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A Contribution to the Paleontology of Trinidad

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PLATES V-XIII

PHILADELPHIA

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PLATES V-XIII

WASHINGTON, D.C.

A CONTRIBUTION TO THE PALEONTOLOGY OF TRINIDAD.

BY CARLOTTA JOAQUINA MAURY, PH.D.

The material described in the following pages was obtained by a geological expedition in charge of Mr. A. C. Veatch, the writer being the paleontologist.

The expedition was carried on under the auspices of the General Asphalt Company of Philadelphia. Opportunity to publish is due to the courtesy of Mr. Arthur Sewall, and Mr. John M. Mack, the present and former presidents of the above company, to whom science is thus indebted for this contribution.

The types have been deposited in the Museum of Cornell University as the gift of Mr. Mack.

The exquisite drawings which illustrate this report are of special value, as they were made by one who is not only an artist but also an eminent paleontologist, Professor G. D. Harris.

Many thanks are due to Dr. Dall, of the United States National Museum; Dr. Stanton, of the United States Geological Survey; Professor G. D. Harris, of Cornell University, and Dr. Rufus M. Baggs for their valuable suggestions.

The specimens were collected from Tertiary beds at Brighton, on the Island of Trinidad, and from the small outlying islets, Soldado and Farallon Rocks. A few are also included from Cretaceous shales and Pleistocene raised beaches,—both on the opposite Venezuelan mainland.

Paleontologically the Tertiary faunas proved very interesting because never before have true basal Eocene beds been found in the Antillean region.

Stratigraphically these faunas were most important because they form a perfect link between the Alabama Midway Eocene and the Pernambuco beds of Brazil, the age of which has hitherto not been determined.

For descriptions of the fossiliferous horizons of Trinidad other than those described in the following pages the reader is referred to the publications of Dr. R. J. Lechmere Guppy, of Port of Spain, Trinidad. Dr. Guppy has for forty-nine years investigated and reported upon the fossil faunas of Trinidad, Jamaica, Tobago, Antigua, and other Antillean islands, and is still contributing able and valuable articles on both the paleontology and stratigraphy of the islands.

OLIGOCENE FOSSILS FROM TRINIDAD.

On the shore near the pier at Brighton are several small exposures of asphalt filled with shells. The two most important of these are respectively 700 feet east and 1000 feet west of the pier. The eastern exposure is an irregular mass much washed by the waves, the western appears to show a distinct northward dip; but on account of the unstable character of the asphalt not much dependence

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can be placed on this, particularly as it is in the direction in which the asphalt would naturally flow. Other and clearly recent flows of asphalt contain no shells.

The following species were collected by Mr. Veatch from the outcrop 1000 feet west of the pier:

- Arca (Noetia) sheldoniana* n. sp.
- Cardium (Trigoniocardia) carolinæ* n. sp.
- Pitaria (Lamelliconcha) circinata* Born.
- Pitaria (Lamelliconcha) labreana* n. sp.
- Chione veatchiana* n. sp.
- Chione dalliana* n. sp.
- Mactra austeniana* n. sp.
- Corbula (Cuneocorbula) helenæ* n. sp.
- Corbula (Bothrocorbula) smithiana* n. sp.
- Marginella dalliana* n. sp.

The locality 700 feet east yielded the following:

- Arca (Argina) billingsiana* n. sp.
- Arca (Argina) brightonensis* n. sp.
- Chione guppyana* n. sp.
- Pholas mackiana* n. sp.
- Columbella labreana* n. sp.
- Columbella asphaltoda* n. sp.
- Cymia woodii* Gabb.
- Cerithium harrisii* n. sp.
- Cerithium isabellæ* n. sp.

A glance at these lists shows that all the species are new except two—*Pitaria circinata* Born and *Cymia woodii* Gabb. Fortunately, both these are most significant because of their remarkable distribution. The genus *Cymia* is entirely extinct now on the east coast of the Americas but is living on the west coast of Central America, where *C. tectum*, a species very closely allied to the fossil form, is common. The genus spread westward from an Antillean center of development. The parent stock was exterminated by disturbances following the rise of the isthmus and the western colony alone survived, continuing to the present day.

The presence of *Pitaria circinata* harmonizes with this. As is well known, very few species of mollusks are living on both the east and west coasts of the Central American region. *Pitaria circinata* is one. It is also found in the Oligocene of the Isthmian beds and of Cumana, Venezuela.

Evidence can also be deduced from several of the new species which agrees fully with that furnished by the two already known. Thus *Arca (Noetia) sheldoniana* is intermediate between the east coast *A. ponderosa* (which it resembles in outline) and the west coast *A. reversa* (which it resembles in the

cardinal area). It also shows a divergence of the west coast species from a common Antillean stock from which it migrated westward before the rise of the isthmus. For this short, high form of *Noetia* is characteristic of the east coast Oligocene. After that period they died out, but the western colonies have continued on to the present.

Mastra austeniana adds a further indication of the Oligocene age of the deposit. Typical Mastras, of which this is one, are not known in America from formations older than the Oligocene.

Pholas mackiana resembles both the recent east coast *P. campechensis* Gmelin and *P. chiloensis* of the Peruvian shores. These species are surprisingly alike, possibly even identical. This fossil *Pholas* from Brighton may well be their common ancestor.

Judging from all the above indications, the age of the shelly asphalt on the Brighton beach is Oligocene—and late Oligocene, perhaps about equivalent to the Chipolan of Florida.

A yellowish-brown ferruginous bed outcrops on the southern main road, just south of Pitch Lake, Brighton, near the 56 $\frac{3}{4}$ Mile Post. It is stratigraphically below the asphaltic beds above described and stratigraphically above the large *Ostrea* horizon of the Union Estate, Brighton.

The fossils in the ferruginous bed are all in the form of casts, the original substance of the shells having been wholly dissolved away. The majority could not be determined. A few forms retained some traces of distinguishing characters. These were:

Arca (Cunearca) chemnitzoides n. sp.

Arca two sp. indet.

Cardita (Carditamera) virginiae n. sp.

Corbula sp. indet.

Martesia oligocenica n. sp.

Terebra sp. indet.

Oliva trinidadensis n. sp.

Purpura sp. indet.

Murex cf. *domingensis* Sby.

Calyptræa centralis Con.

The known species, *Calyptræa centralis*, has never been found in strata earlier than the Chipolan of Florida, hence its presence suggests that the bed is not older than late Oligocene.

The fragmental cast of *Murex* may be *domingensis*. If so this also indicates Upper Oligocene. To this the evidence of the most abundant species of the fauna of the ferruginous bed, *Arca (Cunearca) chemnitzoides*, may be added. Arcas of this type with high umbones and a short, high form are not known below the Oligocene on the southeastern coast of the United States and in the Antilles.

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From these evidences the ferruginous bed does not antedate the Upper Oligocene, but is somewhat older than the asphaltic horizon.

One mile west of the Godineau River on the shore of the Gulf of Paria, Mr. Veatch found in a whitish, decayed rock moulds of large shells. These to all appearances are freshwater species. Some are almost certainly Unios; for one specimen shows imprints of the alternating hinge teeth so characteristic of that genus. There is also a large convex shell which might be of the genus *Anodonta* as it has the general form of *A. grandis*.

The occurrence of these freshwater shells recalls the Comparo Road freshwater horizon described by Dr. R. J. Lechmere Guppy and referred by him to the Pliocene. It is more probable, however, that the Godineau River strata are of Oligocene date, but it is impossible to draw any inference as to the true age because of the very imperfect condition of the fossils.

Near San Fernando, Trinidad, is a small outlying island known as Farallon Rock or Johnson's Island. In a light buff-colored or greyish or even blackish non-asphaltic rock on Farallon are Foraminiferal layers with myriads of Orbitoides and Nummulites. The curious crustacean, *Ranina porifera* Woodward, the Helix-like worm tube, *Serpula chymenioides* Guppy, and the urchin, *Echinolampas ovum-serpentis* Guppy also occur.

The horizon is Lower Oligocene and is a continuation off-shore of the San Fernando Orbitoides formation which also contains the *Ranina* and *Serpula*.

EOCENE FOSSILS FROM SOLDADO ROCK.

On Soldado Rock, an islet one hundred and seventeen feet high, lying near the Serpent's Mouth in the Gulf of Paria, just west of the extreme southwest corner of Trinidad, Mr. Veatch found a succession of eight beds of which Nos. 2, 6, and 8 are fossiliferous.

The basal bed, No. 2, is an extremely hard, greyish to reddish limestone containing quantities of shells which have become an integral part of the rock, from which they have fortunately been brought into high relief by the erosive action of the waves that constantly beat upon them.

This bed lithologically is the exact counterpart of Midway Eocene beds near Ripley, Mississippi; Fort Gaines, Georgia; and Clayton, Alabama. Some samples from these various localities and Soldado cannot be distinguished from one another, and this resemblance is still more striking when fragments of rock from these widely separated places contain the same fossils.

The material from bed No. 2 has yielded the following mollusks:

Ostrea crenulimarginata Gabb.

Ostrea cynthiae n. sp.

Ostrea cf. *percrassa* and *compressirostris* Say.

Ostrea pulaskensis Harris.

Ostrea thalassoklуста n. sp.

- Cucullæa harttii* Rathbun.
Glycymeris (Axinea) viamedia n. sp.
Venericardia alticostata Con.
Venericardia planicosta Lam.
Venericardia thalassoplekta n. sp.
Callista mcgrathiana Rathbun.
Callista mcgrathiana var. *rathbunensis* n. var.
Chione paraensis White var.
Caricella ogilviana n. sp.
Caricella perpinguis n. sp.
Volutilithes pariaensis n. sp.
Lyria wilcoxiana var. *aldrichiana* n. var.
Levifusus pagoda Heilprin.
Fusus colubri n. sp.
Fusus bocaserpentis n. sp.
Fusus meunieri n. sp.
Fusus mohrioides n. sp.
Fusus sewalliana n. sp.
Fusus sirenideditus n. sp.
Clavella harrisii n. sp.
Clavella hubbardanus ? Harris.
Latirus tortilis Whitfield.
Strepsidura ? *soldadensis* n. sp.
Pseudoliva bocaserpentis n. sp.
Trophon progne ? White.
Cassis togatus var. *soldadensis* n. var.
Cypræa bartlettiana n. sp.
Cypræa vaughani n. sp.
Calyptraphorus velatus var. *compressus* Aldrich.
Veatchia carolinæ n. s. g., n. sp.
Cerithium soldadense n. sp.
Turritella humerosa var. *elicitatoides* n. var.
Turritella mortoni Conrad.
Turritella nerinexa Harris.
Turritella soldadensis n. sp.
Mesalia pumila var. *allentonensis* Aldrich.
Mesalia pumila var. *nettoana* White.
Calyptræa aperta Sol.
Amauropsis caloramans n. sp.

As shown by the above list, this fauna comprises a most interesting mingling of such characteristic North American lower Eocene forms as *Venericardia planicosta*, *Levifusus pagoda*, *Latirus tortilis*, *Calyptraphorus velatus* var. *compressus*

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and *Turritella mortoni* with the characteristic Pernambuco forms *Callista mcgrathiana*, *Chione paraensis*, *Cucullæa harttii*, etc.

The new species also show strong affinities with basal Eocene (Midwayan) forms from Alabama.

These relationships not only establish the age of the No. 2 bed at Soldado, but also that of the Pernambuco beds as Midway Eocene.

Bed No. 6 contains myriads of Foraminifera, especially Orbitoides, echinoids, and one imperfect Ostrea shell, probably of *O. crenulimarginata*.

Bed No. 8 is an indurated rock noticeable from being stained deep red with hematite and greenish and purplish with other forms of iron.

The following fossils were obtained from bed No. 8:

MOLLUSCA and BRACHIOPODA.

Ostrea golfotristensis n. sp.

Ostrea thirsæ Gabb.

Spondylus sp. indet.

Modiola alabamensis Aldrich.

Venericardia crucedemaionis n. sp.

Meretrix cf. *nuttalliopsis* Heilprin.

Meretrix subimpressa var. *golfotristensis* n. var.

Venerupis atlantica n. sp.

Corbula (*Cuneocorbula*) *subengonata* Dall.

Corbula (*Cuneocorbula*) *weaveri* n. sp.

Cylichna solivaga n. sp.

Pleurotoma guppyana n. sp.

Caricella ? sp. indet.

Volutilithes sp. indet.

Fusus bocarepertus n. sp.

Fusus longiusculoides n. sp.

Fusus tæniensis n. sp.

Fusoficula juvenis Whitf.

Cassis (*Phalium*) *guppyana* n. sp.

Rimella fowleriana n. sp.

Rimella knappiana n. sp.

Cerithiopsis veatchiana n. sp.

Turritella mortoni var.

Solarium stephanephorum n. sp.

Natica cf. *semilunata* Lea var.

Amauropsis smithiana n. sp.

Liotia lillianæ n. sp.

Dentalium microstria Heilp.

Terebratula stantoni n. sp.

One of the most abundant fossils occurring in this bed is the Lignitic species, *Ostrea thirsæ*. The other species also, although mostly new, show a strong relationship to the Lignitic fauna of the Gulf coast of the United States.

In the judgment of Professor Harris this Soldado horizon is about equivalent to the Nanafalayan of Alabama.

COMPARISON OF THE STRATIGRAPHIC EVIDENCE FURNISHED BY THE
FORAMINIFERA AND THE MOLLUSCA.

Dr. Rufus Mather Baggs most kindly examined the Foraminifera associated with the molluscan fossils found on Soldado and Farallon Rocks. He was asked particularly to express an opinion as to the geological ages of the deposits in which they were found. Dr. Baggs writes:¹ "The Orbitoidal rock marked bed No. 6, Soldado Rock, is Eocene. I am not sure just what horizon but I note *Orbitoides papyracea* (Boubee); *Orbitoides aspera* Gumbel (*O. faujasii*); and probably *O. mantelli*² though I have not access to the literature on the subject. . . . The Soldado bed No. 6 shows a few scattered forms of a typical Cretaceous and early Eocene type which I have never come upon before, namely *Tinoporus vesicularis*, and the more numerous allied species *T. baculatus*. *Tinoporus*,³ while Cretaceous, is equally developed in the Lower Eocene, where I place your rock.

"The specimen from Farallon Rock is exceedingly interesting, and the entire mass seems to be filled with *Operculina complanata* (Defrance) and is undoubtedly Eocene. It is not usual for this species to assume the rôle of the Eocene Nummulitic or Orbitoidal rock types, and I am glad to identify this interesting Foraminiferum, so characteristic of the early Tertiary formation.

"The argillaceous shale from the Godineau River, Trinidad, was insoluble in the caustic alkalies . . . but I am inclined to think it is of Miocene age, since it is rich in diatoms and it has the rather typical Miocene genus *Coscinodiscus* and a *Pyxidicula*. I sent a small fragment of this to Dr. Edwards of New York, but he said he could not make a slide of it that was of any help in identifying the diatoms."

It is interesting to compare these conclusions of Dr. Baggs with those based on the molluscan fauna by the writer, especially as they were reached wholly independently.

The evidence furnished by both Foraminifera and Mollusca as to the age of the No. 6 bed on Soldado Rock point definitely to Lower Eocene.

The Farallon Rock Foraminifera are, however, also referred by Dr. Baggs to the Eocene. This bed is apparently an outlier off shore in the Gulf of Paria of the San Fernando bed, and the latter contains a molluscan fauna of a decidedly Oligocene aspect. There seems to be no question that the San Fernando and

¹ Letter dated January 30, 1912.

² According to Dr. Dall, the West Indian form of *mantelli* is *O. forbesii*.

³ For illustrations see Carpenter's Introduction to the Foraminifera, Plate XV, Figs. 1, 9.

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Farallon beds are the same as they both contain *Ranina porifera*, the very striking species of Crustacea; *Serpula*; and a number of Foraminifera in common. Yet Mr. Veatch from stratigraphic relations was disposed to regard the Farallon bed as possibly Eocene. To harmonize these conflicting indications we may at present regard the bed as intermediate between Eocene and Oligocene; its fauna retaining Eocene foraminiferal forms, mingled with incoming Oligocene moluscan types.

Dr. Bagg's inference that the sample of rock from the Godineau River may be Miocene, calls up the most interesting problem of Antillean stratigraphy, namely whether any true Miocene was ever deposited there. Up to the present no strictly Miocene faunas have been found in the region, although they may yet be discovered.

THE PERNAMBUCO BEDS.

Although many deposits of the coastal plateaus of eastern Brazil from Cape Frio to the Amazon are referred to the Tertiary because of their stratigraphic characters, they are all remarkable for a total absence of organic remains. The only Tertiary beds containing marine fossils have been found in the State of Pernambuco in a narrow coastal belt. The oldest locality is on the Rio Maria Farinha, a small stream emptying into the sea near the town of Olinda.

Dr. Derby was detailed during Professor Hartt's expedition to the Amazon in 1870 to examine this locality. The fossils obtained were described by Dr. Richard Rathbun⁴ who referred them to the Cretaceous, without, however, finding any distinctively Cretaceous forms.

In 1875 Professor Hartt himself visited the Maria Farinha beds with Dr. J. C. Branner and others, and obtained a quantity of material for the Geological Commission of Brazil, of which he was then chief.

This collection was neglected for some years because of the sad death of Professor Hartt in Rio. Later the fossils were described, together with many Cretaceous species from other localities, by Dr. White in a monograph⁵ published in 1887. He also referred the Maria Farinha fauna to the Cretaceous.

Subsequently the Pernambuco localities were again visited by Dr. Branner who consulted Professor G. D. Harris as to the age of the fossils. The latter said that the fauna was not older than Midway Eocene.

Dr. Branner then adopted this view and remarked that the "general aspect of the faunas of the Pernambuco (Maria Farinha, Olinda, and Ponto das Pedras) and Para basins is decidedly Tertiary rather than Cretaceous."

In 1896, Professor Harris⁶ mentioned the close affinity between the Midway of Alabama and that of "the so-called Cretaceous (really Eocene) of Maria Farinha." He added: "No one at all familiar with our Midway fauna can fail to see the close affinities or perhaps identity of *Harpa* (*Pseudoliva*) *dechordata*

⁴ Proc. Boston Soc. Nat. Hist., pp. 241-256, 1875.

⁵ Arch. do Museu Nac. do Rio de Janeiro, vol. VII.

⁶ Bull. Am. Pal., vol. I, p. 40, 1896.

White, *Calyptraphorus chelonitis* White, *Fasciolaria?* (*Mazzalina*) *acutispira* White, *Turritella sylviana* Hartt, *Nautilus* (*Enclimatoceras*) *sowerbyanus* White non Orb., *Gryphæa trachyoptera* White, *Cucullæa hartti* Rath. . . . with Gulf State species."

But in Dr. Branner's latest publications on this subject, his faith is shaken in the Tertiary age of the Maria Farinha beds largely because of the reported discovery of a Cretaceous cephalopod on the island of Itamarica which lies off the Pernambuco coast.

Dr. Derby, State Geologist of Brazil, is now also more strongly disposed to regard the Maria Farinha and related faunas of nearby localities as Cretaceous. In his latest article on the subject he writes: "The geological horizon of the beds with faunas of Tertiary aspect is doubtful, but at present the preponderance of evidence seems in favor of a Cretaceous age."

In view of this difference of opinion, and the uncertainty of the age of the Maria Farinha and related Brazilian faunas, the discovery of the Midway beds on Soldado Rock is most illuminating. On that islet, as shown in the preceding pages, we have found typical North American Midway species together with characteristic Maria Farinha forms, and also species common to all three localities—Alabama, Soldado, and Maria Farinha.

By this commingling of species Soldado Rock links the Alabama basal Eocene fauna with that of Maria Farinha, Brazil. Thus the age of the Pernambuco beds (Maria Farinha, Olinda, and Ponto das Pedras formations) is established as Midway Eocene.

AFFINITIES OF SOUTH AMERICAN EXTINCT FAUNAS.

Great stress has been laid on the resemblances of the ancient forms of life of South America to those of contemporaneous times of the Old World. Relationships have been established between the South American faunas and those of France, Spain, Malta, Morocco, Egypt, Syria, India, and South Africa; but until Dr. Derby's work on the Paleozoics of Brazil little was said of the faunal relationships of the two Americas. In fact it was generally supposed that hardly any communication had taken place between the species peopling North and South America.

To account for the similarity of faunas in the eastern and western hemispheres, and to render possible the migrations of species not pelagic, authors have bridged the ancient seas by imaginary continents.

The most famous of these is Atlantis, which furnished a route passing north-eastward and eastward from the island of Trinidad to southern Europe and northern Africa. This land is thought by some to have been a continent, by others an island chain. Unfortunately for this hypothesis, about which is woven the charm of Greek and Egyptian tradition, there lie in the present bed of the Atlantic several very deep basins (as the Virgin Islands deep) in the line of the hypothetical land bridge.

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A second hypothetical route lay further south and connected the southern part of South America with South Africa. This is thought to have been formed by a northern extension of Antarctica. A strong argument in favor of this is that the present floor of the ocean shows in that region a plateau-like elevation.

As regards the hypothetical eastern lands lying off South America we find ourselves in a dilemma: our knowledge of continental growth indicates that the lands and seas have not changed places to any great extent; yet we are confronted by indirect evidence of the existence of such a land mass,—*first* by the necessity of a pre-existing mass to supply the rock debris for building up the oldest known rocks of northern South America, and *second* by certain faunal relations with the eastern hemisphere.

Messrs. Katzer, Guppy, Jukes-Brown and Harrison, from examinations of the order of deposition of the rock formations of Brazil, Trinidad and Barbados, agree in the conclusion that the material composing the oldest rocks in those areas were furnished by a former land extending to the eastward and northeastward (virtually Atlantis). This is thought to have existed during the Cretaceous and early Tertiary times, then to have been gradually submerged, disappearing beneath the sea in the mid-Tertiary. The crystalline highlands of Guiana and Brazil are looked upon as originally the western end of this vanished continent of which they now constitute the isolated ruins.

But, as above noted, several of the greatest depths of the Atlantic now overlie this supposed sunken continent. It is, however, true that the occurrence of Foraminiferal beds in the southern Antilles, containing genera now found living at great depths, shows that very unusual changes of level have taken place there, and it may be that the normal standards of continental stability cannot be applied in that area.

As regards the South American faunal relations, the discovery of a basal Eocene formation on Soldado Rock containing fossils some of which are common to the southern United States and to Brazil,—joined with Dr. Heilprin's and Dr. Dall's earlier discoveries of the relationship of the Antillean with the Floridian Oligocene—has awakened the writer's belief that the affinities of the Tertiary faunas of South America are far stronger with North America than, as was previously supposed, with the Old World.

From the recent to the early Paleozoic the following faunal resemblances are indicated between the Americas.

But it is true that certain very interesting relationships also exist between the faunas of South America and the Eastern hemisphere. The most striking instances are (1) the well known Devonian *Leptocalia flabellites* fauna which not only is common to North and South America, but is also found on the Falkland Islands and in South Africa; (2) the famous *Glossopteris* flora of the Carboniferous; and (3) the Cretaceous Ammonitic fauna of which the typically South American genus *Pulchellia* has been traced by Douvillé and others through the Alps as far east as Roumania and even into Asia. These pelagic forms were

presumably carried by oceanic currents corresponding to the present Gulf Stream eastward; but the spread of the other genera cannot thus be accounted for. Possibly we have in these instances cases of parallelisms of development.

Recent and Quaternary.	SOUTH AMERICA. Molluscan fauna northward from the La Plata.	NORTH AMERICA. Molluscan fauna southward from Cape Hatteras.
OLIGOCENE	Upper Oligocene faunas of Cumana, Trinidad, Jamaica.	Upper Oligocene of Florida. (Tampa silex beds, Chipola marls.)
	Lower Oligocene faunas of San Fernando and Manzanilla, Trinidad.	Lower Oligocene of Vicksburg, Mississippi.
EOCENE.	Lignitic fauna of Soldado Rock, Gulf of Paria.	Lignitic fauna of Alabama and other Gulf States.
	Midway fauna of Soldado Rock and Pernambuco.	Midway fauna of Alabama and other Gulf States.
CRETACEOUS.	Cretaceous faunas of Venezuela and Colombia.	Cretaceous of the southwestern United States and Mexico.
CARBONIFEROUS.	Faunas of the Amazonian Valley in Brazil, Bolivia and Peru.	Coal measures of the western United States. (More than half the species being identical.)
DEVONIAN.	Eréré formation, Brazil.	Onondaga of the United States.
	Maecuru beds, Brazil.	Oriskany of Alabama, etc.
SILURIAN.	Brazilian and Venezuelan Silurian faunas (Upper formation).	Niagaran of the United States.
	Brazilian Silurian faunas (Lower formation).	Clinton and Richmond of the United States.

As above noted, the Oligocene faunas of Cumana, Trinidad, and the Antilles in general, show close resemblances to the recent fauna of the west coasts of Central America and of northwestern South America. This is due to the pre-Oligocene free waterway over the Isthmus from the Caribbean to the Pacific.

Regarding the resemblances of the Trinidad and other Antillean Oligocene to that of southern France, the writer's observations of Tertiary forms in general are the same as those of M. Douvillé for the South American Cretaceous,—namely, that although the European and American formations include a very few species in common and have a certain *air de famille*, their evolution was distinct.⁷

Studies by Drs. Dall and Verrill of the living molluscan and coral faunas of Florida and the West Indies indicate that the present faunas on the shores of the Gulf Coast of the United States came originally from the coast of Brazil. And, as Dr. Branner has already suggested, it seems very probable that the Tertiary faunas of the Gulf States may have also originated on the Brazilian and Antillean shores. The Soldado Eocene fauna is a strong argument in favor of this hypothesis.

⁷ Ann. de la Soc. Royale Zoologique et Malacologique de Belgique, t. XLI, pp. 142-155, 1906.

DESCRIPTIONS OF SPECIES.

Class PELECYPODA.

Genus OSTREA Linnæus, 1758.

Ostrea crenulimarginata Gabb. Plate V, Figure 11; Plate VI, Figures 1, 2, 3, 4.

Ostrea crenulimarginata Gabb, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. IV, p. 398, pl. 68, figs. 40, 41, 1860.

Ostrea denticulifera Gabb, *Ibid.*, p. 398. Not of Conrad.

Ostrea præ-compressirostra Harris, Ark. Geol. Surv., vol. II, p. 39, 1894.

Ostrea compressirostra Langdon, Geol. Surv. Alabama, p. 413, 1894. Not of Say.

Ostrea tumidula Aldrich, Geol. Surv. Alabama, p. 242, pl. 14, figs. 1, 2, pl. XV, figs. 1, 2, 1894.

