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New or Otherwise Interesting Tertiary Molluscan Species from the East Coast of America

BY

KATHERINE VAN WINKLE

AND

G. D. HARRIS

March 6, 1919

Cornell Univ., Ithaca, N. Y.
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NEW OR OTHERWISE INTERESTING TERTIARY MOLLUSCAN SPECIES FROM THE EAST COAST OF AMERICA

BY

KATHERINE VAN WINKLE

AND

G. D. HARRIS

INTRODUCTION

In resuming an intensive study of the east American Tertiary molluscan fauna after an interval of about twenty years, devoted of necessity to other phases of investigation, the senior author finds that there has accumulated in our laboratory several little lots of fossils, odds and ends, so to speak, that will scarcely fit into the general systematic studies here being undertaken, for some time to come. But a knowledge of these fossils and their occurrence may not be without interest now to Tertiary geologists and paleontologists in that they may give suggestions as to where to look and what to look for in various out-of-the-way places.

The junior author has endeavored to clear up some of the obscure points in the molluscan faunas of the Eocene of Virginia and Trinidad, while the the senior author is responsible for what is said regarding those from the Carolinas and Texas.

REMARKS ON VIRGINIA EOCENE FOSSILS

By KATHERINE VAN WINKLE

The following notes and descriptions are based on material collected by members of the first cruise of the IANTHINA in Virginian waters in 1897. Most material, then new, has been subsequently described by members of the Maryland Geological Survey; and interesting geographic data on the Virginian beds have been published by members of the Survey of that State. However, these few additional notes seem worthy of publication.

Genus **LEDA** Schumacher

Leda cœlatella, n. sp. Pl. 1 Figs. 4, 5

Specific characterization.—Size and general form as indicated by the figures and explanations; rather thick; of the *cœlata* stock, but differing from the Claïborne form by its smaller size, less inflation medially, less relative contraction posteriorly and especially by its more primitive surface marking—great diagonal rugæ of nearly equal strength across the whole valve with only a down-dipping in the young stage as they approach the umbonal ridge, whereas in *cœlata* these rugæ are strong only on the sector just posterior to the middle; in advance of the same such markings become fainter, swing upward across the channel from beak to anterio-basal margin and finally resume their former direction till they reach the margin of the shell; lunule, escutcheon and post-umbonal markings very similar to those of *cœlata*, though the radial ribs are more generally and coarsely granulate, thus recalling *cœlatoides*.

Types and specimens figured.—Paleontological Museum, Cornell Univ.

Horizon.—Probably lower St. Maurice Eocene.

Locality.—New Castle, Va. Collected by 1st Ianthina Expedition, '97.

Genus **CORBULA** Bruguiére

Anapteris, new subgenus

Description.—Lesser or left, only valve known ; large, flat, surface of shell strongly corrugated, this corrugation extends to the anterior margin where the extreme, anterior portion of the valve appears as though it had been broken ; on the interior of the shell this area corresponds to a wing or flare which is bounded below by a strong ridge ; this ridge suggests the original margin of the valve. The wing bears very fine, radiating striæ.

Anapteris regalis, n. sp., Pl. I Fig. 1, 3

Description.—Size and shape of shell as indicated by the figures. Left valve nearly flat, thick, dorsal margin bent outward, giving intimation of a gape ; a pronounced carina extends from the beak to the posterior margin. Surface ornamented with prominent, concentric lines which extend from the umbonal ridge to the anterior end where they terminate in a peculiar manner as though the anterior end had been broken ; on the posterior portion of the shell anterior to the umbonal ridge where the lines merge into the ridge a separation of the lines occurs giving place to very short, equally prominent, surface markings. Just anterior and parallel to the umbonal carina is a fine channel; the prominent lines posterior to the umbonal ridge extend almost vertically to the dorsal margin. On some specimens two slight channels are noted which are situated between the dorsal margin and the posterior ridge and extend from the beak to the posterior margin ; on the anterior internal surface of the left valve a raised margin-like ridge extends from the beak concavely, and then rounds into the ventral margin ; the portion of the shell dorsal to the ridge has the appearance of a flare or wing. The projecting, cartilage process in the left valve in this form differs from that in the genus *Corbula*, in having only a very narrow, short, posterior groove ; the anterior groove is slightly marked, in some cases practically obsolete.

Types and specimens figured.— Paleontological Museum, Cornell Univ.

Horizon.—St. Maurice Eocene.

Localities.—Newcastle, Piping Tree, Va; collected by the 1st Ianthina Expedition, '97.

Genus **FICUS** Klein

Ficus affinis, n. sp., Pl. 1 Fig. 10, a.

Description.—Size and shape of shell as indicated by the figures; whorls five; last two whorls of spire smooth; whorls very convex; surface ornamented by numerous, subequally spaced, longitudinal ribs; the intersection of the ribs gives the surface of the shell a cancellated appearance; both the longitudinal and revoling lines extend over the full length of the body whorl and the first two whorls of the spire.

This form resembles in general outline the species *Ficus mississsippensis* (Conrad) from Vicksburg but differs in the greater regularity of the revoling ribs, in the smaller interspaces between the revoling ribs and in the absence of finer, intervening, revoling lines which are characteristic of *F. mississippensis.* These lines vary in the young and adult stages of the Vicksburg form, from one to two in number. A single, partially developed, intervening line is noted on a specimen of *F. affinis.* The general resemblance of the two species seems to indicate *F. affinis* as the ancestor of *F. mississippensis.*

Types and specimens figured.—Paleontological Museum, Cornell Univ.

Horizon.—St. Maurice Eocene.

Locality.—James river, just below City Point, Va.; 16 or 17 miles above Newburn, on the Neuse river, N. C. Collected by the 1st Ianthina Expedition, '97

Genus **SOLARIUM** Lamarck

Solarium ianthinæ, n. sp. Pl. 1 Figs. 7, 8, 9

Description.—Size and general shape of shell as indicated by the figures; whorls five or six; slightly convex; two revoling channels or furrows extend on the surface of the whorls dividing each whorl into three equal, slightly, elevated areas; about one-third the distance between the suture and the upper furrow a fine groove occurs which gives to the upper portion of the whorl the appearance of a narrow ridge. Numerous longitudinal striæ occur over the whole surface of the whorls, much enlarged on the margin of the whorl just below the suture, giving a slight crenulated appearance ; base flat.

Type and specimens figured.—Paleontological Museum, Cornell Univ.

Horizon.—St. Maurice Eocene.

Locality.—James river, just below City Point, Va. Collected by the 1st Ianthina Expedition, '97.

Genus **ADEORBIS** S. Wood

Adeorbis novi-castri, n. sp., Pl. 1 Fig. 11, 12

Description.—Size and general shape as indicated by the figures ; whorls four or five ; spire depressed ; suture area excavated ; whorls marked with a strong carina just above the suture ; surface smooth except for fine lines of growth. Body whorl discoidal, ornamented with three very strong, equally distant carinæ ; aperture subovate, posterior margin straight ; umbilicus moderately large, surface decorated with fine, regularly, revoling striæ; base convex, smooth ; at about the middle of the volution of the body whorl the basal carina divides, gradually producing two ribs or ridges of equal size with a slight interspace ; they appear to merge into the aperture as one carina, but examination under the microscope shows the dual character.

Type figured.—Paleontological Museum, Cornell Univ.

Horizon.—St. Maurice Eocene.

Locality.—Newcastle, Va. Collected by 1st Ianthina Expedition '97.

Adeorbis? virginiensis, n. sp., Pl. 1 Fig. 13

Description.—Size and shape as indicated by the figures; whorls five ; suture appressed ; surface ornamented by very fine, revoling striæ which occur on the lower portion of each whorl, beginning at the suture and extending about half the width of the whorl ; the remaining portion of the whorls smooth except for fine lines of growth ; near the suture, on the uppermost portion of the preceding whorl a heavy, revoling line or groove extends which gives the surface an appressed-ridged appearance. On the body whorl, the fine, revoling lines of the lower portion extend continuously over the margin and probably over most of the surface of the base.

Types and specimens figured.—Paleontological Museum, Cornell Univ.

Horizon.—St. Maurice Eocene.

Locality.—Newcastle, Va. Collected by the 1st Ianthina Expedition '97.

GEOGRAPHICAL DISTRIBUTION OF MID-EOCENE FAUNA OF THE VIRGINIA BASIN

PELECYPODA

Anapteris regalis, n. sp., Piping Tree.
Anomia lisbonensis Aldrich, Coggins Point.
Anomia marylandica C. & M., Port Royal.
Corbula alabamiensis Lea, Port Royal, Ratcliff, Piping Tree, Newcastle.
Corbula aldrichi Meyer, Popes Creek, Port Royal, Ratcliff, Piping Tree.
Corbula murchisoni Lea, Newcastle, Popes Creek
Crassatellites alæformis (Conrad), Potomac Creek, Piping Tree, below City Point, Coggins Point.
Cucullæa onochela Rogers, Potomac Creek, Newcastle.
Cucullæa transversa Rogers, Potomac Creek.
Dosiniopsis lenticularis Rogers, Potomac Creek.
Glycymeris idoneus (Conrad) ? Newcastle, Coggins Point.
Glycymeris, sp., Port Royal.
Lævicardium, sp., Coggins Point.
Leda magna Lea? Coggins Point.
Leda improcera (Conrad), Port Royal, Marshfield, Woodstock
Leda cultelliformis (Rogers), Popes Creek, Woodstock.
Leda cœlatella, n. sp., Port Royal.
Leda, sp., Coggins Point.
Lucina alveata Conrad, Piping Tree.
Lucina dartoni Clark, Popes Creek.
Lucina papyracea (Lea), Newcastle.
Lucina uhleri Clark, Port Royal, Ratcliff.
Lucina whitei Clark, Popes Creek.

Lucina claibornensis Conrad, below City Point.
Neæra, sp., Newcastle.
Nucula potomacensis C. & M., Popes Creek, Newcastle, below City Point, Coggins Point, Piping Tree.
Meretrix ovata var. *pyga* Conrad, Potomac Creek, Popes Creek, Woodstock, below City Point, Coggins Point.
Meretrix lenis (Conrad), Port Royal.
Meretrix subimpressa Conrad, Popes Creek, Piping Tree, Newcastle, below City Point.
Meretrix, sp., Port Royal.
Modiolus alabamensis Aldrich, Potomac Creek, Popes Creek, Port Royal, Ratcliff.
Ostrea sellæformis Conrad, Popes Creek, Piping Tree, below City Point, Coggins Point.
Ostrea compressirostra Say, Potomac Creek.
Protocardia, sp., Popes Creek.
Pecten choctavensis Aldrich, Popes Creek.
Pecten greggi (Harris), Potomac Creek.
Pecten dalli Clark, Woodstock.
Semele linosa Conrad var. Harris, below City Point.
Spisula paralis (Conrad), Newcastle.
Teredo virgiinana Clark, Popes Creek.
Tellina mooreana Gabb? Marshfield.
Tellina, sp., Popes Creek.
Tellina, sp., Piping Tree.
Venericardia planicosta var. *regia* Conrad, Potomac Creek, Popes Creek, Piping Tree ?, Newcastle.
Venericardia potapocœnsis C. & M., Potomac Creek, Coggins Point.

GASTROPODA

Adeorbis novi-castri, n. sp., Newcastle.
Adeorbis? virginiensis, Newcastle.
Calptraphorus trinodiferus Conrad, Port Royal, Piping Tree?, Newcastle.
Calytraphorus velatus Conrad, Coggins Point.
Calytraphorus, sp., Below City Point.
Calyptrea aperta (Solander), Popes Creek, Newcastle, below City Point.
Caricella pyruloides? Conrad?, Below City Point.
Clavella hercules Whitfield?, Ratcliff.
Crepidula lirata Conrad, Newcastle, below City Point, Coggins Point.
Ficus affinis, n. sp., Below City Point.
Fusus ? interstriatus Heilprin, Ratcliff.
Fusus irrasus Conrad, Newcastle.
Fusus subtenis Heilprin, Port Royal.
Fulguroficus argutus Clark, Potomac Creek.
Lunatia marylandica (Conrad), Potomac Creek, Piping Tree, Newcastle.
Lunatia, sp.,
Marginella, sp., Coggins Point.

Mitra pomonkensis, C. & M., Potomac Creek.
Plejona petrosa (Conrad), Potomac Creek, Ratcliff, Newcastle.
Pseudoliva vestuta var. *clausa* Harris, Newcastle.
Pseudoliva, sp., Coggins Point.
Solarium ianthinæ, n. sp., below City Point.
Strepsidura subscalarium Heilprin, Potomac Creek, Newcastle.
Teinostoma lævis (Meyer), Newcastle.
Teinostoma subrotunda Meyer ?, Newcastle.
Tuba marylandica C. & M., Potomac Creek.
Tudicla, sp., C. & M., Ratcliff.
Turritella clevelandia Harris, Newcastle.
Turritella humerosa Conrad, Potomac Creek, Ratcliff, below City Point, Coggins Point, Fort Washington.
Turritella nasuta Gabb var. *houstonia* Harris, Ratcliff.
Turritella mortoni Conrad, Potomac Creek, below City Point.
Vermetus, sp., below City Point.

SCAPHOPODA

Dentalium asgum De Gregorio, Newcastle.
Dentalium minutistriatum Gabb, Newcastle.
Dentalium thalloides Conrad, Popes Creek, Newcastle.

Shark's teeth Potomac Creek, Newcastle.

A FEW MID-UPPER EOCENE FOSSILS FROM THE CAROLINAS AND TEXAS.

BY

G. D. HARRIS

The following specimens from isolated localities whose geologic horizons are for the most part not very definitely established seem worthy of description and illustration.

Venericardia eutawcolens, Pl. 2. Fig. 1, 2

Specific characterization.—Size and general form as indicated by the figures and explanations ; rather inflated ; substance of the shell rather thin, showing on molds of the interior the position of the ribbing ; ribs about 28-30 in number, compound, tripartite, the middle part strongest, highest and most crenulate or spinose ; interspaces from ½ to ⅓ the width of the compound ribs ; ribs about the umbonal region simple, finely crenulate, distinctly so just in front of the lunule which is small, deeply sunken.

The ornamentation, or ribbing of this form differs materially from that of any other species of the genus with which we are acquainted. In the usual *alticostata* type of ribbing there is a central keel superimposed upon a broader foundation, giving a terraced structure on each side. Here there are actually three raised, radiating, nodose, strong riblets upon each rib, the center one being somewhat the strongest, however. This reminds one of the exterior markings on some Pectens.

The ribs in Conrad's *V. blandingi* are of the very carinate "*wilcoxensis*" type and not of the trilinear style of our new form. The "side-ribs" in *perantiqua* as figured by Whitfield in Mon. U.

S. G. S., No. 9, pl. 30 lack the prominence of those in the South Carolina form and are not nodose while the interspaces are as wide as the ribs.

Type.—C. U. Museum.

Locality.—Eutaw Springs and Centre Hill, S. C. ; specimens are casts in a hard creamy-white limestone.

Metis ? eutawensis, n. sp., Pl. 2. Fig. 3.

Characterization.—A quadrangular cast of the interior of a Tellinoid shell measuring 45x37x8 mm., showing no signs of lateral teeth, with but faint indication or a posterior flexure, but with traces of a profound pallial sinus ; interiorly with low ridges radiating before and behind the anterior muscular scar, accurately delimiting the same, while the posterior muscular scar is not sharply defined ; post-umbonal slope clearly defined but not marked off by a sharply carinated ridge.

Type.—Paleont. Museum, Cornell Univ.

Locality.—Eutaw Springs, S. C. Expedition of '98.

Crassatellites eutawcolens, n. sp., Pl. 2. Fig. 4.

Characterization.—Internal cast of a medium sized (39x30x10 mm), sharply angular and elevated form, quite different from any known Eocene *Crassatellites* above the basal beds of the Gulf States ; marginal crenulation fine on the posterior, very coarse postero-basally and disappearing anteriorly ; basal margin rather full or sub-angular medially ; umbonal ridge sharply defined ; exterior apparently with well-defined, even, concentric lirations.

Type.—Paleont. Museum, Cornell Univ.

Locality.—Eutaw Springs. Cornell Expedition of '98.

Meiocardia carolinæ, n. sp., Pl. 2. Figs. 5, 6.

Characterization.—Size and general appearance as indicated by the figures ; inflated, with a well-defined post-umbonal slope, on which, about two-fifths way from the ridge to the ligamental margin there is a well-defined radiating ridge ; traces of interior radiating lines sometimes present ; marginal impressions indicating a fairly thick shell ; concentric undulations noticeable basally and posteriorly.

Small casts of these species are common at Wilmington and Eutaw Springs. Sometimes at the former locality specimens the size of fig. 5 are found. An impression of the exterior of what appears to be the same species is in our collections, labelled Neuse River, 16-17 miles above Newbern, N. C. This shows, besides rather regular concentric undulations posteriorly, fine concentric lining. These lines are almost rectilinear medially but curve up rather abruptly anteriorly and posteriorly. This reminds one of Dall's *M. agassizi*, a recent West Indian species.

Types.—Paleont. Museum, Cornell Univ.

Localities.—Eutaw Springs, S. C.; Wilmington, N. C., and Neuse River above Newbern.

Pecten trentensis, n. sp., Pl. 2. Figs. 8, 9.

Specific characterization.—Form and size as indicated by the illustrations; ribs highly variable in number, size and amount of ornamentation; generally bifid and generally ornamented by highly raised, scale-like or imbricating concentric lines; costation showing a strong tendency towards a tri-or quinque-costate pattern, especially in the left valve; central rib largest of the three or five major ones.

The general appearance of this shell is so different from anything we have heretofore found in the Eocene of this part of the United States that, owing to a lack of well-known species from the same locality, its horizon must at present be considered as doubtful.

Type and specimens figured.—Deposited by G. D. Harris in Museum at Cornell Univ.

Locality.—Found in light, marly bed, right bank of Trent river, near the water's edge, about six miles below Polloksville, North Carolina, in the so-called Trent formation, The latter has been referred to the upper Claiborne or Jackson Eocene.

Pecten elixatus Con.? Pl. 2. Figs. 10, 11.

A few fragments of another species of *Pecten* were found among the representatives of the species just described, which seem at first sight to belong to *P. poulsoni*. But upon direct comparison of the two the left valve of *poulsoni* is never flat and in some instances decidedly gibbous, whereas in this species the fragment figured indicated a plane, or even concave valve. Again, the ribs on the posterior ear are much more numerous in this North Carolina species and the posterior cardinal angle less than 90°. The tops of the ribs in *poulsoni* appear broad and tri-partite ; in this species, bi-partite. The concentric sculpturing is much the same in both species. However, a large series of these forms may cause them to be finally regarded as one species. If so, it would seem that a considerably greater geologic range should be given to this species than has been admitted heretofore else the horizon on the Trent whence these specimens came is far higher than has been suspected. A rather near relative of *poulsoni* has been described by Dall as *Burnsii* from the Chipola marls of Florida. (Trans. Wag. III, 1898, p. 720, pl. 34, fig. 8.) Conrad's *elixatus* from "near Santee Canal, South Carolina, in white, friable limestone" is generally referred to *poulsoni* Mort.

Pecchiolia dalliana, n. sp., Pl. 2. Fig. 7.

Specific characterization.—Size and general appearance as indicated by the figure ; extremely inflated and generally Exogyroid surface marked by numerous radiating small ribs becoming stronger and farther apart as the position of the umbonal ridge is approached ; there occasional inter-riblets appear ; passing the umbonal ridge the strength of the ribs decreases to the ligamental margin ; a radiating channel divides the post-umbonal into two nearly equal portions ; concentric markings consist of numerous rather irregular and ill-defined undulations, strongest basally.

This shell is strikingly similar to *P. wemmelensis* Vincent from the "*Sables de Wemmel*" (Bull. Soc. royal Mal. de Belg. vol. 32, 1897, p. xxx) and, since these sands are the equivalent of the Barton Beds of England one instinctively thinks of the aid, small though it may be, that this form may render us in correlating the upper Eocene deposits on either side of the Atlantic.

Our specimen is mainly in form of a cast, from the City Quarry near Wilmington, N. C., found among many other beautiful molluscan remains, echinoderms and branchipods.

We take great pleasure in styling this the Dall *Pecchiolia* not only on account of the great and valuable Tertiary work of this author, but especially on account of his early extensive and pains-taking work on this branch of Pelecypoda.

Type.—Deposited by Harris in Museum at Cornell.

Meretrix angelinæ n. sp., Pl. 2. Figs. 12, 13.

Specific characterization.—Shell large (65x54x15mm) and oblong, as indicated by the figures ; anterior somewhat extended as in *Cornelli* but posterior not with broad circular sweep of concentric lines, but with more or less of a rectilinear truncation ; pallial sinus small, V-shaped ; anterior muscular scar sharply defined, posterior scarcely visible ; a few obscure radiating ridges internally and a few radiating lines.

This large species, (figures somewhat less than life size,) is found in the state of casts and impressions in sandy ironstone fragments gathered by A. C. Veatch along the Angelina River, Angelina County, Texas, 2 miles above Marion.

It seems very different from anything with which we are acquainted in the lower Eocene beds, and is here associated with an abundance of *Anomia*, (also *Plicatula filameatosa*, *Ostrea* var. *vermilla*, *Sphærella bulla* and *anteproducta*,) reminding one strongly of the St. Maurice beds of Louisiana ; also a small, smooth *Pecten* ; but most telling among its associates are *Haminea grandis*, *Pleurotoma creno-strinata* Heilp., of Jackson age ; but one of the most abundant species is *Rimella* cf. *texana*, a St. Maurice form. A *Fusoficula* and an unusually large *Tornatina* are among the undescribed associates. (See below.)

Types.—Deposited in the Paleont. Mus., Cornell Univ.

Tornatina angelinæ, n. sp., Pl. 2. Fig, 14.

Specific characterization.—Form and general appearance as figured ; shell thin, smooth, marked only by indistinct longitudinal lines of growth which swing forward in the medial portion of the volution giving the margin of the lip a broad, curved form ; margin of the lip somewhat in-flected ; spire very short, of scarcely over two volutions, suture broadly channelled.

This is a large, imposing type of *Tornatina*, measuring in adult specimens 23mm. in length by 13 in diameter. It is found abundantly in the material above described in association with *Meretrix angelinæ*.

Fusoficula angelinensis, n. sp., Pl. 2. Fig. 15.

Specific characterization.—More or less long—*Scaphella*-shaped as illustrated ; differing from all other members known to the writer in its elongate form, with no traces of a shouldering above on the body whorl and no traces of tri-carination medially ; revolving lines stronger than the longitudinal, and showing generally a secondary intermediate lesser series.

Found associeted with the above on Angelina River, Tex.

REMARKS ON SOME NEW SPECIES FROM TRINIDAD

BY

KATHERINE VAN WINKLE

The material from which the following species were obtained was collected in 1912, on the island of Trinidad by A. C. Veatch under the auspices of the General Asphalt Company of Philadelphia, Miss Carlotta J. Maury being the Paleontologist. The stratigraphy and paleontology was subsequently worked up by Dr. Maury and published in the Journal of the Academy of Sciences of Philadelphia. A few forms not reported seem interesting and worthy of description.

Thanks are due to Professor Harris for the use of the material from both Virginia and Trinidad and for suggestions in the determinations.

The descriptions of the localities where these forms were collected have been taken from the notes of Miss Maury, that were found with the material.

Genus **ASTARTE** Sowerby

Astarte mauriana, n. sp., Pl. 3. Fig. 1.

Description.—Size and shape of shell as indicated by the figures ; inequilateral, beaks situated about one-third the length of the shell from the anterior end ; a very slight, umbonal ridge extends from the beaks part way down the posterior end of the shell causing a faint, noticeable concavity behind ; surface ornamented with wide, heavy concentric ribs, interspaces half the width of the ribs. In the situation of the beaks and in general outline this form varies from a typical *Astarte* and recalls the form of *Pitaria* or allied Venerid genera. Longitude of shell 15mm ;

altitude 12mm.

Type and specimens figured.—Pal. Museum., Cornell Univ.

Geologic horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Astarte trinidadensis, n. sp., Pl. 3. Figs. 2, 3.

Description.—Size and shape of the shell as indicated by the figures; subequilateral; lower portion of the anterior and posterior ends similarly rounded, blunt in outline; surface decorated with six prominent, narrow, raised concentric ribs, the interspaces very wide, two or three times the width of the ribs. This species differs from *A. mauriana*, n. sp., in the beaks being more central, in a more rounded posterior end, lower in form and in the character and number of the concentric ribs. In *A. trinidadensis* the ribs are more pronounced, much narrower and fewer in number. There are less than twice the number of ribs in this species than in our other form of *Astarte*. Longitude of shell 15mm; altitude 10mm.

Type and specimens figured.—Pal. Mnseum, Cornell Univ.

Geological horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad." Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Genus **MARCIA** H. and A. Adams

Marcia pariænsis, n. sp., Pl. 3 Figs. 4, 5.

Description.—Size and shape of shell as indicated by the figures; a slight umbonal ridge extends from the beaks to the posterior, ventral margin; surface ornamented with prominent, concentric lamellæ which are much more pronounced and heavier on the anterior and central portion of the valve, decreasing in size from the posterior umbonal ridge backward. Longitude of shell 16mm; altitude 13mm.

Type and specimens figured.—Pal. Museum, Cornell Univ.

Geologic horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Genus **MACROCALLISTA** Meek

Macrocallista ? veatchi, n. sp.. Pl. 3. Figs. 6, 7.

Description.—Size and shape of shell as indicated by the figures ; high compared with the size of the shell ; beaks situated nearly centrally, swollen ; surface sculpture consists of numerous, moderate in size, radiating ribs with very narrow interspaces, less than one-half the width of the ribs. The first cardinal of the right valve differs from the type of *Macrocallista* in being a very large, heavy tooth, the posterior ligamental groove in this form is not as deep or external as in most species of *Macrocallista*. These characteristics, with the shortness of form probably makes the species of sectional rank. Longitude of shell 22mm : altitude 19mm.

Type and specimens figured.—Pal. Museum, Cornell Univ.

Geological horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Genus **LEVIFUSUS** Conrad

Levifusus whitei, n. sp., Pl. 3. Fig. 11.

Description.—Size and shape as indicated by the figures ; whorls five or six ; on the specimen we have, the last volutions of he spire are broken, but the spire would probably measure half he length of the body whorl ; suture distinct, appressed ; a series of large, sharply rounded nodes occur on the upper portion of he body whorl about one-fourth the distance from the suture to the anterior end ; upper volutions similarly decorated with nodes which begin at the sutural line and become obscure just above the central portion of the whorls ; surface of the shell smooth ; below the nodulation of the body whorl, with the aid of the microscope, very fine revoling striæ may be detected.

Type and specimens figured.—Pal. Museum, Cornell Univ.

Geologic horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Genus **PSEUDOLIVA** Swainson

Pseudoliva soldadoensis, n. sp., Pl. 3. Fig. 10.

Description.—Size and shape of shell as indicated by the figures ; whorl, six, convex, with a slight shoulder ; last three volutions of the spire, narrow and very pointed ; the shoulder of the body whorl extends at about an angle of thirty degrees and bears numerous small nodes. Much of the surface of the body whorl of our specimen has been destroyed but on the remaining portion which is about a third of the whole whorl there are twelve nodes ; on the whorls of the spire a groove extends irregularly around the shoulder ; traces of nodes can be seen along the front of this groove. The surface of the shell is otherwise smooth except for lines of growth. This species is related to *Pseudoliva* sp. that Professor Harris has figured from the Midway of Alabama, pl. 9, fig. 22, Bulletins of American Paleontology, vol. 1, no. 4. They both have the small nodes on the shoulder of the body whorl and the upper portion of the spire, similarly shaped. *P. soldadoensis* n. sp. is a more robust form, the upper portions of the whorls are more convex and the nodes are more numerous. Altitude of the shell 33 mm ; diameter 20 mm ; altitude of spire 7mm ; angle of spire 83°

Type and specimens figured.—Pal. Mnseum, Cornell Univ.

Geological horizon.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trindad."

Collectedby A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Genus **ERATO** Risso

Erato vaughani (Maury) Pl. 3 Figs. 8, 9.

Cypræa vaughani Maury, Jour. Acad. Nat. Sci, Phila., 2nd ser. vol. XV, 1912, p. 87, pl. XI, fig. 14, 15.

Original description.—"Shell small; pyriform, tapering to a pointed base; inflated; surface smooth except for faint lines of growth, which are most apparent on the earlier whorls; spire distinct, acute, showing two small volutions, with a clearly defined suture; aperture rather wide, but so filled with the indurated matrix that all plications are concealed; outer lip much thickened, inner lip with a rather fine callus.

Height of shell 24, greatest width 17, thickness 14 mm.

Remarks: This particular *Cypræa* is wholly unlike anything described from the lower Eocene horizons."

We have been able to obtain, since Miss Maury described this species, three additional specimens and remove the rock matrix so as to reveal the character of the aperture, the smooth columella and crenulated outer lip.

Size and shape of shell as indicated by the figures; whorls five; a deep posterior sulcus, the margin of the outer lip heightened or extending over the whorls of the spire as in many young *Cypræ*; the very characteristic feature of this species is the elongate, Pyrula-like base or canal.

Specimens figured.—Pal. Museum, Cornell Univ.

Geological Horzion.—Midway Eocene.

Locality.—"Bed No. 2, Soldado Rock, Gulf of Paria, Trinidad."

PLEUROPHOPSIS, new genus

Description.—The form known only from casts; large, elongate, inequilateral, beaks situated about one-fourth the length of the shell from the anterior end; surface sculpture consists of heavy, concentric lines of growth; two cardinal teeth in the left valve, the posterior cardinal very large, the anterior slender;

right valve bears two cardinals of subequal size ; anterior adductor impression very large and high with a wide, deep groove behind, which would correspond on the shell to a deep adductor scar and ridge between it and the umbonal area ; pedal muscle scar conspicuous and situated dorsal to the adductor, posterior muscle impression and pallial line very indistinct, no sinus noticeable.

From the dental and muscular structure this form seems to be a descendant of the Pre-Tertiary genus *Pleurophorus*.

Pleuropopsis unioides, n. sp., Pl. 3. Fig. 12.

Unio sp. Maury, Jour. Acad. Nat. Sci. Phila., 2nd ser. vol. XV, 1912, p. 50, pl. VIII, figs. 18, 19.

Description.—Size and shape as indicated by the figures and explanations; slight umbonal ridge extends from the beaks and merges into the posterior ventral margin ; surface sculpture consists of rather heavy, concentric lines of growth. Longitude of shell 77 mm ; altitude 33 mm.

Remarks.—This and the following new species from the same locality represent a large collection of casts, the hinge structure of which, for the most part, are but poorly preserved. The fauna is very peculiar and unlike any known. Because of its uniqueness and questionable origin it was thought that the forms should be figured and described as far as possible, thus placing on record the occurrence of such a fauna.

The species just described, in outline and in the occurrence of the heavy muscular impression, resesembles a *Unio*. But the presence of clear cut dentition eliminates that genus. We have also in the collection a species of *Leda*, *Nucula* and *Modiolaria* as well as a number of marine gastropoda.

Type and specimens figured.—Pal. Museum, Cornell Univ.

Age.—Probably Middle Tertiary.

Locality.—"One mile west of Godineau River on the shore of the Gulf of Paria, about midway between San Fernando and La Brea, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

Pleurophopsis unioides var. **fernandensis**, n. sp., Pl. 3. Fig.13, 14.

Description.—Size and shape as indicated by the figures; umbonal ridge which extends nearly to the posterior, ventral margin well marked in the young; two very wide, deep furrows extend on the anterior portion of the shell from the area of the beak to the ventral margin; the groove most anterior extends practically straight to the basal margin, while the second groove extends obliquely toward the posterior end of the shell; where this furrow merges into the base, the margin of the shell forms on indentation, from here the anterior portion is drawn out at about an angle of 30 degrees to the dorsal margin; this gives the form on aviculoid appearance, this extreme contortion is characteristic of the large, adult specimens, the young show the two anterior furrows but are more moderate in form, showing the shape of the parent species, *P. unioides*; surface sculpture consists of heavy lines of growth which in the adult become very rugose along the umbonal ridge; longitude of shell 134 mm; altitude 55 mm.

Type and specimens figured.—Pal. Museum, Cornell Univ.

Age.—Probably Middle Tertiary.

Locality.—"One mile west of Godineau River on the shore of the Gulf of Paria, about midway between San Fernando and La Brea, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Poiladelphia.

THYASIRA Leach

Thyasira adoccasa, n. sp., Pl. 3. Fig, 15, 16.

Unio sp. Maury, Jour. Acad. Nat. Sci. Phila., 2nd ser. vol. XV, 1912, p. 50, pl. IX, fig. 1.

Description.—Shell attaining a very great size; shape as indicated by the fignres, in the young form the shape is more quadrate, the posterior end less attenuated; in the young and intermediate stages a very characteristic, strong fold or flexure extends from the beaks to the posterior margin; this groove which is so marked in the early and medium stages is greatly reduced in the adult.

Our collection of this species consists of a series of four specimens, which range in length, 22 mm, 87 mm, 118 mm and 123 mm respectively ; were it not for this series showing the gradation in size and umbonal ridge one would not be inclined to identify the two extremes as the same species.

This form resemble *Thyasira bisecta* (Conrad) from the Miocene of the West Coast of North America. The Pacific species, however, does not reach such a ponderous size. No species of this genus has been reported from the East Coast American Tertiaries. This would seem to give our fauna a closer affinity with the West Coast forms of the Middle Tertiary Stages.

Types.—Pal. Museum, Cornell Univ.

Age.—Probably Middle Tertiary.

Locality.—"One mile west of Godineau River, on the shore of the Gulf of Paria, about midway between San Fernando and La Brea, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

SOLARIELLA S. Wood

Solariella godineauensis, n. sp., Pl. 3. Figs. 17, 18.

Descriptiou.—Size and shape of shell as indicated by the figures ; body whorl ornamented with three, pronounced, equally distant carinæ ; all of the whorls are carinated but with each succeeding volution the carination is diminished by one ; as the carinæ extend to the apex they become more and more crenulated ; in the concave area between the shoulder and the suture is a smaller keel very strongly crenulated, producing a nodose condition ; these are caused by the intersection of the keels with prominent, radiating ribs which extend from the suture to the shoulder carina, traces of these ribs may be seen on the lower portion of the body whorl ; they have interspaces of about three times the width of a rib ; aperture wide and flaring, this flare extending conspicuously out from the basal margin ; two or three additional revoling ridges extend on the body whorl below the last carina. Altitude of shell 8 mm ; greatest diameter 9 mm.

Types and specimens figured.— Paleont. Mus., Cornell Univ.

Age.—Probably Middle Tertiary.

Locality.—"One mile west of Godineau River on the shore of the Gulf of Paria about Paria, about midway between San Fernando and La Brea, Trinidad."

Collected by A. C. Veatch in 1912, then of the General Asphalt Company of Philadelphia.

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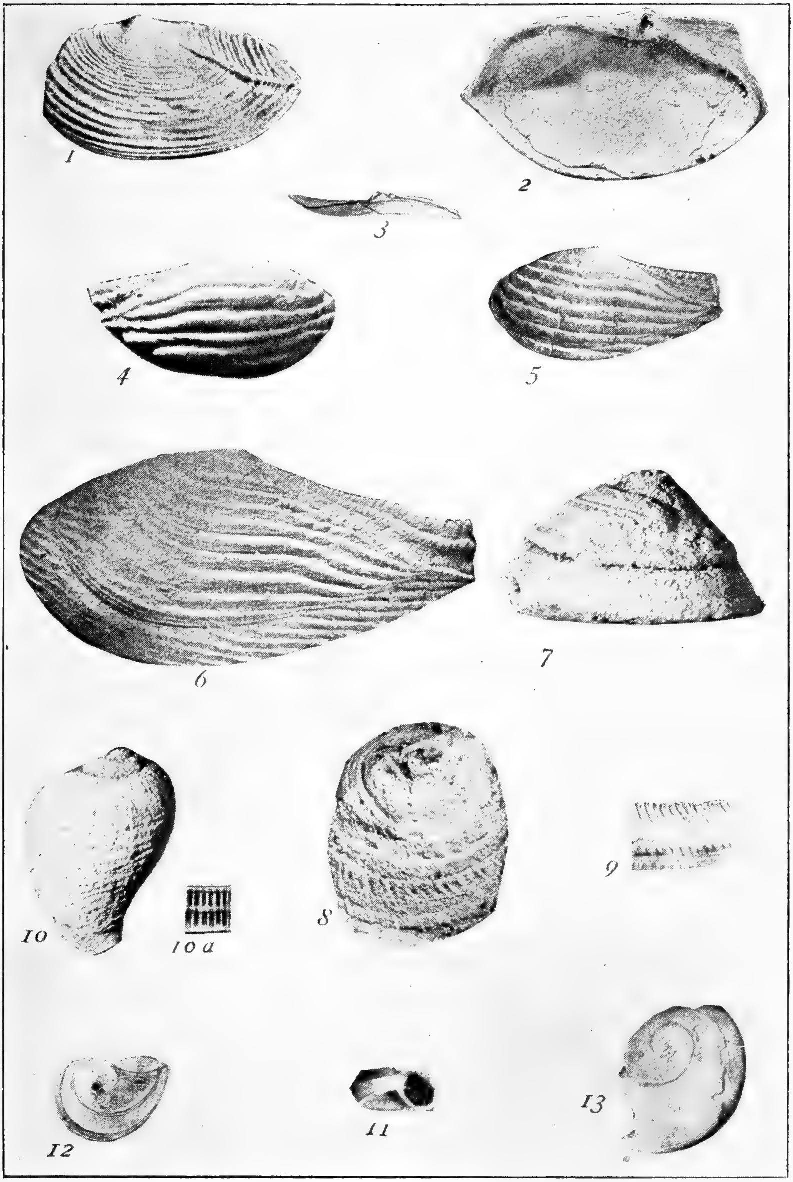
* Greatest dimension.



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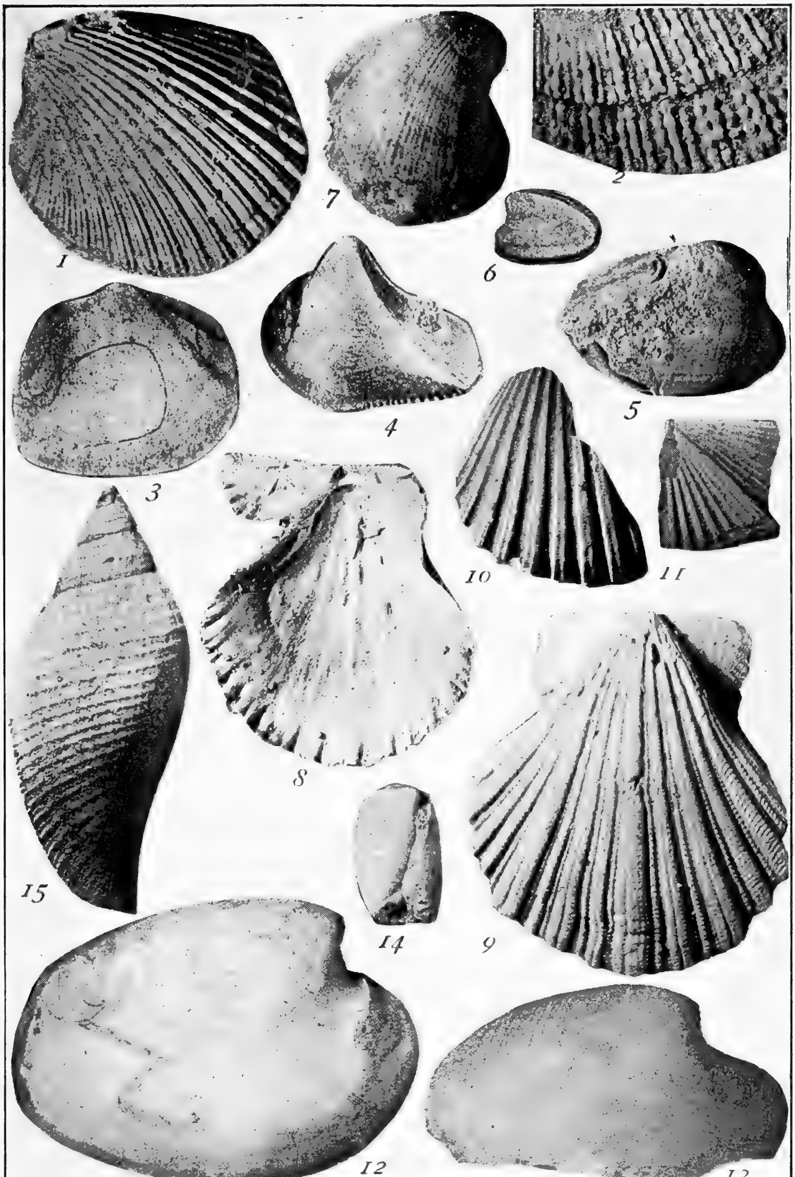
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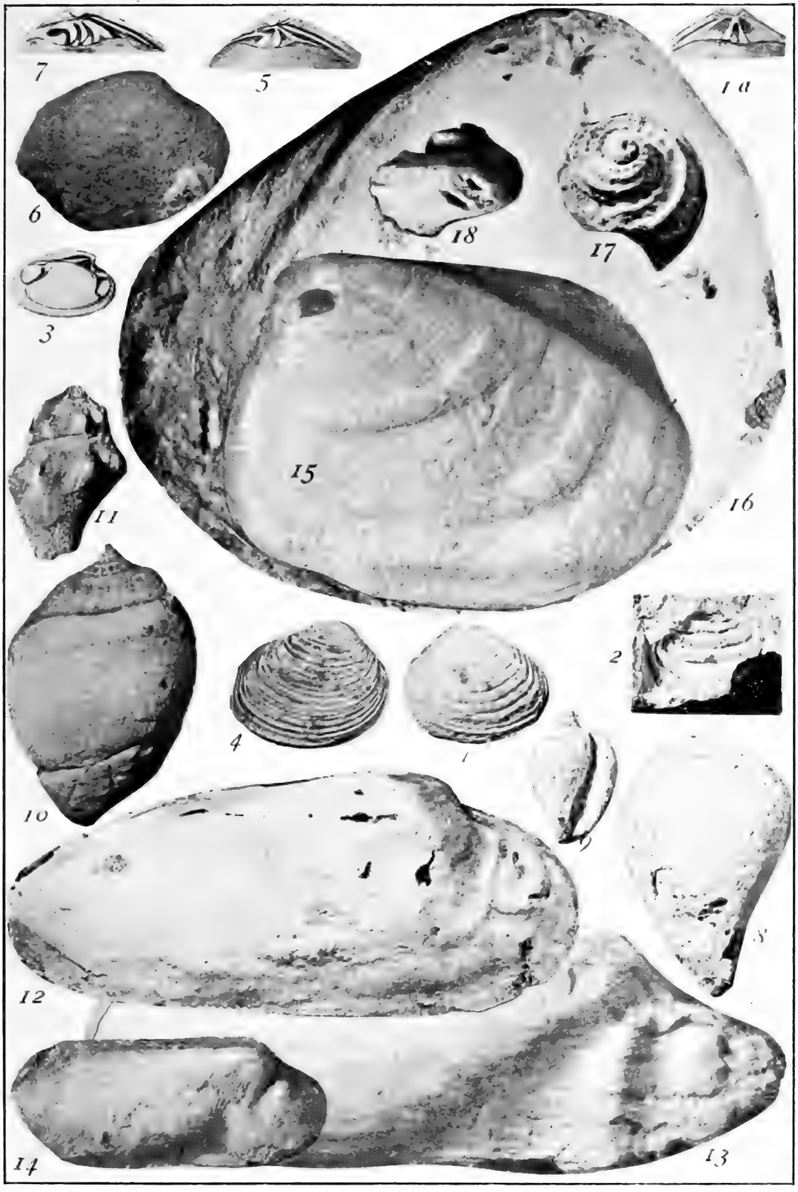
Plate 3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BULLETINS

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RECENT MOLLUSCS OF THE GULF OF MEXICO AND PLEISTOCENE AND PLIOCENE SPECIES FROM THE GULF STATES

Part I: Pelecypoda

BY

CARLOTTA JOAQUINA MAURY

Dec. 15, 1920

Cornell Univ., Ithaca, N. Y.

U. S. A.

Harris Co.

RECENT MOLLUSCS OF THE GULF OF MEXICO AND PLEISTOCENE AND PLIOCENE SPECIES FROM THE GULF STATES

BY

CARLOTTA JOAQUINA MAURY

INTRODUCTION

While acting as paleontologist on the Louisiana State Geological Survey, some years ago, a great number of deep well fossils were placed in my hands for identification by the Director of the Survey, Professor G. D. Harris.

Many of the well fossils had been collected in the Jennings oil field which was then being actively exploited, and an interesting series was presented to the Survey by Mr. Knapp from his experimental wells in Terrebonne Parish. Mr. Krackie of New Orleans also presented a collection from the Gymnasium Club well in that city. Specimens from Alabama wells were loaned by Mr. Aldrich.

Professor Harris made extensive collections of recent shells at points along the coast from Cedar Keys, Florida, to Galveston, Texas, and he and Mr. Whitney collected a large number of Pleistocene shells at Grand Chênier, Louisiana, and at the New Orleans pumping station. These recent and Pleistocene shells were also identified by the writer and used for comparative study with the well fossils.

It is rather singular that while the molluscan faunas of our Atlantic and Pacific coasts have been extensively studied, the Gulf Coast fauna has been comparatively neglected. For this reason it seems as though an annotated catalogue, embracing the results of our work, and that of Dr. Dall, Messrs. Hilgard, Singey, Aldrich, Mitchell, Vanatta and others, might be of value.

The field covered by the following catalogue includes the recent littoral species from Tampa, western Florida, to Galveston and Corpus Christi, Texas; the recent deep water and abyssal species dredged by the Steamer Blake in the Gulf of Mexico, south to the Straits of Florida and the Channel of Yucatan; the Pleistocene, Pliocene, and a few Miocene species from Gulf State wells; the Pleistocene species of Grand Chênier; the marine Pliocene species of North Creek, western Florida, and the curious brackish water Pliocene species of Alexandria, Louisiana, and of Burkeville, Texas, which are closely related to those of the Satilla River, Georgia.

MOLLUSCA

CLASS PELECYPODA

ORDER PRIONODESMACEA

Genus **SOLEMYA** Lamarck

occidentalis Deshayes

Solenomya occidentalis Desh., Jour. de Conch., vol. 7, p. 186, pl. 7, fig. 6, 1858.

occidentalis Dall, Bull. 24, U. S. Geol. Surv., p. 274, 1885; Bull. 37, U. S. Nat. Mus. p. 46, 1889.

Distribution.—Gulf of Mexico to Guadeloupe. Recent. Shallow water.

Gulf Coast.—Western Florida (Dall).

Genus **NUCULA** Lamarck

proxima Say

obliqua Say, Amer. Jour. Sci., vol. 2, p. 40, 1820. (Not *obliqua* Lamarck, 1819).

proxima Say, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 270, 1822; Tuomey and Holmes, Pleoic. Fos. S. C., p. 53, pl. 17, figs. 7-9, 1855; Holmes, Post-Plio. Fos. S. C. p. 17, pl. 3, fig. 6, 1860; Dall, Bull. 37, U. S. Nat, Mus., p. 42, pl. 16, fig. 4, 1889; Trans. Wag. Inst. Sci. 3, pt. 4, p 574, 1898; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 207, pl. 65, figs. 1-4, 1906.

Distribution and range.—Typical from North Carolina to Florida, 2-100 fathoms; variety, *trunculus* Dall, northern, from Long Island to Nova Scotia. Miocene to Recent.

Gulf Coast.—Cedar Keys, Florida.

æegeensis Jeffreys, Proc. Zool. Soc., p. 581, 1879.

ægeënsis Dall, Bull. Mus. Comp. Zool. Harvard Coll., vol. 12, p. 246, 1886; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution and range.—Southward to Trinidad and in the Mediterranean Sea. 5 to 464 fathoms. Recent.

Gulf Coast.—Western Florida in shallow water (Dall).

crenulata A. Adams, Proc. Zool. Soc., p. 52. 1860.

crenulata Dall, Bull. Mus. Comp. Zool. Harvard Coll., vol. 9, p. 123, 1881; *Idem*, vol. 12, p. 247, 1886; Bull. 37, U. S. Nat. Mus., p. 42, pl. 7, fig. 2, 1889.

culebrensis Smith. Challenger Rept. Lamell., p. 228, pl. 18, figs. 11, 11 a, 1885.

Distribution.—Hatteras to Barbados, 30 to 382 fathoms.

Gulf Coast.—Western Florida, 20 miles off shore (Dall).

cymella Dall, Bull. Mus. Comp. Zool., vol. 12, p. 247, 1886.

cymella Dall, Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—Florida Straits to Yucatan. In deep water, 205 to 1100 fathoms. Yucatan Strait, dredged in 540 fms. (Dall).

verrilli Dall

trigona Verrill, Trans. Conn. Acad., vol. 6, p. 438, 1885.

verrilli Dall, Bull. Comp. Zool. Harvard Coll., vol. 12, p. 248, 1886; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—Rhode Island to Yucatan. Recent. Abyssal, 430 to 1605 fms. Gulf of Mexico. Texas region (Dall).

chipolana Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 575, pl. 32, fig. 10, 1898.

chipolana Aldrich, Manuscript Ala. well fossils.

Distribution.—Miocene of the Chipola River marls and lower Alum Bluff bed, Florida; Bascom No. 1 well, Mobile, Alabama, at the Oak Grove horizon, 1550-1556 feet. Aldrich's collection.

Genus **LEDA** Schumacher

acuta Conrad

Nucula acuta Con., Amer. Mar. Conch., p. 32, pl. 6, fig. 1, 1831. (Not of Sowerby, 1837).

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

Nucula acuta Conrad, Fos. Medial Tertiary, p. 57, pl. 30, fig. 2, 1845; Holmes, Post-Plio. Fos. S. C., p. 16, pl. 3, fig. 7, 1860.

Leda jamaicensis Orb., Moll. Cuba, 2, p. 262, pl. 26, figs. 27-29, 1846; Dall, Bull. Comp. Zool., vol. 9, p. 124, 1881.

unca Gould, Proc. Boston Soc. Nat. Hist., 8, p. 282, 1862; Verrill, Trans. Conn. Acad., vol. 5, p. 572, pl. 58, fig. 41, 1882.

acuta Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878; Dall, Bull. 37, U. S. Nat. Mus., p. 44, pl. 7, figs. 3, 8, pl. 45, fig. 15, pl. 64, fig. 140, 1889; Trans. Wag. Inst. Sci., 3, pt. 4, p. 592, 1898; Vanatta, Proc. Acad. Nat. Sci., Phila., vol. 55, p. 756, 1903; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 209, 1906.

acuta Dall, Proc. U. S. Nat Mus., vol. 37, p 250, 1910.

Remarks.—This species, which is ancient and widely distributed, varies greatly in concentric sculpture. Conrad, in the original description, speaks of the concentric striæ as prominent and Dall states that in some instances they may even become coarse ribs or waves. Other forms are nearly smooth. This is generally so with our material from the Gulf border.

Distribution.—East coast, Rhode Island to the Antilles in 30 to 155 fathoms. West Coast, California to Valparaiso, Chile. Miocene to Recent.

Gulf Coast localities.—Recent: Indian Pass, St. Joseph's Bay, Crooked Island, Florida; Point au Fer, Cameron, Louisiana; Galveston.

Pleistocene: Grand Chênier, New Orleans Gymnasium well at 1200 feet, Lake Borgne borings, Knapp's wells, Terrebonne Parish, No. 1 at 1600-1700, No. 2 at 1050-1190, 1519-1542, 1552-1632, No. 3 at 570-700, 1043, 1150-1200, 1200-1300 feet, Bayou City Oil Co.'s well, Texas, at 600 feet.

Miocene: Bascom No. 2 well, near Mobile, Alabama, at 1800 feet.

concentrica Say, Jour. Acad. Nat. Sci., Phila., 1st. ser., vol. 4, p. 141, pl. 10, fig. 6, 1824. (Not *Nucula concentrica* Fischer, Fos. Moscow, 1843).

Nucula eborea Conrad, Proc. Acad. Nat. Sci. Phila., vol. 3, p. 24, pl. 1, fig. 4, 1846.

Leda eborea Dall, Proc. U. S. Nat. Mus., vol. 6, p. 341, 1883.

concentrica Dall, Bull. 37, U. S. Nat. Mus., p. 44, 1889; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 326, 1892; Harris, Bull. Am. Pal., vol. 1, No. 3, p. 89, 1895; Dall, Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 588, 1898; Mitchell, List Marine Shells Texas.

Distribution.—Texas to Trinidad. Upper Miocene to Recent.

Gulf Coast.—Recent: Cedar Keys, Galveston, Corpus Christi. Tampa was Conrad's type locality of *eborea*.

Pleistocene: Gulf Coast (Dall). Upper Miocene: Galveston artesian well ranging from the surface to 2650 feet (Harris).

dodona Dall, Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 589, pl. 32, fig. 6, 1898.

Closely related to the recent *Leda acuta* Conrad, but differing in details of sculpture.

Distribution.—Miocene, Oak Grove, Santa Rosa County, Florida; Bascom No. 1 well, near Mobile, Alabama, at 1500-1556 feet, Oak Grove horizon. Aldrich's collection.

solidula E. A. Smith, Challenger Rept., Lam., p. 233, pl. 19, figs. 6, 6a, 1886.

solidula Dall, Bull. Mus. Comp. Zool., vol. 12, p. 250, 1886 ; Bull. 37, U. S. Nat. Mus., p. 44, 1889.

Distribution.—Deep water, 640 to 1002 fms. Dredged in southern limits of Gulf of Mexico at Yucatan Strait and at Cape San Antonio (*S. S. Blake*). Type locality off Pernambuco, Brazil, in 675 fms. (*S. S. Challenger*).

subæquilatera Jeffreys, Proc. Zool. Soc., p. 579, pl. 56, fig. 3, 1879.

subæquilatera Dall, Bull. Mus. Comp. Zool., vol. 12, p. 252, 1886.

Yoldia subequilatera Dall, Bull. 37, U. S. Nat. Mus., p. 44, 1889.

Leda subequilatera Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 582, 1898.

Distribution.—Norway to Grenada Island in 92 to 1731 fms. Gulf of Mexico, Western Florida region (Dall).

Genus **YOLDIA** Moller

Recent Yoldias in the Gulf of Mexico are all restricted to deep water, as they seek cold temperatures,—the genus being typical of Arctic and Antarctic Seas.

hebes Smith

Leda hebes E. A. Smith, Challenger Rept. Lam., p. 234, pl. 19, fig. 7, 1885.

hebes Dall, Bull. Mus. Comp. Zool., vol. 12, p. 252, 1886.

Yoldia hebes Dall, Bull. 37, U. S. Nat. Mus., p. 44, 1889.

This resembles the North Pacific and circumboreal species, *Yoldia intermedia* Sars (*Portlandia intermedia* Sars, Moll. Reg. Arct. Norv., p. 38, Tab. 4, fig. 9, 1878), but is distinct.

Distribution.—Western Florida to Culebra Island, in 196-805 fms. Off Cedar Keys, Florida (Dall).

liorhina Dall, Bull. Mus. Comp. Zool., vol. 9, p. 127, 1881 ; *Idem*, vol. 12, p. 248, pl. 9, figs. 1, 1 a, 1886 ; Bull. 37, U. S. Nat. Mus., p. 44, pl. 9, figs. 1, 1 a, 1889.

Distribution.—Gulf of Mexico to Barbados in 100 to 1568 fms. Western Florida region (Dall).

solenoides Dall, Mus. Comp. Zool., vol. 9, p. 127, 1881 ; *Idem*, vol. 12, p. 248, pl. 9, figs. 2, 2 a, 1886 ; Bull. 37, U. S. Nat. Mus., p. 44, pl. 9, figs. 2, 2 a, 1889.

Distribution.—Gulf of Mexico, dredged, Lat. 28°, W. Long. 89°, 118 fms. *S. S. Blake* (Dall).

frater Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p, 596, pl. 32, fig. 1, 1898.

Distribution.—Miocene of the Chipola marl and Oak Grove sands, Florida. Miocene, Chipola horizon, of the Mobile Oil Company's No. 2 well, Bascom race track, Mobile, Alabama, at a depth of 1241 feet.

Genus **TINDARIA** Bellardi

cytherea Dall

Nucula cytherea Dall, Bull. Mus. Comp. Zool., vol. 9, p. 123, 1881.

Malletia veneriformis E. A. Smith, Chall. Rept., p. 246, pl. 20, figs. 9, 9 a, 1885.

Malletia (*Tindaria*) *cytherea* Dall, Bull. Mus. Comp. Zool., vol. 12, p. 254, pl. 8, figs. 1, 1 a, 1886 ; Bull. 37, U. S. Nat. Mus., p. 44, pl. 8, figs. 1, 1 a, 1889 ; Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 582, 1898.

Distribution.—Florida Straits to St. Vincent in 200 to 724 fms. Gulf of Mexico off Cape San Antonio, 413-424 fms. Yucatan Strait, 640 fms. Gulf, Lat. 28°, W. Lon. 87°, 724 fms., temperature 40° F.

amabilis Dall

Malletia (*Tindaria*) *amabilis* Dall, Bull. 37, U. S. Nat. Mus. p. 44, pl. 40, fig. 8, 1889.

Tindaria amabilis Dall, Trans. Wagner Inst., vol. 3, pt. 4, p. 582, 1898.

Distribution.—Off Cedar Keys and south to Tobago, 169 to 940 fms.

pusio Philippi

Nucula pusio Philippi, Moll. Sic., vol. 2, p. 47, pl. 15, fig. 5, 1844.

Leda pusio Jeffreys, Proc. Zool. Soc., p. 578, 1879.

Leda (*Saturnia*) *pusio* Dall, Bull. Mus. Comp. Zool., vol. 12, p. 253, 1886; Bull. 37, U. S. Nat. Mus;, p. 44, 1889.

Tindaria (*Neilonella*) *pusio* Dall, Trans. Wagner Inst., vol. 3, pt. 4, p. 582, 1898.

Remarks.—This species formed the type of Seguenza's section *Saturnia*, 1876. Not *Saturnia* of Schrank, 1802. Dall (1898) includes Seguenza's section in *Neilonella* Dall, 1881.

Distribution.—North Atlantic and Gulf of Mexico, deep water, 856 to 1591 fms. Pliocene to Recent.

Genus **LIMOPSIS** Sasso

Limopsis aurita Brocchi

Arca aurita Brocchi, Conch. Foss. Subapp., vol. 2, p. 485, Tab. 11, fig. 9.

Limopsis aurita Jeffreys, Proc. Zool. Soc., p. 585, 1879; Dall Bull. Mus. Comp. Zool., vol. 9, p. 118, 1881; *Idem*, vol. 12, p. 237, 1886; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—Norway to Grenada, 21 to 1582 fms. Gulf of Mexico, west of Florida, in 31 fms. Average temperature 55° F. Miocene to Recent.

cristata Jeffreys, Ann. and Mag. Nat. Hist., p. 434, 1876.

cristata Dall, Bull. Mus. Comp. Zool., vol. 9, p. 119, 1881; *Idem*, vol. 12, p. 237, 1886; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—Norway to Yucatan, 85 to 1095 fms. Gulf of Mexico, Yucatan Strait, 640 fms. (*S. S. Blake*)

minuta Philippi

Pectunculus minutus Philippi, En. Moll. Sic., vol. 1, p. 63, Tab. 5, fig. 3, vol. 2, p. 45.

minuta Dall, Bull. Mus. Comp, Zool., vol, 9, p. 119, 1881 ; *Idem*, vol. 12, p. 236, 1886 ; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—Norway to Barbados, 30 to 2221 fms. Miocene to Recent. Gulf of Mexico west of Florida, 30 fms.

tenella Jeffreys, Ann. Mag. Nat. Hist., p. 433, 1876.

tenella Dall, B. M. C. Z., vol. 9, p. 118, 1881 ; *Idem*, vol. 12, p. 236, 1886 ; Bull. 37, U. S. Nat. Mus., p. 42, 1889.

Distribution.—North Atlantic to Cuba, 197 to 2033 fms. Gulf of Mexico west of Florida (*S. S. Blake*).

Genus **ARCA** Linnæus

occidentalis Philippi, Abbild. u. Beschr., vol. 3, p. 14, pl. 17 b, figs. 4 a-c, 1847.

zebra, Swainson, (in part), Zool. Ill., No. 26, pl. 118, 1831.

noæ Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889. Not *A. noæ* Linnæus of the Mediterranean fauna.

occidentalis Sheldon, Palæont. Americana, vol. 1, p. 8, pl. 1, figs. 8 to 11, 1916.

occidentalis Maury, Bull. Amer. Pal., No. 29, p. 163, pl. 29, fig. 3, 1917.

Distribution.—Hatteras to Yucatan, 1 to 20 fms. Miocene to Recent.

Gulf Coast.—Living on west coast Florida. Pliocene : Caloosahatchie marls, Fla.

umbonata Lamarck, An, s. Vert., vol. 6, p. 37, 1819.

imbricata Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889 ; Mitchell, List Texas Shells, Not *A. imbricata* of Bruguière.

umbonata Dall, Trans. Wagner, Inst., vol. 3, pt. 4, pp. 620, 659, 1898 ; *Idem*, pt. 5, pl. 38, figs. 4, 4 a, 1900 ; Sheldon, Palæont. Americana, vol. 1, p. 8, pl. 1, figs. 12 to 17, 1916 ; Maury, Bull. 29, Amer. Pal., p. 163, pl. 30, fig. 11, 1917 ; New York Acad. Sci., Porto Rico Survey, vol. 3, pt. 1, p. 6, 1920.

Distribution.—Hatteras to Brazil. Oligocene (of Porto Rico and of Tampa, Florida) to Recent. Gulf Coast.—Living : west Florida and Galveston. Miocene : Chipola River, Calhoun Co., Florida. Oligocene : Tampa Bay silex beds.

Subgenus **BARBATIA** Gray

barbata Linnæus

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

barbata, H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 534, pl. 124, figs. 4, 4 a, 4 b, 1858 ; Dall, Bull, 37, U. S. Nat. Mus., p. 40, 1889 ; Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 614, 615, 659, 1898 ; Sheldon, Palæontographica Americana, vol, 1, p. 12, pl. 2, figs. 4 to 7, 1916.

Distribution.—Hatteras to Barbados and the Mediterranean, in 2 to 15 fms. Gulf Coast west Florida and Texas. (Dall). A common European fossil.

(**Calloarca**) **candida** Gmelin

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

jamaicensis Gmelin, Syst. Nat., vol. 6, p. 3312, 1792 ; Dall, (*as Noëtia*), Bull. 37, U. S. Nat. Mus., p, 40, 1889. Not a valid species.

candida Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889 ; Trans. Wagner Inst., vol. 3, pt. 4, p. 626, 1898 ; Dall and Simpson, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 460, 1901 ; Sheldon Palæont. Americana, vol. 1, p. 16, pl. 3, figs. 11, 12, 1916.

Distribution.—Recent : Hatteras to Brazil, tide water to 5 fms Perhaps also African. Gulf coast.—Recent : West Florida. Miocene : Chipola River marl and Chipola horizon, Alum Bluff, Fla.

(Acar) reticulata Gmelin

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

squamosa, *domingensis* and *clathrata* Lamarck, An. s. Vert., vol. 6, pp. 45, 40, 46, 1819.

gradata Broderip and Sowerby, Zool. Jour., vol. 4, p. 365, 1829.

divaricata Sowerby, Proc. Zool. Soc., p. 18, 1833 ; Reeve, Conch. Icon., *Arca*, pl. 16, fig. 108, 1844.

(*Byssoarca*) *reticulata* Dall, Bull. 37, U. S. Nat. Mus., p. 42, 1889.

(*Acar*) *reticulata* Dall, Trans. Wagner Inst., vol. 3, pt. 4, p. 629, 1898 : Sheldon, Palæont. Americana, vol. 1, p. 20, pl. 4, figs. 8 to 12, 1916 ; Dall, Checklist. Moll. Northwest Coast, p. 14, 1916 ; Maury, Bull. 29, Amer. Pal., p. 166, pl. 30; fig. 16, 1917 ; N. Y. Acad. Sci., Porto Rico Surv., vol. 3, pt. 1, p. 7, 1920.

Distribution.—Hatteras to Panama, also in the Mediterranean; Pacific, California to Ecuador, tidewater to 287 fms. Jacksonian Eocene to Recent. Gulf coast.—Recent : west Florida and Texas ; Pliocene : Caloosahatchie River, Florida. Miocene : Chipola River, Calhoun Co., Fla. Upper Oligocene : Tampa silex beds.

(Fossularca) adamsi Shuttleworth

Arca cœlata Conrad, Fos. Med. Tert., p. 61, pl. 32, fig. 2, 1845. Not of Reeve, 1844.

(*Acar*) *Adamsii* Shuttleworth, in Smith Zool. Jour. Linn. Soc., vol. 20, p. 499, pl. 30, figs. 6, 6 a, 1888.

(*Byssoarca*) *Adamsi* Dall, Bull. 37, U. S. Nat. Mus., p. 42, 1889.

(*Fossularca*) *Adamsi* Dall, Trans, Wagner Inst., vol. 3, pt. 4, p. 629, 1898 ; Vaughan, Carnegie Inst. Publ. 133, p. 171, 1910 ; Deussen U. S. G. S. Water-Supply Paper, 335,

p. 77, 1914, (as *Arca Adamsi*); Sheldon, Paleont. Amer., vol. 1, p. 22, pl. 4, figs. 16-18, pl. 5, fig. 1, 1916.

Distribution.—Hatteras to Fernando Noronha, 1 to 116 fms. Miocene to Recent. Gulf coast.—Recent: west Florida. Pliocene: Caloosahatchie, Shell and Alligator Creeks, Fla. (Dall). Miocene: Chipola River and Oak Grove, Fla.; Gilbert well No. 10, Bateson, Hardin Co., Texas, at 323 feet (?). Miocene horizon (Deussen).

adamsi conradiana Dall, Bull. Mus. Comp. Zool., vol. 12, p. 243, 1886; Bull. 37, U. S. Nat. Mus., p. 42, 1889; Proc. U. S. Nat. Mus., vol. 24, p. 508, pl. 31, fig. 1, 1902; Sheldon, Palæont. Amer., vol. 1, p. 22, 1916. A smaller, squarer form than typical.

Distribution.—Hatteras to West Florida, 25 to 52 fms. Cedar Keys, Fla.

(Cucullaria) paserula Sheldon

Macrodon aperula Dall, Bull. Mus. Comp. Zool., vol. 9, p. 120, 1881: *Idem*, vol. 12, p. 244, p. 8, figs. 4, 4 a, 1886: Bull. 37, U. S. Nat. Mus., p. 42, pl. 8, figs. 4, 4 a, 1889. Not *Arca asperula* Deshayes, An. s. Vert., vol. 1, p. 883, pl. 66, figs. 4-6, 1860.

Bentharca asperula Verrill and Bush, Proc. U. S. Nat. Mus., vol. 20, p. 842, 1898.

(*Cucullaria*) *asperula* Dall, Trans. Wagner Inst., vol. 3, pt. 4, p. 659, 1898.

(*Cucullaria*) *paserula* Sheldon, Palæont. Amer., vol. 1, p. 24, pl. 5, figs. 8, 9, 1916.

Distribution.—Fernandina to Yucatan. Abyssal, 310 to 1568 fms. Dredged by S. S. Blake in Gulf of Mexico, bottom temperature 40° F. Also young shell, doubtful, off Cape San Antonio.

Subgenus **NOETIA** Gray

Noetia ponderosa Say

Arca ponderosa Say, Jour. Acad. Nat. Sci. Phila., 1st. ser., vol. 2, p. 267, 1822.

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

elegans Philippi, Zeitschr. Mal., p. 92, 1847. Not *elegans* of Perry, 1811; Rœmer, 1836; d'Orbigny, 1844; Wood, 1846; nor of de Kominck.

ponderosa Holmes, Post-Pleiocene Fos. S. Car., p. 21, pl. 4, figs. 4, 4 a, 1860; Hilgard, House of Rep. Ex. Doc., vol. 1, pt. 2, p. 887, 1878; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, 1892.

(*Noëtia*) *ponderosa* Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889; Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 633, 1898; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903: Clark, Maryland Geol. Surv., Pleistocene, p. 205, pl. 64, figs. 1-6, 1906; Sheldon, Palæont. Amer., vol. 1, p. 28, pl. 6, figs. 6-10, 1916.

Distribution.—Cape Cod to Yucatan. Pliocine to Recent. Gulf Coast.—Recent: Ft. Barranca, Cedar Keys, Indian Pass, St. Joseph's Bay, Crooked Island, Florida: Horn Island, Mississippi; Point au Fer, Louisiana; Galveston, Corpus Christi, Texas.

Pleistocene: Grand Chênier, New Orleans pumping station No. 7, New Orleans artesian well of 1856 at 480 and 560 feet (Hilgard), Lake Borgne borings; Knapp's wells, Terrebonne Parish, No. 2, at 1519-1542, 1632-1726, 1719-1842, No. 3 at 670, 1579-1618, 1700, Crowley well No. 4, Jennings, at 1663-1670 feet.

Upper Miocene: variety *carolinensis* Conrad, Galveston artesian well at 2552-2871 feet (Harris).

Subgenus **SCAPHARCA** Gray

(**Scapharca**) **secticostata** Reeve

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

Anomalocardia Floridiana Conrad, Amer. Jour. Conch., vol. 5, p. 108, pl. 13, fig. 2, 1869.

lienosa Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889. Not *lienosa* Say which is fossil only.

secticostata Dall, Tran. Wagner Inst. Sci., vol. 3, pt. 4, p. 636, 1898 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903 ; Sheldon, Palæont. Amer., vol. 1. p. 36, pl. 8, figs. 3, 4, 5, 1916.

lienosa var. *floridana* Mitchell, List Texas Shells.

Remarks ; This comparatively rare shell has been confused with its ancestral type, *Arca lienosa* of the Miocene, first described by Say.

Distribution.—Hatteras to Trinidad. Pleistocene to Recent. Gulf coast.—Recent : St. Joseph's Bay and Crooked Island, West Florida ; Long Key, Gulf of Mexico ; Galveston, Texas. Pleistocene : North Creek, Little Sarasota Bay, Fla.

(**Scapharca**) **santarosana** Dall, Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 641, pl. 31, figs. 2, 10, 1898.

santarosana Maury, Bull. Amer. Pal., vol. 3, p. 375, 1902 ; Sheldon, Palæont. Amer., vol. 1, p. 38, pl. 9, figs. 1, 2, 3, 1916.

Distribution.—Miocene. Chipola River marl, Calhoun Co., and the Oak Grove sands, Santa Rosa Co., Fla. Also the lower bed, Alum Bluff, Fla. Bacom No. 1 well, near Mobile, Alabama at 1500-1556 feet, Oak Grove horizon ; Bacom No. 2 well at 1241 and 1600 feet. (Well specimens in Aldrich's collection).

(Scapharca) transversa Say

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

transversa Conrad, Fos. Tert. Form., p. 15, pl. 1, fig. 2, 1832; Tuomey and Holmes, Pleoic. Fos. S. C., p. 42, pl. 15, figs. 6, 7, 1856; Holmes, Post-Plio. Fos. S. C., p. 21, pl. 4, figs. 5, 5*a*; Gould, Inv. Mass., Binney's Ed., p. 148, fig. 465*a*, 1870; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, 1892; Dall, Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 645, 1898; Vanatta, Proc. Acad. Nat. Sci., Phila., vol. 55, p. 756, 1903; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 206, pl. 64, figs. 7-10, 1906; Vaughan, in Matson, 2d Ann. Rept. Fla. Geol. Surv., p. 149, 1909; Dall, in Deussen, U. S. G. S. Water Supply Paper 335, p. 77, 1914; Dall, in Matson U. S. G. S. Profess. Paper, 98-L., p. 177, 1916; Sheldon, Palæont. Amer., vol. 1, p. 47, pl. 11, figs. 4, 5, 6, 1916.

Remarks.—This shell is very abundant all along the Gulf coast, and is the commonest *Arca* in the adjacent wells. The specimens from the wells are often extremely small, young forms. A Miocene variety, *busana* Harris, was found in the Galveston well in 1895, It is more elongated and less inflated than the typical form of this species.

Distribution.—Cape Cod to Vera Cruz in 2 to 10 fms. Miocene to Recent. Gulf coast.—Recent: Ft. Barranca, Indian Pass, Crooked Island, Florida; Horn Island, Mississippi; Point au Fer, Cameron, Louisiana; Galveston, Corpus Christi, Texas; Gulf of Campeachy.

Pleistocene: New Orleans artesian well of 1856 at 41, 66, 79, 146, 233, 480, 570 feet; Lake Borgne borings, New Orleans pumping station No. 7; New Orleans Gymnasium well at 1200 feet, Lydia, Grand Chênier; Knapp's wells, Terrebonne Parish, No. 1 at 1600-1700, 2000-2150, 2250-2450, No. 2 at 1050-1190, 1190-1430, 1434-1519, 1542-1632, 1632-1726, 1731-1739, 1780-1790, 1791-1842, No. 3 at 570-

700, 700-780, 790-830, 880-900, 1040-1043, 1150-1200, 1200-1300, 1330-1375, 1400-1440, 1443-1470, 1470-1480, 1500-1525, 1579-1618, 1796-1839, 1865-2029 feet ; Weiss No. 1 well, Saratoga, Texas, (depth not recorded), Teel No. 1, Saratoga, Texas, at 940 feet. Well at Fort Morgan, Alabama at 87 and 100-112 feet. Orient Station, Hillsboro Co., Fla. ; North Creek, Fla. Pliocene : Myakka River, West Fla. Pleistocene to Upper Miocene : Galveston artesian well from the surface to 2920 feet (Harris). Miocene : Gilbert well, No. 10, Bateson, Hardin Co., Texas, at 323 feet (Dall.

(**Scapharca**) **auriculata** Lamarck

Arca auriculata Lamarck, An. s. Vert., vol. 6, p. 43, 1819.
auriculata Reeve, Conch. Icon., *Arca*, No. 35, pl. 6, 1844.
(*Scapharca*) *auriculata* Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889 ; Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 649, 1898 ; Sheldon, Palæont. Amer., vol. 1, p. 50, pl. 11, fig. 19, 1916 ; Maury, Bull. 30, Amer. Pal., p. 175, pl. 28, fig. 3, 1917.

Distribution.—Key West to Martinique, 15 to 40 fms. Miocene to Recent in the Antilles. Gulf coast.—Recent : Texas (Dall).

(**Cunearca**) **incongrua** Say

Arca incongrua Say, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 268, 1822.
incongrua Tuomey and Holmes, Pleioc. Fos. S. C., p. 45, pl. 16, figs. 5, 6, 1856 ; Holmes, Post-Plio. Fos. S. C., p. 19, pl. 4, figs. 1, 1*a*, 1860 ; Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889 ; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, 1892 ; Harris, Bull. Amer. Pal., vol. 1, No. 3, pp. 87, 88, 1895 ; Dall, Trans. Wag. Inst. Sci., 3, pt. 4, p. 635, 1898 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903 ; Sheldon. Palæont. Amer., vol. 1, p. 59, pl. 14, figs. 4 to 7, 1916.

Distribution.—North Carolina to Texas, and the closely related form, *S. brasiliana* Lamarck, south to Sao Paulo, Brazil. Upper Miocene to Recent. Gulf coast.—Recent: Calhoun County, Florida; Horn Island, Mississippi; Cameron, Point au Fer, Louisiana; Galveston, Corpus Christi, Texas.

Pleistocene: New Orleans pumping station No. 7, Grand Chênier, Knapp's wells, Terrebonne Parish, No. 1 at 2000-2150 (?), No. 2 at 1434-1519, No. 3 at 570-700, Beaumont Pretoleum and Liquid Fuel Co.'s well No. 1, Saratoga, Texas, at 705 feet; Weiss No. 1, Saratoga, (depth not recorded). Upper Miocene: Galveston artesian well at 2433-2920 feet (Harris).

(**Cunearca**) **chemnitzi** Philippi

Arca Chemnitzii Philippi, Zeitschr. für Malakozoologie, vol. 8, p. 50, 1851.

(*Noëtia*) *Orbignyi* (Kobelt) Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889.

(*Cunearca*) *Chemnitzi* Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 636, 659, 1898; Sheldon, Palæont. Amer., vol. 1, p. 60, pl. 15, figs. 3, 4, 1916.

Distribution.—Texas and West Florida to St. Thomas (Dall).

(**Argina**) **campechensis** Gmelin

Arca campechensis Gmelin, Syst. Nat., vol. 6, p. 3312, 1792.

campechensis Dillwn, Descr. Cat. Rec. Shells, vol. 1, p. 238, 1817.

pexata Say, Jour. Acad. Nat. Sci., Phila., 2, p. 268, 1822.

americana Gray, Wood's Index Test. Suppl., pl. 2, *Arca*, fig. 1, 1828; Reeve, Conch. Icon., *Arca*, fig. 21, 1844; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878; Holmes, Post-Plio. Fos. S. C., p. 19, pl. 4, figs. 2, 2 *a*, 1860; Dall, Bull. 37, U. S. Nat. Mus. p. 40, 1889; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, 1892.

pexata Gould, Inv. Mass., Binney'sE d., p. 147, fig. 456, 1870; Hilgard, *loc. cit.*, p. 887, 1878; Dall, Bull. 37, U. S. Nat. Mus., p. 40, 1889; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, 1892.

campechensis Dall, Trans. Wag. Inst. Sci., vol. 3, pt: 4, p. 650, 1898 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903 ; Sheldon, Paleont. Amer., vol. 1, p. 61, pl. 15, figs. 6 to 13, 1916.

Distribution.—Cape Cod to Trinidad. Upper Miocene (?) to Recent. Gulf Coast.—St. Joseph's Bay and Indian Pass, both in Calhoun Co., Florida ; Mobile, Alabama ; Horn Island, Mississippi ; Cameron, Point au Fer, Chandeleurs, Louisiana ; Galveston, Corpus Christi, Texas.

Pleistocene : Grand Chênier, New Orleans pumping station No. 7, New Orleans artesian well of 1856, Lake Borgne borings, New Orleans Gymnasium well at 1200 feet, Knapp's well, Terrebonne Parish, No. 1 at 2000-2150, 2250-2450, No. 2 at 1800, No. 3 at 300-400, 880-900 feet. Upper Miocene : (?) Jennings-Heywood Oil Syndicate's well No. 29, Jennings, Louisiana, at 1960-1980 feet.

labiata Sowerby, var.

Arca labiata (Sowerby) Harris, Fourth Ann. Rept. Geol. Surv. Texas, p. 121, 1893.

Arca (small *Limopsis*-like) Harris, *loc. cit.* (very young).

Arca labiata (Sby.) var. Harris, Bull. Amer. Pal. 1, No. 3, p. 89, pl. 1, figs. 1, 1 *a*, 1895.

Distribution.—Upper Miocene of the Galveston artesian well at 2510-2871 feet (Harris).

Remarks.—These well specimens closely resembled the West Coast species *Arca labiata* Sowerby (Proc. Zool. Soc., p. 21, 1833 ; Reeve, Conch. Icon., *Arca*, pl. 1, fig. 7, 1844 ; Dall Proc. U. S. Nat. Mus., vol. 37, p. 253, 1910) which ranges from San Diego, Cal., to Tumbez, Peru, in the recent fauna.

(Bathyarca) glomerula Dall

Arca glomerula Dall, Bull. Mus. Comp. Zool. Harvard Coll., vol. 9, p. 121, 1881.

(*Scapharca* ?) *inæquisculpta* E. A. Smith, Chall. Rept. Lam., p. 267, pl. 17, figs. 8 *a*-8 *c*, 1885.

glomerula Dall, Bull. Mus. Comp. Zool., vol. 12, p. 241, pl, 8, figs. 9, 9 *a*, 1886.

(*Byssoarca*) *glomerula* Dall, Bull. 37, U. S. Nat. Mus., p. 42, pl. 8, figs. 9, 9*a*, 1889.

(*Bathyarca*) *glomerula* Dall, Trans. Wagner Inst, Sci., vol. 3, pt. 4, p. 659, 1898; Sheldon, Palæont. Amer., vol. 1, p. 64, pl. 16, figs. 4, 5, 1916.

Distribution.—Hatteras to St. Vincent, 100 to 683 fms. Gulf of Mexico, western Florida region. (Dall).

(**Bathyarca**) **pectunculoides** Scacchi

Arca pectunculoides Scacchi, Not. Conch. foss. Gravina, in Ann. Civ. Sicil., vol. 6, p. 82, 1834.

pectunculoides var. *orbiculata* Dall, Bull. Mus. Comp. Zool., vol. 9, p. 121, 1881; *Idem*, vol. 12, p. 240, pl. 8, fig. 5, 1886.

(*Bathyarca*) *pectunculoides* Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, pp. 619, 659, 1898; Sheldon, Palæont. Amer., vol. 1, p. 65, pl. 16, figs. 9-11, 1916.

Distribution.—Norway to St. Vincent, 75 to 1568 fms. Variety *orbiculata* dredged by the Blake in Gulf of Mexico.

Genus **GLYCYMERIS** Da Costa

pectinata Gmelin

Arca pectinata Gmelin, Syst. Nat. 6, p. 3313, 1792.

