MARYLAND
GEOLOGICAL
SURVEY

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And with the cooperation of several members of the scientific bureaus of the National Government.

LETTER OF TRANSMITTAL

To His Excellency Edwin Warfield,

Governor of Maryland and President of the Geological Survey Commission.

Sir:—Somewhat over three years ago the first volume of a series of reports dealing with the systematic geology and paleontology of Maryland was presented to the public. This publication which to the average reader might seem highly technical was most favorably received by geological experts both in this country and abroad. I now have the honor of presenting to you the second of this series which, on account of its size, is issued in two parts. It deals with a division of Maryland geology that has received the attention of students for nearly a century. The present work includes a summary of previous observations to which is added a large amount of new information. On account of the highly technical nature of this report it is perhaps fitting to state that a clear comprehension of our geological formations is based on a knowledge not only of the materials out of which the strata are composed but also of the remains of animal and plant life which the rocks contain. In order therefore that our results may receive the recognition of geologists now and in the future, accurate descriptions and illustrations have been considered to be requisite. The several authors of this report, many of whom, as explained later, are among the best known authorities in America upon the subjects herein discussed, have supplied chapters that will place the Maryland Miocene deposits conspicuously before geological workers everywhere.

Trusting the volume submitted may merit your approval, I remain,

Very respectfully,

William Bullock Clark,

State Geologist.

Johns Hopkins University,

Baltimore, *October*, 1904.

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ILLUSTRATIONS

PREFACE

The present volume is the second of a series of reports dealing with the systematic geology and paleontology of Maryland. The first of this series was confined to the Eocene while the present volume comprises a discussion of the next younger geological horizon known as the Miocene. Several other reports are in preparation, two of which are already practically completed. The Pliocene-Pleistocene report is ready for the press, and the Devonian for which the field observations are finished is largely in manuscript form. It is not the intention to issue these volumes in geological sequence as each forms a unit in itself. The following reports are finally contemplated:

Cenozoic:
- Pliocene-Pleistocene
- Miocene
- Eocene

Mesozoic:
- Jurassic-Cretaceous
- Triassic

Paleozoic:
- Carboniferous-Permian
- Devonian
- Silurian
- Cambrian-Ordovician

Crystalline Rocks (Archean-Silurian)

Maryland contains a remarkably complete sequence of geological formations representing nearly every horizon from the Archean to the Pleistocene although the deposits vary greatly in thickness and in the completeness of the faunas and floras which they contain. Two of the divisions, the Crystalline Rocks and the Triassic, are nearly destitute of organic remains. The other seven divisions, however, contain rich faunas and floras. Three of them, the Carboniferous-Permian, the Jurassic-Cretaceous, and the Pliocene-Pleistocene, contain both animal and plant fossils in abundance. The Ordovician-Cambrian, the Silurian, the Devonian, the Eocene, and the Miocene all contain extensive faunas while few if any plant remains are known.

These reports when completed will give both to the geologist and to the general reader a comprehensive view of the past history of Maryland territory from the earliest geological period to the present day. They will be by far the most important publications of the Geological Survey and will have not only present but lasting value to the student of Maryland geology. Long after the general articles and county reports will have become antiquated they will be useful, and must necessarily afford the basis for all subsequent study of Maryland geology. The present volume on the Miocene deals with the middle period of the Cenozoic, and with the Eocene which precedes and the Pliocene which succeeds it embraces what is frequently denominated by geologists as the Tertiary, one of the most important geological horizons represented in Maryland.

The Miocene deposits of Maryland have been studied since the early days of American geology. Fifteen years ago they attracted the attention of the senior author of this report under whose direction Dr. Shattuck has carried out the elaborate stratigraphic studies described in later pages. These investigations have been in progress since the organization of the Survey and large collections of fossils were made both from the historic as well as from new localities. Dr. Shattuck has had in his work the active cooperation of all the members of the Survey, including especially that of the State Geologist, and of Dr. L. C. Glenn and Dr. G. C. Martin, who frequently visited the field to discuss obscure points with the author, while their paleontological studies were carried on in such a way that the results here presented represent the combined labors of the field geologist with the critical laboratory study of the paleontologist.

An important paper by Dr. W. H. Dall accompanies this report in which the results of his wide knowledge of the Miocene of this and other countries have been incorporated. This chapter is by far the most important contribution to the interpretation of the Maryland Miocene deposits which has been hitherto made and shows in a highly philosophical manner the relationship of the Maryland Miocene fauna to that of other regions and to the recent fauna.

The systematic paleontological investigations have been jointly conducted by several experts. Many of them are recognized authorities in the subjects which they have discussed. The Mammalia, Aves, and Reptilia have been studied and described by Dr. E. C. Case of Milwaukee, Wisconsin; the Fishes by Dr. Charles R. Eastman, of Harvard University, Cambridge, Massachusetts; the Ostracoda, Bryozoa, and Hydrozoa by Messrs. E. O. Ulrich and R. S. Bassler of the U. S. Geological Survey; the Corals by Mr. T. Wayland Vaughan of the U. S. Geological Survey; the Foraminifera by Dr. R. M. Bagg, Jr., of Springfield, Massachusetts; the Angiospermæ by Dr. Arthur Hollick of the New York Botanical Garden; and the Thallophyta by Mr. C. S. Boyer of Philadelphia, Pennsylvania. The remaining chapters have been prepared by members of the Maryland Geological Survey. The Malacostraca, the Cirripedia, the Cephalopoda, the Gastropoda, the Amphineura, the Scaphoda, the Brachiopoda, the Vermes, and the Radiolaria have been studied and described by Dr. G. C. Martin, lately appointed to the U. S. Geological Survey; the Pelecypoda by Dr. L. C. Glenn, now of Vanderbilt University, Nashville, Tennessee; and the Echinodermata by Dr. W. B. Clark, the State Geologist.

Very large collections of materials were made preparatory to this work and practically every Miocene fossiliferous locality in the State was exhaustively collected from. The long series of bluffs along the Chesapeake Bay and its tributaries afforded the greatest amount of material, while pits, well-borings, and other exposures of the strata likewise yielded numerous specimens. The commoner species often occur in great profusion forming almost solid beds of shells many feet in thickness. In general, the shells are hard and readily removed so that great numbers of well-preserved specimens have been available for comparative study. There have been for many years extensive collections of Maryland materials in several museums of the country, notably the U. S. National Museum, the Academy of Natural Sciences of Philadelphia, the Wagner Free Institute of Science of Philadelphia, and the Johns Hopkins University. Much larger and more exhaustive collections have been made in recent years by the members of the Maryland Geological Survey. All of the collections, however, have been drawn upon in the present study of the Miocene. The Museum of the Academy of Natural Sciences of Philadelphia contains many of Dr. Conrad's types which have been most important in definitely determining many of the species hitherto described.

The State Geological Survey desires to express its thanks for the aid which has been rendered by the several experts who have contributed to this volume; also to the U. S. Geological Survey, the Academy of Natural Sciences of Philadelphia, the Wagner Free Institute of Science, the U. S. National Museum and Cornell University, through Professor G. D. Harris, which have generously allowed the use of their materials and drawings and have in every way facilitated the present investigation.

Many important suggestions have been received from Dr. W. H. Dall, of the U. S. National Museum, Professor H. A. Pilsbury, of the Academy of Natural Sciences of Philadelphia, and Mr. C. W. Johnson, of the Boston Society of Natural History. The Survey desires especially to thank Rev. Edward Huber, of Baltimore, who has generously placed at the disposal of the Survey his collections of diatoms and radiolaria.

Thanks are particularly due to the artists, the late Dr. J. C. McConnell, of the U. S. Army-Medical Museum; Mr. F. von Iterson, of Princeton, New Jersey; and Mr. H. C. Hunter, of the U. S. Geological Survey, for the beautiful and accurate drawings with which the report is illustrated. Most of the illustrations were prepared by Dr. J. C. McConnell, whose recent death is deeply deplored by all students of paleontology. His knowledge of the requirements of paleontological illustration made his contributions in this field to any scientific work almost equal in value to that of the recognized author. Dr. McConnell has prepared many hundreds of drawings for the various Maryland reports, not only for the Eocene and Miocene volumes now before the public, but likewise for the Devonian and Pliocene-Pleistocene reports which have yet to appear. It is a cause of deep regret to us that his work is ended.

THE MIOCENE DEPOSITS OF MARYLAND

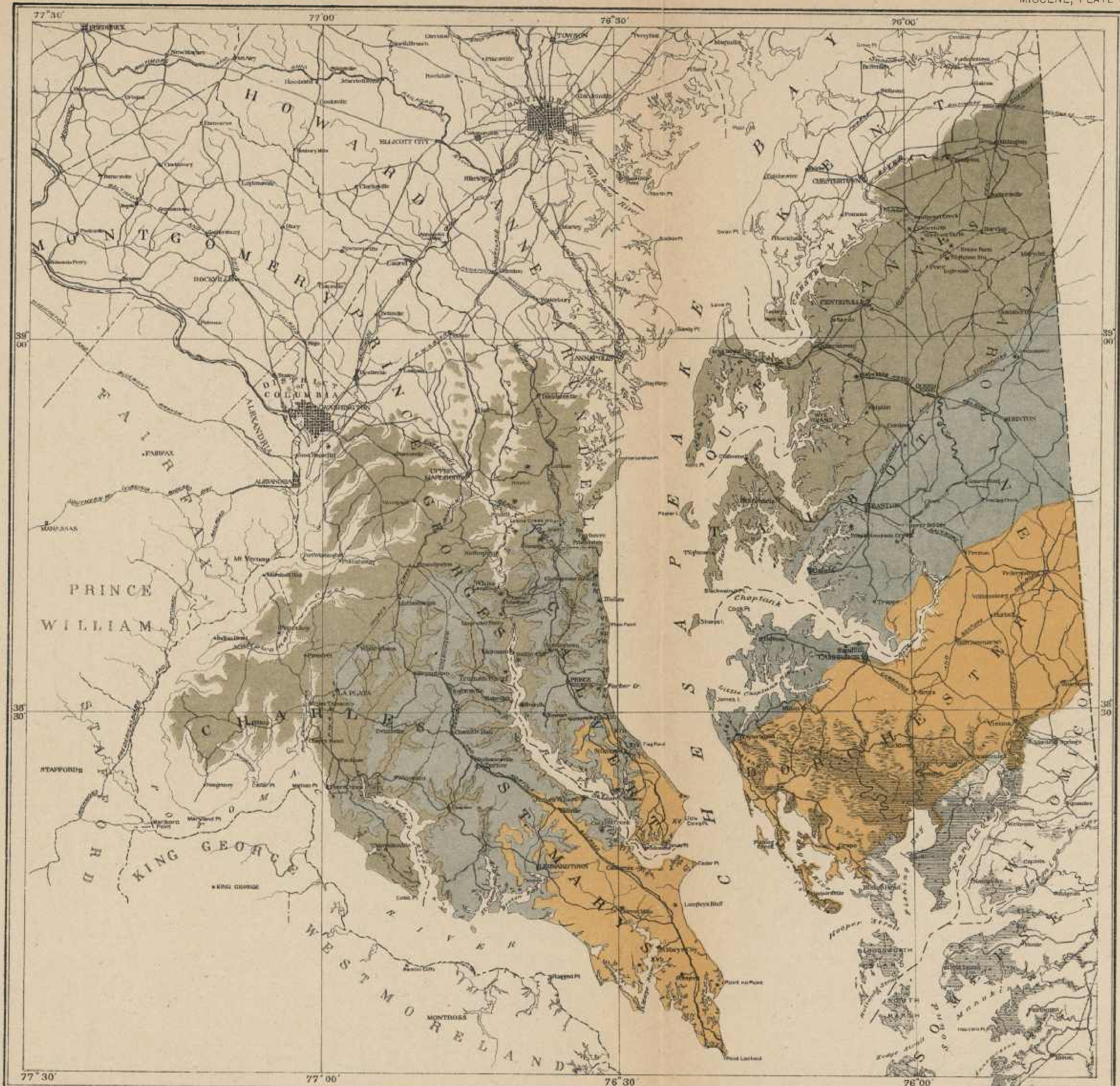
BY

WILLIAM BULLOCK CLARK

GEORGE BURBANK SHATTUCK

AND

WILLIAM HEALEY DALL



MAP
SHOWING THE DISTRIBUTION OF
THE MIOCENE FORMATIONS
OF
MARYLAND

BY

GEORGE BURBANK SHATTUCK

MARYLAND GEOLOGICAL SURVEY

WM. BULLOCK CLARK, STATE GEOLOGIST

1904

Scale: 12 miles = 1 inch.

0 1 2 3 4 5 10 20 MILES

LEGEND.

- *St. Mary's Formation*
- *Choptank Formation*
- *Calvert Formation*
- * *Fossil Localities*
- I—XVI *Location of Sections*

NOTE.—When locations selected for sections contain fossils the asterisk is not added to the Roman numerals

INTRODUCTION

AND

GENERAL STRATIGRAPHIC RELATIONS

BY

WILLIAM BULLOCK CLARK

Introduction.

Geologists recognize three great natural provinces in the Atlantic border region, which are commonly designated the Coastal Plain, the Piedmont Plateau, and the Appalachian Region. Each of these districts possesses distinctive physiographic and geologic characters that easily separate it from the others.

The oldest and most complicated district is the Piedmont Plateau, which is composed largely of ancient schists and gneisses of unknown age, part of which are certainly pre-Cambrian.

The Appalachian Region which adjoins the Piedmont Plateau on the west is mainly composed of Paleozoic sediments which throughout much of the district have been deformed into a series of folds that gradually decrease in intensity westward.

The Coastal Plain, the youngest of the three districts, is composed of a series of largely unconsolidated and horizontal sediments that represent a nearly complete sequence of deposits from the Middle Mesozoic to the present.

Each of these provinces can be traced from Pennsylvania and New Jersey southward to the Gulf States and is approximately parallel with the axis of the great mountain uplift of the Appalachian mountain system which from early geological times has marked the eastern border of the continent. It is evident therefore that a knowledge of Maryland geology cannot be complete without a careful comparison of the formations represented in our own State with those of adjacent commonwealths to the north and south of us. In fact, a solution of many of the problems presented can only be gained after taking into consideration the conditions that have controlled throughout the entire area.

Maryland, with the adjacent States of Delaware and Virginia, embraces what with propriety has been called the Middle Atlantic Slope, which comprises in its geology and mineral resources much that is typical of the entire Atlantic border region. In many particulars the record here presented is more complete than that afforded by the States farther to the north and south. No portion of the Atlantic border area has been more thoroughly studied since the early days of American geology, and much of the region may be considered as classic ground to the student of that science.

The present report is confined to a consideration of a part only of the Coastal Plain. This region embraces the eastern portion of Maryland, crossing the State from north to south in a broad belt of an average width of 75 miles and extending from the ocean border to the head of tide or slightly beyond on the various estuaries and rivers of the region.

Much interest has been manifested in the Coastal Plain geology and paleontology of the Middle Atlantic Slope since the early days of geological investigation in this country. Many of the most potent illustrations of the geologists of the early part of the century were drawn from this region, and although the relations of the deposits were not altogether comprehended, yet the recorded observations show an appreciation of many of the more difficult problems involved. Later, as the complicated geological history of the Coastal Plain became better known, it was recognized that if a full understanding of any single formation was to be gained it was necessary to study carefully not only its lithological and paleontological characteristics but also its relationship to the other members of the series. It was seen that only by an understanding of the broad conditions affecting the whole area could the strata of any one formation be properly interpreted. Recognizing this fact, the writer presents in later pages a brief discussion of the general relations of the strata composing the Coastal Plain in the Middle Atlantic Slope. The fuller discussions will be found in other volumes of the Survey dealing with these formations.

When we come to consider that assemblage of deposits early separated as the Tertiary, portions of which are the special subject of this report, we find that it is divisible into several distinct formations. Even at a relatively early date an older and a younger Tertiary were already established, the former being correlated with the Eocene of England and the European continent, and the latter somewhat later with the Miocene or Pliocene. Attempts were made then and later to find their exact equivalents in one or another of the already established local formations of the English or Continental series, but with very unsatisfactory results.

Even after the American Tertiary strata had received somewhat detailed examination in the various sections of our own country and local divisions had been established, attempts were made from time to time to determine their equivalency. By common consent the diversified and extensive deposits of the Gulf area came to be regarded as the type for the Eocene and the various Eocene deposits of the Atlantic Coast States were assigned to positions in this series. On the other hand, the great development of later Tertiary deposits, which we now know to be largely Miocene, in Maryland and the States immediately to the south of it, led geologists to regard them as the most typical for the Atlantic province and many terms derived from this district have found a permanent usage in geological literature.

The Miocene deposits of Maryland have long been known to geologists for the rich faunas which they contain and great collections of this material have for many years enriched the museums both of this and foreign lands. The exhaustive studies which have been given to the forms found in these deposits must necessarily prove of great interest and value to geologists and paleontologists everywhere.

The description of species of fossils is of little scientific importance to the geologist, however, unless the object is something other than the mere multiplication of new forms, which has too often been the case in such investigations. When the work has in view the fullest possible representation of a fauna or the clearing up of doubtful points in the synonymy of already described species, as well as a more complete knowledge of their geological and geographical ranges, it becomes of the very greatest value, since one whole class of important criteria for the interpretation of the strata is thus made accessible. The present report includes the results of such an exhaustive study of the fauna of the Miocene of Maryland, embracing both a critical review of the species described by previous authors, as well as the description of a large number of new forms. It is believed that a much more accurate idea of the faunal characteristics, as well as of the physical conditions prevailing during the Miocene period on the Middle Atlantic Coast, will result from the methods pursued in this investigation. Certainly the data for the comparison of the fauna with those of other areas will be greatly increased.

General Stratigraphic Relations.

Our knowledge of the Tertiary geology and paleontology of the Middle Atlantic Slope has been largely augmented since the days of Conrad and Rogers, yet few fields have afforded better opportunities in recent years for continued investigations, since very divergent opinions have prevailed and even to-day find expression in the different interpretations of the data.

Both the Eocene and the Miocene divisions of the Tertiary in this area have broad surface exposures, and are represented by characteristic sections along the leading waterways. Both are also highly fossiliferous, although the Miocene shows a greater diversity of species than does the Eocene. This difference, however, is not so great as one would infer from a perusal of the literature, since a large number of Eocene species, many of them very common, have been until recently unrecognized, or at least unrecorded.

A brief discussion of the general relations of the Coastal Plain deposits in the Middle Atlantic Slope is essential to a clear comprehension of the Miocene formations, and several pages will be devoted to this aspect of the subject.

The Coastal Plain consists geologically of a series of formations that were deposited as moderately thin sheets, one above another, along the eastern border of the crystalline belt, elsewhere referred to as the Piedmont Plateau. The coastal deposits are slightly inclined eastward, so that successively later members of the series are encountered in passing from the interior of the country toward the coast.

From the beginning of deposition in the coastal region until the present time sedimentation has apparently been constantly in progress over some portions of the area. Differential movements of the sea floor, with its accumulated sediments, took place, however, from time to time so that the formations present much complexity along their western margins. It is not uncommon to find certain members of the series lacking, as renewed deposition carried a later formation beyond its predecessors. In the absence of distinctive fossils the discrimination of the different horizons at such points is often attended with great uncertainty.

Deformation has also affected the region to a certain extent, the strata in places being slightly warped, so that they do not maintain a uniform strike and dip. This is particularly marked along the western border of the area where there have also been slight displacements in various localities.

Every geological period from the Cretaceous (possibly Jurassic) to the Pleistocene is represented, although in one or two instances the lack of characteristic fossils renders the taxonomic position of certain formations difficult of absolute determination.

Cretaceous

The Cretaceous (in part possibly Upper Jurassic) is extensively represented in the Middle Atlantic Slope. The deposits of this period consist of a series of basal formations that has been designated the Potomac group, comprising the Patuxent, Arundel, Patapsco and Raritan formations, no one of which was deposited under marine conditions. They are overlain in succession by the Matawan, Monmouth and Rancocas formations, which are distinctively marine in origin. All of these formations gradually disappear southward, the lower formations of the Potomac group alone of the Cretaceous deposits being recognized in Virginia. Unconformities characterize the several members of the Potomac group while the marine deposits are also unconformable to the older strata.

The Potomac group consists chiefly of sands and clays, the former frequently arkosic, with gravel at certain points where the shore accumulations are still preserved. The deposits of the Patuxent formation are highly arkosic, the sands and clays showing both a vertical and a horizontal gradation into one another. The sand layers are seldom widely extended, being generally lenticular masses which rapidly diminish in thickness from their centers. Dark-colored clays abound in the Arundel formation and have yielded large amounts of nodular carbonate of iron. Highly-colored and variegated clays largely make up the Patapsco formation. Thick-bedded and widely extended white sands with interstratified clays characterize the Raritan formation. The fossils consist chiefly of the bones of Dinosaurian reptiles and of leaf impressions, the former confined to the Arundel formation, the latter predominating in the Patapsco and Raritan formations. The plants show beyond a doubt the Cretaceous age of the two upper formations while the reptiles have been regarded by high authority to be Upper Jurassic.

The Matawan formation is formed largely of fine sands and clays, clearly stratified and in case of the clays often laminated. The clays and sandy clays are generally dark, often black in color. They are commonly micaceous and at times sparingly glauconitic. The very homogeneous and persistent character of the beds is in marked contrast to the deposits of the Potomac group which they overlie. The fossils consist largely of marine Mollusca which indicate the Upper Cretaceous age of the deposits.

The Monmouth formation consists chiefly of greensand deposits, although the glauconitic element is not so pronounced or so persistent south of the Chesapeake as in the more northern districts. The strata are more arenaceous, and as a result the materials weather more readily, showing generally in greater or less degree the characteristic reddish color of the hydrated peroxide of iron. The common and characteristic *Gryphæa vesicularis, Exogyra costata,* and *Belemnitella americana* are found, especially in the basal beds.

The Rancocas formation is also largely composed of greensands, generally more glauconitic than the Monmouth formation, although at times somewhat argillaceous. The strata are much weathered where exposed and often appear as a firm red rock, the grains being cemented by the iron oxide. The deposits have afforded *Terebratula harlani, Gryphæa bryani* and other characteristic species of the New Jersey area.

FIG. 1.—CLIFFS OF DIATOMACEOUS EARTH IN THE CALVERT FORMATION AT FAIRHAVEN, ANNE ARUNDEL COUNTY.

FIG. 2.—NEARER VIEW OF ONE OF THE CLIFFS AT FAIRHAVEN, CARRYING ROLLED AND REWORKED EOCENE FOSSILS AT THE BASE.

VIEWS OF MIOCENE SECTIONS.

EOCENE

The Eocene is represented in the Middle Atlantic Slope by a group of deposits stretching along the eastern margin of the Cretaceous formations, and overlying them unconformably. They have been discussed in much detail in an earlier volume,[1] where they were described under the names of Aquia and Nanjemoy formations, which together constitute the Pamunkey group.

The deposits of both formations consist largely of greensand marls, which may, however, by weathering lose their characteristic green color and by the deposition of a greater or less amount of hydrous iron oxide become firm red or brown sandstones or incoherent red sands. At times, notably in Southern Maryland and Virginia, the strata become highly argillaceous, the glauconitic elements largely or quite disappearing. Infrequently coarse sands and even gravels are found, the latter chiefly toward the base of the Aquia formation and near the ancient shore line, especially toward the northeast in central and eastern Maryland.

Very commonly the shells of organisms are so numerous as to form the chief constituents of certain beds. Notwithstanding these facts, the deposits are remarkably homogeneous, although the recent investigations of the Survey have shown the necessity of dividing them into two formations on both lithologic and faunal grounds. The lower or Aquia formation is much more arenaceous than the upper or Nanjemoy formation, which, particularly in its lower part, is generally highly argillaceous. The Aquia formation is also much more calcareous than the Nanjemoy formation, indurated layers frequently appearing in the former.

MIOCENE

The Miocene deposits occupy the region to the southeast of and overlie those of the Eocene. They have long been known as the Chesapeake group, from the superb sections found exposed on the shores of Chesapeake Bay, and have been recently divided by the State Survey into three well-defined formations—the Calvert, Choptank, and St. Mary's for-

[1] Maryland Geological Survey, Eocene, 1901.

mations, so-called from Maryland localities where the strata are typically exposed.

The Miocene deposits lie unconformably upon those of the Eocene and overlap them along their western border. In Delaware and southern New Jersey they completely transgress the Eocene beds, the latter having disappeared beneath the cover of Miocene strata.

The Miocene deposits consist of sands, clays, marls, and diatomaceous beds. The last, composed almost exclusively of the tests of diatoms, are chiefly confined to the lower portion of the Calvert formation, where they afford striking, light-colored bluffs along many of the larger stream channels. The nearly-pure diatomaceous earth often reaches a thickness of 30 or 40 feet, although the remains of diatoms are found scattered in greater or less amounts throughout much of the overlying strata. The greater portion of the Chesapeake group, however, is composed of variously colored sands and clays, with which are frequently mingled vast numbers of molluscan shells. Sometimes the shelly materials form so large a proportion of the deposits as to produce nearly pure calcareous strata, which in a partially comminuted state may become cemented into hard limestone ledges. The organic remains are very numerous and show clearly the Miocene age of the deposits. Their great number early attracted the attention of geologists, in whose writings descriptions of them are frequently found. Several faunas have been distinguished on the basis of which, as well as on stratigraphic and structural grounds, the three well-defined formations, above referred to, have been recognized by the State Geological Survey.

The Calvert formation consists of clay, sand, marl and diatomaceous earth, the clayey and sandy elements being more or less combined and often filled with great numbers of fossils, affording a fossiliferous sandy-clay. The Choptank formation consists of clay, sand and marl with well-marked beds of fossils scattered through the formation. The St. Mary's formation is characteristically a fossiliferous sandy-clay with here and there beds of clay and marl, the latter often filled with great numbers of fossils.

PLIOCENE

Overlying the Miocene deposits in portions of southern Maryland and older deposits along the landward borders of the Coastal Plain is a formation composed of gravel, sand and clay, which thus far has afforded no distinctive fossils upon which to base a determination of its geologic age. From the fact that the deposits rest uncomformably upon the underlying Chesapeake and are in turn unconformably overlain by the Pleistocene, they have been thought to represent the Pliocene. The apparent similarity of these deposits to those in Mississippi, described by Hilgard under the name of the Lafayette formation, has led to the adoption of the same name for the strata of the Atlantic Coast. The beds of the Lafayette are very irregularly stratified and often change rapidly within narrow limits. Toward the ancient shore line the deposits are coarse gravel, through which is scattered a light-colored sandy loam, the whole cemented at times by hydrous iron oxide into a more or less compact conglomerate. The eastward extension of the formation shows a gradual lessening of the coarser elements and a larger admixture of loam. Arkosic materials are also present throughout the formation, while the coloring and manner of weathering are highly characteristic, the exposed surfaces presenting what is known as case-hardening.

