulata* and *N. obliqua* are widely distributed occurring from the shallows to the depths.

Genus **ORBITOLITES** Lamarck

Orbitolites oregonensis, n. sp. Plate 2, Figures 10, 11, 12, 13, 14

cf, *Orbitolites* sp. *a*. Arnold 1909 Bull. U. S. G. S. 396, p. 13, pl. III, fig. 6.

Description. Test flat, very thin, medium in size, surface minutely granulate which under the microscope gives the appearance of a fine, beaded structure. On certain portions of some specimens the beads are arranged in regular, concentric rows; see pl. 2, fig. 12. Some specimens show the central portion of the disk slightly more convex than the surrounding surface; see pl. 2, fig. 13; chambers in one tier; chamberlets numerous; megalospheric tests comparatively numerous and show a large round central nucleus with a large second chamber which surrounds the primordial chamber about half its circumference, this is followed by the regular cyclic arrangement of the minute chamberlets, see pl. 2, fig. 16; marginal pores in a single row.

The general appearance and arrangement of the chamberlets is like that of *C. americana* Cushman from the Oligocene of Panama.

Arnold has figured from the Eocene of the Coalinga region, California (Bull. U. S. G. S. 396, p. 13, pl. III, fig. 6) the exterior view of an *Orbitolites* which he states is common. The size is given as 7.5 mm. in diameter which is the size of the Oregon species. The largest specimens in our material measure about 8 mm. in diameter, the average being about 5 mm. in diameter.

Type: Pal. Museum Cornell Univ.

Occurrence: On Four Mile Creek, Coos County, under an old bridge at Sam Smith's old place now DeLong place (1919). Section 4, Township 30 South, Range 14 West.

Horizon: Meganos. Middle Eocene.

EXPLANATION OF PLATE I.

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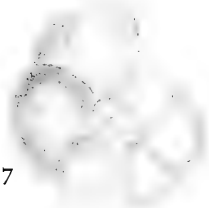

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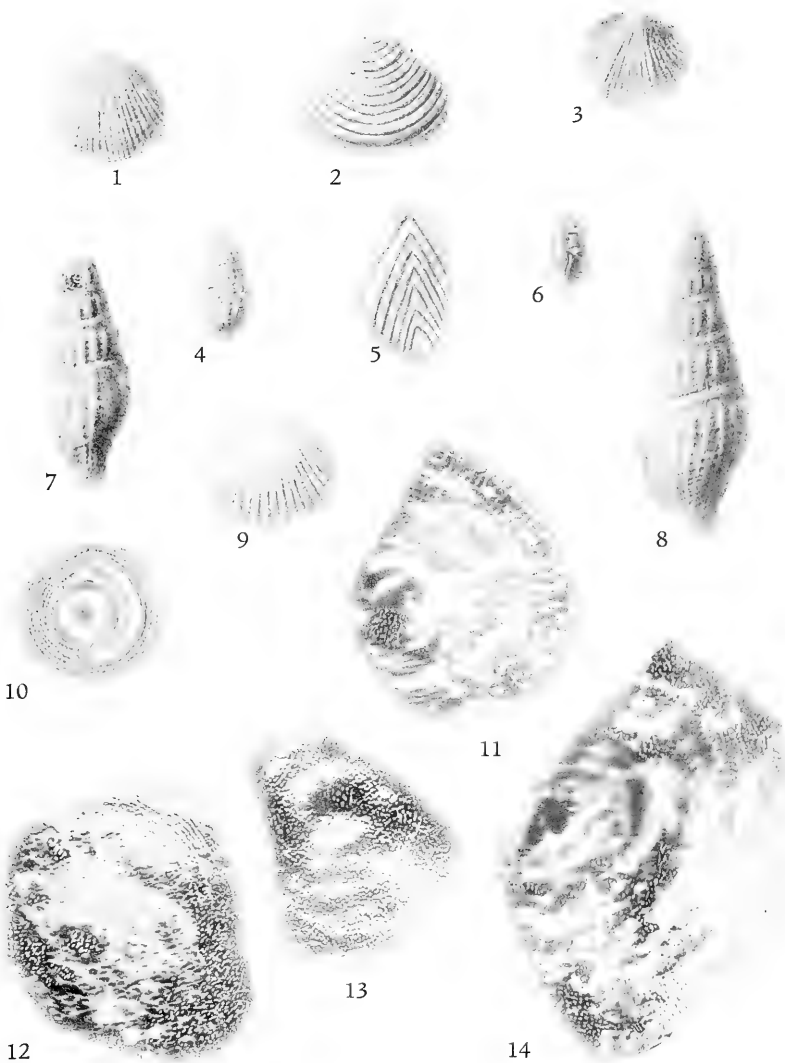
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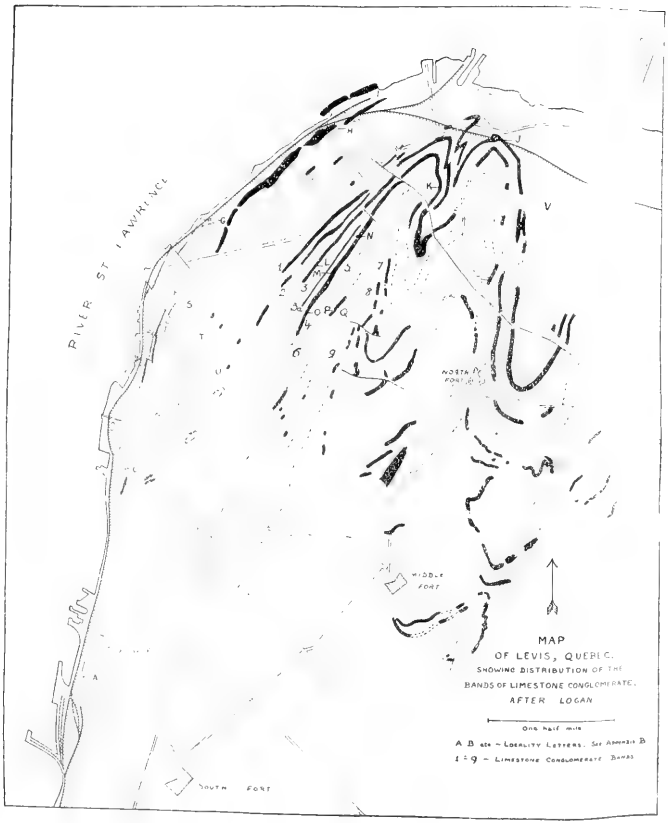
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MAP
OF LEVIS, QUEBEC.
SHOWING DISTRIBUTION OF THE
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One half mile
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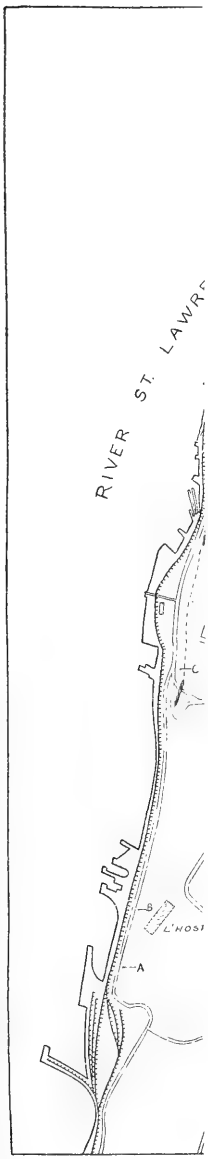
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THE PALEONTOLOGY OF THE BEEKMANTOWN SERIES AT LEVIS, QUEBEC

By Thomas H. Clark

(*Presented to the Faculty of Harvard University in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy*)

June 25, 1924

Harris Co.
Cornell University, Ithaca, N. Y.
U. S. A.

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THE PALEONTOLOGY OF THE BEEKMANTOWN SERIES AT LEVIS, QUEBEC

By Thomas H. Clark

INTRODUCTION

The problem of the best method of treating the Paleontology of the Sillery and Lévis rocks is not so difficult as it is complicated. In most areas one usually begins with the fauna of the lowest formation, stratigraphically, and then works up through more and more recent beds. At Lévis, this method is inpracticable, for in the first place most of the fossils collected from the various formations are not indigenous to them, but to older series, parts of which are included in the Sillery and Lévis rocks as boulders. Thus the Sillery formation has but two authenticated fossils of its own, but in its boulders there may be found a varied Lower Cambrian fauna; in the case of the Lévis rocks nearly one half of the fossils from the limestone conglomerate are of Upper Cambrian age. Moreover, a second complication arises when one considers that the indigenous fauna of the Lévis is of two vastly different types, first the fauna of the limestone conglomerates, consisting of heavy-shelled gasteropods, cepholopods, and articulate brachiopods and fairly large trilobites; and secondly, the fauna of the black shales consisting of graptolites, thin shelled brachiopods and small trilobites. These two groups are incongruous, and could not be rationally treated as a unit. While compactness and simplicity are recognized as desiderata, it nevertheless seems advisable to discuss the Paleontology of each faunal group separately. To do this satisfactorily the faunas of the following geological units will be considered separately:

I. The lower Cambrian boulders in both Sillery and Lévis formations.

II. The Upper Cambrian boulders in the Lévis conglomerates.

III. The Beekmantown fauna of the Lévis conglomerates.
IV. The indigenous fauna of the Sillery formation.
V. The indigenous fauna of the Lévis shales.

I. THE FAUNA OF THE LOWER CAMBRIAN BOULDERS

In spite of the fact that there are no known outcrops of Lower Cambrian rocks within 200 miles of Lévis it is by no means uncommon to find fossiliferous boulders of that age in the limestone conglomerates of both the Sillery and the Lévis formations. In the Lévis they are so much fewer in number than those of Upper Cambrian or Beekman town age that they seem, by comparison, to be exceedingly scarce. In the Sillery there are no other fossiliferous boulders. They have been found at several points along the south shore of the St. Lawrence, north of Lévis, such as Bic, Trois Pistoles and St. Simon. The composite fauna of the boulders from all of the localities where they occur is in essential agreement with the fauna from Anse au Loup and Labrador on the one hand, and with the fauna from various localities in Vermont and eastern New York on the other. Because it is almost impossible to account for the transportation of these boulders along the present strike of the beds from either Anse au Loup or Vermont, it seems necessary to postulate a once continuous mass of Lower Cambrian sediments extending from Newfoundland southwestwards along the site of or parallel to the St. Lawrence to Vermont and Eastern New York, probably, indeed, continuous as far south as Alabama. The outcrops are not now to be seen; they may have been wasted in the process which formed the conglomerates, or if any such rocks do exist they may be buried beneath the overthrust masses of younger sediments.

In this vicinity, Lower Cambrian boulders have been found at Lévis itself at several localities, and also on the south shore of the island of Orleans, on Canoe Island, and on the St. Joseph shore a few miles northeast of Lévis. The complete faunal list from these localities is as follows compiled from Walcott 1890; 1912—both in Supplementary bibliography; Ells, 1888 and the writer's own collections:

Micromitra (*Iphidella*) *walcotti*, sp. nov.
Nisusia (*Jamesella*) *amii* Walcott
Obolella crassa (Hall)
Orthisina, sp. ind.
Hyolithes americanus Billings
Stenotheca, sp. ind.
Salterella rugosa Billings
S. pulchella Billings
S. conulata, sp. ind.
Eodiscus connexus (Walcott)
Olenellus thompsoni Hall
Olenellus, sp. ind.
Ptychoparia cf. *subcoronata* Hall & Whitfield
Ptychoparia, sp. ind.
Olenoides ellsi Walcott

Of the above the writer has collected but three species. Two of these are new, the third, listed as *Olenellus*, sp. ind., consists of two cephala, both small and scarcely indentifiable. One is illustrated in plate 2, fig.11. The two new species are described below.

BRACHIOPODA

Order **ATREMATA** Beecher
Family *PATERINIDÆ* Schuchert

Micromitra (Iphidella) walcotti, sp. nov. Plate 2, Figs. 12, 12a

Known from a single ventral valve. This is small, 7.5 mm. long and 8 mm. wide, nearly circular in outline, moderately convex, but strongly elevated around the beak, although this difference in elevation may be due to crushing. The beak is just within the margin. There is a narrow

area present, but it is poorly preserved. The surface is traversed by a few indistinct radiating ridges close to the beak, and by many closely spaced, distinct concentric growth lines. These latter are crenulated, the minute raised portions so arranged as to form a diagonal network across the surface of the shell. In other species of Iphidella the raised crenulations actually unite to form two sets of ridges which cross the growth lines diagonally, and there are pits between the ridges. In this specimen each raised crenulation is distinct, there is no coalescence into ridges, and consequently no "network" with interstitial pores. It is doubtless an ancestral form to the typical forms of Iphidella, and may be regarded as intermediate between Paterina and Iphidella. Walcott (1912, p. 336) supposed Micromitra *sensu stricto* was intermediate between Paterina and Iphidella, but it seems rather more likely that both Iphidella and Micromitra *sensu stricto,* both of which contain ornamented forms, are derived from Paterina, which contains shells marked only by growth lines. Moreover the crenulations of the concentric striæ of *M.* (*Micromitra s. s.*) *sculptilis* (Meek) are consequent upon their junction with the coarse radial plications, and are by no means homologous with the almost microscopically fine crenulations of Iphidella. Holotype M. C. Z. 8548.

Horizon and locality. Lower Cambrian, boulder from a limestone conglomerate of the Sillery formation on the St. Joseph shore about three miles northeast of Lévis. This boulder also yielded fragments of a Mesonacid trilobite.

CEPHALOPODA

Order **NAUTILOIDEA** Zittel

Suborder ORTHOCHOANITES Hyatt

Family *ORTHOCERATIDÆ* M'Coy

Salterella Billings

Near the new dry dock at Lauzon, less than one mile north of the railroad station at Lévis, there is a thick bed

of limestone conglomerate (Locality 1), which with the exception of a single boulder is apparently unfossiliferous. The exceptional boulder has yielded a single cephalon of Olenellus and an abundance of individuals belonging to the genus Salterella. The latter consist of fragmentary material of various sizes. The longest is 8 mm. long with a maximum diameter of 2.5 mm. The greatest diameter observed on any individual is 4 mm. Most of the specimens are very acute cones, broken at both ends. Their apical angle varies from 8° to 12°. This may be expressed in another way by stating that the restored length of any specimen is about six times the diameter at its widest end.

The smallest specimens are simple cones, aseptate and hollow, open only at the larger end, with the sides diverging at an angle of about 30°, and flaring slightly at the upper rim (fig. 1). In such specimens, which are never more than one millimeter long, the shell is very thin indeed, and translucent. Specimens with a diameter of 1 mm. are nearly cylindrical; they possess septa which are conical and whose inner and outer surfaces are of the same shape (fig. 2). In specimens two or three millimeters in diameter the septa are of a different and a pecular shape (figs. 4-6). They are thick, but their inner and outer surfaces are of different outlines. The posterior, or lower, surface is approximately hemispherical, convex downwards, and continued upwards for a short distance cylindrically. The interior surface is campanulate in form. At the base of the septum is a circular opening around which the shell is continued downwards for a short distance as a siphonal collar. The septum was originally solid, but in some cases only the inner and outer walls are preserved, and these are joined together along the rim and at the collar. In some specimens where solution has not removed the entire septum, it is seen to be composed of laminated material, with the laminæ parallel to the walls (fig. 4).

Through the courtesy of the Canadian Geological

Survey and the Smithsonian Institution I have had the opportunity to examine specimens of *Salterella rugosa* and *Salterella pulchella* from the type locality on the Straits of Belle Isle, and also one from Lévis, Quebec. I have also been able to study collections from the Peabody Museum made by Professor Dunbar near the type locality. In only a few cases was I able to make sections, but such as were made showed a structure in all ways comparable to that of the specimens from Lévis. An illustration of a section of *S. pulchella* from Forteau Bay, Labrador, is given in figure 7. A most careful examination of more specimens recently collected at Lévis and a comparison of them with typical Salterellas left no doubt that the former, too, belonged to that genus.

Salterella conulata, sp. nov. Plate 2, Figs. 1–6, 8–10

Small, straight, elongate, circular-conical forms, composed of a series of conical and cup-shaped septa which are set within one another so that about one half of each is included within the one next below, and the other half free. Each is pierced by a central aperture, from which a siphuncle-like tube projects backward to the next posterior septum. Our specimens lack an external shell. The exterior surface is rough, and marked by annulations which correspond to the edges of the septa.

Horizon and locality. These fossils were collected from a limestone boulder of Lower Cambrian age within a limestone conglomerate presumably of Beekmantown age a few hundred feet south of the new dry dock at Lauzon. Quebec (locality 1). This limestone conglomerate bed is marked D on Logan's map in the atlas accompanying his report on the Geology of Canada, 1863. Within the same boulder was found a single cephalon of Olenellus.

Remarks. The fossils occur in both the pebbles and the paste of a large boulder some two feet in diameter which is itself a part of the prominent ridge of limestone

conglomerate. The only other fossil found in connection with Salterella was a cephalon of Olenellus, which occurred in one of the small pebbles. The conglomerate as a whole is believed to be of Beekmantown age, but the fossiliferous boulders indicate that the fragmentation of limestone and the formation of limestone conglomerates were going on in Lower Cambrian time. Limestone conglomerates of that age are already known from Bic, Quebec, and their present discovery further up the St. Lawrence River may serve to strengthen our conclusions in regard to early Paleozoic conditions in the ancient St. Lawrence Channel. Whatever conditions we postulate to explain the formation of the limestone conglomerates, we must be prepared also to explain the recurrence of those conditions from Lower Cambrian time to the close of the Ordovician. If glacial, then throughout Cambrian and Ordovician times the St. Lawrence region was visited, locally at least, by glaciers. If tectonic, then for those periods the region was one of instability; etc. Thus the discovery of Salterella in both the pebbles and the paste of a conglomerate boulder is of considerable importance in reconstructing the early Paleozoic conditions in the St. Lawrence region.

The place of Salterella in the zoological classification. When Billings first described the genus he considered it to be closely allied to Serpulites, which was then classed as a worm tube. He abandoned this view almost at once, for in 1863 (Geol. Can. p. 949) we find him referring it to the Pteropoda, where it has remained to the present day, with scarcely a question. As far as the writer knows, no pteropods possess a chambered shell. Salterella, like the pteropods, was probably a pelagic form, for it occurs both in the limestone pebbles and therefore in earlier limy mud and also in the sandy matrix around and between the pebbles, suggesting an independence of bottom control; but habitat is no sure guide to systematic position.

Scaphopod shells are always unchambered, curved, and open at the apical end, while Salterella is chambered, straight and, as far as we can observe, closed at the apical end.

It might possibly be related to the corals, especially to that early stage of some Tetracoralla in which no radial septa are present. It is pretty generally believed now, however, that this condition is due to lack of preservation of septa rather than to original deficiency. But, here again, no structures analogous to the septa of Salterella have been observed in corals. The tabulae cannot be compared with them.

The progressive differentiation of the septum in Salterella, which may possibly indicate the history of the evolution of the cephalopod septum, presupposes that at the beginning of Paleozoic time the group to which Salterella belonged had reached a fairly high degree of specialization. Salterella can in no way be considered a primitive cephalopod. Nor does it seem to be directly ancestral to any subsequent form. It is more closely related to Orthoceras than to Endoceras, as the relatively short siphonal collars and the absence of endosiphonal structures indicate.

Relation of Salterella to Volborthella. I have not had access to Schmidt's original description of Volborthella (1888), but Matthew (1890) translates enough of it to give one a good idea of the generic characters. From an examination of the external form alone one could scarcely distinguish the two genera. It remains to be seen, however, how much more detailed structure may yet be observed within Volborthella beyond such as is given by Schmidt. If the two genera should prove to be the same, Billings' genus has the right of priority. Volborthella occurs in the Lower Cambrian near Reval and Kunda, Esthonia. Associated with it are Olenellus and Platysolenites. Schmidt demonstrated the chambered nature of Volborthella and

stated: "I can instance scarcely any essential characters which militate against the Orthoceral nature of our small bodies." (translation).

II. THE FAUNA OF THE UPPER CAMBRIAN BOULDERS IN THE LEVIS CONGLOMERATES

One of the unsolved problems in the stratigraphy of the Lévis formation is that concerning the source of the Limestone boulders of Upper Cambrian age. No trace of the parent bed from which they were derived has yet been discovered in Quebec. The fauna, too, is a distinctive one, most of the species and some of the genera have not been reported from other localities. There is little to suggest affinity with European faunas. Dikelocephalina is the only genus of its family to occur in Europe and it is very scarce there. When one considers the great abundance of of members of the Dikelocephalidæ in the Lévis fauna the impossibility of deriving the latter from European faunas becomes apparent. Dikelocephalids are typically American, and the presence of a single genus in Europe indicates that although there was an open communication between North America and Europe, there seems to have been practically no intermingling of the faunas.

All of the genera which occur elsewhere are characteristic of the interior of North America except Solenopleura and Ptychoparia, which are typically European Middle Cambrian, although they range throughout the Cambrian on both continents. Plethopeltis occurs in the Milton of Vermont, in the Saratogan of New York, and the Croixan of the upper Mississippi valley and may be considered an interior American genus. The genus Acheilus, established for a Lévis species, also occurs in the Milton.

The Milton formation, mentioned above, has been recently exploited by Keith (1923) and its fauna described by Raymond (1924). There is a considerable correspond-

ence in general composition between the Lévis Upper Cambrian and the Milton faunas as the following list of genera will show. Three species only are common to the two faunas, *Plethopeltis angusta* Raymond, *Apatokephaloides inflatus* Raymond, and *Acheilus marcoui* Raymond.

FAMILY	MILTON GENERA	LEVIS UPPER CAMBRIAN GENERA
Agnostidæ	*Agnostus*	*Agnostus*
	Pseudagnostus	*Plethagnostus*, nov.
	Phalacroma	
Shumardiidæ	*Idomesus*	
Endymioniidæ	*Pseudosalteria*	
Conocoryphidæ	*Phoreotropis*	*Phoreotropis*
		Bienvillia, nov.
Olenidæ	*Ctenopyge ?*	
	Westergardia	
Solenopleuridæ	*Onchonotus*	*Onchonotus*
	Hystricurus	
	Phylacterus	
		Solenopleura
Asaphiscidæ	*Asaphiscus*	
	Lloydia	
	Blountia	
	Maryvillia	
Ellipsocephalidæ	*Plethopeltis*	*Plethopeltis*
		Leiocoryphe, nov.
	Stenopilus	*Stenopilus*
Corynexochidæ	*Corynexochus*	
	Acheilus	*Acheilus*
		Denisia, nov.
Remopleuridæ	*Apatokephaloides*	*Apatokephaloides*
Styginidæ	*Leptopilus*	

Dikelocephalidæ	*Dikelocephalus*	*Dikelocephalina*
	Saukia	*Osceolia*
	Richardsonella	*Richardsonella*
	Hungaia	*Hungaia*
	Illænurus	
	Platycolpus	*Platycolpus*
	Ptychaspis	
	Aracnubus	
		Bayfieldia, nov.
Raymondinidæ		*Raymondina*, nov.

Two features stand out in bold relief. First, the number of genera common to the two faunas and secondly the number of new genera that it has been necessary to make. This latter feature serves to indicate that we are far from a thorough understanding of these faunas yet. Although that of the Lévis rocks has been worked over for half a century much remains to be done and eventually the fauna will be increased still further. As for the Milton, Dr. Raymond has described an abundant fauna from a small collection from one locality. It is not to be denied that subsequent collecting from northwestern Vermont will result in a far richer fauna, one which, we dare to hope will lead us to a better understanding of the source of Lévis boulders.

LIST OF SPECIES FROM THE UPPER CAMBRIAN BOULDERS

BRACHIOPODS

Syntrophia elax, sp. nov.

TRILOBITES

AGNOSTIDAE

Plethagnostus gyps Clark
Agnostus canadensis Billings
A. armericanus Billings

A. orion Billings
A. gladiator Clark
A. janei Clark
A. innocens Clark

CONOCORYPHIDAE

Phoreotropis puteatus Raymond

OLENIDAE

Ptychoparia zenkeri (Billings)
Loganellus logani Devine
L. billingsi, sp. nov.
Bienvillia corax (Billings)

ELLIPSOCEPHALIDAE

Plethopeltis armata (Billings)
P. angusta Raymond
Leiocoryphe gemma, sp. nov
L. westoni, sp. nov.
Stenopilus intermedius, sp. nov.

SOLENOPLEURIDAE

Solenopleura trunca, sp. nov.
S. laflammei, sp. nov.

REMOPLEURIDAE

Apatokephalus inflatus Raymond
A. (*?*) *sedgwicki* (Billings)

DIKELLOCEPHALIDAE

Richardsonella oweni (Billings)
R. belli (Billings)
R. cristata (Billings)
R. megalops (Billings)
Platycolpus affinis (Billings)
P. capax (Billings)
P. dubius (Billings)
P. marcoui, sp. nov.
Lisania (*?*) *hisingeri* (Billings)
L (*?*) *devinei* (Billings)
Dikelokephalina broggeri, sp. nov.
Osceolia brevifrons, sp. nov.
Bayfieldia tumifrons, sp. nov.

B. finkelnburgi, sp. nov.
Hungaia magnifica (Billings)
Ptychaspis pauper (Billings)
P. selecta (Billings)
P. sesostris (Billings)

CORYNEXOCHIDAE

Denisia eminens, sp. nov.
D. pusillus, sp. nov.
Acheilus levisensis, sp. nov.
A. marcoui Raymond
Onchonotus nasutus (Walcott)
O. globosus (Billings)
O. (?) salteri (Devine)

RAYMONDINIDAE

Raymondina respecta, sp. nov.

DESCRIPTION OF SPECIES

BRACHIOPODA

Order **PROTREMATA** Beecher

Family *SYNTROPHIIDÆ* Schuchert

Syntrophia Elax sp. nov Plate 3, Fig. 1

This species somewhat resembles *S. calcifera* (Billings) but differs from it in its smaller size. The fold and sinus are much more pronounced than in the Beekmantown species, and the fold is produced beyond the general anterior border of the shell.

The surface is ornamented with fine radiating striæ and concentric lamellose growth markings. Length and width of type, 9.5 mm., 10.5 mm.; of a second specimen 7.75., 8mm.; of a third specimen 8mm., 8mm. Type M. C. Z. 8549.

Horizon and locality. Upper Cambrian, boulder D, locality N, Middle Ridge, Lévis, Quebec.

TRILOBITA

Order **HYPOPARIA** Beecher

Family *AGNOSTIDÆ* M'Coy

Sub-Family AGNOSTINÆ Jackel

Plethagnostus Clark

Axial lobe of pygidium transversely divided, the anterior part short, the posterior one expanding backwards with its lateral margins reaching the flat circum-pygidal border. Genotype *Plethagnostus gyps* Clark.

This genus differs from Pseudagnostus Jaekel in having the divergent dorsal furrows continued to the border of the pygidium. It is probably ancestral to Pseudagnostus.

Plethagnostus gyps Clark Plate 3, Fig. 2.

Clark, T. H. 1923 p. 124, Fig. 9

Known from one pygidium only. This is of medium size, nearly circular, except for the anterior margin slightly wider than long. The shield is moderately elevated, the highest point near the anterior end of axial lobe. A wide, depressed, rounded brim surrounds the shield on three sides; within it there is a distinct groove separating the brim from the rest of the shield. The axis is prominent and consists of two lobes, the anterior one short and wide, contracting posteriorly, strongly elevated, with a median tubercle half as long as the lobe itself, bordered by deep dorsal furrows and a less deep trans-axial furrow whose course is slightly convex forwards and bears a median semicircular indentation, convex forwards, to accommodate the tubercle. The posterior lobe is wide and enlarges backwards, the dorsal furrows are much less distinct than in the anterior one. They reach the marginal groove, so that this lobe is completely surrounded by furrows. It is depressed convex, descending abruptly to the posterior margin. The intramarginal furrow in front of the axial lobe is modified so as to contain two deep pits, one each

side of the center, with a sharp ridge between them. There were probably two backward pointing spines on the margin, but these have been broken off, leaving but the merest traces of their positions. Dimensions, length 3.4 mm., width 3.6 mm., length of anterior lobe 1.8 mm., of posterior lobe .9 mm.

Horizon and Locality. Upper Cambrian, boulder H. collected by Marcou from Lévis, Quebec.

Agnostus innocens Clark Plate 3, Figs. 3, 3a

Clark, T. H. 1923 p. 122 Fig. 7, 7a.

This species is proposed for a type of pygidium which occurs plentifully in boulder G which the writer picked up loose at Lévis, Quebec. Although small, the boulder carried a good number of species, eight in all being recognized. Of these three are members of the Agnostidæ, and are described below.

Pygidium small, sub-circular in outline behind the nearly straight anterior margin. The axial lobe is prominent, two-thirds as long as the pygidium, twice as long as wide, contracted in the middle, expanding towards the anterior end, with two trans-axial furrows. The posterior segment is widest just behind the furrow and narrows rather evenly backwards; it is slightly more than half as long as the axial lobe itself. The middle segment is short and is divided from the anterior one by a furrow which is convex forwards. Both the latter segments bear a long tubercle, which is traversed by the anterior trans-axial furrow. The pleural lobes are evenly and gently convex, and there is a very narrow brim which is upturned in front. The posterior "corners" carry short sharp spines which point slightly outwards. Dimensions, length 3 mm., width 3.5 mm.

The cephalon which is associated with this pygidium is of the same size and shape. The axial lobe is divided into three sub-equal segments by two trans-axial furrows, the anterior of which is concave forwards, the central third

of the other one is sharply curved forwards to accommodate the prominent tubercle on the posterior segment. There are accessory lobes present. The dorsal furrows unite at an acute angle in front of the glabella and are continued to the brim. The latter is narrow. Dimensions, length 2.5 mm., width 2.7 mm.

Horizon and Locality. Upper Cambrian, boulder G, loose at Lévis, Quebec.

The pygidium of this species resembles that of *Agnostus americanus* Billings (Upper Cambrian, Lévis), but in that species the posterior segment is round with two longitudinal furrows, and the long tubercle on the anterior end of the axial lobe is not traversed by the furrow as in our species. The cephalon of Billings' species has but one trans-axial furrow, ours has two.

Agnostus gladiator Clark Plate 3, Fig. 4
Clark, T. H., 1923 p. 124, Fig. 10

Known from one pygidium only, which is sub-quadrate. The axial lobe is prominent, twice as long as wide, rounded posteriorly, rising abruptly from the main part of the shield; it is so much damaged that no segmentation or ornamentation can be made out, although there is a trace of a median trans-axial furrow. A convex brim surrounds the posterior part of the shield, within this there is a wide and shallow depression. The convex part of the pleural lobes is wide and highly elevated toward the front, narrow and low around the posterior margin. There are two remarkably long spines springing from the posterio-lateral margins, directed slightly outwards, and nearly as long as the pygidium itself. The shield is most highly elevated close to the anterior margin. Dimensions, length 2.8 mm., width 3 mm., length of spines 2.5 mm.

Horizon and locality. Upper Cambrian, from a loose boulder, G, at Lévis, Quebec.

The presence of long spines serves to distinguish this

species from most of the Agnostids. Other forms with which this one is associated have small, almost minute spines.

Agnostus janei Clark Plate 3, Fig. 5
Clark, T. H., 1923 p. 124, Fig. 8

Known only from one imperfect cephalon. This is of medium size, subquadrate, with the anterior corners broadly rounded. The genal angles not observed. The glabella is three-fifths the length of the cephalon, the dorsal furrows are wide and shallow, sub-parallel, but converge forwards in the anterior fourth of its length, where is one transglabellar furrow, situated forward of the middle, convex forwards. The posterior lobe of the glabella is rather highly elevated, and has a low long tubercle pointing forwards close to the trans-glabellar furrow. The accessory lobes are large. The circumglabellar furrow is wide and shallow, as is also the median furrow in front of the glabella. The cephalon is surrounded by a nearly flat raised rim, inside of which is a low wide depression of about the same width, the two together being about as wide as the glabella. The lateral parts of the rim are depressed to a remarkable degree, the cephalon rising abruptly from those parts. The surface is minutely pustulose. Dimensions, length 3 mm., width 3 mm., elevation of posterior part of the glabella above the rim 1.75 mm.

Formation and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

This species resembles *A. Orion* Billings and *A canadensis* Billings somewhat, but differs from them both in the wide circumglabellar furrow, the flat rim and its attendant depression. *A. Orion* has no tubercle, and *A. canadensis* has very small accessory lobes and a proportionately longer glabella which tapers forward.

Order **OPISTHOPARIA** Beecher

Family *OLENIDÆ* Burmeister

Loganellus billingsi, sp. nov. Plate 3, Fig. 7

Cephalon of medium size, moderately convex. The glabella contracts somewhat forwards, the dorsal furrows are straight and shallow, the anterior corners of the glabella are rounded, the anterior margin is straight. The glabella is smooth, except for an extremely faint indication of one pair of furrows. The neck furrow is wide, scarcely visible at its extremities, and straight. The neck ring is well developed, widest in the middle. The brim is narrow, with a still narrower raised rim in front. The eyes are small, opposite the central part of the glabella. The eye-lines are wide and low. The anterior parts of the facial sutures are directed obliquely outwards, but curve around so as to coincide with the rim at a point directly in front of the eye; the posterior part is directed obliquely backwards without much curvature. Dimensions, length of cephalon 10 mm., of glabella 8 mm., width of glabella, anterior part 4.72 mm., posterior part 7 mm. Holotype M. C. Z. 1703.

Horizon and locality. Upper Cambrian, boulder A, locality N, North Ridge, Lévis, Quebec.

This species resembles *L. logani* (Devine) in some respects. Its glabella is smooth, whereas Devine's specimen has two pairs of furrows. The neck furrow is faint and straight, but in *L. logani* it is strong and deflected forwards at the ends. The course of the facial sutures in front of the eye is different.

Bienvilla corax (Billings)

In our collection from Boulder D there is a small cranidium of that species which was orignally designated as *Dikelocephalus? corax* (Pal. foss. p. 334). Billings himself was in doubt as to its correct generic position. More recently Walcott (1914, p. 350), in his revision of the species of Dikelocephalus, was apparently unable to assign it to any

genus for he wrote against it "gen. undt." Billings stated that in his specimen which was obviously incomplete "there appears to be a wide smooth border," but in our specimen there is a convex depressed brim bordered by a narrow upturned rim. There are eye-lines which leave the dorsal furrow near its anterior end and proceed outwards and backwards to the broken edge of the specimen. The observed length of this eye-line is slightly more than one millimeter; the broken ends are opposite the middle point of the glabella so that the eyes must have been median in position or somewhat back of the middle. This is the basis for the erection of the following genus.

Genus **Bienvillia**, nov.

Similar to Peltura, but the eyes are far from the glabella and opposite or behind its middle point. Genotype, *Dikelocephalus? corax* Billings.

Family *ELLIPSOCEPHALIDÆ* Matthew

Genus **LEIOCORYPHE**, nov.

Glabella large, convex, perfectly smooth, with or without genal spines, no eyes. Free cheeks marginal, very small.

This genus is evidently closely allied to Plethopeltis, but has progressed further in the smoothening out of the glabella, and also in the tendency towards blindness, or at least a ventral position of the eyes.

Leiocoryphe gemma sp. nov. Plate 3, **Fig. 8**

General form ovate, the cephalon larger than the thorax and pygidium combined. The cephalon is semicircular in outline, very convex, not depressed at the neck segment, and with stout spines at the genal angles pointing backwards but diverging very slightly. There is no brim. The neck furrow is shallow and indistinct, the neck segment wide in the middle, its posterior margin gently curved. Neither eyes nor facial sutures can be seen on the specimens. The thorax consists of eight segments; the axial lobe is wide, the pleura

are a little more than half as long as the width of the axial segments. The axial lobe is arched gently, the dorsal furrows wide and shallow, and the pleura fall away from it so as to give the thorax a tolerably smoothly curved surface as a whole. The pygidium is very small, about twice as wide as long, perfectly smooth. In the type-specimen it is slightly depressed. Dimensions, total length 5 mm., length of cephalon 2.75 mm., width of cephalon across the neck segment 4.25 mm., width of pygidium 2.25 mm., length 1 mm. Genoholotype M. C. Z. 1706.

Horizon and locality. Upper Cambrian. The type occurs in Marcou's collection from the limestone conglomerates from Lévis. The writer has found it in Boulder B, Middle Ridge, Lévis, Quebec.

This species is remarkable not only in belonging to a new genus, but in being represented by two whole specimens, both collected by Jules Marcou. Complete trilobites from the limestone conglomerates at Lévis are exceedingly scarce. The writer has not been successful in finding one, and these two are the only ones in Marcou's collection. Billings figured a few, some lacking only the free cheeks, but even including them, such trilobites are a great rarity. It is unfortunate that we have not been able to find more, for all collectors at Lévis have been bothered with great numbers of unattached pygidia which can only be assigned to specific cephala on the basis of probabilities.

Stenopilus intermedius, sp. nov. Plate 3, Fig. 9

It has already been shown how closely the genus Stenopilus resembles Plethopeltis (Raymand, 1924). It remains here to add that representatives of both genera have been found from the same boulder at Lévis.

Description. The cephalon is very convex, longer than wide and completely smooth. The eyes are small, far from the glabella and near the border of the cephalon. The free cheeks are not preserved, but could only be very narrow. There are short stout genal spines pointing diagonally out-

wards. There is no neck to furrow, but the posterior margin of the nuchal segment, which is not differentiated from the rest of the cephalon, is curved backwards, and bears but the faintest trace of a tubercle. Dimensions, length 6.9 mm., width 5.75 mm. Type M. C. Z. 1707.

Horizon and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

Family *CORYNEXOCHIDÆ* Angelin

Sub-Family CORYNEXOCHINAE Raymond

Denisia, gen. nov.

Trilobites with the general aspect of Corynexochus, from which they differ in lacking all glabellar furrows except the posterior pair. Genotype, *Denisia eminens,* sp. nov.

The genera of the Corynexochinæ may be briefly characterized as follows:

Bonnia Walcott. L. Cambrian. Glabella with subparallel sides, faint traces of two or three pairs of furrows.

Corynexochus Angelin. M. and U. Cambrian. Glabella expanding forwards, two or three pairs of short furrows.

Acheilus Raymond. U. Cambrian. Glabella expanding forwards. Anterior furrows faint, the two other pairs short.

Denisia gen. nov. U. Cambrian. Glabella expanding forwards. Posterior pair of globellar furrows faint, others wanting.

Thus it will be seen that these genera form a well arranged phylogentic group in which the glabella has changed from one with sub-parallel sides to one expanding forwards, and also in the gradual reduction of the glabellar furrows. The line will be complete when that form is found in which the furrows have entirely disappeared. The first two have a brim in front of the glabella, whereas the last two lack it.

Denisia eminens, sp. nov. Plate 3, Fig. 10

Cephalon small. The glabella is relatively large, and

prominent, strongly elevated, the greatest convexity being just behind the middle. It expands forwards, and the anterior end is well rounded. The dorsal furrows are deep and distinct in the posterior half and faint in the anterior part. The glabellar furrows are close to the neck ring, not touching the dorsal furrow, faint, short, and curved inwards and backwards. The neck furrow is persistent for the width of the glabella, the nuchal segment is wide in the middle, contracting rapidly towards the ends but without either spine or tubercle. There is no brim around the anterior end of the glabella. The eyes are large, situated midway of the cephalon, somewhat less than 1 mm. from the glabella. The facial suture runs forward from the eye, but its course near the anterior margin cannot be observed. Behind the eye it proceeds diagonally towards the genal angle. The free cheeks are unknown. The whole surface is pustulose, varied occasionally by fine ridges. Dimensions, length of cephalon 3 mm., of the glabella 2.5 mm., width of the glabella 1 mm. from the anterior end 2.3 mm. Genoholotype M. C. Z. 1713.

Horizon and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

Denisia pusillus, sp. nov. Plate 3, Fig. 11

Cephalon very small. The glabella is about as wide as long, moderately convex, with a pair of faint posterior glabellar furrows and traces of two anterior pairs. The latter are short, direct diagonally inwards and backwards, slightly curved, concave outwards, short, not originating from the dorsal furrows and situated closer to the center of the glabella than to its lateral margins. The dorsal furrows are straight, very lightly impressed, and bent slightly outwards in the middle; so that the glabella is somewhat wider in the middle than elsewhere. The neck furrow is distinct, deeper than the dorsal furrow, straight. The nuchal segment is wide in the center, diminishing rapidly toward the dorsal furrow;

there is no spine or tubercle. The whole surface is granulose. Dimensions, length of cephalon 1.75 mm., of glabella 1.4 mm., width of glabella 1.3 mm. Holotype M. C. Z. 1715.

Horizon and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

Acheilus levisensis, sp. nov. Plate 3, Fig. 12

Cephalon small, wider than long. The glabella is separated from the fixed cheeks by very faint dorsal furrows which become obsolete forwards so that the anterior part of the glabella merges into the convex brim. Two pairs of glabellar furrows are present, both faint; the anterior furrows are practically nothing but shallow pits, the middle furrows are very short, directed somewhat backwards and inwards, the posterior ones are longer but similarly directed and somewhat curved. None of them start at the dorsal furrow, nor do they reach more than half way towards the center of the glabella. The neck furrow is distinct and narrow, and continued across the cephalon, separating a narrow depressed posterior portion from the main part of the cheeks. The fixed cheeks are narrow. The palpebral lobes small, distant from the glabella and opposite its middle. The surface is perfectly smooth. Dimensions, length of cephalon 2 mm., width 3 mm., width of glabella 1 mm. Holotype M. C. Z. 1714.

Horizon and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

This is a smaller form than any previously described. *A. marcoui* Raymond is pustulose and has fairly strong glabellar furrows. *A. macrops* Raymond has a very prominent long glabella raised conspicuously above the fixed cheeks with very distinct furrows. *A. spicatus* Raymond has a long stout nuchal spine.

Acheilus marconi Raymond

Raymond, P. E. 1924

This species was collected from boulders B and D at Lévis. It was described from the Milton formation of Vermont.

Family *SOLENOPLEURIDÆ* Angelin

Solenopleura trunca, sp. nov. Plate 4, Fig 1

Cephalon small. Glabella convex, relatively long, its sides converging only slightly towards the front; the anterior margin is semicircular. There are three pairs of glabellar furrows, the anterior pair is very faint, the middle pair distinct but short, the posterior ones almost meet across the glabella; all the furrows are directed inwards and backwards. The neck furrow is deep and well-marked, preserving its strength throughout its whole length, at its ends it is bent forwards somewhat. The neck ring is slightly wider in the middle than elsewhere, and carries a small median tubercle. The brim is narrow with an upturned marginal rim. The fixed cheeks are tumid and wide. The eye-lines are low and directed backwards. The eyes are long, far from the glabella and opposite its median portion. The anterior part of the facial suture is not preserved, but the posterior part proceeds almost straight towards the genal angle. The surface is smooth. The thorax and pygidium are unknown. Dimensions, length of cephalon 3.3 mm., of glabella 2.9 mm., maximum width of glabella 2.3 mm., eyes .8 mm. from glabella. Holotype M. C. Z. 1704.

Horizon and locality. Upper Cambrian, boulder A, Middle Ridge, Levis, Quebec.

Solenopleura laflammei, sp. nov. Plate 4, Fig. 2

Cephalon small, semicircular in outline, strongly elevated. The glabella is long, with a broadly rounded anterior margin, towards which it tapers. It is bordered by a strongly impressed dorsal furrow. The glabellar furrows, of which there are two pairs, all originate at the dorsal furrows; the posterior pair are deep and wide, curving

backwards and inwards, not quite reaching the neck furrow, their inner ends slightly nearer the dorsal furrows than the center of the glabella. The anterior pair are much shorter, but strongly impressed, deflected slightly backwards. The neck furrow is deep at the sides, shallow in the middle, the neck segment wide. There is a very narrow convex brim in front of the glabella, separated from the latter by the convergent dorsal furrows; beyond this is a narrow raised rim. The fixed cheeks are strongly elevated above the dorsal furrows, but gradually fall away laterally. Eye-lines are present. The position of the eyes is doubtful, probably distant from the glabella by half its width, and opposite a point just in advance of its center. The course of the facial suture behind the eye is sinuous, in front of the eye it cannot be seen, but it probably cuts the rim at a point in front of the eye or outside of such a point. The free cheeks are unknown. Thorax and pygidium unknown. Dimensions, length of cephalon 3.2 mm., width without free cheeks 5.6 mm., length of glabella without neck furrow 2 mm., width of glabella just in advance of the neck furrow 2 mm. Holotype M. C. Z. 1705.

Horizon and locality. Upper Cambrian, boulder X, collected by Marcou from the limestone conglomerates at Lévis, Quebec.

This species bears some resemblance to *S. affinis* (Walcott 1884, p. 54) but that species has a much wider brim and there are other minor differences.

Family *REMOPLEURIDÆ* Corda

Apatokephaloides inflatus Raymond

This is a very rare species in the Milton (Upper Cambrian) at Highgate Falls, Vermont. In our collections only one specimen has been recognized. It is a fragmentary cephalon, but the glabella is preserved entirely and is minutely pustulose all over. The glabella is 4 mm. long.

Horizon and locality. Upper Cambrian, boulder A, Middle Ridge, Lévis, Quebec.

Family *DIKELOCEPHALIDÆ* Miller

Dikelokephalina Brogger

Much uncertainty exists about the legitimate content of the genus Dikelokephalina. As originally defined by Brogger (1896, p. 16) the genus included the four species *Dikelocephalus dicraeurus* Ang., *D. furca* Salter (1886, p. 303) *D.* (*?*) *villebruni* Bergeron, and *Asaphelina barroisi* Mun. Chalm. and Berg. The new genus was based upon the characteristics of the pygidium solely. These enumerated briefly, are as follows: pygidium of pentagonal form, produced into two spines behind, between which the border is straight; the axial lobe long and narrow, but not reaching to the posterior border; the side lobes of the pygidium are flat and broad, with six or possibly more ribs on each side; there is a wide doublure. No whole specimens have been found. Salter provisionally assigned a cephalon to the pygidium which he described as *D. furca,* but that cephalon probably belongs to the new genus Richardsonella Raymond (1924), and not to Dikelokephalina. The only difference between the cephalon in question and Richardsonella is that the facial sutures in the former are incurved at their anterior end, while in the latter they are continued straight out from the eyes diagonally to the anterior margin of the cephalon. As no description accompanied the figure we do not know whether this is the actual condition in the specimen, or whether the sutures really run straight to the margin and have been snubbed off by attrition; this difficulty is not an imaginary one, as a perusal of the literature will show. The shape of the glabella, the glabella furrows, the brim with its row of pits and the wide rim, all point to the genus Richardsonia. This is very interesting, for that genus is as yet unknown outside of the Upper Cambrian of

North America. If it should prove to be present in the Tremadoc, which corresponds to the base of the Beekmantown on this continent, then it may indicate that part of the Upper Cambrian fauna of America migrated to Europe, giving rise to the Ceratopyge fauna there.

The cephalon of *D. dicraeura* Ang. figured by Moberg and Segerberg (1906, p. 90, pl. 5, fig. 12) certainly does not belong to the same genus as that figured by Salter. It is neither a Richardsonella nor a Dikelocephalus. Its position in Dikelokephalina is doubtful. Unless a whole specimen with either a known cephalon or pygidium can be found, mere matching up the heads and pygidia must remain guess work. If it should prove that neither of the cephala mentioned above belong to pygidia of Dikelokephalina, then that referred to *D. furca* must certainly fall into Richardsonella, whereas a new genus should be made for that now called *D. dicraeura*. The writer was led to look into this genus by finding a cephalon which is obviously congeneric with that of *D. dicraeura*, and which is described below.

Dikelokephalina broggeri, sp. nov. Plate 4, Fig. 3

The type and only specimen is an incomplete cephalon. The glabella is wide, the sides are somewhat rounded, converging towards the front, where the boundary between the glabella and the brim is practically obliterated. The glabella is not very wide at the front. It is moderately elevated. On each side of the central line and half way between that and the lateral border there are three depressions, representing the glabellar furrows. The anterior pair are practically circular, the other two pairs are longitudinal depressions, arranged nearly at right angles to the axis of the glabella but deflected slightly backwards and outwards. The occipital ring is not entirely preserved. The brim is wide, nearly as wide as the glabella is long, concave and smooth. The facial suture is inclined forwards from the eye at an angle of about 45°, recurving gently to bring it to the anterior margin of the brim. Eyes and free cheeks

unknown. Dimensions, glabella, length 4.5 mm., width at base 4 mm., width across anterior end 2.25 mm., width of brim 3.75 mm. Holotype M. C. Z. 1708.

Horizon and locality. Upper Cambrian, boulder D, Middle Ridge, Lévis, Quebec.

Osceolia brevifrons, sp. nov. Plate 4, Fig 4.

Caphalon small. Glabella sub-quadrate with the anterior corners rounded and the sides slightly concave, strongly elevated, rising sharply from the anterior brim. There are two pair of glabellar furrows, the anterior pair are faint, inclined backwards, each crossing one-third the width of the glabella; the posterior pair are strong, and together form a trans-glabellar furrow, the outer ends of which are inclined forwards, the middle being straight. There is a very narrow concave rim around the anterior end of the glabella. The eyes are large and situated opposite the middle portion of the glabella. Free cheeks not preserved. The whole surface is rough. Dimensions, glabella 3.6 mm. long, 3 mm. wide. Holotype M. C. Z 1709.

Horizon and locality. Upper Cambrian, boulder D, Middle Ridge, Lévis, Quebec.

No other has so constricted a rim in front. Most of the species have a rim in width about half that of the glabella. *S. fallax* Walcott (Supplementary Bibliography 1914, p. 378) from the Upper Cambrian of Texas, resembles this species somewhat, but it is a much larger form and has two trans-glabellar furrows.

Platycolpus marcoui, sp. nov. Plate 4, Fig. 5

Cephalon of medium size. Glabella quadrate, moderately elevated, somewhat contracted in the middle. The occipital furrow is well developed except at the ends where it is almost obliterated. Occipital ring wide in the middle and bears a small tubercle. There is a very narrow brim bordered by a high but narrow rim. The fixed cheeks are narrow and the small eyes are situated slightly in advance

of the middle of the glabella. The facial sutures are straight in front of the eyes, diverging slightly forwards. Dimensions of type, length of cephalon 11 mm., width of glabella at base 9. 5 mm. Holotype M. C. Z. 1710.

Horizon and locality. Upper Cambrian, boulder D, Middle Ridge, Lévis, Quebec.

This species somewhat resembles *P. capax* (*Billings*) but that species has no brim in front of the glabella, the latter is not contracted in the middle nor does the occipital furrow bear a tubercle. The eyes are smaller and more curved in the new species.

Bayfieldia, gen. nov.

This is proposed for opistoparian trilobites with a prominent, slightly tapering glabella either with very faint furrows or none, eyes close to the glabella and facial sutures proceeding straight forward from the eyes. Genotype, *Bayfieldia tumifrons,* sp. nov.

This genus is most nearly related to Lloydia Vogdes. It appears that the generic diagnosis given by Raymond (1913, p. 66) must be modified somewhat, for specimens of *Lloydia saffordi* (Billings), the genotype, have been found by Mr. J. H. Bradley showing the eyes, and these are large and distant from the glabella. Goniurus Raymond (1913, p. 65) has small eyes close to the glabella, but the latter narrows rapidly in front of the eyes, whereas the facial sutures diverge strongly in that direction. There are also minor differences in the neck furrow.

Bayfieldia tumifrons, sp. nov. Plate 4, Fig. 6

Cephalon of medium size. Glabella strongly elevated, surrounded on all sides by deep furrows to which its surface descends abruptly, especially toward the brim which it overhangs slightly. The sides converge towards the front, the anterior border is obtusely rounded; two pairs of faint glabellar furrows are present. The neck furrow is wide, the neck-ring but little elevated and wider than the glabella. The brim is depressed, with no raised rim. The eyes are

small, close to the glabella and situated opposite its middle. The anterior part of the facial sutures are parallel, the posterior parts are not preserved on our specimens. The whole surface is minutely pitted. Dimensions, length of cephalon 9.75 mm., of glabella 7 mm., width of glabella close to front 4.5 mm., at neck-ring 6 mm. Genoholotype M. C. Z. 1711.

Horizon and locality. Upper Cambrian, boulder A. Middle Ridge, Lévis, Quebec.

Bayfieldia finkelnburgi, sp. nov. Plate 4, Fig. 7

Several glabellæ of a species closely allied to B. *tumifrons* occur in a collection of Upper Cambrian fossils (St. Lawrence fauna) from Osceola Mills, Wis., made by W. A. Finkelnburg. They are associated with pygidia of *Ptychoparia binodosa* (Hall) (Supplementary Bibliography, 1863, p. 160) but it is very doubtful that they belong together. The glabellæ and free cheeks are remarkably smooth and lack any indication of spines or other irregularities, whereas the pygidium figured by Hall is extremely rugose, and probably was spiniferous. Inasmuch as the fauna is an abundant one and contains at least a score of identified species of trilobites, this association may well be considered fortuitous until a whole specimen be found. The pygidium in question must remain as Hall's species, but the cephalon undoubtedly belongs to the new genus described above. If it should be found that the pygidium and cephalon really belong together, then this new specific name will be dropped and the species will be known as *Bayfieldia binodosa* (Hall).

Description. Cephalon of medium size. The glabella is long, tapering forwards; the dorsal furrows are deep, straight, the anterior margin semicircular and strongly elevated, the neck furrow narrow, the occipital ring broad and nearly flat. There is a narrow brim in front of the glabella which is bordered by a strongly raised rim. The

eyes are rather small, situated very close to the glabella. The facial sutures curve sharply downwards and outwards from the eyes and are continued in an almost straight line to near the genal angle, where they are deflected downwards. In front of the eyes they are directed somewhat obliquely outwards until they reach the brim, when they curve abruptly inwards cutting obliquely across both brim and rim. The neck furrow is continuous across the whole cephalon. The inner surface of the free cheeks is ornamented with closely spaced small pits, but none of the exteriors of free cheeks or cranidia shows tubercles. Thorax and pygidium unknown. Dimensions, length of cephalon 13 mm., of glabella 8 mm., width of glabella across neck-ring 7 mm. Holotype M. C. Z. 1712.

Horizon and locality. St. Lawrence Formation, Upper Cambrian, Osceola Mills, Wisconson. Collected by W. A. Finkelnburg.

This species differs from *B. tumifrons* in having a slightly less swollen glabella, in the stightly divergent facial suture in front of the eye, and in the persistent neck furrow.

Order **PROPARIA** Beecher

Proparian trilobites were considered for a long time to have originated with the Ordovician. Within the last few years, however, several genera of proparian trilobites have been recognized from Cambrian rocks. A brief review of these seems to be not out of place here.

Family *MENOMONIDÆ* Wallcott

"Proparia of primative aspect with large, free cheeks, eyes small. Thorax with 23 to 42 segments pygidium small." Supplementary Bibliography, (Walcott, 1916, p. 161.) This includes the following genera:

Menomonia Walcott, U. Camb. of Wisconsin and Minnesota.

Millardia Walcott, U. Camb. of Wisconsin, Minnesota, Pennsylvania and Utah.

Dresbachia Walcott, U. Camb. of Wisconsin and Minnesota.

Family *NORWOODIAE* Walcott

"Proparia with 8 or 9 segments; strongly developed spines at genal angles; eyes small, but well developed." (Walcott, 1916, p. 168).

Norwoodia, Walcott, U. Camb of Tennessee, Alabama, Georgia and Utah.

Family *BURLINGIDÆ* Walcott

"Dorsal shield small, elongate, broad oval in outline. Cephalon about one-fourth the length, transversely semicircular, genal angle acute or spinose; glabella with transverse lobes. Free cheeks small, separate. Facial sutures cut the margin in front of the genal angles, extend into the posterior portions of the eyelobes and outward from the anterior portion to the anterolateral margin of the cephalon. Eyes of medium size, clearly defined.

"Thorax with fourteen segments in the one species preserving them; pleuræ with flat straight furrows.

"Pygidium large, with strong axis and pleural lobes, or small and with medium axis and pleural lobes." (Walcott, 1910, p. 14).

Burlingia Walcott, M. Camb. of British Columbia.

Schmalenseeia Moberg (1903, p. 93. See also Westergard 1922, p. 119) U. Camb. of Scandinavia.

To these families the writer is enabled to add a fourth based upon a cephalon discovered in the limestone conglomerates at Lévis. It is not of primitive aspect as most of the above trilobites have been considered, without, it seems, much reason, but save for the facial sutures, it is surprisingly like its congeners in general appearance.

Family *RAYMONDIDÆ*, nov.

Eyes large, far from the glabella, free cheeks, narrow and short. Genal angles rounded, or at least not produced

into long spines.

Genus **Raymondina** nov.

Glabella long, elevated, with narrow brim in front. Glabellar furrows in two pairs, the posterior pair forked, the main trunk either present or lost. Genotype, *Raymondina respecta,* sp. nov.

Raymondina respecta, sp. nov. Plate 4 Fig. 8

Cephalon small, complete save for the free cheeks, about twice as wide as long, semicircular in outline. The glabella is long, not tapering, rather strongly elevated. The neck furrow is wide and deep especially towards the dorsal furrow; its course is slightly concave forwards. The nuchal segment raised and wide, persistent, but diminishing in height laterally; in the middle it is as high as the glabella. There are two glabellar furrows present, one pair just in advance of the middle of the glabella, starting at the dorsal furrow, and directed straight across the glabella, each furrow extending about one-third the width. Behind these furrows there are two depressions on each side of the glabella which appear to represent the posterior gabellar furrows. The anterior of these are straight, parallel to the neck furrow, but short, the posterior are short, curved, directed diagonally across the corners of the glabella but contained within its borders. These two depressions are so directed that if extended towards the dorsal furrows they would meet before reaching the same. It appears as if they represent two divergent branches of a posterior furrow whose outer trunk has been lost. The dorsal furrows are deep and straight, parallel. The brim is narrow and concave, with a wider convex rim. The fixed cheeks are strongly raised near the glabella but laterally depressed. The palpebral lobes are large, situated opposite the forward third of the glabella and distant from the dorsal furrow about half the width of the glabella. The free cheeks are small, not connected in front. The facial

sutures begin on the rim in front of the eye, and proceed nearly straight backwards to the palpebral lobes, thence diagonally outward to the lateral margin which they reach about one third the length of the cephalon in advance of the genal angles. The neck furrow is continuous across the entire cephalon and joins an intramarginal furrow which extends anteriorly along the lateral margin of the fixed cheeks as far as the facial suture as a broad flat border. The occipital segment is broad at the genal angles, directed slightly backwards, but not produced into a spine; the genal angle is sharply rounded. The entire surface is covered with small granules with fewer pustules of larger size evenly scattered over the surface. Dimensions, length of cephalon 3 mm., of glabella exclusive of neck segment 2.2 mm., width of cephalon 4.5 mm., of glabella 1.75 mm. Genoholotype M. C. Z. 1716.

Horizon and locality. Upper Cambrian, boulder B, Middle Ridge, Lévis, Quebec.

III. THE FAUNA OF THE BEEKMANTOWN BOULDERS AND THE MATRIX OF THE LIMESTONE CONGLOMERATES OF THE LEVIS FORMATION

The writer's collection of fossils from the Beekmantown boulders of the Lévis conglomerates has not been productive of very novel results. No new species have been found, but several individual boulders with their faunas are listed in Appendix A. This is the most satisfactory way to arrive at the composition of the fauna of the Beekmantown limestone from which they were derived. In the list of species given below I have included not only those in boulders with known Beekmantown species, but also a great many listed by Bassler (1915, pp. 1441-2) as "Ozarkian." The association of many of the latter in boulders of

proved Beekmantown age necessitates the change, and the remainder have a much closer relationship to Beekmantown species than to others.

Of the sixty species in the list ten are common to Lévis and Phillipsburg, seven occur in Newfoundland, four in Cape Breton and one in Great Britain. In addition to the ten species common to Lévis and Phillipsburg there are a great many forms at the two localities which are very closely related, and there are but a very few genera which are not found at both localities. All the evidence points to a connection between the two places, and in fact, there was probably a continuous belt of limestone from one to the other. It is probable, too, that the Newfoundland strata were formed in the same sea, but the evidence is less satisfactory for Cape Breton. There does not appear to have been open connection with the European basins, for only one species, *Siphonotreta micula* M'Coy occurs on the other side of the Atlantic.

There remains to be done the very important work of careful collecting from the large masses of limestone of localities L, M, and K. Their fauna, isolated from that of the Beekmantown boulders, appears to be of a slightly younger type. The whole Beekmantown fauna seems to be composed of two units, one with Nileus, Symphsurus, Megalaspis and Pilekia, somewhat older than the remainder. It is unwise to attempt any subdivision of the whole assemblage until such time as careful and detailed collecting can be more accurately recorded.

Early in the discussion of the age of the Lévis fauna Billings (1861, p. 315) presented a table showing the species common to Lévis and Phillipsburg, and concluded that "the upper limestone at Phillipsburg must be on the same geological horizon, very nearly, as that of limestone No. 2 of Point Levi." Later Walcott issued a more explicit statement after he had recognized real Beekmantown fossils in the matrix of band 3 at Lévis. "With these exact data I

was enabled, at once, to correlate the lower belt of limestone [band 3] and conglomerates with the central band of the Phillipsburg section, where an identical fauna occurs 1000 to 1110 feet above the recognized Potsdam sandstone" (1890, p. 112).

This correlation, though sound enough, is unsatisfactory in one respect. We are by no means certain of the exact stratigraphic position of the Phillipsburg section. Now that I have been able to demonstrate the exact position of the limestone bands with respect to the graptolitic shale series, the tables are turned, and we may use the Lévis formation to reassign the Phillipsburg rocks to their correct position.

Logan's section of the rocks at Phillipsburg, which has not been greatly modified, is given below in a much condensed form. The thickness of the division is given in feet.

	D	
3.	Gray and black slates	1500
2.	Black and green slates with limestone conglomerates	1000
1.	Black limestone conglomerates composed chiefly of the ruins of the limestone of C1.	300
	C	
2.	Black slates and thin-bedded limestones	170
1.	Black and dark gray pure limestone. "The fossils are several undescribed species of *Murchisonia* and *Pleurotomaria, Ecculiomphalus Canadensis, E. intortus, E. spiralis,* several undescribed species of *Orthoceras,* and one of *Nautilus.*" (p. 845)	150
	B	
5.	Black massive limestones	350
4.	Black thin-bedded limestones	300
3.	Dark gray and black limestone. "These beds are very fossiliferous, and contain, among other	

genera, *Orthis, Orthisina, Cameralla, Maclurea. Ophileta, Ecculiomphalus, Pleurotomaria, Murchisonia, Holopea, Metoptoma, Orthoceras, Cyrtoceras, Nautilus, Amphion, Bathyurus,* and *Dikelocephalus.* The described species are *Orthis Electra, Camerella calcifera, Maclurea matutina, Ophileta sordida, O. levata, O. complanata,, Ecculiomphalus Canadensis, E. intortus, E. spiralis, Lituites Farnsworthi, Amphion Salteri,* and *Bathyurus Saffordi"* (p. 278). ---------- 150

2. Dark gray and black limestones---------- 120
1. White and dove-gray pure limestones---------- 120

A

3. Reddish gray and black limestones---------- 200
2. White and dove-gray pure limestones---------- 100
1. Dark gray and yellowish dolomites---------- 400

? Upper Cambrian.

If, now, we can definitely correlate band 3 at Lévis with division B3 at Phillipsburg we may be on the road to a much fuller understanding of the Beekmantown series in North America.

LIST OF SPECIES

SPONGIÆ

Calathium pannosum Billings

BRACHIOPODS

Lingulella iris (Billings)
Elkania ida (Billings)
Siphonotreta (?) *micula* M'Coy
Acrotreta ovalis Walcott
Hebertella battis (Billings)
Orthis (?) *apicalis* Billings

O. (?) *eudocia* Billings
O. everyone Billings
O. hippolyte Billings
O. (?) *mycale* Billings
O. panderiana Hall & Clarks
O. (?) *tritonia* Billings
Dalmanella electra (Billings)
D. evadne (Billings)
Leptella decipiens (Billings)
L. sordida (Billings)
Orthidium gemmicula (Billings)
Syntrophia arachne (Billings)
S. arethusa (Billings)
S. calcifera (Billings)

GASTEROPODS

Metoptoma? anomala Billings
M.? augusta Billings
M. melissa Billings
Palæacmæa orphyne (Billings)
P.? quebecensis (Billings)
Scenella? venillia (Billings)
Tryblidum hyrie (Billings)
Lophospira jessica (Billings)
Murchisonia? sylvia Billings
Pleurotomaria postumia Billings
P. rotundispira Billings
P. (*Euconia?*) *quebecensis* Billings
P. (*Eccyliomphalus?*) *vagrans* Billings
Seelya cassandra (Billings)
Ophileta profunda Billings
O. abdita (Billings)
O. complanata Vanuxem
Helicotoma miser Billings
Eccyliomphalus canadensis (Billings)
E. intortus (Billings)
Cyclonema phædra Billings

Fusispira psyche (Billings)
Cliospira curiosa Billings

CEPHALOPODS

Cyrtoceras dictys Billings
C. alethes Billings
C. quebecense Whiteaves
C. surgens Barrande
Cyrtocerina mercurius Billings
Eremoceras syphax (Billings)
Mælonoceras metellus (Billings)
Orthoceras autolycus Billings

TRILOBITES

Solenopleuridae

Hystricurus cordai (Billings)

Bathyuridae

Bathyurus arcuatus Billings
Bathyurellus formosus (Billings)

Asaphiscidae

Lloydia saffordi (Billings)
L. bituberculatus (Billings)
L. strenuus (Billings)

Asaphidae

Megalaspis goniurus (Billings)
Nileus affinis (Billings)
Symphysurus illænoides (Billings)

Fam. Undet.

Leiostegium quadratum (Billings)
Goniurus perspicator (Billings)

Cheiruridae

Pilekia apollo (Billings)
P. eryx (Billings)

P. (*?*) *solitaria* (Billings)

BRANCHIOPODS

Eopteria? ornata Billings

IV. THE FAUNA OF THE SILLERY FORMATION

One reason for the uncertainty regarding the stratigraphic position of the Sillery formation in the minds of the earlier writers is the great scarcity of fossils in those rocks. Throughout the greater part of the formation there are no fossils at all; wherever fossils have been found they are restricted to thin layers, and these only in limited exposures, with little or no chance for one to determine the relation of the fossiliferous horizons to the rest of the Sillery or to the Lévis.

Logan in 1863 mentioned having found three fossils in the Sillery, specimens of the genus Lingula and one of Obolella. Billings had previously (1862) described the later as *O. pretiosa,* citing two localities, the Grand Trunk bridge across the Chaudière and the slates at Cap Rouge. The small *Lingula* was not well enough preserved to be described, but better specimens were later described by Walcott as *Lingulella ellsi.* Ells enlarged the number of Sillery species considerably by listing the following from the St. Joseph shore of the St. Lawrence:

Tetragraptus serra (Brogn.)
Didymograptus extensus (Hall)
Obelella, probably O. pretiosa Billings
Obelella, sp.

This curious mingling of Lévis fossils with *O. pretiosa* indicates that either the latter is not confined to the Sillery, or that there is no sharp dividing line between the two formations. The latter is more likely to be the case. On the same page Ells gives other lists from nearby localities,

but they are all typical Lévis assemblages and represent the lower Lévis strata infolded with the Sillery. On page 57K Ells states that " at the raiway bridge on the Chaudière . . . . the interstratified beds of black and green shale contain abundance of *Obolella pretiosa,* with *Protospongia fenestrata, Lingula,* and two species of *Phyllograptus."* O. pretiosa* is also mentioned as occurring below the Sillery church. Ells also mentions *O. pretiosa* in association with *Tetragraptus* cf. *headi, Clonograptus rigidus* and *C. flexilis,* but the statement of the precise locality is ambiguous. From St. Michel de Bellechasse Ells (66K)) lists the following:

Dichograptus ramulus Hall
Dendrograptus, sp.
Dawsonia, sp.
Obolella desiderata? Billings
O. pretiosa Billings
Acrotreta, sp.

Ells has also reported this species from several other localities associated with fossils characteristic of the Tetragraptus and Phyllograptus zones. Weston is reported as havfound it near St. Gervais associated with crinoid (?) stems.

From the above observations it seems inadvisable to call *Acrothele pretiosa* a guide fossil to the Sillery, unless it occurs practically alone and abundantly. When we consider that this species occurs locally in great abundance in the Sillery proper, and that at other places it has been reported from localities mingled with forms belonging to the lower horizons of the Lévis, and also that in their fuller development these Tetragraptus-Phyllograptus faunas do not contain *Acrothele pretiosa,* there seems to be no escape from the conclusion that the Sillery and Lévis formations have no sharp dividing faunal line between them.

*J. W. Dawson (1888. p. 58) states that the sponge spicules from this locality more closely resemble those of *P. tetranema* Dawson.

BRACHIOPODA

Order **ATREMATA** Beecher

Family *OBOLIDÆ* King

Lingulella ellsi Walcott

Obolus (L.) ellsi Walcott, 1899, p. 402.

Linguella ellsi Walcott, 1912, p. 495, pl. 19, figs. 3, 3 a-c.

In our collection from the shales of the cliff just two miles south of the Lévis railroad station there is a single individual of this species.

Order **NEOTREMATA** Beecher

Family *ACROTRETIDÆ* Schuhert

Acrothele pretiosa (Billings)

Obelella pretiosa Billings, 1862, p. 68, fig. 61.

Acrothele pretiosa Walcott, 1898, p. 402; 1912, p. 652, pl. 58, figs. 1, 1 a-g.

The writer has collected this fossil in great numbers from two localities, in the black shale of the cliff just below the church at Sillery, and in similar shales in the cliff two miles south of Lévis. Most of the specimens from these localities are well preserved, but show no essential difference from those figured by Walcott, which are for the most part distorted. The elevation of the valves is hardly noticeable in most adult specimens even when there is no sign of crushing. In younger specimens elevation of the shell is about one sixth its length. The beak is scarcely ever noticeably eccentric. The largest specimens are 7 mm. wide.

V—THE FAUNA OF THE LEVIS SHALES

For three quarters of a century interest in the Lévis shales has been concentrated on their graptolitic content. This interest has been thoroughly deserved and as a result Lévis has become the type locality for two score species of graptolites, and indeed for the Lévis fauna now so widely recognized all over the world. As far as the graptolites are concerned we may reasonably expect only slight advance in knowledge from time to time, but it is the writer's opinion that the balance of the fauna will become of increasing importance as time goes on.

Logan and Billings were able to recognize only four species from the shales other than the graptolites. These are *Lngulella irene, Lingula quebecensis, Elkania desiderata,* and *Shumardia granulosa.** A Tetradium, an undescribed Strophomena, and *Orthis quebecensis undescribed* are also listed. Raymond (1914, pp. 529-530) increased this small number to thirteen, and the present writer has been able to expand it to forty-three, of which total twenty-six are new species. The most notable increases have been six species of Conodonts, not previously reported from these rocks,twelve new species of brachiopods and four of trilobites. The progress of the expansion of the fauna may best be represented by the following table.

*This last species occurs exclusively in the Shumardia limestone, band A of Logan's map. It was listed from band 1 on page 864 of the Geology of Canada, but this was doubtless a typographical error.

	Logan and Billings 1863	Total up to and including Raymond, 1924	Writer's collection, 1923	New species herein described
Graptolites	51	74	86	4
Conodonts	—	—	6	6
Serpulites	—	—	1	1
Cystids	—	—	1	1
Brachiopods	3	6	18	12
Gasteropods	—	—	1	1
Trilobites	1	5	13	4
Phyllocarids	—	2	2	—
Cirripedes	—	—	1	1
Totals	55	87	129	30

There are four new genera in the collection, two of graptolites, and one each of cystids and trilobites. The Conodonts, Serpulites and the gasteropod Conularia have not been previously reported in North America from rocks as old as the Lévis formation.

Systematic collecting from the shales was first attempted by the Canadian Survey and the material described by Lapworth. The stratigraphic succession was first worked out in 1914 by Dr. Raymond, who established, by means of graptolites a definite series of faunal zones through a thickness of some 600 feet, and demonstrated that the task of unravelling the complicated structure of the Lévis rocks was not altogether hopeless. Until this important step was taken no attempt had been made to use the shales as a key to the structure, except to a limited degree by Ells, but such good results as might have been achieved by him were spoiled by his mistaken assumption that every outcrop of red shale meant an anticline of Sillery

rocks. Probably all subsequent progress in this perplexing problem will come from a study of the shales. It appears now that little more knowledge of the structure can be obtained from a study of the limestone conglomerates, although many vexatious questions in paleontology and stratigraphy may eventually owe their solution in part at least to that source.

For many years but two localities for graptolites were exploited at Lévis, one at the railroad cut (locality G of map) and another in the shales of the cliffs behind the foundry (localities E and D). Hall did not keep the two faunas separate, and it is only by means of the association of species upon slabs that we are able to place his graptolites in the modern stratigraphic sequence. Lapworth did better, but achieved only the very broadest results. Gurley succeeded in recognizing three zones, and it is to be regretted that he did not carry out his intended survey of the North American graptolites. Ells very properly listed the fauna of the shales at a dozen points, some of them inland from the cliff. Raymond was enabled by meticulously accurate collecting along the cliff faces of the Lévis shore to demonstrate that the same zonal arrangement of graptolites which had been previously recognized in Europe and more recently in North America by Ruedemann (1902) was present also at Lévis. The importance of this single step can scarcely be overemphasized for all stratigraphers concede the superiority of graptolites as horizon markers over all their congeners. Ruedemann had previously (1902, p. 559) expressed the opinion that the stratigraphic conditions at Lévis did not justify the subdivision of the Lévis into faunal zones, and this opinion would doubtless have been prevalent today had not Raymond's detailed survey of the shale beds produced such satisfactory results. Dr. Raymond's own account of the section is as follows:

"The best section is in the bluff which faces up the river about one-half mile below the station at Lévis, at the point

where the street car line climbs to the upper level. It is known locally as Begin's Hill. On this bluff about three hundred feet of strata are exposed, all dipping steeply to the southeast. The following is the section, beginning at a layer of conglomerate exposed, in the river at low tide.

SECTION AT BEGIN'S HILL

1.	Massive conglomerate with large pebbles of limestone and sandstone. The matrix is largely limestone, but with abundant rounded sand grains. The whole mass weathers to a rusty yellow color	12 ft.	12 ft.
2.	Shale, mostly concealed by the river and railroad tracks about	100 ft.	112 ft.
3.	Hard, dark gray to black shale, some bands of which weather to a rusty yellow	60 ft.	172 ft.
4.	Thin-bedded rather blacker shales with undeterminable fragments of graptolites all through. Good specimens of *Didymograptus nitidus* and others have been found seven feet below the top	49 ft.	221 ft.
5.	Thin-bedded limestone with shale partings. *Didymograptus similis* and minute trilobites and ostracods	11 ft.	232 ft.
6.	Hard, dark green clay shale. No fossils seen	9 ft.	241 ft.
7.	Banded green and gray shale with very numerous graptolites and brachiopods. The most fossiliferous layer is seventeen feet above the top of No. 5. Lowest bed with *Didymograptus bifidus*	19 ft.	260 ft.
8.	Dark gray shale band	6 ft.	266 ft.
9.	Similar shale, weathering yellow. Contains graptolites. *Didymograptus bifidus* (90° variety) and *Phyllograptus anna* being most characteristic	3 ft.	269 ft.

10.	Dark gray shale	9 ft.	278 ft.
11.	Similar shale weathering yellow Graptolites present. Top of range of *D. bifidus*	4 ft.	282 ft.
12.	Alternating bands of shale which weathers gray or yellow. No fossils seen	51 ft.	333 ft.
13.	Limestone conglomerates, 4 inches		
14.	Dark shale above, and yellow weathering shale with *Tetragraptus serra* below	12 ft.	345 ft.
15.	Limestone conglomerate with 4 inches quartz sand at top	4 ft.	349 ft.
16.	Dark gray shale	30 ft.	379 ft.
17.	Thin-bedded limestone without fossils	3 ft.	382 ft.
18.	Dark gray shale	12 ft.	394 ft.
19.	Thin-bedded limestone with a bed of conglomerate at top and bottom. Zone of *Shumardia granulosa* and *Diplograptus dentatus*	14 ft.	408 ft.
20.	Dark shale, weathering yellow.	14 ft.	422 ft.

. . . . . .

Top of bluff

"About half way between Begin's Hill and the railroad station at Lévis there is a flight of steps by which one may ascend to the upper part of the town. At the base of these steps, at the right hand side of them as one faces the bluff, one may see thin-bedded, light gray limestone, and at the left hard green shale with thin black seams. This limestone contains *Shumardia granulosa,* and the shale above it is full of *Diplograptus dentatus, Climacograptus,* etc., showing that these are the same strata as those at the top of the bluff at Begin's Hill. These strata can be traced in the face of the bluff into well-known anticline on Davidson Street, where one finds the following section, showing the strata above the top of the section on Begin's Hill:

Section above anticline on Davidson Street. (Numbers and measurements continuous with the preceding.)

19.	Thin-bedded limestone, some conglomerate, and shale partings. *Shumardia granulosa* and other characteristic fossils present	30 ft.	---
20.	Interstratified limestone and shale, the shale carrying graptolites, *Diplograptus dentatus* being abundant and characteristic	49 ft.	457 ft.
21.	Hard black and gray shale	80 ft.	537 ft.
22.	Concealed	20 ft.	557 ft.
23.	Red and green shale	10 ft.	567 ft.
24.	Limestone conglomerate with large limestone pebbles	10 ft.	577 ft.
25.	Red shale	15 ft.	592 ft.

"It will be noted that the lower part of the section at Begin's Hill is concealed by the river and the railroad. It is possible, however, to trace the rusty conglomerate, which in this section is numbered 1, for a half-mile north along the railroad, to a small cutting, which may easily be recognized, as it is the only one in this vicinity in which there is a shale on both sides of the track. The rusty conglomerate is not continuous through this half-mile, but is, as is explained by the writer in Guide Book No. 1 of Excursion A1 of the 11th International Geological Congress, twice faulted and pushed to the south. That it is the same conglomerate seems, however, to be quite certain, as it has peculiar lithological characters not shared by the other conglomerates of the region.

"In the small cutting above referred to and about 20 feet above the rusty conglomerate, is a fine-grained black shale which contains many beautifully preserved specimens of a few species of graptolites. *Clonograptus flexilis* and *C. rigidus* are the most important species. About 30 feet higher in the section is a hard dark gray shale, in which the long form of *Phyllograptus typus* is particularly abundant. Only a few other species have been found in this zone.

. . . . . .

"The sections given above show that fossils are distributed through a thickness of nearly 500 feet of strata at

Lévis, and that four faunules may be recognized, the lower two confined apparently to a very narrow vertical range, while the upper two range through a (relatively) considerable thickness of strata and are capable of division into subfaunules. For the convenience of the subjoined table, these zones may be known as A, B, C, and D.

" A is the lowest zone with *Clonograptus flexilis* and *C. rigidus, Tetragraptus quadribrachiatus, T. serra* and *T. approximatus.*

"B is the next higher zone with *Phyllograptus typus, Tetragraptus quadribrachiatus* and *Dichograptus octobrachiatus.*

"C is the *Didymograptus* zone, which may be subdivided into three sub-zones:

"C1, the lowest, is characterized by horizontal species of *Didymograptus,* such as *D. nitidus* and *D. gracilis.*

"C2, the next higher, contains *D. bifidus* in abundance.

"C3 is a thin zone containing that variety of *D. bifidus* in which the two branches are at an angle of about 90°.

"D is the highest zone, characterized by *Diplograptus dentatus* and other Diplograptids. It may be sub-divided into two zones, the lower one being that in which the strata are mostly limestone, and the upper in which the strata are shale. The total range of *D. dentatus* on Davidson Street is about 80 feet.

"D1 is the lower sub-zone with *Shumardia granulosa,* other tribolites, brachiopods, and a great abundance of *Dictyonema.*

"D2 is the upper one, with numerous graptolites, *Diplograptus dentatus, Cryptograptus antennarius,* and *Climacograptus pungens* being especially abundant" (Raymond 1914).

Ruedemann (1902, p. 547) makes three chief zones at Deep Kill, N. Y., with subdivisions. These are as follows:

a. Zone with *Diplograptus dentatus* and *Cryptograptus antennarius,* beds 6 and 7.

b. Zone with *Didymograptus bifidus* and *Phyllograptus anna*, beds 3 and 5.

c. Zone with Tetragraptus, beds 1 and 2.

Elles and Wood (1914, p. 526) give the following zones for the distribution for the British graptolites:

7. *Didymograptus murchisoni*
6. *Didymograptus bifidus*
5. *Didymograptus hirundo*
4. *Didymograptus extensus*
3. *Dichograptus*
2. *Bryograptus*
1. *Dictyonema*

In all they give thirty zones, but the above list includes those that are the equivalent of the Lévis beds. The first two are referred by those authors to the Cambrian and the seventh is generally accepted as the basis of the middle Ordovician. It should be stated that the genus Tetragraptus, which is not used by these authors to designate any particular zone, is characteristic of zones 3, 4, and 5, and especially so of zone 4.

For a detailed correlation table of the graptolite zones of the world the reader is referred to Ruedemann's monograph of 1914. A brief comparative table of the classifications of Raymond, Ruedemann, and Elles and Wood is inserted below:

Raymond Lévis, Que.	Ruedemann Deep Kill, N. Y.	Elles and Wood Great Britain
D 2	Bed 7	
		Zone 6
D 1	6	
C 3	5	
		5
C 2	3	
C 1	2	
		4
B	1	
A	-	3

Dictyonema flabelliforme

Even a casual glance at the various detailed tables of stratigraphic distribution of graptoliteswill show that there is a general concurrence of ranges in all parts of the world. It has been claimed that this synchronism can be applied without fail to individual species, but unfortunately the rule breaks down, as is so often the case, when applied to details. For instance if we examine the ranges of *Didymograptus bifidus, Tetragraptus quadribrachiatus* and *Phyllograptus typus,* we may mark glaring inconsistencies. These species are so well known and so easily indentificable that the lack of harmony in their ranges cannot be laid to the door of careless observation. In the first place, *D. bifidus* occurs in Great Britain in but one zone, that with Climactograptus, Diplograptus, Dicellograptus, Cryptograptus and Trigonograptus. At both Lévis and Deep Kill, N. Y., *D. bifidus* is never found associated with those genera, but always below them. *T. quadribrachiatus* occurs practically throughout the Lévis shales, though especially abundant in the lowest zone. At Deep Kill this species does not occur in the basal beds of the Tetragraptus zone but is very common in the upper Tetragraptus beds. In Great Britain it has approximately the same range as at Lévis. *P. typhus* occurs at Lévis exclusively in Zone B, which should properly be the very base of the Tetragraptus zone. *P.* cf. *typus* is found in Great Britain in zones 5 and 6. At Deep Kill it is common throughout the Didymograptus zone. These inharmonies are accentuated by the fact that these species have all been used as zonal markers; they may serve as warnings against too meticulous subdivision of zones. Certain species range practically throughout the Lévis section and so of course cannot be used as zonal guides at all. The following are a few such species:

Dichograptus octobrachiatus
Tetragraptus fruticosus
T. quadribrachiatus

T. serra
T. similis
Didymograptus nitidus
Phyllograptus ilicifolius
P. anna
P. angustifolius

If we are going to use species as the basis of zonal subdivision it is obvious that our path will be beset with difficulties. The increase in knowledge of the graptolites at Lévis has shown that it is becoming increasingly difficult to limit some of the diagnostic species to narrow zones. The folly of trusting merely to the abundance of a certain species in a certain layer as a horizon marker should be evident to everyone. Such a condition is more likely to be a result of the prevalent local physical conditions than of anything else. Apparently we must depend more and more upon the association of species. At Lévis, the lowest zone is characterized by species of Clonograptus, which even by themselves are sufficient to indicate this lower zone; in addition there are *Tetragraptus approximatus* and *Calamograptus porrectus*, neither of which occurs elsewhere. The most abundant species of this zone however, is *T. quadribrachiatus*, which extends practically throughout the whole Lévis section. We must depend, therefore, upon Clonograptus and the two associated species as guides to this lowest zone. The highest zone contains species of Climacograptus, Cryptograptus, Diplograptus, Trigonograptus, Glossograptus and Retiograptus. With these highly diagnostic genera are associated *Dendrograptus succulentus, Dictyonema rectilineatum, Didymograptus forcipiformis, Isograptus caduceus, I. nanus, and Anomalograptus reliquus* all of which are confined to this upper zone. Thus it appears tolerably easy to recognize the bottom of the series and the top by guide fossils. The great thickness in between, however is characterized by a preponderance of species of Tetragraptus in its lower part and of Didymograptus in its upper part. These genera are, however, so abundantly distributed

throughout that it does not seem advisable to split this middle ground up into two zones. Of the Dichograptidæ not a single species is absolutely characteristic of either Raymond's C1, C2, or C3, except *Didymograptus arcuatus*, an extremely rare form, and the 90° variety of *D. bifidus*, which may be merely a special condition of *D. bifidus* dependent upon preservation, or rather of accumulation. C1 contains many species of Dendrograptus and Ptilograptus not so far known from C2 or C3, but most of the species are known from A or D. *Thamnograptus anna* is confined to C2. It might be possible to subdivide zone C into sub-zones upon the basis of combinations of species, but that implies the absence of other species, and the next collection may show their presence. We are usually dependent upon the zeal and accuracy of the collector, and it is always likely that the later collections will be more detailed as far as zonal collecting goes than the earlier ones. In this case it is far better to avoid misapprehension, if not actual mistakes, by calling this intermediate zone the "Tetragraptus-Didymograptus zone." Dr. Raymond was justified in subdividing the zone C upon the basis of the collections then at hand. Subsequent collecting has demonstrated, however, that there is practically no faunal distinction between the three divisions. There are, as mentioned above, more species of Tetragraptus in the lower part and of Didymograptus in the upper part, but it would be indiscreet, to say the least, to use that as a criterion in regard to a specific bed. The sub-zones are retained in the accompanying table merely for completeness. It is a troublesome problem to know what to do with the upper zone in the railroad cut just above the Clonograptus zone. It certainly should not be included with the latter. It is probably a special phase of the Tetragraptus zone and will be included in that zone in the accompanying table. Because of the great abundance of Tetragraptus in the zone below it does not appear that one may appropriately in-

troduce a zone between it and the true Tetragraptus zone above. For the sake of completeness and also of starting *at* the starting point the tabulated sequence of strata presented below begins with the Dictyonema beds of Deep Kill, N. Y., Cap Rosier, Que., and St. John, N. B. These are the lowest known graptolite beds on the North American continent and are homotaxial with the oldest elsewhere. There is no intermediate zone between them and the Clonograptus zone on this continent, but in Great Britain there is a Bryograptus zone which might belong to our Dictyonema zone, or even to our higher zones, for Bryograptus is fairly abundant up to the top of the Tetragraptus zone.

In general, then, the graptolitic shales at Lévis may be divided into four main zones, as follows:

D *Diplograptus dentatus zone.*
C Tetragraptus-Didymograptus zone.
B Clonograptus zone.
A *Dictyonema flabelliforme* zone of Cap Rosier, etc.

The elaboration of this scheme of zones is given in the accompanying table.

Table showing the succession of the graptolitic zones at Lévis, including the lowest beds at Deep Kill, N. Y.

D2	Thin black shales Davidson Street. Localities A, B.	200	*Diplograptus dentatus* *Climacograptus pungens* *Cryptograptus antennarius* *Trigonograptus ensiformis* *Glossograptus* sp. *Retiograptus tentaculatus*	D2
D1	Shumardia ls. Cliff at Lévis	25	*Shumardia granulosa* *Lingulella raymondi* Abundance of Dictyonema Dendrograptus, Callograptus	D1
C4	Thick and thin-bedded shale. Fossils scarce. Begin's Hill.	128	Didymograptus abundant (D. bifidus, 90° var.) Tetragraptus scarce	C3
C3	Thick and thin-	25	Abundant brachiopods	C2

	bedded shale. Fossil's abundant. Begin's Hill.		Didymograptus more abundant than Tetragraptus	
C2	Thick and thin-bedded shale. Fossils scarce. Begin's Hill.	150	Tetragraptus slightly more abundant than Didymograptus.	C1
C1	Thick-bedded shale. R. R. cut ½ mile north of Lévis.	5-10	*Phyllograptus typus.*	
B	Thin-bedded shale. R. R. cut ½ mile north of Lévis. Localities K, M.	50?	*Clonograptus flexilis* *Tetragraptus approximatus* *Calamograptus porrectus.*	
A	Shale beds at Deep Kill, N. Y.		*Dictyonema flabellforme* *Staurograptus dichotomus*	

List of species identified from the Lévis shales.

GRAPTOLITES

Callograptus diffusus (Hall)
C. elegans Hall
C. salteri Hall
Desmograptus cancellatus (Hopkinson)
Dendrograptus divergens Hall
D. erectus Hall
D. flexuosus Hall
D. fruticosus Hall
D. gracilis Hall
D. striatus Hall
D. (?) *succulentus* Ruedemann
Dictyonema furciferum Ruedemann
D. grande Nicholson
D. irregulare Hall
D. murrayi Hall
D. perexile Gurley
D. quadrangulare (Hall)
D. rectilineatum Ruedemann
D. robusta Hall
Ptilograptus geinitzianus Hall
P. plumosus Hall
Thamnograptus anna Hall

Clonograptus abnormis (Hall)
C. flexilis (Hall)
C. milesi (Hall)
C. remotus (Gurley)
C. rigidus (Hall)
Dichograptus octonarius (Hall)
D. octobrachiatus (Hall)
D. tenuis, sp. nov.
Anomalograptus reliquus, gen. et sp. nov.
Loganograptus logani (Hall)
Bryograptus pusillus Ruedemann
Tetragraptus acanthonotus Gurley
T. alatus (Hall)
T. amii (Lapworth)
T. approximatus (Nicholson)
T. crucifer (Hall)
T. denticulatus (Hall)
T. echinatus, sp. nov.
T. fruticosus (Hall)
T. headi (Hall)
T. pendens Elles
T. quadribrachiatus (Hall)
T. serra (Brogniart)
T. similis (Hall)
Didymograptus arcuatus (Hall)
D. bifidus (Hall)
D. bipunctatus Gurley
D. caduceus nanus Ruedemann
D. extensus (Hall)
D. extenuatus (Hall)
D. forcipiformis Ruedemann
D. furcillatus Lapworth
D. gracillis Tornquist
D. indentus (Hall)
D. nitidus (Hall)
D. patulus (Hall)
D. pennatulus (Hall)
D. similis (Hall)
Phyllograptus anna Hall
P. angustifolius Hall
P. typus Hall
P. ilicifolius Hall

Goniograptus geometricus Ruedemann
G. perflexilis Ruedemann
G. thureaui McCoy
Temnograptus ramulus (Hall)
T. noveboracensis Ruedemann
Hologratus richardsoni (Hall)
Calamograptus porrectus, gen. et sp. nov.
Leptograptus macrotheca Gurley
Climacograptus pungens Ruedemann
Sigmagraptus praecursor Ruedemann
Cryptograptus (?) antennarius (Hall)
Diplograptus dentatus (Brogniart)
D. inutilis Hall
Trigonograptus ensiformis (Hall)
Glossograptus echinatus Ruedemann
G. ciliatus Emmons
G. hystrix Ruedemann
Retiograptus tentaculatus (Hall)
Dawsonia monodon Gurley
D. acuminata Nicholson
D. tenuistriata Nicholson
D. tridens Gurley

VERMES (?)