Ostrea crenulimarginata Harris, Bull. Am. Pal., vol. I, pp. 159-160, pl. I, figs. 1, 1a, pl. II, figs. 1, 1a, pl. III, fig. 1, 1896.

Ostrea crenulimarginata Dall, Trans. Wagner Inst. Sci., vol. III, p. 677, 1898.

Gabb's original description.—"Subtriangular, sometimes elongated, oval, attached; portion of the outside of the shell not attached is very squamose; hinge about an equilateral triangle, central groove of the hinge deep; internal margin strongly crenate, muscular impression large; upper valve?"

"*Dimensions.*—Length 2.2 in., greatest width about 2 in."

Type locality near Middleton, Tennessee, in Midway Eocene marls.

Remarks.—Gabb was misled by the great dissimilarity in appearance of the convex, plicated left (or lower) valves and the nearly flat, smooth right (or upper) valves of this species; and gave to the former the name *crenulimarginata* and to the latter *denticulifera*, supposing them to be two species.

Among the oysters from Soldado Rock, Bed No. 2, are a number of almost flat valves, of elongated oval, or elliptical outline, and sculptured only by rather coarse concentric lines of growth. These, so far as one can judge from the exterior, agree well in form with the flat valves of specimens of *O. crenulimarginata* from the Midway of Alabama.

A young *Ostrea* shell was found in Bed No. 2, which shows the characteristic crenules on the inner margin. It is much like specimens of a varietal form found near Midway, Alabama, which are flat and nearly circular in outline. This shell shows on the exterior faint radial striæ.

We have also from Bed No. 6, Soldado Rock, a single convex valve embedded in a silicious matrix with a mass of Foraminifera. The hinge area and a portion of the exterior is, however, revealed. The former shows along the margin fine striations, like specimens of *crenulimarginata* but somewhat closer and finer; and the surface of the shell shows traces of the rather regular, narrow plications characteristic of the left valves of this species. As the general outline also agrees, the writer is inclined to think that the shell from Bed No. 6 is a left valve of *O. crenulimarginata*.

Locality.—Beds Nos. 2 and 6, Soldado Rock, Gulf of Paria.

Geological horizon.—Midway Eocene (Bed No. 2) and near the Midway and Lignitic contact zone (Bed No. 6).

Ostrea cynthiæ new species. Plate VI, Figure 5.

Description.—Shell large, heavy, becoming greatly thickened, general form obliquely ovate-oblong; left (lower) valve very convex, not plicated, marked by thick, irregular concentric lamellæ marking resting periods of growth; right (upper) valve flat, operculate in form, not sculptured; hinge not heavy, considering the weight of the shell.

Height 140, greatest breadth 90 mm.

Remarks.—These oyster shells have been almost wholly replaced by silica, only a few narrow layers of the original calcite remaining deep in the inner portion of the shell. The silicious deposits form on the surface very curious concentric structures, one of which is shown in the figure near the base of the valve.

This oyster is unlike any described from the lower Eocene of either North America or Brazil.

It is with great pleasure that the writer names the species in honor of Mrs. Arthur Sewall, of Philadelphia.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Ostrea golfotristensis new species. Plate VII, Figure 1.

Description.—Valves rather thin, when complete, ovate-oblong in form; sculpture of very many fine, close-set, radiating riblets, divaricating, fairly regular; hinge with a narrow, rather deep ligament pit.

Height of fragment 15 mm.

Remarks.—Superficially this curious shell resembles somewhat a Midway Alabama fossil mentioned by Professor Harris as *Plicatula* species,⁸ but the Soldado shell has no teeth,—only the deep ligament pit showing it to be an *Ostrea*.

It appears to be of the group of Lea's *Ostrea divaricata*;⁹ but the divaricating riblets are very much finer and more close-set than in that species. The form of the shell is also much less oblique.

The specimens are all more or less broken. The curious aspect of this shell is enhanced by the fact that it is colored moss-green, magenta, and violet by presumably some marine algal growth that has encrusted it. The peculiar formation of concentric rings of silicon on the surface has begun in some cases. This is noted at greater length in the description of the other *Ostreas* from Soldado.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Ostrea cf. *percrassa* Conrad and *compressirostra* Say. Plate VI, Figure 7.

Among the *Ostreas* from Bed No. 2, Soldado Rock, is a very bizarre specimen. It was evidently originally a large rounded oyster of the general shape of *O*.

⁸ Bull. Am. Pal., vol. I, p. 161, pl. 2, figs. 2, 2a, 1896.

⁹ Contributions to Geology, p. 91, pl. 3, fig. 70, 1833.

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percrassa or *O. compressirostra*; but it has become completely hidden by a most singular deposit of silicon in concentric rings. Apparently, the two valves rest together with a layer of the silicious rock matrix between. The surface of the convex valve has been completely encrusted by the concentric rings of silicon, so as to be perfectly hemispherical; while the flat valve is completely hidden in four layers of similar but finer concentric rings of the same character. The singular appearance of this most curious specimen is heightened by the brilliant coloring of the silicious circles which vary from deep violet, moss green, and white to vivid pink.

This coloration is shown to be due to some organisms probably marine algæ that were living on the surface of the rings. For when heated in the flame of a bunsen burner the pink color turns black and then fades out, a sure proof that it is organic.

It is needless to say that identification of the oyster shell forming the nucleus of this mineral growth is impossible. But attention is called to the structure, as it is so very unique and characteristic. The beginnings of the formation of the concentric rings have been seen on other fossils in this bed, as on *Ostrea cynthia*, but in this case it has been carried to an extreme development.

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

Geological horizon.—Midway Eocene.

Ostrea pulaskensis Harris. Plate VII, Figure 2.

Gryphæa vomer Safford, Geol. of Tennessee, p. 419, 1869.

Gryphæa pitcheri Morton? White, Proc. U. S. Nat. Mus., vol. IV, p. 137, 1881.

Ostrea pulaskensis Harris, Ark. Geol. Surv., vol. II, p. 40, pl. i, figs. 3, a-d, 1892.

Gryphæa vomer Langdon, Geol. Surv. Alabama, p. 416, 1894.

Ostrea pulaskensis Harris, Bull. Am. Pal., vol. I, pp. 160-161, pl. i, figs. 2, a-c, 3, a, 1896.

Ostrea pulaskensis Dall, Trans. Wagner Inst. Sci., vol. III, p. 677, 1898.

Harris' original description.—"Outline of the larger valve right angle-triangular; a carination from the umbo to the posterior basal margin forming the hypotenuse, the basal margin the base, and the shorter margin from umbo to base the perpendicular with proportional lengths of 8, 7 and 5 respectively; beak generally very incurving; carination often very pronounced; between it and the margin of the valve are one or two more or less distinct sulci; surface comparatively smooth, though possessing a few slight concentric undulations, which, curving upwards in the middle of the valve, form a very shallow sulcus extending from beak to base; muscular impression not distinctly marked; lesser valve thin, flat, circular; marked exteriorly by lines of growth, smooth within, with an oval muscular impression which is submarginally located.

"This description, and the figures referred to, show the most *Gryphæa*-like phase of this species. Other forms are less distinctly sulcate and carinate."

Midway Eocene of Texas, Arkansas, Tennessee, Mississippi, Alabama, and Georgia.

Remarks.—A specimen of this curious little oyster from Soldado Rock can

be almost perfectly duplicated by shells of the same species collected by Professor Harris from the basal Eocene of Alexander, Arkansas.¹⁰ There can be no question of their identity. The Soldado convex valve measures in height 22, greatest width 18, greatest thickness 14 mm.

This species is closely allied to *O. thirsæ* Gabb, which is the Lignitic analogue of this Midway shell.

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

Geological horizon.—Midway Eocene. Equivalent to that of Alabama and of the Rio Maria Farinha beds, Brazil.

Ostrea thalassoklusta new species. Plate VI, Figure 6.

Description.—Shell small, subcircular in outline, large valve moderately convex; hinge margin slightly alate; basal margin sinuous; valve smooth except for a deep, rather broad sulcus which extends from the umbonal region to the basal margin of the shell, rendering the central part of the valve concave.

Height of larger valve 23, greatest width 21, greatest thickness 10 mm.

Remarks.—This *Ostrea* is closely allied to both the Midwayan *O. pulaskensis* Harris and to the Lignitic *O. thirsæ* but it can readily be distinguished from both by its subcircular form, and especially by the characteristic, deep sulcus which takes the place of the umbonal-basal ridge in those species. Where they are convex it is concave.

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

Geological horizon.—Midway Eocene.

Ostrea thirsæ Gabb. Plate V, Figures 6, 7, 8.

Ostrea emarginata Tuomey (name only), 2d Biennial Rept. Geol. Surv. Alabama, p. 269, 1858.

Gryphæa thirsæ Gabb, Proc. Acad. Nat. Sci. Phila., p. 329, 1861.

Ostrea thirsæ Heilprin, 3d Ann. Rept., U. S. Geol. Surv., p. 311, pl. 63, figs. 4-6, 1884.

Gryphæa thirsæ Aldrich, Bull. I, Geol. Surv. Alabama, p. 58, 1886.

Ostrea thirsæ Harris, Bull. Am. Pal., vol. I, pp. 232-233, pl. 6, figs. 5, 6, 1896.

Ostrea thirsæ Dall, Trans. Wagner Inst. Sci., vol. III, p. 680, 1898.

Gabb's original description.—"Rounded, sub-triangular. Lower valve; beak very small, and close to the hinge, never exsert. Umbone rounded, very prominent and somewhat compressed laterally, the rounded elevation continuing more or less regularly, becoming broader to the middle of the basal margin, at which point this margin is always somewhat emarginate. Ligament area broad, triangular, transversely striate, and with a slight irregular depression in the middle. Interior of valve very deep. Muscular impression nearly ovoid, narrowest on the inner side. External surface marked by a few small, irregular, squamose ridges, most numerous and distinct directly behind the emargination of the base. Upper valve unknown.

"The species resembles, remotely, some of the narrower forms of *G. vesicularis* Lam., but after comparing the series before me with numerous authentic specimens of that species, both American and European, some of the latter labelled

¹⁰ Cornell Paleontological Museum, No. 8400.

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by d'Orbigny and others by Charlesworth, I am satisfied that they are distinct. The beak is so small as to be almost obsolete, and there is always a more or less distinct, rounded, umbonal ridge. In general form, it resembles *G. (Exogyra) columba*, but wants the spiral beak, and is never lobed. The small beaks and absence of all traces of lobes will sufficiently separate it from *G. pitcherii*.

"Length 1.7 in. Greatest width 1.3 in."

Type locality, Nanafalia, Alabama, in the Lignitic Eocene.

Remarks.—This is a very common shell in the fauna of Bed No. 6, Soldado Rock. Specimens from that locality match exactly in size and shape others from Nanafalia, Alabama. The species has been found only in the Lignitic.

Geological horizon.—Lignitic Eocene.

Ostrea abrupta d'Orb. variety ? Plate V, Figures 1, 2.

Cf. *Ostrea abrupta* d'Orbigny, Voyage dans l'Amérique Mérid., T. 3, 4^e partie (Paléontologie), p. 93, pl. 21, figs. 4-6. Republished by Coquand, Monog. du Genre *Ostrea*, Terrain Crétacé, p. 175, pl. 63, figs. 1-3.

Mr. Veatch found in Cretaceous beds on the route to El Pilar, near Coycuar, Venezuela, a slab with plicated oysters which Dr. Stanton refers to the group of *Ostrea abrupta*, described by d'Orbigny from the Cretaceous of Colombia. Dr. Stanton adds, however, that the Venezuelan specimens are much smaller than the type and lack some other characteristics. So that in order to identify them with d'Orbigny's species it would be necessary to assume that the specimens are immature and that the species varies even more than the original description indicates.

Geological horizon.—Cretaceous.

? *Ostrea puelchana* d'Orb. Plate V, Figures 3-5, 9, 10.

On the Union Estate, Brighton, Trinidad, Mr. Veatch found two horizons characterized by oyster shells. These at first seemed to be distinct species, but the difference is chiefly one of size. They are referred by Dr. Dall to *O. puelchana*, which Dr. Dall suggests might be shown to be a southern form of *virginica* if a complete series could be obtained.

It is interesting to note also that Dr. Guppy has referred the specimens of *O. haitensis* Sby. found on Trinidad to *virginica*. The probabilities are that this was the very species that Dr. Guppy had in mind. For certainly the Union Estate shells are remarkably close to a varietal form of *virginica* now living in the Gulf of Mexico.

Localities.—The large form was found in a bed 1000 feet north of the Forest Reserve Road. This bed is stratigraphically about 4000 feet above the Soldado bed.

The small form characterized a layer half a mile from Bamboo Junction. Stratigraphically this bed lies 210 feet below the large oyster horizon.

Geological horizon.—Upper Oligocene.

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Genus **PLICATULA** Lamarek, 1801.

Plicatula torta Gabb? Plate VII, Figure 3.

Cf. *Plicatula torta* Gabb, Cretaceous of Peru, Jour. Acad. Nat. Sci. Phila., vol. VIII, p. 295, pl. 42, fig. 5, 1877.

Mr. Artie Reeds collected a single specimen of an interesting shell which is doubtfully referred by Dr. Stanton to *Plicatula torta*, described by Dr. Gabb from the Cretaceous of Peru. The shell is unfortunately too fragmentary for any positive identification.

Height of the shell 27 mm.

Locality.—Headwaters of the Rio Grande, one mile north of where the river crosses the trail to Guariqueen, Eastern Venezuela.

Geological horizon.—Cretaceous.

Genus **SPONDYLUS** Linnæus, 1758.

Spondylus sp. indet. Plate VII, Figure 4.

Among the shells from Soldado is a fragment of a *Spondylus* too imperfect and fragmentary to describe.

On comparing it with the specimens of *S. bostrychites* Guppy var. *chipolanus* Dall, from the Oligocene of Florida, which it resembles somewhat in type of sculpture, it is found to differ in having the fine radiating ribs always paired or furrowed down the center so as to appear double.

The genus *Spondylus* is rare in both the Tertiary and recent faunas. This is the first ever found in the Midway or Lignitic.

Locality.—Bed No. 8, Soldado Rock.

Geological horizon.—Lignitic Eocene.

Genus **PERNA** Bruguière, 1792.

Perna obliqua Lamarek. Plate VII, Figure 6.

The characteristic manner in which these shells burrow in the rocks of the Gulf of Paria is shown by the illustration.

Locality.—Black Rock, near Soldado, Gulf of Paria.

Geological horizon.—Recent.

Genus **INOCERAMUS** J. Sowerby, 1819.

Inoceramus labiatus Schlotheim. Plate VII, Figures 7, 8.

Inoceramus labiatus Schlotheim, Bronn's Jahrb., vol. VII, p. 93, 1813.

Inoceramus mytiloides Mantell, Geol. of Sussex, p. 215, pl. 28, fig. 2, 1822.

Inoceramus aviculoides Meek and Hayden, Proc. Acad. Nat. Sci., Phila., p. 181, 1860.

Inoceramus plicatus (d'Orbigny) Karsten, Géologie de l'ancienne Colombie Bolivarienne, Vénézuëla, Nouvelle-Grenada et Ecuador, p. 18, 1886.

Inoceramus labiatus Stanton, Bull. U. S. Geol. Surv. No. 106, pp. 77-78, pl. X, fig. 4, pl. XIV, fig. 2, 1893.

Meek's description.—"Shell obliquely elongate-oval, subelliptical or ovate, nearly or quite equivalve, rather compressed, thin and fragile; anterior side forming a slightly convex curve from the beaks obliquely downward and back-

ward, postero-basal extremity rather narrowly rounded; postero-dorsal margin very oblique, compressed, nearly straight, or sometimes a little convex in outline below the middle, and slightly concave above, cardinal border short, straight, compressed, and forming an angle of about 45 degrees with the longest diameter of the shell; beaks terminal, rather small, nearly equal, obtusely pointed, rising little above the hinge, and not much incurved. Surface ornamented by more or less regular, concentric undulations, and smaller marks of growth."

Remarks.—While in Venezuela the writer sent a box of *Inoceramus* specimens to Dr. Stanton, of the United States Geological Survey, that had been obtained by Mr. Veatch and the writer from ravines along the trail from Guanoco to the little temiche hut village of Hurupu. Dr. Stanton very kindly examined the material and wrote as follows:

"The collection from near Guanoco, on the trail to Hurupu, includes a number of specimens of an *Inoceramus* which is almost certainly the species identified by Karsten as *Inoceramus plicatus* d'Orbigny which he reported from the valley of Cumanacoa, eastern Venezuela, and from many other localities in that country. He states that the species occurs at Barbacoas, Province of Trujillo, associated with several species of Lower Cretaceous ammonites and on the basis of this identification and association he refers the *Inoceramus*-bearing rocks of eastern Venezuela to the Lower Cretaceous. *Inoceramus plicatus* was originally described from supposed Lower Cretaceous rocks near Ibaque, Colombia. The fact should be noted, however, that this species is very closely related to *I. labiatus* of the Upper Cretaceous and the specimens in your collection can be almost exactly duplicated by specimens of *I. labiatus* from the Benton of the Rocky Mountain region."

Later more material was obtained from the same locality and among the specimens was one in shale (see figure) which resembles greatly the figures of *I. labiatus* in Dr. Stanton's report on the Colorado Formation.¹¹ This and Dr. Stanton's comparisons incline the writer to regard the Venezuelan shell as a form of this widely distributed species.

Inoceramus labiatus is common in the Niobrara limestone of Kansas, Nebraska, Colorado, and the Upper Missouri region. It is also abundant in the Fort Benton shales in the same states and in equivalent strata in Utah, New Mexico, Texas, and northern Mexico. In Europe it is said to be found only in the Lower Turonian and in southern India it is limited to the Ootatoor group which forms the base of the Upper Cretaceous section of that region.

This species is exceedingly common in certain layers of the Cretaceous limestones in the vicinity of Guanoco. It occurs generally in very dark, exceedingly hard, cherty limestone beds; but it is also found in the Cretaceous shales associated with them. The shells vary from a characteristically deeply and evenly grooved concentric sculpture to nearly smooth forms with the sculpture almost obsolete. This causes them at first glance to appear as different species, but

¹¹ Bull. U. S. Geol. Surv., No. 106, pl. XIV, fig. 2.

further study convinces one that they are mutations of one species. All sizes occur, but a rather large shell measures about 55 mm. in length and 45 in breadth.

As indicated in the synonymy given above, Karsten's *plicatus* is referred, tentatively at least, to *labiatus*.

Locality.—Ravines on the right and left sides of the trail from Guanoco to Hurupu, on the hillside just above the stream called Rio Colorado. Longitude approximately $3^{\circ} 59' 6''$ east of Caracas; latitude approximately $10^{\circ} 8'$ north of the equator.

Geological horizon.—Probably Upper Cretaceous, about equivalent to the Turonian horizon of Europe and the Benton of the United States. Possibly as old as the Gault, but according to Dr. Stanton, not older than that period.

Genus **MODIOLA** Lamarck, 1801.

Modiola cf. *alabamensis* Aldrich. Plate VII, Figure 9.

Cf. *Modiola alabamensis* Aldrich, Bull. Am. Pal., vol. I, p. 68, pl. 5, fig. 13, 1895; Harris, *Ibid.*, vol. II, p. 239, pl. 7, fig. 9, 1897.

Remarks.—A single fragment of a *Modiola* shell was found at Soldado. Unfortunately it is too incomplete for any positive identification or description; but the radiating striæ ornamenting the surface almost exactly match those on a specimen of *alabamensis* from the Lignitic Eocene of Woods Bluff, Alabama, in the Paleontological Museum of Cornell University. It is quite possibly identical with Mr. Aldrich's species.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus **ARCA** Linnæus, 1758.

Arca (*Noetia*) *sheldoniana* new species. Plate VIII, Figures 10, 11.

Description.—Shell small, rather delicate for the genus, nearly rhomboidal, high and short; posterior slope carinate, very slightly produced; beaks nearly touching, opposite the middle of the row of teeth; moderately inflated; interstitial rib present on the posterior half of the valve.

Length 15; height 13.5; thickness of one valve 6 mm.

Remarks.—This shell has somewhat the outline of *Arca* (*Noetia*) *ponderosa* Say¹² of the Pleistocene and recent faunas of the Atlantic and Gulf coasts. But an examination of the ligamental area shows that it is not *ponderosa* because the ligament is wholly anterior and ends at the beak, as in the recent west coast species, *A. reversa* Gray. It is, however, not *reversa* because it has not so sharp a posterior slope as that species which is, moreover, now limited to the Pacific coast.

Thus we have a shell with the outline of the east coast *ponderosa* and the cardinal area characteristic of the west coast *reversa*. The fossil shell is intermediate between these two species and is an interesting indication of the diver-

¹² Jour. Acad. Nat. Sci. Phila., 1st series, II, p. 267, 1822.

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gence of the west coast species from a common stock in the Antilles from which it migrated westward before the rise of the isthmus.

The short, high type of Noetias of which *A. sheldonia* is an example is found in the Oligocene beds of the east coast but apparently at the close of that period it died out in the Antilles. On the west coast it continued to develop to the present time where the type is represented by *Arca* (*Noetia*) *reversa*.

*Arca trinitaria*¹³ described by Dr. Guppy from the Manzanilla beds of Trinidad (which Dall and Guppy in 1896 called probably Eocene but which Dr. Dall later thought to be Oligocene) is of the same short high type of *Noetia*. It also died out. Although evidently a near relative of that species *A. sheldonia* is not nearly so produced posteriorly and is specifically distinct.

Locality.—Along the shore 1000 feet west of Brighton Pier, Trinidad Island, in a black asphaltic marl.

Geological horizon.—Approximately equivalent to the Chipola (Upper Oligocene) epoch of Florida.

This shell is dedicated to Miss Pearl Sheldon, of the Geological Department of Cornell University, who has just completed a monograph on the genus *Arca* and to whom the writer is indebted for help in the differentiation of this species.

Arca (*Cunearca*) *chemnitzoides* new species. Plate VII, Figures 13, 14, 15; Plate VIII, Figure 1.

Description.—Shell trigonal, short and high with prominent and widely separated beaks; cardinal area diamond-shaped with transverse striations and without V-shaped grooves; this and the general form show it belongs to the section *Cunearca*. Nearly all the specimens are in the form of internal moulds, but several were casts of the exterior and gutta-percha impressions of these show the ribs were beaded as indicated in the figure.

Length of an averaged sized mould 22; height 21; diameter 16.5 mm.

Remarks.—Judging from these characters the shell might be taken to be *Arca* (*Cunearca*) *cumanensis* Dall¹⁴ from the Oligocene of Cumana, Venezuela, and from an island in Lake Henriquillo, St. Domingo. This species has never been figured but it is so like *Arca incongrua* Say¹⁵ that Dr. Guppy referred it to that species in his list of the Tertiary shells of the West Indies¹⁶ and Dr. Dall in describing *cumanensis* says it resembles *incongrua* closely, although the valve is shorter and higher. The high narrow beaks and wide cardinal area separate the Trinidad fossil from *incongrua*. And its general aspect is so unlike that species that it could hardly be *cumanensis* which Dr. Dall says is like *incongrua* in miniature.

But the Trinidad shell recalls at once *Arca chemnitzii* Philippi of the recent east coast fauna, and also an ancestral form of that species *Arca alcima* Dall¹⁷ from the Pliocene of Florida. A gutta-percha mould of a specimen of *A. chemnitzii*

¹³ Proc. Geol. Soc. London, vol. 22, p. 583, pl. XXVI, fig. 3a, 3b, 1866.

¹⁴ Trans. Wagner Inst. Sci., III, pp. 633-634.

¹⁵ Jour. Acad. Nat. Sci. Phila., II, p. 268, 1822.

¹⁶ Geol. Mag., 1874, p. 451.

¹⁷ Trans. Wagner Inst. Sci., III, pp. 635-636.

collected by Mr. Schultz in a sandy cave south of Brighton on the Gulf of Paria is almost exactly the shape of the moulds of the fossil shells. But some of the latter appear to have been of considerably larger size than the recent forms attains.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad Island, in a reddish-yellow, highly ferruginous marl. Lithologically the formation is very like that of the Lignitic Eocene at Many, Louisiana.

Geological horizon.—Arcas of this type characterized by high umbones and short high form of shell are not known below the Oligocene on the southeastern coast of the southern United States and the Antillean area. Hence short, high Arcas mean Oligocene or later. Such types have been found in beds called Eocene but which proved later to be really Oligocene. An instance of this is *Arca filicata* Guppy, a form related to the species described above, from the Manzanilla beds of Trinidad. These were first thought to be Lower Miocene¹⁸ then Eocene,¹⁹ then Oligocene.²⁰ From these indications the bed with ferruginous casts would appear to be Oligocene or later.

Arca (Argina) billingsiana new species. Plate VIII, Figures 2, 3.

Description.—Shell transversely oval-elongate, rather thick and strong, beaks nearly touching, incurved over the narrow cardinal area which is similar to that of *Arca campechensis* Dillwyn, ribs of the left valve generally simple, sometimes faintly grooved, about 29 in number.

Length of shell 31; height 22, thickness of one valve 10 mm.

Remarks.—This species recalls the outlines of members of *Scapharca* (*Scapharca*) *transversa* Say²¹ group; but the hinge shows the characters of Gray's section *Argina* (1840) of the subgenus *Scapharca*. In *Argina* the hinge teeth are in two series,—the anterior shorter, more or less irregular and broken, and the posterior longer, normal.

The only members of *Argina* described from the Tertiaries of the Gulf or the Antilles are (1) *Scapharca (Argina) tolepis* Dall²² from the Oligocene of Rio Amina, Santo Domingo; Bowden, Jamaica; and Cumana, Venezuela, and (2) *Scapharca (Argina) campechensis* Dillwyn²³ from both of which the Trinidad shell is specifically distinct.

The Cumana shell, *A. tolepis* was referred by Dr. Guppy in his list of the West Indian Tertiary shells²⁴ to *Arca pexata* Say; but it can be distinguished by its remarkable inflation, its diameter being practically equal to its length.

A recent species of *Argina* was collected by Mr. Alfred Schultz in a sandy cove

¹⁸ Guppy, 1866.

¹⁹ Guppy 1874, Guppy and Dall 1896, Dall 1898.

²⁰ Dall and others.

²¹ Jour. Acad. Nat. Sci. Phila., 1st ser., II, p. 169, 1822.

²² Trans. Wagner Inst. Sci., III, pp. 649–650, pl. 33, figs. 7, 8, 1898.