Pleistocene.

Superficially overlying the deposits hitherto described and with marked variations in thickness, composition and structure are the Pleistocene formations, which lie at various elevations from near sea-level to 200 feet in the different portions of the region. From their typical development in the District of Columbia all the Pleistocene deposits of the Middle Atlantic Slope received the name of Columbia formation by McGee, who described three distinct phases, viz., the fluvial, the interfluvial, and the low-level. Later Darton recognized high-level and low-level phases which he called earlier and later Columbia. More recently Shattuck, of the State Geological Survey, has shown that greater complexity exists in the Maryland Pleistocene deposits than had been before recognized and that the later Columbia will have to be further divided.

The Pleistocene deposits consist of gravel, sand, clay, and loam, the material in general becoming finer and more fully stratified with distance from the old shore-line and river-channels. In the latter instance they at times contain large numbers of marine molluscan shells, forming a characteristic calcareous marl. In general, however, the organic remains consist largely of the branches and leaves of terrestrial plants, many of which are exquisitely preserved.

The Pleistocene deposits of the Middle Atlantic Slope, widely known hitherto under the name of the Columbia group, have been divided by the Maryland Geological Survey into the Sunderland, Wicomico, and Talbot formations. The Sunderland formation, the oldest member of the Columbia group, constitutes the highest of the Pleistocene terraces and often covers the highest levels along the western shore of the Chesapeake Bay, and consists of gravel, sand and clay overlain by loam often carrying ice-borne boulders. The Wicomico formation occupies lower levels skirting the high lands capped with Sunderland deposits. The Wicomico formation like the Sunderland, is composed of gravel, sand and clay which is often capped with loam and marly clay bearing here and there ice-borne boulders. The Talbot formation occupies the lower levels of the Coastal Plain, seldom reaching above 40 feet in altitude. It is composed of gravel, sand and clay, with here and there large deposits of peat, and is generally overlain with loam frequently carrying ice-borne boulders. The Talbot formation constitutes the lowest of the series of terraces previously described and has a very much larger areal extent than any of the other members of the Pleistocene.

GEOLOGICAL AND PALEONTOLOGICAL RELATIONS, WITH A REVIEW OF EARLIER INVESTIGATIONS

BY

GEORGE BURBANK SHATTUCK

Historical Review.[1]

For a period of more than 200 years the Miocene deposits of Maryland have attracted the attention of geologists. Two conditions have been of special importance in creating this extraordinary interest; first, the extensive beds of fossil shells which occur throughout the Miocene formations, and second, the unusually fine exposures which dissect the beds in all directions. Notwithstanding the fact that Maryland holds the key to the Miocene stratigraphy of the Atlantic states the early contributions to our knowledge regarding this region were of little importance even as reconnoissance reports, and only very slowly have the true relations of the Miocene beds been brought to light.

As early as 1669 Nathaniel Shrigley wrote regarding "*Relations of Virginia and Maryland,*" and mentioned fullers earth among the other natural resources found in that region. No definite locality was given where this deposit could be found, but it is probable that the author had in mind the extensive deposits of greenish sandy clay, which occur in the Calvert Cliffs and elsewhere and have long been known to the inhabitants of southern Maryland as "fullers earth."

[1] In citing books in this and the subsequent chapter on *Bibliography*, the author has not confined himself to articles pertaining to Maryland alone, but has also referred to important works which treat of similar deposits in neighboring states. As the geologic province extends from Marthas Vineyard southward to Florida and is not interrupted by political boundaries, some notice of neighboring regions must be given.

A few years later, in 1685, Martin Lister published a figure of *Ecphora quadricostata.* This was the first American fossil to be figured, and the original came from the Miocene of Maryland. Lister's work was republished by Dillwyn in 1823 and his figure of *Ecphora quadricostata* is reproduced as Plate LII, Fig. 3, of this volume.

Nothing more of geologic interest seems to have been written regarding this region until the year 1809 when Silvain Godon published a paper in which he assigned all the country between Baltimore Bay and the right bank of the Potomac, where Washington City is located, to "Alluvium." He did not give boundaries or indicate how far he wished to carry this classification toward Chesapeake Bay, but it is probable that the entire Coastal Plain south of Baltimore and east of the Potomac was included in his conception.

In the same year, 1809, a noteworthy paper was published by William Maclure. He included the entire Coastal Plain of Maryland in one formation, the "Alluvial," and so represented it on a geological map. He described the unconsolidated Coastal Plain deposits from Long Island southward, indicated the boundaries of the Alluvial formation and noted the presence of fossils. This paper was reprinted in substance in various magazines in 1811, 1817, 1818 and 1826. Maclure's views seemed to have attracted considerable attention at first, for in 1820 Hayden incorporated them in his "Geological Essays" and attempted to establish the theory that the Alluvial was deposited by a great flood which came down from the north and crossed North America from northeast to southwest. The following year Thomas Nuttall referred the Coastal Plain deposits to the Second Calcareous formation of Europe, pointed out the fact that it occupied the country east of the primitive and transition formations of the Piedmont Plateau; and fixed Annapolis as about its northern limit. The next year, 1822, Parker Cleaveland brought out his treatise on Mineralogy. In this interesting volume he reproduced Maclure's map and recorded the occurrence of selenite crystals in the Alluvial soil on the St. Mary's bank of the Patuxent river. He probably had in mind the locality directly opposite Solomons Island.

Professor John Finch, an Englishman, who was traveling in America at about this time, visited the Coastal Plain of Maryland and was so impressed with its interesting geology and vast deposits of fossils, that, on his return to Europe, he published an account of his experiences in southern Maryland, and drew some interesting conclusions regarding its geology. Finch in this book, which appeared in 1824, took exception to the classifications proposed by his predecessors. He believed that the deposits included under the term "Alluvial" were contemporaneous with the Lower Secondary and Tertiary of Europe, Iceland, Egypt and Hindoostan. He went further and divided Maclure's "Alluvial" up into Ferruginous Sand and Plastic Clay. He believed that the Plastic Clay was Tertiary, and based his conclusions on the presence of amber, which he found entombed in it at Cape Sable, correlating it with the amber of the Baltic. He also assigned to the Plastic Clay certain of the Indian kitchen-middens, which are found along the shore of Chesapeake Bay, thus opening a controversy regarding the age of these interesting deposits of oyster shells which did not reach a final settlement until many years later. He believed that the materials composing his Ferruginous Sand and Plastic Clay were deposited by a flood from the north or the northwest, agreeing somewhat closely with Hayden in this particular. His correlations were based almost entirely on lithologic distinctions, supported by a general similarity of fossil forms. No critical study of the fossils was undertaken, however, and few localities were given and no geologic boundaries whatever. It is consequently impossible to ascertain where he intended to place the formations which we now ascribe to the Miocene, and which he surely visited. He might have thought them to belong to the London Clay, together with those of the James and Rappahannock rivers, which he also visited and ascribed to this formation, but it is more likely that he placed them in the Plastic Clay. One thing, however, he perceived very keenly—that the deposits in the Coastal Plain would with future work be separated into many distinct formations. This prophecy has since been fulfilled. During the same year Thomas Say described the collection of fossil shells made by Finch, and among them appeared many Maryland forms. This collection is preserved in the British Museum.

In the year 1825 J. Van Rensselaer assigned the deposits of the Coastal Plain to the Tertiary, and divided them into Plastic Clay, London Clay and Upper Marine. He further correlated the deposits of Maryland which we now know as Miocene with the Upper Marine of Europe and probably in part with the London Clay. It should be noted here, however, that Finch had previously used Upper Marine in a different sense. He had applied it to the sand dune formations of Cape Henry and Staten Island, while Van Rensselaer adopted it for a true fossiliferous formation of very much greater age than the deposits which Finch had embraced under the same name. Three years later, in 1828, Morton, although accepting Van Rensselaer's correlation of the great deposits of fossil shells in the Maryland Coastal Plain with the Upper Marine of Europe, apparently used the term in a much wider sense than its author had employed. He also gave a list of the fossil forms occurring in the Upper Marine, and included some which have since been shown to be later than Miocene. During the same year Vanuxem divided the Alluvial and Tertiary of the Atlantic Coast into Secondary, Tertiary and Ancient and Modern Alluvial. In this classification the Miocene of southern Maryland was included in a part of the Tertiary. He stated further that vast numbers of "Littoral" shells occurred in the Tertiary analogous to those of the Tertiary of the Paris and English basins. He mentioned St. Mary's county particularly as being one of the Tertiary localities, and he also pointed out some of the differences between the faunas of the Secondary and Tertiary formations.

Conrad brought out his first publications bearing on the Miocene geology of Maryland in 1830. He agreed with Vanuxem in placing southern Maryland in the Tertiary and pointed out a number of localities where fossil shells could be found. Two years later Conrad published another paper in which he divided up the Coastal Plain deposits into six formations. This was the first time that the Coastal Plain had been classified so as to show its extreme complexity, and from this time on it has been dealt with, not as a deposit containing a few formations but as a series of deposits complex in composition and age. Conrad at this time ascribed the Miocene of Maryland to the Upper Marine

FIG. 1.—DIATOMACEOUS WORKS AT LYONS CREEK WHARF ON THE PATUXENT RIVER, CALVERT COUNTY.

FIG. 2.—VIEW SHOWING CONTACT OF THE CALVERT FORMATION ON THE EOCENE AND THE INDURATED BAND (ZONE 2) 5 FEET ABOVE IT, NEAR LYONS CREEK, CALVERT COUNTY.

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and made it equivalent to the Upper Tertiary of Europe. The following year John Finch published another book on his travels in Maryland which had been made almost a decade before. In this narrative, Finch gives a most interesting account of the great delight which he experienced in collecting from the enormous deposits of fossil shells in St. Mary's county. The same year Morton published another paper in which he proposed a classification of the Coastal Plain deposits. In this no distinct reference was made to Maryland but it is probable that he still regarded the Miocene of this state as Upper Marine. During the same year also Isaac Lea described some fossils from the St. Mary's river and regarded them as older Pleiocene. He, too, doubted the existence of the Miocene in Maryland. The next paper of importance was published by Conrad, in 1835, in which he assigned the Miocene deposits to the older Medial Pleiocene. In the following year Ducatel referred the deposits of St. Mary's and Calvert counties to older Pleiocene and distinctly stated that they were not Miocene. He also published a map of southern Maryland in which various deposits were marked and the names of the formations given in red letters.

W. B. Rogers was the first to recognize the presence of Miocene deposits in Maryland. He made the announcement in 1836 that part of the Maryland Tertiary belonged to the Miocene. The following year Ducatel agreed that if the deposits of Upper Marlboro and Fort Washington were Eocene then the blue marl of Charles county was Miocene. This view, he said, he had formerly entertained but had afterward abandoned it. During the next year Conrad ascribed formations to the Medial Tertiary and correlated them with the Crag of England. He noted the great difference between the fossil and living species, showing that the Medial Tertiary contained but 19 per cent. of living species. He thought that the extermination was due to a fall of temperature. In the same and the following years he described many fossils from the Miocene of Maryland and in 1842 he correlated his Medial Tertiary with the Crag of England and stated it was Miocene. The boundaries which he gave the Miocene at that time were not greatly different from the boundaries which are ascribed to the Chesapeake Group of to-day. In 1844 Bailey described some ten species of diatoms from Maryland and Ehrenberg, in the same year enumerated sixty-eight species from Piscataway and included many Miocene forms among them. Rogers, in the same year, assigned the diatomaceous earth to a position near the base of the Miocene.

About this time much interest was created in the Miocene problem of Maryland by Sir Charles Lyell. He regarded these deposits as Miocene, and gave at some length his reasons for this opinion. He also stated that the Miocene of Maryland agreed more closely with the Miocene of Lorraine and Bordeaux than to the Suffolk Crag. Lonsdale also concluded from the corals collected in the Miocene which were submitted to him for examination, that the American deposits were probably accumulated while the climate was somewhat "superior" to that of the Crag and "perhaps" equal to that of the *faluns* of Lorraine but "inferior" to that of Bordeaux. In the same year Conrad described and figured many fossils from the Calvert Cliffs. In the year 1850 Higgins gave analyses of many samples of marl from Kent, Talbot and Anne Arundel counties. It is probable that many of these marls belong to the Miocene.

No more papers of importance appeared on the Maryland Miocene until 1863 when Dana brought out his first edition of the Manual of Geology. In this work he took occasion to propose the term "Yorktown epoch" for the period during which the Miocene of the Atlantic coast was deposited. The next paper of significance was published by Heilprin in 1881, in which he discussed the Miocene at some length, and divided it into an "Older period" and a "Newer period." The Older period contained the older portion of the Miocene of Maryland; and the Newer period, the later portion. He subdivided the Newer period again into the Patuxent Group and the St. Mary's Group. The next year, the same author revised his classification and divided the Miocene into three groups as follows: the Carolinian or the Upper Atlantic Miocene including the Sumpter epoch of Dana, the Virginian or Middle Atlantic Miocene including part of the Yorktown of Dana and the Newer group of Maryland, and the Marylandian or the Older Atlantic Miocene including the rest of Dana's Yorktown and the older period of Maryland. He suggested that the Virginian was of the same age as the second Mediterranean of Austrian geologists and the *faluns* of Tourraine, and that the Marylandian was, at least in part, equivalent to the first Mediterranean of Austrian geologists and *faluns* of Leognan and Saucats. Three years later the same author published a map showing the distribution of these formations along the Atlantic coast. In 1888 Otto Meyer took exception to Heilprin's correlation and conclusions, and introduced the term *Atlantic Group* to embrace the Tertiary of the Atlantic States, and *Gulf Group* for that of the Gulf States. The Maryland Miocene lay wholly within the Atlantic group.

Three years later Darton employed the term "Chesapeake Group" to cover a portion of the Miocene and in the following year Dall and Harris published their report on the Miocene deposits in the Correlation Papers of the U. S. Geological Survey, and used the term "Chesapeake Group" to include the Miocene strata extending from Delaware to Florida. These deposits were made during the Yorktown epoch of Dana and the group included a large part of Heilprin's Marylandian, Virginian and Carolinian. Two years later Harris, basing his work on a study of the organic remains found in the Miocene, subdivided the Miocene faunas of Maryland into the Plum Point fauna, the Jones Wharf fauna and the St. Mary's fauna.

The following year Darton, by bringing together a large number of well records throughout the Coastal Plain from New Jersey southward, rendered a most important service to the study of the Miocene problem in Maryland by suggesting the structure and extent of the beds throughout the region. In his Fredericksburg folio, published in the same year, he was the first one to express, on a contour map, the development of the Miocene throughout a portion of southern Maryland and eastern Virginia. The following year Dana admitted Harris's faunal zones but still retained the term "Yorktown," to part of which he assigned the Maryland beds. In 1896 Darton published a bulletin under the auspices of the U. S. Geological Survey, in which he brought together a large number of well records throughout the Coastal Plain. He also published the Nomini folio, and carried forward the mapping of the Miocene deposits which he had previously started in the Fredericksburg folio.

COMPARATIVE TAXONOMIC TABLE OF THE MIOCENE STRATA OF MARYLAND

Shattuck 1902	Dall 1898	Harris 1893	Dall & Harris 1892	Dall 1892	Darton 1891	Meyer 1888	Heilprin 1882	Heilprin 1881	Dana 1863	Conrad 1842
St. Mary's formation	St. Mary's zone	St. Mary's fauna					Virginian (Middle Atlantic Miocene)	Newer Period: St. Mary's Group		
Choptank formation	Jones Wharf zone	Jones Wharf fauna	Chesapeake Group (in part)	Chesapeake Group (in part)	Chesapeake formation (in part)	Atlantic Group (in part)		Newer Period: Patnx'nt Group	Yorktown formation	Medial Tertiary
Calvert formation	Plum Point zone[1]	Plum Point fauna					Marylandian (Lower Atlantic Miocene)	Older period		

[1] The Plum Point zone is not equivalent to the entire Calvert formation.

Conrad 1838	Rogers Bros. 1837	Ducatel 1837	W. B. Rogers 1836	Ducatel 1836	Conrad 1835	Lea 1833	Conrad 1832	Vannxem 1828	Morton 1828	Van Rensselaer 1825	Finch 1824	Nuttall 1821	Maclure 1809
Medial Tertiary	Miocene (asserted)	Miocene (suggested)	Miocene (asserted)	Older Pliocene	Medial Pliocene (in part) Older Pliocene	Older Pliocene	Upper Marine	Tertiary (in part)	Upper Marine	Upper Marine and probably some London	Plastic clay (in part)	Second Calcareous (in part)	Allnvial (in part)

FIG. 1.—CLIFFS CONTAINING BEDS OF DIATOMACEOUS EARTH, LYONS WHARF, CALVERT COUNTY.

FIG. 2.—DIATOMACEOUS EARTH PIT OF NEW YORK SILICITE COMPANY, LYONS WHARF, CALVERT COUNTY.

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In 1898 Dall published a most important summary of existing knowledge of the Tertiary of North America, in which he suggested a subsidence and classification of the Maryland Miocene deposits and correlated them with the strata of other parts of North America and of Europe.

BIBLIOGRAPHY.

1669.

SHRIGLEY, NATHANIEL. A True Relation of Virginia and Mary-Land; with the commodities therein, [etc.] London, 1669.

(Repub.) Force's Collection of Historical Tracts, vol. iii, No. 7, Washington, 1844, 51 pp.

1685.

LISTER, MARTINI. Historia sive synopsis methodicæ Conchyliorum. Pl. 1059, fig. 2. London, 1685.

1809.

GODON, SILVAIN. Observations to serve for the Mineralogical Map of the State of Maryland. (Read Nov. 6, 1809.)

Trans. Amer. Philos. Soc., o. s. vol. vi, 1809, pp. 319-323.

MACLURE, WM. Observations on the Geology of the United States, explanatory of a Geological Map. (Read Jan. 20, 1809.)

Trans. Amer. Philos. Soc., o. s. vol. vi, 1809, pp. 411-428.

——— Observations sur la Géologie des États-Unis, survant à expliquer une Carte Géologique.

Journ. de phys. de chem. et d'hist. nat., vol. lxix, 1809, pp. 204-213.

1811.

MACLURE, WM. Suite des observations sur la géologic des États-Unis.

Journ. de phys., de chem. et d'hist. nat., vol. lxxii. Paris, 1811. With map, pp. 137-165.

1817.

MACLURE, WM. Observations on the Geology of the United States of America, with some remarks on the effect produced on the nature and fertility of soils by the decomposition of the different classes of rocks. With two plates. 12mo. Phila., 1817.

1818.

MACLURE, WM. Observations on the Geology of the United States of America, with some remarks on the probable effect that may be produced by the decomposition of the different classes of Rocks on the nature and fertility of Soils. Two plates.

Republished in Trans. Amer. Philos. Soc., vol. i, n. s., 1818, pp. 1-91.
Leon. Zeit. i, 1826, pp. 124-138.

MITCHILL, SAMUEL L. Cuvier's Essay on the Theory of the Earth. To which are now added Observations on the Geology of North America. 8vo. 431 pp. Plates. New York, 1818.

1820.

HAYDEN, H. H. Geological Essays; or an Inquiry into some of the Geological Phenomena to be found in various parts of America and elsewhere. 8vo. pp. 412. Baltimore, 1820.

SAY, THOMAS. Observations on some Species of Zoophytes, etc., principally Fossil.

Amer. Jour. Sci., 1820, vol. ii, pp. 34-45.

1821.

NUTTALL, THOMAS. Observations on the Geological Structure of the Valley of the Mississippi. [Read Dec., 1820.]

Jour. Acad. Nat. Sci., Phila., vol. ii. 1st. ser., 1821, pp. 14-52.

1822.

CLEAVELAND, PARKER. An elementary treatise on Mineralogy and Geology. 6 plates. 2nd Edit. in 2 vols. Boston, 1822.

1823.

DILLWYN, L. W. Martini Lister Historia sive Synopsis Methodicæ Conchyliarum. Editio tertia. Oxonii, 1823.

1824.

FINCH, JOHN. Geological Essay on the Tertiary Formations in America. (Read Acad. Nat. Sci. Phila., July 15, 1823.)

Amer. Jour. Sci., vol. vii, 1824, pp. 31-43.

SAY, THOMAS. An Account of some of the Fossil Shells of Maryland.

Jour. Acad. Nat. Sci., Phila., vol. iv, 1st ser., 1824, pp. 124-155. Plates 7-13.

Reprinted Bull. Amer. Pal., vol. i, No. 5, 1896, pp. 30-76; pl. 7-12.

1825.

ROBINSON, SAMUEL. A Catalogue of American Minerals, with their localities. Boston, 1825.

VAN RENSSELAER, JER. Lectures on Geology; being outlines of the science, delivered in the New York Atheneum in the year 1825. 8vo. pp. 358. New York, 1825.

1826.

PIERCE, JAMES. Practical remarks on the shell marl region of the eastern parts of Virginia and Maryland, and upon the bituminous coal formations of Virginia and the contiguous region.

Amer. Jour. Sci., vol. xi, 1826, pp. 54-59.

1828.

VANUXEM, L., and MORTON, S. G. Geological Observations on Secondary, Tertiary, and Alluvial formations of the Atlantic coast of the United States arranged from the notes of Lardner Vanuxem. (Read Jan., 1828.)

Jour. Acad. Nat. Sci., Phila., vol. vi, 1st ser., 1828, pp. 59-71.

1829.

MORTON, S. G. Description of two new species of Fossil Shells of the genus Scapphites and Crepidula: with some observations on the Ferruginous Sand, Plastic Clay, and Upper Marine Formations of the United States. (Read June 17, 1828.)

Jour. Acad. Nat. Sci., Phila., vol. vi, 1st ser., 1829, pp. 107-119.

1830.

CONRAD, T. A. On the Geology and Organic Remains of a part of the Peninsula of Maryland.

Jour. Acad. Nat. Sci., Phila., vol. vi, 1st ser., 1830, pp. 205-230, with two plates.

MORTON, SAMUEL G. Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States, with Geological remarks.

Amer. Jour. Sci., vol. xvii, 1830, pp. 274-295; vol. xviii, 1830, pp. 243-250.

1831.

CONRAD, TIMOTHY A. Description of Fifteen New Species of Recent and Three of Fossil Shells, chiefly from the Coast of the U. S.

Jour. Acad. Nat. Sci., Phila., vol. vi, 1st ser., 1831, pp. 256-268, plate.

OWEN, S. J. Fossil Remains, found in Anne Arundel County, Maryland.

Amer. Jour. Geol., Phila., vol. i, 1831, pp. 114-118.

1832.

CONRAD, T. A. Fossil Shells of the Tertiary Formations of North America illustrated by figures drawn on Stone from Nature. Phila. 46 pp., vol. i, pt. 1-2 (1832), 3-4 (1833).

(Repub.) by G. D. Harris, Washington, 1893.

RUFFIN, ED. An Essay on Calcareous Manures. Petersburg, Va., 1832.

Second edition, Shellbanks, 1835; third edition, Petersburg, 1842.

MORTON, S. G. On the analogy which exists between the Marl of New Jersey, &c., and the Chalk formation of Europe.

Amer. Jour. Sci., vol. xxii, 1832, pp. 90-95.
Also published separately.

1833.

CONRAD, T. A. On some new Fossil and Recent Shells of the United States.

Amer. Jour. Sci., vol. xxiii, 1833, pp. 339-346.
[Refers to *Upper marine* = Miocene (?).]

FINCH, J. Travels in the United States of America and Canada. 8vo. 455 pp. London, 1833.

GOLDFUSS, AUGUST. Petrefacta Germaniæ. 1833. p. 23. (Kalkversteinerung von den Ufern der Chesapeak Bay.)

The fern is *Madrepora palmata* Goldfuss.

LEA, ISAAC. Contributions to Geology. 237 pp. 6 plates. Phila. 1833. pp. 209-216.

(Rev.) Amer. Jour. Sci., vol. xxv, 1834, pp. 413-423.

MORTON, SAMUEL G. Supplement to the "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States," contained in vols. xvii and xviii of this Journal.

Amer. Jour. Sci., vol. xxiii, 1833, pp. 288-294; vol. xxiv, pp. 128-132, plate ix.

1834.

CONRAD, T. A. Observations on the Tertiary and more recent formations of a portion of the Southern States.

Jour. Acad. Nat. Sci., Phila., vol. vii, 1st ser., 1834, pp. 130-157.

Ducatel, J. T., and Alexander, J. H. Report on the Projected Survey of the State of Maryland, pursuant to a resolution of the General Assembly. 8vo. 39 pp. Annapolis, 1834. Map.

Md. House of Delegates, Dec. Sess., 1833, 8vo, 39 pp.
Another edition, Annapolis, 1834, 8vo, 58 pp., and map.
Another edition, Annapolis, 1834, 8vo, 43 pp., and folded table.
Amer. Jour. Sci., vol. xxvii, 1835, pp. 1-38.

Morton, S. G. Synopsis of the organic remains of the Cretaceous group of the United States. To which is added an appendix containing a tabular view of the Tertiary fossils hitherto discovered in North America. 8vo, 88 pp. Phila. 1834.

(Abst.) Amer. Jour. Sci., vol. xxvii, 1835, pp. 377-381.

Harlan, R. Critical Notices of Various organic remains hitherto discovered in North America. (Read May 21, 1834.)

Trans. Geol. Soc. Pa., vol. i, part 1, 1834, pp. 46-112.
Med. and Phys. Researches, 1835, [with a few additions].
Edinb. New Philos. Jour., xvii, 1834, pp. 342-363; xviii, pp. 28-40.

1835.

Conrad, T. A. Observations on a portion of the Atlantic Tertiary Region.

Trans. Geol. Soc., Pa., vol. i, part 2, 1835, pp. 335-341.

——— Observations on the Teritiary Strata of the Atlantic Coast.

Amer. Jour. Sci., vol. xxviii, 1835, pp. 104-111, 280-282.

Ducatel, J. T. Geologist's report 1834.

——— [Another edition.] Report of the Geologist to the Legislature of Maryland, 1834. n. d. 8vo, 50 pp. 2 maps and folded tables.

———, and Alexander, J. H. Report on the New Map of Maryland, 1834, [Annapolis] n. d. 8vo, 59, i, pp. Two maps and one folded table.

Md. House of Delegates, Dec. Sess., 1834.

Harlan, Richard. Notice of a Pleseosaurian and other fossil Reliquiae from the State of New Jersey.

Med. and Phys. Researches, 1835, pp. 383-385.

1836.

Ducatel, J. T. Report of the Geologist. n. d. 8vo, pp. 35-84. Plate.

Separate publication (see Ducatel and Alexander).