Prioniodus tigris, sp. nov.
P. lelaps, sp. nov.
P. dorceus, sp. nov.
P. theron, sp. nov.
P. melampus, sp. nov.
P. pamphagus
Polygnathus argos, sp. nov.
Serpulites conflexus, sp. nov.

CYSTIDS

Aenigmatocystis brisa, gen. et sp. nov.

BRACHIOPODS

Elkania desiderata (Billings)
Lingulella irene (Billings)
L. raymondi, sp. nov.
Leptobolus incultus, sp. nov.
Paterula westoni, sp. nov.
Lingula quebecensis Billings
Acrothele pretiosa (Billings)
A. rotunda (Nicholson)

A. levisensis Walcott
Acrotreta polita, sp. nov.
A. scarabeus, sp. nov.
Linnarssonella zoar, sp. nov.
Eunoa vicina, sp. nov.
Eoorthis bayfieldi, sp. nov.
E. baddeleyi, sp. nov.
E. bigsbyi, sp. nov.
Leptella exigua, sp. nov.

GASTEROPODS

Conularia pristina, sp. nov.

TRILOBITES

Peronopsis barrandei Clark
P. marcoui Clark
Shumardia granulosa Billings
Endymionia meeki (Billings)
Saleneceme propinqua, gen. et sp. nov.
Ampyx, sp. ind.
Holometopus engelini Billings
Aracnubus subclavatus (Billings)
Triarthrus belli Matthew
T. cf. *angelini* (Linnarsson)
Blountia piluloides, sp. nov.
Symphysurus (*?*) *elongatus* Moberg & Segerberg
Telephus, sp. ind.
Boeckia descensus, sp. nov.

PHYLLOCARIDS

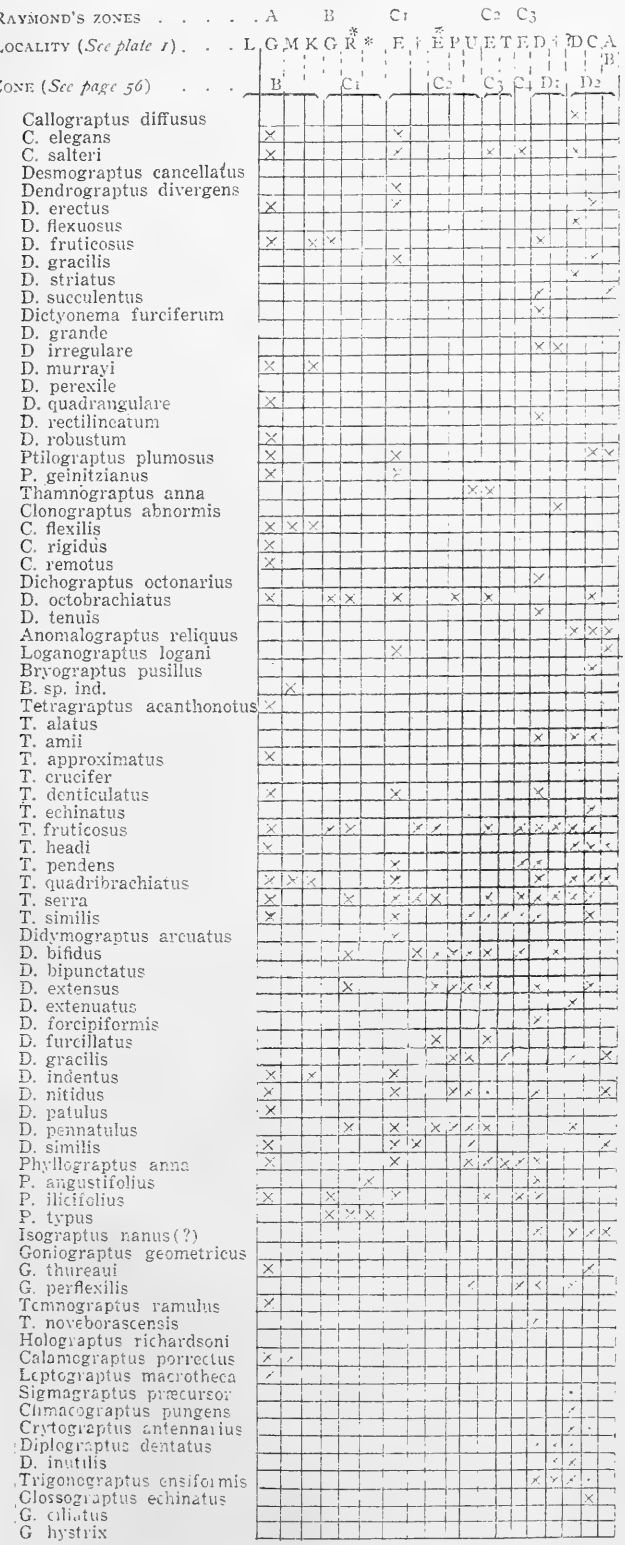
Caryocaris curvilatus Gurley
C. oblongus Gurley

CIRRIPEDES

Plumulites mobergi, sp. nov.

TABLE

Showing known ranges of Graptolites at Lévis; compiled from Gurley, Ells, Raymond and the writer's collection; * refers to lists in Ells, 1888; † refers to Gurley, 1896.



DESCRIPTION OF SPECIES

COELENTERATA

Class GRAPTOLITOIDEA Lapworth

Order **GRAPTOLOIDEA** Lapworth

Family *DICHOGRAPTIDÆ* Lapworth

Calamograptus, gen. nov.

This genus is characterized by a bilaterally symmetrical rhabdosome of great size, consisting of several orders of branches developed from a primitive Didymograptus-like stage by repeated dichotomy of the Clonograptus type, giving branches of at least six orders. The branches of the first order are almost obliterated by accelerated development, so that the rhabdosome has the appearance of a compound Tetragraptus. The branches of the second order are long, but each succeeding dichotomy results in shorter and shorter branches. Thecæ long, curving, with straight apertures.

Genotype, **Calamograptus porrectus,** sp. nov

This genus is closely allied to Clonograptus and to Temnograptus, but it differs from them in its method of dichotomy. In both those genera the branches of the first order are long enough to give the rhabdosome at that stage a very decided Didymograptid appearance, whereas in Calamograptus they are all but obliterated. In Clonograptus the length of the branches increase with each dichotomy; in Temnograptus this is true of branches of the first, second and third orders, the length of subsequent branches approximating that of the third order. These two methods are at variance with the type of dichotomy in Calamograptus in which, disregarding the atrophied branches of the first

order, the branches nearest the sicula are the longest, subsequent ones becoming shorter and shorter. Staurograptus, which seem to be rather more closely allied to Bryograptus than to Clonograptus, is characterized by a crowding of the early dichotomies close to the center of the rhabdosome, so that each dichotomy naturally gives rise to longer and longer branches.

In the evolution of the graptolites this form would appear to be a descendant of Clonograptus, with necessary modifications, becoming extinct without issue. In this it would occupy an equivalent place to that of Temnograptus Nicholson. The genera Schizograptus Nicholson, Trochograptus Holm, and Hologràptus Holm, as well as Goniograptus McCoy, are all characterized by lateral branching, and not by regular dichotomy. Many of their species reach the great size attained by *Calamograptus porrectus*, and some even surpass it.

Calamograptus porrectus, sp. nov. Plate 5, Figs. 1, 2

The rhabdosome is of great size, when complete probably 30 cm. across. The nema and sicula are not preserved. The rhabdosome consists of branches of at least six orders; those of the first order are recognized only in the bilateral symmetry of the central part of the rhabdosome. The branches of the second order are 4.7 cm. long, and dichotomize with an angle of approximately 30° ; the branches of this dichotomy and of subsequent ones are slightly curved toward each other, so as to become subparallel at their distal extremities. The branches of the third order are 3.5 cm. long; those of the fourth order 3 cm. long, the fifth order 2.2 cm. long possibly incomplete. Branches of the sixth order seem to be indicated by a divergence of the margins of a branch of fifth order on the type-specimen. On other specimens showing only the outer branches the terminal branch is seen to be 8 cm. long. The branches of any given order maintain a fairly constant width, but each higher order is characterized by a narrower

branch. The width of the branches of the 2nd, 3rd, 4th, and 5th orders are respectively 5 mm., 4 mm., 2.5., and 1.5 mm. The terminal branches are 2.2. mm. wide. A secondary disk of small proportions is present but consists of but little more than a slight extension between the branches. The thecæ are long, inclined at their bases at an angle of 20°, but curving so that at the aperture they are inclined nearly 40°. They are in contact seven-tenths of their length. The apertural margin is straight, forming an angle of 50° with the axis of the branch. From 8 to 8.5 thecæ occur in the space of 10 mm. Genoholotype M. C. Z. 501, paratype M. C. Z. 502.

Horizon and locality. Clonograptus zone, locality M, North Ridge, Lévis, Quebec.

Anomalograptus, gen. nov.

The rhabdosome is similar to that of Clonograptus but it lacks the distinctive symmetry of that genus. The branches of the first and second order are formed by a regular dichotomy, but those of the third and higher orders originate from dichotomies which are so irregular that the resulting branches simulate a combination of main and lateral ones. The four branches of the second order give rise in the same individual to varying numbers of higher orders; the terminal branch may be of the third, fourth, fifth or even sixth order, so that the number of these may vary between 8 and 64. Genotype, *Anomalograptus reliquus,* sp. nov.

If but one or two specimens of this genus were known, they might be taken for abnormal forms of Clonograptus. We possess seventeen specimens, all from the same horizon and locality, and not one of them shows the characteristic symmetry of Clonograptus. It is true that the latter genus occasionally fails to develop the required number of branches through insufficient dichotomy, but such specimens are very exceptional. Moreover, Clongraptus has been considered to be confined to strata at or below the Tetragraptus

zone, whereas these specimens were found in the *Diplograptus dentatus* zone, several hundred feet higher. Without doubt Anomalograptus is a descendant of Clonograptus, although the intervening degrees of descent are not known, and the strange habit of irregularity may be due to a belated attempt to readjust the Clongraptus type of rhabdosome to the later environment. This appears to be among the last of the horizontal forms to survive.

Anomalograptus reliquus, sp. nov. Plate 5, Figs, 3-5

The rhabdosome is small, seldom more than 5 cm., across. The sicula is short and blunt, but not preserved in such a manner as to indicate the position of the initial thecæ. Branches of the first order are from 1 to 2 mm. long and give rise by dichotomy to four branches of the second order equal in length to those of the first. The terminal branches, which, owing to the suppression of subsequent dichotomies, may be of the third or subsequent orders, are short, usually less than 25 mm. (though one specimen is 40 mm. long), and 1 mm. wide. The thecæ are plainly preserved. They are 2 mm. long, .35 mm. wide, in contact one-half their length, and form an angle of about 25° with the axis of the branch. The aperture is perfectly straight, nearly at right angles to the theca itself. There are 20 thecæ within the space of 10 mm. Genoholotype M. C. Z. 503, paratype M. C. 504.

Horizon and locality. Shumardia and *Dipolograptus dentatus* zones, localities B and C, Lévis, Quebec.

Dichograptus tenuis, sp. nov. Plate 5, Figs. 6, 7

Rhabdosome small. The branches of the first and second orders all equal, about 1.25 mm. in length, uniformly less than .2 mm. wide. The branches of the first order diverge at an angle of 175°; those of the second at an angle of 100° and 120°; the angles of the third dichotomies vary even more. The branches of the third order are long, 13 mm. is the maximum observed, they are never wider than .4 mm. The thecæ are unknown.

This species differs from *D. separatus* Elles (Tetragraptus zone of Great Britain) in its general smaller size, the branches of the first and second orders are uniformly but half as long as in the British species, and the terminal branches are proportionately smaller still. The common form *D. octobrachiatus* Hall, differs from it in its much coarser form and in the crowding of the dichotomies toward the proximal portion. The measurements given above illustrate how unsatisfactory a criterion the angle of any given dichotomy may be. This is especially well shown in some specimens whose branches have "drifted" so as to become sub-parallel; in such cases the angles may be in no sense comparable to each other. Holotype M. C. Z 505, paratype M. C. Z. 506.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

Tetragraptus echinatus, sp. nov. Plate 5, Figs. 8-12

Form or entire rhabdosome unknown. This species is known from half-a-dozen fragments of branches of varying lengths with the general characteristics of either Didymograptus or Tetragraptus. The longest fragment observed is 4.3 cm. long. Exclusive of the spines described below the width is about 3 mm., or less in smaller specimens. The thecæ are spaced 9 to 10 per 10 mm., with some variation in form. Those near the proximal end of the specimen are inclined to the axis of the branch at an angle of about 25° slightly curved, the apertural margin is straight inclined to the axis of the branch of 105°; the width of the branch is about 2 mm. Further away from the proximal portion the form of the thecæ is different: they are quite concave, inclined at a somwhat higher angle, 30°, and the apertural margin, although still straight, is inclined at an angle of 115°; thecæ appear to be much more mucronate in this region than those near the proximal end. The branch is slightly thickened along the edge opposite the thecæ, and

bears numerous spines which stand out at right angles to the branch. These spines are prolongations of the substance of the branch, and not insertions in it. They are .5 mm. to .6 mm. high, mucronate at the point, but spreading at the base. In position they correspond with the thecæ, though they may be wanting in some cases. Some specimens show one spine opposite each theca, in others every third theca is thus favored. They are always at right angles to the edge of the branch.

This species is closely allied to *T. acanthonotus* Gurley (Clonograptus zone, Lévis. Gurley 1896, p. 65) but differs from it in several respects. In our species there are from 9 to 10 thecæ in 10 mm., in *T. acanthonotus* 7 to 8. In the latter species the apertural margins are concave, in our specimens they are straight. In our larger specimens the outer margins are strongly concave, in Gurley's species they are practically straight. The line of division between successive thecæ in *T. acanthomotus* extends backward almost to the dorsal margin of the branch, in our species the lines do not extend to within 1 mm., of the margin. The latter is a constant characteristic. Ruedemann has described a form with similar spines, *Didymograptus spinosus* (Ruedeman, 1904, p. 689), which he suggests may have been derived through *T. acanthonotus*. Both the latter and our new species lack the thecal spines. The purpose of the spines is not clear. The fact that they are placed sympathetically with the thecæ need not in itself predicate an organic connection between them and the thecæ. Holotype M. C. Z. 507, paratypes M. C. Z. 508, 509.

Horizon and locality. Shumardia zone, locality D, Lévis, Que.

VERMES

CONODONTS

One of the most perplexing questions in Paleontology,

and one to which there seems to be at present no answer, is the true zoological position of the so-called Conodonts. As originally described by Pander (1858) they were supposed to be the teeth of fishes. Since that time they have been bandied about by paleontologists from one position to another, such as fish teeth, crustacean spines, molluscan teeth and annelidan teeth. The end of the discussion is not in sight, although they are being less debated to-day. The question is so complicated that the present writer does not feel competent to add to the discussion, nor has he the time to devote to as thorough a study of the group as might be desired. For convenience, the following species will be included among the annelids.

Seven species have been discovered in the Lévis formation. With one exception these occur in the Shumardia limestone. They are all black, shining and carbonaceous, as if once composed of chitin. The only one which shows any part of the interior was once hollow, but is now filled with crystallized calcite. They are associated with a host of other fossils, all small, and all chitinous. The specimens were not found associated together, in fact, they came from different layers. Comparison with described species seems futile, for we do do not even know whether a certain form was restricted to one species, or whether one species possessed but one form of tooth. It seems best to describe each of the specimens as a new species, allowing their final arrangement to wait upon the description of a sufficiently great number of forms.

Conodonts have not been reported previously from strata lower than Chazy. The form figured by Moberg and Segerberg (1906, p. 62) from the *Dictyonema flabelliforme* shales is probably not a conodont.

Prioniodus theron, sp. nov. Plate 6, Fig. 1

This is a fairly large specimen consisting of a base, imperfectly preserved, on which are fourteen small and subequal spines with one large spine so situated that nine of the smaller spines lie to one side and five to the other of it.

The sides of the large spine are straight. The smaller spines have for the most part sides which are convex. Two smaller spines adjacent to the large spine seem to be set somewhat back from the row in which the other smaller spines are, as if they had been displaced by the large one. The smaller spines do not show the nearly perfect alignment which characterizes those of *P. imperator*, the points of those on the left forming a convex line while those on the right are arranged in a descending line. A crushed cylindrical body, broken at its narrow end, appears to be attached to one end of the specimen, at an angle of about 60°; it is doubtful whether this belongs to the specimen or not. It seems to underlie the broken edge of the base, but as some species of Polygnathus possess such an extension of the base it has been included in the figure. Total width 4.75 mm., total height of spines 2 mm., length of oblique cylindrical body 4 mm. Holotype M. C. Z. 1001.

P. melampus, sp. nov. Plate 6 Fig. 2

This is a small form, consisting of a base and three denticles. The latter are very thick, and are much elevated above the surface of the rock on which the specimen lies. Two of the denticles are of the same height, about .35 mm., and the third is about as half as high. Both lateral margins of the base are present and enough of the lower margin is shown to allow a complete restoration to be made with certainty. The completeness of the lateral margins makes this species unique in possessing but three teeth. Height 1 mm., width .9 mm. Holotype M. C. Z. 1002.

Prioniodus dorceus, sp. nov. Plate 6, Fig. 3

Our specimen is fragmentary, and is described here chiefly on account of the interest attached to the group to which it belongs. But two denticles are preserved. These are small, curved, sharply pointed, and unequal in size, so that the smaller is on the concave side of the larger. The denticles are hollow, but partly filled with calcite. The shell of the denticles is extremely thin. No certain trace of the

base is preserved. Dimensions, slightly less than 1 mm. from apex of the larger denticle to the opposite margin. Holotype M. C. Z. 1003.

Prioniodus lelaps, sp. nov. Plate 6, Fig. 4

This species possesses a slight resemblance to the form just described, although it belongs to the type of tooth which Hinde described as annelidan jaws, rather than conodonts which he supposed were fish teeth. The lateral longitudinal projecting fold along the base makes it resemble an annelid jaw, but chiefly for the reason given above the writer includes it under the genus Prioniodus.

Small, with a prominent base produced behind to a point, and carrying a longitudinal projecting fold extending from the middle of the lower edge to near its anterior margin. This margin is continued upwards into the broken base of the stout terminal spine. Both margin and spine are deflected backwards. Six smaller and blunter spines, or their bases, lie along the top margin of the jaw. Dimensions, height .6 mm., height restored .9 mm., length 1.25 mm. Holotype M. C. Z. 1004.

Prioniodus tigris, sp. nov. Plate 6, Fig. 5

This large form consists of a mold of a deep base along whose upper edge there is a stout conical terminal spine with a fringe of smaller but similar spines. The base is slightly imperfect, but its dimensions are as follows: length 3.3 mm., height to base of spines, 1.5 mm. It is subquadrate in outline. The stout terminal spine is a continuation of one of the sides of the base, 1.7 mm. long and .4 mm. thick at its lower end. It is circular in cross-section, in longitudinal section its sides are slightly convex outwards. The smaller spines are twelve in number (fourteen was probably the full complement) each with about half the linear dimensions of the larger spine. These smaller ones are remarkably uniform in size. The lower edge of the base appears to be perfectly flat. Holotype M. C. Z. 1005.

This form resembles *P. elegans* Pander, which occurs in the upper Ordovician near Toronto, and *P. armatus* Hinde (1879, p. 356) from the Genesee beds of Port Stanley, Ont., somewhat, but its great size serves to distinguish it from either.

Prioniodus pamphagus, sp. nov. Plate 6, Fig. 6

Known from two specimens. The type is of medium size and consists of a long straight narrow base upon which are carried twenty-five denticles. The first six of these are large, the remainder are all small and are arranged so that their apices descend in a convex line to the smaller end of the specimen. The other specimen has a secondary row of much smaller denticles under the larger ones; they seem to be borne on a projecting "shelf" as is seen in *P. lelaps* (Pl. 6, fig. 4). Holotype M. C. Z. 1006.

Horizon and locality. Dark shales of the Lévis formation, Locality C, Lévis, Que.

Polygnathus argos, sp. nov. Plate 6, Fig. 7

One partially preserved specimen referable to the above named genus occurs in our collection. Its distinguishing characteristics are a relatively large central spine flanked on each side by smaller ones so arranged that the whole presents a somewhat triangular appearance. All of the spines are extremely sharp, curved, and with their axes approximately parallel. The base is not well preserved, but there is enough of it to indicate that it was deep and probably as wide as the entire height of the specimen. Holotype M. C. Z. 1007.

Order TUBICOLA

Serpulites conflexus, sp. nov. Plate 7, Fig. 3

The specimen is slender, strongly curved, and tapers very gently, nearly semi-circular in outline, but the curva-

ture is by no means regular. It is 70 mm. long, though fractured and incomplete at its narrower end; the maximum width is 4 mm.; 16 mm. from the aperture the width is 3.5 mm., thus giving an increase of .5 mm. in 16 mm. of length. If this increase were regular (there is no way of determining this, for the specimen has been twisted so as to obscure its real width throughout most of its length) the final width of 4 mm. would be obtained only after a growth of 128 mm., but it seems likely that the length of the specimen was somewhat less than this. Two wire-like margins, similar to those on *S. dissolutus,* border the specimen. At the larger end these are .6 mm. in diameter, circular in section, and decidedly elevated above the central portion. At about 25 mm. from this end the margin attains a thickness of .8 mm. Whether or not these margins were hollow could not be determined. No trace of an outer shell could be seen and to all appearances they were solid; should further specimens be found this point may be settled by sectioning them. The flattened test between the margins is deeply and irregularly wrinkled longitudinally, and is ornamented by transverse undulatory ridges and constrictions, four of each within the space of one millimeter. These can be observed at the larger end only.

An examination of the figure will show that the longitudinal wrinkling is for the most part irregular, but one "wrinkle" at least is apparently not the result of the fortuitous contraction of the test. This one maintains a constant width and direction for about 15 mm. close to and parallel to one of the wire-like margins, simulating the impression of a rod or filled tube within the test. No corresponding ridge occurs near the opposite margin, though there are other ridges which maintain a constant width or direction for shorter distances. The specimens is black, shining, and composed of chitin. Holotype M. C. Z. 1008.

Horizon and locality. Tetragraptus zone, Raymond's zone 7, locality E, Lévis, Quebec.

S. splendens Billings (Chazy, Montreal) is a much larger form, 7 to 8 inches long, only gently curved and is ornamented by from 48 to 56 transverse striations per 10 mm. *S. longissimus* Murchison (Silurian, Great Britain; Niagaran, Nova Scotia) is also a far larger form, one-half inch wide, scarcely tapering, when strongly curved it follows an arc with a radius of six inches, and it is ornamented by coarse transverse corrugations each about two millimeters wide. *S. dissolutus* Billings (Black River - Richmond, Eastern North America) resembles this species somewhat, but our form appears to be of a coarser build. According to Billings' original description of *S. dissolutus* its surface is smooth, whereas our species is modified by small corrugations. As described by Whiteaves, the wire-like margins are ornamented by minute transverse undulations, but *S. conflexus* has absolutely smooth margins, even when seen under a high power lens.

In an abstract of a paper read before the Paleontological Society of America at Boston, December, 1919. Dr. W. A. Price restricted the scope of the genus Serpulites and suggested the possibility of a relationship with hydroids and graptolites, and not to worms. Unfortunately, our specimen does not throw any additional light upon the relationship of Serpulites to other forms beyond suggesting a pelagic habitat of the animal, which is more in accord with Price's view than the older ones. In a later publication (1920, pp. 581-588) the same writer has given his results in more detail. This paper is chiefly concerned with Pennsylvanian forms, and it is unfortunate that comparisons could not have been made with such earlier forms as those described by Ruedmann (1916, pp. 83-98). *S. sagittifer* Price (Pennsylvania, West Virginia), is apparently a much narrower form, although the marginal rods are proportionately wider. Only one other species, as far as I have been able to discover, occurs in the Beekmantown, and none below it. *S. interrogans* Ruedemann (Tetragraptus Zone,

Deep Kill, N. Y.) is a very small form, about 20 mm. long and usually attached. Our specimen resembles *S. lumbricoides* Ruedemann (Trenton, New York State) somewhat, but is wider and seems to have a smaller rate of increase in width (1 in 32, instead of 1 in 25). *S. crassifolius* Ruedemann (Utica, New York State) is a wider form and attains a width of 6 mm. The marginal rods are very wide, 1.3 mm. Other species are described and noted in Ruedemann's paper of 1916.

CYSTOIDEA

Order **AMPHORIDEA** Haeckel

Family *ARISTOCYSTIDÆ* Neumayr

Aenigmatocystis, gen. nov.

This genus is proposed to include certain saclike cystids of ovate form, pointed at one end, apparently with an integument in which irregularly arranged plates are embedded. Genotype, *Aenigmatocystis brisa*, sp. nov.

Aenigmatocystis brisa sp. nov. Plate 7, Figs 1, 2

In the collection of graptolites from locality G at the railroad out a mile and a quarter northeast of Lévis station are two slabs of thin-bedded micaceous sandstone, with irregular bedding surfaces in marked contrast to the almost geometrically flat surfaces of the black shale. These sandstone slabs are crossed by what may be a trail or burrow or possibly a plant stem, now replaced by sand; such markings are entirely absent from the black graptolite-bearing shale. On these slabs are also half-a-dozen pyritized bodies, each about an inch in diameter, which I at first supposed to be mere concretions, but which, on account of their peculiar characteristics, may be assigned to the class Cystoidea.

The specimen which shows the arrangement of the

plates to best advantage is illustrated in figure 2. It is 26 mm. long with a maximum width of 15 mm. Its thickness cannot be accurately determined, but where the margin is best exposed it is seen to be 1.2 mm. deep. It is surrounded by a narrow border, from .3 mm. to 1.5 mm. in width, which is slightly elevated above the body of the specimen. Within the border are a number of irregular plates, 45 of these can be charted, 16 others may be inferred, making a total of 61 on the exposed side. No regular arrangement of the plates can be seen, except at one end where a fairly large plate is almost surrounded by eight others, seven of which are of about the same size and one considerably larger. As this is the only such grouping present, and as it is difficult to determine to which end of the column was attached, it is impossible to decide whether this represents the mouth, the anus, or the *aperture fausse* of Barrande. The central position of each plate is elevated, the sutures are shown by linear depressions; where these are not apparent their probable situation has been indicated in the figure by dotted lines. All the specimens are traversed by a network of thin black (carbonaceous?) veinlets, which bear no relation to the position of the sutures, and frequently make the identification of the latter a matter of considerable difficulty.

The larger slab bears four specimens and the site of a fifth. All four differ from that just described in being gently convex with a convex border. The surfaces are not smooth, but covered with small low bosses one to three millimeters across, which no doubt indicate the position of the plates. The boundaries between the bosses, however, could not be easily seen. The plates are ornamented by small tubercles one-half millimeter or less in diameter. Three of the specimens show an acuminate end to the otherwise more or less rounded outline. The largest has what may be a vestige of a stem proceeding from the pointed end. Close to and concentric with two individuals are ripple-like ridges of sand which border them on one or more sides.

These were probably made as the bodies settled slowly into the sandy bottom, first touching at one point, later shifting to another, and finally reaching their present position. The largest specimen lies across the trail (?), and under the weight of the superincumbent material, has been so distorted as to appear to be upwarped above it. It is hard to conceive of this deformation taking place in a mere pyrite concretion.

Integument. All the indications point to an assumption that these organisms possessed a thin but tough flexible coat, perhaps comparable to that of a modern holothurian. It was probably thickly studded with calcareous plates which were thin and seldom, if ever, in contact. The fact that the cystid was depressed on either side of the trail (?) shows that it was either naturally very soft and yielding, or that, although it might once have been tough, post-mortem decomposition had transformed it into a relatively soft mass.

Column. No stem has been observed in connection with these specimens. As noted above, most of them show a contraction at one end to almost a point, which may have been the place of attachment of a column. Indeed, one individual does actually appear to have this acuminate end prolonged into a stem-like body, but this part is not clearly enough preserved to allow one to be certain. While collecting along the cliff between Davidson Street and Begin's Hill, Dr. Raymond found an impression of a large cystid column in a rather sandy layer of black shale. It is too large to be specifically related to *Aenigmatocystis brisa,* but it is especially valuable in proving the presence of cystids in these beds independently of these pyritized fossils. Genoholotype. M. C. Z. 256, paratype M. C. Z. 257.

Horizon and locality. Clongraptus zone, locality G, Lévis, Quebec.

BRACHIOPODA

Order **ATREMATA** Beecher

Family *OBOLIDÆ* King

Linguella raymondi, sp. nov. Plate 8, Figs. 1-3

Shell of medium size. In the dorsal valve the apical angle is always less than 90°, the sides are very gently convex for about a quarter the length of the shell, the remainder of the margins forming part of a circle somewhat flattened at the anterior margin. The ventral valve is more nearly circular, but has the surficial characteristics of the brachial valve. The posterior third of each valve is smooth or ornamented with fine sharp elevated and distant concentric striæ between which the surface of the shell is flat. The anterior part bears strong radial striæ which increase by addition laterally, or, less frequently, by interpolation. These striæ are spaced about two to a millimeter at the anterior margin. The lateral striæ reach the margin in front of the widest part of the shell. There are from ten to twenty principal striæ which extend for more than one-third of the length of the shell, and as many smaller alternating ones. Most of the specimens are compressed, but some show a moderate elevation. Length 15 mm., width 12 mm. Holotype M. C. Z. 8550 , paratype M. C. Z. 8551.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

It is remarkable that this species, which is quite common in the Shumardia limestone should have escaped description by Billings. Its characteristics are so distinct from those associated species that any representative collection from this locality should contain it. The collection of the Canadian Geological Survey made by Weston contains several specimens. It resembles somewhat *L. bella* (Walcott) from the Lower Ordovician of Newfoundland, but that species is proportionately larger and carries fine striations

which begin in some cases within a quarter of the length of the specimen from the beak, and are spaced much more closely than in *L. raymondi*. *L. irene* (Billings) lacks the radial striations, *L lens* (Matthew), Upper Cambrian of Cape Breton is weakly striated and has a less acuminate pedicle valve. *Lingula? corrugata* Moberg and Segerberg (Dictyonema beds of Skane) is much smaller form with fewer and weaker plications.

Leptobolus (?) incultus, sp. nov. Plate 8, Fig. 4

The shell is very small, never longer than 3 mm. and rather less than half as wide, elliptical in outline. It is very slightly convex. Our specimens are composed of transparent or colorless calcite, which appears to be a replacement of chitinous or corneous matter. The shell substance is thin. There is a flat margin around the shells along which the valves were in contact. The cardinal area on the pedicle valve is small and no pedicle groove is visible; there in no area on the brachial valve. The interiors of both valves are devoid of markings except for numerous radiating striæ. No muscle scars are preserved. Holotype M. C. Z. 8552.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

The evidence for placing this "Oboloid" species in the genus Leptobolus is not very strong. Its small size reminds one at once of *L. lepis* of the Utica slate. In so small and delicate a shell it would be remarkable indeed if muscle scars were preserved. The type specimen is slightly exfoliated at the beak, and shows the beginning of a longitudinal muscle scar such as characterize this genus, but none of the specimens is sufficiently well preserved to admit of further elucidation of the musculature. Fine concentric striæ ornament the exterior. An oboloid protegulum is present in all of the better preserved specimens; it is almost circular in outline. This species differs from most known species of Leptobolus in its narrow form.

Paterula westoni, sp. nov. Plate 8, Fig. 5

The shell is small, elliptical in shape, with an average of 7 mm. and width of 5 mm. The valves are of equal size, as far as is known, though no single complete specimen occurs in our collection. Each shell is surrounded by a flat border which is widest just in advance of the umbo, where it is more than 1 mm. wide. It diminishes in width and prominence towards the anterior end. The beak is situated just within this border. The shell consists of a black carbonaceous exterior, and a transparent, colorless or amber colored interior layer; rarely there is a third layer, intermediate in position between these two. The exterior is ornamented by fine concentric striations. The interior bears no concentric lines, but on a few favorably preserved specimens muscle scars can be made out. These are never elevated, and resemble faint impressions more than anything else. In most cases there is near the the posterior margin a small but distinct medial scar frequently obcordate in shape, sometimes semicircular. From this scar lines radiate forward and laterally. On each side there is a pair of prominent lines close together starting from the medical scar or slightly in the rear of it and nearly reaching the lateral margins of the shell. They are often accompanied by several other parallel but less prominent lines. A fan shaped mass of striations radiates from the medial scar almost to the anterior margin There is one pecular arrangement of markings in which there is seen to be a space in the center of the shell marked off by the medial scar and a great many lunoid curves. No prominent lateral lines occur in this specimen. On one or two shells where there is no medial scar there is a general radiation of lines from about the region of the beak. These two different styles of musculature probably distinguish the pedicle and brachial valves, the first described type belonging to the pedicle shell and the complicated one characterizing the brachial one.

As in most of these thin shelled inarticulate brachiopods, the exact generic position is doubtful. The pedicle (?) muscle scars suggest Lingulops, but there is no trace of a platform within the shell. The exterior is of very little value in determining the genus. The musculature of other species of Paterula is quite different from that just described, but not sufficiently so to exclude this species from the genus. Holotype M. C. Z. 8553.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

Order **NEOTREMATA** Beecher

Family *ACROTRETIDÆ* Schuchert

Acrotreta polita, sp. nov. Plate 8, Figs. 6, 6a

Shell of medium size. Both valves have a well rounded anterior margin, but the posterior one is nearly straight. The pedicle valve is wider than long and decidedly acuminate, in a section along the width of the shell the two sides meet at an angle of less than 100°; along the length of the shell the angle is less than 90°. The apex is pointed, very slightly overturned towards the posterior margin. A false cardinal area is present, occupying somewhat less than the central third of the flattened posterior portion of the valve; across it the striations which ornament the shell are finer and more numerous. The brachial valve is very gently convex, and wider than long. The surfaces of both valves are ornamented by inconspicuous concentric and radial striæ. The brachial valve has near the anterior margin a great number of irregularly disposed radiating wrinkles of unequal length, some reaching the margin, some falling short of it. No protegulum observed. Holotype M. C. Z. 8554,

paratype M. C. Z. 8555. Dimensions in millimeters:

(*Type specimen and largest specimen*)

	Length	*Width*	*Height*
Pedicle valve	4.25	5.5	2.75
Brachial valve	4.0	5.5	.5
Pedicle valve	7.5	8.0	4.0
Brachial valve	6.0	7.5	—

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

Acrotreta scarabeus, sp. nov. Plate 8, Fig. 7

Shell small, circular in outline, moderately elevated. The highest point is just behind the middle of the shell. The apex is half way between the highest point of the valve and the posterior margin. A protegulum, itself circular in outline, .75 mm. long and just as wide, extends from the apex to the highest point of the shell, its base sloping upwards and forwards at an angle of 40°-45°. This protegulum is smooth, shining, and almost devoid of ornamentation. The shell outside of the protegulum is covered with closely spaced fine raised concentric striations, crossing which are a few faint sunken radial lines.

Holotype M. C. Z. 8556. Dimensions, length 4.25 mm., width 4.5 mm., elevation 1.75 mm.

Horizon and locality. Shumardia limestone , locality D, Lévis, Quebec.

Linnarssonella zoar, sp. nov. Plate 8, Fig. 8

Shell minute, nearly perfectly circular. The pedicle valve is nearly flat, with the beak elevated very slightly and scarcely produced beyond the circular outline of the shell; a false cardinal area is present on some specimens; the pedicle opening as observed on one individual is relatively large, but as this is caused by oxfoliation around the apex, the opening was probably minute, as in most species of this genus. The brachial is shorter than the pedicle valve, and

its posterior margin is much flattened; this valve is almost perfectly flat. Both shells are composed of shining calcium carbonate, ornamented with very fine concentric lines of approximately equal strength and evenly spaced; they never simulate lamellæ. The interior of one pedicle valve shows two strong divergent markings which are comparable in position to the vascular canals figured by Walcott in some species of Linnarssonella, but are by no means as wide as the latter. Length of type specimen 1.4 mm., width 1.5 mm. Holotype M. C. Z. 8557.

Horizon and locality. Clonograptus zone, locality M. North Ridge, Lévis, Quebec.

This is the only specimen of Linnarssonella so far recorded from Ordovician rocks of North America. It most resembles *L. girtyi* Walcott (Black Hills and Oklahoma, M. Cambrian). It is the smallest species of this genus recorded so far.

Family *TREMATIDÆ* Schuchert

Eunoa vicina, sp. nov. Plate 8, Fig. 9

The type is fragmentary, but enough is preserved to indicate the minimum dimensions of the shell. Only the anterior part of the brachial (?) valve is shown; this has a maximum width of 48 mm. and a length of 36 mm. There is some slight distortion of the specimen, but the anterior outline is practically semicircular. It is ornamented by numerous extremely fine, closely and irregularly spaced concentric striations which are scarcely distinguishable to the unaided eye. The shell is extremely thin, and, unlike most of the shells in the same bed, it is not black, probably preserving some of its original lime content. Holotype M. C. Z. 8558.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

The great size of this specimen serves to distinguish it from its congeners. Eventually, when more and better specimens are found, this form may be found to be conspe-

cified with *E. accola* Clarke (Deep Kill, Melrose, N. Y.), but for the present, although its generic position seems assured, its state of preservation will not admit of definite specific alignment with *E. accola.*

Order **PROTREMATA** Beecher

Family *BILLINGSELLIDÆ* Schuchert

Eoorthis bayfieldi, sp. nov. Plate 8, Fig. 11

Cf. *Orthis, sp.* Westergard,, A. H. Lunds Univ. Arrskrifft. N. F. Afd. 2, Bd. 5, Nr. 3; Kongl. Fysiogr. Sallsk. Handl. N. F. Bd. 20 Nr. 3, p. 54. pl. l. fig. 29, 1909.

Known from one brachial valve alone. Shell small, about half as wide again as long, broadly elliptical, with the posterior margin straight. The greatest width is slightly behind the middle of the shell. The cardinal angles are obtuse, not rounded at all; the cardinal area has not been seen. The valve is moderately elevated; the highest portion is about one-quarter the length of tne shell from the umbo, from which region the surface descends evenly to the anterior and lateral margins, (so that the shell as a whole is convex), but more rapidly towards the cardinal angles, where the shell is flattened. Nine narrow sharply elevated plications ornament the shell, the central one the strongest and starts from close to the beak; succeeding flanking pairs are weaker and start further from the umbo. At the anterior margin these principal plications are about .3 mm. apart. In the anterior third of the shell a few additional intercalated weak plications are present. The relatively flat areas between the plications carry about half-a-dozen faint radical striations. No concentric ornamentation is present. Neither sinus nor fold occurs in tnis valve. Dimensions, length 1.5 mm., width 2.5 mm., height, estimated, .4 mm. Holotype M. C. Z. 8559.

Horizon and locality. Shumardia limestone. locality D, Lévis, Quebec.

Eoorthis baddeleyi, sp. nov. Plate 8, Fig. 12

Shell of medium size, about twice as wide as long. The greatest width is at the hinge-line which is perfectly straight. The anterior margin is semicircular. A well developed but low fold is present, extending the whole length of the shell; on each side of this the shell surface is nearly flat. Radial plications cover the surface; these are scarcely noticeable on the posterior inner portion of the shell, but are very prominent towards the anterior margin, where they are disposed as follows; one large central plication and two smaller lateral ones occupy the fold, and seven or possibly eight pairs lie on each side. The distribution of the plications in pairs along the anterior margin suggests that they have been derived by bifurcation from a smaller number nearer the beak. Owing to the poor state of preservation this could not be verified. The lateral plications on the fold obviously have arisen by implantation. This species is by far the largest articulate brachiopod found in the Lévis formation outside of the limestone conglomerates. Dimensions, length 8 mm., width 15 mm., height, estimated, 1.5 mm. Holotype M. C. Z. 8560.

Horizon and locality. Shumardia limestone, locality D, Lévis, Quebec.

Eoorthis bigsbyi, sp. nov. Plate 8, Fig. 10

Shell small, semicircular in outline, one half wider than long, hinge-line straight. Both valves are fairly flat, the pedicle with a wide low sinus, and a corresponding fold in the brachial valve. For a distance of somewhat less than .5 mm. from the beak the brachial valve is convex and elevated slightly above the general level of the shell giving it a resupinate appearance. The entire surface is covered with sharply angular plications between which are rounded furrows. There are four or five primary plications on each side of the sinus and between these there are secondary ones implanted either singly or in pairs. The plications are .4 mm. apart at the anterior margin. The whole surface is covered

with fine raised concentric striations spaced from ten to twelve in one millimeter. The interior of the pedicle valve shows a central longitudinal furrow traversing the resupinate portion, in front of which are a great many radial linear impressions. Dimensions, length 3 mm., width 6 mm. Holotype M. C. Z. 8561.

Horizon and locality. Shumardia limestone, locality D, Lévis, Quebec.

Family *STROPHOMENIDÆ* King

Leptella (?) exigua, sp. nov. Plate 8, Fig. 13

Shell small, nearly twice as wide as long. The hinge-line is not shown on our specimens; the cardinal angles are almost mucronate, acute, and the outline of the anterior margin of the shell is somewhat flattened. The ventral valve is considerably elevated to a distance equal to about one-third of the length of the shell. The surface of the shell is nearly smooth, but a few concentrically arranged short wrinkles occur not far from the lateral margins, and the whole surface is covered with almost microscopically fine, radial striæ. The beak projects above the cardinal area in the pedicle valve, but the area itself could not be seen. length 1.6 mm., width 2.5 mm. Holotype M. C. Z. 8562.

Horizon and locality. Shumardia limestone, locality D, Lévis, Quebec.

This species bears a slight superficial resemblance to *Leptella decipiens* (Billings) but it differs from that form in being a much smaller species with almost indistinguishable surface markings. *L. sordida* (Billings) is probably a smooth form, but more than twice as large as our species, and its cardinal angles are rounded or only slightly protruding.

GASTEROPODA

Order **OPISTHOBRANCHIA** Milne Edwards

Family *CONULARIIDÆ* Walcott

Conularia pristina, sp. nov. Plate 8, Fig. 14

This, one of the earliest Conularids so far recovered from the rocks, is here described from a single incomplete specimen. It is small, probably not more than 12 mm. long when complete, and 4 mm. wide at the aperture. One lateral face only of the cone is preserved. Both the median groove, and the closely spaced striations show well on the specimen, although the state of preservation is none of the best. A fragment of a second face is present also. Around the apertural margin is a smooth border free from striations and not crossed by the medium groove. It is not clear what purpose this border serves, for in more recent forms the faces are turned inwards towards the actual aperture. Holotype M. C. Z. 27811.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

The oldest species previously described is *C. triangulatus* Raymond from the Chazy. *C. cambria* Walcott (Proc. U. S. Nat. Mus., vol. 13, 1890, p. 270, 1891) is doubtfully referred to this genus. It belongs to the Upper Cambrian of Wisconsin. Evans (1906, 611, 612) has identified *C. margaritifera* Salter and other undetermined species from the homotaxial beds of Wales, containing *Didymograptus extensus, D. nitidus, D. patulus, Tetragraptus serra, T. amii, T. quadribrachiatus,* etc.

TRILOBITA

Order **HYPOPARIA** Beecher

Family *AGNOSTIDÆ* M'Coy

Peronopsis barrandei Clark — Plate 9, Fig. 8

Agnostus orion Billings, Raymond, 1914, p. 530
Peronopsis barrandei Clark, 1923, p. 121

Cephalon only known. This is small, 2.5 mm. in width and the same in length. The anterior margin is rounded, the sides are slightly curved, the posterior margin is almost straight; the whole gives a subdued rectangular impression. Around the front of the glabella is a wide flat border which

is perfectly plain. This border does not extend laterally all around the cephalon, but merges into the slope of the sides.

The glabella is prominent, divided into two lobes which are separated from each other and from the cheeks by deep and prominent sulci. The anterior lobe is somewhat shorter than the posterior, and both together extend for nearly two-thirds the length of the cephalon. The anterior lobe is somewhat wider than long, rounded in front. The transglabellar furrow is convex anteriorly so that the anterior lobe has a reentrant boundary.

The posterior lobe is rather longer than wide, widest toward the front, narrowing somewhat posteriorly. It is very prominent, its convexity being indicated in the accompanying drawing. Close to its anterior margin there is a small tubercle whose front slope is steeper than the rear one, so that it points forwards. The accessory lobes are small, and triangular in outline.

The surface of the cephalon is free from pustules, but it is minutely wrinkled, especially upon its sides.

Two specimens known. The type is deposited in the Museum of Comparative Zoology, the second specimen is the property of the Canadian Geological Survey, and was collected by Dr. Raymond.

Horizon and locality. Beekmantown. Shumarida limestone, locality D, Lévis, Quebec.

This species most nearly resembles *A. fallax* Linnarsson (Middle Cambrian, Scandinavia) from which it may be distinguished by the simple form of its posterior glabellar lobe and by the position of the tubercle, which in *A. fallax* is approximately in the center of that lobe.

The genus Peronopsis, and indeed the subfamily Condylopyginæ, has previously been reported from the Cambrian alone. Its presence in the Lévis shales is its first recorded appearance in the rocks of higher horizon.

Peronopsis marcoui Clark, Plate 9, Fig. 9

P. marcoui Clark, 1923, p. 121
Agnostus sidenbladhi Linnarsson, Raymond, 1914, p. 530

This species is known from one cephalon only. This is sub-quadrate in outline, expanding toward the front. The anterior raised brim is prominent and wide. The dorsal furrows are not produced beyond the glabella. The fairly prominent glabella is separated from the rest of the cranidium by deep but not wide furrows; as a whole it is somewhat peanut-shaped, with the posterior lobe the wider and longer, the anterior lobe being somewhat compressed from front to back. The outline of the glabella is pointed both anteriorly and posteriorly. Its one furrow divides it at about one-third its length from the anterior border. This furrow leaves the margins somewhat ahead of the narrowest part of the glabella and is inclined forwards so as to form an obtuse angle back of which on the posterior lobe is a median tubercle which points forward. The whole glabella rises from front to back so that its highest point is close to its posterior margin. The auxiliary lobes are incomplete, but probably large, and the whole surface is minutely crenulated. Length of cephalon 4.25 mm., greatest width 4.5 mm., maximum elevation 1.5 mm. The type was collected by Dr. Raymond, and is in the collection of the Canadian Geological Survey.

Horizon and locality. Beekmantown. Shumardia zone, locality D, Lévis, Quebec.

This species differs from the previous one in that its cephalon expands forwards and also in the unequal division of the glabella. The form of the glabellar lobe is distinctive. It is a larger form, though with single specimens this is an uncertain criterion. It is not apparently closely related to any other American species but it might be confused with *A. sidenbladhi* Linrs. (Apatocephalus zone of Ceratopyge limestone of Scandinavia) or with *A. fallax* Linrs. (Middle Cambrian of Scandinavia). From the former it differs

slightly in the shape of the cephalon, which in *A. sidenbladhi* scarcely enlarges forward, and markedly in the form and furrow of the glabella. In *A. sidenbladhi* the glabellar margins are straight and the transglabellar furrow is concave forwards. *A. fallax* has much the same form as this new species, but it has a constriction in the posterior lobe of the glabella which is proportionally much longer than in our species. The tubercle is placed in about the middle of the lobe. In *A. fallax* var. *ferox* the glabella is very much wider at its posterior end that elsewhere. Its posterior lobe is fully three times as long as the anterior and the auxiliary lobes are very small. In the two species and the variety mentioned above the margin to the cephalon is narrow, but in *A. marcoui* it is very wide.

Family *SCHUMARDIIDÆ* Lake

Schumardia granulosa Billings Piate 9, Fig. 1-6

This abundant species has lent its name to the limestone in which it is found. When Billings described it no other fossils were reported from the same horizon, in spite of the fact that today almost every fragment of the limestone which bears a cephalon or pygidium of *S. granulosa* also carries one or more specimens of other shells. Of the whole Begin's Hill section, this horizon may be properly called the most productive of fossils.

The specimens consist of dissociated cephala and pygidia in about equal numbers. Only one specimen has been discovered which shows any trace of a thorax. This is shown in figure 3. There are five well defined thoracic segments and possibly a sixth. There is one form of the pygidium which needs to be noted here. It is somewhat larger than the one figured and described by Billings and with seven segments instead of five, and with usually no resupinate curve to the posterior part. It is pustulose, and in outline

is precisely similar to that figured by Billings. Inasmuch as no smaller form of this type occurs, and as it is not associated with a different type of cephalon, the writer feels sure that it is the largest stage recorded of the development of *S. granulosa*. One specimen shows six axial furrows. Occasionally this larger form will show a slight resupinate outline of the posterior end. In all specimens the lateral furrows are very faint. This is the form listed as *S. sp. nov.* by Dr. Raymond in 1914.

Family *ENDYMIONIIDAE* Raymond

Seleneceme, gen. nov.

Associated with *Endymionia meeki* in the Shumardia limestone is a cephalon of one of the Endymioniidae which does not fit into any of the genera now included in that family. I append here a brief summary of the family for convenience:

Family Endymioniidae Raymond. Hypoparia with narrow dorsal free cheeks but no eyes, no glabellar spine, five to seven segments in the thorax, and a short ampycid pygidium.

Endymionia Billings. Cephalon evenly convex with large glabella divided into three parts by a pair of longitudinal furrows. Axial lobe of the thorax about one-third the total width.

Anisonotus Raymond. Cephalon irregularly convex, glabella small, with lateral furrows indicated by pits. Axial lobe of thorax narrow.

Lekanaspis Raymond. Glabella hemispheric, reaching anterior margin of cephalon, one pair of glabellar furrows isolating basal lobes. Thorax with five segments.

It now seems necessary to add the following:

Selesceme gen. nov. Cephalon slightly convex, glabella nearly circular and of moderate size. One pair of longi-

tudinal furrows start from posterior margin of the glabella and die out within it. Thorax and pygidium unknown.

Seleneceme propinqua, sp. nov. Plate 9, Fig. 10

The cephalon is semicircular in outline and nearly flat. The glabella is outlined by furrows which are weak at the posterior end and indistinct around the anterior margin. The glabella, which is nearly circular, is two-thirds the length of the entire cephalon. Two longitudinal furrows, close together and nearly parallel, traverse the posterior part from the neck segment to about the center where they die out. Cephalon, length 5 mm., width 7.5 mm.; glabella, length 3.5 mm., width 3 mm.; glabellar furrows .6 mm. apart. Genoholotype M. C. Z. 1717.

This genus, in connection with Endymionia, prompts a suggestion as to the direction of evolution within the family, and possibly a hint as to its ancestry. The peculiar longitudinal furrows of Endymionia are restricted in Seleneceme so that they end before they reach the lateral or anterior margins of the glabella. A still further advanced stage would be reached if these furrows should become obliterated altogether, so as to leave a smooth glabella. Such a form has not yet been recognized within this family. With regard to the ancestry of the group, it is interesting to compare the furrows with those of the Lichadidæ. In that family, the earliest representative (Lichas s. s., Ord and Sil.) possesses two axial furrows which do not reach the neck furrow. In Amphilichas (Ord.) these have progressed backwards so as to reach the neck furrow. Finally in Ceratolichas (Dev.) the furrows have all disappeared leaving a plain smooth glabella. In this case we are able to trace, by means of specimens, the deflection barckward of the anterior (1st) pair of glabellar furrows, so as to fuse with the median (2nd) and posterior (3rd) pairs, whose deflected ends form, with the anterior pair, a longitudinal furrow. With the loss of the transverse portion of the median and posterior furrows, and according to the distance

which the furrows have progressed backwards, we see forms comparable to Lichas or Amphilichas on the one hand, and Endymionia on the other. Further elimination of the furrows, starting at the anterior end would result in such a form as Seleneceme, whereas the complete obliteration of the furrows is seen among the Lichadidæ in Ceratolichas, whose analog among the Endymionidæ has not yet been found.

Family *RAPHIOPHORIDÆ* Angelin

Ampyx, sp. ind.

This designation is introduced here on account of a single glabellar spine found by Dr. Raymond, and now in the collection of the Canadian Geological Survey.

Family *OLENIDÆ* Burmeister

Boeckia (?) descensus, sp. nov. Plate 9, Fig. 12

Known from an incomplete cranidium only. Glabella complete, semicircular in front, its lateral margins parallel, and well elevated. The neck-ring is delimited by a well defined furrow which inclines slightly forward toward the lateral glabellar margins. Two pairs of glabellar furrows are present; the posterior ones are deep, each with a length more than one-third the width of the glabella so that they fail to meet by less than their own length. They converge backward at an angle of about 150°. The anterior pair are as long but proportionately wider. The neck-ring bears a scar at its central point; this probably indicates the position of a median tubercle, so characteristic of other species of Bœckia. Part of a fixed cheek is attached to the glabella, but unfortunately neither eyelines nor facial sutures can be seen, nor can the palpebral lobes be made out. The fixed cheek is built, however, on the normal trilobite plan, that is,

it slopes laterally downwards away from the glabella whereas in most species of Bœckia and Ctenopyge the fixed cheeks are on the same level as the glabella or slightly above it. Dimensions, glabella, length 1.9 mm., width 1.3 mm. Holotype M. C. Z. 1718.

Horizon and locality. Beekmantown, Shumardia zone, locality D, Lévis, Quebec.

In *B. hirsuta* Brogger (U. Camb. of Sweden) the glabella is shorter than in our form and a third pair of glabellar furrows by joining the neck furrow forms two trangular areas. Both *B. scanica* Westergard and *B. illænopsis* Westergard (U. Camb. of Skane) have shorter glabellæ, which also contract anteriorly, and less distinct furrows.

Triarthus cf. angelini (Linnarsson)

One specimen, provisionally referred to this species is in the collection of the Canadian Geological Survey from the Shumardia limestone.

T. belli Matthew

One incomplete cephalon occurs in our Shumardia limestone collection. It differs in no wise from Matthew's species except that the anterior pair of glabellar furrows do not approach the anterior end of the glabella quite as much as in the type.

Family *ELLIPSOCEPHALIDÆ* Matthew

Leicoryphe westoni, sp. nov. Plate 9, Fig. 13

Small, known from two specimens: the type, a cephalon with four thoracic segments attached, and a second cephalon. The type is small, the cephalon semicircular, evenly elevated, quite smooth and without a brim. There are no eyes observable, nor can the facial sutures be seen. The genal angles are well rounded. There is no neck furrow. The posterior margin of the neck segment is gently bent backwards. The specimen is enrolled and only four thoracic segments can be uncovered with safety. These are of a

simple type, similar to those of *L. gemma*. Dimensions of cephalon, length 1.75 mm., width 2 mm. Type M. C. Z. 1719.

Horizon and locality. Beekmantown, Shumardia limestone, Lévis, Quebec.

This species resembles the genotype *L. gemma* Clark in all known respects except that it lacks the genal spines of the latter.

Family *ASAPHIDÆ* Burmeister

Symphysurus elongatus, Mob. & Segerb.

Several specimens of pygidia identified as this species have been collected from the Shumardia limestone at locality D. There is considerable variation in the strength of the axial lobe on the specimens, one showing only a few faint furrows at the anterior end, only one of which is produced onto the pleural lobes. At the other extreme the axial lobe shows distinctly five furrows, three of which can be traced into the lateral lobes.

Blountia piluloides, sp. nov. Plate 9, Fig. 11

Our specimen consists of an imperfect cephalon, almost minute in size. The glabella appears to the unaided eye to resemble a very small highly polished rounded bead. The glabella is bordered by moderately impressed sub-parallel dorsal furrows, and has a semicircular anterior border; it is widest in the middle (in the figure the dorsal furrows should be almost parallel behind the middle with the neck segment wider); it is highly elevated, its highest point being nearer the neck furrow than its anterior end. In front of the glabella is a wide convex depressed rim bordened by a sharply raised rim. The free cheeks are considerably elevated. The eyes are not preserved but were probably large. There is no trace of glabellar furrows. Free cheeks not preserved. Holotype M. C. Z. 1702.

Horizon and locality. Beekmantown. Shumardia limestone, Lévis, Que.

Family *ÆGLINIDÆ* Pictet

Telephus, sp. indet.

On a slab of the Shumardia limestone there is a fragment of the characteristically reticulated eye of an individual belonging to the genus Telephus. Nothing more than this fragment is present, nor can it be matched with other indeterminable fragments so that we might possibly be able to assign it to some species. It is of sufficient interest to see the genus Telephus so low down in the Ordovician. Evans (1906, pp. 597-642) lists several trilobites from the equivalent of the Lévis beds of N. Wales including *Aeglina* sp. which he found at several localities.

AN APPENDAGE OF A TRILOBITE OF UNDETERMINED SPECIES

"One of the most remarkable fossils from the Shumardia limestone is a single detached appendage of a trilobite. It is small, less than 5 mm. in length and about 1 mm. wide. It consists of the outer part of a coxopodite, a large exopodite, a fragmentary endopodite, and one or two other members to be discussed later." The figure (plate 9, figure 7) "shows the disposition and relations of these parts. It should be borne in mind, however, that this figure represents the writer's interpretation of the specimen. The proximal parts are somewhat crushed, so that other interpretations are possible.

"The exopodite is by far the largest and the most prominent member. Its outline is as shown in the sketch, blunt at the inner end, terminating in a long spine at the distal extremity, widest beyond the middle. The posterior margin carries a score or so of setæ, which are short, stout and pointed outwards. These appear to be *inserted in* the margin of the exopodite, rather than outgrowths of it, for the border is thickened and the setæ appear to come out from under it. Moreover, adjacent setæ, none of which appears to be flexible, emerge from the border at varying

angles, a condition which could scarcely obtain were they prolongations of the substance of the exopodite. Inserted setæ on trilobote appendages have hitherto been found upon endopodites only. The thickened border extends along the posterior side of the exopodite, which has been crushed flat, as is shown by the many cracks and slight displacemnts.

"The endopodite is incomplete. Two or three segments are shown, but it does not appear that the whole member, if completely restored, would be as much as 3 mm. long; it probably would not exceed 2 mm. It is circular in section, and was undoubtly stout, for the thickened border of the exopodite may be seen to bulge above it.

"The coxopodite, adjacent to the blunt end of the exopodite, is small, but probably incomplete. It is roughly rectangular, and crushed flat.

"Below this are two fragments which the writer interprets as a second coxopodite and the base of a second exopodite, both belonging to a single segment. Above the whole is a large patch of black, but less shiny, material, shown by shading in the sketch which, if it be part of this assemblage at all, might represent a fragment of the ventral membrane of the trilobite. This is purely conjectural, but it lies where the ventral membrane would be looked for, immediately above the exopodite.

"Apart from the presence of inserted setae in the exopodite, the most remarkable feature about this specimen is the relation in size between the exopodite and the endopodite. That the animal which bore this appendage was not adapted for crawling is certain; no trilobite with such reduced endopodites could have been a successful benthonic inhabitant. On the other hand, the large paddle-like exopodite might well have been adapted to a nectonic or a planktonic mode of existence. This is in accord with the conclusion reached with regard to the whole Levis fauna.

"This limb does not agree exactly with any of the known trilobite appendages. In Neolenus the endopodites

are relatively very large, much longer than the exopodites. In the Asaphidæ, no exopodites are definitely known, but the endopodites are long, although slender. In Triarthrus, the basipodites, ischiopodites and meropodites are for the most part much modified in form, but in any case the endopodites are as long as, if not longer than, the exopodites. In the form of the exopodite alone, some comparison might be made between the present specimen and Walcott's figured specimen of *Ptychoparia cordilleræ* Rominger (1918, pl. 21, figs. 3-5). In all other trilobites the exopodites are no longer than the endopodites. Thus, on anatomical grounds alone, it would be impossible to connect this form with any trilobite whose appendages are known. Of the genera represented in the Shumardia zone only Isotelus and Triarthrus have so far yielded recognizable appendages. The most abundant trlobite is *Shumaria granulosa* Billings, which outnumbers all others about five to one; but this species is much too small to have possessed the appendage in question. The remaining genera represented in the Shumardia limestone are Agnostus, Endymionia, Symphysurus, Telephus, and Holometopus, to any one of which this appendage might belong. There seems to be no evidence for placing it within any particular one of these genera." (Clark 1922).

CIRRIPEDIA

Family *TURRILEPADIDÆ* Clarke

Genus **Plumulites** Barrande*

It has been the custom, both in America and in England, to consider Plumulites Barrande synonymous with Turrilepas Woodward. In support of this contention it has been pointed out that Barrande's publication of 1872 was preceded by Woodward's in 1865. Barrande recognized this earlier publication, but urged that his generic name be adopted because of an article published by Professor Reuss in 1864 on Fossil Lepadidæ in which the writer alluded,

*See U. S. Nat. Mus. Bull. 92 for bibliography up to 1914.

in a footnote, to Barrande's contemplated genus Plumulites. He published neither figure nor description, and, as a consequence, this reference is of more interest than importance. On the other hand, it has been suggested that Woodward's genus should be rejected because he failed to define it—he merely proposed the name in the text and used it to designate one of his illustrations. However, inasmuch as the name Turrilepas was used in connection with a perfectly clear and understandable figure, it must stand. Hence, if Barrande had described the same species under the name Plumulites, the latter would automatically go into the synonymy. It has recently been pointed out by Professor Moberg that the two genera are quite distinct, (a conclusion reached by Matthew in 1896, q. v.), and hence both are valid. A brief review of Professor Moberg's paper by F. A. Bather (1914) is of much service to those to whom the original is inaccessible.

Plumulites mobergi, sp. nov. Plate 9, Fig. 14, 15 (?)

Known from one lateral plate only. Lateral plate kite-shaped, unsymmetrical, with the axis gently curved, one margin concave, the other convex. A narrow deep groove runs from the apex to the posterior end dividing the plate into two sub-equal parts. The surface on each side of this groove is almost imperceptibly convex. Both sides are ornamented by a series of well-defined curving transverse grooves which are spaced .2 mm. apart at the posterior end, but much closer toward the apex. These lateral grooves are curved but not symmetrically with respect to the axial groove. On either side of the lateral plate there is a narrow marginal belt which might be called a fringe; on the left it consists of two or three hair-like striæ projecting forward from the end of the intergrooval segments, and on the right these appear to be so numerous as to form a solid belt. Nothing analogous to this has come to the writer's notice in published reports on this or allied genera. At first it appeared to be the result of the dragging

of the plate along the bottom, but this does not seem probable. Length 3.6 mm., maximum width 2.3 mm.

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

Cirripedia have been recorded from numerous Ordovician rocks of Europe and North America. Matthew has found them in the Middle Cambrian beds of Newfoundland, and states that they are not rare in the Lower Cambrian. In a list of fossils from the south-west end of the Island of Orleans, Ells (1888, p. 59K) includes "(?) Turrilepas, sp., fragments, with the surface marked by concentrically arranged lines of growth."

Horizon and locality. Shumardia zone, locality D, Lévis, Quebec.

APPENDIX A

REGISTER OF BOULDERS*

BOULDER A, UPPER CAMBRIAN

Ptychoparia zenkeri (Billings)
Loganellus billingsi, sp. nov.
Solenopleura trunca, sp. nov.
Apatokephaloides inflatus Raymond
Bayfieldia tumifrons, sp. nov.
Hungaia magnifica (Billings)
Onchonotus nasutus (Walcott)

BOULDER B, UPPER CAMBRIAN

Agnostus janei Clark
Plethopeltis angusta Raymond
Leiocoryphe gemma, sp. nov.
Stenopilus intermedius, sp. nov.
Osceolia brevifrons, sp. nov.
Denisia eminens, sp. nov
D. pusillus, sp. nov.
Acheilus levisensis, sp. nov.
A. marcoui Raymond
Onchonotus globosus (Billings)
O. cf. nasutus (Walcott)
Raymondina respecta, sp. nov.

*All the boulders listed here except L are in the Museum of Comparative Zoology, Cambridge, Mass.

BOULDER H, UPPER CAMBRIAN, COLLECTED BY MARCOU
Syntrophia walcotti, sp. nov.
?Ptychoparia zenkeri (Billings)
Plethagnostus gyps Clark
Solenopleura laflammei, sp. nov.
Platycolpus capax (Billings)

BOULDER K, UPPER CAMBRIAN, COLLECTED BY MARCOU
Acheilus marcoui Raymond
Onchonotus nasutus Raymond
O. globosus (Billings)
Hungaia magnifica (Billings)

BOULDER D, UPPER CAMBRIAN
Bienvillia corax (Billings)
Agnostus cf. *orion* Billings
Richardsonella megalops (Billings)
R. cristata (Billings)
R. oweni (Billings)
Platycolpus marcoui, sp. nov.
Dikelokephalina broggeri, sp. nov.
Osceolia brevifrons, sp. nov.
Hungaia magnifica (Billings)
Acheilus marcoui Raymond
Syntrophia walcotti, sp. nov.

BOULDER G, UPPER CAMBRIAN
Agnostus gladiator Clark
A. americanus Billings
A. innocens Clark
Bienvillia corax (Billings)
Phoreotropis puteata Raymond
Dikelocephalus, sp. ind.
Acheilus, sp. ind.

BOULDER J. UPPER CAMBRIAN, COLLECTED BY MARCOU
Syntrophia walcotti, sp. nov.
Agnostus canadensis Billings

BOULDER C, BEEKMANTOWN
Syntrophia calcifera (Billings)
Liospira, 2 sp.
Lloydia saffordi (Billings)

BOULDER E, BEEKMANTOWN
Eccyliomphalus, sp. ind.
Orthoceratites, several species.

Lloydia saffordi (Billings)

BOULDER I, BEEKMANTOWN, collected by Marcou
Eccyliomphalus, sp. ind.
Cephalopods
Lloydia saffordi (Billings)
Leiostegium quadratum (Billings)
Hystricurus cordai (Billings)
Lloydia bituberculata (Billings)

BOULDER F, BEEKMANTOWN
Dalmanella electra (Billings)
D. (*?*) *evadne* (Billings)
Syntrophia calcifera (Billings)
Eccyliomphalus vagrans (Billings)
Orthoceras autolycos Billings

BOULDER K, BEEKMANTOWN, collected by Marcou
Eccyliomphalus, sp. ind.
Lloydia saffordi (Billings)
L. bituberculata (Billings)
Leiostegium quadratum (Billings)
Hystricurus cordai (Billings)

BOULDER L. BEEKMANTOWN, collected by Billings. See Pal. Foss. pp. 186, 188, 204-206, 266.
Cliospira curiosa Billings
Fusispira psyche (Billings)
Cyclonema phædra (Billings)
Lloydia strenuus (Billings)
Bathyurellus formosus (Billings)
B. arcuatus Billings
Goniurus perspicator (Billings)
Cheirurus? solitarius Billings

MATRIX, LIMESTONE NO. 1? Walcott, 1890, p. 111.
Syntrophia calcifera (Billings)
Eccyliomphalus canadensis Billings
E. intortus Billings
Ophileta complanata Vanuxem
Pleurotomaria canadensis Billings
Pilekia apollo (Billings)
P. eryx (Billings)
Lloydia bituberculata (Billings)
Leiostegium quadratum (Billings)

APPENDIX B

REGISTER OF LOCALITIES

See Plate 1

A.—Shales at base of cliff between abandoned stone crusher and the Victoria Hotel at Point Lévis Station, 200′ north of fault. Zone D2.

B.—Shales at base of cliff directly below L'Hospital. Zone D2.

C.—Shales in cliff face 150′ north of foot of Cote Passage (Labadie St.). Zone D2.

D.—Shumardia limestone in cliff behind the Fonderie de Lévis, 500′ south of Begin's Hill. Zone D1.

E.—Shales in cliff at Begin's Hill. Zones C2, C3, C4.

F.—Shales in railroad cut 300′ north of Begin's Hill, Zone B.

G.—Railroad cut, shale both sides of the track, about ¾ miles below Lévis station, and at foot of Rue du Fleuve. Zones B, C1.

H.—Thin-bedded limestone along main track south of lumber yard, and a few hundred feet south of Rue la Cureux crossing.

I.—Massive conglomerate west of the lumber yard. Band D on Logan's atlas.

J.—Basel bed of limestone conglomerate in cut opposite St. Joseph railroad station. Band 1.

K.—Shale immediately above (southwest of) limestone of Guay's quarry. Band 4, Zone B.

L.—Low white limestone outcrop in pasture about 50′ across, just south of path. This letter refers to both the limestone and to the sandy matrix on the southeast side. Band 3.

M.—Quarry in North Ridge. This is the southwesternmost of the two, and is developed in a single mass of limestone. In my collection this letter refers to the shales immediately (3 feet) below this limestone. Band 4, Zone B.

N.—Boulders at top of path crossing ridge. Found loose, but with scarcely a doubt weathered out nearly *in situ*. Band 4?

O.—Sandy conglomerate, rusty in color, on southwest slope of North Ridge. Band 4.

P.—Shales immediately below ridge of conglomerate (Band 6). Zone C2.

Q.—Low ridge of limestone conglomerate west of Catholic Cemetery. Band 6.

R.—Shale at City Hall, Lévis. Exact location unknown; see Ells, 1888, p. 53K. Zone C1.

S.—Roadside cut in limestone conglomerates and shales, Montcalm St. Zone D1.

T.—Shale outcrop, 200′ southeast of end of Montcalm St. probably Zone C2.

U.—Small slate pit 300′ southeast of new concrete road, and 600′ due north of College. Zone C2.

V.—Low cut in Rifle Range.

APPENDIX C

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*References to Mineralogy and Economic Geology and the frequent routine references to Quebec and Levis in the Annual and Summary Reports of the Canadian Geological Survey are not included.

series, . . . alternating with calcareous conglomerates in beds, some of which are charged with fossils . . . . 2nd. A conchiferous brown and black limestone . . . . 3rd. Gneiss." Those sedimentary rocks are called Carboniferous, and the Sillery sandstone is described as grauwacke.

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BARRANDE, J. & MARCOU, JULES.—On the primordial fauna and the Taconic system, by

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MARCOU, JULES.—Canadian geological classification for the province of Quebec. Proc. Boston Soc. Nat. Hist., vol. 24, pp. 54–83. Gives several different classifications of the strata, followed by his own.

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SELWYN, A. R. C. —The Geology of Quebec City. Science, vol. 16, p. 359. The "discussion of the citadel rocks has at present passed into the hands of the paleontologist." Compare Selwyn 1888.

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1891. AMI, H. M.—On the Geology of Quebec and environs. Bull. Geol. Soc. Amer., vol. 2, pp. 477–502. The Quebec terrane is the upward extension of which the Lévis is a part. Gives good list of fauna.

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Group at Little Metis on the Lower St. Lawrence. Proc. Roy. Soc. Canada, ser. 2, vol. 2, sect. 4, pp. 91-121. Urges the necessity for the term "Quebec Group" in geological nomenclature.

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EXPLANATION OF PLATES

PLATE 2

Figure — Page

1—6. Six septa of *Salterella conulata* Clark arranged according to size, M. C. Z. types 2329-2334 respectively. Figures 1-3, x 10: 4-6, x 5 ---------- 8

7. Longitudinal section of *S. pulchella* Billings, from Forteau Bay, Labrador M. C. Z. 2336. x 5.

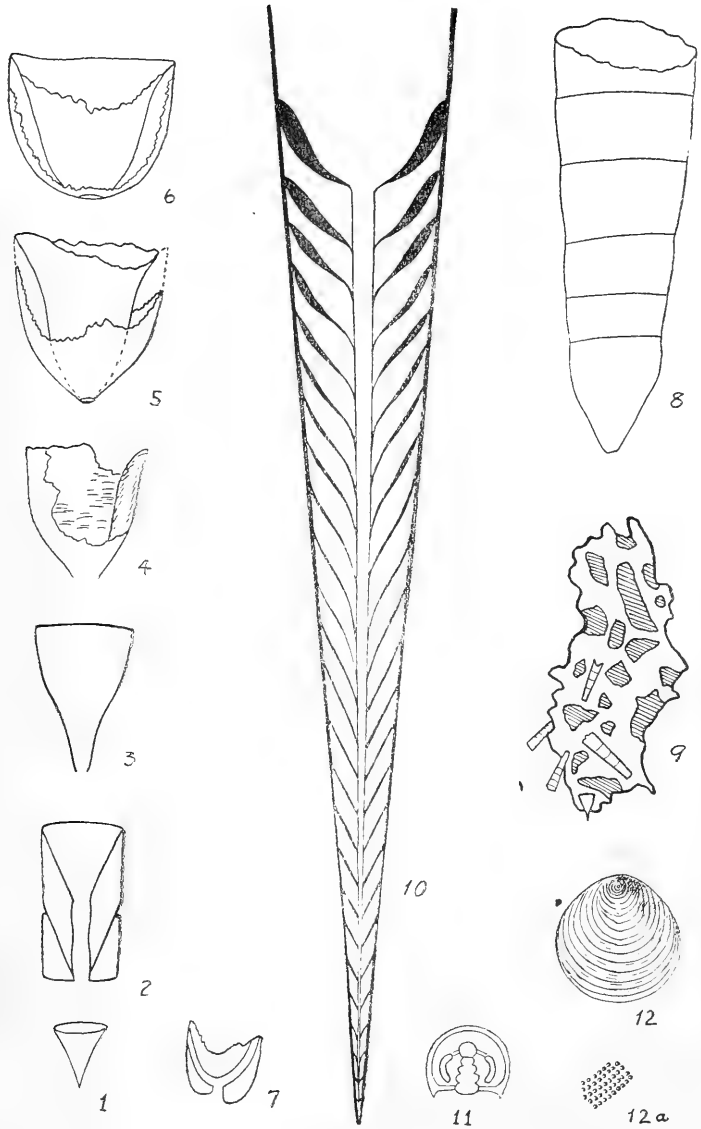
8. *Salterella conulata* Clark. The holotype. M. C. Z. 2335. x 7.5.

9. A specimen of limestone conglomerate from locality I, etched with acid, specimens of *S. conulata* in relief. Natural size except the small conical shell at the lower end of the specimen, which is much enlarged.

10. An ideal restoration of *S. conulata*. x about 5.

11. A cephalon of an immature specimen of *Olenellus* sp., locality I, Levis. M. C. Z. 1701. x 3.

12. *Micromitra (Iphidella) walcotti* Clark. The holotype. x 3. Figure 12a represents a portion of the shell enlarged to show the arrangement of the raised crenulations. x 22.5.---------- 5

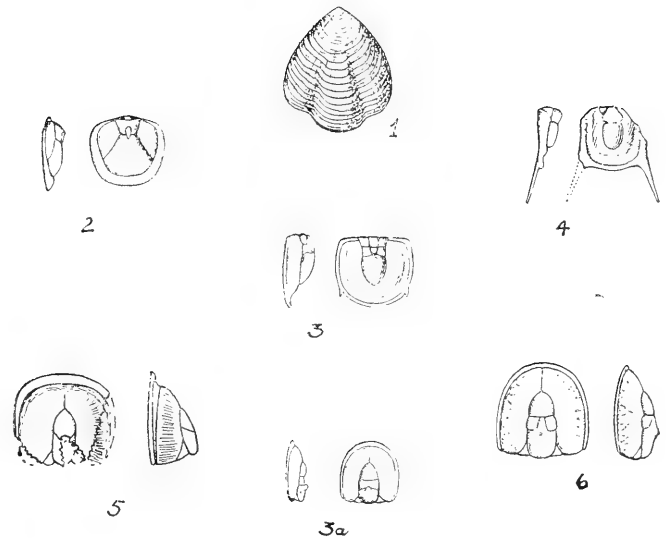


Fossils from the Lower Cambrian boulders of the Lévis formation

PLATE 3

Figure Page

1. *Syntrophia elax* Clark. The holotype. x 1.5 ---- 15
2. *Plethagnostus gyps* Clark. x 3. ---- 16
3. *Agnostus innocens* Clark. x 3 Figure 3a is an associated cephalon, x 3.---- 17
4. *A gladiator* Clark. x 3. ---- 18
5. *A. janei,* Clark x 4---- 19
6. *A. americanus* Billings. A cephalon from Boulder G, x 4.. 18
7. *Loganellus billingsi* Clark. The holotype. x 3. ---- 20
8. *Leiocoryphe gemma* Clark. The genoholotype. x 3. ---- 21
9. *Stenopilus intermedius* Clark. The holotype. x 2.---- 22
10. *Denisia eminens* Clark. The genoholotype. x 4. ---- 23
11. *D. pusillus* Clark. The holotype. x 6. ---- 24
12. *Acheilus levisensis* Clark. The holotype. x 10. ---- 25



Trilobites etc., from the Upper Cambrian boulders of the Lévis Formation

PLATE 4

Figure Page

1. *Solenopleura trunca* Clark. The holotype. x 3. ---------- 26
2. *S. laflammei* Clark. The holotype. x 2. ---------- 26
3. *Dikelokephalina broeggeri* Clark. The holotype. x 2------- 29
4. *Osceolia brevifrons Clark.* The holotype. x 3. ---------- 30
5. *Platycolpus marcoui* Clark. The holotype. x 2. ---------- 30
6. *Bayfieldia tumifrons* Clark. The genoholotype. x 2. ----- 31
7. *B. finkelnburgi* Clark. The holotype. x 2. ---------- 32
8. *Raymondina respecta Clark.* The genoholotype. x 3. ---- 35

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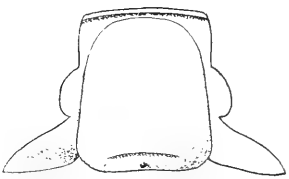

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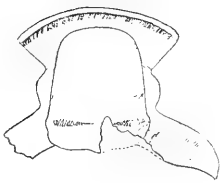

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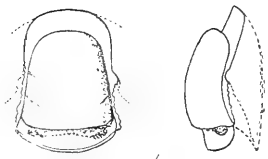

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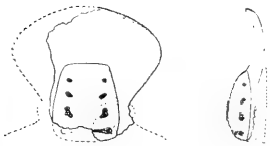

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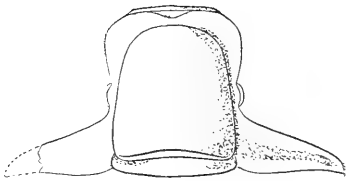

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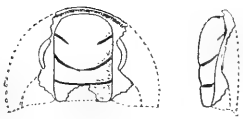

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8

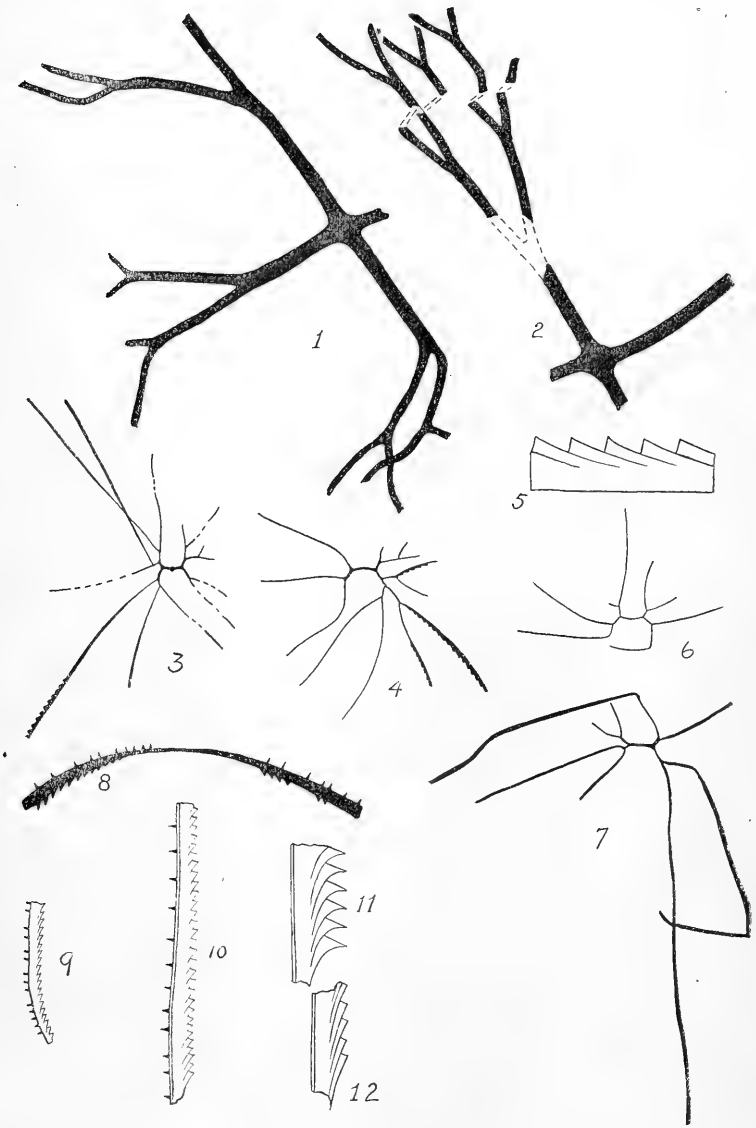
Trilobites from the Upper Cambrian boulders
of the Lévis Formation

PLATE 5

Figure — Page

1. *Calamograptus porrectus* Clark. Paratype, x ½ ---------- 62
2. *C. porrectus Clark.* The genoholotype, x ½
3. *Anomalograptus reliquus* Clark. Paratype. Actual size-- 64
4. *A. reliquus* Clark. The genoholotype. Actual size.
5. *A. reliquus* Clark. Enlargement of a portion of a branch showing the f orm of the thecæ. x 10.
6. *Dichograptus tenuis* Clark. The holotype. Actual size-- 64
7. *D. tenuis* Clark. Paratype. Actual size.
8. *Tetragraptus echinatus* Clark. A specimen showing two branches. Paratype M. C. Z. 508. Actual size---------- 65
9. *T. echinatus* Clark. Paratype M. C. Z. 509. Actual size.
10. *T. echinatus* Clark. The holotype. Actual size.

11, 12. *T. echinatus* Clark. Enlargements of portions of the branches to show the form of the thecæ; fig. 11 near the distal end, fig. 12 near the sicula. Both x 2.

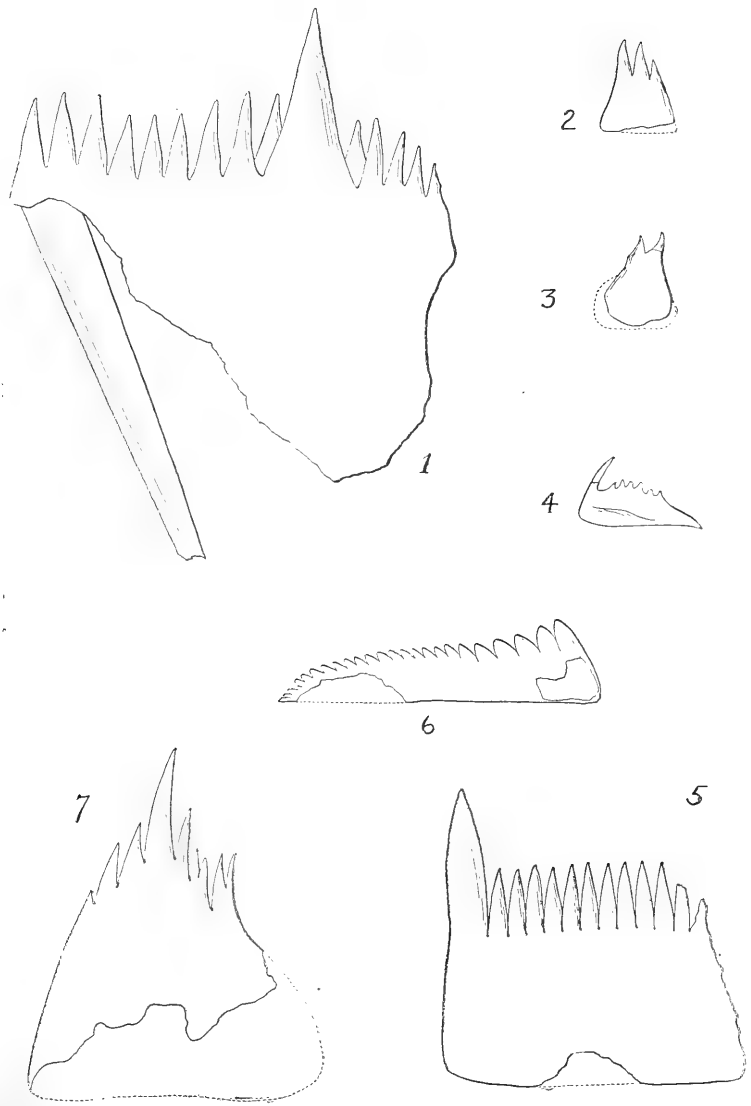


Graptolites from the Lévis shales

PLATE 6

Figure Page

1. *Prioniodus theron* Clark. The holotype. x 12 67
2. *P. melampus* Clark. The holotype. x 12 68
3. *P. dorceus* Clark. The h olotype. x 12 68
4. *P. lelaps* Clark. The holotype. x 12 69
5. *P. tigris* Clark. The holotype. x 12 69
6. *P. pamphagus* Clark. The holotype. x 12 70
7. *Polygnathus argos* Clark. The holotype. x 12 70

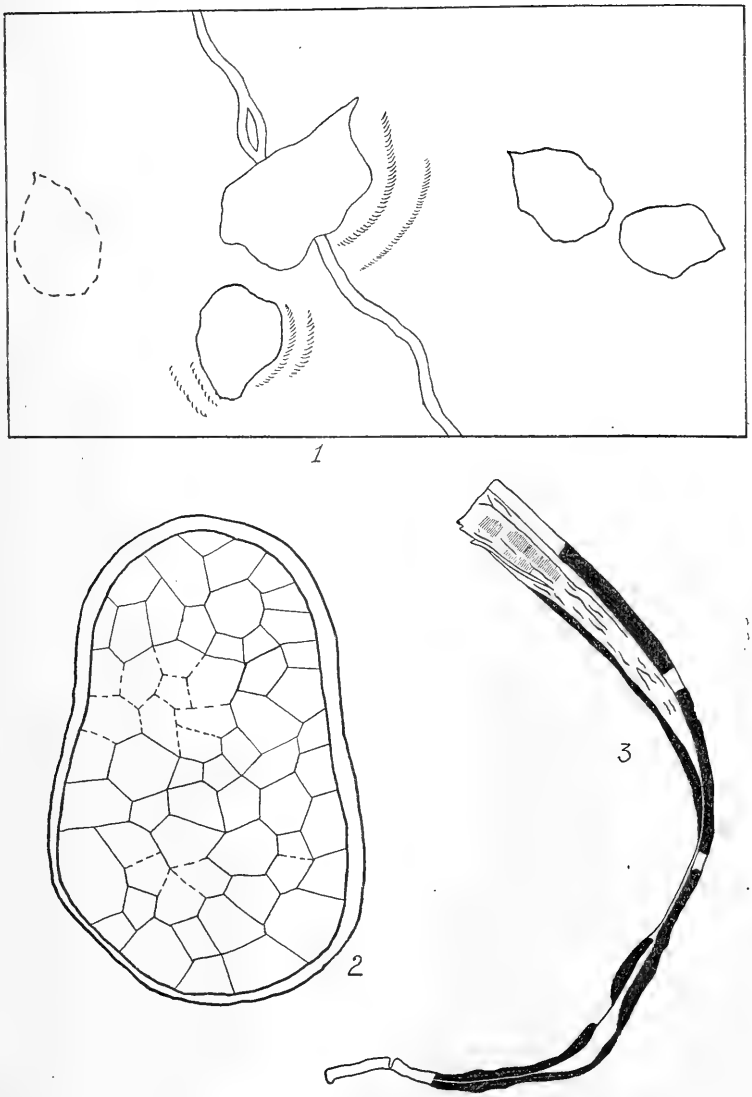


Conodonts from the Lévis shales

PLATE 7

Figure Page

1. Portion of a slab of sandstone from locality G, bearing four, possibly five specimens of *Aenigmatocystis brisa* Clark. x ½.
2. *Aenigmatocystis brisa* Clark. The genoholotype. x 2.5.__ 73
3. *Serpulites conflexus* Clark. The holotype. x 2.__________ 70



Fossils from the Lévis Formation

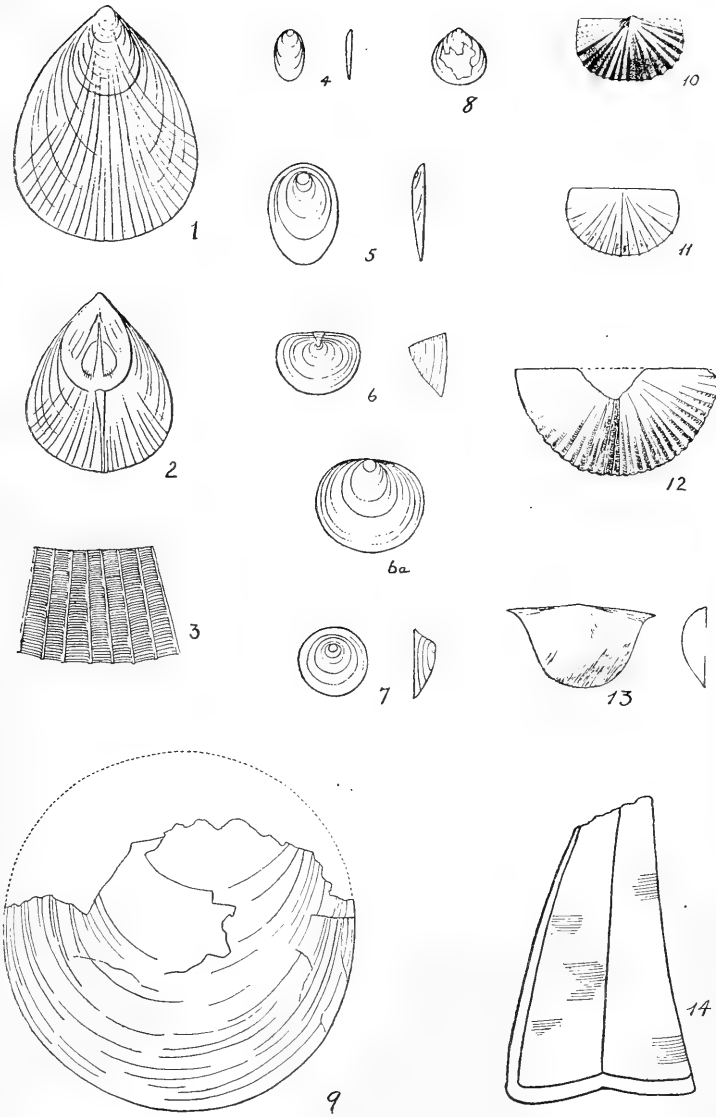
PLATE 8

Figure — Page

1. *Linguella raymondi* Clark. Holotype. x 2 — 76
2. *L. raymondi* Clark. Interior of specimen showing muscle scars. x 2.
3. *L. raymondi* Clark. Enlargement of striæ near anterior end of shell. x 7½.
4. *Leptobolus? incultus* Clark. Two views of the holotype. x 2. — 77
5. *Paterula westoni* Clark. Two views of the holotype. x 2.5 — 78
6. *Acrotreta polita* Clark. Two views of the holotype. x 2. — 79

6a *A. polita* Clark. The largest specimen. x 2.