²³ Descr. Cat. Rec. Shells, I, p. 238, 1817.

²⁴ Geol. Mag., London, 1874.

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of the Gulf of Paria south of Brighton, almost within a stone's throw of the black, asphaltic outcrop in which the fossil *Argina* was found by Mr. Veatch. This is a closely related form and doubtless the descendant of the fossil species. As the recent form has apparently never been described, it seems well to differentiate it and it is now described and figured as *Arca (Argina) schultzana*.

Locality.—*Arca billingsiana* was found along the shore, 700 feet east of the Brighton pier, Trinidad Island, in a black asphaltic marl.

Geological horizon.—Approximately equivalent to the Chipola (Upper Oligocene) epoch of Florida.

The shell is named in honor of Dr. John S. Billings, Director of the Libraries of New York City.

Arca (Argina) schultzana new species. Plate VII, Figures 10, 11, 12.

Description.—This recent species has much the aspect of the Oligocene *Arca (Argina) billingsiana* of which it is undoubtedly the descendant. As with the fossil shell, the outline resembles that of the larger members of the group of *Arca (Scapharca) transversa* Say, but the species is at once differentiated from those shells by the characters of the hinge teeth. The latter are those of typical *Argina*; a short, broken anterior set and a long, normal posterior row. The ribs number about thirty, cardinal area very narrow, beaks approximate, depressed, placed within the anterior fifth of the greatest length of the shell.

Length 35, height 25, diameter 22 mm.

The shell is named in honor of Dr. Alfred Schultz, of Washington, D. C., by whom it was found.

Locality.—In a sandy cove of the Gulf of Paria, a short distance south of the pier at Brighton, Trinidad.

General horizon.—Recent.

Arca (Argina) brightonensis new species. Plate VIII, Figures 4, 5, 6.

Description.—Shell rather small for the genus, oval-elongate, cardinal area very narrow; hinge teeth in the two unequal series characteristic of the section *Argina*, the anterior set being very short; ribs on the left valve about thirty, lightly grooved over the central portion of the valve.

Length 24, height 17, diameter 16 mm.

Remarks.—At first sight this species was taken for a mutation of *Arca campechensis* Dillwyn²⁵ of the Pleistocene of the Atlantic and Gulf coasts, and now living on the shores from Cape Cod to the Antilles. But on comparing the Trinidad shell with several hundred specimens of all sizes of *Arca campechensis* from the Gulf of Mexico, I find that the shells of this species of the same size as the Trinidad *Arca* are invariably rounder and flatter. As Dr. Dall²⁶ has shown, *A. campechensis* is a very protean species, but the typical form is rounder, and

²⁵ Descr. Cat. Rec. Shells, I, p. 238, 1817.

²⁶ Trans. Wagner Inst. Sci., III, pp. 650-652.

occurs throughout the southern range of the shell. There are among a number of recent shells collected by Mr. Veatch along the shore of the Gulf of Paria between La Brea and San Fernando, Trinidad, a couple of Arcas of the section *Argina*, which are elongated and of very nearly the same form as the fossil shell of which they are evidently direct descendants. But the beak of the fossil is much higher and the angle of the posterior slope is different. The ribs of the recent shell are about the same in number as in the fossil form and they are also slightly grooved in the left valve. The length of the recent shell is also 24 mm., but the height is 19 and the diameter 14 mm. Hence the fossil was proportionally less high and more inflated.

Both the fossil and the recent Brighton Arginas, though very unlike the typical southern *campechensis*, do somewhat resemble small specimens of the variety *Arca americana* Gray from the Pleistocene and recent fauna of the Carolinas. But that is a much larger shell, and its distribution is much more northern.

This and the great difference of geological horizon seem to warrant our considering the Brighton fossils as a separate species. For its recent analogue, if its slight difference of form and its presence in the recent fauna differentiate it sufficiently from the Oligocene shell, the writer would suggest the name *pariaensis*.

Locality.—Along the shore 700 feet east of Brighton pier, Trinidad Island, in an impure asphalt.

Geological horizon.—Approximately equivalent to the Chipola (Upper Oligocene) epoch of Florida.

Arca (Argina) pariaensis new species. Plate VIII, Figures 7, 8, 9.

This is the recent analogue of the Oligocene *Arca brightonensis*.

For the description of this shell see remarks under that species.

Locality.—Shores of the Gulf of Paria between La Brea and San Fernando where it was collected by Mr. A. C. Veatch.

Geological horizon.—Recent.

Arca sp. indet. Plate VII, Figure 16.

Remarks.—In addition to *Arca chemnitzoides*, which is the most abundant species in the ferruginous bed south of Pitch Lake, there is also a fragment of a cast of a compressed, elongated species. A gutta-percha mould was made of this, which is shown in the figure.

This species was apparently of somewhat the general form of Dr. Guppy's *A. inæquilateralis* but not identical with it. The single specimen is unfortunately too fragmentary to merit description.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown ferruginous stratum.

Geological horizon.—Oligocene.

Arca sp. indet.

A fragment of an internal mould of an *Arca* was found in the ferruginous marl just south of Pitch Lake, Brighton, that appears to be a different species from

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those mentioned, but it is too incomplete for description. The hinge teeth are, however, perfectly preserved and show that the shell was unquestionably an *Arca*.

Geological horizon.—Oligocene.

Genus *CUCULLÆA* Lamarck, 1801.

Cucullæa hartii Rathbun. Plate VIII, Figure 12.

Arca (Cucullæa?) Hartii Rathbun, Proc. Boston Soc. Nat. Hist., vol. XVII, pp. 248-249, 1875.

Cucullæa (Idonearca) hartii White, C. A. Archivos do Museu Nacional do Rio de Janeiro, vol. VII, p. 65, pl. V, figs. 7, 8, 1887.

Cucullæa hartii Harris, Bull. Amer. Paleont., vol. I, p. 154, 1896.

Cucullæa hartii Branner, Bull. Mus. Comp. Zoology, Harvard College, vol. XLIV, p. 13, 1904.

Rathbun's original description.—"Shell of medium size, elongate, gibbous, with the height nearly two-thirds the length. Outline of internal mould sub-ovate, the height of the posterior extremity being much greater than that of the anterior. The beaks are situated at a little more than one-third the length from the anterior margin, are very prominent and incline strongly forward. Hinge nearly as long as the shell. The posterior margin extends obliquely downward and slightly backward, rounding strongly toward the ventral margin. The anterior margin leaves the hinge abruptly, at nearly a right angle, and curves rapidly round to the ventral margin, which is slightly rounded and descends moderately in extending backward. The valves are very convex and arch strongly from the beak to the ventral margin. The depth of each valve is more than one-third the height of the shell. The posterior slope commences abruptly, along a line extending from just behind the beaks to the lower posterior corner and descends rapidly to the hinge and posterior margin. This slope is broad, quite concave just back of the beaks, but becomes nearly straight posteriorly. The surface is marked by small, rounded or subangular radiating raised lines, which are very fine at the beaks, where they are of about the same width as the interspaces, or narrower, and increase very gradually in size toward the margin, the interspaces there being much the narrower and even reduced to mere striæ. Fine concentric lines cross the shell; on the upper portion of the shell they are very regular, but near the ventral margin they become more numerous and are crowded together. As they cross the radiating lines they become very prominent, sometimes giving to the latter a beaded appearance. On the posterior slope the radiating lines are minute, threadlike and near together, being separated by very narrow depressions. These seem to be made even more beaded in appearance by the concentric lines than are the radiating lines on the main portion of the shell, though they are exceedingly fine. The inner margin of the shell is crenulated.

"The shell is quite a thick one, and none of the exterior characters appear in the interior, so that the angular appearance presented by the external moulds is not apparent in the very numerous interior ones. The characters of the interior are quite obscure in all the specimens obtained rendering the determination of

the genus a little doubtful. The posterior end of the hinge seems to be marked with the longitudinal teeth peculiar to *Cucullæa*, while in the interior moulds there is a slight, rounded depression bordering the posterior muscular imprint below, and extending some distance toward the beak. As to shape the form is truly Cucullean. Size of a medium specimen: length 27 mm.; height 18 mm.; depth of both valves 16 mm.

"Very abundant, as interior moulds, in the whitish limestone of the Cretaceous at Maria Farinha, Province of Pernambuco, Brazil. Dedicated to my teacher and friend, Prof. Ch. Fred. Hartt."

Remarks.—*Cucullæa harttii* is by far the commonest shell of the Soldado Rock, Bed No. 2, fauna. Together with *Calyptrophorus*, *Venericardia*, *Turritella* and other less common forms, it makes up a very indurated shell breccia. All sizes of the species occur from very small, young shells, up to the large adult forms like the one figured, which measured 29 mm. in length, 19 in height and 20 in diameter.

This species has never before been found except at the type locality, near the mouth of the Rio Maria Farinha in the State of Pernambuco, Brazil. The type shells were collected in 1870 by Messrs. O. A. Derby and D. B. Wilmot under the direction of Professor Hartt, and were submitted to Dr. Rathbun for study. As Dr. Rathbun did not figure the species and Dr. White's figures were of imperfect specimens, it has been thought best to figure one of the very fine shells from Soldado.

Locality.—Bed. No. 2, Soldado Rock, Gulf of Paria, near the S.W. point of Trinidad.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of Rio Maria Farinha, State of Pernambuco, Brazil.

Genus **GLYCYMERIS** Da Costa.

Glycymeris (Axinea) viamedia new species. Plate VIII, Figure 13.

Description.—Shell small, ovate-orbicular, thin, slightly convex; beaks low, inconspicuous, pointed, approximate; teeth concealed in all the specimens by the silicious matrix; concentric sculpture of several lightly impressed crenulate lines of growth, irregularly disposed, marking resting stages; radial sculpture of very delicate, narrow, flattened riblets alternating with microscopic, radial threads.

Height of shell 16, length 17, diameter 8 mm.

Remarks.—This very pretty and delicate shell is the first of the genus ever found in the Midway or earliest Eocene.

It was rather a common shell in the Soldado fauna, as we have a number of specimens. The one figured, although showing the sculpture best, has a more sloping hinge line than the majority of the shells.

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

Geological horizon.—Midway Eocene. Equivalent to that of the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

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Genus **UNIO** Philipsson, 1788.

Unio sp. indet. Plate VIII, Figures 18, 19.

A number of casts of large molluscan shells were collected by Mr. Veatch along the shores of the Gulf of Paria, in a white, decayed limestone rock. None can be specifically determined, and the majority not even generically. The example referred to above, however, fortunately shows the characteristic heavy, alternating teeth of *Unio*.

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

Geological horizon.—Probably Oligocene, from its stratigraphic position, but no evidence can be gathered from the fossil because of its very imperfect condition.

Unio sp. indet. Plate IX, Figure 1.

It is not possible to say positively whether these shells are remains of a large *Macra* and hence of marine origin, or fragments of a large *Unio* and of freshwater origin. Their state of preservation is exceedingly imperfect. But the association of one with the cast of a smaller shell showing the teeth of *Unio* inclines one to believe them members of the latter genus.

Locality.—One mile west of the Godineau River, along the shore of the Gulf of Paria, about midway between La Brea and San Fernando, Trinidad, in a white, decayed limestone rock.

Geological horizon.—Probably Oligocene, judging from the stratigraphic position of the bed.

Genus **ANODONTA** Lamarek, 1799.

Anodonta? sp. indet.

Remarks.—Associated with the moulds of a large and small species of *Unio* in the white, decayed lime rock between La Brea and San Fernando, is the mould of a large, convex shell which has much the aspect of an *Anodonta*. Its form recalls such species as *A. grandis* of North American rivers and the larger, similarly shaped *A. gigantea* Spix from the rivers of Brazil.

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

Genus **VENERICARDIA** Lamarek, 1801.

Venericardia alticostata Conrad.

Cardita alticostata Conrad, Amer. Jour. Sci., vol. XXIII, p. 342, 1833.

Venericardia perantiqua Conrad, Amer. Jour. Conch., vol. 1, p. 8.

Venericardia alticostata Harris, Bull. Am. Pal., vol. I, pp. 171-172, pl. 4, fig. 12, 1896.

Conrad's original description.—"Shell subcordate, convex, with about twenty-two profoundly elevated nodulous ribs, which on the anterior side are laterally carinated. Length two inches."

Type locality, Claiborne, Alabama.

Remarks.—Several specimens of this species are in the indurated shell breccia

from Soldado Rock, which match exactly small specimens of *V. alticostata* in the Paleontological Museum of Cornell University from the Lignitic Eocene of Woods Bluff, Alabama. They answer perfectly to Conrad's description and show the characteristic carinating line on the anterior side of the ribs.

This species has also been found in the Midway of Texas and Alabama by Professor Harris. At the very base of the Midway beds at Snow Hill, Alabama, he has found a very small ancestral form, about one centimeter in length. Higher up in the beds the shell assumes a larger size and more typical aspect. The Soldado shells measure about 15 mm. in width. This species was less abundant there than *V. planicosta*.

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

Geological horizon.—Midway Eocene.

Venericardia crucedemaionis new species. Plate VIII, Figure 14.

Description.—Shell small, cordate; substance thin and fragile; sculpture of (a) very narrow, elevated, radial riblets with much wider interspaces; riblets squamose at the posterior end of the valve and nodular-stellate over the central portion; (b) interradial striæ, one on each side of the basal part of the riblets at the anterior part of the shell; but entirely absent from the posterior end of the shell; characters of hinge concealed by the matrix.

Height of shell 6, length of portion exposed 7 mm.

Remarks.—This species is evidently closely related to *V. alticostata* Conrad, but differs in having two interradial striæ, one at the base of each side of the anterior riblets while *alticostata* has only one. This is also a much smaller and more delicate shell than Conrad's species.

It may be that if more specimens of *Venericardias* of the *alticostata* group are ever obtained from Soldado Rock, this species and the larger form, that the writer has described as *V. thalassoplekta*, may be found to be both strongly marked varieties of *V. alticostata*. In the material we have now, there are three forms—one which, though very small, answers perfectly in sculpture to Conrad's description of *alticostata*; the species described above; third, the larger form, *V. thalassoplekta*. Tentatively the two last mentioned are described as separate species. A shell varying in a similar direction from *planicosta* is figured by Professor Harris from the Lignitic of Alabama.²⁷

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene. Equivalent to that of Alabama.

The specific name is given because of the shell's starry nodules. The Southern Cross in Venezuela is called *Cruce de Maio*, since in the month of May it attains its greatest splendor.

Venericardia planicosta Lamarck. Plate VIII, Figures 15, 16.

Venericardia planicosta Lamarck, Syst. des An. s. Vert., p. 123, 1801; Ann. du Mus., VII, p. 55, IX, pl. 31, fig. 10.

Venericardia (planicosta) Lamarck, Ann. du Mus., vol. IX, pl. 31, figs. 10, a, b, 1807.

²⁷ Bull. Am. Pal., vol. II, p. 247, pl. 11, fig. 1.

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- Venericardia planicosta* Sowerby, Min. Conch., 1, pl. L, 1814.
Venericardia planicosta, Deshayes, Coq. Fos. des Envir. de Paris, 1, p. 142, pl. 24, figs. 1-3, 1824.
Venericardia planicosta Conrad, Jour. Acad. Nat. Sci. Phila., vol. VI, pp. 213, 214, 215, 1830.
Cardita planicosta Deshayes, Enc. Méth. Vers., II, p. 198, 1830.
Venericardia ascia W. B. & H. D. Rogers, Trans. Am. Phil. Soc., 2d ser., vol. V, p. 374, pl. 29, fig. 2, 1839.
Cardita densata Conrad, Jour. Acad. Nat. Sci. Phila., 2d ser., vol. I, p. 130, pl. 14, fig. 24, 1848.
Cardita planicosta Conrad, U. S. Mexican Boundary Surv., p. 161, pl. 19, figs. 2, a, b, 1857.
Cardita hornii Gabb, Geol. Surv. Cal. Paleont., vol. I, p. 174, pl. 24, fig. 157, 1864.
Venericardia planicosta var. *regia* Conrad, Am. Jour. Conch., vol. I, p. 8, 1865.
Venericardia mooreana Conrad, Am. Jour. Conch., vol. III, p. 190, 1867.
Venericardia planicosta Conrad (Heilp.), Proc. Acad. Nat. Sci. Phila., p. 366, 1880.
Venericardia planicosta Aldrich, Bull. 1, Geol. Surv. Ala., pp. 50, 53, etc., 1886.
Venericardia planicosta Smith and Johnson, Bull. 43, U. S. Geol. Surv., pp. 40, 44, 45, 50, 51, 1887.
Venericardia planicosta Kennedy, Proc. Acad. Nat. Sci. Phila., vol. 47, p. 145, 1895.
Venericardia planicosta Harris, Bull. Amer. Pal., vol. I, pp. 172, 173, pl. IV, fig. 13, 1896; Bull. Amer. Pal., vol. II, pp. 246, 247, pls. 9, 10, 1897; Geol. Surv. Louisiana, Rept. for 1899, p. 302, pl. 53, fig. 6.
Venericardia planicosta Dall, Trans. Wagner Inst., III, pp. 1418-1423, 1903.
Venericardia planicosta Osborn, Age of Mammals, p. 93, 1910.

Lamarck's original description.—" *Venericardia (planicosta)* oblique cordata, crassissima; costis planis integris; posticis granulatis."

Lamarck adds that this species is found at Grignon, France; in Piedmont, and in the vicinity of Florence, Italy.

Remarks.—Inasmuch as up to the present no true Eocene formations had ever been found in the Antillean region it was thought well to figure a shell and a mould of this well known and most typically Eocene species from Bed No. 2, Soldado Rock. In the face of this shell which Conrad termed the "Finger post of the Eocene" the writer feels confident that the Eocene age of the Soldado Bed No. 2 will pass unchallenged. For this species never occurs *in situ* except in formations of this age.

This is the first time that *Venericardia planicosta* has ever been reported from the Antillean region. And Soldado Rock is the only locality in that area in which it has yet been found. In spite of its great known range this is the most southern point from which it has ever been reported.

Venericardia planicosta was a common species in the Soldado Rock, Bed No. 2 fauna, as a number of young and adult shells were obtained. The full grown specimens show all the characters of this species from the southern United States. When complete the greatest width of the largest shells from Soldado must have been about 70 mm., while some of the young shells measure only 8.

The migrations of this species during the Eocene were most remarkable. It extends over northern France, Belgium, and England, but in Europe it is only found as far south as Piedmont, in northern Italy, about 45° N. Lat. It is very abundant in the southern United States, and a varietal form is even found in California in the Tejon beds. Thus it had an east and west range—in a direct line—of 6000 miles. Soldado Rock, about 10° N. Lat. is the furthest limit yet known of its migration towards the equator. The direct North and South distance from this Rock to northern Belgium is approximately 2650 miles. Dr. Dall²⁸ is persuaded that America is the center from which the group has been distributed.

²⁸ Trans. Wagner Inst. Science, III, pp. 1418-1423, 1903.

During the Midway stage, but especially during the Lignitic of the southern United States, *V. planicosta* showed a vast number of variations.²⁹ But at the close of the Eocene the species absolutely disappeared. No representation is found in the Oligocene, Miocene or Pliocene of North America. Curiously enough, however, the recent analogue of *V. planicosta* occurs only on the Pacific coast in warm waters.

Locality.—Bed No. 2, Soldado Rock, near the Serpents Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway beds of Alabama and of Rio Maria Farinha. State of Pernambuco, Brazil.

Venericardia thalassoplekta new species. Plate VIII, Figure 17.

Description.—Shell of moderate size, subcordate, convex; posterior end of valve concealed in a silicious matrix; anterior and central portion of left valve beautifully sculptured with (a) narrow, elevated ribs, which, beyond the anterior third of the valve, become nodular, (b) two less elevated, intercalary, smooth, rounded riblets, equalling one another in size but narrower than the ribs themselves.

Height 22 mm.

Remarks.—A single specimen of this fine shell was found. It is closely allied to *V. alticostata*; but differs in having the two interstitial riblets and in the ribs being quite smooth over the anterior part of the valve.

The specific name has been given because the sea by constantly striking on the reef has fortunately eroded it in such a way as to leave the fossils standing more or less in relief.

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

Geological horizon.—Midway Eocene.

Genus *CARDITA* (Bruguière, 1789) Lamarck, 1799.

Cardita (*Carditamera*) *virginiae* new species. Plate IX, Figures 2, 3.

Description.—Shell rather small, elongate-elliptical, very inequilateral, beaks low, situated at the anterior fourth of the entire length of the valve; sculpture of fifteen or sixteen well defined ribs, which on the short anterior end of the shell are regularly and closely crenulated, but on the long, posterior part of the shell are smooth or nearly so; characters of the hinge concealed by the matrix.

Length of shell 13, height 7 mm.

Remarks.—This species is most closely allied to Dr. Dall's *Carditamera tegea* from the Oligocene of the Tampa silex beds and the Chipola marls of Florida.

It may, indeed, if more specimens are found, grade into a varietal form of that shell.

The presence of a species of *Cardita* and especially of one near of kin to a Chipola species strengthens the evidence already offered by other species that the horizon in which it was found is Upper Oligocene.

²⁹ See Harris, Bull. Amer. Pal., II, pp. 246-247, 1897.

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Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown, ferruginous marl.

Geological horizon.—Oligocene, probably a rather late stage of that period.

Genus **CRASSATELLITES** Kruger, 1823.

Crassatellites sp. indet. Plate IX, Figure 4.

In the black shales near Coycuar, Venezuela, are a number of very small shells with the marked umbonal-basal carination, and strong concentric groovings characteristic of the young of *Crassatellites*.

They are therefore tentatively referred to this genus.

Locality.—On the trail from Parare to Coycuar, about six miles south of Parare and three south of Caituco, Venezuela.

Geological horizon.—Basal Upper Cretaceous?

Genus **CARDIUM** Linnæus, 1758.

Cardium (*Trigoniocardia*) *carolinæ* new species. Plate IX, Figures 5, 6.

Description.—Shell small, convex, triangularly cordate, anterior margin sloping in a rounded curve to the basal margin, posterior margin truncated; shell divided, by a prominent carina extending from the beak to the posterior end, into a body area and a truncated posterior area; ribs on the body nine, rather sharp-edged, ornamented by bead-like nodules which on the four ribs towards the carina are on the carina side of each rib, on the remaining five ribs the beads are nearly central; ribs on the truncated area eight, more crowded, less elevated, squamose rather than beaded; interspaces on the body much narrower than the ribs, except the space beside the carinal rib, which is wider than the others, and is beautifully and conspicuously marked by the cross striae of lines of growth which also cross the other interspaces, but there are hardly seen except with a lens.

Height of shell 11, greatest width 7, diameter 8 mm.

Remarks.—This exquisite little shell is closely allied to Dr. Guppy's *Cardium castum* from the Manzanilla beds,³⁰ but that species has twenty-two stout rounded ribs, and the posterior slope near the beak is different. In general form also it has a resemblance to *Cardium maturense* Dall from the Pliocene of Matura, Trinidad, and to *C. aiminense* Dall from Santo Domingo Oligocene beds.

The species is dedicated to Mrs. Arthur C. Veatch, of Washington, D. C.

Locality.—Along the shore one thousand feet west of the pier at Brighton, Trinidad, in asphalt.

Geological horizon.—Upper Oligocene about Chipolan.

Genus **PROTocardia** Beyrich, 1845.

Protocardia *coycuarensis* new species. Plate IX, Figure 7.

Description.—Shell of moderate size, nearly equilateral, subcircular in outline; posterior surface ornamented by fifteen radiating ribs; anterior sculptured only

³⁰ Quart. Jour. Geol. Soc. London, vol. XXII, p. 582, pl. XXVI, fig. 4, 1866.

with delicate, concentric lines; characters of interior of shell concealed by the matrix.

Length of shell 24, height 23 mm.

Remarks.—Gerhardt has described a *Protocardia* (*Protocardium elongatum*) from Peru characterized by elongated anterior end and nearly straight hinge line. Gabb also described a species of this genus from Pariatambo, Peru, which like this shell is more triangular, but is characterized by very coarse sculpture.

The original substance of this shell (which has been entirely removed by solution) was evidently exceedingly thin. This indicates that the conditions under which it lived were quiet and rather deep waters. This harmonizes also with the very fine grained shale in which it is found,—evidently formed some distance off shore and at considerable depths.

Locality.—On the trail from Parare to Coycuar, about six miles south of Parare, and three miles south of Caituco, in black shales.

Geological horizon.—Basal Upper Cretaceous?

Genus *MERETRIX* Lamarek, 1799.

Meretrix cf. nuttalliopsis Heilprin. Plate IX, Figure 8.

Heilprin's original description.—"Shell sub-elliptical, moderately ventricose, its surface covered with fine concentric striæ, which are apt to become roughly imbricate on the basal margin; umbones not very prominent, rather anterior; lunule cordate, deeply impressed at about its middle, its outline clearly pronounced by a sharply impressed line; posterior extremity regularly rounded, the anterior somewhat produced; margin entire; pallial sinus somewhat angular, pointing towards the center of the shell.

"Length $1\frac{1}{2}$ inch."

Lignitic of Alabama, where it is very abundant.

Remarks.—Among the fossils from Soldado is a *Meretrix* which resembles in size, form, and concentric sculpture Heilprin's *nuttalliopsis*; but its state of preservation is too imperfect to admit of positive identification. It is, however, very probably this species or a varietal form.

Length of fragment 26, height about 25 mm.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene. Equivalent to that of Alabama.

Meretrix subimpressa Conrad.

Cytherea subimpressa Conrad, Jour. Acad. Nat. Sci. Phila., vol. I, p. 130, pl. 14, fig. 26.

Conrad's original description.—"Ovate, slightly ventricose, smooth and polished, with concentric, slightly impressed lines on the anterior side; anterior side short, rather acutely rounded; posterior side produced, acutely rounded at the extremity; dorsal margin long, oblique, slightly curved; beaks prominent; lunule lanceolate, defined by a slightly depressed line. Length $1\frac{1}{8}$ in. Height .8 in.

"*Locality.*—Marlbourne, Hannover county, Virginia. Mr. Ruffin."

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Meretrix subimpressa var. *golfotristensis* new variety. Plate IX, Figure 9.

Description.—A number of shells of a *Meretrix* were found in bed No. 8, Soldado Rock, which recall the varietal form of Conrad's *subimpressa*, found by Professor Harris in the Lignitic Eocene of Wood's Bluff, Alabama.³¹ But the Soldado shells when compared with the Museum specimens from Wood's Bluff are seen to be smaller, less convex, more sculptured with concentric lines, and with the posterior margin still more prolonged, giving the general outline of the valve a more elliptical form.