———, and ALEXANDER, J. H. Report on the New Map of Maryland, 1835. 8vo, 84 pp. [Annapolis, 1836.]

Md. Pub. Doc., Dec. Sess., 1835.
Another edition, 96, 1 pp. and maps and plate.
Engineer's Report, pp. 1-34.

——— Report of the Engineer and Geologist in relation to the New Map to the Executive of Maryland.

Md. Pub. Doc., Dec. Sess., 1835 [Annapolis, 1836], 8vo. 84, 1 pp., 6 maps and plates.
Jour. Franklin Inst., vol. xviii, n. s. 1836, pp. 172-178.

FEATHERSTONHAUGH, G. W. Report of a Geological Reconnoissance made in 1835 from the seat of government by way of Green Bay and the Wisconsin Territory on the Coteau du Prairie, an elevated ridge dividing the Missouri from the St. Peters River. 169 pp. 4 plates. Washington, 1836.

ROGERS, WM. B. Report of the Geological Reconnoissance of the State of Virginia. Wm. B. Rogers. Phila. 1836. 143 pp. Plate.

1837.

DUCATEL, J. T. Outline of the Physical Geography of Maryland, embracing its prominent Geological Features.

Trans. Md. Acad. Sci. and Lit., vol. ii, 1837, pp. 24-54, with map.

———, and ALEXANDER, J. H. Report on the New Map of Maryland, 1836. 8vo, 104 pp. and 5 maps. [Annapolis, 1837.]

Md. House of Delegates, Sess. Dec., 1836.
Another edition, 117 pp.

ROGERS, W. B. and H. D. Contributions to the Geology of the Tertiary Formations of Virginia. (Read May 5, 1835.)

Trans. Amer. Philos. Soc., vol. v, n. s. 1837, pp. 319-341.

TYSON, PHILIP T. A descriptive Catalogue of the principal minerals of the State of Maryland.

Trans. Md. Acad. Sci. and Lit., 1837, pp. 102-117.

1838.

CONRAD, T. A. Fossils of the Medial Tertiary of the United States. No. 1, 1838. [Description on cover 1839 & '40.] 32 pp. Plates i-xvii.

Republished by Wm. H. Dall, Washington, 1893.

1839.

WAGNER, WILLIAM. Description of five new Fossils, of the older Pliocene formation of Maryland and North America. (Read Jan. 1838.)

Jour. Acad. Nat. Sci., Phila., vol. viii, 1st ser., 1839, pp. 51-53, with one plate.

1840.

CONRAD, T. A. Fossils of the Medial Tertiary of the United States. No. 2. 1840. [Description on cover 1840-1842.] pp. 33-56. Plates xviii-xxix.

Republished by Wm. H. Dall, Washington, 1893

1841.

BOOTH, J. C. Memoir of the Geological Survey of the State of Delaware; including the application of the Geological Observations to Agriculture. i-xi, 9-188 pp. Dover, 1841.

CONRAD, T. A. Description of Twenty-six new Species of Fossil Shells discovered in the Medial Tertiary Deposits of Calvert Cliffs, Md.

Proc. Acad. Nat. Sci., Phila., vol. i, 1841, pp. 28-33.

GOULD, AUGUSTUS A. A Report on the Invertebrate Animals of Massachusetts, comprising the Mollusca, Crustacea, Annelida, and Radiata. Published by the order of the Legislature. 8vo, pp. 373. Cambridge, Mass., 1841. [See p. 85.]

CONRAD, T. A. New Species of Fossil Shells from Calvert Cliffs, Md.

Proc. Acad. Nat. Sci., Phil., vol. i, 1841, pp. 28-33.

1842.

CONRAD, T. A. Observations on a portion of the Atlantic Tertiary Region, with a description of new species of organic remains.

2nd edit., 1854; 3rd edit., 1856.

——— Description of twenty-four new species of Fossil Shells chiefly from the Tertiary Deposits of Calvert Cliffs, Md. (Read June 1, 1841.)

Jour. Acad. Nat. Sci., Phila., vol. viii, 1st ser., 1842, pp. 183-190.

DE KAY, JAMES E. Zoology of New York or the New York Fauna.

Nat. Hist. of New York; 2 vol., pt. 1, Mammalia.

HARLAN, R. Description of a New Extinct Species of Dolphin from Maryland.

2nd Bull. Proc. Nat. Inst. Prom. Sci., 1842, pp. 195-196, 4 plates.

LYELL, CHAS. On the Tertiary Formations and their connection with the Chalk in Virginia and other parts of the United States.
Proc. Geol. Soc., London, vol. iii, 1842, pp. 735-742.

MARKOE, FRANCIS, JR. [Remarks and list of fossils from Miocene.]
2nd Bull. Proc. Nat. Inst. Prom. Sci., 1842, p. 132.

1843.

AGASSIZ, LOUIS. Recherches sur les Poissons Fossiles. Tome III.

CONRAD, T. A. Description of a new Genus, and Twenty-nine new Miocene and one Eocene Fossil Shells of the United States.
Proc. Acad. Nat. Sci., Phila., vol. i, 1843, pp. 305-311.

——— Descriptions of nineteen Species of Tertiary Fossils of Virginia and North Carolina.
Proc. Acad. Nat. Sci., Phila., vol. i, 1843, pp. 323-329.

1844.

BAILEY, J. W. Account of some new Infusorial Forms discovered in the Fossil Infusoria from Petersburg, Va., and Piscataway, Md.
Amer. Jour. Sci., vol. xlvi, 1844, pp. 137-141, plate iii.

EHRENBERG, C. G. Ueber zwei neue Lager von Gebirgsmassen aus Infusorien als Meeres-Absatz in Nord Amerika und eine Verglcichung derselben mit den organischen Kreide-Gebilden in Europa und Afrika.
Bericht. k. p. akad. Wiss., Berlin, 1844, pp. 57-97.
(Rev.) Amer. Jour. Sci., vol. xlviii, 1845, pp. 201-204. By J. W. Bailey.

ROGERS, H. D. Address delivered at the Meeting of the Association of American Geologists and Naturalists.
Amer. Jour. Sci., vol. xlvii, 1844, pp. 137-160, 247-278.

———, WM. B. [Tertiary Infusorial formation of Marylaud.]
Amer. Jour. Sci., vol. xlvi, 1844, pp. 141-142.

1845.

BAILEY, J. W. Notice of some New Localities of Infusoria, Fossil and Recent.
Amer. Jour. Sci., vol. xlviii, 1845, pp. 321-343, plate iv.

——— [Summary and Review of Ehrenberg's Observations on the Fossil Infusoria of Virginia and Maryland, and a comparison of the same with those found in the Chalk Formations of Europe and Africa.]
Amer. Jour. Sci., vol. xlviii, 1845, pp. 201-204.

CONRAD, T. A. Fossils of the (Medial Tertiary or) Miocene Formation of the United States. No. 3. 1845. pp. 57-80. Plates xxx-xlv.

Republished by Wm. H. Dall, Washington, 1893.

LEA, HENRY C. Description of some new Fossil Shells from the Tertiary of Petersburg, Virginia.

Trans. Amer. Philos. Soc., vol. ix, pp. 229-274.

LONSDALE, W. Indications of Climate afforded by Miocene Corals of Virginia.

Appendix Quart. Jour. Geol. Soc., London, vol. i, 1845, pp. 427-429.

LYELL, CHAS. Travels in North America, with Geological Observations on the United States, Canada and Nova Scotia. 2 vols. 12°. New York, 1845.

Another edit., 2 vol., 12°, London, 1845. Another Edit. 2 vols., New York, 1852. Second English edit. London 1855. German edit., translated by E. T. Wolff, Halle, 1846.

——— On the Miocene Tertiary Strata of Maryland, Virginia and of North and South Carolina.

Quart. Jour. Geol. Soc., London, vol. i, 1845, pp. 413-427.
Proc. Geol. Soc., London, vol. i, 1845, pp. 413-427.

1846.

CONRAD, T. A. Observations on the Eocene formation of the United States, with descriptions of Species of Shells, &c., occurring in it.

Amer. Jour. Sci., 2nd ser., vol. i, pp. 209-221, 395-405.

——— Tertiary Fossil Shells.

Proc. Acad. Nat. Sci., Phila., vol. iii, 1846, pp. 19-27, 1 plate.

1847.

GIBBES, ROBT. W. Description of new species of Aqualides from the Tertiary Beds of South Carolina.

Proc. Acad. Nat. Sci., Phila., vol. iii, 1846-7, pp. 266-268.

1848.

GIBBES, R. W. Monograph of the fossil Squalidae of the United States.

Jour. Acad. Nat. Sci., Phila., 2nd ser., vol. i, 1848, pp. 139-148, 191-206.

LEA, HENRY C. Catalogue of the Tertiary Testacea of the United States.

Proc. Acad. Nat. Sci., Phila., vol. iv, 1848, pp. 95-107.

1849.

BAILEY, J. W. New Localities of Infusoria in the Tertiary of Maryland.

Amer. Jour. Sci., 2nd ser., vol. vii, 1849, p. 437.

D'ORBIGNY, A. Note sur les Polypiers fossiles.

1850.

HIGGINS, JAS. Report of James Higgins, M. D., State Agricultural Chemist, to the House of Delegates. 8vo. 92 pp. Annapolis, 1850.

Md. House of Delegates, Dec. Sess. [G].

1851.

BAILEY, J. W. Miscellaneous Notices. 3 Fossil Infusoria of Maryland.

Amer. Jour. Sci., 2nd ser., vol. xi, 1851, pp. 85-86.

1852.

CONRAD, T. A. Remarks on the Tertiary Strata of St. Domingo and Vicksburg [Miss.].

Proc. Acad. Nat. Sci., Phila., vol. vi, 1852, pp. 198-199.

HIGGINS, JAMES. The Second Report of James Higgins, M. D., State Agricultural Chemist, to the House of Delegates of Maryland. 8vo. 118 pp. Annapolis, 1852.

Md. House of Delegates, Jan. Sess., 1852 [C], 8vo, 126 pp.

JOHNSON, ALEXANDER S. Notice of some undescribed Infusorial Shells.

Amer. Jour. Sci., 2nd ser., vol. xiii, 1852, p. 33.

LYELL, CHAS. Travels in North America, in the years 1841-2; with Geological Observations on the United States, Canada, and Nova Scotia. 2 vols. 8vo. New York, 1852.

1853.

CONRAD, T. A. Monograph on the genus Fulgur.

Proc. Acad. Nat. Sci., Phila., vol. vi, 1853, pp. 316-319.

HITCHCOCK, E. Outline of the Geology of the Globe and of the United States in particular, with geological maps, etc. 8vo. Boston, 1853.

2nd edit., 1854; 3rd edit., 1856.

MARCOU, JULES. A Geological Map of the United States and the British Provinces of North America, with an explanatory text, [etc.] 8vo. Boston, 1853.

1854.

DARWIN, CHARLES. A Monograph of the Fossil Balanidae and Verrucidae of Great Britain.

London Palaeontog. Soc., London, 1854, pp. 17-20, plate 1.

HITCHCOCK, E. Outline of the Geology of the Globe and of the United States in particular, with geological maps, etc. 8vo. Boston, 1854. (2nd edition.)

1855.

MARCOU, J. Resumé explicatif d'un carte géologique des Etats-Unis et des provinces anglaises de l'Amérique.

Bull. Soc. Géol. Fr., 2 ser., tome xii, 1855, pp. 813-936; colored geological map.

——— Ueber die Geologie der Vereinigten Staaten und der englischen Provinse von Nord Amerika.

Petermann's Mitth., 1855, pp. 149-159.
Trans. in Geology of North America, pp. 58-70. Zurich, 1858.

1856.

EHRENBERG, C. G. Zur Mikrogeologie. 2 vols. and atlas, roy. folio, forty-one plates. Leipzig, 1854-56.

HIGGINS, JAMES. Fifth Agricultural Report of James Higgins, State Chemist, to the House of Delegates of the State of Maryland. 8vo. 91 pp. Annapolis, 1856 (published separately).

Also Md. House of Delegates, Jan. Sess., 1856.
Md. Sen. Doc.
Another edition, pp. 15-18 omitted, 8vo, 90 pp.

ROGERS, H. D. Geological Map of the United States and British North America.

1857.

TUOMEY, M., and HOLMES, F. S. Pleiocene Fossils of South Carolina. Containing descriptions and figures of the Polyparia, Echinodermata and Mollusca. Charleston, S. C., 1857. [1854-7], pp. 110.

1860.

TYSON, P. T. First Report of Philip T. Tyson, State Agricultural
145 pp. Annapolis, 1860. Maps.
Chemist, to the House of Delegates of Maryland, Jan. 1860. 8vo.

Md. Sen. Doc. [E].
Md. House Doc. [C].

——— Report of Chemist. n. d. [1860], 8vo, 4 pp.

1861.

CONRAD, T. A. Fossils of the (Medial Tertiary or) Miocene Formation of the United States. No. 4. 1861 [?]. pp. 81-89, index and plates xlv-xlix.

Republished by Wm. H. Dall, Washington, 1893.

FROMENTEL, E. DE. Introduction a l'etude des Ésponges fossiles.

Normandie Soc. Linn. Mém., xi. 1860.

JOHNSTON, CHRISTOPHER. Upon a Diatomaceous Earth from Nottingham, Calvert Co., Maryland.

Proc. Amer. Assoc. Adv. Sci., vol. xiv, 1861, pp. 159-161.

NORMAN, GEORGE. On some Undescribed Species of Diatomaceae. (Read Nov. 14, 1860.)

Trans. Microscopical Soc. of London, n. s. vol. ix, 1861, pp. 5-9.

ROGERS, W. B. Infusorial earth from the Tertiary of Virginia and Maryland. (Read May 4, 1859.)

Proc. Boston Soc. Nat. Hist., vol. vii, 1861, pp. 59-64.

TYSON, P. T. [Letter from Mr. Tyson of Maryland on Tripoli.] (Read Dec. 1860.)

Proc. Acad. Nat. Sci., Phila., vol. xii, 1861, pp. 550-551.

1862.

CONRAD, T. A. Catalogue of the Miocene Shells of the Atlantic Slope.

Proc. Acad. Nat. Sci., Phila., vol. xiv, 1862, pp. 559-582.

——— Description of New, Recent and Miocene Shells.

Proc. Acad. Nat. Sci., Phila., vol. xiv, 1862, pp. 583-586.

TYSON, PHILIP T. Second Report of Philip T. Tyson, State Agricultural Chemist, to the House of Delegates of Maryland, Jan. 1862. 8vo. 92 pp. Annapolis, 1862.

Md. Sen. Doc. [F].

1863.

DANA, JAMES D. Manual of Geology. Phila. 1863.

1864.

MEEK, F. B. Check list of the Invertebrate fossils of North America. Miocene.

Smith. Misc. Col., vol. vii, art. vii, 1864, 34 pp.

1866.

CONRAD, T. A. Illustrations of Miocene Fossils, with Descriptions of New Species.

Amer. Jour. Conch., vol. ii, 1866, pp. 65-74, plates 3 and 4.

——— Descriptions of new species of Tertiary, Cretaceous and Recent Shells.

Amer. Jour. Conch., vol. ii, 1866, pp. 104-106.

1867.

COPE, E. D. An addition to the Vertebrate Fauna of the Miocene Period, with a Synopsis of the Extinct Cetacea of the United States.

Amer. Jour. Conch., vol. iii, 1867, pp. 257-270.

COPE, E. D. An addition to the Vertebrate Fauna of the Miocene Period, with a Synopsis of the Extinct Cetacea of the United States.

Proc. Acad. Nat. Sci., Phila., vol. xix, 1867, pp. 138-156.

——— Extinct mammalia from Miocene of Charles Co., Maryland.

Proc. Acad. Nat. Sci., Phila., vol. xix, 1867, pp. 131-132.

GILL, THEODORE. On the Genus Fulgur and its Allies.

Amer. Jour. Conch., vol. iii, 1867, pp. 141-152.

HIGGINS, JAMES. A Succinct Exposition of the Industrial Resources and Agricultural advantages of the State of Maryland.

Md. House of Delegates, Jan. Sess., 1867 [DD], 8vo, 109, iii, pp.
Md. Sen. Doc., Jan. Sess., 1867 [U].

1868.

CONRAD, T. A. Descriptions of new Genera and Species of Miocene Shells, with notes on other Fossil and recent Species.

Amer. Jour. Conch., vol. iii, 1868, pp. 257-270.

——— Descriptions of Miocene Shells of the Atlantic Slope.

Amer. Jour. Conch., vol. iv, 1868, pp. 64-68.

COPE, E. D. [Extinct Cetacea from Miocene of Charles Co., Md.]

Proc. Acad. Nat. Sci., Phila., vol. xx, 1868, pp. 159-160.

——— Second Contribution to the History of the Vertebrata of the Miocene Period of the U. S.

Proc. Acad. Nat. Sci., Phila., vol. xx, 1868, pp. 159, 184-194.

——— [Remarks on extinct Reptiles.]

Proc. Acad. Nat. Sci., Phila., vol. xx, 1868, p. 313.

1869.

Conrad, T. A. Descriptions of and References to Miocene Shells of the Atlantic Slope, and Descriptions of two new supposed Cretaceous Species.

Amer. Jour. Conch., vol. iv, 1869, pp. 278-279.

——— Descriptions of New Fossil Mollusca, principally Cretaceous.

Amer. Jour. Conch., vol. v, 1869, pp. 96-103, pl. ix.

——— Notes on Recent and Fossil Shells, with Descriptions of new Genera.

Amer. Jour. Conch., vol. iv, 1869, pp. 246-249.

——— Descriptions of Miocene, Eocene and Cretaceous Shells.

Amer. Jour. Conch., vol. v, 1869, pp. 39-45, pls. i and ii.

Cope, E. D. Third Contribution to the Fauna of the Miocene Period of the United States.

Proc. Acad. Nat. Sci., Phila., vol. xxi, 1869, pp. 6-12.

Leidy, Joseph. The Extinct Mammalian Fauna of Dakota and Nebraska, including an account of some allied forms from other localities, together with a Synopsis of the Mammalian Remains of North America.

Jour. Acad. Nat. Sci., Phila., 2nd ser., vol. vii, pp. 1-472.

Logan, Wm. E. Geological Map of Canada and the Northern United States.

(Rev.) Amer. Jour. Sci., 2nd ser., vol. xlix, 1870, pp. 394-398.

1870.

Cope, E. D. The Fossil Reptiles of New Jersey.

Amer. Nat., vol. iii, pp. 84-91.

Marsh, O. C. Notice of some Fossil Birds from the Cretaceous and Tertiary Formations of the United States.

Amer. Jour. Sci., ser. ii, vol. xlix, pp. 205-217.

1871.

Cope, E. D. Synopsis of the Extinct Batrachia, Reptilia and Aves of North America.

Trans. Amer. Philos. Soc., vol. xiv, pp. 1-252.

1872.

Hitchcock, C. H. Description of the Geological Map.

Ninth Census, vol. iii, Washington, 1872, pp. 754-756.

1874.

DANA, J. D. Manual of Geology. 2nd edition. New York, 1874. pp. 828.

1875.

COPE, E. D. Synopsis of the Vertebrata of the Miocene of Cumberland County, New Jersey.

Proc. Amer. Philos. Soc., vol. xiv, pp. 361-364.

JOHNSTON, CHRISTOPHER. About the rediscovery of the "Bermuda Tripoli" near Nottingham, on the Patuxent, Prince George's County, Md.

Proc. Boston Soc. Nat. Hist., vol. xvii, 1875, pp. 127-129.

SULLIVANT, J. [Letter to Professor Christopher Johnston on Bermuda Tripoli in Maryland.]

Proc. Boston Soc. Nat. Hist., vol. xvii, 1875, pp. 422-423.

1877.

LEIDY, J. Description of Vertebrate Remains, chiefly from the Phosphate beds of South Carolina.

Jour. Acad. Nat. Sci., Phila., 2nd ser., vol. viii, pp. 241, 242, 243, 245, pl. xxxi, figs. 14-18; pl. xxxii, figs. 6, 6a, 7, 7a; pl. xxxiii, figs. 4 and 5.

1880.

DANA, J. D. Manual of Geology. 3rd edit.

HEILPRIN, ANGELO. On the Stratigraphical Evidence Afforded by the Tertiary Fossils of the Peninsula of Maryland.

Proc. Acad. Nat. Sci., Phila., vol. xxxii, 1880, pp. 20-33.

1882.

HEILPRIN, ANGELO. On the relative ages and classification of the Post-Eocene Tertiary Deposits of the Atlantic Slope.

Proc. Acad. Nat. Sci., Phila., vol. xxxiv, 1882, pp. 150-186.

(Abst.) Amer. Jour. Sci., 3 ser., vol. xxiv, 1882, pp. 228-229. Amer. Nat., vol. xvii, 1883, p. 308. Science, 1882, p. 183.

1883.

BRANTLY, W. T. Maryland.

Encyclopedia Britannica, vol. xv, New York, 1883, pp. 602-605.

LECONTE, JAS. Elements of Geology. 2nd. edition. New York, 1883.

WILBUR, F. A. Marls.

Mineral Resources U. S., 1882, Washington, 1883, p. 522.

1884.

HEILPRIN, ANGELO. Contributions to the Tertiary Geology and Paleontology of the United States. 4to. 117 pp., map. Phila., 1884.

——— The Tertiary Geology of the Eastern and Southern United States.

Jour. Acad. Nat. Sci., Phila., vol. ix, 2nd ser., 1884-85, pp. 115-154, pl. iv.

——— North American Tertiary Ostreidae.

4th Ann. Rept. U. S. Geol. Surv., 1882-83, Washington, 1884, pp. 309-316. (Appendix I to C. A. White's Fossil Ostreidae of North America).

1885.

WILLIAMS, A., JR. (Editor). Infusorial Earth.

Mineral Resources U. S., 1883-1884, Washington, 1885, p. 720.

ZITTEL, KARL A. Handbuch der Palaeontologie. I Abtheil. II Band. Munich und Leipzig, 1885. p. 270.

1886.

PAUTOCSEK, J. Beitrag. Kenntniss foss. Bacillarien Nuganis. Theil I, 1886, p. 35, pl. xxvii, fig. 262.

1887.

DAY, D. T. Infusorial Earth.

Mineral Resources, U. S., 1886, Washington, 1887, p. 587.

DUNCAN, P. M. On a new Genus of Madreporaria (Glyphastraea), with Remarks on the Morphology of Glyphastraea Forbesi Ed. & H. from the Tertiaries of Maryland, U. S.

Quart. Jour. Geol. Soc., London, vol. xliii, 1887, pp. 24-32, pl. iii.

HEILPRIN, A. The Miocene Mollusca of the State of New Jersey.

Proc. Acad. Nat. Sci., Phila., 1887, pp. 397-405.

——— Explorations on the West Coast of Florida and of the Okeechobee Wilderness.

Trans. Wagner Free Inst. Sci., vol. i, 1887, pp. 1-8, 1-134.
Abst. Amer. Jour. Sci., 3rd ser., vol. xxxiv, 1887, pp. 230-232.
Pop. Sci. Monthly, vol. xxxiii, 1887, pp. 418.

——— Fossils of the Pliocene ("Floridian") Formation of the Caloosahatchie. Explorations on the West Coast of Florida, etc.

Trans. Wagner Free Inst. Sci., Phila., 1887, vol. i, pp. 68-104.

HITCHCOCK, C. H. The Geological Map of the United States.

Trans. Amer. Inst. Min. Eng., vol. xv, 1887, pp. 465-488.

1888.

Clark, Wm. B. On three Geological Excursions made during the months of October and November, 1887, into the southern counties of Maryland.

Johns Hopkins Univ. Cir. No. 63, vol. vii, 1888, pp. 65-67.

Day, D. T. (Editor). Infusorial Earth.

Mineral Resources U. S., 1887, Washington, 1888, p. 554.

McGee, W J. Three Formations of the Middle Atlantic Slope.

Amer. Jour. Sci., 3rd ser., vol. xxxv, 1888, pp. 120-143, 328-331, 367-388, 448-466, plate ii.

(Absts.) Nature, vol. xxxviii, 1888, pp. 91, 190.
Amer. Geol., vol. ii, 1888, pp. 129-131.

Hinde, G. J. On the History and Characters of the Genus Septastraea, D'Orbigny (1849) and the Identity of its Type Species with that of Glyphastraea, Duncan (1887).

Quart. Jour. Geol. Soc., London, vol. xliv, 1888, pp. 200-227, pl. ix.

Meyer, Otto. Some remarks on the present state of our Knowledge of the North American Eastern Tertiary.

Amer. Geol., vol. ii, 1888, pp. 88-94.

——— Upper Tertiary Invertebrates from West Side of Chesapeake Bay.

Proc. Acad. Nat. Sci., Phila., 1888, pp. 170-171.

Uhler, P. R. Observations on the Eocene Tertiary and its Cretaceous Associates in the State of Maryland.

Trans. Md. Acad. Sci., vol. i, 1888, pp. 11-32.

1889.

Dall, William Healey. A Preliminary Catalogue of the Shell-bearing Marine Mollusks and Brachiopods of the Southeastern Coast of the United States.

Smith. Inst., U. S. Nat. Mus., Bull. xxxvii.

Uhler, P. R. Additions to observations on the Cretaceous and Eocene formations of Maryland.

Trans. Md. Acad. Sci., vol. i, 1889, pp. 45-72.

Woolman, Lewis. Artesian wells, Atlantic City, New Jersey.

New Jersey Geol. Survey, Report of State Geologist for 1889, pp. 89-99.

1890.

Clark, Wm. B. Third Annual Geological Expedition into Southern Maryland and Virginia.

Johns Hopkins Univ. Cir. No. 81, vol. ix, 1890, pp. 69-71.

Cope, E. D. The Cetacea.

Amer. Nat., vol. xxiv, pp. 599-616, pls. xx-xxiii.

Dall, W. H. Contributions to the Tertiary Fauna of Florida, with especial reference to the Miocene Silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River. Part I. Pulmonate, Opisthobranchiate and Orthodont Gastropods.

Trans. Wagner Free Inst. Sci., Phila., vol. iii, part i, 1890, pp. 1-200, pl. i-xii.

Day, D. T. Abrasive Materials.

Mineral Resources U. S., 1888, Washington, 1890.

Macfarlane, J. R. An American Geological Railway Guide. 2nd edit. 8vo, 426 pp. Appleton, 1890.

Rotthay, J. Revision of the Genus Actinocyclus.

Jour. Luckett-Micro Club, ser. ii, vol. iv, No. 27, 1890, pp. 137-212.

Uhler, P. R. Notes on Maryland.

Macfarlane's An American Geol. R. R. Guide, 2nd Edit., Appleton, 1890.

——— Notes and Illustrations to "Observations on the Cretaceous and Eocene Formations of Maryland."