7. *Acrotreta scarabeus* Clark. Two views of the holotype. x 2. — 80
8. *Linnarssonella zoar* Clark. The holotype. x 7½ — 80
9. *Eunoa vicina* Clark. The holotype. About natural size. — 81
10. *Eoorthis bigsbyi* Clark. The holotype. x 3. — 83
11. *E. bayfieldi* Clark. The holotype. x 6. — 82
12. *E. baddeleyi* Clark. The holotype. x 2. — 83
13. *Leptella exigua* Clark. The holotype. x 6. — 84
14. *Conularia pristina* Clark. The holotype. x 6. — 84



Brachiopods etc. from the Lévis Formation

PLATE 9

Figure — Page

1—6. *Shumardia granulosa* Billings. Figures 1 and 2 are cephala showing variation of form according to size. Figure 3 is the only specimen found with thorax attached. Figures 4—6 are pygidia of various sizes. M. C. Z. 1736- 1741. All x 12. 88

7. An appendage of a tribolite of an unknown species. M. C. Z. 1742. x 10.

8. *Peronopsis barrandei* Clark. x 4. 85

9. *P. marcoui* Clark. x 4. 87

10. *Seleneceme propinqua* Clark. The genoholotype. x 5. 90

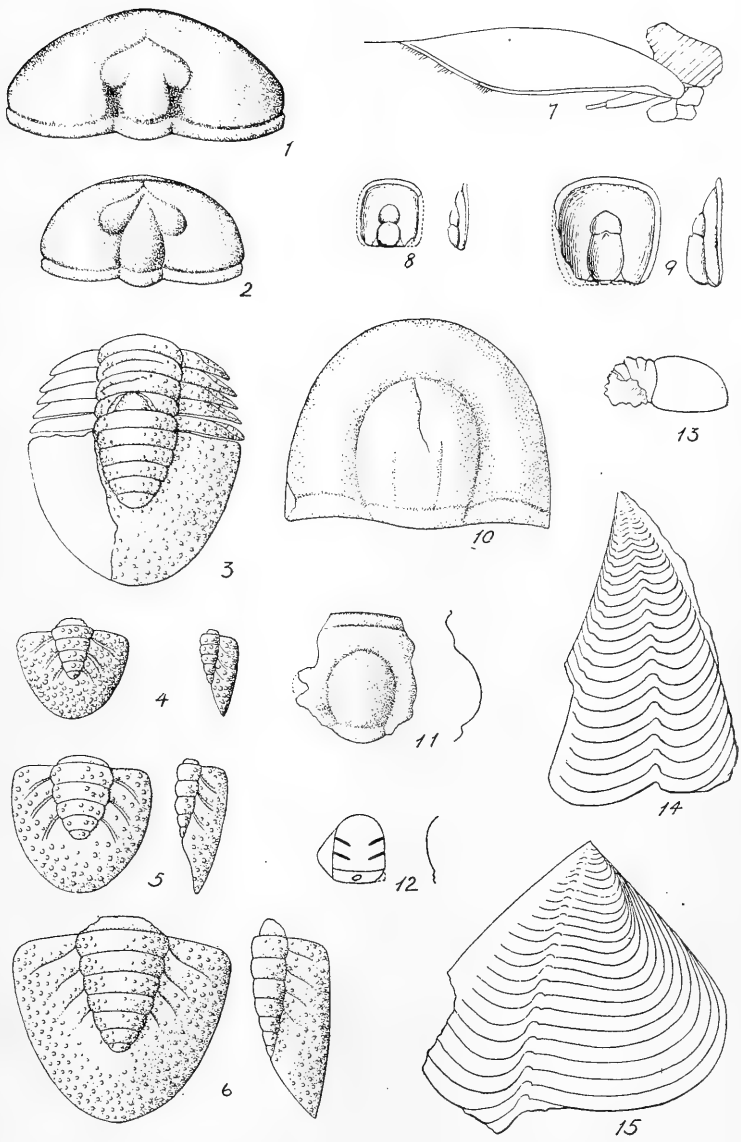
11. *Blountia piluloides* Clark. The holotype. x 12. 93

12. *Boeckia (?) descendus* Clark. The holotype. x 5. 91

13. *Leiocoryphe westoni* Clark. The holotype. x 6. 92

14. *Plumulites mobergi* Clark. The holotype. M. C. Z. x 10. 97

15. *? P. mobergi* Clark. A second plate probably belonging to this species. M. C. Z. 1744. x 10.



Trilobites etc. from the Lévis Formation

ERRATA

Obvious typographical errors, as "cepholopods" p. 3 and "pecular"p. 7, need no special mention here. The following corrections should be made:

Page 7, for (Locality 1) read (Locality I) ; same for p. 8
" 13, last line, read *A. americanus* Billings.
" 23, first line, omit "to".
" 25, botton, for **marconi**, read **marcoui.**
" 28, for Richardsonia read Richardsonella.
" 34, " *NORWOODIAE* read *NORWOODIDAE.*
" 40, " *O. everyone* " *O. euryone.*
" 42, " *Obelella* " *Obolella.*
" 53, " *typhus* " *typus.*
" 60, " *Saleneceme* " *Seleneceme.*
" 60 " *engelini* " *angelini.*
" 65 " Form or entire " Form of entire
" 80 " oxfoliation " exfoliation.
" 88, cross out "*C*" from "*SCHUMARDIIDAE*" etc.
" 109, for " progress, 1886-" read progress, 1868-.
" 110, " 1888 " 1879.

Omit on p. 69 "possesses a slight resemblance to the form just described although it"

Place on p. 56 beneath heading "Table.....Deep Kill, N. Y." the following terms:

ZONE	THICKNESS IN FEET	CHARACTERISTIC FOSSILS	RAYMOND'S ZONE

BULLETINS

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—*—

VOL. 10

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BULLETINS
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Vol. 10

No. 42

A FURTHER CONTRIBUTION TO THE PALEONTOLOGY OF TRINIDAD

(Miocene Horizons)

By CARLOTTA JOAQUINA MAURY

March 27, 1925

Harris Co.
Cornell University, Ithaca, N. Y.
U. S. A.

TO THE PUBLISHERS OF THE
BULLETINS OF AMERICAN PALEONTOLOGY
AND
PALÆONTOGRAPHICA AMERICANA

Dedicated by the Author
Who Has Watched with Admiration the Making
of These Publications
from Their Intrepid Inception
to Their Present Success:
Works for the Advancement of Paleontology,
Original and Fearless

Anno amicitiæ tricesimo

CONTENTS

STRATIGRAPHIC AND FAUNAL RELATIONS

Professor Gilbert D. Harris, of Cornell University, has for the last five years been actively engaged in geological field work on the Island of Trinidad, in the West Indies.

During this period, Professor Harris has made very large collections of fossils from all over the Island, finding many entirely new fossiliferous localities.

These collections have been made under the auspices of the Trinidad Oil Development Company, of which Mr. Gerald A. Waring has been the Geologist constantly in the field. We are greatly indebted to Mr. Waring for facilitating in every way the collection of the fossils.

Mr. Waring is about to publish a report on the general geology of the Island, accompanied by a very beautiful and detailed geological map.

All the specimens described in the present Memoir are from Professor Harris' collections. At his request, I have taken the Miocene and Pliocene forms. The Eocene and Oligocene will be described by Professor Harris and will be accompanied by detailed stratigraphic notes.

Since the publication of my first "Contribution to the Paleontology of Trinidad," in 1912,* a number of us have been devoting ourselves to geological investigations in the Antilles and northern South America. And the pioneer stratigraphic conclusions of that Memoir are now given with their positions revised.

The Soldado Formation.—Migration of mollusca during the early Eocene was comparatively free, as the commingling of Brazilian and Alabamian species in the fauna of Bed No. 2 of Soldado Rock, in the Boca de Serpiente, clearly indicates. This fauna I described in 1912, and in Science, 1925, I proposed the name Soldado Formation, as the type

* Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, pp. 23-112, pls. 5-13, 1912.

of all basal Eocene deposits of northern South America and of the Antilles. In the American Journal of Science, 1925, I referred to this Soldado horizon early Eocene beds of Margarita and Taos Islands. The extension of this basal Eocene deposit has also been traced on the mainland of Trinidad. But the first discovery of beds of this age in that whole region was on Soldado.

The age of Bed No. 6, Soldado Rock, characterized by Foraminifera, is now thought to be Upper (Jacksonian) Eocene; and that of Bed No. 8 either uppermost Eocene or, less likely, basal Oligocene. Its fauna is not very decisive.

The San Fernando and Farallon Rock Eocene.—The curious Annelid worm, *Serpula clymenioides* Guppy, which forms a coiled tube imitating a helicoid shell; and the Crustacean, *Ranina porifera* Woodward, of which the carapaces are preserved as fossils, are figured in my 1912 Memoir. Both these striking forms are in the San Fernando and Farallon Rock beds, and the latter is also in strata on the Island of St. Bartholomew (St. Bart's) in the West Indies. Hence these three deposits are correlated together. Dr. Guppy called them Eocene, and Harris, Vaughan and Woodring now place them in the Jacksonian stage of that period.

The partial isolation of Trinidad Miocene Faunas.—The Caribbean Series (Wall and Sawkins, 1860) of schists and gneisses form a great mountain crescent extending from northern Trinidad, on the other side of the Boca del Draco, through the Peninsulas of Paria and Araya; thence, after the Barcelona break, they form the splendid heights of Caracas and Valencia; and, leaving the coast, swing in a wide curve through Trujillo, Mérida and Táchera.

This mountain barrier has had an important effect on the Miocene faunas of western Trinidad in checking their free migration and tending to isolate them. This explains the limited number of species common to the Trinidad and to the Isthmian, Dominican, and Jamaican Miocene faunas.

Miocene Stratigraphic Sequence in Trinidad.—The fol-

lowing terms may be used to indicate the general stratigraphic sequence of the Trinidad Miocene faunas described in the present Memoir:

(1) Freeport-Todd's Road Miocene.
(2) Springvale Miocene.
(3) Brasso Miocene.
(4) Manzanilla Miocene.
(5) Machapoorie Miocene.
(6) Tamana Micene.

(1) In the western part of central Trinidad, in the Department of Caroni, on the Freeport-Todd's Road at Ward's Shack, near the third mile post; and on the Gomez Estate, 1¾ miles southwest of Todd's Railway Station, are outcrops with *Arca patricia* Sowerby.

Under the description of this great Arca (the ancestor of *A. grandis*) a full discussion is given regarding its probable age. So that it is sufficient to note here that the stratigraphic indications in Trinidad, as in the Dominican Republic, point to a high horizon in the Miocene. Professor Harris is certain from field observations that the *Arca patricia* horizon on Todd's Road lies well above the Springvale Miocene.

(2) The Springvale beds are in west Central Trinidad, Department of Caroni, on a spur of the Montserrat Mountains, near Couva. This splendid collecting ground was first found by Dr. Guppy, in 1910, who then invited me to accompany him on a visit to the quarry; but, to my great regret, this was not possible. Dr. Guppy described a number of new species from Springvale. This, indeed, was his last paleontological work.

Professor Harris and Mr. Liddle recently made large collections from the Springvale beds, their fossils being herein described. This fauna is remarkable for the great size and exuberant vigor of the species. Conditions must have been ideal for molluscan growth. Giant members of the genera *Modiolus, Amusium, Marginella, Xancus, Ancilla*

and *Oliva* were present. But above all the most striking is the huge *Dosinia*—among fossil species comparable only with the great *Dosinia grandis* of the Zorritos Miocene of Peru; and with the living, Pacific shell, *D. ponderosa*.

On the east coast of the Island is a lignitic horizon equivalent stratigraphically to the Springvale. This lignitic, eastern phase affords a number of fossiliferous outcrops in the Department of St. Andrew, as at 600 feet north of Pointe Noir; ¼ mile north of Point Paloma; an unnamed headland north of Manzanilla, towards the mouth of the Oropuche River; and ½ mile south of the mouth of the Oropuche. These four stations are thought by Professor Harris to be all about synchronous. For convenience, I have called them in this Memoir the Pointe Noir beds. Dr. Guppy also thought the outcrop at Pointe Noir equivalent to the western Savanetta beds of Caroni.

(3) Collections were made from Brasso Miocene beds at ½ mile above Brasso Station, in the southeastern part of the Department of Caroni; Brasso Junction, 2 miles east of Brasso; E 24; top of the Brasso section No. 284; and the Junction of the Mayo and Couva main roads.

The Brasso Miocene is allied to the Manzanilla, of which it may, perhaps, be regarded as an upper member. This has been done by Mr. Waring. But I would rather keep them separate, and refer the Brasso to the Gatun and Gurabo formations of the Middle Miocene; and the Manzanilla to the Cercado formation of the Lower Miocene.

The Brasso shows its alliance with the Dominican Gurabo and to the Jamaican Bowden beds by the presence of the Middle Miocene species, *Arca inæquilateralis*, common to all three. To the Gatun beds of Costa Rica it is allied by the presence in both of *Arca pittieri* var. *narivana*.

(4) The original fossiliferous locality of the Manzanilla Miocene is Manzanilla Bay, on the eastern coast of Trinidad, in the southern part of the Department of St. Andrew. All of Dr. Guppy's Manzanilla fossils were

obtained from that vicinity.

Professor Harris has made extensive collections from many stations on both sides of Manzanilla Point and southward along the Bay. But, in addition, he has discovered new fossiliferous outcrops of the Manzanilla horizon—as at 3½ miles south of Brasso; Brasso Venada Ravine; Brasso Creek; 11th mile post on Caparo Road; Guaico-Tamana Road, 7¾ and 8½ miles on; bridge at Tamana road Junction; northeast corner of F. 16 in eastern Trinidad; and E 24.

By such a characteristic fossil as *Arca* (*Cunearca*) *filicata* Guppy, the Manzanilla horizon is traced across from Manzanilla Point on the east coast, through central E 24, southwest E 24 (west central part of the Island) to the 11th mile post on Caparo road. In a similar manner, *Arca trinitaria* Guppy is followed from the type locality on the west side of Manzanilla Point, and many stations on Manzanilla Bay to west central Trinidad (E 24), and northwestern H 3, and the 11th mile post on Caparo Road. Other Manzanilla species are also found in the Brasso Venada Ravine and in Brasso Creek, but in the Creek they are not *in situ*.

So that the Manzanilla has been found to extend, brokenly, from the northeast coast southwest to the vicinity of Brasso.

Dr. Guppy's most important publication relating to the Manzanilla deposits is in the Quarterly Journal of the Geological Society, London, vol. 22, pp. 570-590, pl. 26, 1866. In this he referred these beds to the Lower Miocene; in 1890, he called them Eocene, but in 1913, said again that they might be Lower Miocene.

That they are Miocene is certain for associated with the characteristic Manzanilla species described by Guppy, we have found familiar Dominican Miocene species, as *Drillia henekeni, D. consors, Mitra longa, Mitra henekeni,*

Turris albida, and others.

(5) Collections of Machapoorie Miocene were made from Machapoorie quarry; Poole River (East Central Trinidad) ; Fossil Ravine (Central Trinidad) ; Eastern E 24; Guaico-Tamana Road, 13th mile post; Brasso-Tamana road near the 4½ mile post; Brasso Valley in an outcrop beneath the Manzanilla Miocene beds exposed there. It is probable that Dr. Guppy's Corosal *Cadulus* (*"Ditrupa"*) bed belongs also in the Machapoorie.

The fauna of the Machapoorie is in the form of casts. The most striking and characteristic forms are a high, narrow *Cardium* and the great *Pholadomya walli.* The latter is broken, but I have seen magnificent specimens, evidently the same species, as large as a man's fist, from Venezuela.

The stratigraphic position of the Machapoorie is proved by the Brasso Valley exposure where it is seen underlying the Manzanilla.

(6) Fossils of the Tamana horizon were obtained from Eastern E 25, Central E 25 (both in the northwestern part of the Department of Nariva) ; Mendozo quarry; Central E 24; and 8½ miles on the Tabaquite Road, the last two localities being in the southeastern part of the Department of Caroni, and the last station very near the Tabaquite oil fields. The Tamana fossils are all casts.

The Godineau River Miocene.—A mile west of the Godineau River, on the shore of the Gulf of Paria, about midway between San Fernando and La Brea, is a decayed, white limestone containing internal molds of large molluscs. These were first discovered by Dr. A. C. Veatch, and in my 1912 Memoir, I thought the molds probably of fresh water species and of *Unio*-like form. Later Miss Van Winkle made very careful studies of the traces of hinge structure of certain molds and concluded marine forms were present, as *Thyasira, Solariella* and a new genus *Pleurophopsis* (see Bulletin American Paleontology, No. 33, pp. 23-27, 1919). Subsequently Professor Harris made further collections

from the Godineau River beds and will later publish his conclusions.

Apparently these beds contain a mixed fauna of fresh-water and marine origin, and presumably were deposited where a river entered the sea. They appear to be about Middle Miocene in age.

A similar intermingling of river and sea shells is found in the Oligocene (?) deposits of the Angela Elmira asphalt mine, near Bejucal, Cuba, where *Unio, Hemisinus, Cypræa, Solemya* and other genera are present.

Remarks on the Oligocene and Miocene of the Antilles.—In my 1912 Trinidad Memoir (Journal Academy Natural Science Philadelphia, 2nd ser., vol. 15, pp. 23-112, pls. 5-13), I followed the American usage, established by Dr. Dall in 1896 (Proceedings U. S. National Museum, vol. 19, p. 303), and 1903 (Transactions Wagner Institute Science, vol. 3, part 6), of calling the Antillean beds of Bowden and of Gatun age, and the Chipola beds of Florida, Oligocene. The Americans then called all Antillean beds above the Eocene and below the Pliocene Oligocene, and the English called them all Miocene.

But in 1917, I differentiated the Oligocene and Miocene in the Antilles (Bulletin American Paleontology, No. 30 and Correlation at close) and divided the Dominican Miocene into Middle and Lower, the former represented by the Gurabo and the latter by the Cercado formations.

In 1917, I also put the Gatun beds with *Sconsia lævigata* in the Middle Miocene, along with the Gurabo, because that shell is very characteristic of those beds. This paleontological conclusion was later proved stratigraphically when in 1922, Mr. Olsson found that the Uscari beds of Costa Rica belong in Lower Miocene, beneath the Middle Miocene of the *Sconsia* Gatun beds. He also differentiated a higher, Upper Miocene, phase of the Gatun. (See Bulletin American Paleontology, No. 39, 1922.)

In studying the Tertiary fossils of Porto Rico, collected

by Dr. Chester A. Reeds, Curator Department of Geology, American Museum of Natural History, I correlated the Quebradillas limestone as Lower to Middle Miocene, because while it had the Bowden and Dominican faunas, it was not decisively with the Gurabo or with the Cercado, but had forms common to both. (See American Journal of Science, vol. 48, pp. 212, 214, 1919; also Scientific Survey Porto Rico, vol. 3, part 1, pp. 3-5, and Correlation Table, 1920). Mr. Bela Hubbard later referred the Quebradillas limestone to the Upper Oligocene (Survey Porto Rico, vol. 3, part 2, 1921; also Science, new series, vol. 51, No. 1320, p. 5, 1920). I am very sure that this is erroneous, and think that Mr. Hubbard was deceived by some internal molds.

I am certain that the Lower Miocene is the basal limit of the Quebradillas and it may very likely be found to go with the Bowden, in Middle Miocene.

The Miocene Flora of Trinidad.—Dr. Hollick has described (Bull. New York Botanic Garden, vol, 12. No. 45, 1924) a number of Angiosperms from the porcellanite quarry of Siparia, Trinidad. This is situated on the southern coast of Trinidad, in the southeastern part of the Department of St. Patrick, and the quarry is about 5 miles inland. Apparently Dr. Hollick does not give the horizon, but Professor Harris, who has been on the field, says it is probably Miocene. In the Siparia palæoflora Dr. Hollick found a leaf of *Musa* or *Musophyllum* that he named *trinitense,* which is of special interest as throwing light on the original habitat of the banana (*Musa sapientum*), of which the Siparia species seems an ancestral form ,and suggests a New World nativity of this important genus. There were also a number of species of the fig genus (*Ficus*); *Cassia sipariensis; Clusia vera;* and the myrtle, *Myrcia pseudorostrata.* In the Bluff North of Moruga, south Trinidad, are leaves of *Inga pseudonobilis.*

Dr. Hollick writes (page 321, *loc. cit.*) : "We may infer, therefore, that the West Indian Tertiary flora, in its generic

elements, was identical with the existing flora of the same region, and that a majority of its specific elements were so closely similar to certain existing species of the islands and the adjacent mainland of North America, Mexico, Central America, and South America that it is almost impossible to differentiate between them. . . . Evidently the flora of the region has undergone very little change or modification during the entire period of time that has elapsed since the Tertiary flora flourished there, and this indicates, conclusively, that climatic conditions must have been uniform throughout the same period and practically the same as those that now obtain in the region."

Affinities and correlation of the Trinidad Palæofaunas.— In a recent article on "Venezuelan Stratigraphy" in the American Journal of Science, I correlated certain Venezuela horizons with those of Trinidad. Thus in the Cretaceous, the Cenomanian Rudistid fauna of Pointe-à-Pierre (described in 1922 by Professor Harris), I correlated with the Rudistid limestone of Cumanocoa and between that town and El Pilar, in the State of Sucre, Eastern Venezuela. With the Basal Eocene Soldado formation of Soldado Rock, Bed No. 2, I placed the Margarita and Taos Island Eocene beds. The Upper Eocene *Lepidocyclina* beds of Bontour Point go with those of Rio San Pedro, in Trujillo, and the Las Palmas beds, Lake Maracaibo, and with the Farallon Rock and San Fernando, Trinidad, *Serpula clymenioides* and *Ranina porifera* beds; and with the foraminiferal horizon, Bed No. 6, of my 1912 Memoir.

The Miocene mollusca of Trinidad show a relationship to synchronous faunas of Venezuela, Central America, and the Antilles, but the number of species in common is rather surprisingly limited. As already noted, this is to be explained by the presence of the partial mountain barrier inducing isolation and checking free intermigration.

Judging from faunal affinities, the following grouping of the Trinidad Miocene fossiliferous beds and their equivalency is suggested:

UPPER MIOCENE—

1. Freeport-Todd's Road and Gomez Estate beds with *Arca patricia;* Union Estate, Brighton, *Ostrea* beds; Brighton southern road south of Pitch Lake, fossiliferous ferruginous marls.

Equivalent to the Yabelito beds with *Arca patricia,* State of Falcon, Venezuela; to the Botanic Station beds of Tobago Island with *Arca patricia;* and to the Cerros de Sal *A. patricia* horizon of the Dominican Republic.

2. The Springvale and Savanetta beds of western Trinidad and the equivalent lignitic phase represented by the Pointe Noir beds of eastern Trinidad are decidedly lower members of the Upper Miocene than the *Arca patricia* horizon. Distinctive Springvale fossils are *Dosinia titan,* resembling *D. grandis* of the Zorritos Miocene of Peru, and *Modiolus waringi.*

3. Lower Springvale blue clays are seen west of Brasso Junction, stratigraphically 75–100 feet above the limestone forming the top of the Brasso series. This change in sedimentation was accompanied by a marked change in the *Turritella* fauna. *Turritella altilira* var. *tornata* and its mutations, exceedingly abundant in the Machapoorie, Manzanilla and Brasso, suddenly declines, becomes rare, and vanishes after the Springvale; while *T. planigyrata* gains the ascendancy, prevails in the Springvale and leaves a modern descendant, *T. variabilis* var. *meta,* living on the Trinidad shores.

MIDDLE MIOCENE—

Brasso Miocene with *Arca inæquilateralis* and *A. pittieri* var. *narivana.*

Equivalent to the Gurabo formation, Dominican Republic; Bowden beds, Jamaica; the Gatun of the Isthmus and Costa Rica; the Cumana, Venezuela, beds with *Arca cumanensis* and *A. tolepia;* certain fossili-

ferous beds of eastern Zulia in western Venezuela; and to the Cartagena beds of Colombia.

The Godineau River beds, southwest of San Fernando, Trinidad, with a mixed freshwater and brackish fauna, including *Unio*-ike molds and *Thyasira*, may also be placed in Middle Miocene, but the evidence of the fauna is inconclusive.

LOWER MIOCENE—

1. The Manzanilla Miocene affords many species peculiar to itself; but in addition contains many characteristic Dominican forms which indicate alliance with the Cercado formation, Dominican Republic; and to the Los Quiros beds, western Venezuela, in the eastern part of the State of Zulia.

2. The Machapoorie Miocene beds are shown to be stratigraphically lower than the Manzanilla in a Brasso Valley section where they are seen overlying the latter.

3. The Tamana Miocene constitutes the basal member of the Miocene series of Trinidad.

Pliocene Stratigraphic Sequence in Trinidad.—The following sequence and equivalency of Pliocene deposits in the eastern and western parts of Trinidad is suggested:

PLIOCENE OF TRINIDAD

UPPER PLIOCENE

Western	*Eastern*
Asphaltic marl near Brighton pier. Fauna marine.	Matura Bay deposits. Fauna marine.

LOWER PLIOCENE

Cedros Point beds, Esperanza Bay, in southwestern Trinidad; and Pointe Cou-	Comparo Road beds, near Sangre Grande, northeastern Trinidad. Freshwater

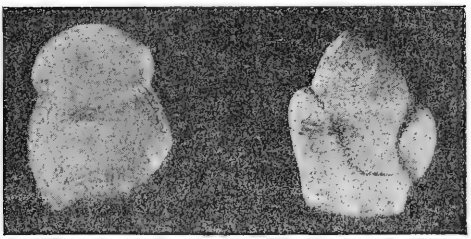
baril beds near Brighton. Both deposits with freshwater faunas.	fauna. Probably equivalent to the Pliocene-Late Miocene, Pebas beds, of the Upper Amazon.

Hemisinus Faunas of the Antillean Tertiary.—The presence of various species of the river shell, *Hemisinus*, in Tertiary deposits of Antigua, Cuba, Dominican Republic and Trinidad, is of interest as throwing light on ancient connections of the Antilles with the main land; and as indicative of the presence of Tertiary Island rivers of considerable permanency. There are four species in the Antiguan Oligocene, and two in the Bejucal beds of Cuba. *Hemisinus truncatus* (*Ectracheliza truncata* Gabb) is the large Dominican representative of this genus in Tertiary time. All these species like the *Hemisinus* of Comparo Road, Trinidad, show strong affinities with Brazilian and other South American living river species, and suggest a former land connection of the Antilles with South America, the ancestral home of *Hemisinus.*

The Hyria Fauna of Cedros Point.—From southwestern Trinidad we have a freshwater mussel of the interesting genus *Hyria,* characteristic of the Neo-tropical Province, and represented by only a few species. The Cedros Point shell is evidently ancestral to the genotype, *Hyria corrugata.*

With the *Hyria* is a *Corbicula* identical with that of Comparo Road ,suggesting the equivalency of these deposits.

It is quite probable that these Lower Pliocene freshwater faunas of Trinidad were living at about the time that the Pebas beds of the Upper Amazon were forming—when the mouth of the Amazon was several thousand miles to the westward of its present position, and the now majestic river was short and comparatively insignificant.



Fetish-like clay concretions from the Turonian of Venezuela. Collected by the author on the Hurupu Trail near Guanoco. Similar ones were placed by the Venezuelans on the arms of a votive cross in the forest wilderness.

DESCRIPTIONS OF SPECIES

MOLLUSCA

CLASS PELECYPODA

Genus *NUCULA* Lamarck

Subgenus *ACILA* H. and A. Adams

Nucula (Acila) schomburgki Forbes

Nucula schomburgki Forbes, 1846, In Schomburgk's History of Barbados, p. 565.
Nucula schomburgki Guppy, 1867, Geol. Mag., London, pp. 497, 498, 500, fig. 5.
Nucula schomburgki Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Nucula schomburgki Guppy, 1874, Geol. Mag., p. 442.
Nucula schomburgki Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 170, pl. 7, fig. 10; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 91, pl. 5, fig. 10.
Nucula schomburgki Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 573.

This species is at once recognized by its divaricating sculpture, characteristic of the subgenus *Acila*. The radials divaricate along an oblique line passing across the center of

the disc from the beak to the base. The shell is thick and nacreous, and the lunule impressed but not circumscribed. Examples vary considerably in length and altitude but Guppy's figure represents the shell as 14 x 9 mm.

Sir Robert Schomburgk first discovered this species on the Island of Barbados, and it was described by Prof. Forbes in 1846. It was rediscovered by Dr. Guppy in 1867 in a greenish-gray shale at San Fernando, Trinidad.

It is entirely unlike in both form and sculpture Gabb's *Acila tuberculata* from the Dominican Miocene.

All living members of the subgenus *Acila* are Pacific in their distribution. The last inhabitant of Atlantic waters was the Pliocene *Acila cobboldiæ* of the British Crag. To this and to the recent Pacific species, *A. divaricata,* the Trinidad and Barbados shell is most closely allied. The sculpture is also somewhat as in *Acila cordata* Dall from the Miocene of Oregon.

Locality.—San Fernando, Trinidad (Guppy).

Horizon.—Dr. Guppy thought the age Eocene. It is probably Upper Eocene, about equivalent to the Jacksonian of the Gulf States. The horizon is, however, somewhat doubtful, as the stratigraphy at San Fernando is most complex and involved.

Subgenus *NUCULA, sensu stricto*

Nucula baccata Guppy Pl. 12, Fig. 5

Nucula baccata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 163, 174; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 42, 53.
Nucula baccata Guppy, 1874, Geol. Mag., London, 2d ser., vol. 1, p. 443, pl. 18, fig. 7.
Nucula baccata Guppy, Proc. Sci. Assoc. Trinidad, vol. 2, p. 171, pl. 7, fig. 12; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 92, pl. 5, fig. 12.
Nucula baccata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 577.

Shell small, sub-ovate, oblique, posteriorly slightly produced, anterior and posterior ends angulate; surface ornamented with fine concentric lines decussated by delicate

radial striæ, interior pearl-shining; hinge-teeth divided by a very oblique pit; inner margins of shell finely crenulate. Guppy's specimen measured 7 mm. in length and 5.5 in height. Ours is also 7 x 5. Type locality, Matura.

A charming little shell, of the *Nucula obliqua* and *similis* group. A striking feature is its marked angularity anteriorly and posteriorly.

Locality.—Matura.
Horizon.—Upper Pliocene.

Nucula vieta Guppy

Nucula vieta Guppy, 1867, Proc. Sci. Assoc. Trinidad, pp. 163, 174; Harris' Reprint, 1924, Bull. Amer. Paleont., No. 35, pp. 42, 53.
Nucula vieta Guppy, 1874, Geol. Mag., London, p. 443, pl. 18, fig. 8.
Nucula vieta Guppy, 1878, Proc. Sci. Assoc. Trinidad, p. 171, pl. 7, fig. 11; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 92, pl. 5, fig. 11.

Shell very small, obliquely-trigonal, with concentric rounded ribs, posterior side slightly produced, very oblique; anterior side short, with few and small teeth; posterior teeth straight. Margins dentate. The largest specimens were 3.5 mm. in height, and 3 in length.

Locality.—Matura, Trinidad.
Horizon.—Upper Pliocene.

Nucula crosbyana Guppy

Nucula crosbyana Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 170, pl. 7, figs. 3, 3a; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 91, pl. 5, figs. 3, 3a.

Oval-elliptical, subequilateral, thin, smooth, shining, faintly marked with concentric riblets; ends rounded, beaks small, hinge teeth about 12 in front of the ligamental pit and 15 behind it. Length 16, height 8.5 mm.

Locality.—Gulf of Paria, Trinidad. (Guppy.)
Horizon.—Recent.

Genus *LEDA* Schumacher

Dr. Guppy took a special interest in the *Ledidæ* and

described a number of Miocene and Recent species. The latter are brought together here for the sake of completeness, but I have not seen the specimens, the figures are inadequate, and I do not feel certain that in all cases his recent species are valid. It is possible that some may fall in synonymy.

Leda illecta Guppy Pl. 12, Fig. 2

Leda illecta Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 174; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 53.
Leda illecta Guppy, 1874, Geol. Mag., p. 442.
Leda illecta Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 173, pl. 7, fig. 5; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 94, pl. 5, fig. 5.
Leda illecta Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

Shell small, inflated, appearing smooth, but showing under a lens very fine, close and delicate concentric striations; posterior end produced into a rostrum which is slightly curved upwards, giving, with the tumid form, a somewhat pear-shaped aspect to the shell. Length of type 10, height 6 mm.

We have a large number of specimens from the type locality and its vicinity. The shells vary in length from 3.5 to 10 or 15 mm., the latter being 7 mm. in height and unusually large.

This species resembles *Leda eburnea* Sowerby, but the posterior end is longer and more curved.

Locality.—Manzanilla Bay at many collecting stations.
Horizon.—Manzanilla Miocene.

Leda guppyi Dall Pl. 12, Fig. 3

Cercomya ledæformis Guppy, 1866, Quart. Jour. Geol. Soc., London, vol. 22, p. 581, pl. 26, fig. 1.
Cercomya ledæformis Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Cercomya ledæformis Guppy, 1874, Geol. Mag., London, p. 441.
Leda guppyi Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 239.
Leda guppyi Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

An elongate, inequilateral, thin species, with fine con-

centric, raised lines which at the posterior carination may rise into small points. Anterior end rounded, posterior rostrate, dorsal margin concave posteriorly. Length of type 24, altitude 9 mm.

The hinge of the type was concealed which misled Dr. Guppy as to the genus, and the shell was renamed by Dr. Dall.

Our shells measure 23 x 7.5 and 24 x 9 mm. In one example over 20 of the anterior series of teeth extend beyond the matrix and are seen to be strong and long for this delicate, much flattened shell. The posterior area bears two carinæ, the uppermost bordering the dorsal area.

Locality.—Manzanilla (type locality) and vicinity.
Horizon.—Manzanilla Miocene.

Leda peltella Dall

Leda acuta Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 255.
Not *Leda acuta* Conrad, 1831, Amer. Marine Conch., p. 32, pl. 6, fig. 1. Not *acuta* Sowerby, 1837.
Leda acuta Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 172, pl. 7, fig. 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 93, pl. 5, fig. 8.
Leda peltella Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 579, pl. 32, fig. 5.
Leda acuta Guppy, 1912, Agric. Soc. Trinidad and Tobago, Paper No. 520, p. 4; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 187.
Leda peltella Maury, 1917, Bull. Amer. Paleont., No. 29, p. 161, pl. 26, fig. 9.

A short, high species, with nearly central beaks, a very convexly rounded basal margin, short, sharp posterior end; and fine concentric sculpture. I have thousands from the Dominican Miocene. They run from about 6–8 mm. in length. Also found at Bowden, Jamaica, and Dr. Guppy recorded it from Trinidad.

The species was renamed by Dall because *acuta* is preoccupied by Conrad's Recent to Pleistocene species, living on both our Atlantic and Pacific coasts.

Locality. — Corosal Road *Cadulus* bed, Trinidad (Guppy coll.).

Horizon. — Perhaps equivalent to the Machapoorie Miocene.

Leda packeri Forbes

Leda packeri Forbes, 1846, In Schomburgk's Hist. Barbados, p. 565.
Leda incognita Guppy, 1867, Geol. Mag., pp. 500, 501, fig. 1.
Leda incognita Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Leda packeri Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 172, pl. 7, fig. 9; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 93, pl. 5, fig. 9.
Leda packeri Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

Ovate, with rounded concentric ribs; rostrated posteriorly. Lunule and posterior dorsal area broad, distinct, circumscribed by the keels which run from the umbones to the extremities. Length 8.5, height 5 mm.

Dr. Guppy's *Leda incognita* was based on on a single specimen from San Fernando. In 1878, he thought this specifically identical with Forbes' Barbados species, *L. packeri.*

Localities.—Barbados and San Fernando, Trinidad (Guppy).

Horizon.—Thought by Guppy to be Lower Miocene.

Leda montserratensis, n. sp. Pl. 12, Fig. 1

Shell transversely subelliptical, greatly compressed, subequilateral, the low and inconspicuous beak being only a little nearer the anterior than the posterior end; dorsal area defined by a linear ridge. Surface of shell marked with occasional, inconspicuous, concentric lines indicating slower growth stages, and sculptured with a far more noticeable series of close, regularly spaced transverse lines which are not parallel to the concentric growth lines but are subparallel to the hinge, cutting across the lower face of the valve and terminating one by one at the basal posterior margin. This feature is very marked and recalls the striations across the face of the disc in the Jacksonian shell, *Leda multilineata* Conrad. The hinge line is very straight. Hinge

teeth concealed by matrix. Length of valve 18, altitude 7 mm.

Locality.—In blue shaly clay, ½ mile above Brasso Station, No. 302.

Horizon.—Lower Springvale Miocene.

Leda clara Guppy

Leda clara Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 87; Harris' Reprint, 1921. Bull. Amer., Paleont., No. 35, p. 71.
Leda clara Guppy, 1874, Geol. Mag., p. 442, pl. 17, figs. 1, 1a; Idem, 1875, p. 42.
Leda clara Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 172, pl. 7, fig. 4; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 93, pl. 5, fig. 4.
Leda clara Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

This species is nearly equilateral, somewhat rostrated, disc smooth and shining. A few close, regular, concentric riblets are present near the indistinct anterior sulcation. Lunule narrow, weakly defined. Beaks prominent. Posterior carina obscure. Length of shell 12, height 6, diameter 4 mm.

The shell is larger and less acutely rostrate than *L. vitrea*. In general shape Guppy compared it with *sapotilla* Gould. But that is fully twice as large, a New England shell, and a *Yoldia*. *Leda clara* has not been reported from Trinidad.

Locality.—Bowden, Jamaica.

Horizon.—Middle Miocene.

Leda indigena Dall

Leda bisulcata Guppy, 1867, Geol. Mag., London, p. 500, fig. 2.
Not *Leda bisculcata* Meek, 1861.
Leda bisulcata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Leda bisulcata Guppy, 1874, Geol. Mag., p. 442.
Leda bisulcata Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 173, pl. 7, fig. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 94, pl. 5, fig. 7.
Leda indigena Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

Dr. Dall renamed this species, because *bisculcata* had

been preoccupied by Meek six years before Guppy named his shell.

This species is about the size of *L. peltella*, attaining a length of 8 or 9 mm., but the posterior end is more produced, and the valve is marked by a posterior ridge and an anterior furrow—the anterior sulcation resembling that in d'Orbigny's figure of his *L. jamaicensis*. The concentric riblets are much finer than in *peltella*. Teeth very prominent.

Locality.—Bowden, Jamaica.
Horizon.—Middle Miocene.

Leda perlepida Guppy Pl. 12, Fig. 4

Leda perlepida Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 163, 173; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 42, 52.
Leda perlepida Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 87; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 71.
Leda perlepida Guppy, 1874, Geol. Mag., London, p. 442, pl. 18, fig. 9.
Leda perlepida Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 172; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 93.
Leda perlepida Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 579.

Original description.—"Transversely oval, subinequilateral, moderately convex, with numerous fine, concentric striæ and occasional deeper and wider concentric furrows; posterior end acutely rostrate; lunule none; dorsal area elongate-lanceolate, longitudinally striate; hinge-teeth numerous, chevron-shaped, widely interrupted beneath the umbo by a large hinge-pit."

The shell thus described was from the Matura Pliocene. But in 1878 Dr. Guppy placed his *perlepida* in the synonymy of *vitrea* d'Orbigny, of the recent fauna.

But we have from Matura a charming little shell, well-meriting the name *perlepida*. The surface is very delicately, microscopically striate, with three or four conspicuous deep, wide furrows and corresponding rounded ridges on the face of the valve. This specimen is 3 mm. long and 2 mm. high. Guppy's figure of *perlepida* measures 8 x 5 mm., so ours is

a young shell, although his figure may be slightly enlarged.

This species is readily distinguished from *L. vitrea* by its furrowed surface.

Locality.—Matura.

Horizon.—Upper Pliocene.

Leda vitrea d'Orbigny

Leda vitrea d'Orbigny, 1845, In de la Sagra's Historia Fisica, Politica y Natural de la Isla de Cuba, pt. 2, vol. 5, *Moluscos*, p. 310, Atlas, pl. 26, figs. 27–29.
Leda vitrea Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, pp. 169, 192, pl. 7, fig. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 90, 93, pl. 5, fig. 6.
Leda vitrea Dall, 1898, Trans. Wagner Inst. Sci., vol. 3 ,p. 579.

Shell ovate, moderately inflated, shining white and glassy, surface finely, concentrically ribbed; anterior end rounded; posterior produced, carinated, rostrate. Length of type 6 mm. D'Orbigny's specimens were from Martinique and Santo Domingo.

This species shows no broad concentric furrows which are such a marked feature in *L. perlepida.*

Dr. Dall in 1898, united *L. milleri* Gabb with d'Orbigny's *vitrea.* And in 1878, Dr. Guppy placed his *perlepida* in the synonymy *of vitrea,* but they differ very markedly in sculpture and appear to me entirely distinct species.

Locality.—Gulf of Paria, Trinidad. Dredged. (Guppy coll.)

Horizon.—Recent.

Leda jamaicensis d'Orbigny

Leda jamaicensis d'Orbigny, 1845, In de la Sagra's Historia Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 310, pl. 26, figs. 30–32.
Leda jamaicensis Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, pp. 169, 173; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 90, 94.

A small, ovate species, concentrically striate, short and rounded anteriorly, and bearing an anterior radial sulcation; posteriorly produced, carinated and pointed. The type

was somewhat over 3 mm. in length, and was found in the Antilles.

In 1920 (Bull. Amer. Paleont., No. 34, p. 6) I followed Dr. Dall in uniting this species with *Leda acuta* Conrad (not *acuta* Gabb, which is *peltella* Dall). But Conrad's species (Amer. Mar. Conch., p. 32, pl. 6, fig. 1, 1831; Foss. Medial Tert., p. 57, pl. 30, fig. 2, 1845) is more rostrate and more recurved posteriorly than d'Orbigny's shell, and the latter has a strong anterior sulcation, which our specimens of *acuta* do not show.

Guppy's Trinidad shells did not exactly correspond to d'Orbigny's type but he thought them referable to this species.

Locality.—Gulf of Paria, Trinidad. Dredged by Dr. Guppy.

Horizon.—Recent.

Leda egregia Guppy

Leda egregia Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, p. 174, pl. 7, figs. 1, 2; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 95, pl. 5, figs. 1, 2.

Large, lanceolate, narrow, ivory-shining, inequilateral, much rostrated; ribs crowded, concentric, somewhat lamellar; almost obsolete on the center of the valve. Hinge teeth in two series separated by a broad triangular pit, immediately beneath the small umbo; posterior dorsal area with two ridges; epidermis dark. Length 25–40, height 8–13 mm.

Intermediate between *tellinoides* Sowerby and *patagonica* d'Orbigny.

This fine species was dredged.

Locality.—Gulf of Paria, Trinidad (Guppy).

Horizon.—Recent.

Leda cf. patagonica d'Orbigny

Leda patagonica d'Orbigny, 1843, Voyage l'Amér. Mérid., p. 544, Atlas, pl. 82, figs. 1–3.

Leda patagonica Guppy, 1878, Proc. Sci. Assoc. Trinidad, vol. 2, pp. 169, 174; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 90, 95.

Shell large, very long, narrow, greatly compressed, white, subequilateral, more or less concentrically ridged; posterior end produced, rostrate, recurved; posterior dorsal region excavated.

D'Orbigny's type was from Bahia de San Blas, Argentina.

Fide Dr. Guppy, two valves of this species were dredged off Trinidad.

They were, however, larger, 49 mm. in length and 16 in height. It seems probable, in view of the distribution, that they were related to the Patagonian species rather than identical with it.

Locality.—Gulf of Paria, Trinidad (Guppy).

Horizon.—Recent.

Genus *GLYCYMERIS* Da Costa

Glycymeris jamaicensis Dall Pl. 18, Fig. 5

Pectunculus pennaceus Guppy, 1866, Quart. Jour. Geol. Soc., London, vol. 22, p. 293. Not of Lamarck.
Axinea pennacea Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 255.
Petunculus decussatus Guppy, 1873, Quart. Jour. Geol. Soc., vol. 32, p. 532. Not of Hanley.
Glycymeris jamaicensis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pp. 608, 1586.
Glycymeris jamaicensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 181, pl. 26, fig. 13.
Glycymeris jamaicensis Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 178, pl. 19, figs. 3, 4.

Shell of medium size, moderately convex, subcircular, but with the posterior basal margin angulate; surface with fine, even, radiating striæ, impressed at intervals giving the effect of obsolete ribs; beaks low, plump, central. Altitude of type 33, length 35, diameter 22 mm. The Trinidad specimen is small, measuring 23 x 24 mm.

Several related species of the Antillean recent fauna have persisted from the Miocene up, but *jamaicensis* became

extinct. The type was from Bowden. We have the shell from Santo Domingo, and it attains a very large size in the Costa Rican Miocene.

Locality.—Two miles southwest of Machapoorie quarry, Trinidad.

Horizon.—Machapoorie Miocene.

Glycymeris jamaicensis var. **machapoorensis,** n. var. Pl. 18, Fig. 15

We have several specimens which differ in some respects from *G. jamaicensis* to which they are, however, very closely related. The main difference appears in details of sculpture. In *jamaicensis* there are five or six radial striæ, then two or three depressed lines, while in the adult sculpture of these specimens there are three or four striæ followed by a single depressed line, so that the groups are narrower and the impressed lines single. The largest shell is 38 in height, estimated length 40, semidiameter 15 mm.

Locality.—Machapoorie quarry.

Horizon.—Machapoorie Miocene.

Glycymeris decussata Linnæus Pl. 18, Fig. 14

Arca decussata Linnæus, 1758, Syst. Nat., ed. X, p. 694.
Pectunculus pennaceus Lamrack, 1819, Anim. sans Vert., vol. 6, p. 51.
Pectunculus pennaceus Reeve, 1843, Conch. Icon., *Pectunculus,* pl. 5, fig. 24.
Glycymeris pennacea Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 608.
Pectunculus decussatus Linnæus, Lamy, 1911, Journ. de Conchyliologie, vol. 59, p. 119, pl. 3, fig. 7.
Glycymeris decussata Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 180, pl. 19, figs. 5, 6.

We have a crushed specimen apparently referable to this species. Normally it is convex and differs from *G. jamaicensis* in being inequilateral, the beaks situated a little behind the center with the ligamental area entirely in front of the beaks. The scultpure is of many, rather coarse, radiating threads, single proximally, but distally divided into three or more. A typical shell measures length 33, height 32, diameter 20 mm. Our crushed shell is 30 x 29 mm.

This species is more generally called by the later name, *pennacea* Lamarck. It is rare, but extends back into Miocene time and is now living in the West Indies.

Locality.—Machapoorie quarry.

Horizon.—Machapoorie Miocene.

Glycymeris canalis Brown and Pilsbry Pl. 18, Figs. 3, 4

Glycymeris canalis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 364, pl. 28, fig. 10.
Glycymeris canalis Olsson (*pro parte*), 1922, Bull. Amer. Paleont., No. 39, p. 177, fig. 2.

We have several specimens from Trinidad closely resembling the illustration of the type of *canalis*. They are of the same form and size and have the same number of ribs. The shell is rather small, subcircular, a trifle higher than long, with 33 strong, round ribs and narrow interspaces, marked with close, concentric striæ. Length 14.5, altitude 15, semidiameter 4.5 mm.

This species, by the development of secondary riblets, may grade into *trilobicosta*. The figure of the type shows the secondary riblets arising distally. The same is true in our specimens but the intercalated riblets are few and inconspicuous.

G. canalis is common in the Gatun stage of the Canal Zone and of Costa Rica.

Localities.—Poole River (East Central Trinidad); Fossil Ravine (Central Trinidad); Machapoorie quarry; Brasso Creek.

Horizon.—All Machapoorie Miocene except Brasso Creek, where the fauna is mixed and doubtfully Manzanilla Miocene.

Glycymeris canalis var. **trinitensis,** n. var. Pl. 18, Fig. 2

Shell rather small, subcircular, somewhat plump, beak a little prominent; surface sculptured with 44 undivided, subequal ribs. Length 18, altitude 16, semidiameter 5 mm.

This differs from typical *canalis* in the much more

numerous ribs, the central ones being slightly disposed to be more sharply edged.

Locality.—Machapoorie quarry.
Horizon.—Machapoorie Miocene.

Glycymeris trilobicosta Pilsbry and Brown Pl. 18, Fig. 11

Glycymeris trilobicosta Pilsbry and Brown, 1918, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 39, pl. 6, fig. 5.
Glycymeris canalis var. *trilobicosta* Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 177, figs. 4, 5.

The type, from the Gatun of Cartagena, Colombia, was an immature shell, only 14.5 in length and 14.6 in height, semidiameter 4 mm., with about 32 ribs. Our Trinidad specimens, like Mr. Olsson's from Costa Rica, are larger, with fewer ribs. The ribs number about 25 and are simple proximally but distally a secondary riblet arises on either side of the primary, making a pretty, tripartite pattern with the central rib of each group the highest. Interspaces very narrow, linear. Length 22, altitude 23, diameter 8.5 mm.

This form when typical is well marked, but it is so protean in its variation that Mr. Olsson, who had a beautiful set from Costa Rica, grouped all under *G. canalis*. But in Trinidad, as it is usually tripartite and is abundant and widespread, it seems appropriate to recognize it as either specific or varietal.

Localities.—(1) Two miles east of Brasso Station; E 24; (2) northeast corner E 24; Guaico-Tamana road quarry at 7¾ mile post; also at 8⅛ mile post; Brasso Venada Ravine, 3 miles east of Brasso Station; (3) eastern E 24; Machapoorie quarry; Guaico-Tamana road at 13th mile post; (4) east central E 25.

Horizons.—(1) Brasso Miocene; (2) Manzanilla Miocene; (3) Machapoorie Miocene; (4) Tamana Miocene.

Glycymeris acuticostata var. **guaica,** n. var. Pl. 18, Fig. 1

We have a very interesting shell in the Trinidad collection which combines features of the Dominican Miocene *G.*

acuticostata Sowerby (for figure see Bull. 29, pl. 26, fig. 10) with those of the *trilobicosta-canalis* group of Colombia and Central America. The shell is ovately rounded with 23 primary ribs. Over the younger half of the shell these are single, narrow and sharp, with concave, fairly wide interspaces, beautifully marked with very fine, concentric threads. In these respects the shell is like *acuticostata*, only that has about 30 ribs. But distally the Trinidad shell develops weak, secondary riblets as in *trilobicosta*, thus showing the interrelationship of the latter species with *acuticostata*. Length about 18.5, altitude 19, semidiameter 4.5 mm.

Locality.—Guaico-Tamana Road, 13th mile post.
Horizon.—Machapoorie Miocene.

Glycymeris mendozana, n. sp. Pl. 18, Figs. 6, 7

Shell fairly large, nearly perfectly circular in outline, greatly flattened, beaks extremely low. Sculpture of 40 to 44 primary ribs, simple, closely set and very sharp-edged over the earlier half of the shell, where the interspaces are narrow and sharply V-shaped. Over the later half of the shell the anterior and posterior ribs remain simple and sharp, but over the central part of the disc the ribs become very much wider and flatter distally although they still retain their ridge lines, and in each interspace a single, auxiliary, radial thread develops, very much smaller and finer than the rib, but sufficing to fill the bottom of the narrow interspace. Length 34, altitude 29, semidiameter 4 mm.

The sharp ribbing shows relationship with *G. acuticostata* Sowerby, but the Trinidad species is different in form and size, the ribs are much more numerous and the character of the interspaces is quite unlike.

Locality.—Mendozo Quarry.
Horizon.—Tamana Miocene.

Genus *ARCA* Linnæus

In the following discussion of the Arcas I am greatly indebted to Dr. Pearl G. Sheldon for many valuable suggestions.

The placing of *Noëtia* directly after *Arca, sensu stricto,* is here followed as in my "Arcas of the Panamic Province." This is in accordance with Dr. Sheldon's view, because of the close relationship indicated between *Arca* and *Noëtia* by the curious form *Arca* (*Litharca*) *lithodomus* Sowerby, of which only three valves have ever been found, one by Hugh Cuming and two by Mr. Olsson. (See Maury, Palæontographica Americana, No. 4, p. 7, 1922.)

Subgenus *ARCA, sensu stricto,* Lamarck

Arca occidentalis Philippi Pl. 1, Figs. 1, 2

Arca occidentalis Philippi, 1847, Abbild. und Beschr., vol. 3, p. 14, pl. 17b, figs. 4a–c.
Arca noæ Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293. Not of Linnæus.
Arca noæ Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42. Not *noæ* Linnæus.
Arca occidentalis Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 531.
Arca occidentalis Sheldon, 1916, Palæont. Amer., No. 1, p. 8, pl. 1, figs. 8–11.
Arca occidentalis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 163, pl. 29, fig. 3; 1920, *Idem,* Bull. 34, p. 11.
Arca occidentalis Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 181, pl. 22, fig. 1.

The true Noah's Ark shell, *Arca noæ* of Linnæus, with which this species has sometimes been confused, lives in the Mediterranean Sea.

Among Trinidad Arcas, *A. occidentalis* is quickly differentiated by its striking form. An average shell measures in length 59, height 25, semidiameter 14 mm., but we have them of all sizes from 10 mm. up.

This species occurs in the Miocene of the Dominican Republic, of Jamaica, and of Costa Rica; Pliocene of Florida; Pleistocene of the Antilles. It is living in the

Antilles, on the west coast of Florida, and from Hatteras south to Yucatan.

This is the *Arca noæ* of Dr. Guppy's Matura lists. We have it from the Miocene to Recent in Trinidad.

Localities.—Springvale; Matura beds; Sans Souci Bay.

Horizons.—Springvale Miocene; Pliocene, Matura; Recent, northern coast of Trinidad.

Arca umbonata Lamarck Pl. 3, Fig. 6; Pl. 8, Fig. 4

Arca umbonata Lamarck, 1819, Anim. sans Vert., vol. 6, p. 37.
Arca umbonata Philippi, 1847, Abbild. und Beschr., vol. 3, p. 13, pl. 17b, figs. 3a–c.
Arca imbricata (Bruguière) Gabb (in part, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 254. Not of Bruguière.
Arca umbonata Arango, 1879, Fauna Malacologica Cubana, p. 261.
Arca umbonata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pp. 620, 659; 1900, *Idem*, pl. 38, figs. 4, 4a.
Arca umbonata Sheldon, 1916, Palæontographica Amer., No. 1, p. 8, pl. 1, figs. 12–17.
Arca umbonata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 164, pl. 30, fig. 11; 1920, New York Acad. Sci., Sci. Surv. Porto Rico, vol. 3, pt. 1, p. 6; 1920, Bull. Amer. Paleont., No. 34, p. 11.
Arca umbonata Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 182.

In the collection is a very small true Ark which is not the young of *A. occidentalis.* The high, full beak, very sharp and prominent carination of the umbonal slope, and subcancellate type of sculpture, indicate a very young specimen of *Arca umbonata,* which this with very little question is. Our shell is the only example ever found in the Trinidad Pliocene.

Arca umbonata ranges from the Tampa Oligocene to the Recent. It is living from Hatteras to Santa Caterina, Brazil, and through the Antilles. Fossil specimens are found in the Miocene of Florida, Porto Rico and Santo Domingo; and in the Pleistocene of the West Indies.

Locality.—Matura.

Horizon.—Pliocene.

Subgenus *NOËTIA* Gray

Noëtia trinitaria Guppy Pl. 3, Figs. 1, 3, 4

Arca trinitaria Guppy, 1866, Quart. Jour, Geol. Soc. London, vol. 22, p. 583, pl. 26, figs. 3a, 3b.
Arca trinitaria Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Arca trinitaria Schuchert, 1905, Bull. U. S. Nat. Mus., No. 53, pt. 1, p. 57.
Arca (*Noëtia*) *trinitaria* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 617, 658.
Arca (*Noëtia*) *trinitaria* Sheldon, 1916, Palæontographica Americana, vol. 1, No. 1, p. 29, pl. 7, figs. 1, 2.

Shell small, solid, subtrigonal, equivalve, very inequilateral, oblique, with high, opisthogyrate beaks; posterior area bounded by a strong, roundly angulated, umbonal carina, and so short as to be nearly flat and cordate when the two valves are together; anterior area short, with rounded margin, inner edges of shell sharply dentate; valves with about forty smooth, narrow, equal ribs, with frequently a threadlike riblet in the interspaces, as is characteristic of *Noëtia;* ribs and interspaces crossed by fine lines arching up over the ribs and down in the slightly concave interspaces; ligament with transverse grooves and lying almost wholly anterior to the beaks, not occupying the posterior part of the cardinal area where there is a smooth band; terminal teeth V-shaped. Length of a specimen with both valves in place 25, altitude 20, diameter 20 mm. A larger single valve is 26 x 23 and 13 mm. in semidiameter. A small valve 15 x 16 x 6.

This very neat species is related to the Costa Rican Miocene *Noëtia macdonaldi* Dall, and to the recent west coast *N. reversa* (Gray) Sowerby, the type of the subgenus *Noëtia.* Indeed, *trinitaria* is almost like a miniature *reversa.*

Localities.—Eastern Trinidad on the northwest side of Manzanilla Point (type locality) and various stations on Manzanilla Bay (Nos. 263, 265, 267, 272, 294, 308); West Central Trinidad in E 24; and H 3, northeastern corner; also at 11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Noëtia mundonuevensis, n. sp. Pl. 5, Figs. 5, 7

Shell rather large, of very striking aspect, being an extreme form of the *Noëtia trinitaria—reversa—macdonaldi* group. General form trigonal, very high, with a narrow base, and rounded umbonal carina. Posterior area extremely compressed and flattened. In the best and largest specimen, a right valve, the ribs number about thirty, twenty situated between the carina and the anterior margin and the remaining ten on the truncated posterior area. On the center of the disc the ribs are very low, flat and rather wide, with interspaces nearly as wide as the ribs, but on the truncation the ribs are much closer and the interspaces narrow. The interstitial threads appear almost entirely obsolete. Ribs and interspaces are crossed by rather fine concentric lines of growth, arching up in the interspaces and down over the ribs, and at the basal margin the ribs project, making the edge markedly dentate. Substance of the shell rather thin for its size, but heavier near the hinge. All the specimens are very fragile and some are distorted from crushing. Beaks very high, full, acute at their apices and strongly opisthogyrate. Cardinal area wholly anterior to the beaks. Length of largest shell 40, altitude 41, semidiameter 19 mm. Another measures 27 x 31 x 14 mm.

This species is much larger and coarser than *Noëtia trinitaria* Guppy, with which it cannot be confused. It is about the size of the living west coast shell, *Noëtia reversa* (Gray) Sowerby, and of the Miocene ancestor of that species, *N. macdonaldi* Dall. But comparison shows that it is much narrower at the base than *reversa*—the posterior margin of which is produced and pointed, while in this species the whole posterior is exceedingly flattened, and compressed, and the base rounded, not pointed. Comparison with specimens of its nearest ally, the typical form of *N. macdonaldi* from the Banana River Miocene, shows that the latter shell is thicker, more pointed posteriorly, more sharply carinate, and with ribbing closer, the interspaces almost linear, instead of nearly equaling the ribs in width

as in the Trinidad species.

Locality.—Near the Junction of Mayo and Couva main roads, west central Trinidad.

Horizon.—Brasso Miocene.

Noëtia centrota Guppy Pl. 8, Figs. 10, 12

Arca centrota Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 175; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 54.
Arca centrota Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 92, pl. 3, figs. 4a, 4b; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, facing p. 75, pl. 1, figs. 4a, 4b.
Arca centrota Guppy, 1874, Geol. Mag., London, pl. 18, fig. 23.
Arca centrota Guppy, 1875, Ann. Nat. Hist., 4th ser., vol. 15, p. 51, pl. 7, fig. 4. (Recent shell figured.)
Arca (*Noëtia*) *centrota* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 617.
Arca (*Noëtia*) *centrota* Schuchert, 1905, Bull. U. S. Nat. Mus., No. 53, pt. 1, p. 55.
Arca (*Noëtia*) *centrota* Sheldon, 1916, Palæontographica Americana, No. 1, p. 29.
Arca (*Noëtia*) *centrota* Maury, 1922, Palæontographica Americana, No. 4, pp. 172, 173.

Shell rather small, elongated transversely, subrhomboidal, with a prominent, rounded carination passing from the beaks to the posterior margin; ribs thirty-six to thirty-eight, finely crenulated, wider than the interspaces. Interstitial thread minutely crenulated, most conspicuous over the umbonal ridge; teeth small and vertical centrally, longer and more oblique distally. Ligament area small, the anterior portion marked with transverse, parallel grooves. Length 27, altitude 15, semidiameter 8 mm.

This species is extremely abundant in the Matura beds where there are the greatest number of young and adult specimens.

Noëtia centrota is the precursor of the recent species *Noëtia martinii* Récluz (Jour. de Couch., vol. 3, p. 409, pl. 12, figs. 3–5, 1852), which is living in the Gulf of Paria and on the Brazilian coast. But Récluz's name is invalid because preoccupied by Bolten. Lamarck's unfigured *A. bisulcata* from Guiana and Brazil may be identical with

martinii and, if so, it is the valid name from the recent species.

The living west coast analogue of the *Noëtia centrota* (+*martinii*+*bisulcata*) group is *N. olssoni* Sheldon and Maury, from the Panamic Province (Maury, Palæontographica Amer., No. 4, pp. 10, 11, pl. 1, fig. 9, 1922). The chief difference is that the west coast shell is less expanded posteriorly, and the bare strip behind the ligament is reduced, but the relation between the Trinidad fossil and the Panamic shell is very close.

In the Springvale material we found a single, very young, valve of *Arca centrota*. Since this species has never before been reported from beds older than Pliocene; and as the shell is very young, it may be a slightly varying ancestral form of *centrota*, but the specimen is indistinguishable from the young of *centrota*.

Localities.—Matura Bay (type locality); Springvale (young shell).

Horizons.—Pliocene, extremely abundant; Upper Miocene, very rare.

Noëtia sheldoniana Maury Pl. 8, Fig. 11

Arca (*Noëtia*) *sheldoniana* Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. 15, p. 43, pl. 8, figs. 10, 11.
Arca (*Noëtia*) *sheldoniana* Sheldon, 1916, Palæontographica Americana, vol. 1, No. 1, p. 69.
Noëtia sheldoniana Cossmann, 1916, Révue Critique de Paléozoologie, No. 3 (Juillet), p. 113.

Original description.—"Shell small, rather delicate for the genus, nearly rhomboidal, high and short; posterior slope carinate, very slightly produced; beaks nearly touching, opposite the middle of the row of teeth; moderately inflated; interstitial rib present on the posterior half of the valve. Length 15, height 13.5, thickness of valve 6 mm."

This species has thirty-eight closely-set ribs, but has somewhat the outline of a very young shell of the recent east coast *Noëtia ponderosa* Say; but the ligament is wholly anterior in *N. sheldoniana* and ends at the beak, as in *N.*

reversa, so that the characters of the cardinal area ally our Pliocene species with the west coast shell. Moreover, *N. ponderosa* has only 25–28 ribs and is a large, very thick species, in the Pliocene of North Carolina, and Recent from Cape Cod to Yucatan, but not recorded by Dr. Guppy from Trinidad. Nor is it in our Trinidad collections.

Noëtia sheldoniana is readily differentiated from *N. trinitaria* by its rhomboidal form and truncate posterior margin, *trinitaria* being trigonal and obliquely produced and pointed posteriorly.

Locality.—Along the shore 1000 feet west of Brighton pier, in black, asphaltic marl.

Horizon.—Pliocene.

Noëtia mayensis, n. sp. Pl. 5, Fig. 2

Shell rather small, transversely elongate-oval, very sharply and conspicuously carinate at the umbonal slope, and anterior to the carina sulcated and compressed. Anterior area rounded, posterior obliquely flattened and produced basally. Ribs about thirty-six, low and closely set, with narrow interspaces. Interstitial thread developed chiefly on the posterior area where there are about twelve ribs, the remaining twenty-four lying between the anterior margin and the carina. Ribs and interspaces are crossed by fine, concentric growth lines which, under a lens, divide into minute blocks the interspaces on the younger part of the valve. Beak low, medially sulcate, opisthogyrate. Cardinal area very short, posterior to the apex of the beak. Length 27, altitude 17, semidiameter 9 mm.

Although this species has a transversely elongated form, it is not like the *Noëtia centrota—bisculcata—olssoni* series, because in that group the cardinal area is long, while in this shell it is extremely short. It appears like a much lengthened out *reversa*.

Although unlike in shape, *Noëtia mayensis* and *Noëtia sheldoniana* both have interstitial ribs all the way around, and their ligamentary characters are similar. Since the

former has been somewhat crushed, it is possible that more material may prove them very closely related.

Locality.—Near Junction of Mayo and Couva main roads.

Horizon.—Brasso Miocene.

Noëtia manzanillæ, n. sp. Pl. 8, Figs. 13, 19

Shell small, trigonal, slightly higher than long, beaks very high, acute, opisthogyrate; anterior area of shell very short, rounded; posterior area somewhat more produced; umbonal slope evenly and gently rounded, not angular. Ribs about thirty, with a microscopic interstitial thread showing clearly where the surface is well preserved. Ligament transversely grooved, high, anterior to the beak, not occupying the posterior portion of the cardinal area. Length 10, altitude 12, semidiameter 6 mm.; another specimen with both valves together measures 9 x 10 and 10 mm. in diameter.

The striking and peculiar feature of this bizarre little species is the rounded posterior slope. All members of the subgenus *Noëtia* excepting the section *Sheldonella* Maury (Bull. Amer. Paleont., No. 29, pp. 166, 167, 1917)—of which the type, *Sheldonella maoica* is so exceedingly abundant in the Cercado formation of Santo Domingo—have an angular posterior slope.

Perhaps this Trinidad species is of sectional value for it differs from *Sheldonella* in form, not being at all like the Bathyarcas. On the other hand, it is certainly a *Noëtia,* as its hinge clearly proves. Though small the specimens are fully grown and, indeed, rather old individuals.

Locality.—North of Manzanilla Point, northeastern coast of Trinidad.

Horizon.—Manzanilla Miocene.

Subgenus *BARBATIA* Gray

Section *CALLOARCA* Gray

Barbatia (Calloarca) candida Gmelin Pl. 8, Fig. 6

Arca candida Gmelin, 1792, Syst. Nat., vol. 6, p. 3311.
Arca jamaicensis Gmelin, 1792, Syst. Nat., vol. 6, p. 3312.
Barbatia bonaczyi Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 254.
Barbatia (*Calloarca*) *candida* Dall, 1989, Trans. Wagner Inst. Sci., vol. 3, p. 626.
Barbatia (*Calloarca*) *candida* Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 460.
Arca (*Barbatia*) *candida* Sheldon, 1916, Palæontographica Amer., No. 1, p. 16, pl. 3, figs. 11, 12.
Not *Barbatia* cf. *Bonaczyi* Maury, April, 1917, Bull. Amer. Paleont., No. 29, p. 165, pl. 30, fig. 15.
Barbatia (*Calloarca*) *candida* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 12.
(?) *Barbatia* cf. *bonaczyi* Hubbard, 1921, Sci. Surv. Porto Rico, vol. 3, pt. 2, p. 106, pl. 14, fig. 4.
Arca bonaczyi Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, pt. 2, p. 403, pl. 39, figs. 1, 2. Figures of Gabb's type.

Shell, when fully grown, large, subtrapezoidal, gaping at the base anteriorly; white; anterior end generally truncate, posterior pointed; beaks high, separated by a rather wide area; surface sculptured with fine to rather strong double or single ribs which are heavier on the posterior slope, ribs intersected by irregular concentric lines and ridges producing a somewhat cancellated or beaded appearance; teeth but little developed; epidermis heavy and shaggy. Length 60, height 35, diameter 28 mm.

Barbatia candida is now living from Cape Hatteras to Santa Caterina, Brazil, and is abundant in the Antilles. It is found in the Miocene of Florida, and is common in the West Indian Pleistocene.

Gabb's Santo Domingan Miocene, *Barbartia bonaczyi,* as shown by Dr. Pilsbry's illustration of the type, is merely a young *Barbatia candida,* which is now also living on the recent beaches of that island. Thus *bonaczyi* falls into the synonymy of *candida.*

The Arca figured by me as *Barbatia* cf. *bonaczyi* Gabb in April, 1917, from Miocene beds of Los Quemados and the Samba Hills, Santo Domingo, was later found by Mr. Olsson

in Gatun beds at Port Limon; and as Gabb's type was then figured, he saw this Arca was specifically distinct and named it *Barbatia mauryæ* (Olsson, Bull. Amer. Paleont., No. 39, p. 182, pl. 22, figs. 4, 7, 1922). As Mr. Olsson compared my Dominican shells with his Costa Rica specimens there is no doubt of their specific identity, and the name he gave is valid.

Mr. Hubbard's Porto Rican *Barbatia* cf. *bonaczyi* may be like Gabb's *bonaczyi,* a young *candida;* but it is not *Barbatia mauryæ* Olsson.

Dr. Dall records *Barbatia candida* from the Pliocene of Trinidad.

We have a beautifully sculptured very young shell of *candida* measuring 10 x 6 x 2 mm.

Locality.—Matura.

Horizon.—Pliocene.

Section *ACAR* Gray

Barbatia (Acar) reticulata Gmelin Pl. 8, Figs. 18, 21

Arca reticulata Gmelin, 1792, Systema Naturæ, 6, p. 3311.
Arca reticulata Chemnitz, Conch. Cab., 7, p. 193, pl. 54, fig. 540.
Arca squamosa Lamarck, 1819, Anim. sans Vertèbres, vol. 6, p. 45.
Arca squamosa Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 43.
Arca (*Barbatia*) *reticulata* Dall and Simpson, 1900, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 460.
Arca (*Barbatia*) *reticulata* Sheldon, 1916, Palæont. Amer., No. 1, p. 20, pl. 4, figs. 8–12.
Barbatia (*Acar*) *reticulata* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 166, pl. 30, fig. 16; 1920, Scientific Surv. Porto Rico and the Virgin Isls., vol. 3, pt. 1, p. 7; 1920, Bull. Amer. Paleont., No. 34, p. 13; 1922, Palæont. Amer., No. 4, p. 19.
Barbatia (*Acar*) *reticulata* Hubbard, 1921, Sci. Surv. Porto Rico, vol. 3, pt. 2, p. 106.

This beautiful little shell is closely related to the West Coast *Barbatia gradata* Broderip and Sowerby. It is easily recognized among Trinidad Arcas by its rich sculpturing. Our largest speciment of *reticulata* from Trinidad measures in length 22, altitude 7, and semidiameter 5 mm.

It is an ancient, static species, first appearing in the

Jacksonian Eocene. At Ponce, Porto Rico, it is in Miocene beds and also living on the Ponce reefs. It ranges in the modern seas from Florida to Texas, and Hatteras to Panama; and is in the Mediterranean Sea.

Lamarck questioned whether his *Arca squamosa* was not identical with Gmelin's *reticulata*. Dr. Dall thinks it is, and that *domingensis* Lamarck and *clathrata* Lamarck are also synonyms of *reticulata*.

Dr. Guppy, in 1867, listed this species (as *squamosa*) from the Matura beds.

Locality.—Matura, northeastern Trinidad.

Horizon.—Pliocene.

Barbatia (Acar) milifilia var. **latrinidadis**, n. var. Pl. 8, Fig. 3

We have half a dozen specimens of a Trinidad member of the rare and beautiful group of Arcas represented by only two species—on the east coast by the Pliocene *A. milifilia* Dall, from Shell Creek, Florida, and on the west coast, Panamic Province, by the living species, *A. illota* Sowerby, of which C. B. Adams' *A. tabogensis* from Taboga Island, Bay of Panama, is a synonym. These two species, *milifilia* and *illota* are very much alike, the living form differing chiefly in the more handsomely developed radial sculpture with tertiary threads. Their striking resemblance, as I noted in 1922, suggests an Atlantic origin and a trans-Isthmian Pliocene migration of the stock—representatives never having been found in beds earlier than that period.

A comparison of *milifilia* (Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 6, pl. 56, figs. 21, 24 and Expl. of plate, p. 1629, 1898) and of *illota* Sowerby (Maury, Palæontographica Amer., No. 4, p. 20, pl. 2, figs. 8, 14, 1922) shows their close affinity.

It is extremely interesting to find a similar Arca in the Pliocene of Trinidad. These shells are greatly like *milifilia* but appear a little longer proportionately, less sulcate mesially, and with finer, sharper, less granose ribbing.

Larger shells measure in length 19, altitude 13, semidiameter 5 mm.

The hinge of this group is typically that of *Acar*, but a single shell of our *illotas* showed a blending of the hinge characters of *Acar* and of *Calloarca;* indicating a transition between these two sections of *Barbatia.*

For the Trinidad shells the varietal name *latrinidadis* is suggested, from the nearby triad mountain that inspired Columbus to name the Island in honor of the Holy Trinity.

Locality.—Matura.

Horizon.—Pliocene.

Section *FOSSULARCA* Cossmann

Barbatia (Fossularca) adamsi (Shuttleworth) Smith Pl. 8, Figs. 1, 8

Arca cœlata Conrad, 1845, Fos. Medial Tert., p. 61, pl. 32, fig. 2.
Not *Arca cœlata* Reeve, 1844, Conch. Icon., *Arca* No. 110.
Arca lactea of C. B. Adams. Not the true *lactea* Linnæus, which is European.
Arca solida Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16.
Not *Barbatia solida* Sowerby, 1833, Proc. Zool. Soc. London, p. 18, which is the West coast analogue.
Arca adamsi Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 43.
Arca (*Acar*) *adamsi* Shuttleworth (MS.), Smith, 1888, Jour. Linn. Soc., Zool., vol. 20, p. 449, pl. 30, figs. 6, 6a.
Barbatia (*Fossularca*) *adamsi* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 629.
Arca adamsi Sheldon, 1916, Palæontographica Americana, No. 1, p. 22, pl. 4, figs. 16, 17, 18, pl. 5, fig. 1.
Arca (*Fossularca*) *adamsi* Vaughan and Woodring, 1921, Geological Reconnaissance Dominican Republic, pp. 150, 168.
Barbatia (*Fossularca*) *adamsi* Maury, 1922, Palæont. Amer., No. 4, p. 22.

From the west central part of the Island we have a small, worn *Arca* which is, however, undoubtedly a specimen of *Fossularca adamsi* (Shuttleworth) Smith; and we have also a number of well preserved specimens from the Matura beds.

This very small, but well marked little species is trapezoidal in form with the basal margin slightly sinuate, and

the umbonal slope carinate, especially just behind the beaks. The sculpture is of many radial riblets formed by rows of trailing blisters, very easily worn off. Towards the basal margin secondary riblets are intercalated. The ligament occupies a small diamond-shaped area between the beaks, and the series of hinge teeth is interrupted opposite to the ligament. A Matura specimen measures in length 11, altitude 7, semidiameter 3.5 mm.

This species has a wide geologic range—from the Miocene of Florida; North Carolina; Bowden, Jamaica; Gurabo formation, Dominican Republic; Pliocene of Florida, to the Recent. It is now living from Cape Hatteras to the Island of Fernando Noroñha, Brazil.

The Pacific analogue is *Fossularca solida* Sowerby, living from San Diego, California, to Paita, Peru. Dr. Guppy reported *adamsi* (as *solida*) from the Matura beds.

Localities.—West central Trinidad in the southwest quarter of E 24; also northeastern Trinidad at Matura.

Horizon.—The age of S. W. E. 24 is doubtfully Manzanilla Miocene; Matura is Pliocene.

Section *CUCULLARIA* Conrad

Barbatia (Cucullaria) perinopinata, n. sp. Pl. 6, Fig. 12

Arca tæniata Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, pp. 5, 9; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 161, 165.

Not *Barbatia (Cucullaria) tæniata* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 631, pl. 25, figs. 1, 1a.

Shell rather small, oblong, moderately inflated, with a strong, wide, radial sulcation passing from the umbo to the basal margin which it renders deeply arcuate. Beaks low, umbonal slope rounded; hinge line straight but the other hinge characters are concealed. The single specimen is a badly preserved cast, but on the umbonal slope of the right valve is a small area where the sculpture is shown. It consists of very closely set, finely crenate, very narrow, paired, radial ribs. Interspaces linear hardly exceeding the

line between each member of a pair of ribs. Length 39, altitude 23, diameter 18 mm.

This species appears nearest to *C. tæniata* Dall, from the Pliocene of Florida, but the Trinidad shell is smaller and of different form, the sulcus more central, and the ribs over the umbonal slope show a paired rather than a quaddipartite plan, the interspaces being narrower than in Dr. Dall's shell.

I have described this shell in spite of its poor preservation because of the rarity of this section of Barbatias. The species of *Cucullaria* now living along the Atlantic coast are in general deep-sea loving. *C. paserula* Sheldon, 1916 (*asperula* Dall, 1881, name preoccupied by Deshayes, 1860), ranges from Fernandino to Yucatan in 310–1568 fathoms; *C. profundicula* Verrill was dredged from 2021 fms., Lat. 37° N.; *C. sagrinata* Dall, from 80 fms., off Cuba; *C. lactocomata* Dall, from 82 to 169 fms., off Martinique and Barbados; *C. pteroëssa* E. A. Smith, is both Atlantic and Pacific, having been dredged by the *Challenger* off the Azores; off Culebra Island, West Indies; and in the North Pacific.

Locality.—Springvale.

Horizon.—Upper Miocene.

Subgenus *SCAPHARCA* Gray

Section *SCAPHARCA* Gray

Scapharca (Scapharca) secticostata Reeve Pl. 1, Fig. 4

Arca secticostata Reeve, 1844, Conch. Iconica, *Arca*, pl. 6, fig. 38.
Anadara secticostata Gray, 1857, Ann. Nat. Hist., 2d ser., vol. 19, p. 371.
Anomalocardia floridana Conrad, 1869, Amer. Jour. Conch., vol. 5, p. 108, pl. 13, fig. 2.
Scapharca secticostata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pp. 636, 637, 659; 1903, *Idem*, p. 1616.
Arca (*Scapharca*) *secticostata* Sheldon, 1916, Palæontographica Americana, No. 1, p. 36, pl. 8, figs. 3, 4, 5.
Scapharca (*Scapharca*) *secticostata* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 16.

This is the cut-ribbed Ark of which we have two recent Trinidad specimens. It is a rather rare species, oblong, very convex, with thirty-three to forty ribs, a large number being deeply medially grooved. Length of larger specimen 90, altitude 56, semidiameter 29 mm.; smaller, 55 x 35 x 14 mm.

Frequently this shell has been confused with its Miocene ancestor, *Scapharca lienosa* Say. It ranges through the Gulf of Mexico and from Cape Hatteras to Trinidad. It does not antedate the Pleistocene, being found in beds of that age in Florida.

Locality.—West coast of Trinidad, between Ally and Mosquito Creek.

Horizon.—Recent.

Scapharca (Scapharca) halidonata Dall Pl. 5, Fig. 8

Arca consobrina Guppy, 1866, Quart. Jour. Geol. Soc., London, vol. 22, p. 293.

Not *Arca consobrina* Sowerby, 1849, Quart. Jour. Geol. Soc., vol. 5, p. 52, pl. 10, fig. 12, which is *Scapharca henekeni* Maury, April, 1917 (*sobrina* Pilsbry and Johnson, May, 1917).

Arca consobrina Guppy, 1874, Geol. Mag., London, p. 443.

Scapharca (*Scapharca*) *halidonata* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 646, pl. 33, fig. 24.

Arca consobrina Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 14; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 156.

Scapharca (*Scapharca*) *halidonata* Sheldon, 1916, Palæont. Amer., No. 1, p. 49, pl. 11, fig. 8.

Scapharca (*Scapharca*) *halidonata* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 168.

Shell rather large, oblong-ovate, inflated; beaks moderately high, strongly prosograte, placed at about the anterior fourth of the total length. Ribs thirty-four, the anterior dozen medially grooved, posterior ribs with three or more grooves; ribs on the posterior slope with a single groove, or entire. Length of shell 55, altitude 40, diameter 40 mm. Large shells attain a length of 68 mm.

This shell is of the general type of the living *Arca* (*Scapharca*) *secticostata,* but much shorter proportionately.

Dr. Guppy's *Arca consobrina* Sowerby, from Jamaica was this species. Sowerby's type was Dominican.

This species is not so high as *Scapharca couvæ* Maury, from the Springvale Miocene, and the anterior ribs are bipartite—never quadripartite or tripartite, as in that shell.

Localities.—Bowden, Jamaica (Olsson coll.); Curaçao (Dall).

Scapharca (Scapharca) auriculata Lamarck Pl. 4, Fig. 2

Arca auriculata Lamarck, 1819, Anim. sans Vertèbres, vol. 6, p. 43.
Arca auriculata Reeve, 1844, Conch. Icon. *Arca*, pl. 6, fig. 35.
Arca (*Scapharca*) *auriculata* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 649; 1903, *Idem*, pt. 6, p. 1586.
Arca (*Scapharca*) *auriculata* Sheldon, 1916, Palæont. Amer., No. 1, p. 50, pl. 11, fig. 19.
Scapharca (*Scapharca*) *auriculata* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 175, pl. 28, fig. 3; 1920, *Idem*, No. 34, p. 18.
Arca auriculata Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 190, pl. 22, fig. 3.

Shell of medium size, inflated, ovate-oblong; posterior dorsal margin emarginate, forming a slight but definite alation, hence the specific name. Ribs about twenty-five, rounded, entire, very finely crenate. Inner margin of valves dentate. Epidermis seal brown. Length 45, altitude 31, semidiameter 15 mm.

This well-known shell has been recorded from Key West to Martinique. It occurs also in the Miocene of Santo Domingo, Jamaica, and Costa Rica. We have gathered recent specimens on the Texas coast and on the beach at Monte Cristi, Dominican Republic. We now extend its southward range to Trinidad.

Locality.—Erin Point, on the southwestern shore of the Island.

Horizon.—Recent.

Scapharca (Scapharca) dehayesi Hanley Pl. 4, Fig. 3

Arca deshayesii Hanley, 1842, Illust. Catalogue Bivalve Shells, p. 157.
Arca deshayesii Reeve, 1844, Conchologica Iconica, *Arca*, pl. 7, fig. 47.
Arca (*Anadara*) *deshayesii* Gabb, 1874–1881, Jour. Acad. Nat. Sci.

Phila., 2d ser., vol. 8, p. 378.
Arca deshayesii Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 659.
Arca deshayesii Dautzenberg, 1900, Mém. Soc. Zool. France, vol. 13, p. 236.
Arca deshayesii Dall and Simpson, 1901, Bull. U. S. Fish, vol. 20, pt. 1, p. 461.
Arca deshayesii Dall, 1901, Proc. Washington Acad. Sci., vol. 3, p. 141.
Arca deshayesii Sheldon, 1916, Palæontographica Americana, No. 1, p. 50, pl. 11, figs. 15, 16, 17, 18.

Shell rather large, resembling *A. auriculata* Lamarck in general form; nearly equivalve; ribs about twenty-six, of which the anterior and those around the umbonal ridge are medially grooved towards the base of the valve. Epidermis dark brown, scaly. Sectional characters intermediate between those of *Scapharca* and of *Anadara*. Length 60, altitude 42, diameter 43 mm.

A rare species. We have examples from Guadeloupe and Jamaica. It ranges as far south as Pernambuco, Brazil. Gabb reported it from the Pliocene of Costa Rica.

The young shells of *A. deshayesi* are auriculate at the upper posterior margin and are practically inseparable from *A. auriculata*. Adult specimens differ from that species in attaining a larger size, losing their alation, and in the medial grooving of the anterior and umbonal slope ribs.

We have a single fossil valve from Curaçao which is probably *A. deshayesi*, but differs in being barely alate even in young stages (as shown by growth lines); and the hinge is of moderate width, while in our few specimens of *deshayesi* it is delicate for the size of the shell. This valve measures 50 x 40 x 21 semidiameter. It also resembles *A. halidonata* Dall, but is closer to *A. deshayesi*, which is a better horizon, *deshayesi* being recent and, *fide* Gabb, Pliocene, while *halidonata* is Miocene. As this specimen is somewhat intermediate between these two species, it may indicate a line of descent from *halidonata* to *deshayesi*.

Dautzenberg, in 1900, placed the *Arca hemidermos* Philippi of d'Orbigny (In de la Sagra's Hist. Fisica, Pol.

y Nat. de la Isle de Cuba, vol. 5, *Moluscos*, p. 345, 1845) in the synonymy of *deshayesi*. D'Orbigny did not figure his specimens which were from Cuba and Martinique; and we have not Philippi's illustration (Abbild. Conch. *Arca*, pl. 2, fig. 5, 1845) of the type of *A. hemidermos*.

Locality.—Island of Curaçao, three miles inland, east of the dock. (Harris coll.).

Horizon.—Quaternary.

Scapharca (Scapharca) couvæ, n. sp. Pl. 7, Fig. 1

Shell rather large, ovate; anterior area short, rounded basally, angulate at the hinge line; posterior area defined by a very prominent, angular umbonal carina, beyond which the posterior slope is concavely excavated; posterior end somewhat produced, subrostrate, junction with hinge angulate. Beaks high and very full, prosogyrate. Ribs thirty to thirty-three. Of these, about twenty-four are anterior to the umbonal carina and each rib of the anterior and central part of the valve bears three or four radial threads finely knotted or beaded, so that the ribs appear tripartite or quadripartite. Ribs high and square-topped. Cardinal area small for the size of the shell, lozenge-shaped, with about three concentric grooves. Hinge showing numerous teeth, the anterior somewhat larger and oblique. Margins of valves fluted. Length 50, altitude 45, diameter 32 mm.

A fine and striking species, quickly distinguished from other Trinidad Arcas by its form and sculpture.

In sculpture it recalls the smaller *Scapharca dodona* Dall, from the Miocene of Oak Grove, Florida. But in that shell the interspaces are much narrower, only half as wide as the ribs, while in our shell they are subequal to the ribs.

Our shell also bears some resemblance to *halidonata* Dall, from the Miocene of Bowden, Jamaica; but that species is longer in proportion to its height and is considerably thicker, and also differs in details of sculpture.

Scapharca veatchi Olsson, from the Canal Zone Miocene has the *Argina* shape, with rounded umbonal slope, and the interspaces are comparatively narrower; while this Trinidad shell has the angular *Scapharca* shape, with the carinate umbonal slope.

Locality.—Springvale, near Couva, Trinidad.

Horizon.—Upper Miocene.

Scapharca (Scapharca) tectum-columbæ, n. sp. Pl. 7, Fig. 4

Shell of medium size, subrhombic, with the umbones only moderately inflated, and general aspect of shell flatish; anterior end convexly rounded, posterior subcompressed, bluntly pointed, umbonal slope rounded, posterior dorsal area flattened; hinge line very straight, sharply angled at both extremities; ribs thirty-nine, of which twenty-nine are in front of the umbonal slope, and ten on the posterior area; about ten of the anterior ribs are grooved, nearly all being bipartite, but two or three are tripartite and on an older shell they become quadripartite distally. There is also the usual tendency for a few of the ribs on the umbonal slope to be medially grooved, although only several on the left valve show this feature. The anterior ribs are crenulated by coarse, concentric threads which traverse the interspaces and rise over the ribs. The cardinal area is long and narrow, wider in front, with the anterior portion much shorter than the posterior. Beaks approximate, narrow, subacute. Length of shell with both valves together 40, altitude 32, diameter 21 mm.

This pretty shell is somewhat *Pteria*-like in form. It is distinguished from *Scapharca couvæ* (1) by the cardinal area which is long and narrow, while in *couvæ* it is short for the size of the shell and much less unsymmetrical; (2) by the close, narrow, pointed beaks, while in *couvæ* the beaks are separated, broader, not curving so closely over the area; (3) by the much more numerous and less subdivided ribs, the ribs in *couvæ* being also higher and squarer;

(4) by the flatter, much less inflated form of the shell, *couvæ* being higher, more inflated, and very convex in the umbonal region.

In general form, *Arca tectum-columbæ* may be likened to *A. callicestosa Dall,* from the Miocene of Virginia.

Locality.—Springvale, Trinidad.

Horizon.—Upper Miocene.

Scapharca (Scapharca) confugium, n. sp. Pl. 7, Fig. 3

Shell rather large, oblong-ovate, rounded anteriorly, produced and pointed posteriorly, with the umbonal slope carinated, especially proximally. Beaks low, incurved, not much inflated. Valves with markedly discrepant sculpture. A left valve with the sculpture preserved over the central and posterior areas shows the central ribs to be medially sulcated with a tendency to further division, while the ribs on the umbonal slope are chiefly quadripartite or sometimes tripartite. Length of shell 56, altitude 32 mm.