Pectunculus aratus Conrad, Am. Journ. Sci., vol. 41, p. 346, 1841; Fos. Med. Tert., p. 62, pl. 34, fig. 2, 1845; Tuomey and Holmes, Pleio. Fos. S. C., p. 50, pl. 17, fig. 6, 1857.

pectiniformis Orb., Moll. Cuba, vol. 2, p. 313, 1853; (not *pectiniformis* Lamarck).

charlestonensis Holmes, Post-Plio. Fos. S. C., p. 16, pl. 3, fig. 5, 1860.

pectinatus Dall, Bull. 37, U. S. Nat. Mus., p. 42, 1889.

pectinata Dall, Trans. Wag. Inst., vol. 3, pt. 4, p. 612, 1898.

Distribution.—Hatteras to Nicaragua, 2-175 fms. Miocene to Recent. Gulf Coast.—Recent: west Florida, Texas. Pleistocene: Knapp's No. 3 well, Terrebonne Parish, 670, 700-780 feet; New Orleans Gymnasium well 1200 feet. Pliocene: Caloosahatchie, Fla,

subovata Say

Pectunculus subovatus Say, Jour. Acad. Nat. Sci., Phila., 1st Ser., vol. 4, p. 140, pl. 10, fig. 4, 1824; Conrad, Fos. Shells Tert. Formations, p. 17, pl. 2, fig. 3, 1832.

subovata Dall, Trans. Wagner Inst, Sci., vol. 3, pt. 4, p. 611, 1898; Aldrich, Manuscript.

Remarks.—This species includes the varieties *tuomeyi* and *plagia* Dall.

Distribution.—Vicksburgian Oligocene of Martin, Fla.; Miocene of Virginia, Maryland, and Florida. Bascom No. 1 well, Mobile, 1550-1556 feet, Oak Grove horizon; No. 2 at 1241, 1600 and 1800 feet.

Genus **ATRINA** Gray

rigida Dillwyn

Pinna rigida Dill., Cat. p. 327, 1817; Reeve, Conch. Icon., *Pinna*, pl. 5, fig. 7, 1858.

seminuda Lam., An. s. Vert., vol. 6, p. 131, 1819. (Not Reeve); Holmes, Post-Plio. Fos. S. C., p. 14, pl. 3, fig. 2, 1860; Singley, Fourth Ann. Rept. Texas Geol. Surv., p. 324, 1892.

muricata, Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 888, 1878; Dall, Bull. U. S. Nat. Mus. No. 37, p. 36, 1889; Singley, *loc. cit.*, p. 324, 1892; and of many American authors but not of Linnæus nor of Reeve.

rigida Dall, Trans. Wagner Inst., vol. 3, pt. 4, p. 663, 1898; Vanatta, Proc. Acad. Nat. Sci., vol. 55, p. 756, 1903.

Distribution.—Hatteras to Central America. Pleistocene to Recent. Gulf Coast.—Recent: Cedar Keys, St. Joseph's Bay (Calhoun Co.), Fla.; Chandeleur Islands, La.; Galveston, Corpus Christi, Matagorda Bay, Mustang and Padre Islands, Texas. Pleistocene: Lake Borgne borings (Hilgard); New Orleans pumping station No. 7.

serrata Sowerby

Pinna serrata Sowerby, Tank. Cat. App., p. 5, 1825; Reeve, Conch. Icon., *Pinna*, 34, fig. 65, 1859.

squamosissima Philippi, Rœmer's Texas, p. 454, 1849.
seminuda Reeve, Conch. Icon., *Pinna*, pl. 2, fig. 2, 1858; Dall, Bull. 37, U. S. Nat. Mus., p. 36, 1889. Not *seminuda* Lamarck.
muricata Holmes, Post-Plio. Fos. S. C., p. 15, pl. 3, fig. 3, 1858. Not *muricata* Linnæus.
serrata Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 664, 1898; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903.

Distribution.—North Carolina to Guadeloupe Isl. Pliocene to Recent. Gulf Coast.—Recent: St. Joseph's Bay, Fla., and Texas. Pleistocene: Tampa Bay, Little Sarastoa Bay, Fla.

Genus **MELINA** Retzius

obliqua Lamarck

Perna obliqua Lamarck, Jour. de Conch., vol. 2, p. 426, Arango, Fauna Mal. Cuba, p. 269, 1878; Dall, Bull. 37, U. S. Nat. Mus., p. 36, 1889.

Distribution.—St. Augustine to Guadeloupe. Gulf coast.—West Florida and Texas.

Genus **PTERIA** Scopoli

colymbus Bolten

Pinctada colymbus Bolten, Mus. Boltenian. p. 167, 1798; Chemnitz, Conch. Cat., vol. 8, p. 141, pl. 81, fig. 723, 1785. (Chemnitz not binomial).
Avicula atlantica Lam., An. s. Vert., 6, p. 148, 1819, (in part); DeKay, Zool. New York, Mollusca, p. 175; Holmes, Post-Plio. Fos. S. C., p. 14, pl. 3, fig. 1, 1858; Dall, U. S. Nat. Mus. Bull. 37, p. 36, 1889.
hirundo Gmelin, Syst. Nat. p. 3357, 1792; Say, Jour. Acad. Nat. Sci. Phila., vol. 2, p. 262, 1822. Not of Bolten.
colymbus Dall, Trans. Wagner Inst. Sci. 3, pt. 4, p. 670, 1898.
columba Mitchell, List Texas Shells.

Distribution.—Hatteras to Venezuela, 10-180 fms. Pliocene to Recent. Gulf coast,—Cedar Keys; typical and variety *brevicauda*, Texas coast. Pliocene: Caloosahatchie.

vitrea Reeve

Avicula vitrea Reeve, Conch. Icon. *Avicula*, pl. 18, fig. 68, 1857.

nitida Verrill, List Fish Comn. Moll., p. 281, 1884; Dall, Bull. 37, U, S. Nat. Mus., p. 36, 1889.

hirundo var. *vitrea* Dall, Trans. Wagner Inst., 3, pt. 4, p. 670, 1898.

Distribution.—Rhode Island to Tortugas, 28 to 192 fms. Pleistocene to Recent. West Florida.

Genus **MARGARITIPHORA** Megerle

placunoides Reeve

Avicula placunoides Reeve, Conch. Icon., *Avicula*, pl. 17, fig. 68.

placunoides List Cameron Shells (Manuscript). Cameron, Louisiana.

radiata Leach

Avicula radiata Leach, Zool. Miscellany, vol. 1, p. 98, pl. 43, 1814.

radiata Dall, Trans. Wagner Inst. Sci., 3, pt. 4, p. 668, 1898.

Pteria radiata Dall and Simpson, Bull. U. S. Fish Comm., vol. 1, p. 463, 1901.

Distribution.—Bermuda to Brazil. Gulf Coast.—Cameron, La., Pass Cabello, Texas.

Genus **OSTREA** Linnæus

virginica Gmelin

virginiana Lister, Historiæ Conch., t. 200, f. 32, 1692. Not binomial.

virginica Gmelin, Syst. Nat., p. 3336, 1792.

borealis Lamarck, An. sans Vert., 6, p. 204, 1819.

virginiana Sowerby, Genera Shells, *Ostrea*, f. 2, 1822; Holmes, Post-Plio. Foss. S. Car., p. 9, pl. 2, fig. 9, 1858.

fundata Holmes, *Idem*, p. 11, pl. 2, fig. 10.
virginica Dall, Bull. Bull. 37, U. S. Nat. Mus., p. 32, 1889; Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 687, 1898; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 204, pls. 41, 42, 43, 1906.

Distribution.—Canada to Mexico and Gulf of California. Miocene to Recent.

Gulf coast.—Recent: Cedar Keys, St. Mark's, Ft. Barranca, Fla.; Belle Isle, Point au Fer, Week's Island, Lake Charles, La.; Port Lavaca, Rockport and Corpus Christi, Texas.

Pleistocene: Grand Chênier; New Orleans pumping station No. 7; New Orleans Gymnasium well at 1200 feet; Knapp's wells in Terrebonne Parish, No. 1 at 1600-1700, No. 2 at 1190-1430, 1434-1519, 1532-1632, 1780-1790, 1791-1842, No. 3 at 570, 700-780, 880-900, 1040-1043, 1150-1200, 1330-1375, 1400-1440, 1443-1470, 1470-1480, 1500-1525, 1579-1618, 1700, 1800 (Oyster bed); Bayou City well, Beaumont, Texas at 600 feet; Weiss No. 1, depth not recorded; Petroleum and Liquid Fuel Co.'s well No. 1, Beaumont, at 705 feet. Orient and West Creek, Fla. Pliocene: Caloosahatchie marl, Fla.

cristata Born

cristata Born, Mus. Vind., p. 112, pl. 7, fig. 3, 1780.
cristata Dall, Bull. 37, U. S. Nat. Mus., p. 32, 1889; Dall and Simpson, Bull. U. S. Fish Comm., vol. 1, p. 464, 1901.

Distribution.—Florida to Martinique. Gulf coast, Tampa.

frons Linnæus

Mytilus frons Linnæus, Syst. Nat., ed. X, p. 704, 1758.
frons Sowerby, Conch. Icon., vol. 18, pl. 19, fig. 41, 1871; Dall, Bull. 37, U. S. Nat. Mus., p. 32, 1889; Dall and Simpson, Bull. U. S: Fish Comm., vol. 1, p. 464, 1901.

Distribution.—East and west coasts Florida to Barbados.

equestris Say

equestris Say, See Tryon, Amer. Marine Conch., p. 193, 1873-1874; Dall Bull. 37, U. S. Nat. Mus., p. 32, 1889;

Trans. Wagner Inst. Sci., 3, pt. 4, p. 672, 1898.
Distribution.—N. Carolina to Florida. Gulf coast.—Charlotte Harbor, Fla.

Genus **UNIO** Philippson

tetralasmus var. **declivis** Say

declivis Say, Transylvania Jour., vol. 4, p. 527, 1831; Amer. Jour. Conch., vol. 3. pl. 35, 1832.

Var. *declivis* Simpson, Proc. U. S. Nat. Mus., vol. 22, p. 740, 1900.

Distribution.—*U. tetralasmus* and its varieties. inhabits the Lower Mississippi drainage area north to Lat, 40°; Alabama River System and extends west through Texas into Northern Mexico. Pleistocene: pumping station No. 7, New Orleans.

Genus **QUADRULA** Rafinesque

apiculata Say

Unio apiculatus Say, New Harm. Diss., vol. 2, No. 2, p. 309, 1829; Amer, Conch., 6, pl. 52, 1834; Conrad, New Fresh Water Shells, p. 67, 1834; Conrad, Monog. Uniondæ, p. 78, pl. 44, fig. 1, 1836.

nobilis Conrad, Jour. Acad. Nat. Sci., Phila., p. 297, pl. 27, fig. 2 (not 3), 1854.

Quadrula apiculata Simpson, Proc. U. S. Nat. Mus., vol. 22, p. 778, 1900.

Distribution.—Rivers and Lakes, Louisiana to Texas, with *Quadrula trapazoides* Lea in Indian shell heaps, Lake Charles, La. Pleistocene: Knapp's No. 3 well, Terrebonne Parish, 500 ft.

Genus **PECTEN** Müller

phrygium Dall, B. M. C. Z., 12, p. 217, '86; Bull. 37, U. S. N. Mus., p. 34, pl. 40, fig. 1, '89.

Distribution.—Hatteras to Grenada, 50-792 fms. Yucatan Banks, Lat. 23° N., Long. 88° W.

(**Euvola**) **ziczac** Linnæus

ziczac Linn., Syst. Nat., p. 1144.

Pecten ziczac Reeve, Conch. Icon. *Pecten*, pl. 6, fig. 29; Dall, Bull. 37, U. S. N. M., p. 32, '89; Trans. Wagner Inst., 3, pt. 4, p, 694, '98.

Distribution.—Tampa to Guadeloupe.

Subgenus **CHLAMYS** Bolten

exasperatus Sowerby, Thes. Conch., 1, p. 54, pl. 18, f. 183-186, '43; Reeve, Conch, Icon., 8, pl. 2, f. 7, 8, '52; Dall, Bull, 37, U. S. Nat. Mus., p. 34, '89.

fuscopurpureus Conrad, J. A. N. S. Phila., pp. 209, 280, pl. 39, f. 10, '49.

Distribution.—Hatteras to Guadeloupe. Pliocene to Recent. Gulf of Mexico: Charlotte Harbor, 13 fms, Yucatan Strait 640 fms., Tampa (type locality of *fuscopurpureus*). Pliocene: Caloosahatchie.

ornatus Lamarck, An. s. Vert., 6, p. 176, 1819; Reeve, Conch. Icon., 19, f. 68, '53; Dall, Bull. 37, U. S. Nat. Mus., p. 34, '89; Trans. Wagner Inst., 3, pt. 4, p. 743, 1898.

Distribution.—N. Carolina to Brazil. Gulf.—Off Cedar Keys, 50 fms.

(**Nodipecten**) **nodosus** Linnæus

Ostrea nodosa Linn., Syst. Nat. ed. X, p. 697, 1758.

Pecten corallinus Chemn. Conch. Cab. 7, p. 306, pl. 64, figs. 609-11, 1784.

fragrosus Conrad, Jour. Acad. Nat. Sci., Phila., 2d Ser. 1, p. 214, pl. 39, f. 11, 1849.

nodosus Dall, Trans. Wag. Inst. Sci., 3, pt. 4, p. 728, 1898; Mitchell, List Texas Shells; Maury. Bull. Amer. Pal. No. 29, p. 186, 1917.

Distribution.—Antilles and Gulf of Mexico. Variety *fragrosus*, Cedar Keys. Pliocene: Caloosahatchie.

(**Plagioctenium**) **gibbus** Linnæus

Ostrea gibba Linn. Syst. Nat., ed. X, p. 698, 1758. Not of Born 1780.

Pecten dislocatus Say, Jour. Acad. Nat. Sci., Phila., 2, p. 260, 1822.

purpuratus Conrad, Amer. Marine Conch., p. 10, pl. 2, f. 1, 1831. Not of Lamarck.

dislocatus Holmes, Post-Plio. Fos. S. C., p. 12, pl. 2, f. 12, 1858; Hilgard, House of Rep., Ex. Doc. 1, pt. 2, p. 888, 1878.

irradians var. *dislocatus* Dall, Bull. 37, U. S. Nat. Mus., p. 34, 1889; Singley, Fourth Ann. Rept. Texas Geol. Surv., 324, 1892.

gibbus var. *dislocatus* Dall, Trans. Wagner Inst. Sci., 3, pt. 4, p. 746, 1898; *Idem*, pt. 6, p. 1615, 1903.

Remarks: Linnæus' description of *O. gibba* was based on the drawing of a Jamaican Pecten by Browne (Civil and Nat. Hist. Jamaica, p. 41, pl. 40, fig. 10, 1756). According to Dr. Dall, this is identical with *dislocatus* Say.

Distribution.—Hatteras to Brazil and west coast of Africa. Miocene to Recent. Gulf coast.—Recent: Cedar Keys, Fla; Matagorda, Corpus Christi, Texas. Pleistocene: Orient and North Creek, Fla.; New Orleans well of 1856 at 235, 480, 546 feet; Lake Borgne borings (?); Knapp's wells, Terrebonne Parish No. 1 at 2000-2150, 2250-2450, No. 3 at 570-700, 1150-1200, 1200-1300, 1330-1375, 1400-1440, 1443-1470, 1500-1525 feet.

(**Plagioctenium**) **gibbus irradians** Lamarck

Pecten irradians Lamarck, An. s. Vert., 6, p. 173, 1819.

concentricus Say, Jour. Acad. Nat. Sci. Phila., p. 259, 1822.

irradians Gould, Binney's Ed. Invert. Mass., p. 199, fig. 496, 1870; Dall, Bull. 37, U. S. Nat. Mus., p. 34, pl. 53, fig. 11, 1889; Singley, Fourth Ann. Rept., Geol. Surv. Texas, p. 324, 1892.

gibbus var. *irradians* Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 748, 1898; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903.

Distribution.—New Jersey to Texas. Pleistocene to Recent. Gulf coast.—Recent: Tampa, Florida; Horn Island, Miss.; Chandeleurs, La.; Corpus Christi, Galveston, Texas. Pleistocene: North Creek, Manatee Co., Fla.;

New Orleans pumping station No. 7; Knapp's wells, Terrebonne Parish, No. 1 at 1600-1700, 2250-2450, No. 2 at at 1434, 1780-1790, 1791-1842, No. 3 at 1700-1712 feet.

Subgenus **PSEUDAMUSIUM** Adams

strigillatum Dall, Bull. 37, U. S. Nat. Mus., p. 34, pl. 42, f. 2, '89.
Distribution.—Fernandina to Cuba, Abyssal, 294 to 1181 fms. Gulf of Mexico : western Fla. region.

vitreum Gmelin
Pecten vitreus Gmelin, Syst. Nat., 6, 1792 ; Dall, Bull. 37, U. S. Nat. Mus., p. 34, pl. 64, fig. 141, 1889.
Distribution.—Arctic Ocean to Patagonia, 50 to 800 fms. West Florida, deep water.

Genus **AMUSIUM** Bolten

papyraceum Gabb
Pleuronectia papyracea Gabb, Trans. Amer. Phil. Soc., vol. 15, p. 257, 1873.
mortoni Dall, Bull. 37, U. S. Nat. Mus., p. 34, 1889. Not *Pecten mortoni* Ravenel 1844.
papyraceum Dall, Trans. Wagner Inst. Sci., 3, pt. 4, pp. 718, 757, 1898, *Idem*, pt. 6, p. 1586, 1903 ; Maury, Bull. Amer. Pal., No. 29, p. 190, pl. 26, fig. 22, 1917.
Distribution.—Antilles and Gulf of Mexico. Miocene, Santo Domingo. Living in deep and shallow water, west Florida.

mortoni Ravenel
Pecten mortoni Ravenel, Proc. Acad. Nat. Sci. Phila., 2, p. 96, 1844 ; Tuomey and Holmes, Pleio. Foss. S. Car., p. 27, pl. 10, f. 1, 2, '55 ; Dall, Trans. Wagner Inst., 3, pt. 4, p. 757, '98.
Distribution.—Miocene : Md., Car. and Fla. Pliocene : Caloosahatchie and Shell Creek, Fla.

dalli Smith, Chall. Rept. Lam., p. 308, pl. 22, fig. 7 *a-c*, '86 ; Dall, B. M. C. Z., 12, p. 209, pl. 4, f. 1, '86 ; Bull. 37, U. S. Nat. Nus., p. 32, pl. 4, f. 1, pl. 40, f. 6, '89.
Distribution.—Bermuda to Barbados, abyssal, 218 to 1591 fms. Gulf of Mexico, western Fla. region, 860 fms.

(Propeamusium) pourtalesianum Dall, B. M. C. Z., 12, p. 211, pl. 4, f. 3, pl. 5, f. 12, '86 ; Bull. 37, U. S. N. Mus., p. 34, pl. 5, f. 12, '89.

Distribution.—Dredged, Cedar Keys to Grenada. Charlotte Harbor at 13 fms. Maximum depth 805. Min. temperature 39° F. Mottled variety=*marmoratum* Dall (B. M. C. Z. 9, p. 117, 1881 ; Bull. 37, U. S. Nat. Mus., p. 34, pl. 4, f. 3, 1889).

cancellatum Smith, Chall. Rept. Lam., p. 315, pl. 23, f. 8, '86 ; Dall, B. M. C. Z., 12, p. 213, pl. 5, f. 1, 2, '86.

Distribution.—Charlotte Harbor to St. Vincent, 13-1591 fms. Cape San Antonio and Yucatan Strait.

Genus **PLICATULA** Lamarck

gibbosa Lamarck, Syst. An. s. Vert., p. 132, 1801.

spondyloidea Meuschen, (as *Ostrea*), Mus. Gronov., 1778. Not Linnæan in nomenclature ; Arango, Fauna Mal. Cuba, p. 271, 1878 ; Dall, B. M. C. Z., 12, p. 227, 1886 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

ramosa Lamarck, An. s. Vert., p. 184, 1819.

cristata Gabb, Trans. Am. Phil. Soc., vol. 15, p. 247, 1873.

vexillata Guppy, Geol. Mag., vol. 1, p. 444, pl. 17, fig. 7, 1874.

ramosa Dall, Bull. 37, U. S. Nat. Mus., p. 32, '89 ; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 324, '92.

gibbosa Dall, Trans. Wagner Inst. Sci., 3, pt. 4, p. 763, '98 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, '03.

Distribution.—Hatteras to Rio la Plata. Gulf coast.—Ft. Barranca, St. Joseph's Bay, Crooked Island, Florida ; Horn Island, Mississippi ; Galveston. Pleistocene : New Orleans pumping station No. 7 ; New Orleans Gymnasium well at 1200 feet ; Labelle, West Fla.

Genus **SPONDYLUS** Linnæus

echinatus Martyn, Univ. Conch,, 2, fig. 154, 1784.

spathuliferus Lamarck, An. s. Vert., 6, p. 191, 1819 ; Dall, Bull. 37, U. S. N. Mus., p. 32, '89.

americanus Lam., An. s. Vert. 6, p. 188, 1819; Reeve, Conch. Icon., pl. 4, fig. 17, '56.

echinatus Dall, T. W. I., 3, pt. 4, p. 759, '98.

Distribution.—Hatteras to Brazil. Pleistocene to Recent. West Florida and Texas.

gussoni Costa, Cat. Sist , p. 42, 1829; Philippi, Moll. Sicil., 1, p. 87, pl. 5, f. 16, 1836; Dall, B. M. C. Z., 12, p. 227, '86; Bull. 37, U. S. N. M., p. 32, '89.

Distribution.—Antilles and Mediterranean. Gulf of Mexico, Yucatan Strait, 640 fms. A small, colorless, deep water species.

Genus **LIMA** Bruguière

tenera Sowerby, Thes. Conch., p. 84, No. 2, pl. 21, f. 10, 11, 1847; Dall, Proc. U. S. Nat. Mus., 6, p. 341, '83; Bull. 37, U. S. N. M., p. 36, '89; Tr. W. I., 3, pt. 4, p. 768, 1898.

Distribution.—Florida to Barbados. Pliocene to Recent. Gulf coast.—Cedar Keys. Pliocene: Caloosahatchie.

inflata Lamarck, An. s. Vert., 6, p. 156; Dall, B. M. C. Z., 12, p. 224, '86; Bull. 37, U. S. N. M., p. 36, '89.

fasciata Sowerby, Thes. Conch., 1, p. 85, pl. 21, f. 16, 17. Not *Ostrea fasciata* Linnæus.

Distribution.—Hatteras to Trinidad. Gulf coast.—Cedar Keys, and dredged off west Fla,, 19 fms.

lima Linnæus, Syst. Nat. ed. X, p. 699, 1758, (as *Ostrea*); Dall, Tr. W. I., 3, pt. 4, p. 767, '98.

radula Chemnitz, Conch. Cat., 6, p. 349, pl. 68, f. 651, 1784.

squamosa Lamarck, Syst. An, s. Vert., p. 136, 1801; Sowerby, Thes. Conch. 1, p. 84, pl. 21, f. 1, 18; Dall, B. M. C. Z., 12, p. 224, '86; Bull. 37, U. S. N. M., p. 36, '89.

Distribution.—Florida to Brazil and almost world wide. Gulf coast.—West Florida, shallow; Yucatan Strait, 640 fms.

(Limatula) confusa E. A. Smith, Chall. Rept. Lam., 1886; Dall, B. M. C. Z., 12, p. 226, '86; Bull. 37, U. S. N. M., p. 36, 1889.

ovata Jeffreys, Ann. Mag. Nat. Hist., p. 426, 1876 ; Dall, B. M. C. Z., 9, p. 118, '81. Not *ovata* Wood.

Distribution.—North Atlantic to Brazil, 31 to 1450 fms. West Fla., deep water.

Genus **ANOMIA** Linnæus

simplex d'Orbigny, Hist. Pol. y Nat. Isla de Cuba, 2, p. 371, 1845 ; Atlas, pl. 28, figs. 31-33, 1855 ; Dall, Bull. 37, U. S. N. M., p. 32, pl. 53, f. 1, 2, '89 ; Tr. W. I., 3, pt. 4, p. 784, '98 ; Maury, Bull. 29, Am. Pal., p, 191, '17.

ephippium Conrad, Med. Tert. Fos., p. 75, pl. 43, f. 4, '45 ; Tuomey and Holmes, Pleio. Fos. S. C., p. 18, pl. 5, fig. 4, '55 ; Holmes, Post-Pl. Fos. S. C., p. 11, pl. 2, f. 11, '58 ; Hilgard, House Rep., Ex. Doc. 1, pt. 2, p. 888, '78.

electrica Gould, Inv. Mass., p. 140, '41.

glabra Verrill, Am. Jour. Sci., p. 213, 1872.

Distribution.—Nova Scotia to Martinique. Miocene to Recênt. Gulf coast.—Ft. Barranca, Cedar Keys, &c, Fla. ; Horn Isl., Miss. ; Point au Fer, Cameron, La. ; Galveston, Corpus Christi, &c, Tex. Pleistocene : New Orleans pumping station 7, New Orleans Gymnasium well at 1200 feet ; New Orleans artesian well of 1856 at 146, 546, 570 feet ; Lake Borgne borings ; Knapp's well No. 3, Terrebonne Parish at 1330-1375, 1400-1440, 1443-1470 feet.

floridana Dall, Trans. Wagner Inst., 3, pt. 4, p. 783, pl. 35, f. 7, 1898.

Distribution.—Miocene, Oak Grove, Fla., Mobile, Ala., No. 2 well, 1241 feet. Oak Grove horizon.

Genus **PODODESMUS** Philippi

rudis Broderip

Placunanomia rudis Broderip, Proc. Zool. Soc., p. 2, 1834 ; Reeve, Conch. Icon., pl. 1, f. 2, 1859 ; Dall, Bull. 37, U. S. N. M., p. 32, '89.

echinata Brod., *abnormalis* Gray and *harfordi* Reeve.

rudis Gray, P. Z. S., p. 121, 1849 ; Dall, Trans. Wagner Inst., 3, pt. 4, p. 779, '98.

Distribution.—Antilles to Rio la Plata. Gulf coast.—Cedar Keys, Fla. Chipolan Miocene (?)

Genus **MYTILUS** Linnæus

conradianus d'Orbigny, Prodr. Pal., 3, p. 127, 1852 ; Dall, Tr. Wagner Inst. 3, pt. 4, p. 787, '98.

incrassatus Conrad, Am. Jour. Sci., 41, p. 347, 1841 ; Fos. Medial Tert., p. 74, pl. 42, fig. 4, '45 ; Tuomey and Holmes, Pleoic. Fos. S. C., p. 32, pl. 14, figs. 1, 2, 1857 ; Harris, Bull. Amer. Pal. 1, No. 3, p. 87, '95. Not *incrassata* Deshayes, 1830.

Mytiloconcha incrassata Conrad, Proc. Acad. Nat. Sci. Phila., for 1862, p. 291.

Distribution.—Miocene of New Jersey, Maryland, the Carolinas, and the Galveston artesian well, Texas, at 2384-2871 feet (Harris).

exustus Linn., Syst. Nat. ed. X, p. 705, 1758 , Dall, Bull. 37, U. S. Nat. Mus., p. 38, '89 ; Singley, Fourth Ann. Rept. Texas Geol. Surv., p. 325, '92 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, '03 ; Mitchell, List Texas Shells.

bidens Linn., Syst., Nat., ed. XII, p. 1157, 1767.

domingensis Lamarck, An. s. Vert., 6, p. 121, 1819 ; d'Orbigny, Moll. Cuba, 2, p. 328, 1845.

Distribution.—Charleston to Bahia, Brazil. Pliocene to Recent. Gulf coast.—Crooked Isl., Calhoun Co., Fla. ; Corpus Christi and Lavaca Bays, Tex. Pliocene: Caloosahatchie and Shell Creek, Fla.

hamatus Say, Jour. Acad. Nat. Sci. Phila., 2, p. 265, 1822 ; Binney's reprint of Say, pp. 91, 204, pl. 50 ; Dall, Bull. 37, U. S. N. M., p. 38, '89 ; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 325, '92 ; Dall, Trans. Wag. Inst. Sci., vol. 3, pt. 4, p. 789, '98 ; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 203, pl. 60, figs. 5, 6, 1906.

striatus Barnes, Am. Jour. Sci., 6. p. 364, 1823 ; Say, Am. Conch, 5, pl. 50, 1832.

carolinensis Conrad, Jour. Acad. Nat. Sci. Phila., 7, p. 244, pl. 20, fig. 6, 1837.

Distribution.—Rhode Island to Costa Rica. Pliocene to Recent. Gulf coast.—Cedar Keys, Fla.; Point au Fer, Weeks Isl., Cameron, La.; Galveston, Corpus Christi, Tex. Pleistocene: Knapp's wells, Terrebonne Parish, No. 2, at 1434-1519, 1519-1542, 1632-1726, No. 3 at 570-700 feet. Pliocene: Caloosahatchie.

Genus **MODIOLUS** Lamarck

Modiolus tulipus Lamarck

Modiola tulipa Lam., An. s. Vert., 6, p. 111, 1819; Reeve, Conch. Icon., pl. 4, fig. 15, 1857; Dall, Bull. 37, U. S. N. M., p. 38, '89; Mitchell, List Texas Shells.

tulipus Dall and Simpson, Bull. U. S. Fish Comm., 1, p. 470, 1901; Vanatta, Proc. Acad. Nat. Sci., Phila., 55, p. 756, 1903.

Distribution.—N. Carolina to Guadeloupe. Gulf coast.—Calhoun and Franklin Cos., Fla.; Chandeleurs, La.; Texas.

(Amygdalum) politus Verrill and Smith

Modiola polita V. and S., Amer. Jour. Sci., 20, pp. 392, 400, 1880; Dall, B. M. C. Z., 12, p. 234, pl. 6, f. 3, '86; Bull. 37, U. S. N. M., p. 38, pl. 6, f. 3, pl. 45, f. 12, '89.

luteus Jeffreys, 1880. *Nomen nudum.*

Distribution.—North Atlantic to Grenada, 111-1000 fms. Temperature 45° F. Gulf of Mexico, abyssal. Variety *sagittatus* Dall, 85-196 fms. off Cedar Keys, Fla.

(Amygdalum) papyrius Conrad

Modiola papyria Conrad, Proc. Acad. Nat. Sci. Phila., vol. 3, p. 24, pl. 1, fig. 8, 1846; Dall, Proc. U. S. Nat. Mus., 6, p. 341, '83; Bull. 37, U. S. Nat. Mus., p. 38, '89; Singley, Fourth Ann. Rept. Texas Survey for '92, p. 325, 1893.

Distribution.—Florida to Texas. Tampa Bay (type locality), Cedar Keys, Fla.; Corpus Christi and Laguna Madre, Texas.

Note.—For *Modiola lignea* Reeve, see *Modiolaria castanea* Say.

(Gregariella) opifex

Modiola opifex Say, Jour. Acad. Nat. Sci. Phila., 4, p. 369, pl. 19, f. 2, *a-b*, 1825; Philippi, Abbild. u. Beschr. n. Conch., 3, *Modiola*, p. 21, t. 2, f, 1; Dall, B. M. C. Z., 12, p. 235, '86; Bull. 37, U. S. N. M., p. 38, '89; Check-list N. W. Coast, p. 18, 1916. *Botulina* Dall, synonym of *Gregariella* Monterosato.

Distribution.—Hatteras to Brazil (Kroyer), 0-52 fms. Also Californian coast. Gulf of Mexico, Yucatan Strait, 640 fathoms. (accidental, Dall). This very beautiful species weaves nests of byssal silk.

(**Brachydontes**) **demissus** Dillwyn, Cat. Rec. Shells, 1, p. 314, 1817; Say, Jour. Acad. Nat. Sci. Phila., 2, p. 265, 1822.

Modiola plicatula Lamarck, An. s. Vert., 6, p. 113, 1819; DeKay, Nat. Hist. N. Y., Moll., p. 184, pl. 24, f. 258, 1843; Verrill, Inv. Vineyard Sound, p. 693, pl. 31, f. 238, '73; Dall, Bull. 37, U. S. N. M., p. 38, pl. 54, f. 1, '89; Singley, Fourth Ann. Rept. Texas Geol. Surv., p. 325, '92.

semicostatus Conrad, Jour. Acad. Nat. Sci. Phila,, 7, p. 244, pl. 20. fig. 7, 1837. Not Dall, Bull. 37, '89.

demissus Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 756, 1903; Dall, in Matson, U. S. G. S. Prof. Paper, 98-L, p. 177, 1916.

Distribution.—Nova Scotia to Texas. Pliocene to Recent. Gulf coast—Cedar Keys, St. Marks, Fla.; Belle Isle, Week's Island, Chandeleurs, La.; Lavaca, Matagorda and Galveston bays, Texas. Pleistocene: New Orleans pumping station No. 7; North Creek, Fla.; Ft. Morgan well, Ala. at 217-321 feet. Pliocene: Caloosahatchie.

Remarks.—Abundant in the streams of salt marshes imbedded in the peaty soil of the banks as at Week's Island, forming sod-like masses among the sedges and grasses. Mitchell has proved by experiments that this species can live twenty-two days without water.

(**Brachydontes**) **citrinus** Bolten.

Mytilus citrinus Bolten, Mus. Bolt., p. 157, 1798.

Modiola sulcata Lamarck, An. s. Vert., 6, p. 113, 1819. (Not of Lamarck, 1807); Reeve, Conch. Icon., 10, pl. 10, f. 74, 1858; Dall, Bull. 37, U. S. N. M., p. 38, '89.

Mytilus cubitus Say, Jour. Acad. Nat. Sci. Phila., 2, p. 263, 1822.

Modiolus citrinus Dall, Trans. Wagner Inst. Sci., 3, pt. 4, p. 796, 1898.

Distribution.—S. Carolina to southern Brazil. Pleistocene to Recent. Gulf coast.—Tampa.

Genus **BOTULA** Morch

cinnamomea Lamarck

Mytilus cinnamomeus etc., Chemnitz, Conch. Cab., 8, p. 152, pl. 82, f. 371, 1785. (Not binomial).

Modiola cinnamomea Lamarck, An. s. Vert., 6, p. 114, 1819; Dall, Bull. 37, U. S. N. M., p. 38, '89.

Modiolus (Botula) cinnamomeus Dall and Simpson, Bull. U. S. Fish Comm., 1, p. 470, 1901.

Distribution.—Cape Fear to Guadeloupe, 0-14 fms. West Fla.

Genus **MODIOLARIA** Beck

lateralis Say

Mytilus lateralis Say, Jour. Acad. Nat. Sci. Phila., 2, p. 264, 1822.

Modiola elliptica H. C. Lea, Am. Jour. Sci., 43, p. 106, pl. 1, fig. 2, 1842.

Crenella lateralis Tryon, Am. Mar. Conch., p. 190, pl. 40, fig. 523, 1874.

Modiolaria lateralis Dall, Bull. 37, U. S. N. M., p. 40, pl. 6, f. 7, 8, '89; T. W. I. S., 3, pt. 4, p. 807, '98; Vaughan, 2d. Ann. Rept. Fla. Geol. Surv., p. 149, 1909.

Distribution—Maine to Venezuela. Pliocene to Recent. Gulf coast.—Cameron, La., and West Fla. Pleistocene: Manatee Station, Fla.

(Lioberus) castanea Say

Modiola castanea Say, Jour. Acad. Nat. Sci., Phila., 2, p. 266, 1822.

lignea Reeve, Conch. Icon., 10, *Modiola*, pl. 10, f. 71, '58; Dall, Bull. 37, U. S, N. M., p. 38, '89.

Modiolaria castanea Dall, Tr. W. I. S., 3, pt. 4, p. 266, '98.

Distribution.—S. Carolina to St. Thomas. West Fla. (Dall).

Genus **CRENELLA** Brown

divaricata d'Orbigny

Nuculocardia divaricata d'Orb., in De la Sagra, Hist. Pol. y Nat. Isla de Cuba, 2, p. 311, pl. 27, f. 56-59, 1847.

divaricata Gabb, Trans. Am. Phil. Soc., 15, p. 252, '73; Dall, Bull. 37, U. S. N. M., p. 40, '89; T. W. I. S., 3, pt. 4, p. 803, '98; Maury, Bull. 29, Am. Pal., p. 194, pl. 26, f. 18, 1917.

decussata Dall, B. M. C. Z., 12, p. 235, '86. Not of Montagu.

Distribution.—Hatteras to Barbados. West Florida. Miocene to Recent.

Genus **LITHOPHAGA** Bolten

bisulcata d'Orbigny

Lithodomus bisulcatus d'Orb., Hist. Pol. y Nat. Isla de Cuba, 2, p. 333, pl. 28, f. 14-16, 1847. (First. ed. 1845).

Modiola appendiculata Philippi, Abb. u. Beschr. 2, p. 150, pl. 1, f. 1, 1846.

Lithodomus appendiculatus Reeve, Conch. Icon., 10, pl. 4, f. 21, and *biexcavatus* Reeve, f. 22, *a-b*, '57.

Lithophagus bisulcatus Dall, Bull. 37, U. S. N. M., p. 38,' 89.

Distribution.—S. Carolina to Rio de Janeiro. Upper Oligocene (of Tampa) to Recent. Living at Cedar Keys, Florida.

aristata Dillwyn

Mytilus aristatus Dillwyn, Cat. Rec. Shells, 1, p. 303, 1917.

Modiola caudigera Lamarck, An. s. Vert., 6, p. 116, 1819.

Lithodomus caudigerus Reeve, Conch. Icon., 10, pl. 3, f. 16, 1857.

Lithophagus forficatus Ravenel, Proc. Acad. Nat. Sci. Phila. for 1861, p. 44; Dall, Bull. 37, U. S. N. M., p. 38. '89.

Lithophaga aristata Dall, Tr. W. I. S., 3, pt. 4, p. 800, '98;

Checklist N. W. Coast, p. 19, 1916.

Distribution.—North Carolina to the Antilles, California to Peru, Red Sea. Upper Oligocene (of Tampa) to Recent. West Florida.

Genus **CONGERIA** Partsch

leucopheata Conrad

Mytilus leucopheatus Conrad, Jour. Acad. Nat. Sci., Phila., 6, p. 263, pl. 11, fig. 13, 1831.

Mytilopsis leucopheatus Conrad, Proc. Acad. Nat. Sci., Phila., p. 167, '57.

Dreissena americana Reeve, Conch., Icon., 10, pl. 10, fig. 43, '58.

Dreissensia (*Mytilopsis*) *leucopheata* Dall, Bull. 37, U. S. N. Mus., p. 40, '89.

leucopheata Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 808, 1898.

Distribution.—Maryland to the Antilles and Nicaragua. Pleistocene to Recent. True *Dreissensia* is European. Gulf coast.—West Florida, Point au Fer and Lake Charles, La. Pleistocene: North Beach, Fla., Knapp's wells, Terrebonne Parish, No. 2 at 1542-1632, 1550-1570, No. 3 from the surface to 700 feet, 1040-1043, 1865-2029 feet.

rossmassleri Dunker, Novitates Conch. Moll. marina, 1858; Reeve, Conch. Icon., f. 45, 1858; Dall, Trans. Wag. Inst. Sci., 3, pt. 4, p. 809, '98.

sallei Reeve, Conch. Icon., f. 44, 1858. Not of Recluz, 1852.

Distribution.—Florida to Brazil. Gulf coast.—Tampa. Shell more triangular and heavier than *leucopheata*.

Note.—A *Congeria* was found by Harris in the Galveston well at 2123-2873 feet. Upper Miocene horizon.

Genus **PERIPLOMA** Schumacher

angulifera Philippi, Zeitschr. fur Malak. for 1847, p. 73; Rœmer, Texas, p. 452, '49; Dall, Bull. 37, p. 64, '89; Singley, Fourth Ann. Rept., Geol. Surv. Texas, p. 330, 1893; Dall, Trans. Wagner Inst. Sci., 3, pt. 6, p. 1529, pl.

57, f. 15, 1903.

Distribution.—Georgia to Honduras. Pliocene to Recent. Gulf coast.—West Fla.; Galveston, Matagorda, Tex. Pliocene : Shell Creek, Fla.

inæquivalvis Schumacher, Essai, p. 115, 1817; Dall, Bull. 37, p. 64, '89; T. W. I. S., 3, pt. 6, p. 1528, 1903.

Distribution.—Antilles. Texas (?)

papyracea (Say) Conrad

Anatina papyratia Say, Jour. Acad. Nat. Sci. Phila., 2, p. 314, 1822.

Periploma papyracea Conrad, Am. Jour. Conch., 2, p. 70, pl. 4, f. 9; *Idem*, p. 281, pl. 15, f. 6, '66; Dall, Bull. 37, p. 64, '89.

Distribution.—West Florida (?) to Santa Cruz.

Genus **THRACIA** Leach

distorta Montagu

Mya distorta Montagu, 1808.

Thracia distorta Dall, Bull. 37, p. 64, '89; Tr. W. I., 3, pt. 6, p. 1523, 1903.

Distribution.—Gulf of Mexico to Honduras. West Florida andTexas. Type of section *Ixartia* Leach.

phaseolina (Lamarck) Philippi, Moll. Sic. 1, t. 1, f. 7, 1836; Dall, B. M. C. Z., 9, p. 110, '81; Bull. 37, p. 64, '89.

papyracea Jeffreys, Brit. Conch., 5, pl. 48, f. 4.

Distribution.—Florida to Yucatan and England. Gulf, Yucatan Strait, 640 fms. Florida Keys, shallow water.

stimpsoni Dall, B. M. C. Z., 12, p. 307, 1886; Bull. 37, U. S. N. M., p. 64, '89.

Distribution.—Gulf of Mexico between Tampa and Tortugas, 28 fms.

Genus **ASTHENOTHAERUS** Carpenter

hemphilli Dall, B. M. C. Z., 12, p. 308, 1886; Bull. 37, p. 64, '89.

Distribution.—Gulf of Mexico : West Fla., 17 fms., Marco, Lee Co., Fla., 2 fms.

Genus **PANDORA** Hwass

(**Kennerleya**) **bushiana** Dall, B. M. C. Z., 12, p. 312, 1886; Bull. 37, p. 68, 1889.

Distribution.—Tampa and Charlotte Harbor, W. Fla., 0-4 fms.

(**Kennerleya**) **arenosa** Conrad, Jour. Acad. Nat. Sci. Phila., 7, p. 130, 1834; Fos. Medial. Tert., p. 2, pl. 1, f. 3, 1838; Dall, Tr. W. I., p. 1518, 1903.

Myadora and *Pandorella arenosa* Conrad.

Pandora carolinensis Bush, Trans. Conn, Acad., 6. p. 474, 1885; Dall, B. M. C. Z., 12, p. 311, pl. 8, f. 8, 8*a*, 86; Bull. 37, p. 68, pl. 8, f. 8, 8 *a*, '89.

Distribution.—Hatteras to Yucatan, 7 to 124 fms. Miocene to Recent. Gulf coast.—Tampa, 6 fms. (Simpson). Pliocene: Shell Creek, Fla.

(**Clidiophora**) **trilineata** Say, Jour. Acad. Nat. Sci. Phila., 2, p. 261, 1822; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 76, pl. 20, fig. 13, '57; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, p. 68, '89; Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 330, '93; Dall, Proc. U. S. Nat. Mus., 24, p. 511, pl. 31, f. 4, 1902; Tr. W. I., 3, p. 1519, 1903.

Pandora nasuta Sowerby, Sp. Conch., figs. 18, 19, 1830; Reeve, Conch. Icon., 19, *Pandora*, pl. 3, fig. 18, 1874.

Clidiophora nasuta Carpenter, Proc. Zool. Soc., p. 597, 1864.

Distribution.—Hatteras to Gulf of Mexico, 6-18 fms. Miocene to Recent. Gulf coast.—Ft. Barranca, Fla., Galveston, Tex. Pleistocene: New Orleans well of 1856 at 61 feet, Lake Borgne borings. Pliocene: Caloosahatchie.

Genus **LYONSIA** Turton

floridana Conrad, Proc. Acad. Nat. Sci. Phila., 1848; *Idem*, Jour., p. 208, '49; Dall, Bull. 37, U. S. N. M., p. 64, '89; Singley, 4th Ann. Rept. Tex. Surv., p. 330, '93; Mitchell, Texas Shells; Dall, Tr. W. I., 3, p. 1514, 1903.

Distribution.—Gulf of Mexico to Nicaragua, 2-5 fms. Gulf coast.—Tampa, Cedar Keys, Fla., Corpus Christi, Texas.

hyalina Conrad, J. N. S. Phila., 6, p. 261, pl. 11, f. 12, (as *Mya*); Tryon, Amer. Mar. Conch., p. 51, pl. 11, f. 2, 1874 ; Dall, Bull. 37, p. 64, pl. 59, f. 11, '89.

Osteodesma hyalina De Kay, Nat. Hist. N. Y., 5, p. 234, pl. 33, f. 311 *a*, *b*, 1843.

Distribution.—Nova Scotia to Texas, 0-30 fms. Miocene to Recent.

(Allogramma) formosa Jeffreys. Dredged in Gulf of Campeche and North Atlantic, 200-600 fms,

(Philippini) beaui d'Orbigny, Moll. Cubana, 2, p. 225, pl. 25, f. 26-28, 1845, (as *beana*, typographical error).

beauii Arango, Fauna Mal. Cuba, p. 240, 1878.

beana Dall, Bull. 37, p. 64, '89 ; Dall and Simpson, B. U. S. Fish Comm., 1, p. 498 , '01.

braziliensis Gould, 1850, and *orbignyi* Fischer, 1857.

Distribution.—Hatteras to Brazil, 0-30 fms. West Fla. Type collected by M. Beau in the Antilles.

Genus **VERTICORDIA** Wood

acuticostata Philippi, Moll. Sicil., 2, p. 42, T. 14, f. 19, 1844, (as *Hippagus*); Seguenza, Jour. de Conchy., 8, p. 291, pl. 10, f. 1 *a-e*, 1860 ; Dall, B. M. C. Z., 9, p. 105, '81 ; Bull. 37, p. 66, '89.

Distribution.—North Atlantic to Barbados, 71-600 fms. Gulf, abyssal, temperature 49° F. Very large shells. Type from upper Tertiary of Calabria.

seguenzæ Dall, B. M. C. Z., Harvard Coll., 12, p. 190, 1886 ; Bull. 37, p. 66, 1889.

Distribution.—Hatteras to Yucatan, 124-640 fms. Gulf of Mexico, Yucatan Strait.

woodi Smith, Challenger Rept. Lam., p. 168, pl, 25, f. 7, 7 *b*, 1885 ; Dall, B. M. C. Z., 12, p. 288, '86 ; Bull. 37, p. 66, 1889.

Distribution.—Gulf of Mexico to Brazil, 100-1060 fms. Texas region.

Genus **HALIRIS** Dall

fisheriana Dall, B. M. C. Z., 9, p. 106, 1881 ; *Idem*, 12, p. 291, pl. 2, f. 4 *a-b*, '86 ; Bull. 37, p. 66, pl. 2, f. 4 *a-b*, 1889.

Distribution.—North Atlantic to Barbados, 84-229 fms. Gulf, West Fla. region.

Genus **ANISODONTA** Deshayes

(Basterotia) quadrata granatina Dall

Corbula quadrata Hinds. See Reeve, Conch. Icon., *Corbula*, f. 40, 1843.

Poromya? granatina Dall, B. M. C. Z., 9, p. 109, '81.

quadrata var. *granatina* Dall. B. M. C. Z., 12, pl. 1, 2, *a-b*, 1886.

Distribution.—Typical form, Cape Lookout to St. Thomas, var., Yucatan Strait, 640 fms.

(Fulcrella) elliptica Recluz

Eucharis elliptica Recluz, Jour. de Conch. 1, p. 168, 1850.

Mya simplex Holmes, Post-Pl. Fos. S. C., p. 55, pl. 8, fig. 16, 1858.

Anisodonta elliptica Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p. 756, 1903.

Distribution.—N. Carolina to West Florida. Pleistocene to Recent. Gulf coast.—Crooked Isl., Calhoun Co., Fla. The ancestral form is *A. carolina* Dall, N. Car. Miocene.

Genus **CETOCONCHA** Dall

bulla Dall, B. M. C. Z., 6, p. 61, 1878, (as *Lyonsia*) ; *Idem*, 9, p. 107, '81 : 12, p. 283, '86, (as *Poromya*); Bull. 37, p. 68, pl. 39, f. 2, 5, pl. 65, f. 130, '89.

Distribution.—Chesapeake to Gulf of Mexico, 1917-1920 fms. Gulf, Lat. 24° N., Long. 84° W., temperature 39° F. All species recent, abyssal.

Genus **CUSPIDARIA** Nardo

glacialis Sars, Moll. Reg. Arct. Norv., 88, pl. 6, f. 8, 1878, (as *Neæra*); Verrill and Bush, Proc. U. S. N. M., 20, p. 800, pl. 71, f. 9, '98 ; Dall, Bull. 37, U. S. N. M., p. 66, '89 ; Johnson Occ. Papers, Bost. Soc. Nat. Hist. 7, No.

13, p. 41, 1915.

Distribution.—Norway and Maine to Gulf of Mexico, where it was dredged by U. S. Fish Com. at 1467 fms.

jeffreysi Dall, B. M. C. Z., 9, p. 111, '81, (as *Neæra*); *Idem*, 12 p. 295, pl. 3, f. 2, '86; Bull. 37, p. 66, pl. 3, f. 2, '89.

Distribution.—Fla. Straits to St. Vincent, 193-687 fms. Gulf of Mexico, Cape San Antonio and Yucatan Strait.

arcuata Dall, B. M. C. Z., 9, p. 113, '81, (as *Neæra*); *Idem*, 12, p. 296, pl. 3, f. 3, 4, '86; Bull. 37, pl. 3, f. 3, 4, '89.

Distribution.—Yucatan Strait, 640 fms. Doubtful species founded on a toothless left valve.

rostrata Spengler. See G. O. Sars, p. 89, t. 6, f. 7*a*, *b*, (as *Neæra*); Dall, Bull. 37, p. 66, '89.

Distribution.—Arctic Ocean to Barbados, 65-1639 fms. West Fla. region. (Dall).

(Cardiomya) costellata Deshayes

Corbula costellata Desh., Expl. Sci. Morea, Géol., p. 86, pl. 7, f. 1-3, 1837.

Sphena costellata d'Orbigny, Moll. Cuba, 2, p. 286, 1846; Atlas, pl. 27, f. 17-20, 1845.

Cardiomya costellata Dall, B. M. C. Z., 12, p. 297, '86; Bull. 37, p. 66, '89.

Distribution.—Hatteras to St, Thomas, 2-205 fms. Gulf coast, Marco, Fla., shallow water.

(Cardiomya) perrostrata Dall, B. M. C. Z., 9, p. 10, '81, (as *Neæra*); *Idem*, 12, p. 296, pl. 2, f. 3 *a-b*, '86; Bull. 37, p. 66, pl. 2, f. 3 *a-b*, '89; Johnson, Occ. Papers, Bost. Soc. Nat. Hist., 7, No. 13, p. 42, 1915.

Distribution.—Martha's Vineyard, Mass.; Gulf of Mexico, off the Tortugas, and South to Grenada, 84-416 fms.

Genus **MYONERA** Dall and Smith

lamellifera Dall, B. M. C. Z., 9, p. 113, '81, (as *Neæra*); *Idem*, 12, p. 304, pl. 3, f. 7, '86; Bull. 37, p. 68, pl. 3, f. 7, '89.

Distribution.—Florida to Jamaica, 84-250 fms. Gulf of Mexico, off Cedar Keys. All species recent, abyssal.

Genus **CORALLIOPHAGA** Blainville

coralliopahga Gmelin, Syst. Nat., p. 3305, No. 25, 1792, (as *Chama*); Lamarck, An. s. Vert. 6, p. 28, 1819, (as *Cypricardia*); Dall, Trans. Wag. Inst., p. 1498, 1903.

carditoidea Blainville, Man. Mal., p. 560, pl. 76, f. 3, 1825; Reeve, Conch. Icon., pl. 2, f. 12; Dall, Bull. 37, U. S. N. Mus., p. 58, '89.

Cypricardia hornbeckiana d'Orbigny, Moll. Cubana, 2, p. 266, pl. 26, f. 33, 34, 1846.

Distribution.—Florida to Curaçao, 0-30 fms. Gulf, Cedar Keys and Texas. Pliocene: Caloosahatchie.

Genus **ASTARTE** Sowerby

globula Dall, B. M. C. Z., 12, p. 260, 1886; Dall, Bull. 37, U. S. Nat. Mus., p. 46, '89; Proc. U. S. Nat. Mus., 26, p. 940, 1903.

Distribution.—Fernandina to Cuba and the Gulf of Mexico, 294-539 fms. First described as a variety of *A. smithi.*

smithi Dall, B. M. C. Z., 12, p. 259, pl. 7, f. 5 *a-b*, '86. Bull. 37, p. 46, pl. 7, f. 5 *a-b*, '89; Proc. U. S. Nat. Mus., 26, p. 940, 1903.

Distribution.—Sombrero to Barbados, 54-1568 fms. Gulf of Mexico, Campeche Bank, 200 fms.

nana Jeffreys, in Smith, Leeds Jour. Conch., p. 213, 1881; Dall, B. M. C. Z., 12, p. 261, pl. 7, f. 6 *a-b*, '86; Proc. N. M., 26, p. 940, 1903.

Distribution.—Hatteras to Sombrero, 6-227 fms. Variety *trigona*. Jeffreys, Gulf of Mexico.

liogona Dall, Proc. U. S. Nat. Mus., 26, pp. 940, 948, pl. 62, f. 9, 1903.

Distribution.—Mississippi Delta region, 118 fms.

Genus **CRASSATELLITES** Kruger

gibbesi Tuomey and Holmes, Pleioc. Fos. S. Car., p. 74, pl. 20, f. 9, 10, 1856; Harris, Bull. Am. Pal. 1, No. 3, p. 7, 1895; Dall, Tr. W. I., 3, p. 1474, 1903.

floridana Dall, B. M. C. Z., 12, p. 256, pl. 6, f. 12, '86;

Bull. 37, U. S. N. M., p. 48, pl. 6, f. 12, pl. 42, f. 4, '89.

Distribution.—Hatteras to Barbados, 3-100 fms. Upper Miocene to Recent. Gulf coast.—Recent : West Fla., 30 fms. Pliocene : Charlotte Harbor, Fla. Upper Miocene : Galveston well at 2158-2920 feet. (Harris).

(**Cuna**) **dalli** Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p. 759, f. 3, 1903.

Distribution.—Indian Pass, West Fla. (type locality). Pleistocene shells resembling this species were found in the New Orleans Gymnasium well at 1200 feet.

Note.—Recent species of *Cuna* were thought to be exclusively Australian and Japanese. The only known American species was Claibornian Eocene. Vanatta's discovery shows that the genus has existed sparsely in the Gulf of Mexico from early Tertiary to Recent time.

Genus **CRASSINELLA** Guppy

galvestonensis Harris, Bull. Am. Pal. 1, No. 3, p. 8, pl. 1, f. 2 *a-b*, 1895, (as *Eriphyla*); Dall, Tr. W. I. S., 3, p. 1478, pl. 49, f. 14, 1903.

Distribution.—Recent : Galveston. Miocene : Md., Va. ; Sea Isle City, N. J., well at 785 feet ; Galveston well at 2600 feet. (Type locality).

Note.—Professor Harris remarked in his description, "The new *Eriphyla* will probably be found Recent on the Gulf shore." Comparisons of shells from the beach with the deep well type now prove this to be the case. The species has continued on unchanged and lived in the same locality from Upper Miocene time.

lunulata Conrad

Astarte lunulata Conrad, Jour. Acad. Nat. Sci. Phila., 7, p. 133, 1834 ; Tuomey and Holmes, Pleio. Fos. S. Car., p. 72, pl. 20, fig. 4, '57 ; Holmes, Post-Plio. Fos. S. C., p. 32, pl. 6, fig. 9, '60 ; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78.

Eriphyla lunulata Dall, Bull. 37, p. 48, pl. 58, f. 11, 13, '89 ;

Singley, Fourth Ann. Rept. Geol. Surv. Texas, p. 326, 1892.

Crassatellites (*Crassinella*) *lunulatus* Dall, Trans. Wag. Inst. Sci., 3, p. 1477, pl. 49, fig. 15, 1903 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

? *mactracea* Linsley, Am. Jour. Sci., 48, p. 275, 1845 ; Johnson, Occ. Papers, Bost. Nat. Hist. Soc., 7, p. 45, 1915.

Distribution.—Tentatively including the northern form, *C. mactracea*, as identical.—Cape Cod to Barbados, 3-100 fms. Miocene to Recent. Gulf coast.—Recent : Indian Pass, St. Joseph's Bay, Crooked and Sarasota Isls., Fla. ; Galveston. Pleistocene : Labelle, Fla., New Orleans pumping station No. 7, New Orleans artesian well of 1856, New Orleans Gymnasium well at 1200 feet, Lake Borgne borings, Knapp's Wells, Terrebonne Parish No. 2 at 1190-1430, 1542-1632, 1780-1790, 1800, No. 2 from the surface to 700 feet, 570-700 700-780, 790-830, 1043, 1150-1200, 1796-1842 feet. Pliocene : Caloosahatchie, Shell and Alligator Creeks, Fla. Miocene : Sharp Benckenstein No. 1 well, Jennings, La., at 2050 feet ; Jennings Heywood Oil Syndicate's well No. 29 at 1941-1961 feet. Type locality Miocene of Suffolk, Va.

Genus **CYRENA** Lamarck

caroliniana Bosc, Hist. Nat. des Coq., 3, p. 37, p. 18, f. 4, 1802, (as *Cyclas*); Say, Amer. Conch., 7, pl. 42, '33 ; Dall, Tr. W. I., 3, p. 1447, 1903.

caroliniensis Lamarck, An. s. Vert., 5, p. 553 ; Holmes, Post-Pl. Fos, S. Car., p. 31, pl. 6, f. 7, '60 ; Mitchell, List Tex. Sh., p. 5 ; Dall, Bull. 37, p. 56, '89.

floridana Sowerby, Conch. Icon., pl. 18, f. 102, '78. Not of Conrad, 1846.

Distribution.—In brackish water, S. Carolina to Cuba. Pleistocene to Recent. Gulf coast.—St. Marks, Fla., Week's Isl., La., Lavaca and Carancahua Bays, Tex. Pleistocene: Osprey, North Creek, Fla.

floridana Conrad, Proc. Acad. Nat. Sci., Phila., 3, p. 23, pl. 1, f.

1, '46 ; Dall, Proc. U. S. N. M., 6, p. 338, '83 ; Bull. 37, p. 58, '89 ; Singley, 4th. Ann. Rept. Tex., p. 328, '92 ; Dall, Tr. W. I. 3, p. 1446, 1903.

protexta Conrad, Am. Jour. Conch., 5, p. 107, pl. 12, f. 3, 1869.

donaciformis Sowerby, Conch. Icon., *Cyrena*, pl. 19, f. 108, 1878.

Distribution.—In salt marshes, Florida to Yucatan. Pleistocene to Recent. Gulf coast.—Sarasota Bay, Tampa, Fla., Point au Fer, Belle Isle, La., Corpus Christi, Laguna Madre, Tex. Pleistocene : Osprey, North Creek, Fla.

Genus **CARDITA** Bruguière

(**Carditamera**) **gracilis** Shuttleworth, Journ. de Conchy., 5, p. 173, 1856 ; Dall, Bull. 37, U. S. N. M., p. 46, '89 ; Proc. Acad. Nat. Sci. Phila., p. 702, 1902.

Distribution.—Florida to St. Thomas, W. I. Gulf coast.—Tampa Bay.

(**Carditamera**) **floridana** Conrad, Fos. Med. Tert., p. 12, 1838 ; Amer. Jour. Sci, p. 393, '46 ; Dall, Bull. 37, U. S. N. M., p. 46, '89 ; Singley, 4th Ann. Rept. Tex., p. 326, '92 ; Mitchell, List Tex. Sh.; Dall, Proc. Acad. N. Sci., Phila., p. 702, 1902 ; Vanatta, *Idem*, p. 756, 1903 ; Dall, Tr. W. I. S., 3, p. 1415, pl. 56, f. 11, '03.

gibbosa Reeve, Conch. Icon., *Cardita*, pl. 4, f. 21, '43 ; Krebs, W. I. Shells, p. 123, 1864.

Distribution.—Florida to Yucatan, shallow water. Pliocene to Recent. Gulf coast.—Crooked Isl., Calhoun Co., Alligator Harbor, Franklin Co.. Ft. Barranca, St. Marks, Cedar Keys, Fla. ; Matagorda and Espiritu Santo Bays, Corpus Christi, Tex. Pleistocene : North Creek, near Osprey, Fla.

(**Glans**) **dominguensis** d'Orbigny, Moll. Cuba, 2, p. 291, 1853 ; Dall, Bull. 37, U. S. N. Mus., p. 46, 1889 ; Proc. Acad. Nat. Sci. Phila., p. 703, 1902 ; Tr. W. I. S., 3, p. 1616, 1903.

Distribution.—Hatteras to Sombrero, 36-124 fms. Recent in the Gulf of Mexico (Dall) and Pleistocene of North Creek, Manatee Co., Fla.

Note.—*Cardita conradi* Shuttleworth, (Journ. de Conchy., 5, p. 173, 1856; Dall, Bull. 37, U. S. N. M., p. 46, '89) is erroneously cited from Tampa. It is an East Indian shell, not found in American waters.

Genus **VENERICARDIA** Lamarck

tridentata Say, Jour. Acad. Nat. Sci., Phila., 5, p. 216, 1826; Binney's Say, p. 124, pl. 40, f. 1-5, '58; Dall, Bull. 37, p. 46, '89; Tr. W. I. S., 3, p. 1433, 1903; Vaughan, Carn. Publ. 133, p. 171, 1910.

Cardita tridentata Conrad, Fos. Medial Tert., p. 76, pl. 43, fig. 11, '45; Tuomey and Holmes, Pleioc. S. Car., p. 67, pl. 19, f. 9, 10, '55; Holmes, Post-Pl. Fos. S. Car., p. 31, pl. 6, f. 8, 58. Not Reeve's figure, which is an exotic shell.

Distribution.—Hatteras to West Fla., 36-124 fms. Miocene to Recent. Gulf coast.—Recent: Charlotte Harbor, Fla. Pleistocene: Labelle, Fla. Pliocene: Caloosahatchie marl:

armilla Dall, Proc. Acad. Nat. Sci. Phila., pp. 704, 713, 1902.

Distribution.—Dredged by S. S. Albatross in 24-196 fms. between the Mississippi delta and Cedar Keys, Fla.

perplana Conrad, Am. Jour. Sci., 41, p. 347, 1841; Dall, Proc. Acad. Nat. Sci. Phila., p. 705, 1902.

flabella Conrad, 1846, (as *Astarte*); Dall, Bull. 37, U. S. N. M., p. 46,'89, (*Venericardia*).

Distribution—Hatteras to Florida. 14-52 fms. Upper Miocene to Recent. Gulf coast.—Charlotte Harbor, Fla.

Genus **CHAMA** Linnæus

congregata Conrad, Am. Jour. Sci, 23, p. 341, 1833; Fos. Med. Tert., p. 32, pl. 17, f. 2, '38; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 23, pl. 7, f. 7-10, '55; Whitfield, Mio. N. J., p. 65, pl. 9, f. 14-18, '95; Dall, Tr. W. I., 3, p. 1400, 1903.

Distribution.—Hatteras to Yucatan, 0-52 fms. Miocene to Recent. Gulf coast.—West Fla.

macerophylla Gmelin, Syst. Nat., 6, p. 3304, 1792 ; d'Orbigny, Moll, Cuba., 2, p. 363, 1853 ; Reeve, Conch. Icon., 4, pl. 2, f. 6, pl. 8, f. 6 *b*, '47 ; Dall, Bull. 37, U. S. N. M., p. 52, '89 ; Tr. W. I. S., 3, p. 1403, 1903. Often, but erroneously, *macrophylla*.

citrea Gmelin, 1792 ; *lazarus* Lamarck. 1819 ; *bicornis* Krebs, 1864, not of Linnæus.

Distribution.—Hatteras to Abrolhos Isls. Pleistocene to Recent. Gulf coast.—Tampa.

Genus **ECHINOCHAMA** Fischer

arcinella

Chama arcinella Linnæus, Syst. Nat. ed. 12, p. 1139, 1767 ; Reeve, Conch. Icon., 4, pl. 5, f. 26 *a-b*, 1846 ; Conrad, Am. Jour. Sci., 2d Ser., 1, p. 404, '46 ; Tuomey and Holmes, Pleio. Fos. S. C., p. 22, pl. 7, f. 4-6, '57 ; Emmons, Geol. Rep. N. Car., p. 287, f. 209, '58 ; Dall, Bull. 37, U. S. N. Mus.. p. 52, 1889 ; Vanatta, Proc. Acad. Nat. Sci. Phila., vol. 55, p. 757, 1903 ; MItchell, List Texas Shells.

Chama (*Echinochama*) *arcinella* Fischer, Man. de. Conchyliologie, p. 1049, 1887.

Echinochama arcinella Dall, Tr. W. I. S., 3, p. 1405, 1903.

Distribution.—N. Carolina to Sao Paulo, Brazil, 0-26 fms. Pliocene to Recent. Gulf coast.—Recent : St. Joseph's Bay, Florida., Matagorda, Tex. Pleistocene : New Orleans pumping station No. 7. Pliocene : Caloosahatchie, Shell Creek, &c,, Fla.

Genus **LUCINA** Lamarck

chrysostoma Mueschen

Tellina crysostoma Mueschen, Mus. Gevers., p. 482, 1787. (Typographical error.).

chrysostoma Philippi, Abb. und Beschr. neu Conchyl., 2, p. 206, pl. 1, f. 3, 1847 ; Dall, Proc. U. S. Nat. Mus., 23, p. 802, 1901 ; Tr. W. I. S., 3, p. 1354, '03 ; Vanatta, Proc.

Acad. Nat. Sci. Phila., 55, p. 756, '03.

Venus edentula Chemnitz, Conch. Cab. 7, pl. 40, f. 427-429, 1784. Not of Linnæus, 1758.

Lucina edentula Reeve, Conch. Icon., *Lucina*, pl. 2, fig. 9, 1850: Heilprin, Tr. Wagner Inst. 1, p. 102, '86.

Loripes edentula var. *chrysostoma* Dall, Bull. 37, U. S. N. M., p. 52, '89.

Distribution.—Florida to Santa Cruz, shallow water. Miocene(?) to Recent. Gulf coast.—Tampa, Ft. Barranca, St. Joseph's Bay and Crooked Island, Fla. Pliocene: Caloosahatchie.

philippiana Reeve, Conch. Icon., *Lucina*, pl. 5, f. 23*a-b*, 1850; Dall, T. W. I., 3, p. 1355, 1903.

edentula Philippi, '47. Not of Linnæus, nor Reeve.

sehrammi Crosse, Jour. de. Conchy., 24, p. 166, '76.

Loripes edentula Dall, Proc. U. S. Nat. Mus., 6, p. 338, '83; Singley, Fourth Ann. Rept. Tex., p. 326, '92; Mitchell, List Texas Shells, p. 14.

Distribution.—West Indies and Gulf of Mexico. Pleistocene to Recent. Gulf coast.—Sarasota Bay, Fla., Matagorda and Corpus Christi Bays, Tex.

Note.—Both this and the preceding genus have been confused with *L. edentula* Linn. According to Hanley, the true *edentula* is oriental.

Genus **MYRTAEA** Turton

compressa Dall, B. M. C. Z., Harvard Coll., 9, p. 135, 1881. (as *Loripes*); *Idem*, 12, p. 266, pl. 14, f. 2, '86; Bull. 37, U. S. N. M., p. 52, pl. 14, f. 2, '89; Proc. U. S. N. M., 23, p. 804, 1901.

Distribution.—Cuba and Sombrero Isl., 72-424 fms.; Gulf of Mexico off Cape San Antonio, 413 fms. Possibly a variety of the following species.

lens Verrill and Smith, Trans. Conn. Acad., 5, p. 569; 6, p. 259, 1880, (as *Loripes*); Amer. Jour. Sci., 20, p. 4; Dall, B. M. C. Z., 12, p. 266; Bull. 37, U. S. N. M., p. 52, 89; Proc. U. S. N. M., 23, p. 804, 1901; Johnson, Occ. P. Bost. Soc. Nat. Hist., 7, p. 61, 1915.

Distribution.—Cape Cod to Rio de Janeiro, 50 to 464 fms. Gulf of Mexico, 321 fms. Temperature 46° F.

(Eulopia) sagrinata Dall, B. M. C. Z., 12, p. 265, 1886, (as *Lucina*); Bull. 37, U. S. N. M., p. 52, '89; Proc. U. S. N. M., 12, p. 263, pl. 14, fig. 11, '89; 23, p. 805, 1901.

Distribution.—Gulf of Mexico to Yucatan, 85-300 fms.

Genus **CODAKIA** Scopoli

cubana Dall, Proc. U. S. N. M., 23, p. 799, 1901.

Loripes icterica Dall, B. M. C. Z., 9, p. 135, '81. Not of Reeve, 1850.

Lucina lenticula Dall, B. M. C. Z., 12, p. 265, '86. Not of Reeve, 1850.

Distribution.—Antilles and Gulf of Mexico, Yucatan Strait, 640 fms.

orbicularis Linnæus, Syst. Nat. ed. X, p. 688, 1758, (as *Venus*); Dall, Proc. U. S. N. M., 23, p. 799, 1901; Dall and Simpson, Bull. U. S. Fish Comm., 1, p. 491, '01; Dall, Tr. W. I., 3, p. 1347, '03. Not *Lucina orbicularis* Sowerby, 1837; nor of Deshayes, 1836.

Venus tigerina var. Linnæus, 1767.

Cytherea tigerina Lamarck, An. s. Vert., 5, p. 574, (not p. 569), 1818.

Lucina tigerina Reeve, Conch. Icon., 6, *Lucina*, pl. 1, f. 3, '50; Dall, Bull. 37, U. S. N. M., p. 50, '89; Singley, 4th Ann. Rept. Texas, p. 326, '93. Not *tigerina* Linnæus.

Distribution.—St. Augustine to northern South America, shallow water. Pliocene to Recent. Gulf coast.—West Fla. and Galveston. Pliocene: Caloosahatchie and Shell Creek, Fla.

Note.—This species has been confused with *tigerina* Linn. which is Indo-Pacific.

(Jagonia) orbiculata Montagu, Test. Brit., Suppl., p. 42, pl. 12, f.

1, 1808, (as *Venus*); Dall, Proc. U. S. N. M., 23, p. 799, 1901; Tr. W. I., 3, p. 1350, '03.

Lucina squamosa Lamarck, An. s. Vert., 6, p. 542, 1818 (not Lam., 1806); Dall, Bull. 37, U. S. N. M., p. 50, '89.

Lucina pecten Lamarck, An. s. Vert., 5, p. 543, 1818; Dall, Bull. 37, p. 50, '89. The true *L. pecten* is Mediterranean.

Lucina imbricatula C. B. Adams, Proc. Bost. Soc. N. Hist., 2, p. 10, 1845.

Note.—Dr. Dall (Synopsis Lucinacea), recognizes four varieties of this species :— *orbiculata* Montagu, *filiata* Dall, *imbricatula* C. B. Adams, and *recurvata* Dall. Our specimens from Cedar Keys seem typical *orbiculata*. The deep water form, *filicata*, 85-300 fms., was dredged off Yucatan, and *recurvata*, 8-300 fms., off Cape San Antonio.

Distribution.—Florida to Brazil, also west coast Africa. Pleistocene to Recent. Gulf coast.—Tampa and Cedar Keys, Florida.

(**Jagonia**) **costata** d'Orbigny, Moll. Cubana., 2, p. 296, pl. 27, f. 40-42, 1846, (as *Lucina*); Dall and Simpson, Bull. U. S. Fish Comm., 1, p. 492, 1901; Dall, Proc. U. S. N. M., 23, p. 799, 1901. Not *costata* Tuomey and Holmes.

Lucina antillarum Reeve, Conch. Icon., *Lucina*, pl. 10, f. 37, 1850; Dall, B. M. C. Z., 9, p. 136, '81; 12, p. 264, 1886.

Distribution.—N. Carolina to Rio de Janeiro. Gulf of Mexico: Charlotte Harbor, Fla., 13 fms., Yucatan Strait, 640 fathoms.

Genus **PHACOIDES** Gray

pectinatus Gmelin, Syst. Nat., 6, p. 3236, 1792; Index Test., pl. 4, f. 44, 1828, (as *Tellina pectinata*); Dall, Proc. U. S. N. M., 23, p. 807, 1901; Tr. W. I. 3. p. 1363, '03. Not of Adams, '47 and '52, nor of Carpenter, '57.

jamaicensis Chemnitz, Conch. Cab., 7, p. 24, pl. 39, f. 408, 409, 1784, (as *Venus*). Not binomial. Spengler, Skrift. Nat. Selsk. Kjobn. 4, 1778, (as *Tellina*); Lamarck, An. s.

Vert., 6, p. 539, 1818, (as *Lucina*); Reeve, Conch. Icon., 6, *Lucina*, pl. 2, f. 7 *a-b*, 1850; Dall, Bull. 37, U. S. N. M., p. 50, '89; Singley, 4th Ann. Rept. Tex., p. 326, '92; Mitchell, List Tex. Sh., p. 5.

scabra Chemnitz, Conch. Cab., 11, p. 207, pl. 199, f. 1943-4, (as *Tellina*); Dillwyn, Descr. Cat., 1, p. 96, 1817.

funiculata Reeve, Conch. Icon., 6, *Lucina*, pl. 7, f. 40, '50.

Distribution.—St. Augustine to Montevideo. Pliocene to Recent. Gulf coast.—Ft. Barranca, Fla., Galveston, Corpus Christi, Keller's, Lavaca, and Matagorda Bays, Tex. Pleistocene: New Orleans pumping station No. 7; North Creek, Manatee Co., Fla.; Pliocene: Caloosahatchie, Shell and Alligator Creeks and Myakka River, Fla.

(Here) pennsylvanicus Linnæus, Syst. Nat., ed. X, p. 688, 1758, (as *Venus pennsylvanica*); Reeve, Conch. Icon., 6, *Lucina*, pl. 6, f. 29, 1850; Dall, Bull. 37, U. S. N. M., p. 50, '89; Tr. W. I. S., 3, p. 1368, 1903; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

grandinata and *speciosa* Reeve, 1850. Not *speciosa* Rogers, '36.

Distribution.—Hatteras to Guadeloupe, and West Florida. Pleistocene: Labelle, West Fla. Pliocene; Caloosahatchie.

(Here) sombrerensis B. M. C. Z., Harvard Coll., 12, p. 264, 1886; Proc. U. S. N. M., 12, p. 263, pl. 14, f. 13,'89; 23, p. 808, 1901.

Distribution—West Fla., 50 fms., Sombrero, 72 fms.

(Pleurolucina) leucomya Dall, B. M. C. Z., 12, p. 264, '86; P. U. S. N. M., 12, p. 263, pl. 14, f. 6, 7, '89; 23, p. 808, '01. Hatteras to Cuba and Gulf of Mexico.

(Cavilucina) trisulcatus Conrad, Trans. Am. Asso. Nat. and Geol. 1, p. 110, 1841 (as *Lucina trisulcata*); Fos. Medial Tert., p. 71, pl. 40, fig. 5, '45; Tuomey and Holmes, Pleio. Fos. S. C., p. 62, pl. 18, f. 18, 19, '57; Holmes, Post-Pl. Fos. S. C., p. 28, pl. 6, f. 4, '60; Dall, Bull. 37, p. 50, '89; Proc. U. S. N. M., 23, p. 808, 1901; Tr. W. I., 3, p. 1369, '03; Vanatta, Proc. A. N. S. Phila., 55, p. 756, '03.

multistriata Conrad, Proc. Acad. Nat. Sci. Phila., p. 307, 1843; Fos. Medial Tert., p. 71, pl. 40, fig. 6, 1845, (as *Lucina*);

Proc. Acad. N. S., Phila., p. 577, '63, (as *Codakia*). Not *multistriatus* Tuomey and Holmes.

Note.—Dr. Dall questions whether this species is found in the Recent, but our specimens resemble the type closely except in not having the interior margin crenulated. To the larger, flatter recent shell from the West Indies, characterized by less pronounced resting stages, Dr. Dall has given the varietal name of *blandus*. (B. U. S. Fish Comm., 1, p. 493, pl. 6, fig. 13, 1901.)

Distribution.—Hatteras to Cuba, 0-18 fms. Miocene to Recent. Gulf coast.—Ft. Barranca and Crooked Isl., Fla. Pliocene: Caloosahatchie and Shell Creek.

(**Cavilucina**) **recurrens** Dall, Tr. W. I. S., 3, p. 1369, pl. 52, f. 11, 1903.

Distribution.—Miocene of Jamaica, Chipola River marl and Oak Grove sands, Fla., and of the Mobile, Ala., No. 2 well, Bascom race track, at 1241 and 1600 feet.

Note.—This little shell was common in the Mobile region during Miocene time, as there are twenty-five valves from the Alabama well. They agree perfectly with specimens from Oak Grove.

(**Lucinisca**) **plesiolophus** Dall, Tr. W. I. S., 3, p, 1196, pl. 40, f. 2, 5, 1900, (as *Lucina*); *Idem*, p. 1371, 1903.

Distribution.—Miocene of the Oak Grove sands, Santa Rosa County, Fla., and of the Mobile Oil Company's No. 2 well, Bascom race track, near Mobile, Alabama, at 1241 feet.

(**Lucinisca**) **nassula** Conrad, Am. Jour. Sci., 2, p. 392, 1846, (as *Lucina*); Proc. A. N. S. Phila., 3, p. 24, '46; Dall, Proc. U. S. N. M., 23, p. 808, '01; Tr. W. I. S., 3, p. 1372, '03; Vanatta, Proc. A. N. S. Phila., 55, p. 756, '03; Vaughan, Publ. Carn. Inst., 133, p. 171, 1910.

lintea Conrad, Am. Jour. Conch., 2, p. 281, pl. 15, f. 7, '66; Dall, Bull. 37, p. 52, '89.

Distribution.—Hatteras to Cuba, 0-200 fms. Pleistocene to Recent. Gulf coast.—Recent: Cedar Keys, Ft. Barranca, St. Mark's, St. Joseph's Bay, Crooked Island, Fla.;

Mobile Bay, Ala. Pleistocene : North Creek and Labelle, West Fla. Pliocene : Variety *caloosana* Dall, Caloosahatchie and Shell Creek.

(**Pseudomiltha**) **floridanus** Conrad, Am. Jour. Sci., 23, p. 344, 1833, (as *Lucina floridana*); Dall Bull. 37, U. S. N. M., p. 50, '89 ; Harris, Bull. Am. Pal., 1, p. 90, '95 ; Dall, List Cameron Sh.; Proc. U. S. N. M., 23, p. 809, '01 ; Vanatta, Proc. A. N. S. Phila., 55, p. 756, '03.

Distribution.—West Florida to Texas. Upper Micocene (?) to Recent. Localities.—Charlotte Harbor, Ft. Barranca, St. Mark's, St. Joseph's Bay, Crooked Island, Fla. ; Horn Island, Miss. ; Chandeleurs, La. ; Corpus Christi, Texas. Pleistocene : Osprey, Fla. Upper Miocene (?): Galveston well at 2236-2861 feet (Harris). Possibly these well fragments were referable to *P. anodonta*, a closely related Miocene and Pliocene species.

(**Callucina**) **radians** Conrad, Trans. Am. Asso. Nat. and Geol. 1, p. 110, 1840, (as *Lucina*); Am. Journ. Sci., 41, p. 347, '41; Emmons, Geol. Rep. N. C., p. 291, '58 ; Tuomey and Holmes, Pleio. Fos. S. C., p. 57, pl. 18, f. 4, 5, '57 ; Holmes, Post-Pl. Fos. S. C., p. 28, pl. 6, f. 3, '60 ; Dall, Proc. U. S. Nat. Mus., 23, pp. 808, 809, pl. 42, f. 8, '01 ; Tr. W. I. S., 3, p. 1380, '03 ; Vanatta, Proc. A. N. S., Phila., 55, p. 756, '03 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

radiata Conrad, Fos. Medial Tert., p. 70, pl. 40, f. 3, 1845, (as *Lucina*); Not of Deshayes, '43.

Distribution.— N. Carolina to Porto Rico, 5-85 fms. Upper Miocene to Recent. Gulf coast.—St. Joseph's Bay, Ft. Barranca, Fla. ; Horn Island, Miss. Pleistocene : New Orleans pumping station No. 7 ; Labelle, Fla.

(**Parvilucina**) **piluliformis** Dall, Trans. Wagner Inst. Sci., 3, p. 1382, pl. 52, f. 6, 1903 ; Aldrich, MS, in coll.

Distribution.—Miocene of Oak Grove, Santa Rosa Co., Fla., and of the Bascom No. 1 well, Mobile, Alabama, at 1500-1556 feet ; Bascom No. 2 well at 1241, 1600 and 1800 feet.