Trans. Amer. Acad. Sci., vol. i, 1890, pp. 97-104.

Woolman, Lewis. Geology of Artesian Wells at Atlantic City, N. J.

Proc. Acad. Nat. Sci., Phila., 1890, pp. 132-147.

1891.

Clark, W. B. Report on the Scientific Expedition into Southern Maryland. [Geology; W. B. Clark. Agriculture; Milton Whitney. Archaeology; W. H. Holmes.]

Johns Hopkins Univ. Cir. No. 89, vol. x, 1891, pp. 105-109.

Dall, Wm. H. Elevation of America in Tertiary Periods.

Geol. Mag. n. s. dec. iii, vol. viii, 1891, pp. 287-288.

——— Elevation of America in the Cenozoic Periods.

Amer. Nat., vol. xxv, 1891, pp. 735-736.

DARTON, N. H. Mesozoic and Cenozoic Formations of Eastern Virginia and Maryland.

Bull. Geol. Soc. Amer., vol. ii, 1891, pp. 431-450, map, sections.
(Abst.) Amer. Geol., vol. viii, 1891, p. 185.
Amer. Nat., vol. xxv, 1891, p. 658.

HARRIS, GILBERT D. On the Compounding of *Nassa trivittata* Say and *Nassa peralta* (Con. sp.)

Amer. Geol., vol. viii, 1891, pp. 174-176.

MCGEE, W J The Lafayette Formation.

12th Ann. Rept. U. S. Geol. Surv., 1890-91, Washington, 1891, pp. 347-521.

——— Geology of Washington and Vicinity.

In Guide to Washington and its Scientific Institutions.
Compte rendu, International Congress of Geologists, 1891.
House Misc. Doc., 53rd Cong., 2nd sess., vol. xiii, No. 107.

——— Administrative Reports. Geologic and Paleontologic Investigations.

12th Ann. Rept. U. S. Geol. Surv., 1890-91, Washington, 1891, part i, pp 72, 76, 117.

WOOLMAN, LEWIS. Artesian wells and water-bearing horizons of Southern New Jersey (with a "note on the extension southward of diatomaceous clays and the occurrence there of flowing artesian wells").

New Jersey Geol. Surv., Rept. State Geologist for 1890, 1891, pp. 269-276. Also published separately.

1892.

DALL, W. H. Contributions to the Tertiary Fauna of Florida, etc. Part II. Streptodont and other Gastropods.

Trans. Wagner Free Inst. Sci., Phila., vol. iii, part ii, 1892, pp. 201-473, pl. xiii-xxii.

——— and HARRIS, G. D. Correlation Papers—Neocene.

Bull. U. S. Geol. Surv. No. 84, 1892.
House Misc. Doc., 52nd Cong., 1st sess., vol. xliii, No. 337.

DARTON, N. H. Physiography of the region [Baltimore and vicinity] and Geology of the Sedimentary Rocks. Guide to Baltimore, with an account of the Geology of its environs and three maps. Baltimore, 1892. pp. 123-139.

DAY, D. T. (Editor). Infusorial Earth.

Mineral Resources U. S., 1889-90, Washington, 1892, p. 459.
Eleventh Census Rept. Mineral Industries, 1892, pp. 707-708.
House Misc. Doc., 1st sess. 52nd Cong., vol. 50, pt. i, 1892; pp. 707-708.

WILLIAMS, G. H. (Editor). Guide to Baltimore, with an account of the Geology of its environs and three maps. Baltimore, 1892.

WOOLMAN, LEWIS. A review of Artesian Horizons in Southern New Jersey, etc.

New Jersey Geol. Surv., Rept. State Geologist for 1891, 1892, pp. 223-245. Also published separately.

1893.

DALL, WM. H. Republication of Conrad's Fossils of the Medial Tertiary of the United States, with Introduction. Phila., 1893.

DARTON, N. H. The Magothy Formation of Northeastern Maryland.

Amer. Jour. Sci., 3rd ser., vol. xlv, 1893, pp. 407-419, map.

——— Cenozoic History of Eastern Virginia and Maryland.

Bull. Geol. Soc. Amer., vol. v, 1893, p. 24.

(Abst.) Amer. Jour. Sci., 3rd ser., vol. xlvi, 1893, p. 305.

GEIKIE, A. Text Book of Geology. 3rd edit. 8vo. 1147 pp. London: Macmillan Co., 1893.

HARRIS, G. D. Republication of Conrad's Fossil Shells of the Tertiary Formations of North America, with Introduction. 8vo. 121 pp. 20 plates. Washington, D. C., 1893.

——— The Tertiary Geology of Calvert Cliffs, Md.

Amer. Jour. Sci., 3rd ser., vol. xlv, 1893, pp. 21-31, map.

——— Remarks on Dall's collection of Conrad's works.

Amer. Geol., vol. xi, 1893, pp. 279-281.

WILLIAMS, G. H. Mines and Minerals [of Maryland].

Maryland, its Resources, Industries and Institutions, Baltimore, 1893, pp. 89-153.

———, and CLARK, W. B. Geology [of Maryland].

Maryland, its Resources, Industries and Institutions, Baltimore, 1893, pp. 55-89.

(Rev.) Amer. Geo., vol. xi, 1893, pp. 396-398.

WOOLMAN, LEWIS. Artesian Wells in Southern New Jersey.

New Jersey Geol. Sur., Report State Geologist for 1892, 1893, pp. 275-311.

1894.

CLARK, WM. BULLOCK. The Climatology and Physical Features of Maryland.

1st Biennial Rept. Md. State Weather Service, 1894.

DALL, W. H. Notes on the Miocene and Pliocene of Gay Head, Martha's Vineyard, Mass., and of the "Land Phosphate" of the Ashley River district, South Carolina.

Amer. Jour. Sci., 3rd ser., vol. xlviii, 1894, pp. 296-301.

DARTON, N. H. An outline of the Cenozoic History of a Portion of the Middle Atlantic Slope.

Jour. Geol., vol. ii, 1894, pp. 568-587.

——— Artesian Well Prospects in Eastern Virginia, Maryland and Delaware.

Trans. Amer. Inst. Min. Eng., vol. xxiv, 1894, pp. 372-379, plates 1 and 2.

——— Fredericksburg Folio. Explanatory Sheets.

U. S. Geol. Surv. Geol. Atlas, folio No. 13, Washington, 1894.

WHITFIELD, ROBERT PARR. Mollusca and Crustacea of the Miocene Formations of New Jersey.

Mon. xxiv, U. S. Geol. Surv., 1894, pp. 112, 113, 123.

WOOLMAN, LEWIS. Artesian Wells in Southern New Jersey.

New Jersey Geol. Surv., Rept. State Geologist for 1893, 1894, pp. 389-421.

1895.

CLARK, WM. B. Description of the Geological Excursions made during the spring of 1895.

Johns Hopkins Univ. Cir. No. 121, vol. xv, 1895, p. 1.

——— Additional observations upon the Miocene (Chesapeake) deposits of New Jersey.

Johns Hopkins Univ. Cir. No. 121, vol. xv, 1895, pp. 6-8.

COPE, E. D. Fourth Contribution to the Marine Fauna of the Miocene Period of the United States.

Proc. Amer. Philos. Soc., vol. xxxiv, pp. 135-155.

DALL, W. H. Contributions to the Tertiary Fauna of Florida, etc. Part III. A New Classification of the Pelecypoda.

Trans. Wagner Free Inst. Sci., Phila., vol. iii, part iii, 1895, pp. 483-570.

——— Diagnosis of new Tertiary Fossils from the Southern United States.

Proc. U. S. Nat. Mus., vol. xviii, 1895, No. 1035, pp. 21-46.

EASTMAN, CHARLES R. Beiträge zur Kenntniss der Gattung *Oxyrhina*, mit besonderer Berücksichtigung von *Oxyrhina Mantella* Ag. (mit Taf. xvi-xviii).

Palaeontogr., vol. xli, pp. 149-192.

GANE, HENRY STEWART. A Contribution to the Neocene Corals of the United States.

Johns Hopkins Univ., Cir. No. 121, vol. xv, 1895, pp. 8-10.

WOOLMAN, LEWIS. Artesian Wells in Southern New Jersey and at Crisfield, Md.

New Jersey Geol. Surv., Rept. State Geologist for 1894, 1895, pp. 153-221.

1896.

CLARK, WM. B. The Eocene Deposits of the Middle Atlantic Slope in Delaware, Maryland and Virginia.

Bull. U. S. Geol. Surv. No. 141, 1896, 167 pp. 40 plates.
House Misc. Doc., 54th Cong., 2nd sess., vol. xxxv, No. 31.
(Abst.) Jour. Geol., vol. v, 1897, pp. 310-312.

COPE, E. D. Sixth Contribution to the Knowledge of the Marine Miocene Fauna of North America.

Proc. Amer. Philos. Soc., vol. xxxv, pp. 139-146.

DARTON, N. H. Artesian Well Prospects in the Atlantic Coastal Plain Region.

Bull. U. S. Geol. Surv. No. 138, 1896, 228 pp., 19 plates.
House Misc. Doc., 54th Cong., 2nd sess., vol. xxxv, No. 28.

——— Nomini Folio, Explanatory sheets.

U. S. Geol. Surv., Geol. Atlas, folio 23, Washington, 1896.

HARRIS, G. D. A Reprint of the Paleontological Writings of *Thomas Say*.

Bull. Amer. Pal., No. 5, 115 pp., Ithaca, 1896.

WOOLMAN, LEWIS. Report on Artesian Wells.

New Jersey Geol. Surv., Rept. State Geologist for 1895, 1896, pp. 65-95.

1897.

CLARK, W. B. Historical sketch embracing an account of the progress of investigation concerning the physical features and natural resources of Maryland.

Md. Geol. Surv., vol. i, pp. 43-138, pls. ii-v, 1897.

——— Outline of present knowledge of the physical features of Maryland, embracing an account of the physiography, geology, and mineral resources.

Md. Geol. Surv., vol. i, pp. 141-228, pls. vi-xiii, 1897.

PARKER, E. W. Abrasive Materials.

Eighteenth Annual Rept. U. S. Geol. Survey, pt. v (continued), Mineral Resources of the U. S., 1896, Washington, 1897, pp. 1229-1230.

SCHUCHERT, CHARLES. A Synopsis of American Fossil Brachiopoda.

Bull. U. S. Geol. Surv., No. 87, 1897, 464 pp.

WOOLMAN, LEWIS. Report on Artesian Wells in Southern New Jersey, etc.

New Jersey Geol. Surv., Rept. State Geologist for 1896, 1897, pp. 97-200.

1898.

BAGG, R. M. The Tertiary and Pleistocene Foraminifera of the Middle Atlantic Slope.

Bull. Amer. Pal., No. 10, 48 pp., 3 pls., Ithaca, 1898.

DALL, W. H. A Table of North American Tertiary horizons correlated with one another and with those of western Europe, with annotations.

18th Ann. Rept., U. S. Geol. Surv., pt. ii, pp. 327-348, 1898.

——— Contributions to the Tertiary Fauna of Florida, etc. Part IV. 1. Prionodesmacea; Nucula to Julia. 2. Teleodesmacea; Teredo to Ervilia.

Trans. Wagner Free Inst. Sci., Phila., vol. iii, part iv, 1898, pp. 571-947, pls. xxiii-xxxv.

——— Notes on the Paleontological Publications of Professor William Wagner.

Trans. Wagner Free Inst. Sci., Phila., vol. v, 1898, pp. 7-11, pls. i-iii.

SHATTUCK, GEORGE BURBANK. Two Excursions with Geological Students into the Coastal Plain of Maryland.

Johns Hopkins Univ. Circ. No. 137, vol. xviii, 1898, pp. 15-16. Also published separately.

WOOLMAN, LEWIS. Fossil Mollusks and Diatoms from the Dismal Swamp, Virginia and North Carolina; Indication of the Geological Age of the Deposit.

Proc. Acad. Nat. Sci., Phila., vol. l, pp. 414-428.

1899.

COSSMANN, M. Essais de Paléoconchologie comparée. Vol. iii, Paris, 1899, 201 pp., pl. i-viii.

GLENN, L. C. The Hatteras axis in Triassic and Miocene time.

Amer. Geol., vol. xxiii, pp. 375-379, 1899.

WOOLMAN, LEWIS. Artesian Wells in New Jersey.

New Jersey Geol. Surv., Report State Geol. for 1898, 1899, pp. 61-144.

1900.

BOYER, C. S. The Biddulphoid Forms of North American Diatomaceae.
Proc. Acad. Nat. Sci., Phila., 1900, pp. 685-748.

DALL, W. H. Contributions to the Tertiary Fauna of Florida, etc. Part V. Teleodesmacea: Solen to Diplodonta.
Trans. Wagner Free Inst. Sci., Phila., vol. iii, part v, pp. 948-1218, pl. xxxvi-xlvii.

GANE, HENRY STEWART. Some Miocene Corals of the United States.
Proc. U. S. Nat. Mus., vol. xxii, pp. 179-198, pl. xv.

WOOLMAN, LEWIS. Artesian Wells.
New Jersey Geol. Surv., Rept. State Geologist for 1899, 1900, pp. 57-139.

1901.

BAGG, R. M., JR. Protozoa.
Md. Geol. Surv., Eocene, 1901, pp. 234, 246, 248, 250.

BONSTEEL, JAY A. Soil Survey of St. Mary's County, Md.
Field Operations of the Division of Soils, 1900, Washington, 1901, pp. 125-145.

——— and BURKE, R. T. AVON. Soil Survey of Calvert County, Md.
Field Operations of the Division of Soils, 1900, Washington, 1901, pp. 147-171.

COSSMANN, M. Essais de Paléoconchologie comparée. Vol. iv, Paris, 1901, 293 pp., pl. i-x.

EASTMAN, CHARLES R. Pisces.
Md. Geol. Surv., Eocene, 1901, pp. 98-122.

1902.

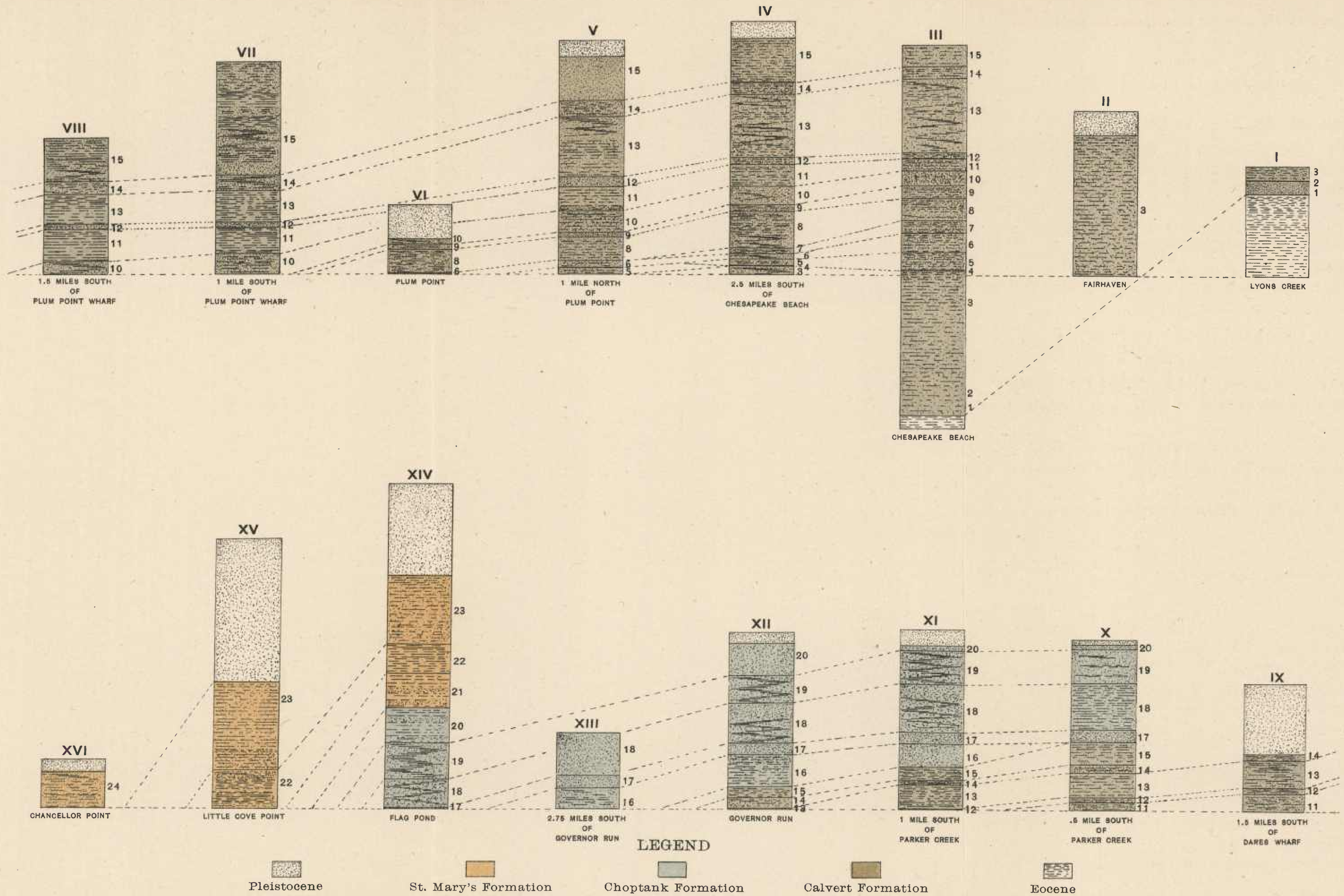
NEWTON, R. BULLEN. List of Thomas Say's Types of Maryland Tertiary Mollusca in the British Museum.
Geol. Mag., Decade iv, vol. ix, No. 457, 1902, pp. 303-305.

SHATTUCK, G. B. The Miocene Formation of Maryland.
Abst. Science, vol. xv, No. 388, p. 906.

HAY, O. P. Bibliography and Catalogue of Fossil Vertebrata of North America.
Bull. U. S. Geol. Survey, No. 179, 1902.

1903.

DALL, W. H. Contributions to the Tertiary Fauna of Florida, etc. Part VI. Concluding the work.
Trans. Wagner Free Inst. Sci., Phila., vol. iii, part vi, 1903, pp. 1219-1654, pl. xlviii-lx.



The Numbers I *to* XVI *correspond to those used in the chapter on "Local Sections"* *The Numbers* I *to* 24 *correspond to those used in the chapter on "The Chesapeake Group in Maryland"*

SCALE 50 FEET = 1 INCH

DETAILED COLUMNAR SECTIONS OF MIOCENE STRATA ALONG CHESAPEAKE BAY

Geographic and Geologic Relations

DISTRIBUTION OF THE STRATA

The Miocene deposits of Maryland form a part of a more extensive series of Tertiary beds, which extend from Massachusetts to Mexico in what has been designated by Dall and Harris as the Atlantic Coast Region. It is not known whether the Miocene beds in this province ever extended across it in an unbroken belt, but it is certain that the processes of erosion, sedimentation and coastal movements have destroyed much of their former continuity and that the Miocene beds are now found in disconnected areas throughout the region.

Massachusetts

The most northerly outcrop of Miocene beds is in the famous Gay Head cliffs of Martha's Vineyard, but material which has been questionably referred to the Miocene has been dredged on Georges Bank and the banks of Newfoundland, indicating, possibly, the extension of the Miocene deposits indefinitely northward beneath the sea. On Martha's Vineyard the Miocene beds rest uncorformably on pre-Tertiary deposits. They consist of two members which are strikingly different from each other in their lithologic composition. The lower member, the so-called "osseous conglomerate" of Hitchcock, is a bed from 12 to 18 inches thick. It is composed of medium sized pebbles of quartz, chert, calcedony and fragments of cetacean bones. The presence of these bones in the formation suggested the name "osseous conglomerate." The upper member which lies immediately above the osseous conglomerate, is a bed of greensand which varies in thickness from nothing to 10 feet. At its base it carries rolled fragments of the under-lying stratum, showing that it was deposited unconformably on the osseous conglomerate.

New Jersey

Immediately south of Martha's Vineyard the Miocene beds disappear but come to the surface once more in New Jersey where they are well developed in the hills south of Matawan, as well as along the coast near Asbury Park. From here, uninterrupted save by shallow estuaries, the Miocene beds extend southwest across New Jersey to Delaware.

They cover, as they pass southward, an ever broadening belt extending from the coast westward to a line running from Matawan southwest through New Egypt, Pemberton, Blackwood and Penns Grove. In this region, two well defined members are recognized, the lower one being a greenish-blue, sandy clay abundantly supplied with fossils. This is seen only in the southern portion of the tract, near Shiloh and Salem. The other member lies above this and consists in part of clay and in part of a fine quartz sand, grading upward into gravel. This member covers by far the greater portion of the district and its upper gravelly portion has been designated by Professor R. D. Salisbury as the Beacon Hill formation.

Much discussion has centered about the age of the gravels which are included in the Beacon Hill formation. Certain features which they possess suggest their reference to the Lafayette formation but there has never yet been discovered a definite line of separation between the gravels above and the sands beneath but rather a gradual change indicating an oscillating character of currents between the time when the purely sandy member was deposited and the purely gravelly member. It is probable, therefore, that no break exists and that the Beacon Hill formation is actually a part of the Miocene.

Delaware

The state of knowledge regarding the Miocene formations of Delaware is far from satisfactory or complete. The surface of the state is covered with Pleistocene sands and gravels to such an extent as to effectually obscure the underlying formations. The information which has been secured from artesian wells and natural sections leaves little room to doubt that the central and southern portions of the state are underlain by the Miocene.

In the vicinity of Smyrna, a blue fossiliferous Miocene clay has been discovered and also near Fredericka the same formation comes to the surface. In both of these outcrops the best fossil-bearing layer is an indurated sand or gravel bed.

Maryland

A glance at the accompanying map (Plate I) will suffice to show the distribution of the Miocene formations in Maryland. They enter the state from Delaware a few miles south of Galena, and after crossing it from northeast to southwest continue on into Virginia. On the Eastern Shore the Miocene formations are found in Kent county, throughout a larger portion of Queen Anne's, Talbot, Caroline and a part of Dorchester counties, and on the Western Shore in southern Anne Arundel, most of Prince George's, a large part of Charles and almost the entire extent of Calvert and St. Mary's counties. Within the limits of Maryland the Miocene beds dip gently to the southeast and usually, where the contact has been seen, are found to lie on the eroded surface of the Eocene beds. Near Good Hope, however, and at Soldiers' Home, in the District of Columbia, the underlying formation belongs to the Potomac Group.

As the Miocene beds lie wholly within the tide-water region of Maryland, the streams which drain the territory are tidal estuaries throughout much of their courses and consequently are slow and sluggish. On the Eastern Shore we have the Chester and Choptank rivers and their tributaries, together with streams emptying into Eastern Bay; and on the Western Shore, the Patuxent and the Potomac and the tributaries which enter the latter below Washington. Throughout much of the area under discussion the country is low and featureless, seldom rising in the eastern counties to 80 feet in elevation. On the Western Shore, however, the surface is more rolling, and the general elevation of the higher portion amounts in certain instances to as much as 300 feet.

Southern Maryland is most favorably situated of all the districts in the northern portion of the Atlantic Coast province for the study of the Miocene formations. Within the borders of this district many of the features which are wanting in other regions find their full development. The materials composing the Miocene beds, which are obscured in some other regions, here differentiate into three well-defined formations, and the organic remains so indispensable to the geologist, while absent in some deposits in other regions, are in Maryland found in great beds many feet in thickness and miles in extent. In other localities the exploration of these deposits is greatly retarded through lack of exposures, but in this State we have, in the famous Calvert

Cliffs, an almost unbroken exposure for more than 35 miles. Southern Maryand is, therefore, the type locality for the Miocene beds of the Middle Atlantic slope.

Virginia

In Virginia, as in Delaware, the underlying formations have been so concealed by the late gravel and sand deposits that they are seldom exposed except along river courses. Sections of the Miocene beds, however, are often met with along the main drainage lines, each of the great rivers of Virginia having exposed portions of the Miocene for study. The best of these sections occurs at the famous Nomini Cliffs a few miles below Mathias Point on the Potomac. These cliffs, although only two miles in extent, surpass the Calvert Cliffs in height, and yield the most comprehensive Miocene section in Virginia. Along the Rappahannock river the exposures are not so important but the Miocene is cut through at intervals over a territory extending from Cherry Point to Mosquito Point.

On the Pamunkey river the Miocene is first met with, overlying the Eocene at Piping Tree. From here it may be traced down stream some little distance before it finally disappears beneath younger material. Lower down on the York river the Miocene is met with once more six miles above Yorktown and again at the famous locality, Bellefield, where it is packed with fossil remains of the most varied character, many of them in a most perfect state of preservation. Yorktown affords another fine exposure of Miocene fossils although they are not as abundant as at Bellefield.

On the James river the Miocene extends from Richmond some distance down the stream but finally disappears beneath its surface as the banks become occupied by younger material. The only other exposures on this river of importance are found at Kings Mill in the vicinity of Williamsburg. At this place, the river has cut into a high bank exposing a cliff crowded with finely preserved Miocene fossils.

North Carolina

In North Carolina the state of our knowledge regarding the Miocene is very imperfect. It is much obscured by a cover of younger material and appears to occupy isolated areas throughout the Coastal Plain, although it is possible it may be more continuous than at first appears. The exposures of the Miocene are found along many of its principal rivers.

South Carolina

The Miocene in South Carolina is not very well known and has not been carefully differentiated from the overlying Pliocene.

Gulf Coast

In Florida the Miocene is better known than in the Carolinas, and the beds probably continue around the southern borders of the Gulf States through Georgia, Alabama, Mississippi, Louisiana and Texas into Mexico.

The Chesapeake Group in Maryland

The Miocene deposits of the Middle Atlantic slope have been described under the name of the Chesapeake Group. In Maryland, the materials which compose the formations of this group consist of clay, sandy-clay, sand, marl and diatomaceous earth. The sandy-clay members are, when freshly exposed, greenish to greenish-blue but slowly change under the influence of the weather to a slate or drab color. As the Miocene beds contain but little glauconite, it is not a difficult task on the basis of lithologic criteria to separate them from the Eocene deposits, and they are still more readily distinguished from the Cretaceous and Potomac beds beneath as well as from the Columbia loams and gravels above.

It has been found possible to separate the beds of the Chesapeake Group into three formations, which are designated, beginning with the oldest, the Calvert formation, the Choptank formation and the St. Mary's formation. The areal distribution of the several formations is shown on the accompanying geological map. (Plate I.)

THE CALVERT FORMATION.