This species is much longer in proportion to its height than *Scapharca couvæ,* the beak is much lower and less inflated, the ribs much lower, and there is more discrepancy in the two valves. The different form at once distinguishes it from *tectum-columbæ.*

Locality.—Springvale.

Horizon.—Upper Miocene.

Scapharca (Scapharca) henekeni Maury Pl. 6, Fig. 10

Arca consobrina Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 52, pl. 10, fig. 12.

Not *Arca consobrina* d'Orbigny, 1844, Pal. Française, Terr. Crét., vol. 3, p. 209, pl. 311, figs. 4–7 (which is the true *consobrina*).

Not *Arca consobrina* Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293 (which is *halidonata* Dall).

Arca (*Anadara*) *consobrina* Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 253.

Arca consobrina Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 531.

Arca consobrina Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 646.

?*Arca consobrina* Guppy, 1910, Agric. Soc. Trin. and Tobago, Paper No. 440, p. 14; Harris' Reprint, 1921, Bull. Amer. Paleont.,

No. 35, p. 156.
Arca consobrina Sheldon, 1916, Palæontographica Americana, No. 1, p. 49.
Arca (*Scapharca*) *henekeni* Maury, April, 1917, Bull. Amer. Paleont., No. 29, pp. 167, 168, pl. 29, fig. 2.
Arca (*Scapharca*) *sobrina* Pilsbry and Johnson, May, 1917, Proc. Acad. Nat. Sci. Phila., vol. 69 (for 1917), 1918.
Arca (*Scapharca*) *henekeni* Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 186, pl. 24, figs. 13, 14.
Arca (*Scapharca*) *sobrina* Pilsbry, 1922, Proc. Acad Nat. Sci. Phila., vol. 73, p. 403.

We have three valves from the Machapoorie quarry which appear to be young specimens of *Scapharca henekeni* Maury. The shells are oblong, with about thirty-five ribs, which are grooved and beaded, except posteriorly where they are nearly smooth. Careful comparison of these shells with young or smaller specimens probably *henekeni* from Cercado de Mao, Bluff 3, shows a close resemblance, although the more typical specimens are larger and from Bluff 2, Cercado de Mao, Dominican Republic.

Locality.—Machapoorie Quarry, west central Trinidad.

Horizon.—Machapoorie Miocene.

Scapharca henekeni var. **trinidadensis**, n. var. Pl. 7, Fig. 5

Shell of medium size, oblong, somewhat expanded posteriorly, anterior area very short; beaks exceedingly far forward; umbonal slope with a rounded carination from the beak to the posterior margin. Ribs twenty-nine, those of the anterior and central portions of the valve being conspicuously medially grooved, posterior ribs entire. Hinge characters concealed by matrix. Length of shell 40, altitude 20, semidiameter 10 mm.

This shell has some of the characters of *Scapharca henekeni* and, as the specimen is unique and the surface somewhat worn, it seems best to regard it at present as a varietal form. More material later may show it to be specifically distinct. The distinguishing feature is the very anterior position of the beaks.

Locality.—Central Trinidad, southwest from Brasso, in

the southwest corner of E 25.

Horizon.—Probably Lower, or Lower Middle Miocene.

Scapharca (Scapharca) dariensis Brown and Pilsbry Pl. 6, Fig. 5

Arca oronlensis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 658. Not of Gabb.
Arca dariensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 362, pl. 22, fig. 10.
Arca gatunensis Toula, Dec., 1911, Jahrb. der K-K. Geol. Reichsanstalt. Wien, vol. 61, p. 493, pl. 30, fig. 4.
Arca dariensis Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 184, pl. 22, figs. 10–13.

Shell small, transversely elongate. Ribs thirty, those on the anterior area and umbonal slope medially divided; on the right valve the anterior and umbonal are finely and prettily crenulate, while the central ribs are smooth and narrow; on the left valve all the ribs are usually crenate. Length 28, altitude 17, semidiameter 8 mm.

Locality.—Gatun.

Horizon.—Middle Miocene, Gatun formation.

Scapharca (Scapharca) fontinalis, n. sp. Pl. 6, Figs. 7, 8

Shell resembling *S. henekeni* Maury, in general form, but differing in the following respects: The substance of the shell is thinner; the beak is less anterior and more central; the anterior end of the shell is more produced, and is not so cut away basally; the hinge line and basal line are much more nearly parallel; the ribs are more numerous (40 against 35 or 36) and are less divided, only the first seven or eight being medially grooved, and there being no tendency at all for the ribs over the central or umbonal regions to divide (which not infrequently happens in *henekeni*).

This absence of any tendency of the ribs to divide over the umbonal slope indicates that this shell is distinct, and not a variety merely of *henekeni.* Length 51, altitude 27 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Scapharca (Scapharca) brassica, n. sp. Pl. 8, Fig. 7

Shell rather small, thin and delicate, oval; sculptured with about thirty-one ribs, all of which are medially grooved excepting the last three at the dorsal posterior margin. The grooving thus extends right over the rounded umbonal slope. The sulcations are deep and rather wide so that only two narrow, nodosely beaded ridges are left on either side of each rib. The beading is especially marked on the anterior fourth of the shell, but all the ribs are more or less crenate except the last three which are smooth and entire. Hinge concealed. Length of shell 26, altitude 18 mm.

This pretty shell has some resemblance to *Scapharca inæquilateralis* Guppy, but differs in its produced posterior end. It is also related to, but specifically distinct from *S. henekeni* Maury. The distinguishing feature is the extended grooving embracing all but the last few ribs.

Locality.—Half a mile above Brasso Station in a blue, shaly clay.

Horizon.—Lower Springvale Miocene, just above the uppermost member of the Brasso Miocene.

Scapharca (Scapharca) inæquilateralis Guppy Pl. 6, Fig. 6

Arca inæquilateralis Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, pl. 18, fig. 2.
Arca inæquilateralis Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Scapharca (Scapharca) inæquilateralis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 647.
Arca inæquilateralis Sheldon, 1916, Palæontographica Amer., No. 1, p. 50.
Scapharca inæquilateralis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 171, pl. 30, fig. 2.
Arca inæquilateralis Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., p. 403.

From central Trinidad we have a worn shell which has the shape and aspect of this pretty, delicate, Bowden and Dominican Ark, and is almost certainly identical with it.

Scapharca inæquilateralis Guppy is related to *latiden-*

tata Dall, from the Florida Miocene. The type of *inæquilateralis* had about thirty crenate ribs, grooved on the anterior and posterior areas. The hinge is long and straight, with many fine teeth. The shell is not much inflated, is thin, and daintily sculptured. A large specimen measures in length 29, altitude 15, semidiameter 7 mm.

This species is found in the Bowden beds, Jamaica; and the Gurabo formation, Dominican Republic. This is the first time it has ever been reported from Trinidad.

Locality.—Two miles east of Brasso Station.

Horizon.—Brasso Miocene.

Scapharca (Scapharca) patricia Sowerby Pl. 2, Fig. 5

Arca patricia Sowerby, Quart. Jour. Geol. Soc. London, vol. 5, p. 52, 1849.
Arca patricia Moore, Quart. Jour. Geol. Soc., vol. 9, p. 129, 1353.
Arca (*Anadara*) *grandis* Gabb, Trans. Phil. Soc., vol. 15, p. 253, 1873.
Arca patricia Guppy, Geol. Mag. London, p. 443, 1874; Quart. Jour. Geol. Soc., vol. 32, p. 531, 1876.
Arca grandis Gabb (in part), Jour. Acad. Nat. Sci. Phila., vol. 8, 2d ser., p. 378, 1874–1881.
Arca patricia Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 642, 658.
Arca patricia Guppy, 1903, Bull. Trinidad Botanical Dept., p. 541 (Tobagan Fossils); Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 131–133.
Arca patricia Sheldon, 1916, Palæont. Amer., No. 1, p. 49.
Scapharca (*Scapharca*) *patricia* Maury, 1917, Bull. Amer. Paleont., No. 29, pp. 173, 174; pl. 27, fig. 1.
Arca (*Scapharca*) *patricia* Vaughan and Woodring, 1921, Geol. Reconnaissance Dominican Republic, pp. 154, 164.
Arca patricia Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 19.
Scapharca patricia Maury, 1922, Palæont. Amer., No. 4, pp. 32, 33.

A large worn *Arca* from central Trinidad corresponds in form, size, and ribbing with our specimens of *Arca patricia* Sowerby from Santo Domingo, the type locality, and seems specifically identical. It measures in length 103, altitude 93, semidiameter 40 mm., and as it was not an old individual it might have attained an even larger size.

Dr. Guppy reported *patricia* from the Caroni series, Trinidad, and from the Robinson Crusoe Island of Tobago, northeast of Trinidad.

It is sometimes said that *Arca patricia* Sowerby is "lost," or is identifiable with *chiriquiensis* Gabb. But Sowerby was a chonchologist of fine discrimination, and his comparison of *patricia* with *Arca grandis,* as well as the very name of his Dominican species indicate that he had this splendid, noble Ark, which is abundant there, and not the smaller, comparatively insignificant *chiriquiensis* of Gabb. Some specimens of the patrician Ark can be found which cannot be distinguished from *A. grandis* Broderip and Sowerby; but *patricia* instantly brings to mind the East coast fossil, and *grandis* its living west coast representative and descendant. There are a number of similar cases of this usage in other genera.

The characters of *Arca patricia* are on the borderland between *Anadara* and *Scapharca, sensu stricto,* and as the former seems an artificial group, it is placed here in the latter section.

In Santo Domingo our *Arca patricia* beds at Caimito were above a concealed part of the section and their position could not be exactly determined, but they certainly were high up in the Miocene section. Dr. Vaughan later corroborated this and found *A. patricia* in the Cerros de Sal formation, of Upper Miocene age.

Professor Harris, from field observations, found the Trinidad *A. patricia* horizon stratigraphically far above the Springvale Miocene.

Localities.—Gomez Estate, about 1¾ miles southwest of Todd's Railroad Station, Caroni Department; Ward's Shack near 3-mile post Freeport-Todd's Road; Freeport-Todd's Road (No. 550).

Horizon.—Uppermost Miocene, above the Springvale Miocene.

Scapharca patricia var. **waringi,** n. var Pl. 3, Figs. 2, 5

Shell moderately large with about twenty-seven ribs which are more or less crenulated by coarse, transverse lines. In general form resembling young shells of *Scaph-*

arca patricia, but none of the many specimens attain the size of an adult shell of that species. Although small, however, they are in many cases very old shells as the gerontic characters of the ligamentary area prove. They constitute a dwarf variety of the true *patricia,* that would seem to mark the approaching extinction of the race. A large specimen measures in length 72, altitude 62, semidiameter 32 mm., others are 70 x 61 x 32, 57 x 54 x 26, 53 x 50 x 28.

The shape of this variety is not altogether like that of the true *patricia.* It differs from *chiriquiensis* chiefly in its larger size.

Locality.—¼ mile north of Point Paloma, Manzanilla Coast; also an unnamed headland, north of Manzanilla Point towards the mouth of the Oropuche River, northeastern Trinidad.

Horizon.—Upper Miocene. A lignitic eastern phase about equivalent stratigraphically to the western Springvale.

Scapharca (Scapharca) chiriquiensis Gabb Pl. 2, Fig. 2

Scapharca chiriquiensis Gabb, 1861, Proc. Acad. Nat. Sci. Phila., vol. 12, p. 567.
Scapharca (*Scapharca*) *chiriquiensis* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 642, 643.
Arca chiriquiensis Sheldon, 1916, Palæontographica Americana, vol. 1, p. 49.
Scapharca (*Scapharca*) *chiriquiensis* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 174, pl. 28, fig. 2.
Arca chiriquiensis Pilsbry (in part), 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 405, pl. 40, figs. 2, 3, 4–6. (Gabb's types.) Exclude *patricia* Sowerby.
Arca (*Scapharca*) *chiriquiensis* Woodring, 1924, Geology Republic of Haiti, pp. 188, 194, pl. 16, figs. 6, 7, 8.

In the collection from the northeastern coast are several valves which may be the young of *Scapharca chiriquiensis* Gabb. They resemble young specimens of that species from the Dominican Republic. All are badly preserved, crushed and exfoliated, and positive identification is not possible. Yet it is certain that they are either the young of *chiriquiensis* or of a closely related form.

This species is found in Chiriqui, Central America; on an island in Lake Henriquillo, southern Santo Domingo; Sabaneta to Guayubin Road, northern Santo Domingo; Thomonde formation and Maissade Tongue, Haiti. The latter beds are placed by Dr. Woodring in the Lower Miocene. On the Sabaneta to Guayubin Road in Santo Domingo, however, we found *A. chiriquiensis* with *A. patricia,* and that horizon from other faunal affinities also seemed very much higher. This Dominican horizon would accord better with the Trinidad horizon than would the Haitian.

Locality.—Six hundred feet north of Pointe Noir, northeastern coast of Trinidad.

Horizon.—Pointe Noir Miocene. An eastern lignitic phase, about equivalent stratigraphically to the western Springvale beds which are Upper Miocene.

Scapharca chiriquiensis var. **stamineopsis,** n. var. Pl. 2, Fig. 1

Shell of medium size, ovate-oblong, with about twenty-seven ribs which are more or less nodular, especially anteriorly. Beaks situated at about the anterior third of the total length of the shell. Length 34, altitude 30, semi-diameter 15 mm.

This Ark is related closely to *Scapharca chiriquiensis* Gabb, but is much smaller than that species. Though less produced posteriorly, in some respects it recalls *Scapharca websteri* Pilsbry, from Haiti; and like it seems best placed as a variety of *chiriquiensis.*

In form it approaches the Maryland Miocene species, *Scapharca staminea* Say, but the character of the ribbing is unlike.

Locality.—North of Manzanilla Point, northeast coast of Trinidad.

Horizon.—Middle Miocene.

Scapharca chiriquiensis var. **carolinoides,** n. var. Pl. 2, Fig. 4

Associated with the preceding variety, and to some

extent grading into it, are specimens also belonging to the *Arca chiriquiensis* group. But extreme examples of these shells approach bilateral symmetry and the beaks are more nearly central. This is the distinguishing character of this form. Ribs about twenty-seven, nodose anteriorly. Length of shell 26, altitude 23, semidiameter 10 mm.

This bears the relation to *stamineopsis* that *Arca carolinensis* Wagner, characterized by central beaks, bears to *Arca idonea* Conrad, characterized by anterior beaks.

Locality.—North of Manzanilla Point.

Horizon.—Middle Miocene.

Scapharca (Scapharca) pointnoirensis, n. sp. Pl. 8, Fig. 2

Shell small, rounded and evenly inflated, the umbonal slope not defined; the beaks so nearly central that the left valve appears almost bilaterally symmetrical. The right valve is less rounded with a more produced, narrower appearance, indicating that the two valves were unequal, the right fitting inside the left, and because of this the bilateral symmetry is less marked in the right valve. The valves are sculptured with about twenty-three entire ribs, wider than the interspaces; ribs on the right valve nearly smooth on the umbonal region, crenulate anteriorly; on the left valve, ribs crenulate. Hinge characters, so far as exposed, those of the section *Scapharca*. Length of shell 18, altitude 15, semidiameter 5 mm.

Locality.—Six hundred feet north of Pointe Noir, north of Manzanilla Point, northeastern coast of Trinidad.

Horizon.—Pointe Noir Miocene, about equivalent stratigraphically to the Springvale beds, which are Upper Miocene.

Scapharca (Scapharca) promentoriana Pl. 2, Fig. 3

Shell small, ovate-oblong, delicate, evenly inflated, anterior and posterior margins rounded; beaks situated at about the anterior third of the total length of the shell. Surface

sculptured with twenty-two entire, rounded ribs about equal to their interspaces. Ribs anteriorly nodose, posteriorly smooth. Hinge not exposed, but the general appearance of the shell is that of a member of the section *Scapharca*. Length of shell 29, altitude 19, semidiameter 8 mm.

This shell is at once recognized by its large, widely spaced ribbing, giving a very pretty, fluted appearance to the valves. For this type of shell it has very few ribs and is rather unique.

Locality.—Six hundred feet north of Pointe Noir, northeast coast of Trinidad.

Horizon.—Pointe Noir Miocene, about equivalent to the Upper Miocene of Springvale, west central Trinidad.

Scapharca (Scapharca) cunearcopsis, n. sp. Pl. 8, Fig. 16

Shell small, subtrigonal, oblique, inflated; anterior area very short, posterior area produced; umbonal slope roundly carinated. Ribs about twenty-five, nodosely crenate anteriorly, smoother posteriorly. Length of shell 22, altitude 18, semidiameter 8 mm.

This species has the form of a *Cunearca*, but the beaks are closely incurved over a rather narrow cardinal area, indicating that it should be placed in the section *Scapharca*, although grooves on the cardinal area were not seen because of the adherence of the matrix.

Locality.—Six hundred feet north of Pointe Noir, northeastern coast of Trinidad.

Horizon.—Pointe Noir Miocene, a lignitic phase about equivalent to the west central Springvale beds, which are Upper Miocene.

Scapharca (Scapharca) thauma, n. sp. Pl. 1, Fig. 3

Shell large, handsome, oblong-elongate, rather heavy and solid; valves with about thirty-nine ribs, wider than the interspaces, ribs over the anterior area medially grooved, the first eight or ten conspicuously so; the ribs and interspaces are crossed by concentric threads which on

the grooved ribs, where the surface is perfectly preserved, make a pretty, herring-bone pattern of parallel series of bars sloping in opposite directions from the central furrow. Hinge line long, teeth centrally short, fine, vertical; distally oblique, curving and broken up. Cardinal area long and wide with about five grooves (seven on a very old valve), not very regular. Length of shell 100, altitude 52, semidiameter 27 mm. The very large specimen is imperfect but its altitude is 60 and semidiameter 30 mm.

In form this splendid Ark recalls *Scapharca margaretæ* Maury, from the Dominican Miocene of Rio Cana, but that has only thirty-one ribs which are entire, and narrower than the interspaces, and the style of ribbing is like that of *aresta* and *campsa* of the Florida Miocene, which is not the case in this Trinidad species. In general aspect this shell also resembles *lienosa* Say, from the Virginia Miocene, but the ribs, except anteriorly, are not divided as in that species.

Scapharca formosa Sowerby, of the west coast, is a modern representative of this handsome group.

Locality.—Springvale, near Couva, Trinidad.

Horizon.—Upper Miocene.

Scapharca (Scapharca) oropuchensis, n. sp. Pl. 4, Fig. 6

Shell large, very heavy, solid, trigonal, nearly equilateral, in form approaching an isosceles triangle. Ribs about twenty-eight, over the umbonal region they are sharply medially grooved, elsewhere the surface is worn, but probably the ribs were more or less grooved excepting those on the posterior slope. Ligamentary area wide, with worn traces of V-shaped grooves; hinge wide and heavy, teeth long. Length of shell 85–90, approximate altitude 75–80, semidiameter 30 mm.

This is a *Scapharca* remotely related to the *Arca idonea* Conrad group of the Maryland Miocene; and to the *Arca patricia-grandis group;* the *idonea* and *grandis* groups being somewhat akin—with shells high and full, with a short,

high ligamentary area, and long hinge teeth. The quickly distinguishing feature of the species now described is its markedly isosceles form and solid, heavy structure, with ribs more or less grooved.

Locality.—Northeast coast of Trinidad, half a mile south of the mouth of the Oropuche River.

Horizon.—Upper Miocene—same as the Pointe Noir beds, and stratigraphically equivalent to the Springvale Miocene of west central Trinidad.

Scapharca (Scapharca) transversa var. **sancti-davidis**, n. var. Pl. 6, Fig. 3

Shell of moderate size, oblong, rather slightly and evenly inflated; anterior and posterior ends rounded. Ribs about thirty-three, rounded, entire, nodose anteriorly, largest over the umbonal slope. Beaks low, medially sulcated; hinge narrow, teeth fine centrally, larger distally. Length 31, altitude 22, semidiameter 9 mm.

This species resembles the Recent to Upper Pliocene shell, *Arca transversa* Say, but in *transversa* the basal and hinge lines are almost parallel; while in this Trinidad ancestral shell the basal and hinge lines are placed at a widely divergent angle.

This variety forms a link in the Recent to Miocene phylogenetic chain of *Arca transversa, plicatura, improcera,* and *arata.*

Locality.—Matura.

Horizon.—Pliocene.

Scapharca (Scapharca) esperanza, n. sp. Pl. 6, Fig. 1

Shell transversely elongate-oblong, flattish, with a slight, but evident, median radial sulcation. Beaks low, situated at about the anterior third of the total length of the shell. Ribs about twenty-seven, all entire, the anterior somewhat crenate from raised growth lines, otherwise the ribs are smooth. They show no tendency to grooving. The ribs are flat and noticeably wider as they reach the umbonal

slope. Interspaces not nearly as broad as the ribs. Cardinal area very narrow. Teeth concealed. Length of shell 29, altitude 17, semidiameter 7 mm.

At first glance this might be taken, because of its general outline, for a member of the *Scapharca transversa* group; but the very narrow cardinal area shows that it does not belong in the *transversa* series.

Its affinity seems to be with the living west coast *Scapharca emarginata* Sowerby, illustrated in my Panamic Arcas (Palæontographica Americana, No. 4, p. 23, pl. 2, figs. 5, 10, 1922), which it resembles in flatness of form, central radial sulcation, and widening of the ribs over the umbonal slope. That species, however, has the dorsal posterior margin notched, and in both our Trinidad fossils that portion of the shell is missing, so one cannot tell whether it was emarginate or not.

Locality.—Brasso Junction quarry.

Horizon.—Brasso Miocene.

Scapharca (Scapharca) balboæ Sheldon

Arca dalli Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., p. 510, pl. 24, fig. 4.
Not *Arca* (*Macrodon*) *dalli* Smith, 1885, Challenger Report, vol. 13, p. 269, pl. 17, figs. 10, 10b.
Arca balboai Sheldon, 1916, Palæont. Amer., No. 1, p. 69.
Arca invalida Hanna, 1924, Proc. Cal. Acad. Sci., 4th ser., vol. 13, No. 10, p. 157.

Dr. G. Dallas Hanna, in his recent "Rectifications of Nomenclature," gave the name *invalida* to Brown and Pilsbry's *Arca dalli.* He overlooked the fact that Dr. Pearl Sheldon had already renamed this Isthmian shell.

From its form, this species is probably a *Scapharca*, but the interior of the type was concealed.

We have no specimens of *A. balboæ* in our collections.

Locality.—Culebra Cut, Isthmus of Panama, in a lignitic clay.

Section *CUNEARCA* Dall

Scapharca (Cunearca) incongrua Say Pl. 7, Fig. 6

Arca incongrua Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 268.
Arca incongrua Reeve, 1844, Conch. Icon., *Arca*, pl. 8, fig. 50.
Scapharca (*Cunearca*) *incongrua* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 635.
Arca (*Cunearca*) *incongrua* Sheldon, 1916, Palæont. Amer., No. 1, p. 59, pl. 14, figs. 4–7.
Scapharca (*Cunearca*) *incongrua* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 18.

Shell subrhomboidal, inequivalve, the left valve the larger, sculpture discrepant on the two valves; ribs twenty-six to thirty; ligament covering all the cardinal area and bordered by a sharp groove; hinge teeth longer and oblique distally; epidermis, when still remaining on the shell, thin, light brown. Length 54, altitude 43, semidiameter 19 mm.; other specimens measure 53 x 43 x 17 mm.; 50 x 40 x 16 mm.

This species in its typical form is distributed from North Carolina to Texas, south of which it merges into *brasiliana*. Typical *incongrua* does not antedate the Pleistocene.

Scapharca (Cunearca) brasiliana Lamarck Pl. 4, Figs. 1, 4, 5

Arca brasiliana Lamarck, 1819, Anim. sans Vertèbres, vol. 6, p. 44.
Arca brasiliana Philippi, 1843, Abbild. und Beschr., vol. 1, *Arca*, p. 2, pl. 1, fig. 3.
Not *Arca brasiliana* Reeve, 1844, Conch. Icon., *Arca*, pl. 3, fig. 17, which is *bifrons* Carpenter, a west coast specimen.
Arca incongrua Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 41; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 21.
Arca incongrua Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42. Not *incongrua* Say.
Scapharca (*Cunearca*) *braziliana* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 635.
Arca brasiliana Sheldon, 1916, Palæont. Amer., No. 1, p. 59, pl. 14, fig. 8.
Scapharca (*Cunearca*) *brasiliana* Maury, 1922, Palæontographica Amer., No. 4, p. 36.

This is the southern form of the northern *Arca incongrua* Say. It differs from that species in being smaller, and proportionately shorter and higher. Its distribution is from

Texas southward to São Paulo, Brazil. Lamarck's type of *brasiliana* was from Rio de Janeiro and measured 35 mm. Our Trinidad shells are as follows: Length 34, altitude 30, semidiameter 14 mm.; 35 x 30 x 14; 40 x 34 x 16; 39 x 37 x 16 mm.

Cunearca brasiliana resembles the west coast *C. bifrons* Carpenter, but is distinct specifically, as d'Orbigny stated years ago.

The relationship between *brasiliana* and *incongrua* is rather puzzling. They merge at their boundary line, yet extreme forms are unlike; and I follow Dr. Dall's suggestion that at least tentatively they should be kept separate.

Localities.—Coast of Trinidad from Ally to Mosquito Creek; on the beach of Matura Bay; and at Mayaro Point.

Horizon.—Recent of Trinidad. Also Pliocene of Costa Rica (Dall). Dr. Guppy remarked on the absence of this species (as *incongrua*) from the Matura Pliocene.

Scapharca (Cunearca) sancti-andreæ, n. sp. Pl. 5, Fig. 6

Shell small, subrhombic, anterior end rounded, posterior end pointed; umbonal slope sharply carinate, and in front of this carina is a radial sulcation. Ribs thirty, on the left valve all handsomely and conspicuously beaded. Between the beads are striations which about the center of the valve are oblique instead of transverse, giving these ribs the effect, under a lens, of a miniature cable of rope. Hinge teeth smaller and closer, but not obsolete centrally; longer, slightly oblique, distally. Interior of valve very strongly and sharply furrowed by the external ribbing. Beak small, acute, not as high as in a *brasiliana* of equal size. Length of largest shell 25, altitude 21, semidiameter 9 mm.; smaller specimens measure 14 x 12 x 5; 10 x 8.5 x 4 mm.

This very pretty shell is allied to *Arca incongrua, brasiliana* and *scalaris*, but does not seem identical with any of these species. It is much more strongly beaded than *incongrua* and its southern form, *brasiliana*—the cross striæ are

further apart than in those shells; the beak is lower, the inner margin more fluted, and the posterior end more pointed. In general appearance this Trinidad shell is most like small specimens of *Arca scalaris* Conrad, which it greatly resembles in form and in details of sculpture. But it has more ribs than that species, which is found in the Miocene of Virginia, Carolina and the upper bed at Alum Bluff, Florida.

Locality.—Matura.

Horizon.—Pliocene.

Scapharca (Cunearca) filicata Guppy Pl. 8, Fig. 5

Arca filicata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 583, pl. 26, fig. 5.
Arca filicata Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Arca filicata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 636.
Arca filicata Schuchert, 1905, Bull. U. S. Nat. Mus., No. 53, p. 56.
Arca (*Cunearca*) *filicata* Sheldon, 1916, Palæont. Amer., No. 1, p. 61, pl. 15, fig. 5.

Shell small, subquadrate, oblique, somewhat inequivalve; ribs about thirty, nodosely crenate, nearly smooth on the center of the right valve; beaks high, very full, apices rather distant, being separated by a wide lanceolate ligamental area; hinge straight, angulate anteriorly and posteriorly; central teeth vertical; terminal more or less oblique. Length 19, altitude 17, diameter 16 mm.

Localities.—West side of Manzanilla Point (type locality); central E 24; southwest quarter of E 24, which is in the west central part of the island; 11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Scapharca (Cunearca) chemnitzi Philippi

Arca rhombea var. Chemnitz, 1784, Conch. Cab., vol. 7, p. 212, pl. 56, f. 553, lit. *b*.
Not *Arca rhombea* Born, 1778, Mus. Cæs. Vind., p. 76; Reeve, Conch. Icon., pl. 2, fig. 12 (the true *rhombea*).
Arca chemnitizi Philippi, 1851, Zeitschr. für Malakozoologie, vol. 8,

p. 50.
Noëtia orbignyi (Kobelt) Dall, 1889, Bull. 37, U. S. Nat. Mus., p. 40.
Scapharca (*Cunearca*) *chemnitzi* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pp. 636, 659.
Scapharca (*Cunearca*) *chemnitzi* Maury, 1912, Jour. Acad. Nat. Sci. Phila., vol. 15, pp. 44, 45.
Scapharca (*Cunearca*) *chemnitzi* Sheldon, 1916, Palæont. Amer., No. 1, p. 60, pl. 15, figs. 3, 4.
Scapharca (*Cunearca*) *chemnitzi* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 19; 1922, Palæont. Americana, No. 4, p. 34.

This species was confused with *Arca rhombea* Born, from the Indian Ocean. Dr. Dall thinks *Cunearca chemnitzi* is identical with the *A. antillarum* of Dunker, and with the *A. bicops* Philippi of d'Orbigny (Moll. de l'Amér. Mérid., p. 652, No. 715; Hist. Pol. y Nat. Isla de Cuba, pt. 2, vol. 5, *Moluscos*, p. 343). In the Gulf of Mexico it ranges from West Florida to Texas, and in the Atlantic through the West Indies to Colon and southward.

Fossil members of the *Cunearca chemnitzi* group of the West Indies and Florida are: *C. filicata* Guppy, *C. chemnitzioides, C. alcima Dall,* and the Costa Rican Miocene forms, *C. pittieri* Dall, *C. lloydi* Olsson, and *C. hindsi* Olsson.

The living analogue on the west coast is *Cunearca nux* Sowerby.

Locality.—Gulf of Paria at Brighton Beach.

Horizon.—Recent.

Scapharca (Cunearca) chemnitzioides Maury

Arca (*Cunearca*) *chemnitzioides* Maury, 1912, Jour. Acad. Nat. Sci. Phila., vol. 15, p. 44, pl. 7, figs. 13, 14, 15, pl. 8, fig. 1.
Arca (*Cunearca*) *chemnitzioides* Sheldon, 1916, Palæont. Amer., No. 4, p. 34.

Original description.—"Shell trigonal, short and high with prominent and widely separated beaks; cardinal area diamond-shaped with transverse striations and without V-shaped grooves; this and the general form show it belongs to the section *Cunearca.* Nearly all the specimens are in the form of internal molds, but several were casts of the exterior and guttapercha impressions of these show

the ribs were beaded as indicated in the figure.

"Length of an average sized mold 22, height 21, diameter 16.5 mm."

In certain characters, this species recalls the *Arca (Cunearca) cumanensis* Dall (Trans. Wagner Inst. Sci., vol. 3, pp. 633–634, 1898) from the Cumana, Venezuela beds.

This species is differentiated from *incongrua* by the high, narrow beaks and wide cardinal area.

As the specific name implies, this Trinidad fossil is closely related to the modern *Cunearca chemnitzi* Philippi. A larger allied form is *C. alcima* Dall from the Florida Pliocene.

Locality.—Brighton, Trinidad, south of Pitch Lake, on the southern road, in ferruginous marl.

Horizon.—Upper Miocene.

Scapharca (Cunearca) cumanensis Dall Pl. 5, Fig. 4

Arca incongrua Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42. Not *A. incongrua* Say.

Scapharca (Cunearca) cumanensis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 633.

Scapharca (Cunearca) cumanensis Sheldon, 1916, Palæont. Amer., No. 1, p. 61.

Scapharca (Cunearca) cumanensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 180.

Arca (Cunearca) cf. *cumanensis* Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, pp. 11, 12.

This species is now figured for the first time, Dr. Dall having kindly loaned a left valve of *A. cumanensis* from an island in Lake Henriquillo, southern Santo Domingo, and one of the type localities. Dr. Dall writes that this valve is almost an exact match of Guppy's Cumana valve on which the species was founded. It measures in length 28 mm., altitude 25, semidiameter 12.

Of our Trinidad Arcas, *A. cumanensis* is nearest to *A. sancti-andreæ* from the Pliocene of Matura but the two species are entirely distinct. In *cumanensis* the diameter is greater, the beak being very much fuller; the marked sul-

cation parallel to the umbonal ridge is lacking; the interspaces are wider; and, judging from left valves, the discrepancy in size of the two valves is much less in *cumanensis*. This is indicated by the fact that in *sancti-andreæ* the mark of the right valve is much further within the crenulated margin of the left than in *cumanensis*. The cardinal area is wider in *cumanensis*, and the general shape of the shell recalls that of *chemnitzi*, while that of *sancti-andreæ* recalls *incongrua* and *scalaris*.

Localities.—Island in Lake Henriquillo, southern Dominican Republic; Cumana, Venezuela. (Perhaps also at Aguada, Porto Rico.)

Horizon.—Probably Middle Miocene. Equivalent to the Gatun and Gurabo formations.

Scapharca (Cunearca) sancti-blasii, n. sp. Pl. 6, Fig. 4; Pl. 8, Fig. 9

A moderately small *Cunearca* with the usual form of this section, but less erect than *A. chemnitzi*. Its inflation is moderate. The anterior end is curved outward, giving the shell a more equilateral, and less oblique, appearance than is usual in the group. The ribs number about thirty-two and are nearly smooth except for a few at the anterior end.

Besides the internal molds of two left valves we have the upper part of the corresponding cast of the exterior of one of these, and a modeling clay impression of this is figured. We have no right valve, but this might be still smoother and have narrower ribs, although the sculpture could not be very discrepant—since the left is the valve which usually shows the strong sculpture. Hinge narrow, with fine teeth. Cardinal area without incipient grooves. Length 23, altitude 21, semidiameter 10.5 mm.

Locality.—St. Blaise Ravine, near the south coast of Trinidad, in the division of Moruga.

Horizon.—A new locality found by Professor Harris of the same age as that of La Luna Point, west of Moruga Point. They are about equivalent to the Manzanilla series.

and are the Moruga beds of Guppy. Fossils very rare.

Scapharca (Cunearca) tabaquita, n. sp. Pl. 8, Fig. 14

Shell rather small, thin and delicate in substance, subrhomboidal—unusual in shape for *Cunearca*—rather flat, only gently inflated; umbonal slope roundly carinate, but near the beak more sharply so; beak sulcated, as though dimpled, at the apex. Ribs on the left valve about twenty-eight, those over the central part of the disc being wide, flat and smooth, which is uncommon on the left valve of *Cunearca;* posterior ribs narrower than the central, smooth and flat, ribs of the anterior third prettily beaded with transverse ripples. Hinge characters as in *Cunearca* except that some, but not all, of the specimens show groovings—this feature being variable in this species, as it also is in *Cunearca chemnitzi,* and indicating the borderland between *Cunearca* and *Scapharca, sensu stricto.* Length of shell 22, altitude 16, semidiameter 7 mm. All of our specimens are left valves.

This species is striking because of its form, and the wide, flat ribbing, smooth on the center, rippled anteriorly.

Localities.—8½ miles on the Tabaquite Road, near the Tabaquite oil field in the southeastern corner of the Department of Caroni, that is, about the center of the island. Also a specimen from Brasso Junction quarry.

Horizon.—Lower Miocene about equivalent to the Tamana horizon (type locality); also Brasso Miocene (Middle Miocene).

Cunearca tabaquita var. molesta, n. var. Pl. 7, Fig. 2

Associated with the preceding species are several shells of more trigonal and more inflated form, with higher beaks, more carinated umbonal slope, and narrower ribs. The general aspect is far less striking than that of *C. tabaquita* and more the ordinary form of *Cunearca.* The beak is sulcated at the apex, moderately full, but not nearly so inflated as in *C. filicata.* Cardinal area marked off by incised lines.

Central teeth fine, distal longer, oblique, curving. Ribs on left valve about twenty-eight, more or less crenate, especially anteriorly. Length of shell 20, altitude 15, semidiameter 7 mm.

A puzzling shell, perhaps best placed as a varietal form.

Localities.—8½ miles on the Tabaquite Road, central Trinidad. Also Brasso Junction quarry.

Horizons.—Lower Miocene, about the Tamana horizon, and Brasso Miocene (Middle Miocene).

Scapharca (Cunearca) pittieri var. **narivana**, n. var.
Pl. 8, Figs. 15, 17, 20

The type of *Arca pittieri* Dall was collected by Professor Pittier near Limon, Costa Rica. It was described by Dr. Dall (Smithsonian Misc. Coll., vol. 59, No. 2, p. 9, 1912) but never figured until Mr. Olsson illustrated his examples from the Gatun beds of the Banana River, Costa Rica (Bull. Amer. Paleont., No. 39, p. 192, pl. 24, figs. 2–6, 1922).

Mr. Olsson's figures 2 and 4, with the very high umbo and quite strongly beaded ribs, may be taken as typical, since these correspond to the original description. We have an incomplete specimen from Brasso Junction quarry which, as far as one can judge from its imperfect condition, may have been like the typical form.

The rest of our Trinidad specimens agree with Mr. Olsson's figure 5, but not with his other figures of *A. pittieri,* nor with Dr. Dall's description which says that the sculpture of the two valves is alike.

As in the type, this variety has about twenty-six ribs; but our shells differ from Dr. Dall's description in having nearly smooth ribs over the umbonal ridge of the right valve, and on the left vale the umbonal ribs are much less beaded than in Mr. Olsson's figures 2 and 6. The posterior side of the umbo is squarish rather than rounded. The striking features of this variety are the comparative smoothness of the ribbing and the lower beak. The largest shell measures in length 30, altitude 23, semidiameter 12

mm. Some specimens have the base slightly sinuate.

This *Cunearca* bears some resemblance to *C. tabaquita*, but is distinct specifically because the left valve is quite unlike the left valve of that species in form and in character of ribbing and beading.

Localities.—½ mile above Brasso Station; Brasso Junction quarry, west central Trinidad.

Horizon.—Brasso Miocene.

Section *ARGINA* Gray

Scapharca (Argina) campechensis Dillwyn Pl. 7, Fig. 8

Arca campechensis Gmelin, 1792, Syst. Nat., vol. 6, p. 3312 (description inadequate).
Arca campechensis Dillwyn, 1817, Descr. Cat. Rec. Shells, vol. 1, p. 238. Not of Wood, 1825, Ind. Test., p. 46, pl. 9, fig. 28.
Arca campechensis Ravenel, 1834, Cat. Coll., p. 5.
Arca campechensis Arrango, 1880, Moll. Cubana, p. 262.
Scapharca (Argina) campechensis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 650.
Arca (Argina) pariænsis Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 47, figs. 7, 8, 9.
Arca (Argina) campechensis Sheldon, 1916, Palæontographica Americana, No. 1, p. 61, pl. 15, figs. 6–13.
Arca (Argina) campechensis Maury, 1920, Bull. Amer. Paleont., No. 34, p. 19.

Argina campechensis is the only *Argina* of the recent East Coast and Antillean faunas.

The earliest description of this shell was by Lister, more than a century and a half ago, who described it as a *Pectunculus*, densely and deeply striated, of an oval shape, and inhabiting the Bay of Campeachy. The typhical form is therefore the southern, which is small and rounded.

Near its northern limit, Cape Cod, Mass., the shell is large, coarse, earthy and densely hirsute—this is variety *pexata* Say. The more elongated, porcellaneous form of the shell, on the South Carolina shore, is variety *americana* Gray.

Our recent Trinidad specimens are the typical southern form. The ribs number about thirty-one to thirty-

three. Length 32, altitude 26, semidiameter 11 mm.

We have *Argina campechensis* from the Pleistocene of the Gulf States, and it is recorded from that of Georgia, South Carolina, New Jersey and southern New England; but this species has never been identified with certainty in horizons earlier than the Pleistocene.

In 1912, I tentatively named a recent Argina from the beach between La Brea and San Fernando, *A. pariænsis*, because it differed somewhat from *A. campechensis*. But after studying our much larger new collections from Trinidad I think *pariænsis* was merely a mutation of *campechensis*.

Localities.—Along the shore Ally to Mosquito Creek, southwestern Trinidad; West of Brighton; Megaro Bay; Hillside near Bontour Point, 75 feet above the sea (perhaps carried by birds).

Horizon.—Recent.

Scapharca (Argina) tolepia Dall

Arca pexata Guppy, 1867 (in part), Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 43; 1874, Geol. Mag. (in part). (Haitian and Cumana specimens.)

Not *Arca pexata* Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 268.

Scapharca (*Argina*) *tolepia* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 649, pl. 33, figs. 7, 8.

Scapharca (*Argina*) *tolepia* Sheldon, 1916, Palæont. Americana, No. 1, p. 63, pl. 15, figs. 14, 15.

Scapharca (*Argina*) *tolepia* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 342.

A small, thin, greatly inflated, rounded species, with finer and more nodulose sculpture than *A. campechensis*, but approaching in outline the typical, rounded, southern form of that species. Length of type 28, altitude 26, diameter 27 mm.

It is so inflated as to be nearly globose, which at once differentiates this shell from its descendant, *A. campechensis*.

The type locality was the Miocene of Rio Anima, Dominican Republic. Also from Bowden, Jamaica, and Dr. Dall included Dr. Guppy's Cumana specimens. Not re-

corded from Trinidad.

Scapharca (Argina) brightonensis Maury Pl. 7, Fig. 7

Arca (*Argina*) *brightonensis* Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 46, pl. 8, figs. 4, 5, 6.
Arca (*Argina*) *brightonensis* Sheldon, 1916, Palæontographica Americana, No. 1, p. 69.

Original description.—"Shell rather small for the genus, oval-elongate, cardinal area very narrow, hinge teeth in the two unequal series characteristic of this section *Argina,* the anterior set being very short; ribs on the left valve about thirty, lightly grooved over the central portion of the valve. Length 24, height 17, diameter 16 mm."

This shell approaches in form *Argina campechensis,* but on comparing it with several hundred specimens of that species, I find that shells of the same size of *campechensis* are invariably rounded and flatter than this Trinidad shell—which, moreover, antedates the Pleistocene—Recent *A. campechensis.*

Locality.—Brighton, along the shore 700 feet east of the pier, in impure asphalt.

Horizon.—Upper Pliocene.

Scapharca (Arginia) billingsiana Maury Pl. 6, Fig. 2

Arca (*Argina*) *billingsiana* Maury, 1912, Jour. Acad. Nat. Sci., Phila., vol. 15, p. 45, pl. 8, figs. 2. 3.
Arca (*Argina*) *billingsiana* Sheldon, 1916, Palæontographica Americana, No. 1, p. 69.

In Trinidad a race of Arginas developed differing from the *Argina campechensis* group, and characterized by their transverse form, the basal line running nearly parallel with the hinge.

Though very unlike the typical, southern, *campechensis,* this group of Arginas does somewhat resemble small specimens of the variety *americana* Gray, from the Pleistocene and Recent faunas of the Carolinas. But that is a much longer shell, its distribution is much more northern, and it

does not antedate the Pleistocene.

A marked example of these Trinidad Arginas is the Upper Tertiary species, *Argina billingsiana,* which may be taken as typical of this race.

Original description. — "Shell transversely oval-elongate, rather thick and strong, beaks nearly touching, incurved over the narrow cardinal area which is similar to that of *Arca campechensis* Dillwyn; ribs of the left valve generally simple, sometimes faintly grooved, about twenty-nine in number. Length of shell 31, height 22, thickness of one valve 10 mm."

In its form this species recalls numbers of the *Scapharca* (*Scapharca*) *transversa* Say group, but its hinge characters are those of the section *Argina*—that is, the teeth of the anterior series are shorter, irregular and broken up, while those of the posterior series are longer, normal.

A reexamination of the type of *A. billingsiana* only strengthens my belief of 1912 that it is specifically distinct from *A. campechensis* Dillwyn.

Locality.—Along the shore, 700 feet east of the Brighton pier, Trinidad, in a black, asphaltic marl.

Horizon.—Upper Pliocene.

Argina billingsiana var. **schultzana** Maury Pl. 5, Fig. 1

Arca (*Argina*) *schultzana* Maury, 1912, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 15, p. 46, pl. 7, figs. 10, 11, 12.
Arca (*Argina*) *schultzana* Sheldon, 1916, Palæontographica Americana, No. 1, p. 69.

Original description.—"This recent species has much the aspect of *Arca* (*Argina*) *billingsiana* of which it is undoubtedly the descendant. As with the fossil shell, the outline resembles that of the larger members of the group *Arca* (*Scapharca*) *transversa* Say, but the species is at once differentiated from those shells by the characters of the hinge teeth. The latter are those of typical *Argina;* a short, broken anterior set and a long, normal posterior row. The ribs number about thirty; cardinal area very narrow, beaks

approximate, depressed, placed within the anterior fifth of the greatest length of the shell. Length 35, height 25, diameter 22 mm.

Locality.—Brighton, south of the pier, in a sandy cove of the Gulf of Paria.

Horizon.—Recent.

Argina billingsiana var. **maturensis**, n. var.
Pl. 5, Fig. 3; Pl. 6, Figs. 9, 11

Shell transversely elongate-oval, rather thin, anterior end rounded, posterior rounded, end slightly flaring, basal margin often somewhat arcuate; beaks very low, touching; ribs thirty-three to thirty-six, a few on either valve being sometimes lightly grooved. Hinge delicate, teeth in the two series characteristic of *Argina*. Largest shell incomplete but its approximate length was 40, height 27, semidiameter 11 mm. Others measure 33 x 23 x 10, 30 x 21 x 9, 30 x 20 x 9, 23 x 15 x 6.

This Pliocene shell from northeastern Trinidad appears nearest to *Argina billingsiana* from the Brighton Pliocene, southwestern Trinidad. It differs from that species in being thinner in substance, less inflated, with much lower umbo, greater number of ribs, and in the rounded, somewhat flaring, posterior outline—instead of being contracted and pointed as in the Brighton shell.

Locality.—Matura.

Horizon.—Pliocene.

Genus *OSTREA* Linnæus

Ostrea haitensis Sowerby Pl. 9, Figs. 1, 2

Ostrea haitensis Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 53.
Ostrea haytensis Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 257.
Ostrea haitensis Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 532.
Ostrea haitensis Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 685.
Ostrea haitensis Joukowski and Clerc, 1906, Mém. Soc. Phys. et d'Hist.

Nat. de Genève, vol. 35, p. 170, pl. 6, figs. 20–23, 32–35.
Ostrea haitensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 182, pl. 31, figs. 1, 2.
Ostrea haitensis Cooke, 1919, Carnegie Inst., Publ. No. 291, p. 129, pl. 7, figs. 1, 2, pl. 8, fig. 1.
Ostrea haitensis Woodring, 1924, Geol. Republic of Haiti, p. 204.

This large and handsome species is typically oblong, but sometimes nearly circular, and aged shells become exceedingly massive and heavy. Both valves are plicated, but the flatter valve less strongly so. The plications frequently divaricate. Sowerby's type from Santo Domingo had only six or seven plications, but we have a Dominican specimen with fourteen, and Cuban shells may have twelve or more. A typical Trinidad specimen of moderate size, with about seven plications, and oblong form measures 115 mm. in altitude, 90 in breadth and 25 in semidiameter. A larger valve is 140 x 120 x 25. Some valves show fine striations near the beak.

Synonyms of *O. haitensis, fide* Dr. Dall, are *O. veatchi* Gabb, 1869, *heermanni* Conrad, 1853, and *vespertina* Conrad, 1869.

The affinities of *Ostrea haitensis* are with *Ostrea gatunensis* Brown and Pilsbry, from the Gatun beds of Panama, and with *O. antiguensis* Brown, from the Island of Antigua and of which Dr. Reeds collected beautiful specimens at Guanica Harbor, Porto Rico. *O. antiguensis* has a wide furrow on the convex valve dividing the seven plications into two sets of five and of two. In *O. gatunensis* the plications rarely divaricate. *Ostrea haitensis* is found in the Miocene of Santo Domingo, of Haiti, Cuba, Jamaica, Florida, and we can now add Trinidad.

Locality.—Springvale.

Horizon.—Upper Miocene.

Ostrea puelchana d'Orbigny
Pl. 10, Figs. 1, 2; Pl. 11, Figs. 1, 2; Pl. 12, Figs. 9, 10

Ostrea puelchana d'Orbigny, 1842, Paléontologie de l'Amérique Méridionale, p. 162, No. 177.
Ostrea puelchana d'Orbigny, 1843, Voyage dans l'Amérique Méridio-

nale, vol. 5, pt. 3, *Mollusques*, p. 672, Atlas, pl. 85, figs. 25, 26.
Ostrea puelchana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 40, pl. 5, figs. 3–5, 9, 10.

This is a very abundant fossil species in Trinidad. Examination of a quantity of these oysters of all sizes and from various localities show that they are all the same species for we have now intermediate sizes between the large and small forms that we had in 1912. This corroborates Dr. Dall's opinion, in 1912, that the large and the small forms were the same species.

The convex valve usually shows its area of attachment at the umbonal region; and in the vicinity of the umbo it typically becomes very thick, convex, and as it were humpbacked. The latter seems a characteristic feature. The surface of the convex valve is marked with very many, very irregular, coarse growth lines and lamellar ridges showing periods of interrupted or slow growth. The flatter valve is often somewhat flexed, is smooth or with growth lines, the beak is frequently pointed and salient, often curved. Aged shells have very heavy beaks. Specimens with both valves together measures as follows: 50 x 33 x 32, 90 x 60 x 45, 115 x 75 x 60 mm. A crude, irregular, hunchbacked shell, variable, yet showing these general features by which it is readily recognized.

Localities.—Union Estate, Brighton at Ridgewood, ½ mile from Bamboo Station; Union Estate at Usine Fork, between Usine River and Vessing River; and Usine Fork, 1000 feet north of Forest Reserve Road; Vessigny oil fields, Brighton; near Point Trinidad; halfway between Machapoorie and Brasso Stations No. 30; 2 miles south of Matura Bay, No. 244. Also very large specimens from eastern Venezuela in a raised terrace.

Horizons.—Middle Miocene; Upper Miocene (Union Estate and Vessing oil field); Pliocene; Pleistocene; Recent.

Ostrea virginica Gmelin

Ostrea virginica Gmelin, 1792, Syst. Nat., p. 3336.

Ostrea virginica Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 164; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 43.
Ostrea virginica Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 257.
Ostrea virginica Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 687.
Ostrea virginica Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 150.
Ostrea virginica Maury, 1917, Bull. Amer. Paleont., No. 29, p. 184; 1920, *Idem*, No. 34, p. 24.

From Matura we have quantities of young forms, many quite minute, and a few adult specimens which resemble shells of *Ostrea virginica* Gmelin.

Dr. Guppy cited this species from Matura and from the Caroni series. We have a young shell, probably this species, also from beds of that age; but, as I noted in 1917, there is some doubt whether true *virginica* is older than Pliocene.

Localities.—Matura; Springvale.
Horizons.—Pliocene and Upper Miocene.

Ostrea messor, n. sp. Pl. 10, Figs. 3, 4

Ostrea megodon Dall, 1898 (*Pro parte*), Trans. Wagner Inst. Sci., vol. 3, p. 685, 1903.
Ostrea megodon Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 195, pl. 18, fig. 1.
Not *Ostrea megodon* Hanley, 1845, Proc. Zool. Soc. London, p. 106.

Shell small, crescent or sickle-shaped, rather thin except at the plicated margin where it is more or less thickened; very inequilateral, nearly equivalve. Beaks sharply pointed, very oblique. Inner margins on either side of the umbo finely crenate. Basal margin with five or six angulated folds, the three or four central much stronger than the terminal ones. Surface of valves above the plications smooth, as the plicæ do not extent towards the beak, but effect only the outer, basal, half of the crescent-shaped shell. Length 45, width 25 mm.

We have been calling the Antillean, Miocene, sickle-shaped, five to six plicated oysters, *Ostrea megodon* Hanley. Unfortunately, we have no specimens of the true *megodon*. But a study of Hanley's description of this recent Peruvian shell shows that it is analogous to, but not specifically identi-

cal with, our fossils. Hanley's type had five or six larger, anterior plications and a number of weaker posterior ones; and the length was five inches, or 127 mm.—that is, more than twice as large as our largest fossils. Moreover, Hanley gives as a most distinctive feature, the *gigantic* tooth-like folds. This would not apply to the plications of our fossils.

Mr. Olsson's figured specimen from the Central American Miocene is very much like the Trinidad *O. messor* and is, I think, the same species.

Locality.—Springvale.

Horizon.—Upper Miocene.

Ostrea messor var. **caimitica,** n. var. Pl. 11, Fig. 3

Ostrea megodon Maury, 1917, Bull. Amer. Paleont., No. 29, p. 183, pl. 34, fig. 3.

Not *Ostrea megodon* Hanley, 1845, Proc. Zool. Soc. London, p. 106.

The specimens from the Dominican Miocene that I referred to *O. megodon,* are of the same general type as the Miocene species from Trinidad now described as *O. messor;* but have much weaker plications. The figured specimen has four in all, and they are rounded and undulate, instead of sharply angulate. The shell appears as a varietal form of *O. messor.* Length 55, width 25 mm.

Localities.—Guayubin to Mao Road; *Teredo* zone, Rio Cana at Caimito.

Horizon.—Miocene.

Ostrea messor var. **tabaquita,** n. var. Pl. 11, Fig. 6; Pl. 12, Fig. 6

From the Tabaquite Road we have a broader, more ovate and less sickle-shaped, though curving, small, plicated oyster with stronger plications than the Springvale shell. The specimen is incomplete and lacks the smaller terminal plications. The inner margins on either side of the umbo are finely crenate for some distance. Estimated length 50, width 35 mm.

Another more ovate, curving shell, perhaps this variety though less strongly plicated, is from the blue, shaly clays above the limestone on the top of the Brasso section, No. 302. In this form the sudden change from the flat, smooth area to the conspicuously plicate border is very striking, and the inner upper margins are very neatly and markedly, closely crenate. It measures 50 x 40 mm.

O. sculpturata var. *osculum* Pilsbry and Brown from Miocene beds near Cartagena, Columbia, has only two, very deep, folds in each valve, is rounded and nearly equilateral, and its affinities are stated to be with *O. sculpturata* Conrad. I have no specimens of this Columbian form, but our Trinidad shells are not like *sculpturata*, because in that species one valve is flat and nearly smooth, or feebly plicate, and the plications on the convex valve are more numerous and less pronounced, and they extend almost to the beak—they are radial rather than marginal.

Locality.—8½ miles on the Tabaquite Road.

Horizon.—Lower Miocene, about equivalent to the Tamana horizon.

Genus *HYRIA* Lamarck

Subgenus *HYRIA* Lamarck

Hyria (Hyria) trinitaria, n. sp. Pl. 13, Fig. 2

Shell subrhomboidal, rather solid, only slightly inflated, when perfect with a narrow, conspicuous, pointed, anterior process and a broad, high posterior dorsal wing terminating when entire in a prominent point. Posterior ridge strongly carinate, slightly biangulate. Beaks very low. Hinge line almost perfectly straight. One specimen shows distinctly a pseudo-cardinal tooth much split up into denticles. Surface marked with close, sharply defined, concentric threads, and on the disc, in front of the umbonal carina are very beautiful V-shaped markings. Length of shell without the anterior and posterior points, 65, greatest height 50, semi-

diameter 18 mm.

This shell is of great interest as being ancestral to *Hyria* (*Hyria*) *corrugata* Lamarck (pl. 13, fig. 1), the genotype, in showing the dawning of the V-shaped corrugations which are so striking in this recent species, found in the rivers of Peru, Guiana and Brazil.

The genus *Hyria* is limited to, and very characteristic of the Neotropical Province of the *Unionidæ*. There are but four species in *Hyria, sensu stricto; corrugata, rugosissima, latialata,* and *transversa,* and one in the subgenus *Triquetrana* Simpson—*stevensi* Lea.

Locality.—Cedros Point, southwestern Trinidad.

Horizon.—Lower Pliocene.

Genus *PECTEN* Müller

Pecten (Pecten) archon, n. sp. Pl. 16, Figs. 2, 3, 5

Pecten crassicardo Guppy, 1910, Agric. Soc. Trinidad and Tobago, Paper No. 440, p. 13; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 155.

Not *Pallium crassicardo* Conrad, 1856, Proc. Acad. Nat. Sci. Phila., p. 313; Arnold, 1906, U. S. Geol. Surv., Prof. Paper No. 47, p. 71, pl. 16, figs. 1, 1a, pl. 17, figs. 1, 1a, pl. 18, figs. 1, 2, 2a.

Shell large, rather sparsely, but very prominently ribbed. Right valve convex, but not extremely so; left valve flat or slightly concave. Both valves have about sixteen ribs of which the anterior and posterior three are small and closely crowded, while the ten or eleven over the center are very much larger. On the right valve they are very bold, high, squarish, and the five or six central ribs are distally medially grooved; but this character does not appear until the shell is more than half grown. Interspaces deep, very narrow proximally, but on old shells at the basal margin nearly as wide as the ribs. Both ribs and interspaces are crossed by fine growth lines. Ears equal. On the right valve the anterior ear has five coarse, equal, radiating threads, the posterior is less strongly and regularly radiately striate. Notch beneath the anterior ear rather shal-

low. A convex valve is 70 mm. in length, 62 in altitude and 20 in semidiameter. Two flat valves measure 68 x 58 and 65 x 53 mm.

This is probably the Springvale Pecten that Dr. Guppy referred approximately to the Californian *Pecten crassicardo* Conrad. But that is a *Lyropecten*, with both valves convex, while this is a true Pecten. The strong ribbing is, however, somewhat alike in the Californian and Trinidad shells.

The distinctive features by which this species is at once separated from the more abundant shells of *P. demiurgus* Dall, with which it is associated, are the dissimilar valves, and the very strong central ribs, lightly medially cleft in later stages of growth.

Locality.—Springvale.

Horizon.—Upper Miocene.

Pecten (Plagioctenium) demiurgus Dall Pl. 14, Fig. 5; Pl. 16, Fig. 6

Pecten comparilis Guppy, 1874, Geol. Mag., vol. 1, p. 451.
Not *Pecten comparilis* Tuomey and Holmes, 1855, Pleioc. Fos. S. Car., p. 29, pl. 11, figs. 6–10.
Pecten (*Plagioctenium*) *demiurgus* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 718, pl. 26, fig. 3.
Pecten demiurgus Guppy, 1910, Agric. Soc. Trinidad and Tobago, Paper No. 440, pp. 12, 13; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 155.

Shell large, suborbicular, somewhat oblique posteriorly. Right valve a little more inflated than the left, being noticeably fuller in the umbonal region. Otherwise, the right and left valves are similar. Ribs twenty, strong, rounded, finely squamose. Ears nearly equal, the anterior more deeply inset, with about six coarse, radial striæ and with a rather deep byssal notch beneath; posterior ear smooth above, the striations nearly obsolete, below with six or seven fine, radial threads. Altitude of type 70, latitude 72, diameter 36 mm. We have an abundance of all sizes from 17 to 75 mm. in altitude. An average-sized adult with both valves in place is 71 x 74 x 34. Splendid single valves 75 x 78 and

75 x 85 mm.

The fact that the right valve is more convex than the left indicates that this species was a very strong swimmer—for usually the left valve is the larger in this genus.

P. demiurgus is very closely related to the living west coast *P. ventricosus* Sowerby, the type of the section *Plagioctenium* Dall, to which most of the shallow water Pectens of our modern coasts belong.

Localities.—Savanetta (type locality, Guppy coll.); Springvale, very fine specimens; fragments southeast corner of E 23; 11th mile post on Caparo Road; also a doubtful cast from the top of the Brasso section.

Horizons.—Springvale Miocene; Manzanilla Miocene, and perhaps Brasso Miocene.

Pecten (Plagioctenium) gibbus Linnæus Pl. 14, Fig. 2; Pl. 16, Fig. 1

Ostrea gibba Linnæus, 1758, Syst. Nat., Ed. X, No. 172, p. 698.
Pecten gibbus Reeve, 1852, Conch. Icon., pl. 9, figs. 37b, 37c, not 37a.
Pecten gibbus d'Orbigny, 1845, In de la Sagra's Hist. Fis. Pol. y Nat. Isla de Cuba, vol. 5, *Muluscos*, p. 362.
Pecten circularis Guppy, 1877, Paria Fauna, p. 155. Not of Sowerby.
Pecten (*Plagioctenium*) *gibbus* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 745.
Pecten (*Plagioctenium*) *gibbus* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 27.

Shell rounded, inflated, both valves convex, not very discrepant in size. Ribs nineteen to twenty-two. Length of adult shell about 40 mm.

From the dwarfed fauna of Matura we have several small, gibbous Pecten valves with nineteen to twenty ribs; the right valve with the interspaces more striated than those of the left, a character noted by d'Orbigny in his discussion of this species, of which these valves are probably stunted specimens. Length of right valve 20, height 22, semidiameter 7 mm.; a left valve is 20 x 20 x 6.

Dr. Guppy listed *Pecten nucleus* Born from Matura, but *fide* Dr. Dall, that has 21–23 ribs, and is recent only. However, *nucleus* is placed by Dall as a variety of *gibbus*, and it is probable that the Matura shells referred by Guppy to

nucleus were the same as ones here referred to *gibbus*.

This species first appeared in the Miocene of Virginia, is present in the Pliocene of Florida, and the Pleistocene raised Antillean beaches, and ranges in the recent fauna from Hatteras to Brazil and in the Gulf of Mexico.

Locality.—Matura.

Horizon.—Upper Pliocene.

Pecten cf. cercadica Maury Pl. 16. Fig. 4

Pecten cercadica Maury, 1917, Bull. Amer. Paleont., No. 29, p. 188, pl. 34, fig. 11.
Cf. *Pecten gardneræ* Cooke, 1919, Carnegie Inst. Washington, Publ. No. 291, p. 134, pl. 7, figs. 5, 6.

There is a group of Antillean Tertiary Pectens of rather small size (22 to 30 mm. in length), fan-like form, fifteen to sixteen rounded, radial ribs, smooth except for very fine concentric growth lines.

In 1917, I described a Dominican shell of this group, naming it *P. cercadica.* The type was a left valve, the only specimen in my collection, and unlike any then in the National Museum. In 1919, Dr. Cooke described from the Cuban Miocene (by error Oligocene) *P. gardneræ* and *vaughani* var. *flabellum;* and from Antiqua *P. vaughani,* of an older horizon. These three are all members of the *cercadica* group. Dr. Cooke's name *vaughani* being preoccupied, I am suggesting for it the name *kunkuma.* See discussion under that heading. The left valve of *gardneræ* is very like that of *cercadica,* which also has a tendency to the grouping of the concentric lines, although these stages are not so regularly spaced as in Dr. Cooke's shell, varying from 1½ to 3 mm. in width. The ears also appear somewhat different.

From Brasso we have two imperfect shells which may be right valves of *cercadica.* They are flat, fan-like; ribs sixteen, strong; anterior ear with six radiating riblets, the upper two decidely scabrous, notch not very sharply angulate. Length of larger valve 31, altitude 29 mm. Specific

identification is not possible, but the valves are certainly of the *cercadica* group.

Locality.—Brasso, top of the section, No. 284.

Horizon.—Brasso Miocene.

Pecten cercadica var. **tabaquita**, n. var. Pl. 14, Fig. 1

From the fine, gray clay on the Tabaquite Road we have a right valve of the *Pecten cercadica* group; but differing from the Brasso valves in having much flatter and weaker ribbing and a very much sharper byssal notch.

This valve is compressed, somewhat oblique, delicate, with sixteen ribs that become weaker posteriorly so as to be hardly more than undulations. The ribs extend to the beak. The anterior ear is slightly the smaller and has six radiating threads, the upper being the coarser and more scabrous. Byssal notch deep, nearly, but not quite, half the length of the ear, very sharply V-shaped. The posterior ear is smooth except for fine growth lines. Length of valve 30, altitude 29 mm.

This valve resembles *P. vaughani* var. *flabellum* Cooke, but in that Cuban shell the ribs do not extend to the beak and the byssal notch is U-shaped, while in this the ribs reach the apex of the beak and the notch forms a very sharp, deep angle.

Locality.—8½ miles on the Tabaquite Road near the Tabaquite oil field.

Horizon.—Lower Miocene, about equivalent to the Tamana horizon.

Pecten kunkuma (new name)

Pecten vaughani Cooke, 1919, Carnegie Institution of Washington, Publ. No. 291, p. 133, pl. 8, figs. 2, 3, 4.
Not *Pecten* (*Lyropecten*) *vaughani* Arnold, 1906, U. S. Geol. Surv., Prof. Paper No. 47, p. 81, pl. 23, figs. 3, 3a, 3b.

Dr. Cooke's name for his Anguilla *Pecten* is preoccupied by Dr. Arnold's *Pecten* from the Miocene of Ojai Valley, Ventura County, California.

For the Anguilla shell the Sanscrit word *kunkuma*, for crocus is suggested.

Locality.—Crocus Bay, Anguilla.

Horizon.—Oligocene.

Pecten kunkuma var. **flabellum** Cooke

Pecten vaughani var. *flabellum* Cooke, 1919, Carnegie Inst. Washington, Publ. No. 291, p. 134, pl. 8, figs. 6a, 6b, 7.

Because of the preoccupation of the name *vaughani*, Dr. Cooke's variety of *flabellum* will fall under *P. kunkuma* Maury.

Localities.—La Cruz and Santiago, Cuba.

Horizon.—Miocene.

Pecten maturensis, n. sp. Pl. 14, Figs. 3, 4

Shell delicate, thin, obliquely suborbicular, fan-like, with both valves much flattened, the left being slightly the more convex, but their difference in form is not marked. Right valves sculptured with about sixteen very roundly and strongly fluted ribs, entirely smooth except for concentric growth lines; ears of moderate size, the anterior with six radiating threads. Left valve feebly sculptured with very low, undulating ribs marked only with growth lines. Length of a right valve 33, altitude 32, semidiameter 5; a left is 31 x 29 x 4 mm.

This species seems nearest to *Pecten thompsoni* Maury, from the Gurabo formation, Dominican Republic.

Locality.—Matura.

Horizon.—Pliocene.

Genus *AMUSIUM* (Bolten) Schumacher

Amusium papyraceum Gabb

Pleuronectia papyracea Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 257.

Amusium papyraceum Dall, 1898, Trans. Wagner Inst. Sci., p. 718; 1903, p. 1586.

Amusium papyraceum Maury, 1917, Bull. Amer. Paleont., No. 29,

p. 190, pl. 26, fig. 22.
Amusium papyraceum Maury, 1920, Sci. Surv. Porto Rico and Virgin Isls., vol. 3, pt. 1, p. 21.
Amusium papyraceum Hubbard, 1921, *Idem*, pt. 2, p. 96.
Amusium papyraceum Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 413, pl. 43, figs. 8, 9. (Gabb's type.)

In the collection are four imperfect valves, probably small specimens of Gabb's *papyraceum*. The external shell is smooth except for fine, concentric striæ, there being no nepionic ribbing at the beak; and the inner ribs are paired, their spacing being similar to that of *papyraceum*. Gabb's type was 54 in length by 52 in height; but some of our Dominican valves were about 100 mm. in altitude. Smaller Porto Rican valves measured 35 x 36. The largest Trinidad shell is 51 mm. in length.

Locality.—Shore of Manzanilla Bay.

Horizon.—Manzanilla Miocene.

Amusium rex-maris, n. sp. Pl. 15, Fig. 1

Shell very large, thin, obliquely subcircular, moderately and evenly convex, margins gently curving. Ears rather large, subequal. Exterior surface of shell where perfect showing conspicuous concentric growth lines and occasional ridges of slower growth periods. Interior of shell with paired radial ribs, there being about fourteen pairs. At the basal margin of the valve each pair occupies three to four, and each interspace, eight to fifteen millimeters, the spacing being variable. The ribs appear only on the lower central portion of the interior of the valve, as they become obsolete towards the hinge, and are absent anteriorly and posteriorly. Length of valve 165, altitude 147, approximate semidiameter 18 mm.

The exterior of the beak is concealed by the matrix which is unfortunate, as Dr. Dall has found the umbonal sculpture of the Amusiums valuable in classification. Thus *A. mortoni* Ravenel, *papyraceum* Gabb, and *luna* Brown and Pilsbry, have perfectly smooth beaks, while *lyoni* Gabb, *sol* and *antiguensis* have radial ribs on the exterior of the shell

in early stages.

On comparing this splendid *Amusium* with other species having paired internal ribs, it is seen to have fewer pairs. Thus *A. mortoni* has a minimum of twenty-one, *luna* and *sol* have about twenty-three pairs each, and *papyracea* has them still more closely-set. The largest *sol* recorded measured 90 x 30 and the largest *luna* 80 x 76 mm.

In size and general aspect our Trinidad *Amusium* is most like *mortoni* Ravenel, the very large Miocene to Pliocene species, but has decidedly fewer paired ribs and instead of being nearly circular is so oblique that there is 20 mm. difference in the length of a radial line dropped from the beak to the anterior basal margin from one dropped to the posterior basal margin—the anterior measuring 120 and the posterior 140 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *PLICATULA* Lamarck

Plicatula gibbosa Lamarck Pl. 11, Figs. 4, 5

Plicatula gibbosa Lamarck, 1801, Syst. Anim. sans Vert., p. 132.
Plicatula ramosa Lamarck, 1819, Anim. sans Vert., vol. 6, p. 184.
Plicatula vexillata Guppy, 1873, Proc. Sci. Assoc. Trinidad., vol. 2, p. 86, pl. 2, fig. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 70.
Plicatula cristata Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 257.
Plicatula vexillata Guppy, 1874, Geol. Mag., London, p. 436, pl. 17, fig. 7.
Plicatula gibbosa Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 763.
Plicatula gibbosa Maury, 1920, Bull. Amer. Paleont., No. 34, p. 30.

Our specimens from Trinidad have usually seven or eight plications. Like all the Matura specimens, they are small, measuring about 15 x 15 x 7 mm. They resemble small gibbosas from Florida.

Fide Dr. Dall, *P. vexillata* Guppy, from Jamaica, is identical with *gibbosa*—as one would surmise from the figure of Dr. Guppy's type.

P. gibbosa is living from Hatteras through the Antilles south to Rio de la Plata.

Locality.—Matura.
Horizon.—Pliocene.

Genus *ANOMIA* (Linnæus) Müller

Anomia simplex d'Orbigny Pl. 12, Fig. 8

Anomia simplex d'Orbigny, 1845, In de la Sagra's Hist. Fiscia, Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 371, Atlas, p. 28, figs. 31–33.
Anomia ephippium Conrad, 1845, Medial Tert. Fos., p. 75, pl. 43, fig. 4.
Anomia ephippium Tuomey and Holmes, 1855, Pleioc. Fos. S. Car., p. 18, pl. 5, fig. 4; Holmes, 1858, Post-Pl. Fos. S. Car., p. 11, pl. 2, fig. 11.
Anomia simplex Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 236.
Anomia simplex Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 784.
Anomia simplex Maury, 1917, Bull. Amer. Paleont., No. 29, p. 191, pl. 26, fig. 15; 1920, *Idem*, No. 34, p. 32.
Anomia simplex Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 209, pl. 21, fig. 6.

Recent specimens from Martinique and Cuba were described by d'Orbigny, the same year that Conrad described the fossil; but d'Orbigny's work was prior. The shell is smooth or concentrically striated, more or less orbicular but irregular in form because of its attached habit, diaphanous, fragile, shining, often used for ornamental shell work. Byssal aperture in the flat valve oval, large. A rounded convex valve from Trinidad is 28 mm. in length, 26 in height, 10 in semidiameter; a high, narrow specimen is 30 in length, 38 in height.

A static species, extending from the Miocene to Recent. Present range, Nova Scotia southward through the Antilles.

Localities.—Quarry ½ mile above Brasso Station; Matura.

Horizons.—Middle Miocene; Upper Pliocene; Recent.

Anomia umbonata Guppy

Anomia umbonata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 325, pl. 30, fig. 6.
Anomia umbonata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 783.
Anomia umbonata Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35,

p. 150.

Shell very small, irregularly suboval, beak pointed, surface with pustules, but no radial striæ. Breadth of type 6 mm.

Locality.—Shell bed, Ally Creek, southwest of San Fernando (Guppy).

Horizon.—Ally Creek Miocene.

Genus *MYTILUS* (Linnæus) Bolten

Section *MYTILUS, sensu stricto*

Mytilus (Mytilus) caroniensis, n. sp. Pl. 12, Figs. 7, 11

In the Brasso quarry, associated with *Modiolus brassoensis,* is a small *Mytilus,* shown by its smooth surface to belong to the section *Mytilus, sensu stricto.*

The shell is small, subtrigonal, with the beak terminal, very acute, and curving forward. The surface is polished and shows no trace of sculpture. The longest radius of the largest shell is 25, and the greatest width 21 mm.

This shell somewhat resembles small shells of *Mytilus edulis,* but is different in form, being more spreading and with a more acute and curving beak.

Locality. — Quarry ½ mile above Brasso Station, Department of Caroni, west central Trinidad.

Horizon.—Brasso Miocene.

Genus *MODIOLUS* Lamarck

Section *MODIOLUS, sensu stricto*

Modiolus (Modiolus) waringi, n. sp. Pl. 17, Fig. 1

Shell exceedingly large, elongate-oblong, very ventricose; anterior end rounded, projecting beyond the full, but low beak, posterior end broad, squarely rounded; posterior dorsal margin high, curving; posterior dorsal area compressed. Center of disc with a rather strong, radial sulcation which, however, only gently emarginates the base.

Surface of shell marked only with quite even concentric, thread-like lines of growth. Length 127, greatest height 60, diameter 45 mm.

A really magnificent shell, in size recalling *M. ducatelli* Conrad from the Maryland Miocene, but very much more inflated, less sulcate, much squarer posteriorly, and with the anterior basal margin deeper. *M. gigas* Wagner from Florida is attenuated anteriorly. This splendid shell is named in honor of Mr. Gerald A. Waring, by whom it was picked up in the quarry.

Locality.—Springvale.

Horizon.—Upper Miocene.

Modiolus (Modiolus) brassoensis, n. sp. Pl. 12, Fig. 12

Shell rather small, narrow anteriorly, wide posteriorly, with a very prominent sulcation passing from the beak to the basal margin. Umbonal slope very rounded. Surface marked only with concentric growth lines, there being no traces of radial striations. Length 40, anterior altitude 16, posterior altitude 24, semidiameter 9 mm.

Comparison with the recent *M. tulipus* Linnæus, shows that the fossil is much more sulcate, has a much less anterior beak, and the posterior dorsal line is straight, so that the greatest height of the shell is near the posterior end instead of about the center, as in *tulipus.* Our shell is much smaller and very much more sulcate than *M. modiolus.*

Modiolus maonis Maury, from the Dominican Miocene, also belongs to the section *Modiolus, sensu stricto;* but is not sulcate, and is quite different in form from this Trinidad shell.

Locality.—Quarry ½ mile above Brasso Station.

Horizon.—Brasso Miocene.

Genus *BOTULA* Moerch

Botula cinnamomea Lamarck

Modiola cinnamomea Lamarck, 1919, Anim. sans Vert., vol. 6, p. 114.
Modiolus cinnamomeus Dall, 1898, Trans. Wagner Inst. Sci., vol. 3,

p. 797.
Modiolus (*Botula*) *cinnamomeus* Cooke, 1919, Carnegie Inst. Washington, Publ. No. 291, p. 145, pl. 14, figs. 4, 5.
Botula cinnamomea Maury, 1920, Bull. Amer. Paleont., No. 34, p. 36.

Shell small, nearly smooth, subrhomboidal, slightly arcuate, inflated; beaks full and high. It may attain a length of 34 mm.

This species is quoted by Dr. Dall from the Tertiary of Trinidad; and by Cooke from that of Santiago, Cuba. In the recent fauna it extends from North Carolina through the West Indies, boring and nestling in soft limestone or shells.

From Zone H. Rio Cana at Caimito, Dominican Republic, I described *Botula hispaniolæ*, which showed very fine radial striæ. Gabb's *incurva* is from Costa Rica.

Locality.—Trinidad (Dall).

Genus *CRENELLA* Brown

Crenella divaricata d'Orbigny Pl. 18, Fig. 13

Nuculocardia divaricata d'Orbigny, 1845, In de la Sagra's Hist. Fiscia, Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 339, Atlas, pl. 27, figs. 56–59.
Crenella divaricata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 252.
Crenella divaricata Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 803.
Crenella divaricata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 194, pl. 26, fig. 18; 1920, Bull. 34, p. 37.

Shell minute, ovate, very convex, sculptured with fine radiating riblets which divaricate prettily on the central part of the valve. Height of shell 4, width 3 mm. D'Orbigny's type was a recent Antillean specimen, a little over 3 mm. in size.

C. divaricata appeared in the Miocene of Santo Domingo, and of Jamaica; and in the Pliocene of Florida and Costa Rica. It is living in the West Indies, the Gulf of Mexico, and also on the Pacific coast.

Locality.—Springvale.
Horizon.—Springvale Miocene.

Genus *TEREDO* Linnæus

Teredo incrassata Gabb Pl. 18, Figs. 9, 10

Kuphus incrassatus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 246; 1881, Jour. Acad. Nat. Sci. Phila., new ser., vol. 8, p. 342, pl. 44, figs. 12a–e.
Teredo fistula Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40. Not of Lea.
Teredo fistula Guppy, 1874, Geol. Mag., London, p. 441.
Teredo fistula Guppy, 1876, Quart. Jour. Geol. Soc. London, p. 529.
Teredo incrassata Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1587.
Teredo fistula Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Teredo incrassata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 235, pl. 39, fig. 24; *Idem*, No. 30, p. 25.
Kuphus incrassatus Vaughan, 1919, Bull. U. S. Nat. Mus., No. 103, p. 558.
Teredo incrassata Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, p. 45.
Teredo incrassata Hubbard, 1921, Sci. Surv. Porto Rico, vol. 3, pt. 2, p. 128.

We have several fragmentary, small tubes, doubtless of this Miocene species of *Teredo,* from Trinidad. No valves have ever been found, although in Santo Domingo the tubes are very common and often several feet long, but the shell itself remains unknown.

Dr. Guppy recorded similar tubes from Santo Domingo and from the Trinidad Miocene as *Teredo fistula* Lea.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *SAXICAVA* Fleuriau de Bellevue

Saxicava trinitaria, n. sp. Pl. 18, Fig. 8

All recent Saxicavas of our Atlantic coast are grouped by Dr. Dall under *S. arctica* Linnæus, which is found in the Miocene of Maryland, Pliocene of Florida, and living from the Arctic Sea south to Barbados. In the Gulf of Mexico is *S. azaria* Dall, of altogether different form.

A comparison of our fossil shells with figures of *arctica* and with specimens brought by Professor Tarr from Green-

land, shows that the beak is very much more anteriorly placed in the Trinidad shell. In *arctica* it is about at the anterior third, while in our fossils it is practically terminal. Directly beneath it the anterior end of the shell is truncate. This is followed by a radial sulcation which emarginates the base. Posterior end produced, roundly truncate. Surface irregular, crude, and marked with uneven, concentric growth lines. Hinge edentulous. Length 21, altitude 9, semidiameter 5.5 mm.

In the Newcomb collection are specimens labelled *Saxicava tenuis* Sowerby, from Panama. These resemble our shells in form and in the anterior position of the beak. This west coast recent shell is the closest ally of our fossil species.

Locality.—¼ mile south of 6th mile post on Freeport-Todd's Road.

Horizon.—Upper Miocene (*Arca patricia* level).

Genus *CORBULA* Lamarck

Section *ALOIDIS* Megerle

Corbula (Aloidis) vieta Guppy Pl. 19, Figs. 3, 4

Corbula vieta Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 8 (right valve).
Erycina tensa Guppy, 1866, *Idem*, p. 582, pl. 26, fig. 6 (left valve).
Corbula vieta Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Cf. *Corbula disparilis* Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 247 (which may be *sancti-dominici* Maury). Not *Corbula disparilis* d'Orbigny, 1845, De la Sagra, Hist. Pol. y Nat. Isla de Cuba, pl. 27, figs. 1–4.
Corbula vieta Guppy, 1874 (in part) Geol. Mag., p. 441.
Corbula disparilis Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 329. Not of d'Orbigny.
Corbula (*Aloidis*) *vieta* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 849.
Corbula vieta Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Not *Corbula vieta* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 231, pl. 39, fig. 13, which is *sancti-dominici* Maury.

From Manzanilla, the type locality, we have a number

of Corbulas which are clearly of the same sort that Dr. Guppy had when he described *Corbula vieta.*

These shells are very small, the larger measuring five to seven millimeters in length. The right valve, represented by Guppy's figure 8 of his type, is subtrigonal, but less equilateral than in his drawing, the anterior end being a little shorter and the posterior very slightly longer. This valve is very convex and is strongly and regularly concentrically ridged, the ribs very close and fine near the beak but becoming coarser distally. About twenty-five can be counted under a lens. One right valve is the size of d'Orbigny's figure of the type of his recent species *C. disparilis,* which was 5.5 mm. long. This shell bears a decided resemblance to d'Orbigny's figure 1, but the beak is not so high and the ribbing is coarser and stronger. This coincides with Dr. Dall's conclusions. In 1896 he united *vieta* with *disparilis,* but separated them in 1898, because of constant slight differences.

The left valve of *C. vieta* has been in doubt. Dr. Dall stated that Guppy's *Erycina tensa,* figure 6 on the same plate as *C. vieta* and also from Manzanilla was the left valve of *vieta.* Mr. Olsson questioned this (Costa Rica Miocene, p. 267) because of the Veneroid form of the *Erycina tensa* and its fine, but very clear radial threads, numbering about 14.

We have several left valves which show no radials, only faint concentric lines; but several others show a number of the radial threads. One valve is very perfect and closely resembles Guppy's figure of *"Erycina tensa,"* and its hinge is that of *Corbula,* not of *Erycina.* Unfortunately, the exact locality of this valve is uncertain.

Locality.—Manzanilla.

Horizon.—Lower Miocene.

Corbula (Aloidis) sancti-dominici, n. sp. Pl. 19, Fig. 2

Corbula (Aloidis) vieta Maury, April, 1917, Bull. Amer. Paleont., pl. 39, fig. 13.

Not *Corbula vieta* Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 8.
Corbula vieta Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 266, pl. 28, fig. 15.
Corbula vieta Maury, not Guppy, Spieker, 1922, Johns Hopkins Studies in Geol., No. 3, p. 170.

As remarked by Mr. Spieker, *loc. cit.*, my Dominican shell referred, in 1917, to *Corbula vieta* Guppy, is not identical with the typical *vieta* from Manzanilla, Trinidad.

But I am convinced that Dr. Guppy included more than one species in his Trinidad *vietas*—for those from the Caroni beds are far more unlike the Manzanilla specimens than is my Dominican shell.

In this memoir I am, therefore, restricting *Corbula vieta* Guppy to the typical form first described from Manzanilla.

On a right valve of a Manzanilla *vieta*, 6 mm. in length, 6 in height and 3 in semidiameter, about twenty-five ribs can be counted under a lens. The Dominican right valve in question measures 10 x 10 x 5 mm., and on it about twenty-six ribs can be counted. It is larger, much more inflated, and the ribs are coarser. For it I suggest the specific name *sancti-dominici.*

Mr. Olsson in comparing his Costa Rica shells referred with a question to *vieta*, concluded that they were identical with my Dominican specimens (Olsson, Bull. Amer. Paleont., No. 39, p. 267), so I here refer them to *sancti-dominici.*

Only a comparison could show whether Gabb's Dominican shells—that he erroneously referred to *disparilis* d'Orbigny, and which Dr. Pilsbry refers to *vieta*—are true *vieta* or are *sancti-dominici.*

Localities.—Bluff 2, Cercado de Mao; Zone I, Rio Cana at Caimito, Dominican Republic (type locality).

Horizons.—Miocene, Cercado formation, Dominican Republic; and Miocene, Gatun stage, Costa Rica.

Corbula (Aloidis) heterogenea Guppy

Corbula heterogenea Guppy MS., in coll., now in U. S. Nat Mus.

Corbula (*Aloidis*) *heterogenea* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, p. 850, pl. 36, fig. 15.
Cf. *Corbula heterogenea* Guppy, 1912, Agr. Soc. Trinidad and Tobago, Paper No. 520, p. 4; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 187.
Corbula (*Aloidis*) *heterogenea* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 107.

A small species, closely related to *Corbula vieta,* but specifically distinct. It differs from *vieta* in having narrower, lower, less prominent beaks, and in the greater extension of the posterior part of the shell. Length of type 9.5, altitude 8, diameter 5 mm. Length of figured type 7.5.

Cited by Dr. Dall from the Gatun beds, Panama; Bowden beds, Jamaica; Miocene and Pliocene of Florida. We have it also from Florida, and from a depth of 1241 feet in a well at Mobile, Ala., where the Chipola Miocene is encountered.

Locality. — Corosal Road *Cadulus* bed, Trinidad (Guppy).

Horizon.—Miocene. Perhaps equivalent to the Machapoorie Miocene.

Corbula (Aloidis) sancti-andreæ, n. sp. Pl. 19, Figs. 5, 6, 7

Shell small, but attaining a somewhat larger size than the Manzanilla *Corbula vieta* Guppy, from which it differs in the following respects: In the right valve of *vieta* the posterior area is rounded, not carinated; the posterior end is very short and roundly truncate, and the valve is subequilateral. In the right valve of this species the posterior area is very strongly carinate, the carination ending in a pointed posterior end; and in front of the carina the disc bears a pronounced radial sulcation. On the umbonal region there may be radial striæ. The left valve of *vieta* is only slightly inflated, the beak is low and smaller than that of the opposite valve; the surface is nearly smooth, with very faint concentrics and sometimes threadlike radials. In the left valve of this species (of which we have a number of specimens with both valves together) the beak is nearly as full as that of the right valve so that in early stages right and

left valves are nearly equally convex, and the left sometimes shows quite strong concentric ridges on the umbo, but later the valve becomes less inflated and smooth except for microscopic growth lines.

An adult shell with both valves together measures in length 6, in height 5, diameter 4 mm. The very largest valve is 8 x 6.5 x 4.

The very convex, subequal beaks are a distinctive feature of this little shell, which in some respects resembles *heterogenea*—that shell being about the same size, or slightly larger, and also produced somewhat posteriorly.

Locality.—Manzanilla, Nos. 262, 263, 265, 294.

Horizon.—Manzanilla Miocene.

Corbula (Aloidis) isla-trinitatis, n. sp. Pl. 19, Figs. 1, 8, 9, 10

Shell large for the genus, valves discrepant in size, form, and sculpture. The right valve is very ventricose, with a very high and full beak, strongly curved over the hinge area; anterior end very abruptly rounded, posterior end somewhat produced, obliquely truncate and biangulate; rostral carina rounded; surface sculptured with thirty-five to forty narrow, rounded, concentric, subequal ribs of which one or two usually divaricate. The ribs may cross the rostral carina but usually become weaker on the posterior area. Interspaces are very narrow, almost linear. The left valve is smaller and fits within the right, leaving quite a projecting margin of the right, especially at the posterior truncation. This valve is marked only by microscopic, concentric growth lines and by a varying number of irregularly spaced, thread-like, radial riblets of which there are usually about seven. There can be no question that this is the left valve because several specimens were preserved with the two valves together in their natural position. Length of a shell with both valves together 17, height 15, diameter 12 mm. Several separate right valves measure 19.5 x 18 x 11, 19 x 16 x 10, 19 x 16 x 9.5 mm. A left valve is 14 x 10 x 4.

This species is like a mammoth *C. vieta*. In size it is

like *C. bradleyi* Nelson from the Peruvian Miocene; but different in form, as the posterior basal margin is not obliquely produced as in Spieker's illustration of that species. Dr. Guppy placed these large *Aloidis* shells all in his *vieta*. But the difference in size is very great. The true *vieta* from Manzanilla is of the *disparilis* type, which never exceeds 9 or 10 mm., and *vieta* is smaller, reaching only 5 to 7 mm. Since this form is three or four times as large as *vieta*, it seems worthy of specific differentiation.

Corbula (*Aloidis*) *heterogenea* Guppy, is also much smaller.

Localities.—In blue shaly clay ½ mile above Brasso Station; also Springvale.

Horizons.—Lower Springvale and Springvale Miocene.

Section *CUNEOCORBULA* (Cossmann) Dall

In the following descriptions, the section *Cuneocorbula* is used in Dr. Dall's extended sense; and not in the original, exclusive sense of its author, Monsieur Cossmann, who restricted his subgenus *Cuneocorbula* to the group of *Corbula biangulata* Deshayes. I have followed Dr. Dall, in order to give uniformity to the treatment of American species—although M. Cossmann was very strongly averse to this interpretation of his *Cuneocorbula*. (See Révue Critique de Paléozoologie, p. 114, Juillet, 1916.)

Corbula (Cuneocorbula) caribæa d'Orbigny Pl. 20, Figs. 5, 9

Corbula caribæa d'Orbigny, 1845, In de la Sagra's Hist. Pol. y Nat. Isla de Cuba, pt. 2, vol. 5, *Moluscos*, p. 323, Atlas, pl. 27, figs. 5–8.
Corbula caribæa Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Corbula caribæa Guppy, 1874, Geol. Mag., London, 2d ser., vol. 1, p. 441.

Shell rather small for the genus, ovate-oblong, inflated, rather thick; both valves sculptured similarly with closely set, concentric, fine ridges—sometimes a little coarser, sometimes almost obsolete; both valves with an umbonal carina-

tion; posterior end, especially of the right valve, a little produced and pointed. The type was somewhat over 9 mm. in length; d'Orbigny's specimens were from the recent of Havana and Santo Domingo.

We have a great number of these shells, dredged by Professor Harris from the Gulf of Paria. The largest, a right valve, is 11 mm. in length, altitude 7, semidiameter 4. The average adult length is about 9; very young shells are only 3 or 4 mm.

Corbula caribæa d'Orbigny and *C. swiftiana* Adams (Contr. Conch., 12, p. 236, 1852) are closely allied, perhaps identical. If so, d'Orbigny's name has priority.

Localities.—Gulf of Paria, Trinidad (very abundant large and small); one mile below Matura, and Matura (young, small valves).

Horizons.—Upper Pliocene and Recent.

Corbula caribæa var. **pergrata**, n. var. Pl. 20, Fig. 8

From Brighton we have a single right valve of a *Corbula*, resembling in form large specimens of *C. caribæa* d'Orbigny, dredged from the Gulf of Paria. But on comparing it with hundreds of valves of that species it is seen to differ in sculpture, being much more sharply, regularly, and elegantly concentrically sculptured.