(Parvilucina) crenulatus Conrad

Lucina crenulata Conrad, in Morton's Synopsis Org. Rem., App., p. 2, 1834 ; Jour. Acad. Nat. Sci. Phila., 7, p. 125, '34, (*nomina nuda*); Conrad, Fos. Medial Tert., p. 39, pl. 19, 2d ed., f. 8 ; p. 39, pl. 20, f. 2, '40 ; Tuomey and Holmes, Pleio. Fos. S. C., p. 60, pl. 18, f. 14, 15, '57 ; Harris, Bull. Am. Pal. 1, No. 3, p. 90, '95. Not of Wood, 1850.

lens Lea, 1845, Not of Deshayes, 1843.

leana d'Orbigny, Prodr. Pal. 3, p. 117, '52 ; Conrad, Proc. Acad. Nat. Sci. Phila., 14, p. 577, '63.

crenulatus Dall, Tr. W. S., 3, p. 1383, pl. 55, f. 12, 1903.

Distribution.—Miocene of New Jersey to Florida (upper bed, Alum Bluff); and of the Galveston well at 2410-2871 feet (Harris).

Note.—Dr. Hilgard identified a shell from the Lake Borgne borings, La., as this species, but it was probably *P. multilineatus*, since *P. crenulatus* is not later than Miocene.

(Parvilucina) multilineatus Tuomey and Holmes

Lucina multilineata T. and H., Pleio. Fos. S. C., p. 61, pl. 18, f. 16, 17, 1857 ; Emmons, Geol. Rep. N. Car., p. 291, Holmes, Post-Pleioc. Fos. S. C., p. 30, pl. 6, fig. 6, 1860 ; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878 ; Dall, Bull. 37, p. 52, '89.

crenulata Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78 ; Dall, Bull. 37, U. S. N. M., p. 50, '89 ; Singley, 4th Ann. Rept. Tex., p. 326, '92. Not of Conrad, 1834.

crenella Dall, Proc. U. S. N. M., 23, pp. 810, 825, pl. 39, f. 2, '01 ; Vanatta, Proc. Acad. N. Sci., Phila., p. 756,' 03 ; Dall, in Matson, U. S. G. S. Prof. P. 98-L, p. 177, 1916.

multilineatus Dall, Trans. Wag. Inst. Sci., 3, p. 1384, '03 ; Vaughan, Carn. Publ., 133, p. 171, 1910.

Remarks.—The recent shell was described as *L. crenella* and its Pliocene and Pleistocene ancestor as *L. multilineata*, but they seem to intergrade. The shell has often been confused with the Miocene *crenulatus*. Tuomey and

Holmes, (Pleio. Fos. S. Carolina, p. 61, 1857), refer *L. multilineata* to Conrad, (Fos. Med. Tert. Form., p. 71, pl. 40, fig. 6), but that species is *L. multistriata* Conrad, a synonym of Conrad's *L. trisulcata*. The only good figure of this species is Dall's, (*crenella*), Proc. U. S. Nat. Mus., vol. 23, pl. 39, fig. 2, 1901.

Distribution.—Hatteras to Cuba, 15-124 fms. Pliocene to Recent. Gulf coast.—Recent : Ft. Barranca, St. Joseph's Bay, Crooked Island, Fla. ; Horn Island, Miss. ; Galveston, Corpus Christi, Tex. Pleistocene : Osprey, Orient, Labelle and Manatee, Fla. ; Fort Morgan, Ala., well at 217-421 feet ; New Orleans artesian well of 1856 at 546 ; Febacher's well, New Orleans, at 1200 ; Lake Borgne borings ; Knapp's wells, Terrebonne Parish, No, 2 at 1050-1190, 1190-1430, 1434-1519, 1519-1542, 1780-1790, No. 3 at 1150-1200, 1330-1375, 1400-1440, 1443-1470, 1500-1525 feet. Pliocene : Caloosahatchie marl.

(Parvilucina) fontis, new species.

PLATE I, FIGURE 1

Shell very small, suborbicular, with nearly central, rather prominent, acute beaks. Lunule deep, lanceolate ; radial sculpture of fine but well-marked, rounded riblets, slightly unequal, not divaricating. and alternating with narrower interspaces. Riblets absent from the dorsal area. Concentric sculpture of narrow, slightly raised lamellæ, which cross the broader riblets. The lamellæ become stronger over the dorsal area where the riblets are absent. Hinge heavy in proportion to the shell. Right valve with a strong posterior, and a weaker anterior lateral tooth, and one rather prominent cardinal tooth. Inner margin of shell crenulate. Length and height 4 mm., semidiameter 1.5 mm. This species resembles closely *Phacoides approximatus* Dall, dredged in the Gulf of California at 26 fms. The two species would seem to have been undoubtedly derived from a common ancestor.

Geological horizon.— The shell was found at great depths at a doubtful horizon where, though recent forms largely prevail, a slight change in the fauna appears. This leads one to think that one may be approaching the Upper Miocene.

Occurrence.—Knapp's No. 1 well, Terrebonne Parish, La., at 2000-2150 and 2250-2450 feet.

(Bellucina) amiantus Dall, Proc. U. S. Nat. Mus., 23, p. 826, pl. 39, f. 10, 1901 ; Tr. W. I. S., 3, p. 1386,'03 ; Vanatta, P A. N. S., Phila., 55, p. 757, '03.

Lucina costata Holmes, Post-Pl. Fos. C., p. 27, pl. 6, fig. 2, 1860. Not of D'Orbigny, 1846 ; nor of Tuomey and Holmes, 1857 (=*tuomeyi* Dall).

costata Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. Nat. Mus,, p. 50, '89 ; Singley, 4th Ann. Rept. Tex., p. 326, '92 ; Mitchell, List Tex. Sh.

Distribution.—N. Carolina to Sao Sebastiao, Brazil, 2-640 fms. Pleistocene to Recent. Gulf coast.—Recent : Cedar Keys, Ft. Barranca, Fla. ; Horn Island, Miss. ; Galveston. Pleistocene : Lake Borgne borings, New Orleans artesian well of 1856, at 41 and 546 feet ; New Orleans pumping station No. 7; New Orleans Gymnasium well at 1200 ft., Knapp's wells, Terrebonne Parish at 1600-1700, 2250-2450, No. 2 at 1050-1190, 1190-1430, 1434-1519, 1519-1542, 1542-1632, 1632-1726, 1731-1739, 1780-1790, 1791-1842, No. 3 at 880-990, 1040-1043, 1200-1300, 1330-1375, 1400-1440, 1443-1470, 1470-1480, 1500-1525, 1796-1839 feet.

Genus **DIVARICELLA** von Martens

quadrisulcata d'Orbigny, Voy. Amér. Mér., Moll., p. 584, 1846, (as *Lucina*); Hist. Pol. y N. Isla de Cuba, 2, p. 294, pl. 27, f. 34-36, '53 ; Dall, Bull. 37, U. S. N. M., p. 50, '89 ; Proc. U. S. N. M., 23, p. 815, '01 ; Trans. W. I. S., 3, p. 1389, pl. 51, f. 1, '03 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03 ; Johnson, Occ. Papers, Bost. Soc. Nat. Hist., 7. p. 62, 1915.

divaricata Lamarck, An. s. Vert., 5, p. 541, 1818, (as *Lucina*, in part). Not of Linnæus. Tuomey and Holmes, Pleio. Fos. C., p. 59, pl. 17, f. 10-11, '57; Holmes, Post-Pl. Fos. S. C., p. 27, pl. 6, f. 1, '60.

conradi d'Orbigny, '52, *strigilla*, Stimpson, '51, *americana* Adams, '52, not Defrance, 1823, (all as *Lucina*).

This species has often been confused with the Mediterranean shell, *D. divaricata* Linnæus, and with the larger, recent American species, *D. dentata* Wood.

Distribution.—Nantucket Island to Rio de Janeiro, 10-50 fms. Miocene (Md. and Va.) to Recent. Gulf coast.—Recent. Ft. Barranca and Crooked Isl., Fla. Pleistocene: Teel No. 1 well, Saratoga, Tex., at 940 feet. Upper Miocene. Galveston well at 2552-2600 feet. (Harris, as *dentata*).

chipolana Dall, Tr. W. I., 3, p. 1389, pl. 51, f. 2, 1903.

Distribution.—Miocene of the Chipola marl and Oak Grove sands, Florida; and of the Bascom No. 1 well, Mobile, Ala., at 1500-1556 feet, Bascom No. 2 well, 1241 and 1600 feet.

Genus **DIPLODONTA** Bronn

punctata Say, Jour. Acad. Nat. Sci. Phila., 2, p. 308, 1822, (as *Amphidesma*); Dall, Tr. W. I. S., 3, p. 1187, 1900; Proc. U. S. N. M., 23, p. 793, '01; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03.

subglobosa C. B. Adams, Proc. Bost. Soc. Nat. Hist. 2, p. 298, '47, (*nomen nudem*); Dall, Bull. 37, U. S. N. M., p. 52, '89.

venezuelensis Dunker, Zeit., Mal., 5, p. 184, '48, (as *Lucina*); Novit. Conch. Moll. Mar., p. 3, pl. 4, f. 7-9, '58; Dall, B. M. C. Z., 9, p. 136, '81.

janeirensis Reeve, Conch. Icon., *Lucina*, pl .8, f. 43, '50, (as *Lucina*).

braziliensis Mittré, Jour. de Conchy., 1, p. 240, pl. 12, f. 7-9, '50. (Not *braziliensis* Philippi).

Mysia pellucida Heilprin, The Bermuda Isls., pp. 179, 190, pl. 17, f. 3, '89.

Distribution—Hatteras to Rio de Janeiro, south through Straits of Magellan to Chiloe Isl., Pacific Ocean. Pliocene (?) to Recent. Gulf coast.—Crooked Isl., Fla. ; Horn Isl., Miss., Galveston (?)

semiaspera Philippi, Wiegm., Arch. 1, p. 225, pl. 7, f. 2 *a-d*, 1836 ; Dall, Bull. 37, U. S. N. M., p. 52, '89 ; Mitchell's List Tex. Shells ; Dall, Tr. W. I. 3, p. 1188, 1900 ; Proc. U. S. N. M., 23, p. 794, 1901.

Lucina granulosa C. B. Adams, Proc. Bost. Soc. N. Hist., 2, p. 9, '45.

Lucina semireticulata d'Orbigny, (in part), Voy. Am. Mér., p. 585, pl. 84, figs. 7-9, '46.

Distribution.—Hatteras to Rio de Janeiro, 14-20 fms. Gulf coast.—Texas (Mitchell); Pliocene : Caloosahatchie.

soror C. B. Adams, Contr. Conch., p. 247, 1852, (as *Lucina*); Dall, Bull. 37, U. S. N. M., p. 52, '89 ; Tr. W. I., 3, p. 1188, 1900 ; Proc. U. S. N. M., 23, p. 794, '01.

kiawahensis Holmes, Post-Pl. Fos. S. C., p. 29, pl. 6, fig. 5, 1858 ; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878.

Distribution.—Texas to Jamaica. Pleistocene : Lake Borgne borings, La.

notata Dall and Simpson, Bull U. S. Fish Comm. 1, p. 495, 1901; Dall, Proc. U. S. N. M., 23, p. 974, '01.

Distribution.—Marco, West Fla., to Porto Rico.

Genus CYRENOIDA Joannis

floridana Dall, Bull. 37, U. S. N. M., p. 50, 1889, (*Nomen nudem*); The Nautilus, vol. 10, p. 52, Sept. 1896, (Description).

Distribution.—Georgia to West Florida,—at Marco and Charlotte Harbor, in either brackish or tolerably salt marshes. Recent. The Caloosahatchie Pliocene species is *caloosaënsis* Dall.

Genus THYASIRA Leach

grandis Verrill and Smith, Trans. Conn. Acad., 6, 1885, (as *Cryptodon*); Dall, Bull. 37, p. 50, pl. 46, f. 22, '89 ; Proc. U. S. N. M., 23, p. 785, 1901.

Distribution.—Lat. 38° 29' N., south to Yucatan straits, Gulf of Mexico, 856-1582 fms. Also off France, 820 fms.

granulosa (Jeffreys) Monterosato, Jour. de Conchy., 22, 1874, (as *Axinus*); Dall, Proc. U. S. N. M., 23, p. 785, 1901.

Distribution.—Gulf of Mexico to St. Lucia, W. I., 60-116 fms. Also Mediterranean and off Canaries.

pyriformis Dall, Bull. Mus. Comp. Zool., Harvard Coll., 12, p. 267, 1886.

Cryptodon ? obesus Dall, *Idem*, 9, p. 136, '81. Not *obesus* of Verrill, Amer. Jour. Sci., 3, p. 287, pl. 7, f. 2, 1872=*trisinuata* d'Orbigny, 1846.

Distribution.—Carolina to Florida. 85-731 fms. Gulf of Mexico, Yucatan Strait, 640 fms. A thinner, flatter and less earthy shell than that of *T. obesus* (=*trisinuata*).

Genus **ERYCINA** Lamarck

floridana Vanatta, Proc. Acad. Nat. Sci., Phila., vol. 55, p. 758, f. 2, 1903.

Distribution.—West Florida at Crooked Island, Calhoun Co.

Genus **ROCHEFORTIA** Vélain

planulata Stimpson, Shells of New England, p. 17, 1851, (as *Kellia*); Verrill, Inv. Vineyard Sound, p. 688, pl. 30, f. 6, '73 ; Dall, Bull. 37, U. S. N. M., p. 48, '89; Pr. U. S. N. M., 21, p. 890, (as *Mysella*); Tr. W. I. S., 3, p. 1161, pl. 45, f. 7, 1900. Johnson, Occ. Papers, Bost. Soc. Nat. Hist., 7, p. 66, 1915.

Montacuta bidentata Verrill and Bush, Proc. U. S. N. M., 20, p. 779, pl. 93, f. 7, 8, pl. 94, 6, '98. Not *bidentata* Montagu, 1803.

Distribution.—Maine to Hatteras. Variety *fragilis* Verrill and Bush, (Proc. U. S. N. M., 20, p. 780, pl. 92, f. 8, '98), Narragansett Bay, R. I., and Corpus Christi, Tex. Pliocene : Caloosahatchie marl, Fla.

Genus **MONTACUTA** Turton

floridana Dall, Proc. U. S. N. M., 21, p. 893, pl. 87, f. 10, 1899 ; Tr. W. I., 3, p. 1174, 1900 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

Distribution.—Recent ; West Florida near the Manatee River. Pleistocene : Osprey, Manatee and Labelle, West Florida. Pliocene : Caloosahatchie.

limpida Dall, Proc. U. S. N. M., 21, p. 894, pl. 97, f. 5, 11, 1899.

Distribution.—Type dredged at 85 fms. in the Gulf of Mexico, 5 miles off Cape Florida.

Genus **SPORTELLA** Deshayes

constricta Conrad, Am. Jour. Sci., 41, p. 347, pl. 2, f. 15, 1841, (as *Amphidesma*); Fos. Medial Tert. p. 76, pl. 43, fig. 10, 1845 ; Dall, Tr. W. I. S., 3, pl. 25, f. 4, 4*a*, 1898 ; *Idem*, p. 1615, 1903.

Distribution.—Miocene of Va. and N. Car. ; Pliocene : Caloosahatchie and Shell Creek, Fla. ; Pleistocene : North Creek, Manatee Co., Fla. Not recorded from the Recent. The *Fabella constricta* Dall, Bull. 37, p. 48, '89, was later referred to *Anisodonta elliptica* Recluz.

Genus **CARDIUM** Linnæus

(Trachycardium) isocardia Linnæus, Syst. Nat., ed. X, p. 679, 1758 ; Chemnitz, Conch. Cab., 6, p. 182, pl. 17, f. 174-176, 1782 ; Reeve, Conch. Icon., 2, *Cardium*, pl. 17, f. 84, 1845 ; Holmes, Post-Pl. Fos. S. C., p. 25, pl. 5, f. 4, '60 ; Dall, Bull. 37, p. 52, '89 ; Post, Nautilus,, 13, p. 23, '99 ; Dall, Tr. W. I. S., 3, p, 1085, 1900 ; Vanatta, Pr. A. N. S. Phila., 55, p. 757, '03 ; Vaughan, 2d Ann. Rept. Fla., p. 148, '09 ; Publ. 133, Carn. Inst., p. 171, 1910.

egmontianum Shuttleworth, Journ. de Conchyl., 5, p. 472, 1856.

Distribution.—Hatteras to Trinidad. Miocene to Recent. Gulf coast.—Recent : Tampa and St. Joseph's Bays, Crooked Isl., Alligator Harbor, Ft. Barranca, Fla. ; Corpus Christi, Tex. Pleistocene : Osprey, Labelle and Manatee, Fla. : New Orleans pumping station No. 7. Pliocene : Caloosahatchie.

(Trachycardium) muricatum Linnæus, Syst. Nat., ed. X, p. 680, 1758 ; Reeve, Conch., Icon., 2, *Cardium*, pl. 6, f. 33, 1844;

Holmes, Post-Pl. Fos. S. C., p. 24, pl. 5, f. 3, '60; Dall, Bull. 37, U. S. N. M., p. 52, '89; Singley, 4th Ann. Rept. Tex., p. 327, '92; Dall, Tr. W. I. S., 3, p. 1089, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03. Not of Tuomey and Holmes, 1857.

campechiense Bolten, Mus. Bolt., p. 191, 1798; *gossei* Deshayes, 1854; *æquilaterale* Hilgard, 1878.

Distribution.—Hatteras to Brazil. Usually very shallow water. Pleistocene to Recent. Gulf coast.—Indian Pass, St. Joseph's Bay, Fla.; Chandeleurs, La.; Galveston, Corpus Christi and Espiritu Santo Bays, Tex., Campeche, (type locality). Pleistocene: New Orleans pumping station No. 7, Lake Borgne borings, (Hilgard's *æquilaterale*).

(Cerastoderma) robustum Solander, Portland Cat., p. 58, 1786, Dall, Tr. W. I. S., 3, p. 1099, 1900; Proc. U. S. N. M., 23, p. 386, '01; Vanatta, P. A. N. S., Phila., 55, p. 757, '03; Vaughan, 2d Ann. Rept. Fla. Surv., p. 149, 1909.

ventricosum Bruguière, Ency. Méth. I, p. 228, 1789.

magnum Born, Ind. Mus. Vind., p. 34; Test. Mus. Vind., p. 46, pl. 3, fig. 5, 1780; Reeve, Conch. Icon. 2, *Cardium*, pl. 4, f. 20, 1844; Holmes, Post-Pl. Fos. S. C., p. 23, pl. 5, f. 2, 2 *a*, '60; Hilgard, Rept. Chief of Engineers to Sec. of War, p. 358, 1870; Dall, Bull. 37, U. S. N. M., p. 52, '89; Singley, 4th Ann. Rept. Tex., p. 327, '92; Harris, Bull. Am. Pal. vol. 1, p. 91, '95; Mitchell, List Texas Sh. Not *magnum* Linnæus, Syst. Nat., ed. X, p. 680, 1758.

inæquilaterale Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 889, 1878.

Distribution.—New Jersey to Campeche. Upper Miocene to Recent. Gulf coast.—Recent: Ft. Barranca, St. Mark's, St. Andrew's Bay, Indian Pass, Crooked Island, Fla.; Horn Island, Miss.; Cameron, Chandeleurs, La.; Galveston, Padre Island, Corpus Christi, Tex. Pleistocene: Labelle, Osprey and Manatee, Fla.; New Orleans well of 1856 at 41 feet, Grand Chênier, Lake Borgne borings (?), New Orleans Gymnasium well at 1200 feet, Knapp's wells, Terrebonne Parish No. 1 at 2000-2150, 2250-2450, No. 2 at 1190-1430, 1791-1842, No. 3, 1200-1300 feet. Pliocene: Caloosahatchie and Shell Creek, Fla. Upper Miocene; Galveston well at 2552-2600 feet (Harris).

(**Fragum**) **medium** Linnæus. Syst. Nat., ed. X, p. 678, 1758; Reeve, Conch. Icon., 2, *Cardium*, pl. 6, f. 30, 1844; Dall, Bull. 37, U. S. N. M., p. 52, '89; Tr. W. I. S., 3, p. 1101, 1900; Proc. U. S. N. M., 23, p. 386, '01; Glenn, Miocene, Md. Geol. Surv., p. 322, pl. 86, f. 6 *a*, 6 *b*, 1904.

Hemicardium columba Heilprin, Tr. W. I. S., 1, p. 93, pl. 11, f. 26, 1886.

Distribution.—North Carolina to Santa Marta, Brazil, 2-15 fms. Miocene (Md. and N. Car.) to Recent. Gulf coast.—W. Florida. Pliocene: Caloosahatchie and Shell Creek.

(**Trigoniocardia**) **galvestonense** Harris, Bull. Am. Pal., 1, No. 3, p. 91, pl. 1, f. 3, 3 *a*, 1895; Olsson, Nautilus, 7, p. 102, pl. 6, f. 8, 9, 11, 12, Jan., 1914.

Distribution.—Miocene of the Galveston well at 2443-2871 feet (Harris), and of the Choptank River, Maryland. (Olsson).

(**Trigoniocardia**) **apateticum** Dall, Tr. W. I. S., 3, p. 1105, pl. 40, f. 15, pl. 48, f. 6, 1900.

Distribution.—Miocene of Oak Grove, Santa Rosa Co., Fla., and of the Mobile Oil Co.'s No. 1 well, Mobile, Ala., at 1500-1556 feet, No. 2 well, Bascom, at 1241 feet.

(**Papyridea**) **spinosum** Meuschen, Mus. Gevers, p. 442, 1787, (as *Cardia*); Dall, Tr. W. I. S., 3, p. 1106, 1900; Proc. U. S. N. M., 23, p. 387, '01.

bullatum of many authors but not of Linnæus.

soleniforme Bruguière, Enc. Méth., Vers., 1. p. 235, 1789; Wood, Gen. Conch., p. 233, pl. 56, f. 3, 1815.

Note.—Meuschen's description of *spinosum*, according to Dr. Dall, was based on a figure by Lister of a Jamaican shell. The Pacific form *aspersum* Sowerby is exceedingly close to this Atlantic species.

Distribution.—Hatteras to Santa Marta, Brazil, 2-300 fms. Pleistocene to Recent. West Florida.

(Lævicardium) serratum Linnæus, Syst. Nat., ed. X, p. 680, 1758; Holmes, Post.-Pl. Fos. S. C., p. 25, pl. 5, f. 5, 1860; Dall, Bull. 37, U. S. N. M., p. 54, '89; Tr. W. I. S., 3, p. 1110, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03; Vaughan, 2d Ann. Rept. Fla. Surv., p. 149, '09; Maury, Bull. Am. Pal. No. 29, p. 212, pl. 36, f. 8, 1917.

citrinum Wood, Gen. Conch., p. 223, pl. 54, f. 3, 1815.

lævigatum Lamarck, An. s. Vert., pt. 1, p. 11, 1819. Not of Born, 1780, nor of Linn. 1758.

oviputamen Reeve, Conch. Icon., *Cardium*, pl. 7, f. 36, 1844.

pictum Ravenel, Proc. Acad. Nat. Sci. Phila., p. 44, 1861.

Distribution.—Hatteras to Bahia, Brazil, 1-100 fms. Miocene to Recent. Gulf coast.—Recent: Indian Pass, St. Joseph's Bay, Crooked Island, Fla.; Horn Island, Miss.; Cameron, La.; Mustang Island, Tex. Pleistocene: Manatee, Fla.; New Orleans pumping station No. 7. Pliocene: Caloosahatchie.

(Lævicardium) mortoni Conrad, Jour. Acad. Nat. Sci. Phila., 6, p. 259, pl. 10, f. 5-7, 1830; Holmes, Post-Plio. Fos. S. C., p. 26, pl.5, f. 6, '60; Dall, Proc. U. S. Nat. Mus., 6, p. 341, '83; Gould, Binney's ed., p. 143, f. 453, '70; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 888, '78; Dall, Bull. 37, U. S. Nat., p. 54, pl. 58, f. 8, '89; Singley, 4th Ann. Rept. Tex., p. 327, '92; Dall, Tr. W. I. S., 3, p. 1111, '00; Mitchell, List Tex. Sh.; Vanatta, Pr. A. N. S. Phila., 55, p. 757, '03; Vaughan, Publ. 133, Carn. Inst., p. 171, '10; Johnson, Occ. Papers, Bost. Soc., N. H., 7, p. 68, 1915.

Distribution.—Nova Scotia to Santa Marta, Brazil, 1 foot to 5 fms. Miocene to Recent. Gulf coast.—Cedar Keys, St. Mark's, Ft. Barranca, St. Andrew's Bay, Fla,; Galveston, Corpus Christi, Port Lavaca, Espiritu Santo Bay, Tex. Pleistocene: Labelle and Osprey, Fla., New Orleans well of 1856, Lake Borgne borings. Pliocene: Caloosahatchie and Shell Creek, Fla.

Genus **PROTOCARDIA** Beyrich

peramabilis Dall, B. M. C. Z., 9, p. 132, 1881, (as *Fulvia*); *Idem*, 12, p. 269, pl. 4, f. 7, '86; Bull. 37, U. S. N. M., p. 52, pl. 4, f. 7, pl. 40, f. 4, '89; Proc. U. S. N. M., 23, p. 388, '01; Johnson, Occ. Papers, Bost. Soc. Nat. Hist., 7, p. 69, 1915.

Distribution.—Rhode Island to Grenada, W. I., 18-164 fms. Gulf of Mexico, west of Florida, 50 fms. The ancestral form of this very lovely deep sea shell appears to be *P. islahispaniolæ* Maury, from the Dominican Miocene.

Genus **DOSINIA** Scopoli

discus Reeve, Conch. Icon., 6, pl. 2, f. 9, 1850, (as *Artemis*); Deshayes, Cat. Conch. Brit. Mus., p. 10, '53; Tryon, Am. Marine Conch., p. 161, pl. 30, p. 399, '73; Dall, Bull. 37, U. S. N. M., p. 56, pl. 89, fig. 1, pl. 90, fig. 1, '89; Singley, 4th Ann. Rept. Tex., p. 328, '92; Dall, Proc. U. S. N. M., 26, p. 366, '03; Tr. W. I. S., 3, p. 1232, '03; Vanatta, Proc. A. N. S., Phila., 55, p. 757, 1903.

concentrica Conrad, Am. Marine Conch., p. 55, pl. 12, 1831; Am. Jour. Sci., 2d Ser., 2, p. 393, 1846; Holmes, Post-Pl. Fos. S. C., p. 37, pl. 7, fig. 4, 1860; Hilgard, House of Rep. Ex. Doc., 1, pt. 2, p. 887, 1878. Not *Venus concentrica* Born, 1780.

Distribution.—New Jersey to Vera Cruz. Pliocene to Recent. Gulf coast.—Recent: Ft. Barranca, St. Joseph's Bay, Crooked Island, &c., Fla.; Horn Island, Miss.; Point au Fer, Chandeleurs, La.; Galveston, Corpus Christi, Tex. Pleistocene: Osprey, Fla.; Grand Chênier (?), New Orleans artesian well of 1856 at 546 feet, Lake Borgne borings (Hilgard's *concentrica*), New Orleans pumping station No. 7, New Orleans Gymnasium well at 1200 feet, Knapp's wells, Terrebonne Parish, No. 1 (?), 1600-1700 feet, No. 2, 1519-1542, No. 3 at 570-700, 880-900, 1330-1375, 1400-1440, 1700-1712 feet.

elegans Conrad, Proc. A. N. S. Phila., 1, p. 325, 1843, (as *Artemis*); Fos. Medial Tert., p. 67, pl. 38, f. 1, 1845; Am. Jour. Sci., 2d Ser., II, p. 393, 1846; Dall, Tr. W. I. S. 3, p. 1231, 1903; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

concentrica Reeve, Conch. Icon. 6, pl. 2, f. 1, 1850; Tuomey and Holmes, Plio. Fos. S. C., p. 82, pl. 21, fig. 7, '55. Not *concentrica* Born, 1780.

transversa Emmons, 1858; *intermedia* Conrad, 1863.

Distribution.—Hatteras toYucatan. Miocene to Recent. Gulf coast.—Tampa, Fla. (Conrad's locality); Texas. Pleistocene: Osprey and Labelle, Fla. Pliocene: Caloosahatchie and Shell Creek.

Genus **TRANSENNELLA** Dall

conradina Dall, Proc. U. S. N. M., 6, p. 340, '83; *Idem*, 24, p. 509, pl. 31, f. 5, 7, 1902; Vanatta, Proc. A. N. S. Phila., p. 757, '03, (as *Meretrix*); Dall, Tr. W. I. S., 3, pp. 1240, 1616, '03.

Distribution.—Hatteras to Key West, 0.31 fms. Pleistocene to Recent. Gulf coast.—Cedar Keys, (type locality), St. St. Joseph's and St. Andrew's Bays, Crooked Island, St. Mark's, W. Fla. Pleistocene: Osprey, Fla.

Genus **GAFRARIUM** Bolten

(Gouldia) cerina C. B. Adams, Proc. Bost. Soc., N. H., p. 9, 1845, (as *Thetis*); Cat. Jamaican Sh., p. 29, '47; Dall, B. M. C. Z. 9, p. 130, '81; *Idem*, 12, p. 263, pl. 7, f. 4 *a-b*, '86; Bull. 37, p. 48, pl. 7, f. 4 *a-b*, '89; Proc. U. S. N. M., 26, p. 369, 1903.

Distribution.—Hatteras to Brazil, 0-229 fms. Gulf coast.—Charlotte Harbor, Fla., 13 fms.

Genus **MACROCALLISTA** Meek

nimbosa Solander, Portland Cat., p. 175, 1786, (as *Venus*); Whitfield and Hovey, Bull. Am. Mus. Nat. Hist., 11, p. 462, 1901 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03; Dall, Tr. W. I. S., 3, p. 1254, '03 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

gigantea Chemnitz, Conch Cab. 10, p. 354, pl. 171, f. 1661, 1788 ; Gmelin, Syst. Nat., 6, p. 3282, 1792 ; Lamarck, An. s. Vert. 5, p. 564, 1818 ; DeKay, Zool. New York, Moll., p. 216, '43 ; Conrad, Am. Jour. Sci., p. 44, '46 ; Sowerby, Thes. Conch. 2, p. 628, pl. 131, f. 86, '51 ; Holmes, Post-Plio. Fos. S. C., p. 36, pl. 7, f. 3, '60 ; Reeve, Conch. Icon., 14, *Dione*, pl. 5, f. 17,' 63 ; Coues, Proc. A. N. S., Phila., p. 136, '71 ; Dall, Bull. 37, U. S. N. M., p. 56, '89 ; Singley, 4th Ann. Rept. Tex., p. 327, '92 ; Mitchell, List Tex. Sh.

Distribution —Hatteras to Cuba (?) Pliocene to Recent. Gulf coast.—Recent : Ft. Barranca, Fla, Mobile, Ala., Matagorda Bay, Tex. Pleistocene : Osprey, Orient and Labelle, Fla. Pliocene : Caloosahatchie beds.

(Paradione) maculata Linnæus, Syst., Nat. ed. X, p. 686, 1758, (as *Venus*); Lamarck, An. s. Vert., 5, p. 566, 1818; Sowerby, Conch. Man., fig. 117 *d*, '42 ; Thes. Conch. 2, p. 629, pl. 131, f. 97, '51 ; Gabb, Jour. A. N. S. Phila., 2d Ser., 8, p. 344, '81 ; Dall, Tr. W. I. S., 3, p. 1256, 1903.

Cytherea dariena Conrad, Pac. R. R, Rept. 6, p. 72, pl. 5, f. 21, 1857. Not *Meretrix dariena* Conrad, which is *Clementia dariena.*

Distribution.—Hatteras to Brazil. Miocene to Recent. Gulf coast.—Recent : Ft. Barranca, St. Joseph's Bay, Crooked Island, etc., Fla. ; Horn Island, Miss. ; Chandeleurs, La; Matagorda Bay, Mustang Island, Corpus Christi, Texas. Pliocene : Caloosahatchie. Miocene : Chipola marl, Calhoun Co. ; Oak Grove sands, Santa Rosa Co., Fla. ; Bascom well, Mobile, Ala. at 1241 feet.

Genus **CALLOCARDIA** A. Adams

vesica Dall, Bull. Mus. Comp. Zool. Harv. Coll., 12, p. 275, 1886, (as *Cytherea*); Bull. 37, U. S. N. M., p. 56, '89 ; Proc. U.

S. N. M., 12, p. 270, pl. 14, f. 8, 12, '89; *Idem*, 26, p. 370, 1903.

Distribution.—Gulf of Mexico, 84 fms., Guadeloupe, 175 fms., Barbados, 100 fms. Dredged, S. S. Hassler.

(Agriopoma) texasiana Dall, Nautilus, 5, No. 12, p. 134, 1892, (as *Cytherea*); Bull. 37, U. S. N. M., 2d ed., pl. 93, f. 1; Proc. U. S. N. M., 24, p. 509, pl. 32, f. 1, 1902; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03; Dall. Proc. U. S. N. Mus., 26, p. 370, '03.

idonea ? (Conrad) Dall, Bull. 37, U. S. N. M., p. 56, 1889.

Distribution.—Gulf of Mexico. Recent: Indian Pass, Calhoun Co., Fla.; Cameron, Point au Fer, Chandeleurs, La.; Galveston, Indianola, Tex. Pleistocene: Grand Chênier, Knapp's wells, Terrebonne Parish, No. 2 at 1542-1632, No. 3 at 570-700.

(Agriopoma) morrhuana Linsley, Am. Jour. Sci., 1st ser., 48, p. 276, 1845, (*Nomen nudem*); Gould, *Idem*, 2d ser., 6, p. 233, 1848; Dall, Pr. U. S. N. M., 26, p. 370, 1903; Tr. W. I. S., p. 1262, pl. 54, f. 14, 1903; Johnson, Occ. Papers, Bost. S. N. H., 7, p. 69, 1915.

convexa Conrad, Jour. A. N. S. Phila., 6, p. 261, 1831, (as *Cytherea*); Gould, Inv. Mass., p. 84, pl. 3, fig. 49, 1841; DeKay, Nat. Hist. N. Y., Moll., 5, p. 216, pl. 27, f. 279, '43; Reeve, Conch. Icon., 14, pl. 10, f. 40, 1863. Not *convexa* Say, which is *Callocardia sayana* Conrad, and known only in the fossil state. Not *convexa* of Brongniart, 1811 (in Cuvier's, "Ossemens fossiles," 2, pt. 2, pl. 8, f. 7), which is a doubtful French species identified by Renevier and Deshayes with *Cyrena semistriata* Deshayes, 1831.

sayi Perkins, Proc. Bost. Soc. Nat. Hist., 13, p. 147, 1869.

Distribution.—Prince Edward's Island to Hatteras, 2-63 fms. Miocene to Recent. Characteristically a cold water species, but cited from the Gulf coast at Tampa (Dall, '89). Tampa shell perhaps *texasiana*.

(**Agriopoma**) **zonata** Dall, Proc. U. S. N. M., 26, pp. 370, 381, pl. 12, f. 4, 1903.

Cytherea ? obovata (Conrad) Dall, Bull. 37, U. S. N. M., p. 56, 1889.

Distribution.—Off Hatteras, 18-22 fms. Gulf coast.—West Florida and Cameron, La. (Dall).

Genus **PITARIA** Romer

simpsoni Dall, Bull. 37, U. S. N. M., p. 56, 1889 ; (*Nomen nudum*); Nautilus 9, No. 1, p. 10, 1895, (as *Cytherea*); Proc. U. S. N. M., 24, p. 510, pl. 32, f. 3, 1902, (as *Meretrix*); *Idem*, 26, p. 371, 1903 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

Distribution.—Florida to Martinique, 0-26 fms. Pliocene to Recent. Gulf coast.—St. Joseph's Bay and Crooked Isl., Calhoun Co., Tampa and Sarasota Bays, Fla.

eucymata Dall, Proc. U. S. N. M., 12, p. 271, pl. 13, f. 11, '89 ; *Idem*, 26, p. 371, 1903 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

Cytherea sp., (No. 290), Dall, Bull. 37, p. 56, '89.

Distribution.—Hatteras to Brazil, 20-111 fms. Gulf coast.—Horn Island, Miss., and dredged between the Mississippi delta and Cedar Keys, 111 fms.

fulminata Menke, Synop. Moll. Mus. Menkeano, 2d ed., 1830 ; Dall, Proc. U. S. N. M., 26, p. 371, 1903. Not of Philippi, 1845.

Cytherea hebræa Lamarck, An. s. Vert. 6, p. 308, 1818 ; Dall, B. M. C. Z., 12, p. 275, 1886 ; Bull. 37, U. S. N. M., p. 56, '89.

Circe hebræa Reeve, Conch. Icon., 14, pl. 8, f. 34, '63.

varians Hanley, 1844 ; *rubiginosa* Philippi, 1845.

Distribution.—Hatteras to Brazil, 0-170 fms. Gulf coast.—West Fla., 30 fms.

Note.—The identity of *hebræa* Lam. with *fulminata* Menke is based on Kreb's statement.

(**Hysteroconcha**) **dione** Linnæus, Syst. Nat. ed. X, p. 684, 1758 ;

Dall, Bull. 37, U. S. N. M., p. 56, '89 ; Dall and Simpson, Bull. U. S. Fish Comm., 1, p. 485, pl. 56, f. 3, 10, '01 ; Dall, Proc. U. S. N. M., 26, p. 371, 1903.

Dione veneris Deshayes, Cat. Conchifera Brit. Mus., pt. 1, 1853 ; Reeve, Conch. Icon., 12, *Dione*, pl. 6, f. 23, 1863.

Distribution.—Gulf of Mexico, Texas coast, to Colon and Trinidad. Type of subgenus *Hysteroconcha* Fischer.

Genus **CYTHEREA** Bolten

listeri Gray, Analyst, 8, No. 24, 1838, (as *Dosinia*); Reeve, Conch. Icon. 12, *Venus*, pl. 5, f. 14, '63 ; Dall, Proc. U. S. N. M., 26, p. 372, 1903.

Venus crispata Dall, Bull. 37, U. S. N. M., p. 54, 1889. Not of Deshayes, 1853.

Distribution.—Gulf of Mexico to Santo Domingo, Tortola and the Virgin Isls. Gulf coast.—West Florida.

Genus **ANTIGONA** Schumacher

(Ventricola) rugatina Heilprin, Tr. Wagner Inst. Sci., 1, p, 92, pl. 11, f. 24, 1887, (as *Venus*); Dall and Simpson, Bull. U. S. Fish Com., 1, p. 483, 1901 ; Dall, Proc. U. S. N. M., 26, p. 372, '03 ; Tr. W. I. S., 3, p. 1277, '03.

rugosa var. *rugatina* Dall, Bull. 37, p. 54, '89.

Distribution.— Hatteras to Porto Rico, 26-84 fms. Pliocene to Recent. Gulf coast.—Tampa, Fla. Pliocene : Caloosahatchie.

(Ventricola) callimorpha Dall, Proc. U. S. N. M., 26, pp. 372, 382, pl. 13, f. 6, 1903.

pilula Dall, B. M. C. Z., 9, p. 136, '81, (as *Diplodonta*); *Idem*, 12, p. 274, pl. 8, f. 13, '86, (as *Callocardia*); Bull. 37, U. S. N. M., p. 54, '89, (as *Venus*). Not *pilula* of Reeve, 1863.

Distribution.— Gulf of Mexico (Dall, '89) to Barbados, 76-300 fms.

Genus **CYCLINELLA** Dall

tenuis Récluz

Dosinia (*Artemis*) *tenuis* Récluz, Jour. de Conchy., 3, p.

250, pl. 10, f. 1, 1', 1852. Not *Artemis tenuis* Sowerby, 1852.

Cyclina tenuis Beau, Cat. Coq. Guadeloupe, p. 24, '58.

Mysia tenuis Dall and Simpson, 1901.

Lucinopsis kroyeri Poulsen, '78, (not of Philippi); *gundlachi* Dunker, '78 ; *tenuis* Dall, Bull. 37, p. 56, '89.

Cyclinella tenuis Dall, Tr. W. I. S., p. 1285, 1903.

Distribution.—Florida to Sao Paulo, Brazil, 0-8 fms. Pliocene to Recent. Gulf coast.—Texas and Cedar Keys, Fla. Pliocene: Caloosahatchie. Type locality Pointe—à—Petre, Guadeloupe.

Genus **CHIONE** Megerle

cancellata Linnæus, Syst. Nat., ed. XII, p. 1130, 1767, (as *Venus*); Sowerby, Thes. Conch., 2, p. 710, pl. 54, f. 28-31, 1853 ; Hilgard, Rept. Chief of Engineers to Sec. of War, p. 358, '70 ; Dall, Bull. 37, U. S. N. M., p. 54, '89 ; Singley, 4th Ann. Rept. Tex., p. 327, 1892 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903; Mitchell, List Tex. Sh.

Chione cancellata Holmes, Post-Pl. Fos. S. C., p. 35, pl. 6, f. 14, '60 ; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78 ; Harris, Bull. Am. Pal. 1, No. 3, p. 92, '95 ; Dall, Tr. W. I. S., 3, p. 1290, 1903 ; Vaughan, 2d Ann. Rept. Fla. Surv., p. 148, 1909.

Venus cigenda Dillwyn, Cat. Rec Shells, p. 161, 1817.

elevata Say, Jour. Acad. Nat. Sci. Phila., 1, p. 272, 1822 ; *lamellata* Deshayes, 1853, not of Linnæus ; *ziczac* Krebs, not Linnæus.

Distribution.—North Carolina to Brazil, shallow water. Upper Miocene (?) to Recent. Gulf coast.—Recent : Ft. Barranca, St. Joseph's Bay, Crooked Isl., Cedar Keys, Fla. ; Horn Isl., Miss. ; Galveston, Corpus Christi and Pt. Isabel, Texas. Pleistocene : Osprey, Manatee, Labelle, Orient, Fla. ; New Orleans artesian well of 1856, Lake Borgne borings, New Orleans pumping station No. 7, New Orleans Gymnasium well at 1200 feet, Knapp's wells, Terrebonne Parish, No. 1 at 2250-2450, No. 2 at 1731-1739, No. 3 at 570-700; 1150-1200, 1200-1300, 1330-1375, 1400-1440, 1443-2470, 1500-1525 feet. Pliocene : Caloosahatchie. Upper Miocene : Galveston well at 1550-2871 feet (Harris).

Note.—Dr. Dall doubts whether this species descends into the Miocene. The Galveston shell may be an ancestral form.

intapurpurea Conrad, Jour. A. N. S., Phila., 1, new ser., p. 209, 1849, (as *Venus*); Dall, Tr. W. I. S., 3, p. 1293, 1903; Proc. U. S. N. M., 26, p. 374, '03.

Chione cribraria Holmes, Post-Pl. Fos. S. C., p. 35, pl. 6, f. 15, 1860 ; Hilgard, House of Rep. Ex. Doc, 1, pt. 2, p. 887, '78 ; Dall, Bull. 37, U. S. N. M., p. 54, '89, (as *Venus*); Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903. Not *Venus cribraria* Conrad, Pr. A. N. S. Phila., 1, p. 310, 1843 ; Fos. Med. Tert., p. 67, pl. 38, f. 2, 1845.

Venus punctulata Conrad, 1843, not of Valenciennes ; *V. lacunata* Reeve, 1863.

Note.—True *Chione cribraria* is Upper Miocene, *cortinaria*, Lower Miocene, *intapurpurea*, Pliocene to Recent. These form a phylogenetic series.

Distribution.—Hatteras to Honduras, 18-124 fms. Gulf coast. Recent : Ft. Barranca, Crooked Isl., St. Joseph's Bay, Fla. ; Horn Island, Miss. ; Texas. Pleistocene : New Orleans artesian well of 1856, at 41 & 225 feet ; New Orleans Gymnasium Club well at 1200 feet ; Lake Borgne borings, New Orleans pumping station No. 7, Knapp's wells, Terrebonne Parish, No. 2, 1050-1190, No. 3, 700-780, 790-830, 1040-1043 feet. Pliocene of Fla.

(Lirophora) burnsi Dall, Tr. W. I. S., 3, p, 1198, pl. 62, f. 4, 11, 1900, (as *Venus*); *Idem*, p. 1294, 1906.

Distribution.—Miocene of the Chipola marl and Oak Grove sands, West Florida, and of the Bascom No. 1 well, Mobile, Ala., at 1500-1556 feet, Bascom No. 2 well, at 1241 ft.

(Lirophora) latilirata Conrad, Proc. A. N. S. Phila., 1, p. 28, 1841, (as *Venus*); Fos. Med. Tert., p. 68, pl. 38, f. 3, '45 ; Tuomey and Holmes, Pleio. Fos. C., p. 85, pl. 21, f. 12, 1857 ; Dall, Tr. W. I., 3, p. 1198, pl. 42, f. 3, 1900 ; p. 1298, 1903.

paphia Lamarck, An. s. Vert., 5, p. 608, 1818, (as *Venus*); Hilgard, Rept. Chief Engineers to Sec. War, p. 358, 1870. Not of Linnæus, Syst. Nat., ed. 12, p. 1129, 1767.

alveata Say, Am. Conch. 7, pl. 63, 1833. Not of Conrad, 1831.

varicosa Sowerby, Thes. Conch. 2, p. 723, pl. 155, f. 67, 1853 ; Dall, Bull. 37, U. S. N. M., p. 54, '89, (as *Venus*).

athleta Conrad, 1864. (as *Circumphalus*).

Note.—The type locality of Conrad's *V. latilirata* was the Miocene of Calvert Cliffs, Maryland. Conrad laid stress upon the irregularity of the ribs (one being usually very wide), of the Miocene specimens, and we have noticed this peculiarity strongly in specimens from great depths in the deep wells. It cannot, however, be taken as an invariable characteristic, for the regularly ribbed type, which is rather more characteristic of the Recent, occurs also in the Miocene.

Distribution.—Hatteras to Rio Grande do Sul, Brazil, 10-124 fms. Miocene to Recent. Gulf coast.—Recent : West Fla. ; Cameron, La., Galveston. Pleistocene : New Orleans artesian well of 1856 at 480 feet, Lake Borgne borings, New Orleans Gymnasium well at 1200 feet. Pliocene : Caloosahatchie marl, Fla. Pleistocene to Upper Miocene (?): Knapp's No. 1 well, Terrebonne Parish, at 2000-2150, 2250-2450, 2443 feet.

(Lirophora) ulocyma Dall, MS. in coll., U. S. N. M. ; Harris, Bull. Am. Pal., 1, No. 3, p. 91, 1895 ; Dall, Tr. W. I. S., 3, p. 1296, pl. 42, f. 5, '03.

Distribution.—Miocene of Alum Bluff (upper bed), Calhoun Co., Fla., and south of Tallahassee, (Vaughan) and of the Galveston well at 2236-2650 feet (Harris).

(Timoclea) grus Holmes, Post-Pl. Fos. S. C., p. 37, pl. 7, f. 5, 1858, (as *Tapes*); Dall, Tr. W. I. S., 3, p. 1299, 1903.

parva Sowerby, Thes. Conch., 2, p. 787, pl. 168, f. 227,

228, 1854. Not of Sowerby, 1829 ; nor Munster, 1836.
trapezoidalis Kurtz, Cat. Sh. N. & S. Car., p. 5, 1860.
pygmæa Hilgard, House of Rep., Ex. Doc. 1, pt. 2, pp. 887, 890, pl. 3, f. 1, 1878, (as *Tapes*); Dall, (in part), Bull. 37, U. S. N. M., p. 54, '89, (as *Venus*); Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903. Not *pygmæa* of Lamarck, An. s. Vert., 2d ed. 6, p. 337, 1818.

Note.—The true *pygmæa* Lam., of the Florida reefs and Antilles is closely related but larger than *grus*. Its synonym is *V. inæquivalvis* d'Orbigny, 1853.

Distribution.—Hatteras to Yucatan, 12-63 fms. Miocene to Recent. Gulf coast.—Recent : Ft. Barranca, St. Joseph's Bay, Crooked Island, Fla. ; Horn Island, Miss. Pleistocene : New Orleans pumping station No. 7, New Orleans Gymnasium well at 1200 feet ; Knapp's No. 2 well, Terrebonne Parish, 1434-1519, 1542-1632, 1780-1790, 1791-1842 feet ; Bush-Johnson well at Logtown, Miss., at 280 feet. Pliocene : Caloosahatchie and Shell Creek, Fla.

Genus **ANOMALOCARDIA** Schumacher

brasiliana Gmelin, Syst. Nat. 6, p. 3289, 1792, (as *Venus*); Dall, Proc. U. S. N. M., 26, p. 375, 1903 ; Tr. W. I. S., 3, p. 1306, '03.
flexuosa Born, Test. Mus. Vind., p. 62, pl. 4, f. 10, 1780, (as *Venus*). Not of Linnæus, 1767.
macrodon Lamarck, An. s. Vert., p. 580, 1818 ; Hanley, Bio. Sh., p. 116, pl. 9, f. 7, 1843 ; Sowerby, Thes. Conch., 2, p. 717, pl. 156, f. 88, 1853.
lunularis Lamarck, 1818, Deshayes, '34, Philippi, '44.

Distribution.—North Carolina to Rio de Janeiro. Gulf coast. Pleistocene : Osprey, West Fla. (Dall). Pliocene : Shell Creek, South Fla.

cuneimeris Conrad, Proc. A. N. S. Phila., vol. 3, p. 24, pl. 1, f. 13, 1846, (as *Venus*); Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 890, pl. 3, f. 5, '78 ; Dall, Proc. U. S. N. M., 26, p. 376, '03 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

rostrata Sowerby, Thes. Conch., 2, 1853 ; Dall, Bull. 37 ,U. S. N. M., p. 54, '89 ; Singley, 4th Ann. Rept. Tex., p. 327, 1892.

flexuosa Chenu, 1862. Not of Linnæus, 1767, nor of Born, 1780.

punctifera Gray (in Sowerby's Thes. Conch., 2), 1853.

Distribution.—Florida to Colombia. *Fide* Dall, '03, not yet authentically reported from the Antilles. Gulf coast.—Recent : Tampa (Conrad's type locality), Galveston and Corpus Christi. Pleistocene : New Orleans artesian well at 1200 feet ; New Orleans well of 1856 at 41 feet.

caloosana Dall, Tr. W. I. S., 3, p. 1198, pl. 43, f. 10, 1900, (as *Venus*); p. 1305, '03 ; Vaughan, 2d Ann. Rept., Fla., p. 148, '09 ; Publ. 133, Carn. Inst., p. 171, '10.

Distribution.—Pliocene : Caloosahatchie beds. Pleistocene : Osprey, Orient, Labelle, Manatee, West Fla. Not reported from the Recent.

Genus **VENUS** Linnæus

mercenaria Linnæus, Syst., Nat. ed. X, p. 686, 1758; Gmelin, Syst. Nat. 6, p. 3271, 1792 ; Lamarck, An. s. Vert., 5, p. 591, 1818; Say, Jour. A. N. S. Phila., 2, p. 271, '22 ; DeKay, Zool. New York, 5, p. 217, pl. 27, f. 276, '43 ; Reeve, Conch. Icon., 14, *Venus*, pl. 2, f. 46,' 63 ; Dall, Bull. 37, U. S. N. M., p. 54, pl. 55, f. 7, pl. 71, f. 1, 3, '89 ; Singley, 4th Ann. Rept. Tex., p. 327, '92 ; Harris, Bull. Am. Pal. vol. 1, No. 3, p. 91, '95 ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903 ; Dall, Tr. W. I. S., 3 p. 1311, '03.

Mercenaria violacea Schumacher, Essai, p. 135, pl. 10, f. 3, 1817 ; Holmes, Post-Pl. Fos. S. C., p. 33, pl. 6, f. 11, '60.

cancellata Gabb, 1860 ; Conrad, '63 ; Whitfield, '95. Not *cancellata* Linnæus, 1758.

antiqua Verrill, 1875. Not of King, 1831.

Distribution.—Gulf of St. Lawrence to Florida and Texas. Miocene to Recent. Gulf coast.—Recent : Cedar Keys, St. Mark's, Ft. Barranca, St. Joseph's Bay, Fla. ; Point au Fer, Chandeleurs, La. ; Galveston, and Corpus Christi, Tex. Pleistocene: New Orleans well of 1856, 41 feet, Lake Borgne borings, Grand Chênier, Knapp's wells, Terrebonne Parish, No. 2 at 1050-1190, 1542-1632, 1791-1839, No. 3 at 570-700, 1400-1550 feet. Upper Miocene: Galveston deep well at 2236-2600 feet (Harris).

Note.—It was from the violet margins of *V. mercenaria* that the Indians of the East coast made the discs of purple wampum which was more costly than the white.

campechiensis Gmelin, Syst. Nat. 5, p. 3287, 1792; Dall, Tr. W. I. S., 3, p. 1315, 1903; Vaughan, Publ. 134, Carn. Inst., p. 171, 1910.

præparca Say, 1822; *mortoni* Conrad, 1837; Holmes, Post-Pl. F. S. C., p. 34, pl. 6, f. 12, 1858; *calcarea* Philippi, 1844; *tenuilamellata* Sowerby, 1853; *alboradiata* Sowerby, 1853, Reeve, Conch. Icon., pl. 3, f. 7, 1863; *tetrica* Conrad, 1838; *permagna* Conrad, 1838, Tuomey and Holmes, Pleio. Fos. S. C., p. 86, pl. 22, f. 2, 1856; *capax* Conrad, 1863; *submortoni* d'Orbigny, 1852; *obtusa*, '66, *cuneata*, '68, and *carolinensis*, '75, Conrad.

Distribution.—Chesapeake Bay to Yucatan, moderate depths. Miocene to Recent. Gulf coast.—Recent: Indian Pass, Crooked Isl., Cedar Keys, Fla.; Horn Isl., Miss.; Cameron, Chandeleurs, La.; Corpus Christi, Alligator Head (dredged), Pass Cabello, Matagorda Bay (immense shells, Mitchell), Galveston, Texas. Dall has named the Texan form var. *texana*. Pleistocene: Labelle and Osprey, West Fla. Pliocene: Shell Creek, Fla.

Genus **GEMMA** Deshayes

gemma Totten, var. **purpurea** H. C. Lea, Am. Jour. Sci., p. 106, pl. 1, f. 1, 1842, (as *Cyrena*); Dall, Tr. W. I. S., 3, pl. 24, f. 2, 4, 4 *b*, 1898; p. 1332, 1903; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03; Johnson, Occ. Papers, Bost. Soc. N. H., 7, p. 71, 1915.

Parastarte concentrica Dall. Bull. 37, U. S. N. M., p. 48, 1889. *Nomen nudum.*

? *manhattanensis* Prime, Jay's Cat., 4th ed., Suppl., p. 466, 1852; Verrill, Inv. An. Vineyard Sound, p. 682, 1873.

Distribution.—Massachusetts to Texas and the Bahamas. Gulf coast.—Recent: St. Joseph's Bay, Calhoun Co., Fla; Corpus Christi Bay, (dredged, Singley). Pleistocene: Corpus Christi, Tex., Osprey, Manatee Co., Fla.

Genus **PARASTARTE** Conrad

triquetra Conrad, Proc. A. N. S., Phila., 3, p. 24, pl. 1, f. 6, 1845, (as *Astarte*); Proc. A. N. S. Phila., p. 28, '62; Dall, Proc. U. S. N. M., 6, p. 339, pl. 10, f. 1-3, '83; Bull. 37, U. S. N. M., p. 48, pl. 49, f. 6, 7, 8, '89; Tr. W. I. S., 3, p. 1333, 1903; Vanatta, Proc. A. N. S. Phila., 55, 757, 1903; Vaughan, 2d Ann. Rept. Fla. Surv., p. 149, 1909; Publ. 133, Carn. Inst., p. 171, 1910.

Distribution.—Peninsula of Florida. Genotype. Miocene (Jackson's Bluff, Ocklockonnee River) to Recent. Gulf coast.—Recent: St. Joseph's Bay, Crooked Isl., Cedar Keys, Sarasota Bay, Tampa Bay, (Conrad's type locality). Pleistocene: Labelle, Manatee and Osprey. Pliocene: Caloosahatchie and Myakka Rivers.

Genus **PETRICOLA** Lamarck

(**Rupellaria**) **typica** Jonas, Zeitschr. Mal., 1, p. 185; Beitr. Moll., p. 1, pl. 7, f. 3, 1844, (as *Choristodon typicum*); Dall, Tr. W. I. S., 3, p. 1059, 1900.

lithophaga Arango, 1880. Not of Retzius and Lamarck.

robusta Dall, Bull. 37, U. S. N. M., p. 58, 1889. Not of Sowerby.

Distribution.—Florida to Guadeloupe. Gulf coast.—West Fla. Pliocene: Caloosahatchie marl.

(**Petricolaria**) **pholadiformis** Lamarck, An. s. Vert., p. 505, 1818; Conrad, Am. Marine Conch., p. 37, pl. 7, f. 3, '31; Say, Am. Conch, pl. 60, f. 1, '34; Holmes, Post-Plio. Fos. S. C., p. 38, pl. 7, f. 6, '60,; Gould, Inv. Mass., Binney's ed., p. 90, fig. 398, '70; Dall, Bull. 37, U. S. N. Mus., p. 58, pl. 59, f. 15, '89; Singley, 4th Ann. Rept. Tex., p. 328, '92; Mitchell, List Texas Shells; Dall, Tr. W. I. S., 3, p. 1061, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903; Clark, Pleistocene of Maryland, Md. Geol. Surv., p. 201, 1906.

fornicata Say, Jour. Acad. Nat. Sci. Phila., 2, p. 319, 1822.

Distribution.—Prince Edward's Island to Nicaragua, burrowing near low water line. Pleistocene to Recent. Gulf coast.—Ft. Barranca, Indian Pass, Crooked Isl. (Calhoun Co.), Fla.; Cameron, La.; Galveston, Corpus Christi, Matagorda Bay, Tex. Pleistocene: New Orleans pumping station No. 7.

Note.—Type of section *Petricolaria* Stoliczka, characterized by transversely elongated shell and great length of siphons.

Genus **TELLINA** Linnæus

interrupta Wood, General Conchology, 1815; Dall, Bull. 37, U. S. N. M., p. 60, 1889; Proc. U. S. N. M., 23, p. 293, 1901.

maculosa Lamarck, An. s. Vert., 1818.

antoni Philippi, Hanley, Thes. Conch., p. 224, pl. 58, f, 74, 1846; Dall, B. M. C. Z., 9, p. 134, '81; 12, p. 277, 1886.

Distribution.—North Carolina to Brazil. Gulf coast.—West of Florida., 19 fms., dredged S. S. Bache. Var. *mexicana* Petit is more slender than the typical form.

lævigata Linnæus, Syst. Nat., ed. X, 1758; Dall, Proc. U. S. N. M., 6, p. 338, 1883; Bull. 37, U. S. N. M., p. 60, '89; Siugley, 4th Ann. Rept. Texas., p. 329, '93; Dall, Proc. U. S. N. M., 23, p. 293, 1901.

lævis Krebs, West. Ind. Mar. Sh., 1864. Not of Rumphius; nor of Wood which =*fausta* Donovan.

Distribution.—Florida to Guadeloupe. Gulf coast.—Tampa, Sarasota Bay, Fla.; Texas.

lineata Turton, Conch. Dict. British Isls., p. 168, pl. 4, f. 16, 1819; Sowerby, in Conch. Icon., 17, pl. 18, f. 89 *a-c*; Dall, Bull. 37, U. S. N. M., p. 60, 1889; Proc. U. S. N. M., 23, p. 292, 1901.

brasiliana Lamarck, 1818, not of Spengler, 1798; *striata* Montagu, 1803, not Chemnitz; *tenuis* Conrad, 1834; *de-*

cussata Adams, 1845.

Distribution.—Florida to Brazil.—Gulf coast.—West Florida.

(**Liotellina**) **radiata** Linnæus, Syst. Nat., ed. X, p. 675, 1758; Sowerby, in Reeve's Conch. Icon., 17, pl. 3, f. 8*b*, 1866; Hanley, in Sowerby's Thesaurus Conch., p. 245; Dall, Bull. 37, U. S. N. M., p. 60, 1889; Singley, 4th Ann. Rept. Tex., p. 329, '93; Dall, Proc. U. S. N. M., 23, p. 293, 1901.

nivea Wood, Gen. Conch., 1815; *unimaculata* Lamarck An. S. Vert., 5, 1818.

Distribution.—Charleston, S. C., to the Antilles. Type of section *Liotellina* Fischer. Gulf coast.—Cedar Keys, Fla., Galveston, Tex.

(**Merisca**) **lintea** Conrad, Jour. A. N. S. Phila., 7, p. 259, pl. 20, f. 3, 1837. Not Conrad 1848 (which is a Vicksburgian, Oligocene species); Dall, Bull. 37, U. S. N. M., p. 60, 1889; Tr. W. I. S., 3, p. 1029, 1900; Proc. U. S. N. M., 23, p. 293, 1901; Vanatta, Proc. A. N. S., Phila., 55, p. 757, 1903.

Distribution.—N. Carolina to Jamaica, 0-30 fms. Miocene to Recent. Gulf coast.—Crooked Isl. (Calhoun Co.), Fla.; Horn Isl., Miss.; Mobile Point, Ala. (type locality).

(**Eurytellina**) **alternata** Say, Jour. A. N. S. Phila., 2, p. 275, 1822; Amer. Conchology, pl. 65, f. 1; Tuomey and Holmes, Pleio. Fos. S. C., p. 89, pl. 22, f. 4, 1857; Holmes, Post-Pl. Fos. S. C., p. 45, pl. 8, f. 1, 1860; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, 1878; Dall, Bull. 37, U. S. N. M., p. 60, '89; Singley, 4th Ann. Rept. Texas, p. 328, '92; Mitchell, List Tex. Sh., p. 9; Dall, Tr. W. I. S., 3, p. 1029. 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

punicea d'Orbigny, In de la Sagra, Moll. Cubana, 2, 1853, (in part). Not *punicea* Born.

Distribution.—Hatteras to British Honduras, and Antilles to Santo Domingo. Pliocene to Recent. Gulf coast.—Recent: Alligator Harbor (Franklin Co.), Indian Pass (Calhoun Co.), Fla.; Horn Island, Miss.; Point au Fer, Cameron, La.; Galveston, Corpus Christi, Matagorda Island, Texas. Pleistocene: Lake Borgne borings, New Orleans artesian well of 1856 at 66 feet; New Orleans pumping station No. 7; Knapp's wells, Terrebonne Parish, No. 1 at 2443 feet, No. 3 at 1150-1200, 1200-1300, 1443-1470 feet. Pliocene: Caloosahatchie.

Note.—Varying in color from an exquisite pink (var. *taylor-iana* Sowerby. in Reeve, 1867), to bluish or pure white. Some, like Say's type, are tinged within with canary yellow.

(Eurytellina) georgiana Dall, Proc. N. S. N. M., 23, pp. 294, 310, pl. 2, f. 3, 1901; Dall and Simpson, B. U. S. Fish Com., 1, p. 479, 1901.

nitida var. *carolinensis* Dall, Bull. 37, U. S. N. M., p. 60, 1889. Not *carolinensis* Conrad, 1875.

Distribution.—Hatteras to St. Thomas, West Indies. Dredged in Gulf of Mexico, 32 fms. Slightly resembles the European species *T. nitida* Lamarck.

(Phyllodina) squamifera Deshayes, Proc. Zool. Soc. London, p. 365, 1854; Reeve, Conch. Icon., *Tellina*, pl. 55, f. 325, 1869: Dall, Bull. 37, U. S. N. M., p. 60, '89; Proc. U. S. N. M., 23, p. 294, 1901.

Distribution.—Hatteras to Sombrero Isl., 22-85 fms. Not in the China Sea, as cited by Sowerby. Gulf coast.—West Florida.

(Mœrella) gouldii Hanley, Thes. Conch., p. 272, pl. 56, f. 26, 1846; Dall, B. M. C. Z., Harv. Coll. 9, p. 134, 1881; 12, p. 278, '86; Proc. U. S. N. M., 23, p. 294, 1901.

cuneata d'Orbigny, In de la Sagra's Hist. Isla de Cuba, 2, p. 256, pl. 26, f. 23, 1853; Dall, Bull. 37, U. S. N. M., p. 60, 1889.

Distribution.—Hatteras to Yucatan, 2-50 fms. Gulf of Mexico; Tampa, Fla.; Yucatan Strait, 640 fms.

(Mœrella) martinicensis d'Orbigny, In de la Sagra's Hist. Pol. y Nat. Isla de Cuba, 2, p. 253, pl. 26, f. 6, 8, 1845; Dall, Proc. U. S. N. M., 23, p. 295, 1901.

tumida and *obtusa* Sowerby, Mon. *Tellina*, in Reeve's Conch. Icon., 17, 1867-1868.

Distribution.—Florida to the Antilles. Gulf coast.—Tampa.

(Angulus) magna Spengler, Skrifter Natur. Selskabet, 4, 1798; Hanley, Mon. Genus *Tellina* in Sow., Thes., p. 274, No. 96, pl. 65, f. 239, and pl. 63, f. 201 ; Dall, Bull. 37, U. S. Nat. Mus., p. 60, 1889 ; Proc. U. S. Nat. Mus. 23, p. 295, 1901 ; Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p. 757, 1903.

acuta Wood, General Conch., 1815.

elliptica Lamarck, An. s. Vert., 1818.

Distribution.—Hatteras to the Virgin Isl's. Gulf coast.—Crooked Isl., Fla.

(Angulus) tenera Say, Jour. Acad. Nat. Sci. Phila., 2, p. 303, 1822 ; Hilgard, Rept. Chief Eng. to Sec. of War, p. 358 '70 ; House of Rep. Ex. Doc., 1, pt. 2, p. 887, '78 ; Dall, Bull. 37, U. S. N. M., p. 60, pl. 55, f. 1, pl. 56, f. 13, '89; Proc. U. S. N. M., 23, p. 295, 1901 ; Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p, 757, 1903. Not the figure of *tenera* Sowerby, in Conch. Icon., pl. 34, f. 195, 1867.

? elucens Mighels, Proc. Bost. Soc. Nat. Hist., 1, 1844.

agilis Stimpson, Shells of New Eng., 1857 ; Dall, Proc. U. S. N. M., 6, p. 338, 1883.

omoia Ravenel, 1875.

Distribution.—Prince Edward's Id. to Barbados, 0-80 fms. Pliocene to Recent. Gulf coast.—Indian Pass (Calhoun Co.), Cedar Keys, (variety); dredged west of Florida in 30 fms. Pleistocene : Lake Borgne borings ; New Orleans well of 1856, at 235 and 570 feet ; Knapp's No. 3 well, Terrebonne Parish, surface to 700 feet, 570-700, 790-830, 1400-1440, 1443-1470 feet. Closely allied to *polita* and *iris*.

Note.—*Tellina tenella* Verrill (Rept. Inv. An. Vineyard Sound, U. S. Fish Com., 1872) was listed by Dr. Dall from Tampa (Bull. 37, U. S. N. M., p. 60, 1889), but on further examination he decided the Tampa shell was not this species (which ranges from Mass. to New York). *Modesta*, Verrill, 1872, not of Carpenter, 1864, is *fide* Dall, a synonym of *tenella* Verrill. Name *tenella* is preoccupied.

(**Angulus**) **texana** Dall, Proc. U. S. N. Mus., 23, pp. 295, 313, 1901.

Distribution.—Charlotte Harbor, West Fla., Corpus Christi Bay, Tex., 3-4 feet of water. Nearest ally is the northern form, *tenella* Verrill.

(**Angulus**) **versicolor** Cozzens, In DeKay, Nat. Hist. New York, 5, p, 209, pl. 26, f. 172, 1843 ; Dall, Bull. 37, U. S. N. M., p. 60, '89; Singley, 4th Ann. Rept. Tex., p. 329, '92; Dall, Proc. U. S. N. M., 23, p. 295, 1901.

Distribution.—Connecticut to Brazil, 15-50 fms. Gulf coast. West Fla., Corpus Christi, Tex. Pleistocene: Osprey, Florida.

(**Angulus**) **consobrina** d'Orbigny, In de la Sagra's Hist. Isla. de Cuba, 2, p. 254, pl. 26, f. 911, 1845 ; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 480, 1901 ; Vanatta, Proc. A. N. S., Phila., 55, p. 757, 1903.

Distribution.—Antilles and Gulf of Mexico at Crooked Isl., Fla., and Horn Isl., Miss. (Vanatta). Closely related to and perhaps a variety of *versicolor* Cozzens.

(**Angulus**) **sybaritica** Dall, Bull. Comp. Zool. Harv. Coll., 9, p. 134, 1881 ; 12, p. 277, pl. 6, f. 11, '86 ; Bull. 37, U. S. N. M., p. 60, pl. 6, f. 11, '89 ; Proc. U. S. N. M., 26, p. 295, 1901.

Distribution.—Hatteras to Brazil, 20-640 fms. Gulf of Mexico, Yucatan Strait. Its bright rose pink is very unusual in a deep water shell. Pleistocene : Osprey, West Fla.

(**Angulus**) **sayi** Deshayes, Manuscript; Dall, Tr. W. I. S., 3, p. 1034, 1900.

polita Say, Jour. A. N. S. Phila., 2, p. 275, 1822 ; Am Conch., pl. 65, f. 2, '34 ; Holmes, Post-Pl. Fos. S. C., p. 45, pl. 8, f. 2, '58 ; Hilgard, House of Rep. Ex. Doc. 2, p. 887, '78 ; Dall, Bull. 37, U. S. N. M., p. 60, '89 ; Singley, 4th Ann. Rept. Texas, p. 328, '92 ; Dall, Proc. U. S. Nat. Mus., 23, p. 296, 1901 ; Vanatta, Proc. A. N. S., 55, p. 757, 1903. Not *polita* of Spengler, 1798; nor of Sowerby, 1825; nor of Poli and Risso.

Note.—Inasmuch as the name *polita* had already been given several times to species of *Tellina* before Say named his shell, Dr. Dall proposed the name *sayi*, which was suggested in a manuscript of Deshayes in Dr. Dall's possession.

Distribution.—North Carolina to Progreso, peninsula of Yucatan. Pliocene to Recent. Gulf coast.—St. Joseph's Bay, Fla.; Corpus Christi, Tex. Pleistocene: Lake Borgne borings and the New Orleans artesian well of 1856 (Hilgard). Pliocene: Caloosahatchie.

(**Angulus**) **pauperata** d'Orbigny, In de la Sagra's Hist. Pol. y Nat. Isla de Cuba, 2, 1846; Dall, Proc. U. S. N. M., 23, p. 296, 1901; Vanatta, A. N. S. Phila., 55, p. 757, 1903.

Distribution.—Florida to Martinique. Gulf coast.—Tampa and St. Joseph's Bay and Crooked Isl., Calhoun Co., Fla.

(**Angulus**) **tampaensis** Conrad, Jour. Acad. Nat. Sci. Phila., 2, p. 281, pl. 15, f. 8, 1866; Dall, Bull. 37, U. S. N. M., p. 60, '89, (as *Macoma*); Singley, 4th Ann. Rept. Tex., p. 329, '93; Mitchell, List Tex. Sh., p. 17; Dall, Proc. U. S. N. M., 23, p. 296, 1910.

Distribution.—West Florida to Texas, Pliocene to Recent. Localities: Tampa Bay (type locality), Fla.; Corpus Christi Bay, (dredged), Espiritu Santo Bay, living on the flats. Pliocene: Caloosahatchie.

(**Angulus**) **mera** Say, Amer. Conchology, 1834; Dall. Bull. 37, U. S. N. M., p. 60, 1889; Proc. U. S. N. M., 23, p. 296, 1901.

Distribution.—South Carolina to the Bahamas. Pliocene to Recent. Gulf coast—Tampa, Florida. Pliocene: Caloosahatchie beds.

(**Angulus**) **promera** Dall, Proc. U. S. N. M., 23, pp. 296, 312, pl. 2, f. 11, 1901.

Distribution.—West Fla., at Tampa Bay to Curaçao Isl.

(**Angulus**) **simplex** d'Orbigny, In de la Sagra's Hist. Pol. y Nat.

Isla de Cuba, 2, 1846; Dall, Proc. U. S. N. M., 23, p. 296, 1901.

Distribution.—Gulf of Mexico to the Antilles. Dredged at 60 fms. between Cedar Keys and the Mississippi delta.

(Scissula) similis Sowerby, British Miscellany, 1806; Dall, Proc. U. S. N. M., 23, p. 296, 1901.

decora Say, Jour. A. N. S. Phila., 5, 1827; Hanley, Thesaurus, pl. 56, f. 27 (only), 1846; Dall, Bull. 37, U. S. N. M., p. 60, 1889.

Distribution.—Florida to Venezuela. Gulf coast.—West Fla.

(Scissula) iris Say, Proc. A. N. S. Phila., 2, p. 302, 1822; Dall, Bull. 37, U. S. N. M., p. 60, 1889; Proc. U. S. N. M., 23, p. 297, 1901.

caribæa d'Orbigny, In de la Sagra's Hist. Isla de Cuba, 2, 1846.

Distribution.—North Carolina to Guadeloupe Isl. Gulf coast. St. Mark's, Cedar Keys, Ft. Barranca, Fla.; Cameron, La. Pleistocene: New Orleans pumping station No. 7, (last identification doubtful).

Note.—As its name implies, this lovely shell is remarkable for the play of rainbow colors on the valves.

Genus **STRIGILLA** Turton

carnaria Linnæus, Syst. Nat., ed. X, p. 676, 1758; Dithyra Britanica, p. 117, pl. 7, f. 15, 1822; Dall, Proc. U. S. N. M., 23, p. 297, 1901; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 482, pl. 58, f. 3, 1901; Dall, in Matson, U. S. G. S., Prof. Paper 98–L, p. 177, 1916.

carneosum Da Costa, 1778, (as *Cardium*).

areolata Menke, Zeitschr, Mal., 1847.

Distribution.—North Carolina to Brazil. Apparently not reported from the Recent Gulf fauna, but cited by Dr. Dall from the Gulf Pleistocene in a well at Ft. Morgan, Ala., at 100-112 and 169-175 feet.

flexuosa Say, Jour. A. N. S. Phila., 2, p. 303, 1822, (as *Tellina*; Holmes, Post-Pl. Fos. S. C., p. 44, pl. 7, f. 14, 1860; Hilgard, Rept. Chief of Engineers to Sec. of War,

p. 358, '70 ; House of Rep. Ex. Doc. 1, pt. 2, pp. 887-889, '78 ; Dall, Bull. 37, U. S. N. M., p. 62, '89 ; Tr. W. I. S., 3, p. 1039, 1900 ; Proc. U. S. N. M., 23, p. 297, '01; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03.

mirabilis Philippi, Arch. f. Natur., 1, p. 260, 1841, (as *Tellina*).

carolinensis Conrad, Proc. A. N. S., Phila., for 1862, p. 573.

Distribution.—Hatteras to Guadeloupe. Miocene to Recent. Gulf coast.—Recent : Ft. Barranca, Fla. ; Horn Island, Miss. : Galveston, Texas. Pleistocene : New Orleans well of 1856, New Orleans pumping station No. 7, New Orleans Gymnasium well at 1200 feet ; Saratoga, Texas, Teel well No. 1 at 940 feet.

galvestonensis Harris, Bull. Am. Pal., 1, No. 3, p. 92, pl. 1, f. 4, 1895.

Distribution.—Upper Miocene, Galveston artesian well at 2552-2733 feet (Harris).

Genus **TELLIDORA** Morch

cristata Récluz, Révue Cuvier, p. 270, 1842 ; Dall,Bull. 37, U. S. N. M., p 62, '89 ; Tr. W. I. S., 3, p. 1037, 1900 ; Proc. U. S. N., 23, 298, 1901 ; Mitchell, List Tex. Sh. ; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903 ; Vaughan, Publ. 133, Carn. Inst., p. 171, 1910.

lunulata Holmes MS.; Adams, Genera Rec. Moll., 1, p. 401, 1856 ; Holmes, Post-Pl. Fos. S. C., p. 47, pl. 9, f. 7 *a-b*, 1858 ; Hilgard, House of Rep., Ex. Doc. 1, pt. 2, pp. 887, 1878.

Distribution.—North Carolina to Campeche. Pliocene to Recent. Gulf coast.—Crooked Isl., West Fla. ; Texas. Pleistocene : Lake Borgne borings, New Orleans well of 1856 ; Labelle, Fla. Pliocene : Caloosahatchie and Shell Creek, Fla.

Genus **METIS** H. and A. Adams

interstriata Say, Jour. A. N. S. Phila., 5, p. 218, 1827, (*intastriata* by typographical error. *Tellina*); DeKay, Zool. N.

Y., p. 211, 1843 ; Dall, Bull. 37, U. S. N. M., p. 62, '89 ; Tr. W. I. S., 3, p. 1043, 1900 ; Proc. U. S. N. M., 23, p. 298, '01 ; Vanatta, Proc. A. N. S. Phila., 55, p, 757, 1903.

grüneri Philippi, Zeitschr f. Mal., 2, p. 150, 1845.

ephippium Gregory, Quart. Jour. Geol. Soc. London, p. 293, 1895 ; not of Spengler, 1793.

sagræ d'Orbigny, Pal. Cub., pl. 4, f. 8, 9, (1853 ?). Internal cast, probably this species.

Distribution.—Florida to Guadeloupe, 30 or less fms. Pleistocene to Recent. Gulf coast.—St. Joseph's Bay, West Fla. ; Texas.

Genus **MACOMA** Leach

constricta Bruguière Mém. Soc. Hist. Nat. 1, p. 126, No. 3, 1799, (as *Solen*); Philippi, Abb. und. Beschr., 1, p. 9, pl. 1, f. 5, 1843 ; Dall, Bull. 37, U. S. N. M., p. 60, '89 ; Siugley, 4th Ann. Rept. Texas., p. 329, '93 ; Dall, Tr. W. I. S., 3, p. 1050, 1900 ; Proc. U. S. N. M., 23, p. 298, '01. Mitchell, List Tex. Sh. ; Vanatta, Proc. A. N. S. Phila., 55, 757, 1903.

cayennensis Lamarck, An. s. Vert., 5, p. 514, 1818, (as *Psammobia*); Deshayes, An. s. Vert., ed. 2, 6, p. 177, 1835 ; Hanley, Thes. Conch., p. 312, pl. 62, f. 190, 1846 ; Holmes, Post-Plio. Fos. S. C., p. 47, pl. 8, f. 4, 1859.

lateralis Say, Jour. A. N. S. Phila., 5, p. 218, 1827 ; *inornata* Adams.

Distribution.—New Jersey to Brazil. Pliocene to Recent. Gulf coast.—Recent : St. Mark's, Cedar Keys, Indian Pass, Fla. ; Point au Fer, Cameron, La. ; Galveston, Sabine Pass, Matagorda, Carancahua, Lavaca, and Turtle bays, Tex. Pleistocene : Grand Chênier, New Orleans pumping station No. 7. Pliocene : Caloosahatchie.

cerina C. B. Adams, Proc. Bost. Soc. Nat. Hist., 2, 1845 ; Dall, Bull. 37, U. S. N. M., p. 60, '89 ; Proc. U. S. N. M., 23, p. 299, 1901.

Distribution.—Florida to Jamaica. Gulf coast.—Shark River, Monroe Co., southwestern Fla.

leptonoidea Dall, Nautilus, 9, p. 33, 1895; Proc. U. S. N. M., 23, pp. 299, 323, pl. 4, f. 4, 9, 1901; Checklist Rec. West Coast Moll., p. 36, 1916.

Distribution.—Matagorda Bay, Texas (type locality), in shallow, warm water; Santa Barbara channel, California, dredged at 332 and 314 fms., temperature 44° F. Showing an unusual adaptability to warm and cold temperatures.

mitchelli Dall, Nautilus, 9, p. 33, 1895; Proc. U. S. N. M., 23, pp. 299, 314, pl. 2, f. 4, 5, 1901; Bull. 37, U. S. N. M., reprint suppl. pls., pl. 92, f. 4; Mitchell, List Tex. Sh., page 4.

Note.—Mr. J. D. Mitchell discovered this species in Carancahua Bay, in muddy sediments just beneath the surface.

Distribution—Charleston, S. C., and Matagorda and Carancahua Bays, Texas.

phenax Dall, Proc. U. S.N. M., 23, pp. 299, 314, 1901.

Distribution.—Chesapeake Bay; Tampa Bay.

tenta Say, Am. Conch., pl. 65, f. 3, 1834, (as *Tellina*); Holmes, Post-Pl. Fos. S. C., p. 46, pl. 8, f. 3, '60; Gould, Inv. Mass., Binney's ed., p. 96, f. 402, '70; Hilgard, Rept. of Engineers to Sec. of War, p. 358, 1870; House of Rep. Ex. Doc., 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. N. M., p. 60, pl. 56, f. 10, '89; Tr. W. I. S., 3, p. 1049, 1900; Proc. U. S. N. M., 23, p. 299, '01; Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p, 757, 1903.

souleyetiana Récluz, Jour. de Conch. 3, p. 253, pl. 10, f. 5, 1852. Not *souleyeti* Hanley, Proc. Z. S., p. 71, 1844.

récluziana Tryon, Cat. Tell., p. 98, '69.

Distribution.—Cape Cod to Rio la Plata. Pliocene to Recent. Gulf coast.— Crooked Isl., Fla. (?); Point au Fer, La. Pleistocene: Lake Borgne borings; New Orleans well of 1856, at 41 feet; (?) New Orleans Gymnasium club well at 1200 feet. Pliocene: Caloosahatchie.

Note.—Variety *souleyetiana* Récluz is the more southern form, tinted delicately with orange.