Calvert county has suggested the name for this formation because of its typical development there. In the famous Calvert Cliffs along the eastern border of this county the waves of Chesapeake Bay have cut an almost unbroken exposure rising nearly 100 feet in height and extending from Chesapeake Beach to Drum Point, a distance of about 30 miles.

Areal Distribution.

The Calvert Formation which lies at the base of the Chesapeake Group in Maryland crosses the state from northeast to southwest. On the Eastern Shore it is found in the southeastern corner of Kent county, throughout almost the entire extent of Queen Anne's and the northern portions of Talbot and Caroline counties. Throughout this region the Calvert is so completely buried beneath the loam and sand of the Columbia formations that its boundaries cannot with certainty be established in all places. Its northern boundary, however, appears to enter the state in the southeast corner of Kent county, passes over into Queen Anne's near Crompton, and then continues along the southern bank of Chester river and crosses the southern half of Kent Island to the Bay. The location of the southern boundary of the Calvert formation cannot be definitely fixed, at the present stage of our knowledge. It appears, however, to enter the state near Greensboro and to cross Caroline and Talbot counties as it passes southwest to the mouth of the Choptank river.

On the Western Shore the Calvert formation is found extensively developed in Anne Arundel, Prince George's, Charles, Calvert and St. Mary's counties. It appears as a long line of outcrop extending from the hills near the head of South river estuary to a place on the Calvert Cliffs near Point of Rocks. With this breadth, it extends across southern Maryland from Chesapeake Bay to the Potomac river, and is developed along the latter stream from the hills north of Washington to the mouth of the Wicomico.

Notwithstanding this great development, the Calvert formation is seldom met with on the surface of the country but must be sought in the cliffs of the larger estuaries and in the walls of stream gorges. As on the Eastern Shore so on the Western, the Calvert formation is covered up by younger formations. Thus, north of a diagonal line running from Herring Bay to Popes Creek, which marks the disappearance of the Eocene beds beneath tide level, the Calvert formation rests on the Eocene deposits and is covered up by loam, sand and gravel belonging to both the Lafayette and Columbia formations, while south of the diagonal line the Calvert formation occupies the base of the sections and is overlain with sands and clays belonging to the Choptank formation, the next succeeding member of the Chesapeake Group.

The northern and southern margins of the Calvert formation, or the line of its contact with older and younger beds respectively, are not in all places definitely known. The heavy mantle of Lafayette and Columbia gravels makes it impossible to locate it accurately in all places, but enough contacts have been discovered to establish its position in many instances and to render the calculation of its presence possible in others.

Strike, Dip and Thickness

The strike of the Calvert formation is in general from northeast to southwest, but due to erosion and change in topography the outcrop frequently becomes very sinuous and the strike apparently changes. Thus on the Eastern Shore, where the country is low and very flat and has been little dissected by streams, the outcrop is regular and approximately coincides with the strike. But on the Western Shore the country is higher and the streams have carved out deep valleys, producing a most irregular outcrop which departs widely from the direction of strike.

The dip is, as a whole, about 11 feet to the mile toward the southeast. Apart from the exposures on the Calvert and Nomini cliffs, there are no good places for examining the dip and as it must be calculated as a whole over extensive regions, slight changes which may occur in the dip are not often brought to light.

The full thickness of the Calvert formation has been nowhere actually observed. The formation has been diagonally truncated above by the Choptank and younger formations under which it lies unconformably, so that in the region of Davidsonville the Calvert formation shows only about 50 feet in thickness. We are fortunate in possessing a reliable well-record at Crisfield in Somerset county, which passes through the entire thickness of Miocene strata. In this well, the thickness of the Calvert formation is apparently about 310 feet. Located as this is in the extreme southern portion of the state and well down the dip, the data probably indicate a rapid thickening of this formation as it passes southeast toward the ocean. At Crisfield, the Calvert formation lies 465 feet below the surface of the country, at Centerville it is found at a depth of 81 feet and is 65 feet thick, while at Chesapeake Beach on the Bay shore in Calvert county, a well which begins in the Calvert formation a little above tide, passes out of it at a depth of 60 feet.

The Calvert formation occupies the hilltops throughout the northern portion of its area and gradually dips to lower and lower levels as it passes toward the southeast until it finally sinks beneath tide level. The line along which it finally disappears on the Western Shore is a diagonal line extending from near Point of Rocks on Chesapeake Bay through the mouth of Indian creek on the Patuxent to the mouth of Wicomico river on the Potomac. On the Eastern Shore, as stated above, the country is everywhere flat and no marked difference in elevation of the Calvert formation is discernible.

Subdivisions.

The Calvert formation cannot be readily divided throughout the Eastern Shore, as it is so completely covered up by younger deposits that the bipartite division if present there has not been observed. On the Western Shore, however, the divisions are more clearly marked and have been traced from Chesapeake Bay to the Potomac river. The two divisions into which the Calvert formation falls are the Fairhaven diatomaceous earth and the Plum Point marls.

FAIRHAVEN DIATOMACEOUS EARTH.—This member lies at the base of the Calvert formation and is characterized by the presence of a large proportion of diatoms imbedded in a very finely divided quartz matrix. Calcareous material is present in this bed only in very small amounts. Beside diatoms, there are other Miocene fossils, usually in the form of casts, and organic remains reworked from the underlying Eocene beds. Fairhaven, Anne Arundel county, where the beds are well developed, has suggested the name for this division.

The contact of the diatomaceous earth with the Eocene beds lies about two feet beneath a band of siliceous sandstone from 4 to 8 inches in thickness, which carries casts of *Pecten humphreysii* and other Miocene

FIG. 1.—VIEW OF THE CALVERT CLIFFS FROM CHESAPEAKE BAY.

FIG. 2.—NEARER VIEW OF THE CALVERT CLIFFS SHOWING THE CONTACT OF THE CHOPTANK AND CALVERT FORMATIONS AT GOVERNOR RUN, CALVERT COUNTY.

VIEWS OF MIOCENE SECTIONS.

fossils. Above this sandstone is the diatomaceous earth proper. This diatomaceous bed, which is about 20 feet in thickness, is greenish-blue when fresh but weathers to brown or a light buff color on long exposure to the atmosphere. In the extensive pits at Lyons Creek, where the material is being worked for commerce, the transition from the greenish-blue to buff color may be seen in the masses removed progressing in concentric rings. In such specimens, the fresh greenish material is found at the center passing gradually into the buff-colored material toward the periphery.

The low cliffs which border Chesapeake Bay south of the pier at Fairhaven are composed of diatomaceous earth with a capping of Columbia gravel. From Fairhaven the beds cross southern Maryland in a northeast-southwest direction following the line of strike, and are worked at Lyons Creek on the Patuxent and again at Popes Creek on the Potomac. They may also be found at innumerable places between these points in cuttings made by water-ways. North of this diagonal line, extending between Fairhaven and Popes Creek, the diatomaceous beds gradually rise until they rest on hilltops, while south of the diagonal line, they gradually disappear below tide.

The diatomaceous earth, on account of its porosity and compactness, is used in water filters. It is reduced readily to a fine powder and makes an excellent base for polishing powders. On account of its porous nature, diatomaceous earth is used as an absorbent in the manufacture of dynamite, while its non-conductivity of heat makes it a valuable ingredient in packing for steam boilers and pipes, and in safes. This latter is the principal use to which it is put. It has been thought that the diatomaceous earth might be of use in certain branches of pottery manufacture which require on the part of the materials refractoriness and an absence of color when burned. Dr. Heinrich Ries tested a sample of the diatomaceous earth from Lyons Creek at cone 27 in the Deville furnace and found that the material fused to a drop of brownish glass. The non-refractory character of the diatomaceous earth is thus clearly demonstrated.

The Fairhaven diatomaceous earth has been subdivided into three zones, which may be characterized as follows:

Zone 1.—At the base of the Calvert formation and lying unconformably on the Eocene deposits is a bed of brownish sand carrying *Phacoides contractus*. This stratum varies somewhat in thickness from place to place, but does not depart widely from six feet on the average.

Zone 2.—Lying immediately above Zone 1 is a thin stratum of white sand of about one foot in thickness which is locally indurated to sandstone. It contains a large number of fossils, of which the following are the most important: *Ecphora tricostata, Panopea whitfieldi, P. americana, Corbula elevata, Phacoides contractus, Venericardia granulata, Astarte cuneiformis, A. thomasi, Thracia conradi, Pecten madisonius, P. humphreysii, Chione latilirata, Cytherea staminea.*

Zone 3.—This stratum when freshly exposed consists of a greenish colored diatomaceous earth which, on weathering, bleaches to a white or buff-colored deposit breaking with a columnar parting and presenting perpendicular surfaces. It is very rich in diatomaceous matter, the mechanical analysis of specimens yielding more than 50 per cent of diatoms. The thickness of this bed varies from place to place, but where it is penetrated at Chesapeake Beach by an artesian well it has a thickness of about 55 feet. At Fairhaven, where it is well exposed, it carries large numbers of *Phacoides contractus*. This zone is best exposed at Popes Creek, Lyons Creek, Fairhaven, and in stream gullies lying along the northern margin of the Miocene beds.

Plum Point Marls.—The Plum Point marls occupy the remainder of the Calvert formation above the Fairhaven diatomaceous earth. Plum Point in Calvert county where the beds are typically developed, has suggested the name for this member. These marls consist of a series of sandy-clays and marls in which are imbedded large numbers of organic remains including diatoms. The color of the material is bluish-green to grayish-brown and buff. Fossil remains although abundant through the entire member are particularly numerous in two prominent beds from 30 to 35 feet apart. These beds vary in thickness from 4½ to 13 feet. They may be easily traced along the Calvert Cliffs from Chesapeake Beach to a point 2 miles below Governor Run. At Chesapeake Beach they lie high up in the cliffs and pass gradually downward beneath the surface of the water as the formation is followed southward. Along the Patuxent river the Plum Point marls are not exposed so extensively as in the Calvert Cliffs but they are visible at intervals from the cliffs below Lower Marlboro southward to Ben Creek, in Calvert county. On the west bank of the river they may be occasionally seen from a point opposite Lower Marlboro down the stream to 1½ miles below Forest Wharf.

On the Potomac river, the banks are usually very low and composed of Columbia sand and gravel. In consequence of this the Plum Point marls are seldom met with. On the Maryland side of the river they may be seen in the low cliffs at the mouth of the Chaptico Bay and on the Virginia side a considerable thickness of the marls is exposed the entire length of the Nomini Cliffs.

When fresh, the Plum Point marls and the Fairhaven diatomaceous earth do not differ much in appearance from each other. The thickness of the Plum Point marls increases constantly down the dip and it is probable that the greater portion of the 310 feet of the Crisfield well section, which has been assigned to the Calvert formation, is to be referred to this member.

From a detailed study of the exposures along the Calvert Cliffs, it has been found possible to subdivide the Plum Point marls into 12 zones. They are characterized as follows:

Zone 4.—At the base of the Plum Point marls and lying conformably on Zone 3, the uppermost member of the Fairhaven diatomaceous earth is a six-inch deposit of greenish sandy clay carrying *Ostrea percrassa.* This zone first makes its appearance along the Calvert Cliffs at Chesapeake Beach and continues on down the shore for about 2½ miles, when it can be no longer distinguished. Throughout this distance, the zone does not dip toward the southeast in harmony with the other zones which are visible above it, but actually appears to rise slightly against the dip until it finally vanishes at the point indicated. The erratic behavior of this zone would seem to indicate a local migration and temporary occupation of this particular area by *Ostrea percrassa.* This zone corresponds to "Zone a" of Harris.[1]

Zone 5.—This zone is developed immediately above Zone 4 and at Chesapeake Beach has a thickness of 7 feet; as it is followed southward, however, along the Calvert Cliffs, it is found to thin rapidly until at

[1] Tertiary Geology of Calvert Cliffs, Maryland. Amer. Jour. Sci., vol. xlv, 1893, pp. 21-31.

a distance of about 2½ miles south of Chesapeake Beach it has a thickness of only 2 feet and 6 inches. At this point the base actually lies higher than at Chesapeake Beach, although on account of the thinning the top lies lower. From this point southward it dips away in harmony with the dip of the other beds of the Calvert formation. The materials making up this zone consist of a greenish sand clay, which carries scattered bands of *Corbula elevata.*

Zone 6.—This zone consists of a greenish sandy clay carrying large numbers of *Corbula elevata* which are distributed thickly throughout the stratum and not separated into scattered bands as in the zones immediately below and above it. At Chesapeake Beach, where this zone is best developed, it attains a thickness of eight feet, but thins rapidly toward the south, like the two preceding ones, until at a point 2½ miles south of Chesapeake Beach it has diminished to a thickness of two feet. From this place it continues at about the same thickness until it finally disappears beneath the beach at Plum Point.

Zone 7.—Lying immediately above the last is a layer of greenish sandy clay carrying scattered bands of *Corbula elevata,* resembling very much in appearance Zone 5.

Zone 8.—This stratum is lithologically like those immediately preceding, but varies from them in either being devoid of fossils or in carrying only a few poorly preserved fossil casts of a *Corbula,* which is probably *Corbula elevata.* It consists of a greenish sandy clay varying from 9 to 15 feet in thickness. It may be best seen along the Calvert Cliffs from Chesapeake Beach to Plum Point.

Zone 9.—This zone consists of greenish and greenish blue sandy clay carrying scattered layers of *Corbula elevata* and varying in thickness from 6 feet at Chesapeake Beach to 2 feet at Plum Point.

Zone 10.—On account of its great and varied assemblage of fossils this stratum is the most conspicuous zone in the entire Calvert formation. It conists of a grayish green or a yellow to a brown sandy clay varying in thickness from 6 to 9 feet and is continuously exposed along the Calvert Cliffs from Chesapeake Beach till it dips below tide two or three miles south of Plum Point Wharf. The following is a partial list of the fossils found in this zone: *Turritella indentata, Phacoides anodonta, Crassatellites melinus, Astarte cuneiformis, Ostrea*

FIG. 1.—VIEW OF DRUM CLIFF, NEAR JONES WHARF, ST. MARY'S COUNTY, SHOWING THE CHOPTANK FORMATION.

FIG. 2.—ANOTHER VIEW OF DRUM CLIFF, SHOWING THE CHOPTANK FORMATION WITH THE INDURATED LAYER AT BASE OF SECTION.

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sellæformis, Pecten madisonius, Macrocallista marylandica, Atrina harrisii, Arca subrostrata, Glycimeris parilis, etc. It corresponds to "Zone b" of Harris.[1]

Zone 11.—This stratum consists of a greenish blue to a brown sandy clay changing locally to a sand. It thickens somewhat as it passes down the dip from 5 feet where it is exposed in the bluffs at Chesapeake Beach to 13 feet 1½ miles south of Plum Point Wharf where it approaches tide level. It is unfossiliferous or carries a few imperfect fossil casts.

Zone 12.—When typically developed, this zone consists of a brownish sandy clay, although at times it changes to a bluish color. In many of its exposures only imperfect fossil casts can be distinguished, but in other places it is found to carry *Ecphora quadricostata var. umbilicata, Venus mercenaria, Cytherea staminea,* etc. It varies in thickness from two to four feet and corresponds to "Zone c" of Harris.[1]

Zone 13.—The materials of this zone consist of a bluish sandy clay more or less changed in sections to a yellowish or brownish color. It carries imperfect fossil casts and varies in thickness from 32 feet at Chesapeake Beach to 10 feet at a point one mile south of Parker Creek, thus gradually thinning as it passes down the dip.

Zone 14.—The materials which make up this stratum consist of a brownish to yellowish sandy clay abundantly supplied with *Isocardia fraterna.* It varies in thickness from 2 to 7 feet and corresponds to "Zone d" of Harris.[1]

Zone 15.—This zone is the uppermost member of the Calvert formation and consequently has been considerably eroded so that its true thickness is not definitely known. It consists of a yellowish sandy clay grading down locally into yellowish sand at its lower portions. At a point one mile south of Plum Point Wharf this zone shows a greater thickness than anywhere else along the Calvert Cliffs; at that place it measures 48½ feet. Sections north and south of this point have either been in great part replaced by Pleistocene sand or have suffered by the unconformable overlapping of the Choptank formation.

[1] Loc. cit.

THE CHOPTANK FORMATION.

The Choptank river has suggested the name for this formation because of its great development on the northern bank of that estuary a short distance below Dover Bridge. In this locality the Choptank formation is very fossiliferous and may be seen at the base of a low cliff which borders the stream for some distance.

Areal Distribution.

The Choptank formation, which constitutes the second member of the Chesapeake Group in Maryland and lies immediately above the Calvert formation, is found in Caroline, Talbot and Dorchester counties on the Eastern Shore, and Anne Arundel, Calvert, Prince George's, Charles and St. Mary's counties on the Western Shore. On the Eastern Shore the Choptank formation is so completely buried beneath the surface cover of Columbia sand and loam that its exact areal distribution is not definitely known. Its presence, however, has been detected in the area indicated in numerous marl pits and well borings, although the location of its northern and southern boundaries is largely a matter of conjecture. The northern boundary appears to enter Caroline county a little northeast of Greensboro and from there crosses in a southwestern direction to the mouth of the Choptank river. The southern boundary follows a parallel course, cutting across southern Caroline county, crossing the Choptank river not far from Cambridge and reaching the Bay in about the middle of Taylor Island.

In Calvert county, on the Western Shore, the Choptank formation is not so much obscured by the Columbia deposits as it is in the counties of the Eastern Shore. It may be found in a long line of outcrops extending from the hilltops just west of Herring Bay to a place on the Calvert Cliffs a little distance north of Cove Point. It is also found at intervals along the Patuxent river, but west of this estuary it is almost as much obscured by younger deposits as on the Eastern Shore. The boundaries of the Choptank formation in Calvert county, although in part conjectural, are better known than in any other portion of southern Maryland, but the limitations set to its distribution in certain parts of Prince George's and Charles counties have been determined more by calculation than from observation. They are believed, however, to be approximately correct and are fixed as accurately as our present knowledge warrants.

The streams of the Western Shore have cut deeper and more ramifying channels than those of the Eastern Shore and the contact of the Choptank with the Calvert formation appears consequently very irregular. The northern border of the Choptank formation extends in a N. E.-S. W. direction from the hills west of Herring Bay to the flat country at the head-waters of Wicomico river. The southern border of the Choptank formation is also a diagonal line running approximately parallel with the northern border and extending from near Cove Point on Chesapeake Bay to the mouth of Flood Creek on the Potomac river. This last locality is only approximately fixed as the Miocene beds in this region are obscured by younger deposits. The point where the Choptank formation dips below the tide cannot, however, be very far from the locality indicated.

Strike, Dip and Thickness.

The strike of the Choptank formation is in general from northeast to southwest; but due to erosion, particularly on the Western Shore, as pointed out above, the outcrop is very sinuous, and the strike appears to change locally. On the Eastern Shore, as the country is extremely flat, the rivers have not opened up extensive drainage lines and the outcrop is therefore approximately parallel to the strike.

The dip does not appear to be constant throughout the entire extent of the formation. In Calvert county, where the Choptank is best exposed, the northern portion of the formation down to Parkers Creek seems to lie almost horizontal; but south of this point the base of the formation dips away at about 10 feet to the mile. Due to this structure, the Choptank formation occupies hilltops in the northern portion of its area and gradually occupies lower and lower levels, until in the southern portion of its area it is found in river bottoms and finally disappears beneath tide. The best place to examine the dip of the Choptank formation is along the Calvert Cliffs between Parker Creek and Point of Rocks. Here an almost unbroken exposure of the Choptank may be seen dipping gradually toward the southeast.

The thickness of the Choptank formation is variable. In the Nomini

Cliffs, Virginia, it is present as a 50-foot bed between the Calvert formation below and the St. Mary's formation above. This is the thickest exposure which is open to direct observation. In the well section at Crisfield, mentioned above in connection with the Calvert formation, the Choptank formation attains a thickness of about 175 feet. It will thus be seen that the Choptank formation, like the Calvert, thickens as it passes down the dip.

Character of Materials.

The materials composing the Choptank formation are extremely variable. They consist of fine, yellow, quartz sand, bluish-green sandy-clay, slate-colored clay and, at times, ledges of indurated rock. In addition to these materials, there are abundant fossil remains disseminated throughout the formation. The sand phase is well shown in the Calvert Cliffs from Parker Creek southward to Point of Rocks. The sandy-clay and clayey members may be seen in the same cliffs near Point of Rocks and southward. The indurated rock is well shown in Drum Cliff on the Patuxent and at Point of Rocks, and the fossil remains are seen typically developed on the Choptank river, at Drum Cliff and at Governor Run.

Stratigraphic Relations.

The Choptank formation lies unconformably on the Calvert formation. This unconformity is in the nature of an over-lap but is not easily discernible even where the contact is visible. The best place to observe the unconformity is in that portion of the Calvert Cliffs just below the mouth of Parker Creek. Even here, the unconformity cannot be seen while standing on the beach but may be observed from a boat a short distance from the shore. The unconformity of the Choptank on the Calvert formation is also proved from the fact that at the above-mentioned locality the fossil bed which lies lowest in the Choptank formation rests on the Calvert, while at Mt. Harmony and northward the upper fossil bed of the Choptank rests on the Calvert formation. There are also certain differences between the fauna of the Calvert and that of the Choptank. How far this unconformity continues down the dip after the beds disappear from view is not

FIG. 1.—VIEW FROM THE BLUFFS AT THE DOVER BRIDGE LOCALITY ON THE CHOPTANK RIVER, TALBOT COUNTY.

FIG. 2.—VIEW SHOWING FOSSIL BED IN THE CHOPTANK FORMATION AT DRUM CLIFF, NEAR JONES WHARF, ST. MARY'S COUNTY.

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known, as the data from well records are too meagre to draw any conclusion regarding this question. Above, the Choptank formation lies conformably beneath the St. Mary's formation.

Subdivisions.

Zone 16.—This zone varies in composition from yellowish sand to bluish or greenish sandy clay. It is about 10 feet thick and may be found exposed along the Calvert Cliffs from near Parker Creek southward to a point a little north of Flag Pond, where it disappears beneath the beach. Where the Choptank first makes its appearance in the Calvert Cliffs at Parker Creek this zone is absent, and Zone 17 of the Choptank rests immediately upon Zone 15 of the Calvert. Zone 16 is for the most part unfossiliferous, although about 3 miles south of Governor Run a few fossils have been discovered in it, of which the following are among the number: *Ecphora quadricostata, Venus campechiensis var. cuneata, Dosinia acetabulum, Phacoides contractus,* etc.

Zone 17.—The Choptank formation carries two well-defined fossil zones. Of these, Zone 17 is the lower one. The material composing this stratum is mostly yellow sand along the Calvert Cliffs. It is almost entirely composed of fossils, the yellow sand simply filling in the spaces between the organic remains. The fauna of this zone is extremely large, but the following will suffice to give an idea of some of the types: *Ecphora quadricostata, Turritella plebia, Panopea americana, Corbula idonea, C. cuneata, Metis biplicata, Macrocallista marylandica, Venus mercenaria, V. campechiensis var. cuneata, Dosinia acetabulum, Isocardia fraterna, Cardium laqueatum, Crassatellites turgidulus, Astarte thisphila, Pecten coccymelus, P. madisonius, Melina maxillata, Arca staminea,* etc. This zone makes its appearance along the Calvert Cliffs at Parker Creek, where it is about 6 feet in thickness, and is continuously exposed until it dips beneath tide a little north of Flag Pond. It may also be seen at various points on the Patuxent River and on the Eastern Shore. Zone 17 appears to thicken considerably southwestward along the strike, for where best exposed on the Patuxent River, as near the mouth of St. Leonards Creek, it is at least 18 feet thick, and over 30 feet thick at Drum Cliff. This zone corresponds to "Zone e" of Harris.[1]

[1] Loc. cit.

Zone 18.—This zone is for the most part unfossiliferous, although in places it carries some imperfect fossils and fossil casts. The material of which it is composed is for the most part yellowish sand above but grades down into bluish clay below and at times the entire stratum is composed of bluish clay. In thickness it varies from 18 to 22 feet along the Calvert Cliffs and is continuously exposed along the Calvert Cliffs from Parker Creek to a point a few miles south of Flag Pond. Where this zone is exposed at Drum Cliff it is thinned down to about 8 feet in thickness.

Zone 19.—This constitutes the upper of the two great fossiliferous zones of the Choptank formation. Like Zone 17 it is composed almost entirely of fossils with the interstices filled with reddish and yellow sand. It varies in thickness from 12 to 15 feet along the Calvert Cliffs and is continuously exposed from Parker Creek southward to near Cove Point, where the stratum dips beneath the beach. The following is a partial list of fossils found within this zone: *Balanus concavus, Corbula idonea, Macrocallista marylandica, Dosinia acetabulum, Cardium laqueatum, Phacoides anodonta, Crassatellites marylandicus, Astarte thisphila, Ostrea carolinensis, Pecten madisonius, Arca staminea,* etc. This zone corresponds to "Zone f" of Harris.[1]

Zone 20.—This zone lies at the top of the Choptank formation. It consists of greenish sand which is frequently oxidized to a red color, and at times it carries bands of clay. It seems to be devoid of fossils and is 15 feet thick, although it has frequently suffered by erosion. It may be best seen near Flag Pond, where it is overlain by the St. Mary's formation.

THE ST. MARY'S FORMATION.

The name of this formation has been suggested by St. Mary's county on account of its great development within that region. The formation is found exposed in numerous places along the St. Mary's river, in the vicinity of St. Mary's City as well as along the southern bank of the Patuxent river.

Areal Distribution.

The St. Mary's formation, like the Calvert and the Choptank formations, crosses the state from northeast to southwest. On the Eastern

[1] Loc. cit.

Shore, it is present, if at all, in Caroline, Talbot, Wicomico and Dorchester counties. This region, however, is covered by a heavy mantle of sand and loam so that it has never been found extensively developed on the surface, nor is there any paleontological evidence of its presence in the records of excavations and well borings. This surface-cover makes it extremely difficult to fix definitely the northern and southern boundaries of the formation, and the lines which indicate them on the map are only approximately correct. The northern boundary of the St. Mary's formation probably enters Caroline county about midway between Denton and Federalsburg, runs southwest, passing south of Cambridge and on to Chesapeake Bay. The southern boundary doubtless runs in a direction approximately parallel to the northern one. It probably enters the state in the northern part of Wicomico county and then runs southwest to the mouth of the Honga river. Throughout this region, the country is low and flat. Streams have not opened up channels of any importance, and the occurrence of the St. Mary's formation must be, consequently, nearly coincident with the line of strike.