Unlike the very small, dwarfed valves of *C. caribæa* from the Matura Pliocene, this shell is large for the species. Length 11, altitude 7.5, semidiameter 2.5 mm.

Locality.—Brighton shore, in pitch sand containing Mollusca.

Horizon.—Pliocene.

Corbula (Cuneocorbula) cubaniana d'Orbigny Pl. 20, Figs. 2, 3, 4

Corbula cubaniana d'Orbigny, 1845, In de la Sagra's Hist. Fisica, Pol. y Nat. Isla de Cuba, p. 322, Atlas, pl. 26, figs. 51–54.
Corbula cubaniana Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Corbula cubaniana Guppy, 1874, Geol. Mag., London, p. 441.

Shell ovate, subequivalve, white, opaque, concentrically ribbed; anterior end short rounded, posterior acutely carinate and obliquely truncate. The type was over 11 mm. in length. Recent from Havana.

In our Matura collection are a number of Corbulas much like d'Orbigny's *C. cubaniana,* except that they are smaller, our largest shell measuring 8 x 6 mm. Both valves are similarly sculptured and nearly alike in form, the left seemingly being a little less high.

These Pliocene shells also have some resemblance to Gabb's Dominican, Miocene specimen, described and figured by Pilsbry as *Corbula knoxiana fossilis* (Proc. Acad. Nat. Sci. Phila., vol. 73, p. 427, pl. 46, fig. 14, 1922), which differs from *knoxiana* only in having a less marked carina. For description of *knoxiana* see C. B. Adams, Contr. to Conch., No. 12, p. 238, 1852).

Locality.—Matura.

Horizon.—Pliocene.

Corbula (Cuneocorbula) daphnis, n. sp. Pl. 20, Figs. 10, 11

From Matura, eastern Trinidad, we have two left valves of a *Corbula,* differing in sculpture from our other Corbulas, and seemingly unlike any of Adams' unfigured, living Jamaican species.

The shell is of medium size, transversely ovate, subequilateral, evenly and moderately inflated, rounded anteriorly, pointed posteriorly; beak low; the posterior area lying between a rostral and a dorsal marginal carina, neither very marked. Radial sculpture absent. Concentric sculpture faint, so that the surface except under a lens appears almost smooth. The riblets number about twenty-six, and near the base is a strong, concentric furrow, probably peculiar to this particular valve. Length 14, height 8, semidiameter 4 mm.

A smooth, neat, regular species.

Locality.—Matura.

Horizon.—Pliocene.

Corbula (Cuneocorbula) sericea Dall

Corbula (*Cuneocorbula*) *sericea* Dall, 1898, Trans. Wagner. Inst. Sci., vol. 3, p. 848, pl. 36, fig. 8.

A short, high, very small species with a very pronounced sulcation in front of the carina. Scupture of very fine, numerous, concentric riblets crossed by fine radial striæ. Both valves similarly sculptured. Length 4.5, altitude 3.5, diameter 2.3 mm. The largest measured 5.4 x 4 mm. Type locality, Bowden, Jamaica.

This species resembles in the radial striations d'Orbigny's recent Antillean shell *Corbula lavalleana;* but is shorter and higher, and bears the strong sulcation in front of the carina which is not present in the living species.

Another species of the *Corbula lavalleana-sericea* group is the Dominican Miocene *C. cercadica* Maury, which is proportionately longer than *sericea* and lacks the sulcation anterior to the umbonal ridge. It also shows faint radial striæ.

Dr. Dall's placing *Corbula cubaniana* Guppy (Geol. Mag., 1874, p. 441) in the synonymy of *sericea* is erroneous, because Guppy listed *cubaniana* from Matura, and our specimens from that locality are very unlike *sericea* but greatly resemble *C. cubaniana* d'Orbigny.

Locality.—Bowden, Jamaica.

Horizon.—Middle Miocene.

Corbula (Cuneocorbula) manzanillensis, n. sp. Pl. 20, Figs. 6, 7

Shell minute, ovately triangular, convex anteriorly; compressed, sulcate, carinate, flexed and truncate posteriorly; basal margin convexly rounded anteriorly, slightly concave in front of the carina. The right valve has the beak smooth, followed by an area with widely-spaced, sharp, concentric riblets, later stages with closer riblets. Riblets in all numbering ten to twelve. There is also a delicate, but sharply defined radial sculpture of microscopic threads, well marked in the interspaces. The left valve of the same specimen is smaller, fitting within the right, leaving quite

a margin. In form the left valve is less inflated, except the beak which is subequal to that of the right. The anterior end is rounded, posterior truncate. The sculpture is similar to that of the right, but not so bold. The smooth beak is followed by six or seven very narrow, concentric ridges, with wide interspaces, and many microscopic, radial threads. Length of specimen with both valves in place 3.5, altitude 2.8, diameter 2.5 mm. The largest right valve is 5 x 3 mm. Many are 2 x 3.

This little shell is very common in the Manzanilla Bay beds. It resembles in general form and type of concentric ribbing, *Corbula whitfieldi* Dall, from the Oak Grove Miocene of Florida; but that is a larger shell and has no trace of radial sculpture. In the presence of radials, the Trinidad shell recalls *Corbula barrattiana* C. B. Adams, which is allied to Dr. Dall's *whitfieldi.*

Locality.—Manzanilla Bay Nos. 267, 268, 175 feet above, and 100 feet below the conglomerate.

Horizon.—Manzanilla Miocene.

Corbula (Cuneocorbula) hexagonella, n. sp. Pl. 20, Fig. 1

Shell very small, trigonal, convex. Left valve inflated anteriorly, subcompressed posteriorly, almost equilateral, but, while the anterior end is evenly rounded, the posterior end terminates in two rounded points, of which the lower is the more prominent. These points are the terminations of the two carinæ which border the margins of the posterior area. Between them is a sulcus which is arcuate at its termination, thus with the two projecting ridges making the little shell minutely birostrate. The surface is divisible into three areas: The smooth umbonal region; the central area which is sculptured with about sixteen closely set, flattish, band-like concentric riblets; and the smooth, basal region which occupies about one-third of the height of the shell, over which the riblets become obsolete. The earlier half of this left valve is marked by about five irregularly spaced, impressed radial lines of unequal lengths. Length of

valve 6, altitude 5, semidiameter 2.5 mm.

There are a few other left valves which resemble this valve in the character of the concentric ribs, but they have not the smooth, basal area, nor the birostrate end. It is doubtful whether they are the same species. There is also a broken right valve which resembles the left valve described above as the type of *hexagonella,* in the radial impressed lines, and in the character of the ribbing, except that the ribs do not become obsolete basally. I think it is the same species. If, so, the valves are subequal, and similarly sculptured, and the species belongs to the section *Cuneocorbula.*

Locality.—Manzanilla.

Horizon.—Lower Miocene.

Corbula (Cuneocorbula) brassoensis, n. sp. Pl. 20, Fig. 12

Shell small, transversely ovate, very markedly pointed and twisted posteriorly, strongly carinate, with a pronounced sulcus in front of the carina; basal margin strongly arcuate at the termination of the sulcation; posterior margin truncate; beaks low, subequal. Right valve a little the larger, but less strongly sculptured; the umbonal region is nearly smooth, and over the lower part of the disc are about seven rather unequal and unevenly-spaced concentric ridges. Left valve slightly smaller, but more boldly sculptured, with about ten unequal, concentric ridges; in form it resembles the right. Neither valve has any trace of radials. Length of shell with both valves together 6, altitude 4, diameter 3 mm.

This little species is at once differentiated from our other Trinidad Corbulas by its very pointed and twisted posterior end. It is like *sarda* Dall, in having the sculpture stronger on the left than on the right valve.

Locality.—½ mile above Brasso Station, No. 302.

Horizon.—Lower Springvale Miocene.

Corbula (Cuneocorbula) helenæ Maury Pl. 20, Fig. 15

Corbula (*Cuneocorbula*) *helenæ* Maury, 1912, Contribution Paleont. Trinidad, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 62, pl. 9, fig. 25.

Shell small, sub-equilateral, nearly equivalve; oblong-ovate, carinate and truncate posteriorly; beaks low, approximate; concentric sculpture on both valves of numerous, closely-set, feeble and more or less obsolete ribs; radial sculpture, especially on the left valve, of fine, close striations, extending from the beak to the lower margin, and most conspicuously developed on the third of the disc in front of the carina. Length 8, height 5, diameter 3 mm.

This species is most like *Corbula brassoensis* in our present collection from Trinidad, but is larger and more inflated than that shell, and is further differentiated from it by the radial sculpture of *C. helenæ,* which is entirely lacking in *brassoensis.*

Locality.—Brighton, southwestern Trinidad, 1000 feet west of the pier in an impure asphalt.

Horizon.—Pliocene.

Section *BOTHROCORBULA* Gabb

Corbula (Bothrocorbula) viminea Guppy Pl. 19, Fig. 19

Corbula viminea Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, pl. 18, fig. 11.
Corbula viminea Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Bothrocorbula viminea Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 247.
Corbula viminea Guppy, 1874, Geol. Mag., London, p. 441.
Corbula viminea Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p, 529.
Corbula (*Bothrocorbula*) *viminea* Dall, 1898, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 850.
Not *Corbula viminea* Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 6, 13; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 149, 155.
Corbula (*Bothrocorbula*) *viminea* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 233, pl. 29, figs. 20, 21.
Corbula viminea Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 270, pl. 28, fig. 25.

Shell rather large, solid, transversely oblong, rounded anteriorly, acutely beaked posteriorly; sculpture of stout, roundish, concentric ribs; hinge with a prominent cardinal tooth and a deep, orbicular pit in front of it. Guppy's type was from Bowden, Jamaica. His drawing measures 20 x 14 mm., and was, perhaps, slightly enlarged, as our Dominican specimens measure about 16 x 10.5 and Gatun shells 15 x 10.

Gabb, on finding Guppy's Jamaican species in Santo Domingo, made it the type of a new genus, *Bothrocorbula*. But the lunular pit is not constant in related forms which grade into *Cuneocorbula*, so that *Bothrocorbula* has been classed as a section instead of a genus.

In 1898, Dr. Dall questioned whether the Peruvian Miocene *Corbula bradleyi* Nelson might not be identical with *C. viminea*. But Nelson's shell has recently been figured by Spieker, which shows it to be in form very unlike *viminea*.

C. viminea was erroneously identified by Dr. Guppy from Springvale. His specimen is not *viminea*, but is the large *Aloidis* that I have called *A. isla-trinitatis*. True *Bothrocorbula viminea* has never been found in Trinidad.

Localities.—Cercado formation, Dominican Republic; Bowden beds, Jamaica; Gatun stage of Costa Rica.

Horizons.—Lower and Middle Miocene.

Corbula (Bothrocorbula) smithiana Maury Pl. 20, Fig. 18

Corbula (Bothrocorbula) smithiana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 63, pl. 9, figs. 29, 30.

Shell small for this section, nearly equilateral, solid, ovate, carinate and pointed posteriorly; beaks low and small; sculpture of about twelve narrow, concentric, rather sharply edged ribs with wider interspaces, extending from the base to a short distance below the beaks which are nearly smooth. Length of left valve 8.5, semidiameter 3 mm. A lunular pit is present.

This species is smaller, much more closely ribbed than *C. viminea*, and the ribs are sharp, not rounded, as in that

species.

Locality.—Brighton, 1000 feet west of the pier in an impure asphalt.

Horizon.—Pliocene.

Corbula (Bothrocorbula) guaiconensis, n. sp. Pl. 19, Figs. 13, 14, 18

Shell of medium size, solid, ovately oblong, pointed posteriorly, valves similarly sculptured and subequal, the left being only slightly smaller and shorter than the right; beaks moderately elevated, small; anterior end rounded, posterior pointed, with a rostral carina in front of which the base is slightly emarginate; sculpture of strong, rounded undulations, numbering about seven, ending at the carina, not extending upon the umbones, and strongest basally. Interspaces narrower than the ribs. Rostral area concentrically striated. Surface, where perfect, shows fine concentric growth lines and microscopic, radial striæ. Lunular area ill-defined, not forming a cavity, or cellule, and thus approaching *Cuneocorbula.* Length of shell 13, altitude 9, diameter 7 mm.

An affinity of this species is *Bothrocorbula radiatula* Dall, but that shell is at once differentiated by the presence of a conspicuous lunular cellule directly in front of the beak. Our shell also resembles the much larger Gatun species, *C. hexacyma* Brown and Pilsbry.

Localities—Guaico-Tamana Road at 13th mile post; Fossil Ravine (central Trinidad); Machapoorie quarry.

Horizon.—Machapoorie Miocene.

Corbula (Bothrocorbula) cistellula, n. sp. Pl. 19, Fig. 20

Shell of moderate size, very solid, oblong, trigonal, subequilateral, coarsely and sparsely ribbed, posterior end pointed, basal margin arcuate; basal regions of both valves broadly and equally flattened and at right angles to their earlier growth, so that the margins come together like those of a little chest, and the diameter at the base is equal

to the greatest diameter of the shell. The right valve is slightly the larger and has two very coarse and two much weaker concentric ribs. The left valve shows one strong basal rib and traces of a smaller above it. Interior of the valves concealed but there is no indication of a cellular pit. Length of shell with both valves together 14, altitude 8, diameter 7 mm.

A very striking form. The flattened base resembles that of a shell of *viminea* from Santo Domingo (Bull 29, pl. 39, fig. 21) which I thought pathologic. But this shell has not the form of *viminea*, shows no trace of the cellule, and has fewer ribs.

This peculiar growth of the valves at maturity at right angles to their former plane takes place also, to a less abrupt degree, in *Corbula dietziana* C. B. Adams; but this species in other respects is not like this Trinidad shell.

Locality.—Fossil Ravine (central Trinidad).

Horizon.—Machapoorie Miocene.

Corbula (Bothrocorbula) arionis, n. sp. Pl. 19, Figs. 11, 12, 17

Shell rather small, ovately-trigonal, irregular in form; right valve with the anterior end produced, rounded, longer than the pointed posterior end; basal margin ascending posteriorly as though the shell were pinched toward the tip. Surface marked by fine, close, concentric lines seen only with a lens, and by about three coarse, rounded, concentric ridges, bounding growth areas, each of which is at a different plane from the earlier. These areas constitute the umbonal, central, and basal parts of the valve. Hinge concealed, length of right valve 11, height 7.5, semidiameter 5 mm.

There are two more left valves probably belonging to this species, since they also have the few, irregular, heavy ridges with wide areas between them. These valves are smaller, measuring 9.5 x 6 x 2.5 and 10 x 6 x 2.5 mm.

A clumsy little shell, quite unlike our other Corbulas.

Locality.—Matura.
Horizon.—Upper Pliocene.

Corbula (Bothrocorbula) dianæ, n. sp. Pl. 19, Figs. 15, 16

Shell of medium size for the genus, solid, nearly equilateral, very shortly pointed behind, posterior area with a single carina, base slightly arcuate. Right and left valves subequal, the right a trifle higher and longer; beaks nearly equal, full, not high, their apices small, acute. Sculpture on right valve of eight or nine rather coarse, rounded, concentric ribs with narrower interspaces; on crossing the carina the ribs break up into coarse striations. The upper part of all the valves is eroded, but the beaks are smooth and the later umbonal region weakly sculptured, so that the ribbing was present chiefly on the lower two-thirds of the shell. The interior of a right valve shows prominent scars, a small pallial sinus, and a strong cardinal tooth; the lunular area is hardly impressed, and does not form a cellule in front of the cardinal. Left valve with traces of about eleven ribs, being somewhat more finely and closely ribbed than the right. No radial sculpture is present. A shell with both valves together measures in length 12, altitude 10, diameter 7.5 mm. A large, single, right valve is 14 x 11.

This species has somewhat the form and hinge characters of *Corbula* (*Bothrocorbula*) *synarmostes* Dall, from the Chipola Miocene, Florida; but the base is not nearly so arcuate and the ribbing is finer in the Trinidad shell—which approaches more nearly to *Cuneocorbula.*

Locality.—Brasso Valley.

Horizon.—Machapoorie Miocene, since the strata at this locality lie below the Manzanilla beds.

Genus *MACTRA* (Linnæus) Lamarck

Subgenus *MACTROTOMA* Dall

Section *MICROMACTRA* Dall

Mactra (Micromactra) macescens Guppy Pl. 21, Fig. 1

Mactrinula macescens Guppy, 1866, Quart. Jour. Geol. Soc., London, vol. 22, p. 581, pl. 26, figs. 2, 2a, 2b.
Mactrinula macescens Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 40.
Mactrinula macescens Guppy, 1874, Geol. Mag., London, p. 441.
Mactra (Micromactra) macescens Dall, 1898, Trans. Wagner. Inst. Sci., vol. 3, p. 894.

Shell small for the genus, thin, oblong-trigonal, compressed; posterior dorsal area smooth, marked off on both valves by a single, sharp, narrow, radial ridge, passing from the beak to the posterior basal margin; beaks very small, low, strongly concentrically undulated with rounded ripples which extend from the anterior of the shell to the posterior radial ridge. The rippling varies in different individuals but tends to become obsolete over the lower half of the valve, especially centrally. Hinge as shown by Guppy's figures 2a, 2b. Length 42, altitude 26, semidiameter 7 mm.

This species is much more strongly undulated, but in its dentition resembles *M. undula* Dall, from the Florida Pliocene. Both are allied to the recent, west coast, *M. californica* Conrad, the type of the section *Micromactra*.

In general external appearance this curious and striking species from Manzanilla bears a marked resemblance to *Mactra (Harvella) reevesi* Gray (Reeve, pl. 17, fig. 92) from Malacca, Malay Peninsula; but *Harvella* belongs to the subgenus *Mactrella*, while *fide* Dall, *macescens* belongs in the section *Micromactra* of the subgenus *Mactrotoma*. Dr. Guppy, however, placed *macescens* in the section *Mactrinula* allied to *Harvella* and in the subgenus *Mactrella*.

Locality.—Manzanilla.

Horizon.—Manzanilla Miocene.

Subgenus *MACTRELLA* Gray

Mactra (Mactrella) alata Spengler Pl. 21, Fig. 3

Mactra alata Spengler, 1802, Skriv. Nat. Selsk., vol. 5, pt. 2, p. 99.

Mactrella alata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 248.
Mactra (*Mactrella*) cf. *alata* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 231.
Mactra (*Mactrella*) *alata* Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 263, pl. 28, fig. 3.

This large, handsome *Mactra* is quickly recognized by its thin, inflated form, and very sharp, posterior carina. It is the type of the subgenus *Mactrella*. A Trinidad shell is 80 in length, 58 in altitude and 19 mm. in semidiameter.

M. alata is found in the Lower Miocene, Cercado formation, Dominican Republic; Middle Miocene, Gatun stage, of Costa Rica; and living on sandy shores of Porto Rico, Trinidad, and the Caribbean side of the Isthmus.

Locality.—Matura Bay, east coast of Trinidad.

Horizon.—Recent.

Section *HARVELLA* Gray

Mactra (Harvella) sancti-blasii, n. sp. Pl. 21, Fig. 2

We have a single cast of a shell apparently a *Harvella*. The substance is entirely gone but presumably was exceedingly thin and delicate. The form is roundly trigonal. The surface is very evenly and handsomely sculptured with concentric waves which terminate abruptly at the sharp radial carina bordering the posterior dorsal area. Beaks small, acute, prosogyrate, curving over the small, impressed, cordate lunule. Escutcheon narrow and smooth. Hinge characters not known. Length 35, altitude 34, semidiameter 8.5 mm.

This species has a higher, narrower form than either *Mactra* (*Harvella*) *estrellana* or *H. sincola* Olsson, from the Costa Rican Miocene. The Trinidad shell approaches rather nearer to the recent *Harvella elegans* Sowerby (type of the section) in its general aspect.

Locality.—St. Blaise Ravine, near the south coast of Trinidad. Fossils exceedingly scarce.

Horizon.—About equivalent to the Manzanilla Miocene.

These are the Moruga beds. Same horizon is at La Luna Point.

Genus *SOLEN* Linnæus

Subgenus *SOLENA* Moerch

Solen (Solena) obliquus Spengler Pl. 18, Fig. 12

Solen obliqua Spengler, 1794.
Solen (*Solena*) *obliqua* Dall, 1899, Proc. U. S. Nat. Mus., vol. 22, p. 107.
Solen (*Solena*) *obliquus* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 954.
Solen (*Solena*) *obliquus* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 230.

This species is found living in the Antilles, as at Cuba, Porto Rico and St. Thomas; and we collected fine specimens on the Monte Cristi beach, Dominican Republic. We also obtained a fragment from the Miocene at Caimito.

In the Trinidad collection is a single shell which appears to be a small valve of this species. It measures in length 35, altitude 13, semidiameter 4 mm.

The generic name of the razor-shell or spout-shell, *Solen*, is masculine, derived from the Greek word meaning a snout or gutter.

Locality.—Matura.

Horizon.—Upper Pliocene.

Genus *DONAX* Linnæus

Donax fabagelloides Guppy

Donax fabagella Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16. Not of Lamarck.
Donax fabagelloides Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 162, 173; Harris' Reprint, 1921, Bull. 35, pp. 189, 200.
Donax fabagelloides Guppy, 1874, Geol. Mag., London, p. 435, pl. 18, fig. 10.
Donax fabagelloides Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 968.

An oblong, subequilateral, species zoned with broad

dark bands, and finely radiately striate. Resembling *fabagella* Lamarck, but more equilateral and proportionately not so high. It is also akin to *Donax æquilibrata* Dall, from the Miocene of North Carolina, but that is more attenuated and angulated posteriorly.

Locality.—Matura (Guppy).

Horizon.—Pliocene.

Donax striata Linnæus

Donax striata Linnæus, 1767, Syst. Nat., ed. XII, p. 1127.
Donax striata Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16.
Donax striata Guppy, 1867, Proc. Sci. Assoc. Trinidad. pt. 3, p. 162; Harris' Reprint, 1921, Bull. 35, p. 41.
Donax striata Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 968.

This species is now living in the Antilles and also occurs as a fossil.

Locality.—Matura (Guppy).

Horizon.—Pliocene.

Donax couvana, n. sp. Pl. 20, Fig. 19

Shell of medium size, rather thin, apparently nearly smooth when the surface was fresh; but faint radial striæ are seen near the center of the disc under a lens, and striations show beneath the abraded surface. Anterior end long, produced and narrowed, rounded at its termination; anterior dorsal margin sloping. Posterior end short, the posterior dorsal margin sloping and forming with the anterior dorsal margin an angle of about 120 degrees. Length of shell 25, altitude 15, semidiameter 5.5 mm.

This shell was in an entirely new fossiliferous locality, the deposit being a greenish blue, decayed, conglomerate. Associated with the *Donax* were *Arca* (*Noëtia*) *mundonuevensis* and *Noëtia mayensis*.

Locality.—Junction of Mayo and Couva main roads.

Horizon.—Brasso Miocene.

Genus *SANGUINOLARIA* Lamarck

Sanguinolaria unioides Guppy

Sanguinolaria unioides Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 327, pl. 30, fig. 11.

Original description.—"Ovate-oblong, slightly ventricose, smooth, with shallow concentric sulci and fine radiating striæ. Length 63, height 44 mm."

Dr. Guppy remarked that this was a somewhat *Unio*-like shell of uncertain affinities.

We have nothing answering to the description of this species.

Locality.—Tertiary beds, Savana Grande, Trinidad (Guppy).

Genus *SEMELE* Schumacher

Semele proficua Pulteney Pl. 21, Fig. 5

Tellina proficua Pulteney, 1799, Hutch. Dorset., p. 29, pl. 5, fig. 4.
Amphidesma orbiculata Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 307.
Amphidesma orbiculata Tuomey and Holmes, 1856, Pleioc. Fos. Car., p. 94, pl. 23, fig. 4.
Amphidesma radiata (Chemn.) Reeve, 1853, *Amphidesma*, pl. 5, fig. 29.
Semele proficua Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 991.

This species is found in the Pliocene of Florida and ranges in the recent fauna from southern United States to Brazil and through the Antilles.

Locality.—Barbados, on the beach west of Bridgetown; also Erin Point, Trinidad.

Horizon.—Recent.

Semele purpurascens Gmelin Pl. 20, Fig. 17

Venus purpurascens Gmelin, 1792, Syst. Nat., 6, p. 3288.
Tellina obliqua Wood, 1815, Gen. Conch., p. 152, pl. 41, figs. 4, 5.
Amphidesma variegata Lamarck, 1818, Anim sans Vert., vol. 5, p. 490.
Amphidesma obliqua Reeve, 1853, Conch. Icon., *Amphidesma*, pl. 1, figs. 5a, 5b.
Semele variegata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 41.
Semele variegata Guppy, 1874, Geol. Mag., London, p. 441.

Semele purpurascens Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 993.
Semele purpurascens Maury, 1920, Bull. Amer. Paleont., No. 34, p. 90.

A marked character of this species is the presence, on the anterior and central part of the shell, of fine ridges, passing a little obliquely across the concentric growth lines. The living shell is purplish-white, maculated with fawn. It attains about 40 mm. in length and 30 in height.

This species first appeared in the Pliocene of Florida and Costa Rica, and is now living from North Carolina to Rio de Janeiro. It was listed by Guppy from Matura (as *variegata*).

Semele proficua Pulteney [=*Amphidesma reticulata* (Chemnitz) d'Orbigny] may also be found in the recent and Pliocene of Trinidad, since it ranges southward to Brazil; likewise the handsome, small species, *Semele bellastriata* Conrad, which is Pliocene to Recent, and ranges from Hatteras to Cape San Roque, Brazil.

Locality.—Matura (Guppy).

Horizon.—Pliocene.

Semele claytoni var. **couvensis**, n. var. Pl. 21, Fig. 4

From Trinidad we have a single imperfect specimen of a *Semele* of the same form as *S. claytoni* Maury (Bull. Amer. Paleont., No. 29, p. 227, pl. 35, fig. 9) from the Dominican Miocene, and with the concentric lamellæ similarly spaced. The sculpture is rougher and less perfectly regular than in the Dominican shell, although this may be partly due to uneven wearing. But the most important point of difference is the presence on the Trinidad shell of microscopic radial striæ, which, especially on the younger half of the valve, extend from the crest of each ridge across the interspace to the point of origin of the next lamella. The radii seem also to have slightly crenulated the edges of the lamallæ. Estimated length 63, estimated height 50, diameter 20 mm.

Semele claytoni Maury, was described from the Cer-

cado formation of the Lower Miocene of Rio Cana at Caimito; and was later identified by Mr. Olsson from the Uscari stage of Costa Rica, which is also Lower Miocene. Thus the typical form is older than this variety.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *TELLINA* (Linnæus) Lamarck

Tellina caroniana, n. sp. Pl. 20, Fig. 20

Tellina strophia Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 12; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 155.
Not *Tellina strophia* Dall, 1900, Trans. Wagner. Inst. Sci., vol. 3, p. 1019, pl. 47, fig. 11.

Shell narrowly elongate, nearly equilateral, with extremely low beaks; posterior slope bicarinate with a sulcation between the ridges, posterior end bluntly pointed. Entire surface sculptured with subequal, very closely-set, thin, slightly raised, concentric lamellæ, which become much coarser on the posterior dorsal area. Lunule very narrow. Length of shell 65, altitude 26, semidiameter 5 mm.

This species is of the general type of *Tellina strophia* Dall, from the Miocene of Florida, but differs in form and in details of sculpture. It is also akin to *Tellina rovala* Olsson, from the Gatun stage of Costa Rica, but that is a smaller form, attaining only half the size and is more elegant in its sculpture—the posterior concentric lamellæ being arranged in two series divided by a radial groove, and the shell is more constricted and pointed posteriorly.

Locality.—Springvale.

Horizon.—Upper Miocene.

Tellina waringi, n. sp. Pl. 20, Fig. 14

Shell small, thin and fragile, nearly equilateral, compressed. Surface smooth except for very fine concentric growth lines. Interior concealed by the matrix. Under

the lens and in certain lights the surface shows a very beautiful iridescence, such as is seen in some of the living members of the genus—as for example, in *Tellina iris*, so named from its delicate, prismatic, rainbow hues. At first thought, it seems remarkable that our shell should have retained this character, which one would think so evanescent, but it is doubtless due to the nature of the shell substance, causing the prismatic diffraction of light. Length 22, altitude 14, semidiameter 4 mm.

This species was found in a new and interesting fossiliferous bed of decayed, greenish blue, conglomerate. Associated with it were *Arca* (*Noëtia*) *mundonuevensis; N. mayensis*, and *Donax couvana*. Presumably the age is about equivalent to the Brasso.

This pretty, delicate, iridescent *Tellina* is dedicated to Mr. Gerald A. Waring, as a token of appreciation of his unfailing helpfulness and interest in the collection of the Trinidad fossils.

Locality.—Junction of Mayo and Couva main roads.

Horizon.—Brasso Miocene.

Genus *STRIGILLA* Turton

Strigilla pisiformis Linnæus Pl. 20, Fig. 13

Tellina pisiformis Linnæus, 1758, Syst. Nat., ed. X, p. 677.
Cardium discors Montagu, 1803, Test. Brit., p. 84.
Strigilla carnaria Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16. Not *carnaria* Linnæus.
Strigilla carnaria Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 162; Harris' Reprint, 1921, Bull. 35, p. 41.
Strigilla carnaria Guppy, 1874, Geol. Mag., London, p. 441.
Strigilla pisiformis Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1039; 1903, *Idem*, p. 1587.

After examining Dr. Guppy's specimens of *Strigilla* from Trinidad, and from Bowden, Dr. Dall pronounced them all identical with *S. pisiformis* Linnæus. This species extends from the Miocene up and is in the recent fauna throughout the West Indies, ranging as far north as Cape

Hatteras.

This pretty species is represented in our collection. The largest measures in length 10, height 10, semidiameter 3 mm., smaller are only 6 x 6. The entire surface is very finely and beautifully marked with undulating and V-shaped delicate groovings.

Locality.—Matura.

Horizon.—Pliocene.

Genus *METIS* H. and A. Adams

Metis trinitaria Dall Pl. 22, Figs. 1, 2, 8

Tellina biplicata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 588; 1867, Proc. Sci. Assoc. Trinidad, p. 161; 1874, Geol. Mag., London, p. 441; 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 530.

Not *Tellina biplicata* Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. 7, p. 152.

Tellina sagræ Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 329.

Cf. *Tellina sagræ* d'Orbigny, 1855, Paleontologia Cubana, pl. 4, figs. 8, 9, 10.

Metis trinitaria Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, pt. 5, p. 1041, pl. 46, fig. 24.

Tellina sagræ Guppy, 1910, Agri. Soc. Trinidad and Tobago, Springvale Fossils. See Harris' Reprint, 1921, Bull. Amer. Paleont., vol. 8, p. 302.

Metis trinitaria Maury, Sept., 1919, Amer. Jour. Sci., vol. 48, pp. 212, 214.

Metis trinitaria Cooke, Oct., 1919, Carnegie Inst. Washington, Publ. No. 291, p. 148, pl. 14, figs. 2a, 2b.

Metis trinitaria Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, p. 42.

Metis trinitaria Hubbard, 1921, Sci. Surv. Porto Rico, vol. 3, pt. 2, p. 125, pl. 10, fig. 7.

Cf. *Metis postrema* Pilsbry and Johnson, 1918, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 202; Pilsbry, *Idem*, 1922, vol. 73, p. 426, pl. 46, fig. 8.

Shell under favorable circumstances becoming very large, oval-oblong, anterior end rounded, produced, posterior end shorter, bisculcate on the right valve; left valve with one posterior sulcation corresponding in position to the arch between the two furrows of the right; surface smooth except for fine, concentric lines of growth. Pallial sinus very large, rounded, somewhat larger and higher in

the left than in the right valve. A large shell measures in length 72, altitude 57, diameter 30 mm.; smaller specimens 40 x 33 x 14; 34 x 29 x12. The type was 52 x 41 x 19, and *fide* Dr. Dall, the shell may attain twice this size.

This species is characterized by the marked anterior elongation and arcuate form.

In differentiating Porto Rican horizons by faunal groups I found *Metis trinitaria* to be one of the most abundant fossils of the Quebradillas limestone, northwestern Porto Rico. It also occurs, but rarely in the Los Puertos and Ponce limestones, which are on the southern side of the island. In Cuba it is reported from Santiago, La Cruz, and Vento; from Anguilla at Crocus Bay; from Barbuda; and very large shells, perhaps his species, are in the Columbia University collection from Sombrero Island.

Localities.—Springvale, Department of Caroni, very large specimens (the type was from the Caroni series); a smaller specimen, probably the same species, from the northwest corner of F 16 (in the southern part of Department of St. Andrew, west of Manzanilla Bay); Guaico-Tamana Road at 7¾ miles; Manzanilla.

Horizons.—Springvale Miocene; Manzanilla Miocene.

Genus *PETRICOLA* Lamarck

Petricola caroniana, n. sp. Pl. 20, Fig. 16

Shell transversely elliptical, moderately convex, thin and fragile. Beaks low, approximate, situated at about the anterior third of the total length. Anterior and central areas gently convex, posterior area slightly compressed dorsally; posterior and anterior margins rounded. Basal margin nearly parallel to the hinge line. Entire surface closely and prettily sculptured with fine, radiating threads, their interspaces somewhat wider; on the posterior area the threads are rather closer than on the center of the disc, but they are of much the same strength all over the shell. Narrow, concentric ridges mark the surface at irregular inter-

vals, usually not interrupting the radial threads, but occasionally altering the trend of their direction. Length of larger shell 30, altitude 22, diameter 14; the smaller is 26 x19 x 13 mm.

This species has the type of sculpture and somewhat the form, though proportionally shorter, of *Petricola* (*Petricolaria*) *calvertensis* Dall, from the Maryland Miocene. It is even more closely akin to *P. millestriata* Brown and Pilsbry, from the Gatun beds. The latter species, however, has higher, more prominent beaks, and the base is not parallel to the hinge but is obliquely produced posteriorly, so that the height of the posterior end of the shell is considerably greater than that of the anterior. More material may possibly show the Trinidad shell to be a variety of the Gatun. These three, *calvertensis, millestriata* and *caroniana*, seem to form a group—although the internal characters of the last two are unknown.

In the Dominican Miocene, *P. camitica* Maury, is characterized by its very varied V-shaped sculpture, while *P. riocanensis* Maury is akin to the living *Petricola* (*Rupellaria*) *typica* Jonas (=*lithophaga* Arango; *robusta* Dall, not Sowerby). This appeared first in the Florida Pliocene and now ranges through the Antilles. It is radiately ridged, more coarsely so posteriorly. Another recent Antillean species is *Petricola lapicida* Gmelin (=*divergens* Gmelin; *costata* Lamarck; *divaricata* d'Orbigny), with ziczac markings on the young stages and coarse, posterior ridges on the adult. It is the type of *Petricola, sensu stricto.* The handsomest Antillean and Nicaraguan recent form is *P.* (*Petricolaria*) *pholadiformis* Lamarck, with strong, crenulated, anterior ribs and elsewhere radial striations. These recent species are mentioned as they may be found on the shores of Trinidad.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *CARDIUM* (Linnæus) Lamarck

Subgenus *TRACHYCARDIUM* Morch

Cardium (Trachycardium) inconspicuum, Guppy

Cardium inconspicuum Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, pl. 18, fig. 12.
Cardium inconspicuum Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Cardium inconspicuum Guppy, 1874, Geol. Mag., London, p. 442.
Cardium (*Trachycardium*) *inconspicuum* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1182.

Shell rather small, ovate, with thirty-six to forty-two ribs (the type had thirty-eight), all of which except those on the posterior area are finely imbricated with close, concentric threads. Posterior ribs smooth and polished. Interspaces narrower than the ribs, squamose. The type was about 20 mm. in length and 24 in height.

Localities.—Bowden, Jamaica; Chipola, Florida.

Horizons.—Middle and Lower Miocene.

Cardium (Trachycardium) caroniense, n. sp. Pl. 22, Fig. 4

Shell rather small, ovate, thin, with a delicate hinge; moderately inflated. Ribs twenty-three. Of these, the three or four in front of the umbonal slope are rounded, but all the others are angulate, the ridge of the anterior ribs being directed backwards, and the ridge of each of the posterior ribs being directed forwards, so that both sets face towards the rounded central ribs. All the ribs appear entirely smooth. Length 21, height 26, semidiameter 11 mm.

This species is a member of the group of *C. dominicanum* Dall, from the Miocene of Santo Domingo, and *C. costaricanum* Olsson, from the Gatun stage of Costa Rica. *C. dominicanum* is solid, with a heavy hinge, and twenty-seven ribs, and our shell is much nearer to *C. costaricanum*. A comparison shows, however, that the Costa Rican shell is much produced at the termination of the umbonal slope, so that a radius from the beak to the posterior basal margin would be much longer than one to the anterior basal margin.

But the basal margin of the Trinidad shell is nearly evenly rounded and there would be but little difference in an anterior and a posterior basal radius. Moreover, although the ribs are about the same in number, the anterior and posterior ribs of the Trinidad shell are sharper-edged and overlap like the clapboards of a house and on the single specimen we have the ribs are smooth, while the anterior and some of the central ribs of Mr. Olsson's shell are finely beaded or granose on their ridges. But the most striking difference is in the form of the shells.

Locality.—Springvale.

Horizon.—Upper Miocene.

Cardium (Trachycardium) isocardia, Linnæus Pl. 22, Figs. 5, 7

Cardium isocardia Linnæus, 1758, Syst. Nat., ed. X, p. 679.
Cardium isocardia Chemnitz, 1782, Conch. Cab., vol. 6, p. 182, pl. 17, figs. 174–176.
Cardium isocardia Reeve, 1845, Conch. Icon., *Cardium*, pl. 17, fig. 84.
Cardium isocardia d'Orbigny, 1845, Hist. de la Isla de Cuba, vol. 5, *Moluscos*, p. 337.
Cardium egmontianum Shuttleworth, 1856, Journ. de Conchyliologie, vol. 5, p. 472.
Cardium isocardium Guppy, 1864, Trans. Sci. Assoc. Trinidad, pp. 36, 40; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 16, 20.
Cardium eburniferum Guppy, 1875, Ann. and Mag. Nat. Hist., 4th ser., vol. 15, p. 51, pl. 7, fig. 3.
Cardium (*Trachycardium*) *isocardia* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1085.
Cardium (*Trachycardium*) *isocardia* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 62.

Linnæus included in *C. isocardia* the East Indian form, later separated by Gmelin as *C. squamosum*.

C. isocardia is the type of the subgenus *Trachycardium*. It is "the equiheart cockle"—obliquely cordate, typically with about thirty-four squarish ribs, bearing rather distant, obliquely-set, arched scales, often spinose posteriorly. Living shells vary in color, some are white maculated with pinkish straw, others with red-purple, or orange-brown. Large specimens mays attain a height of 80 or 90 mm. Ours from Venezuela are small, the largest 49 in height, a smaller in length 37, height 42, semidiameter 16 mm. A feature of

the Trinidad and Venezuelan specimens is the greater number of ribs—thirty-five to thirty-nine against twenty-seven to thirty-four in shells from the more northern localities. This parallels the increased ribbing of *C. muricatum* as the shell approaches its more southern limits.

In Dr. Guppy's 1864 Matura list *C. isocardia* is given, but in 1874 he substituted *C. muricatum*. *C. eburniferum* Guppy is identical with *C. isocardia*.

The range of *C. isocardia* is from Hatteras to Trinidad, and west to Venezuela, also through Cuba, Nevis, St. Lucia and Martinique. It first appeared in the Miocene. The west coast analogue is *C. consors* Broderip and Sowerby, with closer, more numerous scales.

Localities.—Southern coast of Trinidad; La Guayra roadstead, Venezuela.

Horizon.—Recent.

Cardium (Trachycardium) lingua-leonis, Guppy Pl. 23, Fig. 17

Cardium lingua-leonis Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 293, pl. 18, fig. 7.
Cardium lingua-leonis Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Cardium lingua-leonis Guppy, 1874, Geol. Mag., London, p. 442.
Cardium (*Trachycardium*) *lingua-leonis* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1084.
Cardium (*Trachycardium*) *lingua-leonis* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 210.

Shell large, very high and narrow, hardly oblique, with thirty-two ribs. The ribs bear side keels which are waved and rippled on their crests in a manner aptly compared by Dr. Dall to confectioners' rippled candy, or like rippled decorations on cakes. A shell from the type locality collected by Mr. Olsson, in 1923, is 35 mm. in length, 50 in height and 20 in semidiameter.

This species is a very beautiful and striking member of the group of *Cardium isocardia* Linnæus. Gabb erroneously placed it in the synonymy of *C. subelongatum* Sowerby, 1840, from which it is quite distinct.

A related Dominican Miocene species is *C. linguatigris*

Maury, with forty-two ribs, flatter and smoother.

Locality.—Bowden, Jamaica.

Horizon.—Middle Miocene.

Cardium (Trachycardium) muricatum Linnæus Pl. 22, Fig. 9

Cardium muricatum Linnæus, 1758, Syst. Nat., ed. X, p. 680, No. 69.
Cardium campechiense Bolten, 1798, Mus. Boltenianum, p. 191, No. 407.
Cardium muricatum d'Orbigny, 1843, Voyage dans l'Amér. Mérid., vol. 3, *Mollusques*, p, 591.
Cardium muricatum Reeve, 1844, Conch. Icon., *Cardium*, pl. 6, fig. 33.
Cardium muricatum d'Orbigny, 1845, Hist. Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 335.
Cardium gossei Deshayes, 1854, Proc. Zool. Soc., p. 330.
Cardium muricatum Guppy, *pro parte*, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42; 1874, Geol. Mag., p. 442.
Cardium æquilaterale Hilgard, 1878.
Cardium (*Trachycardium*) *muricatum* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1089; 1900, Proc. U. S. Nat. Mus., vol. 23, p. 385.
Cardium (*Trachycardium*) *muricatum* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 62.

Shell of moderate size, obliquely ovate, with thirty to forty-one ribs, the anterior twelve or fourteen bearing pedunculated nodules, and the central and posterior ribs with easily abraded, minute tooth-like spines, posterior ribs frequently split. The Trinidad shells have more ribs (36–41) than our Gulf coast Pleistocene and recent specimens (32–33), which tallies with Dr. Dall's statement that individuals from the northern part of the range, and fossil forms, have sparser ribbing than those from the southern part of the range. Color usually white maculated with brown and orange, but one of ours is very handsome, white, with pale ecru and straw, banded with salmon pink; another is white with rose-purple. A shell from Erin Point is in length 44, height 51, semidiameter 17 mm., but the species may attain 54 x 60 mm.

The range is from Hatteras to Brazil and the Gulf of Mexico—type locality, Gulf of Campeche. Pleistocene to Recent.

Localities.—Southwest of San Fernando between Ally

and Mosquito Creek; Erin Point. on the south coast; Mayaro Point, Trinidad; also Venezuelan coast.

Horizon.—Recent.

Cardium (Trachycardium) couvense, n. sp. Pl. 23, Fig. 12

Shell rather small, plump, subequilateral, suborbicular, with full, low beaks nearly central in position. Ribs varying in number from thirty-five to forty, narrow, with linear interspaces. The posterior ribs are more or less cleft and all the ribs show definite traces of murication. Length of shell 23, altitude 21, semidiameter 6 mm.

This delicate shell is evidently an ancestral member of the *C. muricatum* group.

Locality.—Springvale, near Couva.

Horizon.—Upper Miocene.

Cardium (Trachycardium) bowdenense, Dall

Cardium muricatum Guppy, *pro parte*. Not of Linnæus, 1758.
Cardium (*Trachycardium*) *bowdenense* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1087.

There is confusion regarding this species. Dr. Dall places in his synonymy *C. muricatum* Guppy, 1874, Geol. Mag., p. 450, and then says: "This species from the Bowden marl and from the Tampa silex beds at Ballast Point, Tampa Bay, Florida, was identified with the recent *muricatum* by Guppy." But on p. 442 (not 450) of the Geological Magazine, *C. muricatum* is listed by Guppy from the Matura Pliocene, not from Bowden; nor can I find any reference to *C. muricatum* from Bowden by Guppy. But the specimen might have been in his collection, later purchased by the United States National Museum.

Cardium bowdenense has thirty-seven to forty-one ribs, the sculpture being like that of *muricatum* in miniature. The shell is less inflated, and always small—the largest being 15.5 x 15.5 x 9 in diameter. It has apparently never been figured.

Localities. — Tampa, Florida, silex beds; Bowden,

Jamaica.

Horizons.—Upper Oligocene and Middle Miocene.

Cardium (Trachycardium) sancti-davidis, n. sp. Pl. 22, Fig. 3

Shell of moderate size, subcircular in outline, thin and delicate, plump, nearly equilateral, with low beaks. Ribs usually forty-three, but varying from forty-one to forty-four. The anterior seventeen to twenty-four bear minute pedunculated nodules, after which the ribs have minute denticles, these being on the posterior edge of the ribs in front of the carination, and on the anterior edge of those behind it. The ten posterior ribs are more or less grooved. Length of largest specimen 30, height 31, semidiameter 11 mm. The majority are about 26 x 27 mm.

This dainty shell is a chain in the ancestrial line of the Pleistocene to Recent *C. muricatum* Linnæus. It is smaller, about half the size of *muricatum*, but twice as large as the Oligocene-Miocene *C. bowdenense* Dall. The general plan of sculpture is like that of *muricatum*, but the ribs are more numerous and the pedunculated nodules extend over a wider area. The form of the shell is more circular and less oval than our Trinidad specimens of *muricatum*.

C. bowdenense is described by Dr. Dall as less inflated than *muricatum*, but the Matura shell is fully as plump as *muricatum* if not more so. The Florida Pliocene *C. œdalium* Dall of the *muricatum* line has fewer ribs and is much more coarsely and differently sculptured.

Locality.—Matura.

Horizon.—Upper Pliocene.

Cardium (Trachycardium) tamanense, n. sp. Pl. 22, Fig. 6

From Miocene beds in central Trinidad we have many specimens of a *Cardium* apparently the same species although much deformed by pressure. The normal form seems to have been ovate to subcircular and although all the specimens are merely casts, a few show traces of imbricating scales on the ribs. The shell is referred only tenta-

tively to *Trachycardium*.

This species can, however, be recognized among other Trinidad species of *Cardium* by the equal, even, closely-set and very numerous ribs, of which there are about forty-eight to fifty.

In the crowded ribbing the shell recalls the Dominican Miocene *C. dominicense* Gabb, with sixty ribs. But no comparison is possible because of the crushed form and absence of surface sculpture of the Trinidad specimens. A cast of ovate form measures in length 35, height 40, semidiameter 12 mm. This and the rounded casts may not be the same species, but the distortion of the specimens forbids any discrimination beyond the fact that a many-ribbed *Cardium* is abundant in the Tamana Miocene.

Locality.—Central E 24, No. 393; East Central E 25, No. 381.

Horizon.—Tamana Miocene.

Cardium (Trachycardium) venadense, n. sp. Pl. 23, Figs. 11, 16

Shell of medium size, ovate, nearly equilateral, not much inflated. Beaks low, small, inconspicuous. The entire surface is very finely, neatly, evenly and closely sculptured with a great number of narrow ribs of which there are about sixty. The ribs over the anterior half are distinctly shown by the best preserved shell, which is incomplete, to have been muricated and some appear also to have been nodose. In the other specimen all the ribs are more smooth. Hinge normal, delicate. Inner margin of shell very finely serrate. Largest specimen 34 mm. altitude, 30 length, 9 semidiameter. A smaller is 28 x 26 and 18 in diameter.

In the great number of ribs this recalls *C. dominicense* Gabb, but is much more narrowly ovate, and the ribs are all very even, while in the Dominican shell they become much coarser posteriorly and the inner margin is coarsely serrate. The Trinidad shell is much more delicate, regular and evenly sculptured.

Locality.—Brasso Venada Ravine, three miles east of

Brasso Station.

Horizon.—Manzanilla Miocene.

Cardium serratense, n. sp. Pl. 23, Fig. 15

Shell fairly large, very high and protracted, subequilateral. Anterior area somewhat compressed, anterior basal margin rounded, central area very convex; umbonal slope rounded, not carinate; posterior area flattened. Beaks high, narrow, curving. Ribs about twenty, the anterior and posterior more crowded than those over the center of the shell which are strong and prominent. The specimens are all in the form of casts and the finer details of the sculpture are not known. Length 30, height 45, semidiameter 13 mm.

This species is entirely different in form from any of the other Trinidad *Cardiums,* and can be readily known by its very narrow, proctracted aspect and coarse ribbing.

Locality.—Half a mile above Brasso Station in the quarry at the junction of the roads.

Horizon.—Brasso Miocene, uppermost member of the section.

Cardium (Trachycardium) machapooriensis, n. sp. Pl. 23, Figs. 13, 18

Shell ovate, narrow, and high, inflated, nearly equilateral. Beak very high and very strongly curved forwards. Entire surface sculptured with exceedingly fine, close-set, subequal, radial ribs numbering about forty-six. Every rib bears on its crest a row of minute, cone-shaped, hollow scales. Interspaces linear. Our largest specimen measures in length 21, altitude 32, semidiameter 14 mm.

Locality.—Machapoorie quarry.

Horizon.—Machapoorie Miocene.

Subgenus *FRAGUM* Bolten

Cardium (Fragum) medium Linnæus Pl. 23, Fig. 19

Cardium medium Linnæus, 1758, Syst. Nat., ed. X, p. 678.
Cardium medium Reeve, 1844, Conch. Icon., *Cardium,* pl. 6, fig. 30.

Cardium medium d'Orbigny, 1845, Hist. Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 336.
Cardium (*Fragum*) *medium* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1101.
Cardium (*Fragum*) *medium* Maury, 1920, Bull. Amer. Paleont., No 34, p. 64.
Cardium (*Fragum*) *medium* Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 226, pl. 27, fig. 6.

Shell of moderate size, cordately subquadrate, anterior rounded, umbonal slope strongly carinate, posterior area sulcate, concave, and truncate. Ribs thirty-six, subequal, smooth and polished when abraded; but when living and perfect the ribs are exceedingly closely-set with beautifully imbricating scales, their edges giving an annular aspect under a lens, or like piles of coins pushed obliquely. Large shells measure 44x43 mm.—ours are small, only 29x30x24.

This species ranges from North Carolina to Santa Marta, Brazil, and is abundant in the West Indies. It appears first in the Miocene of Maryland, is in the Gatun stage of Port Limon, Costa Rica, and the Pliocene of Florida.

Locality.—Grenada Island, West Indies.

Section *TRIGONIOCARDIA* Dall

This section is characteristic of the Eastern and Western Middle American and the Antillean regions. Dr. Dall traces its origin as an off-shoot of *Fragum*, beginning in the Eocene. An interesting light is thrown on this relationship by our Pliocene *C.* (*Trigoniocardia*) *perii-maris*, which in form is strikingly like young shells of *Fragum medium*, but differs in having fewer ribs and in the cross striate interspaces, characteristic of *Trigoniocardia*.

Cardium (Trigoniocardia) castum Guppy Pl. 23, Figs. 2, 3, 7

Cardium castum Guppy, 1866, Quart. Jour. Geol. Soc., London, vol. 22, p. 582, pl. 26, fig. 4.
Cardium castum Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Cardium castum Guppy, 1874, Geol. Mag., London, p. 442.

Our specimens from Manzanilla, the type locality, answer well to Dr. Guppy's description of this species. The shell is very small, somewhat oblique, squarish posteriorly, and with a rather prominent beak. Typically the umbonal slope is roundly carinate, but in some specimens it is quite sharply so. The ribs are as many as nineteen to twenty-two (as in the type), thirteen or fourteen ribs being on the body, and seven or eight on the truncation. When perfectly preserved, the ribs on the body and on the truncation bear minute pustules, very easily abraded and rarely seen. Interspaces with the strongly marked cross striations characteristic of the section *Trigoniocardia*. Large valves are 7 mm. in length, by 6 altitude, and 3 semidiameter; 6.5 x 7 x 3; 6 x 6 x 2.5 mm. The young shells are 4 mm. or less in length.

Localities.—Manzanilla Bay, Nos. 272, 273, 385; Brasso section near bridge at Tamana Road Junction.

Horizon.—Manzanilla Miocene.

Cardium (Trigoniocardia) castum var. brassicum, n. var. Pl. 23, Fig. 6

Shell differing from *C. castum* in is much higher, elongate-oval form, sharply carinated umbonal slope, and produced posterior basal margin. Umbones high, acute. Ribs nineteen or twenty, about eleven on the body and eight on the truncation, all closely and prettily beaded. Length 7, greatest height 10, semidiameter 4 mm. A large valve measures 8 in length by 12 in height.

Localities.—½ mile above Brasso; near bridge at Tamana Road Junction.

Horizons.—Brasso Miocene; Manzanilla Miocene.

Cardium (Trigoniocardia) manzanillense, n. sp. Pl. 23, Fig. 4

Shell minute, very sharply carinate on the umbonal slope, with nineteen or twenty ribs, about eight on the truncation and eleven on the body. Those on the truncation are low and flat. The two or three ribs on the body in front of the carination are very bold, large, and with a

sharp medial ridge, minutely beaded when perfect. The interspaces between these large ribs are wide and deep. The anterior ribs are somewhat more coarsely beaded. Length of largest valve 5 mm., altitude 5.5.

This shell is distinguished from *C. castum* by the different character of the ribbing—the two or three larger ribs in front of the carina standing out very prominently, which is not the case in *C. castum*. In the boldness of the central ribs *C. manzanillense* resembles the recent *C. antillarrum* d'Orbigny; but the fossil shell is easily differentiated by its higher, much more sharply carinated form.

This pretty and striking species was found at only one collecting station.

Locality.—Manzanilla.

Horizon.—Manzanilla Miocene.

Cardium (Trigoniocardia) antillarum d'Orbigny Pl. 23, Fig. 5

Cardium antillarum d'Orbigny, 1845, In de la Sagra's Hist. Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 338, Atlas, pl. 27, figs. 53-55.
Cardium ceramidum Dall, 1886, Blake Rept. 1, p. 269, pl. 4, fig. 6.
Cardium antillarum Dall, 1889, Bull. U. S. Nat. Mus., No. 37, p. 52, pl. 4, fig. 6.
Cardium (*Trigoniocardia*) *antillarum* Dall, 1900, Proc. U. S. Nat. Mus., vol. 23, p. 386.

Shell minute, with twenty or twenty-one radial ribs, those on the anterior part of the valve being prettily and finely beaded, the three or four central ribs are much larger and bolder, the posterior, narrower and closer. Interspaces with the transverse striæ of *Trigoniocardia*. The type measured a trifle over 7 mm.; Dr. Dall's, 12.5; our largest is about 4 mm.

D'Orbigny says that the central ribs are smooth, and in some of ours they are; but in others, they are beaded. Either the beading is variable, or the nodules are abraded. I rather think that when perfect all the ribs are more or less beaded.

This very attractive little shell ranges from Florida Strait through the West Indies, in 2–182 fathoms. Its

southern limit was given by Dr. Dall as Guadeloupe; but we can now extend its range to Trinidad.

Locality.—Gulf of Paria, ¼ mile west of Farallon Rock, off San Fernando.

Horizon.—Recent.

Cardium (Trigoniocardia) maturense Dall Pl. 23, Figs. 1, 9

Cardium haitense Guppy, *pro parte*, 1865, Geol. Mag., p. 256; 1874, Geol. Mag., p. 450.
Not *Cardium haitense* Sowerby, 1849, Quart. Jour. Geol. Soc., vol. 5, p. 52, pl. 10, fig. 11.
Cardium (*Trigoniocardia*) *maturense* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1105, pl. 48, fig. 7.

Shell rather small, obovate with a rounded umbonal slope. Ribs twenty to twenty-two, of which eight or nine are on the truncation and twelve or thirteen on the body. Ribs when perfect with very small bead-like nodules. Interspaces strongly cross striated. Length of type 6.6, altitude 9, diameter 7 mm.

From the type locality we have several valves of this species, but larger, measuring 7 x 9 and 9 x 12 mm.

Locality.—Matura.

Horizon.—Upper Pliocene.

Cardium (Trigoniocardia) mirandense, n. sp. Pl. 23, Fig. 10

Shell small, triangulate, very sharply carinate, posterior basal margin pointed, beak high, acute. Sculpture of twenty-two ribs of which eight are on the truncation and fourteen on the body. All the ribs are conspicuously and evenly beaded. Interspaces cross barred, as in *Trigoniocardia*, but very clearly and neatly so. Length 11.5, greatest height 12, semidiameter 5 mm.

A very handsome species noticeable for its exact form and precise and elegant beading.

Locality.—State of Zulia, District of Miranda, northwestern Venezuela.

Horizon.—Lower Miocene, about equivalent to the Cercado formation of the Dominican Republic.

Cardium (Trigoniocardia) perii-maris, n. sp. Pl. 23, Fig. 8

Shell rather small, cordately subquadrate, rounded anteriorly, pointed behind, obliquely truncate posteriorly, beaks rather high, umbonal slope very markedly carinate, and in front of the carination is a deep sulcation from beak to base, which renders the basal margin deeply arcuate. There is also a lesser sulcation behind the carina, on the posterior area, which slightly emarginates the posterior margin. The sculpture is of twenty-four ribs, of which fifteen are on the body and nine on the truncation. The ribs on the body are very low, flat, and wide, those on the truncation are narrower and closer. All the ribs appear to be entirely smooth. Interspaces very narrow, almost linear, crossed by minute, equidistant, transverse bars, the spaces between giving a punctate appearance to the interspaces. Inner margins of shell fluted. Hinge delicate, but teeth rather strong. Length 12, height 11.5, semidiameter 5 mm.

This species is at once distinguished from our other Trinidad Trigoniocardias by the wide ribs, without nodules, and the very narrow, punctate interspaces. In sculpture, the shell is very like Dr. Dall's *C. apateticum* from the Oak Grove, Florida, Miocene. That, however, has fewer ribs and differs in form, being evenly inflated with no suggestion of the two striking sulci in the Trinidad shell.

C. heredium Olsson, from the Gatun of Costa Rica, has wider interspaces without the punctate character of those of the Trinidad and Florida shells.

Locality.—Matura.

Horizon.—Upper Pliocene.

Cardium (Trigoniocardia) carolinæ Maury

Cardium (*Trigoniocardia*) *carolinæ* Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 54, pl. 9, figs. 5, 6.

Shell small, triangularly convex, rounded anteriorly, truncated posteriorly, umbonal slope carinate; ribs on the

body nine, rather sharp-edged, ornamented with bead-like nodules, which on the four ribs towards the carina are on the posterior side of each rib, on the remaining five ribs are nearly central; ribs on the truncated area eight, more crowded, less elevated, squamose rather than beaded, interspaces on the body much narrower than the ribs, except the space beside the carinal rib, which is wider than the others, and is beautifully marked by cross striæ which also cross the other interspaces, but there are hardly seen except with a lens. Height 11, length 7, diameter 8 mm.

An exquisite shell, allied to *castum* Guppy, from Manzanilla, but that has twenty-two rounded ribs and the posterior slope is different.

Locality.—Brighton, a thousand feet west of the pier, in impure asphalt.

Horizon.—Upper Pliocene.

Subgenus *PAPYRIDEA* Swainson

Cardium (Papyridea) spinosum Meuschen

Cardia spinosa Meuschen, 1787, Mus. Gevers., p. 442, No. 1637 (after Lister, pl. 342, fig. 179, Jamaica, and Knorr, 6, pl. 7, fig. 6).
Solen bullatus Chemnitz, 1782, Conch. Cab., vol. 6, p. 65, pl. 6, figs. 49, 50.
Not *Solen bullatus* Linnæus, 1758, Syst. Nat., ed. X, p. 673. (=*Arca*, sp.)
Cardium bullatum Reeve, 1844, Conch. Icon., *Cardium*, pl. 2, fig. 8.
Cardium bullatum d'Orbigny, 1845, Hist. Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 337.
Cardium (*Papyridea*) *bullatum* Dall, 1889, Bull. U. S. Nat. Mus., No. 37, p. 54.
Cardium (*Papyridea*) *spinosum* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1106; 1900, Proc. U. S. Nat. Mus., vol. 23, p. 387.
Cardium (*Papyridea*) *spinosum* Maury, 1920, Bull. Amer. Paleont., No. 34, p. 64.

Shell transversely ovate, thin, gaping; with about forty-seven rather narrow ribs, the anterior crenulated, the posterior squamose. Interspaces with a fine radial thread. White variegated with rose or purple. Length 53, height 34 mm.

This very beautiful shell is apparently not recorded from Trinidad; but likely to be found there, as its range

extends south to Santa Marta, Brazil.

Localities.—West Indies generally, as Nevis, St. Vincent, Jamaica, Cuba, Martinique, St. Lucia and Guadeloupe.

Horizons.—Pleistocene (Florida and Antilles); Recent.

Cardium (Papyridea) semisulcatum Gray

Cardium semisulcatum Gray, 1825, Ann. Phil., vol. 9, p. 137.
Cardium ringiculum Sowerby, 1840, Proc. Zool. Soc., p. 106; 1841, Conch. Illust., *Cardium*, p. 2, pl. 48, fig. 11.
Cardium Petitianum d'Orbigny, 1845, Hist. Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 337, Atlas, pl. 27, figs. 50–52.
Cardium semisulcatum E. A. Smith, 1885, Challenger Rept., Biv., p. 162.
Papyridea Petitiana Dall, 1889, Bull. U. S. Nat. Mus., No. 37, p. 54.
Cardium (*Papyridea*) *semisulcatum* Dall, 1900, Trans. Wagner Inst. Sci., vol. 3, p. 1108.
Cardium (*Papyridea*) *semisulcatum* Dall, 1900, Proc. U. S. Nat. Mus., vol. 23, p. 387.

This exquisite little species is elongate, compressed; anterior end rounded, posterior truncated; gaping, with twenty-six ribs, the posterior very much coarser than the anterior. Color varying from white to red, yellow, rose and red-purple. D'Orbigny's *Petitianum* measured 18 mm.

The range is from southern Florida to Cape San Roque, Brazil; also off Liberia and the Cape of Good Hope. It first appeared in the Miocene of North Carolina.

Locality.—Trinidad (Dall).

Horizon.—Recent.

Subgenus *LÆVICARDIUM* Swainson

Cardium (Lævicardium) serratum Linnæus Pl. 23, Fig. 14

Cardium serratum Linnæus, 1758, Systema. Naturæ, ed. X, p. 680; 1767, ed. XII, p. 1123.
Cardium lævigatum Lamarck, 1819, Anim. sans Vert. VI, pt. 1, p. 11. Not of Linnæus, 1758, Syst. Nat. X, p. 680; nor of Born, 1780, Mus. Vind. Test., p. 47.
Cardium (*Lævicardium*) *serratum* Dall, 1900 (in part), Trans. Wagner Inst. Sci., vol. 3, pt. 5, p. 1110; 1903, 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. 36, fig. 8; *Idem*, No. 30, pp. 10, 22, 23, 24.
Cardium (*Lævicardium*) *serratum* Vaughan, 1919, Bull. U. S. Nat.

Mus., No. 103, p. 562.
Cardium (*Lævicardium*) *serratum* Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, pp. 36, 37; 1920, Bull. Amer. Paleont., No. 34, p. 65.
Cardium (*Lævicardium*) *serratum* Hubbard, 1921 (in part), Sci. Surv. Porto Rico, vol. 3, pt. 2, p. 114.
Cardium (*Lævicardium*) *serratum* Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 228, pl. 27, figs. 11, 12.

This well-known species ranges from Miocene to Recent, its present distribution being from Hatteras to Brazil and in the Gulf of Mexico from Florida to Texas.

In the Miocene it is found in the Dominican Republic, Porto Rico, Jamaica, the Gatun stage of the Canal Zone, and Costa Rica. It is often erroneously regarded as identical with *Lævicardium venustum* Gabb; but, as I noted, in 1917, *venustum* is a distinct species, with much fuller beaks, turned strongly forward, and the form of the shell is more ovate and less triangulate than in *serratum*.

Our many specimens indicate that *serratum* was common on the Miocene beaches of Trinidad.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *DOSINIA* Scopoli

Section *DOSINIDIA* Dall

Dosinia (Dosinidia) titan, n. sp. Pl. 24, Figs. 1, 2; Pl. 25, Fig. 3

Dosinia liogona Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 12; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 154.
Not *Dosinia liogona* Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1230, pl. 53, figs. 4, 7, pl. 54, fig. 11.

Shell remarkably large, suborbicular, very convex for the genus, with small, acute beaks curving towards the impressed, cordate lunule. Surface sculptured with narrow, concentric groovings alternating with much wider strap-like bands about two millimetres in width. Towards the base of the disc the sculpture tends to become obsolete. Ligament sunken. Hinge plate not very wide. In the right

valve the posterior cardinal tooth is deeply sulcated and cleft into two nearly equal narrow ridges, the median and anterior cardinals are approximate and nearly equal, the median being only slightly larger and broader; together they form a notch for the interlocking of the left valve; beneath and anterior to this is a small pit for the left anterior lateral. Length of the largest complete shell 105, height 99, diameter 48 mm. Others are 103 x 93; 90 x 88 x 42; 83 x 82 x 34 mm.

This species closest fossil ally is *Dosinia grandis* Nelson, from the Miocene, Zorritos formation, of Peru; but the posterior dorsal margin of the Trinidad shell is higher and less sloping, and the ventral margin less produced than in the Peruvian species. In *grandis* the height is equal to or greater than the length of the shell, Nelson's types measuring 46 x 47 x 22 and 95 x 95 x 47; and Spieker's recent figure clearly indicates the relatively greater height (Paleont. Zorritos Form, John Hopkins Studies in Geol., No. 3, p. 138, pl. 8, fig. 4, 1922) measuring 93 x 96 mm. But in the Trinidad shell the length exceeds the height, so that the two species present a different form. Nelson (Trans. Conn. Acad., vol. 2, p. 201, 1870) described the right median cardinal tooth of *grandis* as *large and pointed* which suggests that these two great Dosinias also are somewhat unlike in the hinge characters.

The nearest living relative of *Dosinia titan* is also Pacific. It is *D. ponderosa* Gray (*gigantea* Sowerby), ranging from Lower California to Paita, Peru, and found in the Pleistocene of San Diego, Calif. As in the Trinidad species, the length of *ponderosa* is greater than the height; but the shell is smoother, the concentric sculpture being nearly obsolete on the center of the valve where fine, radial striæ are developed.

A very young shell in the Trinidad collection bears some likeness to *Dosinia liogona* Dall, from the Oak Grove Miocene of Florida. Probably Dr. Guppy had only a similar shell, and no adults, and hence was led to refer the Trinidad

species to *liogona*.

This great *Dosinia* exceeds in size all fossil species; but is eclipsed by a giant recent shell of *ponderosa* from Lower California, measuring 128 x 126 x 61 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Dosinia (Dosinidea) concentrica Born Pl. 25, Fig. 2

Venus concentrica Born, 1780, Mus. Vindob, p. 71, pl. 5, fig. 5.
Dosinia (Dosinidia) concentrica Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1232.

This modern representative of *Dosinia*, which is found in the Pleistocene of Cuba, and living from the Florida Keys to Rio de Janeiro, seems very insignificant in comparison with the titanic, Upper Miocene *Dosinia* from Springvale.

Our Trinidad shell measures in length 34, altitude 34, semidiameter 11 mm.

Locality.—Gulf of Paria, off Farallon Rock, Trinidad.

Horizon.—Recent.

Genus *CLEMENTIA* Gray

Clementia dariena Conrad Pl. 26, Figs. 1, 3, 5, 6,7

Meretrix dariena Conrad, 1856, Pacific R. R. Reports, vol. 5, p. 328, pl. 6, fig. 55.
Clementia dariena Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1235.
Clementia dariena Toula, 1908, Jahrb. der K-K. Geol. Reichsanstalt, vol. 58, p. 725, pl. 27, figs. 9, 10.
Not *Clementia dariena* Hubbard, 1921, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 2, p. 118, pl. 19, figs. 10, 11 (which is *C. rabelli* Maury).
Clementia dariena Olsson 1922, Bull. Amer. Paleont., No. 39, p. 232, pl. 31, fig. 4 (Isthmian shells, but not the Porto Rico reference)

Because of the delicate texture of these shells, the individuals of *Clementia* are very plastic, and tend to assume an oblique form, and are easily subject to deformation. All degrees of obliquity and distortion can be found among our northern South American and Isthmian specimens of *C. dariena* as well as among the large quantity of specimens

of *C. rabelli,* collected by Dr. Reeds in Porto Rico, and now in the American Museum.

In forming concepts of species in this genus, it seems to me that, instead of measuring degrees of obliquity and deformation, as Mr. Hubbard has done, we must study the normal.

The normal form of *Clementia dariena* is that of a large clam-shaped shell, as shown by the figure herein given of an Isthmian specimen. This, like Conrad's figure of the type, and Olsson's figure 4 of a typical shell, shows a considerable projection of the shell in front of the beak. This specimen measures in length 60, altitude 55, diameter 32 mm.

The true form of the Porto Rican *Clementia rabelli* Maury (Sci. Surv. Porto Rico, vol. 3, pt. 1, p. 37, pl. 6, figs. 2, 3, 1920) is shown by the type, which was chosen from a great number of distorted specimens, as revealing the normal form. See Plate 26, Figure 1.

This species, which is very characteristic of the Collazo shales of Porto Rico, differs from *C. dariena* in being very short anteriorly. The shell, as shown by my type and by Mr. Hubbard's fig. 10, projects very little in front of the beak. It has almost exactly the form of the living *Clementia papyracea* of the Philippines. It also does not attain as large a size as *dariena,* the type measuring in length 43, altitude 36, diameter 25 mm.

Mr. Olsson in his synonymy (Bull. 39, p. 232, 1922) united *rabelli* with *dariena;* but later said he thought the Porto Rican shell was, after all, a distinct species.

In the Trinidad collection, we have two small specimens of *Clementia,* probably young shells of *C. dariena.* One measures in length 36, altitude 33, diameter 20; the other is 33 x 34 x 17 mm.

Localities.—Guaico-Tamana Road, at 7¾ mile post; also two specimens from Manzanilla, retaining the shell substance.

Horizon.—Manzanilla Miocene.

Clementia (?) tæniosa Guppy

Arcopagia tæniosa Guppy, M S
Clementia ? tæniosa Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 327, pl. 30, fig. 8.
Clementia tæniosa Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1235.
Clementia tæniosa Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, vol. 11, p. 9; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 165.
Clementia tæniosa Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, p. 37.

Described by Dr. Guppy as "subtriangularly suborbicular, scarcely ventricose, concentrically ribbed, the ribs rounded with concave sulci between them. Alt. 43, lon. 47 mm." The type was an internal cast with imperfect hinge, but Dr. Dall thought there was little doubt that it was a species of *Clementia*. The nearly central beak with anterior and posterior margins sloping about equally to the rounded base, are differentiating characters of this species.

We have in our collections nothing corresponding to this description of *Clementia tæniosa;* and a search was vainly made for Dr. Guppy's type in the National Museum, in 1924.

Locality.—Savanetta, west central Trinidad (Guppy).
Horizon.—Upper Miocene.

Genus *TIVELA* Link

Tivela mactroides Born Pl. 26, Fig. 8; Pl. 27, Fig. 3

Venus mactroides Born, 1778, Test. Mus. Cæes. Vind.
Venus corbicula Gmelin, 1782, *Tivela vulgaris* Link, 1807, *Venus turgens* (Solander MS), Dillwyn, 1817, *Cytherea corbicula* Lamarck, 1818.
Cytherea mactroides Reeve, 1863, Conch. Icon., *Cytherea*, pl. 5, figs. 18a, b, c.
Tivela mactroides Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 367.

Shell when well grown quite large and solid, trigonal, rather compressed anteriorly and posteriorly, ventricose; beaks high and swollen; pallial sinus, broad and round;

color whitish stained with pinkish purple or reddish chestnut, sometimes partly covered with a thin horny epidermis. A shell from St. Thomas, W. I., measures in length 45, altitude 40, diameter 28 mm.

Distributed through the Bahamas, Antilles and adjacent continential shores to Santa Catarina, Brazil. It is the type of the section *Tivela, sensu stricto.*

Young shells of *T. mactroides* were collected by Professor Harris on Trinidad.

Locality.—Erin Point on the southwestern coast.

Horizon.—Recent.

Tivela austeniana Maury Pl. 27, Fig. 2

Mactra austeniana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 61, pl. 9, figs. 22, 23.

Shell small, thin, oblong-trigonal, posterior end somewhat produced and bluntly pointed; lunule very inconspicuous, ill-defined; teeth as shown in the figure, hinge plate narrow, pallial sinus rather short, broad and rounded. Length of type 27, altitude 21, semidiameter 7 mm.

A young shell of *T. mactroides* Born (measuring, length 25, alt. 24, sd. 8 mm.) of approximately the same size as *T. austeniana* is much higher, much shorter posteriorly, more inflated and has fuller beaks, so that the outline of the two shells is very different.

Tivela nasuta Dall (Proc. U. S. Nat. Mus., vol. 26, p. 380, pl. 12, fig. 2, 1902) approaches more nearly in form to *T. austeniana,* but has the lunule impressed, and defined by a distinct incised line, while in *austeniana* the lunule is not impressed, and is very faintly bordered by a raised thread. Moreover, in *nasuta* the surface is rudely striated, but in *austeniana* where not worn it is very smooth.

Locality.—Along the shore, 1000 feet west of the Brighton pier, in an impure asphalt.

Horizon.—Upper Pliocene.

Tivela austeniana var. **maturensis,** n. sp. Pl. 27, Fig. 1

We have a number of Tivelas from the Matura beds which are intermediate in form between the Pliocene *austeniana* and young shells of the Recent *mactroides*.

They are about the size of *austeniana* and resemble it in the form of the umbo and degree of convexity, but the posterior end is shorter, as in young *mactroides* which the base of the shell approaches in form. The hinge is heavy for the size of the shell, much more so than in *austeniana*. The largest specimen measures in length 25, altitude 24, semidiameter 7 mm.

Locality.—Matura, northeastern Trinidad.

Horizon.—Upper Pliocene.

Genus *MACROCALLISTA* Meek

Section *CHIONELLA* Cossmann

Macrocallista (Chionella) maculata Linnæus Pl. 25, Figs. 1, 4, 5

Venus maculata Linnæus, 1758, Syst. Nat., ed. X, p. 686.
Cytherea maculata Lamarck, 1818, Anim. sans Vert., vol. 5, p. 566.
Cytherea maculata Sowerby, 1842, Conch. Man., fig. 117d; 1851, Thes. Conch., 7, 629, pl. 131, fig. 97.
Callista maculata Moerch, 1853, Cat. Yoldi, vol. 2, p. 28.
Cytherea dariena Conrad, 1857, Pacific R. R. Rept., vol. 6, p. 72, pl. 5, fig. 21.
Dione maculata Reeve, 1863, Conch. Icon., *Dione*, pl. 3, figs. 11a, 11b.
Callista maculata Gabb, 1881, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 8, p. 344.
Macrocallista (*Chionella*) *maculata* Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1256.
Macrocallista maculata Maury, 1920, Bull. Amer. Paleont., No. 34, p. 68.
Macrocallista maculata Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 234, pl. 31, figs. 6. 7.

Shell rather large when adult, oval, somewhat compressed, substance porcellaneous, smooth except for fine concentric growth lines; living shells waved and spotted with violet-brown; epidermis, horny, shining. Recent specimens may attain 78 mm. in length and 58 in altitude. They show both a higher and a less elevated form, as figured by Reeve, 11a, 11b. The Trinidad fossils also show this variation of

form, but the less elevated is far commoner. Our largest fossils measure 63 in length by 44 altitude; 59 x 45; 56 x 41, and are about 12 mm. in semidiameter. Young shells measure 29 x 20 and 36 x 26 x 14 in diameter.

Comparison of these with Chipolan shells of *maculata* shows smaller specimens duplicate those from Florida, but the Trinidad Miocene shells attained a larger size than the Chipolan, being almost as large as the recent. The hinge is precisely the same as in Chipolan valves.

This species is found in the Miocene of Florida, Dominican Republic, Costa Rica and elsewhere; Pliocene of Florida and living from Hatteras through the Antilles to Brazil and in the Gulf of Mexico.

Gabb's unfigured variety *cuneata* was from Costa Rica. We have no specimens corresponding to his description.

Locality.—Springvale.

Horizon.—Upper Miocene

Genus *CALLOCARDIA* A. Adams

Subgenus *AGRIOPOMA* Dall

Callocardia (Agriopoma) gatunensis Dall Pl. 27, Figs. 5, 7

Callocardia (Agriopoma) gatunensis Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1260, pl. 54, fig. 1.
Callocardia (Agriopoma) gatunensis Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 370.
Callocardia (Agriopoma) gatunensis Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 235, pl. 32, fig. 1.

Shell of moderate size, ovate, thin, inflated; beaks low, incurving; lunule large, cordate; surface marked by fine, close, concentric growth lines. Length 33, height 28, diameter 17 mm. The type measured 38 x 31 x 21 and was from Gatun. The species is also recorded from Ponton, Dominican Republic; Claremont, Jamaica; and the more coarsely sculptured variety, *multifilosa* Dall, from the above localities and from the Gatun beds of Costa Rica.

Localities.—Brasso; Machapoorie quarry.

Horizons.—Brasso Miocene; Machapoorie Miocene.

Genus *PITARIA* (Roemer) Dall

As in earlier publications, I continue to use *Pitaria*, Dr. Dall's Latinized form of the African vernacular word *Pitar*. The leading French, English and American conchologists, specializing in the Veneridæ, have adopted *Pitaria*.

Section *PITARIA, sensu stricto*

Pitaria fulminata Menke Pl. 27, Fig. 9

Cytherea fulminata Menke, 1830, Synopsis Molluscorum in Musco Menkeana, 2d ed. Not *C. fulminata* Philippi, 1845, nor *Venus fulminata* Valenciennes.
Pitaria fulminata Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 371.

This is the recent member of the Miocene-Pleistocene, *Pitaria catharinæ-subaresta* group. It ranges from Hatteras through the Antilles to Brazil, and is living on the shores of Trinidad. It attains quite a large size, a full grown Trinidad shell measuring in length 36, altitude 32, semidiameter 12 mm.

The color is cream white with radial or ziczac dashes of bright yellowish brown. The surface is marked with closely set, concentric threads; and the form is like that of *catharinæ*, but many times larger and without the slight basal sinuosity.

This is the Varying Circe of Reeve, pl. 9, fig. 39 (*Cytherea varians* Wood; *Dione varians* Deshayes) and the *Cytherea rubiginosa* of Philippi. The west coast analogue is *P. tomeana* Dall.

Another less common West Indian and northern South American recent *Pitaria* is *P. albida* Gmelin, which is squarish, elongated and pure white.

From Matura we have dwarfed shells of *P. fulminata*, the largest measuring in length 14, altitude 12, semidiameter 5 mm., and we have many recent specimens.

Localities.—Matura, on the east coast; Erin Point, on

the southwestern coast of Trinidad.

Horizons.—Upper Pliocene; Recent.

Pitaria catharinæ, n. sp. Pl. 27, Fig. 4

Shell small, suborbicular, very plump and chubby; anterior extremity rounded, posterior end very short, roundly subtruncate; posterior basal margin very slightly sinuate. Beaks very full but low, their acute apices curving over the broadly lanceolate lunule, which is large for the size of the shell, not much depressed and bordered by a delicate line. Escutcheon not present. Surface marked with very numerous, very closely set, concentric threads which not infrequently anastomose. Hinge characters concealed. Length of specimen 18, altitude 16, diameter 12 mm.

This pretty shell is named in honor of Mrs. Katherine Van Winkle Palmer, whose fine Monograph on the *Veneridæ* will soon appear.

The affinities of *Pitaria catharinæ* are with the Pleistocene *P. subaresta* Dall, from Mt. Hope on the Isthmus, but the Trinidad fossil has very much coarser concentric lines, and the lunule, though large, is proportionately smaller than that of *subaresta.* The latter also attains a larger size.

Locality.—Ravine on east side of road about ¾ mile south of Brasso.

Horizon.—Manzanilla Miocene.

Section *HYPHANTOSOMA* Dall

The type of this section is *Pitaria carbasea* described, in 1866, by Dr. Guppy from Bowden, Jamaica, as *Cytherea carbasea.* Like all members of this section, *P. carbasea* is characterized by striking, but fine, ziczac sculpture on the surface of the shell. We have good specimens from Jamaica, and this shell is also found in the Miocene of the Dominican Republic; but it has never been collected in Trinidad.

Subgenus *HYSTEROCONCHA* Fischer

Pitaria (Hysteroconcha) dione Linnæus Pl. 27, Fig. 8

Venus dione Linnæus, 1758, Systema Naturæ, ed. X, p. 684.
Venus dione Chemnitz, 1782, Conch. Cab., 6, p. 282, pl. 27, figs. 271, 272.
Venus dione d'Orbigny, 1845, In de La Sagra's Historia Pol. y Nat. Isla de Cuba, vol. 5, *Moluscos*, p. 317.
Dione veneris Deshayes, 1853, Cat. Conch. British Mus., pt. 1, *Veneridæ*.
Dione veneris Reeve, 1863, Conch. Icon., 12, *Dione*, pl. 6, fig. 23.
Pitaria (*Hysteroconcha*) *dione*, Dall and Simpson, 1901, Bull. U. S. Fish. Comm., 1, p. 485, pl. 56, figs. 3, 10.
Pitaria (*Hysteroconcha*) *dione* Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 371.
Pitaria (*Hysteroconcha*) *dione* Maury, 1920, Gulf. Moll., Bull. Amer. Paleont., No. 34, p. 70.

This handsome shell, dedicated to Venus by Deshayes, is white tinged with purple-violet, concentrically ridged, and usually spinose on the posterior slope—but a spineless variety occurs. A good-sized shell is 40 mm. in length, 33 in altitude and 10 in semidiameter.

D'Orbigny recorded this species from the shores of Trinidad. It is elsewhere in the Antilles, and on the Texas coast southward to Colon. It is the type of the subgenus *Hysteroconcha*, the members of which inhabit tropical American seas.

Localities.—Erin Point, southwestern Trinidad; and Mayaro Point, east coast, Trinidad.

Horizon.—Recent.

Section *LAMELLICONCHA* Dall

Pitaria (Lamelliconcha) circinata Born Pl. 27, Figs. 12, 13

Venus circinata Born, 1780, Testacea Musei Cæsarei Vindobonensis, p. 61, pl. 4, fig. 8.
Venus rubra Gmelin, 1792, Systema Naturæ, 6, p. 3288.
Dione circinata Deshayes, 1853, Cat. Conch. British Mus., p. 77.
Cytherea circinata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 41.
Pitaria (*Lamelliconcha*) *circinata* Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 372.
Pitaria (*Lamelliconcha*) *circinata* Dall, 1903 (in part), Trans. Wag-

ner Inst. Sci., vol. 3, pt. 6, p. 1269.
Pitaria (*Lamelliconcha*) *circinata* Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 56, pl. 9, figs. 12, 13.
Pitaria (*Lamelliconcha*) *circinata* Maury, 1917 (in part), Bull. Amer. Paleont., No. 29, p. 215; Olsson, 1922 (in part), No. 39, p. 236.

This shell is common and abundant in the Antilles, on the eastern shores of Central America, and the coast of northern South America as far south as Santa Caterina, Brazil. The Pacific mutation has a more convex, larger shell, and is the variety *alternata* Broderip (Proc. Zool. Soc., p. 45, 1835).

Like all the Matura Pliocene species, the specimen of *circinata* from that locality is dwarfed, measuring only 13 mm. in length.

An extremely large shell of *circinata*, measuring in length 45, altitude 39, semidiameter 12 mm., was collected by Professor Harris at La Guayra, Venezuela. It is also on the Trinidad shores.

Localities.—Matura, northeastern Trinidad; also 1000 feet west of the Brighton pier in asphaltic marl; and La Guayra, Venezuela.

Horizons.—Pliocene and Recent.

Pitaria circinata var. **juncea** Guppy Pl. 27, Figs. 6, 10

Cytherea juncea Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 582, pl. 26, fig. 13.
Cytherea juncea Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 41.
Cytherea juncea Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 531.
Cytherea juncea Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 5; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 161.

As noted by Dr. Guppy, this form is very closely allied to *P. circinata* with which it is often united. Dr. Dall observed that the hinge of *juncea* tends to be somewhat heavier. The hinge in all our specimens is concealed. In the description of the type, the thin concentric lamellæ were alternately rather higher; but this is a variable feature, as some specimens show it very clearly and others only ante-

riorly and posteriorly.

The type of *juncea* was from Cumana, Venezuela, and Dr. Guppy also recorded the shell from the Bowden beds, Jamaica, and Springvale, Trinidad.

Locality.—Machapoorie quarry.

Horizon.—Miocene.

Pitaria (Lamelliconcha) labreana Maury Pl. 27, Fig. 11

Pitaria (Lamelliconcha) labreana Maury, 1912, Jour. Aca. Nat. Sci. Phila., 2d ser., vol. 15, p. 57, pl. 9, figs. 14, 15.

Original description—"Shell elongate ovate, rather compressed, inequilateral, lunule small, well-defined, lanceolate; valve sculptured with narrow, round-edged lamellæ with much wider grooves between them; hinge characters shown in the figure; pallial sinus very deep, rounded, broad, extending beyond the center of the valve. Length of shell 17, height 13, diameter 6 mm."

The nearest ally of this species is the west coast, recent shell, *Pitaria concinna* Sowerby.

Localities.—1000 feet west of the Brighton pier (type locality), also in a new collection from Brighton beach, both from outcrops of impure asphaltic marl.

Horizon.—Upper Pliocene.

Genus *CYCLINELLA* Dall

Cyclinella cyclica Guppy Pl. 26, Fig.4

Dosinia cyclica Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 282, pl. 26, fig. 15a, b.

Dosinia cyclica Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.

Cyclina cyclica ? Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 250.

Lucinopsis cyclicus Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 329.

Cyclinella cyclica Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1285.

Dosinia cyclica Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.

Cyclinella cyclica domingensis Pilsbry and Johnson, 1918, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 200; Pilsbry, 1922, *Idem*, vol. 73, p. 424, pl. 47, fig. 8.

Shell suborbicular, varying somewhat in outline, certain specimens being truncate posteriorly and hence subquadrate in form, while others dip down a trifle at the posterior, basal margin. Surface sculpture in perfectly preserved shells, of fine, close, concentric striations with more widely-spaced coarser lines which are more apparent when the surface is somewhat worn.

Lunule clearly seen in specimens with the shell substance eroded away, lanceolate, measuring six or seven by three mm. in smaller shells; but where the surface is preserved the lunule is inconspicuous, not depressed, bordered only by a light line, rather coarsely striate, and measuring on a full-sized shell 8.5 x 4.5 mm. Hence the contradictory statements regarding the lunule, Guppy saying it was entirely wanting and Dall that it was large and lanceolate. Hinge with three cardinal teeth in each valve, central largest, right posterior bifed. Pallial sinus V-shaped, directed obliquely upwards. Length of Guppy's type 40, altitude 39 mm. Measurements of some of our specimens: 35 x 34 x 17; 30 x 28 x 14; 22 x 21 x 10 mm. The largest is imperfect but has an altitude of 40 mm.

In the early seventies, Gabb collected in Santo Domingo, a single shell which he referred with a question to this species. Pilsbry and Johnson recently described this shell of Gabb's as variety *domingensis*. But among our Trinidad collection are specimens corresponding in size, shape and surface markings to the figure of *domingensis*. The coarser concentric lines show best on somewhat worn shells, and are the occasional subrugose lines of growth among the finer striæ mentioned by Dr. Guppy in describing his type. On my expedition to Santo Domingo we did not get any Cyclinellas; but it seems as if Gabb's shell were a small worn specimen of *cyclica*.

The recent species in the Gulf of Mexico and from Florida to São Paulo, Brazil, is *C. tenuis* Récluz, referred to *Dosinia, Artemesia, Cyclina, Mysia* and *Lucinopsis*, and

in 1902 made by Dr. Dall the type of a new genus, *Cyclinella* (Nautilus, vol. 16, p. 44). The west coast species is *Cyclinella subquadrata* Hanley. The Panama Gatun Miocene form is *C. gatunensis* Dall, and in the same formation in Costa Rica are *C. beteyensis* Olsson, and *subquadrata* var. *quitana* Olsson.

Localities.—Manzanilla (type locality); also northwest corner of F 16 (eastern Trinidad).

Horizon.—Manzanilla Miocene.

Genus *CHIONE* Megerle von Mühlfeld

Section *CHIONE, sensu stricto*

The American species of this section have been divided by Dr. Dall into three groups with representatives in every horizon from the Miocene to the Recent. The groups are (1) That of *Chione cancellata* with trigonal shell, and concentric lamellæ rather distant; (2) that of *Chione subrostrata* Lamarck, which has the sculpture delicate and concentric lamellæ rather close and low; and (3) that of *Chione pubera* with concentric lamellæ close, very numerous and crenulate, so that the interspaces appear punctuate.

All three groups are represented in the Trinidad material.

(1) Group of *Chione cancellata:*

Chione (Chione) cancellata Linnæus Pl. 28, Figs. 1, 5

Venus cancellata Linnæus, 1767, Systema Naturæ, ed. XII, p. 1130.
Venus cingenda Dillwyn, 1817, Cat. Rec. Shells, vol. 1, p. 161.
Venus elevata Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 272.
Venus lamellata Deshayes, 1853, Cat. Conch., British Mus., p. 134. Not of Linnæus.
Chione cancellata Holmes, 1860, Post. Pl. Fos. S. Car., p. 35, pl. 6, fig. 14.
Venus cingenda Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16; also Geol. Mag., 1864, vol. 2, pp. 256–261.
Chione cancellata Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 373; 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1290.
Chione cancellata Maury, 1920, Bull. Amer. Paleont., No. 34, p. 72.

This attractive, abundant and variable shell, type of the section *Chione, sensu stricto,* has been known under many names. It is the *Venus dysera* of many authors, but not of Linnæus; and the *V. ziczac* of Moerch and Krebs, not of Linnæus; *Cardium bicolor* Martyn 1784, and *Venus maculosa* Gmelin, 1792.

The present range of *Chione cancellata* is through the Gulf of Mexico, the Antilles, Bermuda, and Cape Fear, North Caroline, to Brazil. It occurs in Pliocene beds in South Carolina and Florida. We obtained it from a depth of over two thousand feet in Pleistocene beds, in a trial oil well in Terrebonne Parish, Louisiana.