The largest specimen measures in length 20, height 10, thickness of one valve 3 mm.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria (Golfo Triste of the early navigators).

Geological horizon.—Lignitic Eocene. Equivalent to the Lignitic of Alabama.

Genus *PITARIA* Römer, 1857.

Pitaria (*Lamelliconcha*) *circinata* Born. Plate IX, Figures 12, 13.

Venus circinata Born, Test. Mus. Vind., p. 61, pl. IV, fig. 8, 1780.

Venus rubra Gmelin, Syst. Nat., VI, p. 3288, 1792.

Cytherea juncea Guppy, Quart. Jour. Geol. Soc. London, XXII, p. 582, pl. XXVI, fig. 13, 1866.

Chione circinata Gabb, Geol. St. Dom., p. 250, 1873.

Pitaria (*Lamelliconcha*) *circinata* Dall, Trans. Wagner Inst. Science, vol. III, p. 1269, 1903.

Description.—Shell subequilateral, less trigonal and more circular in outline than is usual in this group, somewhat compressed; substance thin, rather delicate; surface handsomely sculptured with close-set, regular, sharp edged, concentric lamellæ; lunule small, narrowly cordate; escutcheon not defined.

Length of shell 10, height 8.5, diameter 4 mm.

Remarks.—Except in respect of size this shell is exactly like Dr. Guppy's *Cytherea juncea* from Cumana, Venezuela. It is no doubt a young specimen of this very interesting species. Dr. Dall says of *P. circinata*, "It is one of the very small number of *Veneridæ* which occur on both the Atlantic and Pacific coasts of middle America, and in harmony with this exceptional distribution also occurs in the Isthmian Oligocene."

This species has remained practically unchanged from Oligocene to recent times. It is akin to the characteristic Lower Oligocene *P. imitabilis* Conrad from Vicksburg, Mississippi.

P. circinata has been reported from the Oligocene of Panama (Gatun beds) and of Cumana, Venezuela; from the Pliocene of Trinidad; and is living on both coasts of Central America and in the Antilles.

Locality.—Along the shore 1000 feet west of the pier at Brighton, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene. Equivalent to the Chipolan stage of Florida.

³¹ See Bull. Am. Pal., vol. II, p. 255, pl. 12, figs. 6, 7, 1897.

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Pitaria (*Lamelliconcha*) *labreana* new species. Plate IX, Figures 14, 15.

Description.—Shell elongate-ovate, rather compressed, inequilateral, lunule small, well-defined, lanceolate; valve sculptured with narrow, round-edged lamellæ, with much wider grooves between them; hinge characters shown in the figure; pallial sinus very deep, rounded, broad, extending beyond the center of the valve.

Length of shell 17, height 13, diameter 6 mm.

Remarks.—This species is akin to *P. hilli* Dall from the Oligocene of Gatun on the Panama canal. It differs from the latter shell in having a bolder, more distally ribbed type of concentric sculpture, and, as far as shown, is much smaller.

Locality.—Along the shore 1000 feet west of the pier at Brighton, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene. Equivalent to the Chipolan stage of Florida.

Genus *CALLISTA* Poli, 1791.

Callista mcgrathiana Rathbun. Plate IX, Figure 10.

Callista McGrathiana Rathbun, Proc. Boston Soc. Nat. Hist., vol. XVII, p. 255, 1875.

Callista McGrathiana White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 95-96, pl. V, figs. 36, 37, 38, 1887.

Rathbun's original description.—"Shell small, elongate, and with the valves moderately convex; length somewhat greater than the height; outline sub-elliptical.

"The beaks are situated a little in advance of the middle, are prominent and incline rather strongly forward. Their internal moulds are sharply pointed and incurve slightly. The hinge margin descends quite rapidly from the beaks posteriorly, and is moderately curved, nearly the same curve being continued in the larger part of the posterior margin, while the ventral margin is also very regularly, but more gradually rounded.

"The point of greatest convexity of the valves is just above the middle, though the curvature of the surface from the beaks to the ventral margin is usually quite regular. The curvature along the antero-posterior diameter is moderate and more or less regular. The slope toward the posterior and hinge margins is usually quite rapid, and increases in strength near the beaks; it is always well rounded.

"The surface of the shell is marked with numerous small, rounded, concentric raised-lines, separated by similar interspaces of slightly greater width. They are quite equally disposed, sometimes, however, differing in width and placed nearer together. They round up strongly in front.

"The muscular imprints are of moderate size, slightly excavated, and are situated just above the antero-posterior axis. Of the cardinal teeth, the anterior is nearly perpendicular, bending slightly forward below, while the posterior, which is the longer, extends backward, bending a little downward. The dental prominence in front of the cardinal teeth is somewhat elevated.

"This small form, not represented by any perfect impression of the exterior,

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seems to be a true *Callista*, as indicated by shape and hinge markings. Size: length 14 mm.; height 11 mm.; depth of two valves 6 mm.

"Moderately abundant in the Cretaceous beds at Pt. Nova Cruz and São José, Prov. of Pernambuco, Brazil. Respectfully dedicated to Dr. McGrath of Pernambuco, to whom Prof. Hartt and his party are indebted for many favors and valuable information regarding the geology of the vicinity of Pernambuco."

Remarks.—The specimens from Soldado Rock vary a good deal in size, from about 14 mm. in length (the size of Rathbun's type) to 21 mm. The locality was evidently very well adapted to the species which is quite common.

Dr. White records this species also from the Rio Maria Farinha beds, State of Pernambuco, and from Rio Piabas, State of Para.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Callista mcgrathiana Rathbun var. *rathbunensis* new variety. Plate IX, Figure 11.

Description.—Shell similar to a large specimen of *Callista mcgrathiana*; but characterized by the sudden cessation of the concentric groovings over the lower, central portion of the valve. Elsewhere the concentric sculpturing is beautifully regular, then it abruptly becomes obsolete.

Length of shell 21, height 15 mm.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

This variety is named in honor of Dr. Rathbun, of the United States National Museum, who was the first to describe shells from the Rio Maria Farinha beds, Brazil.

Subfamily VENERINÆ.

Genus *CHIONE* von Muhlfield, 1811.

Chione veatchiana new species. Plate IX, Figures 17, 18.

Description.—Shell moderately small for the genus, ovate-triangular, slightly rostrated posteriorly; substance rather thin; hinge characters shown in the figure; pallial sinus short, triangular; inner margin of valves finely and sharply crenate; sculpture of close-set, feeble, very slightly raised lamellæ, cancellated by slightly more conspicuous, radiating striæ.

Length of shell 25, height 20, diameter 14 mm.

Remarks.—This species is allied to *Chione walli* Guppy²² from the Manzanilla beds of Trinidad; but the outline of the latter shell is circular instead of elongately-triangular, and the concentric sculpture tends to be stronger than the radial, while in the species now described the opposite is true.

The shell is dedicated to Mr. Arthur C. Veatch, by whom it was collected.

Locality.—Along the shore 1000 feet west of the pier at Brighton, Trinidad, in impure asphalt.

²² Quart. Jour. Geol. Soc., XXII, pl. XXVI, fig. 16, 1866.

Geological horizon.—Upper Oligocene. Equivalent to the Chipolan stage of Florida.

Chione dalliana new species. Plate IX, Figure 16.

Description.—Shell rather small for the genus, subcircular in outline; hinge characters concealed by the matrix; inner edge of valves finely crenulate; sculpture of regular, low concentric lamellæ crossed by very fine, close-set, radial striæ which with the lamellæ form a delicate cancellation over the entire surface; anteriorly the radial sculpture strengthens, forming about seven well marked plications.

Length of shell 20, height 17, diameter approximately 8 mm.

Remarks.—In general form and type of sculpture this species resembles Dr. Guppy's *Chione walli* from the Manzanilla beds of Trinidad; but it is at once distinguished from that species and from the other related forms described in this report by the very characteristic anterior radial plications.

The shell is dedicated to Dr. W. H. Dall, of the National Museum, Washington.

Locality.—Along the shore 1000 feet west of the pier at Brighton, Trinidad, in impure asphalt.

Geological horizon.—Upper Oligocene. About equivalent to the Chipola stage of Florida.

Chione guppyana new species. Plate IX, Figure 19.

Description.—Shell of moderate size, suborbicular, slightly obtusely pointed at the posterior end, sculpture of same general type as *C. veatchiana*,—that is, finely and delicately cancellated by the intersections of radiating threads with somewhat less pronounced, concentric lamellæ; interior margin finely and sharply crenate; pallial sinus quite deep and obtusely triangular; hinge characters as shown in the drawing.

Length of shell 19, height 16 mm.

Remarks.—This species is readily distinguished from *C. veatchiana* by its more circular outline and the striking differences in the form of the pallial sinus which in *veatchiana* is typical, but in *guppyana* rather deep and broad for the genus. From *C. dalliana* this species is distinguished by the absence of the characteristic seven or eight strong radial plications on the anterior end of that shell.

This species is dedicated to Dr. R. J. Lechmere Guppy, of Port of Spain, Trinidad.

Locality.—Along the shore 700 feet east of the Brighton pier, Trinidad, in impure asphalt.

Geological horizon.—Upper Oligocene. About equivalent to the Chipolan stage of Florida.

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Chione paraensis White.

Venus (Chione) paraensis White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 94-95, pl. V, figs. 34, 35, 1887.

White's original description.—"Shell rather small, gibbous, transversely sub-elliptical in marginal outline; lunule moderately large, cordiform, prominent, distinctly grooved by a narrow, sharply impressed groove; escutcheon long, lanceolate, concave from side to side, bounded on each side by a distinct ridge which extends from the beak by a gentle outward curve, to the posterior border; umbones slightly elevated; beaks small, closely incurved upon the cardinal margin and turned forward; cardinal margin broadly and regularly convex; anterior and posterior margins regularly and almost equally rounded; basal margin broadly and regularly convex; cardinal teeth well developed; sublunular tooth comparatively strong. Surface marked by numerous sharply raised, finely crenulate, concentric lamellæ which cover the whole surface including the lunule but not including the narrow escutcheon. These lamellæ consist of merely close-set, raised striæ upon the beaks, but they become stronger and wider apart towards the free margins.

"Length 21 millimeters; height from base to umbones 18 millimeters."

Rio Piabas, State of Para, Brazil.

Chione paraensis White var. Plate IX, Figure 20.

A varietal form of Dr. White's *Chione paraensis* is rather common in the Soldado fauna. It differs from the type in its less convex form.

Length of largest shell 20, height 15 mm.

Locality.—Bed No. 2, Soldado Rock, Gulf of Paria, near the Serpent's Mouth.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Maria Farinha beds, State of Pernambuco, Brazil.

Genus *VENERUPIS* Lamarck, 1818.

Venerupis Lamarck, An. s. Vert., V, p. 506.

Venerupis Sowerby, Conch. Man., p. 113, 1839.

Rupellaria H. and A. Adams, Genera Rec. Moll., II, p. 437, 1857. Not *Rupellaria* of Fleuriau.

Venerupis Fischer, Man. de Conchyl., p. 1087, 1887.

Irus Herrmannsen, Ind. Gen. Mal., II, p. 684. Not *Irus* of Oken, Lehrb. der Naturg., pp. 230 848, 1815.

Venerupis atlantica new species. Plate IX, Figure 21.

Description.—Shell characterized by its very striking sculpture which consists of (a) sharp-edged, nearly regular and equidistant, thin, erect, concentric lamellæ, which are more elevated at the upper posterior margin; (b) radiating striæ which are very fine, close, nearly regular, and ornament the surface of the shell between the erect ridge-like lamellæ which the striæ do not cross; hinge lacking.

Height of fragment 10 mm.

Remarks.—This is the first species of *Venerupis* ever found in the fossiliferous beds of the eastern coasts of the Americas.

The genus now lives in all the European seas, and the Indian and the Pacific Oceans. It is not now represented in the Atlantic.

For this reason the specimen has been identified as *Venerupis* with some hesitation; but its resemblance to Fischer's figure of *Venerupis exotica*, and to Kobelt's figure of *V. irus* (the geno-type) is so striking that although, unfortunately, the hinge characters are not known, yet it cannot be any other genus. It does not resemble the *Petricolas*.

Apparently the genus *Venerupis* became extinct on the east coast of the Americas at the close of the Lignitic, just as *Cymia* died out at the close of the Oligocene. *Venerupis* is found in the California Pliocene and is now living on the coast of that state.

The oldest species of the genus are found in the Cretaceous.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus **MACTRA** Linnæus, 1758.

Mactra austeniana new species. Plate IX, Figures 22, 23.

Description.—Shell of moderate size; triangular, rather thin, moderately convex; beaks low, approximate; surface sculptured only by concentric lines of growth; pallial sinus small, rounded; hinge of right valve with a short double anterior lateral tooth, a strong bifid or reversed V-shaped cardinal, a triangular chondrophore (about equalling in size the bifid tooth), and a double elongated posterior lateral tooth; the narrow, lanceolate ligament area is separated from the chondrophore by a shelly plate.

Length of largest specimen 27, height 21, diameter 14 mm.

Remarks.—Small individuals of this species superficially recall *Mulinia lateralis* in their general outline; but the hinge characters are very different,—the shelly plate lying between the ligament and the chondrophore separating this shell at once from *Mulinia*.

This species seems to be more closely allied to true *Mactra*, *sensu stricto*, than to any of the other genera of the sub-family Mactrinæ.

We are enabled by this fact to add a further indication of the Oligocene age of the horizon. For according to Dr. Dall³³ typical Mactras are relatively modern and are not known in America from rocks older than the Oligocene.

Two suggestions are also given by this shell that the horizon it occurs in is late Oligocene. *First*, *Mactra*, *sensu stricto*, does not occur on the Pacific coast in the recent fauna, although there is one species still living in the Caribbean area. This suggests that the genus developed late in the Oligocene and its spreading westward was interrupted by the rise of the Isthmus. *Second*, there is also a true *Mactra* found in the Chipola marls (late Oligocene) of Florida, *Mactra chipolana* Dall.

The writer takes great pleasure in naming this shell in honor of Mr. Austen, Librarian of Cornell University. His kind help in matters of bibliography has greatly facilitated our researches.

³³ Trans. Wagner Inst. Science, vol. III, p. 892.

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Locality.—Along the shore 1000 feet west of the Brighton pier, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene, about equivalent to the Chipola marls of Florida.

Genus **CORBULA** Bruguière, 1792.

Corbula (*Cuneocorbula*) *helenæ* new species. Plate IX, Figure 25.

Description.—Shell small, sub-equilateral, nearly equivalve; general form oblong-ovate, posterior slope carinate, posterior end truncate, anterior end broadly rounded; beaks low, approximate; concentric sculpture on both valves of numerous, close-set, more or less obsolete and feeble ribs; radial sculpture, especially on the left valve, of very fine, close striæ radiating from the beaks to the lower margin, most strongly developed near the carina.

Length 8, height 5, diameter 3 mm.

Remarks.—In general outline this shell is nearest to *Corbula* (*Cuneocorbula*) *sarda* Dall from the Chipola Oligocene of Florida, but *C. helenæ* is a shorter and more delicate shell.

The radiating striæ in *C. helenæ* are unusual in the genus, but occur in some species as *C. (Cuneocorbula) sericea* Dall from the Bowden Oligocene of Jamaica and in *C. lavalleana* Orbigny, of the recent Antillean fauna.

This shell is named in honor of Mrs. Alfred Schultz, of Washington, D. C.

Locality.—Along the shore at Brighton, Trinidad, 1000 feet west of the pier, in an impure asphalt.

Geological horizon.—Upper Oligocene, about equivalent to the Chipola horizon of Florida.

Corbula (*Cuneocorbula*) *subengonata* Dall. Plate IX, Figure 24.

Corbula engonata Aldrich, Bull. I, Geol. Surv. Alabama, p. 58, 1886. Not of Conrad, Proc. Acad. Nat. Sci. Phila., III, p. 294, 1848.

Corbula alabamensis Lea var., Harris, Bull. Am. Pal., vol. II, p. 260, pl. 13, fig. 14, a, 1897.

Corbula subengonata Dall, Trans. Wagner Inst. Sci., vol. III, p. 841, 1898.

Corbula subengonata Clark and Martin, Eocene, Maryland Geol. Surv., p. 163, pl. XXXII, figs 1, a, 2, a, 1901.

Harris' description.—"This variety is by no means so large nor so inflated as *alabamensis*, yet some specimens seem to indicate a transitional stage so far as form is concerned. From *Corbula engonata* this is distinguished by its more compressed form, smaller concentric lines and more rectilinear base" (1897). Type locality, Gregg's Landing, Alabama. Lignitic Eocene.

Dall's description.—"This form is smaller, less inflated, thinner, and with more nearly parallel dorsal and ventral borders than *C. alabamensis*. The sculpture is finer than in *C. engonata*; which is a more elongated species" (1898).

Remarks.—On comparing one of our two species of *Corbula* from Bed No. 8, Soldado Rock, with a specimen of *engonata* from Gregg's Landing, the shells are found to match perfectly in size and shape. The only difference is that the concentric grooving is somewhat more distant, bolder, and coarser in the Soldado form.

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Altitude of Soldado shell 6.5, length approximately 10.5 mm.

Locality.—This species is very common in the Eocene of Maryland and Virginia. Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Corbula (Cuneocorbula) weaveri new species. Plate IX, Figure 28.

Description.—Shell small, sharply carinate, subtriangular, not very convex, anterior end rounded, posterior end acutely pointed; sculpture of about five concentric, rather rounded ridges and alternate deep groovings.

Length of shell 8, height 5.5, thickness of one valve 2 mm.

Remarks.—In its general outline this shell is not unlike the Midway *C. subcompressa* Gabb; but the anterior slope is not rounded as in that species, and the sculpture is decidedly bolder in the Soldado form. Of the described Lignitic species, it is nearest *C. subengonata*, but is shorter and more triangular and more strongly sculptured.

This shell is named in honor of Mr. Paul Weaver, of Brooklyn, N. Y., who assisted Mr. Veatch in collecting at Soldado Rock.

Locality.—Bed No. 8, Soldado Rock, near the Serpent's Mouth in the Gulf of Paria.

Geological horizon.—Lignitic Eocene, about equivalent to the Nanafalayan.

Corbula (Bothrocorbula) smithiana new species. Plate IX, Figures 29, 30.

Description.—Shell small, nearly equilateral, very solid and thick, convex, with a very deep cavity in the interior, general form ovate, posterior slope carinate, posterior end pointed, slightly rostrate; anterior gently rounded; beaks low and small; sculpture of about twelve narrow, concentric, rather sharply edged ribs with wider interspaces extending from the basal margin to a short distance below the beaks which are nearly smooth. Only a single (left) valve was found.

Length of shell 8.5, height 5, diameter 6 mm.

Remarks.—This shell is of the general type of *C. viminea* Guppy from the Oligocene of Jamaica and Haiti, and like it belongs to Gabb's section *Bothrocorbula*, of which *C. viminea* is the type. Shells of this section of the genus are found in the Antilles from the Oligocene to the recent faunas. Two species extended northward to the Chipola and Oak Grove beds of the Florida Oligocene, and one species occurs in the Pliocene of the Caloosahatchie, Florida.

On comparing *C. smithiana* with Dr. Guppy's *viminea*, the latter is at once seen to be shorter, higher, more boldly sculptured, and is a much larger shell.

The species is named in honor of Captain Smith of the S. S. Viking, Port of Spain, Trinidad.

Locality.—On the shore at Brighton, Trinidad, 1000 feet west of the pier, in an impure asphalt.

Geological horizon.—Upper Oligocene, about equivalent to the Chipolan of Florida.

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Corbula sp. indet. Plate IX, Figures 26, 27.

A number of moulds of the interior of a species of *Corbula* were found in the ferruginous marl south of Pitch Lake. It was evidently a common species.

In form the shell was of the short, high, very convex type; the moulds are nearly equilateral, rounded anteriorly, truncated posteriorly; with the two valves not differing much in size.

Length of mould 11, height 9, diameter 7 mm.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad.

Geological horizon.—Oligocene.

Genus *PHOLAS* (Lister, 1687), Linnæus, 1758.

Pholas mackiana new species. Plate IX, Figure 31.

Description.—Shell oblong-ovate, slightly inflated, small for the genus, thin and fragile; sculpture of concentric fluted lines of growth which at the anterior end of the valve are raised into close-set, radial riblets on which the fluting is more strongly marked than elsewhere; beyond the anterior end the concentric lines become more pronounced and are marked with V-shaped folds, while the radial sculpture is lost.

Height of shell 14 mm.

Remarks.—When compared with the Miocene species of *Pholas* from the southeastern United States, the Trinidad shell is found first to differ very markedly from *P. arcuata* Conrad. For in the latter species the radial sculpture is prominent all over the shell; and it is also much heavier and less fragile than *mackiana*. To *P. producta* Conrad and *P. memmingeri* Tuomey and Holmes, both South Carolinian species, the shell from Trinidad bears only a generic resemblance.

On comparing *P. mackiana* with living species, it is at once seen to be quite unlike the common *Pholas costata* Linn. that ranges from Massachusetts to Brazil. *P. costata* is the recent analogue of *P. arcuata*, and like the latter has radial sculpture all over the shell. But the Trinidad fossil does resemble in type of sculpture both *P. campechensis* Gmelin living in the southern United States and the West Indies, and *P. chiloensis* on the shores of Peru and Chile. These species, as Tryon has pointed out,³⁴ are very closely related and apparently almost identical, which is surprising because of their being east and west coast shells.

Now, as the writer is convinced, the key to the explanation of this resemblance of these east and west coast recent species is the Trinidad fossil. It represents the ancestral Oligocene stock from which both the recent forms started from a center of development in the lower Antilles. Before the rise of the Isthmus of Panama the western form migrated to the Pacific and has continued to develop there, while the eastern has been slowly spreading along the Atlantic coast.

Pholas mackiana thus furnishes a further indication of the Oligocene age of the asphaltic marl in which it was found.

³⁴ Mon. Pholadidæ, Proc. Acad. Nat. Sci. Phila., p. 76, 1862.

It is also interesting as the first undoubted³⁵ species of *Pholas* ever described from the Oligocene of either the Gulf States or the Antilles.

Locality.—Along the shore 700 feet east of Brighton pier, Trinidad Island, in an impure asphalt.

Geological horizon.—Approximately equivalent to the Chipola (Upper Oligocene) epoch of Florida.

This species is named in honor of Mr. John Mack, of Philadelphia.

Genus *MARTESIA* (Leach) Blainville, 1824.

Martesia oligocenica new species. Plate IX, Figures, 32, 33.

Description.—Shell rather small, ovate-oblong, inequivalve; anterior end short, roundly gaping, obliquely truncate; posterior end elongate, obtusely pointed; smaller valve lying within the posterior margin of the larger; furrow well marked, slightly oblique, placed near the anterior end of the valve; anterior surface sculptured with fine, slightly imbricated lines of growth.

Length of shell 14, height 8, diameter 7 mm.

Remarks.—This is the first undoubted species of *Martesia* yet recorded from the Oligocene of the southern United States or the Antilles.³⁶

It is evidently closely related to the recent and Pliocene species, *Martesia striata*, Linn., of which it may be an ancestral form. *M. striata* has been found in the Pliocene of Trinidad and Costa Rica.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown, ferruginous layer.

Geological horizon.—Upper Oligocene.

Class GASTROPODA.

Genus *CYLICHNA* Lovén, 1846.

Cylichna solivaga new species. Plate X, Figure 1.

Description.—Shell small, rounded cylindrical; substance thin; spire involute, sunken; surface of shell entirely smooth and unsculptured except for fine microscopic striae over the lower basal fourth of the shell; other characters concealed by the matrix.

Height of shell 9.5, greatest diameter about 5 mm.

Remarks.—A single imperfect specimen of this species was found.

It is more convex than *C. sylvarupis* Harris from the Alabama Lignitic and does not appear to be identical with any other species described from the lower Eocene horizons.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

³⁵ A shell from the Bowden beds of Jamaica was referred with a question by Dr. Guppy to this genus and described by him as *Pholas? sphaeroidalis*. See also footnote 36.

³⁶ According to Dr. Dall *M. sphaeroidalis* Guppy from Jamaica is probably referable to another group.

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Genus **TEREBRA** Adanson, 1757.

Terebra sp. indet. Plate X, Figure 2.

Remarks.—The impression of a fragment of what appears to have been a shell of *Terebra* was found in the ferruginous marls at Brighton.

The drawing is from a gutta-percha mould taken from the original.

The sculpture suggests such forms as varieties of *T. dislocata* Say and of *T. bipartita* Sowerby.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown, ferruginous layer.

Geological horizon.—Upper Oligocene.

Genus **PLEUROTOMA** Lamarck, 1799.

Pleurotoma guppyana new species. Plate X, Figure 3.

Description.—Shell small, fusiform, when complete, number of whorls known six; whorls ornamented by (1) a nearly central row of small, equidistant, rectangular nodules; (2) spiral threads revolving over the volutions on either side of the row of nodules, being most marked on the basal side; (3) a slightly elevated, subsutural ridge; (4) transverse lines of growth which swing far back at the nodular rows, making angular curves and forming an oblique cancellation with the spiral threads.

Length of fragment 9, greatest width 5 mm.

Remarks.—The close relationship of this shell to the group of *Pleurotoma denticula* (Basterot) Edwards is at once apparent. It is very near to specimens from the Lignitic of Alabama described as *Pl. denticula* var. by Professor Harris,³⁷ from which it differs some in outline and in the presence of the subsutural ridge; but the type of sculpture is very like that of the Alabama shells.

Pleurotoma denticula was originally described from the southwest of France by Basterot.³⁸ Later, in 1860, Edwards referred a number of varying forms found in the Barton beds of southern England to varieties of this species, and Professor Harris has found certain varietal forms from England grade into those in the Alabama Lignitic. It is now of interest to find a type closely allied to the Alabama forms so far south as approximately 10° N. Lat.

The writer takes great pleasure in dedicating this species to Dr. R. J. Lechmere Guppy, of Port of Spain, Trinidad, whose unremitting interest, enthusiasm and careful study has done so much to further the world's knowledge of the paleontology of the Antilles.

Locality.—Bed No. 6, Soldado Rock, Gulf of Paria, near the Serpent's Mouth.

Geological horizon.—Lignitic Eocene.

³⁷ Bull. Am. Pal., vol. III, pp. 12-13, pl. i, fig. 21, 22, 1899.

³⁸ Descr. Géol. du Bass. Tert. Sud-ouest de la France, p. 63, pl. 3, fig. 12, 1825.