(Psammacoma) tageliformis Dall, Tr. Wagner Inst. Sci., 3, p. 1055, 1900; Proc. U. S. N. M. 23, pp. 300, 315, '01; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 482, pl. 55, f. 10, 11, 15, 1901.

Distribution.—Texas and Porto Rico, W. I. Recent: Galveston and Corpus Christi. Pleistocene: Corpus Christi.

(Cydippina) brevifrons Say, Am. Conch., pl. 64, f. 1, 1834, (as *Tellina*); Binney's Say, p. 227, 1858; Dall, Bull. 37, U. S. N. M., p. 60, '89; Singley, 4th Ann. Rept. Texas, p. 329, '92; Dall, Tr. W. I. S., 3, p. 1055, 1900; Proc. U. S. N. M., 23, p. 300, '01; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 481, pl. 55, f. 3, 12, 13, '01; Vanatta, Proc. Acad. Nat. Sci. Phila., 55, p. 757, 1903.

Distribution.—New Jersey to Rio de Janeiro. Pliocene to Recent. Gulf coast.—Horn Island, Miss.; Galveston, Tex. Pliocene Caloosahatchie marl, Monroe Co,, Fla.

(Cydippina) limula Dall, Bull. 37, U. S. N. M., p. 60, 1889 (*nomen nudum*); Nautilus 9, p. 32, 1895; Proc. U. S. N. M., 23, pp. 300, 315, pl. 2, f. 1, 1901.

Distribution.—North Carolina to Barbados, 22-100 fms. West Florida (Dall).

(Cydippina) extenuata Dall, Proc. U. S. N. M., pp. 300, 314, pl. 2, f. 7, 1901.

Distribution.—Dredged at 32 fms., U. S. Fish Com., between the Missitsippi delta and Cedar Keys, Fla.

Genus **SEMELE** Schumacher

proficua Pulteney, In Hutchin's Dorset., p. 29, pl. 5, f. 4, 1799, (as *Tellina*); Dall, Tr. W. I. S., 3, p. 991, 1900; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 477, 1901.

decussata Wood, Gen. Conch., p. 190, pl. 43, f. 2, 3, 1815. Reeve, Conch. Icon., *Amphidesma*, pl. 4, f. 23, 1853.

orbiculata Say, Jour. A. N. S. Phila, 2, p. 307, 1822; Tuomey and Holmes, Pleio. Fos. S. C., p. 94, pl. 23, f. 4, 1856, (as *Amphidesma*); Holmes, Post-Pl. Fos. S. C.. p. 51, pl. 9, f. 8, 1858.

radiata Say, Jour. A. N. S. Phila., 5, p. 230, 1826. Not of Reeve, 1853.

jayanum Adams, Proc. Bost. S. N. H., 2, p. 10, 1845.

reticulata (Chemnitz) d'Orbigny, Moll. Cuba, p, 240, 1846; Reeve, Conch. Icon., *Amphidesma*, pl. 5, f. 29, 1853; Dall, Bull. 37, U. S. N. M. p. 62, '89; Singley, 4th Ann. Rept. Texas, p. 329, '92; Mitchell, List Tex. Sh. Not *reticulata* Linnæus, Syst. Nat., ed. XII, p. 1119, 1767, which Linnæus said was brought by Tesdorf from India.

subtruncata (Sowerby) Reeve, Conch. Icon., *Amphidesma*, f. 11, 1853.

carolinensis Conrad, Am. Jour. Conch., 3, p. 14, 1867.

Distribution.—Virginia to Brazil. Pliocene to Recent. Gulf coast.—West Florida and Galveston, Tex.

purpurascens Gmelin, Syst. Nat., 6, p. 3288, 1792, (as *Venus*); Morch, 1853, Krebs, 1864, Arango, 1878; Dall, Tr. W. I. 3, p. 993, 1900; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 477, 1901. Not of Sowerby, Reeve or Lamarck.

obliqua Wood, General Conch., p. 152, pl. 41, f. 4 and 5, 1815, (as *Tellina*); Reeve, Conch. Icon, *Amphidesma*, pl. 1, f. 5 *a*, *b*, '53; Dall, Bull. 37, U. S. N. M., p. 62, '89, Singley, 4th Ann. Rept. Texas, p. 329, '92; Mitchell, List Tex. Sh., p. 16.

variegata Lamarck, An. s. Vert., 5, p. 490, 1818; d'Orbigny, Moll. Cuba, 2, p. 239, 1853.

ornata Gould, 1862; Tryon, 1874.

Distribution.—North Carolina to Rio de Janeiro. Pliocene to Recent. Gulf coast.—West Florida, Galveston and Matagorda peninsula, Tex. Pliocene: Caloosahatchie.

bellastriata Conrad, Jour. Acad. Nat. Sci. Phila., 7, p. 239, pl. 20, f. 4, 1837, (as *Amphidesma*); Dall, Tr. W. I. S., 3, p. 993, 1900; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 477, 1901; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

cancellata d'Orbigny, In Sagra's Hist. Cuba, 2, p. 241, pl. 25, f. 42-44, 1853; Dall, Bull. 37, U. S. N. M., p. 62, '89.

nexilis Gould, Otia Conch., p. 238, 1862 ; Dall, Proc. U. S. N. M., 6, p. 338, 1883.

lata (Adams) Bush, Trans. Conn. Acad., 6, pt. 2, p. 476, 1885. *Lapsus pennæ.* There is no *S. lata* Adams.

Distribution.—Hatteras to Brazil, moderate depths. Pliocene to Recent. Gulf coast.—Recent : Cedar Keys (*nexilis* Dall, '83), St. Joseph's Bay, West Fla., also 30 fms. off shore ; Horn Island, Miss. ; Mobile Point, Ala. (type locality). Pleistocene : New Orleans pumping station No. 7. Pliocene : Caloosahatchie, Fla.

(Semelina) nuculoides Conrad, Am. Jour. Sci., 41, p. 347, 1841 ; Fos. Med. Tert., p. 73, pl. 41, f. 6, 1845, (as *Amphidesma*); Pr. A. N. S., Phila., p. 574, 1863, (as *Abra*); Dall, Bull. 37, U. S. N.M., p. 60, '89 ; Tr. W. I. S., 3, p. 994, 1900; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 477, 1901. Not *Syndosmya nuculoides* Whitfield, Mio. N. J., 1894, =*Sportella* sp. (Dall).

Distribution.—Hatteras to the Antilles, 2-124 fms. Miocene (Oak Grove, Fla. ; var. *striatula* Dall ; N. C. and Va.) to Recent. Gulf coast.—Recent : Tampa and Pensacola, Fla. Pleistocene : Gymnasium club well at 1200 feet, New Orleans. Pliocene : Caloosahatchie beds, Fla.

Note.—Comparison of specimens from the Gymnasium well shows close agreement with specimens of *nuculoides* from the Miocene of Curry, N. Car. Shell having the anterior end long, posterior short, sinus enormous.

Genus **CUMINGIA** Sowerby

tellinoides Conrad, Jour. Acad. Nat. Sci. Phila., 6, p. 258, pl. 11, f. 2, 3, 1831 ; Amer. Marine Conch., pl. 14, f. 2, 1831, (as *Mactra*); Holmes, Post-Pl. Fos. S. C., p. 53, pl. 8, f. 12 '60 ; Gould, Inv. Mass., Binney's ed., p. 79, f. 390, '70 ; Dall, Bull. 37, U. S. N. M., p. 62, pl. 56, f. 14, '89 ; Singley, 4th Ann. Rept. Texas, p. 329, 1892 ; Mitchell, List Tex. Sh. ; Dall, Tr. Wagner Inst. Sci., 3, p. 1000, 1900 ; Clark, Md. Geol. Surv., Pleistocene, p.

197, pl. 56, f. 1-5, 1906; Johnson Occ. Papers, Bost. Soc. N. H., 7, p. 74, 1915.

borealis Conrad, Am. Jour. Conch. 2, p. 76, 1866.

Lavignon petitiana and *antillarum* d'Orbigny, Moll. Cuba, 2, 1846.

Distribution.—Prince Edward's Island to Florida. Pleistocene to Recent. Gulf coast.—Ft. Barranca, Fla.; Shamrock Cove in Corpus Christi Bay, Texas. Pleistocene: Grand Chênier, La.

Note.—Conrad's *tellinoides* from the Miocene (Fos. Med. Tert. p. 28, pl. 15, f. 4, '38) is not identical with the recent shell, and is placed by Dall in synonymy with *C. medialis* Conrad.

Genus **ABRA** Leach

æqualis Say, Jour. Acad, Nat. Sci. Phila., 2, p. 307, 1822 (as *Amphidesma*); Conrad, Fos. Med. Tert., p. 76, pl. 43, f. 9, 1845; Tuomey and Holmes, Pleio. Fos, S. C., p. 93, pl. 23, f. 3, '56; Holmes, Post-Pl. Fos. S. C., p. 50, pl. 8, f. 7, '60; Conrad, Proc. A. N. S. Phila., p. 574, '63; Harris, Bull. Am. Pal. 1, No. 3, p. 92, '95; Dall, Proc. U. S. N. M., 6, p, 338, '83; Singley, 4th Ann. Rept. Tex. p. 329, '92; Dall, Bull. 37, U. S. N. M., p. 62, '89; Tr. W. I. S., 3, p. 998, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903; Johnson, Occ. Papers, 7, Bost. Soc., N. H., p. 75, 1915. Not of Whitfield, 1894 (=*Semele* sp., Dall).

nuculiformis Conrad, Am. Jour. Conch., 3, p. 14, 1867.

Distribution.—Hatteras to Gulf of Mexico, moderate depths. Miocene (N. and S. Car.) to Recent. Gulf coast.—Recent: Cedar Keys, Ft. Barranca, Indian Pass, St. Joseph's Bay, Crooked Island, Fla.; Horn Island, Miss.; Point au Fer, La.; Galveston, Tex. Pleistocene: Galveston artesian well, surface to 900 feet (Harris); New Orleans Gymnasium well at 1200 feet; New Orleans pumping station No. 7; Grand Chênier; Knapp's No. 2 well, Terrebonne Parish, at 1050-1190, 1519-1542 feet.

lioica Dall, Bull. Mus. Comp. Zool. Harv. Coll., 9, p. 133, 1881, (as *Syndosmya*); 12, p. 278, pl. 4, f. 8, '86 ; Bull. 37, U. S.N. M., p. 62, pl. 4, f. 8, '89 ; Tr. W. I. S, 3, p. 998, 1900 ; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 478, 1901.

Distribution.—Rhode Island to Martinique, 14-860 fms. Pleistocene to Recent. Gulf coast.—Ft. Barranca, Fla. ; Cameron, La. ; Galveston, Tex. Pleistocene : Grand Chênier, La.

longicallus Scacchi, Notiz., p,. 16, pl. 1, f. 7, 1836, (as *Tellina*); Philippi, En. Moll. Sic., 2, p. 8, pl. 13, f. 7, 1844, (as *Syndosmya*); Dall, B. M. C. Z., 9, p. 133, '81 ; 12, p. 278, '86 ; Bull. 37, U. S. N. M., p. 62, '89.

Distribution.—Arctic Ocean to Grenada Isl., W. I., 50-1467 fms. Also European. Pliocene to Recent. Gulf of Mexico, dredged, Lat. 23° N., Long. 83° W. at 860 fms. Temperature 42° F.

Genus **PSAMMOBIA** Lamarck

(Gobræus) vaginata Reeve, Dall, Bull. 37, U. S. N. M., p. 58, 1889 ; Proc. A. N. S. Phila., 50, p. 57, '98 ; Tr. W. I. S., 3, p. 976, 1900.

Distribution.—Charlotte Harbor, Florida. (Doubtful).

Note.—This genus has now nearly vanished from Antillean and Gulf waters where all species are extremely rare.

Genus **SANGUINOLARIA** Lamarck

sanguinolenta Gmelin, (as *Solen*); Fischer, Man. de Conch., p. 1105, 1887 ; Dall, Tr. W. I. S. 3, p. 972, 1900.

rosea Lamarck ; Dall, Bull. 37, U. S. N. M. p. 60, 1889 ; Singley, 4th Ann. Rept. Tex., p. 328, '92 ; Mitchell, List Tex. Sh., p. 13 ; Dall, Proc. A. N. S. Phila., 50, p. 58, 1898.

Distribution—Gulf of Mexico to Trinidad. Also Ceylon (Dall). Gulf coast.—West Florida ; Pass Cabello and Galveston, Tex.

(Psammotella) operculata Gmelin ; Dall, Proc. A. N. S. Phila., 50, pp. 58, 62, 1898.

Tellina rufescens Chemnitz.

Soletellina rufescens Dall, Bull. 37, U. S. N. M., p. 58, 1889.

Distribution.—Gulf of Mexico to Brazil. Gulf coast.—Tex.

(**Psammotella**) **vitrea** Deshayes ; Dall, Proc. A. N. S. Phila., 50, p. 58, 1898.

Distribution.—Texas to Colon.

Genus **HETERODONAX** Morch

bimaculata Linnæus, Syst. Nat., ed. X, p. 677, 1758, (as *Tellina*); Sowerby, Conch. Icon., 17, pl. 18, f. 94 *a-c*, 1866 ; Dall, Bull. 37, U. S. N. M., p. 58, '89 ; Proc. A. N. S. Phila., 50, p. 59, '98 ; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 475, 1901 ; Dall, Checklist West Coast Sh., p. 38, 1916.

Tellina vicina C. B. Adams.

Distribution.—Florida to Brazil. Also Monterey, California, to Panama. Recent. Gulf coast.—West Fla.

alexandra Dall, Proc. U. S. N. M., 46, p. 228, pl. 20, f. 8, 1914.

Distribution.—Pliocene, Satilla formation. Well near Alexandra, La., at 49 feet.

Genus **ASAPHIS** Modeer

coccinea Martyn, Univ. Conch., No. 135, pl. 135, 1784, (as *Cardium*); Ed. Chenu. pl. 41, f. 2 ; Morch, Jour. de Conch., 7, p. 140, 1858 ; Dall, Proc. A. N. S. Phila., 50, p, 59, 1898 ; Dall and Simpson, Bull. U. S. Fish Com., p. 476, 1901.

deflorata (Linn.) d'Orbigny, (as *Capsa*); Dall, Bull. 37, U. S. N. M., p. 60, 1889.

Distribution.—Charlotte Harbor, West Florida, to Brazil.

Genus **TAGELUS** Gray

gibbus Spengler, Skrift Nat. Selsk., 3, p. 304, 1794, (as *Solen*); Dall, Proc. U. S. N. M., 6, p. 337, 1883 ; Bull. 37, U. S. N. M., p. 58, pl. 55, f. 3, pl. 56, f. 3, '89 ; Singley, 4th Ann. Rept. Texas, p. 328, '92 ; Mitchell, List Tex. Sh., p. 3 ; Dall, Tr. W. I.S., 3, p. 983, 1900 ; Clark, Pleistocene of Maryland, p. 200, pl. 57, 1906.

guineensis, Chemn., 1795; *adansoni* Bosc., 1802; *declivis*, Turton, 1819; *notata* Schumacher, 1817.

caribæus Lamarck, 1818; Conrad, Am. Marine Conch., p. 22, pl. 4, f. 3, 1831; DeKay, Nat. Hist. New York, 5, p, 243, f. 302; Sowerby, Conch, Icon., *Solecurtus*, f. 21 *a-b*, '74; Holmes, Post-Pl. Fos. S. C., p. 54, pl. 8, f. 14, '60. Not of Conrad, Med. Tert., 1845.

centralis Sowerby, 1874, not of Say.

Distribution.—Cape Cod, Mass., to Brazil also northwest coast of Africa. Miocene of Va. to Recent. Gulf coast.—Recent: Ft. Barranca, St. Mark's, Fla.; Chandeleurs, La.; Port Lavaca, Fort Isabel, Galveston and Matagorda, Corpus Christi, Carancahua, Keller's and Espiritu Santo Bays, Texas. Pleistocene: New Orleans. Pliocene: Caloosahatchie beds, Fla.

(Mesopleura) divisus Spengler, Skrift. Nat. Selsk. 3, p. 96, 1794, (as *Solen*); Gould, Inv. Mass., Binney's ed., p. 44, f. 368, 1870; Dall, Bull. 37, U. S. U. S. N., p. 58, pl. 56, f. 5, '89; Tr. W. I. S., 3, p. 984, 1900; Mitchell, List Tex. Sh.; Vanatta, Proc. A. N. S. Phila., 55, 757, 1903; Vaughan, 2d Ann. Rept. Fla., p. 148, 1909.

bidens Chemnitz, 1795; *bidentatus* Spengler, 1794; *fragilis* Pulteney; *centralis* Say, 1822, not or Sowerby, 1874; *floridana* Conrad, 1848; *carpenteri* Dunker, 1861; *equalis* Conrad 1863.

Distribution.—Massachusetts to the Antilles. Pliocene to Recent. Gulf coast.—Indian Pass and Crooked Island, Calhoun Co., Fla.; Texas. Pleistocene: Osprey and Orient, West Fla.; New Orleans pumping station No. 7. Pliocene: Caloosahatchie marls.

Genus **PSAMMOSOLEN** Risso

(Azor) cumingianus Dunker, Proc, Zool. Soc., p. 425, 1861, (as *Macha*); Dall, Proc. U. S. N. M., 22, p. 108, 1989; Tr. W. I. S., 3, p. 961, 1900.

lineatus Gabb, Jour. A. N. S. Phila., 2d ser., 8, p. 370, pl. 47, f. 71, 1881, (as *Tagelus*).

multilineata Dall, Tr. W. I. S., 3, p. 938, pl. 28, f. 15, 1898, (as *Macha*).

Distribution.—North Carolina to Brazil. Gulf coast.—Recent: West Fla. and Texas. Pliocene : Caloosahatchie, Fla.

Genus **DONAX** Linnæus

denticulata Linnæus, Syst. Nat., ed. X, p. 683, 1758; Reeve, Conch. Icon., 8, pl. 7, f. 48*a*, *b*, 1854 ; Dall. Bull. 37, U. S. N. M., p. 58, 1889; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 476, 1901.

Distribution.—Texas, West Florida and the Antilles to Rio de Janeiro.

fossor Say, Jour. A. N. S., Phila., 2, p. 306, 1822 ; Tryon, Am. Mar. Conch., p. 153, pl. 27, f. 376, 377, 1873 ; Dall, Bull. 37, U. S. N. M., p. 58, '89 ; Tr. W. I. S., 3, p. 967, 1900.

variabilis Tuomey and Holmes, Pleio. Fos. S. C., p. 95, pl. 23, f. 6, 1857. Not of Say.

angustatus Sowerby, 1866 ; *protractus* Conrad 1849 ; *parvula* Philippi, 1845.

Distribution.—New Jersey to Florida Keys. Miocene (of N. Car.) to Recent. Gulf coast.—West Florida and Texas (Dall, '89). Pliocene: Caloosahatchie beds.

tumida Philippi, Zeitschr. Mal., p. 147, 1848 ; Rœmer's Texas, p. 453, 1849; Singley, 4th Ann. Rept. Tex., p. 328, 1892 ; Harris, Bull. Am. Pal., 1, No. 3, p. 92, '95 ; Dall, List of Cameron Sh., (MS.); Mitchell, List Tex. Sh. ; Dall, Nautilus 5, p. 126, 1892.

Distribution.—St. Augustine to Texas and Vera Cruz, Mexico. Pleistocene to Recent. Gulf coast.—Recent : Cameron, Chandeleurs, Southwest Pass, Point au Fer, La. ; Galveston (type locality), Corpus Christi, Tex. Pleistocene: Galveston well, surface to 458 feet (Harris); Teel No. 1 well, Saratoga, Texas, at 940 feet ; Grand Chênier, La. ; New Orleans Gymnasium well at 1200 feet.

texasiana Philippi, Zeitschr. für Malakozoologie, 4, p. 77, 1847 ; Rœmer's Texas, p. 452, 1849 ; Dall, Nautilus 5, p. 126, '92.

Distribution.—Galveston, Texas, to Vera Cruz, Mexico.

rœmeri Philippi, Rœmer's Texas, p. 452, 1849; Singley, 4th Ann. Rept. Texas, p. 328, 1892; Dall, Nautilus 5, p. 125, 1892; Mitchell, List Tex. Sh., p. 13; Dall, Tr. W. I. S., 3, p. 969, 1900.

Distribution.—Texas to Vera Cruz, Mexico. Gulf coast.—Galveston (type locality), Corpus Christi and Matagorda Island, Tex.

variabilis Say, Jour. A. N. S. Phila., 2, p. 305, 1822; Coues, Proc. A. N. S., Phila., p. 137, '71; Tryon, Am. Mar. Conch., p. 154, pl. 27, f. 378-379, '73; Hilgard, Rept. of Chief of Engineers to Sec. of War, p. 358, '70; House of Rep. Ex. Doc. 1, pt. 2, pp. 887, '78; Dall, Proc. U. S. N. M., 6, p. 338, '83; Bull. 37, U. S. N. M., p. 58, '89; Tr. W. I. S. 3, p. 969, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903. Not of Tuomey and Holmes, 1857, which is *fossor*.

Distribution.—Hatteras to St. Thomas, W. I. Pleistocene to Recent, Gulf coast—Recent: Ft. Barranca, Indian Pass, St. Joseph's Bay, Crooked Isl., etc., Fla.; Horn Island, Miss. Pleistocene: New Orleans artesian well of 1856 at 41 and 76 feet, and Lake Borgne borings (Hilgard).

Note.—Coues studied the habits of this mollusc at Fort Macon where it is very abundant.

(Machærodonax) galvestonensis Harris

carinata (Hanley) Harris, 4th Ann. Rept. Geol. Surv. Tex., p. 121, 1892, (pub. 1893).

carinata var. *galvestonensis* Harris, Bull. Am. Pal., vol. 1, No. 3, p. 92, 1895.

Distribution.—Miocene of the Galveston artesian well, ranging in depth from 2552 to 2920 feet (Harris).

Note.—*Donax obesa* has been cited by Dall (Bull. 37, U. S. N. M., p. 58, 1889) and by Vanatta (Proc. A. N. S. Phila., 55, p. 757, 1903), from the Gulf at Indian Pass, St. Joseph's Bay, Crooked Isl., Fla.; Horn Island, Miss., and

Texas. But the true *Donax obesa* d'Orbigny (Voy. l'Amér. Mérid., p. 541, pl. 81, f. 28-30, 1846) is a west coast species, living from Panama to Paita, Peru. It is not identical with the Californian *Donax obesa* of Gould, 1851, which is *lævigata* Deshayes, 1854.

(Iphigenia) brasiliana Lamarck, An. s. Vert., 5, p. 553, 1818, (as *Capsa*); Ency. Méth., pl. 261, f. 10; Dall, Bull. 37, U. S. N. M., p. 58, 1889; Nautilus, 5, p. 126, 1892; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 476, 1901.

Distribution.—Florida to Rio de Janeiro and the Antilles. Gulf coast.—West Florida and Texas.

Genus **SOLEN** Linnæus

viridis Say, Jour. A. N. S. Phila., 2, p. 316, 1821, Conrad, Am. Mar. Conch., 2, p. 28, pl. 5, f 2, 1831; Dall, Bull. 37, U. U. S. N. M., p. 72, 1889; Tr. W. I. S., 3, p. 952, 1900.

Distribution.—Rhode Island to Georgia. Cited by Dall, 1889, from Sarasota, West Florida.

Genus **ENSIS** Schumacher

directus Conrad, Proc. Acad. Nat. Sci. Phila., 1, p. 325, 1843, (as *Solen*); Dall, Proc. U. S. N. M., 22, p. 107, 1899; Tr. W. I. S,, 3, p. 954, 1900; Vanatta, Proc. A. N. S. Phila., 55, p. 757, '03: Clark, Md. Geol. Surv., p. 196, pl. 55, f. 9, 10, 1906.

magnodentatus H. C. Lea, Tr. Am. Phil. Soc., 2d Ser., 9, p. 236, pl. 34, f. 8, 1845. (as *Solen*).

ensis Conrad, Bull. Nat. Inst. 2, p. 191, 1842; Tuomey and Holmes, Pleio. Fos. S. C.,p. 101, pl. 24, f. 3, 1857; Holmes, Post-Pl. Fos. S. C., p. 53, pl. 8, f. 13, 1860. Not of Linnæus, Syst. Nat. 1114.

americana Gould, Inv. Mass., p. 42, f. 366, '70; Verrill, Inv. An. Vineyard Sound, p. 674, pl. 32, f. 245, 1873; Dall, Proc. U. S. N. M., 6, p. 337, '83; Mitchell, List Tex. Sh., p. 3; Dall, Bull. 37, U. S. N. M., p. 72, pl. 53, f. 4, pl. 55, f. 4, 5, 1889.

Note.—The American species is larger and broader than the

European *Ensis ensis* of Linnæus, with which it was at first confused. Mitchell, who has studied the habits of this shell on the Texan coast, finds that it lives in a cell about four inches deep.

Distribution.—Labrador to Florida Keys, 0-25 fms. Miocene (Oak Grove, Fla.) to Recent. Gulf coast.—Cedar Keys, Crooked Isl., Fla. ; Cameron, Chandeleurs, La. ; Corpus Christi, Matagorda Bay, Laguna Madre, Texas.

minor Dall, Proc. U. S. N. M., 22, p. 108, 1899 ; Tr. W. I. S., 3, p. 955, 1900.

Solen ensis, "small variety", Conrad, 1831.

Distribution.—Cape May, New Jersey, to Texas. Pleistocene to Recent. Gulf coast.—Cedar Keys, St. Mark's, Fla. ; Matagorda and Corpus Christi bays, Tex.

Genus **MACTRA** Linnæus

(Mactrotoma) fragilis Gmelin, Syst. Nat., p. 3261, No. 22, 1792 ; Reeve, Conch. Icon., 8, pl. 11, f. 47, 1854 ; Dall, Proc. U. S. N. M., 6, p. 338, 1883 ; Nautilus, 8, p. 26, 1894 ; Proc. Malacological Soc., 1, p. 211, 1895 ; Tr. W. I. S. 3, p. 894, pl. 27, f. 1, 4, 8, 18, 1898. Not *Spisula fragilis* Gray, 1838.

dealbata Pulteney, 1803.

braziliana Lamarck, An. s. Vert., 5, p. 478, 1818 ; Dall, Bull. 37, U. S. N. M., p. 62, 1889 ; Singley, 4th Ann. Rept. Tex., 1892 ; Mitchell, List Tex. Sh., p. 16.

ovalina Lamarck, of authors.

oblonga Say, Jour. A. N. S. Phila., 2, p. 310, 1822 ; *oblongata* Ravenel, 1834 ; *bilineata* (C. B. Adams) Reeve, 1854 ; *silicula* Reeve, 1854, not of Deshayes.

anserina Guppy, Ann. Mag. Nat. Hist. 15, p. 50, pl. 7, f. 1, 1875.

Distribution.—Hatteras to Rio de Janeiro, also cited from west coast of Africa. Pliocene to Recent. Gulf coast.—Recent : Cedar Keys, Fla. ; Corpus Christi, Carancahua, Matagorda, and Espiritu Santo Bays, Texas. Pleistocene :

New Orleans Gymnasium Club well at 1200 feet, Pliocene: Caloosahatchie beds, Fla. Type of subgenus *Mactrotoma* Dall.

Genus **SPISULA** Gray

(Hemimactra) similis Say, Jour. Acad. Nat. Sci Phila., 2, p. 309, 1822; DeKay, Zool. New York, *Mollusca*, p. 230; Holmes, Post-Pl. Fos. S. C., p. 39, pl. 7, f. 8, 1860; Gould, Inv. Mass., Binney's ed., p. 75, '70; Dall, Bull. 37, U. S. N. M., p. 62, '89; Nautilus, 8, p. 26, 1894; Mitchell, List Texas Shells, p. 10; Singley, 4th Ann. Rept. Texas, p. 329, '92; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903; Vaughan, 2d Ann. Rept. Fla., p. 148, 1909; Johnson, Occ. Papers, Bost. Soc. N. H., 7, p. 76, 1915. Not *Mactra similis* Gray, 1828.

Distribution.—Cape Cod to Antilles. Pliocene to Recent. Gulf coast.—Cedar Keys, Ft. Barranca, Indian Pass, St. Joseph's Bay, Crooked Island, Alligator Harbor (Franklin County), Fla.; Horn Island, Miss.; Cameron, La.; Galveston, Corpus Christi and Matagorda Bays, Tex. Pleistocene: New Orleans pumping station No. 7, Grand Chênier, La.; Orient, West Fla.

similis variety **raveneli** Conrad, 1831; Coues, Proc. A. N. S. Phila., p. 137, 1871; Dall, Nautilus 8, p. 26, 1894; Newcomb, MS. in coll., Dall, Tr. W. I. S., 3, p. 901, 1898.

Distribution.—Very abundant at Fort Macon, Ga. Gulf coast Ft. Barranca, Fla.; Galveston, Tex. Pleistocene: Grand Chênier, La.

Note.—Indeterminable fragments of several species of *Mactra* and *Spisula* were found in the Pleistocene of the Zigler well No. 15, Jennings, La., at 1650-1700 feet; Knapp's No. 2 well, Terrebonne Parish at 1731-1739 feet, and in the Miocene of the Jennings Heywood Oil Syndicate's No. 28 well at 1887-1880 feet.

quadricentennialis Harris, MS., Fifth Ann. Rept. Tex. Surv. (Unpublished); Dall, Proc. U. S. N. M., 17, p, 105, 1894 (as *Spisula*); Harris, Bull. Am. Pal., vol. 1, No. 3, p. 11, pl. 2, f. 2, *a-c*, 1895 (as *Rangia*); Dall, Tr. W. I. S. 3, p. 905, 1898.

Gnathodon, n. sp. Harris, 4th Ann. Rept. Texas for 1892, p. 121, pub, 1893.

Note.—This curious shell appears to be a *Spisula* as the cartilage pit is not closed above. This is the second time only that the species has been found. It is interesting to trace it from Texas into Louisiana.

Distribution.—Upper Miocene: Galveston well at 2100-2249 feet (Harris); Jennings, La.—Dusen and Lyons Oil Company well No. 1 at 1860-1910 feet (?); Crowley No. 25 at 2585-2600 feet.

Genus **MULINIA** Gray

lateralis Say, Jour. A. N. S. Phila., 2, p. 309, 1822 (as *Mactra*); Conrad, Proc. A. . S. Phila., p. 573, '63; Holmes, Post-Pl. Fos. S. C., p. 40, pl. 7, f. 9, '60; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. N. M., p. 62, pl. 69, f. 8, '89; Harris, Bull. Am. Pal. 1, No. 3, p. 93, 1895; Dall, Nautilus 8, p. 27, '94; Tr. W. I. S., 3, p. 901, '98; Vanatta, Proc. A. N. S., 55, p. 757, 1903; Clark, Md. Geol. Surv., p. 194, pl. 55, f. 1-4, 1906; Vaughan, 2d Ann. Rept. Fla., p. 148, 1909; Dall, U. S. G. S., Water Supply Pa., 335, p. 77, 1914; Dall, U. S. G. S. Prof. Pa. 98-L., p. 177, 1916.

subtruncata Greene, 1833, not of Da Costa, 1788.

Distribution.—Maine to the Antilles. Miocene (of Duplin Co., N. C., and Pascagoula clays, Miss.) to Recent. Gulf coast.—Recent: Indian Pass, St. Joseph's Bay and Crooked Island (all in Calhoun Co.), Fla.; Horn Island, Miss.; Point au Fer, Cameron, La. Pleistocene: New Orleans Gymnasium well at 1200 feet, New Orleans pumping station No. 7; Knapp's wells, Terrebonne Parish, La,, No. 2 at 1050 to 1842, No. 3, 700 to 2029 feet: Bayou City well, Beaumont, Texas, at 600 feet; Osprey, Orient and Labelle, West Fla.; Fort Morgan, Ala., well at 32-87, 100-112, 217-321 and 1290-1330 feet. Pleistocene to

Miocene : Galveston well, 300-2920 feet (Harris). Miocene : Jennings-Heywood Oil Syndicate's well No. 27 at 1970-1980 feet ; Gilbert well, No., 10, Bateson, Hardin Co., Tex., at 323 feet.

lateralis variety **corbuloides** Deshayes, Proc. Zool. Soc., p. 63, 1854 ; Reeve, Conch. Icon., *Mactra,* f. 103, 1854 ; Dall, Nautilus, 8, p. 27, 1894.

rostrata Philippi, Abbild u. Beschr. 3, p. 138, pl. 3, f. 6, 1845. Not of Spengler, 1802.

Distribution.—With the typical form but generally in its southern range. Gulf coast.—Cameron, Point au Fer, La. ; Galveston, Corpus Christi, Sabine Pass, etc., Texas. Pleistocene : New Orleans pumping station No. 7 ; Grand Chênier, La. ; Osprey, West Fla.

sapotilla Dall, Tr· W. I. S., 3, p. 902, pl. 28, f. 7-9, 14, 1898 ; Proc. U. S. N. M., 46, p. 228, 1914.

Distribution.—Pliocene : Alexandria, La., well at 49 feet ; Producer's Oil Co.'s well, Pine Prairie, La. at 1540 feet. Very characteristic Caloosahatchie River marl, Fla. and also in the brackish water Pliocene of the SatillaRiver,Ga.

quadricentennialis Harris, Bull. Am. Pal., vol. 1, No. 3, p. 11, pl. 2, f. 3, *a*, *b*, 1895, (as *Mactra*).

Mactra, n. sp. Harris, 4th Ann. Rept. Texas Geol. Surv., p. 121, 1893.

Note.—This species resembles *sapotilla* Dall, but is in earlier horizons.

Distribution.—Upper Miocene, in deep wells of Texas and Louisiana. Type locality.—Galveston well at 2236-2871 feet (Harris); Jennings, La., wells : Teche No. 1 at 1158-1190 ; Producers, Latreille tract, No. 3, at 1975, No. 4 at 1720-1750, 1800-1860, No. 8 at 1990-2012 ; Zigler No. 15 at 1700-1745, 1745-1770 ; Crowley No. 19 at 1880-1885, 1940-1955, No. 24 at 1923-1935, No. 25 at 1830-1860, No. 36 at 1680-1700, 1800-1880 ; Jennings Heywood Oil Syndicate well No. 29 at 1941-1961 feet.

Genus **RANGIA** Desmoulins

cuneata Gray, In Sowerby, Gen. Shells, No. 36, f. 1-7, 1831, (as *Gnathodon*); Holmes, Post-Pl. Fos. S. C., p. 41, pl. 7, f. 10, '60; Hilgard, House Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. N. M., p. 62, '89; Singley, 4th Ann. Rept. Tex., p. 329, '92; Dall, Proc. U. S. N. M., 17, p. 97, '94; Nautilus, 8, p. 27, '94; Tr. W. I. S., 3, p. 904, '98.

cyrenoides Desmoulins, Actes Soc. Lin. de Bordeaux, 5, p. 57, f. 1-3, 1832; Conrad, Proc. Acad. Nat. Sci. Phila., 1., p. 232, '61.

grayi Tuomey and Holmes, Pleio. Fos. S. C., p. 99, pl. 23, f. 11, 1857. Not of Conrad.

minor Holmes, Post-Pl. Fos. S. C., p. 41, 1860. Not of Conrad 1840=*R. clathrodon* Con.

Note.—Often referred to *Gnathodon* Gray, 1831, preoccupied by Goldfuss, 1820 (fish genus). This species is the genotype. *Rangia* is peculiar to North America. In Louisiana *R. cuneata* extends up streams into freshwater for several miles. Extremely abundant in Pleistocene time as shown by shell banks underlying Mobile and Charleston. In Pleistocene range extended north to Cornfield Harbor, Md., at the mouth of Potomac River. Extremely common iu the Gulf State wells, extending to a depth of 2106 feet, (Teche No. 1), and not infrequently associated with *R. johnsoni*.

Distribution.—West Florida to Vera Cruz. Pascagoula Miocene to Recent. Gulf coast.—St Mark's, Ft. Barranca, Fla.; Mobile Bay, Ala.; Belle Isle, Point au Fer, Cameron, Lake Charles, La.; Matagorda Bay, Nueces River, etc., Texas. Pleistocene: Grand Chênier, New Orleans pumping station No. 7; Knapp's wells, Terrebonne Parish, No. 1 at 2000-2150, No. 2, from 1050 to 1842, No. 3, surface to 1800 feet; Bayou City well, Beaumont, Texas, 600 feet. Pliocene: Caloosahatchie, Fla. Pleistocene and Upper Miocene: Jennings wells, Franklin No. 1, 784 to 1621 feet; Teche No. 1, 876 to 2106; Dusen and Lyons, 1530 to 1860; Shippers, No. 4, 1240 to 1493; Jennings-Heywood, No. 27, 1980, No. 28, 800 to 1892, No. 29, 200 to 1940, No. 30, 1169 to 1840 feet.

cuneata variety **nasuta** Dall, Proc. U. S. N. M., 17, p. 98, pl. 7, f. 8, 1894.

Distribution.—Port Lavaca, Texas (type locality); Point au Fer, La. Recent, in salt water.

cuneata variety **solida** Dall, Proc. U. S. N. M., 46, p. 228, pl. 20, f. 7, 1913.

Distribution.—Pliocene: Alexandria, La., well at 49 feet. Also Satilla River brackish water Pliocene beds, Atkinson, Ga.

cuneata variety **galvestonensis** Harris, Bull. Am. Pal. 1, No. 3, p. 93, pl. 2, f. 1, *a*, *b*, 1895.

Distribution.—Galveston deep well at 1510-2920 feet (Harris', locality); Prairie Mamou, La., well, with *R. johnsoni*, at approximately 2200 feet, Pascagoula Miocene horizon.

johnsoni Dall, Science, 20, p, 165, 1892, (as *Gnathodon*). *Nomen nudum.* Tr. W. I. S., 3, p. 337, pl. 22, f. 18, 1892; Proc. U. S. N. M., 17, p. 100, pl. 7, f. 7, 1894; Tr. W. I. S, 3, p. 905, 1898.

mobiliana Johnson, Science, 20, p. 151, 1892. *Nomen nudum.*

Distribution.—Upper Miocene or maybe Early Pliocene. In surface exposures, Greene Co., near Vernal, Miss. (Johnson's type locality, 1889); 3½ miles north of Merrill, Miss.; Shell Bluff, Pascagoula River, Miss., Tensaw River, (?) Baldwin Co., Ala. Deep wells, Ala., Miss. and La. Very common in Jennings wells. The highest level at which *R. johnsoni* occurs in the Jennings field is at 1040-1120 feet, (Jennings-Heywood Oil Syndicate well No. 29), and the lowest at 2564-2664 feet (bottom of Franklin No. 1). Upper Miocene of deep wells: Mobile Brewery well at 750-770 feet; Mobile, Bascom No. 2, at 1241 feet; Mobile artesian well, 735 feet; Biloxi, Miss. artesian well, 700 feet; Jennings, La., wells, Benckenstein No. 3 at 1990 to 2045; Jennings-Heywood No. 24, 1700; No. 27, 1970-1980, No. 29, 1040-1961; Crowley No. 25, 1900 to 2650; Teche No. 1, 1322 to 2074; Franklin No. 1, 2183 to 2664 feet. Also in the Crowley well near Evangeline, La., at 2000 feet, where it was found with *galvestonensis*.

(Rangianella) flexuosa Conrad, Am. Jour. Sci. 38, p. 92, 1839; Pr. A. N. S. Phila., 7, p. 31, 1855, *Idem*, p. 232, for 1860; Dall, Mon. Genus *Gnathodon*; Proc. U. S. N. M., vol. 17, p. 102, pl. 7, f. 3, 6, 1894; Mitchell, List Texas Shells.

rostrata Petit, Jour. de Conch. 4, pp. 84, 164, pl. 5, f. 1-3, 1853, (as *Gnathodon*); Prime, Proc. Boston Soc. Nat. Hist. 7, p. 348, 1861; Conrad, Am. Jour. Conch. 3, suppl. p. 30, 1868; Dall, Bull. 37, U. S. N. M., p. 62, 1889; Singley, 4th Ann. Rept. Texas, p. 329, 1892.

Distribution.—Florida to Vera Cruz, salt water. Pleistocene to Recent. Rare. Gulf coast.—Recent: Point au Fer, La; Galveston, Texas. Pleistocene: New Orleans pumping station No. 7.

Genus **LABIOSA** (Schmidt) Moller

lineata Say, Jour. A. N. S. Phila., 2, p. 310, 1822, (as *Lutraria*); Dall Bull U. S. N. M. p. 64, '89; Nautilus 8, p. 27, '94; Tr. W. I. S. 3, p. 906, 1898.

nuttallii Reeve, Conch. Icon., *Mactra*, f. 125, 1854. Not of Conrad.

recurva Gray, Wood's Ind. Test. Suppl,, f. 2, 1828.

papyracea Conrad, Am. Conch., pl. 10; Adams, Genera Moll., 2, p. 386. Not of Lamarck.

Distribution.—New Jersey to Sao Paulo, Brazil. Gulf coast. West Fla., Cameron, La., and Texas.

(Raeta) canaliculata Say, Jour. A. N. S., Phila., 2, p. 310, 1822, (as *Lutraria*); Reeve, Conch. Icon., *Mactra*, f. 122, 1854; Holmes, Post-Pl. Fos. S. C., p. 43, pl. 7, f. 13, 1860; Dall, Bull. 37, U. S. U. S., p. 64, '89; Singley, 4th Ann. Rep., Texas, p. 330, '92; Dall, Nautilus, 8, p., 28, '94; Harris, Bull. Am. Pal. 1, No. 3, p. 94, '95; Mitchell, List Tex. Sh. ; Dall, Tr. W. I. S., p. 907, '98 ; Vanatta, Proc. A. N. S. Phila., 55, 757, 1903.

campechiensis Gray, Wood's Ind. Test. Suppl., f. 3, 1828.

Distribution.—New Jersey to Southern Brazil. Type of subgenus *Raëta* Gray. Pleistocene to Recent. Gulf coast. Recent : Alligator Harbor (Franklin County), Indian Pass (Calhoun County), Fla. ; Horn Island, Miss. ; Point au Fer, Cameron, La. ; Galveston, Matagorda Bay, Corpus Christi, Tex. Pleistocene : Osprey, Fla. ; New Orleans pumping station No. 7, Knapp's wells, Terrebonne Parish, No. 2 at 1542-1632, No. 3 at 1330-1375 feet. Pleistocene to Upper Miocene : Galveston deep well, from 46 to 2871 feet (Harris).

Genus **ERVILIA** Turton

concentrica Gould, Otia Conch., p. 329 ; Proc. Bost. S. N. H., 8, p. 280, 1862, Dall, Bull. 37, U. S. N. M., p, 62, '89 ; Dall and Simpson, Bull. U. S. Fish Com., 1, p. 474, pl. 58, f. 2, 1901 ; Vanatta, Proc. A. N. Phila., 55, p. 757, 1903.

Distribution.—Hatteras to Florida, 124 fms. Gulf coast.—Recent : St. Joseph's Bay and Crooked Isl., West Fla.

planata Dall, Tr. W. I. S., 3, p. 915, 1898.

Distribution.—Miocene of Oak Grove, West Fla., and of the Bascom No. 1 well, Mobile, Ala., 1500-1556 feet (Aldrich).

Genus **CORBULA** Bruguière

(Aloidis) disparilis d'Orbigny, In Sagra's Hist. Pol. y Nat. Isla de Cuba, 2, p. 283, pl. 27, f. 1-4, 1845 ; Dall, Bull 37, U. S. N. M., p. 70, pl. 1, f. 4 *a-b*, 1889 ; Tr. W. I. S., 3, p. 853, 1898.

philippi Smith, 1885 ; *operculata* Philippi, 1849.

Distribution.—Hatteras to Barbados, 5-805 fms. Pliocene to Recent. Gulf coast.—Off West Florida in 30 and 50 fms. Pleistocene : Teel No. 1 well, Saratoga, Tex. at 940 feet ; Knapp's No. 3 well, Terrebonne Parish, La., 1330-1375 feet.

(Aloidis) galvestonensis Harris, Bull. Am. Pal., 1, No. 3. p. 94, pl. 2, f. 4, 4 *a*, 1895; Dall, Tr. W. I. S., 3, p. 852, 1898; In Deussen, U. S. G. S., Water Supply Paper, 335, p. 77, 1914.

Distribution.—Upper Miocene, Galveston well, 2443-2650 feet (Harris); Gilbert well No. 10, Bateson, Hardin Co., Texas, at 323 feet (Dall).

(Aloidis) heterogenea Guppy, MS. in coll., Dall, Tr. W.I. S., 3, p. 850, pl. 36, f, 15, 1898.

Distribution.—Miocene of Gatun and of the Chipola and Oak Grove beds, Fla., and of the Bascom No. 2 well, Mobile, Ala., at 1241 feet. Pliocene of the Caloosahatchie, Fla.

(Cuneocorbula) contracta Say, Jour. Acad. N. S. Phila., 2, p. 312, 1822; DeKay, Nat. Hist. N. Y., 5, p. 241, pl. 28, f. 285, '43; Reeve, Conch. Icon., *Corbula*, pl. 4, f. 27, '44; Holmes, Post-Pl. Fos. S. C., p. 56, pl. 8, f. 17, '60; Gould, Inv. Mass., Binney's ed., p. 90, f. 377, '70; Dall, Bull. 37, U. S. N. M., p. 70, pl. 1, f. 6 *a*, *b*, pl. 59, f. 10, '89; Tr. W. I. S., 3, p. 855, '98; Clark, Md. Geol. Surv., p. 193, pl. 53, f. 1-4, 1906; Johnson, Occ. Pa., Bost. S. N. H., 7, p. 78, 1915.

cuneata Tuomey and Holmes, Pleio. Fos. S. C., p. 75, pl. 20, f. 11, 1857; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, pp. 887, 889, '78. Not *cuneata* Say, Jour. A. N. S. Phila., 4, p. 152, pl. 13, f. 3, 1824, which is a Miocene to Pleistocene species, not Recent.

Distribution.—Cape Cod, Mass., to Jamaica, 3-60 fms. Pliocene to Recent. Gulf coast.—West Fla. and Galveston. Pleistocene: New Orleans pumping station No. 7; Lake Borgne borings; Knapp's wells, Terrebonne Parish, La., No. 1 at 1600 to 2443, No. 2 at 1190 to 1842, No. 3 at 570 to 1739 feet; Teel No. 1 well, Saratoga, Texas, at 940 feet.

(Cuneocorbula) barrattiana C. B. Adams, Contr. Conch., 12, p. 237, 1852; Dall, B. M. C. Zool., 12, 313, pl. 2, f. 7 *a-c*, 1886; Bull. 37, U. S. N. M., p. 70, pl, 2, f. 7 *a-c*, 1889; Tr. W. I. S., 3, p. 856, 1898.

Distribution.—Hatteras to Jamaica, 2-287 fms. Pliocene to Recent. Gulf coast.—Recent : West Florida, 30 fms. Pliocene : Caloosahatchie marl.

(**Cuneocorbula**) **engonata** variety **burnsi** Dall, Tr. W. I. S., 3, p. 847, 1898.

Distribution.—Upper Oligocene of Tampa, Fla, and Lower Miocene of the Chipola marl, Fla., and of the Bascom well No. 2, Mobile, Ala., at 1241 feet, Chipola horizon (Aldrich).

(**Cuneocorbula**) **swiftiana**,, C. B. Adams, Contr. Conch., 12, p. 236, 1852 ; Dall, B. M. Ç. Z., 9, p. 114, '81 ; 12, p. 314, pl. 2, f. 5 *a-c*, '86 ; Dall, Bull. 37, U. S. N. M., p. 70, pl. 2, f. 5 *a-c*, '89 ; Tr. W. I. S., 3, p. 855, 1898.

Distribution.—Hatteras to Venezuela. Recent. Typical form not on Gulf coast.

swiftiana variety **harrisi** Dall, Tr. W. I. S., 3, p. 855, 1898.

Corbula, sp. indet., Harris, 4th Ann. Rept. Texas for 1892, p. 121, pub. 1893.

swiftiana ? Harris, Bull. Am. Pal. 1, No. 3, p. 94, pl. 2, f. 6, 1895.

Distribution.—Pleistocene to Upper Miocene, Galveston well, 300 (?) to 2920 feet (Harris).

(**Cnneocorbula**) **dietziana** C. B. Adams, Contr. Conch., p. 235, 1852 ; Dall, Bull. M. C. Z., 9, p. 114, '81 ; 12. p. 314, pl. 1, f. 5, *a-b*, 1886 ; Bull. 37, U. S. U. S. , p. 70, pl. 1, f. 5, *a-b*, 1889.

Distribution.—Hatteras to Barbados, 14-100 fms. Gulf coast. Dredged off West Florida, 30 fms.

(**Cuneocorbula**) **whitfieldi** Dall, Tr. W. I. S., 3, p. 849, pl. 36, f. 18, 1898.

Distribution.—Miocene of Oak Grove sands, West Fla., and (a varietal form) Bascom No. 1 well, Mobile, Ala., at 1500-1556 feet, Oak Grove horizon (Aldrich).

(**Cuneocorbula**) **conradi** Dall, Tr. W. I. S. 3, p. 842, 1898.

nasuta Conrad, Mexican Boundary Rept. I, p. 161, pl 19, f. 4, 1857 : Singley, 4th Ann. Rept. Texas, p. 330, 1892 Dall, Bull. 37, U. S. N. M., p. 70, pl. 2, f. 6 *a, b, c, d*

1889. Not *nasuta* Conrad, Fos. Med. Tert. Form., p. 38, 1883=*alabamiensis* Lea, Eocene. Not *nasuta* Sowerby, Proc. Z. S., p. 35, 1883, which is a Recent, West Coast Central American species.

Distribution.—Hatteras to Haiti, 4-63 fms. Gulf coast. West Fla. and Tex.

(Erodona) priscopsis Harris, Bull. Am. Pal., vol. 1, No. 3, p. 94, pl. 2, f. 5, 5 *a*, 1895 ; Dall, Tr. W. I. S. 3, p. 853, '98.

Note.—The only member of the section *Erodona* Daudin (*Potamomya* Sowerby, 1835 ; *Azara* d' Orbigny, 1839), ever found in the North American marine coastal Tertiary. Type *Mya labiata* from South American estuaries. Upper Miocene, Galveston well at 2443-2448 feet (Harris).

(Bothrocorbula) radiatula Dall, Tr. W. I. S., 3, p. 851, pl. 36, f. 1-3, 1898.

Distribution.—Miocene of Oak Grove, Fla., and of the Bascom well, Mobile, Ala., at 1241 feet.

Genus **PARAMYA** Conrad

subovata Conrad, Fos. Med Tert., p. 65, pl. 36, f. 4, 1845, (as *Myalina*); Proc. A. N. S., Phila., for 1860, p. 232 ; Dall, Bull. 37, U. S. N. M., p. 70, 1889 ; Tr. W. I. S., 3, p. 861, 1898.

Distribution.—North Carolina to Florida, 12-30 fms. Miocene (of Va. and N. C.) to Recent. Gulf coast.—West Fla.

Genus **SAXICAVA** Fleuriau

artica Linnæus, Syst. Nat., ed, XII, p. 113, 1767, (as *Mya*); Dall, Bull. 37, U. S. N. M., p. 70, pl. 59, f. 13, 1889 ; Tr. W. I. S., 3, p. 834, 1898 ; Johnson, Occ. Pa., B. S. N. H., 7, p. 78, 1915.

rugosa Lamarck, 1818, Gould, 1870. For other synonyms see Dall, 1898.

Distribution.—Arctic Sea to Barbados, 0-100 fms. Miocene (of Md., N. C. and N. J.) to Recent. Gulf coast.—Recent : West Fla. Pliocene : Caloosahatchie beds.

azaria Dall, Bull. M. C. Zool., 9, p. 116, 1881 ; 12, p. 317, pl. 4,

f. 9 *a-b*, 1886; Bull. 37, U. S. N. M., pl. 4, f. 9 *a-b*, '89.

Distribution.—Gulf of Mexico.—Off Charlotte Harbor, Fla., 13 fms.; 16 miles N. of Jolbos Isls., 14 fms.

Genus **PANOPE** Menard

bitruncata Conrad, Proc. A. N. S. Phila., for 1872, p. 216, pl. 7, f. 1; Dall, Tr. W. I. S. 3, p. 832, 1898; Vanatta, Proc. A. N. S. Phila., 55, p. 757, 1903.

Distribution.—North Carolina to Florida. Gulf coast at Tampa and Crooked Isl., West Fla.

floridana Heilprin, Tr. W. I. S., 1, p. 91, pl. 10, f. 21, 1887; Dall, Tr. W. I. S., 3, p. 831, 1898.

menardi Heilprin, Tr. W. I. S., 1, p. 90, pl. 9, f. 19, 1887. Not of Deshayes.

navicula Heilprin, *Idem*, p. 91, pl. 10, f. 22, 1887.

reflexa, Dall, Bull. 37, U. S. N. Mus., p. 70, 1889, (as *Glycymeris*); Not *reflexa* Say, 1824, which is Miocene only.

Distribution.—North Carolina and Gulf coast at Mobile Point, Ala. Pliocene of the Caloosahatchie beds, West Fla.

Genus **GASTROCHAENA** Spengler

ovata Sowerby, Proc. Zool. Soc., p. 21, 1834; Hanley, Descr. Cat. Rec. Sh., p. 10, pl. 9, f. 42, 1842; Dall, Bull. 37, U. S. N. M., p. 72, 1889; Tr. W. I. S., 3, p. 824, 1898.

Distribution.—Charleston, N. C. to the West Indies, 0-27 fms. Gulf coast.—West Fla.

cuneiformis Spengler, Nova Acta Soc. Hafn., 2, p. 179, f. 8-11, 1788; Lamarck, An. s. Vert., 5, p. 447, 1818; Dall, Bull. 37, U. S. N. M., p. 72, '89; Tr. W. I. S., 3, p. 825, 1898.

hians Gmelin, 1792, (as *Pholas*); H. and A. Adams, 1856, (as *Rocellaria*); Tryon, 1862.

rupestris Bosc, Hist. Nat. Coq., 2, p. 205, 1802.

Distribution.—Cape Fear, N. C., to Guadeloupe, 0-25 fms. Gulf coast.—West Fla.

(**Spengleria**) **rostrata** (Spengler) Dall, Bull 37, U. S. N. M., p. 72, '89; Tr. W. I. S., 3, p. 824, '98.

Distribution.—West Florida to St. Thomas, W. I. Type of subgenus *Spengleria*, Tryon.

Genus **PHOLAS** Linnæus

(Thovana) campechiensis Gmelin, Syst. Nat., 6, p. 3216, 1792; Hanley, Descr. Cat. Rec. Sh., p. 6, pl. 9, f. 44, 1842; Tryon, Proc. A. N. S. Phila., p. 76, 1862; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. N. M., 72, 1889; Tr. W. I. S., 3, p. 815, '98.

oblongata Say, Jour. Acad. Nat. Sci. Phila., 2, p. 320, 1822; Holmes, Post-Pl. Fos. S. C., p. 58, pl. 9. f. 2, '60. Not of Tuomey and Holmes, Pleio. Fos. S. C., p. 103, pl. 24, f. 5, 1857 which, is *producta* Conrad.

candeana d'Orbigny, Moll. Cuba, p. 215, pl. 25, f. 18-19, 1845.

Distribution.—Hatteras to Brazil. Pleistocene to Recent. Gulf coast.—West Fla. and Texas.

Genus **BARNEA** (Leach) Risso

costata Linnæus, Syst. Nat., ed. X, p. 669, 1758; Lamarck, An. s. Vert., 5, p. 445, 1818; Holmes, Post-Pl. Fos. S. C., p. 58, pl. 9, f. 1, 1 *a*, '60; Gould, Inv. Mass., Binney's ed., p. 36, f. 363, '70; Hilgard, House of Rep. Ex. Doc. 1, pt. 2, p. 887, '78; Dall, Bull. 37, U. S. N. M., p. 72, pl. 68, f. 9, 1889; Singley, 4th Ann. Rept. Tex., p. 331, '92; Dall, Tr. W. I. S., p. 816, '98; Clark, Maryland Geol. Surv., p. 192, pl. 52, 1906.

virginianus Lister, Hist. Conch., ed. II, pl. 5, f. 434, 1770.

Distribution.—Massachusetts to Brazil. Pliocene to Recent. Gulf coast.—Recent: Indian Pass (Calhoun Co.), Fla.; Point au Fer, Cameron, Chandeleurs, La.; Galveston, Corpus Christi, Matagorda Bay, Tex. Pleistocene: Grand Chênier, New Orleans artesian well of 1856, at 41, 66, 235, 546 feet; New Orleans pumping station No. 7, Lake Borgne borings; Knapp's wells, Terrebonne Parish, No. 2 at 1434-1519, 1519-1542, No. 3 at 570-700, 1200-1300, 1330-1375 feet.

Note.—This is the larger and more fragile descendant of the Miocene species *arcuata* Conrad. Popularly named the angel's wing. Mitchell has studied its habits on the Texan coast.

truncata Say, Jour. Acad. Nat. Sci, Phila., 2, p. 321, 1822 ; Sowerby, Thes. Conch., 1, p. 488, pl. 104, f. 29, 30, '49 ; DeKay, Zool, N. Y., Moll., p. 248, pl. 34, f. 323 *a-b*, '43 ; Holmes, Post-Pl. Fos. S. C., p. 57, pl. 9, f. 4, '60 ; Gould, Inv. Mass., Binney's ed., p. 38, f. 364, 1870 ; Dall, Bull. 37, U. S. N. M., p. 72, pl. 59, f. 12, 1889 ; Singley, 4th Ann. Rept. Tex., p. 331, '92 ; Mitchell, List Texas Shells, p. 2 ; Dall, Tr. W. I. S., 3, p. 816, '98 ; Johnson, Occ. Pa. B. S. N. H., 7, p. 79, 1915.

Distribution.—Maine to Texas. Pleistocene to Recent. Gulf coast.—West Florida ; Corpus Christi, Matagorda and Espiritu Santo Bays, Texas.

maritima (d'Orbigny) Dall, Bull. 37, U. S. N. M., p. 72, 1889.

Distribution.—Cited by Dr. Dall from West Fla. and Texas.

Genus **MARTESIA** Leach

cuneiformis Say, Jour. A. M. S. Phila., 2, p. 322, 1822, (as *Pholas*); Gibbes, Tuomey's Geol. S. C., app., p. 22 ; DeKay, Zool. New York, Moll., p. 248, '43 ; Holmes, Post-Pl. Fos. S. C., p. 59, pl. 9, f. 3, '60 ; Tryon, Mon. Pholadacea, p. 91, '62 ; Dall, Proc. U. S. N. M., 4, p. 337, '83 ; Bull. 37, U. S. N. M., p. 72, '89 ; Mitchell, List Tex. Sh. ; Dall, Tr. W. I. S., 3, p. 820, '98 ; Johnson, Nautilus, 18, p. 101, f. 2, 1904 ; Occ. Pa., B. S. N. H., 7, p. 80, 1915.

Distribution.—Connecticut to Trinidad. Miocene (of Va.) to Recent. Gulf coast.—Cedar Keys, Fla. ; Texas.

striata Linnæus, Syst. Nat., ed. XII, p. 1111, 1767, (as *Pholas*); Tryon, Mon. Pholadacea, p. 92, 1862 ; Fischer, Man. de Conch., p. 1136, pl. 23, f. 21, '87 ; Dall, Bull. 37, U. S. N. M., p. 72, '89 ; Johnson, Nautilus, 18, p. 100, f. 1, 1904.

clavata Lamarck, An. s. Vert., 5, p. 446, 1818, (as *Pholas*). Genotype.

Distribution.—South Carolina to Grenada Isl. Also England, 0-12 fms. Often burrowing in driftwood. Pliocene (Trinidad and Costa Rica, Guppy and Gabb) to Recent. Gulf coast.—West Florida ; Cameron, Chandeleurs, La. ; Galveston, Tex. Pleistocene : New Orleans pumping station No. 7 (?)

corticaria Sowerby, Thesaurus Conch., 2, p. 495, pl. 108, f. 94-96, 1855, (as *Pholas*); Tryon, Mon. Phol., p. 92, 1862 ; Dall, Bull. 37, U. S. N. M., p. 72, '89 ; Johnson, Nautilus, 18, p. 101, 1904.

Distribution.—Charlotte Harbor, West Florida, to Guadeloupe. Placed by Johnson in synonymy of *M. striata*. Sowerby's type found in drifted mahogany log.

(Diplothyra) caribæa d'Orbigny, In Sagra's Hist. Pol. y Nat. Isla de Cuba, 2, p. 281, f. 20-21, 1845 (Spanish ed.); French ed., p. 211, pl. 25, f. 20-21, 1853, (as *Pholas*); Johnson, Nautilus, 18, p., 102, f. 3, 1904.

smithi Tryon, Proc. A. N. S. Phila., p. 450, 1862 ; Mon. Pholadacea, p. 126, f. 2, 1862 ; Dall, Bull. 37, U. S. N. M., p. 72, 1889 ; Johnson, Nautilus, 18, pp. 102, 103, 1904.

Distribution.—Staten Island, N. Y., to Cuba, boring in shells and limestone. Gulf coast.—Manatee River, West Fla., and Texas.

Genus **TEREDO** Linnæus

navalis Linnæus, Syst. Nat., ed. XII, p. 1267, 1767 ; Forbes and Hanley, Brit. Moll. 1, p. 74, pl. 1, f. 7, 8, pl. 18, f. 3, 4 ; Tryon, Proc. A. N. S., Phila., p. 468, Sept. 1862 ; Gould, Inv. Mass., Binney's ed., p. 28, 355, '70 ; Dall, Bull. 37, U. S. N. M., p. 74, pl. 55, f. 6, pl. 59, f. 2, '89; Singley, 4th Ann. Rept. Texas, p. 331, '92 ; Mitchell, List Texas Shells, p. 17 ; Johnson, Occ. Pa., Bost. S. N. H. 7, p. 81, 1915.

marina Sellius, Nat. Hist. Tered. tab. 2, f. 2, 3, 6, 1733.

Note.—The borings of this famous shipworm suggested to Brunel many years ago his method of tunneling the Thames. First recognized as a bivalve mollusca by Sellius, in 1733.

Distribution.—Arctic Ocean to Florida. Recent. Gulf coast. West Fla., Galveston and the entire Texan coast. Very destructive to wooden wharves at Galveston. Found in driftwood, Texas coast, by Rœmer, in 1849.

megotara Forbes and Hanley, Brit. Conch., 1, p. 77, pl. 4, f. 6, pl. 18, f. 1, 2, 1853; Sowerby, Ill. Br. Shells, pl. 1, f. 3; Tryon, Pr. A. N. S. Phila., p. 466, '62; Gould, Inv. Mass., Binney's ed., p, 30, f. 357, '70; Dall, Pr. U. S. N. M., 6, p. 337, '83; Bull. 37, U. S. N. M., p. 74, pl. 59, f. 3, pl. 65, f. 127, '89; List Cameron Shells (MS.).

Note.—Placed by Johnson in synonymy of *Teredo nana* Turton, (Conch. Insul. Brit., p. 16, pl. 2, f. 6, 7, 1822).

Distribution.—Arctic Ocean to Florida. Pleistocene to Recent. Gulf coast.—Cedar Keys, Fla.; Cameron, La.

norvegica Spengler, Skriv. Nat. Selsk Kjobenhaven, 2, pt. 1, p. 102, pl. 2, f. 4-6, 1792; Gould, Inv. Mass., p. 29, f. 356, 1870; Dall, Bull. 37, U. S. N. M.. p. 74, pl. 68, f. 2, '89; Johnson, Occ. Pa. Bost. S. N. H., 7, p. 81, 1915.

Distribution.—Northern Europe and New York to Florida. Gulf coast.—Manatee, West Fla.

thomsoni Tryon, Proc. A. N. S. Phila., p. 280, pl. 2, f. 3-5, 1863; Gould, Inv. Mass., p. 31, f. 358, 1870; Dall, Bull. 37, U. S. N. M., p. 74, pl. 59, f. 4, 1889; Johnson, Occ. Pa., B. S. N. H., 7, p. 81, 1915.

Distribution.—Cape Cod, Mass., southward. Cited by Dr. Dall from West Fla.

(**Lyrodus**) **chlorotica** Gould, Inv. Mass., Binney's ed., p. 33, f. 360, 1870; Dall, Proc. U. S. N. M., 6, p. 337, 1883; Bull. 37, U. S. N. M., p. 74, pl. 68, f. 3, 1889; Johnson, Occ. Pa., Bost. S. N. H., 7, p. 82, 1915.

Distribution.—Massachusetts Bay to Florida. Recent. Type of subgenus *Lyrodus* Gould. Gulf coast.—Cedar Keys, Fla.

Genus **XYLOTRYA** Leach

fimbriata Jeffreys, Syn. Brit. Teredo, Ann. and Mag. Nat. Hist. 3d ser., 6, p. 126, 1860; Tryon, Proc. A. N. S. Phila., 13, p. 478, '62; Gould, Inv. Mass., Binney's ed., p. 34, f. 361, 1870; Dall, Bull. 37, U. S. N. M., p. 74, pl. 59, f. 1, '89; List Cameron Sh., 1906 (MS.); Johnson, Occ. Pa. Bost. Soc. N. H., 7, p. 82, 1915.

palmulata of Forbes and Hanley, Perkins, and a number of other authors; but not *palmulata* Lamarck, An. s. Vert., 2d ed., 6, p. 38; nor of Philippi.

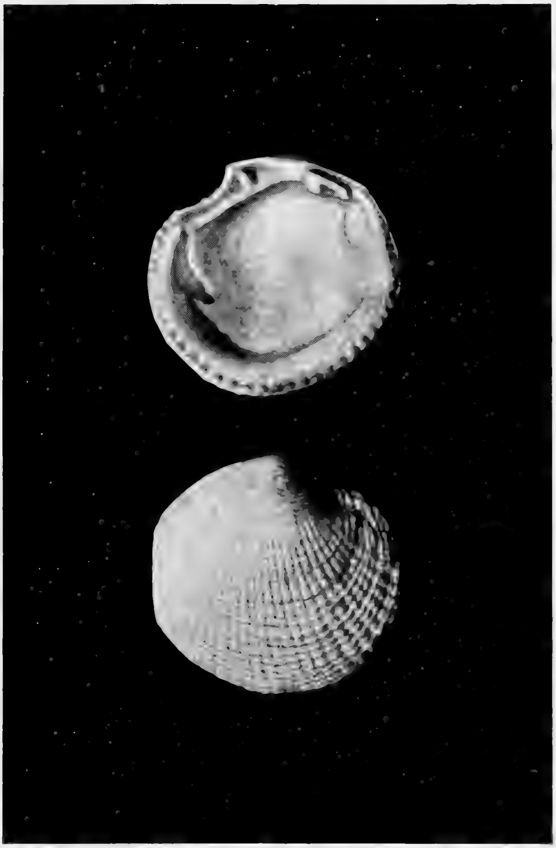
Distribution.—Rhode Island to the Gulf of Mexico, burrowing in wharves and timbers. Gulf coast.—Errol Isl., West Fla.; Chandeleurs, La.; Texas.

fimbriata variety **subæqualis** Dall, Proc. U. S. N. M., 6, p. 337, 1883.

Distribution.—Cedar Keys, Fla.

bipennata (Turton) Jeffreys, Ann. and Mag. Nat. Hist., 3d ser., 6, p. 126, 1860; Dall, Bull. 37, U. S. N. M., p. 74, 1889.

Distribution.—North Atlantic to St. Vincent, W. I. Gulf coast.—West Florida.



Phacoides (*Parvilucina*) *f ontis*, n. sp.

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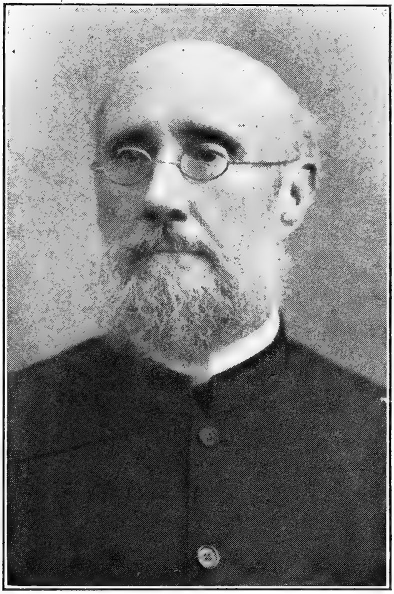

Robert John Lechmere Guppy
1836 - 1916

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A REPRINT OF THE MORE INACCESSIBLE PALEONTOLOGICAL WRITINGS OF ROBERT JOHN LECHMERE GUPPY

BY

G. D. Harris

March 15, 1921

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

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PREFACE

Robert John Lechmere Guppy was born August 15, 1836 and died August 5, 1916. Though a native of London he spent the greater share of his life in Trinidad. He was a great lover of Natural History. In spite of grave difficulties he succeeded in preparing a large number of papers for publication. To list them completely would now doubtless be quite an impossible task since many appeared in ephemeral publications, newspapers, and are no longer extant. However the more serious paleontological articles, sometimes assuming the nature of monographs, were nearly all published in the *Quarterly Journal of the Geological Society of London* or in the *Geological Magazine.* Between the purely popular and ephemeral, and the more serious, as classified above, a third class may be recognized, for the most part short articles, read before local natural history societies, clubs, etcetera, often semi-popular in nature but sometimes containing remarks on, or descriptions of new fossil species. Some of these too went abroad to the English Journals, although first appearing in the "Proceedings" of some local society.

In preparing the following reprint, such articles of the third class, mentioned above, have been selected, as were not republished abroad, or, at least not republished in the same wording or in easily accessible volumes. In other words an attempt is here made to give to the scientific public an exact reprint of such of Guppy's papers as were printed in "Proceedings" of local clubs, papers now quite inaccessible to paleontological workers in the best universities and government surveys. The organizations responsible for many of these papers no longer exist and their papers are scattered and gone. Fortunately Guppy kept a fairly complete copy of his various works, personally, and after his death, four bound volumes of Transactions and Proceedings of the Scientific Association of Trinidad, Journal of the Field Naturalists' Club and Proceedings of the Victoria Institute were purchased for the library of the Trinidad Leaseholds Company and are now in charge of Mr. F. W. Penny, geologist of that organization. To him science owes a great debt for the loan of these unique copies, that the reprint may be made directly from the original without the dangers of mistakes and the loss of time involved in having all these articles typewritten.

Guppy's latest publications, of the class here concerned, appeared in the Proceedings of the Agricultural Society of Trinidad and Tobago. But even these are quite difficult to obtain, being quite generally "out of print." Through the efficient assistance of Mr. G. A. Waring of the Trinidad Petroleum Development Company, by going the rounds of the libraries, public and semi-private, practically all of Guppy's paleontologic papers have been assembled, though in one case a typewritten copy had to be made of the only copy found.

Of the forty-one articles referred to below, twenty-five are herewith republished as being now quite inaccessible to paleontological workers in the best equipped laboratories.

In the various papers reprinted the subject matter is given page for page, with the original orthography, unless otherwise indicated. The punctuation and capitalization in some of the later papers become extremely erratic, yet it has seemed best to adhere strictly to "copy" lest Guppy's intentions should be slightly modified by corrections introduced.

The diagrams illustrating geologic sections have often been reduced in size since nothing is to be gained by large cuts while smaller ones show clearly all details.

On plate 7, fig. 1, no attempt has been made to color the carapace of *Ranina cuspidata* yellow as was done in the original.

Guppy's bibliographical notes on the geology of the West Indies are mainly recorded below in the Synopsis, pp. 7 and 193, from the Transactions of the Canadian Institute. Additional and supplemental references are given in his paper on Some Recent Geological Discoveries in the West Indies, reprinted in this Bulletin as PAPER No. 22, pp. 178-178.

SYNOPSIS OF GUPPY'S MORE IMPORTANT ARTICLES BEARING ON WEST INDIAN PALEONTOLOGY

4. On the Tertiary Mollusca of Jamaica.
Quart. Journ. Geol. Soc. Lond., vol. 22, 1866, pp. 282-295, with three plates.
Describes and illustrates the Barrett collection from Jamaica.

5. On Tertiary Brachipoda from Trinidad.
Quart. Journ. Geol. Soc. Lond., vol. 22, 1866, pp. 295-296, one plate.
Describes three brachiopod species from "the gypseous marl containing *Orbitoides mantelli* and *Nummulina*."

6. On Tertiary Echinoderms from the West Indies.
Quart. Journ. Geol. Soc. Lond., vol. 22, 1866, pp. 297-301, with figures. Specimens mostly from Anguilla; one from Trinidad.

7. On the relations of the Tertiary formations of the West Indies by R. J. Lechmere Guppy, Esq., F. G. S.; with a note on a new species of Ranina by Henry Woodward, Esq. F. G. S.; and on the Orbitoides and Nummulinæ by Prof. T. Rupert Jones, F. G. S.
Quart. Journ. Geol. Soc. Lond., vol. 22, 1866, pp. 570-593.
Gives three transverse sections of Trinidad, describes and figures ten new molluskan species

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from the Manzanilla beds ; lists the molluscan species from Anguilla ; refers to the literature on Antigua ; lists the species from Santo Domingo, Trinidad, Cumana, and from the last locality describes and figures four new species.

8. Notes on West Indian Geology, with Remarks on the existence of an Atlantis in the Early Tertiary Period ; and descriptions of some new fossils, from the Caribean Miocene.

Geological Magazine, vol. 4, 1867, pp. 496-501, with six text figures of fossils.

The meaning of the occurrence of *Nucula schomburgki* in the "Lower Miocene" of San Fernando is discussed and a new figure of it is given. Also *Mactra subovalina*, *Leda incognita*, and *Stomatia eidolon* are described and figured as new from this locality. *Tornatina coix-lachryma* is described and figured from Cumana and Jamaica ; also *Leda bisulcata*, from Jamaica.

9. On the Tertiary Fossils of the West Indies with especial reference to the classification of the Kainozoic Rocks of Trinidad.

Republished herewith as Paper No. 4... 24

10. On the Discovery of Organic Remains in the Caribbean Series of Trinidad.

Quart Journ. Geol. Soc. Lond., vol. 26, 1870, 413-415.

Abstract mentioning finding *Eozoon caribbœum*, *Favosites* near *fenestralis*, plates and stems of echinoderms, one near the Devonian *Eleacrinus*, Cystidean remains ; and worm tubes like *Salterella*. Guppy believes the Caribbean series will ultimately prove to be "pre-Silurian."

12. On Foraminifera from the Tertiaries of San Fernando, Trinidad.

Read before the *Scientific Association* of *Trinidad*, Jan. 10, 1872 and published in the "*Proceedings*"

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exposé of the microzoic fauna and its origin as seen in Trinidad.

22. The Microzoa of the Tertiary and other Rocks of Trinidad and the West Indies.

Republished herewith as **Paper No.** 12...113

23. On some Foraminifera from the Microzoic Deposits of Trinidad, West Indies.

Proc. Zool. Soc. Lond., 1894, pp. 647-653, with pl. 41.

Described the new forms derived from the investigations discussed in Article 20.

24. Descriptions of Tertiary Fossils from the Antillean Region. By Guppy and Dall.

Proc. U. S. Nat. Mus., vol. 19, 1896, pp. 303-331 with plates 26-30.

Discusses some old forms and describes and figures as new several of the specimens in the Guppy collection acquired by the U. S. National Museum.

25. Remarks on some fossils from the Eocene of Naparima.

Republished herewith as **Paper No. 13**...127

26. Notes on the passage between the Foraminifera beds and the Radiolarian marls of Naparima.

Republished herewith as **Paper No. 14**...128

27. Note on a specimen of Globigerina rock from Naparima.

Republished herewith as **Paper No. 15**...130

28. On the Naparima rocks, Trinidad.

Geological Magazine, 1900, pp. 332-325.

Believes the Nariva beds more or less derived from, hence younger than, the Naparima beds. And "The Nature and origin of the Argiline are similar to those of the Naparima foraminiferal and radiolarian marls, and it contains similar Radiolaria and Foraminifera."

PAPER No. 1

ON THE OLDER PARIAN FORMATION AT POINT A PIERRE TRINIDAD

Paper read before the Geologists' Association (London), June 6, 1862, and published on pp. 267-270 of its Proceedings, vol. 1 (volume dated 1865). Published also with slight modifications in *The Geologist*, 1863, pp. 204-207 under the title: On the older Parian Formation of Trinidad.

The earlier text, that of the Proceedings of the Geologists' Association is followed in the reprint given below.

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The Government Geologists, when in Trinidad, gave the name of Older Parian to a series of sandstones and shales extending across the island from east to west, and occupying an extent of about 97 square miles. This formation is only exposed for a short distance

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on the shores of the Gulf of Paria ; but the same formation has been found at Cumana and other places in Venezuela on the continent of South America. The few fossils found in Trinidad and in the same formation at Cumana have led to the belief that the Older Parian was probably of Neocomian age.

During a short visit to Pointe à Pierre, I obtained several fossils from the Older Parian rocks, and these fossils are the subject of the present communication.

The extreme point of the cliff at Pointe à Pierre in the Gulf of Paria is formed of a hard ferruginous sandstone, which is somewhat brittle and coarse in its structure, and contains no fossils. The dip from 40° to 45° S.

The most conspicuous among the organic remains is a *Trigonia* considered by Mr. Ethridge to be the same species as that fonnd at Bogota, and named by D'Orbigny *Trigonia subcrenulata**. Of this fossil I found one entire specimen and several disunited valves.

Mr. Etheridge notices the entire absence of Cephalopoda in the collections made by the geologists when here, stating that the want of such fossils prevented a comparison with the strata at Bogota and other parts of South America.† I have obtained a specimen of *Belemnites* from Point à Pierre, so very imperfect and worn, however, that it is difficult to ascertain to what section of the genus of Cephalopoda it belongs. If, however, it belongs, as seems probable, to the sub-section *Acuarii* of Bronn's section *Acœli*, it furnishes additional evidence of the correctness of Mr. Etheridge's determination of the age of the strata exhibited at Pointe à Pierre as Neocomian. The presence of the Belemnite is at once a proof of the Mesozoic age of the older Parian group ; and, as the genus is not found above the Gault, we must consider the Pointe à Pierre deposits as older than the true Chalk.

Numerous fragments of an Oyster, somewhat like *Ostrea carinata* of the Lower Greensand, are found with the *Trigonia*. At the same locality I have found Oysters referable perhaps to two other species. One of these is somewhat like the recent *Ostrea edulis*, and in one of my specimens the markings of the hinge-cartilage are well shown.

* Geological Survey of Trinidad, p. 163.

† Ibid., and Quarterly Journal of the Geological Society, vol. xvi, p. 465.

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I have also found a single valve of a deeply sulcated species of *Avicula*. This is small, and the sulci, though deep, are not more than five or six in number. It was probably a young shell.

Gasteropoda are represented among the fossils from Pointe à Pierre; but the specimens are generally so imperfect as to render the determination of their relationships difficult. A cast in my possession, upwards of two inches in length from the apex to the peristome, seems to be of a naticoid type. Another cast which has some shelly matter remaining on it may be either a *Trochus* or a *Pleurotomaria*, probably the latter; but the aperture is not perfect enough for identification.

All the fossils I have yet been able to obtain from Pointe à Pierre have been from the beach. They seem to have been washed out from the strata in which they were originally deposited and intermingled with the alluvium of a little hollow in which stand the old works of the Bon Accord Estate. Tney are consequently much worn; and it is hardly possible to ascertain from what portion of the group they have been derived. Were quarries opened in the adjoining hills this might be decided. The *Trigoniæ* and Oysters are tolerably well preserved as far as their structure goes, but the shells of the Gasteropoda have nearly or entirely disappeared, leaving only casts. The thick and massive character of the shells is worth notice, and it prevails alike in all the specimens in which the shell is preserved.

From what I have said, it will be seen that the evidence of the age of the Older Parian formation is in favor of Mr. Etheridge's view.* Until, however, more fossils can be obtained, and their position in the formation better determined, it will be as well to leave the precise age of the formation an open question. The interest attaching to the point is not confined to Trinidad, as the Older Parian is developed on the main land of South America, at Cumana and other places; and therefore it is to be hoped that on further search more fossils will be discovered.

The following is a list of the fossils found in the Older Parian strata at Cumana and in Trinidad :—

* Geological Snrvey of Trinidad, p. 162.

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Belemnites.	*Cytherea?**
Cerithium.	*Cardium.*
Turritella.	*Arca.*
Natica?	*Avicula.*
Pleurotomaria?	*Ostrea Couloni.*
Pteroceras.	*Ostrea*, 2 or 3 sp.
Trigonia subcrenulata.	*Echinus.*

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*Not mentioned in the foregoing paper. The specimen is a single valve, 2½ inches long and 2 inches in height, with well-marked concentric lines of growth.

PAPER No. 2

ON THE OCCURRENCE OF FORAMINIFERA IN THE TERTIARY BEDS AT SAN FERNANDO, TRINIDAD

Read before the "Scientific Association, 1863".

Printed in the *Transactions of the Scientific Association of Trinidad, 1863-66, Port-of-Spain*, vol. 1, dated 1866.

Also published with slightly different wording in *The Geologist*, 1863, p. 159, under the title: On some Foraminifera from the Tertiaries of Trinidad.

The "Scientific Association's version is herewith followed.