Miocene ancestral forms are *C. erosa* and *C. chipolana* Dall, both Floridian. We have many specimens from the Pliocene of Matura and very fine recent shells, one from near Farallon Rock measuring 26 x 23 and 15 in diameter.

Localities.—Matura (also recorded by Guppy as *cingenda*); Gulf of Paria near Farallon Rock; and Scotland Bay, Trinidad.

Horizons.—Upper Pliocene; Recent.

(2) Group of *Chione subrostrata:*

Chione (Chione) subrostrata Lamarck

Venus subrostrata Lamarck, 1818, Hist. des Animaux sans Vertèbres, vol. 5, p. 588; Encyclopédie Méthodique, pl. 267, fig. 7.
Venus subrostrata Reeve, 1863, Conch. Iconica, *Venus,* pl. 14, figs. 54a, 54b.
Chione (Chione) subrostrata Dall, 1902 (in part), Proc. U. S. Nat. Mus., vol. 26, p. 372; 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, pp. 1289, 1291.

According to Reeve, the figure in the Encyclopédie to which Lamarck referred his type was *Venus lamarckii,* a Chinese species, but the type locality of *subrostrata* is stated by Lamarck to be the Antilles. Dr. Dall, in 1902, included in the synonymy of *Chione subrostrata, C. portesiana* d'Orbigny, 1846; *C.beaui* Récluz, 1852; *C. crenifera* of Carpenter's Mazatlan Catalogue, and of Sowerby, 1835, and

probably also *lunularis* Philippi, 1844, not *lunularis* Lamarck, 1818.

But as our Trinidad specimens resemble very closely d'Orbigny's figure of *C. portesiana* and are unlike Reeve's of *subrostrata,* they are here referred to the former member of this group.

Chione (Chione) portesiana d'Orbigny Pl. 28, Fig. 3

Venus Portesiana d'Orbigny, 1835–1843, Voyage dans l'Amérique Méridionale, vol. 5, pt. 3, Mollusques, p. 556; Atlas, pl. 83, figs. 1, 2.

Shell rather small, ovate-trigonal, white more or less stained with blackish ziczac or radiating markings. Described by d'Orbigny as somewhat resembling *C. pectorina* Lamarck in sculpture; but differing in its more triangular, less rounded form, its more prominent concentric ridges, and by the fact that each radial rib is composed of three or four striæ. Length of type 30 mm.

This species was collected nearly a century ago by d'Orbigny on his South America voyage and travels (1826–1833). It was named by him the Venus of the Harbors (Venus des Portes) because he found it in the Bay of Rio de Janeiro, living buried in sand at low tide level.

Our Trinidad specimens agree perfectly with d'Orbigny's figure of *portesiana.* On the center of the valves the radii are often in triads, sometimes in pairs with a third weaker, but the triad plan is most frequent. Posteriorly and at the extreme anterior the radii are single. Our largest shell measures in length 29, altitude 24, semidiameter 7 mm.

Localities.—Shores of the Gulf of Paria and Atlantic coast, Erin Point, southern Trinidad.

Horizon.—Recent.

Chione portesiana var. **beaui** Récluz Pl. 28, Fig. 7

Venus Beauii Récluz, 1852, Journal de Conchyliologie, vol. 3, pp. 412, 413.

We have in the Cornell Museum a specimen of *Chione beaui* collected by Dr. Newcomb from Récluz's type locality, the Island of Guadeloupe. Our shell is smaller than the type measuring in length 28, altitude 23, diameter 20 mm., while Récluz's shell was 38 x 32 x 27 mm.; but otherwise corresponds exactly to his excellent figure, even in the slight curve of the radial riblets.

The Guadeloupe shell is more convex, more angulate posteriorly than our Trinidad specimens and is also slightly sulcate and arcuate in front of the umbonal slope. It also attains a somewhat larger size. For these reasons it would seem as if the name *beaui* might be retained as a variety.

Locality.—Guadeloupe Island, W. I.

Horizon.—Recent.

Chione (Chione) dalliana Maury Pl. 28, Fig. 10

Chione dalliana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 59, pl. 9, fig. 16.

Original description—"Shell rather small for the genus, subcircular in outline; hinge characters concealed by the matrix; inner edge of valves finely crenulated; sculpture of regular, low lamellæ crossed by very fine, close-set radial striæ which with the lamellæ form a delicate cancellation over the entire surface; anteriorly the radial sculpture strengthens, forming about seven well marked plications. Length of shell 20, height 17, diameter approximately 17 mm."

This species, as I noted in 1912, is allied to the Miocene *Chione walli* Guppy, and like it is a member of the *Chione subrostrata* group. *C. dallina* is a smaller, rounder, thinner shell than *walli,* and unlike that species is radially plicated anteriorly. Moreover, in *C. walli* the radial striæ over the center of the valve are typically in pairs, with an alternating weaker thread.

Chione dalliana is without doubt ancestral to *C. portesiana* d'Orbigny; but is not identical with that species.

A comparison of the figure of d'Orbigny's type with that of *dalliana* shows their essential differences. *C. dalliana* is smaller, rounder, more delicate with much finer sculpture, the concentric lamellæ closer, lower and finer. The anterior plications are similar, but the radials on the center of the valve are not in the form of riblets composed of triad or paired striæ, but are low, and equal. On the type of *dalliana* radials and concentric are subequal and resemble fine single threads.

The type of *dalliana* was collected by Dr. Arthur C. Veatch, in 1911, at Brighton, in an asphaltic marl then thought to be of Chipolan (Miocene) age; but later extensive studies in the field by Professor Harris have led him to conclude that the formation is much younger, probably late Pliocene.

Locality.—Along the shore 1000 feet west of the pier at Brighton, southwestern Trinidad.

Horizon.—Upper Pliocene.

Chione dalliana var. **veatchiana** Maury Pl. 28, Fig. 14

Chione veatchiana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 58, pl. 9, figs. 17, 18.

Original description—"Shell ovate-triangular, slightly rostrated posteriorly, substance rather thin; hinge characters shown in the figure; pallial sinus short, triangular; inner margin of valves finely and sharply crenate; sculpture of close-set, feeble, very slightly raised lamellæ, cancellated by slightly more conspicuous, radiating striæ. Length of shell 25, height 20, diameter 14 mm."

This has five or six weak, anterior radial plications, and over the umbonal slope the radial sculpture begins to suggest, though faintly, the riblets of paired and triad striæ of *pectorina.*

The much more elongated and trigonal form distinguishes this shell from *C. dalliana,* and the radial scultpure is somewhat stronger and foreshadows the grouping of the

striæ.

Locality.—Along the shore 1000 feet west of the pier at Brighton.

Horizon.—Upper Pliocene.

Chione dalliana var. **guppyana** Maury Pl. 28, Figs. 4, 13

Chione guppyana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 59, pl. 9, fig. 19.

Original description — "Shell suborbicular, slightly obtusely pointed at the posterior end, sculpture of same general type as *C. veatchiana*—that is, finely and delicately cancellated by the intersections of radial threads with somewhat less pronounced concentric lamellæ; interior margins finely and sharply crenate; pallial sinus quite deep and obtusely triangular; hinge characters as shown in the drawing. Length of shell 19, height 16 mm."

In form this is like *C. dalliana,* but the radial sculpture has become progressively stronger so that the paired and triad plan of the striæ, feebly shown in *veatchiana,* is much more obvious.

The type of *guppyana* was found by Dr. Veatch at Brighton, but lately Professor Harris collected some shells in the Matura beds, on the opposite side of the island, very closely resembling the type and seemingly identical in form and details of sculpture, and in the quite deep and tongue-like shape of the pallial sinus. The latter feature is very unlike the short, triangular sinus of *veatchiana,* as the drawings of the types will show.

These three related forms, *dalliana, veatchiana* and *guppyana,* I originally described as separate species; but here I have placed the latter two as varieties of the first, and arranged them in a series according to their development towards the detailed radial structure of the modern *C. portesiana.*

Localities.—Along the shore 700 feet east of the Brighton pier, southwestern Trinidad, in an impure asphalt (type locality) ; Matura beds, northeastern Trinidad.

Horizon.—Upper Pliocene.

Chione (Chione) walli Guppy Pl. 28, Figs. 2, 11, 15

Venus Walli Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 581, pl. 26, fig. 16.
Venus Walli Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 161; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 41.
Chione Walli Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, pp. 1291, 1587.
Chione walli Spieker, 1922, Paleont. Zorritos Formation, pp. 151, 154.

Shell of medium size, subtrigonal, anteriorly rounded, posteriorly somewhat angulated, lunule defined by an impressed line, cordate, striate; concentric sculpture of rather prominent finely fluted ridges, at intervals of about two millimetres, radial sculpture of fine riblets, interrupted by the concentric ridges; the radiating riblets are paired on the central part of the valve and usually a smaller riblet lies between every pair, on the posterior slope the riblets are single. Length of a large shell 35, altitude 33, semidiameter 12 mm.

This handsome species is an ancestral member of the east coast *Chione subrostrata* group, but is much more strikingly like *Chione amathusia* Philippi of the Pacific shores. A shell of the latter is figured for comparison. See Plate 28, Figure 9.

In this connection, Mr. Spieker's statement is interesting. In discussing *C. variabilis* Nelson and *C. propinqua* Spieker, he says that all the Chiones, *sensu stricto*, known from the Zorritos formation of Peru have the double riblets, thus suggesting a racial affinity with *C. walli* of the Manzanilla formation.

Dr. Dall has identified *C. walli* from the Bowden beds of Jamaica.

Localities.—Manzanilla Bay, eastern Trinidad, at many collecting stations.

Horizon.—Manzanilla Miocene.

(3) Group of *Chione pubera:*

Chione (Chione) pubera Valenciennes Pl. 29, Figs. 12, 13

Venus pubera Valenciennes, 1827, Name in Bory St. Vincent's Explanation of Plates, p. 152, Encyclopédie Méthodique, figs. 4, 4a.
Venus crenulata Reeve, 1863, Conch. Icon., *Venus*, pl. 10, fig. 33.
Not *Venus crenulata* Chemnitz, 1782, Conch. Cab., vol. 6, p. 370, pl. 36, fig. 385. An East Indian, closely allied species. Name prior to *crenata* but Chemnitz not binomial.
Not *Cytherea crenata* Gmelin, 1792, Systema Naturæ, vol. 6. Correct name for the East Indian shell.
Venus superba Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 91, pl. 3, fig. 2; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 74, pl. 1, fig. 2.
Chione (*Chione*) *pubera* Dall, 1902, Synopsis Veneridæ Proc. U. S. Nat. Mus., vol. 26, p. 374; 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1289.
Venus halidona Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 11; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 154.
Not *Venus halidona* Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1307, pl. 38, figs. 1, 1a, pt. 5, p. 1194.

Shell large, handsome, ovate-trigonal, subventricose, sculptured with closely-set, erect or slightly recurving concentric ridges which are even, regular and finely fluted, interspaces radiately striated. Living shell whitish variegated with waves of red-brown. Length of largest fossil 72, altitude 60, diameter 38 mm.; best fossil specimen, in form of a cast, length 50, altitude 39; a recent Brazilian shell 59 x 50, semidiameter 19 mm.

Dr. Guppy's *superba* was a recent shell that he collected on the beach of Cumana, Venezuela. It is undoubtedly this species, which ranges through the West Indies and along the shores of northern South America.

As far as one can judge from the material, the Trinidad fossil form is specifically identical with the living shell.

Venus halidona Dall is from the Tampa silex beds, is a true *Venus*, is smaller, and its concentric ridges are not fluted. In *Chione pubera* the fine fluting of the ridges is a very marked character and gives a punctate appearance to the shell.

Locality. — Mt. Pleasant quarry, Springvale, near

Couva, west central Trinidad.
Horizon.—Upper Miocene.

Section *CLAUSINELLA* Gray

Chione (Clausinella?) sancti-davidis, n. sp. Pl. 28, Fig. 12

In the collection is a single worn valve of a *Chione* which is of special interest since it appears to be a representative of the section *Clausinella* which is not now living in the North American or the Antillean seas.

The shell is small, oblong-trigonal, very flat. The surface is sculptured with very round, concentric ribs, the interspaces about equalling the ribs in width. Both on the ribs and on the posterior region are distinct traces of concentric striæ. These may possibly be a deception due to wearing, but seem rather to be the fine concentric lines characteristic of the section *Clausinella*, of which the European shell, *Chione fasciata* Donovan, is the type. The Trinidad shell is much longer, with the posterior end far more produced than in *C. fasciata*, and the beak is lower and less curving. But it is quite probable that our fossil is a member of the same section. This can only be proved by more perfect specimens. Length of shell 13, altitude 11, semidiameter 3 mm.

A species of *Clausinella* is also listed by Drs. Vaughan and Woodring from the Province of Barabona, Dominican Republic.

Locality.—Matura.
Horizon.—Upper Pliocene.

Section *LIROPHORA* Conrad

Chione (Lirophora) latilirata Conrad Pl. 29, Figs. 1, 2, 9

Venus paphia Lamarck, 1818, Anim. sans Vert., vol. 5, p. 608. Not of Linnæus, 1767.
Venus alveata Say, 1833, Am. Conch., vol. 7, pl. 63. Not of Conrad, 1831.
Venus latilirata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 28; 1845, Fos. Medial Tert., p. 68, pl. 38, fig. 3.

Venus varicosa Sowerby, 1853, Thes. Conch., 2, p. 723, pl. 155, fig. 67.
Circumphalus (*Lirophora*) *athleta* Conrad, 1864, Proc. Acad. Nat. Sci. Phila., pp. 575, 586.
Chione (*Lirophora*) *latilirata* Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 375; 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1298, pl. 42, fig. 3.
Chione latilirata Glenn, 1904, Maryland Geol. Surv., Miocene, p. 309, pl. 77, figs. 3–6.
Chione latilirata Maury, 1920, Bull. Amer. Paleont., No. 34, p. 73.

This species is trigonal, flattened and sculptured with concentric ribs which, over the main part of the disc, are heavy and wide.

From the dwarf, late Pliocene, fauna of Matura, we have several small specimens, the largest being 13 mm. in length, 11 in altitude and 4 in semidiameter. From the early Pliocene, north of the Matura River, normal-sized specimens were obtained. These can be duplicated among specimens from the Cape Fear River, North Carolina.

The type locality of *latilirata* was the Miocene of Calvert Cliffs, Maryland; and the species continued on unchanged through Pliocene and Pleistocene to the Recent. The present range is from Hatteras to Rio Grande do Sul, Brazil.

Localities.—400 feet north of Matura River; also Matura.

Horizons.—Lower Pliocene; Upper Pliocene; Recent.

Chione (Lirophora) riomaturensis, n. sp. Pl. 29, Fig. 4

We have several imperfect but interesting shells of a *Chione* which is intermediate in characters between *C. latilirata* Conrad and *C. paphia* Linnæus.

The shell is of medium size, trigonal, flat, with about four heavy, broad, flat, concentric ribs over the main part of the disc, with a number of increasingly finer riblets extending to the apex of the beak. In the broad, heavy ribbing the shell resembles *latilirata*. But posteriorly the thick ribs suddenly thin out and are continued over the posterior dorsal area as narrow, elevated ridges which extend to the border of the escutcheon.

This thinning out of the ribs is a characteristic of *C. paphia;* the ribs in *latilirata* extending in their full width as far as the escutcheon. When entire this Trinidad form would measure about 31 mm. in length, 26 in height, and 10 in semidiameter.

These specimens are not dwarfed but of normal size. The fauna of which they were members is quite independent of, and earlier than the dwarfed, late Pliocene fauna of Matura.

Locality.—400 feet north of the Matura River, eastern Trinidad.

Horizon.—Lower Pliocene.

Chione (Lirophora) caroniana, n. sp. Pl. 29, Figs. 5, 7, 8

Venus glyptocyma Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 11; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 153.

Not *Chione (Lirophora) glyptocyma* Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1296, pl. 55, fig. 21.

Shell of medium size, roundly trigonal, solid, becoming robust with age, moderately convex; beaks low, acute, curving towards the striated lunule, escutcheon long, striated with growth lines, discs typically sculptured with broad, flat, irregular, concentric ribs which extend over the central portion of the valves, but anteriorly and posteriorly, on nearing the lunule and escutcheon, tend to alter suddenly into thin lamellæ. The striking feature is the coarse, broad, irregular ribbing, seemingly due to fusion. Occasionally the ribs are obsolete. Even on the beaks, the ribs are low and broad, but become wider over the discs where they vary from three to five, six or even eight millemetres in width. The largest shell measures in length 38 mm., height 30, diameter 19. An average adult is 30 x 24 x 16 mm.

This was a very common shell on the Miocene beach of Springvale.

A comparison with specimens of *Chione glyptocyma* Dall, from Oak Grove, Florida, shows a decided difference

of sculpture, the Floridian shells have more abundant and narrower ribs. In the confluence of the ribs the Trinidad species approaches more nearly to *C. burnsi* Dall, from Bailey's Ferry, Florida, but that has characteristically radial striations, as shown on our shells and Dr. Dall's figure 4 of his type. The Trinidad specimens show no trace of radial markings.

This species is related to the Miocene to Recent shell *Chione latilirata* Conrad; but the ribbing is lower, more irregular, confluent and occasionally obsolete. Our shell also is allied to the recent *Chione paphia* Linn. (*vetula* Da Costa) but in that species the broad ribs are high and recurved.

Chione chiriquiensis Olsson from the Gatun formation of Costa Rica is a miniature relative of this group which is typified by *latilirata.*

Chione ebergenyii Bose from Tuxtepec, Mexico, and *C. hendersoni* Dall from Bowden, Jamaica, are much more finely ribbed.

Locality.—Springvale, Trinidad. Very abundant.

Horizon.—Upper Miocene.

Section *TIMOCLEA* Brown

Chione (Timoclea) pectorina Lamarck Pl. 28, Figs. 6, 8

Venus pectorina Lamarck, 1818, Anim. sans Vert., vol. 5, p. 589.
Venus elegans Gray, 1828. Not of Lamarck.
Venus pectorina d'Orbigny, 1835–1843, Voyage l'Amérique Mérid., vol. 5, pt. 3, Mollusques, p. 555.
Venus pectorina Reeve, 1863, Conch. Icon., *Venus*, pl. 8, fig. 25.
Venus pectorina Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16.
Chione (*Timoclea*) *pectorina* Dall, 1902, Syn. Veneridæ, Proc. U. S. Nat. Mus., vol. 26, p. 374.

This is the "heart-shaped Venus"; whitish or rusty, often with reddish, purplish or blackish markings. The sculpture is of very numerous fine, equal, sharp radiating threads, alternating with almost microscopic radial striæ, crossed by very fine concentric raised lines, making, under

the lens, a beautiful and intricate lattice-work. Our largest shell measures in length 33, altitude 29, diameter 21 mm.

D'Orbigny found this *Timoclea* very abundant in the sands at lowest tide level in the Bay of Rio de Janeiro. It ranges from the Antilles to São Paulo, Brazil. Dr. Guppy recorded it from the Matura beds.

Localities.—Shores of Gulf of Paria, Trinidad, and Matura beds.

Horizons.—Upper Pliocene and Recent.

Genus *ANOMALOCARDIA* Schumacher

Anomalocardia brasiliana Gmelin Pl. 29, Figs. 10, 11

Venus brasiliana Gmelin, 1792, Syst. Naturæ, 6, p. 3289.
Venus flexuosa Born, 1780, Test. Mus. Vind., p. 62, pl. 4, fig. 10. Not of Linnæus, 1767.
Cytherea macrodon Lamarck, 1818, Anim. sans Vert., vol. 5, p. 580.
Cytherea lunularis Lamarck, 1818, *Idem*, p. 580.
Venus macrodon Hanley, 1843, Biv. Shells, p. 116, pl. 9, fig. 7; Sowerby, 1853, Thes. Conch., 2, p. 717, pl. 156, fig. 88.
Venus lunularis Philippi, 1844, Abb. und Beschr., vol. 1, p. 177, pl. 3, fig. 10.
Venus macrodon Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 16.
Anomalocardia brasiliana Dall, 1902, Proc. U. S. Nat. Mus., vol. 26, p. 375; 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1306.
Anomalocardia brasiliana Maury, 1920, Gulf. Moll., Bull. Amer. Paleont., No. 34, p. 75.

On Freeport-Todd's road many Anomalocardias were collected which comparison shows are identical with the recent *A. brasiliana* Lamarck. This species is variable assuming a short, high and a long, produced form. Often there is a slight basal emargination in front of the umbonal slope. The sculpture is of concentric ripples conspicuous anteriorly and some times present posteriorly but obsolete on the center of the valve which is smooth. Nearly all the Freeport-Todd's road specimens are the high form, an average shell measuring in length 22, altitude 18, semi-diameter 7.5 mm.

Like all the Matura molluses, the specimens from there are dwarfed, but show both the high and low form.

A very large, elongated, recent Brazilian specimen is 41 in length, 28 in altitude and 11 in semidiameter, and a short shell is 30 x 29 x 10. But we have smaller ones that match the Trinidad fossils. Living shells are white, or creamy, delicately painted with violet in ziczac and arabesque designs.

Localities.—Freeport-Todd's road, associated with *Arca patricia,* near the 2d mile post; and ¼ mile south of the 6th mile post; also at Matura.

Horizons.—Upper Miocene (*Arca patricia* horizon); Upper Pliocene; Recent.

Genus *THYASIRA* (Leach) Lamarck

Thyasira sancti-andreæ, n. sp. Plate 30, Fig's 2,3

Shell rather large, moderately inflated, subtrigonal with a rounded base; and markedly concave dorsally, anterior to the beaks. Substance extremely thin. Surface smooth except for fine, concentric growth lines. Beaks full but low, their apices very small, sharply pointed, strongly prosogyrate. Anterior dorsal area with a cordate lunule, more or less impressed in different individuals. Posterior area with a delicate but clearly defined, linear, radial plication passing from behind the beak towards the base, but usually fading out before reaching the posterior basal margin. Hinge characters concealed. The largest shell measures in length 45 mm., the smallest 15, the most perfect is 40, 34 in altitude and 23 in diameter.

Dr. Dall most kindly helped in determining the generic position of this puzzling shell. He writes: "I have carefully examined your shell, and by removing one side of it with acid the matrix seems to show a Lucinoid entire pallial line and muscular impression. I think the genus is *Thyasira* . . . If my surmise is correct there should be only a small knob in the hinge under the beaks."

This species is common at collecting station No. 316, at Manzanilla, where 20 specimens were obtained. Many

are much distorted from pressure to which the strata have been subjected.

Dr. Dall likens this shell to the very much smaller *Thyasira sarsii* Philippi, which he says might be a miniature of the Trinidad fossil. *T. sarsii* is known from north Europe and Greenland, but not from America east, or west. So the relationship of the Manzanilla species is with a boreal, Atlantic recent form.

The Godineau River beds of Trinidad contain *Thyasira adoccasa* Van Winkle, known only in the form of internal molds, attaining a maximum length of 123 mm. Its nearest ally is *Thyasira bisecta* Conrad, Miocene to Recent, on the west coast of the United States.

In the Pliocene of Florida is *Thyasira trisinuata* d'Orbigny; and in the Pleistocene of northeastern North America is *T. gouldii*. Both these species are still living, the latter extending south as far as Martinique in the West Indies. But it is a lover of the cold and becomes larger to the north and in the deeps. The distribution of these two species suggests a circumpolar origin as they inhabit also the North Pacific.

Locality.—Manzanilla.

Horizon.—Manzanilla Miocene.

Genus *PHACOIDES* Blainville

Subgenus *LUCINISCA* Dall

Phacoides (Lucinisca) roigi, n. sp. Pl. 29, Fig. 6

Shell resembling the recent, West Indian, *Phacoides* (*Lucinisca*) *muricatus* Spengler; but differing in the ribbing which is much sparser and more spinose than in the living shell. In our specimens of "*L. scabra*" (*muricatus*) as well as those of *muricatus*, the ribbing is exceedingly close, even more so than represented by Reeve's figure (pl. 8, fig. 45)—there being about fifty ribs. But in the Trinidad

fossil shells there are only about twenty-five counting in the smaller intercalary riblets that frequently, but not always, alternate with the larger ribs. The ribs are ornamented with very conspicuous hollow vaulted scales—much more pronounced than in the recent *muricatus*—so that the surface appears covered with thorny spines. The dentition is similar to that of *muricatus*. Length of shell 11, altitude 10.5, semidiameter 2 mm.

The only two recent, east coast and Antillean members of *Lucinisca* given in Dr. Dall's Synopsis of the *Lucinacea*, are *muricatus* (Spengler) and *nassula* Conrad. In the latter the concentric equals the radial sculpture, forming a nearly uniform reticulation and the spines are not prominent. In *muricatus* and in our fossil the concentric sculpture is hardly apparent—except on the umbo of our shell where two or three concentric lines appear, preceding the radials, which then develop, the concentrics becoming obsolete.

Phacoides (*Lucinisca*) *cercadicus* Maury, from the Cercado formation, Dominican Republican, is not spinose, but beaded at the intersections of the radial and concentric riblets, while *L. hoveyi* Maury, from the Miocene, Quebradillas limestone of Porto Rico, is finely latticed and has no secondary riblets.

This very beautiful shell is named in honor of Dr. Mario Sanchez Roig, of Havana, in recognition of his recent fine Memoir on the Fossil Echinoderms of Cuba.

Locality.—Matura, eastern Trinidad.

Horizon.—Pliocene.

Genus *CHAMA* (Linnæus) Bruguière

Chama involuta Guppy Pl. 29, Fig. 3

Chama involuta Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 86, pl. 2, fig. 5; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 70.

Chama involuta Guppy, 1874, Geol. Mag., London, p. 436, pl. 17, figs. 5a-c.

Chama involuta Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32,

p. 531.
Chama involuta Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, pp. 1398, 1586.
Chama involuta Maury, 1917, Bull. Amer. Paleont., No. 29, p. 199, pl. 33, figs. 4, 5, 6.
Chama involuta Pilsbry, 1922, Jour. Acad. Nat. Sci. Phila., vol. 73, p. 416.

In the Trinidad collection is a *Chama* valve of the same form and size and with the prominent, extremely spiral, *Diceras*-like beak of *Chama involuta* Guppy. If complete it would measure about 22 mm. in length.

The specimen is a convex, left valve with the scar of attachment below the beak. The surface is covered with granose ridges, and remains of the larger, more or less erect scales; but the shell is not as well preserved as those I figured from the Dominican Republic, in Bulletin 29, to which the reader is referred.

Mr. Vendryes collected the type in Jamaica and sent it to Dr. Guppy for description. It has never before been recorded from Trinidad.

Locality.—Brasso Creek.

Horizon.—Manzanilla Miocene.

Genus *ECHINOCHAMA* Fischer

Echinochama yaquensis Maury

Chama arcinella Moore, 1853, Quart. Jour. Geol. Soc. London, vol. 9, p. 130. Not *arcinella* Linnæus.
Chama arcinella Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 294.
Chama arcinella Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 251.
Chama arcinella Guppy, 1874, Geol. Mag., London, p. 442.
Echinochama antiquata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 201, pl. 33, fig. 10. Not *antiquata* Dall.
Echinochama antiquata var. *yaquensis* Maury, 1917, Bull. 29, p. 201, pl. 33, figs. 11, 12.
Echinochama trachyderma Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Phila., p. 197.
Echinochama yaquensis trachyderma Pilsbry, 1922 (Jan.), Proc. Acad. Nat. Sci. Phila., vol. 73, p. 416.
Echinochama yaquensis Olsson, 1922 (June), Bull. Amer. Paleont., No. 39, p. 219, pl. 28, fig. 5.

The Dominican Chamas were very puzzling and Mr. Olsson is probably correct in regarding my *antiquata* as

merely a larger *yaquensis*.

The true *antiquata* Dall, is from Bowden, Jamaica, and from the Gatun stage of Costa Rica.

In the Trinidad material is a fragmentary specimen which shows the characteristic pustulose surface and the form of the umbonal region of *E. yaquensis*. But it is too incomplete to figure and the reader is referred to the illustrations of the *Dominican* type in Bulletin 29, from the Gurabo formation.

E. yaquensis has been found by Mr. Olsson in the lower Gatun of Old Harbor, Costa Rica.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station.

Horizon.—Manzanilla Miocene.

Genus *CARDITA* (Bruguière) Lamarck

Section *CARDITAMERA* Conrad

Cardita (Carditamera) guppyi Dall

Cardita minima "Sowerby", Guppy, 1867, Geol. Mag., London, p. 18.
Cardita minima Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 163; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 42.
Not *Cardita minima* Reuss, 1844, Böhm Kreidef, vol. 2, p. 14, pl. 33, fig. 14.
Cardita (*Carditamera*) *Guppyi* Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1413, pl. 56, fig. 3.

Shell minute, trapezoidal, with about fourteen rounded riblets, coarsely crenulated, and separated by narrower interspaces; beaks low, inconspicuous. Larger specimens are 4 mm. in length and 3 in height.

Fide Dr. Dall, there is no *Cardita minima* of Sowerby, and at any rate that specific name was preoccupied by Reuss.

Locality.—Matura; abundant.

Horizon.—Pliocene.

Cardita (Carditamera) virginiæ Maury

Cardita (*Carditamera*) *virginiæ* Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 53, pl. 9, figs. 2, 3.

Shell rather small, elongate-elliptical, beaks low, at the anterior fourth of the entire length of the valve; sculpture of fifteen or sixteen well-defined ribs, which anteriorly are regularly and closely crenulated, but posteriorly smooth, or nearly so. Length 13, height 7 mm.

Locality.—Brighton, southern main road just south of Pitch Lake, in a yellowish-brown, ferruginous marl.

Horizon.—Upper Miocene, a little younger than Springvale.

Genus *VENERICARDIA* Lamarck

Venericardia terryi var. **brassica**, n. var. Pl. 30, Fig. 5

Shell of moderate size, ovately cordate, convex; beaks situated very anteriorly, very high and full but with extremely small, acute apices very much curved and inclining over the exceedingly small lunule. Surface sculptured with seventeen to eighteen low, radial ribs which are narrow over the umbonal region, the anterior showing subacute ridges; but over the central part of the valves the ribs become rounded, wide, flat and undulating, with interspaces merely linear. Length of most perfect specimen 27, height 30, diameter 20 mm. A larger, worn shell is 32 x 37 x 27 mm.

This species is very closely akin to *Venericardia terryi* Olsson, from the Gatun Miocene of Costa Rica; but the Trinidad shell has more numerous ribs, is higher and fuller in the umbonal region and is larger. A comparison with Mr. Olsson's types show that they are more circular and less ovate in outline, and have twelve to thirteen against seventeen to eighteen ribs. Both these forms are ancestral to the recent Pacific *Venericardia crassicostata* Sowerby.

Localities.—Brasso Junction; and top of Brasso section, No. 284.

Horizon.—Brasso Miocene.

Vencricardia trinidadensis, n. sp. Pl. 30, Fig. 6

Shell cordate, inflated, with umbones full and high, their apices small, pointed, incurved; surface ornamented with eighteen high, sharp, narrow, radial ribs coarsely and rather irregularly nodose. The anterior and central ribs have on either side a fine radial thread. Interspaces deeply and roundly channelled and marked with concentric growth lines. We have many specimens—small shells from 12 mm. in length, 11 in height and 8 in diameter; 23x20x17, to a large valve 30 in length by 28 in height. A perfect right adult valve measures 26 in length, 25 in height, and 12 semidiameter.

Adolescent shells of this species resemble *Venericardia scabricostata* Guppy, from the Miocene of Jamaica, Santo Domingo and Costa Rica; but the Trinidad shell can be distinguished by the auxiliary radial threads on either side of the anterior and central ribs. These threads are not present in *scabricostata;* and in that species the crenulation of the ribs is fine and regular while in this it is coarsely nodular.

In some respects this Trinidad shell recalls the Dominican Miocene *V. cerrogordensis* Maury, but that is very much flatter, with low beaks, and low ribs, and the auxiliary, radial threads form weak keels on either side of the ribs.

Localities.—Upper Poole Road (central Trinidad); Guaico-Tamana Road; Machapoorie quarry; Fossil Ravine (central Trinidad); Brasso-Tamana Road near 4½ mile post; also Brasso Venada Ravine.

Horizons.—All Machapoorie Miocene except the last locality, which is Manzanilla Miocene.

Genus *ERYCINELLA* Conrad

Subgenus *CARDITOPSIS* Smith

Erycinella (Carditopsis) guppyi, n. sp. Pl. 27, Fig. 14

Shell extremely minute, subquadrate, very inequilateral, beaks low, very anteriorly situated; exterior of shell boldly

radially sculptured; interior shining, with the exterior sculpture reflected by conspicuous, riblike, radiating rays, inner margins strongly dentate. The exterior of the valve is sculptured wih nine strong, rounded, nodose, radial ribs and a tenth, much weaker, near the posterior dorsal margin. Interspaces narrow, deeply channeled. Hinge of left valve with two cardinal teeth, a resilium between them, a long anterior lateral ridge and a posterior lateral groove and socket. Length of shell 2.5 mm., height 2 mm.

This tiny shell is of a rare genus, a member of Bernard's family *Condylocardiidæ,* comprising minute relatives of the *Carditidæ* which, when adult, retain hinge characters of nepionic shells of *Cardita.* The genotype of *Erycinella* is *E. ovalis* Conrad, from the Virginian Miocene, which our shell is unlike in form and sculpture. This Trinidad species is much nearer *E.* (*Carditopsis*) *bernardi* Dall, from the Pliocene of Costa Rica; but that species has more numerous ribs (14), the beak is not so anteriorly placed, and the form is less quadrate.

Locality.—Matura.

Horizon.—Pliocene.

Genus *CORBICULA* Megerle

Subgenus *CYANOCYCLAS* Férussac

This subgenus is limited to and characteristic of the streams of Central and South America and Mexico.

Corbicula (Cyanocyclas) comparana, n. sp.
Pl. 30, Figs. 1, 4, 8, 10, 11, 12

Shell subtrigonal, moderately inflated, with very high and pointed beaks. Substance rather thin. Surface marked with fine, concentric growth lines. Teeth strong, the posterior lateral very long. A young specimen measures in length 19, height 20, diameter 12; and a large shell is 30 x32 x 21 mm.

The distinguishing character of this species is its tri-

gonal form and very high pointed beak. In old shells, however, the umbo is usually eroded from the action of CO_2 in the river water. In its form, this species has quite a striking resemblance to *Corbicula oleana* Marshall, of the recent South American fauna.

Specimens from Comparo Road can be exactly matched among those from Cedros Point. In both localities the shells are abundant, and show that this species lived in Pliocene times in streams on both sides of the Island.

This may be the shell that Dr. Guppy, in 1908, (Bull. Misc. Inform. Botanical Dept. Trinidad, p. 114) referred to *Cyrena semistriata* Deshayes, but it is not the true *C. semistriata* of Europe,.

Localities.—½ mile on Comparo Road near Sangre Grande, N. E. Trinidad; shore near Cedros Point, S. W. Trinidad.

Horizon.—Lower Pliocene.

Corbicula (Cyanocylas) coubarillia, n. sp. Pl. 30, Fig.7

Shell subcircular, nearly equilateral, moderately and evenly inflated. Beaks low. Entire surface sculptured with fine, narrow, concentric ridges, and about five growth stages are indicated. Hinge and interior concealed. A mold measures in length 26, altitude 27, diameter 24 mm.

This species is distinguished from our other Trinidad Corbiculas by its low beak and rounded form, which may be likened to that of the recent Uruguayan, *Corbicula circularis* Marshall.

Locality.—Point Coubaril, Brighton.

Horizon.—Lower Pliocene.

Corbicula (Cyanocyclas) caroniana, n. sp. Pl. 30, Fig. 9

Shell roundly cordate, evenly and gently convex; anterior end much shorter than the posterior, the shell being decidedly inequilateral. Beaks moderately high. Sculpture of fine, concentric lines. Cardinal teeth strong, and laterals

long and well developed. Largest specimen imperfect but about 26 mm. in length and 25 in altitude. A small, perfect shell is in length 19, altitude 18, diameter 13 mm. This species is characterized by its medium beak and sub-rotund form. It may be likened in general form to the recent *Corbicula compacta* Marshall, from Uruguay.

Locality.—Freeport-Todd's Road at ½ mile post; also ¼ mile south of the 6th mile post.

Horizon. — Upper Miocene. Associated with *Arca patricia* and *Anomalocardia brasiliana.*

Genus *CRASSATELLITES* Krüger

Section *SCAMBULA* (Conrad) Dall

Crassatellites (Scambula) trinitarius, n. sp. Pl. 31, Figs. 1, 7

Crassatella melina Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 164.

Not *Crassatella melina* Conrad, 1832, Foss. Tert. Form., p. 23, pl. 9, fig. 2.

Shell elongate, not much inflated, substance solid and thick, very inequilateral, the anterior end very much the shorter; valves equal; anterior end rounded, posterior produced, bluntly pointed, briefly truncated. Lunules impressed. Beaks low, their apices flattened, with about seven, concentric waves. The surface of the rest of the shell on the anterior area is very finely concentrically ribbed, the riblets resembling fine threads. Central and posterior areas smooth except for growth lines. The posterior dorsal area is bordered by a narrow, radial ridge and on the umbonal slope is a weak carina, in front of which the valve tends to be sulcated, although some specimens are not. Length of adult 53, altitude 32, diameter 17 mm.; a young shell is 38 x 23 x 13 mm.

Dr. Guppy referred a specimen he collected at Springvale to *Crassatellites melinus* Conrad; but the type locality of that species is the Miocene of New Jersey; and our shell is quite different in shape, being very much more elongate

posteriorly, and smoother than Conrad's.

In the recent Antillian fauna the genus *Crassatellites* is represented by *C. antillarum* Reeve, extremely rare, and never found as a fossil. The accepted locality of the type is Margarita Island, which Dr. Dall somewhat doubts. Another representative is *C. gibbesi* Tuomey and Holmes (=*floridanus* Dall, young specimen), appearing in the Upper Miocene of Carolina and living from Cape Hatteras to Barbados. It attains 65 mm. in length, and the entire surface is very finely, concentrically ribbed.

Locality.—Springvale.

Horizon.—Upper Miocene.

Crassatellites (Scambula) montserratensis, n. sp. Pl. 31, Fig. 3

From Springvale we have a *Crassatellites* of different form from the preceding. The shell is proportionately shorter and higher, with a greater thickness; the umbonal region is much more inflated, and the five or six concentric waves on the beak are very much coarser, more distant and heavier. The vales are unequal, the left being more convex, but this inequality may be in part due to pressure. The umbonal slope is strongly carinate, and the posterior end of the shell is short, so that the anterior and posterior areas are subequal in length; but while the anterior is evenly convex, the posterior is sulcate in front of the carina. The beaks are nearly central. The surface below the rippled beaks is marked only with concentric growth lines. Length 58, estimated height 39, diameter 23 mm.

This shell has somewhat the form of *C. melinus* var. *meridionalis* Dall, but the umbonal region is higher and fuller, and the umbonal waves much coarser, fewer, and more distant in the Trinidad shell.

Locality.—Springvale, in the quarry which is on a spur of the Monsterrat range.

Horizon.—Upper Miocene.

Genus *CRASSINELLA* Guppy

Crassinella guppyi Dall Pl. 31, Fig. 5

Crassinella miocenica Guppy, MS.
Crassatellites (*Crassinella*) *Guppyi* Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 326, pl. 30, fig. 5; 1903, Trans. Wagner Inst. Sci., vol. 3, pt. 6, p. 1476.
Crassinella guppyi Guppy, 1910, Agric. Soc. Trinidad and Tobago, Paper No. 440, p. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.

Shell extremely small, flat, roundly trigonal, with ten to twelve concentric lamellar ridges, much narrower than their interspaces. Altitude of type 4.6, longitude 4.6 mm. Type locality, Miocene of Bowden, Jamaica. Our largest Trinidad specimen is 5 x 5 mm.

This striking little shell is generally lopsided, as shown in the figure of the type; in this respect resembling the larger Recent and Miocene species *C. guadalupensis* d'Orbigny.

Locality.—Springvale.

Horizon.—Upper Miocene.

Crassinella guadalupensis d'Orbigny Pl. 31, Figs. 4, 6

Crassatella guadalupensis d'Orbigny, 1845, In de la Sagra's Hist. Fisica, Politica y Natural de la Isla de Cuba, pt. 2, vol. 5, *Moluscos*, p. 326, Atlas, pl. 27, figs. 24–26.

Shell small, greatly compressed, white or purplish, concentrically ribbed, riblets high, equidistant; interspaces ridged; anterior end short, posterior produced. Length of type a trifle over 5 mm.

This species d'Orbigny recorded from Cuba, Guadeloupe, Santo Domingo, St. Thomas, and elsewhere in the Antilles.

We have many Crasinellas from Matura, ranging from two to over five millimetres in length. They tend to have more ribs than the Springvale examples and to develope secondary riblets in the interspaces which is characteristic of d'Orbigny's *C. guadalupensis.* Many also have the

unsymmetrical form of the latter shell.

Locality.—Matura.

Horizon.—Upper Pliocene. Also in the recent fauna.

Crassinella martinicensis d'Orbigny Pl. 31, Fig. 2

Crassatella martinicensis d'Orbigny, 1845, In de la Sagra's Hist. Fisica, Pol. y Nat. de la Isla de Cuba, pt. 2, vol. 5, *Moluscos*, p. 325, Atlas, pl. 27, figs. 21–23.
Astarte (Gouldia) martinicensis Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 36; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 26.
Gouldia martinicensis Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 162; Harris' Reprint, 1921, Bull. 35, p. 41.
Crassinella Martinicensis Guppy, 1874, Geol. Mag., London, p. 442.

This species is distinguished from *C. guadalupensis* by its bilateral symmetry. The anterior and posterior ends are so nearly equal that the shell has the form of a diminutive isosceles triangle, or of a Greek Delta, with the base a segment of an arc instead of a straight line.

Professor Harris obtained recent specimens by dredging in the Gulf of Paria, off the west coast of Trinidad, which agree perfectly with those from the east coast Pliocene beds. A large Pliocene specimen is 5 mm. in length and 5 in altitude.

Localities.—Matura; Gulf of Paria.

Horizons.—Upper Pliocene; Recent.

Genus *THRACIA* Blainville

Sugenus *CYATHODONTA* Conrad

Thracia (Cyathodonta) semirugosa Reeve

Thracia plicata Reeve, 1859, Conch. Icon., *Thracia*, pl. 2, fig. 7a. Not *plicata* Deshayes, from Senegal, 1832.
Thracia semirugosa Reeve, 1859, Conch. Icon., *Thracia*, notes to pl. 2, fig. 7, West Indies.
Thracia dissimilis Guppy, 1874, Ann. and Mag. Nat. Hist., 4th ser., vol. 15, p. 52.

Ovate-oblong, compressed, roughened by radiating lines of fine granules, surface with strong concentric ripples. Length 40, height 27, diameter 15 mm.

Dr. Dall unites Guppy's *dissimilis* with *semirugosa* Reeve.

Locality.—Coast of Trinidad (Guppy).

Horizon.—Recent; Pliocene of Florida.

Thracia (Cyathodonta) meridionalis Guppy Pl. 31, Fig. 9

Raëta meridionalis Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 8, pl. 3, fig. 1; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 164, pl. 8, fig. 1.

In our material from the type locality of this species are two valves apparently similar to Dr. Guppy's *Raëta meridionalis*. The shell is oblong-oval, rather compressed, very thin and papery in substance; the entire surface waved in concentric undulations. Neither Dr. Guppy's specimens nor ours show the hinge characters and the shells are incomplete; but I am disposed to put this species in *Cyathodonta* rather than in *Raëta* because of the details of sculpture. In *Raëta* the undulations are very finely transversely marked with vermiculate striæ, but the Trinidad fossil has much coarser streaks, like those of a paint brush when the paint is too thin. These markings are in general longitudinal but at variance with the undulations and are like the marking on *Cyathodonta tristani* Olsson. Moreover, in our fossil there is a change of direction in the undulations in the center of the valve which also may occur in *Cyathodonta*. Estimated length of largest specimen when complete 44, height 32, diameter 14 mm.

This species is closest to *Cyathodonta tristani* Olsson, from the Gatun of Costa Rica. From the Tertiary of Guadeloupe Island, Dr. Dall described *C. guadalupensis* and *C. spenceri*. *C. vicksburgiana* Dall, from the Oligocene of Mississippi, is quite similar in form to *C. reedsi* Maury, from the Porto Rican Miocene—these two forming a group very unlike the other species mentioned.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *PHOLADOMYA* Sowerby

The genus *Pholadomya* began in the Lias, culminated during the Mesozoic, became rare in the Tertiary, and in the Recent is represented by only two species—*Pholadomya candida* Sowerby, the genotype, from the Island of Tortola in the West Indies, and an Oriental species living in the Japanese seas. The *Pholadomya arata* of Verrill, dredged off Martha's Vineyard, Mass., was placed by Dall in *Aporema*—a genus created by Dall for this Vineyard species.

The rare Tertiary genus, *Phenacomya* Dall (Trans. Wagner Inst. Sci., vol. 3, p. 823, footnote) of which the type is *Phenacomya cuneata* Sby. (Deshayes, Anim. sans Vert. Bassin de Paris, vol. 1, p. 277, pl. 9, figs. 6–8, 1869) includes but two American species—*Phenacomya petrosa Conrad* and *P. mauryi* Harris (Bull. Amer. Paleont., No. 4, p. 71, pl. 6, fig. 17, 17a, 1896).

I have never before found *Pholadomya* in the Antillean Miocene, but species are present in beds of that age in Venezuela.

Pholadomya walli, n. sp. Pl. 31, Figs. 8, 11

We have a single imperfect cast of the anterior portion of a *Pholadomya* which, although incomplete, seems worthy of description because of the present and Tertiary rarity of the genus.

The shell is large, when complete oblong-ovate, exceedingly ventricose. Beaks low, touching, very full, extremely far forward in position. Anteriorly and posteriorly, as far as the fragment extends, the surface is sculptured with concentric ribs, narrow and close proximally but becoming coarser and less regular distally. This concentric ribbing does not, however, extend over the posterior dorsal area which is concave and smooth. A short distance back from the anterior end the radial sculpture commences and consists of coarse, not perfectly regular, narrow ribs which pass obliquely from the umbo to the basal margin. The

radial ribs equal the concentric and form with them a coarse, oblique cancellation over the anterior—central part of the shell. Although the entire posterior portion of the specimen is missing, one can see from the umbonal region that radials did not extend over the posterior region of the shell. Length unknown, height 50, diameter 45 mm.

When entire, this must have been a fine shell, approaching in size the Maryland Eocene *Pholadomya marylandica* Conrad; but much shorter anteriorly, and very much more boldly and handsomely sculptured.

This rare shell is named in memory, and in honor of G. P. Wall, pioneer geologist of Trinidad, and director of the first geological survey of the West Indies.

Locality.—Guaico-Tamana Road quarry.

Horizon.—Machapoorie Miocene.

Pholadomya sawkinsi, n. sp. Pl. 31, Fig. 10

Shell much smaller than the preceding species, transversely oblong, widely gaping posteriorly. Beaks situated very far forward. Anterior end very short, posterior end much produced. Some of the original substance still remains upon the mold and indicates that the shell was very thin. The surface is sculptured with unequal, uneven, concentric ridges which fade out on reaching the posterior dorsal area. The radial sculpture consists of irregular, unequal, oblique ribs which extend from about the anterior fourth of the shell to the region of the umbonal slope, in front of which they cease. Length 45, height anteriorly 15, posteriorly 25, diameter 25 mm.

This species may be likened in size and general aspect to some forms assumed by the recent *Pholadomya candida*, as that figured by Tryon (Struct. and Syst. Conch., pl. 108, fig. 76). Our Newcomb collection specimen of *candida* is not so much like the fossil, but members of *Pholadomya*, as of all boring genera, vary with their individual habitat. And we may regard this fossil as the Miocene ancestor of

the living Antillean species.

This shell is named in memory, and in honor of James G. Sawkins, the colleague of Wall on the first West Indian survey.

Locality.—Machapoorie quarry.

Horizon.—Machapoorie Miocene, which is next but one to the base of the Lower Miocene series of Trinidad.

CLASS SCAPHOPODA

Genus *CADULUS* Philippi

Cadulus parianus Guppy

Cadulus parianus Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 325, pl. 30, fig. 7.

These shells were formerly referred to *Ditrupa* by Dr. Guppy, who thought them the tubes of this Annelid worm; but they are Scaphopod shells.

Horizon.—Miocene.

CLASS GASTROPODA

Genus *CARINARIA* Lamarck

Carinaria caperata Guppy

Carinaria caperata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 318, pl. 27, fig. 14.

Locality.—Shell bed, Ally Creek, Naparima (Guppy).
Horizon.—Miocene.

Genus *TEREBRA* Adanson

Terebra sulcifera Sowerby Pl. 32, Fig. 3

Terebra sulcifera Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 47.
Terebra sulcifera Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 37.
Terebra robusta Gabb, 1873, *pro parte,* Trans Amer. Philos. Soc., vol. 15, p. 224.

Not *Terebra robusta* Hinds, 1843, Proc. Zool. Soc., p. 149.
Terebra sulcifera Guppy, 1874, Geol. Mag., London, p. 439.
Terebra sulcifera Guppy, 1876, *pro parte* Quart. Jour. Geol. Soc., London, vol. 32, p. 525, pl. 29, fig. 8.
Terebra sulcifera Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, pp. 4, 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 161, 164.
Terebra sulcifera Maury, 1917, Bull. Amer. Paleont., No. 29, p. 22, pl. 3, figs. 12, 13.

Typical, Dominican, specimens of *T. sulcifera* Sowerby, have the earlier whorls with two upper bands, both obliquely striated, and the second about half the width of the first, followed by a vertically striated area. On the later whorls the banding becomes obsolete. The columella is uniplicate.

The Springvale specimens have the second band very narrow, hardly more than a heavy, raised cord, and the lower area correspondingly wider. The columella, as far as can be seen, appears to have a single plication. A fragment of four lower whorls measures 55 x 18 mm.

It is rather curious that specimens of *T. sulcifera* from the Chipolan Miocene of Florida should, like these from Trinidad, have the second band on each volution narrower than is typical.

A specimen from near Brasso has the division between the two upper bands ill-defined; it measures 40 x 15 mm. and includes 6 whorls.

This species is also in the Bowden beds, Jamaica.

Localities.—Springvale; Brasso Venada Ravine.

Horizons.—Springvale Miocene; Manzanilla Miocene.

Terebra bipartita Sowerby Pl. 32, Fig. 2

Terebra bipartita Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 47.
Terebra bipartita Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 225.
Terebra (*Acus*) *bipartita* Dall, 1895, Proc. U. S. Nat. Mus., vol. 18, No. 1035, p. 38.
Terebra bipartita Maury, 1917, Bull. Amer. Paleont., No. 29, p. 23, pl. 3, fig. 14.
Terebra bipartita Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 35, pl. 1, figs. 1, 2.

This species has every volution divided into nearly equal halves. The columella is biplicate. A Trinidad fragment of five lower whorls measures 51 x 18 mm.

Dr. Guppy united *T. bipartita* with *sulcifera* and *inæqualis*—but erroneously, for the columellar plications as well as the sculpture indicate a difference. *T. bipartita, oligomitra, spirifera* and *cirrus* form a biplicate group; and *T. sulcifera, inæqualis* and *isaacpetiti* a uniplicate group.

T. biplicata was first collected in the Dominican Republic by Colonel Heneken. It is also in the Chipolan Miocene of Florida, and has been found in the Gatun Miocene of Costa Rica by Mr. Olsson.

Locality.—Springvale.

Horizon.—Upper Miocene.

Terebra manzanillæ, n. sp. Pl. 32, Fig. 8

Shell small, very slender and tapering. The single example lies half buried in the matrix. It consists of sixteen whorls, the first two or three nuclear. Subsequent volutions strongly sculptured with sharp-edged, longitudinal ribs, about seven to every half circumference. In the interspaces are very faint, impressed spiral lines. Every whorl is cut at its upper third by an incised groove. The ribs, however, are but slightly, if at all, deflected in direction by this groove. Aperture concealed. Height 16, greatest width 5 mm.

Locality.—Manzanilla.

Horizon.—Lower Miocene.

Terebra isaacpetiti, new name

Terebra Petiti Maury, 1917, Bull. Amer. Paleont., No. 29, p. 31, pl. 4, fig. 4.
Not *Terebra Petiti* Kiener, Coq. viv., p. 37, pl. 13, fig. 2.

The enthusiasm that I felt in dedicating a fine Dominican Miocene *Terebra* to Mr. Isaac Petit, American Consul at Monte Cristi, who proved such a kind and valuable friend

to the Maury Expedition in 1916, caused me to overlook the recent *Terebra petiti* Kiener, named many years prior for the conchologist Petit. Therefore, I now change the name of the Dominican shell to *Terebra isaacpetiti.*

Locality.—Zone A, Rio Gurabo at Los Quemados.

Horizon.—Middle Miocene, Gurabo formation.

Genus *CONUS* Linnæus

Conus stenostoma Sowerby Pl. 34, Fig. 3

Conus stenostoma Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 44.
Conus stenostoma Guppy, 1866, *Idem*, vol. 22, p. 287. pl. 16. fig. 2; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 38.
Conus stenostoma Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 230.
Conus catenatus Guppy, 1876, *pro parte*, Quart. Jour. Geol. Soc., vol. 32, p. 527. Not *C. catenatus* Sowerby.
Conus stenostoma Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1583.
Conus stenostoma Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, pp. 4, 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 161, 163.
Conus stenostoma Maury, 1917, Bull. Amer. Paleont., No. 29, p. 39, pl. 6, fig. 4.
Conus stenostoma Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 42, pl. 3, fig. 2.

Shell of medium size, with sharply angulated shoulder, narrow aperture, and deep U-shaped posterior sinus which, as the shell grows, renders the upper surface of the whorls on the spine concavely sulcate. Our largest Trinidad specimen is 52 mm. in height and 28 in width.

Sowerby's type was collected by Colonel Heneken in Santo Domingo where we obtained this species in the Gurabo formation. It is also found at Bowden, Jamaica; and in the Gatun stage of Port Limon, Costa Rica.

Locality.—Springvale.

Horizon.—Upper Miocene.

Conus cf. **williamgabbi** Maury

Cf. *Conus williamgabbi* Maury, 1916, Bull. Amer. Paleont., No. 29, p. 36, pl. 5, fig. 2.

In the collection is an internal mold of a very large, broad Cone, measuring when entire about 70 mm. in length and 48 in greatest width. It is evidently closely related to, or identical with, the flat-topped, heavy Dominican species, *C. williamgabbi* Maury, but being only a mold no certain identification is possible.

Locality.—Road quarry at 7¾ mile post on Guaico-Tamana Road.

Horizon.—Manzanilla Miocene.

Conus planiliratus Sowerby Pl. 34, Fig. 6

Conus planiliratus Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 44.
Conus planiliratus Guppy, 1866, *Idem*, vol. 22, p. 287, pl. 16, fig. 7; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 38.
Conus planiliratus Gabb, 1873, *pro parte*, Trans. Amer. Phil. Soc., vol. 15, p. 230.
Conus planiliratus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528.
Conus regularis Gabb, 1881, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 8, p. 359, pl. 46, figs. 45–48. Not *C. regularis* Sowerby.
Conus planiliratus Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1583.
Conus planiliratus Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Conus planiliratus Cossmann, 1913, Jour. de Conchyliologie, vol 61, p. 48, pl. 3, figs. 25, 26, 27.
Conus planiliratus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 45, pl. 7, fig. 10.
Conus planiliratus Olsson, 1922, *Idem*, No. 39, pl. 3, figs. 10, 13.

A small Cone, high spired, and with the body spirally sulcated. A Trinidad shell is 26 mm. in height, 13 in width.

The recent *C. planiliratus* Sowerby (Proc. Zool. Soc., p. 255, pl. 22, fig. 1) is altogether different from the Miocene fossil that Sowerby described from Santo Domingo, which is also in the Gatun Miocene of Port Limon, Costa Rica, and at Bowden and Mindi.

Locality.—Springvale.

Horizon.—Upper Miocene.

Conus burckhardti Bose Pl. 34, Fig. 5

Conus Burckhardti Bose, 1906, Bol. Inst. Geol. Mexico, No. 22, p. 50, pl. 5, figs. 39, 40.
Conus Burckhardti Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 52, pl. 3, figs. 4, 5.

In the collection is a slender, high-spired Cone with the body spirally grooved. Whorls about eleven, the two or three nuclear, minute, smooth, the next finely longitudinally ribbed, later volutions smooth except for well-marked, arching growth lines. Grooves on the body much narrower than the bands and finely cross-striated. Bands smooth, flat. Estimated length 20, greatest width 9 mm.

This species was first described from Mexico. Later found in Panama and Costa Rica. Our shell resembles closely Bose's figure 39, from which it differs chiefly in being slightly smaller.

Conus gracilissimus Guppy and *C. tortuosostriatus* Toula are readily distinguished from this species by their spirally striated and delicately coronated spires.

Locality.—13th mile post on Guaico-Tamana road.

Horizon.—Machapoorie Miocene.

Genus *TURRIS* Bolten

Turris albida Perry Pl. 32, Fig. 11

Pleurotoma albida Perry, 1811, Conch. Expl., pl. 32, fig. 4.
Pleurotoma albida Dall, 1890, Trans. Wagner Inst. Sci., vol. 3, p. 28, pl. 4, fig. 8a.
Turris albida Dall, 1915, 90, U. S. Nat. Mus., p. 38, pl. 5, fig. 13, pl. 14, fig. 7.
Turris albida Maury, 1917, Bull. Amer. Paleont., No. 29, p. 50, pl. 8, figs. 4–8; 1922, Bull., 38, p. 32.
Turris albida Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 58, pl. 4, figs. 1, 2.

The many varieties of this species are noted and figured in my Dominican Memoir, in which the long synonymy is also given. Our Trinidad specimens from the Brasso Venada Ravine are like the variety *haitensis* Sowerby. The canals of all are broken, but if complete the shells would

measure about 45 mm. in length and 12 in greatest width. From Manzanilla, we have a very young shell, only 8 mm. long, but it shows the strong, spiral ridges, with interspaces decussated by coarse growth lines, which is a striking feature of this protean species.

Localities.—Manzanilla; Brasso Venada Ravine, 3¦ miles east of Brasso Station; Brasso Creek; 11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Turris albida var. **sancti-davidis**, n. var. Pl. 32, Figs. 6, 7

In the collection are specimens resembling *Turris albida* Perry, but instead of the intervals between the spirals being obliquely cross-striated, they bear exceedingly fine and delicate spiral striæ. The first two volutions are smooth, nuclear. The following three or four are markedly tuberculate. Spiral sculpture sharp and strong. Whorls centrally bicarinated. Height 22, greatest width 9 mm.

Locality.—Manzanilla.

Horizon.—Lower Miocene.

Genus *DRILLIA* Gray

Drillia henekeni Sowerby Pl. 32, Fig. 13

Pleurotoma Henikeri Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 50, pl. 10, fig. 6.
Turris (*Surcula*) *Henekeni* Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 207.
Pleurotoma henekeni Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 526.
Not *Drillia henekeni* Cossmann, 1913, Journ. de Conchyliologie, vol. 61, pl. 3, figs. 10, 11.
Drillia Henekeni Maury, 1917, Bull. Amer. Paleont., No. 29, p. 53, pl. 8, figs. 17, 18.

In the Trinidad collection is a specimen which, on comparison, agrees in every respect with Dominican examples of *Drillia henekeni* Sowerby. It is broken at the base, but if complete would measure about 58 mm. in length and 17 in greatest width.

D. henekeni is present in the Bowden beds, Jamaica, as well as in both the Gurabo and Cercado formations, Dominican Republic.

Locality.—11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Drillia henekeni var. **caroniana**, n. var. Pl. 32, Fig. 12

Shell resembling the Dominican Miocene *Drillia henekeni* Sowerby, in general aspect, but differing in the character of the ribbing. Specimens of *henekeni* have seven or eight rounded, coarse and prominent longitudinal ribs on each of the last two whorls, but this Trinidad form has eleven or twelve. Thus the costæ are more numerous, and they are also lower and less pronounced and more regular than in the typical shells. One specimen has the ribbing obsolescent on the body whorl. Estimated length of complete shell 57, greatest width 16 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Drillia belahubbardi, new name

Drillia grabaui Hubbard, 1921, New York Acad. Sci., Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 2, p. 158, pl. 24, fig. 10.
Not *Drillia grabaui* Maury, 1910, Bull. Amer. Paleont., No. 21, p. 8, pl. 2, fig. 3.

Since I had named a *Drillia* from the Chipola Miocene, at Bailey's Ferry, Florida, in honor of Professor Grabau, eleven years earlier, Mr. Hubbard's *Drillia grabaui* from the Quebradillas limestone, Porto Rico, requires a new name. It seems appropriate to dedicate the Porto Rican species to Mr. Bela Hubbard, himself.

Locality.—Quebradillas, northern Porto Rico.

Horizon. — Quebradillas Miocene, which is Upper Lower, or Middle Miocene.

Drillia consors Sowerby Pl. 32, Fig. 10

Pleurotoma consors Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 50.
Pleurotoma consors Guppy, 1866, Quart. Jour., vol. 22, p. 280; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159; Harris Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 38; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 527.
Drillia consors Maury, 1917, Bull. Amer. Paleont., No. 29, p. 53, pl. 8, figs. 15, 16.
Drillia consors Jones, 1918, Jour. Geol., vol. 26, p. 741.
Drillia consors Vaughan, 1919, Bull. 103, U. S. Nat. Mus., p. 561.
Drillia consors Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands (New York Acad. Sci.), vol. 3, pt. 1, p. 71.
Drillia consors Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 62, pl. 4, figs. 8, 10, 13.

More complete synonymy is given in my Dominican Memoir; and as there noted, the recent related form is the deep water *Drillia alsidota* var. *macilenta* Dall.

Although *D. consors* has been found in Miocene beds of Jamaica, Panama and Martinique, as well as the type locality, Dominican Republic, this is the first time it has been reported from Trinidad. Our specimens are more closely and finely ribbed than the typical, and resemble mutations from further south.

Localities.—Half a mile above Brasso Station; Brasso Venada Ravine; 3 miles east of Brasso Station; 13th mile post on Guaico-Tamana Road.

Horizons.—Brasso, Manzanilla, and Machapoorie Miocene.

Drillia manzanillica, n. sp. Pl. 32, Fig. 4

Shell of moderate size, markedly fusiform, with a long and slender anterior canal, resembling that of *Drillia fusiformis* Gabb, but very different from that species in sculpture. Whorls ten or eleven, the first two smooth, nuclear. Later volutions at first nearly flat but becoming progressively more convex, so that the body whorl above the canal is very round. But the posterior sinus is deeply U-shaped, and with the growth of the shell leaves a conspicuous, concave zone, especially on the last two whorls, just beneath

the suture. The longitudinal sculpture is of narrow, sharp ribs which arch backwards over the concave zone but over the rest of the whorl are nearly vertical. On the last volution the ribs number about sixteen. The spiral sculpture is of revolving threads which are most apparent in the interspaces but on the body area cross lightly over the ribs. The subsutural zone is also spirally striate and the ribs there are somewhat lower and weaker. Length of largest shell 23, greatest width 8 mm.

In the general type of spire sculpture this species resembles *D. callistopleura* Pilsbry and Johnson, but differs markedly in the excavated subsutural zone and in the form of the body and canal.

Localities.—Manzanilla Nos. 263, 264; also Brasso Creek.

Horizon.—Manzanillia Miocene.

Drillia vaningeni var. **sancti-andreæ,** n. var. Pl. 32, Figs. 1, 14

Shell resembling in form and type of sculpture *D. vaningeni* [*Pleurotoma* (*Gemmula*) *vaningeni* Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 505, pl. 22, fig. 4, 1912] from the Miocene of the Gatun Locks, but differing in the following respects: In this Trinidad shell the raised, nodose band between the two sulci is not so prominent; the nodulations are finer, closer, and more numerous; and the spirals in the sulci appear stronger than in the Gatun type. All our specimens are incomplete but when perfect the largest would be about 33 mm. in height and 12 in greatest width. Above the nodules the growth lines swing backward and below them they swing forward, showing that the notch was on the shoulder as in *Drillia.*

Localities.—11th mile post on Caparo Road (two shells); Manzanilla (fragments of two spires).

Horizon.—Manzanilla Miocene.

Drillia vaningeni var. **machapoorensis,** n. var. Pl. 32, Figs. 5, 9

In the collection are a number of specimens with the *vaningeni* type of sculpture, but much smaller and more delicate than the variety *sancti-andreæ*. When complete the largest would measure about 19 x 6.5 mm. Those are about the dimensions of the Gatun type of *vaningeni* but that shell is very much more boldly ornamented.

In this Trinidad variety, at the base of every whorl is a spiral, above which is a duplex, beaded zone, followed by a /\-shaped carina with spiral striæ on either slope. The carina is nearly as prominent as the beaded zone, while in the type of *vaningeni* the tuberculate ridge is very much the stronger.

Locality.—13th mile post on Guaico-Tamana Road.

Horizon.—Machapoorie Miocene.

Genus *BORSONIA* Bellardi

Borsonia varicosa Sowerby Pl. 34, Fig. 7

Mitra varicosa Sowerby, 1849, Quart. Jour. Geol. Soc., vol. 5, p. 46. (Heneken's shell).
Cordiera varicosa Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 210.
Borsonia varicosa Maury, 1917, Bull. Amer. Paleont., No. 29, p. 51, pl. 8, fig. 9 (Gabb's shell).
Borsonia (*Paraborsonia*) *varicosa* Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 325, pl. 17, figs. 19, 20, 21 (Gabb's shell).

We have two rather worn shells which show the biplicate columella, and characteristic notch of *Borsonia,* and the sculpture is like that of the Dominican Miocene species, *B. varicosa* Sowerby. Our most complete shell is 19 mm. in height and 7 in greatest width.

This is the first time that this genus has been found in Trinidad. The type locality of *varicsoa* is the Dominican Republic. Recent species are in the abyssal zone of the Antilles.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station, in west central Trinidad.

Horizon.—Manzanilla Miocene.

Genus *SCOBINELLA* Conrad

Scobinella morierei (Laville) Cossmann Pl. 34, Figs. 1, 8

Euchilodon Morierei (Laville, MS.) Cossmann, 1913, Journ. de Conchyliologie, vol. 61, p. 34, pl. 3, figs. 6, 7.
Scobinella Morierei Olsson, 1922, Bull. Amer. Paleont., No. 29, p. 79, pl. 4, figs. 3, 4.

We have from Trinidad a single imperfect specimen of this interesting shell. Although incomplete, it shows the characteristic beaded sculpture and the four strong folds on the columella. Figured with our Trinidad shell is a copy of Cossmann's type from the Gatun of Mindi, Canal Zone. The type was 42 by 11 mm.

This species was referred by Monsieur Cossmann to *Euchilodon;* but, as that genus has more numerous columellar plaits (in some species as many as twelve) it is better placed in Conrad's *Scobinella.*

In the Dominican Miocene are *S. magnifica* Gabb, a more slender, elongated and elegant species, and *tristis* Pilsbry and Johnson, which has more the form of *morierei,* but has the spire less boldly and handsomely sculptured.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station.

Horizon.—Manzanilla Miocene.

Genus *CANCELLARIA* Lamarck

Cancellaria epistomifera Guppy Pl. 35, Fig 7

Cancellaria Moorei Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 236. Not *C. Moorei* Guppy, 1866.
Cancellaria epistomifera Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520, pl. 28, fig. 29.
Cancellaria epistomifera Cossmann, 1913, Journ. de Conchyliologie, vol. 61, pp. 53, 54, pl. 4, figs. 5, 6.
Cancellaria epistomifera Maury, 1917, Bull. Amer. Paleont., No. 29, p. 63, pl. 10, figs. 3, 4, 5.
Cancellaria epistomifera Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 83.

We have in the collection a single young, and somewhat

crushed, specimen of a *Cancellaria* which corresponds to young shells of similar size of *C. epistomifera* Guppy, from Santo Domingo. The form, cancellation, position of the varix and columellar plaits agree and the shell seems identical with this species. The shell measures 30 mm. in height, 18 in width. Large Dominican specimens are 38 x 25 mm., and have on the outer lip towards the base the characteristic little spout. *C. epistomifera* is found not only in the Dominican Republic which is the type locality ("Haiti" of Guppy), but also on Martinique and at Gatun.

Locality.—Springvale.

Horizon.—Upper Miocene.

Cancellaria montserratensis, n. sp. Pl. 35, figs. 6, 8

Shell rather small with seven or eight whorls, spire acute and relatively slender for the size of the last volution. The whorls are sharply angulated and shouldered beneath the suture; and are cancellated by the intersection of spiral, strap-like, bands and longitudinal ribs. On the last whorl there are about ten prominent spirals with two weaker ones on the flattened area beneath the suture and three close, fine threads at the base of the shell. The penultimate whorl has four spirals. The ribs on the body number about twelve and their points of intersection with the spirals are slightly tuberculate, especially those on the spiral which edges the shoulder carina. Columella triplicate, the basal fold bordering the anterior canal. Outer lip lirate within. Length of shell 28, greatest width 16 mm.

In general shape this is somewhat like *C. harrisi* Maury from the Dominican Miocene, but instead of the very fine and elegant ornamentation of that species, this shell is coarsely sculptured. In the shouldering of the whorls it resembles *C. conradiana* Dall.

Locality.—Springvale. The quarry is in a spur of the Montserrat range.

Horizon.—Upper Miocene.

Genus *OLIVA* Bruguière

Oliva cylindrica Sowerby Pl. 33, Figs. 3, 5

Oliva cylindrica Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 45.
Oliva reticularis Guppy, 1866, *Idem*, vol. 22, p. 288. Not *O. reticularis* Lamarck.
Oliva cylindrica Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 215.
Oliva cylindrica Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 526.
Oliva cylindrica Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1583.
Oliva cylindrica Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Oliva cylindrica Maury, 1917, Bull. Amer. Paleont., No. 29, p. 67, pl. 10, figs. 14, 14a.

In the collection are a large number of Olives which correspond to medium-sized specimens of *O. cylindrica* Sowerby, from the Dominican Miocene. The average size of the Trinidad specimens is about 46 mm. in height, 20 in width, and length of aperture 40 mm. The shell is broader and the spire lower than in an adolescent shell of equal size of the associated species, *Oliva couvana.*

Locality.—Springvale.

Horizon.—Upper Miocene.

Oliva couvana, n. sp. Pl. 33, Fig. 6

Shell very large, moderately slender, with a rather high, very acute spire. Whorls eight, the first two and a half, nuclear, smooth and glassy. Subsequent whorls porcellaneous with very narrowly channelled sutures. Columella with the callus quite thick at the base, thinning out above, plaits three, striations about twenty-two, all nearly equal in strength except the two most anterior. Height of largest shell 80, greatest width 31, length of aperture 65 mm.

This very fine shell is nearest to *Oliva proavia* Pilsbry and Johnson of Gabb's Dominican collection; but in the Trinidad species the body is broader, the spire shorter, the aperture is longer—coming up higher on the body—and the

columellar striæ are subequal. The type of *proavia* measured 81.5 x 27, aperture 65, showing the above-described differences in proportion.

Adolescent specimens of 45 or 55 mm. resemble in size adult shells of *Oliva cylindrica* Sowerby from Santo Domingo; but the Trinidad shells are slenderer and more tapering at the shoulder.

Locality.—Springvale.

Horizon.—Upper Miocene.

Oliva trinidadensis Maury

Oliva trinidadensis Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 67, pl. 10, fig. 4.

A small, broad shouldered species tapering towards the base. Height 15, greatest width 8 mm.

Locality.—Southern main road south of Pitch Lake, Brighton.

Horizon.—Upper Miocene.

Oliva cercadia, n. sp.

Oliva brevispira Maury, 1917, Bull. Amer. Paleont., No. 29, p. 68, pl. 10, figs. 16 (Gabb coll.), 17 (Maury coll.).
Oliva brevispira Gabb, in coll., but not Gabb's type of *brevispira.*

My Dominican specimens that I called *O. brevispira* agreed with a specimen in the Cornell Museum collected by Professor Gabb and labelled by him *brevispira.* But they are not like his type of *O. brevispira* lately figured by Dr. Pilsbry. This is, however, not surprising because Gabb often had several distinct species in one box all labelled the same.

As this shell was very abundant at Cercado, the name *cercadica* seems appropriate.

Localities.—Bluffs 2 and 3, Cercado de Mao; Zone G, Rio Gurabo at Los Quemados; Zones H and I, Rio Cana at Caimito, Dominican Republic.

Horizon.—Lower Miocene, Cercado formation.

Genus *OLIVELLA* Swainson

Olivella mutica Say Pl. 33, Fig. 2

Oliva mutica Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 228.
Oliva mutica Holmes, 1860, Post-Pl. Fos. S. Car., p. 76, pl. 12, fig. 8.
Olivella mutica Tryon, 1883, Man. Conch., vol. 5, p. 64, pl. 14, figs. 43-55.
Olivella mutica Dall, 1889, Bull. U. S. Nat. Mus., No. 37, p. 106, pl. 34, figs. 1, 2.
Olivella mutica Dall, 1898, *pro parte*, Trans. Wagner Inst. Sci., vol. 3, p. 45.
Olivella mutica Maury, 1922, Bull. Amer. Paleont., No. 38, p. 46.

Olivellas are in the collection which resemble small specimens of *O. mutica* Say.

Gabb's *Olivella muticoides* is much plumper, while Guppy's *indivisa* has a very high, slender spire.

O. mutica is present in beds of Miocene age in Florida and the Dominican Republic. It is now living among the Antilles, Trinidad being its most southern limit.

Localities.—Springvale; Matura; also shores of Trinidad.

Horizons.—Upper Miocene; Pliocene; and Recent.

Genus *ANCILLA* Lamarck

Ancilla lamellata Guppy Pl. 33, Figs. 7, 11

Ancillaria lamellata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 579, pl. 26, fig. 9.
Ancillaria lamellata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 159; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 186.
Ancillaria lamellata Guppy, 1874, Geol. Mag., London, p. 439.
Not *Ancillaria lamellata* Guppy, 1910.

Shell rather small, ovately conic, with a short, acute spire and moderately inflated body. Whorls five, the first smooth, embryonic, minute. All the subsequent whorls of the spire and the upper half of the body whorl are coated with enamel which is finely and regularly spirally striated. Sometimes these striations extend down to the lower limit of the enamel on the body, or sometimes the lower portion of the enamel is smooth. The enamel descends into the inner lip. The columella posteriorly bears a curious plate-like

process, not a fold, but a single lamella. For this the specific name was given. Length of our largest specimen 30, maximum width 14 mm.

Dr. Guppy's type was from Manzanilla. We also have specimens from there; but our finest are from the central part of the island.

Localities.—Manzanilla; also the NE. ¼ E. 24, No. 394; and Brasso Creek.

Horizon.—Manzanilla Miocene.

Ancilla caroniana, n. sp. Pl. 33, Figs. 4, 10, 12

Ancillaria lamellata Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 10; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 153.
Ancillaria lamellata Guppy, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 9; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 165.
Not *Ancillaria lamellata* Guppy, 1866.

Shell very much larger and more ventricose than the Manzanillan species, *Ancilla lamellata* Guppy. The body whorl is very large and inflated, the spire extremely acute. Each whorl has just above the suture a low, but sharp, carina. There are no spirals whatever upon the spire, nor upon the body whorl except just at the base, which bears a pair of deeply incised lines, followed by a more distant third line, and this by two basal grooves. The entire spire and the upper third of the body whorl are covered with a polished enamel coating which terminates very neatly and abruptly, bounding the upper third of the last volution, except at the aperture, which it descends along a sharp, oblique line, 6 or 7 mm. beyond the aperture, then swings forward, thickens, and form a hollow loop in the upper part of the aperture, then descends and becomes applied to the lower part of the pillar. Length of largest specimen 60, greatest width 27 mm.

This is distinguished at once from *A. lamellata* by its large size and the entire absence of spirals on the spire and upper part of the body.

The type of the Jamaican *Ancilla pinguis* Guppy (Geol. Mag., London, p. 434, pl. 16, fig. 3, 1874) is a small form, about 21 x 9 mm. The figure is poor and the description brief; but it is unlike this fine, large species.

Ancilla shepardi Dall from the Oligocene of Tampa, Florida, is somewhat like this Trinidad shell in general form, but entirely different in the characters of the aperture. It has not the great loop of callus extending into the aperture from the pillar.

Localities.—Springvale (large and fine), types; 11th mile post on Caparo Road small, but apparently this species.

Horizons.—Springvale Miocene and Manzanilla Miocene.

Ancilla brassica, n. sp. Pl. 33, Figs. 1, 8, 9

Shell ovate-conic, inflated, short and broad. Whorls about six, the penultimate more or less concavely excavated. Spire entirely smooth and covered with enamel. A young shell shows the callus extending almost to the base of the body whorl. Older specimens are entirely callused over, even to the very base of the pillar. Estimated length of largest shell when entire 30, greatest width 16 mm.

This is even plumper than the Jamaican *A. pinguis* Guppy, and in that species the callus ends above the center of the last whorl.

Localities.—Brasso district; half a mile above Brasso Station; 13th mile post on Guaico-Tamana Road.

Horizons.—Brasso and Machapoorie Miocene.

Genus *MARGINELLA* Lamarck

Marginella calypsonis, n. sp. Pl. 34, Figs. 12, 13

Shell rather small, solid, polished, with about four whorls. Spire acute, rising about 4 mm. above the summit of the outer lip, coated with callus in front, but at the back showing the sutures. Callus very heavy on both inner and outer lips, producing almost a *Cypræa*-like effect. Outer

lip smooth within, with the thick edging of callus reflected and grooved externally. The callosity on the inner lip is slightly flattened, extends upon the spire and is continuous with that of the outer lip. Pillar with four plaits, about equidistant, the basal bordering the anterior canal. Length of shell 21, greatest width 11 mm.

This species is nearest akin to the larger, Costa Rican, Gatun Miocene species, *M. macdonaldi* Dall, and perhaps should be considered a variety of that form.

Locality.—Springvale.

Horizon.—Upper Miocene.

Marginella springvalensis, n. sp. Pl. 34, Figs. 10, 14

Shell moderately large, very solid, polished, five-whorled. Spire short, rather acute, more or less washed over with callus which, however, usually does not entirely obliterate the sutures. Outer lip very thick, smooth within, rolled back, and grooved externally. Aperture narrow posteriorly, widening anteriorly. Pillar with five, strong plaits, the upper nearly horizontal, the lower bordering the anterior canal. Length 43, greatest width 25 mm.

In general form this resembles *M. aurora* Dall, from the Chipolan Miocene of Florida; but the Trinidad shell is nearly twice as large, and the outer lip is smooth within, instead of finely denticulate.

Locality.—Springvale.

Horizon.—Upper Miocene.

Marginella guaica, n. sp. Pl. 34, Figs. 2, 4

Shell high-spired, with about five whorls. The earlier whorls are smooth. On the later volutions an incised spiral develops beneath the suture, and on the shoulder region longitudinal plications appear. These become progressively stronger so as to be a striking feature of the shell, especially on the upper part of the back of the body whorl. Outer lip sharply denticulate below the region of the posterior canal. Inner lip with three strong, medially grooved

folds, and a fourth borders the anterior canal. Height 11.5, greatest width 6.5 mm.

In form and in the grooving of the columellar plicæ this resembles the much larger Dominican shell, *M. sowerbyi* Gabb, but that lacks the longitudinal riblets.

Locality.—13th mile post on Guaico-Tamana Road.

Horizon.—Machapoorie Miocene.

Marginella dalliana Maury

Marginella dalliana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 67, pl. 10, figs. 5, 6.

Somewhat like *M. ballista* Dall and *coniformis* Guppy. Height 20, greatest width 13, length of aperture 18 mm.

Locality.—Brighton, 1000 feet west of the pier, in impure asphalt.

Horizon.—Pliocene.

Marginella solitaria Guppy

Marginella solitaria Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 308, pl. 29, fig. 14.

Locality.—*Cadulus* bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Subgenus *VOLUTELLA* Swainson

Marginella (Volutella) maiæ, n. sp. Pl. 34, Fig. 9

Shell very large, nearly equalling in size the recent *M. bullata* Born, from Bahia, Brazil, which is the giant of the genus, attaining 2½ to 3½ inches in length. This Trinidad fossil is, however, of different form. *M. bullata* is very tapering towards the base, while this shell, although broken anteriorly, shows that its form was much more cylindrical, and at the lower third would be proportionately wider than *bullata*. Our shell consists of about four volutions, but the spire is so very flat that the upper margin of the outer lip rises several millimetres above it. The inner lip shows no callus, but the outer has a very heavy

thickening which is rolled back and furrowed. Pillar with four plaits, the uppermost short, nearly horizontal, the remainder very oblique. Estimated complete length 57, greatest width 35 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Subgenus *PERSICULA* Schumacher

Marginella (Persicula) couviana, n. sp. Pl. 34, Fig 11

Shell small, with the spire depressed and coated with enamel so that the volutions are concealed. Outer lip slightly thickened, smooth within, not grooved externally. Inner lip with five plications, the two lower very much stronger and longer than the three upper. The largest specimen shows faint traces on the body whorl of a color pattern of fine, revolving, brownish lines. Height 10, greatest width 7 mm. The two small shells are about 8 x 5 mm.

The Dominican Miocene *Persicula cercadensis* Maury, differs in having the outer lip faintly crenate within, and bears eight plications on the inner lip.

Locality.—Springvale.

Horizon.—Upper Miocene.

Marginella (Persicula) arcuata Guppy

Marginella (*Persicula*) *arcuata* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 308, pl. 19, fig. 13.

Locality—Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *MITRA* Lamarck

Mitra henekeni Sowerby Pl. 35, Fig. 2

Mitra Henekeri Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 46, pl. 9, fig. 5.
Mitra Henekeni Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 219.

Mitra Henekeni Guppy, 1876, *pro parte*, Quart. Jour. Geol. Soc. London, vol. 32, p. 528.
Mitra Henekeni Maury, 1917, Bull. Amer. Paleont., No. 29, p. 74, pl. 12, figs. 5, 5a.
Mitra Henekeni Jones, 1918, Jour. Geol., vol. 26, p. 741.
Mitra Henekeni Maury, 1920, Sci. Surv. Porto Rico and the Virgin Isls., vol. 3, pt. 1, p. 65.
Mitra Henekeni Hubbard, 1921, Porto Rico and the Virgin Isls., vol. 3, pt. 2, p. 155, pl. 24, fig. 1.

In the collection is a single very young shell which agrees perfectly in form and sculpture with young Dominican specimens of *Mitra henekeni* Sowerby. The Trinidad shell is broken at the base but when entire would be about 19 or 20 mm. in length. Fine adult specimens from the Gurabo and Cercado formations measure 56 x 15.5 mm. It also occurs at Bowden, Jamaica.

Locality.—Manzanilla.

Horizon.—Manzanilla Miocene.

Mitra longa Gabb

Mitra longa Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 219, Pilsbry's fig. of type, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, pl. 24, fig. 3.
Mitra longa Maury, 1917, Bull. Amer. Paleont., No. 29, p. 74, pl. 11, figs. 11, 11a.
Mitra longa Olsson, 1922, Bull. No. 39, p. 101, pl. 6, fig. 10.

We have a worn specimen which resembles in form adolescent shells of *M. longa* Gabb, and measures 35 x 10 mm. It is probably this species but, apparently because of its decorticated condition, all the major spirals appear to be double-edged. Possibly this is natural, but it seems more likely a deceptive effect, such as one often sees on worn shells of *Arca* where single ribs seem medially grooved.

Locality.—Manzanilla.

Horizon.—Manzanilla Miocene.

Mitra longa Gabb var. **couvensis**, n. var. Pl. 35, Figs. 1, 4

Mitra Henekeni Guppy, 1910, Springvale Fossils. Agr. Soc. Trin. and Tobago, Paper No. 440, p. 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 151.
Not *Mitra Henekeni* Sowerby, 1849, Quart. Jour. Geol. Soc. London,

vol. 5, p. 46, pl. 9, fig. 5.

Shell very closely related to *Mitra longa* Gabb (Trans. Amer. Phil. Soc., vol. 15, p. 219, 1873) but differing in its contours, the body whorl being more convex and the spire more acutely tapering. This is probably why Dr. Guppy referred the species to *M. henekeni* Sowerby, which it somewhat approaches in form; but a comparison with specimens of *henekeni* from the type locality, shows that the Springvale shell is certainly not that species. The more elongated, more cylindrical body whorl of the Springvale shell, and the very pretty sculpturing of two or three fine spiral threads crossed by vertical growth lines in the intervals between the strong revolving cords, indicate its kinship with *M. longa*. But the body whorl is more shouldered and bevelled just beneath the suture and its greater convexity is shown by the following measurements. The body whorl of a metatype of Gabb's *longa* measures 43 mm. in length and 13 in greatest width, while that of a Springvale shell is 43 x 15 mm. The last whorl of our largest shell measures 48 x 18. A nearly perfect medium-sized specimen has a total length of 50 and width of 15 mm.

We have typical *M. longa* from Cercado de Mao and Caimito, Dominican Republic; and it is reported from Gatun beds of the Canal Zone and from Cartagena, Colombia.

Locality.—Springvale, near Couva.

Horizon.—Upper Miocene.

Mitra sancti-francisci, n. sp. Pl. 35, Fig. 13

Shell attaining a large size when adult, coarsely and crudely sculptured, excavated or bevelled beneath the suture, and the body whorl with a central constricted or flattened region; columellar plications about three, the third feeble. Sculpture of sharp-edged, subequal, spiral ridges of which there are sixteen on the body whorl and five on the two preceding volutions. Interspaces slightly concave, marked only with longitudinal growth striæ.

Approximate length of large shell when perfect 65, greatest width 20 mm.

In general form this species bears a resemblance to the living west coast *Mitra swainsoni* Broderip, and to its Gatun Miocene variety *limonensis* Olsson. The living shell is nearly smooth. Mr. Olsson's shell in sculpture is more like the Trinidad, but has six spirals on the two whorls before the last, the suture is not excavated, and the constriction not nearly so marked. On comparing the type of *limonensis* it is seen not to be identical with this shell, but appears to be its nearest ally.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *TURRICULA* (Klein) Adams

Turricula bristoli, n. sp. Pl. 35, Fig. 5

Shell small, fusiform, whorls convex, sculptured with narrow, longitudinal ribs, and incised spirals in the interspaces. On the body whorl there are fifteen ribs. Outer lip with eight liræ within. Columella with four plications. Height 12, greatest width 5 mm.

In general form this resembles *T. tortuosa* Gabb, in miniature, but the spire is relatively even more convex. In the narrow ribbing it is like *T. tortuosella* Pilsbry and Johnson, but the spire of that species is much slenderer even than that of *tortuosa,* and very much more so than in our species.

This pretty shell is named in honor of Professor George P. Bristol, head of the Greek Department, Cornell University, as a token of appreciation of his interest in this Memoir.

Locality.—Brasso Junction quarry.

Horizon.—Brasso Miocene.

Genus *FUSUS* Lamarck

Fusus springvalensis, n. sp. Pl. 35, Fig. 11

Fusus haitensis Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 4 (Springvale fossils); Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 161.
Not *Fusus Haitensis* Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 49.
Not *Fusus Haitensis* Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 524, pl. 28, fig. 2.

In the Trinidad material is a large *Fusus* about the size of the handsome *Fusus henekeni-haitensis-veatchi* group of the Dominican Miocene.

Probably the shell is similar to that Dr. Guppy collected at the same place and referred to *F. haitensis* Sowerby, but it is not that species.

Our species is nearest to *F. veatchi* Maury, which it resembles in the absence of longitudinal ribs on the last two whorls; but in the Trinidad shell this gerontic character is carried much further, and even the third volution from the last is almost smooth; but shows faint traces of about twelve obsolete ribs. On the corresponding volution of *veatchi* there are eight or nine strong costæ. The spire of the Trinidad shell also tapers much less rapidly and the canal is not so slender. It was evidently a much stouter, more robust shell. The entire surface is sculptured with coarse spiral ridges, often alternating with weaker threads. The incomplete shell measures 63 mm. in length, and 22 in greatest width.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *FASCIOLARIA* Lamarck

Fasciolaria, sp. indet.

In the collection are three fragments of the internal molds of a large *Fasciolaria.* The condition of preservation does not permit a description, but there are inequalities

on the shoulder of the body which suggest that the surface may have been tuberculate. Our largest mold, of the two last whorls with the pillar broken off, is 110 mm. long and 65 wide.

This may be the same species that Dr. Guppy collected at Springvale and said it exceeded eight inches in length. He referred it, but erroneously, to *Fasciolaria semistrata* Sowerby. But that shell never attains any such size—my largest from Santo Domingo, the type locality, are 95 x 40 mm., and this Trinidad species when entire seems to have reached a length of 200 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *XANCUS* Bolten

Xancus prævoideus Maury Pl. 38, Fig. 1

Turbinella ovoidea Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 218. Not *Turbinella ovoidea* Kiener, Reeve Icon., fig. 23.
Turbinellus ovoideus Guppy, *pro parte*, 1874, Geol. Mag., London, p. 438; 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 523.
Turbinella ovoidea Tryon, *pro parte*, 1882, Man. Conch., vol. 4, p. 70. Not the recent shell.
Turbinellus ovoideus Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Xancus prævoideus Maury, 1917, Bull. Amer. Paleont., No. 29, p. 83, pl. 14, fig. 18.
Xancus prævoideus Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 343.

This species differs from the recent *X. ovoideus* Kiener, in having the early whorls tuberculately costate as well as spirally striate, the spirals persisting for one or two whorls beyond the termination of the costæ. In *ovoideus* the spire has the early whorls striated only, not tuberculate.

In the Trinidad collection are some large and heavy shells of *Xancus* resembling the types of *prævoideus,* except that the last whorl of the Trinidad shell is even more ventricose; but the characters of the spire and general aspect otherwise correspond. The best specimen equals in

length the largest Dominican shells, and measures 200 mm. in length and 60 in greatest width.

Locality.—Springvale.

Horizon.—Upper Miocene.

Xancus trinitatis, n. sp. Pl. 39, Fig. 1

Shell exceedingly large and heavy, differing in contour from *præovoideus*, the shape being more fusiform, the body proportionately longer and less wide and all the volutions less convex. The very early whorls are lacking, but below the last striated volution the first whorls are slightly but clearly carinate below the suture. All the shells are incomplete, but the largest is 255 mm. long and when entire would measure 300 x 100 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *MELONGENA* Schumacher

Melongena consors Sowerby Pl. 35, Fig. 12

Pyrula consors Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 49.