Genus *OLIVA* Bruguière, 1789.*Oliva trinidadensis* new species. Plate X, Figure 4.

Description.—Shell rather small, characterized by being more pyriform and less cylindrical than is usual in the genus; whorls three, convex; suture deeply impressed, narrowly channelled; base of shell slightly notched; characters of pillar and aperture concealed by the ferruginous matrix.

Height of shell 15, greatest width 8 mm.

Remarks.—In its breadth of shoulder and tapering base this species resembles the much larger, recent *O. fusiformis* Lamarck, but it is still broader proportionally and widens more suddenly than that shell.

Dr. Guppy in his list mentions *O. cylindrica* Sowerby from the Caroni beds of Trinidad, and *O. reticularis* from Jamaica, *ispidula* and *cylindrica* from Haiti. The latter Dr. Dall³⁹ places in synonymy with *O. litterata*, and also remarks that *ispidula* is quite possibly a variety of *litterata*.⁴⁰

These species are all of a cylindrical outline, quite unlike the shell described above.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad.

Geological horizon.—Upper Oligocene.

Genus *MARGINELLA* Lamarck, 1801.*Marginella dalliana* new species. Plate X, Figures 5, 6.

Description.—Shell of moderate size, rather solid and strong, subpyriform; whorls four; spire very short, nearly entirely enrolled by the last volution; sides of shell convex; evenly rounded; outer lip in adult specimens much thickened along the margin, not lirate, marked off by an impressed line behind it; aperture wide for the genus, especially toward the anterior; inner lip with only a very light callus; columellar plaits four, of which the two anterior are very oblique, the two posterior only slightly so, or nearly horizontal.

Height of shell 20, greatest breadth 13, length of aperture 18 mm.

Remarks.—In its general form this species is not unlike Dr. Dall's *M. ballista* from the Tampa silex beds, of the Florida Oligocene,—only that shell has a decided compression at the central part of the outer lip, and the four columellar plaits all sloping at about the same angle.

Dr. Guppy's *M. coniformis*, from the Oligocene of Jamaica and Haiti, is also of somewhat the same form; but is a much slenderer shell with the outer lip slightly lirate, and the aperture much narrower.

The writer takes great pleasure in naming the Trinidad species in honor of Dr. W. H. Dall of the Smithsonian Institute, Washington, D. C., as a slight token of appreciation of his invariable kindness and helpful suggestions during many years.

Localities.—Along the shores at Brighton, Trinidad, 1000 feet west of the pier, and also 700 feet east of the pier, in an impure asphalt.

³⁹ Trans. Wagner Inst., III, p. 44.

⁴⁰ Loc. cit., p. 45.

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Geological horizon.—Upper Oligocene, about equivalent to the Chipola marls of Florida.

Genus *CARICELLA* Conrad.

Caricella ogilviana new species. Plate X, Figure 7.

Description.—Shell of moderate size, thick and strong as shown where it is fractured; whorls six, sloping evenly from a short, acute spire, last volution not at all shouldered, gently rounded; sutural line inconspicuous, surface of shell entirely smooth, lines of growth very faint, seen only with a lens; plaits of the columella concealed by the silicious matrix.

Length of shell 25, greatest width 14, thickness 12 mm.

Remarks.—This species is entirely unlike any known *Caricella* from the lower Eocene horizons. Its general form, however, is considerably like *Caricella isabellæ* Maury from the Oligocene of Florida. One specimen only was found.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Named in honor of Dr. Ida H. Ogilvie, of Barnard College, Columbia University.

Caricella perpinguis new species. Plate X, Figure 8.

Description.—Shell medium sized; pyriform, solid and strong, as shown by the thickness of the fractured lip; whorls six, sloping rather suddenly from a short, very acute spire; last volution extremely convex and inflated; sutural line distinct, impressed; surface of shell entirely smooth, lines of growth visible only with a lens; plaits of the columella concealed by the silicious matrix.

Length of shell 29, greatest breadth 17, thickness 15 mm.

Remarks.—Only a single shell was found also of this *Caricella*, which can at once be distinguished from *C. ogilviana* by the decided difference in outline. When placed side by side *C. ogilviana* is comparatively slenderly and gracefully proportioned, while *C. perpinguis* as its name implies, is an exceedingly robust shell. The number of whorls is the same in both shells, which precludes the possibility of one being a younger form.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene.

Caricella sp. indet. Plate X, Figure 9.

Among the collection of fossils from Soldado is a portion of the spire of a shell which belongs in or near the genus *Caricella*. This is indicated by the peculiarity of its sculpture. All the whorls exposed are perfectly smooth, except that at the top of the spire which show very distinct traces of fine, very oblique, longitudinal riblets.

This character, as Dr. Dall has shown in his review of the *Volutidæ*,⁴¹ is typical of the *Caricella* group of the *Voluta* family.

⁴¹ Trans. Wagner Inst. Science, vol. III, pp. 57-91.

The Soldado shell has these plications unusually oblique, otherwise the spire resembles those of specimens of *C. heilprini* from the Lignitic of Wood's Bluff, Alabama. The single example from Soldado is, unfortunately, too imperfect for any positive identification or description.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus **VOLUTILITHES** Swainson, 1840.

Volutilithes pariaensis new species. Plate X, Figure 10.

Description.—Shell broadly fusiform; spire acute, about one-third the total height; whorls eight, of which the first two are minute, smooth, nuclear, the following sculptured by rather delicate spiral striæ and more marked longitudinal riblets (six in the dorsal side of the last volution), riblets interrupted especially on the body whorl by a large subsutural spiral groove which gives a very pretty coronate or beaded appearance; columella entirely concealed by a silicious matrix.

Height of shell 18, greatest width 9 mm.

Remarks.—This shell exhibits the general features of sculpture of *V. rugata* Conrad⁴² from the Midway of Texas and Alabama. Indeed, the writer is in doubt whether it should not be placed as a variety of that species. Yet on comparing with a large number of specimens of *rugata* it is so unlike them in form, so much broader and shorter, that it is finally left tentatively as a separate species.

The Soldado shell in outline is like *V. saffordi*⁴³ which Professor Harris regards as a variety of *rugata*.⁴⁴ But the type of Gabb's shell is only part of the body whorl and too fragmentary for positive comparisons. It was obtained from the Midway of Tennessee, and, as far as one can judge, was very similar to the Soldado shell.

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

Geological horizon.—Midway Eocene.

History of the genus.—Dr. Dall⁴⁵ makes some interesting remarks on the history of *Volutilithes*. It began during the Cretaceous, and reached its greatest development in the Eocene. After a period it gradually decreased in number of species, until only one typical species (*V. philippiana* Dall), and a second belonging to another section (*V. abyssicola* Ad. & Reeve) are known in the living state. Both are found in deep water where they appear as remnants of a fauna which has become mostly extinct in shallow water.

Volutilithes whitensis new species.

Volutilithes radula White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 126-127, pl. X, figs. 15-17, 1887. Not of Sowerby, Forbes (1846), nor Stoliczka, 1868.

Volutilithes radula Arnold (in Branner's report), Bull. Museum Comp. Zoology, Harvard College, vol. XLIV, p. 16, 1904.

⁴² Jour. Acad. Nat. Sci. Phila., vol. IV, p. 292, pl. 47, fig. 32, 1860.

⁴³ *Fasciolaria saffordi* Gabb, Jour. Acad. Nat. Sci. Phila., vol. IV, p. 390, pl. 68, fig. 6, 1860.

⁴⁴ Bull. Amer. Pal., I, pp. 187-198, 1896.

⁴⁵ Trans. Wagner Inst. Science, vol. III, p. 74.

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White's description.—"Shell elongate-subovate; spire less than one-third the total length of the shell; volutions six or more in number, convex, marked by moderately strong longitudinal varices, which are crossed by narrow revolving depressions, or grooves, the broadest one of which is at the distal side, near the suture. These grooves usually give the varices a distinctly crenulated aspect, and sometimes the crenulations are so prominent as to appear subspinous. The varices upon the last volution are long, but they become obsolete before reaching the beak, that portion of the shell being marked only by coarse revolving raised lines; beak somewhat narrow; aperture elongate, acute posteriorly, and ending anteriorly in a narrow, short, slightly deflected canal; outer lip thin; inner lip bearing two well defined folds.

"Length 22 mm.; breadth of the last volution 10 mm." These are the dimensions of the example figured on Plate X. Some of the examples in the collection are fully one-third larger than this.

The Brazilian collections contain a considerable number of examples of this species, but most of them are imperfect.

Remarks.—As later studies have shown that this Brazilian shell is not identical with the Cretaceous species from southern India that was identified by Forbes and Stoliczka with Sowerby's *radula*, the writer would suggest naming the shell in honor of Dr. C. A. White, as a token of his great contribution towards our knowledge of the Brazilian Cretaceous and Tertiary faunas.

As will be seen by the description given above, this shell has much in common with *V. rugata* Conrad, of the Midway Eocene of Texas and Alabama.

Locality.—Olinda and the Rio Maria Farinha beds, and also at Ponto das Pedras, all three localities being in the State of Pernambuco, Brazil.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of bed No. 2, Soldado Rock, Gulf of Paria.

Volutilithes sp. indet. Plate X, Figure 11.

A small and very fragmentary shell, apparently a young *Volutilithes*, was found at Soldado in the Lignitic horizon. It is too imperfect to identify or describe; but on comparing it with young shells of *V. petrosus* from the Lignitic beds of Wood's Bluff, Alabama, it shows considerable resemblance to them.

Height of shell 13 mm.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *LYRIA* Gray, 1847.

Lyria wilcoxiana Aldrich.

Lyria? sp. Dall. Trans. Wagner Inst. Science, vol. III, p. 69, 1890.

Lyria wilcoxiana Aldrich, Geol. Surv. Alabama, p. 243, pl. 12, fig. 4, 1894.

?*Lyria wilcoxiana* Harris, Bull. Am. Paleont., vol. I, p. 199, pl. 8, fig. 5, 1896.

Aldrich's original description.—"Shell rounded fusiform, whorls four, spire blunt, first three whorls smooth, body whorl transversely ribbed, the ribs rather

sharp with concave spaces; no spiral sculpture shown; suture distinct, not deeply impressed; body whorl long, terminating in a canal, which is missing in specimen figured; aperture long and narrow, inner lip showing a few plications, but the aperture is filled in so that the lips are almost completely hidden."

Type locality in or near McConnico's plantation, Wilcox County, Alabama. Midway Eocene.

Remarks.—In view of the columellar plaits on *L. wilcoxiana* and on the variety *aldrichiana* it seems doubtful whether the specimen from near Midway, Alabama, mentioned by Professor Harris⁴⁶ is this species. As far as could be determined, the columella of that shell was smooth.

Lyria wilcoxiana Aldrich var. *aldrichiana* new variety. Plate X, Figures 12, 13.

Description.—The Soldado shell although a varietal form is apparently the most perfect specimen of this species ever found.

It shows distinctly six, short well marked plications on the columella. These were obscured in Mr. Aldrich's type by the matrix.

The Soldado form differs from Mr. Aldrich's description in not having a distinctly marked suture, and especially in the fact that the plications extend only over the dorsal half of the last whorl. This peculiar characteristic is well illustrated by the figure.

The writer takes pleasure in naming this variety for Mr. T. H. Aldrich, of Birmingham, Alabama, by whom the species was described.

Height 23, greatest diameter 14 mm.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds in Brazil.

Genus LEVIFUSUS Conrad.

Levifusus pagoda Heilprin. Plate X, Figure 14.

Pleurotoma pagoda Heilprin, Proc. U. S. Nat. Museum, vol. 3, p. 149, fig. 1, 1880.

Fusus pagodiformis Heilprin, Proc. Acad. Nat. Sci. Phila., p. 375, 1880.

Fusus pagodiformis Aldrich, Geol. Surv. Alabama, Bull. 1, p. 55, 1886.

Levifusus pagoda var. Harris, Bull. Am. Pal., vol. I, p. 207, p. 19, fig. 8, 1896.

Levifusus pagoda Harris, Bull. Am. Pal., vol. III, p. 51, pl. 6, fig. 10, 1899.

Heilprin's original description.—"Ventricose; whorls about nine, the body whorl nodulated on the most convex portion (nearly central), the nodulations consisting of a single series of sharp, obtusely pointed, and flattened spines or nodes which frequently appear double by the crossing of an impressed line over their basal portion; upper volutions with a similar series of nodes almost immediately above the sutural line, and gradually dividing off into a crenulation, upper surface of the whorls concave, faintly striated, the sinual rugæ indicating but a faint sinus; lower surface with numerous well developed revolving lines, which show a tendency to alternate. Aperture exceeding the spire in length, considerably contracted at about its center.

⁴⁶ Bull. Am. Pal., I, p. 199, pl. 8, fig. 5, 1896.

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"Length $1\frac{1}{2}$ inch.

"Geological horizon.—Eocene of Alabama."

Remarks.—A single specimen of this striking species was found by Mr. Veatch at Soldado Rock. It is fragmentary and eroded, but can easily be recognized by its peculiar and characteristic aspect. In the Soldado shell the sharp spines are very prominent, and (as in the type) developed on the most convex portion of the whorls some distance above the suture.

The Soldado form was evidently unusually large and heavy, for the fragment has an altitude equal to that of the entire shell from Alabama.

This species is found in the Midway and Lignitic horizons of Alabama.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus *FUSUS* (Klein, 1753) Lamarck, 1801.

Fusus colubri new species. Plate X, Figure 18.

Description.—Shell small, very slender, fusiform; number of whorls known four; longitudinal sculpture of narrow, well-marked riblets (about ten on the last volution), and of fine lines of growth, visible only with a lens; transverse sculpture of spiral threads which are more distant from one another and more prominent where they revolve over the riblets of the body whorl; aperture small, rounded; canal very straight, long and slender.

Height of incomplete shell 25, greatest width 10 mm.

Remarks.—The slender, elongated form of this shell recalls such species as *Fusus meyeri* Midway variety, and *F. ottonis* Aldrich from the Alabama Lignitic Eocene, but the whorls of both those shells are carinated.

The nearest analogue of the Soldado shell is Dr. White's *F. longiusculus* from the Rio Maria Farinha beds, Brazil. That has the same uncarinated, convex whorls and apparently the same number of riblets; it also corresponds nearly in size. The difference is chiefly in the transverse sculpture, the spiral threads in the Brazilian shell being more pronounced and much further apart.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene.

Fusus bocarepertus new species. Plate X, Figure 17.

Description.—Shell rather short and broadly fusiform; number of whorls not known, the single specimen being very imperfectly preserved; the distinguishing characteristic is the regular, spiral, rather distant, grooving, which ornaments the surface of the shell; longitudinal sculpture of subequal rounded riblets, about six on the last volution.

Height of incomplete shell 20, greatest width 12 mm.

Remarks.—Though not greatly resembling the typical forms of *Fusus subtenuis* Heilprin, this species is quite like in general form specimens in the Cornell

Paleontological Museum of a variety of Heilprin's species from the Lignitic of Alabama. But instead of a series of groovings that shell has raised flattened threads.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria, near the southern Bocas. Hence the name.

Geological horizon.—Lignitic Eocene.

Fusus bocaserpentis new species. Plate X, Figures 15, 16.

Description.—Shell of moderate size, stout, broadly fusiform, number of whorls known seven, earlier whorls eroded; transverse sculpture of (a) undulate, nodular costæ (seven on half of the body whorl), developed on all the whorls, but only on the most convex portion of the last, where they become obsolete above and below, and (b) of irregular, wavy lines of growth; spiral sculpture of coarse, subequal revolving liræ; the latter intersect the finer lines of growth and give the surface of the shell when viewed under a lens a reticulated appearance; sutural lines not impressed, angulated; upper portion of whorls rendered concave by a broad, shallow subsutural sulcus.

Height of spire 35, greatest diameter 22 mm. Length of canal not known.

Remarks.—This shell is unlike any described from the Midway beds of either the United States or Brazil.

The only species at all of the same general outline and type of sculpture is *Fusus harrisi* Aldrich⁴⁷ from the Lignitic Eocene of Gregg's Landing, Alabama; but that is a smaller shell with only about half as many ribs and with much weaker revolving liræ.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Fusus longiusculoides new species. Plate X, Figure 19.

Description.—Shell small, slender, fusiform, number of volutions known four; longitudinal sculpture of rounded ribs (eight on the penultimate whorl), which extend from suture to suture; spiral sculpture of sharply-defined, equidistant threads of which there are six on the next to the last volution; canal straight; other characters of the aperture lacking.

Height of fragment 12, greatest width 5 mm.

Remarks.—This shell resembles in its general form and type of sculpture Dr. White's *Fusus longiusculus* from the Midway beds of Maria Farinha, Brazil. It is also akin to our Soldado Midway species, *Fusus colubri*.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Fusus meunieri new species. Plate X, Figure 20.

Description.—Shell small when complete, rather broadly fusiform; number of whorls known four, very convex, slightly angulated; longitudinal sculpture of

⁴⁷ Bull. Amer. Pal., vol. I, p. 64, pl. 4, figs. 2 and 8, 1895.

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narrow, rounded riblets of which there are eight on the last volution; transverse sculpture in the convex part of the whorls of rather coarse spiral threads, between which revolve sets of about five very delicate striæ visible only with a lens; elsewhere the striæ are fine and subequal.

Height of fragment 18, greatest width 10 mm.

Remarks.—In the rather sudden increase in diameter of the body whorl this species recalls the outline of *Fusus subtenuis* Heilprin⁴⁸ from the Lignitic Eocene of Alabama, but the type of sculpture is wholly different. For a sculpture resembling that of *F. meunieri* we must turn to *F. interstriatus* Heilprin also from the Lignitic Eocene of Alabama. In that species there is a similar intercalation of groups of fine striæ between coarser threads, but it is all over the surface of the shell, and not merely, as in the Soldado shell, on the regions of greatest convexity of the whorls.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth in the Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Named in honor of Professor Stanislaus Meunier, Musée d' Histoire Naturelle, Paris, as a souvenir of delightful hours spent in geologizing with him in the fields and forests of France.

Fusus mohrioides new species. Plate X, Figure 21.

Description.—Shell of moderate size, known whorls four; ornamentation of transverse, almost spinous nodules, strongest on the penultimate volution where there are about ten, apparently becoming obsolete on the body whorl; and of spiral threads of which three more pronounced than the rest revolve over the rows of nodules.

Height of fragment 22, greatest width 16 mm.

Remarks.—The single specimen of this shell obtained from Soldado is so imperfect that at first it seemed better not to found a new species upon it. But an examination showed that certain well defined characters were still retained even in its fragmentary condition.

These characteristics ally it rather closely with Mr. Aldrich's *Fusus mohri*.⁴⁹ The figure of that shell does not represent its sculpture at all well, but on comparing the Soldado form with specimens of *mohri* from the Lignitic Eocene of Matthew's Landing, Alabama, the nodules of the two shells almost match, and the increase in thickness of the three or four spiral threads, when they revolve around the rows of nodules, is also very marked in the Alabama shell. The species are certainly nearly related, though probably specifically distinct.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene.

⁴⁸ Proc. Acad. Nat. Sci. Phila., p. 371, pl. 20, fig. 4, 1880.

⁴⁹ Bull. Am. Pal., vol. I, p. 64, pl. 3, fig. 6, 1895.

Fusus sewalliana new species. Plate X, Figure 22.

Description.—Shell rather large, original shape fusiform, number of known whorls four; surface of shell handsomely sculptured by (a) longitudinal ribs, of which there are ten on the last volution, these extend from the broad and shallow subsutural sulcus to the succeeding suture or, on the last whorl, almost to the beginning of the anterior canal; (b) by rather regular longitudinal lines of growth; (c) by narrow, rounded spiral ridges which are more widely separated from one another where they revolve over the most prominent part of the longitudinal riblets; sutural line not well defined, wavy.

Length of fragment 40, greatest width 20 mm.

Remarks.—This species is unlike any known *Fusidæ* from the Midway of either North America or Brazil. In general form and type of sculpture it recalls *Fusus mortoni* var. *mortoniopsis* Gabb from the Lower Claiborne Eocene of Texas; but the Soldado shell is much larger and a more elegantly sculptured shell.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

The writer takes great pleasure in naming this shell in honor of Mr. Arthur Sewall, of Philadelphia, in appreciation of his very great interest in the scientific results of the Venezuelan Expedition.

Fusus sirenideditus new species. Plate X, Figure 23.

Description.—Shell large and strong with a thick and heavy columella; the single specimen is very imperfectly preserved, but is sufficiently striking to merit description; sculpture consisting of fairly coarse longitudinal lines of growth, interrupted by strong, narrow, revolving, spiral ridges (eight on the lower three-quarters of the last volution); above these the shell is somewhat shouldered and bears a few nearly obsolete longitudinal plications; those on the penultimate whorl are developed into well-marked, nodular riblets.

Height of fragment 40, greatest width 23 mm.

Remarks.—This species, which, when perfect, must have been a fine shell, seems to be quite unique in its characters among the lower Eocene faunas.

Locality.—Bed No. 2, Soldado Rock, Gulf of Paria. Hence the dedication to the Siren of the Rock.

Geological horizon.—Midway Eocene.

Fusus tæniensis new species. Plate X, Figure 24.

Description.—Shell rather small, short, fusiform; number of whorls exposed, three; sculpture of (a) coarse, close-set, regular, sub-equal, revolving, spiral threads which cover the entire surface of the shell; (b) well marked, nearly equidistant, longitudinal wave-like riblets, of which there are five on the exposed half of the last volution; canal straight.

Height of incomplete shell 15, greatest width 10 mm.

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Remarks.—At the first glance this shell might be taken for the species which was found accompanying it, *F. bocarepertus*; but the character of the sculpture differentiates them.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *CLAVELLA* (Swainson, 1835) Agassiz, 1846.

Clavella harrisii new species. Plate X, Figure 25.

Description.—Shell rather solid, fusiform, spire and anterior canal long, tapering nearly equally to acute apices; number of known whorls, five; body whorl with only the faintest suggestions of obsolete longitudinal folds, penultimate whorl also nearly smooth, but the whorl preceding that is sculptured with about eight strong nodular costæ; these are also present on the two whorls next above; the third, fourth and fifth whorls (counting upwards) are ornamented with fine, rather regular spiral threads, which are not present on the body and penultimate volutions; these are marked only by lines of growth, and are quite strongly carinated by a broad, subsutural sulcus, which makes the upper part of these two whorls concave.

Height of the single fragment found 29, greatest width 14 mm.

Remarks.—No *Clavella* at all resembling this has yet been found in the Midway Eocene of the southern States.

*C. kennedyanus*⁵⁰ was described by Professor Harris from the Lower Claiborne of Texas, and was later found by him in the Lignitic of Alabama. This bears a considerable resemblance to the Soldado form, but the two latter whorls are evenly rounded, not carinated. The genus came in with the Eocene and flourished during that period. It has since constantly diminished, until at present there is but a single species in existence. This is *C. serotina* Hinds, living in the Polynesian waters.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

The writer takes much pleasure in naming this species in honor of Professor G. D. Harris, of Cornell University.

Clavella hubbardanus ? Harris. Plate X, Figure 26.

Fusus hubbardanus Harris, Bull. Am. Paleont., vol. I, p. 201, pl. 8, figs. 10, 11, 1896.

Harris' original description.—"General form and size as indicated by the figures; whorls at least 10; ornamented by (a) spiral lirations, about five very strong ones below the shoulder, with an equal number of fainter alternate striæ, and five or six faint ones above, growing fainter as they approach the suture; (b) by obtuse nodular costations, 14 on the penultimate whorl strong at the shoulder but dying out rapidly above, less rapidly below; lines of growth fine

⁵⁰ *Clavilithes kennedyanus* Proc. Acad. Nat. Sci. Phila., p. 73, pl. 7, fig. 8, 1895.

but well marked, especially on the body whorl. On the last mentioned whorl the nodular costæ are faint and confined to the humeral angle; the spiral lirations below, about 10 in number, are strong; columella long, straight. Suture more or less filled by a revolving ridge."

Midway of Mississippi and Alabama.

Remarks.—A fragment of a large fusoid shell, probably *Clavella hubbardanus* was found at Soldado. It shows the characteristic rather faint longitudinal costæ on the humeral angle of the body whorl, and the general form proves that the Soldado shell was either identical with or closely allied to the Mississippi and Alabama species.

The illustration is of Professor Harris' type specimen from Mississippi.

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

Geological horizon.—Midway Eocene.

Genus *LATIRUS* Montfort, 1810.

Latirus tortilis Whitfield. Plate XI, Figure 1.

Fusus tortilis Whitfield, Am. Jour. Conch., p. 260, pl. 27, fig. 5, 1865.

Fusus tortilis Harris, Bull. Amer. Paleont., vol. I, p. 203, pl. VIII, fig. 14, 1896.

Whitfield's original description.—"Shell elongate, fusiform; spire slender, especially in the upper part, consisting of seven or eight sub-angular volutions; each marked by six strong longitudinal folds or varices, which are spirally arranged, those of one volution being a little behind the corresponding one of the preceding volution, the whole making about one-fourth of a turn in the length of the spire; canal long and straight, making, with the narrow, ovate aperture, rather more than one-half of the entire length; surface marked by somewhat alternating revolving lines, strongest on the largest part of each volution.

"*Dimensions.*—Length 1.75 inches, transverse diameter .7 inch.

"*Locality.*—Nine miles below Prairie Bluff, Alabama."

Remarks.—The single shell from Soldado, although eroded and imperfect, shows the general form and traces of the characteristic spiral striæ of *L. tortilis*.

On comparing the specimen from Soldado with shells of this species from the Alabama, Georgia and Mississippi Midway it is seen that the Soldado form tends to be somewhat larger, and broader across the last volution, with the sculpture rather bolder and more angular. In the latter respect it approaches the Lignitic variety *nanafalina* Harris from Alabama. But the typical form of *L. tortilis* sometimes as at Matthew's Landing, Alabama, developed during the Lignitic into larger and heavier shells than that from Soldado. Hence there seems no doubt that it is the same species.

Height of Soldado fragment 23, greatest width 13 mm.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and to that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus *FUSOFICULA* Sacco.*Fusoficula juvenis* Whitfield. Plate XI, Figures 2, 3.*Pyrula juvenis* Whitfield, Am. Jour. Conch., vol. I, p. 259, 1865.*Pyrula multangular* Heilprin, Proc. Acad. Nat. Sci. Phila., p. 374, pl. 20, fig. 2, 1886.*Pyrula juvenis* Aldrich, Geol. Surv. Alabama, p. 25, pl. 6, fig. 8, 1886.*Pyrula juvenis* Harris, Bull. Am. Pal., vol. I, pp. 216-217, pl. 10, figs. 5, 6, 1896.*Fusoficula juvenis* Harris, Bull. Am. Pal., vol. III, pp. 66-67, pl. 8, figs. 15, 16, 1899.*Fusoficula juvenis* Clark and Martin, Eocene, Maryland Geol. Surv., p. 143, pl. XXIV, figs. 4, 4a, 1901.