On the Western Shore the St. Mary's formation is found developed in southern Calvert and in southern St. Mary's counties. In this region, also, it is very much obscured by a mantle of younger material belonging to the Columbia group and is, therefore, seldom seen on the surface. Good exposures, however, are found along the Bay shore, the Patuxent river and its tributaries and in the banks of the St. Mary's river. The most extensive exposure is found in Calvert county along the Bay shore from Point of Rocks to Drum Point. Other exposures are found on both banks of the Patuxent river. In St. Mary's county, exposures may be seen one-half mile west of Millstone on the Patuxent river, where the beds contain beautiful clusters of gypsum crystals, and along St. Johns Creek and Mill Creek. On St. Mary's river, the formations are exposed at intervals from Windmill Point up the stream toward its head-waters.

The northern boundary of the St. Mary's formation on the Western Shore is very sinuous and can only be approximately located on account of the cover of surface loams which obscure the underlying formation. The exact location of the southern border is also a matter of conjecture, but cannot be very far from correct. Marls belonging to the St.

Mary's formation have been found outcropping just west of St. Jerome Creek and in the head-waters to the east at Smith Creek. In the extreme southern portion of St. Mary's county, however, the St. Mary's formation seems to have been removed and loams and clays belonging to the Columbia group deposited in its stead.

Strike, Dip and Thickness.

The strike of the St. Mary's formation, like that of the two preceding ones, is from northeast to southwest. On the Eastern Shore, the occurrence and strike are approximately coincident; on the Western Shore, however, due to the greater diversity in the topography, the outcrop is extremely irregular and departs very widely from the direction of strike. The St. Mary's formation rests conformably on the underlying Choptank and is overlain unconformably by younger materials. The dip averages about 10 feet to the mile toward the southeast.

The thickness of the St. Mary's formation varies from nothing to about 280 feet. In the hilltops south of Prince Frederick, where the dip carries the formation up to an elevation of 100 feet or more, the thickness thins down gradually to nothing; while in the well boring at Crisfield it occupies a thickness of about 280 feet, although it is possible that the upper portion of this may be Pliocene.

Character of Materials.

The materials composing the St. Mary's formation consist of clay, sand and sandy clay. As exposed in Maryland, it is typically a greenish-blue sandy clay bearing large quantities of fossils and resembling very closely the sandy clay of the Calvert formation described above. Locally, the beds have been indurated by the deposition of iron and again in other localities, notably on the south bank of the Patuxent river about one-half mile west of Millstone Landing and again near Windmill Point, clusters of radiating gypsum crystals are found.

Stratigraphic Relations.

The St. Mary's formation lies unconformably on the Choptank formation. It is overlain unconformably by clays, loams, sands and gravels belonging to various members of the Columbia group. There are

FIG. 1.—VIEW SHOWING THE LOW SHORE-LINE NEAR ST. MARY'S CITY, ST. MARY'S COUNTY.

FIG. 2.—VIEW SHOWING BLUFFS AT COVE POINT, CALVERT COUNTY, WITH THE ST. MARY'S FORMATION EXPOSED AT BASE OF SECTION.

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certain faunal differences which separate it from the Choptank formation. It has been subdivided into the following zones:

Subdivisions.

Zone 21.—This zone lies at the base of the St. Mary's formation and conformably on the Choptank formation. It consists of a drab clay carrying sand bands of about the same color and appears to be devoid of fossils. It may best be seen aong the cliffs south of Flag Pond, where it has a thickness of about 15 feet.

Zone 22.—Lying immediately above the last mentioned stratum is another band of drab clay in which thin beds of fossils are developed. These first made their appearance in the cliffs south of Flag Pond, and although the continuity of this bed is interrupted along the Bay shore by talus slopes and overgrowth of woodland, still it is believed to be continuous with the fossil-bearing beds at the base of the cliff at Cove Point. The following are some of the more important fossils found in this zone: *Balanus concavus, Terebra inornata, Mangilia parva, Nassa peralta, Columbella communis, Ecphora quadricostata, Turritella plebeia, T. variabilis, Polynices heros, Corbula inæqualis, Pecten jeffersonius, Arca idonea,* etc. This stratum is about 14 feet in thickness. It corresponds to "Zone g" of Harris.[1]

Zone 23.—This zone is composed of drab clay and sand. It has suffered considerably from erosion, but along the Calvert Cliffs it carries some fossils of which *Turritella plebeia* is the most important. It shows a thickness of 30 feet but is unconformably overlain by the Pleistocene sands and gravels.

Zone 24.—A break in the stratigraphic continuity of the St. Mary's formation occurs south of Drum Point and the exact relation of this zone to those preceding is not definitely known. It is believed, however, to lie very close to Zone 24. At Chancellor Point on the St. Mary's river, where it has been studied, 15 feet of bluish sandy clay are exposed, overlain unconformably by Pleistocene loams. At this place a large number of fossils are present, of which the following may be mentioned: *Acteon ovoides, Retusa marylandica, Terebra curvilirata, Conus diluvianus, Surcula engonata, Fulgur fusiforme, Turritella varia-*

[1] Loc. cit.

bilis, Panopea goldfussi, Callocardia sayana, Venus campechiensis var. mortoni, Isocardia fraterna, Phacoides anodonta, Pecten madisonius, P. jeffersonius, etc.

Local Sections.

The formations and zones described above are based on a large number of local sections found scattered throughout the Miocene area of Maryland. The most continuous and complete series of sections is found along Chesapeake Bay from Fairhaven southward to Drum Point, but other instructive and important sections are found in the valleys of the Potomac and Patuxent rivers and along many of the rivers of the Eastern Shore.

CHESAPEAKE BAY SECTIONS.

The most complete section of the Miocene deposits along the Atlantic Coast occurs in the famous Calvert Cliffs from Chesapeake Beach southward to Drum Point. Throughout this distance the bluffs yield a complete sequence of the various beds of the formations, and the fossils are numerous and usually very well preserved. The entire Chesapeake Bay section is given in detailed columnar sections in Plate V, and the relations of zone to zone indicated. The detailed description of each of these sections will now be given.

I. *Section on a southern branch of Lyons Creek.*

			Feet.
Miocene.	Calvert Formation.	White diatomaceous clay (Zone 3)	5
		White sandstone containing following fossils: *Ecphora tricostata, Panopea whitfieldi, P. americana, Corbula elevata, Phacoides contractus, Venericardia granulata, Astarte cuneiformis, A. thomasi, Thracia conradi, Pecten madisonius, P. humphreysii, Chione latilirata, Cytherea staminea* (Zone 2)	1
		Brown sand containing *Phaciodes contractus* (Zone 1)	6
Eocene		Greenish gray sandy clay	35
		Total	47

II. *Section at Fairhaven, one-half mile south of wharf.*

			Feet.
Pleistocene.		Gravel, sand and clay	10
Miocene.	Calvert Formation.	Diatomaceous sandy clay bleached to a whitish color, jointed so as to have a rough columnar appearance carrying *Phacoides contractus* (Zone 3, in part)	24
		Diatomaceous greenish sandy clay breaking with concoidal fracture, carrying *Phacoides contractus* and bearing rolled and reworked fossils from Eocene in lower $2\frac{1}{2}$ feet (Zone 3, in part)	36
		Total	70

III. *Section at Chesapeake Beach.*

			Feet.	Inches.
Miocene.	Calvert Formation.	Yellow sandy clay (Zone 15)	9	
		Yellow sandy clay (Zone 14)	5	
		Blue sandy clay changing to yellowish brown sandy clay in the upper 12 feet, fossiliferous throughout upper portion (Zone 13)	32	
		Greenish brown sandy clay bearing fossil casts (Zone 12)	2	6
		Greenish brown sandy clay (Zone 11)	5	
		Grayish green sand containing some clay containing following fossils: *Turritella indentata, Phacoides anodonta, Crassatellites melinus, Astarte cuneiformis, Ostrea sellæformis, Pecten madisonius, Macrocallista marylandica, Atrina harrisii, Arca subrostrata, Glycimeris parilis*, etc. (Zone 10)	6	
		Greenish sandy clay carrying scattered layers of *Corbula elevata* (Zone 9)	6	
		Greenish sandy clay apparently devoid of fossils (Zone 8)	9	
		Greenish sandy clay carrying scattered layers of *Corbula elevata* (Zone 7)	6	
		Greenish sandy clay carrying large numbers of *Corbula elevata* (Zone 6)	8	
		Greenish sandy clay carrying *Thracia conradi* (Zone 5)	7	
		Greenish sandy clay carrying *Ostrea percrassa* (Zone 4)		6
		Bluish-green sandy clay revealed in well-boring (Zone 3, 2 and 1)	62	
Eocene.		Glauconitic sandy clay		
		Total	97	

IV. *Section* 2.5 *miles south of Chesapeake Beach.*

			Feet.	Inches.
Pleistocene.		Yellowish sandy loam	7	
Miocene	Calvert Formation.	Yellow sandy clay (Zone 15)	19	
		Fossiliferous yellowish sandy clay with an indurated portion at top (Zone 14)	5	
		Brownish and bluish sandy clay containing imperfect fossil casts (Zone 13)	27	
		Chocolate colored sandy clay carrying imperfect fossil casts (Zone 12)	3	
		Unfossiliferous blue clayey sand (Zone 11)	9	
		Fossiliferous brown sand and clay (Zone 10)	8	
		Fossiliferous bluish clayey sand (Zone 9)	3	
		Brownish sand and clay containing poorly preserved casts of *Corbula* (Zone 8)	15	
		Brownish sandy clay containing scattered bands of *Corbula elevata* (Zone 7)	2	6
		Bluish clayey sand carrying large numbers of *Corbula elevata* (Zone 6)	2	
		Bluish clayey sand carrying scattered bands of *Corbula elevata* (Zone 5)	2	6
		Bluish clayey sand carrying *Ostrea percrassa* (Zone 4)		6
		Fossiliferous bluish clayey sand (Zone 3)	4	
		Total	107	6

V. *Section one mile north of Plum Point.*

			Feet.	Inches.
Pleistocene.		Yellowish sandy loam	7	
Miocene.	Calvert Formation.	Yellowish sandy clay (Zone 15)	19	
		Yellowish sand carrying *Isocardia fraterna* (Zone 14)	7	
		Bluish and brownish sandy clay (Zone 13)	25	
		Brownish sand (Zone 12)	4	6
		Bluish clay grading downward into brown sand (Zone 11)	10	6
		Yellowish brown sandy clay bearing the following fossils: *Siphonalia devexa. Ecphora tricostata, Turritella plebeia, T. variabilis; T. variabilis var. cumberlandia, Polynices heros, Corbula inæqualis, Phacoides anodonta, Crassatellites melinus, Astarte cuneiformis, Pecten madisonius, Venus rileyi, chione latilirata, Cytherea staminea, Melina maxillata, Atrina harrisii, Arca subrostrata, Glycimeris parilis,* etc. (Zone 10).		
		Bluish green clayey sand carrying *Corbula elevata* (Zone 9)	2	
		Bluish green clayey sand carrying imperfect casts of *Corbula elevata* (?) (Zone 8)	10	
		Bluish green clayey sand containing large numbers of *Corbula elevata* (Zone 6)	3	
		Bluish green clayey sand containing fossil casts of *Corbula elevata* (Zone 5)	3	
		Total	100	

VI. *Section at Plum Point.*

			Feet.
Pleistocene.		Yellowish sandy loam and gravel	14
Miocene.	Calvert Formation.	Yellowish sandy clay bearing characteristic fossils (Zone 10)	2
		Greenish sandy clay carrying scattered layers of *Corbula elevata* (Zone 9)	2
		Greenish blue clayey sand carrying few imperfect fossils (Zone 8)	10
		Bluish clayey sand carrying *Corbula elevata* (Zone 6)	1
		Total	29

VII. *Section one mile south of Plum Point Wharf.*

			Feet.	Inches.
Miocene.	Calvert Formation.	Fossiliferous yellowish sandy clay grading into yellow sand in its lower portions (Zone 15)	48	6
		Brownish sandy clay containing *Isocardia fraterna* (Zone 14)	7	
		Bluish clay breaking with conchoidal fracture (Zone 13)	13	6
		Brownish sandy clay carrying imperfect fossil casts (Zone 12)	2	6
		Unfossiliferous bluish clay (Zone 11)	11	
		Greenish sand bearing characteristic fossils (Zone 10)	9	
		Total	91	6

VIII. *Section 1.5 miles south of Plum Point Wharf.*

			Feet.	Inches.
Miocene.	Calvert Formation.	Yellowish sandy clay (Zone 15)	19	
		Brownish sandy clay containing *Isocardia fraterna* (Zone 14)	6	
		Bluish clay (Zone 13)	14	
		Brownish sandy clay containing *Ecphora quadricostata var. umbilicata, Venus mercenaria, Cytherea staminea* (Zone 12)	2	6
		Bluish clayey sand carrying few imperfect fossils (Zone 11)	13	6
		Bluish green sandy clay carrying characteristic fossils (Zone 10)	6	
		Total	61	

IX. *Section* 1.5 *miles south of Dares Wharf.*

			Feet.
Pleistocene.		Yellowish loam, sand and gravel	30
Miocene.	Calvert Formation.	Bluish sandy clay carrying *Isocardia fraterna* (Zone 14)	3
		Bluish clay (Zone 13)	12
		Brownish sandy clay carrying *Ecphora quadricostata var. umbilicata, Venus mercenaria, Cytherea staminea* (Zone 12)	2
		Bluish clay (Zone 11)	8
		Total	55

X. *Section .5 miles south of Parker Creek.*

			Feet.	Inches
Pleistocene.		Reddish sandy loam	2	
Miocene.	Choptank Formation.	Reddish sand (Zone 20)	2	
		Reddish sandy clay containing *Balanus concavus, Corbula idonea, Astarte thisphila, Pecten madisonius, Venus campechiensis var. cuneata, Dosinia acetabulum, Cardium laqueatum, Arca staminea*, etc., (Zone 19)	14	
		Yellowish sandy clay containing fossil casts (Zone 18)	20	
		Yellow sand containing *Ecphora quadricostata, Turritella plebeia, Panopea americana, Corbula idonea, C. cuneata, Metis biplicata, Macrocallista marylandica, Venus mercenaria, V. campechiensis var. cuneata, Dosinia acetabulum, Isocardia fraterna, Cardium laqueatum, Crassatellites turgidulus, Astarte thisphila, Pecten coccymelus, P. madisonius, Melina maxillata, Arca staminea*, etc. (Zone 17)	6	
	Calvert Formation.	Bluish clay (Zone 15)	9	
		Brownish sandy clay containing *Isocardia fraterna* (Zone 14)	4	
		Bluish sandy clay (Zone 13)	10	6
		Brownish sandy clay carrying *Ecphora quadricostata var. umbilicata, Venus mercenaria, Cytherea staminea* (Zone 12)	1	6
		Bluish clay (Zone 11)	4	
		Total	73	

XI. *Section one mile south of Parker Creek.*

Epoch	Formation	Stratum	Feet.
Pleistocene.		Yellow sand	7
Miocene.	Choptank Formation.	Red sand (Zone 20)	2
		Yellow sand containing a little clay and carrying characteristic fossils (Zone 19)	14
		Yellowish sand above, grading into bluish clay below and carrying bands of poorly preserved fossils (Zone 18)	22
		Yellow sand carrying characteristic fossils (Zone 17)	5
		Yellowish sand (Zone 16)	10
	Calvert Formation.	Bluish unfossiliferous clay (Zone 15)	5
		Bluish clayey sand containing *Isocardia fraterna* (Zone 14)	2
		Bluish unfossiliferous clay (Zone 13)	10
		Bluish clay carrying characteristic fossils (Zone 12)	1
		Total	78

XII. *Section at Governor Run.*

Epoch	Formation	Stratum	Feet.
Pleistocene.		Reddish sandy loam	5
Miocene.	Choptank Formation.	Reddish sand (Zone 20)	13
		Yellowish sandy clay carrying characteristic fossils (Zone 19)	12
		Yellowish sandy clay carrying a few poorly preserved fossils (Zone 18)	18
		Yellow sand carrying characteristic fossils (Zone 17)	5
		Bluish sandy clay (Zone 16)	13
	Calvert Formation.	Bluish clay (Zone 15)	4
		Brownish sandy clay carrying *Isocardia fraterna* (Zone 14)	4
		Bluish clay (Zone 13)	1
		Total	75

XIII. *Section 2.75 miles south of Governor Run.*

Epoch	Formation	Stratum	Feet.
Pleistocene.		Reddish yellow loam, sand and gravel	15
Miocene.	Choptank Formation.	Yellowish sand carrying characteristic fossils (Zone 17)	5
		Greenish sandy clay carrying *Ecphora quadricostata, Venus campechiensis var. cuneata, Dosinia acetabulum, Phacoides contractus,* etc. (Zone 16)	9
		Total	29

XIV. *Section at Flag Pond.*

Epoch	Formation	Stratum	Feet.
Pleistocene.		Reddish loam, sand and gravel	40
Miocene.	St. Mary's Formation.	Drab clay and sand (Zone 23)	29
		Drab clay carrying scattered bands of fossils which contain the following species: *Balanus concavus, Spisula marylandica, Callocardia subnasuta, Cardium laqueatum, Pecten madisonius, Melina maxillata, Yoldia lævis* (Zone 22)	14
		Drab clay with sandy bands (Zone 21)	15

			Feet.
Miocene.	Choptank Formation.	Drab clay with sandy bands (Zone 20)	15
		Sandy clay indurated above which contains the following species: *Balanus concavus, Corbula idonea, Macrocallista marylandica, Dosinia acetabulum, Cardium laqueatum, Phacoides anodonta, Crassatellites marylandicus, Astarte thisphila, Ostrea carolinensis, Pecten madisonius, Arca staminea*, etc. (Zone 19)	15
		Bluish green sandy clay carrying a few fossil casts (Zone 18)	12
		Bluish green sandy clay carrying characteristic fossils (Zone 17)	1
		Total	141

XV. *Section at Little Cove Point.*

			Feet
Pleistocene.		Reddish and yellow loam, sand and gravel	62
Miocene.	St. Mary's Formation.	Bluish sandy clay containing 8 feet from base a 6-inch layer of fossils consisting mostly of *Turritella plebeia* (Zone 23)	30
		Bluish sandy clay containing numerous layers of fossils, among which are the following species: *Balanus concavus, Terebra inornata, Mangilia parva, Nassa peralta, Columbella communis, Ecphora quadricostata, Turritella plebeia, T. variabilis, Polynices heros, Corbula inæqualis, Pecten jeffersonius, Arca idonea*, etc., (Zone 22)	17
		Total	109

XVI. *Section at Chancellor Point.*

			Feet.
Pleistocene.		Sandy loam	5
Miocene.	St. Mary's Formation.	Bluish sandy clay containing the following fossils: *Actæon ovoides, Retusa marylandica, Terebra curvilirata, Conus diluvianus, Surcula engonata, Fulgur fusiforme, Turritella variabilis, Panopea goldfussi, Callocardia sayana, Venus campechiensis var. mortoni, Isocardia fraterna, Phacoides anodonta, Pecten madisonius, P. jeffersonius*, etc. (Zone 24)	15
		Total	20

OTHER SECTIONS.

None of the other drainage lines exhibit as complete sections of the Miocene as are found along the Calvert Cliffs, but occasionally good exposures are met with, some of the more important of which are given below.

Section .25 miles below mouth of St. Leonards Creek.

			Feet.	Inches
Pleistocene.		Yellowish gravel and sand	18	6
Miocene.	Choptank Formation.	Greenish sand partially indurated above, solidified to solid rock at base of section carrying the following species: *Balanus concavus, Panopea americana, Corbula idonea, Cardium laqueatum, Astarte thisphila, Pecten madisonius, Melina maxillata*, etc. (Zone 17, in part)	18	6
		Total	37	

Section at Drum Cliff near Jones Wharf.

			Feet.	Inches
Pleistocene.		Reddish yellow loam, sand and gravel.........	42	
Miocene.	Choptank Formation.	Greenish clay containing poorly preserved fossils carrying the following species: *Balanus concavus, Panopea americana, Phacoides contractus, Cardium laqueatum, Pecten madisonius, Ostrea carolinensis*, etc. (Zone 19, in part)	6	6
		Greenish unfossiliferous clay (Zone 18).......	8	
		Brownish and greenish fossiliferous sand partially indurated above, solidified to solid rock at base, carrying the following species: *Balanus concavus, Ecphora quadricostata var. umbilicata, Turritella plebeia, Corbula idonea, Macrocallista marylandica, Dosinia acetabulum, Cardium laqueatum, Crassatellites turgidulus, Astarte thisphila, Pecten madisonius, Melina maxillata, Arca staminea, Scutella aberti*, etc. (Zone 17, in part)...............	30	
		Total..................................	86	6

Section at Boston Cliffs, Choptank River, 1.5 *miles below Dover Bridge.*

			Feet.
Pleistocene.		Yellowish sand and gravel.........................	10
Miocene.	Choptank Formation.	Reddish and yellowish fossiliferous sand containing the following species: *Pleurotoma albida, Ptychosalpinx multirugata, Ecphora quadricostata var. umbilicata, Ecphora tampaënsis, Scala marylandica, Seila adamsii, Cæcum patuxentium, Turritella plebeia. Crucibulum multilineatum, Cadulus thallus, Saxicava artica, Corbula idonea, Corbula inæqualis. Asaphis centenaria, Metis biplicata, Melina maxillata, etc.* (Zone 19, in part).....................	12
		Total	22

Origin of Materials.

The materials which compose the Miocene deposits of Maryland may be divided in regard to their origin into two classes, viz., the silicious and arenaceous materials which are land-derived and the calcareous materials which are of organic origin. The ultimate source of the former was doubtless the rocks of the Piedmont Plateau and regions beyond in Western Maryland and neighboring territory, but more immediately they have been derived from older coastal plain deposits; the one which enters into the Miocene most conspicuously being the Eocene. Near the contact of the Miocene and Eocene, a rolled fauna derived from the latter is reworked in the former and occasionally grains of glauconite, which were in all probability formed in the Eocene occur in the lower portions of the Miocene.

The organic remains, which consist, for the most part, of shells of mollusks and bones of vertebrates, are usually in a very good state of preservation. They have been but slightly disturbed since deposited and evidently now occupy the same relative positions which they did at the time when they lived.

Geological and Geographical Distribution of Species.

The geological and geographical distribution of the species obtained from the Maryland Miocene has already been partly indicated in the discussion of the various zones. A more complete presentation of the occurrence of these forms is shown in the following tables as well as in the chapters on systematic paleontology.

Note.—In a few instances forms have been described in the literature as occurring at Maryland localities where members of the Maryland Survey have not been able to corroborate their occurrence. In such cases their presence is indicated in the following tables by a * and a superior letter indicating the authority. Thus:

*[c]	Indicates	an	occurrence	on	the	authority	of	Conrad.
*[cp]	"	"	"	"	"	"	"	Cope.
*[d]	"	"	"	"	"	"	"	Dall.
*[f]	"	"	"	"	"	"	"	Foreman.
*[s]	"	"	"	"	"	"	"	Say.
*[w]	"	"	"	"	"	"	"	Wagner.

The few instances in which specimens have been described from the deep well at Crisfield have been tabulated under "Crisfield well, St. Mary's Formation (?)" since the uppermost members of the Miocene there exposed belong to that formation and through possible accidents during the driving of the well forms may have fallen in from the upper horizons and been recorded as occurring at greater depth. The exact depths at which the forms were found are given in the text and footnotes. The base of the Miocene lies about 776 feet below the surface.

No.	SPECIES.	Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¾ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
		LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																		Calvert Formation (?)	
	MAMMALIA.																																				
1	*Squalodon atlanticus* Leidy							*																													
2	*Squalodon protervus* Cope							*																													
3	*Priscodelphinus gabbi* Cope							*																													
4	*Priscodelphinus ruschenbergeri* Cope							*																													
5	*Priscodelphinus lacertosus* Cope							*																													
6	*Priscodelphinus* (?) *crassangulum* Case																*																				
7	*Priscodelphinus uracus* Cope																																				
8	*Priscodelphinus grandaevus* Leidy									*																											
9	*Ixacanthus conradi* (Leidy)							*																													
10	*Ixacanthus stenus* Cope							*																													
11	*Ixacanthus spinosus* Cope							*																													
12	*Ixacanthus atropius* Cope							*																													
13	*Ixacanthus coelospondylus* Cope							*																													
14	*Zarhachis flagellator* Cope							*																													
15	*Zarhachis tysonii* Cope																																				
16	*Cetophis heteroclitus* Cope							*																													
17	*Rhabdosteus latiradix* Cope							*																													
18	*Lophocetus calvertensis* (Harlan)																																			*	
19	*Delphinodon mento* Cope							*																													
20	*Delphinodon leidyi* (Hay)							*																													
21	*Hypocetus mediatlanticus* (Cope)																																				
22	*Orycterocetus crocodilinus* (?) Cope							*																													
23	*Metopocetus durinasus* Cope																																				
24	*Cephalotropis coronatus* Cope																																				
25	*Cetotherium megalophysum* Cope																																				
26	*Cetotherium parvum* Trouessart																																				
27	*Cetotherium cephalum* Cope							*																													
28	*Siphonocetus expansus* Cope																																				
29	*Siphonocetus priscus* Leidy							*																													
30	*Siphonocetus clarkianus* Cope																																				
31	*Ulias moratus* Cope																																				
32	*Tretulias buccatus* Cope																																				
33	*Balaenoptera sursiplana* Cope																																				
34	*Balaena affinis* Owen																																				
35	*Cetacean* (?)																																				
36	*Trichechus giganteus* (?) De Kay													*																							
	AVES.																																				
1	*Sula loxostyla* Cope																																			*	
2	*Puffinus conradi* Marsh																																				
	REPTILIA.																																				
1	*Trionyx cellulosus* Cope							*																													
2	*Trionyx sp.*							*																													
3	*Chelone sp.*							*																													
4	*Chelone sp.*							*																													
5	*Chelone sp*																							*													
6	*Thecachampsa* (?) *sericodon* Cope							*																													
7	*Thecachampsa* (?) *sicaria* Cope																																				
8	*Thecachampsa* (?) *contusor* Cope							*																													
9	*Thecachampsa* (?) *antiqua* (Leidy)																																				

LOCAL DISTRIBUTION.