Melongena melongena Gabb, 1873, *pro parte*, Trans. Amer. Phil. Soc., vol. 15, p. 205. Not *M. melongena* Linnæus; nor *M. patula* Brod. and Sby.

Pyrula melongena Guppy, 1874, *pro parte*, Geol. Mag., London, p. 438; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 523.

Melongena consors Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1584.

Melongena consors Maury, 1917, Bull. Amer. Paleont., No. 29, p. 85, pl. 14, fig. 5.

Melongena consors Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 112, pl. 9, fig. 1.

Shell when well grown very large and heavy, an aged Dominican specimen being 120 mm. in height and 60 in greatest width. The early whorls are unarmed, but the later volutions develope stout spines, of which there are usually two or three rows on the shoulder and one row towards the base; but the spines form a somewhat variable feature.

From Springvale we have the incomplete spire and shoulder of a *Melongena,* very badly preserved, but seemingly a fragment of a large example of *M. consors.*

There are also two smaller specimens 50 x 33 and 52 x 34 mm. both partially concealed but probably young shells of this species; and also a very worn and abraded, somewhat larger specimen.

The recent *M. melongena* is no doubt a descendant of *consors.* The chief points of difference are that *consors* is heavier, has a higher spire, and the body whorl is coarsely spirally striate.

The type locality is Santo Domingo, where we collected it in the Cercado formation. It is also found at Bowden, Jamaica, and in the Gatun stage of Costa Rica.

Localities. — Springvale; Manzanilla; Brasso Creek; Junction Mayo and Couva Roads.

Horizons.—Springvale Miocene; Brasso Miocene; Manzanilla Miocene.

Genus *SOLENOSTEIRA* Dall

Solenosteira semiglobosa Guppy Pl. 36, Fig. 1

Solenosteira semiglobosa Guppy, 1910, Agr. Soc. Trinidad and Tobago, vol. 11, Paper No. 454, p. 7, pl. 2, figs. 5, 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 163, pl. 8, figs. 5, 6.

Shell pyriform, subglobose, seven-whorled. Sculpture of strong, even, spiral grooves, alternating with sharply defined ridges. Both grooves and ridges bear fine, spiral threads, crossed by fainter longitudinal growth lines. Whorls more or less longitudinally ribbed, last whorl slightly tuberculate on the type; but the shells usually have little or no ribbing. Spire acute, outer lip dentate, strongly lirate within, columella lirate posteriorly. Length 34, width 24 mm.

Shorter and more globose than *S. cochlearis* Guppy. Type from Springvale where it is rather common.

Locality.—Springvale.

Horizon.—Upper Miocene.

Solenosteira cochlearis Guppy Pl. 36, Fig. 3

Solenosteira cochlearis Guppy, 1910, Agr. Soc. Trinidad and Tobago, vol. 11, Paper No. 454, p. 7, pl. 2, fig. 3; Harris' Reprint, 1921, Bull Amer. Paleont., No. 35, p. 164, pl. 8, fig. 3.

Shell solid, subpyriform, more purpuroid and less globose than *S. semiglobosa*, and the tubercules on the shoulder are not confined to the last whorl. Spiral ridges triple or quadruple, crossed by rather strong, irregular growth lines. Lip dentate, canal moderately long. Length 41, width 25 mm.

The type was a very imperfect shell from Springvale.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *PHOS* Montfort

Phos cf. **erectus** Guppy

Phos erectus Guppy, 1874, Geol. Mag., London, p. 410, pl. 16, fig. 1.
Phos erectus Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 312.

We have a single specimen in the Trinidad material which resembles the Jamaican Miocene *Phos erectus* Guppy. It is, however, too imperfect for positive specific identification but is either that or a closely related species. The shell measures 30 mm. in height and 13 in greatest width.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station, in west central Trinidad.

Horizon.—Manzanilla Miocene.

Genus *ALECTRION* Montfort

Alectrion brassica, n. sp. Pl. 36, Fig. 12

Shell small, broadly conic, spire acute. Three smooth nuclear whorls are followed by half a volution showing only fine, longitudinal riblets. Spirals then appear, there being about five on each of the two whorls preceding the final volution, and on the latter there are about sixteen. Longi-

tudinal ribs closely-set, well-marked, numbering twelve on the body whorl. Outer lip bordered by a strong terminal varix. Height 8, greatest width 5 mm.

This species is of the *Alectrion losquemadica-ambigua* group.

Locality.—Brasso Junction quarry.

Horizon.—Brasso Miocene.

Genus *COLUMBELLA* Lamarck

Columbella inflata var. **brassica, n. var** **Pl. 36, Fig. 8**

Shell resembling the Dominican Miocene *Columbella inflata* Gabb, in the form of the upper portion; but differing markedly in the anterior angulation of the outer lip, the flexure of the canal, and the almost obsolete varix. It is also much smaller than *C. inflata,* measuring in length 17, greatest diameter 9, against 25 x 13 mm.

A rare form. Gabb found only one specimen of *inflata,* and my expedition found none in the Dominican Republic. And we have but a single shell of the variety in the Trinidad collection.

Locality.—Brasso District.

Horizon.—Middle Miocene.

Columbella asphaltoda Maury

Columbella asphaltoda Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 81, pl. 12, fig. 2.

Shell with fine longitudinal riblets and spiral threads. Height 16, greatest width 7 mm.

Locality.—Brighton, 700 feet east of the pier, in impure asphalt.

Horizon.—Pliocene.

Columbella (Anachis) labreana Maury

Columbella labreana Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d

ser., vol. 15, p. 80, pl. 12, fig. 1.

A small species, somewhat akin to *Anachis obesa* C. B. Adams. Height 5, greatest width 2 mm.

Locality.—Brighton, 700 feet east of the pier, in impure asphalt.

Horizon.—Pliocene.

Genus *STROMBINA* Moerch

Strombina guaica, n. sp. Pl. 36, Figs. 10, 11

Shell when entire with about eight whorls. The earliest are nuclear and smooth. The two or three following are closely and sharply longitudinally ribbed but not spirally sculptured. Subsequent whorls with longitudinal ribs (14 on the last volution) and strongly spirally sculptured with alternating bands and grooves. Outer lip within bearing anteriorly about eight denticles, and a shallow notch posteriorly. Inner lip callused, finely denticulate. Height 17, greatest width 7 mm.

This resembles somewhat *Strombina ambigua* (*Columbella ambigua* Guppy, Quart. Jour. Geol. Soc., 1866, p. 288, pl. 16, fig. 8) but that has spirals only towards the base of the body. It also resembles Sowerby's *venusta* (*Columbella venusta* Sowerby, Quart. Jour., 1849, p. 46, pl. 9, fig. 6) but that has a weaker varix, spirals on the early whorls, and the spire is less convex in form than in our shell.

Locality.—13th mile post, Guaico-Tamana Road.

Horizon.—Machapoorie Miocene.

Genus *CERITHIUM* Adanson

Cerithium harrisi Maury

Cerithium harrisi Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 90, pl. 12, fig. 18.

A small, beaded and spirally striated species, 15 mm. in height and 5 in diameter.

Locality.—Brighton, 700 feet east of the pier.

Horizon.—Pliocene.

Cerithium isabellæ Maury

Cerithium isabellæ Maury, 1912, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 15, p. 91, pl. 12, fig. 19.

Differs from *C. harrisi* in its broader form, greater number of spirals and absence of varices. Height 16, diameter 8 mm.

Locality.—Brighton, 700 feet east of the pier, in impure asphalt.

Horizon.—Pliocene.

Cerithium tinkeri Maury

Cerithium tinkeri Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 92, pl. 12, fig. 17.

Longitudinally ribbed, and the ribs interrupted by four or five impressed spirals, the one below the suture constituting a groove. Height 25 mm.

Locality.—Southern main road south of Pitch Lake, Brighton.

Horizon.—Upper Miocene.

Genus *MUREX* Linnæus

Subgenus *PHYLLONOTUS* Swainson

Murex (Phyllonotus) cornurectus Guppy

Murex (*Chicoreus*) *megacerus* Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 202. Not *M. megacerus* Sowerby.
Murex cornurectus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 521, pl. 28, fig. 4.
Murex cornurectus Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 6, 9; Paper No. 454, p. 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 149, 151, 164.
Murex (*Phyllonotus*) *cornurectus* Maury, 1917, Bull. Amer. Paleont., No. 29, p. 103, pl. 16, figs. 9, 10.
Murex (*Phyllonotus*) *cornurectus* Hubbard, 1921, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 2, p. 150.
Murex cornurectus Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 131.

As in 1917, I follow Dr. Dall's advice in keeping *M. cornurectus* separate from *M. brevifrons* at least until

really careful study has been given to the entire *brevifrons* series.

We have from Trinidad an imperfect specimen of *Murex* with the varices heavy and ascending spirally upon the spire, and with a short tuberculate rib alternating with the varices on the body whorl. These characters and the form show that it is of the *cornurectus-brevifrons* group, but it is not sufficiently well preserved to figure.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *TYPHIS* Montfort

Typhis alatus var. **obesus** Gabb Pl. 36, Figs. 6, 9

Typhis obesus Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 203.
Typhis alatus var. *obesus* Dall, 1890, Trans. Wagner Inst. Sci., vol. 3, p. 151.
Typhis obesus Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., p. 354, pl. 28, figs. 5, 6. (Gabb's type.)

As our specimen combines certain characters of *alatus* Sowerby (Quart. Jour. Geol. Soc. London, vol. 5, p. 48, pl. 10, fig. 4) with others of Gabb's *obesus,* I follow Dr. Dall in regarding *obesus* as a variety of *alatus.*

The tubes of our shell are worn, but the surface shows the marked spirals of *alatus* while the shell inclines to the form of *obesus,* being broad and short. Height 29, greatest width 20.

The type of *obesus* is Dominican, but this variety has also been found in the Chipolan Miocene of Florida.

Locality.—At the 11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Typhis linguiferus Dall Pl. 35, Figs. 4, 5

In the collection are three specimens, probably the same as the Chipolan *linguiferus,* but both spines and tubes are broken, so a certain identification is not possible. On every whorl are four varices and alternating with the varices are the tubes. Presumably the varices when perfect ended in

spines. Height 14, greatest width 7 mm.

Locality.—13th mile post, Guaico-Tamana Road.

Horizon.—Machapoerie Miocene.

Genus *CYMIA* Moerch

Cymia brightoniana Maury, n. sp.

Cymia woodii Maury, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 82, pl. 11, figs. 9, 10. Not *C. woodii* Gabb from Shiloh, N. J.
Cymia Henekeni Maury (*pro parte*), 1916, Bull. Amer. Paleont., No. 29, p. 105. Reference to Trinidad shells but not the figures, nor the Dominican specimens which are *henekeni.*

Further examination of the specimens indicates that the Trinidad shells are specifically distinct from the Dominican which I called *henekeni.* For the Trinidad species I suggest the name *brightoniana.*

Locality.—Brighton, 700 feet east of the pier.

Horizon.—Pliocene.

Genus *ACLIS* Lovèn

Aclis ? (Amblyspira) teres Guppy

Aclis ? (*Amblyspira*) *teres* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 314, pl. 28, fig. 6.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *MELANELLA* Bowdich

Subgenus *EULIMA* Risso

Melanella (Eulima) egregia Guppy Pl. 35, Fig. 3

Eulima egregia Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 314, pl. 28, fig. 11.
Eulima egregia Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 5, 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 148, 150.

Shell turreted, smooth and polished, with about fourteen slightly convex whorls; suture well-marked, aperture suboval, columellar callus reflected over the body whorl. We

have one specimen exactly the size of the type, 29 mm. in height and 10 in width; but several broken shells indicate that this species attained 40 mm. or more in height and 13 or 14 in greatest width.

Dr. Guppy's types were collected in the Tertiary beds of Montserrat—in the same region as ours—and later he found this species also near Couva.

Locality.—Springvale, near Couva.

Horizon.—Upper Miocene.

Genus *TURBONILLA* Leach

Turbonilla plastica Guppy

Turbonilla plastica Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 316, pl. 28, fig. 4.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Turbonilla (Stylopsis) octona Guppy

Turbonilla (*Stylopsis*) *octona* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 317, pl. 27, fig. 8.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *DISTORTRIX* Link

Distortrix simillima Sowerby

Triton simillimus Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 48.

Persona simillima Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 288, pl. 17, fig. 13; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 37.

Distortio simillimus Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 212.

Persona simillima Guppy, 1874, Geol. Mag., London, p. 439; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 522.

Distortrix simillima Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1584.

Distorsio (*Distortrix*, *Persona*) *gatunensis* Toula, 1908, Jahrb. der K.-K. Geol. Reichsanstalt, Wien, vol. 58, p. 700, pl. 25, fig. 10.

Persona simillima Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper

No. 440, p. 6; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 149.
Distorsio gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 356, pl. 26, fig. 8.
Distortrix simillima Maury, 1917, Bull. Amer. Paleont., No. 29, p. 107, pl. 17, fig. 4, 5.
Distorsio constrictus simillimus Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 356.
Distortrix simillima Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 133.

As in 1917, I follow Zittel and Dall in using for this genus Link's name, *Distortrix*, 1807, because Bolten's name, *Distorsio*, although prior (1798), is based on Moerch, 1852. Montfort's *Persona* was given in 1810, two years after Link's.

In the Trinidad collection is a fragment of this species, of which a perfect specimen is figured in my Dominican Memoir, Bulletin 29. It resembles the living west coast *D. constricta;* but is still closer to a shell labelled *ringens* (Reeve) Newcomb, from St. Thomas, W. I., in the Newcomb collection, Cornell University.

Distortrix simillima is abundant and large in the Gurabo formation, Dominican Republic. It is also in the Bowden Miocene, Jamaica, and in the Gatun of Gatun, Canal Zone, and of Costa Rica.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station.

Horizon.—Manzanilla Miocene.

Genus *BURSA* Bolten

Bursa crassa Dillwyn

Ranella crassa Dillwyn, Reeve, Conch. Icon., fig. 18b.
Ranella crassa Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 18, fig. 9.
Ranella crassa Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 157; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 36.
Bursa crassa Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 212.
Ranella crassa Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 522.
Gyrineum crassum Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1584.
Bursa crassa Maury, 1917, Bull. Amer. Paleont., No. 29, p. 108, pl. 17, figs. 6, 7.

Bursa crassa Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 134, pl. 15, fig. 19.

A basal fragment, showing the form and sculpture of this species, is in the Trinidad collection.

This form is present in the Miocene of the Dominican Republic, Jamaica, and Costa Rica, and is living in the West Indies.

Locality.—11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Genus *DOLIUM* Lamarck

Subgenus *MALEA* Valenciennes

Malea camura Guppy

Malea camura Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 17, fig. 9; 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158.
Malea ringens Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 223. Not *ringens* Swainson.
Malea camura Guppy, 1874, Geol. Mag., London, p. 439; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 525.
Malea camura Maury, 1917, Bull. Amer. Paleont., No. 29, p. 112, pl. 19, fig. 3.
Malea camura Jones, 1918, Jour. Geol., vol. 26, p. 741.
Malea camura Vaughan, 1919, Bull. 103, U. S. Nat. Mus., p. 561.
Malea camura Maury, 1920, Sci. Surv. Porto Rico and the Virgin Isls., New York Acad. Sci., vol. 3, pt. 1, p. 59.

A number of internal molds of this species are in the collection, and a perfect shell is figured from the Dominican Republic. The largest Trinidad mold is 50 x 35 mm.

The type of *camura* was Jamaican. It is also abundant in the Dominican Republic, and has been recorded from Gatun and from Haiti. It is also near Quebradillas, Porto Rico.

Locality.—Near 7¾ mile post on Guaico-Tamana Road.

Horizon.—Machapoorie Miocene.

Malea camura var. **elliptica** Pilsbry and Johnson

Malea elliptica Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 169; 1922, *Idem*, vol. 73, p. 363, pl. 39, fig. 3.
Malea elliptica Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 139,

pl. 12, fig. 2.

The variation in the spiral banding and relative width of grooves to bands in *Malea camura* Guppy, is protean. In my Dominican material all sorts of mutations present themselves. Closely banded specimens in Gabb's Dominican collections, Pilsbry and Johnson have named *elliptica.* A similar specimen before me measures 55 x 40 mm. A large, typical *camura* may attain 70 x 40 mm. (See Maury, Bull. 29, p. 113, pl. 19, fig. 3.) The living analogue is the west coast *ringens* Swainson.

In the Trinidad collection are three greatly distorted, crushed specimens of *camura,* closely banded, like the mutation *elliptica.*

Locality.—Quarry, ½ mile above Brasso Station, No. 284.

Horizon.—Brasso Miocene, and uppermost member of that series.

Genus *CYPRÆA* Linnæus

Cypræa henekeni Sowerby Pl. 37, Fig. 1

Cypræa Henekeni Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 45, pl. 9, fig. 3.
Cypræa Henekeni Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 39.
Cypræa Henekeni Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 235.
Cypræa Henekeni Guppy, 1874, Geol. Mag., London, p. 440; 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528.
Cypræa Henekeni Dall, 1890, Trans. Wagner Inst. Sci., vol. 3, p. 165.
Cypræa henekeni Guppy, 1912, Agr. Soc. Trinidad and Tobago, Paper No. 520, p. 3; Harris' Reprint, 1912, Bull. Amer. Paleont., No. 35, p. 186.
Cypræa Henekeni Maury, 1917, Bull. Amer. Paleont., No. 29, p. 114, pl. 19, fig. 4.

Typically, this shell attains a moderately large size, and has two prominent, rather symmetrically placed, tubercles which bear a fanciful resemblance to the ears of a mouse, or the widely open and questioning eyes of some bizarre creature. The modern descendant is *C. mus* variety *bicornis* Sowerby, of the Atlantic and Mediterranean faunas,

which, however, has a different color pattern from *henekeni.* Sometimes the tubercles are absent or only one is developed in *henekeni* but our many Dominican Miocene specimens show that there is almost always at least a trace of them.

In the Trinidad collection is a single shell that agrees very well with the Dominican specimens in form and general aspect, except that the edges are more corrugated, but some of them show this feature nearly as much, although often the sides are smooth. The Trinidad shell happens to have only one tubercle, but it is in the right place. Length 54, height 28, width 38 mm.

The variety mentioned by Brown and Pilsbry from Gatun (Proc. Acad. Nat. Sci. Phila., 1911, p. 356, pl. 26, figs. 9, 10) is very much more corrugated. *C. almirantensis* Olsson, from the Gatun stage, Water Cay, Panama, is longer and narrower than *henekeni,* measuring 60 x 30 x 38 mm., and the tubercles are lower and more lumpy, but it is a member of the *henekeni* group.

Dr. Guppy recorded *henekeni* from Springvale.

Locality.—11th mile post on Caparo Road (west central Trinidad).

Horizon.—Manzanilla Miocene.

Cypræa henekeni var. **lacrimula,** n. var. Pl. 37, Fig. 2

From Central Trinidad we have an incomplete *Cypræa* resembling somewhat *C. henekeni* Sowerby. But instead of the two tubercles, this Trinidad shell has on one side a cluster of three, and on the other of two, conspicuous tear-shaped blisters. There is also a fourth near the margin of the aperture. The sides of the shell have been crumpled by pressure, but they may have been somewhat corrugated. The tear-like clusters are certainly natural, and not due to deformation, and give the shell an amusingly lachrymose air. The specimen is 45 mm. in width.

Locality.—Eastern E 24, No. 407 (central Trinidad).

Horizon.—Machapoorie Miocene.

Cypræa caroniensis, n. sp. Pl. 37, Figs. 3, 5, 6

Shell very large, the youngest specimen with the back very high and humped, resembling in form the recent *Cypræa stercoraria* var. *rattus* Lamarck and *C. decipiens* Smith. An older incomplete shell, 60 mm across, shows that with age the shell became proportionately flatter and attained a very large size. This specimen has a single, prominent, horn-like tubercle near the center of the back, somewhat to one side. A trace of this tubercle is apparent in a smaller adult shell, but the adolescent shell does not show it, though it may have been broken off. Aperture curving; teeth coarse, rather distant, becoming obsolete. Width of smaller adult shell 50, height 35, approximate length 70 mm. Estimated length of largest shell 75 to 80 mm.

The large Dominican species, *C. noueli* Maury, from Cercado de Mao, is more evenly globose and bears no trace of tubercles.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *STROMBUS* Linnæus

Strombus bifrons Sowerby Pl. 36, Fig. 2

Strombus bifrons Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 48, pl. 9, fig. 9.
Strombus bifrons Guppy, 1866, Quart. Jour., vol. 22, p. 287; 1876, vol. 32, p. 521.
Strombus bifrons Dall, 1890, Trans. Wagner Inst. Sci., vol. 3, p. 176; 1903, *Idem*, p. 1584.
Strombus bifrons Maury, 1917, Bull. Amer. Paleont., No. 29, p. 119, pl. 20, figs. 2, 3.
Strombus cf. *bifrons* Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, New York Acad. Sci., vol. 3, pt. 1, p. 56.

Two fragments of this species are in the collection. A perfect shell is figured from the Dominican Republic which is the type locality. It is the most attractive of all the Miocene Antillean Strombs. The living analogue is the Oriental *S. columba.*

S. bifrons is present in both the Gurabo and Cercado

formations of the Dominican Middle and Lower Miocene; in the Bowden beds, Jamaica; and a mold probably of this shell was collected by Dr. Reeds on Señor Rabell's ranch, Rio Guajataca, Porto Rico. Its range is now extended to Trinidad.

Locality.—At the 13th mile post, Guaico-Tamana Road.

Horizon.—Machapoorie Miocene.

Genus *CLAVA* Martyn

Clava venada, n. sp. Pl. 41, Fig. 10

Shell tapering, with about twelve whorls which increase fairly rapidly in diameter. Last whorl with a conspicuous rounded varix on the left side of the aperture. Sculpture on each volution of three major, strongly nodose, spirals, alternating with a finer thread in each interspace. Outer lip lacking, and columella concealed. Height 29, greatest diameter 11 mm.

This species resembles the Dominican Miocene *Clava plebeia* Sowerby; but the diameter of the Trinidad shell is greater (10-11 against 8-9) and the sculpture is coarser than in typical specimens of Sowerby's species.

In the *Errata* of Bull. Amer. Paleont., No. 29 (after the last plate), I noted that the genus *Clava* had been accidentally misplaced in my Dominican Memoir.

From the Gatun of Costa Rica, Mr. Olsson has described *Clava costaricana* and *C. alajuela.* The former is much larger (measuring 40 x 15), and the latter smaller and slendered (17 x 6) than the Trinidad shell.

Locality.—Brasso Venada Ravine, 3 miles east of Brasso Station.

Horizon.—Manzanilla Miocene.

Genus *PYRULA* Lamarck

Pyrula trinitaria, n. sp. Pl. 41, Figs. 9, 12

Shell large, fig-shaped, ventricose, with six whorls, of which the first two and a half to three are entirely smooth, embryonic; later whorls cancellated. The fully developed sculpture on the last volution is elegant and sharply defined. It consists of strong, primary spiral threads at intervals of about four millimetres, and centrally placed between every pair of these primary spirals is a finer, secondary thread, with a still finer tertiary lying on either side, and on either side of each tertiary lies a yet more delicate thread—making in all seven threads between every pair of primaries. Sometimes the finest threads are lacking, so there are but five between the primaries. The primaries and secondaries stand out delicately but clearly. The spirals are crossed by fine, closely-set, longitudinal threads about the thickness of the secondary spirals. There is no trace of knotting at the intersections. Greatest width of adult shell 40 mm., approximate height 70 mm. The nearest affinity of this species is the Pacific *Pyrula ventricosa* Sowerby, which has five to seven finer spirals between every pair of primaries, but the primaries are stronger and more distant in *ventricosa*.

Other east coast fossil forms with west coast affinities are *Pyrula hoveyi* Maury, from the Porto Rican Miocene, akin to *P. reticulata* Lamarck; and *P. micronematica* Brown and Pilsbry, from the Canal Zone, akin to *decussata* Wood. But *hoveyi* has strong axial threads equalling the primary spirals; and *micronematica* has rather widely-spaced axials knotted at their intersections with the spirals, and the type was small, measuring only 28 mm.

According to Mr. Burnett-Smith (Proc. Acad. Nat. Sci. Phila., p. 217, 1907), in the genetic development of *Pyrula* there is a law of progressive reduction in the number of smooth, embryonic whorls, exemplified by the 2½–3 smooth whorls in the Vicksburgian *P. mississippiensis* and the single smooth whorl in the modern *P. papyratia*. Our Trinidad species shows the ancestral character of possessing nearly three smooth whorls.

Locality.—Springvale.

Horizon.—Upper Miocene.

Pyrula carbasea Guppy Pl. 41, Fig. 5

Ficula carbasea Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 580, pl. 26, fig. 7.
Ficula carbasea Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 158; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 37.
Ficula carbasea Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 80; Harris' Reprint, 1921, p. 64.
Ficus mississippiensis Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 223.
Not *Ficula mississippiensis* Conrad, 1847, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 1, p. 117.
Ficula carbasea Guppy, 1874, Geol. Mag., p. 439.
Ficula mississippiensis Guppy, 1876, Quart. Jour. Geol. Soc., vol. 32, p. 525.
Ficula carbasea Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 10; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 152.
Pyrula carbasea Maury, 1920, Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 1, p. 60.

Shell with a low spire and sunken suture, when adult with five whorls, of which the first 1½ to 1¾ are smooth. Later volutions sculptured with spiral threads of which there are typically three finer between every two of the larger threads. Spirals cancellated by axials about equalling the finer spirals in thickness. Interspaces appearing slightly concave because of the prominence of the major spirals. The type measured about 65 x 45 mm. Our shell is young and only 35 x 24 mm.

This species has the same sort of sculpture as *mississippiensis,* but that is much smaller, with a higher spire, and with 2½ to 3 smooth, embryonic whorls.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *SERPULORBIS* Sasso

Serpulorbis decussata Gmelin Pl. 41, Fig. 3

Serpula decussata Gmelin, 1791, Syst. Nat., 13, p. 3745.
Siphonium decussatum Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 35; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 15.

Vermetus decussatus (Moerch) Tryon, 1886, Man. Conch., vol. 8, p. 181, pl. 53, fig. 71.
Serpulorbis decussata Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 304; 1915, Bull. U. S. Nat. Mus., No. 90, p. 96.

From the quarry near Springvale, we have a poorly preserved specimen which resembles the Miocene to Recent *Serpulorbis decussata* Gmelin. It is not nearly so handsomely reticulated by the granules as the Dominican Miocene specimen that I referred to *granifera* Say; but the sculpture is chiefly of very closely-set, longitudinal, granular striæ. The tube measures 6 mm. in diameter.

From Matura we have a number of small tubes, seemingly also of this species. The largest is 4 mm. in diameter.

S. decussata first appeared in the Tampa Oligocene of Florida.

It is now living from North Carolina southward through the Antilles.

Localities.—11th mile post on Caparo Road; Springvale; Matura.

Horizons.—Manzanilla Miocene; Springvale Miocene; Pliocene.

Serpulorbis papulosa Guppy

Vermetus papulosus Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 292, pl. 17, fig. 3.
Vermetus papulosus Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 155; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 35.
Petaloconchus sculpturatus Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 241. Not of H. C. Lea.
Vermetus papulosus Guppy, 1874, Geol. Mag., p. 437; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 519.
Serpulorbis papulosa Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 303; *Idem*, 1903, p. 1585.
Serpulorbis papulosa Maury, 1917, Bull. Amer. Paleont., No. 29, p. 127, pl. 22, fig. 10.
Serpulorbis papulosa Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 145, pl. 12, fig. 1.

We have from Springvale several worn tubes which here and there show rows of tubercles and are probably this species. And from Brasso is a small but well preserved bit, showing the rows of papillæ with the crenate

longitudinal striations in the interspaces. This measures 8 mm. in diameter.

A very fine Dominican specimen from the Gurabo formation is figured in Bulletin 29. Frequently there are three striæ in each interspace, but this is a variable feature, for there may be but one, as in Mr. Olsson's Costa Rican specimens. The type locality was Bowden, Jamaica.

Localities.—Springvale; Brasso Creek.

Horizons.—Springvale Miocene; Manzanilla Miocene.

Genus *PETALOCONCHUS* H. C. Lea

In the discussion of the *Vermetidæ* I follow Dr. Dall (Bull. U. S. Nat. Mus., No. 90, pp. 95, 96, 1915) in regarding *Petaloconchus* and *Vermicularia* as of generic rank.

Petaloconchus sculpturatus var. **domingensis** Sowerby
Pl. 41, Figs. 2, 4, 7

Petaloconchus domingensis Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 51, pl. 10, figs. 9a, b, c.
Petaloconchus sculpturatus Guppy, 1876, Proc. Sci. Assoc. Trinidad, p. 156; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 35.
Cf. *Petaloconchus sculpturatus* H. C. Lea, 1845, Trans. Amer. Philos. Soc., 2d ser., vol. 9, p. 233, pl. 34, fig. 3.
Petaloconchus sculpturatus Gabb, 1873, Trans. Amer. Philos. Soc., vol. 15, p. 240.
Petaloconchus sculpturatus Guppy, 1874, Geol. Mag., London, p. 438; 1876, Quart. Jour. Geol. Soc., vol. 32, p. 519.
Vermetus (*Petaloconchus*) *sculpturatus* Dall, 1892 (in part), Trans. Wagner Inst. Sci., vol. 3, p. 305.
Vermetus (*Petaloconchus*) *pulcher* Bose, 1906, Boletin Inst. Geol. de Mexico, No. 22, p. 32, pl. 3, figs. 22, 23.
Petaloconchus sculpturatus Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 5, 10; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 148, 153.
Petaloconchus domingensis Pilsbry and Brown, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 359.
Petaloconchus domingensis Maury, 1917, Bull. Amer. Paleont., No. 29, p. 128, pl. 22, fig. 11.
Petaloconchus domingensis Hubbard, 1921, Sci. Surv. Porto Rico and the Virgin Isls., vol. 3, pt. 2, p. 139.
Petaloconchus sculpturatus Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 146, pl. 14, figs. 10, 15.
Vermetus (*Petaloconchus*) *domingensis* Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 377.

The species *sculpturatus* was made by H. C. Lea, the

type of his genus *Petaloconchus*. In 1892, Dr. Dall reduced *Petaloconchus* to a subgenus of *Vermetus* and this has been followed by Pilsbry and some others, but in 1915 Dr. Dall restored *Petaloconchus* to generic rank.

Sowerby's species *domingensis* was based on Heneken's shell from the Miocene of Santo Domingo. As the above synonymy indicates, *domingensis* has by some writers been united with *sculpturatus*, and by others held distinct. Sowerby's figure so perfectly represents the usual Dominican form that, in 1917, I retained his species. But now I have from Trinidad the widening cylinders typical of the coiling of *domingensis* and also one tapering cone similar to the form frequently assumed by *sculpturatus*. But the whorls of the Antillean shells are much flattened and *domingensis* may perhaps be best regarded as a variety of Lea's species.

We have quite a number of these oddly coiled, tubular shells in the Springvale material. The majority are subcylindrical, about 44–34 mm. long and 16–20 at their greatest diameter. The largest shows well the characteristic obsolescence of the coiling and measures 80 x 20 with a maximum diameter of the tube of 7 mm.

From Brasso we have a small coil which, like the young Springvale coils, shows about three spirals to a volution, crossed by coarse, irregular growth lines. It is only 14 x 11 x 4 mm.

Localities.—Springvale; ¾ mile south of Brasso.

Horizons.—Springvale Miocene; Manzanilla Miocene.

Genus *VERMICULARIA* Lamarck

Vermicularia spirata Philippi Pl. 41, Fig. 13

Vermiculus spiratus Philippi, 1836, Arch. für Naturg., p. 244.
Vermetus (*Vermicularia*) *spiratus* Tryon, 1886, Man. Conch., p. 187, pl. 55, fig. 99.
Serpulorbis (*Vermicularia*) *spirata* Dall, 1892, *pro parte*, Trans. Wagner Inst. Sci., vol. 3, p. 304.
Vermicularia spirata Maury, 1922, Bull. Amer. Paleont., No. 38, p. 102.

In the recent fauna this species is quite a large shell. In early stages it coils evenly and closely, in excellent imitation of a *Turritella,* and the longitudinal ridges then appear as spirals. But in later stages of growth the coils are not continguous. The range is from Massachusetts Bay to the southern Antilles.

The figured specimen is from Florida. It measures 65 mm. in height and 9.5 in greatest diameter.

Horizon.—Recent.

Vermicularia spirata var. **trilineata** Guppy Pl. 41, Fig. 6

Vermetus royanus (d'Orbigny) Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 34; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 15.
Vermetus trilineatus Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 35, 49.
Vermetus trilineatus Guppy, 1874, Geol. Mag., London, p. 437.

Dr. Dall thought Guppy's *trilineata* was a young shell of Gmelin's *spirata* and placed it in the synonymy of that species. (Trans. Wagner Inst. Sci., vol. 3, p. 304, 1892). But we have a number of specimens from Guppy's type locality and they are uniformly very small. For this miniature Pliocene form it would seem appropriate to retain Dr. Guppy's name *trilineata* as a variety. But the three ridges are equally characteristic of *spirata* as of the dwarf form. A shell of the latter measures in height 13 and the greatest diameter of the tube is 4 mm.

Locality.—Matura.

Horizon.—Upper Pliocene.

Vermicularia cf. **radicula** Stimpson Pl. 41, Fig. 1

Vermetus lumbricalis Gould, 1841, Inv. Mass., 1st ed., p. 287. Not of Linnæus.
Vermetus radicula Stimpson, Shells of New Englands, p. 37.
Vermetus lumbricalis Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 34; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 15.
Vermetus radicula Binney's Gould, 1870, Inv. Mass., 2d ed., p. 316, fig. 584.
Vermetus lumbricalis Guppy, 1874, Geol. Mag., p. 437.

The *lumbricalis* of Linnæus is Oriental, yet very similar forms are found on the Atlantic coast of the United States and in the Antilles. To these Stimpson gave the name *radicula.* This Tryon placed as a variety of *spirata* Philippi, and Dall placed it in the synonymy of *spirata.* But Tryon's figure of *radicula* (pl. 55, fig. 100) does not resemble Stimpson's figure of his species—Tryon's being strongly tricarinate, while Stimpson's is not, and looks much more like *lumbricalis.*

We have a carinate *Serpulorbis* from Springvale resembling *lumbricalis,* and Guppy had specimens from Matura that he referred to *lumbricalis.*

Judging from the figures of the types, *spirata* has about three to five strong, longitudinal carinæ, while *lumbricalis* and *indicus* have one ridge which is more prominent and carinates the tube. It seems clearer to retain Stimpson's name *radicula* for Atlantic shells resembling the Oriental *lumbricalis.*

As our specimen is not well preserved, and as neither *spirata* nor *radicula* have been reported from beds older than Pliocene, the Springvale shell is not identified with certainty.

Localities.—Matura (Guppy). Doubtful shell, Springvale.

Horizons.—Recent, Pliocene and perhaps also Upper Miocene.

Genus *TURRITELLA* Lamarck

Turritella gatunensis Conrad Pl. 42, Fig. 12

Turritella gatunensis Conrad, 1857, Pacific Railroad Rept., vol. 6, p. 72, pl. 5, fig. 10.
Turritella conradi Toula, 1909, Jahrb. der K-K. Geol. Reichsanstalt, Wien, vol. 58, p. 694, pl. 25, fig. 4.
Turritella gatunensis Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., vol. 63, p. 358, pl. 27, figs. 4, 5, 9.
Turritella gatunensis Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 148, pl. 14, figs. 12, 13.

In the Trinidad collection are a number of Turritellas which resemble in all respects specimens obtained by Mr. Olsson at the type locality, Gatun.

This species has gently convex whorls, overhanging the following volutions, spirally striated, and with a constricted central zone. The shell is never large, when complete about 40 mm. long. The adult Trinidad specimens are all fragmentary. One specimen of four whorls is 21 x 11 mm. in greatest diameter.

Localities.—Near bridge at Tamana Road Junction; ¾ mile south of Brasso; Brasso Creek.

Horizon.—Manzanilla Miocene.

Turritella trinitaria, n. sp. Pl. 42, Fig. 10

Shell large, increasing quite rapidly, whorls gently convex, basally carinate, excavated sharply and deeply beneath the carina, not overhanging the following volution. Each whorl is sculptured with about a dozen unequal, coarse, spiral threads, tending to alternate in strength. Of the spirals, two are much stronger than the rest. These major spirals are on the lower half of the whorls and the basal one edges the carination. Between it and the upper major thread is a slender spiral. This produces somewhat the effect of a cingulation, but the zone included by the major spirals is not constricted. One specimen of about five whorls is 45 mm. in height and 25 in greatest diameter; the other, of three whorls, is 35 x 25 mm. This large and handsome shell is a little like a giant *T. gatunensis,* but the whorls do not overhang and are not constricted centrally. *T. lloydsmithi* Pilsbry and Brown, from the Miocene of Cartagena, Colombia, tapers more gradually than this Trinidad species, and has nearly flat whorls with about half as many spirals.

Locality.—Springvale.

Horizon.—Upper Miocene.

Turritella altilira var. **tornata** Guppy Pl. 42, Figs. 3, 4, 5

Turritella tornata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 12.
Turritella tornata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 156; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 35.
Turritella tornata Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, p. 79; Harris' Reprint, 1921, Bull. 35, p. 63.
Turritella tornata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 240.
Turritella tornata Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 312.
Turritella tornata Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 4; Harris' Reprint, 1921, Bull. 35, p. 160.
Turritella tornata Guppy, 1913, Agr. Soc. Trinidad and Tobago, Paper No. 549, p. 2; Harris' Reprint, 1921, Bull. 35, p. 189.
Turritella tornata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 130, pl. 22, fig. 15.

Typically *Turritella tornata* has on every whorl two beaded spiral keels, and in the concavity between them two fine, granose spiral threads, and a granular spiral line lies above the upper keel, just beneath the suture.

But the following mutations occur: (1) the beading is variable, (2) the spiral threads may increase or diminish. Thus, among the Brasso Creek (Manzanilla Miocene) specimens, some have three main spirals in the concavity, while others have two main and four secondary threads, six in all. On the other hand, practically all the Machapoorie Quarry (Machapoorie Miocene) specimens have no spirals in the concavity, or some, one faint line. Among the specimens from Tamana Road Junction (Manzanilla Miocene) the subsutural spiral is increased to the size of a keel, so that the upper keel appears paired. Specimens from the limestone forming the top of the Brasso Miocene lack the subsutural spiral but the upper keel is extra heavy.

Along with these mutations, however, a shell with typical sculpture may be present, so that the mutations are hardly of stratigraphic value, although the Machapoorie shells certainly strongly tend to absence of spirals in the concavity.

Dr. Guppy's figured type was a young shell from Cumana, Venezuela, and in writing his description he had specimens from Jamaica and Santo Domingo. He later identified the Springvale form as this species.

We have a quantity of specimens but none perfect. Large fragments of lower whorls measure 17 mm. in diameter, so that, as the shells taper gradually, the complete length must have been considerable. Terminal portions are long and slender, as 35 x 9 mm.

T. tornata is of Conrad's *altilira* race, and so closely allied that it may perhaps best be ranked as a variety of that species. Some Trinidad specimens are almost exactly like *T. altilira* var. *chiriquiensis* Olsson, from the Costa Rican Miocene. Others with the double upper keel and three spirals in the concavity approach the beautiful *T. altilira culebrina* Maury, from the Porto Rican Miocene.

Localities.—Brasso Creek; Springvale; Southwest quarter of E 24; ¾ mile south of Brasso; 11th mile post on Caparo Road; Brasso Junction; near bridge at Tamana Road; Blue clay above the calcareous bed represented by No. 284; 13½ miles on Cunapo Southern Road; 7¾ miles on Guaico-Tamana Road; 13 miles on Guaico-Tamana Road; Brasso Venada Ravine 3 miles east of Brasso Station; Brasso Junction quarry; Brasso Creek; Machapoorie quarry; ½ mile above Brasso Station; N. W. ¼ F. 16; Eastern E 20; Central E 20; 1 mile west of Erin Point.

Horizons.—Machapoorie Miocene; Manzanilla Miocene; Brasso Miocene; Lower Springvale and Springvale Miocene. (Very scarce in the last two).

Turritella planigyrata Guppy Pl. 42, Figs. 6, 7, 8

Turritella planigyrata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 169; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 35, 48.

Turritella planigyrata Guppy, 1874, Geol. Mag., London, p. 408, pl. 18, fig. 5.

Cf. *Turritella planigyrata* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519.

Turritella planigyrata Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 5, 11; Harris' Reprint, 1921, Bull. 35, pp. 148, 153.

In this species the whorls are slightly convex to nearly

flat, very rarely the later whorls show a slight overhang basally. The sculpture is of very fine spiral lines. Aperture subquadrate. An average adult Springvale specimen, which comprises twelve whorls, is 64 mm. in height and 18 in greatest diameter. A very large fragment from Springvale, seemingly the same species, comprises five whorls and is 65 x 25 mm.

The Dominican *Turritella* that I figured in Bulletin 29 as *T. planigyrata* has coarser spirals, but the form is not unlike some of the Trinidad shells.

In general aspect *T. planigyrata* (especially the examples with the slight overhang) recalls *T. minetes* Brown and Pilsbry, from Gatun, but the spirals of the Trinidad species are finer and closer.

Of recent forms *T. planigyrata* is not unlike *T. variegata* var. *meta* Reeve, now living on the shores of Trinidad (See Plate 42, Figure 9) ; but the fossil shell is more finely sculptured. Besides Springvale, where Dr. Guppy had also collected *T. planigyrata,* Professor Harris found a new and very interesting location on the road leading west of Brasso Junction. At that point there is a blue clay stratigraphically 75-100 feet above the limestone that ends the Brasso section. This blue clay is the base of the Springvale Miocene and in it are shells of *planigyrata.* This seemed to be the earliest appearance of this species; but there is a fragment exactly like Springvale specimens, from the Manzanilla Miocene, on Caparo Road.

Localities.— Springvale; Road leading west of Brasso Junction; 11th mile post on Caparo Road; Brasso Creek.

Horizons.—Springvale and Lower Springvale Miocene; Manzanilla Miocene. (Very scarce in the latter).

Turritella cartagenensis Pilsbry and Brown Pl. 42, Fig. 13

Turritella cartagenensis Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 34, pl. 5, fig. 13.

In the Trinidad collection, we have a fragment com-

prising two later whorls of a Turritella which corresponds to the discription and figure of *T. cartagenensis* Pilsbry and Brown, from the Miocene near Cartagena, Colombia. The shell is large with slightly concave whorls, sculptured with fine, somewhat unevenly spaced and unequal, spiral threads. The slight concavity of the whorls differentitates it from larger specimens of *T. planigyrata* Guppy. Height of two lower whorls 29 mm., diameter 22.

This species is related to *T. oreodoxa* Olsson, from the Miocene of Costa Rica; but in that shell the whorls are more concave and much swollen beneath the sutures.

Locality.—At the 11th mile post on Caparo Road.

Horizon.— Manzanilla Miocene.

Turritella caparonis, n. sp. Pl. 42, Figs. 1, 2

Adult shell large, increasing rather rapidly. Earlier whorls sculptured with three equal, equidistant, finely beaded, high, narrow, spiral ridges, and at the suture a smooth spiral thread. With age, the whorls develop one or two very fine, crenate striæ above the uppermost ridge, and the sutural thread becomes heavier and may be somewhat crenate. The interspaces between the three ridges are concave and smooth. The beading shows only on unworn specimens. The oldest fragment, of about four basal whorls, is 35 mm. in height and 17 in greatest diameter. A younger of about ten whorls measures 45 x 15 mm.

Localities.—Caparo Road; Guaico-Tamana Road at 7¾ miles; E 24 (No. 391); Machapoorie quarry; Guaico-Tamana Road at 13th mile post.

Horizons:—Manzanilla Miocene; Brasso Miocene; Machapoorie Miocene.

Turritella machapoorensis, n. sp. Pl. 42, Fig. 11

Among the Turritellas from Machapoorie is a specimen unlike *T. caparonis*. The shell tapers rapidly, the whorls are very flat with the suture ill-defined. The sculpture on

each volution consists of two strong, basal spirals followed by a concave zone with two fine, secondary, spiral threads, and sometimes also tertiary striæ. Above the concavity is a third major, strong, spiral and about three fine subsutural spiral threads. So there are three major and five or six minor spirals to a whorl. Although the specimen is well preserved, the spirals show no traces of beading. An apical fragment of about thirteen whorls, two of which are smooth and nuclear, is 29 mm. in height and 11 in greatest diameter.

Locality.— Machapoorie quarry, in the northwestern part of the Department of Nariva.

Horizon.—Machapoorie Miocene.

Genus *HEMISINUS* Swainson

Hemisinus comparanus, n. sp. Pl. 35, Figs. 9, 10

Hemisinus sulcatus Guppy, 1908, Bull. Misc. Inform., Botanical Dept., Trinidad, p. 114; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 140.

Not *Hemisinus sulcatus* Conrad, 1871, Amer. Jour. Conch., vol. 6, pt. 3, p. 194, pl. 10, fig. 2.

From the freshwater beds of Comparo Road, associated with *Corbicula*, we have specimens of a *Hemisinus*, presumably the same that Dr. Guppy had from the same locality and referred to *H. sulcatus* Conrad.

Comparison of our shells with Conrad's description and figure show about fourteen spirals on the last volution against twenty-three; and the body whorl is much more convex than in Conrad's shell, which was from Pichua, 3 miles below Pebas, 2200 miles up the Amazon Valley.

As is common in fluviatile shells, our specimens are all much eroded from CO_2 in the water, so that the earlier whorls are lacking, and the shells appear truncated. The subsequent whorls are sculptured with alternating spiral grooves and bands. On the whorls of the spire there are six bands to a volution, and on the last whorl about fourteen; aperture, when complete, showing a short basal canal.

Young shells are more slender, but adult specimens tend to much greater convexity. Height of decollate shell 25, greatest width 11 mm.

Locality.—Half a mile on Comparo Road, northeastern Trinidad.

Horizon.—Lower Pliocene.

Genus *ARCHITECTONICA* Bolten

Architectonica granulata Lamarck Pl. 40, Fig. 1

Solarium granulatum Lamarck, 1822, Anim. sans Vert., 7, p. 3; 1792, Ency. Méthod, pl. 446, fig. 5a-b.
Architectonica perspectiva Tuomey and Holmes, 1857, Pleioc. Fos. S. Car., p. 120, pl. 26, fig. 6. Not *S. perspectiva* Linnæus, nor of Lamarck.
Solarium granulatum Dall, *pro parte*, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 329.
Solarium gatunense Toula, 1908, Jahrb. der K.-K. Geol. Reichsanstalt, Wien, vol. 58, p. 693, pl. 15, fig. 3.
Solarium granulatum Maury, 1917, Bull. Amer. Paleont., No. 29, p. 131, pl. 23, fig. 3.
Architectonica granulata Maury, 1922, Bull. Amer. Paleont., No. 38, p. 108.
Architectonica granulata Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 154, pl. 13, figs. 10, 11, 12.

This ancient, very static species, has remained unchanged from Lower Miocene time. Like the more dainty, but closely allied, Dominican species, *A. quadriseriata* Sowerby, the sculpture is of four spiral bands to each volution. These on the earlier whorls in *A. granulata* are beaded and sometimes the bands of the last volution are also crenate: but frequently they are smooth. We have two specimens from Trinidad, one with the bands on the body beaded, the other with them smooth. The maximum diameter of the former shell is 30, height 12 mm.

A. granulata is found in the Miocene of Florida, Dominican Republic and Costa Rica; and is living in the Antilles, and on the Pacific coast in the Panamic Province.

Localities.—Springvale; Brasso Venada Ravine, 3 miles east of Brasso Station; 11th mile post on Caparo Road.

Horizons.—Springvale Miocene; Manzanilla Miocene.

Architectonica quadriseriata Sowerby

Solarium quadriseriatum Sowerby, 1849, Quart. Jour. Geol. Soc. London, vol. 5, p. 51, pl. 10, figs. 8a, b, c.
Solarium quadriseriatum Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 291.
Architectonica quadriseriata Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 228.
Solarium quadriseriatum Guppy, 1874, Geol. Mag., London, p. 438.
Solarium quadriseriatum Dall, 1903, Trans. Wagner Inst. Sci., vol. 3, p. 1585.
Solarium quadriseriatum Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 8; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 151.
Solarium quadriseriatum Maury, 1917, Bull. Amer. Paleont., No. 29, p. 131, pl. 23, figs. 1, 2.

A single imperfect specimen is in the Trinidad material. In the Dominican Republic it is in both the Gurabo and Cercado formations.

Locality.—Brasso Creek, Trinidad.

Horizon.—Manzanilla Miocene.

Genus *RISSOA* Fréminville

Rissoa (Alvania) pariana Guppy

Rissoa (*Alvania*) *pariana* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 321, pl. 29, fig. 9.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *BENTHONELLA* Dall

Benthonella turbinata Guppy

Benthonella turbinata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 321, pl. 27, fig. 10.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *MODULUS* Gray

Modulus tamanensis, n. sp. Pl. 40, Figs. 2, 3

Shell rather stout, broadly conic, nuclear whorls lack-

ing. Subsequent volutions sculptured with a strong, round, cord-like carina on which the suture is wound. Above the carina are four subequal, strong spirals followed by the larger cord which is the keel of the earlier volution. All the spirals are wrinkled by oblique growth lines. Base with eight spirals somewhat flatter and broader than those of the spire. Aperture subquadrate. Outer lip strongly lirate within, the liræ corresponding to the external spirals. Pillar very short, with one strong, lamellar-like tooth. Callus on inner lip thin. Shell imperforate. Altitude of adult specimen when entire, about 20 mm., greatest diameter 19 mm.

This species is nearest to *Modulus willcoxi* Dall, from the Miocene of Florida; but is proportionately broader, and has a single, instead of a duplex keel. *Modulus basileus* (*Monodonta basilea* Guppy, Geol. Mag., 1874, p. 434, pl. 6, fig. 2) from the Jamaican Miocene is tuberculate. *M. turbinatus* Heilprin is entirely unlike—the spire having strong, oblique waves and no spirals.

Localities.—Machapoorie quarry; Guaico-Tamana road at the 13th mile post.

Horizon.—Machapoorie Miocene.

Genus *NATICA* Scopoli

Natica canrena (Linnæus) Moerch Pl. 40, Fig. 8

Nerita canrena (Linnæus *pars*) Auct., Moerch, 1877, Malak. Blatt., 24, p. 62.
Natica canrena Guppy, 1867, Proc. Sci. Assoc. Trinidad. pt. 3, p. 156; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 35.
Natica canrena Gabb, 1873, Trans. Amer. Phil. Soc., vol. 15, p. 223.
Natica canrena Guppy, 1874, Geol. Mag., London, p. 437; 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 518.
Natica canrena Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 364.
Natica canrena Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, pp. 6, 11; *Idem*, Paper No. 454, p. 5; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 148, 153, 162.
Natica canrena Maury, 1917, Bull. Amer. Paleont., No. 29, p. 134, pl. 23, fig. 10; 1920, Sci. Surv. Porto Rico and the Virgin Isls., vol. 3, pt. 1, p. 48; 1922, Bull. Amer. Paleont., No. 38, p. 117.
Natica canrena Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 155, pl. 13, fig. 9.

This ancient, static species, is quickly recognized by the tangential plicæ adjoining the suture, the surface elsewhere being smooth. A good sized Trinidad specimen measures in height 35, width 31 mm.

N. canrena is found in the Miocene of Florida, N. Carolina, Jamaica, Porto Rico, Dominican Republic, and Panama. Its present range is from Hatteras to Pernambuco and throughout the Antilles.

Localitiy.—Springvale.

Horizon.—Upper Miocene.

Natica youngi Maury Pl. 40, Fig 4

Natica Youngi Maury, 1917, Bull. Amer. Paleont., No. 29, p. 135, pl. 23, figs. 11, 12.
Natica youngi Vaughan and Woodring, 1921, Geol. Reconn. Dominican Republic, p. 143.

On comparing the Trinidad specimens with my Dominican types of *Natica youngi* they were seen to correspond perfectly. The shell is subglobose, with the suture well-defined, and the surface smooth, except for fine growth lines. A large Trinidad shell is 25 mm. in height and 24 in width.

This is a descendant of the Eocene *N. permunda* Conrad. *Natica youngi* is present in both the Gurabo and Cercado formations, Dominican Republic; and Mr. Olsson has described variety *cocleana* from the Gatun stage of Costa Rica.

Locality.— Springvale.

Horizon.— Upper Miocene.

Natica cuspidata Guppy Pl. 40, Figs. 9, 10

Natica cuspidata Guppy. 1910, Agr. Soc. Trinidad and Tobago, Paper No. 454, p. 5, pl. 2, fig. 4; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 162, pl. 8, fig. 4.

Shell large, moderately thick, somewhat depressed, being *Sigaretus*-like in general form. Surface smooth except for growth lines. Callus heavy, large, with a well

marked transverse groove dividing it into nearly equal portions. Our largest specimen is 45 mm. in height and 55 in width. Guppy type was 60 x 70. It was obtained from the same place as our specimens.

Locality.— Springvale.

Horizon.—Upper Miocene.

Natica perlineata Dall

Natica perlineata Dall, 1889, Blake Report, Gastr., p. 294.
Natica perlineata Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322.

Recent in the Antilles. Fossil in the Miocene of Montserrate. (Guppy and Dall.)

Genus *POLINICES* Montfort

Polinices stanislas–meunieri Maury Pl. 40, Fig. 7

Polinices Stanislas-Meunieri Maury, 1917, Bull. Amer. Paleont., No. 29, p. 136, pl. 23, figs. 15, 16.
Polinices Stanislas-Meunieri Olsson, 1922, Bull. Amer. Paleont., No. 39, p. 157, pl. 13, fig. 7.

Many of our Trinidad shells seem to agree in all respects with the Dominican types of *stanislas-meunieri.* This species is larger than *subclausa* Sowerby; but relatively thinner, with a higher spire.

A large Trinidad shell measures 39 in height and 30 in diameter; a medium-sized specimen is 33 x 24, the type was 36 x 28 mm.

The type locality was along Rio Cana, Dominican Republic. A Costa Rican shell, 43 x 35 mm., seems typical except in being unusually large.

Locality.—Springvale.

Horizon.—Upper Miocene.

Polinices caparona, n. sp. Pl. 40, Fig. 5

Shell large, ovate, resembling in general form *Polinices stanislas-meunieri* Maury, but of larger size than typical; and differing markedly in the conspicuous concavely

excavated subsutural zone. Height 48, diameter 37 mm.

Locality.—11th mile post on Caparo Road.

Horizon.—Manzanilla Miocene.

Polinices springvalensis, n. sp. Pl. 40, Fig. 6

Shell rather large, rotund, differing from *Polinices stanislas-meunieri* in the very conspicuous shouldering of the whorls. Beneath the suture of each whorl is a little shelf which gives a squarish aspect, quite unlike the evenly and gently rounded contours of *P. stanislas-meunieri*. Height 40, diameter 31 mm.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *EPITONIUM* Bolten

Epitonium (?) leroyi Guppy Pl. 41, Figs. 8, 11

Scalaria leroyi Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 168; Harris' Reprint, 1921, Bull. Amer. Paleont., No 35, p. 47.

Not *Scalaria leroyi* Guppy, 1874, Geol. Mag., London, p. 406, pl. 16, fig. 10 (Jamaica specimen), nor pl. 18, fig. 2 (Trinidad mold of a different shell).

Scalaria leroyi Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 7; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 47.

We have a number of curious molds which are certainly the same as those Dr. Guppy found at Springvale, and in all probability the same as the large molds, "from the Caroni series Savanetta," which constituted the type of his *Scalaria leroyi*. But the illustration of what he thought a small mold of the same species, and figured in the Geological Magazine, 1874, pl. 18, fig. 2, is of something else, and must be entirely rejected.

These molds are of a turreted shell with very convex whorls and a deeply impressed suture. The whorls show only here and there a few spiral threads, and at the base of the body whorl there are one or two strong spirals. But the striking character is that nearly the entire surface of the volutions is dented and faucetted from the attachment of

foreign particles, some of which have left imprints of sculpture and were evidently shell fragments. Most of our specimens measure about 40 x 11 mm., but one has a diameter of 22 mm. All are fragmentary and the complete shell was large, for, *fide* Guppy, the molds may attain six inches in length.

I have never seen or heard of an *Epitonium* with the agglutinative habit, similar to that of *Xenophora agglutinans,* which these molds certainly indicate. Moreover, the characteristic sculpture of *Epitonium* is not shown. The generic position of the molds is very doubtful and they are left in *Epitonium* because one is puzzled to know in what genus they would more truly be placed.

Locality.—Springvale.

Horizon.—Upper Miocene.

Epitonium (Acrilla) pseudoleroyi, n. sp.

Scalaria leroyi Guppy, 1874, Geol. Mag., London, p. 406, pl. 16, fig. 10. Not pl. 18, fig. 2.
Not *Scalaria leroyi* Guppy, 1867, Proc. Sci. Assoc. Trinidad, p. 168; Harris' Reprint, Bull. Amer. Paleont., No. 35, p. 47.
Scala (Acrilla) leroyi Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, No. 1110, p. 328.
Scalaria leroyi Guppy, 1910, Agr. Soc. Trinidad and Tobago, Paper No. 440, p. 7; Harris Reprint, 1921, Bull. 35, p. 47.

The original description of Guppy's *Scalaria leroyi,* in 1867, was based on molds from Trinidad. These are entirely unlike the Jamaican cancellated shell described by Dr. Guppy in 1874, in the Geological Magazine, page 406, and figured pl. 12, fig. 10, as *Scalaria leroyi.*

For this Jamaican species the name *pseudoleroyi* would seem appropriate.

Locality.—Jamaica.

Horizon.—Miocene.

Epitonium (Cirsotrema) tamanensis, n. sp. Pl. 37, Fig. 4

We have a single broken and worn *Epitonium* that appears to belong to the group of *E. cochlea* Sowerby, of

the recent Mediterranean and Antillean faunas, but of much larger size. The specimen shows only the last whorl, which is sculptured with very closely-set, very thin lamellæ, and bears at intervals heavy, rounded varices. The whorl is very strongly carinate above and greatly flattened, forming a wide, flat shoulder, as in *cochlea*. Aperture rounded, surface decorticate. Height of last whorl 20, greatest width 17 mm.

Locality.—13⅛ miles on Cunapo Southern Road.

Horizon.—Tamana Miocene.

Genus *CALYPTRÆA* Lamarck

Calyptræa centralis Conrad Pl. 43, Fig. 2

Infundibulum centralis Conrad, 1841, Amer. Jour. Sci., vol. 41, p. 348.
Infundibulum Candeana d'Orbigny, 1842, Moll. Cuba 2, p. 190, pl. 24, figs. 28, 29.
Calyptræa centralis Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 353.
Calyptræa centralis Maury, 1912, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 15, p. 100, pl. 13, fig. 6.

An ancient species, ranging from Lower Miocene to Recent, and extending from Cape Hatteras almost to the Straits of Magellan.

Our largest Trinidad shell measures 15 mm. in diameter.

Localities.—Southern main road, just south of Pitch Lake, Brighton; Matura.

Horizons.—Upper Miocene; Pliocene.

Genus *CREPIDULA* Lamarck

Crepidula aculeata Gmelin

Patella aculeata Gmelin, 1788, Syst. Nat., p. 3693.
Crepidula aculeata Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 35; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 15.
Crepidula aculeata Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 160; Harris' Reprint, 1921, Bull. 35, p. 39.
Crepidula aculeata Guppy, 1874, Geol. Mag., London, p. 441.
Crepidula aculeata Tryon, 1886, Man. Conch., vol. 8, p. 129, pl. 39, figs. 61, 62.
Crepidula aculeata Dall, 1889, Bull. U. S. Nat. Mus., No. 37, p. 152.
Crepidula aculeata Maury, 1922, Bull. Amer. Paleont., No. 38, p. 114.

Comparison of Trinidad fossil specimens with recent Florida shells of *C. aculeata* shows a perfect similarity.

When the surface is not worn, this species has narrow, radiating riblets bearing short, prickly spines. Length of largest fossil shell 25, greatest width 18 mm. The typical form appeared in the Pliocene of Florida and is now living on the east coast from Lat. 35° N. to Lat. 35° S., and on the west coast from California to Chile.

Locality.—Matura.

Horizon.—Upper Pliocene.

Crepidula fornicata Linnæus

Patella fornicata Linnæus, 1767, Syst. Nat., ed. 12, vol. 1, p. 1257.
Crepidula fornicata Gould, 1870, Invert. Mass., p. 271, fig. 532.
Crepidula fornicata Dall, 1889, Bull. 37, U. S. Nat. Mus., p. 152, pl. 48, fig. 16, pl. 50, figs. 23, 24; 1892, Trans. Wagner Inst. Sci., vol. 3, p. 356.

In the collection is a young shell, and a larger imperfect specimen, resembling recent examples of *C. fornicata* from Florida. But the identification is not certain because the interior of the fossils is concealed by the matrix.

This species is boat-shaped, arched, convex, with half of the cavity floored over. The degree of convexity varies with the nature of the object to which the shell is attached.

C. fornicata first appeared in the Chipolan Miocene of Florida, and is now living along the Atlantic coast to Cartagena, Colombia, and through the Antilles.

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *CALLIOSTOMA* Swainson

Calliostoma decipiens Guppy Pl. 43, Fig. 9

Trochus decipiens Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 161, 172; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 40, 51.
Trochus decipiens Guppy, 1874, Geol. Mag., London, p. 435, pl. 18, fig. 18.

Shell conic, imperforate, with about seven whorls, the first two nuclear, smooth, porcellaneous. Later whorls

angulated near their lower margins, slightly concave above, and ornamented with rows of granules that tend to alternate in strength. Aperture squarish, wider than high. Columella covered with a callus. Altitude 14, greatest diameter 15 mm.

This species is a member of the group of *Calliostoma philanthropus* Conrad, of the Maryland Miocene, and *C. euglyptum* A. Adams, of the Recent fauna. It is at once distinguished from the associated species, *C. plicomphalus* Guppy, by its imperforate shell and carinated whorls.

Locality.—Matura.

Horizon.—Upper Pliocene.

Calliostoma decipiens var. **laticarinatum** Guppy Pl. 43, Figs. 5, 10

Trochus granulatus Guppy, 1864, Trans. Sci. Assoc. Trinidad, p. 35; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, p. 15. Not *granulatus* Born.

Trochus decipiens var. *laticarinatus* Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 161, 172; Harris' Reprint, 1921, Bull. 35, pp. 40, 51.

Trochus decipiens var. *laticarinatus* Guppy, 1874, Geol. Mag., London, p. 435, pl. 18, fig. 19.

This variety is more strongly keeled than the typical form, with the whorls above the carination more concavely excavated. As in the typical *decipiens,* the two whorls following the nuclear, are not only striate but also very delicately, longitudinally ribbed, forming a dainty, microscopic cancellation. Later whorls ornamented only with the granular spiral striæ which generally alternate in strength. Altitude 12, greatest diameter 14 mm. In form this is not unlike *C. philanthropus* var. *eliminatum* Dall, but differs in sculpture from that Cape Fear River, Miocene shell.

Locality.—Matura.

Horizon.—Upper Pliocene.

Calliostoma caronianum, n. sp. Pl. 43, Fig. 8

Shell of moderate size, imperforate, with about eight whorls, the first two nuclear. Later volutions with a carination at the lower third, above which there is an excavated

zone extending to the suture. The entire surface is sculptured with very numerous, very fine, subequal, beaded threads often with crenate striæ between them. On the base the revolving threads are coarser centrally and are crenated by growth lines. Towards the margin the spirals become as fine as those on the upper surface of the shell. Basal periphery roundly carinate. Altitude 16, greatest diameter 16 mm.

This differs from the Pliocene *C. decipiens* in being much more closely and finely spirally sculptured, and in its carinated whorls. From *decipiens* var. *laticarinatum,* it differs in its much greater altitude and in the form of the whorls above the carination.

Like *C. decipiens, C. caronianum* is a member of the group of *C. philanthropus,* and in form and general type of sculpture resembles *C. conradianum* Dall (perhaps a variety of *philanthropus*), but is less than half the size of that splendid shell.

Locality.—Springvale.

Horizon.—Upper Miocene.

Section *EUTROCHUS* A. Adams

Calliostoma (Eutrochus) plicomphalus Guppy Pl. 43, Figs. 11, 13, 15

Trochus plicomphalus Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 161, 173; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 40, 52.

Trochus plicomphalus Guppy, 1874, Geol. Mag., London, p. 435, pl. 18, fig. 17.

Shell large, very broadly conic, the diameter being greater than the height, with about eight whorls, very deeply circularly perforate, the perforation bordered by a coarsely beaded thread. The sculpture is of closely-set, spiral granular lines, frequently alternating in strength. Aperture subquadrate. Columella nearly straight. Our largest shell is 20 mm. in altitude and 25 in greatest diameter. A smaller one measures 13 x 15 mm.

This species is very close to the recent *C. jujubinum*

var. *perspectivum* (Koch) Philippi (=*tampænsis* Conrad) which is living from Cape Hatteras to Honduras but the Trinidad fossil is broader. As Dr. Guppy said, it has much the general form of the Mediterranean *C. zizyphinum* Linnæus, but is not keeled.

Locality.—Matura.

Horizon.—Upper Pliocene.

Calliostoma (Eutrochus) olssoni, n. sp. Pl. 43, Fig. 6, 14

Shell small, broadly conic, about five-whorled, low, perforate; body whorl carinate; suture deeply channelled and bordered beneath by a handsome row of large beads. Elsewhere the sculpture is of spiral rows of much finer granules, often alternating with still finer granose striæ. On both the penultimate whorl, and on the last volution above the carina, there are about five spirals, each set capped by its row of beads. The carina is a smooth spiral cord and all the spirals on the under surface of the shell are smooth, except the two or three nearest to the perforation which are granose. Aperture strongly angled by the basal carina. Altitude of largest shell 7, greatest diameter 13 mm. The smaller measures 4.5 x 7 mm.

A most attractive species, distinguished from the associated Calliostomas by its flattened form and the row of large beads bordering the suture. It is dedicated to Mr. Axel Olsson.

Locality.—Matura.

Horizon.—Upper Miocene.

Genus *DILLWYNELLA* Dall

Dillwynella errata Guppy

Dillwynella errata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 323, pl. 27, fig. 2.

Cadulus bed, Pointe-à-Pierre (Guppy).

Horizon.—Miocene.

Genus *SOLARIELLA* S. Wood

Solariella caroniana, n. sp. Pl. 43, Figs. 7, 12

Shell small, conic, with about five volutions. General form of whorls rounded, but beneath the suture they are strongly flattened and shouldered. Each shoulder is edged by a spiral thread, finely and daintly beaded. On the body whorl, a spiral of equal strength, but not beaded, borders the periphery, and equidistant between it and the shoulder spiral are a pair of much finer spirals. Beneath the rounded periphery are two major spirals and many very fine threads. The very deep, circular perforation is boardered by a coarse, crenate thread. The entire surface of the upper part of the shell is marked with raised, oblique threads in harmony with the direction of growth. These lines at their intersection with the shoulder spirals produce the beading. Height of shell 7, greatest diameter 7 mm.

This species resembles *Solariella altiuscula* Guppy (Proc. U. S. Nat. Mus., vol. 19, pl. 27, fig. 17, 1896) from the Jamaican Miocene; but that is more strongly spirally sculptured and lacks the beading on the carinæ.

Locality.—Springvale.

Horizon.—Upper Miocene.

Solariella (?) semidecussata Guppy

Solarium semidecussatum Guppy, 1867, Proc. Sci. Assoc. Trinidad, pt. 3, pp. 156, 170; Harris' Reprint, 1921, Bull. Amer. Paleont., No. 35, pp. 35, 49.

Solarium semidecussatum Guppy, 1874, Geol. Mag., London, p. 408, pl. 18, fig. 14.

Solarium semidecussatum Dall, 1892, Trans. Wagner Inst. Sci., vol. 3, p. 407.

Fide Dr. Dall, this species is probably a *Solariella*. Guppy's description sounds like it, but is inadequate and the figure is poor. The shell is small, orbicular, depressed, strongly decussate on the upper surface, nearly smooth beneath. Perforation deep, crenate on the margin.

Locality.—Matura (Guppy).

Horizon.—Upper Pliocene.

Genus *TEINOSTOMA* A. Adams

Teinostoma caroniense, n. sp. Pl. 43, Figs. 3, 4

Shell very small, imperforate, polished and shining. Spire flattened, suture distinct, impressed; whorls five, the first two minute, nuclear. Body whorl convexly rounded. Callus covering the umbilical region somewhat crescent-shaped. The surface of the shell appears entirely smooth; but under a compound microscope faint growth lines are seen, and on the last volution extremely fine, incised spiral striæ. On the third whorl, these are very delicately cancellated by the growth lines, but this is seen only with high magnification. The greatest diameter of the larger specimen is 4.5, altitude 2.20 mm.

This species differs from *Teinostoma sandomingense* Maury, from the Dominican Miocene in the following respects: The callus in the Dominican shell is larger and spreads circularly over the umbilicus, while in the Trinidad shell it is like a plug pushed in, and continuous with the callosity of the lip; the surface of the Dominican shell shows no spirals even under the compound microscope; and the body whorl is flattened and somewhat excavated beneath the suture which is not the case in the Trinidad shell. *Teinostoma angulatum* Gabb, has very much fainter spirals. *T. depressum* Gabb is entirely smooth, and *vitreum* Gabb, has only 3¾ whorls and is less than half the size of *caroniense.*

Locality.—Springvale.

Horizon.—Upper Miocene.

Genus *FISSURIDEA* Swainson

Fissuridea alternata Say Pl. 43, Fig. 1

Fissurella alternata Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 281.
Fissuridea alternata Dall, 1892, Trans. Wagner Inst. Sci., vol. 3,

p. 428.
Fissuridea alternata Maury, 1917, Bull. Amer. Paleont., No. 29, p. 157, pl. 24, fig. 22.
Fissuridea alternata Maury, 1922, Bull. Amer. Paleont., No. 38, p. 136.

In addition to the alternation in size of the riblets, every fourth ray tends to be larger, as is often the case in the recent specimens. Probably our Trinidad specimens are stunted examples of this species, which appeared first in the Dominican Miocene, and ranges now from Cape Hatteras to Brazil.

Locality.—Matura.

Horizon.—Pliocene.

PLATES

Photo's by G. D. Harris
Halftn's by the Ithaca Engraving Company

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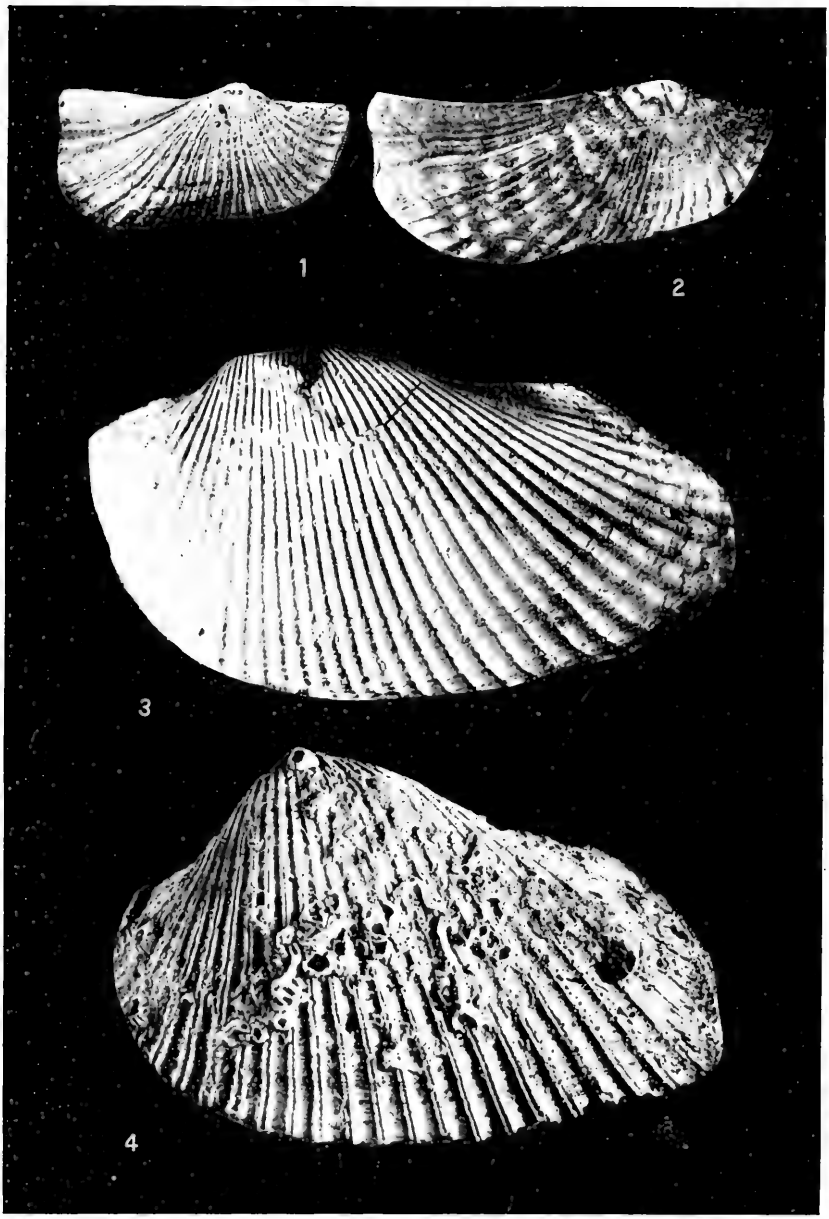
Figures are natural size unless the dimensions are given.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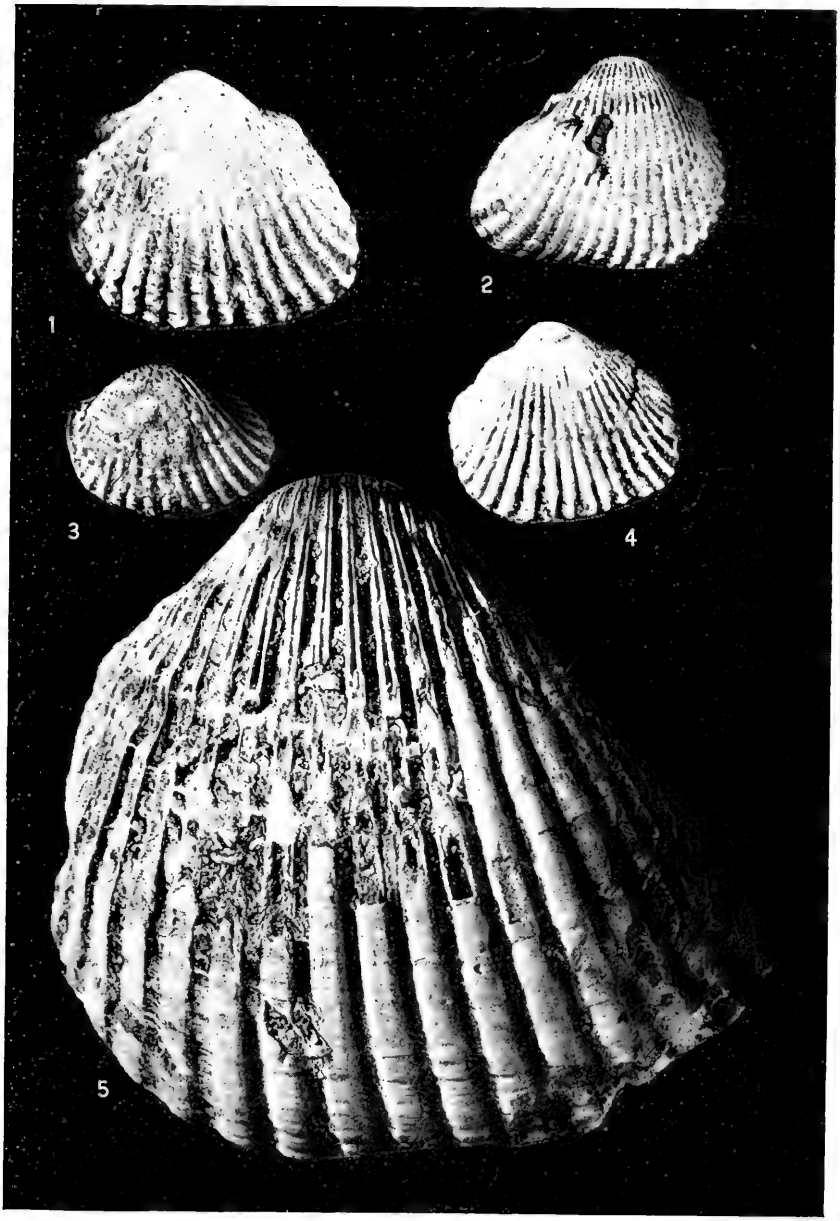
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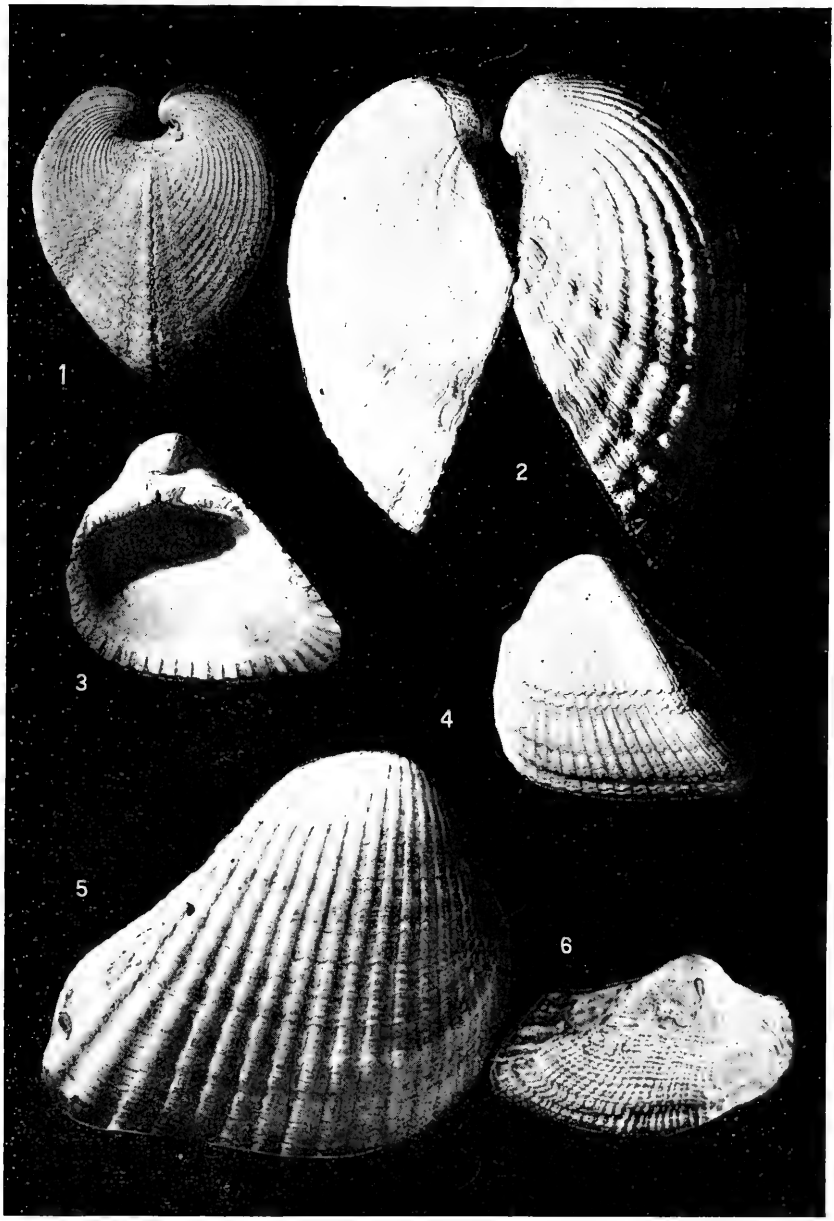
Explanation of Plate 3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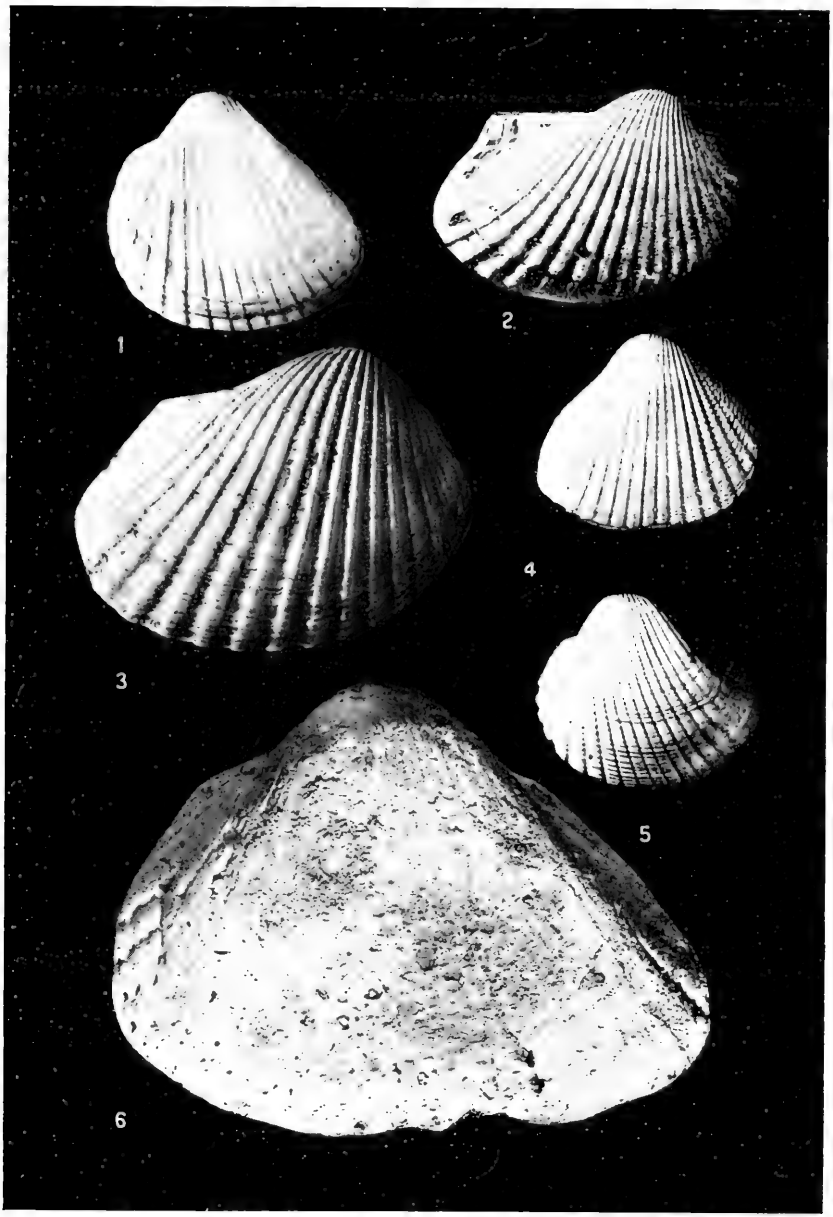
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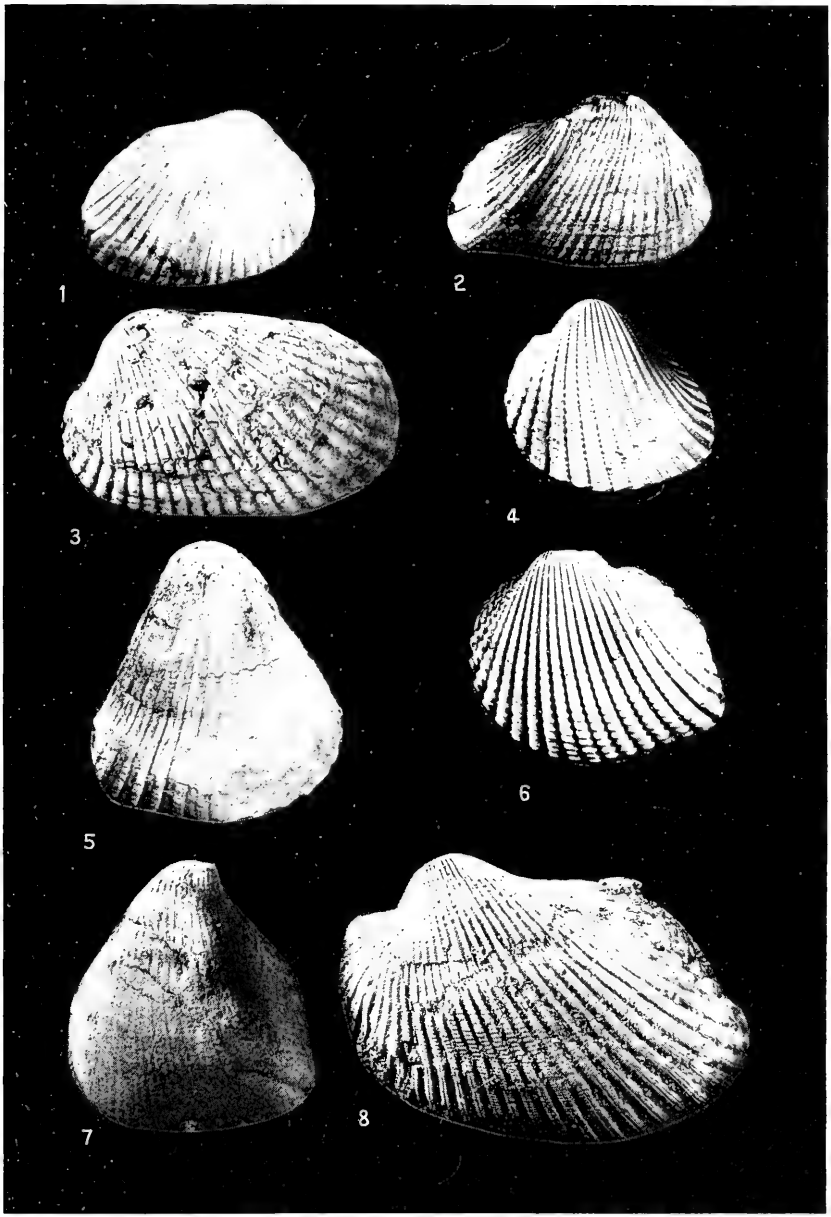
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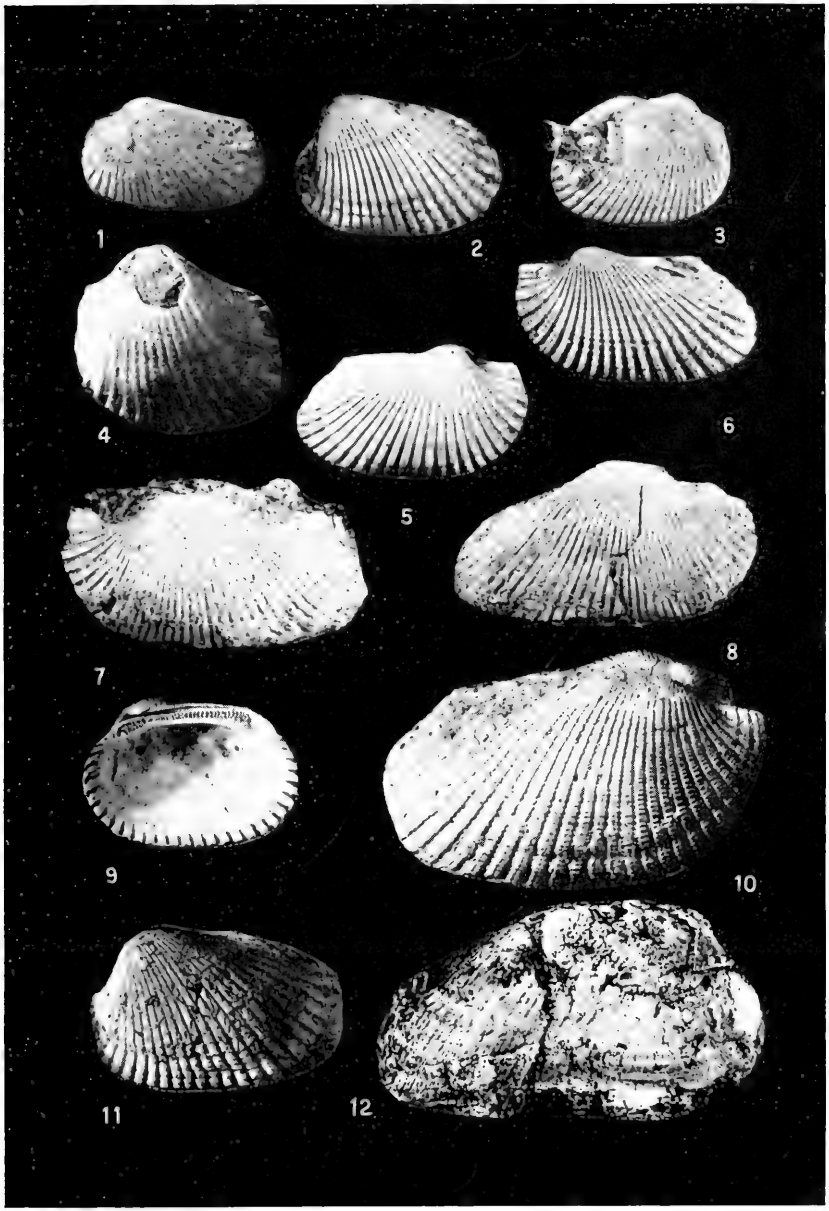
Explanation of Plate 6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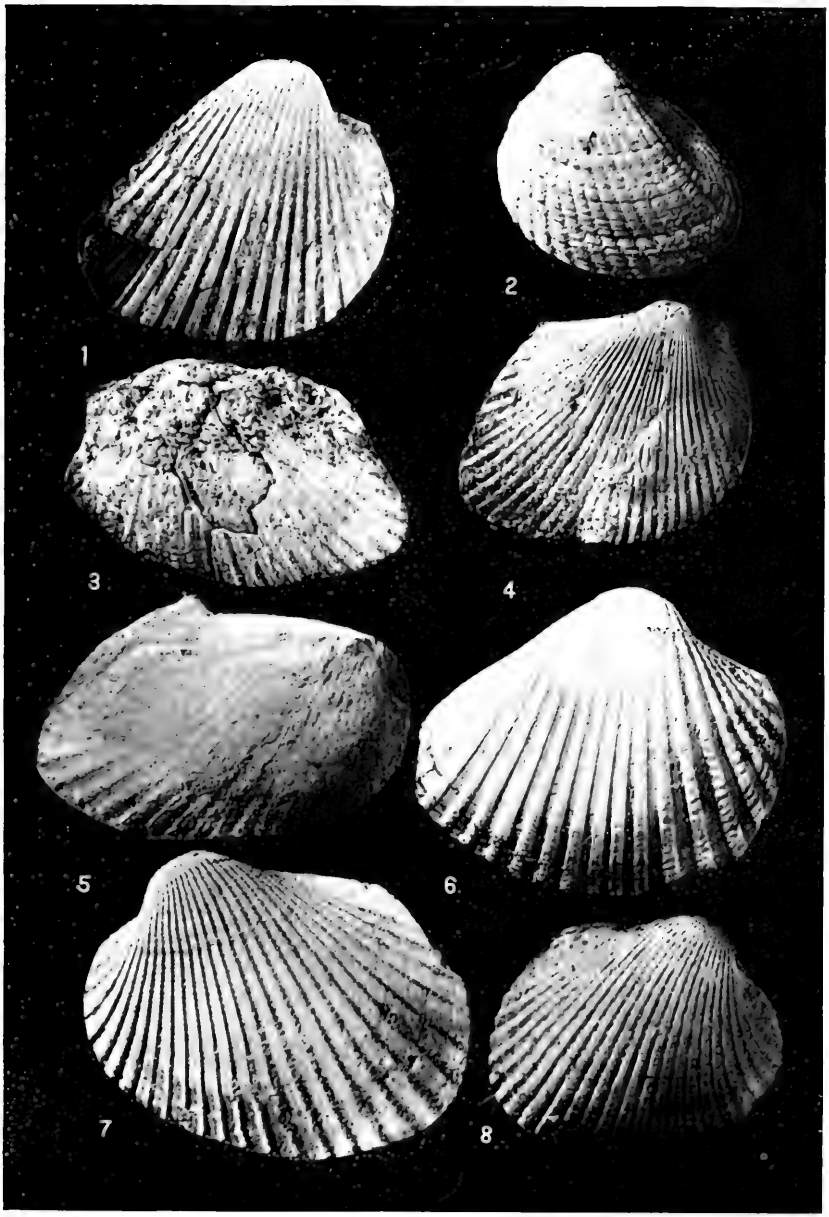
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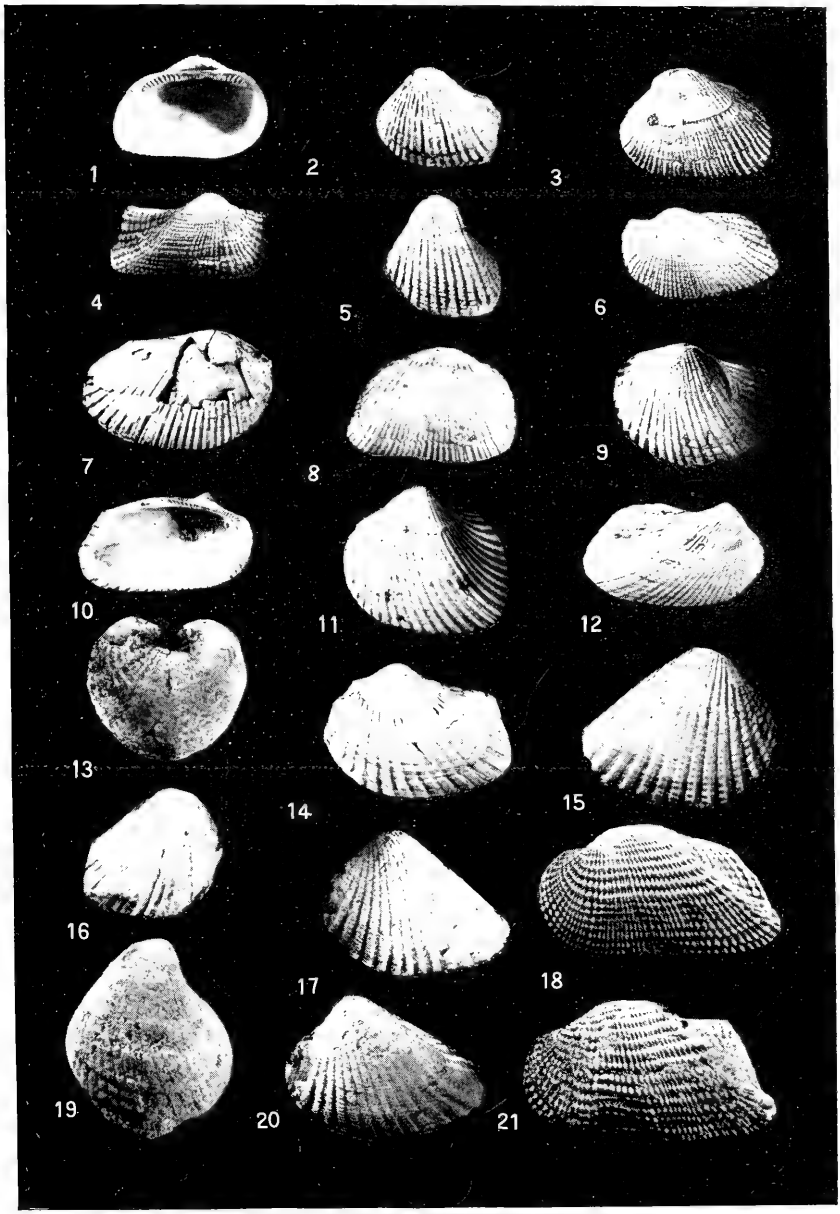
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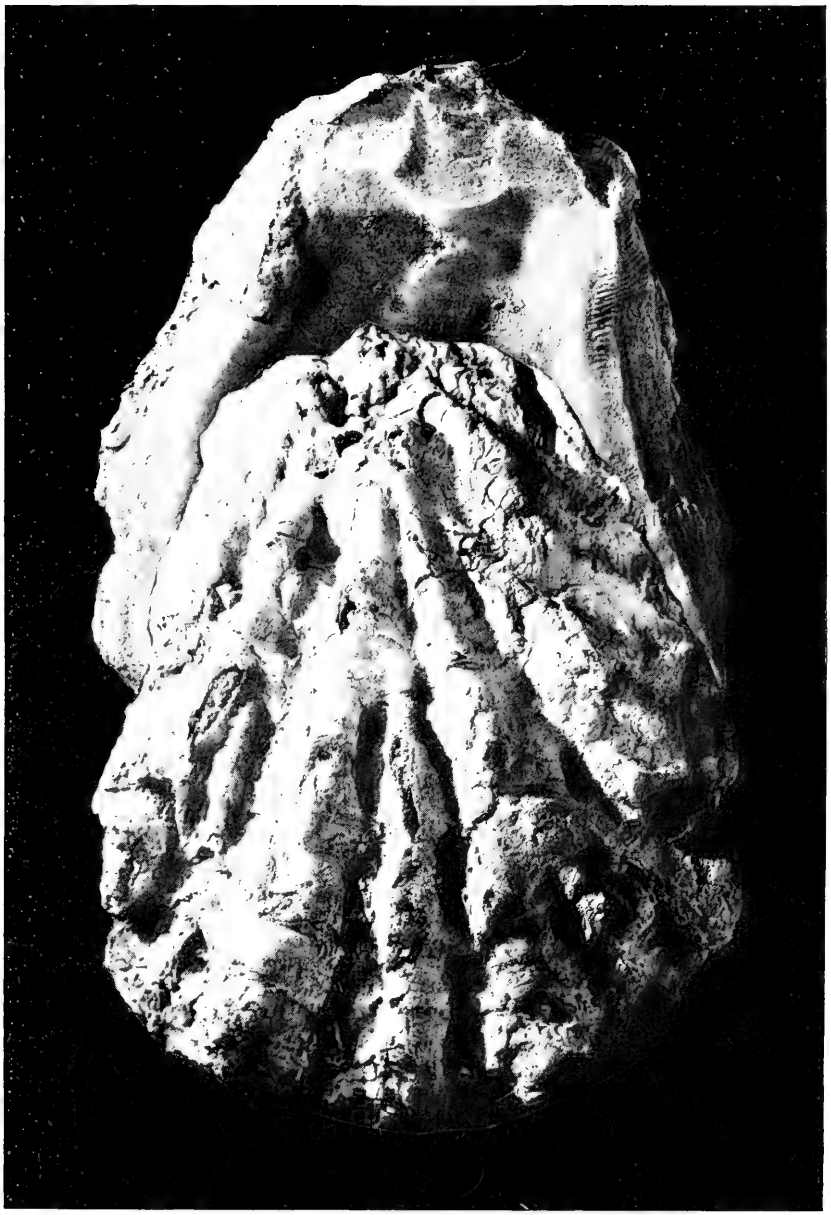