Whitfield's original description.—"Shell small and fragile; spire elevated; columella slender, slightly bent; aperture large, elongate, ovate or subelliptical; volutions three, marked on the periphery by three distinct carinæ or subangular revolving ridges, the upper one marked with closely arranged longitudinally elongated nodes, the others simple; entire surface marked by very fine revolving lines, which are somewhat fasciculate below the lower carina, there being three finer ones between each larger one."

Type locality, six miles above Claiborne, Alabama.

Remarks.—This is a remarkably protean species, varying from three to four or with even traces of a fifth carina, and from simple carinate to crenulate forms.

The Soldado shells show no crenulations; in one there are three strong carinæ, in another three nearly obsolete carinæ, in still another the carinæ are entirely absent, the shell sloping up gently and evenly to the base of the spire. The lines of growth are prominent on all the Soldado shells, equalling in strength the spiral striæ, with which they form a beautiful cancellation over the entire surface.

Height of largest specimen 19, greatest width 7 mm.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *STREPSIDURA* Swainson, 1840.*Strepsidura ? soldadensis* new species. Plate XI, Figure 4.

Description.—Shell solid, pyriform, spire rather short, diminishing rather abruptly in diameter above the last volution; whorls about five, all ornamented with longitudinal costæ (about eight on the penultimate whorl) which, on the shoulder of the last volution, were angulated or perhaps slightly spinous; surface of the exterior of the shell covered with revolving spiral threads, fine and close set on the earlier whorls, but becoming more distant and prominent on the body whorl.

Height of fragment 24, greatest width 20 mm.

Remarks.—This shell is referred to *Strepsidura* largely because of the general resemblance it bears to *Strepsidura ? mediavia* Harris⁵¹ from Alabama. It is a much larger and heavier shell, but is closer to that species than any that has been described.

Unfortunately, the single shell from Soldado is so fragmentary that all the

⁵¹ Bull. Am. Pal., Vol. I, pp. 205-206, pl. 8, figs. 16, a, 17, 1896.

columellar characters are lost. But the anterior canal appears not to have been sharply reflexed. In this as well as in the general form of the spire it resembles *mediavia*.

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

Geological horizon.—Midway Eocene.

Genus **MELONGENA** Schumacher, 1817.

Melongena melongena Linnæus. Plate XI, Figure 5.

Pyrula melongena Linnæus, Syst. Nat., Ed. 12, 1220.

Pyrula melongena Guppy, Geol. Mag., p. 438, 1874 (*pars*).

Melongena melongena Tryon, Man. Conch., vol. III, p. 107, 1881.

Remarks.—This species does not extend below the Pliocene. In the Oligocene of Jamaica and Haiti and in the Manzanilla beds of Trinidad there is a closely related form, *Melongena consors* Sowerby. Gabb in 1873 regarded the latter species as identical with the Pliocene and recent *M. melongena*; but Dr. Guppy in 1876 questioned this,—and Dr. Dall in 1890 after examining the Santo Domingan shells decided they were specifically distinct.

As is characteristic with the genus, *M. melongena* varies greatly in the development of spines. It is found living throughout the West Indies. Some specimens are occasionally entirely smooth and devoid of spines; but according to Tryon there are usually on adult shells one to three rows of spines on the upper part of the body whorl and an additional row half way to the base of the whorl. This is the case with the shell figured from the Quaternary of Venezuela. This specimen shows three rows of spines on the shoulder and one row near the base of the shell.

This species evidently flourished in the fauna of the raised beach near Guanoco, where it is well developed and abundant. It also occurs in the Pliocene and recent faunas of Trinidad. A large specimen measures 90 mm. in length and 68 in breadth.

Locality.—The Barranca, along the Guanoco and La Brea railroad about a mile northeast of Guanoco, Venezuela.

Geological horizon.—The fossils occur in a raised beach of Quaternary age.

Genus **PSEUDOLIVA** Swainson, 1840.

Pseudoliva bocaserpentis new species. Plate XI, Figure 6.

Description.—On first examination, this shell appeared as a varietal form of *P. scalina* Heilprin⁵² from the Midway Eocene of Alabama. But further study makes it appear rather as a distinct species. The single specimen obtained from Soldado Rock is unfortunately fragmentary but shows very well marked characters. These place it in an intermediate position between *Pseudoliva scalina* and *P. ostrarupis* Harris⁵³ from the Midway of Texas. The Soldado shell resembles *scalina* in having longitudinal plications on the body whorl, but these,

⁵² Proc. Acad. Nat. Sci. Phila., p. 371, pl. 20, fig. 12, 1880.

⁵³ Proc. Acad. Nat. Sci. Phila., p. 75, pl. 8, figs. 3a, 1895.

instead of extending to the sulcus as in that species, become obsolete a short distance below the shoulder; nor has the Soldado shell the five impressed spiral lines revolving round the basal part of the body whorl below the sulcus,—only one rather faint line is present. A more striking difference between these forms is the breadth of the shoulder of the last volution in the Soldado shell, and the very strong wrinkles which pass diagonally across it and over the penultimate whorl. These wrinkles recall at once those of *P. ostrarupis*, but in that species they do not extend over the preceding whorl; the Soldado shell also resembles *P. ostrarupis* in the general form of the lower part of the body whorl which is broader and less pointed than in *scalina*.

As the Soldado shell is thus about equally allied to both *scalina* and *ostrarupis* of the Gulf Coast Midway, it would be perplexing to determine which affinity is closer, and rather than place it as a variety of either, it is described as an independent, but intermediate species.

Remarks.—It is an interesting fact showing the close resemblances between the Soldado Rock, Bed No. 2 fauna, and that of the southern United States that a specimen of *scalina* from the Lignitic beds at Nanafalia, Alabama, in the Cornell University Paleontological Museum (No. 12110) shows the same tendency of the longitudinal plications to become obsolete not far below the shoulder of the last volution. The diameter of the Soldado *Pseudoliva* is about 15 mm.

Dr. C. A. White in 1887 described from the Rio Maria Farinha beds, State of Pernambuco, Brazil, *Harpa dechordata*,⁵⁴ which Professor Harris in 1896 placed with a question under the synonymy of *Pseudoliva scalina*.⁵⁵ This Brazilian form is unlike the Soldado shell, but it is very like *Pseudoliva scalina* which it almost certainly is.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to that of Alabama and of Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus **COLUMBELLA** Lamarck, 1799.

Columbella labreana new species. Plate XII, Figure 1.

Description.—Shell very small, biconic, very convex; number of whorls five, the first being nuclear, very small and smooth (lacking in the specimen illustrated); subsequent whorls ornamented by flattened spiral threads most marked towards the base of the shell and becoming obsolete above the middle of the last volution; longitudinal sculpture of regular, narrow, close-set, rounded ribs (eighteen on the last whorl), not extending quite to the suture, being interrupted above by a narrow, subsutural band; outer lip somewhat thickened, internally dentate on the margin and lirate within, columella very finely and closely plicate.

Height of shell 5, greatest width 2 mm.

Remarks.—This little shell seems to be akin to Sowerby's *C. haitensis*, as far as one can judge by a bare description.

⁵⁴ Arch. do Museu Nac. do Rio de Janeiro, VII, pp. 136-137, pl. XIII, figs. 7, 8.

⁵⁵ Bull. Am. Pal., I, p. 214.

It is very like specimens of the recent *Columbella* (*Anachis*) *obesa* C. B. Adams from the shores of the Gulf of Mexico, but is larger and stronger than the latter shell, of which it would seem to have been an ancestral form.

Locality.—Along the shore 700 feet east of the pier at Brighton, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene. Approximately equivalent to the Chipolan stage of Florida.

Columbella asphaltoda new species. Plate XII, Figure 2.

Description.—Shell of moderate size, broadly fusiform, with an acute spire; number of volutions seven, of these the first two are nuclear and nearly or quite smooth; subsequent whorls ornamented by regular, rather close-set, narrow, sharply defined, longitudinal ribs (sixteen on the last whorl), extending from suture to suture, and on the last whorl beyond the periphery, becoming obsolete on the base; spiral sculpture of rather strong flattened threads, most marked on the base and interspaces between the ribs, which they do not cross except at the basal portion of the shell; aperture elliptical, rather short and broad, inner lip not plicate, with a mere wash of callus, outer lip very slightly thickened with only three or four faint liræ within.

Height of shell 16, greatest width 7 mm.

Remarks.—Of the *Columbellas* described from the Antillean beds this shell in its type of sculpture is nearest to *C. venusta* Sowerby from Santo Domingo and Cumana, Venezuela. The latter shell is however a more slender and elongated form with a strongly lirate outer lip and a plicated columella.

This shell and *C. labreana* are the first *Columbellas* yet found in beds older than Pliocene on Trinidad.

Locality.—On the shore 700 feet east of the Brighton pier, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene, about equivalent to the Florida Chipolan.

Genus **TROPHON** Montfort, 1810.

Trophon progne ? White. Plate XI, Figures 7, 8.

Trophon progne White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 139-140, pl. XI, fig. 14, 1887.

White's original description.—"Shell short, fusiform; spire much shorter than the last volution, including the beak, volutions six or more in number, convex, angular at their periphery; the last volution proportionally large; the distal side of the volutions of the spire broader than the proximal side, flattened and sloping outward and forward from the suture; the peripheral portion of the volutions bearing prominent nodes or short varices which, on the last volution, become subspinous. The surface of the distal side of the volution is marked only by lines of growth, but the proximal side is marked by coarse revolving raised lines, and these are crossed by distinct lines of growth; aperture large; columella strong; canal short; beak reflexed.

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"Length 26 mm.; breadth of the last volution 18 mm."

Type locality. Rio Maria Farinha beds, State of Pernambuco, Brazil.

Remarks.—Two fragments of a *Trophon*, probably of this species, were found at Soldado, but their condition is such that a positive identification is not possible. They may have constituted a variety of Dr. White's species, for the sculpture of transverse raised lines is closer and less regular, and one shell evidently was considerably larger than the Brazilian type.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus **PURPURA** Bruguière, 1789.

Purpura sp. indet. Plate XII, Figure 4.

A fragment of an interior mould of a species of *Purpura* was found south of Pitch Lake.

In the general form and presence of two rows of nodules on the periphery of the body whorl it recalls young shells of the recent species *Purpura hæmastoma* Linn. of which it is apparently an ancestral form.

No positive identification is possible because of the very imperfect condition of the fossil.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown, ferruginous marl.

Geological horizon.—Upper Oligocene.

Cymia woodii Gabb. Plate XI, Figures 9, 10.

Fasciolaria Woodii Gabb, Jour. Acad. Nat. Sci. Phila., 2d ser., IV, p. 375, pl. 67, fig. 7, 1860;

Conrad, Proc. Acad. Nat. Sci. Phila., XIV, p. 561, 1863.

Fasciolaria Woodii Conrad, Am. Jour. Conch., III, p. 186, 1867.

Cuma tectum Gabb, Trans. Am. Phil. Soc., n. s., XV, p. 214, 1873.

Not *Cuma tectum* of Kiener (*Pyrula tectum*), nor of Wood (*Buccinum tectum*), nor of Reeve (*Turbinella tectum*).

Cymia Woodii Dall, Trans. Wagner Inst. Sci., III, p. 155, 1890.

Fasciolaria Woodii Whitfield, Monograph U. S. Geol. Surv., No. XXIV, pp. 98-99, figs. 7, 8, 1894. (Gabb's type refigured.)

Purpura (Cuma) Woodii Guppy, Canadian Inst. Trans., p. 390, 1909.

Gabb's original description.—"Fusiform; whorls four or five, flattened so as to make the sides of the spire nearly straight; outer lip plain; columella with one prominent fold; canal moderate, umbilicus nearly obsolete; surface marked by numerous revolving ribs which exhibit a slight tendency to alternate in size.

"Dimensions.—Length 1.3 in., width of body whorl .8."

Locality.—Miocene marl, near Shiloh, Cumberland Co., N. J.

Remarks.—The *Cymia* from Trinidad is very like specimens of *Cymia tectum* Wood, now living on the west coast. On comparing the fossil with shells in the Newcomb collection that were found living on the coast of Ecuador, the spires are almost exactly alike, but there is a difference in the contour and proportional lengths of the body whorls. The most striking difference, however, is that the

Trinidad shell has two rows of tubercles on the last volution. No doubt the Trinidad shell is the ancestral form of the living *C. tectum*.

The history of the description of the fossil shell is interesting. In 1873 Gabb found in the "Miocene" of Santo Domingo a large series of shells, similar to the specimens from Trinidad now under discussion, which showed a remarkable tendency to variations. He referred them to *Cuma tectum* Wood and remarked:⁵⁶ "This well known Panama shell is very common in the Santo Domingo beds, and goes through an astonishing series of variations. I have it with a rounded body, without a tubercle, and varying from that to a broadly angulated and umbilicated form, with six immense tubercles on the angle. Between these, and other extremes, I fortunately possess complete series connecting them without question."

But in 1860⁵⁷ Gabb had described *Fasciolaria woodii* from the "Miocene" marl near Shiloh, New Jersey. This is a nearly smooth form, externally not unlike a young *Fasciolaria*. Indeed, with only the two extremes to compare, one could not believe that the nearly smooth New Jersey form and the strongly tuberculated southern form are the same species. However, Dr. Dall on examining the type shell of Gabb's *Fasciolaria woodii* from New Jersey found that it was a typical *Cymia*. Later, on studying Gabb's series of "*Cuma tectum*" from Santo Domingo, he found that the smooth varieties grade perfectly into the New Jersey form. Hence the species called by Gabb *Fasciolaria woodii* and those referred by him to "*Cuma tectum*" from Santo Domingo are identical specifically. In Dr. Dall's opinion, however, the "*Cuma tectum*" of Gabb from the Santo Domingo beds is not the same species as the *Cuma tectum* of Wood and of Kiener, a recent species common in the Panama region and found along the west coast of Central America as far south as Ecuador (Newcomb). Dr. Dall says:⁵⁸ "On examining the unique type of Gabb's *Fasciolaria woodii* I saw at once that it is a typical *Cymia*; but my astonishment was great when, on looking over the large series of the Miocene fossil from Santo Domingo which Gabb had referred to *Cuma tectum*, I found that the two could not be separated specifically, and that neither should be referred to *C. tectum*."

"The *C. woodii* is a very variable shell with or without tubercles and peripheral carina, and varying much as some *Purpuras* do. The fine series at Philadelphia shows this well, and among the smoother varieties the exact duplicate of the New Jersey fossil can easily be found."

Dr. Dall⁵⁹ calls attention to the fact that Conrad's *Tritonopsis subalveatum*⁶⁰ may be this species, as it is a true *Cymia*. It was found at the base of the Vicksburg beds (Lower Oligocene) of Mississippi, but no positive specific identification of it has been made.

⁵⁶ Trans. Am. Phil. Soc., XV, p. 214, 1873.

⁵⁷ Jour. Acad. Nat. Sci. Phila., 2d ser., IV, p. 375, pl. 67, fig. 7, 1860.

⁵⁸ Trans. Wagner Inst. of Sci., III, p. 155.

⁵⁹ Trans. Wagner Inst. Sci., vol. III, p. 155.

⁶⁰ Jour. Acad. Nat. Sci. Phila., 2nd ser., II, p. 41, pl. 1, figs. 2, 8, 1850 = *Triton subalveatum*, *op. cit.*, I, p. 207, 1849.

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Locality.—Along the shore 700 feet east of the Brighton pier, Trinidad Island, in an impure asphalt.

Geological horizon.—Judging from the indications reviewed under the genus *Cymia*, and from the distribution of this series, the writer believes the horizon in which the shell was found to be approximately equivalent to the Chipola epoch (Upper Oligocene) of Florida.

Genus **MUREX** Linnæus, 1758.

Murex cf. *domingensis* Sowerby. Plate XII, Figure 3.

Cf. *Murex domingensis* Moore, Quart. Jour. Geol. Soc. London, vol. VI, p. 49, pl. X, fig. 5, 1850.

A fragment of an interior cast of a *Murex* was found in the ferruginous marl south of Pitch Lake.

In its general form it suggests *Murex domingensis* which is found in Jamaica, Haiti, and Cumana, Venezuela. It may perhaps be a cast of that species, but no definite determination is possible because of the fragmentary and imperfect condition of the fossil.

Locality.—Southern main road, just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown, ferruginous bed.

Geological horizon.—Upper Oligocene.

Genus **CASSIS** (Klein, 1753) Lamarck, 1799.

Cassis (*Phalium*) *guppyana* new species. Plate XII, Figures 5, 6.

Description.—Young specimens small, short and very rounded so as to appear almost globular; whorls about four or five; spiral sculpture of (1) fine revolving striæ which are most strongly marked on the lower part of the last volution, where, in well preserved shells, they alternate with finer raised lines, and (2) of three carinæ, one on the shoulder and two below; the humeral carina in all the specimens bears short, spinous nodules, while the two below either are nearly smooth (as in the figured shell) or are decorated with smaller nodules; characters of the columella and aperture concealed by the indurated matrix.

Height of fragment figured 13, greatest diameter 9 mm.

A fragment of part of the outer lip of a *Cassis* was found in the same bed as the young shells described above. The strong probabilities are that this is a fragment of an adult individual of the same species. It shows six well marked plications which, judging from the curve of the fragment, would be situated near the central part of the outer lip.

Remarks.—The Soldado *Cassis* is very closely allied to *Cassis* (*Phalium*) *brevidentatum* (Conrad) Aldrich.⁶¹ This has typically a single row of nodules on the shoulder, although Professor Harris has figured⁶² a variety from the Alabama Lignitic with the two lower carinæ nodular on the back of the shell but not in front. That variety, however, differs from the Soldado shell in being

⁶¹ *Cassidaria brevidentatum* Aldrich, Jour. Cinn. Soc. Nat. Hist., p. 152, pl. 3, fig. 20, 1885.

⁶² Proc. Acad. Nat. Sci. Phila., p. 479, pl. 22, fig. 10, 1896.

broadly and deeply sulcate between the carinae and the plications on the outer lip are obsolete.

The history of *C. brevidentata*, is rather confused. It was first mentioned by Conrad⁶³ from the Claiborne sands, but was not figured for many years. In 1890, a shell specifically the same was described by Dr. Dall⁶⁴ as *C. globosum* from the Oligocene of Chipola, Florida, and was figured in 1892.⁶⁵ Dr. Dall's figure 11, which is of a young Chipolan specimen, is very like the young Soldado form. Yet, although the general type is the same, the Soldado shell shows minor differences, as greater breadth of shoulder, more spinous and less rib-like nodules and a less highly sculptured spire. Moreover, if we may assume the fragment of the outer lip of the adult *Cassis* to be of the same species as the young shells, it settles the question rather definitely. It is strongly plicate even in the central part, while *brevidentatum* is described by Mr. Aldrich as smooth in the center; and Dr. Dall says that the outer lip of *globosum* is feebly denticulate.

For the above reasons the writer is disposed to regard the Soldado shell as a different species but closely allied to *C. brevidentatum* (= *globosum*).

The Soldado form is named in honor of Dr. R. J. Lechmere Guppy, of Port of Spain, Trinidad.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria, near the Serpent's Mouth.
Geological horizon.—Lignitic Eocene.

***Cassis togata* White.**

Strombus togatus White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 170-171, pl. XV, figs. 13, 16, 1887.

White's original description.—"Shell comparatively short; spire equal in length to about one-quarter of the full length of the shell; volutions five or more in number, the last one large; those of the spire convex; their distal side closely appressed against the preceding volution; each volution bearing from eight to ten narrow, abruptly raised, longitudinal varices, which end at the small appressed fold at the distal border of the volutions of the spire, but they reach the suture upon the proximal border. These varices on the last volution extend forward a little more than one-half its breadth, where they become obsolete. The surface upon the anterior portion of the last volution is marked by coarse, revolving, raised lines; and sharp, close-set lines of growth are visible on well preserved surfaces; aperture moderately large, ending in a short, slightly flexed canal at the front, and at the maturity of the shell the outer lip became expanded both laterally and posteriorly, its margin being everted and a little thickened, rounded at its postero-lateral portion, and bearing a shallow notch near the anterior portion.

"Length 29 mm., breadth of the last volution 16 mm."

Locality.—Maria Farinha beds, State of Pernambuco.

⁶³ Jour. Acad. Nat. Sci. Phila., 1st ser., vol. VII, p. 146, 1834.

⁶⁴ Trans. Wagner Inst. Sci., vol. III, pp. 161-162.

⁶⁵ *Ibid.*, p. 262, pl. 20, figs. 6, 11.

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Cassis togatus var. *soldadensis* new variety. Plate XII, Figure 7.

Remarks.—Two shells were collected by Mr. Veatch from Bed No. 2, Soldado Rock, which are very closely related to *Cassis togatus* White from the Maria Farinha beds, Brazil.

Dr. White's description and his figure 13 tally so well in the main with the Soldado shell that the differences between these forms seem varietal only.

Description.—The Soldado shells can be distinguished from those of Maria Farinha by their sharper varices; also in well preserved specimens, by the fine and beautiful cancellation of the entire surface of the body whorl due to the intersection of close, sharp transverse striæ with more delicate lines of growth.

This cancellation is slightly indicated in White's figure 15, but it is much sharper and more regular on the Soldado shell.

When complete the shells from Soldado would not have measured more than 23 or 24 mm. in length, while those from Brazil reached nearly 30 mm.

In general the Soldado variety was a somewhat smaller and more elegantly formed and sculptured shell than the Brazilian type. This species has not been found in the Eocene of our Southern States.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus *CYPRÆA* Linnæus, 1758.

Cypræa bartlettiana new species. Plate XI, Figures 11, 12, 13.

Description.—Shell small, solid, broadly pyriform, very globose; surface unsculptured, wholly smooth except for fine, transverse lines of growth; spire entirely enrolled and concealed, very slightly sunken; aperture rather narrow, widening towards the base; inner lip with about twelve fine plications decreasing in size from the base upwards, plications on the outer lip concealed by the indurated matrix; columella pinched at the base into a very sharp ridge.

Height 18, width 14, thickness 11 mm.

Remarks.—This and the succeeding species are the only *Cypræas* that have ever been described⁶⁶ from the Midway Eocene. A single species *C. smithii* has been described by Mr. Aldrich from the Lignitic of Alabama.⁶⁷ The latter shell is of somewhat the same general type as *C. bartlettiana*, and has the same sharp columellar ridge, but the form of the shell is flattened instead of globular.

In 1887 Dr. White described a peculiar *Cypræa*-like fossil from Rio Piabas, State of Para, Brazil, as *Cypræactæon pennæ*, new genus and species.⁶⁸ This has a very deeply sunken spire, and bears no resemblance to the Soldado shell.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

⁶⁶ Professor Harris (Bull. Am. Pal., vol. I, p. 217, 1896) mentions finding two *Cypræas* in the Midway of the Gulf States, one smooth, the other reticulated, but neither was sufficiently well preserved to describe or figure.

⁶⁷ Geol. Surv. Ala., Bull. 1, p. 33, pl. 5, fig. 3, 1886.

⁶⁸ Arch. do Museu Nac. do Rio de Janeiro, VII, p. 178, pl. IX, figs. 1-5.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Named in honor of Mr. F. R. Bartlett, of Easton, Maryland, who aided Mr. Veatch in collecting fossils from wave-swept Soldado.

Cypræa vauhani new species. Plate XI, Figures 14, 15.

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 peculiar *Cypræa* is wholly unlike anything described from the lower Eocene horizons.

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

Geological horizon.—Midway Eocene.

Named in honor of Mr. T. W. Vaughan, Washington, D. C., of the United States Geological Survey.

Genus *ROSTELLARIA* Lamarck, 1799.

Subgenus *Calyptrophorus* Conrad, 1857.

Calyptrophorus velatus Conrad var. *chelonitis* White.

Calyptrophorus ? chelonitis White, Arch do Museu Nac. do Rio de Janeiro, vol. VII, pp. 174-175, pl. XI, figs. 17, 18, 19, 1887.

Dr. White in 1887 described a *Calyptrophorus* from Rio Maria Farinha beds, Province of Pernambuco, Brazil, as *Calyptrophorus ? chelonitis*. His description was as follows: "Shell small, subfusiform; the side upon which the aperture opens at maturity is flattened by a large accumulation of callus, by which all trace of the division of the spire into volutions is obliterated upon that side and almost wholly upon the opposite side also. Upon the latter side the accumulation is more irregular, apparently leaving only one spot at the middle, upon which no callus was deposited when the shell reached maturity. The aperture is comparatively small, oblong, ending anteriorly in a minute channel which is excavated out of a long slender beak, which is straight and in line with the axis of the shell; outer lip a little thickened and reflexed, truncated at both the posterior and anterior ends; the outer margin gently convex and bearing at its anterior end a small obtuse projection."

In all respects except the very last, namely, the *obtuse* projection of the labrum—Dr. White's description answers to the Soldado forms. This character, however, is important, and brings the Brazilian shell closer to the type of *velatus* than those from Soldado. But as it is constantly smaller, and differs in some other respects from *velatus*, the writer would suggest that Dr. White's specific name *chelonitis* should be used as a varietal name to distinguish the Brazilian form of the species *velatus*.

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Locality.—Rio Maria Farinha beds, State of Pernambuco, Brazil.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the No. 2 bed of Soldado Rock, Gulf of Paria.

Calyptraphorus velatus Conrad var. *compressus* Aldrich. Plate XII, Figures 8, 9, 10.

Anchura White, U. S. Geol. Surv., Bull. No. 4, p. 17, 1884.

Rostellaria velata Aldrich, Geol. Surv. Alabama, Bull. No. 1, p. 59, 1886.

Rostellaria Smith and Johnson, U. S. Geol. Surv., Bull. No. 43, p. 66, 1887.

Calyptraphorus velatus Harris, Geol. Surv. Arkansas, vol. II, p. 46, 1892.

Rostellaria (C.) velatus var. *compressa* Aldrich, Geol. Surv. Alabama, p. 244, pl. 12, figs. 2, 2a, 2b, 1894.

Calyptraphorus velatus var. *compressa* Harris, Bull. Amer. Paleont., vol. I, p. 218, pl. 10, figs. 7a, b, 8, 1896.