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At page 38 of the "Report on the Geology of Trinidad" is given a representation of a remarkable stratum of Asphaltic rock. This stratum is nearly vertical and projects from the cliff to some little distance in the waters of the Gulf, seeming to possess greater coherence and therefore resisting better the encroachment of the waves than the remaining portions of the cliff. Upon a close examination, the vertical mass is found to consist chiefly of the shells of *Nummulites* and *Orbitoides*, two genera of Foraminifera whose remains, as is well known to Geologists and Palæontologists, form in various parts of the world thick masses of rock; the *Orbitoides* being generally characteristic of the Eocene period in the Western hemisphere, while the *Nummulites* are regarded as indicative of the Middle Eocene in Europe and Asia. Here, however, we find the remains of both these genera associated in strata of supposed Miocene age.* *Nummulites* is regarded as a strictly Tertiary form of Rhizopod, while *Orbitoides* has been found in the Chalk or upper Mesozoic deposits as well as in the Lower Tertiary formations.

Of the *Orbitoides*, vast numbers exist in the San Fernando Tertiaries. They are found both in the gypseous marls and in the asphaltic portions of the group. In the marls they chiefly occur in the nodular concretions and in the indurated veins and layers. In the singular mass of rock figured by Wall and Sawkins the *Orbitoides* seem to form the greater part of its bulk. They are not referable to any species of which I have seen figures. The *Nummulites* found in the same deposit belong to the sinuo-radiate group.

*Report on the Geology of Trinidad, pp. 35, 161, 164.

When a portion of the rock is submitted to heat and the asphalte thus driven off, the *Nummulites* generally fall into two pieces, each of which, presents a good transverse section of the shell, showing very plainly the internal structure. Were it not for this curious circumstance it would have been difficult to have obtained sections of these shells, as owing to their fragility they would scarcely bear the process of grinding down however delicately conducted.

Some specimens of *Bryozoa* have occurred among the *Orbitoides*, but I have not succeeded in detaching a specimen. They are so brittle that the most careful manipulation is insufficient to prevent them from falling to powder under the hand of the operator. I have not detected any other organic remains in the same bed as the *Orbitoides* and *Nummulites* ; but both above and below it are found tertiary fossils probably not of more recent date than the Miocene age. I hope to be able to present my observations respecting those fossils in a collected form at some future time. Suffice it to say for the present that the evidence derived from them does not, so far as I yet know, militate against the presumption of the Middle Tertiary origin of the deposits in question. We know too little of the Tertiaries of this part of the world to be able to pronounce a more decided opinion ; but should the supposition of the Miocene age of this group be shown to be well founded, we should have here the remarkable phenomenon of the association of an Old-World with a New World form of Lower Tertiary Rhizopod in a deposit of Middle Teritary age. It would be very possible in that case that the homotaxical representatives in Europe of the deposits at San Fernando may be found amongst the lowest members of the Miocene group. But this observation must not be taken to apply to those portions of the Tertiaries which are found further inland, at Jordan Hill, St. Croix, and Montserrat, for instance. The fossils from those places, as well as those from Manzanilla, and other parts of the East coast of Trinidad, seem to me to belong to a later date.

P. S.—Since writing the above, I have observed in the Quarterly Journal of the Geological Society, an account of the association of *Nummulinæ* with *Orbitoides* in some Tertiary beds in the Island of Jamaica, It seems to me very probable that these *Nummulinæ* and *Orbitoides* are identical with those found at San Fernando. (Quart. Journ. Geol. Soc., vol. 19, p. 514.) The paper referred to contains valuable remarks on the affinities of the Foraminifera mentioned.

PAPER NO. 3

ON LATER TERTIARY DEPOSITS AT MATURA ON THE EAST COAST OF TRINIDAD

Read to the Scientific Association, Nov. 8, 1864.

Published in the *Transactions of the Scientific Association of Trinidad* for that year, p. 33-43. Republished with slight changes in the Geological Magazine, vol. 2, pp. 256-261 under the title: On some deposits of Late Tertiary age at Matura on the East Coast of Trinidad. Dated, August, 1864.

The Association's version is given below.

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In the map appended to the "Report on the Geology of Trinidad" we find the principal coal-bearing strata of the island indicated by a more or less irregular band of dark color stretching from Chaguanas, Couva, and Savonetta on the western or Parian coast to Manzanilla on the eastern or Atlantic side. To the north of this band lies a sterile region of detrital matter, chiefly silicious, marked in the map by yellow with red spots. I wish to draw attention more particularly to that part of this latter formation which lies on the eastern coast between the river Matura and Saline Bay.

On approaching Matura from Valencia, after having crossed the Oropouche River, an evident change for the better is observable in the nature of the soil; for instead of the intensely sterile and hungry quartzose sand and white clays which form the principal part of the detrital series, we find that a portion of calcareous matter has mingled with the earth and rendered it somewhat more suitable for agriculture. This calcareous matter seems to have been derived from underlying beds which would

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probably be classified as belonging to the "upper part of the Newer Parian" of the Government Geologists. These beds are composed, in part, at least, of a dark-colored and fine-grained calcareous sandstone containing an abundance of small shells. No great extent of these beds is exposed ; but near the Rincon, a natural savana bordering on Matura Bay, the erosion caused by a small stream and the wasting action of the sea have brought into view a fossiliferous bed, the organic remains from which may probably give us an insight into the question of the age of the stratum, and may even lead ultimately to a knowledge of some of the physical phenomena which succeeded to the deposition of the earlier tertiaries of the island.

2.—*Organic Remains.*

The fossils found by me in the beds alluded to in the foregoing section amount in number to more than ninety species, and have close relationships with the recent fauna, with that of the post-pliocene deposits of the Antilles (Barbados, &c.), and with that of the other tertiaries of this island. As respects the two former cases, I have been able for the most part to compare specimens, but in regard to the New Parian fossils I have not been able to obtain such full information as is desirable. The indications furnished in the Appendix to the Geological Report are very meagre ;* and after a lengthened but nevertheless somewhat unatisfactory examination of the Matura fossils, I have drawn up the following list :—

†	Fusus sp.	R
	Fusus canaliculata *Lam.* sp.	
†	" sp.	
*	Murex sp.	R
	Nasssa incrassata? *Müll.*	
	Buccinum clausiforme ? *Kien.* ..	
*	Terebra succinta *Gmel.* ..	R
*	Columbella sp.	

*Report on the Geology of Trinidad, pp. 161-166.

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†	Columbella sp.	R
	Fossarus costatus? *Brocchi*	R
*	Oliva oryza *Lam.*	VN
*	Conus verulosus *Brug.*	
	Pleurotoma sinuosa *Mout.*	
*	" fusca ? *Gray*	
	" virgo ? *Lam.*	
	" nodifera ? *Lam.*	
†	" sp.	
	Daphnella sicula *Reeve*	
*	Volvaria catenata ? *Mont.* sp.	N
*	Persicula sp.	
*	Marginella cærulescens *Lam.*	
†	" sp.	
*	Erato sp.	
*	Natica straminea *Recluz*	
†	Odostomia sp.	R
†	Chemnitzia sp.	
*	Eulima polita *Lin.*	
*	Cerithiopsis sp.	
*	" subulatum *Mont*	
	Triphoris ventricosus *Gmel.*	
	Leiostraca acuta *Sow.*	
*	Scalaria pyramidails *Sow.*	
*	Turritella imbricata *Lin.*	
†	" sp.	
*	Cæcum pulchellum	
	Vermetus royanus *d'Orb.*	
*	" lumbricalis *Lin.*	N
*	Siphonium decussatum *Gmel.*	
	Trochus granulatus *Born*	
*	" sp.	R
*	Sigaretus delessertii *Chenu*	R
†	Adeorbis sp	R
†	" sp.	R
†	" ? sp.	R
*	Fissurella pileola *Dil.*	
*	Crepidula aculeata *Lam.*	
	Calyptræa (Crucibulum ?) albida ?	
	Crucibulum striatum *Say.*	N
	" tubifer *Sow.*	N

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*	Dentalium apicinum *Lam.*	N
*	" entalis *Lin*	
	Chiton sp.	R
*	Tornatina olivula	N
*	Bulla striata *Brug.*	
*	Physa ancillaria *Say*	R
*	Planorbis sp.	R
	Ostrea cucullata *Born*	
	" " ? *var.* terebratuliformis	R
	Pecten nucleus? *Born*	
*	Modiola sulcata *Lam.*	
*	Arca noæ *Lin.*	N
*	" solida *Sow.*	N
*	" donaciformis *Reeve*	
*	" sp.	
†	" sp.	
*	Pectunculus decussata *Chemn.*	
	Nucula similis ? *Sow.*	
†	" sp.	
*	Leda eburnea ? *Sow.*	
*	Chama macrophylla *Chemn.*	
*	Cardium isocardium *Lin.*	
†	" (Papyridea) sp.	VN
	" obovale *Sow.*	N
*	Lucina squamosa *Lam.*	
†	Diplodonta ? sp.	
*	Strigilla carnaria *Lin.*	N
*	Astarte (Gouldia) martinicensis *d'Orb.*	VN
*	Venus pectorina *Lam.*	N
*	" cingenda *Dil.*	
*	" macrodon *Desh.*	
†	Cytherea sp	R
*	Trigona mactroides *Chemn.*	
†	Tapes sp.	R
*	Mactra turgida *Gmel.*	
†	" ? sp.	R
	Donax fabagella *Lam.*	
*	" striata *Lin.*	
*	Tellina acuta *Wood*	R
*	Corbula pygmœa *Hanley*	VN
*	" bicarinata *Sow.*	VN

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Corbula pisum ? *Sow.*	. .	. .	. .		
* Gastrochæna ovata *Sow.*		. .	. .		
* Pholadidea calva *Gray*		. .	. .		
† Lunulites sp.	. .	. .	. .	. .	VN
Cellaria salicornia *Pallas*		. .	. .		R
† ? Discopora sp.	. .	. .	. .	. .	
? Eschara sp.	. .	. .	. .	. .	

(VN. very numerous. N. numerous. R. Rare.)

In addition the fossils enumerated in the foregoing list there are a few small bones, probably of fishes, and a single tooth has come to light. Crustacea are represented by *Balani* and by fragments of brachyurous decapoda. There are also a few spines and fragments of echinoderms.

The shells marked * in the preceding list are known to me by recent examples to be still existing in neighboring seas. Those marked † are species unknown to me either from published works or specimens.—*Ostrea cucullata* is, I believe, a shell of the eastern seas.—*Cardium* (*Papyridea*). This is not the recent *C.* (*Papyridea*) *ringiculum*; it is however allied to that species, but much smaller and thicker.

It will be observed that there are 27 species known as existing in contiguous waters out of a total number of 56 gasteropoda, including 2 freshwater shells and 2 opisto branchs. Then 16 of the remainder, if not found in the surrounding seas, are probably existing elsewhere. To two of these I have assigned the names *Nassa incrassata* and *Trochus granulatus*, on account of their resemblance to the European species of those names, but at the same time with much hesitation. The proportion of recent species thus arrived at is nearly 80 per cent.; or 20 per cent. of unknown and extinct species, but making due allowance for imperfect knowledge, there would probably remain at least 10 per cent. of extinct species of Gasteropoda.

With regard to the Conchifera, the proportions are nearly the same. There are 22 species out of the total of 36 which are certainly known to me to exist in con-

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tiguous seas. To this number may be added 4 species, some of which probably exist elsewhere. *Nucula similis* and *Corbula pisum* are species of the European Eocene. I can detect no difference between the Matura examples and the English species, but some doubt of course rests on the determination, owing to the distance both of locality and of time. I think, from what has been stated, that we may consider it moderately safe to infer, that of the fossil mollusca of the Matura deposit there is a percentage of at least 10 extinct species. This would bring the deposit within the Pliocene period according to the classification of Lyell*, and in searching for European equivalents, we should probably find that the glacial deposits of Europe present the closest analogies with the Matura beds.

I may remark, by the way, that the fact has not practically been overlooked by Geologists that even where all the species are recent, yet if some of them are only found in distant seas and existing under different climatal conditions to those obtaining in the localities where such species are found fossil, the differences between the recent and fossil faunæ mark a real progress in geological time, and entitle the strata from which the fossils are obtained to a distinctive name. The Matura deposits are however less remarkable in this respect than in regard to the small size of the shells found in them, a point which will be dwelt upon in the following sections of this paper.

3.—*Conditions of Deposit.*

I shall now proceed to consider the conditions under which the present deposit was formed. It is probable from the sandy nature of the beds, that they were not thrown down at any very great distance from land ; while it is evident that it could not have been in the form of a beach that the deposit was accumulated. The shells are many of them too fragile to have withstood the attrition which accompanies exposure on a

* Lyell, Manual of Elementary Geology, 5 ed. p. 105, and Supplement, p. 13.

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beach. We must look, therefore, for a condition intermediate between the two as probably the nearest to the truth. And we find that the fauna is one which would suit a depth of from twenty to fifty fathoms. On those tropical beaches where univalves predominate, we have *Litorinæ*, *Patella*, and *Nerita*. None of these are represented in the Matura beds. On the other hand, on those long stretches of seabeach in the tropics where the molluscan fauna is chiefly bivalve, we find *Mactra turgida*, *M. carinata*, *Trigona mactroides*, *Donax denticulata*, *D. striata*, and more rarely *Venus granulata*, *Cytherea dione*, and a few Tellens. In the deposits at Matura we have, however, shells characteristic of a certain depth of water : such as *Terebra*, *Oliva*, *Marginella*, *Conus*, *Erato*, *Chemniztia*, *Eulima*, *Odostomia*, *Cœcum*, *Dentalium*, &c., &c., and several of the *Conchifera*. The only strictly litoral gasteropod in this collection, viz., *Chiton*, is represented by a solitary plate. As to the two freshwater species, each of which is represented by a single example, they may have been borne out on floating wood or otherwise, from some stream of the neighbouring land.

The comparative numbers of the individuals of each species found in the fossil and recent condition is another matter which deserves some consideration, though I fear I cannot make many observations of a complete and accurate nature on that head. The little rice snell, *Oliva oryza*, seems to have been almost as commou during the deposition of the Matura beds as at present ; while the *Astarte* (*Gouldia martinicensis*) is much more rare now than it would appear to have been formerly. This small shell occurs in immense numbers in the Matura deposit. *Corbula pygmæa* is not quite so numerously represented. The latter is by no means rare in some localities at the present day, but it is second only to the *Astarte* before mentioned in point of numbers in the Matura deposits.

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4.—*Climate of the period of deposition.*

Bearing in mind what has been said respecting the proportion of recent and extinct species, it will appear that these deposits probably belong to an epoch not far removed from that of the glacial and preglacial beds of Europe.

But the extremely small size of the fossils found at Matura is one of the most remarkable features of the deposit. Even where the shells belong to recent types of average size, the fossil representatives are almost invariably dwarfed. There are only one or two exceptions to this rule, e. g. *Cardium isocardium*, *Turritella imbricata* and *Bulla striata*, which attain an ordinary but not a large growth.

When the fossils belong to recent types of small size and arctic genera, they are not smaller than their living representatives. As examples of this, I may cite *Astarte* (*Gouldia*) *martinicensis*, the *Corbulæ*, the *Leda*, and the *Nuculæ*.

I have been led from a consideration of the above facts to enquire whether the refrigeration caused by the extension of glacial action southwards during the newer Pliocene period may not have affected lands situated so far south and so near the equator as Trinidad. And it must be confessed, considering the general aspect of the organic remains from the Matura beds, their small size, and the probable contemporaneity of the period of their deposition with the glacial epoch in Europe and North America, that there is some likelihood that glacial influences had a share in the modification of the fauna of the Matura beds. The influence of climate seems to show itself in the numerical preponderance of individuals belonging to species of arctic or northern types, and in the diminutive size generally of the shells rather than in the presence of arctic species.

5.—*Relations with other Deposits.*

Several of the species found in the Matura beds are identical with those occurring in the Tamana series,

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and there are also specific affinities with the other tertiaries of the Island, as mentioned in Sec. 2. But it does not seem, from the lists* given by the Geological Survey, that there is, anywhere, as far as has been discovered, the same assemblage of species. The number of recent forms in the beds under consideration forbids us however to assign an older date than the "upper part of the New Parian" to them ; and further, the shells from the deposits described in the Geological Report do not possess that feature of diminutiveness which is so remarkable in the Matura fossils. The ark found so abundantly in most of the Tertiary deposits of this Island (*Arca incongrua*) seems to be absent from the Matura beds. Further researches will be required to show how far some of the species of arctic types now existing in the West Indian seas may have commenced their existence in the tropics from the date of the supposed glacial influence.

There is a ferruginous conglomerate at Saline Bay, some little distance north of the Matura deposit, which may possibly belong to the same period as the latter ; but it seems to be unfosssiliferous.

6.—*Concluding Remarks.*

The facts relative to the Matura Deposits may be of great interest and importance when our knowledge shall have been far enough advanced to enable us to pronounce with some degree of certainty on the physical changes of this part of South America in late geological epochs. There is a great deal to be done in this respect. Before any set of conclusions can be established firmly, the observations on which they have been founded must be confirmed by prolonged investigation. There is, however, an interest of its own attaching to the exploration of our later tertiaries, and with regard to the Matura deposit, I may quote the very apposite remark of Mr. Smith, of Jordanhill, "as it belongs to one of "the first steps in the descending series, every circum-

*Report on the Geology of Trinidad p. 163-6.

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"stance connected with it should be carefully observed "and recorded, that researches into the more ancient "formations may be conducted with greater success ;" * and in addition, it is probable that important inferences with respect to the climate of the earth in former epochs may flow from comparisons such as those attempted in the present paper.

I shall conclude with a few remarks in connexion with the possibility of a colder climate having prevailed in the West Indies during the newer pliocene period. It is known that species of cryptogamous plants found in the arctic regions have been discovered on mountains in the torrid zone. Plants indigenous to Lapland have been observed on the Peak of Teneriffe and on the Blue Mountains in Jamaica. Similar facts have been noticed relative to the Andes.† It remains to be seen how far those phenomena are attributable to the former prevalence of colder climates over larger portions of the earth's surface. It is possible that the plants referred to may have first appeared within the tropics during a period when the climate was colder than at present, and that when the conditions of temperature become altered these plants receded from the lowlands, ultimately occupying only the higher summits of mountains. There is however nothing to show that the climate of the torrid zone was ever such that ice could have been present in any great quantity.

The idea of those alterations in the climate of the earth, which are admitted on all hands to have taken place, having been widely spread, is not now brought forward for the first time, and hypotheses in explanation have been suggested by various observers. There may even have been more than one period of comparative coldness, and the phenomena may have recurred according to definite and fixed laws.‡ Again, the climates of the globe might have been such, that while the southern hemisphere was enjoying more than an average

* Smith, Post-Tertiary Geology, page 5.
† Humboldt, Travels, (Bohn's ed. 1852). vol. 1, p. 115.
‡ Page, Past and Present Life of the Globe, p. 190.

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share of warmth, the climate of the northern portions of the globe was in a corresponing degree colder, and *vice versa*. But to do more than merely to allude to what has been brought forward on these subjects is beyond the scope of a paper like the present.

In the above paper I have confined myself to a very few remarks on those species of the mollusca from the Matura beds which are probably new. I have done so because I do not yet feel justified in publishing new specific names. Means of reference either to Museums or to published works there are none in this Island. Our public library scarcely possesses any but the most elementary works on Natural Science.* It is however but fair to state that the Governors of the Colony have not always been indifferent to the claims of science; and it may be hoped that the time is not far distant when some efforts will be made for the institution of a local Museum and of a Scientific Library in connection therewith.

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*See Crüger in Geological Report on Trinidad, p. 176

PAPER No. 4

ON THE TERTIARY FOSSILS OF THE WEST INDIES WITH ESPECIAL REFERENCE TO THE CLASSIFICATION OF THE KAINOZOIC ROCKS OF TRINIDAD

Read before the Scientific Association, July 9, 1867, and appearing in Part III of the Proceedings of the Scientific Association of Trinidad, Dec. 1867, pp. 145-176.

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The desire to know something of the constitution and history of the earth we live upon has always held a place in

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the human breast and we find the earliest philosophers hazarding speculations upon the subject. This desire is quite natural, and forms a part of the thirst after knowledge which is one of the attributes of human beings.

Leaving on one side the more or less fanciful geology and cosmogony of the ancients, we find that the first developments of geological science were chiefly confined to the study of the mineralogical and petrological features of the earth. The first rude classification of rocks rose out of this study; and the principles upon which that classification were based have held sway for a very long time over geological science. Accordingly we find that the first attempts to classify the rocks of the Caribean area were made upon old principles. Nearly every traveller to the West-Indies and equinoctial America has had something to say upon the physical structure of this part of the globe. The illustrous Humboldt, in his Personal Narrative and his Political Essay on the Island of Cuba, presents us with his observations on the Geology of Venezuela and Cuba. He noticed the fossilferous rocks of Cumana, and put the query whether any of their organic contents were identical with existing species in the adjoining seas; a query answered by me in my paper on the Relations of the Tertiary Formations of the West Indies.

Among the more noteworthy of Humboldt's successors in this field I may mention the names of Dauxion Lavaysée, St. Claire Deville, Nugent, and De la Beche, who have written upon the geology of Trinidad, Tobago, Jamaica and other islands.

It was not however until the science of Paleontology arose that Geology was evolved from the chaos in which it had lain previously to the beginning of the present century.

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By degrees, as the natural sciences advanced, it became more and more clear that the true means of classifying the rocks which form the earth's crust, and which are therefore the only one accessible to our observation, was by the study of their imbedded organic remains. It is not within the limits of this paper, devoted as it is solely to West Indian geology and especially to that of our own island, to detail or even glance at the various steps by which the progress of geology was facilitated by the advance of paleontological knowledge. I shall therefore pass on at once to the first notices of fossils found in the West Indies. Moreau de Jonnées* appears to have been one of the first to observe such objects. Humboldt, as I have already mentioned, had noticed the fossils of Cuba and Venezuela. Duchassaing, a medical practitioner in St. Thomas, collected and determined the fossils of Guadeloupe, and with the assistance of Michelin published the results in the "Bulletin" of the Geological Society of France. Other collections were made by Nugent and others; but our first real knowledge of the Caribean tertiary fauna is due to Colonel Heneken, who was engaged in military operations in Haiti in the year 1849. The collection of fossils made by him was examined and described by Mr. Carrick Moore and the results published in the Journal of the Geological Society. Fortunately for West-Indian geology this series of remains was in very fine preservation, and it was therefore easy to compare them with the beautiful fossils of Bordeaux, Dax, and Vienna, their European analogues. The fossil molluska of the miocene beds of Haiti have consequently served as a standard for ascertaining the relative age of the tertiaries of the West-Indies.

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* Histoire Physique des Antilles françaises.

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The next important step in our knowledge of the geology of the islands was the commencement of the Government Geological Survey; the island first examined being Trinidad. The determination of the tertiary rocks of the island was base upon what had been previously published by Mr. Carrick Moore. But the classification thus arrived at was imperfect. This fault was in great measure due no doubt to the very little attention paid to the fossils; the object of the survey being principally economic and practical geology. Still, a useful warning may be drawn from this, as to the impossibility of obtaining correct views without the aid of the higher sciences.

The greatest share of the verification of the Caribean Miocene fell to the lot of Dr. Duncan, who described the rich series of fossil corals from the tertiary beds of Antigua, Jamaica, Haiti and other islands Dr. Duncan's elaborate and highly successful investigations enabled him to confirm the previous generalizations on the age of the Caribean Miocene, and to perceive and illustrate the applicability of the theory of the migration of organized beings to the case in question. His researches tended to give a greater degree of probability to the hypothesis of the tertiary Atlantis on which Heer had labored, and to the support of which the arguments of Forbes, Godwin-Austen and Darwin had lent such force.

The next advance in West-Indian geology was due to the zeal and industry of Mr. Barrett, Director of the Geological Survey of the West-Indies. That naturalist collected a fine series of remains from the Jamaican tertiaries; but before he could describe them he lost his life in diving for those living organisms a knowledge of which was necessary to enable him to judge accurately as to the true nature of

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the fossil species. Having temporarily taken Mr. Barrett's place in Jamaica, Mr. Wall, in conjunction with Dr. Duncan, communicated a very important notice of the geology of that island to the Geological Society. That communication embodied descriptions and figures of many of the fossil corals of Jamaica.

The remains collected by Mr. Barrett in Jamaica having been deposited in the British Museum, were examined by Mr. Carrick Moore, who communicated in 1863 a notice of them to the Geological Society. In 1865, being then in London, I undertook at the request of Mr. Woodward the description of these fossils, for which I had been prepared by several years study of the fossils and recent shells of the West-Indies, and at the same time I described and enumerated other fossil molluska and echinoderms from the West-Indies, including Trinidad. Subsequently I communicated to the Geological Society a resumé of what was known of the geology and paleontology of the tertiary formations of the West Indies, enumerating the fossils and describing such new species as were accessible to me.*

It will of course be understood that the present paper relates to the tertiary geology only of Trinidad and the Caribean area. But by way of parenthesis I may allune to the secondary rocks of Trinidad, the conclusions as to which have been based upon the researches of Boussingault, Rœmer, Karsten, Lea, Von Buch, d'Orbigny, &c. On this subject I have published a paper in the "Geologist." The crectaceous rocks of Jamaica have been treated of by Barrett and Woodward, and the latter has described from that

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* This paper contains references to most of the published works on West-Indian Geology, and to it therefore I would refer those desirous of working at the subject. It was published in the 22nd vol. of the Quarterly Journal of she Geological Society. London 1866.

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formation a new genus of shells under the name of *Barettia*. Some corals have also been enumerated by Dr. Duncan.

§2. *The Atlantis Theory*.

My present limits will not admit of my going at any great length into the conclusions arrived at from the researches which have been made into the geology of the West Indies. After having therefore briefly touched upon some of the points alluded to in the first part of this paper I shall conclude with a list of the species of the molluska, articulata, echinodermata and protozoa described from the tertiary rocks, showing in what localities the species are found. The columns of the table are arranged in the presumed order of the antiquity of the deposits occurring in the localities.

The most remarkable perhaps of the results of the investigations referred to in the close alliance exhibited between the fauna of the Caribean miocene and that of the European beds of Malta, Bordeaux, Dax, Vienna, and Piedmont, and with the existing fauna of the Eastern Seas. According to the ideas entertained by the most advanced naturalists of the present day, this close alliance must be accounted for by a migration of species accompanied by a modification of their forms. But as land is as necessary for the migration of most marine animals as it is for terrestrial beings it follows that there must have been land on areas now occupied by the ocean.

Heer had advocated the theory of a miocene atlantis, basing his conclusions on his investigations of the miocene flora of Switzerland. That flora exhibits a remarkable

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analogy with that now existing in the Southern United States of North America. But there was a part of it which was also allied to eastern Asiatic forms ; and Professor Oliver hence endeavored to show that it was more probable that the plants had migrated by way of Eastern Asia to the miocene regions of Europe. Though I am of opinion, and though I have endeavoured to prove in my papers on West Indian geology, that Professor Oliver's hypothesis is scarcely the most probable, I am glad that his very able essay will still be of great service ; for the data given by him are really as much to the point if we assume a migration towards the East, a proposition which is indeed far more tenable on physical grounds, though at first sight apparently not so, on account of the great depth and width of the Atlantic which makes us recoil from the idea of a land connection between the shores of the Atlantic, so lately, speaking geologically, as the period in question, that of the upper miocene. This latter argument seems to have weighed very strongly with Sir Charles Lyell who, in the 6th edition of his Elements of Geology, devotes several pages to a close examination of this question. These learned gentlemen seem to have overlooked the fact that the European miocene flora is extinct, whilst that of North America, Japan, &c., is living, and that, as Mr. Hamilton has remarked, it is not possible that a migration should take place from a living to an extinct flora.

At first sight this difficulty seems to be removed by the researches of Lesquereux and Newbery who have shown that the Eocene flora of North America is closely allied to that of the Miocene of Europe. But this argument, though available for either hypothesis, bears much more strongly

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in favor of the Atlantis theory, providing it be admitted that the Atlantis was pre-miocene.

In the last volume (the 22nd) of the Quarterly Journal of the Geological Society. I have given the arguments upon which I base my views as to the Atlantis hypothesis; and as no one has yet shown those views to be untenable, I shall now only briefly state that my conclusions, derived from a careful study of all the evidence, are that the Atlantis continent was most likely pre-miocene, and that during the miocene period probably only the higher summits of the land remained as coral islands, much as in the existing Pacific Ocean. This view is strongly supported by the evidence before referred to, which has been brought forward by Forbes and Godwin-Austen, and which has been concurred in by Darwin, and further supported by Dr. Duncan's investigations.

The migration then of organized beings during the miocene period, as indicated by the alliances of the fossil and recent animal and plants, was probably from meridional America across the Atlantic and through North Africa and South Europe to the East Indies.

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§3. *The Classification of the Tertiary Rocks of Trinidad.*

The researches which have been made into the paleontology of the tertiary strata of Trinidad enable me to offer an improved classification of these rocks. At the same time I must state that my opportunities have not sufficed for a satisfactory determination of all the beds included by Messrs. Wall and Sawkins in the Tamana Series nor of those composing the Naparima Marls. Neither have I been able to investigate the relationships of either the Moruga or the

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Nariva Series. The want of specific determinations of the fossils procured by the Geological Survey renders it difficult for me to establish any comparison between the fauna of the deposits referred to and those of the Manzanilla and San Fernando beds on the one hand. Consequently I cannot be quite sure that I am correct in my classification of the Moruga and Tamana beds.

I propose that the names Newer Parian and Older Parian applied by the Geological Survey should be dropped. The Newer Parian includes the whole of the tertiary formations older than the postpliocene detrital series, whilst the term Older Parian was given to the lower cretaceous strata. These latter may retain the local name of Pointe à Pierre Beds, their geological age being probably neocomian.

Classification of the Tertiaries of Trinidad, in descending Order, with some of the Deposits in the other West Indian Islands, &c.

Trinidad.	Antilles, &c.
I. POSTPLIOCENE.	
a. Unstratified detritus, alvial accumulations of recent date, &c.	Terrains à Galibis of Guadeloupe. Detrital and recent formations in many of the Antilles.
b. Stratified detritus.	
II. PLIOCENE.	
a. Wanting.	Newer Pliocene Beds of Barbados and the Antilles containing recent species only.

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b. Matura Beds, with 10 or 15 per cent. of extinct species.	

III. UPPER MIOCENE.

a. Moruga Series.	
b. Jordan-Hill and St. Croix beds containing fossil corals and mollusca (Mya, &c.)	Tertiaries of Cumana, Barbuda, Jamaica, Haiti, Anguilla, Antigua, Scotland formation of Barbados, &c.
c. Savonetta Beds (Caroni Series).	

IV. LOWER MIOCENE.

a. Manzanilla Beds (Tamana Series).	? Terebratula beds of Guadeloupe.
b. San Fernando beds.	"Isolated Rock" in Scotland formation of Barbados.

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List of the Fossil Molluska, Echinodermata, Articulata and Protozoa hitherto discovered and recorded from the Tertiary Rocks of the Caribean Area (exclusive of the Postpliocene).

	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Subkingdom MOLLUSKA.											
Class GASTEROPODA.											
Physa rivalis Mat. and Rack.	I	I	..	..	..	..	..	..	..	..	
Planorbis terversanus d'Or.	I	I	..	..	..	..	..	..	..	..	
Gundlachia ancyliformis Pf.	I	I	..	..	..	..	..	..	..	..	
Bulla striata Brug.	I	I	I	I	..	..	I	..	..	..	Europe
paupercula Sow.	..	..	..	..	..	..	I	..	..	..	
granosa Sow.	..	..	..	..	..	..	I	..	..	..	
Tornatina coixlacryma Guppy.	..	..	..	..	..	I	..	..	..	..	
canaliculata d'Or.	I	I	..	..	..	..	..	..	..	..	
Cylichna ovumlacerti n. sp.	..	..	..	..	..	..	..	..	I	..	
Scalaria clathrus Lam.	I	I	..	..	..	..	..	..	..	..	
Leroyi n. sp.	..	..	..	..	I	..	..	..	..	..	
Ehrendergi Forbes	..	..	..	..	..	..	..	..	..	..	Barbados
Chemnitzia turris d'Orb.	I	I	..	..	..	..	..	..	..	..	
subcarinata d'Or.	I	I	..	..	..	..	..	..	..	..	
Leiostraca clavata n. sp.	I	..	..	..	..	..	..	..	..	..	
Odostomia lævigata d'Orb.	I	I	..	..	..	..	..	..	..	..	
cancellata d'Orb.	I	I	..	..	..	..	..	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Aclis helecteroides n. sp.	..	I	..	..	.	..	..	..	..	.	
Natica canrena Linn.	I	I	..	.	..	..	..	..	..	..	
sulcata Born	I	..	I	..	..	I	I	..	..	..	
phasianelloides d'Orb.	..	..	..	..	..	I	I	I	..	I	Cuba
subclausa Sow.		..	..	..	..	I	I	..	..	..	
Sigaretus depressus Phil.	I	I	..	..	..	..	..	..	..	..	
Turtitella imbricata Linn.	I	I	..	..	..	..	..	..	..	..	
tornata Guppy	..	..	I	..	..	I	I	..	..	..	
planigyrata n. sp		..	..	..	I	..	..	..	..	..	
Vermetus papulosus Gupp	..	..	..	..	..	I	I	..	..	..	
lumbricalis L.	I	I	..	..	..	..	..	..	..	..	
trilineatus n. sp.		I	..	..	..	..	..	..	..	..	
Petaloconchus sculpturatus Lea.	..	..	..	..	I	..	I	..	..	..	U. States
Siphonium decussatum Gml.	I	I	..	..	..	..	..	..	..	..	
Natica sulcata d'Orb	I	I	..	..	..	..	..	..	..	..	
Triforis guttata n. sp.	..	I	..	..	..	..	..	..	..	..	
Cerithiopsis punctatum Lin.	I	I	..	..	..	..	..	..	..	..	
Cerithium plebeium Sow.	..	..	I	..	..	I	I	I	..	..	
uniseriale Sow.	..	..	I	..	..	..	..	..	..	..	
Solarium semidecussatum n. sp.	..	I	..	..	..	..	..	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Upper Miocene: Barbuda	Upper Miocene: Caroni Series Trinidad	Upper Miocene: Jamaica	Upper Miocene: Haiti	Upper Miocene: Anguilla	Lower Miocene: Manzanilla Trinidad	Lower Miocene: San Fernando Trinidad	Additional Tertiary Localities
S. quadriseriatum Sow.	..	..	..	..	I	I	I	I	..	..	
Cancellaria Barretti Gupp.	..	..	..	..	..	I	I	..	..	..	
lævescens Gupp.	..	..	..	..	I	I	I	..	..	..	
Moorei Guppy	..	..	I	..	..	I	I	..	..	..	
Strombus pugilis Linn.	I	..	..	..	..	I	I	I	..	..	Cuba
bifrons Sow.	..	..	..	..	..	..	I	..	..	..	
ambiguus Sow.	..	..	..	..	..	..	I	..	I	..	
haitensis Sow.	..	..	..	..	..	..	I	..	..	..	
proximus Sow.	..	..	..	..	..	..	I	..	..	..	
Murex domingensis Sow.	..	..	I	..	..	I	I	..	..	..	
Typhis alatus Sw.	..	I	..	..	..	..	I	..	..	..	
Ranella crassa Dillw.	I	..	..	..	..	I	..	..	..	..	
Triton variegatus Lam.	I	..	..	..	..	..	I	..	..	..	
femoralis Linn.	I	..	..	..	..	..	I	..	..	..	
gemmatus Reeve	I	..	..	..	..	..	I	..	..	..	
Latirus infundibulum Gml.	I	..	..	..	I	I	..	..	..	..	N. America
Turbinellus ovoideus Kien.	I	..	..	..	I	..	I	..	..	..	
validus Sow.	..	..	..	..	I	..	I	..	..	..	
haitensis Sow.	..	..	..	..	..	..	I	..	..	..	
Fasciolaria semistriata Sow.	..	..	..	..	..	..	I	..	..	..	
intermedia Sow.	..	..	..	..	...	..	I	..	..	..	
Tarbelliana Grat.	..	..	I	..	..	..	..	..	..	..	Chile Europe
Pyrula melongena Linn.	I	..	I	..	..	I	..	..	..	..	Europe
Fusus Henekeni Sow.	..	..	..	..	..	..	I	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
F. haitensis Sow.	..	..	..	..	..	..	I	..	..	..	
Phos Moorei Gupp.	..	..	..	..	..	I	I	..	..	..	
elegans Guppy	.	..	I	..	..	I	I	..	..	..	
Nassa incrassata Müll.	I	I	I	..	..	I	I	..	..	..	Europe
solidula Guppy	..	..	I	I	..	..	..	..	..	..	
Terebra inæqualis Sow.	..	..	I	..	..	I	I	..	..	..	
bipartita Sow.	..	..	..	..	..	..	I	..	..	..	
flammea Linn.	I	..	..	..	..	..	I	..	..	..	
sulcifera Sow.	..	..	..	..	..	..	I	..	..	..	
Cassis sulcifera Sow.	..	..	..	..	..	I	I	..	..	..	
monilifera Gupp.	..	..	..	..	..	I	..	..	..	..	
Cassidaria lævigata Sow.	..	..	..	..	..	..	I	..	..	..	
sublævigata Gupp.	..	..	..	..	..	I	..	..	..	..	
Oniscia domingensis Sow.	..	..	..	..	..	..	I	..	..	..	
Malea camura Guppy	..	..	..	..	..	I	I	..	..	..	
Ficula carbasea Guppy	..	..	..	..	I	..	..	I	..	..	
Persona simillima Sow.	..	..	I	..	..	I	I	..	..	..	
Crepitacella cepula Guppy	..	..	I	..	..	..	..	..	..	..	
Columbella Duclosiana d'Or.	I	I	..	..	..	..	..	..	..	..	
pulchella Kien.	I	I	..	..	..	..	..	..	..	..	
peculiaris n. sp.	..	I	..	..	..	..	..	..	..	..	
haitensis Sow.	..	..	..	..	..	..	I	..	..	..	
venusta Sow.	..	..	I	..	..	..	I	..	..	..	
gradata Guppy	..	..	I	..	..	I	..	..	..	..	
ambigua Guppy	..	.	..	..	..	I	..	..	..	..	
Oliva reticularis Lam.	I	..	..	..	..	I	..	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
hispidula Lam.	I	..	I	..	..	..	I	..	..	..	
cylindrica Sow.	..	..	I	I	I	..	I	..	..	..	
oryza Lam.	I	I	.	..	..	..	..	..	..	..	
Ancillaria glandiformis Lam.	..	..	..	..	..	I	I	..	..	..	Europe
lamellata Guppy	..	..	..	..	..	..	..	..	I	..	
Pleurotoma											
consors Sow.	..	..	..	..	..	I	I	..	..	..	
venustum Sow.	..	..	..	..	..	I	I	..	..	..	
Barretti Guppy	..	..	I	..	..	I	I	..	..	..	
jamaicense Gup.	..	..	..	..	..	I	..	..	..	..	
Henekeni Sow.	..	..	..	..	..	..	I	..	..	..	
haitense Sow	..	..	I	..	..	..	I	..	I	..	
jaquense Sow.	..	..	..	..	..	..	I	..	..	..	
elatior d'Orb.	I	I	..	..	..	..	..	..	..	..	
luctuosa d'Orb.	I	I	..	..	..	..	..	..	..	..	
Conus recognitus Guppy	..	..	..	..	..	I	I	..	..	..	
planiliratus Sow.	..	..	..	..	I	I	I	..	..	..	
stenostomus Sow.	..	..	..	..	..	I	I	..	..	..	
granozonatus Guppy	..	..	..	..	..	I	I	..	..	..	
interstinctus Guppy	..	..	..	..	..	I	I	..	..	..	
gracilissimus Guppy	..	..	I	..	..	I	I	..	..	..	
haitensis Sow.	..	..	..	..	..	..	I	..	..	..	
symmetricus Sow.	..	..	I	..	..	..	I	..	..	..	
marginatus Sow.	..	..	..	..	..	..	I	..	..	..	
domingensis Sow.	..	..	I	..	..	..	I	..	..	..	
catenatus Sow.	..	.	..	..	..	..	I	..	..	..	
consobrinus Sow.	..	..	..	..	..	..	I	..	..	..	
prototypus n. sp.	..	..	..	..	I	..	..	..	..	..	
pusio Brug.	I	I	..	..	..	..	..	..	..	..	
Mangelia micropleura n. sp.	..	I	..	..	..	..	..	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Mitra Henekeni Sow.	..	..	..	..	1	1	1	..	..	..	
varicosa Sow.	..	..	..	..	..	..	1	..	..	..	
Voluta soror Sow.	..	..	.	..	..	..	1	..	..	..	
pulchella Sow.	..	..	..	..	..	..	1	..	..	..	
Marginella coniformis Sow.	..	..	1	..	1	1	1	..	..	..	
interrupta Lam.	1	..	1	..	..	..	..	..	..	..	
cœrulescens Lam.	1	1	..	..	..	..	..	..	..	..	
Volvarina pallida Lam.	1	1	..	..	..	..	..	..	..	..	
catenata Mont.	1	1	..	..	..	..	..	..	..	..	
Erato Maugeræ Gray	1	1	..	..	..	..	..	..	..	..	
Cypræa pustulata Lam.	1	..	..	..	..	..	1	..	..	..	
Henekeni Sow.	..	..	..	..	..	..	1	..	..	..	
Dentalium missisipense Conr.	..	..	..	..	..	..	1	..	..	..	U. States
dissimile Guppy	..	..	..	..	..	1	..	.	..	..	
disparile d'Orb.	1	1	..	..	..	..	..	..	..	..	
antillarum d'Orb.	1	1	..	..	..	..	..	..	..	..	
Trochita Candeana d'Orb.	1	1	..	..	..	..	..	..	..	..	
Crucibulum piliferum n. sp.	..	1	..	..	..	..	..	..	..	..	
subsutum n. sp.	..	1	..	..	..	..	..	..	..	..	
Crepidula aculeata Lam.	1	1	..	..	..	..	..	..	..	..	
Gadinia afra Gray	1	1	..	..	..	..	..	..	..	..	
Fissurella cayennensis Lam.	1	1	..	..	..	..	..	..	..	..	
Stomatia eidolon Guppy	..	..	..	..	..	..	..	..	..	1	
Neritina Woodwardi Guppy	..	..	..	..	..	1	..	..	..	..	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Upper Miocene: Barbuda	Upper Miocene: Caroni Series Trinidad	Upper Miocene: Jamaica	Upper Miocene: Haiti	Upper Miocene: Anguilla	Lower Miocene: Manzanilla Trinidad	Lower Miocene: San Fernando Trinidad	Additional Tertiary Localities
Trochus decipiens n. sp.	..	I	..	..	..	I	..	..	..	..	
var. laticarinatus	..	I	..	..	..	..	..	..	..	..	
plicomphalus n. sp.	..	I	..	..	..	..	..	..	..	..	
Turbo castaneus Chemn.	I	..	I	..	..	I	..	..	..	..	
Cyclostrema bicarinatum Gupp.	..	..	.	..	..	I	..	..	..	..	
Vitrinella marginata n. sp.	..	I	..	..	..	..	..	..	..	..	
Class CONCHIFERA.											
Martesia striata Linn.	I	I	..	..	..	..	..	..	..	..	
Teredo fistula Lea	..	..	..	..	I	..	I	..	..	..	
Gastrochæna cuneiformis Lam.	I	I	..	..	..	..	..	..	..	..	
Corbula viminea Guppy	..	..	..	..	..	I	I	..	..	..	
vieta Guppy	..	I	..	..	I	I	..	..	I	..	
cubaniana d'Orb.	I	I	..	..	..	..	..	..	..	..	
caribæa d'Orb.	I	I	..	..	..	..	..	..	..	..	
Neæra costellata Desh.	I	..	..	..	..	I	..	..	..	..	
Cercomya ledæformis Gupp.	..	..	..	..	..	..	..	..	I	..	
Mactra turgida Gmel.	I	I	..	..	..	..	..	..	..	..	
subovalina Gupp.	..	..	..	..	..	..	..	..	..	I	
Mactrinula macescens Gupp.	..	..	..	..	..	..	..	.	I	..	
Tellina biplicata Conrad	..	..	..	I	I	..	I	..	..	..	Cuba; U. States

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			Upper Miocene						Lower Miocene		
	Recent	Matura-Pliocene	Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Strigilla carnaria Linn.	1	1	..	..	..	..	..	..	..	..	
Semele variegata Lam.	1	1	..	..	..	..	..	..	..	..	
Donax striata Linn.	1	1	..	..	..	..	..	..	..	..	
fabagelloides n. sp.	..	1	..	..	..	..	..	..	..	..	
Lucina tigrina Linn.	1	..	1	..	..	..	1	..	..	..	Egypt Europe
pensylvanica Linn.	1	..	1	..	..	1	1	..	..	..	U. States Piedmont
muricata Chemn.	1	1	..	..	..	..	..	..	..	..	
Gouldia martinicensis d'Orb.	1	1	..	..	..	..	..	..	..	..	
Trigona mactroides Born	1	1	..	..	..	..	..	..	..	..	
Cytherea planivieta Guppy	..	..	..	..	..	1	..	..	..	..	
carbasea Guppy	..	..	..	..	..	1	..	..	..	..	
juncea Guppy	..	..	1	..	..	..	..	..	..	..	
convexa Say	1	..	1	..	..	..	..	..	..	..	
circinata Born	1	1	..	..	..	..	..	..	..	..	
Venus paphia Linn.	1	..	1	..	..	1	1	..	..	..	Vienna
rugosa Chemn.	1	..	.	..	..	..	1	..	..	..	
puerpera Linn.	1	..	..	..	..	..	1	..	..	..	
flexuosa Linn.	1	1	..	..	..	..	..	..	..	..	
cancellata Gronov.	1	1	1	..	..	..	1	..	..	..	
crenulata Chemn.	1	1	..	..	..	..	..	..	..	..	
Walli Guppy	..	..	..	..	..	..	..	..	1	..	
Woodwardi Guppy	..	..	1	..	.	..	..	..	..	..	
Dosinia acetabulum Conr.	1	..	..	..	..	1	..	..	..	.	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
cyclica Guppy	..	..	..	..	..	..	..	..	I	..	
Cardium muricatum Linn.	I	I	..	..	..	..	..	..	..	..	
haitense Sow.	I	I	I	..	..	I	I	..	..	..	
lingua-leonis Guppy	..	..	..	..	..	I	..	..	..	..	
inconspicuum Guppy	..	..	..	..	..	I	..	..	..	..	
castum Guppy	..	..	..	..	..	..	..	..	I	..	
Cardita minima Sow.	I	I	..	..	..	..	..	..	..	..	
scabricostata Guppy	..	..	..	..	..	I	I	..	..	..	
Chama arcinella Lam.	I	..	..	..	..	I	I	..	..	..	N. America
ruderalis Lam.	I	I	..	..	..	..	..	..	..	..	
Erycina tensa Guppy	..	..	..	..	..	..	..	..	I	..	
Leda bisulcata Guppy	..	..	..	..	..	I	..	..	..	..	
incognita Guppy	..	..	..	..	..	..	..	..	..	I	
Packeri Forbes	..	..	..	..	..	..	..	..	..	..	Barbados
perlepida n. sp.	..	I	..	..	..	..	..	..	..	..	
illecta n. sp.	..	..	..	..	..	..	..	..	I	..	
Nucula Schomburgki Forbes	..	..	..	..	..	..	..	..	..	I	Barbados
baccata n. sp.	..	I	..	..	..	..	..	..	..	..	
vieta n. sp.	..	I	..	..	..	..	..	..	..	.	
Arca noæ Linn.	I	I	..	..	..	I	I	..	..	..	
incongrua Say	I	..	I	..	..	..	..	.	..	..	
consobrina Sow	..	..	I	..	..	I	I	..	..	..	
inæquilateralis Guppy	..	..	..	..	..	I	..	..	..	..	
patricia Sow.	..	..	..	..	I	..	I	..	..	..	
trinitaria Guppy	..	..	..	..	..	..	..	..	I	..	
filicata Guppy	..	..	..	..	..	..	..	..	I	..	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Upper Miocene: Barbuda	Upper Miocene: Caroni Series Trinidad	Upper Miocene: Jamaica	Upper Miocene: Haiti	Upper Miocene: Anguilla	Lower Miocene: Manzanilla Trinidad	Lower Miocene: San Fernando Trinidad	Additional Tertiary Localities
ce trota n. sp.	..	1	..	..	..	..	..	..	..	..	
Adamsi Shuttl.	1	1	..	..	..	..	..	..	..	..	
squamosa Lam.	1	1	..	..	..	..	..	..	..	..	
pexata Say	1	1	1	..	..	..	1	..	..	..	N. America
Pectunculus											
pennaceus Lam.	1	..	1	..	..	1	..	..	..	..	
acuticostatus Sow.	..	..	1	..	..	1	1	..	..	..	
Pecten exaspe-ratus Sow.	1	..	..	..	..	1	..	..	..	..	
inæqualis Sow.	..	..	..	..	..	1	1	..	..	..	
thetidis Sow.	..	..	..	..	..	..	1	..	..	..	
nucleus Born	1	1	..	..	..	..	..	..	..	..	
oxygonus Sow.	..	..	..	..	..	..	1	..	..	..	
comparilis Tuomey & Holmes	..	..	..	..	1	..	..	..	..	.	N. America
anguillensis n. sp.	..	..	..	..	.	..	..	1	..	..	
Mortoni Ravenel	..	..	..	..	..	..	..	1	..	..	N. America
Spondylus bos-trychites Gupp.	..	..	..	..	..	..	1	1	..	..	
Ostrea virgini-ca Gmel.	1	..	..	..	1	..	1	1	1	..	Europe U. States
cucullata Born	1	1	.	..	..	..	..	..	..	..	
Gryphæa athy-roides Guppy	..	..	..	..	..	..	..	..	..	1	
Class BRACHIO-PODA											
Terebratula lec-ta Guppy	..	..	..	..	..	..	..	..	..	1	
trinitatensis Guppy	..	..	..	..	..	..	..	..	..	1	
carneoides Gupp.	..	..	..	..	..	..	..	..	..	1	
Class POLYZOA.											
Cupularia pyri-forme	1	1	1	..	..	1	1	..	..	..	

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			Upper Miocene						Lower Miocene		
	Recent	Matura-Pliocene	Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Cupularia calyx-glandis n. sp.	..	..	..	..	..	..	..	..	I	..	
Cellaria salicornia Pallas	I	I	..	..	..	..	..	..	..	..	
Subkingdom ECHINODERMATA.											
Class ECHINIDÆ											
Cidaris melitensis Wright	..	..	..	..	..	..	..	I	..	..	Europe
metularia Lam.	I	..	..	..	..	..	..	..	..	..	Guadeloupe
Tripneustes ventricosus Ag.	I	..	..	..	..	..	..	..	..	..	Do.
Echinus cameleo Mich.	I	..	..	..	..	..	..	..	..	..	Do.
Echinometra lobata Blainv.	I	..	..	..	..	..	..	..	..	..	Do.
acufera Blainv.	I	..	..	..	..	..	..	I	..	..	
Clypeaster Duchassaingi Mich.	..	..	..	..	..	..	..	..	..	..	Guadeloupe
parvus Duch.	..	..	..	..	..	..	..	..	..	..	Do.
crustulum Mich.	..	..	..	..	..	..	..	..	..	..	Do.
ellipticus Mich.	..	..	..	..	..	..	..	I	..	..	Do.
Scutella Michelini Duch.	..	..	..	..	..	..	..	..	..	..	Do.
Encope Desmoulinsii Duch.	I	..	..	..	..	..	..	..	..	..	Do.
Echinoneus cyclostomus Leske	I	..	..	..	..	..	..	I	..	..	Antilles
orbicularis Desor	..	..	..	..	..	..	..	..	..	..	Cuba
Caratomus pisiformis M. & D.	..	..	..	..	..	..	..	..	..	..	Guadeloupe
Cassidulus guadalupensis M. & D.	..	..	..	..	..	..	..	..	..	..	Do.

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Echinolampas semiorbis Guppy	..	..	..	..	..	..	..	I	..	..	
lycopersicus Guppy	..	..	..	..	..	..	..	I	..	..	
ovum-serpentis Guppy	..	..	..	..	..	..	..	..	..	I	
Pygorhynchus jamaicensis Mich.	..	..	..	..	..	I	..	..	..	..	
Amblypygus americanus Mich.	..	..	..	..	..	I	..	..	..	..	
Hemiaster Michelotti Mich.	..	..	..	..	..	..	..	..	..	..	Cuba, Guadeloupe
Schizaster cubensis d'Orb.	..	..	..	..	..	..	..	..	..	..	Do. Do.
Scillæ Desm.	..	..	..	..	..	..	I	..	..	..	Europe.
Brissus dimidiatus Ag.	I	..	..	..	..	..	I	..	..	..	Cuba.
Class CRINOIDEA											
Pectacrinus rotularis n. sp.	..	..	..	..	..	..	..	..	..	I	
obtusus, n. sp.	..	..	..	..	..	..	..	..	..	I	
Subkingdom ARTICULATA.											
Ranina porifera H. Woodw.	..	..	..	..	..	..	..	..	..	I	
Spirorbis clymenioides Guppy	..	..	..	..	..	..	..	..	..	I	

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	Recent	Matura-Pliocene	Upper Miocene: Cumana	Barbuda	Caroni Series Trinidad	Jamaica	Haiti	Anguilla	Lower Miocene: Manzanilla Trinidad	San Fernando Trinidad	Additional Tertiary Localities
Subkingdom PROTOZOA											
Closs RHIZOPODA											
Nummulina Ramondi Defr.	..	..	1	..	..	1	1	..	..	1	Widely distributed
Orbitoides Mantelli Morton	..	..	1	..	..	1	1	1	..	1	Do.
Orbitolites complanatum Lam.	1	..	..	..	..	..	..	1	..	..	Do.
Milola seminulum	1	..	..	..	..	..	..	1	..	..	Do.
Nodosaria raphanistrum	1	..	..	..	..	..	1	..	..	..	Do.
affinis	1	..	..	..	..	..	1	..	..	..	Do.
Robulata cultrata	1	..	..	..	.	..	1	..	..	..	Do.
Rosalina Beccarii	1	..	..	..	..	..	1	..	..	..	Do.
INCERTÆ SEDIS											
Cisseis asterisca Guppy	..	..	..	..	..	..	..	..	..	1	
SUMMARY											
Species still existing	103	61	17	1	4	16	27	7	..	1	
Pliocene: Matura	61	79	6	1	1	5	8	..	1	..	
Upper Miocene:											
Cumana	17	6	42	3	2	22	29	2	1	2	
Barbuda	1	1	3	4	2	..	3	..	..	..	
Caroni Beds, Trinidad	4	1	2	2	22	7	14	3	1	..	
Jamaica	16	5	22	..	7	71	45	5	1	3	
Haiti	27	8	29	3	14	45	105	7	2	4	
Anguilla	7	..	2	..	3	5	7	29	..	2	
Lower Miocene:											
Manzanilla beds	..	1	1	..	1	1	2	..	15	..	
San Fernando Beds	1	..	2	..	..	3	4	2	..	18	
Total Species 280	103	79	42	4	22	71	105	29	15	18	

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APPENDIX

Notes on the foregoing Table, with Descriptions of the New species.

It is highly probable that some of the names given in the above list will prove, upon a close examination of the fossils, to be synonyms—and doubtless others will be found to be still existing, such as *Cardium haitense* of Sowerby, which I dredged up in the Gulf of Paria. But there are still a great number of undescribed and extinct species, chiefly in the collection of the Geological Society. and many othe.s will yet be discovered.

*Cylichna ovum-lacerti** n. sp.

Shell small, cylindrical-subovate, minutely striate transversely ; spire small, sunken ; aperture as long as the shell, dilated anteriorly ; outer lip straight, blunt ; columella callus with a strong tortuous fold.

Lower Miocene, Manzanilla.

Scalaria Leroyi,* n. sp.

Shell turreted, cylindric, many-whorled, longitudinal ribs few, indistinct, base spirally striate, aperture oval.

The example figured is a small one, but like nearly all the molluska of the Caroni series in Trinidad, the shell appears to have grown to a very large size, for another specimen in my cabinet is upwards of six inches long. I have dedicated this species to my friend Mr. Louis Alexander Le Roy, to whom I am under great obligations for his kindness in procuring me specimens of the Savanetta fossils, and without whose assistance my knowledge of the

[*Most of these species are figured in *Geological Magazine*, vol. 1, 1874, pl. XVIII. G. D. H.]

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upper miocene fauna of Trinidad would have been much more limited than it is.

Caroni beds, Savonetta.

Chemnitzia turris d'Orb. Moll. de Cuba, pl. xvi. f. 10-24. Other forms of this species are distinguished specifically by d'Orbigny as *C. pulchella*, *C. ornata*, and *C. modesta*.

These and other varieties are common in the Matura Beds.

Aclis helecteroides, n. sp.

Shell turreted, cylindric, many-whorled, shining, whorls slowly increasing, impressed with a deep groove below the suture, which is equally deep, forming a spiral thread; aperture sub-circular, columella slightly reflexed, peristome simple.

Pliocene, Matura. It resembles a *Proto*, but the columella prevents its reference to that genus. I will not be sure, however, that it ought not to be placed in the neighborhood of *Turritella*. Its smooth texture seems to be against that view of its affinities. I refer it to the genus *Aclis* provisionally only.

Leiostraca clavata n. sp.

Shell rather club-shaped, whorls smooth, flattened, the last forming more than ⅓; spire acuminate, suture linear, scarcely impressed; aperture suboval, elongate, narrow above, dilated in front; peristome simple, columella some what reflected and thickened.

Pliocene, Matura. Allied to *L. acuta*.

Turritella planigyrata n. sp.

Conic-cylindric, striate by fine spiral lines, whorls very slightly convex, the later ones nearly flat; aperture subquadrate.

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Caroni Series, Savanetta. A very distinct species, remarkable for its almost entire want of ornamentation, and the flatness of its whorls. I have lately received another species of *Turritella* from Mr. LeRoy, which is more like *T. imbricata.*

Vermetus trilineatus n. sp.

Conic-cylindric, turreted, spire pointed, whorls flat, bearing three narrow spiral keels; lower whorls irregular: suture distinct, linear shallow.

Pliocene, Matura. The young shell is not to be distinguished from a small *Turritella,* but the subsequent growth supplies the Vermetiform character. This shell was given as *Vermetus Royanus* in my list of Matura fossils published in 1864. It has not a deep suture as that species has.

Triforis guttata n. sp.

Reversed, cylindrical; whorls about 8, zoned with three spiral lines of small obtuse points which are connected spirally and longitudinally by threads; suture impressed; base with three or four strong striations; aperture produced into a canal; peristome produced, inner margin with a narrow defined callus.

Pliocene, Matura. Allied to *T. ventricosus* Gmel., under which name it is given in my list of Matura fossils, 1864.

Solarium semidecussatum n. sp.

Small, orbicular depressed, strongly decussate on the upper surface, nearly smooth on the lower surface; umbilicus deep, its margins crenate and spirally striate.

Pliocene, Matura. It is with some doubt that I refer this species to the genus *Solarium.*

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Columbella peculiaris n. sp.

Cylindric-suboval, often a little distorted ; whorls 6, slowly increasing, the last forming about ½ ; spire obtuse ; suture somewhat irregular or dentate ; aperture small, pointed above, peristome simple, columella simple, truncate.

Pliocene, Matura. Perhaps allied to *C. clausiformis* Kien., but of shorter and more ventricose figure.

Mangelia micropleura n. sp.

Subfusiform, longitudinally ribbed, the ribs crossed by numerous striæ, of which a prominent one forms an angle on the upper part of the whorls ; last whorl longer than the spire ; aperture rather narrow, lanceolate, with a sinus on the posterior part of the thickened peristome.

Pliocene, Matura. Allied to M. pulchella. The ribs vary considerably as to size and distance apart. It was denominated *M. tæniata* in my list of 1864.

Conus recognitus.

C. solidus, Sow, Quart. Journ. Geol. Soc., vol. vi., p. 45.
" " Guppy, Quart. Journ. Geol. Soc., vol. xxii., pl. xvi., f. 1.

As the name given by Sowerby had been previously applied to another Cone, I propose the name of *recognitus* for the present shell found in Haiti and Jamaica.

Conus prototypus n. sp.

Somewhat pyriform, finely striate anteriorly, becoming quite smooth on the angle of the whorls, which bears a rather indistinct keel ; spire mucronate, rather elevated ; aperture somewhat widened towards the anterior canal.

Caroni Series, Savanetta. A cone which departs very considerably from the usual type in its swelling outlines

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and the consequent direction and shape of the aperture. It is more of the shape of *C. bulbus* than of any other species I know. It is, however, probably a young specimen.

Crucibulum piliferum n. sp.

Shell covered with numerous erect tubular spines which are small towards the apex, larger towards the base ; apex small smooth, spirally recurved.

Pliocene, Matura. Given as C. tubifer in my previous list. It may be a variety of the next species, but its plicæ are smaller, whilst the spines furnish an easily-recognized character.

Crucibulum subsutum n. sp.

Strongly striate, rugose, somewhat irregularly oval ; striations with a tendency to run in pairs.

Pliocene, Matura. Allied to C. striatum Say, under which name it appears in my paper on the Matura beds.

Trochus decipiens n. sp.

Topshaped, imperforate, ornamented by many spiral lines of moniliform granules ; whorls rather concave above, and bearing a rather broad angular keel on their lower portion ; base flattened, covered with lines of rather square granules, aperture subquadrate, wider than high, broadly angulate by the keel ; columella thickened, spreading into a callus over the umbilicus.

Var. *laticarinatus.*

Keel broader and higher, whorls deeply concave above, suture deeply impressed ; lines on the base squamosely granular.

Pliocene, Matura. As *Trochus granulatus* in my list of 1864.

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Trochus plicomphalus n. sp.

Topshaped, deeply perforated by a small circular umbilicus, zoned with many spiral granular lines, aperture subquadrate, columella straight, thickened ; base with many (10—20) moniliform rows of granules, umbilicus deep, its margins dentate.

Pliocene, Matura. It resembles *T. ziziphinus* in shape, but is devoid of any keel on the whorls.

Vitrinella marginata n. sp.

Orbicular, umbilicate, discoidal, few-whorled, minutely spirally striate ; outer margin with about four small articulated keels not visible from above, the outer one forming the periphery ; whorls somewhat convex above, spire raised, ornamented with articulated radiating striæ ; aperture nearly circular, rather oblique.

Pliocene, Matura. A most elegant little shell.

Donax fabagelloides n. sp.

Transversely oblong, somewhat triangular, subequilateral, anterior and posterior angles rounded ; zoned with broad dark bands, and finely radiately striate ; margins crenate-dentate.

Pliocene, Matura. Remarkable for its resemblance to *D. fabagella*, under which name it appeared in my list of 1864. It is more equilateral than that species, and not so high relatively to its length.

Leda perlepida n. sp.

Transversely oval, subinequilateral, moderately convex, with numerous fine concentric striæ, and occasionally deeper and wider concentric furrows ; posterior end acutely rostrate ; lunule none ; dorsal area elongate-lanceolate, longi-

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tudinally striate; hinge-teeth numerous, chevron-shaped, widely interrupted beneath the umbo by a large hinge-pit.

Pliocene, Matura. As *L. eburnea ?* in my list of 1864.

Leda illecta n. sp.

Smooth, ovate-transverse, inequilateral, somewhat tumid on the central portion, posterior end produced into a rostrum which is almost curved upwards; hinge-line somewhat deflected upwards and interrupted at the umbo; umbones approximated, scarcely prominent beyond the hinge-line; posterior cardinal area broad, smooth and ill-defined.

Lower Miocene, Manzanilla. This species also resembles *L. eburnea* Sow., but the rostrated posterior end is longer and more curved. It is allied to several recent and fossil species, but although it cannot be identified with any I have been able to find, it is somewhat difficult to exhibit clearly the differences in words. From the pliocene species *L. perlepida* it may be distinguished by its greater length and compressed rostrum.

Nucula baccata n. sp.

Subovate, inequilateral, a little produced posteriorly, ornamented by minute concentric ribs which are decussate by still finer radiating striæ; anterior and posterior ends angulate, interior pearl-shining; hinge-teeth slightly bent, divided by a very oblique hinge-pit; margins dentate.

Pliocene, Matura. As *N. similis* in my previous list; a species which it strongly resembles.

Nucula vieta n. sp.

Subequilateral, obliquely suborbicular, slightly produced posteriorly with regular rounded concentric ribs; posterior side very obliquely descending, posterior teeth straight, an-

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terior side short, its teeth few and small; margins dentate.
Pliocene, Matura.

Arca centrota n. sp.

Transversely subrhomboidal, with a strong wide carination running from the umbo to the posterior angle; ornamented with many (36-38) squamosely nodose radiating ribs each with a fine subsidiary thread-like rib in the narrow interstice; anterior margin short, rounded; posterior margin strongly sinuate, angulate above with the hinge-line and forming a more rounded angle with the strongly crenate lower margin. Hinge-teeth small in the middle of the straight hinge, but becoming larger and diverging considerably towards the angles; ligamental area more or less grooved, especially anteriorly.

Pliocene, Matura. The nodosities on the ribs are arranged, at least on the disk, in regular longitudinal rows, and the intermediate thread-like ribs are wanting on the central portion, becoming developed anteriorly and posteriorly.

Cupularia calyx-glandis n. sp.

A crateriform species allied to *C. pyriforme* and *C. Owenii* but distinguished by its more completely cup-shaped form. The details of the cells are not very easily made out from my specimens, but they seem to resemble *C. pyriforme* in general arrangement.

Lower Miocene, Manzanilla.

Pecten anguillensis n. sp.

Shell fan-shaped. ornamented with radiate muricate striæ, and about 10 or 11 prominent rounded ribs, which are crossed by concentric striæ, the concave interstices broader than the ribs. Upper valve nearly flat, lower one gently concave.

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Miocene, Anguilla. Allied to *P. peedeensis* Tuomey and Holmes, North America.

Spondylus bostrychites n. sp.

S. bifrons Sow. (non Goldfuss) Quart. Journ. Geol. Soc., vol. vi., p. 53.

A species found in Haiti and Anguilla. As the name *bifrons* had been already given by Goldfuss to a species of the same genus it is necessary to change the name.

Pentacrinus rotularis n. sp.

No other part than the stem of either of the species here named has been discovered. The stem of *P. rotularis* is circular in section, composed of numerous joints whose diameter is rather more than thrice their height.

Lower Miocene, San Fernando.

Pentacrinus obtusus n. sp.

Stem angular, somewhat irregularly pentagonal in section; joints about 1½ mill. high and about 4½ mill. in diameter.

The differences between the stems to which I have assigned these names and all other species of which I have any knowledge seem to be sufficient to warrant the creation of provisional specific appellations.

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PAPER No. 5

ON SOME NEW TERTIARY FOSSILS FROM JAMAICA

Published in The Proceedings of the Scientific Association of Trinidad, 1873, vol. 2, pp. 72-88.

§ I.—INTRODUCTORY REMARKS.

Mr. Vendryes, an ardent naturalist and zealous collector of shells and fossils in Jamaica, has kindly forwarded to me a fine set of the miocene fossils of that island. These have been in my possession for some time; but although several novelties are contained in the collection, want of time and opportunity has hitherto prevented my working them out. The high interest attaching to these fossils has however induced me to draw up descriptions of the new species, and to indicate those which although previously described from other localities are now for the first time added to the Jamaican list.

The determination of the geological age of the Jamaica beds and of the remarkable relations of the fossil fauna of the Westindian miocene to that of Europe and the living fauna of the eastern seas is strikingly supported by the new fossils now described. We have a Murex, an Ovulum, a Cassis and a Fasciolaria whose nearest congeners are European miocene and Asiatic recent; a Scalaria, previously described indeed, but from inadequate material, whose relations are similar, and a Naticina, a genus almost extinct in the Westindies, but whose present distribution is along the path pointed out as that of the migration of

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organized beings during the Tertiary period from America to the Pacific Ocean through North Africa and South Europe.

Among the collection it will be noticed that there are a few shells, e. g. *Turbo casteneus*, *Strombus pugiloides*, and *Plicatula vexillata*, which like the *Conus fuscocingulatus* of the European miocene, retain traces of the coloring which ornamented them while living. It is only where the strata are of such composition as to be extremely favorable to the preservation of molluskan remains that such a circumstance could occur. In Jamaica and Haiti the miocene formations have been remarkably suited to this end, and hence we have from them a series of organic remains scarcely surpassed in beauty even by those of Bordeaux, Dax or Paris. In Trinidad the shells of similar age are for the most part extremely altered and their characters more or less obliterated. It is therefore fortunate that we have those of Haiti and Jamaica upon which to found and rectify our determinations of the Trinidad rocks and fossils of like age.

The list of Jamaica fossil shells is now made as complete as the materials in my hands will allow: all the species known to me which are well enough preserved to admit of identification are described or named either in the present paper or in that published in the Journal of the Geological Society vol. xxii., pp. 281-295.

I ought not on the present occasion to pass by without notice the very important addition made to the Scientific literature of the Westindies by the publication of the Geological Report on Jamaica. To Trinidad belongs the honor of having initiated the Geological Survey of the Westindies: but the complicated nature of its physical structure, and the imperfect condition of the fossils found

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here have operated to render the report on our island far less complete than that of Jamaica. Besides this, since the Report on Trinidad has been published, a great deal of work has been accomplished on the paleontology and natural history of the Westindies; and the relations of the fossil shells, echinoderms, corals and foraminifera of the Caribean area have been largely worked out. Sir Roderick Murchison remarks in his preface to the Jamaica Report that the Appendix to that report by Mr. Etheridge, paleontologist to the Geological Survey of Great Britain, is not the least valuable portion of the book: and indeed I may say that to Naturalists it is the most important part of it. Mr. Etheridge's appendix relates to the paleontology of the island; and in it he has done full justice to the labors of Professors Duncan, Rupert Jones, and others, whose results have been published, with excellent illustrations for the most part, in the Journal of the Geological Society and in the Geological Magazine. He has presented such a resumé of our knowledge of the paleontology of the Caribean area as cannot fail to be highly useful if not indispensable to every worker on the Geology of that area. On one point alone have I to say anything in disparagement of this report—that is the numerous misprints in all the appendices, but particularly in the botanical and paleontological portions. In all other respects the work is well executed: there are, besides a general geological map of the island, numerous detailed sections showing the structure of the island.

§ II.—Description of the Fossils.

Hyalaea (*Diacria*) *vendryesiana* n. sp. Pl. II., figs. 2a, 2b.* Shell elongate, smooth; both valves somewhat inflated, but the superior one more so than the other: terminated on each side by two sharp mucrones, and posteriorly

[*Geological Magazine, vol. 11, 1874, pl. 17 .]

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by a narrow curved mucro not so long as the body or main portion of the shell. Lips everted, the inferior one bordered exteriorly by a raised ridge which towards the lateral mucrones gradually becomes confluent with the edges of the lips. Length 5 mm. of which the terminal mucro forms about 2. Breadth nearly 3 mm.

Related to *H. inflexa* and *labiata* of D'Orbigny—It differs chiefly in being more inflated, especially the inferior valve, and in being narrower behind the lateral mucrones, a character it would seem of some importance in this genus.

The length of the terminal portion of the shell seems to be relied upon as the distinction between *Diacria* and the more typical members of the genus *Hyalaea*. The present species belongs to *Diacria* on account of this character.

Scalaria leroyi Guppy, Pl. I, f. 10.*

Proceedings of the Scientific Association of Trinidad 1867, p. 168.

Turreted, cylindric, many-whorled, cancellated by numerous transverse and spiral costellæ, except on the base which is spirally striate only. Aperture suboval. Pillar-lip somewhat everted forming a callus on the columella. Outer lip simple, sharp, a little dilated anteriorly. Whorls regularly rounded, suture deeply sunk.

My original description of this shell was drawn up from an examination of the specimens found in Trinidad which are so much altered by fossilization that the character of the surface is not determinable. The examples from Jamaica are in good preservation, though they are not so large as those found in Trinidad, one of which is more than six inches long. Some of the specimens from Jamaica exhibit a variation in the character of the surface which might induce a belief that there are two species. I do

[*Geological Magazine, vol. 11, 1874, pl. 16.]

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not however take that view. One beautiful example has the transverse costellæ larger and more distant than the spiral ones, the latter being thread-like and rising upon the former. In this example the spiral striation of the base is also more marked. *Sc. leroyi* may be compared with *Sc. magnifica* Sow.; but there are points of resemblance between it and *Sc. decussata*, *raricosta*, and *lineata*. None of the recent Westindian species bear any resemblance to the fossil except in that general shape which is common to nearly all the members of the genus. On the whole however the nearest ally of the Jamaican fossil may perhaps be found in *Sc. tenuistriata* Orb. (Bahia Blanca).

Ringicula tridentata n. sp.

Ovate-conic, moderately thick, smooth, shining. Spire conic. Whorls about 4. Aperture suboval: columella thickened and bearing two strong spiral plaits, the callus continued backward, and carrying a stout tooth on the body-whorl; the latter separated by a deep notch or canal from the thickened and somewhat everted outer lip. Length nearly 2 mm., breadth about 1.

Distinguished from *R. semistriata* Orb. (Cuba shells, vol. ii, p. 103, pl. xxi, f. 17—18) by a wider mouth and less thickened outer lip. *R. tridentata* does not exhibit any trace of the striation which marks the anterior portion of *R. semistriata*, which was described by D'Orbigny as a recent shell from Jamaica.

Naticina regia n. sp., Pl. II, f. 6.*

Oval oblong, spirally striated by fine equidistant grooves, which are crossed by a few rather irregular lines of growth. Whorls about 5, the last very large. Spire short, acuminate. Aperture semioval rather narrowed above. Umbilicus round, very partially hidden by the everted columella

[*Geological Magazine, vol. 11, 1874, pl. 17.]

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callus. Outer lip sharp, indistinctly dentate. Length 15 mm. Breadth nearly 10.

Closely akin to *N. lamarckiana* from which it is distinguished by its narrower mouth. It is almost as near to *N. papilla* (Africa) but it is less elongate in its proportions.

Bulla vendryesiana n. sp., Pl. I, f. 6.*

Rimate, rather cylindrical-ovate, solid, smooth. Spire deeply sunk. Aperture longer than the shell, dilated anteriorly. Inner lip covered with a callus which is everted over the narrow umbilicus, and extends backward to the canal separating the body-whorl from the sharp outer lip. Length about 15, breadth about 9 mm.

Allied to *B. striata* Brug. particularly to that form called *B. maculosa* Mart. The surface of the fossil is not well preserved, and does not admit of an exact description of its characters. *B. vendryesiana* is rather more cylindrical in shape than *B. striata*, and from *B. maculosa* to which it is nearer in figure it is distinguished by its greater solidity and its thicker and more everted columella callus.

Tornatina coixlacryma Guppy.

Geological Magazine. vol. iv (1867) p. 500.

Tornatella textilis n. sp., Pl. I, f. 4.†

Oval-oblong, solid, a little ventricose, closely cancellated by numerous spiral riblets and finer longitudinal threads most distinct in the spiral grooves. Spire short, conic. Whorls about 7. Aperture elongate, narrow, dilated anteriorly into a canal. Columella twisted, bearing a single stout fold. Outer lip sharp, finely dentated by the spiral riblets. Length 17, breadth 9 mm.

In shape this shell approaches *T. fasciata*. It is of more solid structure, its spire is somewhat shorter, and it is at once distinguished by its cancellated surface.

[*Geological Magazine, vol. 11, 1874, pl. 16].
[†Geological Magazine, vol. 11, 1874, pl. 16].

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Cancellaria scalatella n. sp. Pl. II, f. 4.*

Turreted, umbilicate, spirally striate by numerous close spiral threads, more elevated on the stout rounded longitudinal variciform ridges of which there are 6 or 7 on a whorl. Suture very deeply sunk. Whorls about 7, slightly rounded, angulate and crowned above by the ridges. Aperture almost triangular, rounded above, angular and formed into an obsolete canal anteriorly. Outer lip sharp, grooved within. Inner lip continuous, thin, sharp, slightly reflected and bearing two folds. Base angulate, perforated by a small round umbilicus.

Related to *C. varicosa* Brocchi (Miocene, Piedmont); but smaller and of somewhat stouter figure. The spiral striæ are coarser, and the peristome is finely grooved instead of being coarsely dentate only. In *C. varicosa* the spiral striæ are crossed by very fine longitudinal ones, which do not exist in *C. scalatella*. The most striking difference however is that the whorls are rounder and the suture much more deeply sunk in *C. scalatella*, whilst the longitudinal ridges project upon the angle of the whorls so as to give a coronate appearance.

The three Cancellariæ hitherto described from the Jamaican miocene are all akin to European fossils of the same date; but two of them belong to the type of the recent *C. reticulata*. The present is of more decidedly miocene aspect than either of the three previously described.

Ovulum immunitum n. sp. Pl. I, f.7 †

Fusiform-elongate, pointed at both extremities. Outer lip thickened, extending in a nearly regular slight curve from the posterior to the anterior canal; slightly dilated anteriorly. Inner lip with two strong folds at the anterior end. Aperture as long as the shell ; narrow poster-

[*Geological Magazine, vol. 11, 1874, pl. 17.]
[† " " vol. 11, 1874, pl. 16.]

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orly, growing wider gradually until near the middle of the whorl, then increasing in width by the expansion of the outer lip and the recession of the whorl to form the slightly twisted pillar lip. Length about 20, breadth about 7 mm.

Allied to *Ov. leathesi* Wood of the English Crag. It is nearly of the same size, but is more slender in its proportions and in some particulars is more close to *Ov. spelta*, including under that term both the fossil and recent species so called.

Turritella tornata Guppy.

Journal Geol. Soc. vol. xxii, p. 580, pl. xxvi, f. 12.

This shell occurs also in the Miocene of Haiti and Trinidad.

Conus recognitus Guppy.

C. solidus, *Sowerby*, Journ. Geol. Soc. vol. vi, p. 45.

C. recognitus, *Guppy*, Proc. Scient. Assoc. 1867, p. 171.

The name *solidus* having been used for another Cone, I proposed in 1867 the name of *recognitus* for this species.

Conus consobrinus Sow., Pl. II, f. 4.*

Sowerby, Journ. Geol. Soc. vol. vi, p. 45.

I have referred this shell to Sowerby's species, but if my determination be correct Sowerby's description is in need of amendment. The zones or rather spiral ribs can scarcely be called granose, although they exhibit a tendency to become so towards the completion of the last whorl, which is usually devoid of the tubercular crowning of the previous whorls.

This species was hitherto only known from Haiti, but it is now added to the Jamaican list.

Pleurotoma henekeni Sowerby.

Journ. Geol. Soc. vol. vi, p. 50, pl. x, f. 6.

[*Geological Magazine, vol. 11, 1874, pl. 17].

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Pleurotoma haitense Sowerby.

Journ. Geol. Soc. vol. vi, p. 50.

Ficula carbasea Guppy.

Journ. Geol. Soc. vol. xxii, p. 580, pl. xxvi, f. 7.

Previously known from Anguilla and Trinidad.

Purpura miocenica n. sp. Pl. I, f. 9.*

Subpyriform, rather ventricose above, rimate, narrowed and produced anteriorly, adorned with longitudinal ribs (about 10 to the whorl) which are crossed by coarse rugose high narrow spiral ridges or threads. Whorls about 6, apex acuminate. Pillar lip smooth, reflected over the shallow umbilical fissure. Canal produced. Outer lip sharply dentate by the spiral ridges. Length about 21, breadth about 15 mm.

The outer layer of the shell is usually removed, and where this is the case each spiral rib appears to be double; but when the outer surface is preserved the somewhat foliated or echinated rugosities of these ribs are very obvious.

This is a Coralliophila, and is related to the *P. galea* (Chemn.) of D'Orbigny of which the name ought probably to be *P. plicata*. the appellation *galea* being the rightful property of a closely allied Eastindian shell. Another form with which the Jamaican fossil may be compared is *P. squamulosa* Reeve.

Fasciolaria textilis n. sp. Pl. I, f. 2.†

Elongate, fusiform, closely cancellated by numerous spiral ridges from 1 to 2 mm. distant between which are (especially anteriorly) one, two or three finer threadlike ribs; and by numerous closer and smaller longitudinal lines. Whorls 6, the first two of which are smooth, the

[*Geological Magazine, vol. 11, 1874, pl. 16.]

[† " " vol. 11, 1874, pl. 16.]

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apex deciduous and usually wanting, the last more than two-thirds of the shell, rather ventricose above the middle, produced and rather attenuated anteriorly ; bearing on the upper half 5—7 elongate rounded tubercular prominences. Columella margin with three strong tooth-like plaits.—Interior of peristome smooth. Length nearly 70 mm. breadth 30.

The cancellation gives to the surface an appearance like that of coarse cloth or bagging. This species should be compared with the *F. intermedia* of Sowerby from the Haitian miocene. It bears a resemblance to *F. filamentosa*, but is shorter, stouter, and less angular in all its features except only the tubercles, which are disposed in similar fashion, but are perhaps somewhat larger and more elongate. It is very different from *F. tarbelliana* Grat. which occurs at Cumana in Venezuela, as well as in Chili and Europe. *F. textilis* exhibits the close alliance of the genus to *Turbinellus*.