	Choptank Formation. Zone 17 (Lower Bed).								Zone (?)									Zone 19. (Upper Bed).							
	Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.
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	Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)		
	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.
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	Chesapeake Group.											General Distribution.				
	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed). Choptank Formation.	Zone 19 (Upper Bed). Choptank Formation.	Choptank Formation.	St. Mary's Formation.
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	SPECIES	LOCAL DISTRIBUTION.																																	
		CALVERT FORMATION.																																Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	PISCES.																																				
1	*Squatina occidentalis* Eastman																									*											
2	*Raja* (?) *dux* Cope							*																													
3	*Myliobatis gigas* Cope							*																													
4	*Myliobatis pachyodon* Cope							*																													
5	*Myliobatis frangens* Eastman							*																													
6	*Aetobatis arcuatus* Agassiz							*																													
7	*Notidanus primigenius* Agassiz							*						*											*												
8	*Odontaspis cuspidata* (Agassiz)							*						*											*												
9	*Odontaspis elegans* (Agassiz)																								*												
10	*Oxyrhina desorii* Agassiz							*																	*												
11	*Oxyrhina hastalis* Agassiz							*						*											*												
12	*Oxyrhina sillimani* Gibbes							*						*											*												
13	*Oxyrhina minuta* Agassiz																																				
14	*Otodus obliquus* Agassiz							*																													
15	*Carcharodon megalodon* (Charlesworth)							*						*											*												
16	*Carcharias* (*Prionodon*) *egertoni* (Agassiz)							*	*					*																							
17	*Carcharias laevissimus* (Cope)							*						*																							
18	*Carcharias collata* Eastman							*	*					*											*												
19	*Carcharias magna* (Cope)							*																													
20	*Carcharias incidens* Eastman								*																												
21	*Galeocerdo contortus* Gibbes							*			*			*											*												
22	*Galeocerdo latidens* Agassiz							*						*																							
23	*Galeocerdo aduncus* Agassiz							*						*											*												
24	*Galeocerdo triqueter* Eastman							*																													
25	*Hemipristis serra* Agassiz							*						*											*		*										
26	*Sphyrna prisca* Agassiz							*																	*												
27	*Sphyraena speciosa* Leidy							*																													
	ARTHROPODA. Malacostraca and Cirripedia.																																				
1	*Cancroidea*								*																*												
2	*Balanus concavus* Brown								*		*														*							*					
	ARTHROPODA. Ostracoda.																																				
1	*Cythere clarkana* Ulrich & Bassler																								*												
2	*Cythere clarkana var. minuscula* U. & B.																								*												
3	*Cythere planibasalis* Ulrich & Bassler																								*												
4	*Cythere calverti* (?) Ulrich & Bassler																																				
5	*Cythere inaequivalvis* Ulrich & Bassler																								*												
6	*Cythere plebeia* Ulrich & Bassler																								*												
7	*Cythere plebeia var. modica* U. & B.																								*												
8	*Cythere plebeia var. capax* U. & B.																								*												
9	*Cythere burnsi* Ulrich & Bassler																								*												
10	*Cythere paucipunctata* Ulrich & Bassler																																				
11	*Cythere tuomeyi* Ulrich & Bassler																																				
12	*Cythere porcella* Ulrich & Bassler																								*												
13	*Cythere nitidula* Ulrich & Bassler																								*												
14	*Cythere nitidula var. calvertensis* U. & B.																								*												
15	*Cythere punctistriata* Ulrich & Bassler											*																									
16	*Cythere vaughani* Ulrich & Bassler																																				
17	*Cythere francisca* Ulrich & Bassler																																				
18	*Cythere subovalis* Ulrich & Bassler																																				

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.												Choptank Formation.				
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																							
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	3 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	½ miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	½ miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 63 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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LOCAL DISTRIBUTION.

	SPECIES.	Calvert Formation.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	ARTHROPODA. Ostracoda.—*Continued.*																																				
19	*Cythere martini* Ulrich & Bassler																								*												
20	*Cythere dorsicornis* Ulrich & Bassler																								*												
21	*Cythere dorsicornis var. bicornis* U. & B.																																				
22	*Cythere lienenklausi* Ulrich & Bassler																								*												
23	*Cythere producta* Ulrich & Bassler																								*												
24	*Cythere micula* Ulrich & Bassler																								*												
25	*Cythere exanthemata* Ulrich & Bassler																								*												
26	*Cythere rugipunctata* Ulrich & Bassler																																				
27	*Cythere evax* Ulrich & Bassler																								*												
28	*Cythere evax var. oblongula* U. & B.																								*												
29	*Cythere spiniplicata* Ulrich & Bassler.																								*												
30	*Cythere (?) shattacki* Ulrich & Bassler																																				
31	*Cythereis cornata var. americana* U. & B																								*												
32	*Cythereis alaris* Ulrich & Bassler.																																				
33	*Cytheridea subovata* Ulrich & Bassler																								*												
34	*Cytheridea (?) chesapeakensis* U. & B.																								*												
35	*Cytherideis ashermani* Ulrich & Bassler																								*												
36	*Cytherideis cylindrica* Ulrich & Bassler																								*												
37	*Cytherideis subaequalis* Ulrich & Bassler																								*												
38	*Cytherideis semicircularis* Ulrich & Bassler																								*												
39	*Cytherideis longula* Ulrich & Bassler											*													*												
40	*Cytheropteron nodosum* Ulrich & Bassler																																				
	MOLLUSCA. Cephalopoda.																																				
1	*Nautilus (?) sp.*																								*												
	MOLLUSCA. Gastropoda.																																				
1	*Actaeon ovoides* Conrad											*													*												
2	*Actaeon pusillus* (Forbes)																																				
3	*Actaeon shilohensis* Whitfield										*														*												
4	*Actaeon calvertensis* Martin																								*												
5	*Volvula iota* (Conrad)																								*												
6	*Volvula iota var. marylandica* Martin																								*												
7	*Volvula iota var. diminuta* Martin																																				
8	*Volvula iota var. calverta* Martin																								*												
9	*Volvula iota var. patuxentia* Martin																																				
10	*Retusa (Cylichnina) marylandica* Martin																																				
11	*Retusa (Cylichnina) conulus* (Deshayes)											*													*												
12	*Retusa (Cylichnina) subspissa* (Conrad)																								*												
13	*Cylichna (?) greensboroënsis* Martin																																				*
14	*Cylichna calvertensis* Martin																								*												
15	*Terebra unilineata* Conrad																								*												
16	*Terebra (Acus) curvilineata* Dall																																				
17	*Terebra curvilineata var. whitfieldi* Martin.																								*												
18	*Terebra curvilineata var. dalli* Martin										*	*													*												
19	*Terebra curvilineata var. calvertensis* Martin																								*												
20	*Terebra (Acus) curvilirata* Conrad																																				
21	*Terebra (Acus) sincera* Dall																																				
22	*Terebra (Hastula) simplex* Conrad																																				
23	*Terebra simplex var. sublirata* Conrad																																				

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
CHOPTANK FORMATION.																												ST. MARY'S FORMATION.										St. Mary's Formation (?)			CHESAPEAKE GROUP.												Choptank Formation.				
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).								Choptank Formation (?)																																
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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	SPECIES.	LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																	Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¼ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?).
	MOLLUSCA. Gastropoda.—*Continued.*																																				
24	*Terebra (Hastula) inornata* Whitfield																																				
25	*Terebra (Hastula) patuxentia* Martin																																				
26	*Conus diluvianus* Green																																				
27	*Conus marylandicus* Green																																				
28	*Pleurotoma (Hemipleurotoma) albida* Perry																																				
29	*Pleurotoma (Hemipleurotoma) communis* Conrad																																				
30	*Pleurotoma (Hemipleurotoma) communis var. protocommunis* Martin																							*												
31	*Pleurotoma (Hemipleurotoma) choptankensis* Martin																																				
32	*Pleurotoma (Hemipleurotoma) bellacrenata* Conrad																							*												
33	*Pleurotoma (Hemipleurotoma) calvertensis* Martin																							*												
34	*Surcula rugata* Conrad																							*												
35	*Surcula marylandica* Conrad																							*												
36	*Surcula biscatenaria* Conrad																																			*
37	*Surcula engonata* Conrad																																				
38	*Surcula rotifera* Conrad																							*												
39	*Surcula mariana* Martin																																				
40	*Mangilia parva* (Conrad)																							*												
41	*Mangilia parvoidea* Martin																																				
42	*Mangilia cornelliana* Martin																							*												
43	*Mangilia patuxentia* Martin																																				
44	*Mangilia (Glyphostoma) obtusa* Martin																							*												
45	*Drillia incilifera* (Conrad)																																				
46	*Drillia incilifera var. angulata* Martin																																				
47	*Drillia incilifera var. distans* (Conrad)																																				
48	*Drillia whitfieldi* Martin											*																									
49	*Drillia calvertensis* Martin																							*												
50	*Drillia limatula* Conrad																							*												
51	*Drillia limatula var. dissimilis* Conrad																																				
52	*Drillia limatula var. pyramidalis* Martin																																				
53	*Drillia pseudeburnea* (Whitfield)																							*												
54	*Cancellaria alternata* Conrad						*					*												*												
55	*Cancellaria engonata* Conrad																							*												
56	*Cancellaria lunata* Conrad																																				
57	*Cancellaria prunicola* Martin																							*												
58	*Cancellaria reticulatoides* Martin																							*												
59	*Cancellaria corbula* Conrad																																				
60	*Cancellaria (Admete) marylandica* Martin																																				
61	*Cancellaria (Trigonostoma) perspectiva* Conrad																																				
62	*Cancellaria (Trigonostoma) biplicifera* Conrad																							*												
63	*Cancellaria (Sveltia) patuxentia* Martin																																				
64	*Cancellaria (Sveltia) calvertensis* Martin																							*												
65	*Cancellaria (Sveltia) sp.*																							*												
66	*Cancellaria (Cancellariella) neritoidea* Martin																																				

Local Distribution. Choptank Formation. Zone 17 (Lower Bed). Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Zone (?). Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Zone 19 (Upper Bed). Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Choptank Formation (?). Calvert Cliffs.	Bristol.	Jones Wharf.	St. Mary's Formation. Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 33 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	St. Mary's Formation (?). Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Chesapeake Group. Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	General Distribution. Calvert Formation.	Choptank Formation. Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation	St. Mary's Formation.	
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	SPECIES.	LOCAL DISTRIBUTION.																																		
		CALVERT FORMATION.																																		Calvert Formation (?)
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs. Plum Point (?)
	MOLLUSCA. Gastropoda.—*Continued.*																																			
67	*Oliva litterata* Lamarck											*																								
68	*Oliva harrisi* Martin																								*											
69	*Marginella minuta* Pfeiffer																								*											
70	*Marginella denticulata* Conrad																																			
71	*Marginella calvertensis* Martin																								*											
72	*Scaphella solitaria* (Conrad)																								*											
73	*Scaphella (Aurinia) mutabilis* (Conrad)																																			
74	*Scaphella (Aurinia) typus* (Conrad)								*																*											
75	*Scaphella (Aurinia) obtuso* (Emmons)																								*											
76	*Turbinella (?) demissa* Conrad																																			
77	*Scaphella trenholmii* (T. & H.)																																			
78	*Mitra mariana* Martin																																			
79	*Fulgur spiniger* (Conrad) *var*																								*											
80	*Fulgur fusiforme* Conrad																																			
81	*Fulgur tuberculatum* Conrad																																			
82	*Fulgur coronatum* Conrad																																			
83	*Fulgur coronatum var. rugosum* Conrad																								*											
84	*Fulgur alveatum* (Conrad)																																			
85	*Lirosoma sulcosa* Conrad																																			
86	*Chrysodomus patuxentensis* Martin																								*											
87	*Buccinofusus parilis* Conrad																																			
88	*Siphonalia devexa* (Conrad)																								*											
89	*Siphonalia migrans* (Conrad)																								*											
90	*Siphonalia marylandica* Martin																																			
91	*Siphonalia (?) calvertana* Martin																								*											
92	*Pisonio (Celatoconus) protractus* (Conrad)																								*											
93	*Ptychosalpinx altilis* (Conrad)																																			
94	*Ptychosalpinx multirugata* Conrad																								*											
95	*Ptychosalpinx lienosa* Conrad																								*											
96	*Ilyanassa? (Paranassa) porcina* (Say)																																			
97	*Nassa calvertensis* Martin																								*											
98	*Nassa gubernatoria* Martin																																			
99	*Nassa trivittatoides* (Whitfield)						*																													
100	*Nassa greensboroënsis* Martin																																		*	
101	*Nassa marylandica* Martin																																			
102	*Nassa peralta* (Conrad)																																			
103	*Nassa peraltoides* Martin											*		*											*											
104	*Nassa trivittata* Say																																			
105	*Bulliopsis integra* Conrad																																			
106	*Bulliopsis quadrata* Conrad																																			
107	*Bulliopsis marylandica* Conrad																																			
108	*Columbella (Astyris) communis* (Conrad)						*																		*											
109	*Columbella calvertensis* Martin																								*											
110	*Murex (Pterorhytis) conradi* Dall																																			
111	*Typhis acuticosta* Conrad																								*											
112	*Muricidea shilohensis* (Heilprin)																								*											
113	*Trophon tetricus* Conrad																																			
114	*Trophon tetricus var. laevis* Martin																																			
115	*Trophon chesapeakeanus* Martin																								*											
116	*Traphon sp*																																			

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
CHOPTANK FORMATION.																									Choptank Formation (?)			ST. MARY'S FORMATION.										St. Mary's Formation (?)			CHESAPEAKE GROUP.												Choptank Formation.				
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																								
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation	St. Mary's Formation.	
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	SPECIES	LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¾ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	MOLLUSCA. Gastropoda.—*Continued.*																																				
117	*Scalaspira strumosa* Conrad																																				
118	*Urosalpinx cinereus* (Say) ?																																				
119	*Urosalpinx rusticus* (Conrad)																																				
120	*Ecphora quadricostata* (Say)																																				
121	*Ecphora qaudricostata var. umbilicata* (Wagner)																																				
122	*Ecphora tricostata* Martin																																				
123	*Ecphora tampaensis* (Dall)								*		*			*											*?								*	*			
124	*Coralliophila cumberlandiana* (Gabb)											*																									
125	*Scala sayana* Dall																																				
126	*Scala marylandica* Martin																			*																	
127	*Scala* (*Opalia*) *calvertensis* Martin								*		*	*													*												
128	*Scala* (*Opalia*) *reticulata* Martin										*														*												
129	*Scala* (*Opalia*) *prunicola* Martin																								*												
130	*Scala* (*Sthenorhytis*) *expansa* Conrad																								*												
131	*Scala* (*Sthenorhytis*) *pachypleura* Conrad																*																				
132	*Eulima eborea* Conrad																								*												
133	*Eulima laevigata* (H. C. Lea)						*					*													*												
134	*Eulima migrans* Conrad																																				
135	*Niso lineata* Conrad																								*												
136	*Odostomia conoidea* (Brocchi)										*														*												
137	*Odostomia* (*Chrysallida*) *melanoides* (Con.)																																				
138	*Odostomia* (*Evalea*) *mariana* Martin																																				
139	*Odostomia* (*Syrnola*) *marylandica* Martin																																				
140	*Odostomia* (*Pyrgulina*) *calvertensis* Mart.																								*												
141	*Eulimella* (*Anisocycla*) *marylandica* Mart.																								*												
142	*Turbonilla* (*Chemnitzia*) *nivea* Stimpson																																				
143	*Turbonilla* (*Chemnitzia*) *nivea* Stimpson *var.*																																				
144	*Turbonilla* (*Pyrgiscus*) *interrupta* (Totten)						*																		*			*									
145	*Turbonilla* (*Tragula*) *gubernatoria* Martin.																																				
146	*Tritonium centrosum* (Conrad)							*c																	*												
147	*Pyrula harrisi* Martin																								*												
148	*Cassis caelata* Conrad																																				
149	*Erato perexigua* (Conrad)																								*												
150	*Scila adamsii* (H. C. Lea)						*					*													*												
151	*Cerithiopsis calvertensis* Martin								*																*												
152	*Cerithiopsis subulata* (Montagu)																																				
153	*Goniobasis marylandica* Martin																																				
154	*Caecum calvertense* Martin						*					*																									
155	*Caecum patuxentium* Martin								*																												
156	*Caecum greensboroënse* Martin																																				
157	*Vermetus graniferus* (Say)						*		*																*												
158	*Vermetus virginicus* (Conrad)								*																*												
159	*Turritella indenta* Conrad								*		*								*c		*				*			*	*			*					
160	*Turritella aequistriata* Conrad	*					*					*	*												*										*		
161	*Turritella plebeia* Say								*		*														*							*					
162	*Turritella variabilis* Conrad																																				
163	*Turritella variabilis var. alticostata* Con.																																				
164	*Turritella variabilis var. cumberlandia* Con.								*		*	*													*			*				*					
165	*Turritella variabilis var. exaltata* Conrad								*		*														*												

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
CHOPTANK FORMATION.																									Choptank Formation (?)			ST. MARY'S FORMATION.										St. Mary's Formation (?)			CHESAPEAKE GROUP.												Choptank Formation.				
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																								
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 65 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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	SPECIES.	LOCAL DISTRIBUTION. CALVERT FORMATION. Between McKindes and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs. } Calvert Formation (?)	Plum Point (?)
	MOLLUSCA. Gastropoda.—*Cantinued.*																																				
166	*Turritella variabilis var.*								*		*			*											*							*		*			
167	*Tachyrhynchus perlaqueatus* (Conrad)																								*												
168	*Littorina irrorata* (Say)																																				
169	*Fossarus (Isapis) dalli* (Whitfield)										*	*													*												
170	*Solarium trilineatum* Conrad										*														*												
171	*Solarium amphiterinum* Dall																																				
172	*Rissoa (Onoba) marylandica* Martin						*					*													*										*		
173	*Rissoa sp*						*																														
174	*Adeorbis supranitidus* S. Wood																																				
175	*Crucibulum costatum* (Say)						*		*			*													*										*		
176	*Crucibulum costatum var. pileolum* (H. C. Lea)																																				
177	*Crucibulum constrictum* Conrad																																				
178	*Crucibulum multilineatum* Conrad																																				
179	*Calyptraea aperta* (Solander)						*		*		*	*													*			*						*			
180	*Calyptraea centralis* (Conrad)																																				
181	*Calyptraea greensboroënsis* Martin																																				
182	*Crepidula fornicata* (Linné)						*																		*												
183	*Crepidula plana* Say																								*												
184	*Amalthea marylandica* Martin																																				
185	*Xenophora conchyliophora* (Born)																								*												
186	*Polynices (Neverita) duplicatus* (Say)											*													*												
187	*Polynices (Lunatia) hemicryptus* (Gabb)										*	*													*												
188	*Polynices (Lunatia) heros* (Say)						*							*											*												
189	*Sigaretus fragilis* Conrad																								*												
190	*Calliostama bellum* (Conrad)																								*												
191	*Calliostoma philanthropus* (Conrad)																								*												
192	*Calliostoma philanthropus var.*																																				
193	*Calliostoma virginicum* (Conrad)																																				
194	*Calliostoma distans* (Conrad)																																				
195	*Calliostoma eboreum* (Wagner)										*																	*					*				
196	*Calliostoma wagneri* Dall																																				
197	*Calliostoma aphelium* Dall																																				
198	*Calliostoma peralveatum* (Conrad)																								*												
199	*Calliostama humile* (Conrad)																																				
200	*Calliostoma reclusum* (Conrad)																																				
201	*Calliostoma marylandicum* Martin																								*												
202	*Calliostoma calvertanum* Martin																								*												
203	*Teinostoma nanum* (Lea)																																				
204	*Teinostoma calvertense* Martin											*													*												
205	*Teinostoma liparum* (H. C. Lea)																								*												
206	*Teinostoma greensboroënse* Martin																																				
207	*Cochliolepis striata* Dall																								*												
208	*Molleria minuscula* Dall																																				
209	*Fissuridea alticosta* (Conrad)																																				
210	*Fissuridea griscomi* (Conrad)						*					*																									
211	*Fissuridea marylandica* (Conrad)								*					*											*												
212	*Fissuridea nassula* (Conrad)																																				
213	*Fissuridea redimicula* (Say)																																				
214	*Emarginula marylandica* Martin																																				

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
Choptank Formation.																												St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.																
Zone 17 (Lower Bed).								Zone (?)									Zone 19. (Upper Bed).								Choptank Formation (?)																												Choptank Formation.				
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappo Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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No.	SPECIES.	LOCAL DISTRIBUTION.																																			
		Calvert Formation.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	½ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¼ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?).
	MOLLUSCA. Amphineura.																																				
1	*Chaetopleura apiculata* (Say)										•														•												
	MOLLUSCA. Scaphopoda.																																				
1	*Dentalium attenuatum* Say																																				
2	*Dentalium danai* Meyer								•																•												
3	*Dentalium caduloide* Dall								•		•														•							•					
4	*Cadulus thallus* (Conrad)																								•												
5	*Cadulus newtonensis* M. & M.										•														•			•									
	MOLLUSCA. Pelecypoda.																																				
1	*Pholas (Thovana) producta* Conrad																																				
2	*Barnea (Scobina) arcuata* (Conrad)																																				
3	*Martesia ovalis* (Say)																																				
4	*Panopea whitfieldi* Dall																								•			•						•			
5	*Panopea goldfussii* Wagner													•							•				•									•	•		
6	*Panopea americana* Conrad																								•										•		
7	*Saxicava arctica* (Linné)										•										•							•							•		
8	*Corbula idonea* Conrad						•		•		•														•									•			
9	*Corbula elevata* Conrad								•		•														•			•									
10	*Corbula inaequalis* Say						•		•		•			•							•				•			•				•		•			
11	*Corbula cuneata* Say						•		•		•	•		•							•				•							•		•	•		
12	*Mya producta* Conrad																								•												
13	*Sphenia dubia* (H. C. Lea)																								•												
14	*Paramya subovata* Conrad																								•												
15	*Mesodesma mariana* Glenn																								•												
16	*Ervilia planata* Dall											•																									
17	*Mactra clathrodon* Lea						•																		•												
18	*Spisula (Hemimactra) delumbis* (Conrad)								•																												
19	*Spisula (Hemimactra) marylandica* Dall																								•												
20	*Spisula (Hemimactra) curtidens* Dall			•																																	
21	*Spisula (Hemimactra) subponderosa* (d'Orbigny)																																				
22	*Spisula (Hemimactra) confraga* (Conrad)								•																			•									
23	*Spisula (Hemimactra) subparilis* (Conrad)										•														•												
24	*Spisula (Hemimactra?) chesapeakensis* Glenn																									•											
25	*Labiosa (Raëta)* sp.																											•									
26	*Ensis directus* (Conrad)																																				
27	*Ensis ensiformis* Conrad													•											•			•									
28	*Psammobia gubernatoria* Glenn																								•												
29	*Asaphis centenaria* (Conrad)													•							•	•			•												
30	*Semele carinata* (Conrad)								•		•														•												
31	*Semele carinata var. compacta* Dall																															•					
32	*Semele subovata* (Say)						•					•		•																							
33	*Abra longicallus* (Scacchi)																																				
34	*Abra marylandica* Glenn																								•												
35	*Cumingia medialis* Conrad																																				
36	*Tellina aequistriata* Say																																				
37	*Tellina (Angulus) declivis* Conrad																								•												
38	*Tellina (Angulus) producta* Conrad																								•												

LOCAL DISTRIBUTION.

Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.											General Distribution.					
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																							
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappo Landing.	Calvert Cliffs	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed). Choptank Formation.	Zone 19 (Upper Bed.) Choptank Formation.	Choptank Formation.	St. Mary's Formation.	
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SPECIES.	LOCAL DISTRIBUTION.																																			
	CALVERT FORMATION.																																		Calvert Formation (?)	
	Between McKindes and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	½ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	3 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
MOLLUSCA. Pelecypoda.—*Continued.*																																				
39 *Tellina (Angulus) dupliniana* Dall																																				
40 *Tellina (Angulus) umbra* Dall																																				
41 *Metis biplicata* Conrad																							*												
42 *Macoma lenis* (Conrad)																							*												
43 *Macoma marylandica* Glenn									*										?													*	*		
44 *Petricola harrisii* Dall																																				
45 *Petricola calvertensis* Dall																																				
46 *Venus ducateli* Conrad																																				
47 *Venus rileyi* Conrad										*																								*	
48 *Venus mercenaria* Linné																							*												
49 *Venus plena* (Conrad)																							*												
50 *Venus campechiensis var. tetrica* Conrad																																				
51 *Venus campechiensis var. mortoni* Conrad																																				
52 *Venus campechiensis var. cuneata* (Conrad)																																				
53 *Venus campechiensis var. capax* Conrad	*																										?								
54 *Chione latilirata* (Conrad)																																				
55 *Chione parkeria* Glenn							*		*			*						*	*				*			*									
56 *Chione alveata* (Conrad)																					*	*													
57 *Macrocallista marylandica* (Conrad)																																				
58 *Callocardia (Agriopoma) subnasuta* (Conrad)							*		*	*													*												
59 *Callocardia (Agriopoma) prunensis* Glenn									*														*												
60 *Callocardia (Agriopoma) sayana* (Conrad)																							*												
61 *Cythere (Antigona) staminea* Conrad																																				
62 *Dosinia acetabulum* Conrad							*		*	*									*				*			*									
63 *Clementia inoceriformis* (Wagner)									*										*				*			*									
64 *Isocardia markoči* Conrad																*							*									*			
65 *Isocardia mazlea* Glenn																							*										*		
66 *Isocardia fraterna* Say																							*												
67 *Isocardia ignolea* Glenn																							*												
68 *Cardium (Cerastoderma) laqueatum* Conrad																																				
69 *Cardium (Cerastoderma) leptopleurum* Con																																				
70 *Cardium (Cerastoderma) craticuloide* Con.																		*					*												
71 *Cardium (Cerastoderma) calvertensium* Glenn									*														*												
72 *Cardium (Cerastoderma) patuxentium* Glenn												*											*												
73 *Cardium (Fragum) medium* Linné																														*		*			
74 *Cardium (Lævicardium) mortoni* Conrad																																*	*		
75 *Solecardia (Spaniorinus) cossmanni* Dall																																				
76 *Sportella whitfieldi* Dall																							*												
77 *Sportella pelex* Dall																							*												
78 *Sportella petropolitana* Dall																																				
79 *Sportella recessa* Glenn																							*												
80 *Sportella patuxentia* Glenn																										*									
81 *Hindsiella acuta* Dall																																				
82 *Erycina (Pseudopythina?) americana* Dall																																				
83 *Erycina calvertensis* Glenn																																				
84 *Erycina pruna* Glenn																							*												
85 *Erycina marylandica* Glenn																							*												
86 *Erycina rickardia* Glenn									*														*												
87 *Erycina speciosa* Glenn																							*												
88 *Bornia mactroides* (Conrad)																							*												

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.																
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																								
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well at depth of 776 feet.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed.) Choptank Formation.	Zone 19 (Upper Bed.) Choptank Formation.	Choptank Formation.	St. Mary's Formation.	
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	SPECIES.	LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¾ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	MOLLUSCA. Pelecypoda.—*Continued.*																																				
89	*Bornia triangula* Dall						*																														
90	*Bornia marylandica* Glenn																								*												
91	*Bornia depressa* Glenn																								*												
92	*Kellia rotundula* Glenn																																				
93	*Thecodonta* (*Dicranodesma*) *calvertensis* Glenn																								*												
94	*Montacuta mariana* Dall																								*												
95	*Aligena æquata* (Conrad)																																				
96	*Aligena æquata var. nuda* Dall																								*												
97	*Aligena pustulosa* Dall																																				
98	*Diplodonta acclinis* Conrad											*		*														*									
99	*Diplodonta shilohensis* Dall																																				
100	*Diplodonta subvexa* (Conrad)																								*												
101	*Phacoides* (*Pseudomiltha*) *foremani* (Con.)																								*												
102	*Phacoides* (*Pseudomiltha*) *anodontus* (Say)								*		*														*												
103	*Phacoides* (*Here*) *trisulcatus* (Conrad)						*		*		*	*													*							*					
104	*Phacoides* (*Lucinoma*) *contractus* (Say)										*			*						*	*				*												
105	*Phacoides* (*Parvilucina*) *crenulatus* (Con.)								*		*														*			*									
106	*Phacoides* (*Parvilucina*) *prunus* Dall																								*												
107	*Phacoides* (*Lucinisca*) *cribrarius* (Say)																																				
108	*Divaricella quadrisucata* (d'Orbigny)																				*[1]																
109	*Chama congregata* Conrad						*				*	*													*							*					
110	*Cardita protracta* (Conrad)						*					*		*								*			*												
111	*Venericardia granulata* Say								*		*														*							*					
112	*Venericardia castrana* Glenn											*																*									
113	*Crassatellites melinus* (Conrad)								*		*	*		*							*				*												
114	*Crassatellites marylandicus* (Conrad)																																				
115	*Crassatellites turgidulus* (Conrad)																																				
116	*Crassatellites undulatus* (Say)																																				
117	*Crassatellites* (*Crassinella*) *duplinianа* Dall																								*												
118	*Crassatellites* (*Crassinella*) *galvestonensis* (H.)																																				
119	*Astarte vicina* Say										*														*												
120	*Astarte thomasii* Conrad																				*				*												
121	*Astarte calvertensis* Glenn																								*												
122	*Astarte symmetrica* Conrad																																				
123	*Astorte cuneiformis* Conrad								*		*										*				*							*					
124	*Astorte castrono* Glenn											*													*			*									
125	*Astorte obruto* Conrad																																				
126	*Astorte thisphilo* Glenn																								*												
127	*Astorte perplana* Conrad																																				
128	*Astarte parma* Dall																								*				*								
129	*Pondora* (*Clidiophora*) *crassidens* Conrad																																				
130	*Pondoro* (*Kennerleyia*) *lota* Dall																																				
131	*Periploma peralto* Conrad																																				
132	*Throcia conradi* Couthouy								*					*							*				*												
133	*Margaritario obrupto* (Conrad)																																	*			
134	*Mytilus conradinus* d'Orbigny								*		*	*													*												
135	*Mytilus* (*Mytiloconcha*) *incurvus* Conrad											*																	*			*					
136	*Lithophaga subalveata* Conrad						*																														
137	*Lithophaga ionensis* Glenn																																				
138	*Crenella virido* Glenn																																				

[1] "Prince George's Co.," and elsewhere.