Aldrich's original description of the variety.—"This form is intermediate between *R. trinodifera* Con. and *R. velata* Con. The adult has the enamel on the front part as in *R. trinodifera*, but on the opposite side the line of demarkation of the enamel comes down only to the (body) whorl. The specimens are also much smaller than the normal adult. A similar form that cannot be separated from this variety is common in the Matthew's Landing group, but is nearly twice as large, and more rotund than those figured. The figures given are somewhat larger than the type."

Remarks.—Professor Harris has found this variety in the Midway of Texas, Arkansas, Tennessee, Mississippi, Alabama and Georgia. He says⁶⁹ "The smaller type of this variety is common in the lower and medial Midway beds. It is one of the first to appear above the Eocene-Cretaceous contact line. The larger specimens differ from the *Calyptraphorus velatus* from the Claiborne sand mainly by the pointed exterior-posterior termination of the labrum; in *velatus* this portion of the labrum is rounded, as shown by figure 5, Plate 15, of Conrad's *Fossil Shells*, etc., 1835."

In view of the wide distribution of this variety in the Midway horizons of the southern states of North America—it is exceedingly interesting to find that it is a common shell at Soldado Rock, Bed No. 2. It occurs in it with masses of *Cucullæa harttii*, *Turritella mortoni*, *T. nerinexa*, *Venericardia planicosta* and a mass of moulds and fragments of other species forming a veritable shell breccia like the modern *coquina* rock.

One specimen of the *Calyptraphorus* fortunately shows the sharply pointed posterior termination of the labrum which differentiates this variety. The shells are the small early Midway type, the fragments measuring about 25 by 14 mm.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

⁶⁹ Bull. Am. Pal., I, p. 218, 1896.

Subgenus *Rimella* Agassiz.

Rimella fowleriana new species. Plate XII, Figure 11.

Description.—Shell of moderate size, rather broadly fusiform; number of whorls known five; sculpture on last volution consisting only of about fifteen delicate, spiral striæ revolving around the basal half of the whorl which is elsewhere entirely smooth; sculpture on penultimate whorl consisting of one strong medial spiral thread and a few rather irregular, more or less obsolete, longitudinal riblets, better developed on the earlier half of the whorl; sculpture on third whorl consisting also of one medial revolving spiral and a number of close-set longitudinal riblets or plications; the latter also form the ornamentation of the fourth and fifth volutions; each whorl has one or more rather inconspicuous varices.

Length of incomplete shell 21, greatest width 10 mm.

Remarks.—This is the first *Rimella* found in the Lower Eocene. None has before been discovered in either the Midway or Lignitic horizons of southeastern North America or northeastern South America.

The writer takes great pleasure in naming this shell in honor of Mr. William Fowler, of Guanoco, Venezuela, whose many kindnesses did so much to render pleasant her visit to Venezuela.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Rimella knappiana new species. Plate XII, Figures 12, 13.

Description.—Shell of moderate size, slender, subfusiform, with a high, very acute and tapering spire; whorls nine or ten; spiral sculpture, on very well preserved specimens, of microscopic striæ which are exceedingly fine all over the shell, and of about ten strong spiral lines at the base; longitudinal sculpture of sharp-edged, close-set plications which are present on all the whorls (although in some cases the whorls appear perfectly smooth, which is because the entire outer surface has been removed by erosion); this handsome and even plication of the whorls, extending over the last volution as well, immediately differentiates this species from *R. fowleriana*; characters of base of shell and outer lip shown by the second figure; the posterior canal in adult shells forms a sharply-ridged gutter extending almost to the tip of the spire to which it is adherent.

Height of shell 22, greatest width 8 mm.

Remarks.—This shell is one of the most abundant species in the Soldado Lignitic fauna.

The writer takes great pleasure in naming it in honor of Mr. I. N. Knapp, of Morgan City, Louisiana, whose kind gift of deep well fossils has done so much to further our knowledge of the depth and extent of the Quaternary strata of the Gulf States.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *ROSTELLARIA* Lamarck, 1799.Subgenus *Veatchia* new subgenus.

Description.—A single fragment of a shell was found at Soldado Rock, Bed No. 2, which in general form resembles the subgenus *Orthaulax* Gabb. It differs, however, from the latter in a very curious characteristic which marks it as altogether *sui generis*.

This differentiating character is the curving into loops of the posterior canal, which is adherent to the upper portion of the body whorl. In this respect the shell approaches the subgenus *Calyptraphorus* Conrad, in which the posterior canal makes one semicircular curve over the dorsal side of the body whorl.

Thus the subgenus *Veatchia* lies in an intermediate position between the subgenera *Orthaulax* and *Calyptraphorus*.

The writer dedicates this new subgenus to Mr. Arthur C. Veatch, of Washington, D. C., in pleasant memory of our geological work in Venezuela.

Veatchia carolinæ new species. Plate XII, Figures 14, 15, 16.

Description.—Shell when complete rather large, thick and heavy, spire short, obtusely pointed, whorls completely concealed, all the upper portion of the shell being self-enrolled by the posterior prolongation of the last volution, which is wrapped about the spire like a mantle; characters of the columella and anterior canal not known; posterior canal described above under the subgenus.

Height of fragment 27, greatest width 28, greatest thickness 21 mm.

This species is named in honor of Mrs. Veatch.

It is the type of the subgenus.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus *CERITHIUM* Adanson, 1757.

Cerithium harrisii new species. Plate XII, Figure 18.

Description.—Shell rather small, solid, strong; conic, with an acute spire; nuclear whorls two, smooth; subsequent whorls four, ornamented on the penultimate volution by three spiral rows of bead-like nodules, with intervening faint, spiral threads; last volution also with three prominent rows of beads alternating with spiral threads, but with a similar, though more or less obsolete, ornamentation over the basal part of the whorl; penultimate whorl with a varix which angulates the outline of the shell; body whorl with two rather strong varices.

Height of shell 15, greatest width 5 mm.

Remarks.—Dr. Guppy cites *C. uniseriale* Sow. and *C. plebium* Sow. from Trinidad, to neither of which this shell bears any except a generic resemblance.

Gabb briefly described about ten species of *Cerithium* from Haiti. These have never been figured, and without the types it is almost hopeless to attempt to recognize them.

Locality.—Along the shore 700 feet east of the pier at Brighton, Trinidad, in an impure asphalt.

Geological horizon.—Upper Oligocene, about equivalent to the Chipolan stage of Florida.

Cerithium isabellæ new species. Plate XII, Figure 19.

Description.—Shell short and broad, conic, with a rather obtuse spire; whorls about five, of which the penultimate is ornamented with three spiral rows of bead-like nodules, with sets of three (less frequently two) revolving spiral threads intervening between the rows of beads; last volution also with three main rows of nodules with intervening sets of spiral threads, this ornamentation being continued more or less obsoletely towards the base of the shell; varices apparently not developed (shell partially concealed by the matrix).

Height 16, greatest width 8 mm.

Remarks.—This shell resembles in form and sculpture *C. webbi* Harris from the Lower Claiborne Eocene of Texas. It is an interesting fact that three species of *Cerithium* described in this report (*C. soldadense*, *C. harrisii*, and *C. isabellæ*), should resemble the Texan shell, and be quite unlike any figured from Florida.

This species can be distinguished from the closely related form, *C. harrisii*, by its much broader proportions, greater number of spiral threads, and absence of varices.

Locality.—Along the shore 700 feet east of the pier at Brighton, Trinidad, in an impure asphalt.

Geological horizon.—Oligocene. About equivalent to the Chipolan stage of Florida.

Cerithium soldadense new species. Plate XII, Figure 20.

Description.—Shell small, convex, number of whorls not known; transverse sculpture of narrow, curving, rather irregular, plications, present chiefly on the penultimate volution; spiral sculpture of revolving beaded threads alternating with finer beaded lines; on the body whorl there are two or three of the coarser beaded threads, and then a fine row of beads just below the suture.

Diameter of last whorl 4 mm.

Remarks.—This species has no resemblance to any described from the Midway of the southern States, nor has it been found in the Maria Farinha beds of Brazil. Its closest affinity in general form and type of sculpture is *C. webbi* Harris⁷⁰ from the Lower Claiborne Eocene of Texas.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, in the Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and that of the Rio Maria Farinha Beds, State of Pernambuco, Brazil.

⁷⁰ Proc. Acad. Nat. Sci. Phila., p. 79, pl. 9, fig. 3, 1895.

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Cerithium tinkeri new species. Plate XII, Figure 17.

Description.—Shell, judging from the gutta-percha cast made from its impression, rather broad, solid and strong, number of whorls known seven; longitudinal sculpture of numerous narrow riblets which are interrupted by four or five impressed spiral lines, the one immediately below the suture constituting a narrow groove.

Height approximately 25 mm.

This species is named in honor of Dr. Tinker, of Cornell University.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a ferruginous marl.

Geological horizon.—Upper Oligocene.

Genus *CERITHIOPSIS* Forbes and Hanley, 1849.

Cerithiopsis veatchiana new species. Plate XII, Figure 21.

Description.—Shell small and slender, tapering to a high, acute spire; whorls fourteen, of which the three nuclear are smooth, the fourth from the apex ornamented only with revolving striae; subsequent volutions with (a) four or five rather strong spiral threads; and (b) numerous narrow, oblique longitudinal plications (about twenty on the last volution); these at their intersections with the spiral threads become slightly nodular; columella showing two rather faint plications.

Height of shell 8, greatest width 3 mm.

Remarks.—This very delicate little shell is unlike any described from the Lower Eocene.

It is dedicated to Mr. Arthur C. Veatch, of Washington, D. C., by whom it was found.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *TURRITELLA* Lamarck, 1799.

Turritella humerosa Conrad.

T. humerosa Conrad, Trans. Geol. Soc. Penn., vol. 1, p. 340, pl. 13, fig. 3, 1835.

T. humerosa H. C. Lea, Proc. Acad. Nat. Sci. Phila., vol. IV, p. 107, 1848.

T. humerosa Conrad, Amer. Jour. Conch., vol. I, p. 32, 1865.

T. eurynome Whitf., Amer. Jour. Conch., vol. I, p. 266, 1865.

T. multilira Whitf., *ibid.*, p. 266.

T. bellifera Ald., Geol. Surv. Ala., Bull. No. 1, p. 34, pl. 1, fig. 13, 1886.

*Turritella elicit*a White, Arch. do Museu Nac. do Rio de Janeiro, VII, pp. 162-163, pl. XVIII, figs. 6, 7, 1887. Not of Stoliczka.

T. cathedralis var. *bellifera* De Greg., Mon. Faun. Eoc. Ala., p. 127, pl. 11, figs. 17, 18, 1890.

T. humerosa Harris, Amer. Jour. Sci., ser. III, vol. XLVII, p. 303, 1894.

T. humerosa Clark, Bull. 141, U. S. Geol. Surv., p. 70, pl. XIV, fig. 1, 1896.

T. humerosa Harris, Bull. Amer. Pal., vol. I, pp. 110-111, pl. 11, fig. 11 (typical), 1896; Bull.

Amer. Pal., vol. III, p. 75, pl. 10, figs. 5, 6, 7, 1899; Geol. Surv. La., p. 308, pl. 55, fig. 5, 1899.

T. humerosa Clark, W. B., Eocene, Md. Geol. Surv., pp. 148-149, pl. XXVII, figs. 1, 1a, 1901.

*T. elicit*a Arnold in Branner, Bull. Mus. Comp. Zoology, Harvard College, vol. XLIV, 1904.

Conrad's original description.—"Shell turritid, subulate; whorls with fine regular revolving striae; an obtuse slight elevation on the summit, a shallow groove at the base of each.

"From the Eocene of Piscataway, Maryland."

Remarks.—Dr. C. A. White in 1887⁷¹ described and figured a *Turritella* from the Rio Maria Farinha beds, State of Pernambuco, Brazil, which he identified as *Turritella elicita* Stoliczka, originally described from the Cretaceous rocks of southern India.⁷²

Dr. White says: "The Brazilian examples differ from the Indian only in a little greater distinction of the revolving lines which mark the surface; but this may be due to a difference attending the fossilization of the shells; and if not, it is not deemed of specific importance." The Maria Farinha specimens were all fragmentary, but the full length of an adult example was estimated by Dr. White as not far from 150 mm. with a diameter of the last volution of 27 mm. Now the Brazilian shell differs from that from Soldado in the presence in the former of slender revolving raised lines, and in the greater prominence of the rounded ridge at the distal border of each volution near the suture. These characteristics, especially as indicated in Dr. White's fig. 7,⁷³ ally the shell more closely with typical *T. humerosa* Conrad than with the Soldado variety or with the Indian *Turritella elicita* Stol. Indeed Dr. White's figures are so exactly like typical specimens in the Cornell University Museum of *T. humerosa* from Nanafalia, Alabama, that there can be no question of the identity of the Brazilian and Alabama forms.

This species ranks secondary to *T. mortoni* as a typical lower Eocene shell.

Professor Harris has found that although this species is most typically represented in the Lignitic of Alabama, Virginia and Maryland, it occurs very abundantly in nearly all horizons of the Midway, and displays a remarkable variety of forms. It is common in Alabama, Texas and Arkansas.

The true identity of the Maria Farinha *Turritella* is thus not with the Cretaceous species of India, *T. elicita* Stoliczka from the Arrialoor group; but with Conrad's *T. humerosa* from the North American Lower Eocene. The same species was found by Dr. Branner in Ponto das Pedras, State of Pernambuco, Brazil, where the fauna is of the same age as that of Maria Farinha.

Turritella humerosa Conrad var. *elicitoides* new variety. Plate XII, Figure 22.

Cf. Turritella elicita Stoliczka, Pal. Indica, II, p. 221, pl. XIV, fig. 3, 1868.

Remarks and description.—Several fragments of a *Turritella* resembling *T. humerosa*, were obtained from Soldado Rock, Bed No. 2. These show none or only the very faintest traces of the "fine revolving striæ" characteristic of the typical specimens. In this respect they are like a large variety of this species from Prairie Creek (No. 204 U. S. Nat. Mus.), figured in Professor Harris' Midway stage;⁷⁴ but the whorls of that shell are much shorter proportionally than those of the Soldado form. The latter also resembles a rather smooth specimen (not typical) from Nanafalia, Ala.

⁷¹ Arch. do Museu Nac. do Rio de Janeiro, pp. 162-163, pl. XVIII, figs. 6, 7.

⁷² Pal. Indica, vol. II, p. 221, pl. XVI, fig. 3, 1868.

⁷³ *Loc. cit.*

⁷⁴ Bull. Amer. Pal., vol. I, pl. 21, fig. 12, 1896.

The Cretaceous shell described by Stoliczka⁷⁵ as *Turritella elicita* from the Arrialoor group at Ninnyoor, southern India, is much more closely allied to the Soldado shells than to those of Maria Farinha, Brazil, with which Dr. White identified it, but, judging from the illustration, the Indian *Turritella* was more slender in proportion to its length than the Soldado form.

Stoliczka's original description of *T. elicita* is as follows: "Turr. testa perlonga, valde attenuata anfractibus numerosis, postice late tumescentibus, ad medium paulo excavatis, superioribus spiraliter minute striatis atque liratis, inferioribus lævigatis; striis incrementi minutis, supra medium valde insinuatis; ultimo anfractu ad peripheriam basalem subcarinato; basi paululum producta; apertura subquadrangulari, altiore quam lata."

Both the Indian and the Soldado shell show a marked flattening of the prominent ridge at the distal border of the whorls close to the suture. Judging from the fragments the Soldado adult shells must have been about 140 mm. in length. But as only few and fragmentary specimens have been obtained from the Soldado Midway and from the Indian Cretaceous beds (Ninnyoor, Arrialoor group) exact comparisons cannot be made. At present one can only say that with the exception of its slenderer form the Indian *Turritella* appears to be almost identical with that from Soldado. Whether this resemblance is due to specific descent or merely to parallelism in development is left as an interesting and open question.

Locality.—Bed No. 2, Soldado Rock, Gulf of Paria, near the Serpent's Mouth.

Geological horizon.—Midway Eocene. Equivalent to that of the Alabama Midway and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Turritella nerinexa Harris. Plate XII, Figure 25.

Turritella nerinexa Harris, Proc. Acad. Nat. Sci. Phila., p. 82, pl. 9, fig. 9, 1895.

Turritella nerinexa Harris, Bull. Amer. Pal., vol. I, p. 225, pl. 11, fig. 14, 1896.

Harris' original description.—"Size and general form of a fragment (the only known specimen) as indicated by the figure; number of whorls unknown, ornamented by (1) fine, even spiral striæ, (2) a subsutural row of pustules or crenules, and (3) a slightly raised or faint ridge at the base of each whorl becoming obsolete in the lower whorls, but increasing in strength above so as to nearly equal in size the subsutural line of crenules.

Locality.—Black Bluff, Brazos River, extreme northern limit of Milam Co., Milam Bluff of Penrose's report.

Geological horizon.—Midway Eocene.

Type.—Texas State Museum."

Remarks.—It is most interesting to find at Soldado this *Turritella* which is as beautiful as it is rare. After finding the single specimen in Texas, Professor Harris later found others, also in the Midway Eocene, in Alabama, and in Arkansas.

The shells from Soldado answer the description of the type perfectly. One

⁷⁵ Pal. Indica, Geol. Surv. India, vol. II, p. 221, pl. XIV, fig. 3, 1868.

rather large specimen even shows the typical characteristic of the ridge above the row of beadings becoming obsolete on the lower whorls.

Height of shell figured 20, greatest diameter 9 mm. Greatest diameter of largest specimen found at Soldado 12 mm.

In 1887 Dr. White described a shell with very similar form and ornamentation from the Maria Farinha beds, Province of Pernambuco, Brazil, under the name of *Nerinea buarquiana*.⁷⁶

As Professor Harris has already pointed out,⁷⁷ this species has much in common with *T. nerinexa*.

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

Geological horizon.—Basal (Midway) Eocene. Equivalent to the Midway of Alabama and of the Maria Farinha beds, Brazil.

Turritella mortoni Conrad. Plate XII, Figure 23.

Turritella mortoni Conrad, Jour. Acad. Nat. Sci. Phila., vol. VI, pt. 1, p. 221, pl. 10, fig. 2, 1829.

Turritella mortoni Conrad, Fossil Shells of the Tertiary Formation of North America, vol. I, No. 3, p. 40 (96), pl. XV, fig. 11, 1835.

Turritella mortoni H. C. Lea, Proc. Acad. Nat. Sci. Phila., vol. IV, p. 107, 1848.

Turritella mortoni Conrad, Am. Jour. Conch., vol. 1, p. 32, 1865.

Turritella mortoni Heilprin, Proc. Acad. Nat. Sci. Phila., vol. 31, p. 219, 1879.

Turritella sylviana (Hartt) White, C. A., Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 161-162, pl. XVIII, fig. 10, 1887.

Turritella mortoni Smith and Johnson, U. S. Geol. Surv., Bull. 43, pp. 30, 33, 1887.

Turritella mortoni de Gregorio (ex parte), Am., Geol. et Pal., p. 122, pl. 11, fig. 7, 1890.

Turritella mortoni Kennedy, Proc. Acad. Nat. Sci. Phila., vol. 47, p. 147, 1895.

Turritella mortoni Clark, W. B., U. S. Geol. Surv., Bull. No. 141, pp. 40, 44, 45, 46, pl. XIII, figs. 1a-1e, 1896.

Turritella mortoni Harris, Bull. Am. Pal., vol. I, p. 224, 1896; Geol. Surv. Louisiana, p. 229, pl. 52, fig. 9, p. 308, pl. LV, fig. 4, 1899; Bull. Am. Pal., vol. III, pp. 74-75, pl. X, figs. 3, 4, 1899.

Turritella mortoni Clark and Martin, Eocene, Md. Geol. Surv., pp. 147-148, pl. XXVI, figs. 1-5, 1901.

Conrad's original description.—"Shell turreted, conical, thick, with revolving distant, and finer intervening striæ; whorls with an elevated acute carina near the base of each; volutions about 11; the striæ are largest on the elevations of the whorls, which are slightly concave above, and abruptly terminate at the sutures; the lines of growth on the last whorl are strong and much undulated."

Type locality, Maryland.

Remarks.—This *Turritella*, which is a rather common species at Soldado Rock in the Bed No. 2 fauna, is one of the most important and characteristic fossils of the Lower Eocene deposits of the Atlantic and Gulf coasts of the United States. It was first described by Conrad in the Maryland Eocene where it is exceedingly abundant. Dr. Clark⁷⁸ shows a photograph of blocks of the Aquia Creek formation made up almost wholly of *T. mortoni*. And great masses of this *Turritella* rock strew the shore at the base of the Aquia Creek and the Potomac Creek bluffs.

Professor Harris⁷⁹ remarks that this species occurs in the form of casts in great abundance, large size and of most typical form in a soft layer in the Midway

⁷⁶ Arch. do Museu Nac. do Rio de Janeiro, pp. 142-144, pl. XIV, figs. 8, 9, 10, 11.

⁷⁷ Bull. Am. Pal., I, p. 225, 1896.

⁷⁸ Eocene Md., 1901, pl. III, fig. 2.

⁷⁹ Bull. Am. Pal., vol. I, p. 224.

limestone near its base along the Chattahoochee River. Other Midway localities where more or less typical forms have been obtained are in Texas near Kemp, Kaufman County, and in Arkansas near Little Rock. The species also occurs in Tennessee (Middleton), Alabama, and Mississippi; and later Professor Harris adds that the shell presents a great many varietal forms in the Lignitic, and finally merges through the variety *postmortoni* Harris into *T. carinata* of the Claiborne Eocene.

Such being its distribution on the North American continent we will now trace it as far as known in the South American region.

In 1887 Dr. White described *Turritella sylviana* (which is specifically identical with *mortoni*) from the Rio Maria Farinha beds in the State of Pernambuco, Brazil. The figures are very like the Soldado shells both in form and size. It appears as if *T. mortoni* in the far south had become smaller; or else all found so far have been young individuals.

The shells from Soldado Rock, Bed No. 2, are in every respect remarkably close to Conrad's type. They show the sharp carination of the lower part of each whorl which gives a slightly overhanging effect, and the tendency, like the type, to three prominent raised lines near the base of the whorls. They differ only in being smaller.

Length of shell figured approximately $16\frac{1}{2}$ mm., breadth of last volution 6 mm. This is close to the Pernambuco shells which measured about 18 by $6\frac{1}{2}$ mm.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Maria Farinha beds, Pernambuco, Brazil.

History of the genus.—It is a singular fact that the genus *Turritella*, which began in the Cretaceous, and is so very abundantly represented in the American Tertiaries, in which more than eighty species have been named, should be rare in our seas of to-day. Very few species and individuals are now found, especially on the Atlantic coast of the Americas.

Turritella mortoni Conrad var. Plate XII, Figure 24.

Remarks.—A number of specimens of a *Turritella* were found in the Lignitic fauna of Soldado.

They are probably a varietal form of *T. mortoni* Conrad.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Turritella soldadensis new species. Plate XII, Figure 26.

Description.—Shell small, slender, number of whorls not known; sculpture on each volution consisting of three primary spiral ridges; of which the one directly above the suture is by far the most prominent; and of very faint intermediate spiral threads, only visible with a lens. The lowest basal revolving ridges have a slightly beaded aspect which may be due to erosion.

Height of fragment 12, greatest diameter 6 mm.

Remarks.—This species is allied to *T. clevelandia* Harris⁸⁰ from the upper Eocene (Jackson) of Arkansas, which is also ornamented by "three prominent revolving lines and a few subordinate ones," but each volution slopes abruptly both above and below to the suture; making a deep furrow at the sutural lines, which is not the case in the Soldado shell.

Another allied species apparently more closely related is *T. soaresana* (Hartt) White⁸¹ from the Rio Maria Farinha beds of the State of Pernambuco, Brazil. This has the same type of ornamentation, but is also more excavated at the sutures, and was an apparently larger shell than *T. soldadensis*.

Locality.—Bed No. 2, Soldado Rock, near the Serpent's Mouth, Gulf of Paria.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Genus **MESALIA** Gray, 1842.

Mesalia pumila Gabb.

Turritella pumila Gabb, Jour. Acad. Nat. Sci. Phila., vol. IV, p. 392, pl. 68, fig. 14, 1860.

Mesalia pumila Harris, Bull. Am. Pal., I, p. 226, pl. 11, fig. 15, 1896.

Gabb's original description.—"Turrited, whorls? (spire is broken) rounded and strongly striate; mouth round; shell very thick; surface marked by three heavy revolving lines on the convexity of the whorl, and one at the base just above the suture, which is small but distinct.

"*Dimensions.*—Length of fragment .5 in., width of body whorl .3 in., diameter of mouth .1 in."

Type locality, Middleton, Tennessee.

Remarks.—During the Lower Eocene period this species developed many varieties. Two of these are in the Soldado Rock, Midway, fauna.

Mesalia pumila var. **allentonensis** Aldrich. Plate XII, Figure 27.

Turritella allentonensis Aldrich, Geol. Surv. Alabama, p. 246, pl. 13, figs. 4a, 6, 1894.

Mesalia pumila var. *allentonensis* Harris, Bull. Am. Pal., I, p. 227, pl. 11, figs. 20, 21, 1896.

Description.—In the Paleontological Museum of Cornell University there are several specimens of this variety from the Midway Eocene near Palmer's Mill, Alabama, which are very close to one of the Soldado shells. The latter has four or five instead of the typical three heavy revolving lines, and is more deeply channeled at the suture than is the type.

Height 34, greatest width 14 mm.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds of Brazil.

Mesalia pumila var. **nettoana** White. Plate XII, Figure 28.

Mesalia nettoana White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 164-165, pl. XVIII, figs. 3, 4, 1887.

⁸⁰ Rept. Geol. Surv. Arkansas, vol. 2, p. 170, pl. 6, fig. 9, 1894.

⁸¹ Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 160-161, pl. XVIII, figs. 8, 9, 1887.

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Remarks.—The majority of the Mesalias from Soldado Rock, Bed No. 2, are somewhat further removed from Gabb's type of *M. pumila* than the variety *allentonensis*. These correspond to Dr. White's description and figures of *M. nettoana* from the Rio Maria Farinha beds in Brazil. The Soldado shells are of practically the same size and are also ornamented with seven, or more rarely eight, raised revolving lines. There is no question of the identity of the Soldado and Brazilian shells.

White's original description.—"Shell moderately elongate; volutions ten or more in number; distinctly and regularly convex, and marked by seven abruptly raised revolving lines or slender ridges of nearly uniform size, and which are separated by interspaces of about equal width with the ridges; the anterior side of the last volution is marked by four or more revolving ridges similar to the others; aperture moderately large, subcircular in outline.