Phos erectus n. sp. Pl. I, f. 1.*

Solid, turreted, conic-cylindric, finely striated longitudinally and adorned with stout longitudinal variciform ridges which are highest on the angle of the whorls, become obsolete at the shallow suture and are twisted at the base : coarse spiral threads cross the longitudinal grooves and ridges, rising on the latter into low scarcely noticeable tubercles. Whorls about 9, increasing very gradually, slightly angulated, the last forming more than one half the length of the shell. Aperture rather narrow. Columella twisted bearing one spiral plait. Outer lip simple, having 12—15 entering grooves, and furnished with a small sinus near the anterior canal ; joined posteriorly with the body-whorl by a callus. Length about 21, breadth about 10 mm.

[*Geological Magazine, vol. 11, 1874, pl. 16.]

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Phos solidulus Guppy.

Nassa solidula, Quart. Journ. Geol. Soc. vol. xxii—p. 579. pl. xxvi. f. 11.

Strombus pugiloides n. sp.

The shell for which I propose the above appellation was considered to be *Strombus pugilis* by Mr. Carrick Moore. The name was printed *fragilis* in his paper in the Journal of the Geological Society, vol. xix, p. 511. In my papers on the tertiary fossils of Jamaica and the Westindies the species was recorded under the name *Str. pugilis.* In ordinary specimens like those usually found in Jamaica, Haiti, and elsewhere, the only well-marked differences that can be noticed between the fossil shell and the recent *Strombus pugilis* are that in the former the last whorl is usually devoid of the spiniform tubercles and that the shell is of shorter and broader figure. But some examples supplied me by my friend Mr. Vendryes exhibit an unexpected character. They show chevron-shaped bands of color, about 12—15 on the last whorl. Each band takes the shape of a V, the apex of which occurs near the middle of the whorl and forms an angle of about 30° pointing backwards or away from the aperture. These bands of color are about 2 mm. wide and the spaces between them are about 3 mm. Numerous specimens of the recent *Str. pugilis* have passed through my hands, but I have never noticed the slightest approach to such a character. The recent shell is pale red or pink only relieved by an indistinct band of paler tint following the middle of the whorl. A less constant difference may be found in the low rounded lamellar dentition inside the outer lip which is very faint or altogether wanting in *Strombus pugilis*, but more marked in the fossil.

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Strombus bifrons

Journ. Geol. Soc. vol. vi, p. 48, pl. ix, f. 9.

Murex collatus n. sp. Pl. I, f. 8.*

Ovate, rimate, slightly flattened, adorned with numerous thin slightly fimbriate or crenulate varices often doubled especially the later ones ; about 7 on the last whorl ; their interstices indistinctly crossed by low transverse costæ which terminate in points on the varices ; the upper point large, acute and projecting, giving an angulate appearance to the shell : varices uniting below to form an irregular and contorted canal. Whorls 6—7, somewhat angulate. Spire sharp. Outer lip expanded and crenulate, obtusely dentate within. Pillar lip smooth. Length about 25 mm. Breadth about 15. Total length of last whorl including canal about 18 mm.

Very closely related to *M. calcitrapa* Lam. (Eocene, Europe). It is smoother and the whorls less angulate. Those shells belong to a small group of Murices which exhibits the connection through *Trophon*, *Rapana*, *Latiaxis*, *&c.* to *Purpura*. *M. collatus* would perhaps be ranked by some conchologists as a *Trophon*, as has already been done with *M. calcitrapa*.

Typhis alatus Sowerby

Journ. Geol. Soc. vol. vi., p. 48, pl. x. f. 4.

A species almost as near to *T. tubifer* (Eocene, Europe) as *Murex collatus* is to *M. calcitrapa*. The living analogues of *T. alatus* are *T. pinnatus* and *T. sowerbyi*.

Ancillaria pinguis n. sp. Pl. I, f. 3.†

Ovate conic, spire elevated, acuminate. Suture usually visible through the enamel which covers the spire and accompanied at a little distance by a keel the ridge of which is thread-like. Aperture suboval, elongate—Um-

[*Geological Magazine, vol. 11, 1874, pl. 16].
[†Geological Magazine, vol. 11, 1874, pl. 16].

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bilicus deep, narrow, partly hidden by the callosity of the inner lip. Columella callus strongly twisted—central portion of last whorl without enamel.

Bears some resemblance to *Anc. lamellata* Guppy. A near relation is perhaps *A. rubiginosa*, which has a spire of similar character.

Ancillaria glandiformis Lam.

I think it possible that some of the examples of *Ancillariæ* from Jamaica belong to this species, as I noticed in the Geological Magazine, vol. iv, p. 498.

Cassis reclusa n. sp.

Ovate, ventricose, sulcated by about 18 narrow and shallow equidistant spiral grooves, the flattened intervening ridges being raised into knobs by somewhat obscure longitudinal costæ. Spire conic, cancellated. Apex smooth, blunt. Columella expanded into a granose callus; canal short: outer margin thickened and reflected, dentate.

Very closely related to *C. subulosa* (a Bordeaux fossil). It is chiefly to be distinguished by its larger spire and apex, generally narrower and less ventricose figure, and somewhat stouter ornamentation. Amongst recent Westindian species the nearest relation of *C. reclusa* is *C. granulata* (?=ciacatricosa Meusch.)

Crepitacella cepula Guppy

Melanopsis cepula, Journ. Soc., vol. xxii, p. 580, pl. xxvi, f. 14.

Crepitacella cepula, Geol. Magazine, vol. iv. (1867) p. 500.

This shell is related to *Cyllene pulchella* Adams. It is not impossible that some other fossils described as Melanopsis really belong to the group *Crepitacella*.

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Monodonta basilea n. sp. Pl. I, f. 2*

Top-shaped, umbilicate. Apex smooth, sharp. Whorls about 7, very strongly carinate, the stout keel on the angular ridge bearing a row of rounded undulate tubercles and having near the suture a less distinctly marked keel, between which and the keel on the angle there is a slight concavity marked only by faint spiral ridges crossed by lines of growth. Lower half of last whorl forming the base covered with strong spiral ridges. Mouth subcircular. Columellar lip callous, produced into a broad tooth above a short broad rather effuse canal. Outer lip dentate, grooved within. Total length about 15, greatest breadth about 12 millimetres.

In general characters there is some resemblance between this shell and *Trochus cypris* Orb. (=*Monodonta elegans* Bast.)

Neaera costellata Desh.

Corbula vieta Guppy.

Journ. Geol. Soc. vol. xxii, p. 580, pl. xxvi, f. 8.

Venus blandiana n. sp.

Suborbicular, subequilateral, moderately convex, adorned with numerous equidistant concentric lamellæ, between each of which there are about 7 or 8 concentric striæ : somewhat angulate in front and subtruncate behind : margins crenate. Lunule smooth, impressed. Posterior dorsal area not defined, striate continuously with the lamellæ of the disk. Umbones small. Cardinal teeth 2 under the lunule ; lateral tooth 1 nearly halfway down the posterior slope.

Referred to hitherto in papers on Westindian fossils as *Venus rugosa* var., to young specimens of which species it bears a somewhat close resemblance. The Jamaican ex-

[*Geological Magazine, vol. 11, 1874, pl. 16].

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amples are smaller than those from Haiti. A specimen in the British Museum from the latter place is labelled *V. circinaria*, but it is not *Cytherea circinata*, nor even nearly allied to it.

When describing *Cytherea juncea* from Cumana I omitted to point out the close kinship between that fossil and *C. circinata*.

Chama involuta n. sp. Pl. II, f. 5.*

Left (attached) valve deep internally, very convex externally, often spiral, completing a turn and a half, covered externally with distant large foliaceous scales more or less erect, between which are small irregular diverging granose ridges. Right valve patulous, ornamented with numerous close concentric sinuous foliaceous laminæ. Umbones, large, prominent, spiral. Margin and laminar cardinal tooth crenate.

Mr. Vendryes suggested that this might be a *Diceras* : but I see no ground for referring it to that genus. It is certainly a very spiral chama ; but otherwise its characters are in all respects those of the genus. It is apparently always attached by the umbo of the left valve, and the place of attachment is generally marked by the remains or impressions of the septa of corals. It has some resemblance to a recent species found in the Westindies, which if I have identified it correctly is *Ch. ruderalis* Lam. but besides other considerable differences the latter is always attached by its right valve.

Plicatula vexillata n. sp. Pl. II, f. 7.†

Inequivalve, irregularly fanshaped ; valves, usually with the disk almost smooth, adorned towards the margin by 7 or 8 stout obtuse radiating ribs along each of which are disposed a few lines of reddish brown (probably red when

[*Geological Magazine, vol. 11, 1874, pl. 17.]
[† " " vol. 11, 1874, pl. 17.]

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alive) and between which are some distant almost foliaceous concentric striæ of growth. Longest diameter about 17 mill.

Very near to *P. ramosa* Lam. Florida.

Spondylus bostrychites Guppy.

S. bifrons Sow. (name preoccupied). See Proceedings Scient. Assoc. Trinidad, 1867, p. 176.

Leda clara n. sp.

Subelliptical, lanceolate, nearly equilateral, somewhat but not extremely rostrated. Disk smooth, shining; Valves with a few fine close regular concentric riblets perceptible near the anterior angle where an indistinct sulcus runs upwards towards the umbo. No distinct escutcheon. Lunule narrow, indistinctly defined. Umbones prominent. Ventral margin slightly angulated at about a third of its length from the posterior point where an obscure carina runs to the margin from the umbo. Length 12 mill. height 6, thickness about 4.

In shape somewhat like *L. nasuta*. It is rather difficult to describe the smooth plain species of this genus; their differences being most generally noticeable in shape and extent of rostrum &c. The following species have been already described from Westindian tertiaries.

Leda packeri	Forbes	Lower Miocene	Barbados.
incognita	Guppy	"	Trinidad.
bisulcata	"	Upper Miocene	Jamaica.
illecta	"	Pliocene	Trinidad.
perlepida	"	"	"

Three species of *Nucula* have been recorded from the same formations.

Ditrupa dentalina n. sp.

Tube clavate, curved, slightly irregular in diameter,

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gradually increasing from the smaller end, which is annulate, becoming smooth towards the middle of the shell; the lower half smooth, shining, rather suddenly thickened near the aperture, to form which it as suddenly contracts to a diameter not greater than that of the smaller third of the tube.

There are no very distinct characters by which to separate this annelid case from *D. planum* of the European Eocene. I have thought it as well nevertheless to indicate its presence in the Jamaica tertiaries under a provisional name.

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PAPER No. 6
ON NEW SPECIES OF BIVALVE MOLLUSKA FOUND AT CUMANA, VENEZUELA.

Paper presented to the Scientific Association of Trinidad, Dec. 10, 1873 and published in vol. 2 of the "Proceedings," pp. 90-2, with plate 3.

One of the shells now to be described is a large and fine species of *Venus*. Specimens of this have been in my cabinet more than four years; but although it appeared to me unlikely that so large and handsome a shell should have escaped notice, yet I have not been able to find anything published relating to it. The species is certainly allied to *V. cancellata*, but by no means very closely. Its square equidistant ribs are not unlike those of *V. rugosa*, and the shape and color may recall *V. gallinula*, but it must be admitted that these resemblances are somewhat illusory.

The other shell is a *Mactra*, not belonging to the typical group of that genus, but on the contrary, somewhat of an aberrant form. It is a large and interesting species.

The recent not less than the fossil shell fauna of Cumana

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is very interesting. Among the recent shells are several which are by no means common in the Westindies; as for instance the true *Persona reticularis* (Linn.) which though nearly allied to must not be confounded with the *P. clathrata* of Madagascar nor with the fossil *P. similima* of the Westindian miocene. *Dispacus glabratus* occurs at Cumana: and I have also from that place an undetermined species of *Fusus* (which resembles young shells of *Fasciolaria gigantea* except that it has a longer canal), and also the following: *Solarium tesselatum*, *Phos guadelupensis*, *Venus flexuosa*, *Calyptraea auriculata*, (of which apparently there is a good figure in the large edition of Cuvier's Regne Animal pl. 48, f. 4, under the name of *C. cuvieri* Desh.) *Oliva reticularis* (several forms), and *O. monilifera* Reeve (?=*O. mutica* Say=*nitidula*).

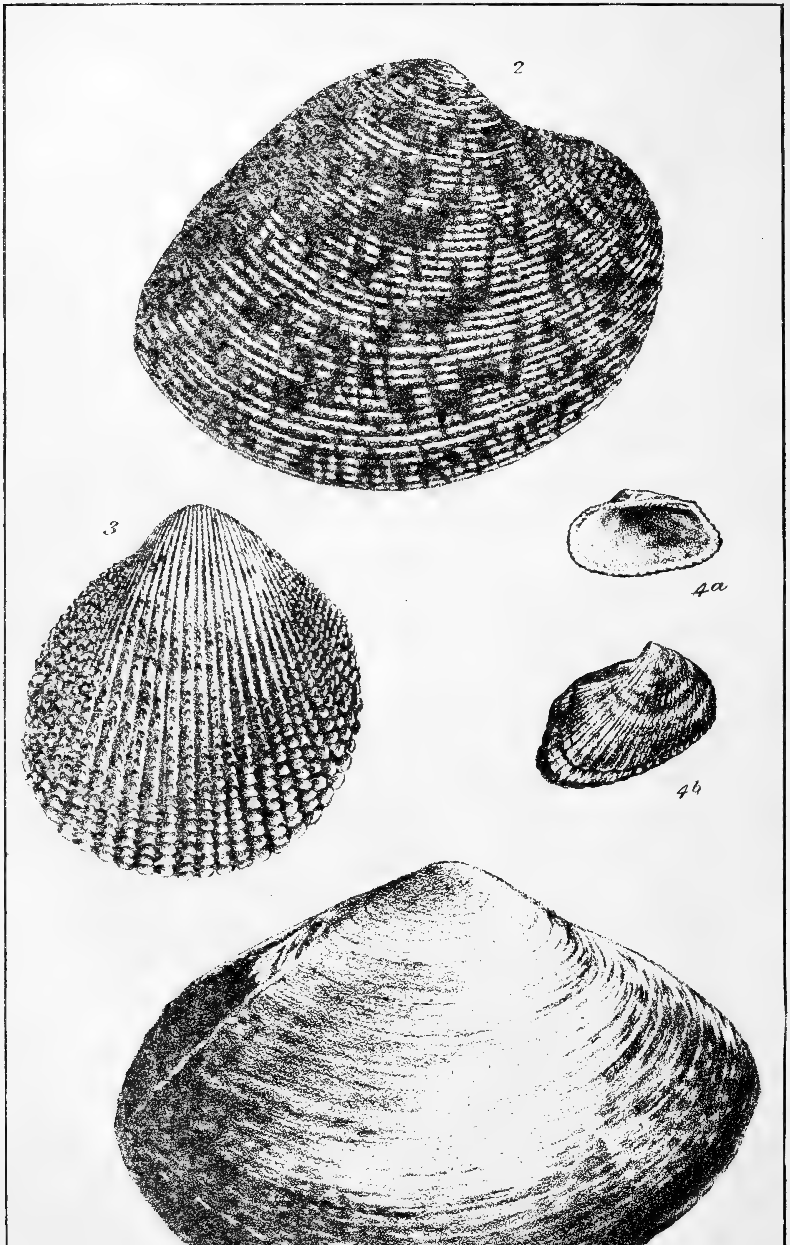
Venus superba n. sp. Pl. III. f 2.

Ovate, slightly subtrigonal, a little inequilateral, ventricose; anteriorly produced and rounded; posteriorly produced and subangulate; umbones closely approximate; lunule large, striated with irregular diverging lamellæ, distinctly defined by a sharp groove: posterior dorsal area large, striate, not distinctly defined. Valves marked with numerous irregular angulate streaks of chesnut or brown and adorned with numerous concentric crenate ribs, which are rather more distant, thinner, and more distinctly crenate near the anterior and posterior margins: on the disk the ribs are square, flattened and polished, and the crenation is less marked. Length 70, height 55, thickness about 45 mm.

Mactra anserina n. sp. Pl. III. f 1.

Oval, compressed, subequilateral, gaping widely posteriorly, anteriorly somewhat produced and subangular,

PROC. SCIENT. ASSOC. TRINIDAD. VOL 2, PL. 3.



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posteriorly high with a decided obtuse angle formed by a low keel running from the umbo, on the upper and posterior side of which keel the shell is covered with a black epidermis. Valves flattened, white, rather fragile, marked with concentric striæ of growth, which are worn smooth on the disk and umbones, but towards the ventral margin are covered with a yellowish brown wrinkled epidermis. Length 85, height 60, thickness 30 mm.

The details of the hinge are somewhat similar to those of the hinge of *Hemimactra gigantea*, but the postcardinal area resembles that of *Schizodesma*. The latter feature is much developed in our shell, and is remarkable for its black epidermis, that of the other portions of the shell being of a light brown. *M. anserina* may possibly be allied to the *M. similis* of Gray in Beechey's Voyage, an Australian shell, (not the *M. similis* of Say—*ovalis* Gould, which is an inhabitant of North America.)

EXPLANATION OF PLATE III.

All the figures are of the natural size.

Fig. 1. *Mactra anserina*, right valve—Cumana, Venezuela.
" 2. *Venus superba*, right valve
" 3. *Cardium eburniferum*, right valve - S. Coast, Trinidad
" 4a *Arca centrota*, right valve, interior.
" 4b " " right valve of a large specimen, [exterior.

The last two species were described in the Proceedings of the Scientific Association of Trinidad. vol. i, 1869, pp. 367-368. *Arca centrota* had been previously described as a fossil at p. 175 of the same vol. (1867).

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PAPER No. 7.

ON THE PHYSICAL GEOGRAPHY AND FOSSILS OF THE OLDER ROCKS OF TRINIDAD.

Read before the Scientific Association of Trinidad, June 27, 1877 and published in the "Proceedings," vol. 2, pp. 103-115, with three full page figures.

1. *General Considerations.*

The older rocks of Trinidad were described by Messrs. Wall and Sawkins in their Report on the Geology of Trinidad under the name of the "Caribean Group." The age of the series was not determined by them, although they surmised it to be of considerable antiquity. The position as well as the lithological structure of these rocks are such as lend strong support to the theory of their great age: but the absence of fossils rendered all attempts futile at a nearer determination.

The series in question occupies a considerable portion of the litoral cordillera of Venezuela, and extends eastward through the north of Trinidad to Tobago. It is composed of gneiss, gneissose, talcose, and micaceous slates and crystalline and compact limestones. The compact limestones however, may possibly be of a much later age than the other portions of the group—they lie unconformably upon the upper beds of the metamorphic slates.

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In Trinidad the northern range of mountains is composed of rocks, belonging chiefly if not entirely to the "Caribean Group." These rocks attain collectively a thickness of more than 10,000 feet. The whole thickness of the group is probably much greater than this; for the evidence furnished by dip and other circumstances leads to the inference that a portion of the series, as developed in Venezuela, is inferior in position to any of the rocks exposed in Trinidad. In the diagram, Fig. 3, this older portion is represented as thrown down to the north of Trinidad, beneath the waters of the Caribean Sea (Fig. 3, *a*). Besides this downthrow we have evidence of two or three other lines of dislocation which traverse the range through its length from east to west. These dislocations are marked with a star in Fig. 3, and are indicated on the sketch map, Fig. 1. They have caused, in conjunction with other movements, of which I shall presently speak, some peculiar phenomena in the physical geography of the valleys, which are much narrower, and in some cases quite ditch-like, to the south of the line of the greatest dislocation (between *c* and *d*, in Fig. 3), and widen out above into large basins.

The separation of Trinidad from Venezuela was probably produced by a great downthrow, which I have attempted to represent in Fig. 2. The line of that downthrow, passing through the Boca Grande, is laid down in the sketch map, Fig. 1. From the facts intended to be illustrated by these diagrams, it would appear that the Gulf of Paria occupies an area of depression, the lowest axis of which passes through the Boca Grande, running approximately north and south. The amount of subsidence diminishes gradually as we pass eastward, until at the valley of Arouca its effects disappear

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(*see* diagram, Fig. 2). Plain evidences of this remarkable subsidence are to be found in the submerged valleys about the Bocas,—valleys obviously produced by subærial denudation, but now sunk below the level of the sea. Not less clear is the testimony of the wide and comparatively shallow valleys of Carenage and Diegomartin, originally much deeper, but now to a great extent filled up by alluvium. As we go eastward from Diegomartin the valleys become steeper and narrower, assuming the form of mere ditches in their lower portions, but having immense delta-like deposits of alluvium at their mouths, ranging from 80 to 200 feet in height above the level of the Caroni plain. These moraine-like deltas are evidences of upheaval rather than of subsidence; they are not found in the valleys west of Portofspain, but, beginning with the Santacruz valley, they increase in magnitude as we go east.

I have already said that the petrological and physical features of the Caribean group would lead us to assign a high antiquity to it; but the absence of fossils has prevented any precise determination of its age. I shall presently indicate what evidence we have gained on this head, since the publication of the Geological Report on Trinidad.

2. *Fossils of the Caribean Group.*

In 1869 I had communicated to the Geological Society of London my discovery of organic remains in the Caribean Series of Trinidad. I described to that Society a piece of limestone which exhibited unmistakeable marks of organic origin. The specimen in question was a part of an irregular string of limestone, found on digging a trench in the decomposed micaslate in the San François valley, north of the

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Laventille Hills. The bulk of the specimen was composed of a calcareous structure which appeared to me to bear a resemblance to the Eozoon of Dawson and Carpenter. There were also fragments of echinoderms and corals. I described the first-mentioned structure under the name of *Eozoon caribeum*, pointing out some obvious differences between it and *E. canadense*. I sent specimens to Dr. Carpenter, who however after a slight examination did not pronounce any definite opinion upon them. He says he treated them with acid ; but that operation could scarcely be of much use except where the spaces formerly occupied by the living body were infiltrated with a silicious deposit. In the present case the infiltration as well as the skeleton itself is calcareous. I should not consider it necessary to insist upon the eozoonal theory in reference to this rock, if evidence hereafter point to the contrary ; but I think no doubt can rest upon the organic origin of the whole structure ; and I prefer for the present therefore to adhere to the name of *Eozoön caribeum*, though subsequent researches may render it doubtful whether it is congeneric with *E. canadense.*

Besides the fossil which I have regarded as an Eozoon, and of which the greater part of the specimen just described is made up, there are other organisms observable in it. A few small pieces of coral occur. One form I have named *Favosites fenestralis*, a minute species, which probably has its nearest analogue in *F. fibrosa.* No pores or tabulæ are visible in our fossil, whence its identification with Favosites may appear to be doubtful ; but I am rather disposed to attribute the absence of those structures to metamorphism.

The remains of echinodermata are distinct enough to allow of our referring them without doubt to that division of

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the animal kingdom ; but the generic and even the ordinal characters are difficult to make out. There are plates, stems, and spines scattered through the stone ; the most perfect consisting of five ambulacral plates and four pairs of pores. Another specimen, though much broken, shows portions of at least twenty ambulacral or pseudo-ambulacral plates, somewhat resembling the Devonian *Eleacrinus*. In some of the calciferous slates from the same series very similar remains occur, but no perfect or nearly perfect specimen has come to hand. Some of the fossils appear to be fragments of cystidea.

There is nothing improbable in the association of serpuline, molluskan, and echinoderm remains with Eozoon. Speaking of the Canadian rocks, Dr. Dawson refers to fragments possessing appearances highly characteristic of crinoidal remains, and mentions that these and other appearances would indicate that in addition to the débris of Eozoon, other calcareous structures more like those of crinoids, corals, and shells have contributed to the formation of the Laurentian limestones.

I give here a list of the fossils I have with more or less certainty identified from the calciferous slates and intercalated limestones of the mica and clay-slates of the Caribean group. Small as this list may appear, it is a great advance upon anything previously published as to the paleontology of these rocks. It may be noticed that there is no mollusk in the list, nor have I yet seen any fossil from the Caribean Group (inclusive of the compact limestone) which I could refer with any degree of probability to the subkingdom molluska.

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Fossils of the Caribean Group.

? Eozoon caribeum Guppy.
Favosites fenestralis "
Petraia (like P. bina Lonsd).
Pseudocrinites (species like Ps. magnificus Forbes).

The other remains have not been assigned with any certainty to their generic positions.

3. *The Blue or Compact Limestone.*

The southern borders of the ranges formed by the Caribean Group are fringed here and there by low hills chiefly of limestone, with occasional interstratified beds of clay-slate and shale, lying unconformably upon the micaschists and clayslates, which constitute the larger elevations. This compact dark-blue limestone, often nearly black, contains abundant fossils, but in so metamorphosed a state as to be generally irrecognizable. We find in some beds what appears to be a mass of serpuline remains, occasionally small univalves show themselves, and rarely a few distinct corals. But the rock is so hard, and the structure of the fossils so altered, as to make it next to impossible to extract any of these organic remains in a state which might admit of study or identification. Consequently we are almost as much in the dark as ever as to the age of these rocks. One important conclusion, however, has been gradually forcing itself upon my mind, which is that the compact blue limestone of Gaspari, Pointe Gourde, the Cotoras, and Laventille does not belong to the same formation as the mica and talc schists and sandstones, the clayslate, quartzite and crystalline limestones of the Caribean group. The compact limestone is of a later age ; for while the Caribean Group appears to belong to an older paleozoic epoch, the compact limestone

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may turn out to be newer paleozoic or even older secondary. This is perhaps speaking rather widely ; but the state of the fossils found so far does not allow of a more definite statement. Professor Tate is of opinion that the whole series is jurassic.

My attention was first called to the fossils of the compact limestone by Dr. Stevens, who was engaged at the gold mines of Venezuelan Guiana. He showed me a piece of limestone containing small gastropods, like Murchisonia (*M. anna* Billings), and small bivalves like Leptodomus. Dr. Stevens was aware that I had already discovered organisms in the clay slates and calciferous slates of the older series. Further search in the blue limestone resulted in my finding a shell differing slightly from Dr. Steven's specimens, and more resembling another North American species of Murchisonia (*M. linearis* Billings). Lately I have discovered at the Cotoras (at Five Islands) a number of specimens of a Turritella-like shell, which, however, I am not able to refer with any certainty to Murchisonia, although there is a possibility that it may belong to that or an allied genus. There was, I thought, a resemblance between the specimens and some of the narrow forms of Nerinea, but I was unable to demonstrate either a hollow axis or folds on the columella. Several specimens also occurred of another and much smaller gastropod (like *Loxonema lincta* Phill. Pal. Foss). Supposing my ideas of the resemblances of these fossils to be somewhere near the truth, the age of the compact limestone might be Devonian or Carboniferous. The corals found associated with the shells are of a massive kind, but I could not detach a fragment. I have been told of the discovery of a heterocircal fish in these rocks, the specimen having

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been found in one of the quarries near Portofspain, but I have not seen it. It might throw some light upon the question. Unfortunately, no fossil that I have seen is sufficiently decided in its characters for me to pronounce more certainly upon the subject. The discovery of a trilobite, a graptolite, or an ammonite, would relieve us from a great deal of perplexity, and I feel great faith that some such evidence will be forthcoming eventually.

Some of the beds of the blue limestone have a strong resemblance to certain varieties of oolite. A section of this exhibits a number of very closely packed elongate-oval opaque-grey grains, embedded in a darker material. When this rock is weathered, the grains are dissolved out and the intermediate material remaining bears a resemblance to Stromatopora or Eozoon.

Organic Remains from the Blue Limestone.

? Murchisonia, two or three species. Leptodomus species.
? Loxonema species.
also a massive reef-coral and many serpuline fossils.

II. ON THE DISCOVERY OF TERTIARY COAL AT WILLIAMSVILLE, SAVANAGRANDE. By R. J. Lechmore Guppy, F.L.S.. F.G.S., etc.

Preliminary Notice.

A short account of the Coal Bed discovered at Williamsville may be of interest to the members of the Association. A visit to the spot where the bed is being worked enabled me to take a few notes with respect to it.

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The site of the discovery is on the Montserratt road, about half a mile from the railway between Union and Brothers. The workings are in the valley along which the road runs. The seam is from four to five feet thick, and the coal is apparently of fair quality, but so extremely friable that it falls on handling into very small pieces. This property is prejudicial to the value of the article.

The dip of the bed is between 50° and 60° to the W.N.W., consequently the strike is about N.N.E. The containing strata are clays without fossils, probably belonging to the upper part of the miocene (*h*, Fig. 3), lying unconformably upon the secondary rocks. The strata are probably the equivalents of the Caroni series (*h''*, Fig. 3), but they are deposited on the opposite (southern) side of the neocomian ridge which traverses the middle of the island. Our knowledge of the geological structure of this part of the country is extremely deficient owing to the want of exposures, without which no geologist could ascertain with precision the position and relations of the rocks. In Fig. 3 I have endeavoured to present an improved view of the succession of the rocks of Trinidad, based upon the results of the geological survey; but with such improvements as observations extending over fifteen years have enabled me to suggest. In this diagram *h*, *h'*, *h''*, and *h'''* represent the miocene or tertiary coal-bearing formations, which probably pass up near the south coast into pliocene beds, which also include lignite and carbonaceous shales. The extent of the eocene formation is not clearly defined; this formation does not contain beds of lignite so far as known, but many of its beds are impregnated with asphaltic products, which in my opinion are derived from the miocene formation.

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There can be no doubt of the existence in the Caroni carbonaceous series (Miocene) and its equivalents both to the north and to the south of the central ranges of extensive deposits of tertiary coal which will sooner or later be of much value to the island. The seam which is the subject of this paper is not at present worked to a greater depth than eight or ten feet, owing to the influx of water, which cannot easily be drained off, but would require engine power if the pits are carried much deeper. Moreover, the clays cave in, and would require appliances such as are generally used in mining operations to keep the pits open. But as the seam runs into the hill a greater depth of it will at every step be available without serious hindrance from water, provided proper means be used to prop the working and prevent caving in.

Want of time and opportunity prevents me at present from following up this subject more closely, but I trust hereafter to be able to pay some attention to it.

I have seen specimens of coal from other seams in the Montserrat district, which, owing to their less friable nature, will probably prove to be of higher value. The Williamsville coal may prove useful for making gas, and also for smithy purposes ; but to be adapted for general purposes without waste it would have to be manufactured into a form similar to the so-called "patent fuel." In any case, however, the precise value of the article must be determined by experiment, for it is difficult to pronounce upon its exact qualities by inspection only. A reference to the geological map will show that the existence in the neighborhood of the Guaracara of deposits of asphalt and petroleum has already been indicated ; and some recent discoveries of glance asphaltum

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in quantity may possibly lead to the opening up of a new branch of productive industry in the island.

The quantity of rocks in this island yielding asphaltic and bituminous substances which may hereafter be valuable for the production of illuminating and other oils by distillation is very great. Tertiary coal was discovered and worked in Couva many years ago. The site of the beds is marked on the geological map, and they probably extend with more or less interruption all across the island to the north of the Tamana and Montserrat ranges. I append hereto an extract from a report on the Couva coal by Mr. Wall, Director of the Geological Survey.

The late discoveries added to my own observations make it seem probable that the Nariva series of the Government geologists, is the equivalent on the south side of the central range of the Caroni carbonaceous series on the north ; and if this be correct, we may expect to find a series of coal beds extending from the Guaracara valley on the west to the Nariva swamp on the east. In support of this view I may state that the section made by the Geological Survey of the country between Sanfernando and Montserrat bears out the theory of the contemporaneity of the so-called Nariva series with the Miocene (Caroni) series.

Extract from a Report by G. P. WALL, F.G.S., *Director of the Geological Survey, on the Mineral Fields of the Couva District, dated "Trinidad, 1st May, 1857."*

The deposits of mineral fuel in the district of Couva, consist of carbonaceous beds of a character intermediate between lignite and coal. A practical trial of the economic value of this substance was made by Mr. Maurice Rostant, who was

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perfectly satisfied that if a quantity could be obtained it would be of great use in the operations of the sugar works, although, from the proximity to the surface, and the consequent exposure to atmospheric and aqueous deterioration, the specimens employed must have been much inferior to that existing at a depth. The only beds at present known—three in number—are intersected by the Savanetta river on the Caracas estate. The thicknesses are twenty inches for the upper and twelve inches each for the two lower seams. They are associated with clays, sands, and peculiar blue and grey shales, which repose on an extremely ferruginous stratum, under which are the limestones and calcareous sandstones of the Montserrat hills, near the base of which range the strata in question are situated. Proceeding north toward the plain of Couva, the carboniferous clays and shales are soon covered with loose sands, so that their extension in this direction is at present indeterminate. The section (Fig. 4) illustrates the stratigraphical relations just described.

In mineral character, these beds of lignitic coal bear considerable resemblance to specimens of a similar substance discovered at Pointe Noir ; and the geologists have ascertained that both belong to the same formation, which extends, as described in their Report, across the island.

In passing from the center of the ridge (in the vicinity of Tumana) to the Caroni, the sequence showed in Fig. 5 was observed. In this section there is a much greater development of the same ferruginous stratum as exists at Couva ; but one passes directly from it to the sands, without traversing any intervening clays or shales. If then the carboniferous series exist there they must be concealed by the greater extent and thickness of the sands in this locality.

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EXPLANATION OF DIAGRAM.

Fig. 1 shows approximately the lines of the principal dislocations which have affected the older rocks of Trinidad, and produced the Gulf of Paria and the Bocas.

Fig. 2 is a diagram showing the probable extent of the subsidence by which the Bocas and Gulf of Paria were produced.

Fig 3 shows the general succession of the Rocks of Trinidad—*a* *b*, *c*, *d*, Caribean Group ; *e*, compact limestone ; *f*, secondary rocks ; *g*, eocene of Tamana and Manzanilla ; *g'*, eocene of Sanfernando ; *h*, miocene of Guaracara ; *h'*, miocene of South Naparima : *h''*, miocene, of Couva, Savanetta, Pointe Noir, etc. ; *h'''*, miocene and pliocene of Moruga, Mayaro, etc. ; *i*, post pliocene or detrital series.

* Principal dislocations or faults.

Figs. 4 and 5 are referred to in Mr. Wall's report.

PROC. SCIENT. ASSOC. TRINIDAD, 1877.

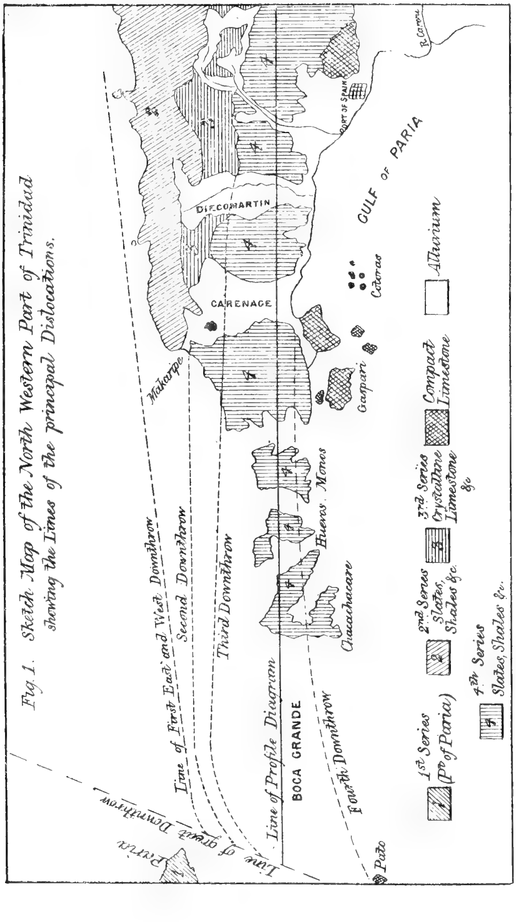

Fig. 1. Sketch Map of the North Western Part of Trinidad showing the Lines of the principal Dislocations.

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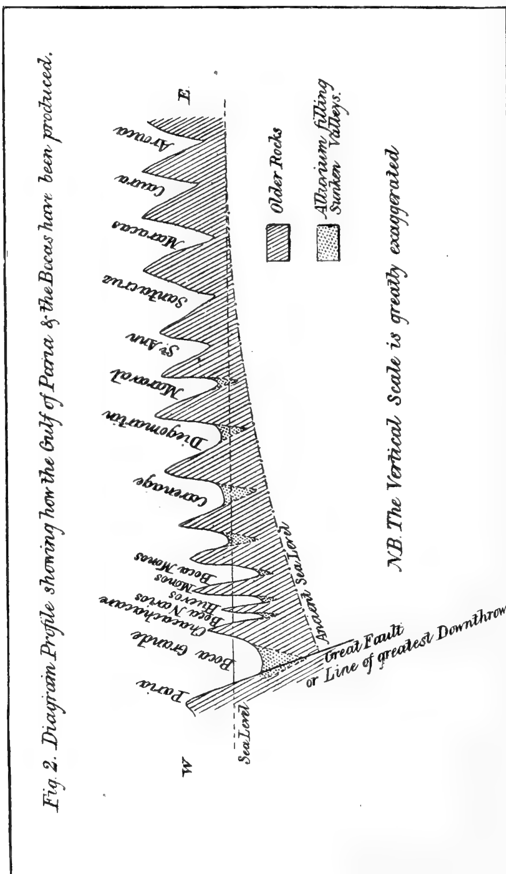

Fig. 2. Diagram Profile showing how the Gulf of Paria & the Bocas have been produced.

PROC. SCIENT. ASSOC. TRINIDAD. 1877.

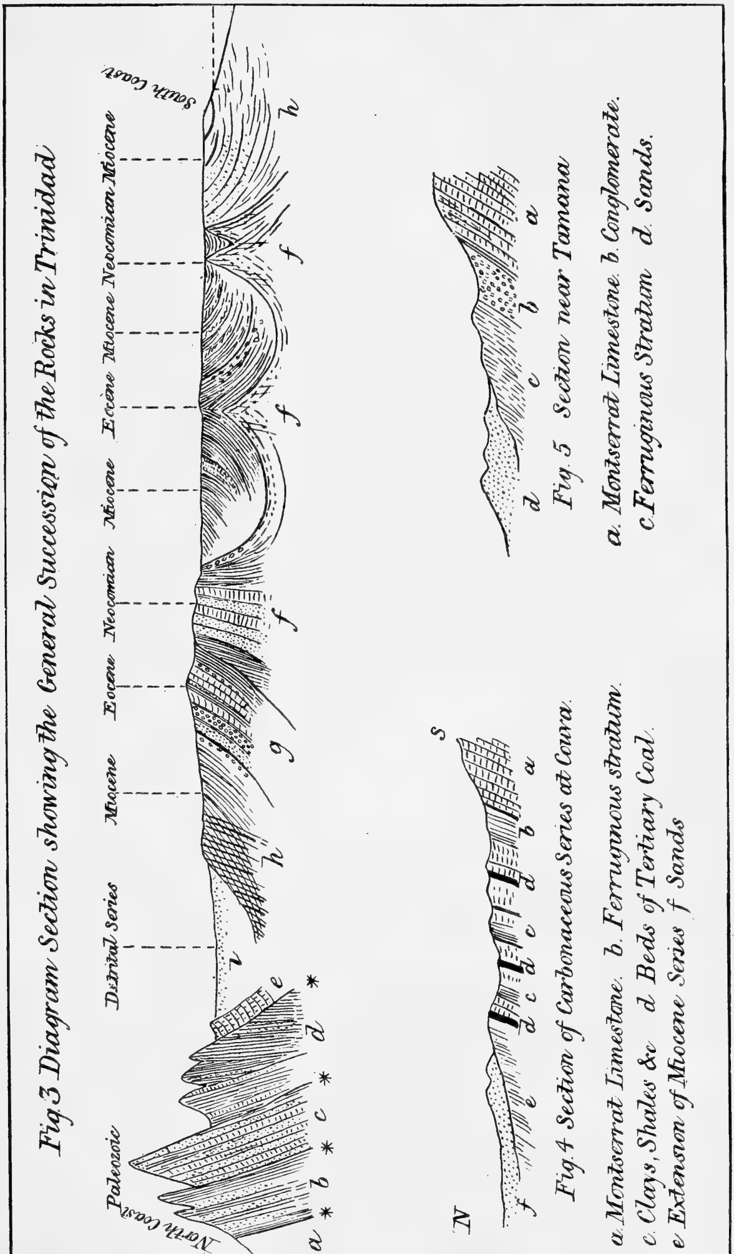

Fig. 3 Diagram Section showing the General Succession of the Rocks in Trinidad

Fig. 4 Section of Carbonaceous Series at Couva.

a. Montserrat Limestone. b. Ferruginous stratum. c. Clays, Shales &c d Beds of Tertiary Coal. e Extension of Miocene Series f Sands

Fig. 5 Section near Tamana

a. Montserrat Limestone. b. Conglomerate. c. Ferruginous Stratum d. Sands.

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PAPER No. 8.

ON THE RECENT AND TERTIARY SPECIES OF LEDA AND NUCULA FOUND IN THE WEST INDIES: WITH NOTICES OF WESTINDIAN SHELLS.

Read before the Scientific Association of Trinidad, Nov. 20, 1878 and published in the "Proceedings", vol. 2, pp. 168-180 with pl. 7.

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Preliminary Observations.

The genus *Nucula* was created by Lamarck in 1799, for small bivalve shells having a nacreous interior and a line of numerous hinge-teeth interrupted beneath the umbo by a pit for the insertion of the ligamental cartilage. The few species known to Linné were included in his genus *Arca*. The genus *Leda* is ascribed to Schumacher, who published the name in 1817. But it was not until some twenty or thirty years ago that the name was generally adopted for the rostrated species formerly included in Nucula. Of the little group of Arcadæ formed by these two genera, D'Orbigny describes only two species in his "Mollusques de Cuba;" viz., *L. vitrea* and *L. jamaicensis*, both of which have been found in the Gulf of Paria. The same author, in his "Voyage dans l'Amerique Meridionale," mentions nine species of Leda and five of Nucula. Of these, *Nucula semiornata* and *Leda patagonica* (the latter now recorded from the Gulf of Paria), are the only ones named from the eastern side of the South American continent, the other twelve being all west coast shells, and apparently different from any Westindian or Brazilian species. Hanley gives two species as Westindian (Recent Bivalves, 1843-56), one being the *Nucula tellinoides* said to have been found at Cumana, and the other the *N. recurva* of Conrad, neither of which has occurred to me. Krebs, in his list of the Westindian Molluska (1864) does not name any species of the group.

Other general observations on the Molluska treated of in this communication will be found prefixed to the descriptions in each of the following sections: it is only necessary here for me to express the hope that the roughness of the accompanying illustrations will be pardoned on the gronnd that

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artistic skill for the execution of such work is not to be found here. The figures are only intended to give, in conjunction with the descriptions, a fair general idea of the shells wished to be represented, and it should not be supposed that they are meant for finished drawings.

§ 2. *The Species of Nucula and Leda.*

1. *Nucula schomburgki.* Forbes (Pl. vii., f. 10.)

N. schomburgki, Forbes, in Schomburgk, History of Barbados, p. 565.

N. schomburgki Guppy, Geol. Mag., 1867, p. 500.

The likeness of this shell to *N. bivirgata*, *N. ornatissima*, and *N. cobboldiæ* was remarked by Prof. Forbes when describing it, and he gave the greater weight to its alliance with the latter. Nevertheless, to me it appears more nearly allied to *N. bivirgata*. The recent species of the small group of divaricately ornamented Nuculas, in which the above extinct species find their place, are *N. castrensis* and *N. divaricata*. Eocene, Barbados, Trinidad (Sanfernando).

2. *Nucula crosbyana* n. sp. (Pl. vii, f. 3, 3a).

Oval-elliptical, sub-equilateral, scarcely attenuated behind, thin, smooth, shining, indistinctly marked by some close concentric riblets, more visible towards the regularly curved ventral margin ; ends rounded, slightly gaping, the anterior end the shortest, forming an angle with the hinge-line ; umbones small, scarcely prominent; hinge-teeth about twelve before the ligamental pit and about fifteen behind it. Length, 16 mm. ; height, 8½ mill.

I received from Mr. W. O. Crosby two dead valves of this species, dredged by him in the Gulf of Paria. In shape it is

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like a *Solenella*, and it partakes indeed of some of the characters of that genus, as well as of *Nucula* and *Leda*, and were it rostrated it would be referred to the latter. It is quite of a different type to the Nuculas which follow, and to those like *N. nucleus*.

3. *Nucula vieta* Guppy (Pl. vii., f. 11).

Proc. Scientific Assoc. Trinidad, 1867, p. 174.

Geological Magazine, 1874, pl. xviii., f. 8.

A Nucula of obliquely subtriangular form, like *N. proxima* and *N. mixta*, with regular round concentric ribs. Small specimens only have occurred in the Pliocene of Trinidad, but it would not be surprising if it proved to be also a recent shell attaining greater dimensions than those we have seen, the largest of which are 3½ mill. in height and 3 mill. in breadth.

4. *Nucula baccata*, Guppy (Pl. vii, f. 12).

Proc. Scientific Assoc. Trinidad, 1867, p. 174.

Geological Magazine, 1874, Pl. xviii., f. 7.

A Nucula of the group of *N. obliqua* and *N. similis*, somewhat similar in style to *N. vieta*, but distinguished by its less triangular form, greater size, and almost smooth surface. The margins of both species are crenulate. *N. baccata* has only hitherto been found in the Pliocene of Trinidad. Our specimens measure 7 mill. in breadth, and 5½ mill. in height. As nearly all the shells of living species found in the Pliocene (Matura) beds of Trinidad are smaller than their living representatives, it may be anticipated that if any of those now known only as fossils are discovered to be living, the recent examples will be of larger size.

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5. *L. packeri*, Forbes (Pl. vii., f. 9).

Nucula (Leda) Packeri, Forbes, in Schomburgk, Hist. Barbados, p. 565.

Leda incognita, Guppy, Geol. Mag., 1867, p. 500.

Transversely ovate, with round concentric ribs ; rostrated posteriorly ; lunule and dorsal area broad, distinct, circumscribed by the keels running from the umbones to the extremeties. Length 8½ mill., height 5 mill.

I described a single specimen obtained from the eocene of Sanfernando as a new species under the name of *L. incognita* ; but I am now disposed to attribute the differences between it and the *L. packeri* of Forbes to variation and to the state of preservation of the specimens.

6. *Leda vitrea*, Orb. (Pl. vii., f. 6).

Leda vitrea, D'Orbigny, Moll. Cuba, vol. ii., p. 262, pl. xxvi., f. 27—29.

L. perlepida Guppy, Geol. Mag., 1874, pl. xviii., f. 9.

I am inclined to think that *L. perlepida* from the Pliocene of Trinidad is identical with *L. vitrea* of D'Orbigny, of which I have dredged dead valves in the Gulf of Paria.

7. *Leda clara*, Guppy (Pl. vii., f. 4).

Leda clara, Guppy, Geol. Mag. 1874, pl. xvii., f. 1 ; 1875, p. 42.

Somewhat like *L. vitrea*, but larger and less acutely rostrated. In general shape like *L. sapotilla*, Gould.

Miocene, Jamaica.

8. *Leda acuta*, Gabb (Pl. vii., f. 8).

Leda acuta, Gabb, Trans. Amer. Phil. Soc., vol. xv., p. 255.

Distinguished from the preceding by its rather more tumid

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form and its regular equal concentric riblets, which are not (at least posteriorly) parallel with the lower margin.

9. *Leda illecta*, Guppy (Pl. vii., f. 5).

Leda illecta, Guppy, Proc. Scient. Assoc. Trinidad, 1867, p. 174.

A Leda somewhat like *L. eburnea* Sow., distinguished from the preceding by its smoothness and somewhat pear-shaped form. I copy the original description: "Smooth, ovate-transverse, inequilateral, somewhat tumid on the central portion, posterior end produced into a rostrum which is almost curved upwards; hinge-line somewhat deflected upwards, and interrupted at the umbo ; umbones approximated, scarcely prominent beyond the hinge-line; posterior cardinal area broad, smooth, and ill defined." Length 10 mill., height 6 mill.

Eocene, Manzanilla, Trinidad.

10. *Leda bisulcata*, Guppy (Pl. vii., f. 7).

Leda bisculcata, Guppy, Geol. Mag. 1867, p. 500, f. 2.

This is as tumid as *L. acuta*, Gabb, but is more rostrated, the riblets are much finer, and are parallel with the margin, whilst the sulcus down the anterior end forms a good distinguishing mark. A trace of a similar sulcus may be observed in *L. jamaicensis*, whose ornamentation, however, is of a much bolder character.

Miocene, Jamaica.

11. *Leda jamaicensis*, Orb.

Leda jamaicensis, D'Orbigny, Moll. Cuba, vol. ii., p. 263, pl. xxiv., f. 30—32.

This has not been recorded as fossil. Examples dredged in the Gulf of Paria differ slightly from D'Orbigny's figure.

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11. *Leda egregia* n. sp. (Pl. vii., f. 1, 2).

Lanceolate, narrow, compressed, ivory-shining, inequilateral, much rostrated posteriorly, somewhat rounded anteriorly, with numerous crowded somewhat lamellar concentric ribs, which become almost obsolete on the central portion of the valves ; hinge-teeth fine and long, about 30 in the anterior and 40 in the posterior series, the two series separated by a broad triangular cartilage pit immediately beneath the small and scarcely prominent umbo ; anterior dorsal margin gently curved ; posterior dorsal area incurved and very distinctly bounded, covered with a dark epidermis, and bounded below by a prominent ridge upon which the concentric riblets rise into small white points ; another ridge runs from the umbo down to the margin to form the lower angle of the posterior end. Length 25—40 mill., height 8—13 mill.

Intermediate between *N. tellinoides* Sow. and *N. patagonica* Orb. Several specimens dredged in the Gulf of Paria by Mr. W. O. Crosby.

13. *Leda patagonica*, Orb.

L. patagonica, D'Orb. Voy. Amer. Mer., p. 544, pl. lxxxii., f. 1—3.

This fine species in general aspect is not unlike *L. lanceolata* and *L. egregia*. It is distinguished from *L. egregia* by the flattened, not lamellar, ribs ; it is less rostrated ; the dorsal area is not incurved, and is narrower. The other differences are not easily described, but are readily appreciable upon a comparison of specimens. Our examples are larger than D'Orbigny's, and measure 49 mill. in length and

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16 in height. Two dead valves, dredged by W. O. Crosby in the Gulf of Paria.

§ 3. THE MIOCENE PTEROPODA OF JAMAICA.

In my paper on the Tertiary Molluska of Jamaica, published in the *Geological Society's Journal*, August, 1866, p. 281, I quoted a passage from a letter of Mr. Lucas Barrett to Dr. Woodward, in which it was stated that a marl-bed exists in that island, containing abundance of Pteropoda of the genera Cleodora, Creseis and Cuvieria. Up to the present time I have heard no more of that discovery, and we have not, I believe, any account of the specific forms found in Jamaica, except the description given by me of *Hyalea vendryesiana*. In Haiti, Gabb has discovered six species of Pteropoda, which he has named as follows :—

Diacria bisulcata.	Planorbella imitans.
Balantium undulatum.	Atlanta rotundata.
Styliola sulcifera.	" cordiformis.

I have received additional specimens of the tertiary fossils of Jamaica from Mr. Vendryes, and among them I find two apparently new species of Hyalea, which I take the present opportunity of describing.

1. *Hyalaa vendryesiana*, Guppy.

Geol. Mag. 1874, p. 405, pl. xvii., f. *2b* (not *2a*).

This species belongs to the section *Diacria*, whilst the following two may be placed among the typical forms of the genus. There seems to be an error in my original description, for it does not appear that in *H. vendryesiana* the lips are everted or thickened. That character belongs to *H. digitata*, an imperfect example of which is figured with *H. vendryesiana* (fig. *2a*). In *H. vendryesiana* the lips are

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thin, straight, and projecting, and the mouth widely open. In *H. ventricosa* the lip formed by the upper valve is very much curved, so as to come quite over and hide the narrow mouth, and in *H. digitata* the lips are thickened and everted.

2. *Hyalea ventricosa* n. sp. (Pl. vii., f. 15).

Almost globular, rounded and much inflated in front; lower valve swollen; upper valve spoon-shaped, inflated, adorned by three keels or ribs radiating from the umbo to the extremely reflected and recurved lip; the central keel more pronounced and distinct; the lateral ones broader and more rounded; lateral mucrones simply angular, not pointed, terminal mucro short and pointed; mouth narrow, hidden by the protusion of the sharp thin lip. Lenth 4½ mill., breadth 4 mill.

Bears some resemblance to *H. globulosa* Rang and to *H. quadridentata* Les. in general character. In our shell the lateral mucrones are single, and there is a decided terminal mucro; the central rib is narrower and more defined than the broader rounded one on each side of it.

3. *Hyalea digitata* n. sp. (Pl. vii., f. 16).

Oblong, rather compressed; lower valve inflated; upper valve slightly convex, adorned with three nearly equal rounded radiating ridges, constricted in front, and bordered by a thickened lip; mouth narrow, lips thickened and everted; terminal mucro short, sharp; lateral mucrones scarcely produced. Length 5 mill., breadth 3 mill.

In some respects resembles *H. tridentata* Bosc, and *H. uncinata* Rang, but is not so inflated, and has shorter and less curved lateral mucrones.

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§ 4. DESCRIPTIONS OF SOME SPECIES OF WESTINDIAN MOLLUSKA.

I take advantage of the present opportunity to give sketches and descriptions of five shells, two of which have been previously described, but not figured ; the other three are new. Of the five, four are inhabitants of the Gulf of Paria, and the fifth is a small but curious shell from the miocene of Jamaica. *Metula lintea* and *Periploma orbicularis* were dredged in the Gulf of Paria by Mr. W. O. Crosby, of the Boston Society of Natural History. Mr. Crosby discovered not only the species mentioned in this communication as dredged by him, but several others which he kindly communicated to me, and which are of remarkable interest as being either identical with, or nearly allied to fossils of the Westindian miocene. As the specimens referred to are all dead shells, devoid of colour, it has occurred to me as a possibility that they might have been derived from some tertiary bed at the bottom of the Gulf. An hypothesis like this, however, would be at once refuted by the finding of a single living example.

1. *Periploma orbicularis* n. sp. (Pl. vii., f. 13).

Suborbicular, subequilateral, somewhat compressed, thin, nacreous internally, shagreened externally by minute rugosities disposed in radiating lines, and covered with a thin epidermis ; anterior side regularly rounded ; posterior side somewhat produced, sinuate, and obliquely truncate; umbones prominent, fissured. Height 25 mill., length 30 mill.

Resembles the *Periploma compressa* of D'Orbigny (Voy. Amer. Merid., p. 514, pl. lxxviii., f. 19, 20), but having a greater relative height from the umbo to the margin, is more

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orbicular in shape. There is also some likeness between our shell and *Anatina globulosa* Lam.

2. *Lithodomus bipenniferus* Guppy (Pl. vii., f. 14).

L. bipenniferous Guppy, Proc. Scient. Assoc. Trinidad, 1877, p. 155.

Described in my list of Molluska from the Gulf of Paria. Several species of Lithodomus have been described from the Westindies ; but none that I know of possessing the peculiar characters of this shell, which appears to be most nearly allied to the *L. caudigerus* of West Africa. It is found in almost every piece of limestone and coral in the Gulf.

3. *Metula lintea* n. sp. (Pl. vii., f. 18).

Regularly fusiform, imperforate, cancellated by longitudinal and revolving lines—the latter stronger on the lower whorls, the longitudinal ones more evident above ; spire-turreted, whorls eight, gradually increasing, slightly convex, the first two smooth, the last forming more than two-thirds of the shell ; suture subcrenate, bordered, aperture elongate ; columella truncate, simple or slightly twisted, covered with a thin callus spread along the body-whorl to the outer lip, which is thin and sharp, thickening backwards into a variciform ridge. Length 27 mill., breadth 10 mill.

Dredged by Mr. W. O. Crosby in the Gulf of Paria. Allied to *M. cancellata* Gabb, of the Miocene of Haiti and Jamaica. Our single specimen is distinguished from *M. cancellata* by its very much finer ornamentation, and by the absence of varices ; the thickening near the mouth showing only the incipient existence of the variciform tendency.

4. *Pleurotoma miranda* n. sp. (Pl. vii., f. 19).

Fusiform turreted, whorls about eight, angulated, narrow-

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ing rapidly, and bearing a row of pointed crenate lamellar tubercles or spines on the angle, above which is a continuous plain revolving ridge ; last whorl about two-thirds of the length of the shell ; spire elevated, acuminate ; aperture elongate, with two sinuses, one corresponding to the angle of the whorls, and the other to the ridge above it ; canal long, columella smooth. From the angle of the last whorl to the end of the canal is about one half the length of the shell. Length 13 mill., extreme breadth 5 mill.

Though, on account of the keel above the angle of the whorls and the corresponding sinus of the aperture, I have provisionally described this little shell as a *Pleurotoma*, and assign it as an ally to *Pl. rotata* (Miocene Europe), I cannot overlook its likeness to *Fusus pagodus* and *F. echinatus*. It also has a striking similarity in general outline to the *Thatcheria mirabilis* of G. F. Angas (P. Z. S. 1877, p. 529, pl. liv., f. 1), which is not, indeed, so ornate as our species, and is much larger.

Miocene, Jamaica (H. Vendryes).

5. *Purpura trinitatensis*, Guppy (Pl. vii., f. 17).
Proc. Scient. Assoc. Trinidad, 1869, p. 366.
Ann. and Mag. Nat. Hist., Jan. 1875, p. 50.

EXPLANATION OF PLATE VII.

Fig. 1. Leda egregia, exterior of left valve.
" 2. " another specimen, interior.
" 3. Nucula crosbyana, left valve, exterior ; 3*a*, interior.
" 4. Leda clara, left valve, interior.
" 5. " illecta, right valve, exterior.
" 6. " vitrea, right valve, interior ; magnified.
" 7. " bisulcata, left valve, exterior ; magnified.
" 8. " acuta, right valve, exterior ; magnified.
" 9. " packeri, right valve, exterior.

PROC. SCIENT. ASSOC. TRINIDAD, VOL. 2, PL. 7

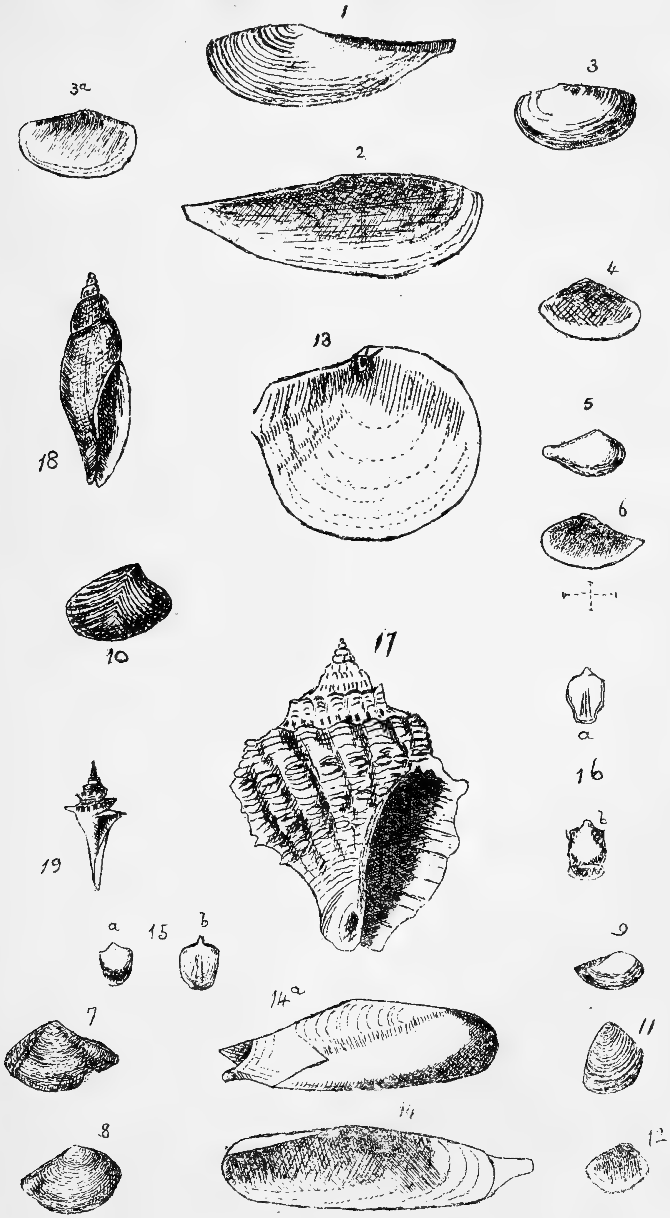

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Fig. 10. Nucula schomburgki, right valve, exterior.
" 11. " vieta, right valve, magnified.
" 12. " baccata, left valve, interior.
" 13. " Periploma orbicularis, left valve, interior.
" 14. Lithodomus bipenniferus, right valve, interior.
" 14a. " exterior.
" 15. Hyalea ventricosa ; *a* lower valve, *b* upper valve.
" 16. " digitata ; *a* upper valve, *b* lower valve.
" 17. Purpura trinitatensis.
" 18. Metula lintea.
" 19. Pleurotoma miranda.

[N.B.—The figures are all of the natural size, except where it is otherwise specified.]

PAPER No. 9

ON A HETEROCERCAL FISH FOUND IN THE BLUE LIMESTONE SERIES OF THE LAVENTILLE HILLS.

Read before the Scientific Association of Trinidad, Nov. 20, 1878 and published in the "Proceedings", vol. 2, pp. 180-181, with plate 8.

In a paper on the Blue Limestone of the Laventille Hills (Proc. Scient. Assoc. Trin., 1877, p. 109), I referred to the discovery of a fish in one of the beds of the series. I had not then seen the specimen, but it has since come into my possession, and is now exhibited to the Association. It consists of part of the vertebral column with the tail-fin of a heterocercal fish. There are about thirty vertebræ present, and the rays of the tail are about fifteen in number. There are traces of fine needle-like spines extending backward from the vertebræ near the tail. The length of the specimen is nearly six inches (15 centimetres); the anterior portion is nearly straight, the posterior part slightly curved. The thickness of the stoutest vertebræ is 5 millimetres; they are nearly all of the same dimensions up to the origin of the caudal fin, whence they rapidly taper off to its extremity.

The specimen came from the Piccadilly quarry on the east side of Portofspain. It is exposed on the surface of a thin

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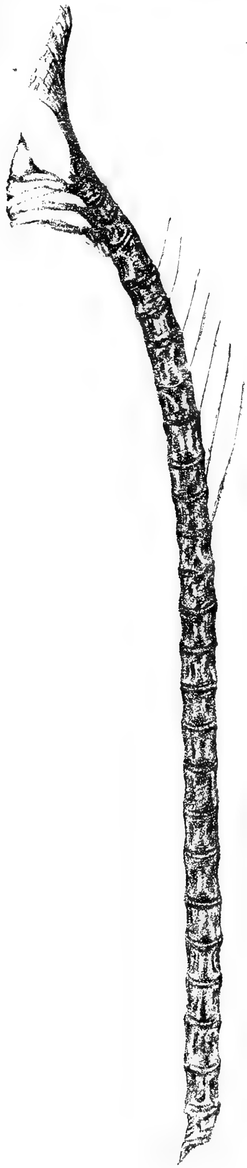
dark-red micaceous sandy lamina, the usual parting between the beds of limestone in the quarry named. There is not a vestige of dermal tissue, or of any other portion of the fish, except those described above. (See Plate VIII.)

Notwithstanding the meagreness of the characters afforded by the specimen, I venture to assign it a provisional name, and a place among the Ganoid fishes, as *Acanthodes elongatus.* The genus *Acanthodes*, to which I refer our fossil, is characteristic of Devonian and carboniferous rocks; and, supposing my determination to be near the truth, the additional evidence just furnished is in favour of the view taken by me in the paper referred to at the commencement of this notice as to the probable age of the Blue Limestone series, and its entire distinctness as a formation from the mica and talc-schists and sandstones, the clayslate, quartzite and crystalline limestones of the Caribbean group.

PROC. SCIENT. ASSOC. TRINIDAD. VOL. 2, PL. 8



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PAPER No. 10.

ON THE FOSSIL ECHINODERMATA OF THE WEST INDIES.

Read before the Scientific Association of Trinidad, July 16, 1879 and published in abstract in the "Proceedings," vol. 2, pp. 193-199.

(*Abstract*).

The author stated that in 1868-9 Professor P. T. Cleve, of the University of Upsala, travelled in the Westindies and investigated the geology and mineralogy of several of the islands, an account of which he published in 1870. He made collections of fossils, among which was a fine series of echinoderms from the islands of S. Barts and Anguilla. These were studied by M. Cotteau, who distinguished thirty-

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three species, all of which were carefully described and delineated in a paper published in 1875. By the kindness of Professor Cleve, the collection had come into the possession of the present author, who now took the opportunity of exhibiting the specimens, and of presenting some observations upon them. A very large addition had now been made to our knowledge of the tertiary echinoderm-fauna of the Westindies, and strong support was thereby given to the determination, previously made, of the relative ages of the S. Barts and Anguilla beds, as Eocene and Miocene respectively. The author concluded with a reference to the paleozoic and mezozoic echinoderms of the Caribean area, which, though of great interest, were known chiefly from imperfect material.

List of the Species.

1. *Cidaris melitensis*, Wright.

   C. melitensis, Wright (as of Forbes) Ann. and Mag. Nat. Hist., 1855, p. 7, pl. iv., f. 1.

   C. melitensis, Guppy, Journ. Geol. Soc., vol. xxii., p. 297.

   C. melitensis, Cotteau, Description des Echinides Tertiaires des Iles S. Barthélemy et Anguilla (Kongl. Svenska Vetenskaps-Akademiens Handb., band 13, No. 6) 1875, p. 8, pl. i., f. 1—10.

I should include under this name *Cideris clevi*, Cott. (pl. i., f. 15, 16) and *C. anguillæ*, Cott. (pl. i., f. 17, 18). It is well known that some cidarids have two different kinds of spines; and in the matrix containing the specimen of *C. anguillæ* is one broken example of the usual form figured by Cotteau (pl. i., f. 9, 10) as the spine of *C. melitensis*. On the tablet containing the three original examples of *C. melitensis*

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procured by myself from Anguilla I affixed, in 1865, a specimen of a spine identical with *C. anguillæ*, Cott.

Miocene, Anguilla.

2. *Cidaris loveni*, Cott.

Cotteau, Echinides tertiaires de S. Barts and Anguilla, p. 10, pl. i., f. 11—14.

Though very near to *C. melitensis*, this species appears to be characterized by good and permanent differences.

3. *Echinometra prisca*, Cotteau.

Cotteau, Echinides tertiaires, p. 12, pl. i., f. 19—27.

The specimens are similar in all respects to those recorded by me (Journ. Geol. Soc., vol. xxii., p. 299), as *Ech. acufera*, and perhaps differ sufficiently from the recent form to be under the circumstances entitled to a recognition as of specific rank.

4. *Echinoneus minor*, Leske.

Cotteau, Echinides tert., p. 14, pl. 1., f. 28—30.

M. Cotteau does not give a specific name to this. It is probably the same as the *Ech. cyclostomus* of my paper, for which, however, the name Ech. minor may be preferable.

5. *Clypeaster antillarum*, Cotteau.

Cotteau, Echinides tert., p. 15, pl. ii., f. 1—3.

In M. Cotteau's paper this is stated to be from Anguilla, but the label assigns the species to Portorico, and I am inclined to the belief that the latter is correct.

6. *Clypeaster concavus*, Cotteau.

Cotteau, Echinides tert., p. 16, pl. ii., f. 4—8.

In my account of the Westindian fossil Echinidæ I considered this to be the *Clyp. ellipticus* of Michelin. Cotteau disagrees with this view, and gives the name of

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Cl. concavus to the species. Among my original specimens from Anguilla are some which approach more nearly to the figure of *Cl. ellipticus* given by Michelin than the example figured by Cotteau does ; and I am not at all sure whether upon an examination of a large series my first determination may not ultimately be adopted.

7. *Sismondia antillarum*, Cotteau.
Cotteau, Echinides tert., p. 17, pl. iii., f. 1—4.
Eocene, S. Barts.

8. *Sismondia anguillæ*, Cotteau.
Cotteau, op. cit., p. 18, pl. iii., f. 5—8.
Miocene, Anguilla.

9. *Echinolampas ovumserpentis*, Guppy.
Journ. Geol. Soc., vol. xxii., p. 300, pl. xix., f. 4—6.
Cotteau, Echinid. tert., p. 20, pl. iii., f. 13—21.
I am inclined to regard *Ech. antillarum*, Cotteau (p. 19, pl. iii , f. 9—12), as a form of this species.
Eocene, S. Barts (also Trinidad).

10. *Echinolampas clevei*, Cotteau.
Cotteau, Echinid. tert., p. 23, pl. iv.. f. 1—5.
Apparently a very distinct form. Eocene, S. Barts.

11. *Echinolampas lycopersicus*, Guppy.
Journ. Geol. Soc., vol. xxii., p. 300, pl. xix., f. 8.
Cotteau, Echinid. tert., pl. iii., f. 22—26.
I regard *Ech. anguillæ* (Cotteau, p. 24, pl. iv., f. 6—8) as merely an unusual form of this species.
Miocene, Anguilla.

12. *Echinolampas semiorbis*, Guppy.
Journ. Geol. Soc., vol. xxii., p. 299, pl. xix, f. 7.
Cotteau, Echinid. tert., p. 24, pl. v., f. 1, 2 ; and pl. vi., f. 1. Miocene, Anguilla.

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13. *Echinanthus antillarum*, Cotteau.

Cotteau, Echinid. tert., p. 26, pl. iv., f. 9—12.
Eocene, S. Barts.

14. *Schizaster* (*Periaster*) *elongatus*, Cotteau.

Cotteau, Echinid. tert., p. 27, pl. v., f. 6.
Eocene, S. Barts.

15. *Schizaster subcylindricus*, Cotteau.

Cotteau, Echinid. tert., p. 31, pl. v., f. 14—17.

I feel quite unable to separate *Sch. antillarum* (Cotteau, p. 28, pl. v., f. 3—5) from this species. The points of difference noted by Cotteau are subject to great variation in the species of this group, and cannot usually be depended on for specific characters.

Eocene, S. Barts.

16. *Schizaster scillæ*, Desm.

Guppy, Journ. Geol. Soc., vol. xxii., p. 301.

The *Schizaster loveni* of Cotteau (p. 29, pl. v., f. 9—13) is the same as the species recorded by me under the above name. The specimen called *Sch. clevei* (Cotteau, p. 29, pl, v., f. 7, 8) appears to be a somewhat abnormal form of the same.

Miocene, Anguilla.

17. *Agassizia clevei*, Cotteau.

Cotteau, Echinid. tert., p. 33, pl. vi., f. 2—10.

The genus *Agassizia* is represented in the existing seas by two species only, so far as known, one found on the west coast of South America, the other in the Antilles. The species under notice is interesting as being the only echinoderm known to be found in both the Miocene and Eocene of the Westindies.

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18. *Prenaster loveni*, Cotteau.

Cotteau, Echinid. tert., p. 34, pl. vi., f. 11—15.

It seems to be straining generic distinctions rather tightly to separate *Prenaster* from *Agassizia;* but it is to be feared that many authors carry subdivision to an excessive length among echinoderms.

Eocene, S. Barts.

19. *Brissus exiguus*, Cotteau.

Cotteau, Echinid. tert., p. 35, pl. vi., f. 16, 17.

The examples of this species recorded by me in 1866 Journ. Geol. Soc., vol. xxii., p. 301) as *Br. dimidiatus* Ag. (=*unicolor* Klein) were much larger and in better preservation than the single specimen of Cleve's collection. I leave the species under the name given to it by Cotteau, though I have doubts as to the possibility of finding grounds for a clear specific distinction between it and the recent form.

20. *Brissopsis antillarum*, Cotteau.

Cotteau, Echinid. tert., p. 37, pl. vi., f. 19—25.

Miocene, Anguilla.

21. *Macropneustes antillarum*, Cotteau.

Cotteau, Echinid. tert., p. 39, pl. vii., f. 1—3.

Eocene, S. Barts (also Cuba).

22. *Macropneustes clevei*, Cotteau.

Cotteau, Echinid. tert., p. 40, pl. vii., f. 4—7.

Miocene, Anguilla.

For these two species, and for another one found in the Pyrenees, Cotteau has created a new genus, *Peripneustes*.

23. *Plagionotus loveni*, Cotteau.

Cotteau, Echinid. tert., p. 41, pl. viii., f. 7, 8.

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The genus *Plagionotus* appears to be scarcely distinct from *Eupatagus*.

Eocene, S. Barts.

24. *Eupatagus antillarum*, Cotteau.
Cotteau, Echinid. tert., p. 43, pl. vii., f. 7—11.
Eocene, S. Barts.

25. *Eupatagus clevei*, Cotteau.
Cotteau, Echinid. tert., p. 44, pl. viii., f. 1—4.
Under this name I must also include *E. grandiflorus* (Cotteau, p. 45, pl. viii., f. 5, 6).
Eocene, S. Barts.

25. *Asterostoma cubense*, Cotteau.
Cotteau, Echinid. tert., p. 46.

For the names of the Westindian Fossil Echinodermata, not mentioned in the above list, see Geol. Mag. 1874, p. 444, and Proc. Scient. Assoc. Trinidad, vol. i., p. 165. For a reference to the paleozoic species, see Proc. Scient. Assoc. Trinidad, vol. ii., p. 108, (Dec. 1877).

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PAPER No. 11.

REMARKS ON THE GEOLOGICAL POSITION OF THE POLYCYSTINA BEDS OF SOUTH NAPARIMA.

Published in "The Agricultural Record", vol. 3, Aug.-Dec., 1890, pp. 178-180.

The subject of the Polycystina beds of South Naparima appears to have attracted some little notice of late, for we find communications thereon in the pages of the *Agricultural Record.* I do not pretend to be well up in all the points of discussion. The few words I have to say will be chiefly directed to the elucidation of the geological position of the polycystina deposits.

I have not been able to find the first mention of the occurrence of radiolaria in Trinidad rocks. I am told that a paper on the subject appeared in one of the English scientific journals, but I have never been able to find it. The references to the subject in the Geological Report on Trinidad are rather scanty.

In a paper published in the 22nd volume of the Journal of the Geological Society (1866, p. 571) I gave a diagram of the coast section at Sanfernando. This sketch was very imperfect on account of the disintegrated materials from the upper part of the cliff having obscured the nature and relations of the beds. Nevertheless, in main features the diagram fairly represents the position and succession of the rocks. I was wrong, however, in supposing certain of these beds to be unfossiliferous. I subsequently discovered that they contained abundant foraminifera, and in 1872 I published an account of of the discovery with a preliminary list of the foraminifera. They were as follows :—

Nummulina ramondi	—Defr.	These are only found in the lower beds of the Eocene.
Orbitoides mantelli	—Morton	
Amphistegina vulgaris	—Orb.	
Spiroloculina nitida	—Orb.	From the Nodosaria Beds.
Glandulina lævigata	—Orb.	
Nodosaria glabra	—Orb.	
" *hispida*	—Orb.	
" *raphanistrum*	—Linn.	
" *ovicula*	—Orb.	
" *pyrula*	—Orb.	
Dentalina elegans	—Orb.	
" *filiformis*	—Orb.	
" *communis*	—Orb.	
Orbulina universa	—Orb.	
Globerigerina bulloides	—Orb.	
Polymorphina gibba	—Orb.	
Rotalia orbicularis	—Orb.	
" *corallinarum*	—Orb.	

In the paper referred to, which was published in the December

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1872 part of the "Proceedings of the Scientific Association Trinidad," and in the Geological Magazine (1873, p. 62), I gave particulars to which I would refer for further elucidation of the matter. I have only now to add with reference to this part of the question that I have not been able to explore that part of the coast section at Sanfernando which lies between the portion shown in my diagram in the Geological Society's Journal (previously referred to) and the mouth of the Sipero River, and that I think it likely that an exploration of that portion of the section would throw some further light upon the relations of the Sanfernando beds (Eocene) and the South Naparima marl (Miocene).

In my paper published in the "Proceedings of the Scientific Association of Trinidad" for December, 1877, I gave a diagram (fig. 3) to show the general succession of the rocks of Trinidad. In engraving this diagram the artist left out several of the letters of reference, of which an explanation is given on page 115 of the accompanying text. According to the diagram and the explanation the rock formations of Trinidad are in ascending order as follows:—

(*a b c d*) Caribean group (paleozoic).
(*e*) Compact limestone (Devonian) ?
(*f*) Secondary rocks (Neocomian).
(*g*) Eocene of Sanfernando.
(*g'*) Eocene of Manzanilla.
(*h*) Miocene of Guaracara.
(*h'*) Miocene of South Naparima (including the polycystina marls.
(*h''*) Miocene of Savaneta, Point Noir, &c.
(*h'''*) Miocene and Pliocene (mostly the latter, I believe), of Moruga, Mayaro, &c.
(*i*) Postpliocene.

The letters omitted by the artist were *g*, *h* and *h'*, while *g'* was written as *g*. Had these errors not been committed, my views as to the relative age of the rocks of Trinidad, including the Eocene marls of Sanfernando and the Miocene marls of South Naparima, would have been clear to any one referring to the diagram quoted and its explanation.

In December, 1888, and January, 1889, I corresponded with Mr. Jukes-Browne, then in Barbados. Under date 8th January, he asks me: "Is the P. marl at San F. interbedded with the other beds? If not and if the exposure is an isolated one, is it not possible that the marl overlies the Eocene as it does here? In the absence of contained fossils (except Radiolaria) and in the absence of direct evidence, it seems to me that the marl may be of any age later than Eocene." I replied to this, sending Mr. Jukes-Browne a copy of my diagram and explanation (fig. 3 and

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page 115 of the "Proceedings of the Scientific Association," December, 1877,) supplying the missing letters in the diagram, showing that the Miocene Polycystina marls are not interbedded with the Eocene beds.

It is a little difficult to indicate without the diagram itself where the missing letters ought to come, but I will try to do so. Setting the diagram before one, and measuring from the line marking the righthand margin of the plate along the line intended to indicate the surface of the ground, it is about 45 millimetres to where the letter *h'* should have been placed. The *g* should have been 50 to 55 millimetres from the same starting-point or 5 to 10 millimetres to the left of *h'*, the latter coming under the word "Miocene" and the *g* coming under the word "Eocene." Then the *g* under the word "Eocene," somewhat to the left of the middle of the diagram, should be turned into *g'*. The answer to Mr. Jukes-Browne's query, which I have quoted, is therefore in the affimative.

A study of so much as is known of the Sanfernando Eocene inclines me to the belief that the lower beds of that formation were deposited in shallow water, and that during the deposition of the succeeding beds the water was gradually deepening, until at the close of the Eocene period the deposits assumed an oceanic character. The enormous changes in the physical geography of the Caribean area of which we have evidence, and upon which I have touched in several of my papers, probably took place upon the close of the Eocene period and extended far into or even occupied the whole of what we call the Miocene epoch of this area, which includes not only the West Indies, but some considerable portion of Central and South America.

I have put together the foregoing notes in somewhat of a rough and imperfect manner ; but I propose, should opportunity serve, to draw up a more complete account of the Eocene and Miocene deposits referred to, with illustrations and a more extended notice of the organic remains.

P. S.—To the list of Foraminifera from the Orbitoides beds must be added *Tinoporus baculatus*, P. and J., that being the name of the organism described by me in the 22nd volume of the Journal of the Geological Society as *Cisseis asterica*. The list of fossils from the nodosaria beds will have to be largely augmented.

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PAPER No. 12.

THE MICROZOA OF THE TERTIARY AND OTHER ROCKS OF TRINIDAD AND THE WEST INDIES.

Paper published in the "Journal of the Field Naturalists' Club" for Dec. 1893, pp. 277-290.

On any question relating to the geology of Trinidad the first reference naturally is to the Geological Report of G. P. Wall and J. G. Sawkins. Previous to the publication of that report in 1860 the knowledge we possessed relative to the structure of the island was of the most meagre and erroneous kind. But the conditions of the Colony restricted so much the time and means at the disposal of the Surveyors that a general outline only was possible to them, leaving the details to be filled in by the irregular and erratic hand of the amateur. Hence the descriptions of the sedimentary strata of the district of Naparima contained in the report were more imperfect even than the natural conditions and difficulties of observation, themselves pretty considerable, need have made them. The relations of the various

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strata, their position and order of succession as well as their origin and organic contents were imperfectly elucidated ; and for part of this there is the excuse that it is exceedingly difficult if not impossible to obtain anything like clear evidence of superposition among the different beds or formations. It is usually by inference alone that we have to deduce the respective positions and age of the beds. And in this of course there is liability to error.

The tertiary rocks of Naparima in Trinidad are described in the Report as a series of marls, conglomerates and calcareous sands. The Report mentions the cliffs of marl, the most important exposure of the series, on the shore of the Gulf of Paria. These cliffs extend some distance north and south of the Town of San Fernando. After alluding to the extensive presence of asphalt in the beds, the Report states the existence of calcareous nodules, thin beds of limestone, and some sandstones, and refers particularly to a stratum to the south of the Town standing out into the Gulf and appearing at first sight like a vertical dyke of asphalt. This stratum is figured in the Report and the authors state that on examination they found it to be merely a highly inclined layer of marl with fragments of shells and a large proportion of bitumen. This is the bed referred to in my communication of July 1863* to the Scientific Association of Trinidad as being entirely or almost entirely composed of the remains of Orbitoides and Nummulina. I referred to this bed again in 1866 when I read to the Geological Society a paper on the relations of the Tertiary formations of the West Indies. Among the illustrations to that paper was a diagram sketch of part of the coast section near San Fernando,† and Professor T. Rupert Jones was good enough to append a note on the Orbitoides and Nummulinæ.‡ I had indicated as unfossilferous certain other beds exposed in the coast section. The oolitic texture of these and others of the Naparima rocks had been noted in the Geological Report, but apparently the exact nature of that texture had not occurred to the authors any more than it had to me when writing my paper of 1866. A subsequent and more careful examination showed me that the supposed oolitic grains were no other than minute fossils belonging chiefly to the order Foraminifera.