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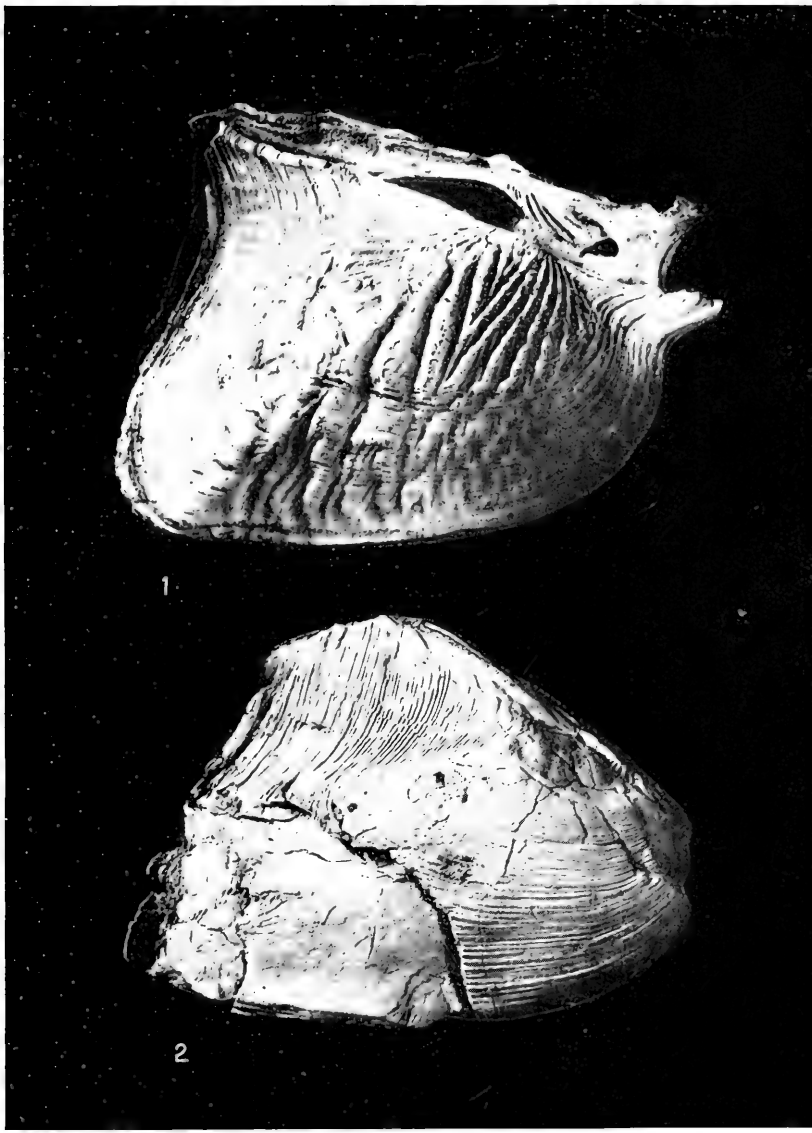
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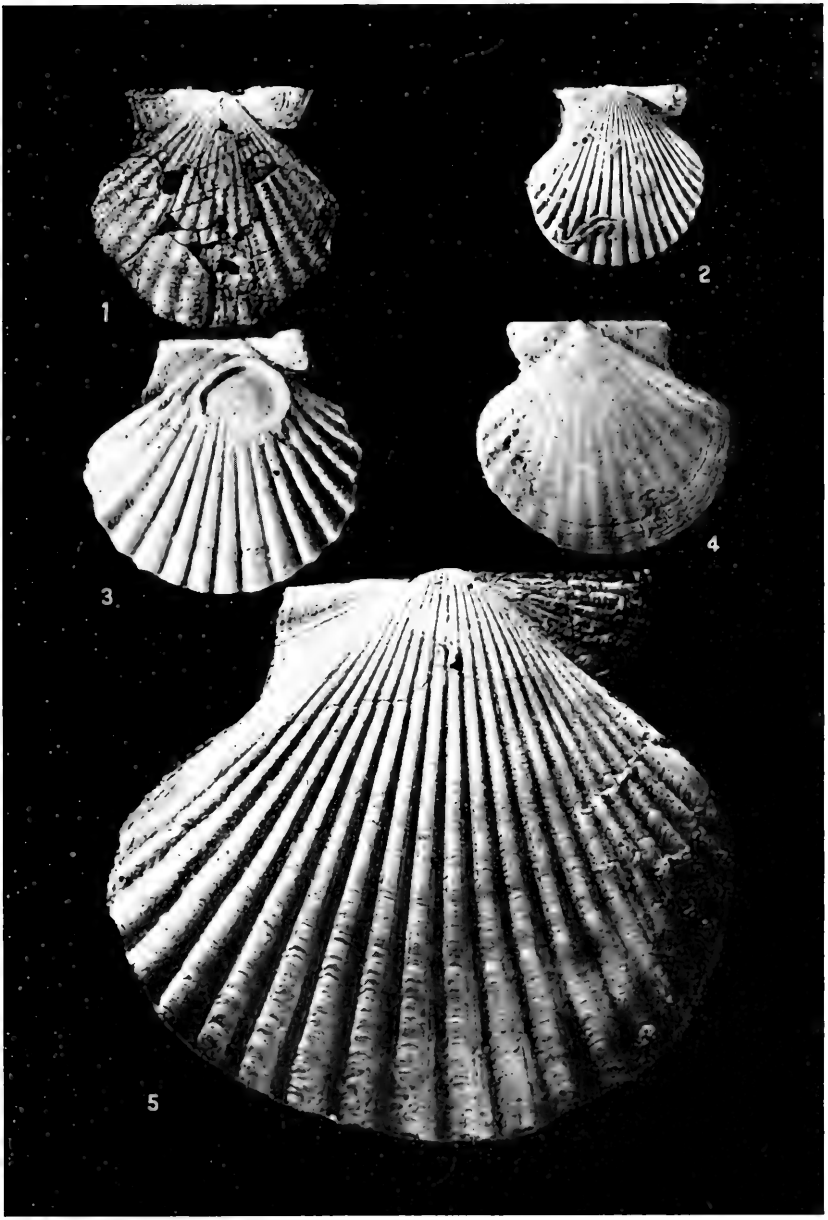
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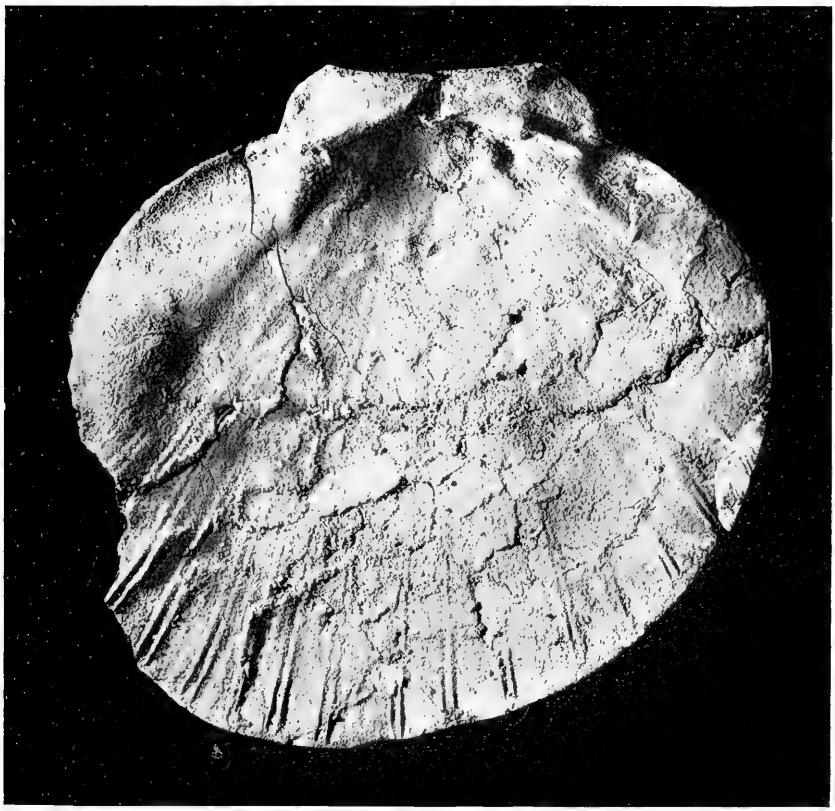

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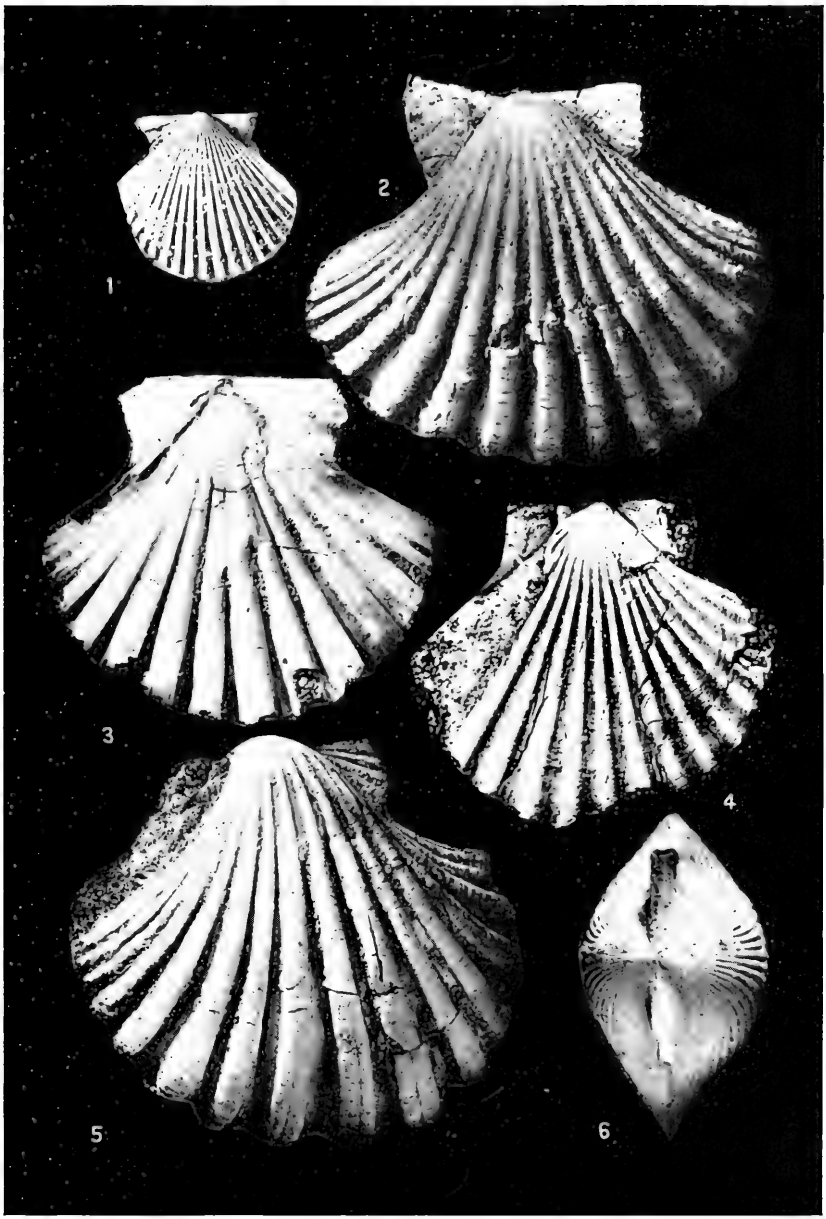
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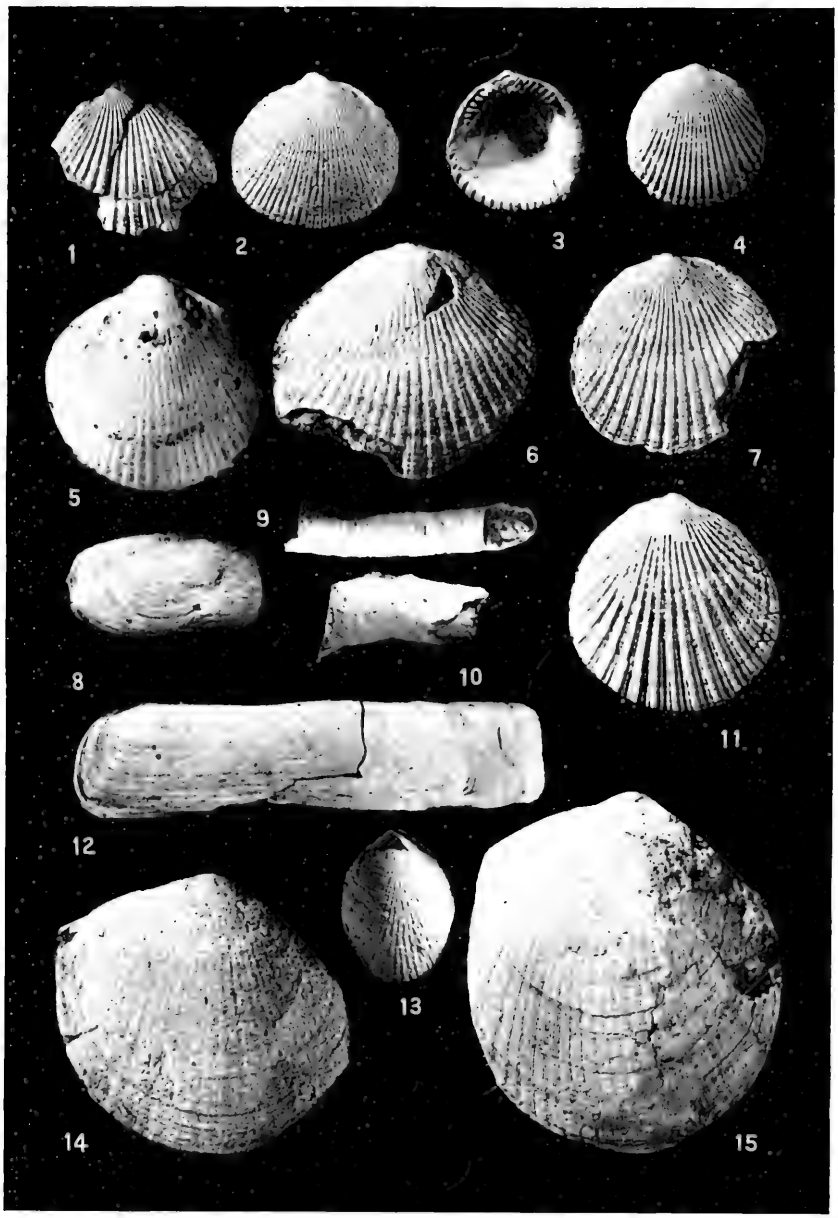
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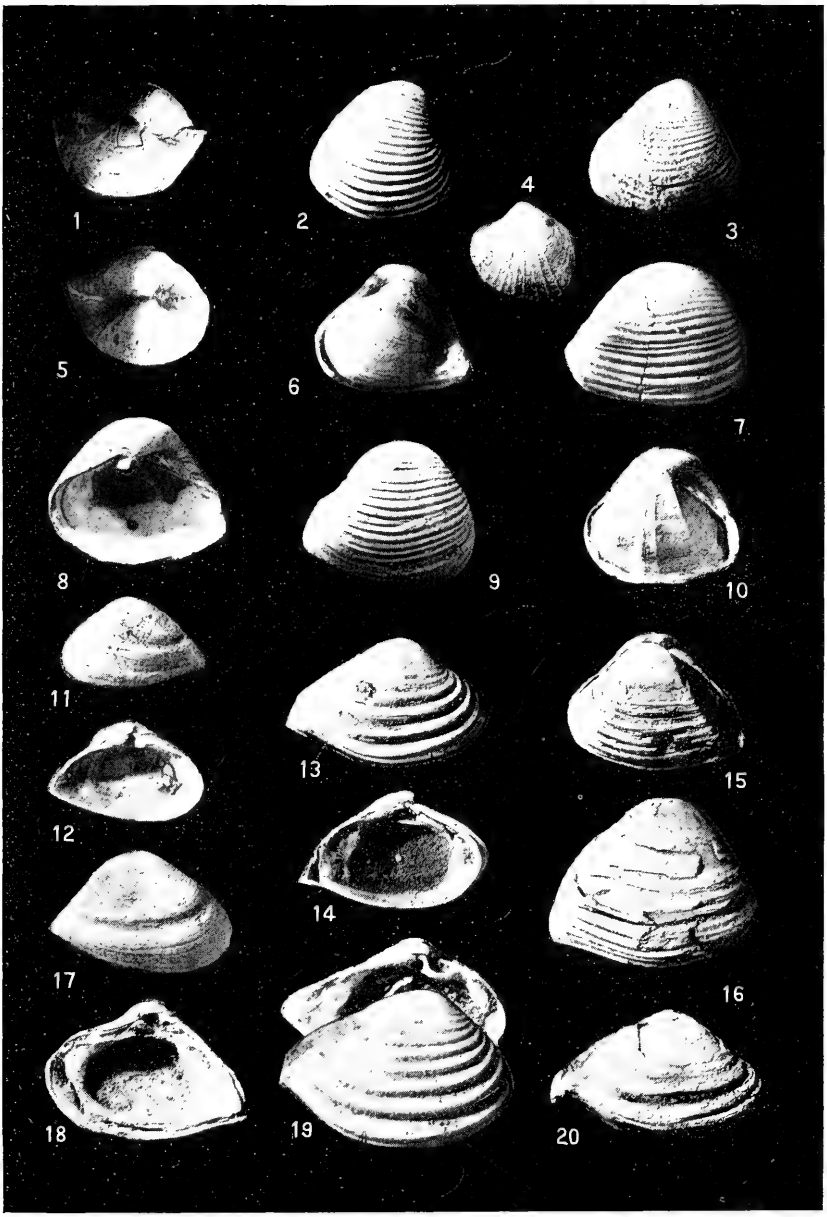
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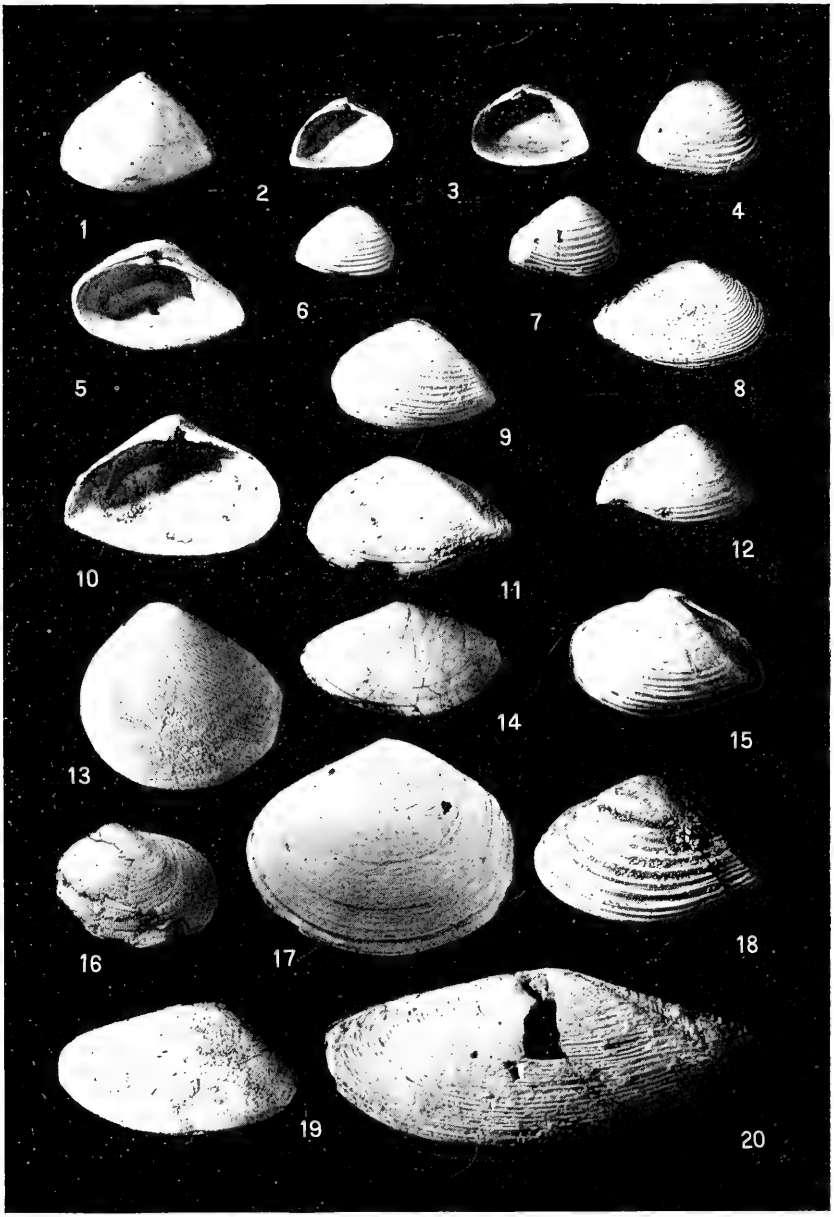
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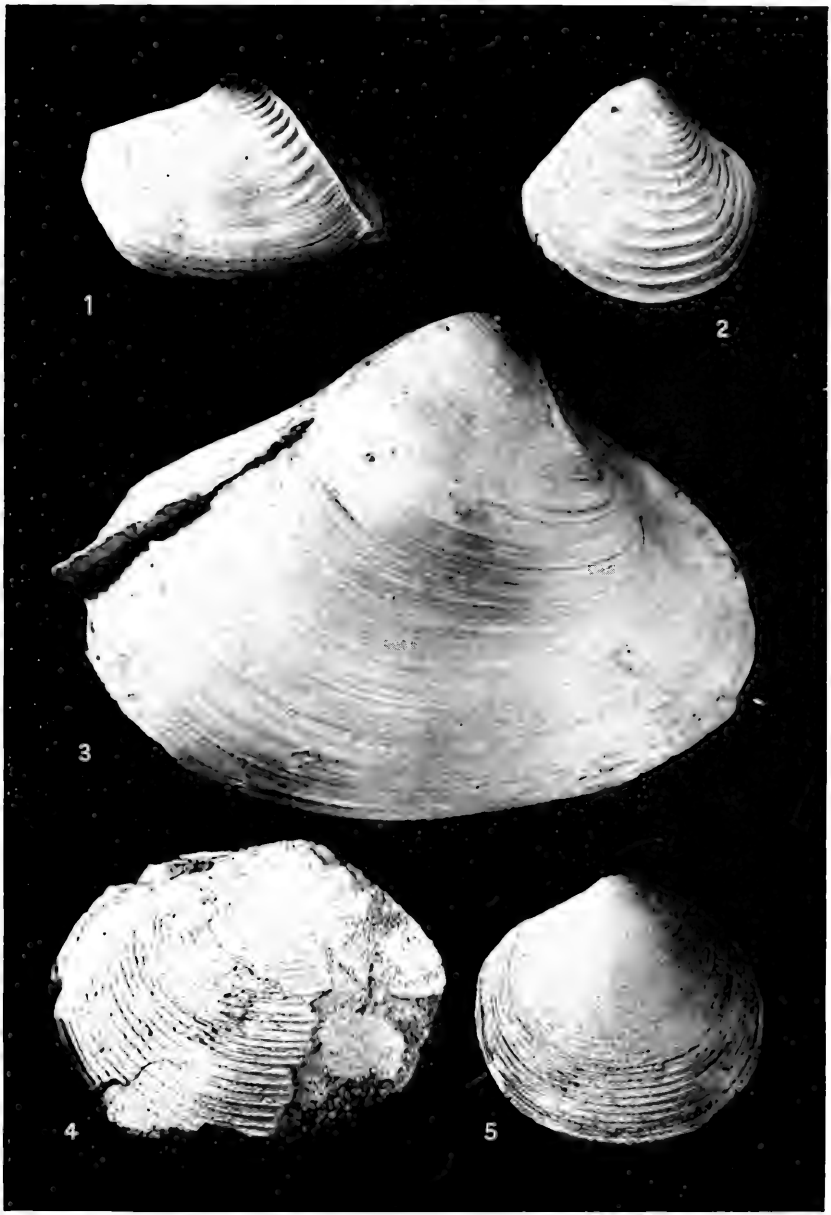
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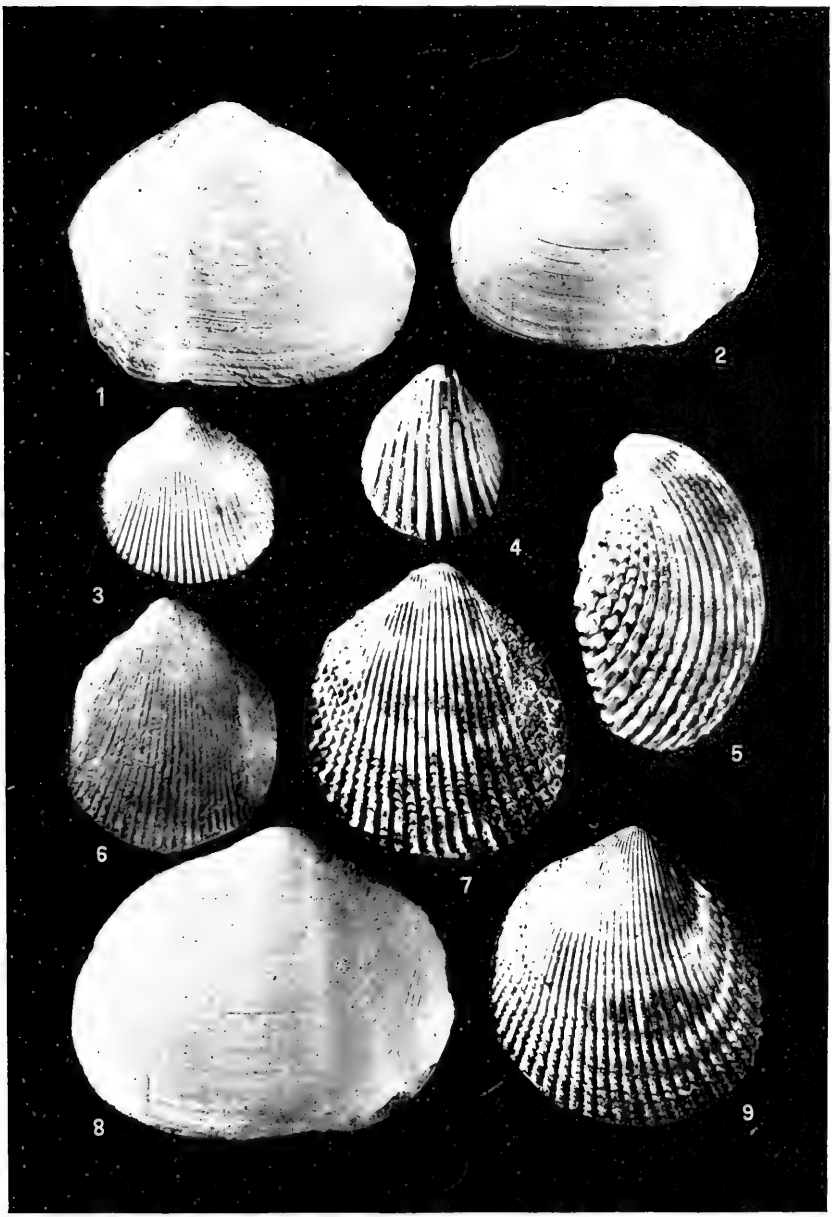
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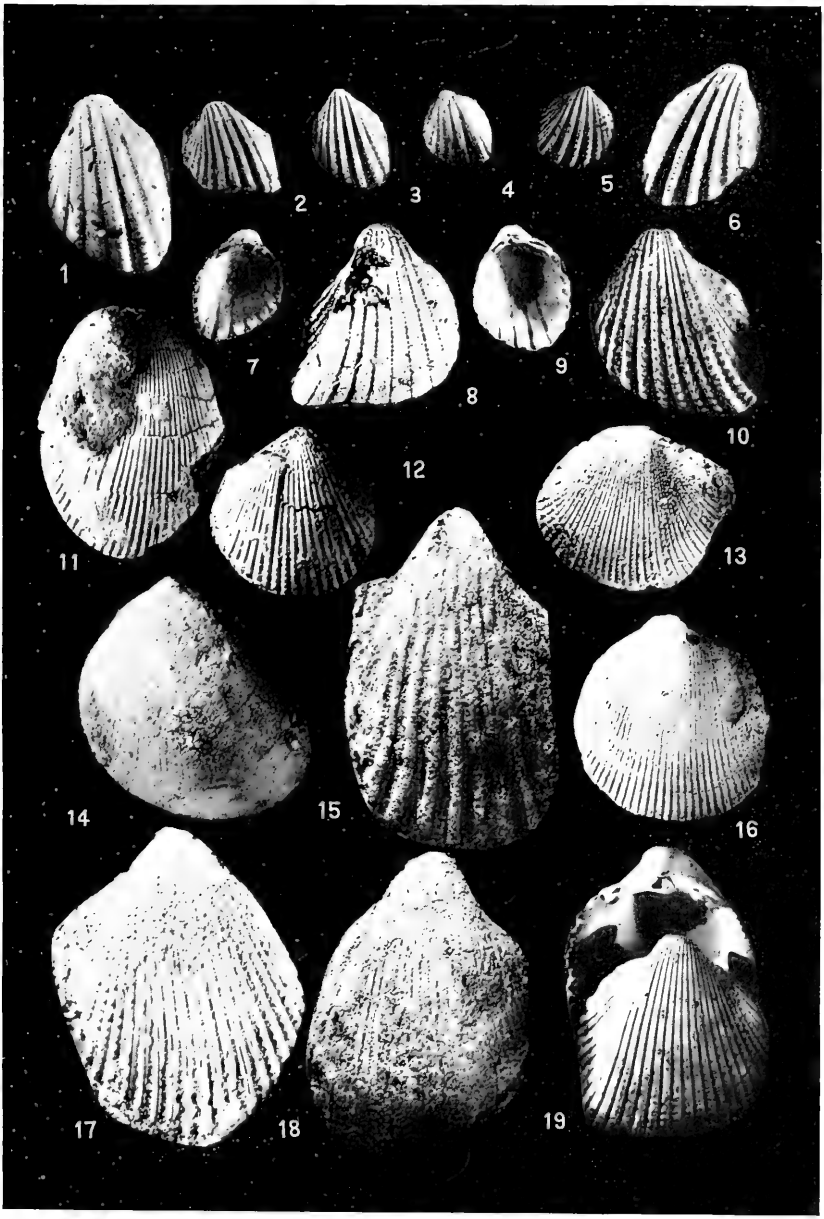
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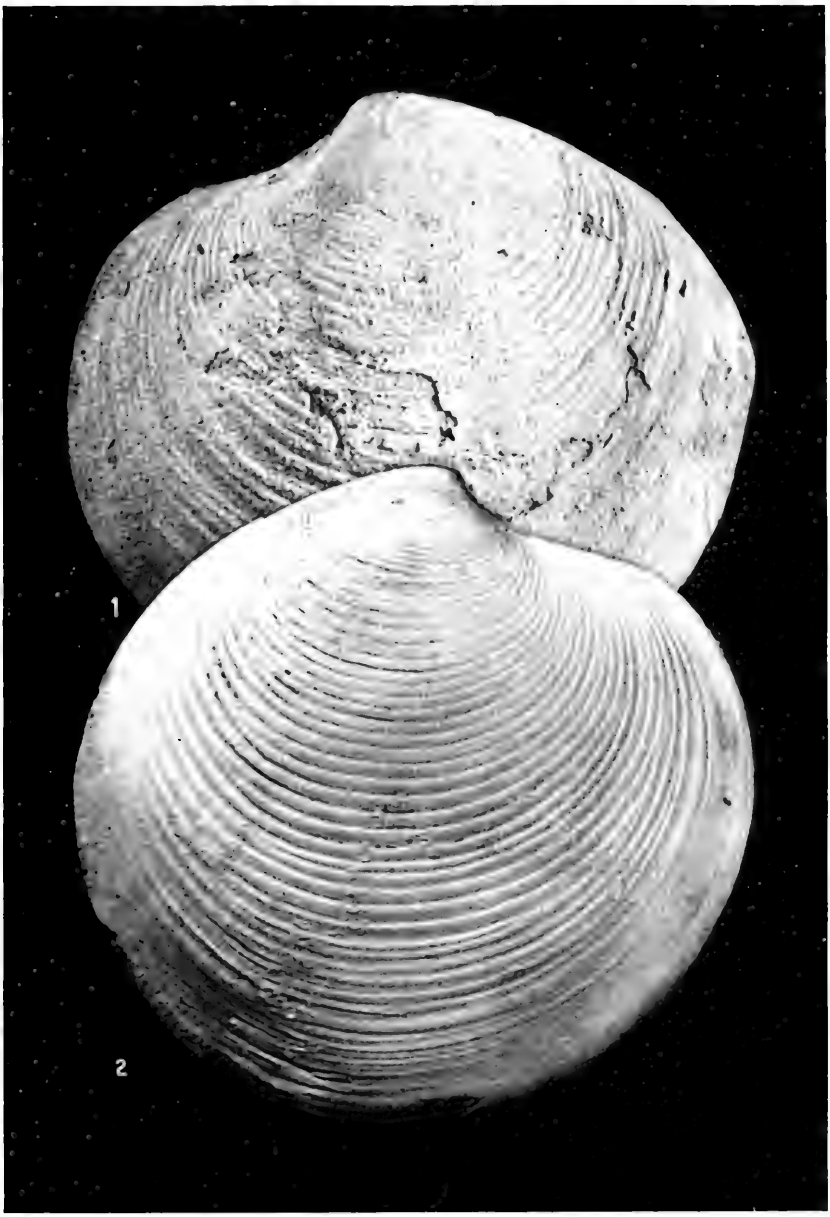
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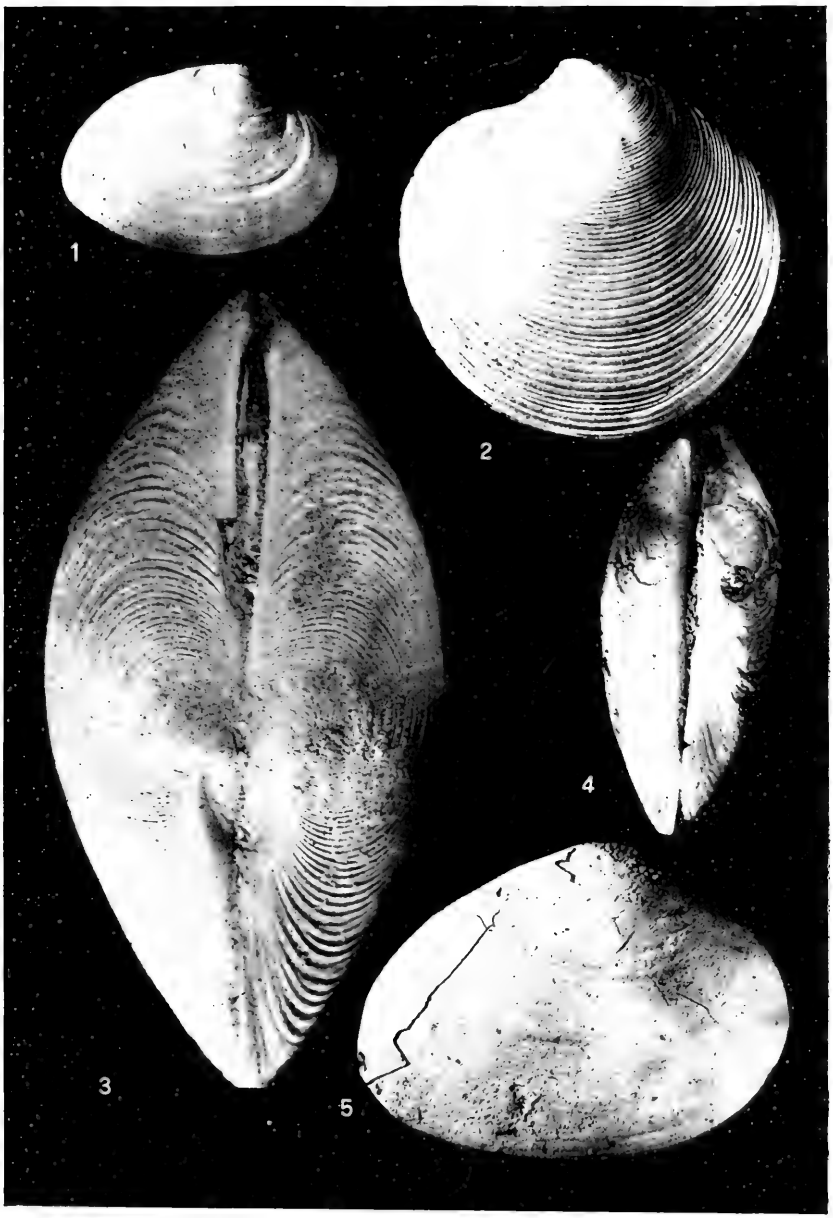
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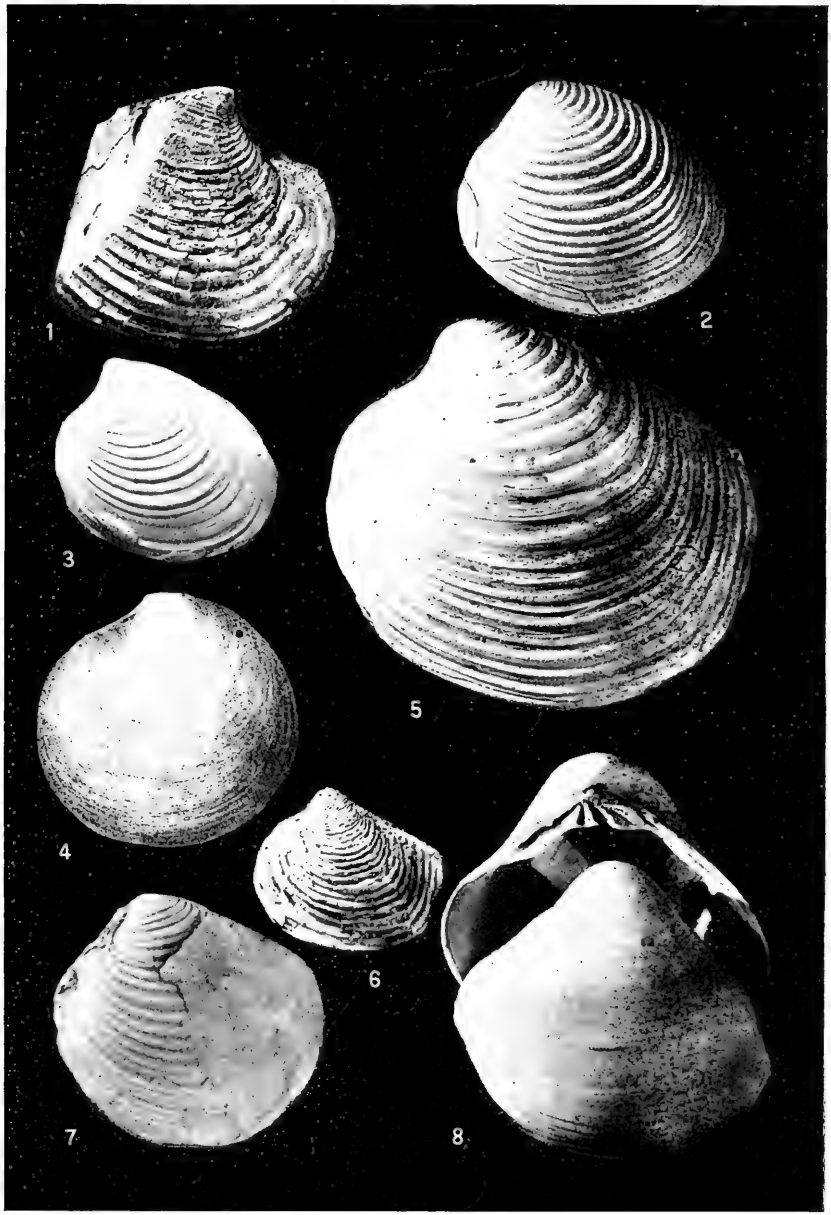
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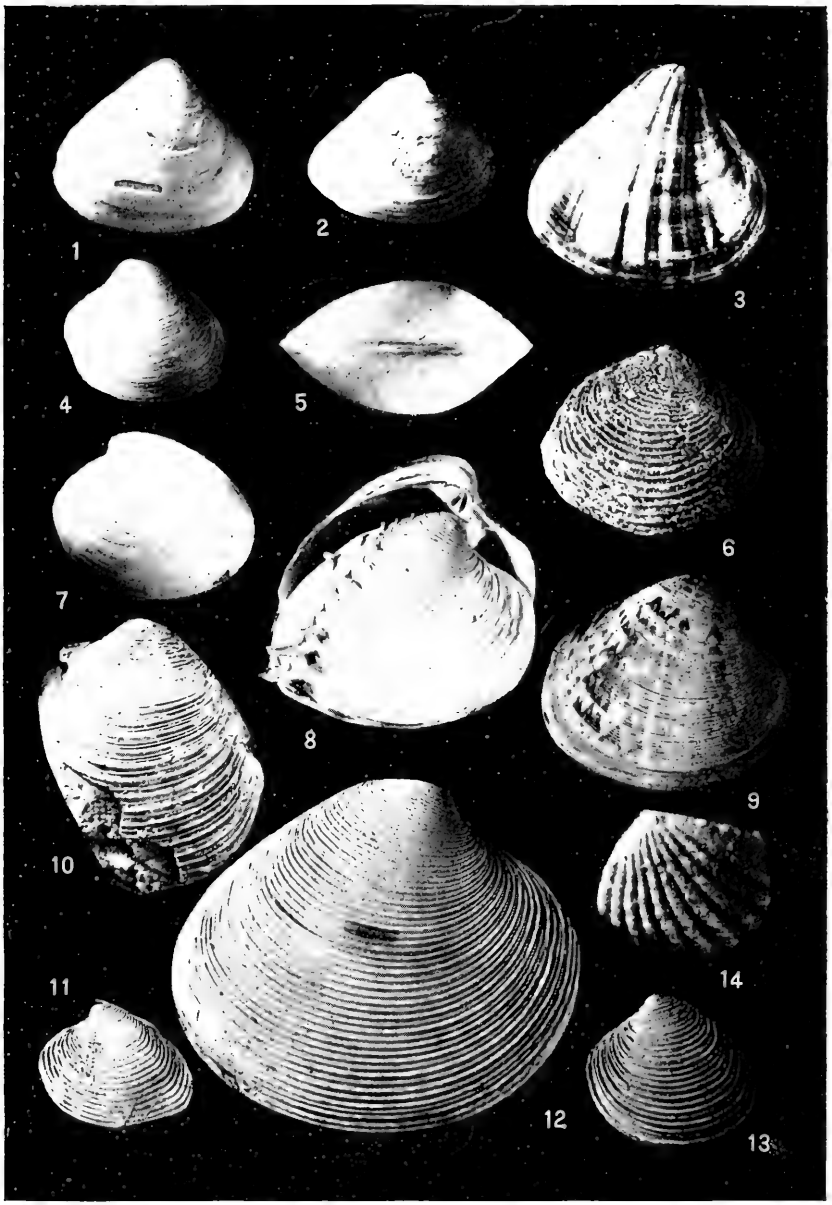
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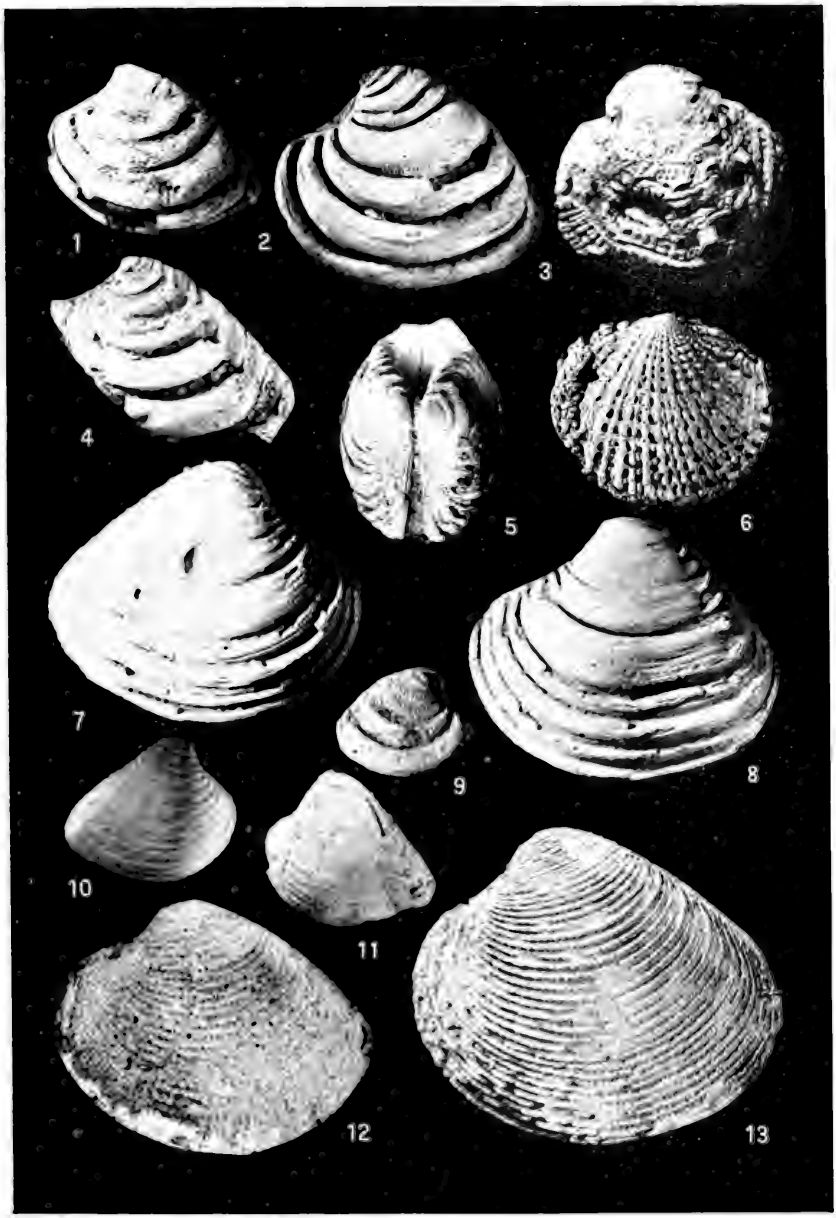
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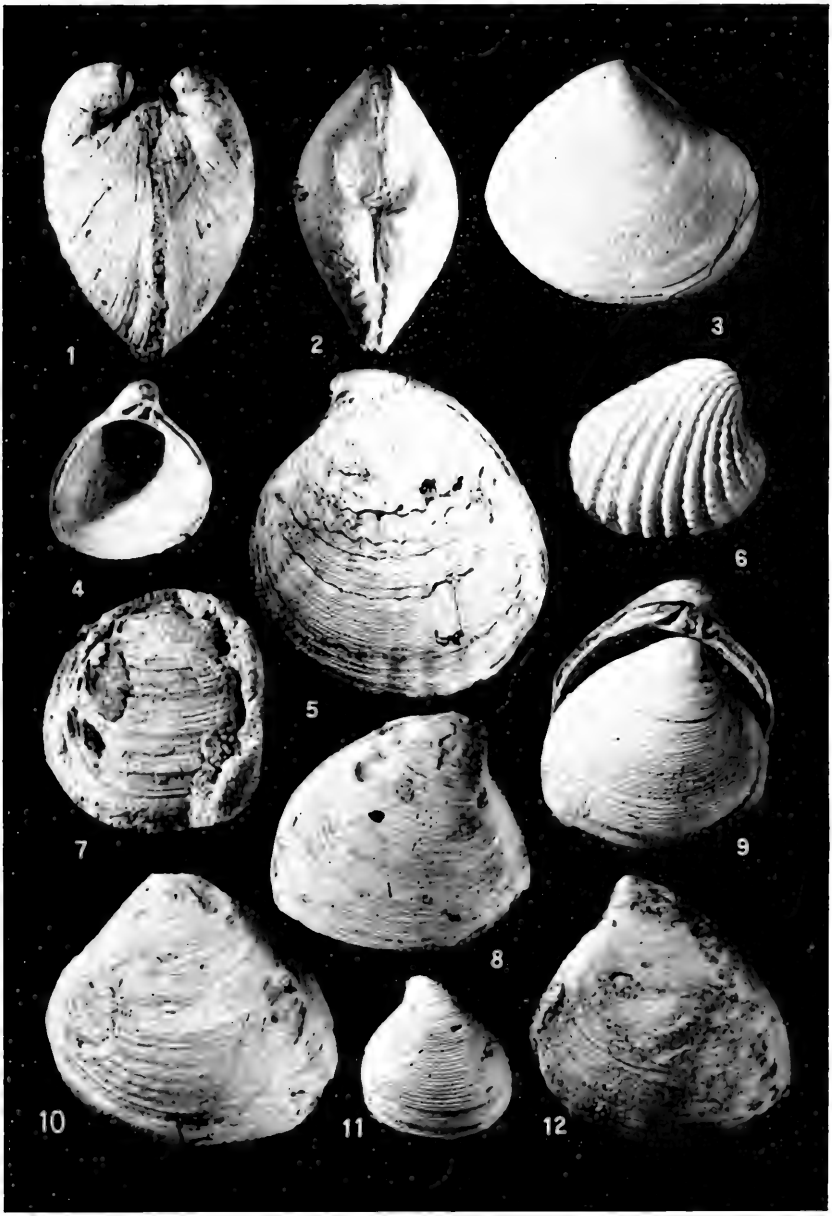
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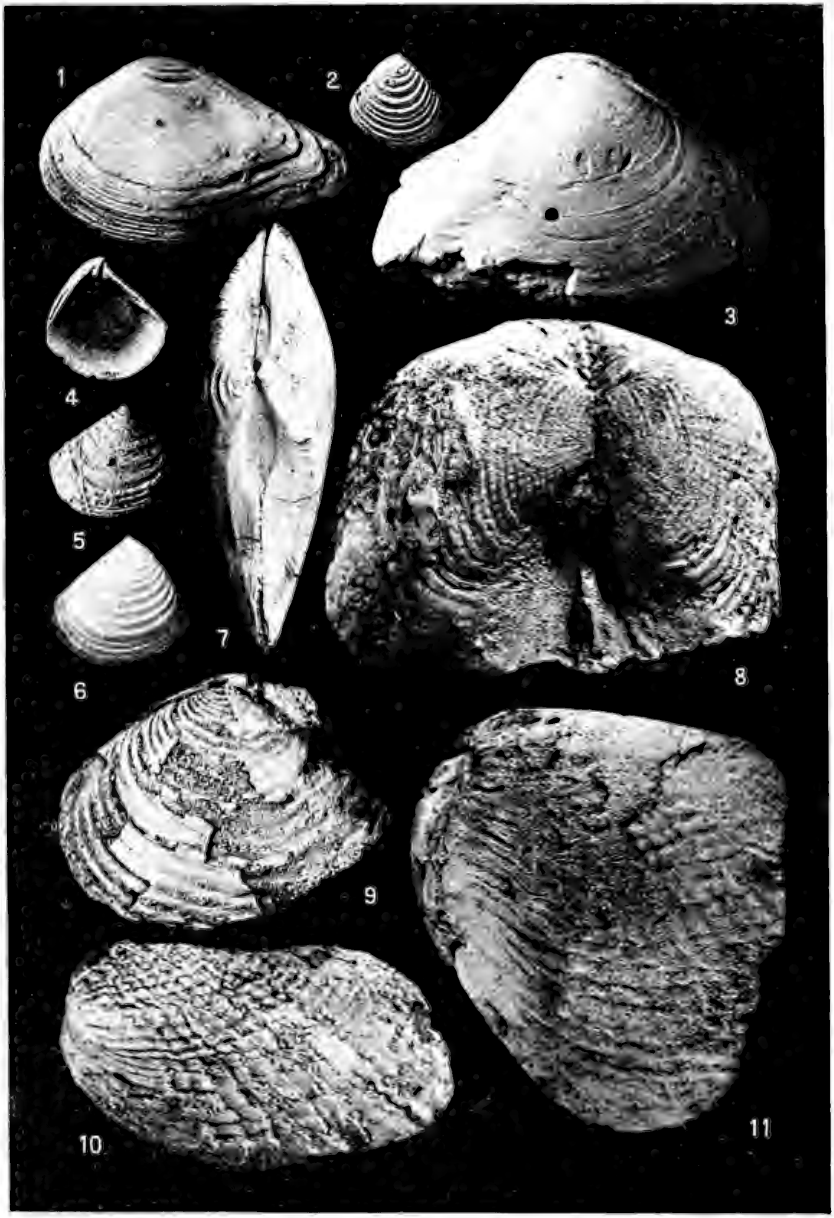
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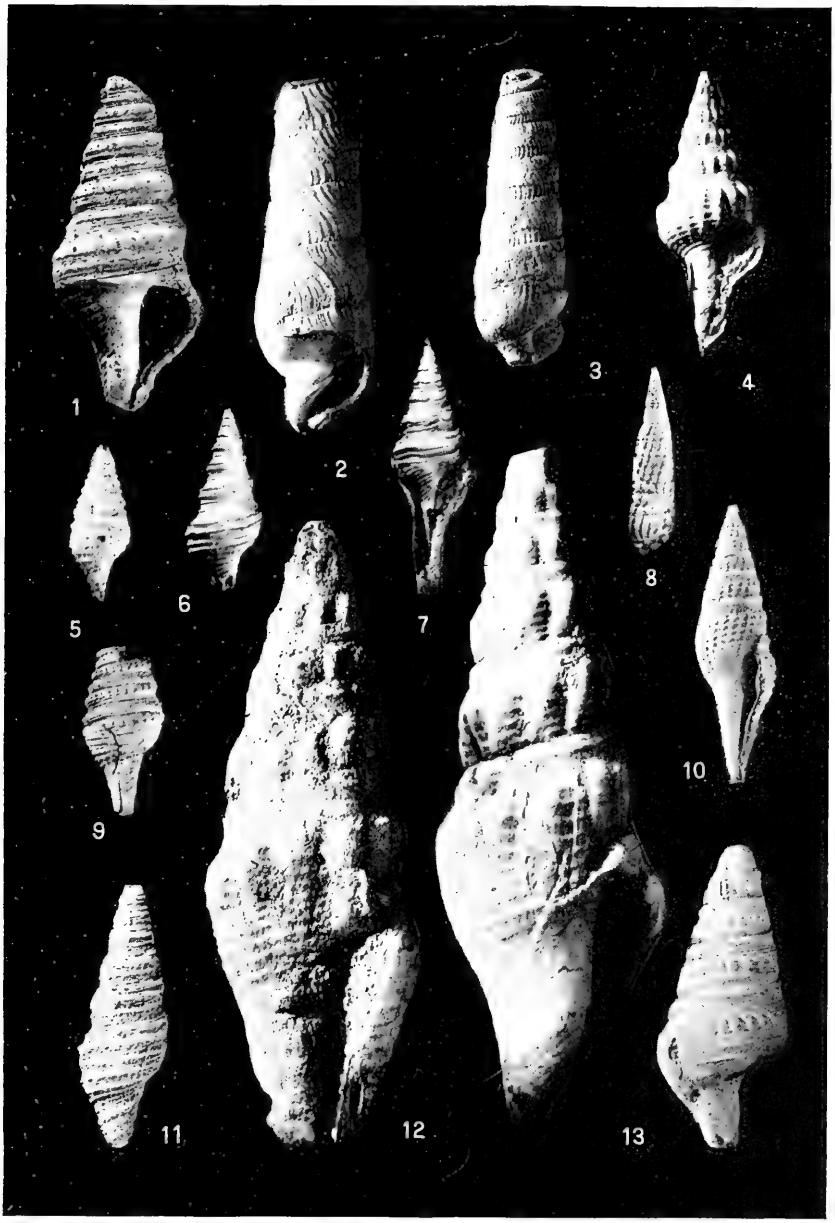
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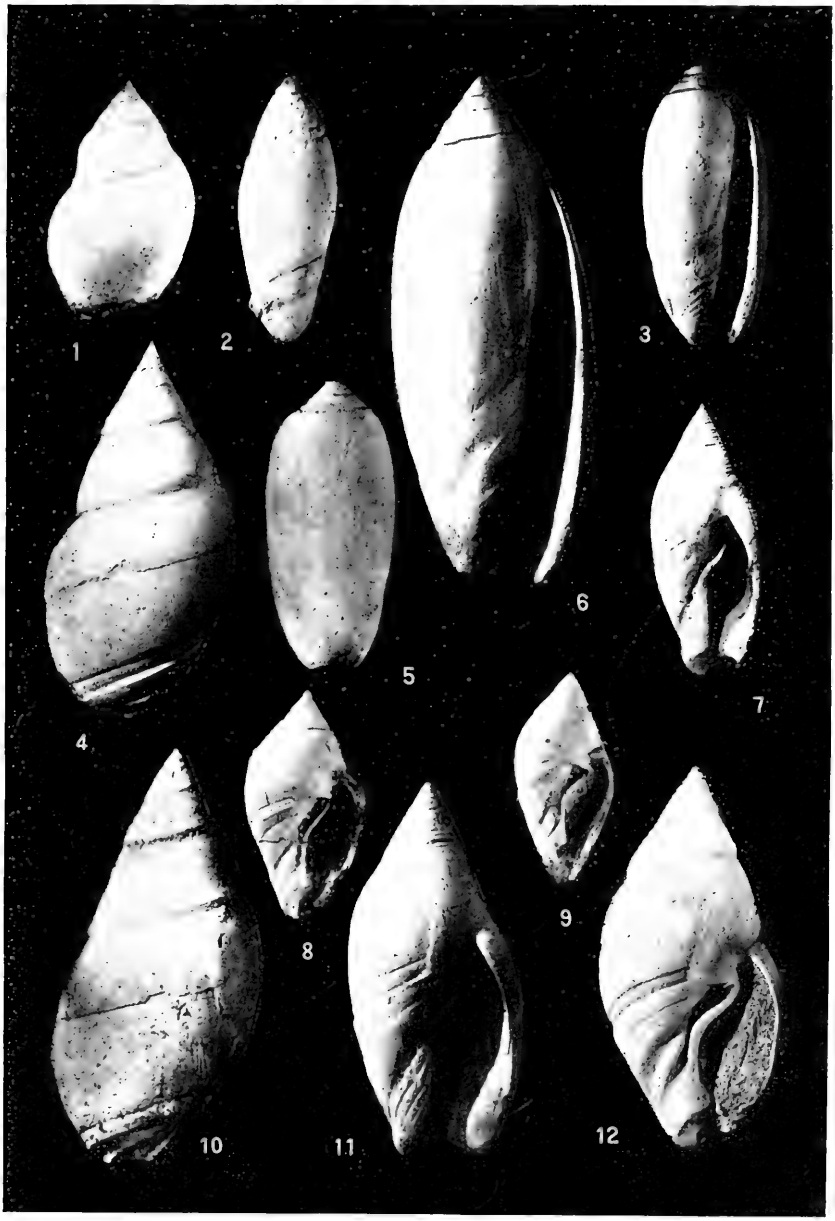
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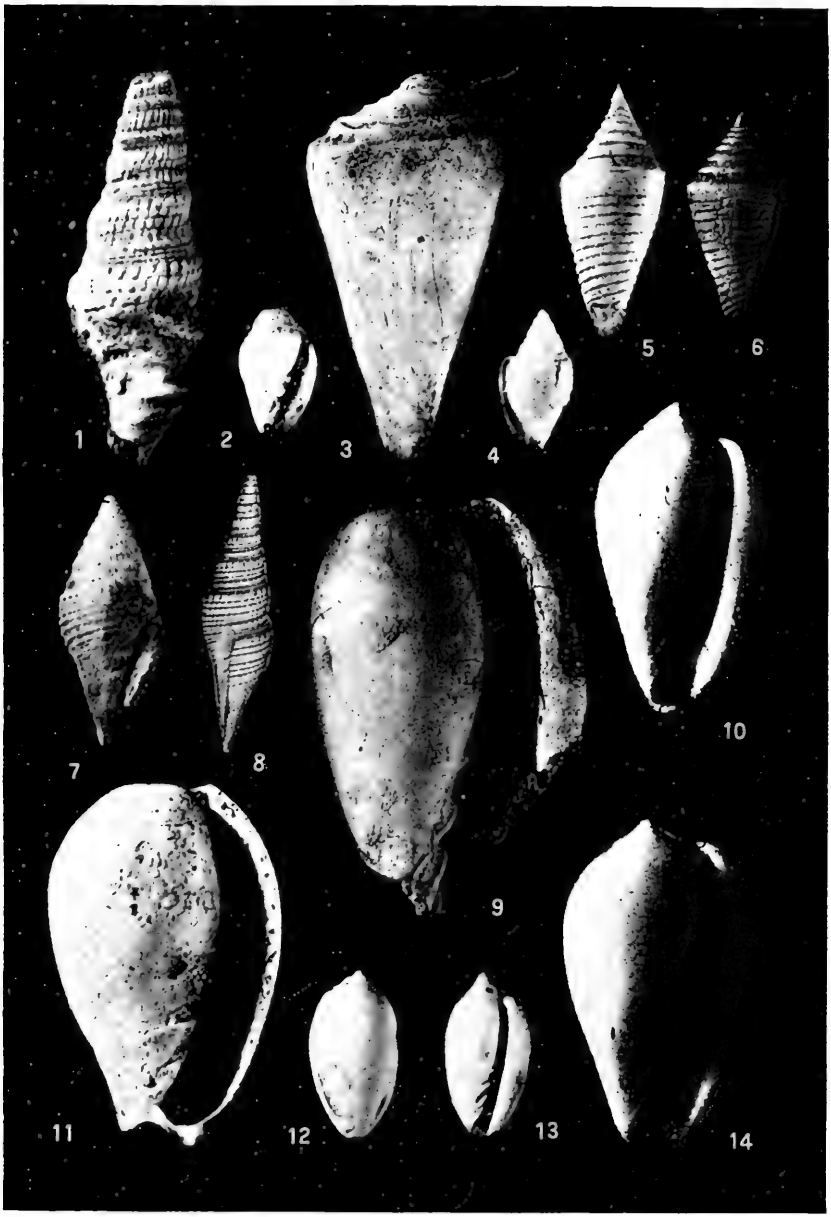
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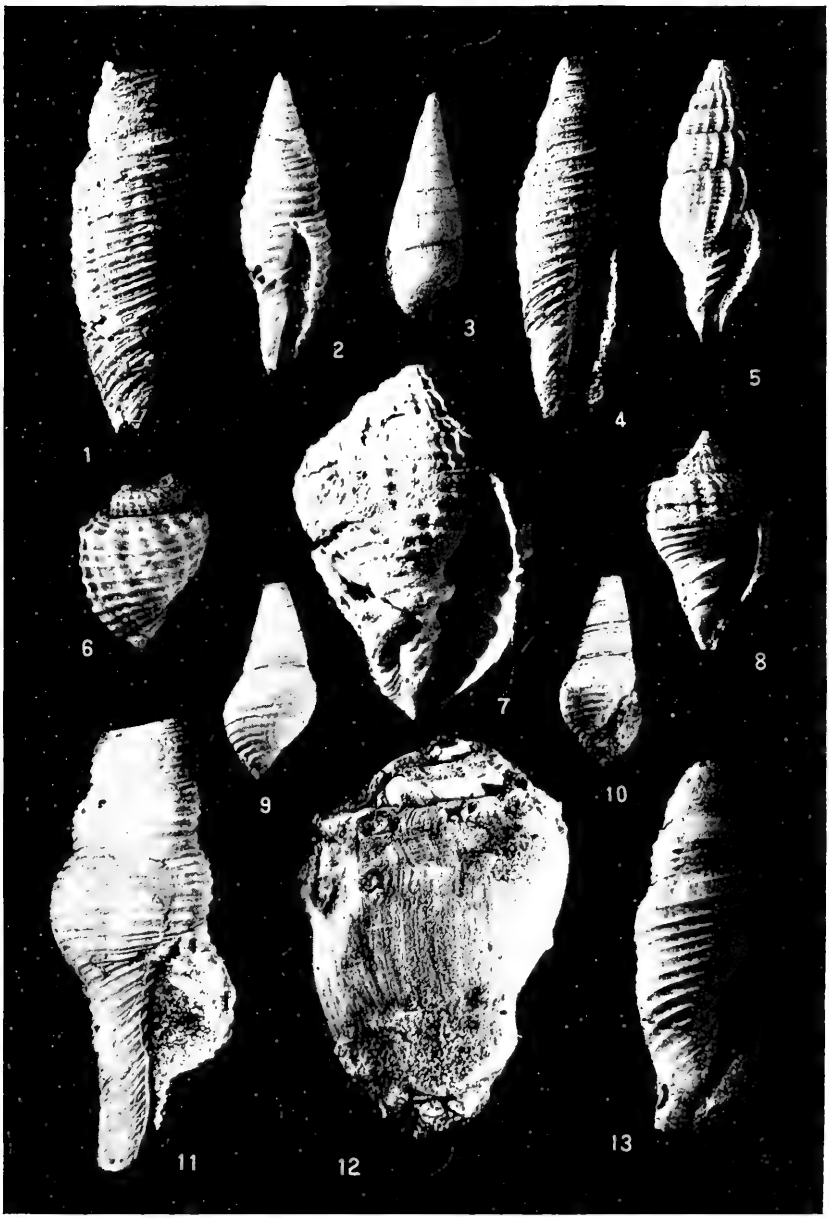
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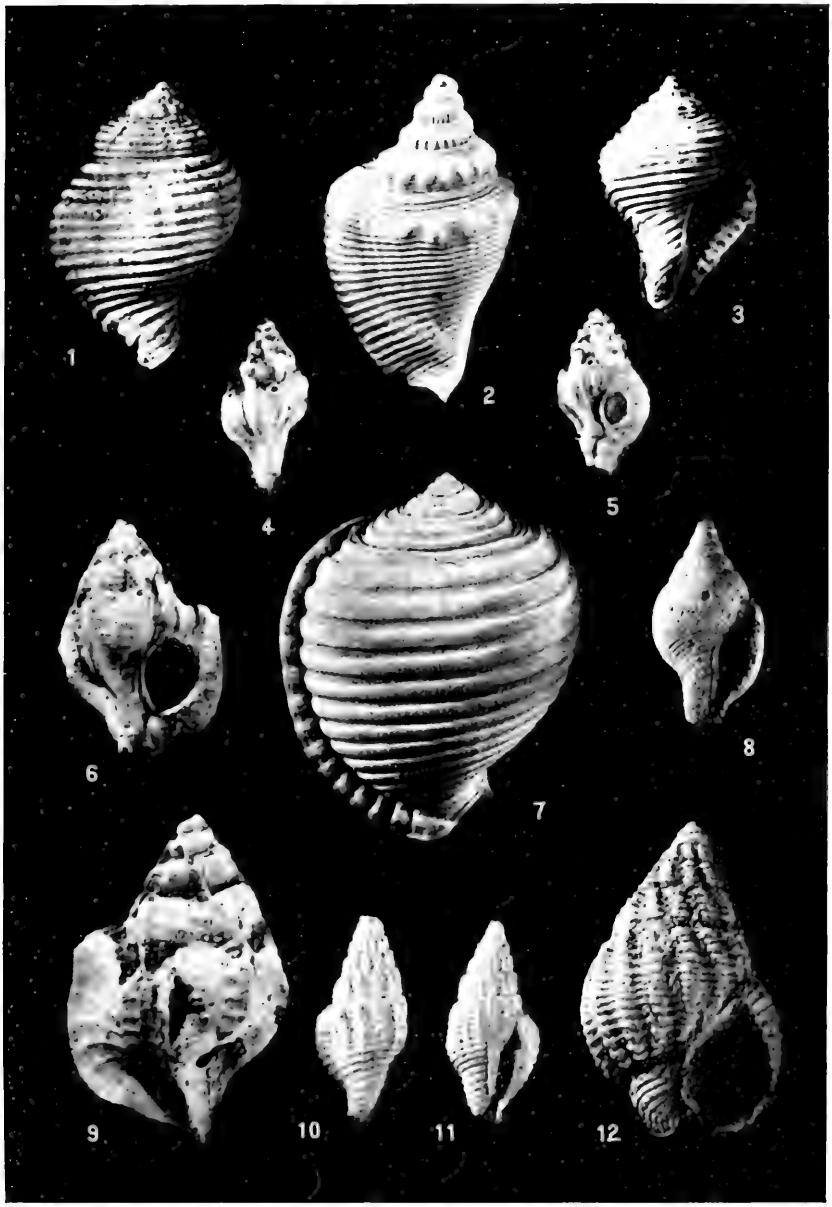
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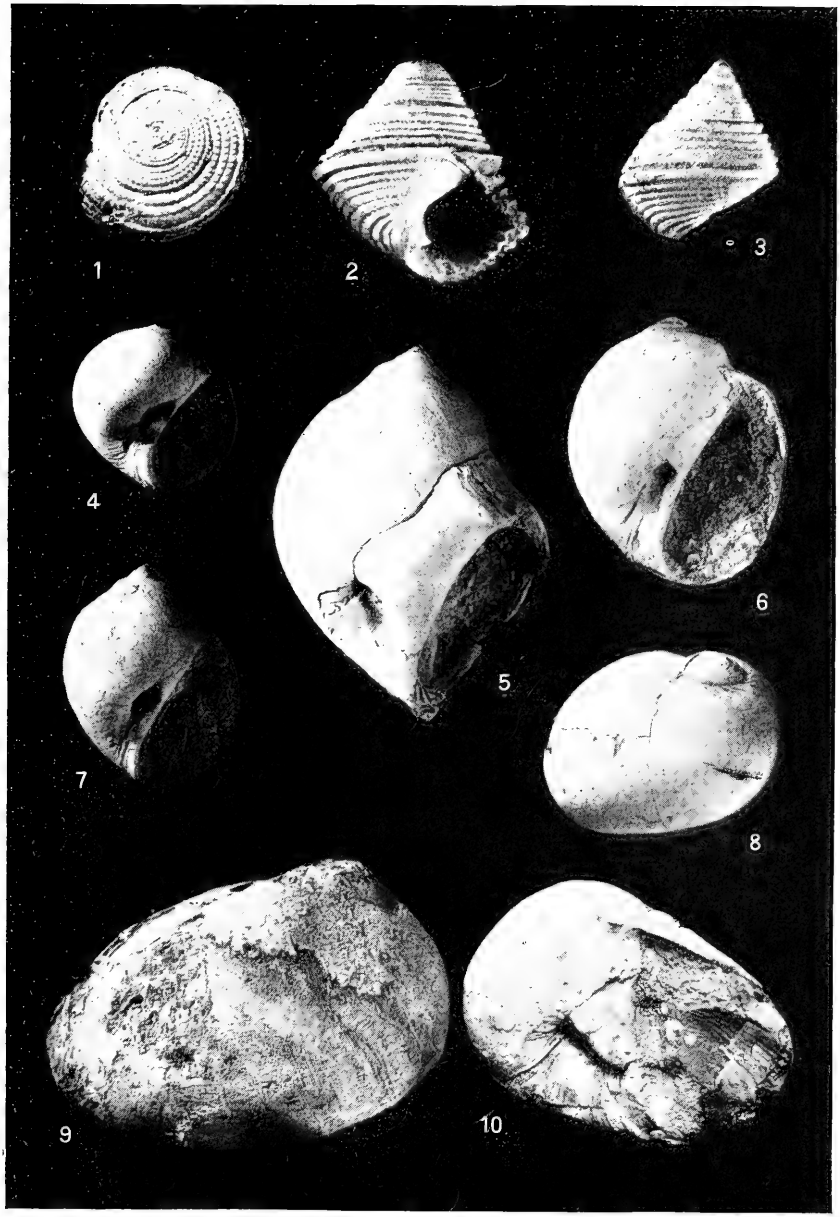
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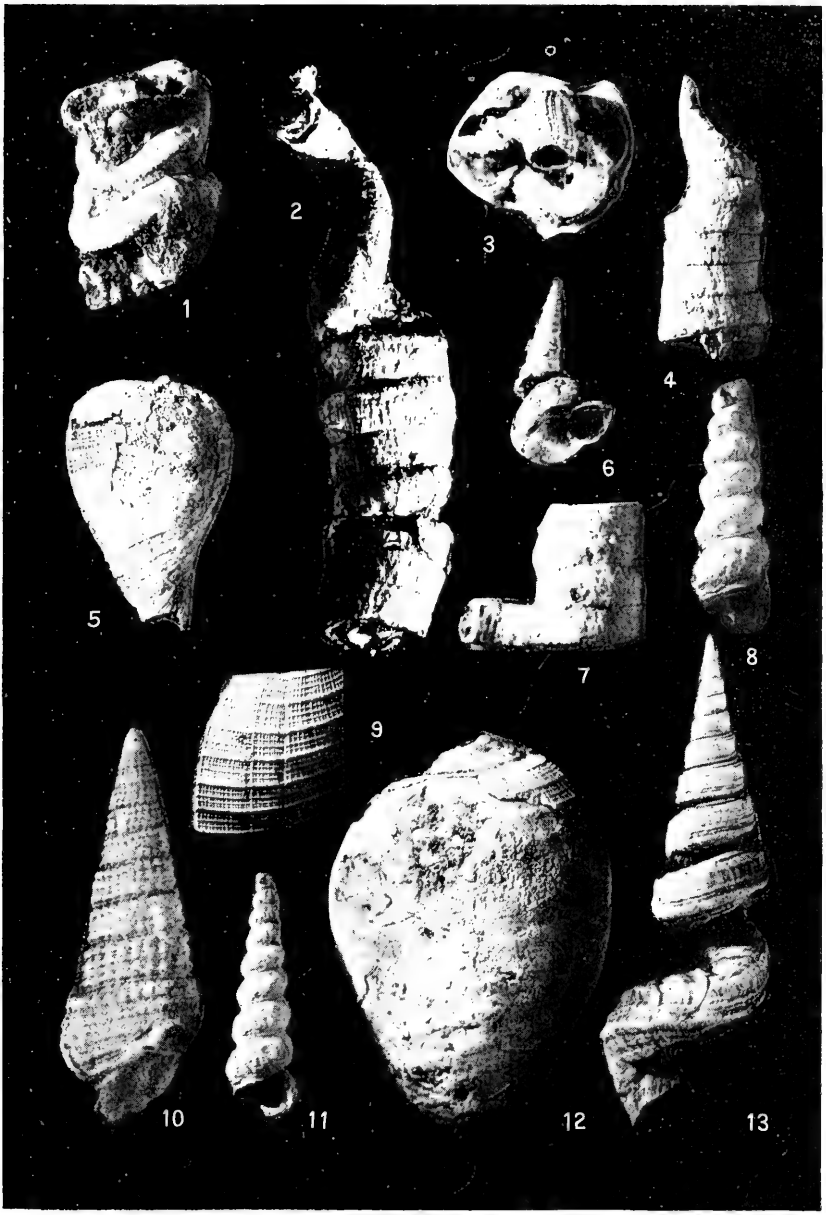
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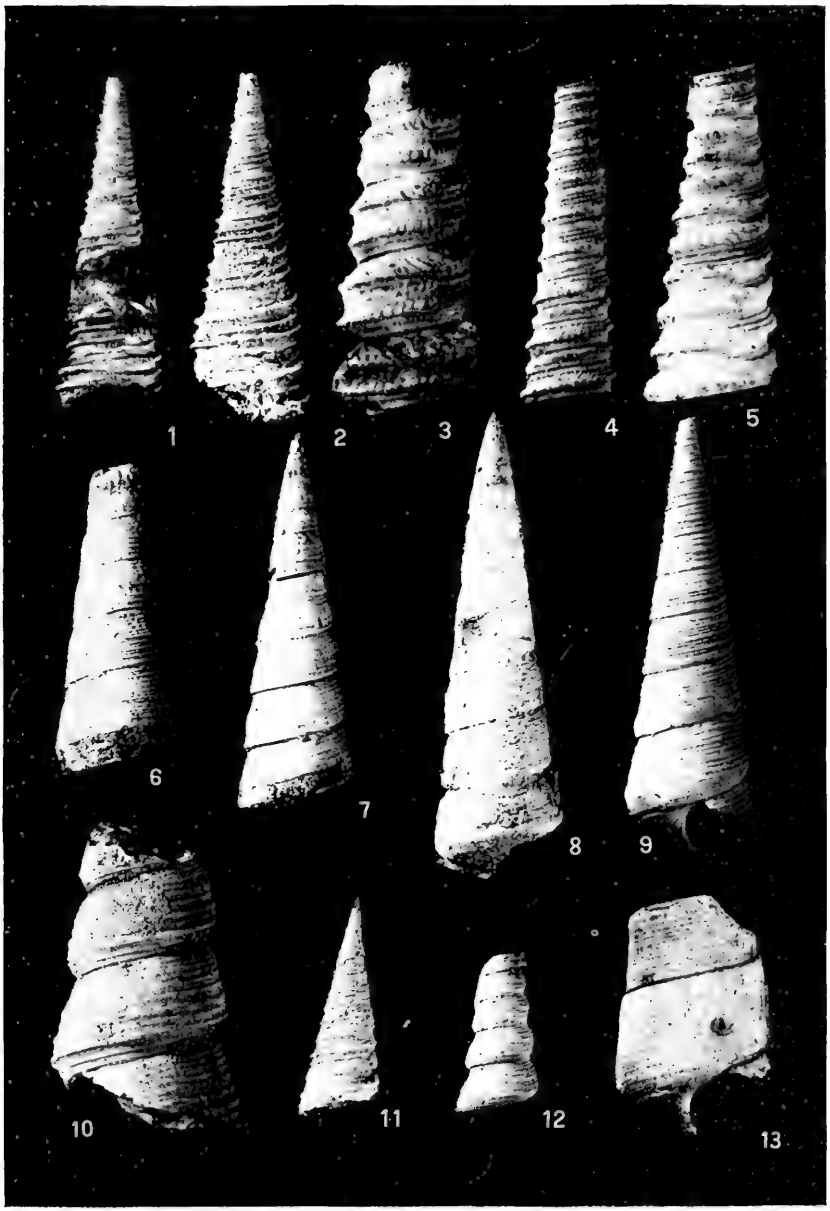
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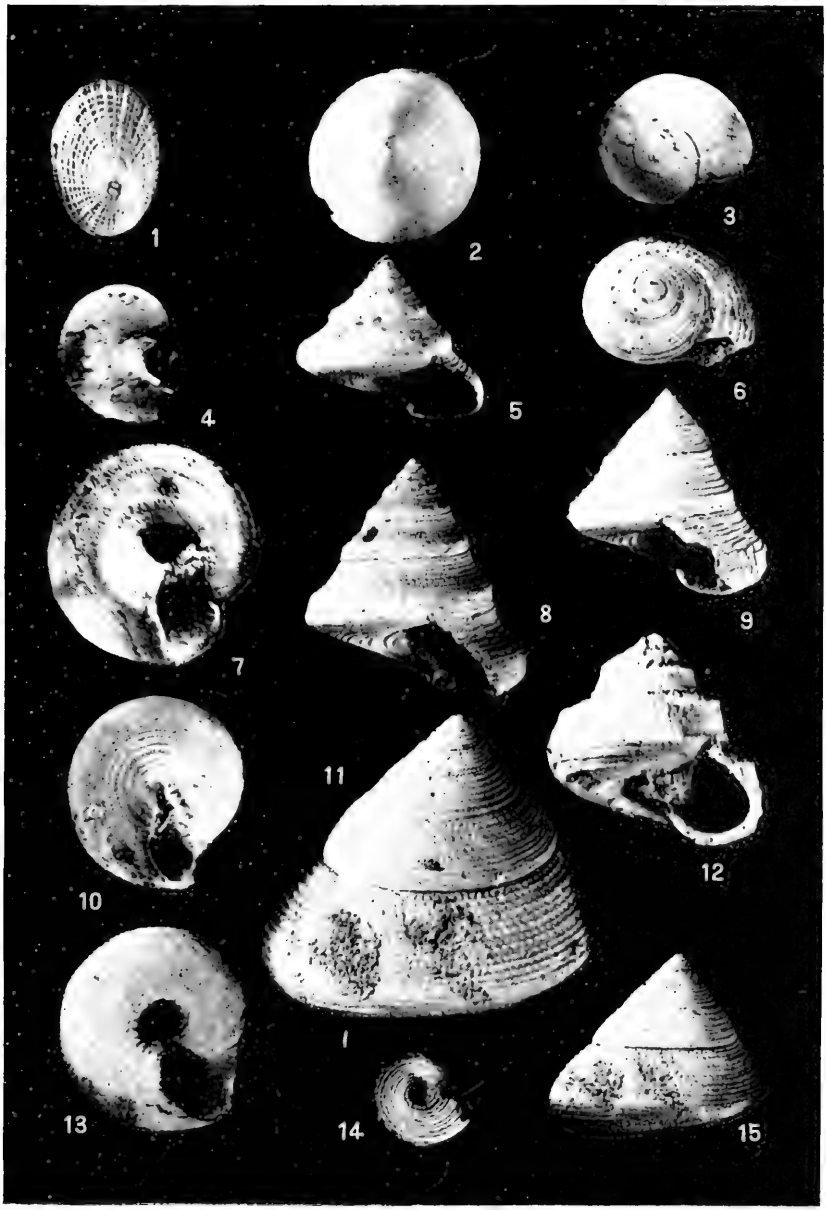
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