Length about 55 millimeters; breadth of the last volution 22 mm.

Comparison of the Soldado with other forms.—On the front of the specimen figured, the four revolving ridges at the very base of the last volution, mentioned by Dr. White, have apparently been eroded away and the surface seems smooth, but the lines show well on the other side of the shell.

Height of largest fragment from Soldado 42 mm. Diameter of specimen figured 20 mm.

This variety would seem not to have been confined to the tropics; for in the Paleontological Museum of Cornell University there is a specimen (No. 10122) of *Mesalia pumila* Gabb from one mile north of Midway of Alabama of precisely the same form and size as one of these Soldado shells, from which it differs only in having one or two finer raised revolving lines. Otherwise they cannot be distinguished.

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

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds in Brazil.

Genus *SOLARIUM* Lamarek, 1799.

Solarium stephaneporum new species. Plate XIII, Figures 1, 2.

Description.—Shell circular in outline, depressed conic, being rather more flattened than the majority of the genus; whorls six, of which the uppermost are small and nuclear; volutions ornamented by (a) transverse, oblique, faint lines of growth, visible only with a lens; (b) coarser and finer raised spiral threads, not beaded. The sculpture of the last volution consisting of (counting from the suture towards the periphery) three or four fine, close-set spirals, bounded by a more prominent spiral, these occupying the flat area of the whorl; then follows a sloping area ornamented by two fine spirals followed by a stronger one, which with two following form the rounded keel of the shell; under surface as far as not obscured by the matrix is also ornamented by spiral threads.

Height of shell 7, greatest diameter 17 mm.

Remarks.—This simply but handsomely sculptured shell bears a considerable resemblance to flatter specimens of Heilprin's *S. cupolum* from the Lignitic of Alabama. But although the general type of sculpture is not unlike, the base and periphery of the Alabama shell is wholly different, the periphery having a sharp, overhanging keel while that of the Soldado shell is evenly and gently rounded. The other Solariums which resemble *S. stephanephorum* in shape have the beaded type of sculpture which shows a specific difference.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus **AMPULLARIA** Lamareck, 1799.

Ampullaria luteostoma Swainson. Plate XIII, Figure 3.

Several broken shells of this species were found in the Barranca near Guanoco, Venezuela. These match exactly shells of the same species now living in the water near by, and our drawing shows the broken fossil shell (shaded) supplemented by a recent one (dotted line) of the same size.

Ampullaria luteostoma is very common in the streams and ditches in Venezuela. It shows great variation in color designs; some shells being a uniform yellowish-green, while others are variously banded with chocolate or reddish brown.

Locality.—The Barranca, along the Guanoco-Felicidad railway, Venezuela.

Geological horizon.—Pleistocene. A raised beach formation.

Ampullaria (Ceratodes) cornuarietis Linn. Plate XIII, Figure 4.

Remarks.—Like all the Ampullarian shells belonging to the section *Ceratodes* Guilding (*Marisa* Gray) this species is discoidal in form, resembling superficially *Planorbis*.

Ceratodes cornuarietis lives in Brazil, and is exceedingly common in Venezuela where it is much prized by the Guarauno Indians as an article of food. The writer has seen it in hundreds in the brackish water streams and ditches along the Guanoco-Felicidad railway. It varies greatly in its decoration of bands,—some shells being of a uniform amber color, while others are handsomely variegated with bands of reddish brown of various widths and patterns.

A few broken specimens of this species were found in the shell bank near Guanoco above the ditch in which the recent shells are living.

The fossil and recent forms are exactly alike, and the figure shows the fossil fragmentary shell (shaded) supplemented by a recent one of the same size (lined only).

Locality.—The Barranca, along the Guanoco-Felicidad railway, Venezuela.

Geological horizon.—The fossils are found in a raised beach of Quaternary age.

Genus **CALYPTRÆA** Lamareck, 1799.

Calyptrea aperta Solander. Plate XIII, Figure 5.

Trochus apertus Solander, Foss. Hant. p. 9, figs. 1, 2, 1766.

Calyptrea trochiformis Lamareck, Ann. du Mus., vol. 1, p. 385, 1802.

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- Calyptræa trochiformis* Deshayes, Coq. fos. bas. Paris, II, p. 30, pl. 4, figs. 1, 2, 3, 1824.
Infundibulum urticosum Conrad, Fos. Shells Tert. Form., 1st ed., No. 3, p. 32, 1833.
Infundibulum trochiformis Conrad, Fos. Tert., 2d ed., p. 46, pl. 16, fig. 18, 1835.
Trochita alta Conrad, Wailes, Geol. Miss., p. 289, pl. XV, figs. 3a, 3b, 1854.
Calyptræa (Trochita) trochiformis Heilprin, Proc. Acad. Nat. Sci. Phila., vol. 31, p. 219, 1879.
? Galerus olindensis White, Arch. do Museu Nac. do Rio de Janeiro, vol. VII, pp. 167-168, pl. XVIII, figs. 15, 16, 1887.
Calyptræa trochiformis Dall (pars), Trans. Wagner Inst. Sci., vol. III, pp. 352-353, 1892.
Calyptræa trochiformis Vaughan, U. S. Geol. Surv., Bull. 142, p. 50, 1896.
Calyptræa aperta Harris, Bull. Am. Pal., vol. III, p. 84, pl. 11, figs. 13-16, 1899.
Calyptræa aperta Clark, Eocene Rept. Maryland Geol. Surv., p. 152, pl. XXVIII, figs. 4, 5, 1901.

Solander's original description.—"Trochus (*apertus*) testa gibboso-conica exasperata obliquata subtus concava, apertura angustata.

"Primo intuitu *Patellis* assimilatur illisque quæ *Labio interno* instructæ sunt, cfr. Linn. Syst. nat. n. 654-658. Specimina autem perfecta spiram ostendunt completam, *anfractus* licet pauciores quam in congeneribus; *Apertura* etiam magis contracta est.

"Testa magnitudine Juglandis sed depressior, sæpeque minor; tabula imposita conum formans *gibbosiusculum*, quo etiam a congeneribus differet; externe scabra, subtus leavis, concava.

"Apertura angustata, lateribus magis roduntatis quam in reliquis hujus generis."

Remarks.—This shell, which was first described from the Barton beds in southern England, is also in the Eocene of the Paris basin, and in that of the Atlantic and Gulf States of North America.

The Soldado shell corresponds closely to young specimens from Vicksburg, Mississippi.

In 1887 Dr. White described *Galerus olindensis* from the town of Olinda, and the Rio Maria Farinha beds, both in the State of Pernambuco, Brazil. This is probably identical with *C. aperta*, although the peculiar sagging outward of the last whorl (which however was probably an individual and not a specific character) makes a positive identification of Dr. White's shell impossible.

The vertical as well as the geographical range of this species was wide, for it occurs in the Eocene, Oligocene and Miocene formations.

Locality.—Bed No. 2, Soldado Rock, Gulf of Paria, near the Serpent's Mouth.

Geological horizon.—Midway Eocene. Equivalent to the Midway of Alabama and of the Rio Maria Farinha beds, State of Pernambuco, Brazil.

Calyptræa centralis Conrad. Plate XIII, Figure 6.

Infundibulum centralis Conrad, Am. Jour. Sci., XLI, p. 348, 1841; Medial Tert., p. 80, pl. 45, fig. 5, 1845.

Trochita Collinsii Gabb, Jour. Acad. Nat. Sci. Phil., 2d ser. IX, p. 249, pl. 35, fig. 39, 1845.

Infundibulum Candearia d'Orb., Moll. Cuba, II, p. 190, pl. XXIV, figs. 28, 29, 1842.

Calyptræa centralis Dall, Trans. Wagner Inst. Sci., vol. III, pp. 353, 354, 1892.

Calyptræa centralis Martin, Maryland Geol. Surv., Miocene, p. 248, pl. LIX, figs. 2a, 2b, 2c, 1904.

Conrad's original description.—"Obtusely ovate, with fine concentric irregular lines; apex central."

Remarks.—This widely distributed species is found in the Oligocene of

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Chipola, Florida, and of Costa Rica; it extends through the Miocene, Pliocene, and Pleistocene of the United States, and is now living on the coasts of North and South America from Cape Hatteras almost to the Straits of Magellan.

Dr. Guppy reports this species (as *Trochita candeana* d'Orb.) from the Pliocene and recent faunas of Trinidad.

The presence of this shell in the Brighton marl suggests a horizon not earlier than late Oligocene, as it is not known to have existed earlier than the Chipolan of Florida.

Locality.—Southern main road just south of Pitch Lake, Brighton, Trinidad, in a yellowish-brown ferruginous marl.

Geological horizon.—Upper Oligocene.

Genus *NATICA* Adanson, 1757.

Natica eminulopsis new species. Plate XIII, Figure 7.

Description.—Shell resembling smaller specimens of *N. eminula* Conrad, especially the variety found in the Lignitic Eocene of Wood's Bluff, Alabama,⁸² but with a higher spire and more elongated body whorl; volutions four; perforation not covered by callus, characters of the aperture concealed by the indurated matrix.

Height of shell 12, greatest width 9 mm.

Remarks.—The writer is in some doubt whether this should be regarded as a variety of *eminula* rather than as a separate species. But as typical *eminula* is Claibornian Eocene, it seemed best to regard the Midway form as of the same group and a precursor of *eminula* but a distinct species.

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

Geological horizon.—Midway Eocene.

Natica cf. *semilunata* Lea var. Plate XIII, Figure 8.

A shell of a *Natica* was found in the Soldado Lignitic fauna, which compares well with small specimens of a varietal form of *N. semilunata* from the Lignitic of Wood's Bluff, Alabama.⁸³

The aperture of the Soldado shell is, however, concealed, and renders a definite comparison impossible. Yet it is very probable that the Soldado form is a variety of Lea's shell or else a closely related species.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus *AMAUROPSIS* Mörch, 1857.

Amauropsis caloramans new species. Plate XIII, Figure 9.

Description.—Shell of moderate size, ovate; substance thin and fragile, as shown where the shell is fractured; surface entirely smooth except for delicate

⁸² See Harris, Bull. Am. Pal., vol. III, p. 88, pl. 11, fig. 22, 1899.

⁸³ See Bull. Am. Pal., vol. I, p. 86, pl. II, figs. 18-20, 1896.

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microscopic lines of growth; number of known whorls three, evenly rounded, full, slightly shouldered at the upper portion; suture impressed, marked by a narrow channel; aperture and characters of the columella concealed by the silicious matrix.

Height of shell approximately 30, greatest width 21 mm.

Remarks.—The only other *Amauropsis* described from the Midway Eocene is *A. tombigbeensis* Harris from Alabama, which is wholly unlike the Soldado shell. There is also in the Paleontological Museum of Cornell University an undescribed Midway species somewhat like the latter but smaller. The nearest ally of the Soldado shell is *A. perovata* Conrad from the Claibornian Eocene.⁸⁴

It is a curious fact that all the living species of *Amauropsis* are in Arctic and Antarctic seas, yet a number of Tertiary species lived like the Soldado shell in tropical and subtropical waters. Has the genus fled to the less crowded frigid oceans to escape the pressure of competition in the tropics?

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

Geological horizon.—Midway Eocene.

Amauropsis ? *guariqueenensis* new species. Plate XIII, Figure 10.

Remarks.—In a limestone ravine near Guariqueen, Venezuela, there are traces of quantities of the remains of large gastropod shells.

Several species are represented; but it is impossible to separate the fossils from the rock. Hundreds of sections cutting through the shells at various planes were observed on slabs of the limestone, but not a single complete specimen was to be had.

A drawing is given of the best specimen obtained after treating with various acids in the unsuccessful attempt to disclose the whorls. The shells are all turned to a blackish crystalline spar, and form an integral part of the excessively indurated limestone.

The general form of the shell indicates a large species of *Amauropsis*. Others, with very oblique outlines, suggest such forms as *Neritidomus* from the Brazilian Cretaceous figured in White's monograph.

Locality.—Along the trail from Pitch Lake to Guariqueen, Venezuela, in a limestone gorge.

Geological horizon.—Probably Cretaceous.

Amauropsis smithiana new species. Plate XIII, Figures 11, 12, 13.

Description.—Shell of moderate size, varying considerably in that respect; substance thin and fragile; number of whorls known, five, very convex, gently rounded, slightly shouldered beneath the suture; shell entirely without sculpture, perfectly smooth, suture impressed; aperture nearly semi-lunar; callus very thin.

Approximate height of largest specimen 18, greatest breadth 17 mm.

Remarks.—This is the commonest species in the Lignitic fauna of Soldado.

⁸⁴ Bull. Am. Pal., vol. I, p. 49, pl. 1, fig. 1.

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It varies in size, but the specimens all show the same characteristics in other respects and apparently are all the same species.

An *Amauropsis* was described by Professor Harris from the upper Claibornian Eocene of Texas⁸⁵ as *A.ingleyi*. This species is closely allied to *A. smithiana*.

The writer takes great pleasure in naming this shell in honor of Mr. Edward Eggleston Smith, of the Geological Survey, Washington, D. C.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Genus **LIOTIA** Gray, 1842.

Liotia lillianæ new species. Plate XIII, Figure 14.

Description.—Shell small, rather solid, depressed-conic; whorls convex, four, of which the uppermost is nuclear and smooth, the rest being ornamented with granulated threads, last volution with three such granulated or finely beaded threads followed by a much stronger basal carina, and that by a subbasal ridge about equal in size to the carina; surface more or less reticulated by the intersection of the revolving beaded threads by transverse, oblique lines of growth; suture deeply channelled.

Height of shell 3, greatest breadth 4 mm.

Remarks.—This pretty shell is of much the same shape and size as the only known Eocene species, *L. granulata* Lea,⁸⁶ from the Claiborne and Lignitic of the Southern states. But on comparing it with specimens of Lea's species, the sculpture is found to be quite different.

The genus *Liotia* was rare in the Eocene, but became more abundant in the later Tertiaries of Florida; and is now represented by about a dozen species in the recent Floridian and Antillean faunas. It also flourishes on the coasts of Australia and the Philippines.

The Soldado species is dedicated to Mrs. E. E. Smith, of Washington, D. C.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Class **SCAPHOPODA.**

Genus **DENTALIUM** (Aldrovande, 1618) Linnæus, 1758.

Dentalium microstria Heilprin. Plate XIII, Figure 15.

Dentalium microstria Heilprin, Proc. Acad. Nat. Sci. Phila., p. 375, pl. 20, fig. 3, 1880.

Dentalium microstria Dall, Trans. Wagner Inst., vol. III, pp. 438, 439, 1892.

Dentalium microstria Aldrich, Bull. Am. Pal., vol. I, p. 55, pl. i, fig. 6, 1895.

Dentalium microstria Harris, Bull. Am. Pal., vol. III, pp. 3-4, pl. i, fig. 1, a, 1899.

Heilprin's original description.—"Shell slender, considerably curved and greatly attenuated, faintly striated, the striæ most conspicuous on the attenuated portion; posterior aperture entire, there being no fissure; anterior aperture circular.

"Length $1\frac{1}{2}$ to 2 inches."

⁸⁵ Proc. Acad. Nat. Science Phila., p. 84, pl. 9, fig. 12, 1895.

⁸⁶ Cont. to Geol., p. 122, pl. 4, fig. 111, 1833.

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Remarks.—A single *Dentalium* shell was found at Soldado. On comparing this with a large number of *D. microstria* from the Lignitic of Alabama, it is found to resemble them very closely, the only apparent difference being that the microscopic striæ on the Soldado shell are slightly more pronounced and a trifle more close-set than those on the Alabama shells. They appear to be the same species, although the Soldado shell should perhaps be classed as a variety.

Locality.—Bed No. 8, Soldado Rock, Gulf of Paria.

Geological horizon.—Lignitic Eocene.

Class CEPHALOPODA.

Genus AMMONITES (Breyn, 1732) Lamarck, 1801.

Ammonites cf. *mosqueræ* Karsten. Plate XIII, Figure 16.

Remarks.—Associated with *Inoceramus plicatus* (Orb.) Karsten (which is apparently identical with *Inoceramus labiatus* Schlotheim) in the dark, cherty, hard layers of the Cretaceous limestones near Guanoco, Venezuela, are a number of small, worn Ammonites.

Dr. Stanton, of the United States Geological Survey, well-known as the leading American Cretaceous paleontologist, kindly examined a number of the latter and compared them in general form and sculpture with Karsten's *Ammonites mosqueræ* and *A. barbacoensis*. Dr. Stanton remarked in his letter, "Unfortunately, your specimens do not show either the sutures or the character of the ventral margin, and it is therefore impossible to assign them to their proper genera. Their form and sculpture—so far as it is preserved in these specimens—are practically duplicated in the genera *Schlaenbachia*, *Prionotropis*, etc., which are common in the lower part of the Upper Cretaceous and are represented by similar types as low as the Gault."

On comparing the specimen figured with Karsten's *A. mosqueræ*⁸⁷ the general type of ornamentation is seen to be the same. It is very likely this species, for both *A. mosqueræ* and *barbacoensis* were found by Karsten with *Inoceramus plicatus* in the Barbacoas limestone.

Locality.—Ravine on the right hand side of the trail going from Guanoco to Hurupu, Venezuela, just above Rio Colorado. Latitude approximately 10° 8' North; longitude approximately 3° 59' 6" East of Caracas.

Geological horizon.—Upper Cretaceous, probably equivalent to the European Turonian, or the Benton of the western United States,—certainly not lower than the Gault (Stanton).

Class BRACHIOPODA.

Genus TEREBRATULA (Llhwyl, 1699) Klein, 1753.

Terebratula stantoni new species. Plate XIII, Figures 17, 18.

Description.—Shell of moderate size, oblong, substance thin and fragile; beak slightly incurved, terminated by a large, circular foramen; surface orna-

⁸⁷ Géol. de l'ancienne Colombie Bolivarienne, pl. IV, figs. 4a, 4b, 1886.

mented only by faint lines of growth and very delicate, microscopic, radiating striæ, otherwise entirely smooth; convexity of dorsal and ventral valves nearly equal.

Height of a rather large shell 20, greatest breadth 18, greatest diameter 13 mm.

Remarks.—At first glance this species resembles Dr. Guppy's *T. lecta* from the San Fernando beds, but the basal margin of that shell is somewhat sinuate and pointed, while the Soldado species is truncate, and the hinge margin is also straighter than in *lecta*, nor is there the flattening of the ventral valve noted by Dr. Guppy in his species.

This was one of the most abundant shells in the Soldado fauna. Trinidad seems to have been the favorite haunt of the genus *Terebratula* during the Tertiaries, for this is the fourth species described from that island. The genus has lived on from the Devonian to the recent seas.

This is the first species described from the Lignitic horizon.

The writer takes pleasure in naming this shell in honor of Dr. Stanton, as a slight appreciation of his kindness in identifying the Cretaceous fossils from Hurupu, Venezuela.

Locality.—Bed No. 8, Soldado Rock, near the Serpent's Mouth, in the Gulf of Paria.

Geological horizon.—Lignitic Eocene. Equivalent to the Lignitic of Alabama.

Class VERMES.

Genus SERPULA.

Serpula clymenioides Guppy. Plate XIII, Figures 20-22.

Spirorbis clymenioides Guppy, Quart. Jour. Geol. Soc., vol. XXII, p. 584, pl. XXVI, fig. 10, 1866.

Spirorbis clymenioides Guppy, Geological Magazine, new series, Decade II, vol. I, p. 444, 1874.

Guppy's original description.—"Tube coiled, discoidal, compressed; whorls usually three to four, flattened or even fused together, with sinuo-radiate lines of growth; periphery carinate; aperture constricted, circular; nucleus with an obsolete aperture nearly as large as the terminal one.

"The nearest species to this is *S. spirulæa*, Lam. (*Spirulæa nummularis* Schlot), from which the present species may be distinguished in never having the last whorl produced or separated.

"San Fernando beds, Trinidad. Specimens frequently occur in the cherty nodules, containing immense numbers of *Orbitoides mantelli* and *Nummulina*."

Remarks.—This odd tube, simulating a helix-like molluscan shell, is made by a worm of the suborder *Tubicola* (*Sedentaria*) of the genus *Serpula* Linnæus. This includes the majority of the fossil tubicolous Annelids. They build firm, irregularly twisted, or sometimes spirally enrolled, free or adherent calcareous tubes, frequently clustered in large numbers. The genus began in the Silurian, and is rare throughout the Paleozoic; but becomes very common in the Lower Cretaceous, and its recent distribution is world wide. *S. spirulæa* Lamarck, the form most closely allied to that from Trinidad, is an abundant and characteristic Eocene species of southern Europe.

Serpula clymenioides is quite common in the Foraminiferal beds of Farallon Rock, where Mr. Veatch succeeded in finding nearly a dozen shells. They were associated with the curious crustacean carapace of *Ranina porifera* Woodward and a number of sea urchins.

Locality.—Farallon Rock (also called Johnson's Island), near San Fernando, Trinidad, in the Gulf of Paria.

Geological horizon.—Lower Oligocene. Approximately equivalent to the San Fernando beds of Trinidad, and probably to the Vicksburgian of Mississippi.

Class CRUSTACEA.

Genus RANINA.

Ranina porifera Woodward. Plate XIII, Figure 23.

Ranina porifera Woodward, Quart. Jour. Geol. Soc. London, XXII, pp. 591-592, pl. XXVI, fig. 18, 1866.

Ranina porifera Guppy, Geol. Mag., p. 443, 1874.

Woodward's original description.—"A specimen of a Crustacean placed in my hands for examination by my friend Mr. R. Lechmere Guppy, from the Tertiary formation of Trinidad, proves to be a portion of the dorsal surface of the carapace of a Brachyurous Decapod—nearly approaching the *Anomura*—belonging to the subsection *Notopoda* and the genus *Ranina*.

"The species of this genus (which was established by Lamarck in 1801) are not only most singular in form, but they are of special interest to the paleontologist as occurring in the Nummulitic Limestone of Bavaria, Austria and Italy, Asia Minor, Scinde, and the West Indies (Trinidad), and also in the Oligocene of Germany and the Miocene of Turin. Nor has the genus now disappeared; for at the present day it is represented by the *Ranina dentata* of Latreille, which is found living in the Sandwich Islands, the Moluccas, the Mauritius, and Japan,⁸⁸ whilst a nearly allied genus, the *Raninoides*, Edw., is found living in the Philippine Islands, and Trinidad, having been collected in this latter locality by Mr. Guppy.

"The *Raninae* are all burrowing forms of Crustacea living for the most part in deep water, buried in sand or mud, for digging in which their limbs are most admirably adapted.

"Unfortunately none of the appendages are preserved in the specimen under consideration; but all the species of this genus are curiously sculptured upon the dorsal surface of their carapaces, and the ornamentation is extremely characteristic of the group. It consists of irregular transverse pectinated ridges, sometimes interspersed with small punctuations, the ridges being more or less curved and intercalating with one another.

"In Prof. Reuss' work⁸⁹ these peculiarities are very well shown, but neither in these nor in the various specimens which I have been able to examine can I detect the same ornamentation as that observable in the *Ranina* from Trinidad.

⁸⁸ De Haan, Siebold's Fauna Japonica, 1833, p. 139, t. 34, 35.

⁸⁹ Foss. Krabben der k. k. Akad. der Wissenschaften, Wien.

"Each minute point forming the pectinate border to the several ridges has a small indented pit near its extremity, which has suggested the specific name *porifera*. It is to be hoped, however, that more perfect specimens will reward the zealous labors of Mr. Guppy, as the determination of species, offering such meagre characters as the one now noticed, is by no means safe, except in very peculiar and well-marked forms, such as the species of the genus *Ranina*."

Type locality, San Fernando beds, Trinidad. Later the species was found at St. Bart's.⁹⁰

Remarks.—Woodward adds to his interesting description that in spite of the wide distribution of the genus in the old world ten species only are known to him. These range from the Eocene to the recent period.

The specimen now under consideration was collected by Mr. Arthur C. Veatch at Farallon Rock, off San Fernando, in the Gulf of Paria. Under a lens the minute pores characteristic of the species bordering the pectinated ridges of the carapace show most beautifully, and leave no doubt that this and the San Fernando specimen are the same species.

On Farallon Rock *Ranina porifera* is associated with masses of Foraminifera, with echinoderms and with the curious spiral worm tube, *Serpula chymenioides* first described by Dr. Guppy from the San Fernando beds. Thus the fauna of Farallon Rock and San Fernando have much in common. This is quite surprising, as, though the localities are not distant from one another, the lithological characters of the beds are wholly different. The San Fernando beds are black and highly asphaltic, while those of Farallon Rock in which these fossils occur are a fine yellowish grey sandy marl.

Locality.—Farallon Rock (also called Johnson's Island), near San Fernando, Trinidad, in the Gulf of Paria.

Geological horizon.—Lower Oligocene. Approximately equivalent to the San Fernando beds, and probably to the Vicksburgian of Mississippi.

Class ECHINOIDEA.

Genus ECHINOLAMPAS Gray.

Echinolampas ovumserpentis Guppy.

Echinolampas ovum-serpentis Guppy, Quart. Jour. Geol. Soc. London, vol. XXII, p. 300, pl. XIX, figs. 4-6, 1866.

Echinolampas ovumserpentis Guppy, Geol. Mag., p. 444, 1874.

Guppy's original description.—"Test oval, subcylindrical or nearly circular, wider behind than before, slightly rostrated anteriorly, and truncate posteriorly, sometimes having a tendency to become polygonal; ambulacra raised, petaloid, open at the ends, extending nearly to the tumid margins, the pores connected by an oblique groove; base convex, except towards the mouth, where it becomes somewhat concave; dorsum rather evenly convex; ambulacral summit sub-central; anus small, circular, situate between the peristome and the margin, much nearer to the latter than the former.

⁹⁰ Guppy, Geol. Mag., p. 443, 1874.

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"This seems to be an extremely variable species, both as to general shape and as to the form of the mouth. It is distinguished from the preceding (*E. lycopersicus* Guppy) by its small circular vent and wider ambulacra. The mouth is usually subpentagonal, but occasionally becomes transversely oval. Some examples which approach the circular form have a tendency to become subconical.

"San Fernando, Trinidad."

Remarks.—Among the Echinoderms from Farallon Rock was one exactly like Dr. Guppy's figure 4b.

Locality.—Farallon Rock, near San Fernando, Gulf of Paria.

Geological horizon.—Lower Oligocene. Equivalent to the San Fernando beds of which this horizon appears to be a continuation.

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