I announced this discovery in a paper read before the Trinidad Society in 1872 and published in the "Geological Magazine" for 1873. In it I gave the names of fifteen species of foraminifera besides those already recognized from the Orbitoides bed. Subsequently I published in the "Geological Magazine" (Sept. and

*Reprinted in "Geologist," 1864, page 159.
†Quart. Journ. Geol. Soc. vol. xxii (1866) p. 571.
‡See also Geol. Mag. vol. i, p. 102.

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Oct., 1874,) a further account of the West Indian tertiary fossils with a list of all the species of invertebrates (except corals) known up to that time from the tertiary rocks of the West Indies, leaving out the most recent formations whose fossils are all or nearly all of living species. Since then some other fossils have been described by the late professor W. M. Gabb* and by myself ; † but until the late discussion arose on the microzoic rocks of Trinidad and Barbados the only name to be added to the list of forty-four foraminifera recorded from six West Indian localities was *Tinoporus pilaris* Brady, a fossil from Jamaica, Cumana and other places.

The gradual accumulation of evidence on the subject of the relative age of the West Indian geological formations led to the conclusion that the fossiliferous beds of Naparima and Manzanila in Trinidad ought to be separated from the Miocene deposits of Haiti, Jamaica and Cumana as of distinctly older date and containing a decidedly different fauna. Consequently in my paper of 1874 just quoted the name Eocene is used for these older beds.‡ There still remains in Trinidad a considerable series of formations (the Caroni series) having fossils similar to those of the miocene beds of Haiti, Jamaica and Cumana.

In my paper published in the "proceedings of the Scientific Association of Trinidad" for December, 1877, I gave a diagram to show the general succession of the Rocks of Trinidad. According to that diagram and the explanation thereof the rock-formations of Trinidad are in ascending order as follows :—

(*a b c d*) Caribean group (paleozoic)
(*e*) Compact Limestone (Devonian?)
(*f*) Secondary rocks (Cretaceous)
(*g*) Eocene of Naparima (including the foraminifera-beds)
(*g*) Eocene of Manzanilla.
(*h*) Miocene of Guaracara (Nariva Series)
(*h'*) Miocene of South Naparima (including the Radiolarian Marls)
(*h''*) Miocene of Savaneta, Point Noir &c. (Caroni series)
(*h'''*) Miocene and Pliocene (probably the latter in most part) of Moruga, Mayaro, &c.
(*i*) Postpliocene (including the "Detrital Series)

Though the diagram was very rough and susceptible of much

*Trans. Amer. Phil. Soc. vol. xv. p. 49, and Proc. Acad. Nat. Sci. Phil. 1872 p. 270.

†Quart. Journ. Geol. Soc. vol. xxxii 1876 p. 516.

‡On this point see Cleve, Kongl. Svenska Vetenskaps-Akad. Handl. Band ix No. 12 (1871), and Annals New York Academy of Science vol. ii (1881) p. 190 ; also Cotteau on West Indian Fossil Echinoderms, Kongl. Svenska Vetenskaps-Akad. Handl. Band. xiii, No. 6, (1875).

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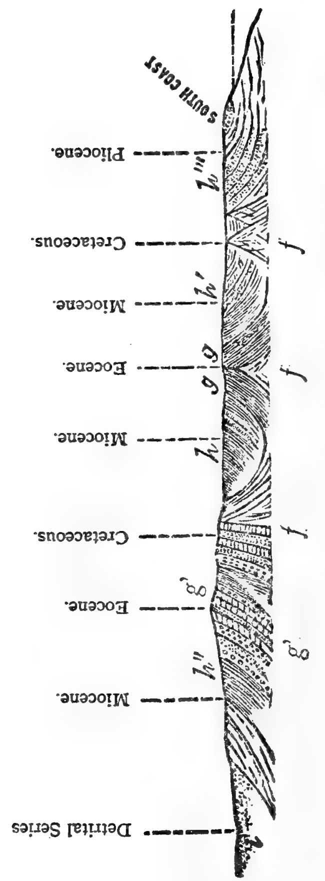
amendment yet as it represented fairly correctly the main features of the succession of the Rocks in Trinidad I reproduce here that portion of it which relates to the cretaceo-tertiary formations with the letters corresponding to the synopsis just given.



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The principal deductions from the observations I have made on the Microzoic deposits of Naparima are stated in my paper read to the Geological Society* and I do not propose now to go over the same ground again. I may, however, briefly state some of those conclusions namely that deep water (say somewhere about 1000 fathoms more or less †) existed where Naparima now is ; that the nearest land was some twenty to twenty-five miles distant from thence and that that land was the Parian range that is to say the northern mountain range of Venezuela then forming a continuous and unbroken chain with our northern hills. We infer also that the Parian range was the southern boundary of a mass of land occupying some portion of the present Caribean Sea but of what extent we have not the means of judging at present. Any one wishing for fuller information on the subject can refer to my paper just quoted. I may mention as matters of economic importance that the use of some of the Naparima marls for the manufacture of cement, and of the Argiline of the Naparima Hill for polishing purposes as well as railway ballast are alluded to in the paper. Some account has been given first in the Geological Report and next in my paper just referred to of the so called Argiline of Naparima Hill. Identifiable fossils have not hitherto been found in this rock. However, we are only on the threshold of knowledge as regards this as well as the other formations of Trinidad. Beds of different texture occur in the argiline, some being more sandy in composition. In these I have found very evident organic remains though I cannot yet say exactly what they are. In another stratum of the same rock I found two or three identifiable foraminifera, namely *Pullenia* and *Sphaeroidina*, both deep water forms But many of the other Naparima and Pointapier rocks contain a great variety of remarkable and interesting Microzoa and other fossils. Besides the Foraminifera and Radiolaria we have some small corals and polyzoa and many spines and plates of echinoderms (including Holothurians, brittle-stars, common sea-stars and sea-eggs,) spicules of seafans and seapens and of sponges (both siliceous and calcareous). The Pointapier Ditrupa-bed contains abundance of such organisms as well as coccoliths, peculiar little organisms characteristically abundant in deep sea deposits ; and also pretty little star-like objects figured by Jukes-Brown and Harrison in their paper. These I have considered to belong to

*Quart. Journ. Geol. Soc. vol. xlviii (1892) p. 519.

†Brady (cited by Jukes-Brown and Harrison, Quart. Jour. Geol. Soc. vol. xlviii (1882) page 197) estimates the depth of water in which the foraminiferal beds of Barbados were deposited at from 500 to 1000 fathoms. The fauna of our Naparima beds is almost identical. When my paper was written I had not seen Jukes-Brown and Harrison's paper and had no knowledge of its contents.

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organisms like that called *Calcaroma* by W. Thomson (see The Atlantic, vol. 1 page 233). Of larger animals the chief remains are those of fishes. Otolites are the most abundant of these and very curious they are. Teeth are not uncommon, but not so abundant as otolites *.

Little attention seems to have been paid to the Ostracoda either recent or fossil of the West Indies. They are doubtless of high interest and I have made a beginning in the identification of the forms found in the Naparima rocks. I might have included them in the table, but as none are recorded from any West Indian deposit I content myself with giving a simple list. But the determinations are only approximate and possibly some even maybe generically wrong as my slender acquaintance with these minute crustacea does not admit of greater exactness and there is no literature to refer to on the subject of West Indian Ostracoda.

Pontocypris faba Reuss N.
trigonella Sars N
simplex Brady N.
Cythere dictyon Brady N.
circumdentata Brady N.
vinimea Brady N.
rastromarginata Brady P.

Cytherella polita Brady N.P.
dromedaria Brady N.
Bairdia amygdaloides Br. N.P.
Krithe bartonensis Jones N.P.
producta Brady P.

(N. Naparima beds. P. Pointapier Ditrupa bed.)

On account of the minuteness of the Radiolaria and Diatoms and the quantity of extraneous matter associated with them they are difficult to isolate and mount and I have not done much in this way. So far as the Radiolaria are concerned I believe our deposits contain the identical forms found in Barbados. One afternoon I sat down and made out from a slide of South Naparima marl of my own mounting the following forms named by Ehrenberg from Barbados specimens :—

Eucyrtidium ampulla
excellens
montgolfieri
acephalum
gematum
Podocyrtis argulus
puellasinensis
dominasinensis
mitrella
Haliomatina humboldti
entactinia
oculatum

Carpocanium coronatum
Rhabdolithis ingens
Lithopera lagena
Halicalyptra setosa
Flustrella concentrica
Perichlamydium spirale
accrescens
Stylosphæra
Anthocyrtis
Lithocyclia
Cornutella
Stylodictya

* On Otoliths of Fish see Stoddart, Intell. Observer vol. iii (1863) p. 98.

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Besides the above I have identified a good many others with more or less certainty. In the foraminifera-rocks I have come across the following among others

Periphæna decora — Halioma oculatum
Spongosphæra rhabdostyla — Lithocyclia ocellus.

I have not done more work in the identification of the radiolaria and diatoms partly on account of the difficulty already mentioned of isolating and mounting them and partly on account of the unscientific way in which they have been named. What are evidently merely individual forms have been described as genera and species. There is little satisfaction therefore in working at the nomenclature of these organisms until someone undertakes the task of its revision and simplification, in fact to do for this subject what Parker, Jones and Brady and Carpenter have done for the Foraminifera.

As regards the Foraminifera which constitute the most important element of this Microzoic fauna and the one I am best acquainted with, I have introduced some slight changes from my former paper. A few names I was not quite sure of have been omitted including some forms of doubtful validity and a few I have since discovered have been added. There are still some whose affinities are undetermined. Of the forms whose names are given there are some which are marked varieties or show constant differences from the types and these may probably hereafter receive distinctive names. The foraminifera of the radiolarian marls are generally poor and small examples.

Several of the Microzoa are of limited occurrence and very few indeed pass through the series. Globigerina occurs most abundantly in all the beds except the shallow water ones, namely the Orbitoides and Amphistegina beds and the Ally creek shell-bed. The Nummuline forms (Orbitoides, Nummulina, Heterostegina, Amphistegina and Tinoporus) are confined to these beds. The following occurred each in a single sample of rock from the Globigerina beds ; Anomalina polymorpha, A. anomala.

The following are also of very restricted occurrence though the first three are tolerably abundant in the beds in which they occur.

Miliolina (several forms)
Amodiscus incertus, A. charoides
Discorbina bertheloti
Pulvinulina menardi — Very rare.
Nonionina (one or two species)

Another very rare form is one I have not yet determined—this is like a Glandulina in shape but appears to unite some of the characters of Lagena and Miliolina (Biloculina). I do not say, however, that it really combines the characters of those groups.

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The most abundant Nodosarias are those identified as N. abysorum and N. rugosa, both to a certain degree anomalous, the first an account of the polymucronate apex, the latter on account of the peculiar structure of its test. In the columns of the appended table relating to the Trinidad rocks an attempt has been made to give an idea of the relative frequency of occurrence of each of the forms named. This has been done according to the following scale :—

1000	represents	1000 examples or more.
500	"	500 to 1000 examples.
100	"	100 to 500.
50	"	50 to 100.
10	"	10 to 50.
5	"	5 to 10.
1	"	1 to 5.

For the other localities I could not add such indications, being without any information as to relative frequency of occurrence. I feel sure that many if not all the gaps in the table will hereafter be filled up when sufficient search has been made for rocks of corresponding age and conditions of deposit. We have information of the occurrence in Cuba and Haiti of oceanic beds. The table clearly shows the strong resemblance between the fossil foraminiferal faunas of Trinidad and Barbados.

The table is not intended to give an exhaustive list.* There are many other forms in my collection. Even of the forms ranked under the names here given some have marked and constant differences which might intitle them to varietal distinction.

* I might also add that if my object had been to give a long list of names I might have almost doubled the number given in the table, so numerous are the varieties occurring in the Trinidadian rocks.

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Tables showing the Distribution of the Foraminifera of the Cretaceo-Tertiary Microzoic Rocks of Trinidad.

	Trinidad					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbadoa Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
Miliolina venusta	50	...	...	...	*	...
oblonga	5	...	...	...	...	...
agglutinans	10	...	5	*	...	...
seminulum	1000	50	...	...	...	*
subrotunda	10	...	...	...	...	...
cuvieriana	100	...	...	...	...	...
auberiana	5	...	...	...	...	...
trigonula	...	10	10	*	...	...
Spiroloculina tenuis	5	...	5	...	*	...
tenuiseptata	10	...	...	...	...	...
limbata	...	...	10	*	...	*
fragilissima	1	...	...	...	...	...
excavata	...	...	5	...	...	...
alata	...	1	...	...	...	...
Biloculina ringens	5	...	1	...	...	...
depressa	...	...	1	*	...	...
lævis	...	...	5	...	...	...
Cornuspira involvens	1	...	...	...	...	...
Planispirina celata	...	...	50	*	...	...
contraria	10	...	...	...	...	...
sigmoidea	...	...	1	...	...	...
Trochamina coronata	...	...	10	...	...	...
conglobata	...	...	10	...	...	...
Webbina clavata	1	...	10	...	...	...
Hormosina globulifera	...	...	10	...	...	...
Amodiscus incertus	1	5	500	...	...	...
charoides	...	...	10	...	...	...
gordialis	5	...	5	...	...	...
Vertebralina striata	...	...	...	...	...	*
Orbitolites complanatum	...	...	...	...	...	*
Cyclamina cancellata orbicularis	...	...	50	...	...	...
Haplophragmium agglutinans, glomeratum, emaciatum	...	...	10	*	...	...
Haplostiche soldanii	...	...	...	...	...	*
Reophax nodulosa pilulifera	...	...	10	...	...	...
Clavulina communis	50	...	10	...	...	...

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	TRINIDAD					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbados Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
parisiensis	10	...	10	...	...	...
Verneuilina pygmæa	...	...	10	...	...	...
polystropha	10	...	...	...	...	...
propinqua	...	...	10	...	...	...
spinulosa	1	...	...	...	...	...
triquetra	5	...	5	...	*	...
Bigenerina capreolus						
pennatula	...	...	100	*	*	...
Pavonina flabelliformis	...	...	5	...	...	...
Spiroplecta americana	...	...	5	...	...	...
annectens	...	...	1	*	*	...
Textularia agglutinans	...	...	10	...	*	*
turris	...	...	5	...	...	...
barretti	...	1	1	...	...	*
sagitula	10	...	5	...	...	...
Gaudryina pupoides	...	...	10	*	...	...
baccata	...	...	10	...	...	...
pariana	10	...	...	...	...	...
Cuneolina pavonia	...	...	...	...	...	*
Bulimina contraria	5	...	1	...	...	...
pyrula	10	...	...	...	...	...
striata	...	...	...	...	*	...
inflata	1	...	5	...	...	...
buchiana	...	...	1	...	...	...
elegans affinis ovata pupoides	...	...	10	*	*	*
Pleurostomella brevis	...	...	10	...	*	...
rapa	...	...	5	...		...
alternans	...	...	10	...	*	...
subnodosa	...	...	50	*	*	...
Chilostomella ovoidea	...	...	1	...	...	...
Bolivina pusilla	...	...	5	*	..	...
robusta	...	...	...	*	*	...
nobilis	100	...	...	...	...	...
ænariensis	...	...	...	*	...	...
beyrichi alata	100	...	...	...	...	...
Cassidulina crassa	...	...	...	...	*	...
lævigata	1	...	5	...	...	...
subglobosa	...	...	100	...	*	...
Ehrenbergina serrata	...	...	...	...	*	...

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	Trinidad					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbados Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
Ellipsoidina ellipsoides	?	...	10	...	*	...
exponens	...	...	1	...	*	...
Glandulina rotundata, lævigata, obtusissima	...	...	10	...	...	...
æqualis	...	...	5	...	...	...
Nodosaria radicula	...	...	10	*	...	...
communis	...	...	10	*	*	...
pauperata	...	...	10	...	*	...
mucronata	...	...	10	...	*	...
longiscata	...	...	10	...	*	...
arundinea	...	...	10	...	...	...
farcimen	...	...	10	...	*	...
ovicula	...	...	10	...	*	...
pyrula	5	...	50	*	*	...
hispida	...	...	5	*	*	...
veruculosa	...	...	10	...	...	...
plebeia	...	...	10	...	*	...
raphanus	5	..	10	*	*	...
obliqua	5	...	10	*	*	...
rœmeri	...	...	10	...	...	...
filiformis	...	...	10	...	...	...
consobrina	...	...	10	...	...	...
simplex	...	...	10	...	...	...
rugosa	...	...	100	*	...	...
abysorum	...	...	100	...	...	...
raphanistrum	...	5	10	*	...	*
acicula	...	...	5	...	...	*
scalaris	...	...	1	...	...	...
comata	...	...	1	...	...	...
Vaginulina legumen	...	...	5	...	*	*
Rhabdogonium tricarinatum	...	...	...	...	*	...
Margiculina glabra	...	...	1	*	*	...
costata	...	...	1	...	...	...
Allomorphina trigona	...	...	...	...	*	...
Frondicularia milleti	...	...	1	...	*	...
pupa	...	...	5	*	...	...
interrupta	...	...	5	...	...	...
inæqualis	...	...	10	...	...	...
complanata, alata	5	...	5	...	...	*
Cristellaria tenuis	...	...	...	...	*	...
crepidula	1	...	5	...	*	...

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	Trinidad					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbados Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
Cristellaria wetherelli / aculeata	50	...	...	...	*	...
cultrata	10	10	50	*	*	*
rotulata	10	5	10	...	*	*
orbicularis	...	...	5	...	...	...
cassis	...	...	1	...	...	...
italica	...	...	5	...	...	*
compressa	...	...	10	...	...	...
obtusata	...	...	10	*	...	...
nitida	...	...	10	...	...	...
gibba	...	...	10	...	...	...
echinata	...	...	5	...	...	...
papillosa	...	10	...	...	...	...
calcar	10	...	1	...	...	*
Lagena striata	...	...	1	...	*	...
sulcata	...	...	5	...	*	...
striato punctata	...	...	1	...	*	...
fimbriata	...	...	1	...	*	...
alveolata	...	...	5	...	*	...
lævigata	...	...	...	...	*	...
marginata	1	...	5	*	*	...
lagenoides	...	...	...	...	*	...
pulchella	...	...	1	...	*	...
trigonomarginata	...	...	...	...	*	...
apiculata	...	...	10	...	...	...
distoma	1	...	1	...	...	...
lævis	...	...	5	...	...	...
squamosomarginata	...	...	5	...	...	...
castrensis	1	...	1	...	...	...
orbigniana	...	...	5	*	...	...
tetragona	...	...	1	...	...	...
hispida	...	...	10	*	*	...
aspera	...	...	10	...	...	...
crenata	...	...	1	...	...	...
formosa	...	...	1	...	...	...
longispina	...	...	1	...	...	...
Polymorphina lactea	...	...	50	*	...	...
angusta	...	...	1	...	*	...
problema	...	...	10	*	...	...
elegantissima	...	...	10	...	...	...
anceps	...	1	10	...	...	...
gibba	...	...	10	*	...	...
burdigalensis	...	...	10	...	...	...

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	Trinidad					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbados Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
Polymorphina fusiformis	...	...	10	...	...	...
lanceolata	...	...	10	...	...	...
cylindroides	...	...	10	...	...	...
sororia	...	...	10	...	...	...
Uvigerina pygmæa	10	...	50	*	*	...
angulosa	1	...	...	*	...	...
schwageri	5	...	5	...	...	...
porrecta	10	...	...	...	...	...
tenuistriata	...	...	10	*	...	...
canariensis	...	...	5	...	...	...
aculeata	1	...	...	...	...	...
asperula	...	...	50	*	*	...
Sagrina virgula	...	...	1	...	...	...
nodosa	...	...	...	...	*	...
raphanus	...	...	1	...	...	...
Globigerina bulloides	1000	...	2000	*	*	...
inflata	...	...	1000	*	*	...
dutertrei	...	...	1000	*	*	...
conglobata	...	...	1000	*	*	...
pachyderma	...	...	1000	*	...	...
æquilateralis	...	...	100	...	*	...
triloba	10	...	100	...	...	...
quadrilobata	10	...	100	...	...	...
cretacea	...	...	100	...	...	...
digitata	...	...	10	...	...	...
Orbulina universa	100	...	500	*	*	...
Sphæroidina bulloides	...	...	50	*	*	...
variabilis	100	...	...	...	...	...
Pullenia sphæroides	1	...	50	*	*	...
quinqueloba	...	1	...	*	...	...
Planorbulina larvata	...	1	...	...	...	...
Discorbina bertheloti	...	1	10	...	...	*
Truncatulina lobatula	...	...	...	...	*	...
akneriana	...	...	10	...	*	...
haidingeri	...	1	500	...	...	...
tenera	...	...	50	...	...	...
mundula	...	...	10	...	...	...
culter	...	...	500	...	...	...
reticulata	100	...	...	...	...	...
Anomalina ariminensis	...	...	...	...	*	...
amonoides	5	...	...	...	*	...
wullerstorfi	...	50	1000	*	...	...
grosserugosa	...	...	500	...	*	...

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	TRINIDAD					
	Ditrupa-bed Pointapier	Orbitoides-bed, Amphistegina- & Shell-beds.	Globigerina-beds of Naparima.	Radiolarian-beds of S. Naparima.	Barbados Oceanic-beds	Miocene of Haiti, Jamaica, Cumana, &c.
Anomalina polymorpha	...	...	10	...	*	...
Pulvinulina canariensis	100	...	...	*	...	...
pauperata	...	...	500	*	*	...
elegans	...	...	10	...	...	...
crassa	...	...	...	...	*	...
Rotalia soldanii	...	...	500	*	*	...
orbicularis	...	...	100	...	...	...
broeckiana	...	100	1	...	*	...
beccarii	...	...	...	...	...	*
Nonionina exponens	...	...	1	*	...	...
depressula	...	1	...	...	...	...
pompilioides	...	...	1	...	...	...
umbilicatula	...	...	...	...	*	...
Tinoporus pilaris	...	1	...	...	*	...
asteriscus	...	1000	...	...	...	...
vesicularis	...	...	...	...	...	*
Amphistegina lessoni	...	1000	...	...	...	*
Heterostegina depressa	...	10	...	...	...	*
Operculina complanata	...	10	...	...	...	*
Nummulina radiata	...	50	...	...	...	*
ramondi	...	1000	...	...	...	*
rouaulti	...	...	...	...	...	*
Orbitoides mantelli	...	1000	...	...	...	*
Carpenteria monticularis	...	...	...	...	*	...

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PAPER No. 13.

REMARKS ON SOME FOSSILS EROM THE EOCENE OF NAPARIMA.

Read before the Victoria Institute of Trinidad, May 31, 1897 and published in the "Proceedings" for that year, pp. 169-170.

Unfortunately for Trinidad, my collection of West Indian Fossils has left the country, having been acquired by the United States National Museum. To make a collection to replace this would be a work of time, labor and expense which I could hardly undergo. I have, however, availed myself of all such opportunities as have occurred to me to collect Fossils. I here exhibit a few specimens deserving of notice. Some examples of *Echinolampas ovumserpentis* are on the table ; and there is one specimen of

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Echinolampas which differs so much from this that it would generally be regarded as a different and probably a new species, for in some of its characters it is intermediate between the eocene *Ech. ovumserpentis* and the miocene *Ech. semiorbis*. I should be inclined to refer it to the *Echinolampas antillarum* Cotteau (Descr. Echinid. tert. 1875 p. 19, pl. iii., f. 9-11) but it has more of a subcircular contour and a conical profile.

Another Fossil before you is a specimen of *Terebratula carneoides*. This is the finest I have seen of the species. It recalls somewhat *Ter. bicanaliculata*, Schlot. (Bayle and Coquand Foss. de Chili, Mem. Soc. Geol. France, 2 ser. t. 4, pl. viii., f. 17-19) and also perhaps *T. haueri*, Karst. (Kreidebildung von Sudamerika, taf. vi., f. 1.) The principal distinction between *T. carnea* of the Chalk and *T. carneoides* of the West Indian Eocene is the much larger foramen of the latter. From *T. depressa*, Lam. of the Chalk, *T. carneoides* is distinguishable by the absence of a Deltidium. These characters it may be admitted seem scarcely weighty enough to separate species, but they appear to be pretty constant. The cretaceous alliances of our Fossil are evidently strong, but too much weight must not be attached to this point because as pointed out by Davidson the form is represented in the living Fauna by *T. vitrea*.

T. carneoides was described by me from the Naparima Beds in quart. Journ. Geol. Soc. 1866 p. 296 pl. xix. f. 2. It was much better figured and described from the Eocene of the Island of St. Barts by Thomas Davidson in Geol. Mag. 1874, page 158 pl. viii., f. 11.

PAPER No. 14.

NOTES ON THE PASSAGE BETWEEN THE FORAMINIFERA BEDS AND THE RADIOLARIAN MARLS OF NAPARIMA.

Read before the Victoria Institute, May 31, 1897 and published in the "Proceedings" for that year, pp. 170-172.

On a visit I paid some time ago (November, 1894) to the South Naparima District, my friend Mr. Ludovic de Verteuil pointed out to me what he believed to be the junction beds between the Radiolarian marls and the Foraminifera beds. On examination I was able to verify the fact. I was also able to

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observe evidence of the fact that a gradual transition takes place from the Foraminifera beds to the Radiolarian marls—the junction beds occupying a width of about 50 yards or so measured across the upturned edges of the beds at right angles to the strike. From a diagram kindly furnished to me by Mr. de Verteuil it appears that the line of strike of the junction beds extends so far as known from Beausejour and Plaisance through Cedar Grove, La Resource and Philipine, passing to the north-west of Dunmore Hill. This of course is quite agreeable to all former observations of the strike of the Naparima beds.

As regards physical characteristics it may be noted that the junction beds contain a larger proportion of pumice and felspathic material than any other of the rocks of the district that I have examined. Silicous casts of Globigerina are another feature worthy of notice in these beds. These casts of the interior of the Foraminifer are of a brilliant white bristling with what look like small spines but which are casts of the pores in the Globigerina Shell. In character generally as well as in position the junction beds are intermediate between the Foraminifera and Radiolarian beds. It is now I think proved by indisputable evidence that the passage is conformable and gradual. Previously we have not been able to assert this fact which is one of very great importance and interest from a geological point of view, and has been the source of much inquiry and discussion.

I regret not having been able to make so exhaustive an examination as I could have wished.—Among the Foraminifera I have identified the following.

Globigerina bulloides.
Biloculina depressa—one moderate example
Pleurostomella subnodosa—small and attenuate forms
" brevis—a few
Ellipsoidina subnodosa, Guppy
Gaudryina pupoides—two fine examples
Lagena—several species
Polymorphina horrida
Nodosaria abysorum and perhaps two other forms
Pullenia sphæroides
Pulvinulina pauperata
Anomalina grosserugosa
" wullerstorfi (rare and small)

The abundance of Lagena is remarkable. Nodosaria is poorly exhibited and small forms only occur. Globigerina is fine and large—Pullenia is nowhere common to my knowledge, but it is quite as abundant here as I have ever found it.

N. B.—Mr. L. de Verteuil pointed out the junction beds to me in November, 1894, and in February, 1895, I went over the ground again with him and Prof. J. B. Harrison.

PAPER No. 15.

NOTES ON A SPECIMEN OF GLOBIGERINA ROCK FROM NAPARIMA.

Read before the Victoria Institute May 31, 1897 and published in the "Proceedings," p. 172.

This specimen given to me for examination by Professor J. B. Harrison came from the neighborhood of the S. Madelein Factory. It is a Globigerina Rock of blue-grey tinge containing a large proportion of mud. It shows signs of brecciation. The residue after washing contains a fair series of Foraminifera, but none of fine development—sandy forms including Trochamina, Clavulina, etc., are pretty abundant, and so is Gaudrina pupoides, but I saw none full grown. Bigenerina is common but small.

I am inclined to think that this was deposited in relatively shallow water.

APPENDIX.

I give here the names of some additional species of Foraminifera from the Microzoic Rocks of Naparima described or determined since my paper on the subject was read to the Field Naturalists' Club.

Ellipsoidina ellipsoides, Seguenza
" subnodosa, Guppy
" exponens, Brady
Stillostomella rugosa, Guppy
Frondicularia flabelliformis, Guppy
Gaudryina lobata, Guppy
" pariana, Guppy
Gonatosphæra prolata, Guppy

The two latter are from the Ditrupabed of Pointapier.

(See paper in Proc. Zool. Soc.—1894, page 647.)

PAPER No. 16.

TOBAGAN FOSSILS

Recorded in the "List of Scientific Papers" by Guppy as having been published in the "Bulletin of the Trinidad Botanical Department, April 1903, p. 541." The separate is labelled :

514.—TOBAGAN FOSSILS.—On some specimens of Fossils from Tobago in the Victoria Museum, Trinidad.

Page 1—of the Separate

At the Victoria Museum the other day I saw some Specimens from Tobago—one had a Label carefully wrapped round it to the effect that it had been determined by the British Museum Authorities to be *Arca grandis* and therefore was of pleistocene age. This at first puzzled me exceedingly as there did not appear to me the slightest evidence that the Fossil was an Ark—it looked more like an Oyster. However I looked at the other Specimens and the truth then flashed upon me. These two specimens were *Arca patricia* described by Sowerby at Page 52 of Vol. VI. (1850) of the Journal of the Geological Society of London (*see* my Report on the Tobago Specimens 1901). The likeness of *Arca patricia* to *A. grandis* is alluded to by Sowerby in the place indicated and the differences are pointed out. If a Conchologist met with this shell by itself he might probably identify it with *Arca grandis* and that being a living species he might thence infer the age of the stratum containing it to be pleistocene. But in Haiti and also in Trinidad *Arca patricia* occurs with a very extensive molluskan Fauna containing a large proportion of extinct species many of which bear a remarkable resemblance to living pacific species ; and those Paleontologists who have studied the matter have decided the age of the formation to be miocene (*see* my Paper on the West Indian tertiary Fossils Geological Magazine 1874, Page 433 ; also Proceedings of the Scientific Association of Trinidad, December 1867, Page 146).

Though Gabb in his account of the Geology of San Domingo identifies *Arca patricia* with *A. grandis* and gives his reasons for so doing I am not prepared (having often found myself at variance with him as to the identification of Fossils, &c.,) to follow him in this matter. *Arca patricia* is no doubt the West Indian miocene Analogue of *A. grandis*, but the latter is not found on the Atlantic side of America. There are many other shells of the West Indian miocene in the same predicament as *Arca patricia*, that is they are the West Indian miocene Analogues of living pacific shells. Several such species are indicated in my writings: but I would not assume their absolute identity on the ground of their resemblance. The species of the cabinet Naturalist is not always a natural species. I quote from my Paper on the Gulf of Paria on this subject :—"The cabinet Naturalist is often at a loss to find characters whereby to separate what are really distinct species while he finds no difficulty in noting characters whereby to separate a single species into several or even into two or three Genera." In the Paper quoted I have said more on this subject but this may suffice for the present.

(NOTE.—The specimen having the label wrapped round it is not an Ark at all but an Oyster, the same as occurs in the other specimens examined by me but I did not determine its specific name.)

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The following paper on fossils from Tobago was originally published in the *Official Gazette* of Trinidad by order of the Governor August 1901 but as that publication is not widely read the paper is for facility of reference reprinted here :—

REPORT ON FOSSILS FOUND IN TOBAGO.

1. SPECIMENS FROM LAMBEAU.

"This is a calcareous conglomerate with broken shells. This is a beach deposit—the pebbles included in it are derived from the older rocks of Tobago, the most abundant being of quartzite of a variety characteristic of the Tobagan rocks. The shells are usually too much broken to be specifically determinable but they are of tertiary aspect and probably of miocene or later date. The shells and pebbles are included in a calcareous paste or matrix formed by the destruction of shells and other calcareous organisms.

2. SPECIMENS FROM BOTANIC STATION.

"This is an impure Limestone with small pebbles derived from the older rocks of Tobago. It contains numerous shells but not in recognizable condition. One Fossil however is with little doubt, the *Arca patricia* of the Haitian Deposits and this I think fixes the age of the Stratum as miocene. The deposit was a shallow-water one.

3. SPECIMENS FROM MOUNT IRVINE.

"The specimens are Limestone of a different kind to those from the other localities—they have more of a stalagmitic character. They have been picked up on the seashore as they have recent marine organisms adhering to them. This Limestone was probably deposited inside a coral reef or in the lagoon or space between the reef and the shore.

CONCLUSION.

"The existence of miocene strata in the Island of Tobago is indicated. More investigation would be required before a more definite opinion could be given. Doubtless better specimens of the Fossils will be forthcoming in time. The material from the Botanic Station would be suitable for burning for lime and if in sufficient quantity for the purpose it might be profitable.

"On a short visit I paid to Tobago some years ago, I remarked that the Geology was of an interesting character and highly deserving of investigation. I had however neither time or means to investigate it."

R. J. LECHMERE GUPPY.

Glenside, Tunapuna, Trinidad,
29th July, 1901.

Note.—In No. 26 of Vol. V. *Bulletin*, page 335 Mr. Guppy kindly favored us with a preliminary Report. At page 362 there is a further short note on a Fossil Oyster also found in Tobago. —(ED.)

PAPER No. 17.

SECOND NOTE ON THE MARBELA MANJAK MINE

Dept. Agr. Trinidad, Bull. Agr. Information, Jan-Apr., 1909, pp. 51-54.

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Having been favoured by James Wilson, Esquire, of Messrs. Goodwille and Wilson, with samples of the rocks found in the Marbela Manjak mine, I was enabled to present a short preliminary note on the subject published in the Proceedings of the Victoria Institute, 1904, and in the Geological Magazine, London, 1904, page 276.

The receipt of additional samples of the rocks, the last of which came through L. J. Bernstein, Esquire, induces me to modify my opinion on some points, and I therefore contribute a second note on the subject.

Down to a depth of about 40 or fifty feet the material obtained in sinking the mine is mostly of a heterogeneous character, showing extensive disintegration and disturbance due partly to pluvial and weathering agencies and partly to human interference. Below that we have indurated clays and sandstones containing gypsum, and it is in these and the subjacent strata that the manjak occurs in veins and seams. These continue down to about 160 feet, and were apparently laid down in an area where tide-water and flood-water were alternately admitted. These deposits were extremely fine grained and the clastic matter in them is mostly very fine sand with a large proportion of argillaceeus matter, showing that its origin was at a considerable distance. But below this the fluviomarine character gives place to a decidedly marine one, though the proportion of calcareous matter is still much less than in the typical Naparima rocks. These rocks show the gradual shoaling of the water by matter brought down by the rivers from the neighboring continent. The foraminiferal fauna which in the lower beds is of an entirely deep sea character becomes gradually driven out, and only those species remain which are capable of existing under estuarine or fluviomarine conditions.

The following is a List of the Foraminifera from the deposits below 160 feet in vertical depth :—

Spiroloculina limbata.
robusta.
Chilostomela ovoidea.
Webina clavata.
Trochamina proteus.
Amodiscus tenuis.
incertus.
Cornuspira polygyra.
Cyclamina cancelata.
pusila.
Reophax nodulosa.
Haplophragmium neocomianum.
foliaceum
Clavulina eocæna.
Bigenerina nodosaria.
Spiroplecta biformis.
Bolivina beyrichii.
Nodosaria comata.
soluta.
raphanistrum.
Glandulina lævigata.
Cristelaria limbata.
echinata.
crepidula.
clypeata.
italica.
Frondicularia inæqualis.
striata.
mucronata.
Uvigerina pygmæa.
Polymorphina comunis.
Bulimina pyrula.
Globigerina buloides.
Truncatulina præcincta.

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Textularia gramen.
trochus.
Ellipsoidina subnodosa.
Lagena formosa.
orbigniana.
haidingeri.
ariminensis.
Pulvinulina pauperata.
elegans.
Rotalia soldanii.

(This List is only a preliminary one.)

I have no evidence as to the dip of the strata in the Marbela Mine, except that it is high and variable. The strike is approximately S.W. to N.E.

The sample referred to as having been furnished to me by Mr. Bernstein, came from a depth of about 200 feet. It was a moderately hard very fine-grained sandstone—a sandy Mudrock in fact ; black in color with some argillaceous matter in it, and some larger fragments of stone, one or two of which were 6-7 mm. in diameter. The black color seems to be due to carbonaceous matter which is very small in quantity and probably infiltrated from adjoining beds. This rock contained a considerable number of Orbitoides, similar to those found in the lowest beds of the Naparima Tertiaries. They show that the Orbitoides-bed underlies this series of strata and that the base of the tertiaries has been reached. This bed appears again near the San Fernando Railway Station and at Point Bontour, also at Ali Creek.

The Orbitoides are almost exactly the same as those figured by Brady from Sumatra (Geol. Mag. 1875, Pl. XIV., Figs. 2 and 3), and may for the present be called *O. dispansa*, Sow., though I could not assert the specific distinctness of the specimens placed under that name, and I should prefer to adhere to my former treatment of the nomenclature as recorded in the Journal of the Geological Society, 1892, p. 532. Silvestri has referred the Form called *O. dispansa* to *Lepidocyclina marginata* Micheloti in a Paper in Atti Acad., romana 1906. (*See* also Silvestri "Sulla Orbitoides gumbelii" in Atti Acad. romana Dec. 1905, page 34). The superficial characters of our Form are similar to those illustrated by Silvestri. Among the Marbela specimens we may roughly distinguish three Forms ; 1.° the small or young forms, nearly smooth ; 2.° the medium-sized forms, having a pitted or foveate surface ; these are much thinner towards the edges than the third form in which the superficial cells are converted into tubercles owing to the development of exogeneous deposit. This which may be called the adult form is almost evenly biconvex. In the small form the process of shell construction is going on, the sarcode body forming cells on a definite cyclical plan for its reception. Having attained its full growth the extension of the sarcode body is lodged in cells constructed for its accommodation on the outer surface of the disk, forming the pitted or foveolate structure of that surface. The organism growing older but still retaining some of its power of secreting calcareous matter gradually covers over or fills up these superficial cells with exogeneous deposit forming the lumps or tubercles seen in old specimens.

The Orbitoides found at Point Bontour where I originally discovered the Orbitoides-bed are easily cut across whereby the internal arrangement of the chambers is seen. But the Marbela

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specimens are so infiltrated with mineral matter that the internal structure is obscured. Nevertheless enough is seen to make their relationships tolerably certain.

We originally obtained the names of *Orbitoides mantelii* and the other varieties found in Trinidad, &c., and recorded in my Paper in the Geological Society's Journal, and elsewhere, from T. Rupert Jones, who published a Paper on the Orbitoides from Jamaica in the same Journal in 1863, page 514, and again in the Geological Magazine, 1864, page 103. It was from this last rather than the first-named Paper that we got the names above-mentioned, for in my Paper of 1863, read to the Scientific Association, and re-published in the "Geologist," 1864, page 159, I did not venture to use specific names. Speaking of the Antiguan Orbitoides, Rupert Jones says: "This large thin Orbitoides is of considerable interest; it belongs to that species of Orbitoides which is characterized by having vertical partitions to its central layer of chambers, and these more or less cylindrical, namely, *O. mantelii.* It is the exact counterpart of the Orbitoides I have lately observed in the limestone from Malta." He further states that he found the same variety of *O. mantelii* in the Jamaican limestone mixed with *O. dispansa* and *O. fortisii.* Dall, (Proc. U. S. N. Museum 1896, page 329) observes that in no case which he has examined has the West Indian species proved to be the true *O. mantelli.* Upon this Hill remarks (Geology of Jamaica, page 144): "It is now apparent that Dall's recent statement * * * to the effect that *Orbitoides mantelli* has not been found in the West Indian species is incorrect, and we must accept the occurrence of this species as identified by the eminent authorities T. Rupert Jones and R. M. Bagg." The variation in Orbitoides leads me to believe that the different forms found in the Trinidad and other West Indian rocks are all really of one species. I cannot see any true and constant differences between our fossils and those figured by Brady and Silvestri in the places quoted, and by Carpenter (Introd. Pl. XX). In these circumstances I do not feel competent to make any change in the nomenclature, and to avoid confusion I leave matters in this respect as they were before. Hill's observation that Orbitoides are not found above the Eocene is, in my opinion fully borne out by the facts here as well as in Jamaica.

I consider that the rocks occurring in the Marbela Mine down to the depth of 160 feet represent the Nariva series, while the lower beds represent the Naparima oceanic deposits. These last differ in some respects from the Naparima oceanic beds, and the difference may be due to the deposition of the sediments in a shallower sea on the flanks of the cretaceous ridge crossing the middle of the Island and lying to the north of the great Naparima Anticline. In my first note already quoted I described the difference in these words : "A very noticeable difference is that the material of the oceanic beds when washed yields a residue consisting almost entirely of Foraminifera (chiefly globigerina), while that of the Marbela deposit consists of small pieces of slaty-looking and ferruginous materials, the foraminiferal fauna being much scantier than that of the oceanic beds." While admitting a large amount of variation in composition in the

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Naparima rocks, this may be held to be true generally of the oceanic beds. We have to assume therefore a shallower sea and a greater quantity of muddy sediment in this area than in that to the south of Naparima Hill. (*See* my Section in Journal of the Geological Society, 1892, p. 522).

From Mr. Wilson I received some additional samples of a hard sandstone which appear to have come from a lower depth than the Orbitoides bed, some 220 feet deep. These contain fossils but not in a determinable condition, and the rock is so hard that there is no means of extracting them. I believe, however, that these rocks are the very base of the tertiaries or top of the cretaceous. I consider therefore, that the rocks at the Marbela Mine represent the equivalent in time of the whole Naparima series and extend downwards from the Miocene inclusive to the Eocene and top of the cretaceous. They were however deposited in a shallower sea than the true oceanic beds and one wherein the conditions varied somewhat from those.

During the cretaceous period the Amazonian and Orinocan region was occupied by sea as shown by Karsten (Geognostiche Verhältnisse des westlichen Columbien), while at the same time a portion of the Atlantic Ocean was occupied by land. As explained in my papers ("Growth of Trinidad" and "Geological Connexions of the Caribean Region,") the sediments of which the rocks of Trinidad are composed were up to the end of the cretaceous period derived from the land which existed to the north and north-east. But upon the close of the cretaceous period and the gradual rise and filling up of the Amazonian and Orinocan region, the sediments now came from the west and south-west inaugurating the period of asphaltic and carbonaceous deposits which probably continued throughout the tertiary period.

The origin of the carbonaceous substances is to be found in the vast quantities of vegetable matter brought down by the rivers from the continent of South America. This matter being of a slightly greater specific gravity than water, is subject to the laws which govern the removal and deposition of sediment or clastic material. Now one of these laws is that material of like specific gravity and of like fineness or coarseness of grain or dimensions of the component parts is deposited together and apart from dissimilar materials. Hence the vegetable matter brought down by the rivers was deposited in layers banks or strata becoming interstratified with other sedimentary materials as the process of sedimentation and deposition went on. Chemical changes supervened which converted the vegetable tissues into the forms in which we now find them, namely Lignite, Asphalt, Manjak and Petroleum.

P. S.—Basing my opinion on the theory expounded above, I predicted two or three years ago that petroleum would be found in the deltas or sedimentary formations at the mouths of tropical rivers. The prediction has already been verified in the cases of Nigeria and Tampico.

PAPER No. 18.

ON SOME FOSSIL SHELLS FROM COMPARO ROAD, TRINIDAD.

Published in the July No. (1908) of the Bull. Misc. Inform., Botanical Dept. Trinidad, pp. 114-115.

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Among the fossils submitted to me for determination at different times by Mr. Cunningham-Craig, lately Government Geologist, was one collection of peculiar interest consisting of fresh water shells of Genera and species not now found in Trinidad and forming a fauna completely distinct from any now existing here. The locality given me was Comparo Road. I furnished Mr. Craig with the names of the shells and notes on them; but as I have already waited some considerable time and it may be long yet before any general paper by him appears I think it as well to put on record the names of these fossils.

1. Hemisinus sulcatus, Conr.

Amer. Journ. Conch. 1870.

Conrad assigns *H. tenellus* as a near ally of this shell. It is however very closely akin to *H. bicinctus* Reeve an existing species of South American Rivers. *Melania cingulata* Moricand (Journal de Conch. 1860, Pl. xii F. 6) and *M.* (*Melanopsis*) *brasiliensis* Mor. (Ibid. Pl. xii, F. 7.) are also very near.

2. Leptoxis crenocarina, Myricand.

An inhabitant of Brazilian rivers. A remarkable and aberrant form of *Melania*.

3. *Anodon batesii, Woodward.*

Ann. and Mag. M. H. 1871-4 Ser. Vol. vii. P. 103 Pl. v. F. 10.

There is no need to go to Asia for the nearest Analogue of this Bivalve, which is related to the *Anodon Leotaudi* of our Rivers and equally so to *A. sirionos* Orb. and *A. puelchana* Orb.

of South America. The African Shell figured under the name of *Margaritana pfeifferiana* by Bernardi (Jonrnal de Conch. 1860, Pl. xii, F. 1, 2) bears much likeness to the species named, which are all closely related.

4. Cyrena semistriata, Desh.

I had attached the MS. name of *craigiana* to this Shell ; but a closer comparison of the numerous specimens contained in a Slab presented by Mr. Craig to the Victoria Museum caused me to feel doubtful whether it ought to be accounted distinct from the *C. semistriata* of the European tertiaries (Pictet, Paleontologie, Pl. lxxvi, Fig. 10 ; and Forbes, Isle of Wight, Pl. iii, F. 2). It is akin to *C. solida* Phil. of Central American Rivers.

5. There is also a very remarkable Bivalve whose fragmentary condition prevents determination.

The collection indicates fluviatile or estuarine conditions and has resemblances to the tertiary deposits of the Amazon's valley

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whose Fauna has been described by Conrad (Amer. Journ. Conch. 1870) and Woodward (Ann. & Mag. N. H, 1871.) I am of opinion that a pliocene age is denoted.

NOTE.—In addition to the papers referred to by Woodward in the place above cited there is a paper by Etheridge in the Journal of the Geological Society of London, 1879, P. 82 on Fossils collected by Barington Brown in the Amazon's valley.

PAPER No. 19.

PRELIMINARY NOTICE OF A DISCOVERY OF FOSSILS IN THE TAMANA DISTRICT, TRINIDAD.

Dept. of Agr., Trinidad ; Bull. Agr. Inform., Jan.-Apr., 1909, pp. 55-56 with plate.

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Mr. P. W. Jarvis, of the Colonial Bank, has been kind enough to furnish me with some samples of fossiliferous rock from Machipur near Montserrat in the Tamana district. These samples are an indication of the richness of that locality in fossils, and no doubt many remarkable and interesting deposits will be found in the district. The present collection contains corals so highly altered by fossilization as to be scarcely determinable. They are like some of those described by P. M. Duncan from West Indian localities, and better specimens may hereafter be found admitting of specific determination. Most of the specimens are a coral limestone, and in the interstices of this is found a calcareous sandy deposit containing numerous foraminifera polyzoa and echinoderm remains, none of which are in a state for identification except for one foraminifer, namely *Amphistegina*, and this occurs abundantly, but of small size. The most interesting fossil is a crab, of which I append a description. Among molluska there is an olive and a concentrically-ribbed bivalve which might be a Venus, but the hinge and interior are not visible. A small imperfect bivalve seems to be a *Limea*.

Ranina cuspidata.—New Species.

The Carapace is rather evenly convex and the general contour is almost circular, antero-lateral angles being formed by four flattened acute spines pointing outwards beyond the general outline of the Carapace. These spinose projections are somewhat similar to the foliaceous expansions of *R. palmacea* from which they differ in pointing outwards instead of forwards. The median portion of the Carapace is formed by a round carina which is separated off by moderately deep grooves from the lateral portions, thus dividing the back into three parts, the median par bearing a single row of distant, low, but acuminate tubercles ; and each lateral portion two rows of similar tubercles somewhat irregularly arranged. The length of the specimen is about 5 centimetres by 4½ centimetres in extreme width.

A specimen of *Ranina* collected by me from the Naparima rocks was described by my friend Dr. Henry Woodward, F.R.S., in 1866, under the name of *R. porifera*, (Jour. Geol. Soc., Vol. XXII, p. 591.) Dr. Woodward gave a list of all the species of Ranina then known to him, eleven in number, of which ten were fossils from tertiary deposits, and the remaining one is a living species found in Japanese and Eastern seas. I am not aware of any additions having been made to Woodward's list. I am unable positively to allege that our present species is different from that described by Woodward, inasmuch as in the latter the superficial characters of the Carapace are preserved whereas in the present specimen the shell has disappeared. *R. porifera* also lacks the frontal margin so that we do not know what the form

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of it was, while in *R. cuspidata* the frontal margin is almost perfect. Further, the dorsal surface of *R. porifera* is free from tubercles.

The occurrence of *Ranina* in the tertiary rocks of Trinidad is another fact to be added to those noticed in my Paper on the "Geological Connexions of the Caribean Region," showing the probable connexion by sea between the Caribean Sea and the Pacific Ocean at a former epoch.

The concentrically-ribbed bivalve referred to in the foregoing Paper is probably *Venus blandiana*, Guppy, (Proc. S. A. Trin., 1873, page 85. Pl. II, F. 8 ; Geol. Mag. 1874. Pl. XVII, F. 8). It is said by Dall, Florida Fossils, Part VI. page 1277) to be like his *Cytherea strigilina*, but I do not know that species. It is like *V. versatilis*, Dolf., Faluns of Touraine (Journ. Conch. 1888, Pl. XII. F. 4).

EXPLANATION OF THE PLATE.

Tertiary Fossils, Trinidad.

Fig. 1.—Ranina cuspidata—Machipur Tamana, Trinidad.
Figs. 2–3.—Orbitoides dispansus—Bontour Point, Naparima, Trinidad.
" 4–6.—Orbitoides dispansus—Marbela Manjak Mine.

PAPER No. 20.

ON A COLLECTION OF FOSSILS FROM SPRINGVALE NEAR COUVA, TRINIDAD.

Agr. Soc. Trin. and Tobago ; Society Paper No. 440, paged separately, 1-15. Laid before the Society, Dec. 20, 1910.

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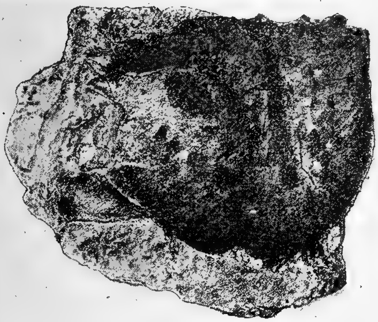
In our study of the Geology of Trinidad, we must proceed step by step, but the general cultivation of elementary geology would facilitate a more rapid progress. Everyone who digs a quarry or makes a boring should preserve samples of the materials, even the least likely looking, found or passed through, and submit them to those who have the means of scientific examination. We have now made a real and important advance in our knowledge of the Tertiaries ; first, from the information gained from the Manjak Mines and secondly, from the discovery of the Springvale fossils. These give us the means of effecting some improvement upon our previous classifications, and to speak with more certainty upon some points, but we have a long way to go before reaching finality, or anything like it.

I make these remarks prefatory to a report on a collection of shells found at Springvale, near Couva, in this Island. These fossils have been confided to me by the Agricultural Society for examination.

The two kinds of matrix adherent to these fossils seem to indicate that they come from two beds, one a ferruginous shelly



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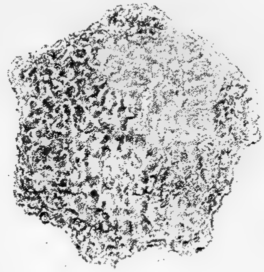

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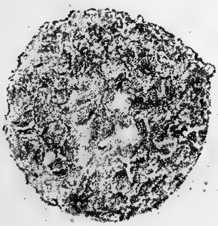

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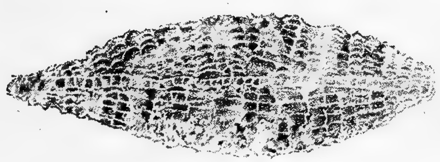

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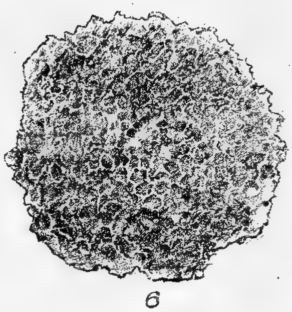

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1. *Ranina Cuspidata.* 2-6. *Orbitoides Dispansa.*

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conglomerate, the other a grey calcareous sandstone which often consists of little else than comminuted shells. The grains of sand found in varying proportions are fine and of uniform size, indicating deposit in tranquil waters of moderate depth. There are many minute black specks which are probably manganese.

To show the distribution of these fossils, I have appended a table showing the occurrence of the species elsewhere. The presence of characteristic species of the Haitian Miocene indicates that the deposit belongs to that period. Though Dall and others have used the term "Oligocene" for the deposits of this age I see no reason for doing so as the epithet Miocene is sufficiently good for the typical series of deposits found in Haiti, Jamaica, Cuba, Trinidad, Panama, &c., &c. (See my paper on the Caribean Region, Trans. Can. Inst. 1908-9, p. 381.) Most of the species dealt with in this paper are well-known to me as occurring in the Caroni beds of Savaneta. Many of them were procured for me by my excellent friend, the late Louis Alexander Leroy, a planter and colonist of high intelligence and attainments. These I described and published in scientific journals. For the naming of the present collection, I have referred chiefly to the works of Carrick Moore and Sowerby on the Haitian fossils, and to my own writings on the Jamaican, Haitian and Trinidadian fossils. I have also referred to Gabb's work where necessary, and in a few cases to Dall's fine monograph on the Florida fossils.

Some time ago, I published a Note on Fossils from Tamana. As these are of the same geological age as the present collection and as the corals of the Tamana deposit are similar to those of St. Croix, Naparima, I take this opportunity to correct an error made by P. Martin Duncan in his paper on these corals.* His statements as to the alliances of the Naparima fossils and rocks are incorrect. The St. Croix beds and the Tamana beds are

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*Journal Geological Society, 1867, Page 12.

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miocene as my researches have shown. The Manzanilla beds may be older. The lowest beds of the Naparima series, the Orbitoides bed, &c., formerly called by me the San Fernando beds, are eocene and pass down into the Cretaceous. Here I may take the opportunity to say a few words in reference to the correlation of the West Indian deposits of tertiary age. Gregory has written a valuable paper in which he deals with this question.* I have made use of his paper in mine on the "Geological Connexions of the Caribean Region." His erudition and research are profound. From time to time I have sent him copies of my papers. I wish he had been equally kind to me. But he is a "Professor,' and has achieved fame in many fields, while I have no titles or any recognition of my work from any scientific authority and probably he looks upon me as one of the small fry not worth notice.† Still if he had sent me his papers I should not have remained so long in ignorance of what he has written. It is difficult in his country, where science is unwelcome, to find the means of making oneself acquainted with all that is published on geological subjects connected with the West Indies. Our Public Library is useless for any scientific purpose, being devoted to the supply of fiction and the scientific works stored there being neglected and inaccessible. Our little scientific institution (called Victoria Institute) gained after years of asking and patient waiting, which might have done something to meet the want, has been perverted from the objects of its foundation to those of a music hall and billiard saloon. Consequently, when I want any information I cannot get within the walls of my own library and museum I have to go at great cost and inconvenience to myself to the scientific museums and libraries of Europe and America. And as I am now getting past work of that sort, having spent over fifty years in the malarious and enervating climate of

* Journal Geological Society 1895, Page 255.

† In this matter I am quite content to be in the same Company with though on a much lower plane than that eminent man William Smith the father of English Geology—(See what Marcon says about him in "Roches du Jura." Page 353).

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Trinidad and been subject, not only to the most terrible fevers, but also the deadly persecution of those who hate science and freedom, and who command all influence in the community, I can do but little.

As I have said, Professor Gregory's erudition and research are profound, but they have not saved him from falling into the error of mixing up the Miocene with the Eocene and calling the result Oligocene. So far as I am concerned, I have objected to the use of the latter term which has only come into use since my eyes have been opened to the distinctions between the Eocene and Miocene of the West Indies. For the deposits containing *Arca patricia*, *Petaloconchus*, *Solarium*, *Turbinelus*, *Conus*, *&c.*, *&c.*, in Haiti, Jamaica, Cumana (Venezuela), Trinidad, &c., I prefer to retain the term Miocene. In his paper of 1895 (Journal of the Geological Society, Vol. LI., page 295) Gregory refers to two Echinoids sent him from Antigua as most typical of the West Indian "Oligocene." Of these *Echinanthus antilarum* is stated by Cotteau to be an eocene species from St. Barts while *Clypeaster concavus* (Cotteau) is stated to be from the miocene of Anguilla, having been previously recorded by me from that island under the name of *C. elipticus*. I fear that some mistake has crept in here, for while the St. Barts formation is eocene that of Anguilla is decided to be miocene. I am the more inclined to suspect a mistake here because I find that *Echinolampas semiorbis*, which I described from the miocene of Anguilla, has been assigned by Cotteau to the eocene of St. Barts. The error is a serious one, because Cotteau cites *E. semiorbis* from Cuba, and much confusion has already arisen as regards the classification and arrangement of the West Indian strata, owing to the want of due care in assigning the fossils to their proper beds. (See Vaughan Jennings in the Journal of the Geological Society, 1892, page 541.) I shall not go further into these points just now because I have in hand a paper on the Geology of Antigua and other parts of the West Indies in which I shall touch on this question. In

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the meantime, what I have said is, I think, sufficient to justify the use of the term miocene for the fossils which are the subject of this paper.

LIST OF THE MIOCENE MOLLUSKA OF TRINIDAD, 1910.

The species found at Springvale, near Couva, are distinguished by the letter S. Those previously known from the Caroni beds have an asterik (*) added. C denotes the occurrence of the species at Cumana in Venezuela, P in the Pointapier Ditrupa bed, J in Jamaica and H in Haiti (San Domingo),

Bula paupercula—Sow. * H. C. J.
vendryesiana—Guppy. * J.
Scalaria leroyi—Gup, S * J.
Trochita colinsii—Gab. S.
Natica subclausa—Sow. * J. H.
canrena—Lin. S. H.
phasianeloides—Orb. S. J.

Aclis teres—Gup. D.
Ringicula tridentata—G. D. J.
Eulima egregia—Gup. S *.
Turbonila plastica—Gup. D.
octona—Gup. D.
Turitela planigyrata—G. S *.
Petaloconchus sculpturatus—Lea. S * H.
Mathilda plexita—Dal. D.
Carinaria caperata—G. *
Solarium quadriseriatum—Sow. S * J. H.
Risoa pariana—G. D.
Benthonela turbinata—G. D.
Dilwynela erata—G. D.
Cadulus parianus—G. D.

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Cancelaria lævescens—G. J. H.
scalatela—G. J. H.

Murex miocenica—Dal. S.
cornurectus—G. S. H.
Typhis alatus—Sow. D. J. H.
Latirus teselatus—Dal. S. * J.
Turbinelus validus—Sow. S. H.
ovoideus—Kien. * H.

Fasciolaria semistriata—Sow. S. J. H.
Ficula carbasea—G. S. * J.

Persona similima—Sow. * J. H.
Coraliophila magna—Dal. S.

Oliva cylindrica—Sow. S * C. J. H.
Ancilaria lamelata—G. S.

Conus planiliratus—Sow. S * J. H.

Marginela coniformis—Sow. S * J. H.
solitaria—G. D.
arcuata—G.
Mitra henekeni—Sow. S * J. H.

Clementia tæniosa—G.
Sanguinolaria unioides—G.
Telina sagræ—Orb. S * H.
strophia—Dal. S.

Dosinia liogona—Dal. S.
cyclica—G. *.
Teredo fistula—Lea. * H.
Corbula vieta—G. * J. H.
viminea—G. S. J. H.

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Crasinela gupyi—Dal. * J. H.
Cytherea planivieta—G. S. J.

Venus blandiana—G. * J.
  halidona—Dal. S.
  glyptocyma—Dal. S. J. H.
Arca patricia Sow. * H.
  consobrina—Sow, S * C. J. H.
Limopsis subangularis—G. D.
Pecten inæqualis—Sow. S. * J. H.
  crasicardo—Com. S.
Cardium compresum—Dal. S.
Ostrea virginica—Gmel. * H.
  percrasa.
Anomia umbonata—G. *.

ARTICULATA.

Ranina cuspidata—G. *.
Balanus porcatus—Darw. S *.

ECHINODERM.

Brisus exiguus—Cot. S.

This list, though having no pretension to completeness will show how large a proportion of the miocene fossil molluska of Trinidad are found in Jamaica, Haiti and Venezuela.

NOTES ON THE SPECIES.

Scalaria leroyi.—GUPPY.

Geol. Mag. 1874 P. 466 Pl. xvi F. 10 and Pl. xviii F. 2.

The surface characters of the Shells are so much destroyed by the fossilization that a doubt rests on the correctness of the determination.

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Eulima egregia.—GUPPY.

Proc. U. S. Nat. Museum Vol. xix (1896) P. 314 Pl. xxviii F. 11.

The original specimen figured as above came from the Montserrat beds.

Solarium quadriseriatum. —SCWERBY.

Journ. Geol. Soc. 1850 P. 81 Pl. x, F. 8.

Varieties of this chiefly based on surface ornamentation have been described by Dall from the Tertiaries of Florida, and by Toula from Gatun (Panama).

Marginela coniformis.—SOWERBY.

Journ. Geol. Soc. 1850 P. 45.
" " 1866 Pl. xvii F. 2.

The examples are large and fine and may be compared with *M. aurora* Dal. Flor. Foss. Pt. i Pl. vi F. 4A. Others of Dall's Species are very similar, See *M. balista*, *elegantula* and *newmani* figured on Pl. iv of that Work, possibly also M. *floridana* Dal. *M. Sowerbyi* of Gabb figured by me in Journ. Geol. Soc. Pl. xxviii F. 1 is a Form with a higher Spire. I thought that *M. denticulata* Dal. (Flor. Foss. Pt. i Pl. v F. 8) might be the same.

Mitra henekeni.—SOWERBY.

M. henekeni.—Sow.—Geol. Journal, 1850, p. 46,
Pl. ix. F. 5.

Mitra silicata.—DAL.—(Flor. Foss. Pt. i Pl. iv F. 10) seems very like this. *M. symetrica* and *M. longa* of Gabb are probably forms of this, and *M. titan*—Gab. is a large form without surface ornament.

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Murex miocenica.—DAL.

Florida Fossils, Part i., p. 146, Pl. ix., Fig. 9.
A single imperfect example.

Murex cornurectus.—GUPPY.

Journ. Geol. Soc., 1876, p. 521, Pl. xxviii., F. 4.
An imperfect example.

Turbinelus validus.—SOW.

Journ. Geol. Soc. 1850, p. 50.
An imperfect example.

Fasciolaria semistrata.—SOWERBY.

Journ. Geol. Soc. 1850, p. 49.
Idem 1866, p. 288, Pl. xvi., F. 12.

The specimens from Springvale are remarkable for size, exceeding eight inches in length. The diameter varies from 3½ to 5 inches. Like all shells of the Genus the characters vary with age and growth. The apical Whorls are tuberculated or polygonal and cancellate like *F. textilis* which is probably a form of this : the later ventricose whorls are smooth only showing light spiral striation. The most slender example simulates *Achatina reticulata* (an African landshell) in figure. The three columellar plaits are very strong. See for further remarks on this species my paper on the Haitian Fossils, Journ. Geol. Soc., 1876, page 523.

Latirus teselatus.—DAL.

Florida Fossils, Part i., p. 108, Pl. x., F. 8A.

I adopt Dall's name for the miocene representative of *T. infundibulum.*—Gmel.

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There is only one example of this species, and it was entirely invested externally with an organism like *Membranipora*, which on examination proves to be more like *Stromatopora.* On the spire, the covering forms a thin layer only, but on the last whorl near the Aperture the incrusting organism forms a Boss of several concentric layers. It resembles Carpentaria but there are no large Apertures. The likeness to Orbitoides (see Carpenter, Journ. Geol. Soc., 1850, Pl. vii) should not be overlooked.

Ficula carbasea.—GUPPY.

Journ. Geol. Soc., 1866, p. 580, Pl. xxvi., F. 7.

F. misisipiensis—Gab.—See Guppy, Haitian Fossils, Journ. Geol. Soc., 1876, page 525.

Allied to the Pacific form *F. reticulata.*

Casts only, but retaining sufficient of the shell substance to make the determination certain.

Coraliophila magna.—DALL.

Florida Fossils, Pt. i., page 155, Pl. xi., F. 11.

Ancilaria lamelata.—GUPPY.

Journ. Geol. Soc., 1866, p. 579, Pl. xxvi., F. 9.

This has some resemblance to *A. shepardii.*—DALL. (Flor. Foss. Pt. i., page 46, Pl. iv., F. 4). These full-grown examples are scarcely distinguishable from *A. glabrata* of the Caribean Sea. The Spire is covered with enamel and the lamellar pit leaves a chink between it and the Body-whorl. On these characters the generic name of *Dispacus* has been invented for the shell.

Petaloconchus sculpturatus. —LEA.

P. domingensis Sow. Journ. Geol. Soc. 1850.
Page 51 Pl. x, F. 9.
Dall, Flor. Foss. Pt. ii. P. 305.

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Trochita colinsii.—GABB.

Caribbean Fossils 1878, Page 342 Pl. xliv, F. 11.

Natica canrena.—LINNE.

There are two forms among the Naticas in the Collection, but with no better material at hand I hesitate to separate them.

Turitela planigyrata.—GUPPY.

Proc. Scient. Assoc. Trin. 1867, Page 169.
Geol. Mag. 1874, Pl. xviii, F. 5.

Venus glyptocyma—DALL.

Florida Fossils, Part vi Page 1294 Pl. lv, F. 21.

V. hendersonii Dall, Flor. Foss. Pt. vi., P. 1295 Pl. lv, F. 22.

V. burnsii Dall, Flor. Foss. Pt. v, Pl. xlvii F. 11.

V. burnsii Dall is from the "Oligocene" of Florida. The Form from Jamaica and Haiti has been called *hendersoni* by Dall. *V. glyptocyma* Dall is also from the "Oligocene" of Florida. All these are in my opinion forms of the one Species which following Carrick Moore I called *V. paphia* that being the name of the recent representative of the Group.

Venus halidona.—DALL.

Flor. Foss. Pt. vi, page 1307 Pl. xxxviii, F. 1, 1a.

An imperfect specimen from which much of the Shell has been removed.

Venus blandiana.—GUPPY.

Geological Magazine 1874, P. 444 Pl. xvii, F. 8.

This is included here to complete the List but no specimens were found at Springvale. See my Paper on the Tamana Fossils 1909.

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Cytherea planivieta.—GUPPY.

Journ. Geol. Soc. 1866, P. 292 Pl. xviii F. 3.

The figure is poor and barely conveys an Idea of the Shell whose affinities are indicated at the Page cited.

Dosinia liogona.—DALL.

Florida Fossils Pt. vi, P. 1230 Pl. liv, F. 11.

Telina sagræ.—ORB.

Guppy, Journ. Geol. Soc. 1876, Page 530.

Telina constricta Gab.

Metis trinitaria Dal. Flor. Foss. Pt. v, P. 1041, Pl. xlvi F. 24.

Dall suggests that D'Orbigny's "Paleontologie de Cuba" was never published. Although it was incomplete I consulted it at the British Museum Library during my investigation of the Haitian, Jamaican and Trinidadian Fossils. I have little Doubt that the Figure of *T. sagræ* given by D'Orbigny was intended to represent the species before us, which resembles *T. biplicata* Conrad and *T. sobralensis* Sharp. among tertiary Fossils and *T. constricta* and *T. gruneri* among living shells. In Carrick

Moore's first List of the Haitian Fossils it was inserted as *T. ephippium*.

Telina strophia.—DALL.

Flor. Foss. Pt. v, P. 1019, Pl. xlvii, F. 11.

A mere fragment of shell attached to a cast, but the peculiar sculpture admits of the determination.

Pecten inæqualis.—SOWERBY.

Journal Geol. Soc. 1850, Page 52.

Guppy, Journ. Geol. Soc. 1866, Pl. xviii F. 6.

Pecten demiurgus Dal. Flor. Foss. Pt. iii, P. 718 Pl. xxvi, F. 3.

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The specimen originally figured by me from Jamaica was a small example of this species which is much better figured and described by Dall under the name of *demiurgus*. It is abundant and of large size at Springvale.

My reference to *comparilis* (Tuomey and Holmes) is uncertain, but I am inclined to suspect that *P. eccentricus* Gabb belongs to this species.

Pecten crasicardo.—CONRAD.

Arnold, California Pectens, P. 71, Pl. xi, F. 5, 6 also Pl. xvi, xvii, xviii.

To avoid having to make a new name I take this as an approximate identification merely. There is a large number of Pectens in the miocene and their range of size and variation is so great that without an ample supply of specimens and access to all the literature it is difficult to be certain about the right name. The Pectens not less than certain other Molluska found in the Miocene beds attain a great individual as well as numerical development and the larger specimens assume characters different from those of the smaller ones.

Corbula viminea.—GUPPY.

Journ. Geol. Soc. 1866, P. 293 Pl. xviii F. 11.

Dall, Flor. Foss. Pt. iii., P. 850.

Ostrea percrassa.—CONRAD.

Tertiary Fossils. Page 50, Pl, xxv, F. 1.

Our specimens are thick and heavy, but they agree with Conrad's Figure. The name is appropriate. It may possibly be the same as *Ostrea tryonii* Gab. (Miocene Fossils 1878, P. 348 Pl. xlv, F. 27). The other two Forms of Oyster found in the

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Westindian Miocene, *O. haitensis* and *O. virginica*, do not appeár in this collection.

Cardium compressum DALL.

Flor. Foss. Pt. v, P. 1109, Pl. xlviii, F. 21.

Arca consobrina.—SOWERBY.

Journ. Geol. Soc. 1850, Pl. x, F. 12.

Dall prefers the name of *halidonata* (Flor. Fos. Part iii, Page 646) and he rejects Gabb's identification with *A. floridana*. Like most arks the shell is variable but I am satisfied that our shell is the one intended by Sowerby in his Figure. Dall's figure in my opinion does not represent Sowerby's *consobrina*, which is more like his actinophora in shape, though the proportions are not exactly the same.

Ranina cuspidata.—GUPPY.

This crustacean from the Tamana beds was described and figured by me in the Bulletin of the Agricultural department, 1909.

Balanus porcatus.—DARWIN.

Barnacles probably of this species are not uncommon in the miocene deposits and there is a bed composed chiefly of them at the Government farm in Tobago. A few specimens are in the collection from Springvale.

Brisus exiguus.—COTTEAU.

Echinides tertiaires de S. Barts, &c., p. 35. Pl. vi, F. 16-18.

The examples are large, but are only casts. The species was recorded by me in 1866 from Anguilla under the name of *B. dimidiatus* from which it differs slightly.

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LIST OF WORKS CONSULTED IN THE PREPARATION OF THE FOREGOING PAPER.

Carrick Moore & Sowerby—Journ. Geol. Soc., 1850.
Guppy—Jamaican Fossils— Ibid. 1866.
" West Indian Tertiaries— Ibid. 1866.
" West Indian Tertiary Fossils—Geological Magazine, 1874.
" Haitian Fossils—Journ. Geol. Soc., 1876.
Gabb—San Domingo. Geology and Fossils—
Gabb, Caribean and Costarican Fossils.

See the list of works on West Indian Geology appended to my paper on "The Growth of Trinidad" Trans. Canadian Institute, 1904-5. Several additions must be made to this list, among others the following :—

1909 Toula—Tertiary Fauna of Gatun.
Jahrbuch der Geolg. Reichsanstalt—Wien.

Though the author has described most of the Fossils found at Gatun, under new names, they appear to be identical with species of the Haitian and Jamaican Miocene.

PAPER No. 21.

FOSSILS FROM SPRINGVALE NEAR COUVA, TRINIDAD.—SECOND REPORT—IN CONTINUATION ON SOCIETY PAPER NO. 440.

Agr. Soc. Trin. and Tob.—Society paper No. 454. Separate paging, 1-10 with line etching figure and half-tone plate of fossil remains. Plate caption "Proceedings Agricultural Society, Vol. 11, pls. 1 and 2."

Page 1

I have already made a first Report on the Springvale Fossils which has appeared in the Proceedings of the Society for November 1910, page 447. Under the Auspices of the Agricultural Society I visited the Springvale quarry, on the 16th November, in company with Dr. Fredholm and others. The Road Officer, Mr. Todd, who is in charge of the quarry gave us every assistance. This enabled me to glean some further information. The deposit is one of remarkable richness in fossil shells and the variety of species found in the one place is quite astonishing. The shells are generally well-preserved, but their fragility is such that many beautiful specimens go to pieces on handling or in transport. I found that the difference in color of different samples of

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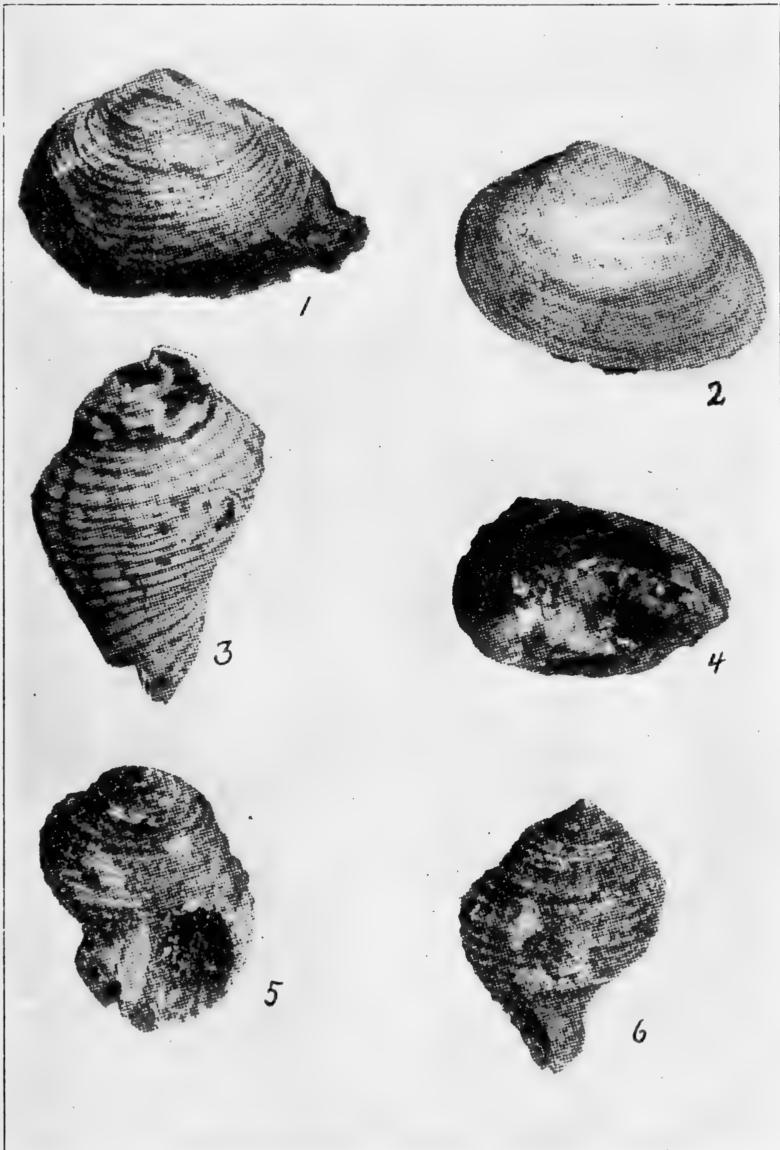
the bed, which I had previously noticed, was due merely to oxidation, the portions of the bed near the surface being converted to a reddish-brown color, while the inner parts were gray. This is quite a common or rather almost universal change produced by the access of air and Water.

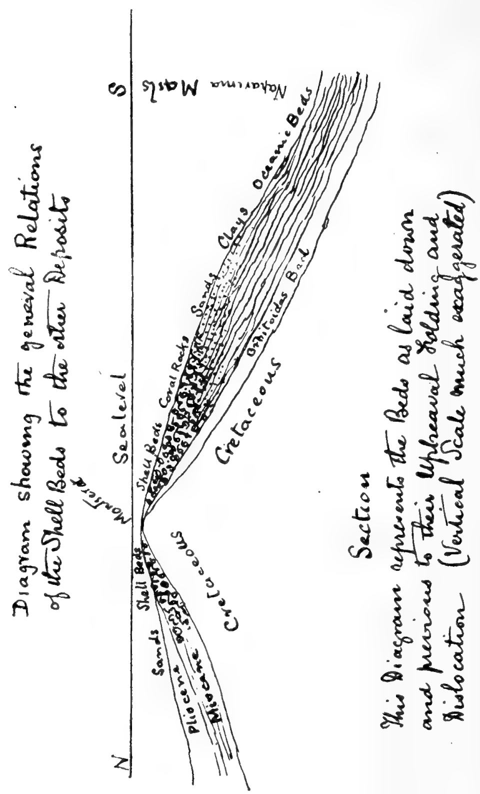
The quarry is situated on the side of a low hill, one of the lateral spurs of the Montserrat range. It is in a cacao wood and the neighbouring surfaces are covered with vegetation, so that it could only be with axe, pick and spade that further exploration could be made. I should think it likely that the deposit would be found to extend to a considerable distance. The material would be useful on a soil destitute of lime, but the soils in the immediate neighborhood are fairly supplied with this substance.

Proceedings Agricultural Society. Volume Xi. Plate 2



TERTIARY FOSSILS, TRINIDAD.

Proceedings Agricultural Society. Volume XI, Plate 1



There are plenty of soils in the Couva district and neighbouring parts which would be improved by the addition of this fossiliferous rock. As a road material it may serve in default of better, but it would not be of any great durability, and could not stand heavy traffic.

I endeavored without success to obtain some information as to dip and strike and the relations of the bed to other beds in the neighbourhood. There was a kind of false bedding which obscured the real relations of the strata—but as no other beds were visible above or below I could not ascertain any other facts. Still in order to exhibit the relations of the strata I subjoin a diagram which I hope will assist in making the general relations clear. This shows that the Couva and Montserrat miocene shell deposits were in course of formation at the same time as the latter part of the oceanic deposits. The subsequent folding dislocation and upheaval have altered the apparent relations of the formations. Until we know the ground better, and have detailed information as to the outcrop, &c., of the geological formations we cannot give a more definite Section than this approximate one, which is only diagrammatic.

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The terms Eocene Miocene and Pliocene were originally fixed by Lyell for the three great divisions of the tertiary strata (see Principles of Geology 8th Ed. page 177 ; Elements 6th Ed. page 187 ; and Student's Manual 1878 page 122) in accordance with the percentage of recent species found in the formations so designated. The percentage test though fundamentally a useful one is not always free from difficulty in its application to particular cases, and the West Indian miocene formation is one of these cases. And this arises in some degree from the fact that the proportion of recent species varies with each observer. According to the list of names I give, amounting to about a hundred species, there are not more than three or four still-existing species in our miocene beds, and even these can easily be disposed of by giving them other names which in most cases are ready to hand. When we come to examine the shells we find a large number of them so near to living species that it is only by critical tests that we can separate them. But the recent Analogues of these shells resolve themselves into at least two catagories, namely 1° species still living in the West Indies, and 2° species not now living in the West Indies. And we find the resemblances of the West Indian miocene shells are largely with Pacific and Indian species rather than with West Indian species. Many again are akin to European miocene species, so that when we compare the fossil Fauna as a whole we find it very unlike the recent West Indian Fauna.

It may be noted as regards this collection that litoral shells are absent from it.

At different times I determined Fossils for Mr. Cunningham Craig. Several of these had previously occurred to me in the Caroni beds of Savaneta and are included in my list already published. To complete the list of miocene fossils so far known I add the names of such as were not given in that list to those of the Springvale Fossils now recorded. These Fossils are addition-

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al evidence of the miocene age of the Springvale Savaneta and Montserrat beds and of the essential identity of their Fauna with that of the Bowden beds of Jamaica and the miocene formations of Haiti and Cumana.

ADDITIONAL LIST OF FOSSILS FROM SPRINGVALE, &C.

[In this list the same letters are used as in the former list in which, however, the letter P (page 451 line 9) should be D.]

MOLLUSKA—I GASTROPODA.

Natica cuspidata new species S.
Capulus efluens new species S.
Turitela tornata Guppy* S.J.H.
    apicalis Heilprin S.
Dentalium domingense Sow.* H.
Conus recognitus Guppy * S.H.J.

stenostomus Sow. S.H.J.
Pleurotoma henekeni Sow. S.H.J.
haitense Sow * H.J.
venustum Sow. * S.H.J.
squamosum Gab. D.
Glyphostoma dentiferum Gab. * H.
Casis sulcifera Sow. S.H.
Fusus haitensis Sow. * H.
Phos moorei Guppy * J.H.
Terebra sulcifera Sow. S. H.
Columbela venusta Sow. S.H.D.
Murex domingensis Sow. S.H.
Solenosteira semiglobosa n. sp. S.
cochlearis n. sp. S.
Turbinelus scolymoides Dal. S.
Modulus turbinatus Heilpr. S.
Turbonila simplicior Guppy. D.

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2. CONCHIFERA.

Ræta meridionalis n. sp. S.
Crasatela melina Conr. S.J.
Cytherea juncea Guppy * S.J.
Cardium haitense Sow. * H.J.
Cardita scabricostata Guppy * J.
Pectunculus acuticostatus Sow. * H.J.
Arca tæniata Dall S.
Pecten lyonii Gab. S.H.
soror Gab. S.H.
Placenta patinata new species near orbicularis.

3. POLYZOON.

Cupularia calyxglandis Guppy *

NOTES ON THE SHELLS WITH DESCRIPTIONS OF THE NEW SPECIES.

NATICA CUSPIDATA (new Species). Pl. 2. Fig. 4.

Shell moderately thick, smooth with lines of growth somewhat sinuate near the Suture-globose-depressed-ovate. Spire pointed—Whorls five or six. Callus large stout conical, impressed with a transverse sulcus—Umbilicus a narrow deep chink. Largest diameter 70 mm. Height 60 mm. Like N. didyma Bolton, with a similar but more developed Callus. The shell is more sigaretiform.

NATICA CANRENA Linn. The Miocene fossil is called N. plicatela by Conrad. See Dall, Flor. Foss. Part 1 Page 364. The eastern Analogue is N. alapapilionis Chemn.

CADULUS EFLUENS (new Species).

Shell obliquely spiral. Whorls rapidly increasing, fluted with longitudinal grooves separated by scarcely-defined rounded

Page 6

keels or ridges. Spire small uncinate. Aperture large. Length 20 mm. Height 15 mm.

The specimens are imperfect and not separable from the matrix, but they seem to deserve a name. The shell is similar in shape to C. mitrula, but it is distinguished by its larger longitudinal flutings. It recalls our old friend C. ventustus.

TURITELA TORNATA, Guppy—Journal Geological Society 1866, Page 580 Pl. xxvi, Fig. 12.

T. altirata Gab. and gatunensis Gab. appear to be synonyms.

This widely distributed and variable species has been redescribed as F. gabii by Toula (Gatun Fossils, Tafel xxv (1) F. 5).

CONUS RECOGNITUS Guppy—Journ. Geol. Soc. 1876 P. 527
C. solidus Sow. Journ. Geol. Soc. 1850 P. 45.

CONUS STENOSTOMUS Sow.—Journ. Geol. Soc. 1850 P. 44.
Id. Guppy—Journ. Geol. Soc. 1866 P. 287
Pl. xvi Fig. 2.
C. catenatus Sow. l. c. P. 45 Pl. ix Fig. 2.
C. interstinctus Guppy l. c. P. 288 Pl. xvi F. 3.
?C. sulculus Dal. ? C. planiceps Heilprin

Compare also C. haitensis, symetricus and domingensis Sow. The variation among the cones is great, and I think that we have already more names than species, consequently it is hard to find the right name for a specimen.

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PLEUROTOMA VENUSTUM Sow.—Journ. Geol. Soc. 1850.

Page 50 Pl. x. Fig. 7. A single small specimen of the form of this I described as Pl. jamaicense (Journ. Geol. Soc. 1856 P. 290 Pl. xvi Fig. 6) occurs in the collection. See Journ. Geol. Soc. 1876 Page 527.

PLEUROTOMA HENEKENI Sow. Journ. Geol. Soc. 1850 P. 50.
Pl. x Fig. 6 (including P. jaquense Sow and
Pl. longicaudata and P. humerosa of Gabb).
Is allied to Pl. belardii of the european Miocene

CASIS SULCIFERA Sow. Journ. Geol. Soc. 1850 Page 47 Pl. x F. 1.

Fragments apparently belonging to this Species.

COLUMBELA VENUSTA Sow. Journ. Geol. Soc. 1850 P. 46 Pl. ix F. 6.

Metulela venusta Gab. J. A. N. S. Phil. 1872
Pl. xi F. 3.

SOLENOSTEIRA SEMIGLOBOSA (new Species. Pl. 2. Fig. 5, 6.)

Shell pyriform strongly lirate subrimate spirally tuberculate on the angle of the last Whorl. Spire pointed. Whorls about seven, carinate. Spiral liræ or keels subacute. Aperture ovate. outer lip dentate—Columella Callus sometimes granulate.

Nearly allied to Rapana and Rapa, but on account of the differences I provisionally use Dall's generic name Solenosteira (Florida Fossils Part I P. 122).

SOLENOSTEIRA COCHLEARIS (new Species. Pl. 2. Fig. 3.)

Shell solid subpyriform rimate spirally lirate tuberculate on the angle of the whorls. Keels or Liræ strongly subacute, triple or quadruple, crossed by strong rather irregular lines of growth.

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Aperture ovate. Lip strongly dentate. Callus rather thin. Spire (imperfect probably) rather conic. Canal moderately long.

This is more purpuroid and less globose than S. semiglobosa, and the tubercles on the angle of the whorl are not confined to the last whorl. I assign it to Dall's genus for the same reason as the last. I would not undertake to say without further study in what group these shells should definitively be placed.

MUREX CORNURECTUS Guppy Journ. Geol. Soc. 1876.
P. 521 Pl. xxviii F. 4.

It is closely related to M. mo-quinianus Duval of West Coast of Africa (teste Petit) Journ. de Conch. 1853 Page 203 Pl. v F. 4.

TEREBRA SULCIFERA Sow. Journ. Geol. Soc. 1850 P. 47.
Guppy Journ. Geol. Soc., 1876 Page 525 Pl. xxix Fig. 8.
T. bipartita Sow. and inæqualis Sow. are synonyms.

RÆTA MERIDIONALIS new Species Pl. 2 Fig. 1.

Oval-oblong rather rostrate somewhat inflated medially concentrically sulcate with smaller lines or grooves between the larger ones.

There are no means of getting at the hinge of the single imperfect example. The proportions appear to be slightly more elongate than those of R. canaliculata (Adams, Gen. Moll. Pl. cii Fig. 4.)

CRASITELA MELINA Conrad. Dall, Florida Fossils Part V, Pl. xxxvii Fig. 6.
Cr. marylandica Guppy Proc. U. S. National Museum 1896 Page 329.

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Compare also Cr. jamaicensis Dal. Flor. Foss. Part vi Page 1471, Pl. xlix Fig. 13.

One Specimen.

CLEMENTIA TÆNIOSA Guppy. Proc. U. S. National Museum 1896 P. 327, Pl. xxx, Fig. 8.

From the Montserrat Beds. One specimen.

CYTHEREA PLANIVIETA Guppy. Journ. Geol. Soc. 1866 Page 292 Pl. xviii Fig. 3.

This species is abundant and finely developed at Springvale, hence we give a figure of it (Pl. 2. Fig. 2). The concentric plication is very variable and some specimens are quite smooth. Its kinship to C. erycinoides and C. striatela of the European Tertiaries, also to the recent C. erycina, was noted in the original description, and it may further be remarked that it is a member of the same group as the well-known C. chione of European seas.

ARCA TÆNIATA Dal. Flor. Fos. Part iii Page 631 Pl. xxv, Fig. 1.

There is only a fragment in the collection attached to a cast. It belongs to the Section Barbatia and is near to A. obliquata Wood of the Indian Ocean.

ANCILARIA LAMELATA Guppy. A. shepardi Dall Flor. Fos. Part i Page 46 Pl. iv, Fig. 4.

MODULUS TURBINATUS Heilpr. Dall Flor. Foss. Part ii Pl. xviii, F. 12.

A Fragment.

TURITELA APICALIS Helipr. Dall Flor. Foss. Part i, P. 316 Pl. xvi, F. 10-13.

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TURBINELUS SCOLYMOIDES Dal.

Flor. Foss. Part 1 Pl. iii, F. 2, 5.

A Fragment.

PECTEN LYONII Gab.

Gabb, Caribean Fossils, Journ. Acad. N. S. Phil. 1881 (vol. viii) P. 347, Pl. xlv, F. 25. Near to P. japonica and P. pleuronectes. A specimen is near six inches (140 mm.) in diameter. It goes to pieces on a touch. It is found in the Miocene of Anguilla and Jamaica, also Central America. Gabb's P. papyracea from Haiti is probably a young specimen.

PECTEN SOROR Gab.

Geology of San Domingo Page 257.

Dall, Flor. Foss. Part iii Page 712.

The convex valve has twenty ribs, but the flat one has only about a dozen. Only two or three disunited valves have occurred.

PAPER No. 22.

AN ACCOUNT OF SOME RECENT GEOLOGICAL DISCOVERIES IN THE WEST INDIES.

Agr. Soc. Trin. and Tob. ; Soc. Pap. No. 493.

Read before the Society Jan. 20, 1912 and published in the "Proceedings" of the Society, Jan-Feb. 1912, Vol. 12, 1912, pp. 22-37.

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I have always considered it my duty to make known to my fellow countrymen whatever of interest or importance I have discovered in the course of my investigations. I think that the subjects I bring before you to-day are of sufficient interest to justify me in asking your attention to what I have to tell you about them.

I shall preface my observations with an extract from an article published in a scientific journal, and I do this because it expresses more clearly some of my views than I could do in my own words. And I hope that you will award me your patience, because the matter of this extract is absolutely applicable to our needs and our condition.

(*Extract from an article in "Nature," 30th June, 1910.*

The object of Science is to increase the knowledge of mankind in general and not merely that of the workers in Science. The methods of Science may be only understood by the workers in each particular branch, but the conclusions are for all, and should be made accessible to all. * * * I think most will agree that students of Science should make known their discoveries in such a way as to be understood by the layman.

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In making these remarks I have Biology in mind. Nothing is known of biology outside the ranks of biologists. Even Darwin's theory of evolution is most imperfectly understood by the ordinarily educated man. Probably working biologists have no idea how much it is misunderstood. When the late Lord Salisbury at Oxford said that there was nothing but pure chance to ensure the transmission of an advantageous variation he left out of consideration the survival of the fittest, an integral part of the theory. Sir Oliver Lodge, in "Man and the Universe" speaking of the persistence of favourable variations, says : "Given their appearance, their development by struggle, inheritance and survival can be explained ; but that they arose spontaneously, by random change, without a purpose, is an assertion that cannot be justified." This passage shows that the writer has not fully grasped the elements of the theory : the changes take place in every direction, but all variations, except those in favourable directions, are wiped out in the struggle for existence. Such at any rate is the theory. When we consider that Darwin's theories are not fully grasped by scholars, it is hardly to be wondered at that the ordinarily educated man has but the vaguest ideas of biology, ideas made still more vague by the ordinarily educated writers in the daily, weekly and monthly press. To the ordinary man, the word Darwinism means the theory that his ancestors were monkeys ; he will have heard the words "Survival of the fittest" used as a catch phrase, but he will have no idea of their meaning. "Struggle for existence" will have no biological sense for him. "Selection" he will think has something to do with sex. Biologists may say either that I am exaggerating or that the educated men of my acquaintance must be singularly few ; but I can assure them that such misconceptions are shared by very many men who have been educated at our public schools and universities which is generally, though perhaps erroneously, considered the criterion of a good education. It is quite common to come across persons who say that Darwinism is discredited by new discoveries especially by Mendelism ; they have no other idea of the meaning of Mendelism, and seeing that

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their notion of Darwinism is no more than I have stated above, they arrive at conclusions that would rather astonish the average biologist.

I think it is the duty of Biologists to educate the uneducated in biological matters ; to tell them how matters really stand, and to tell them how far old theories are or are not modified by new views.

I would add to these very pertinent remarks the observation that they are no less applicable to Geology than to Biology. I would further point out that while the payment of professors, of geologists and entomologists and of other specialists is all very right and proper in its way, it is of comparatively little value unless there is a general diffusion of knowledge, which is one of our great needs and which was one of the objects we had hoped to attain by means of the Victoria Institute ; but that, as you know, has been perverted from its original objects. In illustration of what I say, I will mention a case of late occurrence here. It is that of the caterpillars for the collection and destruction of which planters paid money. The collectors thought one kind of worm was as good as another, even though one might be a grub and the other a caterpillar. So they collected and were paid for grubs as well as caterpillars, though the distinction is easy to see ; and in this case the grub is harmless while the caterpillar is noxious to the agriculturist. A very small knowledge of natural history would have avoided this mistake. But what is needed is not merely the technical knowledge required for use in a particular case, but the development of the intelligence of the people for use in all cases, for upon this will follow the development of the industry and welfare of the colony. All measures for the advancement of the colony are useless until you make up your mind to this.

So much by way of introduction. I will now turn to the subject I have to bring before you today.

In order more easily to recall to your minds the relative position in the earth's crusts of the strata developed in this part of the world, I have here a rough diagram in which the strata I am referring to are distinguished by colours while those which are not

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represented here are left uncoloured. On this diagram I have shown our oldest strata, those of the northern hills, as being between the carboniferous and devonian. This is a sort of compromise to represent the uncertainty of our knowledge of the exact age of these formations, for up to the present time we have failed to find any very satisfactory evidence of their age. The geological surveyors of 1859 nowhere distinctly state an age for these formations, but it may be inferred from what they say in the geological report and from what Wall says in his paper on Venezuela that they were inclined to consider that they are of paleozoic age. Until now I have so treated them. My friend, the late Ralph Tate, Professor of Geology in the University of Adelaide, thought that they might be jurasic. I infer from what Mr. Cunningham Craig says about them that he leans to a cretaceous age for these rocks. On looking over the evidence, however, I cannot think that they are younger than carboniferous. The only paleontological evidence is that found by me, except a Rhynconela mentioned by Mr. Cunningham Craig which I have not seen. But that brachiopod genus ranges from the Silurian to the present time, so it can hardly be said to have any decisive effect upon the question. In a paper read by me to the Scientific Association of Trinidad in 1877 I gave an account of the older rocks of Trinidad and referred to a previous paper which I had communicated to the Geological Society of London on the subject. I gave a list of the fossils I had discovered—a very small list of imperfect specimens, but which, so far as it went, was in favour of the paleozoic age of these rocks, as was admitted by W. O. Crosby of Boston in reviewing my work on them. From the blue limestone I obtained more distinct fossils, some of which induced me to assign a possible devonian or carboniferous age to that rock. There were also a fish and a Kephalopod. The latter I identified as a Goniatites and named *G. caribeus.* But other authorities decided that it was *Amonites peruvianus* described and figured by Vonbuch in "Petrifactions recueillees en Amerique" (page 4, fig. 5, 6, 7), and figured again by Marcou in Geology of North America (page 34, Pl. v., fig. 1). It was admitted to

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have resemblances to *Hamites. Am. peruvianus* has been found in several places in South America, including Barbacoes near Trujillo in Venezuela, and also in Texas, and if one were quite satisfied as to the identification one might have to admit a lower cretaceous age for the blue limestone. But that would not necessarily carry a similar age for the mica and clayslates and associated rocks of the Caribean group which might still be devonian or carboniferous, for I cannot agree with Mr. Cunningham Craig in his theory of a Fan structure for this series of rocks. The series lies on top of a ridge of hypogene rock which comes to the surface in Tobago and also on the north coast of Trinidad near Toco. The whole series was, I think, conformably deposited upon this Hypogene rock and the great dislocations which occur in it were subsequently produced, as I have endeavoured to show in several papers, notably that entitled "The Growth of Trinidad." I have taken a part in solving some of the problems presented by West Indian geology ; but many others, including that of the relations of the old sedimentary rocks called by Wall the "Caribean Group" to the underlying Hypogene rocks yet remain to be worked out.

In many papers of mine I have alluded to the dislocations and earth movements which have occurred in the region which for convenience I have called the "Caribean Region," including the lands and islands bordering on the Caribean Sea. At the end of my paper on the "Growth of Trinidad" will be found a list of works on this subject, which will serve as an index to the literature. I have, to some extent, made a special study of these earth movements, and in my paper on the "geological connexions of the Caribean Region" I indicated on a map what I conceived to be the course of the principal dislocations, the most evident of which I have called the "great antillian dislocation." I exhibit this map to you now. In the early part of 1910 I visited Antigua and other islands with a view to extending my acquaintance with the geology of these Islands. In previous years I had explored several of the islands, particularly Dominica, St. Vincent and

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Grenada. In spite of my physical disqualifications I was enabled to discover some very important facts and to make these known I drew up a paper which was read to the Geological Society of London on the 24th May last. I exhibit copy of the paper and will briefly explain its purport.

Before my visit to Antigua I was under the impression that the volcanic rocks of that island belonged to a different period and that the great antillian dislocation did not pass through it but to the west and south of it. There was nothing in the writings of the authors who had previously written of Antigua to lead me to doubt this view.

After noticing the work of former observers on the geology of Antigua, I gave a brief description of the formations of that island, showing that it is divided into three principal regions—(1) the Volcanic (or Igneous) Region ; (2) the Central Plain ; and (3) the Calcareous Formation, the first-named being, according to previous authors, the oldest, as it is pre-tertiary, and the others following in succession. The calcareous formation, hitherto considered the newest, contains fossils, of which the most remarkable is a species of *Orbitoides*. After a discussion of these formations and especially of the evidence for the so-called 'Oligocene' age of the calcareous formation, the conclusion is reached that this formation is the oldest—not the youngest, and is probably Eocene or older. The island was raised above sea-level by the development of the great antillian dislocation, which divides each of the islands of Guadelupe and Antigua into two parts, of which the eastern is calcareous and the western volcanic. In

Antigua the Central Plain intervenes between the two parts, while in Guadelupe they are only separated by a narrow channel. In support of this proposition the physical features of Antigua are discussed, and it is shown that the island has not been submerged since the volcanic period.

The position and age of the Scotland series of Barbados are then discussed, and that series is shown to be Eocene, the lower beds being possibly cretaceous and being a remnant of the Atlantis Continent.

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The extension, age and position of the *Orbitoides* bed of Trinidad are next dealt with, and some further remarks are added on the physical history of the Caribean Region.

In my second "Note on the Manjak Mine" I have given a brief summary of our knowledge of the origin of asphaltic and petroleum deposits. I thought this should have a more extended publicity, and accordingly included it in my paper just mentioned. In connection with this I may notice the recent upheaval of a mudbank on the South coast of Trinidad. As Dr. Fredholm has given an account in the *Mirror* newspaper of the causes of this phenomenon I will merely add that in all essential features it is similar to the mud-lumps of the Mississippi River. These have been fully described by Lyell in the "Principles of Geology" (tenth edition 1867) Vol. I., p. 447. His description is the best and fullest, but as that of Geikie (Text Book of Geology 1882, p. 386) is the most condensed I quote it: "A singular feature of the Mississippi Bars is the formation upon them of mud-lumps. These are masses of clay varying in size from mere protuberances, like tree trunks, up to islands several acres in extent. They rise suddenly and attain heights of three to ten, sometimes even eighteen, feet above the sea level. Salt springs emitting inflammable gas rise upon them. After the lapse of a considerable time the springs cease to emit gas and the lumps are worn away by the currents of the river and the gulf. The origin of these excrescences has been attributed to the generation of carburetted hydrogen by the decomposing vegetable matter in the sediment underlying the tenacious clay of the bars."

The material of this mud-lump (which may be called the "Despatch Reef Mudlump"), for samples of which I am indebted to Mr. John Wilson, is of very various degrees of consistency, hardness and fineness of component parts. It contains a large quantity of sulphuret of iron and a few pieces of lignite. Beds of clastic matter varying from small pebbles to find sand indicate estuarine beaches and these are derived from the degradation of tertiary and cretaceous rocks, but there is nothing to indicate the

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existence of deep-sea deposits. In the softer material, a very impure gray ooze or clay, I have found two or three Foraminifera, for example, *Cyclamina cancelata* and *Amodiscus incertus*, but their condition shows that they have been derived from older beds and they are not characteristic of deep water.

The sunken valleys of the Bocas Region are worthy of notice and they show how much the interest of the traveller in what he sees would be increased by a slight acquaintance with geology. We have in this region almost every kind of sunken or submerged valley. First we have the submerged valley which has been enlarged to several times its original width by the rapid tidal currents running through it. Such are the channels between the Gulf of Paria and the Caribean Sea called the Bocas. Next we have the valley which has been partly submerged, but which has not been enlarged to any noticeable extent, because no current runs through it. As an example of this we may take Scotland Bay. On the opposite side of the gulf, that is on the Venezuelan coast, there are several examples of this kind. Teteron is an inintermediate case between the submerged valley and that which is partly filled up. The valley of Chaguaramas and more notably those of Cuesa and Diego-martin are examples of sunken valleys of which the lower parts have been filled up.

These phenomena are alluded to in several of my papers (See particularly "Growth of Trinidad" Trans. Canadian Inst. 1904-5. p. 141, &c. Ibid. 1908-9, p. 379.)

I have now to call your attention to the deposit of fossil shells discovered at Spring Vale, near Couva. By the enlightened action of the Agricultural Society and the public spirit of its Secretary, Mr. Tripp, this deposit has been examined and the results published in the Proceedings of The Society. In view of this it will be unnecessary for me to go into detail on this subject. But I will read an extract from the report and explain, so far as I can by means of a sketch on the blackboard, the position of the beds as regards the other formations in Trinidad. First I will refer to the general diagram of strata where these shell-beds

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occupy the position shown as Miocene. About one hundred species of fossils are found in these and other beds of corresponding age in Trinidad, the names being given in the report referred to. At present, owing to the want of a place to exhibit them, these fossils are packed up. It is, I believe, the intention of the Agricultural Society to place them in some suitable Museum whenever such becomes available. I have a few specimens together with other fossils I have collected, and it will give me much pleasure to show these to anyone who will favour me by visiting my study for the purpose of seeing them.

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The Ditrupabed of Pointapier was noticed in my paper published in the Journal of the Geological Society 1892. It lies to the north of the cretaceous Ridge passing through the middle of the Island, coming out on the shore at Pointapier. The rounded grains of quartz noticed in this Rock are derived from the cretaceous sandstones. The fossil Molluska were mostly described in a paper in the Proceedings of the United States National Museum 1896 (Vol. XIX) by W. H. Dall and myself, and they are again named in my paper on the Springvale Fossils in the Proceedings of the Agricultural Society. The Foraminifera had been previously enumerated in my paper of 1892, and some new forms were described in the Proceedings of the Zoological Society 1894. From the exposure on the shore of the Gulf at Pointapier

I could not obtain much information. But Mr. Raspass has lately discovered what appears to be the same bed on the Corosal road about eight miles inland from Pointapier. As this is the only deep-water deposit yet discovered to the north of the cretaceous anticline it is of importance as showing that after their deposition in shallow water the cretaceous beds sank to a sufficient depth to allow of the deposition of the Ditrupa-bed, which I should suppose was deposited in 200 fathoms of water or thereabouts. The Foraminiferal Fauna contains some species, e.g. Planorbulina larvata Gonatosphæra prolata, Gaudryina pariana, Haplostiche soldanii, Cristelaria aculeata &c., which are not found in the Naparima oceanic beds ; while on the other hand some species characteristic of the Naparima beds are not found in the Ditrupa-bed, for example, Nodosaria abysorum. Lagenas and Ratalines also are comparatively rare in the Ditrupa-bed, except Pulv. canariensis which occurs in that bed though not found or very rare in the Naparima beds. (See my paper in the Proceedings of the Field Naturalists' Club 1893. The exposure of this Ditrupabed discovered by Mr. Raspass is probably not much more than a mile from the Spring Vale quarry which yielded the Miocene Fossils lately described in the Proceedings of The Society. The significant difference in organic contents between the Ditrupa-bed and the Nariva beds shows that the Pointapier cre-

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taceous ridge separated the two areas at the time of their deposition, while the comparatively shallow water area of the Nariva beds was marked off from the oceanic beds of Naparima by the great Naparima Anticline. It would be highly interesting to know the exact relations between the Spring Vale bed and the Ditrupabed, for while the former was deposited in water fifty fathoms deep the Ditrupabed was laid down at a depth probably of one or two hundred fathoms. It may be observed that every discovery of the kind I have referred to in this paper enlarges our knowledge of the geological structure of the country and involves rectification of previous conclusions.

To prevent misapprehension I should note that the term "deep-water" is a relative one and that while the Ditrupabed may be said to be "deep-water" as compared with the Springvale Shellbed it was laid down in much shallower water than the Naparima oceanic beds. The Foraminifer *Planorbulina larvata* is characteristic of a depth from 15 to 200 fathoms, while *Nodosaria abysorum* has only been found in the recent state at 1,825 fathoms.

I should notice here that the characteristic Foraminifera of the Ditrupabed are absent so far as I have examined from the exposure discovered by Mr. Raspass. Instead there is an extraordinary Abundance of *Planorbulina larvata* a species only sparsely represented in the shore exposure at Pointapier, but much more plentiful in a sample given me by Mr. Cunningham Craig from Tamana Road. I have nevertheless considered the deposit discovered by Mr. Raspass to be of the Horizon of the Ditrupabed on account of its position, mineral composition and molluskan Fossils.

My friend Alfredo Silvestri, Professor R. Liceo of Spoleto in Italy, one of the greatest authorities on Foraminifera and especially on *Orbitoides*, considers those from the Manjak mine to be *Lepidocyclina tournoueri* Lem. and Douv. a varity of *L. marginata* Mich. found in Italian Tertiaries. He also finds among these *Orbitoides* a (probably) new species of *Lepidocyclina*, the

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embryonic part of which is very remarkable. He considers the Orbitoides from Antigua to be *Lepidocyclina elefantina* Munier Chalmas, a form also found in Italian and Indian Tertiaries (Aquitanian). I am unable as I have so often stated to admit the validity of the distinctions so much relied on by experts to characterize so-called Genera and species. While I have no doubt as to the correctness of Silvestri's identifications for my own use I prefer the designations already arrived at as referred to in my note on the Manjak mine. In estimating the probable age of the Naparima Tertiaries we must give due weight to the evidence of the Echinodermata Brachiopoda fish &c., &c., and these have decidedly cretaceous affinities.

THE ATLANTIS.

As I have so often referred to the lost Continent perhaps it would not be out of place to say a word or two on the subject of the Atlantis. Many of our geological questions are more or less connected with this problem. The evidence on the subject so far as known to us may in part be gleaned from my papers published during the years from 1866 to the present time and from the works alluded to in those paper. From time to time fresh accessions are made to the evidence. But in the first place I may explain that there are three Altantises : first the mythological one which is the one referred to by Platon in the Timæus ; the physical basis of this is the clouds which appear over the Atlantic Ocean at Sunset and which the modern mariner calls cape Flyaway. The second is the theosophical one upon which much ingenious writing has been bestowed, and while the first mentioned one has a mythological basis this one has a mythical basis. But the third one is the geological Atlantis and this is the one which has been the subject of my inquiries. This Atlantis has a geological basis, that is to say, a basis in what we know of the history of the Earth.

Among later observations which I have not before referred to are those of Standing in the Transactions of the Zoological Society for 1908. He therein states his belief that American

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Monkeys and Lemurs were differentiated in an equatorial Continent connecting Africa with South America. He cites several facts in support of this conclusion ; among others he notices that the only other plant belonging to the genus of which the Traveller's Tree of Madagascar, so well known to all here, is a member is that called Phenacospermum a native of Brazil and Guiana.

SUPPLEMENTARY LIST OF WORKS RELATING TO THE GEOLOGY OF THE CARIBEAN AREA.

NOTE.—In the transactions of the Canadian Institute vol. viii 1904-5 page 148 I have given a list of Works relating to the Geology of the Caribean Area. That list never made any pretensions to completeness, nor does the supplementary list I now subjoin do so. Moreover I do not give the titles of the Works, but merely an Indication of the subject of each work.

1847—Duchassaing, Guadeloupe, Soc. Geol. Française.
48—Schomburgk, History of Barbados.
D'Orbigny, Paleontologie de Cuba.
62—Woodward, Baretia, Geologist, p. 372.
64—Duncan, Fossil Corals, Journ. Geol. Soc. Vol. XX.
64—Jones (T. Rupert) Westindian Orbitoides, Geol. Mag. Vol. I.
Poey, Union of Cuba and Centralamerika.
75—Owen, Prorastomus sirenoides, Journ. Geol. Soc. Vol. XXXI.
76—Jones Parker and Brady, Foraminiferes de Jamaique Soc. mal. belge. Tome XI.
78—Crosby. Pitch Lake, &c., Amer. Nat. p. 229.
78—Crosby, Phys. Geogr., &c., of Trinidad, Bost. Soc. N. H.
89—Gregory, Cystechinus crasus, Journ. Geol. Soc. Vol. XLV.
92—Gregory, Archæopneustes abruptus, Journ. Geol. Soc. Vol. XLVII.
96—Guppy and Dall, Antillian Fossils, Proc. U. S. N. Museum.
1902—Flett, Volcanic Dust, St. Vincent, Journ. Geol. Soc., Vol. LVIII.
2—Spencer, Dominica Martinique, &c. Journ. Geol. Soc. Vol. LVIII.

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2—Harrison and Jukes-Browne, Barbados, Geol. Mag.
2—Messerly—Asphalt, &c.
5—Gadow, Middle America, P.Z.S.
1905—Guppy, Growth or Trinidad, Trans. Can. Institute, Vol. VIII.

1905—Cunningham-Craig, Geol. Structure of Trinidad.
1906—Cunningham-Craig, Oilfields of Trinidad, Proc. Colonial Institute.
1907—Harrison, Coral Rocks of Barbados, Journ. Geol. Soc., Vol. LXIII.
8—Guppy, Fossils from Comparo, Bul. Bot. Dept. Trinidad.
8— " Cement Materials " "
8—Ellis, Trinidad and Barbados, Proc. Roy. Soc. Canada.
8—Raspass, Manjak, Proc. Inst. Mining Engineers.
9—Guppy, Geol. Connexions of Caribean Region Trans. Can. Inst. Vol. VIII.
9—Guppy, Manjak Mine, Bul. Agr. Dep. Trinidad.
9— " Tamana Fossils Idem.
9—Toula, Tertiary Fauna of Gatun, Jahrbuch der Geol. Reichsanstalt, Wien.
10—Rust, Petroleum, Victoria Inst., Trinidad.
10—Guppy, Springvale Fossils, Proc. Agr. Soc. Trinidad.
11— " Idem Part II. Idem.
11— " Antigua &c. Journal Geol. Soc.

OBSERVATIONS ON WEST INDIAN GEOLOGY BY DR. FRANCIS WATTS, C.M.G.

In the course of the discussion which followed the reading of Mr. Guppy's paper, Dr. Watts expressed the great pleasure that it had been to him to listen to Mr. Guppy's address and he recognized with satisfaction the importance which the Author attached to an understanding of the geology of Antigua, as throwing light on the geology of the West Indies generally.

Some confusion existed in the minds of the early observers with regard to the nature of the so-called volcanic hills in the southern and western part of the island : these were described by most of the writers including Nugent, Purves and Spencer, as

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truly volcanic ; but careful observation convinced the speaker that the rocks composing these hills were really uniform with those of the Central Plain and immediately underlying the limestones ; they were contorted and altered by volcanic activity, being thrust up to elevations of 1,000 to 1,300 feet, but were sedimentary rocks, probably of Eocene age ; the volcanic activity had resulted in the intrusion of a few masses and dykes of lava, but in few places was there any definite flow of lava.

These rocks consist of sandstones of various degrees of fineness and contain abundance of fossil wood and also well-preserved fossil shells of fresh or brackish-water types, bearing testimony to the former existence of the Antillian land area referred to by Mr. Guppy as possibly Atlantis.

In various parts of these rocks of the Central Plain and the south-western hills there occur outlying masses of limestone, such as Mr. Guppy stated he would expect to find had the limestone at one time extended over a larger area than it does at present. These outliers had been misinterpreted by Purves, who took them to be a definite layer of Miocene limestone underlying the rocks the Central Plain.

A correct understanding of the sedimentary nature of the rocks of these hills that have so long been mistaken for volcanic appeared to the speaker to be of the first importance, for he believes that they represent a portion of a large formation extending throughout the West Indies from the Virgin Islands southward, possibly as far as Trinidad, and that evidence of their existence is to be found in Grenada, St. Lucia, and possibly even in Dominica. Fossil wood is known to occur in St. Lucia and this may be regarded as confirmatory of these views.

The lower limestones of the northern part of the island were probably of Miocene age and had undoubtedly formed islets in a shallow sea at a time when, as Mr. Guppy had said, the sea flowed over what is now the Central Plain. Throughout the whole length of the Central Plain are raised beaches of water-worn pebbles marking the boundaries of this shallow sea.

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The limestone formations are very confused and difficult to study from the fact that on the shores of the islets consisting of Miocene limestone above referred to corals and shells of latter date were formed, giving rise to beds in which fossils of various ages are mingled in a confusing manner.

The opinion was expressed that a careful study of the geology of Antigua would probably serve to elucidate the geology of the whole of the West Indies and the speaker hoped that attention might be drawn to this so that it might attain early fulfilment.

PAPER No. 23.

NOTE ON DR. WATTS' REMARKS ON THE GEOLOGY OF ANTIGUA.

Agr. Soc. Trin. and Tob. ; Soc. Pap. 498 cont.

Published in Vol. 12 of the "Proceedings" for Jan.-Feb., 1912. Referred to as beginning on p. 75 but paged separately, 1-4.

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When on the reading of my paper at the Queen's College on the 20th of January, Dr. Watts was kind enough, at my invitation, to make some remarks setting forth his views on the subject of the geology of Antigua, I was unable to make any reply. His remarks have been printed in the report of the discussion on my paper in the *Proceedings of the Agricultural Society.* I now wish to make a few observations on them having had the advantage of being favoured with Professor Harrison's views which I trust he will allow me to mention so far as they relate to the geological questions.

The points referred to by Dr. Watts are matters of fact to be ascertained by investigation ; but for the reasons given in my paper on Antigua I could not undertake any rectification of the stratigraphical details given by Purves. For such a task I should have required much more time and better health. I devoted myself therefore principally to a few points of inquiry.

One of these was whether the volcanic rocks underlay the calcareous formation. I found no evidence that they did, though

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they [it] may be admitted that it is very difficult to find anything like a satisfactory exposure of the junction of the rocks. I arrived at the conclusion that the volcanic rocks do not pass under the calcareous formation. In this conclusion I am supported by Professor Harrison, who also agrees with me on the second point of my inquiry, which was as to whether the volcanic series had undergone submergence and re-elevation. It is probable that the sea at one time overflowed the central plain for it has left marine deposits and other marks of its sojourn there. But that it ever covered the volcanic hills since their formation is highly improbable. Meteoric water in cutting out and enlarging the ravines and denuding the slopes has no doubt given to the materials re-deposited by it the character of alluvial or sedimentary deposits, but this scarcely affects the general facts. When in England I submitted my rock specimens to Mr. Prior, Mineralogist of the British Natural History Museum, and he was good enough to supply me with the following remarks: "One specimen no doubt comes from a lava-flow, the others are andesitic tuffs such as are described in Purves' paper." The specimen he decides to be from a lava-flow came from a bed on the central plain. The andesitic tuffs are varied in appearance, but as Mr. Prior pointed out to me their origin from fragmentary matter can easily be detected. The central plain has been the scene of the most varied volcanic phenomena, including those of hot springs and lakes and of eruptions of lava and ejections of matter from Drewhill and other volcanic vents. Not only does the central-plain contain volcanic accumulations and tuffs but it also contains disrupted fragments and outliers of the calcareous formation and deposits from lakes and hot springs. I have already pointed out that the calcareous formation of Antigua is not a fragment of land, but a fragment of a marine formation devoid of the debris of land. No remains of any such formation are found on the volcanic islands of the Antilles at a greater height than 300 feet. Up to that height local marine deposits are found

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as pointed out by Spencer (see his paper of 1901, Journ. Geol. Soc. Vol. lvii. p. 542, and 1912, ibidem. Vol. lviii. pp. 348, 352, and also my paper on Dominica). These deposits are of Pliocene or late Tertiary date and do not necessarily indicate subsidence, as they may have been merely pauses in the last stages of the elevation of the Antillean islands, though of course it is not impossible that minor movements of elevation and depression may have operated all along the chain of the Antilles and in other parts of the West Indies. All these later marine deposits are more or less covered by volcanic matter, but being generally littoral they are exposed by erosion of the sea or of streams.

I do not think that the evidence we have is sufficient to sustain the conclusions of Spencer as stated by him at page 353 of the Journal of the Geological Society 1902. Whether the islands were ever all united into one continental mass as imagined by Spencer is, I think, very problematical, and I doubt if there is any evidence for it.

The occurrence of a tooth said to be that of an elephant in Guadelupe is insufficient to build any hypothesis upon.

The facts which form the subject of this note have been stated generally in my paper on Antigua ; but as Dr. Watts seems to have taken a different view of them I thought it desirable to restate them for the sake of possibly greater clearness.

Whether or not there exist in Antigua or in others of the Antilles any of the ancient rocks developed in the Virgin Islands is more than I can say. It is possible that the Seaforth Limestone, so-called by Spencer, is such a rock, but there is no certain evidence of it, and I have seen nothing of the formation referred to by Dr. Watts as extending through the West Indies from the Virgin Islands southward.

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Since I wrote my paper on Antigua etc. I have received from Mr. Forrest more definite information as to the locality in which the fossil fish described by Professor Hussakof was discovered. Mr. Forrest says : The quarry in which the fossil fish was found is at Golden Grove situated at about three-quarters to one mile south of St. John or three quarter mile W. S. W. of Drewhill or Belmont Estate. It is in the central plain and is not a calcareous formation. To the central plain belong also the beds of chert with land and freshwater shells and silicified fossil woods and beds of fine grained sandstone with leaf impressions."

The nearest relations of this fossil fish are found in the eocene of Europe (Monte Bolca, etc.) and living in the Pacific and Indian Seas.

PAPER No. 24.

FURTHER NOTES ON THE CARONI SERIES AT SAVANETA.

Paper read before the Agricultural Society Sept. 13, 1912 and published as Society Paper No. 520, Agr. Soc. Trinidad and Tobago, 1912. Paging of Separate from 1 to 5.

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By the kindness of F. J. Morris, Esq., of Forres Park, I was able to make a second visit to the Springvale Quarry and also have a general look at the country in the neighbourhood which I had not seen for some years. This enabled me to gain some additional information of importance in settling the position, &c. of the Springvale Shellbed. Indeed, I found that the bed named was really an outcrop of the same series as that discovered by the late Louis Alexander Leroy, the fossils from which I have already described and named. Mr. Morris took me to the Quarry where I found that the later excavations had revealed the thickness dip and position of the Shellbed. It was apparently from three to four feet thick. The dip was about 30 degrees to the N. W. The Shellbed lay conformably upon which I might call a mudbed ; a stratum of impure clay with comminuted shells. These observations bring the Springvale Shellbed into line with the Caroni series as laid down by Wall and Sawkins in the Geological Report on Trinidad, 1860, pp. 43, 45. The strata under-

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lying the Shellbed pass downwards into fine-grained soft rocks characterized by the Foraminifer *Planorbulina larvata*. This position is correctly indicated in the Diagram at p. 30 of *The Proceedings* of the Society illustrating my Paper on Recent Geological Discoveries (Vol. XII., 1912). These strata are there indicated by the letter h3 and h2 (Page 9 of separate copies.)

Interstratified with the mudbeds are strata of a more permeable quality, consisting of fine sandstones, and these pass in places into gravel beds sometimes indurated and these sandy and gravel beds allow of the percolation and storage of water whence the springs which are common in this country. The lower portion of the Caroni Series especially contains gravel beds which seem to overlie the cretaceous rocks. In fact the gravelly and sandy beds of the Tertiaries are here chiefly derived from the cretaceous series. I did not see the lower miocene beds (the Tamana Series) exposed anywhere in this locality, and it is possible that they may not have been developed here, or they may be in part or wholly represented by the strata underlying the Shellbed.

On one point it seems necessary to give a caution. That is, the diagrams attached to my papers are not intended in any way as finished plans or sections. Thus the diagram of the Orbitoides Bed (*Proceedings, p. 204*) is intended only to show approximately the position of that bed ; it is not drawn to scale nor is it intended to show the dip or the relations of the other beds. The diagram is sufficient for its purpose. The faults shown in the diagram of which it is a modified copy (Journ. Geol. Soc., 1892, Page 522) are not indicated. Again the diagram at Page 9 of my Paper on Recent Geological Discoveries, (page 30 of *Proceedings*) is purely diagrammatic. It shows correctly the relations of the strata so far as yet ascertained. But these diagrams are merely generalized sections, and for convenience the height

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is greatly exaggerated and no attempt is made to show the minute details of structure or to give the exact proportions of the different beds. As regards faults it is rarely easy in the case of the Naparima Rocks to ascertain whether a dislocation is certainly a fault or merely a fold. There is usually crushing and displacement accompanied by disintegration especially along synclinal or anticlinal lines. The intimate relation of faulting and folding is shown by Mellard Reade in the *Geological Magazine* for 1896, page 353.

Owing to the kindness of M. Morris I secured from the Springvale Quarry an example of *Cypræa henekeni*, a species discovered in the Haitian Miocene and not since recorded from any other locality. The species is remarkable fo r the bosses or tubercles, which resemble those of *C. mus* an allied living species.

The Corosal Road Ditrupabed and the Pointapier Ditrupabed have proved to belong to the Upper Miocene series called the Caroni series by Wall and Sawkins. The material supplied me by Mr. Raspass contains molluskan fossils as well as the characteristic Foraminifer *Planorbulina larvata*. I give the names of some of these, but there are many more species.

The Foraminifer *Planorbulina larvata* seems to have played in the Caroni Miocene Series a part similar to that of the *Orbitoides* in the Eocene formations. Both are extremely abundant in beds whose fauna and constitution denote a moderate depth, say fifty to two hundred fathoms of water. The Orbitoides type of foraminifera is altogether extinct : while the Planorbulina, which is an extreme cyclical development of the type exemplified by *Pl. mediteranensis* and *Pl. vulgaris* is only found in the living state in the Pacific and Indian seas.

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The tubeshell found abundantly in the Ditrupabed of Pointapier and taken by me in the first instance to be the shell of a worm and hence called by me Ditrupa, was afterwards determined to be a Mollusk. It was described as *Cadulus parianus* in the Proceedings of the U. S. National Museum (Vol. xix, 1896, Page 323, Pl. xxx F. 7.) in the Corosal Road Bed a somewhat similar shell occurs. This is marked by distinct characters. It widens more gradually from the initial to the oral end, and it is annulate by rounded costæ while C. *parianus* is smooth. Thus it has some resemblance to Cæcum. It may be diagnosed as follows.

CADULUS PERANULATUS N. SP.

Shell tubular curved widening somewhat rapidly, annulate by regular rounded riblets, swollen near the broader end and constricted at the aperture. Length 4 mm. greatest diameter 1 mm. The annulations become larger and obsolescent towards the oral end.

I have also detected the following Molluska in the Corosal Ditrupabed

Cylichna mirrotrema Dal.	Corbula heterogenea Gup.
Turbonila tenuilineata Gup.	Leda acuta Gab.
Benthonela turbinata Gup.	Leda flexuosa Heilp.
Marginela arcuata Gup.	
Marginela soverbii Gab.	Dentalium prisma Dal.
Mangelia consentanea Gup.	
Clavatula labiata Gab.	
Pleurotoma haitense Sow.	
Teinostoma (Vitrinela) vitrea Gab.	
Clea truncata Gab.	
Nasa caribea Gab.	

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Some polyzoa also occur in the bed, the most noticeable being *Diastroporlea umbelata* or a nearly allied species, and a Vincularia. These are also found in the Pointapier Ditrupabed : they are almost always in fragments. Besides *Planorbulina larvata* other Foraminifera occur for instance *Cornuspira* and *amodiscus*. Many others await a diligent collector. The determinations I have given are in some cases approximate only and must be verified by additional examples and further study. There is a grand field here for the collector of fossils.

PAPER No. 25.

OBSERVATIONS ON THE GEOLOGY OF MARTINIQUE WITH NOTE ON FOSSILS FROM TRINIDAD AND VENEZUELA.

Agr. Soc. Trin. and Tob. ; Society Paper No. 549.
Read before the Society Apr. 11, 1913 and published in the "Proceedings" for Apr., 1913, vol. 13, pp. 159-163.

Page 1

Jules Maingot, Esquire, of Arima, having kindly furnished me with a copy of a paper by Mr. Dublancq-Laborde of Martinique on the existence of calcareous blocks in the ancient tufs of Mont Pelée I was by him placed in communication with that gentleman with a view to gaining same further information on the geology of Martinique, and especially with reference to the remarks of Dr. Watts made on the reading of my paper at the Queen's College in January 1912—which paper was duly published in the *Proceedings* of the Society. Mr. Dublancq Laborde was kind enough to supply me with ample information respecting the calcareous blocks in question and with specimens of the rocks and photographs of the organic remains found in them.

For particulars as to the mode of occurrence of these calcareous blocks I must refer to Mr. Dublancq-Laborde's paper published in the "Comtes rendus des Seances de l'Academie des Sciences" t. 154, P. 824. It is sufficient to state here that these calcareous blocks lend a considerable support to the theory of Dr. Watts. They appear in some cases to have been thrown out with bombs and ejectamenta discharged by Mont Pelée and other volcanic vents in Martinque. They contain fossil Foraminifera

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and Algæ namely, *Amphistegina* and other Foraminifera and *Lithothamnion*. Similar Foraminifera occur in the Miocene rocks of Trinidad and Barbados, and the *Lithothamnion* is a component of some of those of the latter Island. It seems further that in some of these rocks eocene fossils such as *Orbitoides* occur, for

Mr. Dublancq-Laborde informs me that besides the formations of Mont Pelée there are in Martinique two fossilferous horizons.

1. Limestones at St. Marie and caravelle containing *Lithothamnion Orbitoides* (*Lepidocylina*) *and Spiroclypeus.* These are probably eocene. 2. Beds near La Trinite containing *Turitela tornata*, *Natica sulcata clypeaster elipticus* and *Orbitolites complanata.* These correspond to the West Indian miocene, with which is correlated the miocene of Panama, Jamaica (Bowden), Haiti, Trinidad (Caroni series) etc., etc.

These indications support the view of Dr. Watts that a fossiliferous limestone formation underlies the volcanic series of the Antilles ; and we have evidence here that the volcanic period was subsequent to these formations, and was therefore of miocene date. These calcareous formations were deposited along the margin of the atlantis land, the Caribean Sea being then a gulf communicating with the Pacific Ocean, as shown in the map appended to my paper on the geological connections of the Caribean Region (Trans. Can. Inst., 1908-9.)

This discovery of Mr. Laborde's does not affect generally my observations on the geology of Antigua but it may involve some correction of the views of Purves on the central plain of that island. The analogy of the Martinique formations would dispose us to regard that central plain as a part of the calcareous formation dislocated and broken-up by volcanic agency and altered by erosion, and subsequent deposits due to marine action, and to the hot springs and fluviatile phenomena developed near and along the line of the great Antillean dislocation passing through Antigua.

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I take the opportunity of bringing to the notice of The Society the work of Miss Maury on the Paleontology of Trinidad. Miss Maury was a member of Mr. Veatch's party under the auspices of the General Asphalt Company of Philadelphia, and she did the Paleontological work. Miss Maury has added a large number of new names to the list of Trinidad fossils, but it will remain for further investigation to determine which of these are valid. She retains the misleading expression "Oligocene" including under that head rocks and fossils of miocene as well as of eocene date.

I had often conjectured that Soldado Rock in the Serpents Mouth (the Southern entrance into the Gulf of Paria might be of eocene age and the conjecture has been verified by Miss Maury, who gives a list of over forty species of molluska from that rock.

This discovery is of interest from a stratigraphical point of view because it shows that the anticline of eocene rocks running through the southern part of the island from Guayaguayare to Cedros, (Brigit Point, Coral Point) comes out on the southwestern point of the island parallel with the Naparima anticline and terminating in the Gulf of Paria by an elevation of hard rock; Soldado off Cedros being thus analogous to Farallon off Naparima. Just as in the case of the Naparima anticline this brings up cretaceous and eocene rocks along its course. I am bound however to record my dissent from Miss Maury's classification of the tertiary rocks of Trinidad. The Manzanilla beds may be lower miocene (Oligocene), but the Cumana beds are upper miocene, and the lower beds of the Naparima series (San Fernando beds) are eocene, thus leaving the Caroni series and the oceanic beds of Naparima as miocene, and probably the equivalents of the Bowden beds of Jamaica, and the beds in Haiti, containing *Arca patricia* (see my paper on the Geology of Antigua etc., Journ. Geol. Soc. Vol. 67, November 1911, Page 699).

I also record here two collections of tertiary fossils, one made by Mr. C. S. Rogers, Forest Officer, to the Tamana Dis-

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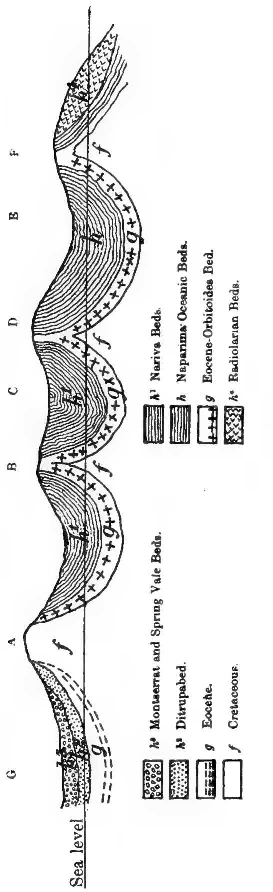
trict, and one made by Mr. Cunningham Craig in Venezuela. The first is a most encouraging collection, as it indicates a paleontological wealth yet unexplored, and shows what may be expected at the hands of an interested collector. As usual in such collections some of the specimens were not in a condition for identification, but I determined some seven species of which two (*Modulus basileus*) and *Corbula dominicensis*) are hitherto unrecorded from Trinidad. The list is as follows :—



G. Couva. A. Pointapier Anticline. B. Monchagrin Anticline. D. Naparima Anticline.

Generalized Section from Couva and Montserrat to Oropuche Lagoon.

Pleurotoma consors Sow., Guppy. Journ. Geol. Soc. 1876, Pl. xxviii. F. 7.

Venustum var. jamaicense Guppy Journ. Geol. Soc. 1866, Pl. xvi, F. 6.

Modulus basileus Guppy, Geol. Mag. 1874 Pl. xvi F. 2 (Modulus wilcoxii Dal. Flor. Foss. I, Pl. 18, F. 1a) see also Guppy and Dal. Antilean Fossils Proc. U. S. National Museum, Vol. xix, P. 319.

Conus planiliratus Sow. Guppy, Journ. Geol. Soc. 1866. Pl. xvi, F. 7.

Cancelaria lævescens Guppy, Journ. Geol. Soc. 1866. Pl. xvii F. 12. (Forms or varieties of this have been described as bareti and moorei Guppy and dariana Toula).

Corbula dominicensis Gab. Sandomingo, P. 247.

Pectunculus acuticostatus Sow. Journ. Geol. Soc. 1849, Pl. x, F. 13.

The collections made by Mr. Cunningham-Craig consist of two lots from localities in the State of Falcon, Venezuela, named Caudevalito and Yabalito near Urumaco. The latter is characterized by *Arca patricia*, a miocene fossil known from the Caroni series of Trinidad, the Haitian beds, and Tobago. Bearing in mind the accompanying fossils these specimens though smaller than the type leave little doubt on my mind as to the miocene age of the deposit from which they came. The likeness of these collections to the Gatun Fauna (Isthmus of Panama) is striking.

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Fossils from Yabalito, Urumaco, Venezuela.

Cardium gatunense Toula, Gatan Fauna. Pl. iii F. 4. This is probably C. compressum Dall, Flor. Foss. VI. Pl. xiviii, F. 21.

Arca patricia Sow.

Clementia tæniosa Guppy. Antillean Fossils Pl. xxx. F.S. (near dariena Conr.)

Turitela tornata Guppy (gabbii Toula, Gatun Fauna, Pl. i. F. 5.)

Malea camura Guppy, Journ. Geol. Soc. 1886, Pl. xvii., F. 9.

Sigaretus gatunensis Toula Gatun Fauna P. 697 Pl. iv. F. 3.

Natica plicatela Conr. (canrena.)

Arca phalarca Dal. Flor. Foss. III., Pl. xxxiii., F. 3.

Pecten inæqualis Sow.

Balanus varians Darwin, S. America, Pl. ii. F. 4, 5, 6.

Most of these determinations must be received as doubtful or provisional, as specimens are imperfect.

The collection from Caudevalito contains only one or two fairly well preserved shells, the others are indeterminable, and on the whole I would rather not say anything about them (except that they appear to be of tertiary age) pending the receipt of more and better specimens.

APPENDIX I

(*From Article 31 of Synopsis.* *See page 5 of this Bulletin*).

Guppy (p. 146) summarizes his article thus :

1. The land of which Trinidad formerly formed part, originated from deposits laid down in the sea and derived from pre-existing land. When this operation was going on the whole area occupied by Trinidad was sea.
2. When the Parian Range rose above the waters it was the southern portion of a large continental mass of land whose extent we have not the means at hand to enable us to determine with any approach to exactitude. At this time the valleys of the Orinoko and Amazons were sea.
3. During the neozoic or cretaceo-tertiary period, the rocks now forming the southern portions of the island of Trinidad were deposited ; and were raised above the level of the sea towards the close of that period. During that time there was no separation of Trinidad from South America, and the land surface was continuous. It is probable that simultaneously with the rise of this land surface, extensive dislocations and depressions took place in the Caribean area resulting finally in the separation of Trinidad from Venezuela, the formation of the Gulf of Paria, and the reduction by denudation of the newly-separated land to near its present level. The contemporaneous phenomena in other parts of the West Indies have been made the subject of discussion by W. J. Spencer, Gregory and others.

* * *

In an Appendix (p. 148) to this article Guppy gives a list of works relating to the geology of the Caribbean region from 1819 to 1904, as follows :

1819. NUGENT, Antigua. Trans. Geol. Soc.. Lond., Vol. V.
1839. VONBUCH, Petrifactions rec. par Humboldt.
18 ... HOVAY, Antigua. Am. Journ. Sc., Vol. XXXV.
1842. *ORBIGNY, Fossiles de Columbie. Inst. de France.
1850. MOORE, Sandomingan Fossils. Journ. Geol. Soc., Vol. VI.
1851. *BAYLE & COQUAND, Foss. du Chili.
1853. HENEKEN, Sandomingo. Journ. Geol. Soc., Vol. IX.
1858. *KARSTEN, Kreidebildung von Colombia.
1859. DUCHASSAING, Formations de Guadelupe.
1860. WALL, Venezuela and Trinidad, Journ. Geol. Soc., Vol. XVI.
1860. WALL & SAWKINS, Geology of Trinidad.
1863. DUNCAN, West Indian Fossil Corals, Journ. Geol. Soc., Vol. XIX.
1863. SAWKINS. Jamaican granite, Ibidem.
1863. GUPPY, Older Parian in Trinidad, Geologist, pp. 204 and 363.
1863. MOORE, Jamaican Fossils, Journ. Geol. Soc., Vol. XIX.
1864. GUPPY, Fossil Foraminifera, Geologist p. 159.
1865. GUPPY, Late Tertiaries Trinidad, Geol. Mag., Vol. II.
1865. DUNCAN & WALL, Jamaica, Journ. Geol. Soc., Vol. XXI.
1866. GUPPY, Jamaican Fossils, Journ. Geol. Soc., Vol. XXII.
1866. GUPPY, Tertiary Formations of W. I., Journ. Geol. Soc., Vol. XXII.
1867. GUPPY, West Indian Geology and Atlantis, Geol. Mag., Vol. IV.
1868. DUNCAN, Fossil Corals of W. I., Journ. Geol. Soc., Vol. XXIV.
1869. BARRET & WALL, Geology of Jamaica.
1869. *TATE, Guiana, Journ. Geol. Soc., Lond., Vol. XXV.
1869. *FOSTER, Caratal Goldfield, Journ. Geol. Soc., Vol. XXV.
1870. GUPPY, Fossils of Caribean Group, Journ. Geol. Soc.. Vol. XXVI.
1871. CLEVE, North-eastern West Indies, Svenska Ak. Band. 9.
1872. GUPPY, Naparima Foraminifera, Proc. S. A. Trinidad.
1872. GUPPY, Dominica, Geol. Mag., Vol. IX.
1872. GABB, New Genera of Molluska, Proc. Acad. N. S. Phil.
1873. GABB, Sandomingo, Trans. Amer. phil. Soc., Vol. XV.
1873. GUPPY, Naparima Foraminifera, Geol. Mag., Vol. X.
1873. DUNCAN, Eocene Corals, Journ. Geol. Soc., Lond., Vol. XXIX.
1874. DAVIDSON, Tertiary Brachiopoda, Geol. Mag., Dec. II, Vol. I.
1874. GUPPY, West Indian Fossils, Geol. Mag., Dec. II, Vol. I.
1875. GABB, West Indian Fossils, Geol. Mag., Dec. II., Vol. II.

*The works marked thus do not refer to the geology of the Caribean area, properly speaking, but are nevertheless useful in connection therewith.

1875. COTTEAU, Echinides Tertiaires, Svenska Ak. Band 13.
1875. *BROWN & SAWKINS, Geology of British Guiana.
1876. GUPPY, Haitian Fossils, Journ. Geol. Soc. Lond., Vol. XXXII.
1877. GUPPY, Older Rocks of Trinidad, Proc. S. A. Trin., Part XI.
1877. GUPPY, Coal at Williamsville, Idem.
1877. FRANCIS, Idem. Idem.
1878. GABB, Caribean Miocene Fossils.
1878. GABB, Costarican Fossils.
1880. CROSBY, Guiana, etc., Bost. Soc. Nat. Hist.
1881. CLEVE, North-eastern West Indies, An. Lyc. N. H., New York.
1881. COTTEAU, Echinides de Cuba, Soc. Geol. Belge.
1884. PURVES, Antigua, Bull. Mus. N. H. Belge. Tom. III.
1890. HARRISON & JUKES-BROWNE, Geology of Barbados.
1891. GUPPY, Water-bearing Rocks, Agric. Record, Trinidad.
1891. JUKES-BROWNE & HARRISON, BARBADOS, Journ. Geol. Soc., Vol. XLVII.
1892. JUKES-BROWNE & HARRISON, Barbados, Ibidem, Vol. XLVIII.
1892. GUPPY, Microzoic Formations, Ibidem, Ibidem.
1893. GUPPY, Fossil Microzoa, Journ. F. N. Club, Trin., Vol. 1.
1894. GUPPY, Fossil Foraminifera, Proc. Zool. Soc. Lond.
1895. SPENCER, Cuba, Geol. Soc. Amer., Vol. VII.
1895. SPENCER, Antillean Continent, Ibidem.
1895 SPENCER, Antillean Valleys, Trans. Can. Inst., Vol. V.
1895. GREGORY, West Indies, Journ. Geol. Soc. Lond., Vol. LI.
1895. HILL, Cuba, Bull. Mus. Harvard, Vol. XVI.
1897. SPENCER, Changes of Level Mexico, etc., Geol. Soc. Amer.
1898. Changes of Level Jamaica, etc., Trans. Can. Inst.
1898. GUPPY, Eocene Fossils Naparima, Proc. VI., Trinidad.
1898. FRANKS & HARRISON, Barbados, Journ. Geol. Soc., Vol. LIV.
1899. HILL, Jamaica, Bull. Mus. Cambr., Vol. XXXIV.
1899. HARRISON & JUKES-BROWNE, Oceanic Deposits, Journ. Geol. Soc., Vol. IV.
1900. GUPPY, Naparima Rocks, Geol. Mag.
1901. SPENCER, Development of Antilles, Journ. Geol. Soc., Vol. LVII.
1902. GUPPY, Tobagan Fossils, Bull. Botanic Dep., Trinidad.
1902. GUPPY, Coal, Gold, etc., Proc. Vict. Inst., Trinidad.
1902. SPENCER, Windward Islands, Trans. Can. Inst.
1904. GUPPY, Sangregrande Borings, etc., Geol. Mag.

*The works marked thus do not refer to the geology of the Caribean area, properly speaking, but are nevertheless useful in connection therewith.

APPENDIX II*

Notes on the Life of R. J. L. Guppy

A glance at the Frontispiece of this Bulletin will suffice to convince the reader that Robert John Lechmere Guppy was no ordinary character. His grandmother was a daughter of Admiral Lechmere of Plantagenet descent, his paternal ancestors date back to the Guy Pigli family of Florence. Migrating to France, the family name became Goupil, and finally, after the revocation of the Edict of Nantes when the family fled to England the name was modified to its present form. Robert John Lechmere Guppy was born in England, August 15, 1836. His father was the Hon. R. Guppy, M.A., Barrister-in-law, and for many years Mayor of San Fernando, Trinidad. After completing his studies in Civil Engineering, Guppy traveled in Australia, Tasmania and New Zealand but returned to England in 1858. Early in 1859 he served as assistant to Mr. Curtis, the engineer in charge in the construction of the Cipero railway. Upon completion of this road in July, 1859, since no similar work was available he accepted an appointment in the Colonial Secretary's office where he became Chief (Confidential) Clerk and Clerk of the Councils in 1861. In 1868 he was appointed Chief Inspector of Schools, a position which he held till retirement in 1891. The work involved in building up a new system of education was arduous. Little time and strength was left for the delights of

*Since the foregoing pages of this Bulletin were printed and ready for distribution, (March 1921) we have been awaiting a biographic sketch of Mr. Guppy by a member of the family, one who naturally could do justice to the subject. Bulletins 36 and 37 have long been ready for mailing but have been withheld till this Appendix could be written, and hence these Bulletins could be sent out in their proper order. Fortunately, Mr. Waring has been able to borrow a good photograph of Mr. Guppy, and the same is herewith reproduced as Frontispiece but the biographic sketch has as yet (June '21) failed to appear. The few notes here given are from Newton's Obituary notice, published in the *Geological Magazine*, vol. 3, 1916, pp. 479-480, from a few pamphlets and a letter sent by Mr. Guppy, and from conversation with a son in San Fernando.

Natural History studies. Nevertheless he managed to note and even publish a multitude of facts relating to the Natural History of Trinidad. It seems indeed pathetic to find him in later days regretting that in the prime of life he had no time nor means for the work he most loved, while in life's eve, when time and more means were at his command he no longer had strength to work —one or two hauls of the seine producing complete exhaustion. All phases of Natural History appealed to him, but it was to animal life, especially the Invertebrates that he devoted most of his attention. He cheerfully bore the hardships incidental to the collection of new facts in the field, but his greatest delight was in their interpretation. Note for example his interpretation of the meaning of the Matura dwarf fauna, the origin of the Bocas and his reasons for an "Atlantis". Among the Invertebrates the Foraminifera and the Mollusca received most attention. These he found, ranging in age from the Cretaceous to the Quatenary. In fact, some few indications he seemed to find of Paleozoic remains in the Northern range, and on two occasions he published the known molluscan fauna of the Gulf of Paria.

He was a zealous worker for the upbuilding of local scientific organizations as the published proceedings of the *Scientific Association of Trinidad*, the *Field Naturalists' Club*, and the *Victoria Institute* clearly attest. In the latter he hoped for real results by way of library and museum facilities. He found, however, its resources gradually turned into non-scientific channels. Fortunately he was spared the pain of witnessing its recent destruction.

The opposition, even bitterness, encountered in introducing modern, efficient, secular education in new territory can well be imagined and easily understood. But the lack of sympathy shown to an original natural history worker in a distant land by those who had it within their power to aid rather than criticize seems far more difficult to explain. Guppy wisely knew the weakness of his own situation, without an adequate library, without museum material for comparison, and without means he could devote to his scientific work. This is reflected in the mildness of his replies to his critics, mildness in upholding his opinions, many of which are proving today to be correct.

After leaving the Educational Department he spent some time touring in England, Holland, Belgium, Germany, Switzerland, Italy and France then settled for a while at Tunapuna, Trinidad, devoting his time to agriculture and apiculture. He afterwards moved to Port-of-Spain where he died after a brief illness, August 5, 1916. He was survived about six months by his wife, who died on the 2d of February, 1917. They had eight children, three daughters and five sons, all of whom are living, as follows:

Mrs. Alex Fraser, wife of the Manager of Furness Withy Co., Port-of-Spain.

Mrs. Patrick Jones of Port-of-Spain.

Mrs. Low, wife of the headmaster of Queen's Royal College in Port-of-Spain.

Plantaganet L. Guppy (eldest son) Treasurer of Tobago.

Percy F. L. Guppy, now in Calfornia.

G. E. L. Guppy, Intendent of Crown Lands, Port-of-Spain.

R. F. L. Guppy, District Commissioner in Madras, India.

John L. Guppy, Civil Engineer, San Fernando.

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Vol. 8

No. 36

ILLUSTRATIONS AND DESCRIPTIONS OF FOSSIL MOLLUSCA CONTAINED IN THE PALEONTOLOGICAL COLLECTIONS AT CORNELL UNIVERSITY

BY

KATHERINE E. H. VAN WINKLE

March 1, 1921

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

ILLUSTRATIONS AND DESCRIPTIONS OF FOSSIL MOLLUSCA CONTAINED IN THE PALEONTOLOGICAL COLLECTIONS AT CORNELL UNIVERSITY.

BY

KATHERINE E. H. VAN WINKLE

NOTES AND ILLUSTRATIONS OF SOME TYPES OF WEST COAST SPECIES DESCRIBED BY CARPENTER.

While recently arranging collections in the Paleontological Museum of Cornell University, the discovery was made of two forgotten types which belonged to the Jewett Collection, bought many years ago by Ezra Cornell.

In 1866, Carpenter* described in the Annals and Magazine of Natural History, five new species of mollusca, from material collected and sent him by Col. E. Jewett, from the Pleistocene of Santa Barbara, California. To explain what happened to those forms described by Carpenter we quote a note which follows the article describing the species: "Unfortunately, during the long interval which has elapsed between the transmission of the MS. and receipt of the proof, the types have been returned to the owner, and (with the remainder of Col. Jewett's invaluable collection of fossils) have become the property of a college in New York State. As they are packed in boxes, and at present inaccessible, I am unable to give the measurements; but the unique specimens were drawn on wood by Mr. Sowerby for the

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* Carpenter, Philip P. On the Pleistocene Fossils collected by Col. E, Jewett, at Sta. Barbara, California; with Descriptions of New Species. Ann. Mag. Nat. Hist. 3rd Ser. Vol. XVII, pp. 274-278, 1866; Smith. Misc. Coll. 252, pp. 319-325, 1872.

Smithsonian Institution.—P. P. C., Montreal, Feb. 22, 1866."

The "college in New York State" was Cornell University where the collection has remained since its purchase, referred to in Carpenter's note. The finding of the two types offers occasion for their illustration inasmuch as they have not heretofore been figured. The species described as new were :

1. *Turritella Jewettii,*

2. *Bittium armillatum*—the type is stated by Bartsch to be in the U. S. N. M., Cat. No. 15653 and is figured by him in Proc. U. S. N. Mus., vol. 40, 1911, pl. 52, fig. 6.

3. *Opalia* (*? crenatoides*, var.) *insculpta*—type C. U. M. Cat. No. 4950.

4. *Trophon tenuisculptus*—type ; C. U. M. Cat. No. 4951.

5. *Pisania fortis.*

Dentiscala insculpta (Carpenter) 1866. Pl. 1. Figs. 10, 11.

Opalia (*? crenatoides* var.) *insculpta* Carpenter, Rep. Brit. Asso. Ad. Sci. for 1863, 1864, p. 660 ; Ann. Mag. Nat. Hist. 1866, 3rd ser., vol. XVII, p. 277. Reprint, Smith Misc. Coll. 1872, 252, p. 324.

Dentiscala insculpta Dall, Proc. U. S. Nat. Mus. 1917, vol. 53, p. 473.

Remarks 1863. "Like the C. S. L. form and *crenata*, but ribs closer, without spiral sculpture, sutural holes behind the basal rib."

Original description.—"*O.* testa *O. crenatoidei* simili ; sed costis radiantibus pluribus, xiii,—xvi., in spira validis ; anfr. ult. obsoletis ; sculptura spirali nulla ; punctis suturalibus minus impressis, circa fasciam basalem lævem postice, non antice continuis.

Hab. Sta. Barbara, Pleistocene, 1 sp. (*Jewett*).

Very closely related to *O. crenatoides*, now living at Cape St. Lucas, and, with it, to the Portuguese *O. crenata*. It is quite possible that the three forms had a common origin."

The exterior of the shell of this type has been worn away except in the sutural region, hence the exact character of the longitudinal ribs cannot be described, however prominent impressions of each reveal fourteen ribs on the whorls.

Dimensions of type.—Height 14 mm. ; width of body whorl 7 mm.

This specimen has an original label which reads "Drawn by Sowerby for the SI."

Boreotrophon tenuisculpta (Carpenter) 1866. Pl. 1. Figs. 6-9.

Trophon tenuisculptus Carpenter, Rep. Brit. Ass. Ad. Sci. for 1863, 1864, p. 25 ; Ann. Mag. Nat. Hist., 3rd ser., vol. XVII, p. 277, 1866 ; Reprint Smith. Misc. Coll. 252, 1882, p. 324.

Not *Trophon tenuisculptus* Tryon Man. Conch. 1880, vol. 11, pl. 33, fig. 359 (after Kobelt, Küster, Conch. Cab. t. 76, f. 9.)

Trophon (*Boreotrophon*) *tenuisculpta* Arnold Mem. Cal. Acad. Sci. 1903, vol. III, p. 253.

Boreotrophon tenuisculptus Dall, Proc. U. S. Nat. Mus. 1902, vol. 24, p. 541.

Original Description.—"*T.* testa *T. Barvicensi* simili, sed sculptura minus extante ; vertice nucleoso minimo ; anfractibus uno et dimidio lævibus, apice acuto ; normalibus v., tumidis, postice subangulatis, suturis impressis ; costis radiantibus x.-xiv., plerumque xii., haud varicosis, angustis, obtusis ; liris spiralibus majoribus, distantibus, quarum ii.-iii. in spira monstrantur, aliis intercalantibus, supra costas radiantes undatim transeuntibus ; tota superficie lirulis incrementi, supra liras spirales squamosis, eleganter ornata ; canali longiore, subrecta, vix clausa ; labro acutiore, postice et intus incrassato, dentibus circ. v. munito ; labio conspicuo, lævi ; columella torsa.

Hab. Sta. Barbara, Pleistocene formation (*Jewett*).

This very elegant shell is like the least-sculptured forms of *T. Barvicensis*, from which it appears to differ in its extremely small nucleus. It is very closely related to *T. fimbriatulus*, A. Ad., from Japan, but differs in texture, and is regarded by Mr. Adams as distinct. It stands on the confines of the genus, there being a slight columellar twist, as in *Peristernia*."

Dimensions of specimens.—Height 16 mm ; max. width body whorl 8 mm.; height 13 mm.; max. width body whorl 7 mm.

There are two specimens of this species, on the original card, labelled "type."

Volvula cercadensis, n. n.

Not *Volvula cyclindrica* Carpenter 1863, Rep. Brit. Ass. Ad. Sci., p. 647 ; 1865, Ann. Mag. Nat. Hist. 3rd ser., vol. XV, p. 179 ; 1872, Smith Misc. Coll. 252, p. 281.

Not *Volvula cylindrica* Smith, 1871, Proc. Zool. Soc., London, p. 738, pl. LXXV, fig. 29 (= *V. smithii* Pilsbry 1893. Man. Conch. XV, p. 233).

Volvula cylindrica Gabb 1873, Trans. Phil. Soc., n. s. 15, p. 246.

The name *Volvula cylindrica* used by Gabb in 1873 for a shell from Santo Domingo was previously used in literature and applied in 1863 by Carpenter to a recent species from Santa Barbara, California. His description at that time is too inadequate and would therefore be rejected but in 1865 he gave a full description of this species thus making the name valid from the latter date.

NEW SPECIES FROM THF EOCENE AT NEW CASTLE, VIRGINIA.

In a former number* of the Bulletins of American Paleontology, we published a few notes and descriptions of new species from Eocene localities in Virginia. The material had been collected on the 1st expedition of the *Ianthina* to the south, in 1897. Recently, (summer of 1920), Mr. Axel Olssen collected material from Newcastle, Virginia and more material from the '97 trip was found in the laboratory which had not been worked up. Both of these collections contained some interesting new things as well as a greater number of the old.

From the material we have revised and increased the list of species identified from Newcastle, Virginia and include the list in this article.

The species described are all from Newcastle, Virginia and are all of St. Maurice, Eocene age. The types or specimens figured are in the Paleontological Museum of Cornell University.

* Bull. Amer. Pal. 1919, vol. 8, No. 33, pp. 6-12.

PELECYPODA

1. *Anapteris regalis* Harris & Van Winkle.
2. *Anomia marylandica* Clark.
3. *Arca rhomboidella* Lea.
4. *Corbula aldrichi* Meyer.
5. *Corbula murchsoni* Lea.
6. *Corbula subengonata* Dall.
7. *Glycymeris idoneus* (Conrad).
8. *Leda cœlatella* Harris & Van Winkle.
9. *Leda cutelliformis* (Rogers).
10. *Leda parva* (Rogers).
11. *Leda potomacensis* Clark & Marten.
12. *Lirodiscus virginianus* n. sp.
13. *Macrocallista subimpressa* (Conrad).
14. *Mactropsis olssoni* n. sp.
15. *Ostrea sellæformis* Conrad.
16. *Pecten clarkeanus* Aldrich.
17. *Phacoides claibornensis* Dall ?
18. *Phacoides pomilia* var. *smithi* Meyer.
19. *Pitaria ovata* (Rogers).
20. *Pteropsis harrisi* n. sp.
21. *Protocardia lenis* Conrad.
22. *Spisula paralis* (Conrad).
23. *Tellina papyria* Conrad.
24. *Venericardia planicosta* Lamarck var.

GASTROPODA

1. *Adeorbis novi-castri* Harris & Van Winkle.
2. *Adeorbis ?* virginiensis Harris & Van Winkle.
3. *Calyptrea aperta* (Solander).
4. *Calyptraphorus trinodiferus* Conrad.
5. *Crepidula lirata ?* Conrad.
6. *Latirus* sp.
7. *Levifusus* sp.
8. *Lunatia marylandica* (Conrad).
9. *Plejona petrosa* (Conrad).

10. *Pseudoliva vestuta* (Conrad).
11. *Ringicula dalli* Clark.
12. *Strepsidura subscalarina* Heilprin.
13. *Teinostoma lævis* (Meyer).
14. *Teinostoma subrotunda* Meyer ?
15. *Turritella clevelandica* Harris, var. Harris.

SCAPHOPODA

1. *Dentalium minutistriatum* Gabb.
2. *Dentalium thalloides* Conrad.

Genus **LIRODISCUS** Conrad

Lirodiscus virginianus n. sp. Pl. 1. Fig. 1.

Description.—Shell thick, subrectangular, umbones flattened; surface ornamented with prominent, concentric undulations ; margin crenulated.

Long. 19 mm. ; alt. 14 mm.

This species is of the *L. tellinoides* stock but differs from the typical specimens in the lack of the posterior sulcus and from all varying forms of that species in the less rounded, ventral margin, in this respect *virginianus* is more like *L. protractus ?* Dall. Meyer's figures of *protractus* show a greater production of the posterior end, as well as the margin entire. *L. smithvillensis* Har. is shorter and more rounded.

From material collected on 1st *Ianthina* Expedition, '97.

Genus **MACTROPSIS** Conrad

Mactropsis Olssoni n. sp. Pl. 1. Figs. 4, 5.

Description.—Shell moderately thin, triangular ; posterior umbonal slope prominent, angulated, the sharpness of the angulation varies in different specimens, on the type specimen the slope is great enough to hide the posterior margin from an external, medial view ; beaks high and full ; posterior and anterior regions with large, well-marked areas, differentiated by indentations which extend from the beak to the margin of the shell. Exterior surface with prominent, regular, concentric striæ, which decrease in number and become more pronounced on the anterior and posterior, dorsal areas.

Long. 9 mm. ; alt. 8 mm.
From material collected by Axel Olsson in 1920.

Genus **PTEROPSIS** Conrad

Pteropsis harrisi n. sp. Pl. 1, Figs. 12, 13.

Description.—Shell very thin and fragile, probably subovate in shape ; surface covered with wavy, regular undulations which terminate, on the posterior margin a short distance anterior to the extremity of the margin, in a ridge which extends from the beaks ventrad ; anterior dorsal portion inflated, bearing slight traces of the undulations.

The only specimen we have of this species has the ventral portion broken, the anterior margin is slightly crushed, giving that region an appearance of greater inflation than we believe it would normally have. The concentric sulci are very much like those of *P. lapidosa* Con.; *P. harrisi* may be only a variety of *lapidosa* or possibly the same species, but that can be decided only by more material.

The hinge of this species is so well preserved and being a right valve (the left valve only of the type of the genus having been figured) we believe it worthy an illustration. A small amount of matrix had to be left in the anterior region to act as support for the crushed portion of the shell above.

From material collected on the 1st *Ianthina* expedition in '97.

Genus **CORBULA** Bruguière

Subgenus **ANAPTERIS** Harris & Van Winkle

Anapteris Harris & Van Winkle, Bull. Am. Pal. 1919, Vol. 8, p. 7.

Description of right valve.—Shape and ornamentation as in the left valve, exhibiting on the posterior end the characteristic flare or wing. The ridge which bounds the wing has a narrow groove which extends along the posterior side of the ridge from the umbonal region to the posterior ventral margin, a corresponding groove may or may not extend on the anterior side of the ridge ; valve convex.

Anapteris regalis H. & V. W. Pl. 1. Figs. 2, 3.

TYPE : *A. regalis* H. & V. W., *l. c.* p. 7, pl. 1, figs. 1, 2, 3.

This new and peculiar corbuloid form was described from the left valve only. Finding in our later work on Newcastle, Va. material, two specimens of the right valve, we include the figure of one with those of new forms described in this article.

From material collected on 1st *Ianthina* Expedition in '97.

PLATE I

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EXPLANATION OF PLATE.

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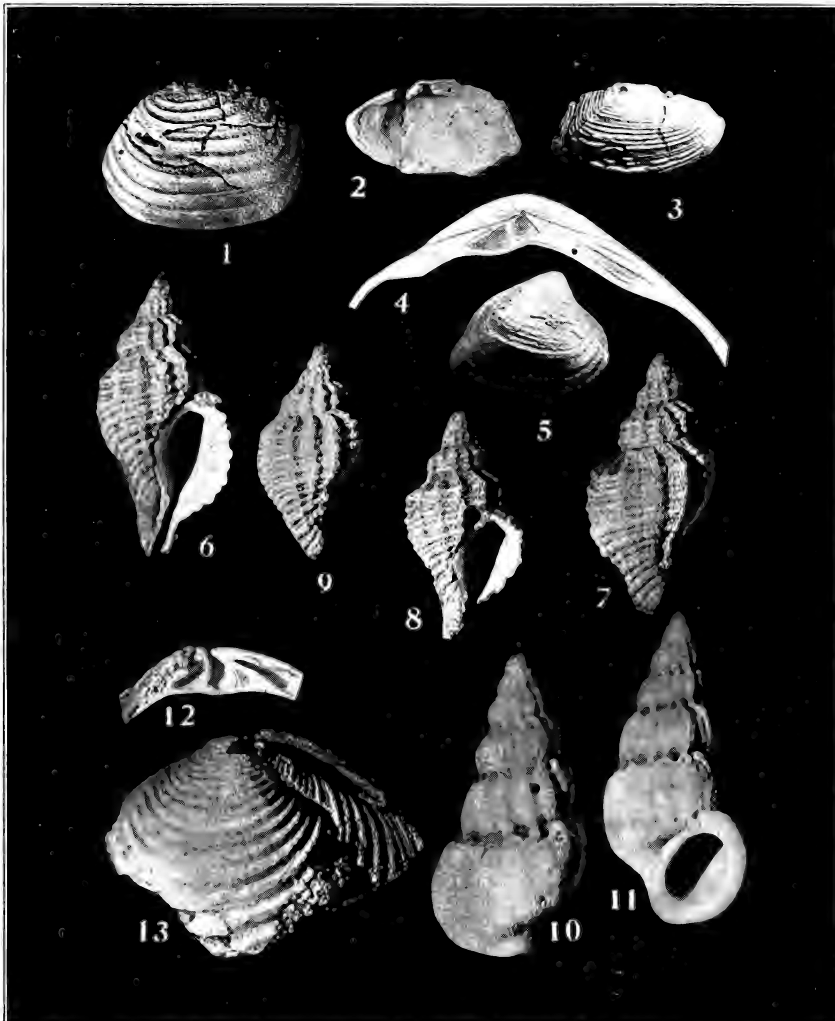
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CORRIGENDA

Bulletin 34, p. 71 (*103*), cut out *Antigona* (*Ventricola*) *callimorpha* Dall as extralimital. Not yet found in the Gulf of Mexico (Dall, 1921). Remove *pilula* Dall from synonymy with the above and refer to genus *Vesicomya*. Also extralimital.

Bulletin 36, p. 6, (*352*) 2d line, change *Volvula cyclindrica* to *Volvula cylindrica*.

ADDENDA

Bulletin 34, p. 26 (*58*). Under genus *Unio* add the following species : *musinus*, *alixus* and *sandrinus* Dall, Proc. U. S. N. Mus., 46, pp. 229-230, pl. 20, figs. 2, 4, 5, 6, 1914. Brackish water Upper Miocene or Pliocene, well near Alexandria, Louisiana, about 48 feet below the surface.