Local Distribution.																																																				General Distribution.					
Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.																
Zone 17 (Lower Bed).								Zone (?)										Zone 19 (Upper Bed).																																						
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed), Choptank Formation.	Zone 19 (Upper Bed), Choptank Formation.	Choptank Formation.	St. Mary's Formation.	
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LOCAL DISTRIBUTION.

CALVERT FORMATION.

No.	SPECIES.	Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs. } Calvert Formation (?)	Plum Point (?)
	MOLLUSCA. Pelecypoda.—*Continued.*																																				
139	*Crenella gubernatoria* Glenn																																				
140	*Modiolus ducatelii* Conrad								*		*														*			*									
141	*Modiolus virginicus* (Conrad)																																				
142	*Modiolus dalli* Glenn																																				
143	*Modiolus ionensis* Glenn																																				
144	*Modiolaria curta* Glenn																								*												
145	*Anomia simplex* d'Orbigny																																				
146	*Anomia aculeata* Gmelin										?														*												
147	*Lima papyria* Conrad																								*												
148	*Plicatula densata* Conrad											*																									
149	*Pecten humphreysii* Conrad			*d		*			*					*							*				*			*				*		*			
150	*Pecten (Amusium) mortoni* Ravenel																																				
151	*Pecten (Pseudamusium) cerinus* Conrad							*																	*												
152	*Pecten (Chlamys) coccymelus* Dall								*		*														*												
153	*Pecten (Chlamys) rogersi* Conrad																																				
154	*Pecten (Chlamys) clintonius* Say																																				
155	*Pecten (Chlamys) marylandicus* Wagner														*																			*			
156	*Pecten (Chlamys) madisonius* Say						*		*		*	*		*							*	*			*			*				*		*	*		
157	*Pecten (Chlamys) jeffersonius* Say																																				
158	*Pecten (Chlamys) jeffersonius var. edgecomensis* (Conrad)																																				
159	*Pecten (Chlamys) jeffersonius var. septenarius* Say																																				
160	*Ostrea sellæformis var. thomasii* (Conrad)							*?	*		*														*							*					
161	*Ostrea trigonalis* Conrad																																				
162	*Ostrea carolinensis* Conrad																																				
163	*Ostrea percrassa* Conrad								*		*			*	*			*				*			*			*					*				
164	*Ostrea* sp.						*					*																	*								
165	*Melina maxillata* (Deshayes)						*		*			*						*							*			*						*			
166	*Atrina harrisii* Dall								*																*							*		*			
167	*Atrina piscatoria* Glenn								*																												
168	*Arca (Scapharca) subrostrata* Conrad						*		*		*	*													*			*	*			*		*	*		
169	*Arca (Scapharca) elnia* Glenn																																				
170	*Arca (Scapharca) clisea* Dall																																				
171	*Arca (Scapharca) staminea* Say																																				
172	*Arca (Scapharca) arata* Say																																				
173	*Arca (Scapharca) idonea* Conrad																																				
174	*Arca (Noëtia) incile* Say																																				
175	*Arca (Barbatia) centenaria* Say											*		*																							
176	*Arca (Barbatia) marylandica* Conrad					*	*																		*											*[1]	
177	*Arca (Barbatia) virginiæ* Wagner																																				
178	*Glycymeris parilis* (Conrad)								*		*	*													*			*			*	*			*		
179	*Glycymeris subovata* (Say)																																				
180	*Leda liciata* (Conrad)								*		*														*							*					
181	*Leda liciata var. amydra* Dall																								*												
182	*Leda concentrica* (Say)																																				
183	*Yoldia lævis* (Say)											*		*							*		*			*								*			
184	*Nucula proxima* Say						*				*	*		*											*							*					
185	*Nucula sinaria* Dall																																				
186	*Nucula taphria* Dall																																				
187	*Nucula prunicola* Dall								*		*														*												

[1] At depth of 140 feet.

LOCAL DISTRIBUTION.

Choptank Formation.

Zone 17 (Lower Bed).								Zone (?)									Zone 19. (Upper Bed).								
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	
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Choptank Formation (?)		St. Mary's Formation.											St. Mary's Formation (?)			Chesapeake Group.											General Distribution.					
Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 58 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed). Choptank Formation.	Zone 19 (Upper Bed). Choptank Formation.	Choptank Formation.	St. Mary's Formation.	
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	SPECIES	LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	¼ mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	¾ mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	MOLLUSCOIDEA. Brachiopoda.																																				
1	*Discinisca lugubris* (Conrad)								*		*			*							*											*					
	MOLLUSCOIDEA. Bryozoa.																																				
1	*Idmonea (?) expansa* Ulrich																																				
2	*Crisina striatopora* Ulrich																																				
3	*Theonoa glomerata* Ulrich																																				
4	*Membranipora oblongula* Ulrich								*																*			*									
5	*Membranipora fossulifera* Ulrich																											*									
6	*Membranipora caminosa* Ulrich																																				
7	*Membranipora germana* Ulrich																																				
8	*Membranipora parvula* Ulrich																											*									
9	*Membranipora bifoliata* Ulrich																																				
10	*Membranipora nitidula* Ulrich																																				
11	*Membranipora fistula* Ulrich																																				
12	*Amphiblestrum constrictum* Ulrich																																				
13	*Amphiblestrum agellus* Ulrich																																				
14	*Cupularia denticulata (?)* (Conrad)																																				
15	*Microporella præciliata* Ulrich																																				
16	*Microporella inflata* Ulrich																																				
17	*Microporella (?) bifoliata* Ulrich																																				
18	*Adeonellopsis umbilicata* (Lonsdale)																																				
19	*Schizoporella informata* (Lonsdale)																																				
20	*Schizoporella subquadrata* Ulrich																																				
21	*Schizoporella latisinuata* Ulrich																																				
22	*Schizoporella doverensis* Ulrich																																				
23	*Schizoporella cumulata* Ulrich																																				
24	*Retepora doverensis* Ulrich																																				
25	*Lepralia maculata* Ulrich										*														*												
26	*Lepralia montifera* Ulrich																																				
27	*Lepralia marylandica* Ulrich																																				
28	*Lepralia (?) reversa* Ulrich																																				
29	*Palmicellaria convoluta* Ulrich																											*									
30	*Palmicellaria punctata* Ulrich																											*									
31	*Cellepora massalis* Ulrich								*																*												
32	*Cellepora cribrosa* Ulrich																											*									
	VERMES.																																				
1	*Spirorbis calvertensis* Martin																								*												
	ECHINODERMATA. Echinoidea.																																				
1	*Echinocardium orthanotum* Conrad																																				
2	*Scutella aberti* Conrad																																				
	ECHINODERMATA. Ophiuroidea.																																				
1	*Ophioderma (?)* sp.																																				
	COELENTERATA. Hydrozoa.																																				
1	*Hydractinia multispinosa* Ulrich										*														*												
2	*Milleaster incrustans* Ulrich																								*												
3	*Milleaster (?) subramosus* Ulrich																								*												

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
CHOPTANK FORMATION.																									Choptank Formation (?)			ST. MARY'S FORMATION.										St. Mary's Formation (?)			CHESAPEAKE GROUP.																
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																			Choptank Formation.			
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	3 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 63 to 75 feet deep.	St. Mary's River.	Crisfield Well	Mouth of Patuxent River	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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	SPECIES.	LOCAL DISTRIBUTION.																																			
		CALVERT FORMATION.																																		Calvert Formation (?)	
		Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Cliffs.	Plum Point (?)
	COELENTERATA. Anthozoa.																																				
1	*Paracyathus vaughani* Gane																																				
2	*Astrhelia palmata* (Goldfuss)						*					*													*			*	*	*		*					
3	*Astrangia lineata* (Conrad)																																				
4	*Astrangia* (*Coenangia*) *conradi* Vaughan																																				
5	*Septastrea marylandica* (Conrad)																																				
	PROTOZOA. Radiolaria.																																				
1	*Distephanus crux* (Ehrenberg)													*													*										
2	*Distephanus speculum* (Ehrenberg)																										*										
3	*Dictyocha fibula* (?) Ehrenberg																																				
4	*Lithocampe marylandica* Martin																				*																
5	*Eucyrtidium calvertense* Martin																				*																
6	*Stichocapsa macropora* Vinassa																								*		*										
7	*Anthocyrtium doronicum* Haeckel																				*						*										
8	*Lithastericus radiatus* Ehrenberg																																				
9	*Spongasteriscus marylandicus* Martin																				*																
10	*Dictyoryne profunda* Ehrenberg																				*				*		*										
11	*Rhopalodictyum marylandicum* Martin																				*						*										
12	*Rhopalodictyum calvertense* Martin																				*																
13	*Porodiscus concentricus* (Ehrenberg)																				*				*		*										
14	*Phacodiscus calvertanus* Martin																				*																
15	*Cannartidium* sp.																										*										
16	*Cannartiscus amphicylindricus* Haeckel																				*				*		*										
17	*Cannartiscus marylandicus* Martin																								*												
18	*Acanthosphaera parvula* Vinassa																										*										
19	*Hexalonche microsphaera* Vinassa																								*												
20	*Hexastylus simplex* Vinassa																				*																
21	*Cenosphaera porosissima* Vinassa																				*				*												
	PROTOZOA. Foraminifera.																																				
1	*Nonionina scapha* (Fichtel & Moll)								*																												
2	*Polystomella striatopunctata* (F. & M.)																																				
3	*Discorbina orbicularis* (Terquem)																																				
4	*Planorbulina mediterranensis* d'Orbigny								*																												
5	*Truncatulina lobatula* (Walker & Jacob)																								*												
6	*Truncatulina variabilis* d'Orbigny																								*												
7	*Anomalina grosserugosa* (Gümbel)								*																												
8	*Rotalia beccarii* (Linné)																																				
9	*Rotalia beccarii var. broeckhiana* Kerrer																																				
10	*Globigerina bulloides* d'Orbigny								*																*												
11	*Globigerina cretacea* d'Orbigny								*																												
12	*Textularia abbreviata* d'Orbigny																																				
13	*Textularia agglutinans* d'Orbigny								*																*												
14	*Textularia articulata* d'Orbigny								*																*												
15	*Textularia gramen* d'Orbigny																																				
16	*Textularia carinata* d'Orbigny								*																												
17	*Textularia sagittula* Defrance								*																*												
18	*Textularia subangulata* d'Orbigny																																				
19	*Bolivina beyrichii var. alata* Seguenza								*																												
20	*Cristellaria cultrata* (Montfort)																																				

[1] Breton Bay, Claiborne. [2] Breton Bay. [3] Crisfield well, 790 ft. [4] Crisfield well, 485–500 ft.

LOCAL DISTRIBUTION.																																																				GENERAL DISTRIBUTION.					
Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.												Choptank Formation.				
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																							
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed).	Zone 19 (Upper Bed).	Choptank Formation.	St. Mary's Formation.	
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[5] Cambridge well, 192-335.

LOCAL DISTRIBUTION.

CALVERT FORMATION.

No.	SPECIES.	Between McKindee and Pindell.	Blakes.	Burch.	Calvert Cliffs.	Centerville.	3 miles west of Centerville.	Charles County near Patuxent River.	Chesapeake Beach.	1/4 mile south of Chesapeake Beach.	3 miles south of Chesapeake Beach.	Church Hill.	Evans' Farm near Church Hill.	Fairhaven.	Friendship.	Good Hope Hill.	3/4 mile north of Governor Run.	Hollin Cliff.	Huntingtown.	Jewell.	Lyons Creek Wharf.	Magruder Ferry.	Parker Creek.	2 miles south of Parker Creek.	Plum Point.	3 miles north of Plum Point.	Popes Creek.	Reeds.	Skipton.	Southeast Creek.	Tilghmans Station.	Truman Wharf.	Wescott Farm near Church Hill.	White Landing.	Wye Mills.	Calvert Formation (?): Calvert Cliffs.	Calvert Formation (?): Plum Point (?)
	PROTOZOA. Foraminifera.—*Continued.*																																				
21	*Cristellaria wetherellii* (Jones)																																				
22	*Polymorphina compressa* d'Orbigny								*																*												
23	*Polymorphina compressa var. striata* Bagg																																				
24	*Polymorphina elegantissima* Parker & Jones								*																												
25	*Polymorphina gibba* (d'Orbigny)								*																												
26	*Polymorphina lactea* (Walker & Jacob)																								*												
27	*Polymorphina regina* Brady, Parker & Jones								*																												
28	*Uvigerina canariensis* d'Orbigny																																				
29	*Uvigerina pygmææ* d'Orbigny																																				
30	*Uvigerina tenuistriata* Reuss																																				
31	*Sagrina spinosa* Bagg																																				
32	*Miliolina seminulum* (Linné)																																				
33	*Spiroloculina grata* Terquem								*																												
34	*Spiroloculina tenuis* (Czjzek)																																				
	PLANTÆ. Diatomaceæ.																																				
1	*Diplonels microtatos var. christianii* Cleve																								*												
2	*Rhaphoneis gemmifera* Ehrenberg								*					*						*			*		*											*	
3	*Sceptroneis caduceus* Ehrenberg								*					*						*			*		*											*	
4	*Stephanopyxis corona* (Ehrenberg)								*					*									*		*											*	
5	*Paralia sulcata* (Ehrenberg)								*					*									*		*											*	
6	*Biddulphia acuta* (Ehrenberg)								*					*																							
7	*Biddulphia condecora* (Ehrenberg)								*					*									*		*											*	
8	*Biddulphia decipiens* Grunow																																				
9	*Biddulphia interpunctata* (Grunow)																			*																	
10	*Biddulphia semicircularis* (Brightwell)								*					*						*																	
11	*Biddulphia suborbicularis* Grunow																																				
12	*Biddulphia tessellata* (Greville)								*					*						*			*		*											*	
13	*Graya argonauta* Grove & Brun																			*	*																
14	*Pseudauliscus spinosus* (Christian)													*																							
15	*Aulacodiscus rogersii* (Bailey)								*					*						*			*		*											*	
16	*Eupodiscus inconspicuus* Rattray								*					*									*		*											*	
17	*Actinoptychus heliopelta* Grunow																			*																	
18	*Actinoptychus undulatus* Kützing																																				
19	*Craspedodiscus coscinodiscus* Ehrenberg													*						*																	
20	*Craspedodiscus elegans* Ehrenherg																			*																	
21	*Actinocyclus ellipticus* Grunow																																				
22	*Actinocyclus moniliformis* Ralfs								*					*						*			*		*											*	
23	*Coscinodiscus apiculatus* Ehrenberg								*					*						*			*		*											*	
24	*Coscinodiscus asteroides* Truan & Witt																				?				*												
25	*Coscinodiscus heteroporus* Ehrenberg																																				
26	*Coscinodiscus lewisianus* Greville																																				
27	*Coscinodiscus lineatus* Ehrenherg																				*																
28	*Coscinodiscus perforatus* Ehrenberg								*					*						*			*		*											*	

[1] For additional localities consult text. [2] Norfolk well, 645 ft. [3] Crisfield well at 776 feet.

LOCAL DISTRIBUTION.

Choptank Formation.																									Choptank Formation (?)			St. Mary's Formation.										St. Mary's Formation (?)			Chesapeake Group.											General Distribution.					
Zone 17 (Lower Bed).								Zone (?)									Zone 19 (Upper Bed).																																				Choptank Formation.				
Cuckold Creek.	Flag Pond (Lower Bed).	Governor Run (Lower Bed).	2 miles south of Governor Run.	Jones Wharf.	Pawpaw Point.	St. Leonard Creek.	Turner.	Cordova.	David Kerr's.	Davis Mills.	Flag Pond.	Governor Run.	1 mile north of Governor Run.	2 miles south of Governor Run.	Greensboro.	Skipton.	Choptank River.	Dover Bridge.	Flag Pond (Upper Bed).	Governor Run (Upper Bed).	2 miles south of Governor Run.	Peach Blossom Creek.	Sand Hill.	Trappe Landing.	Calvert Cliffs.	Bristol.	Jones Wharf.	Little Cove Point.	Drum Point.	Langley's Bluff.	Great Mills.	Mouth of Patuxent River.	Mouth of Potomac River.	Point-no-Point.	Pocomoke City Well, 53 to 63 feet deep.	Pocomoke City Well, 53 to 75 feet deep.	St. Mary's River.	Crisfield Well.	Mouth of Patuxent River.	St. Mary's River.	Centerville Well at depth of 170 feet.	Cambridge Well.	Chesapeake Group (?)	Locality (?)	Maryland.	New Town.	Pocomoke City Well.	Chesapeake Group.	Maryland or Virginia.	Nomini Cliffs.	Virginia.	Calvert Formation.	Zone 17 (Lower Bed.)	Zone 19 (Upper Bed.)	Choptank Formation.	St. Mary's Formation.	
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Explanation of Charts of Distribution.

The following charts contain only those Mollusca of the Maryland Miocene which are found in regions outside of the State or which range below or above the horizons from which they have been described in this report. The charts have been arranged as follows:

Column 1 gives the range in depth in terms of fathoms for the genera, sub-genera, species or varieties placed opposite. A zero indicates that the species occurs at low water mark. When no depth is given it is believed that the form inhabits shallow water near shore or between high and low tide. Column 2 gives their extreme northern range, and column 3 their extreme southern range so far as it is known. In the columns from 4 to 15, inclusive, are shown the conditions under which the forms were found. An asterisk (*) indicates that the form was picked up on the beach or secured between high water and fifty fathoms. A dagger (†) indicates that the form comes from fifty to eight hundred fathoms. When a dagger and asterisk are both present, in some locality the form was found or supposed to exist in both shallow and deep water.

Columns 16 to 38, inclusive, show the geological horizons in which the various formations have been found in regions outside of Maryland.

When an X is placed in the column, it indicates that the form has been reported from the horizon, but no locality given. The numbers refer to the various localities of which the following is the key:

LIST OF LOCALITIES.

1. Alabama.
2. Alaska.
3. Alligator Creek, Florida.
4. Alum Bluff, Lower Bed, Chattahoochee River, Florida.
5. Alum Bluff, Upper Bed, Chattahoochee River, Florida.
6. Antilles.
7. Archer, Florida.
8. Artesian Well, Galveston, Texas.
9. Ashley Phosphate, S. C.
10. Atlantic City Well, N. J.
11. Bailey's Ferry, one mile below Chipola River, Florida.
12. Ballast Point, Tampa Bay, Florida.
13. Bartow, Florida.
14. Bellefield, Va.
15. Bowden, Jamaica.
16. Bridgeton, N. J.
17. Cainhoy, S. C.
18. Caloosabatchie River, Florida.
19. Cape Fear River, N. C.
20. Cape May Well, N. J.
21. City Point, Va.
22. Cocoa Post Office, Choctaw Co., Alabama.
23. Coggins Point, Va.
24. Costa Rica.
25. Creole Bluff, Grant Parish, La.
26. Crosswicks, N. J.
27. Cumberland Co., N. J.
28. Darlington, S. C.
29. De Leon Springs, Florida.
30. Dinwiddie, York River, Va.
31. Dismal Swamp, Va.
32. Duplin Co., N. C.

33. Eastern United States.
34. Ecphora Bed, Alum Bluff.
35. Edgecomb Co., N. C.
36. Fall Post Office, Choctaw Co., Alabama.
37. Florida.
38. Gaskins Wharf, York River, Va.
39. Goose Creek, S. C.
40. Grove Wharf, Va.
41. Guion's (Mrs.) Marl Bed, Cape Fear River, N. C.
42. Gulf Coast.
43. Haiti.
44. Heislerville, N. J.
45. Hinds Co., Miss.
46. Jackson, Miss.
47. Jamaica.
48. James River, Va.
49. James River near Smithfield, Va.
50. Jericho, N. J.
51. Johns Island, S. C.
52. Jones Wharf, Va.
53. Lee Co., Texas.
54. Magnesia Spring, Alachua Co., Florida.
55. Magnolia, N. C.
56. Martin Station, Hernando Co., Florida.
57. Meherrin River, N. C.
58. Murfreesburg, N. C.
59. Myakka River, Florida.
60. Natural Well, Duplin Co., N. C.
61. Neuse River below Newberne, N. C.
62. Newton, Miss.
63. Nomini Cliffs, Va.
64. North Carolina.
65. North Creek, Osprey, Florida.
66. North Creek, Little Sarasota Bay, Florida.
67. Oak Grove, Santa Rosa Co., Florida.
68. Ocala, Florida.
69. Peach Creek near Arcadia, Florida.
70. Peedee River, S. C.
71. Petersburg, Va.
72. Point Shirley, Mass.
73. Portland, Maine.
74. Prairie Bluff, Alabama.
75. Purdy's (Mrs.) Marl Bed, Cape Fear River, S. C.
76. Sankaty Head, Nantucket, Mass.
77. San Domingo.
78. San Pedro, Cal.
79. Sapote, Costa Rica.
80. Santa Barbara, Cal.
81. Santo Domingo.
82. Shell Creek, Florida.
83. Shiloh, N. J.
84. Shoal River, Walton Co., Florida.
85. Simmons Bluff, S. C.
86. Snow Hill, N. C.
87. South Carolina.
88. Suffolk, Va.
89. Suffolk on Nansemond and York Rivers, Va.
90. Stone Creek, N. J.
91. Sumpter District, S. C.
92. Tarboro, Edgecomb Co., N. C.
93. Tilly's Lake.
94. Temple Place on York River, Va.
95. Turk Cave, Alabama.
96. Turkey Creek, S. C.
97. Urbanna, Va.
98. Vicksburg, Miss.
99. Virginia.
100. Volusia Co., Florida.
101. Waccamaw District, S. C.
102. Walton Co., Florida.
103. Wahtubbee, Carson Creek, Miss.
104. Warwick, Va.
105. West Florida.
106. White Beach, Little Sarasota Bay, Florida.
107. Williamsburg, Va.
108. Wilmington, N. C.
109. Woods Bluff, Alabama.
110. Yorktown, Va.

Columns 39 to 46, inclusive, give a summary of the geological distribution of the various forms.

In compiling this chart only data secured from the works of the more recent investigators have been admitted. Dr. William H. Dall, of the U. S. National Museum, has been most helpful in generously allowing the writer to freely consult unpublished notes.

	SPECIES.	Recent.														
		Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Gastropoda.															
1	*Actæon*	7-2574	N. Atlantic	Brazil	†	†	†*	†	†*	†*	†*	†*	†*	..	†	..
2	*Actæon pusillus* (Forbes)	111-450	N. Atlantic	Havana	..	..	..	..	..	†	†	..	†	..	†	..
3	*Actæon shilohensis* Whitfield	2-63	Cape Cod	Haiti	..	..	†*	..	*	*	*	..	*	..	..	..
4	*Volvula*	5-200	Hatteras	Barbados	..	..	†*	†	†	..	..	..	†	..	*	..
5	*Retusa*	5-1000	Norway	Brazil	†*	..	†*	†	†	*	..	..	†*	..	†*	..
6	*Cylichnina*	31-294	Arctic Seas	St. Thomas	*	..	†*	†	..	..	..	..	?	..	*	*
7	*Terebra*	3-640	Maryland	Venezuela	..	..	*	*	†*	†*	†*	*	†*	*	..	..
8	*Terebra (Acus) curvilineata* Dall	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
9	*Terebra (Acus) curvilin. var. whitfieldi* Martin	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
10	*Terebra (Acus) curvilineata var. dalli* Martin	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
11	*Terebra (Acus) curvilirata* Conrad	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
12	*Terebra (Hastula) inornata* Whitfield	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
13	*Conus*	0-200	Hatteras	Brazil	..	..	†*	..	*	*	†*	*	†*	*	*	..
14	*Pleurotoma*	26-1591	Hatteras	Bahia	..	..	†	†	†	†	†*	†	†*	..	..	..
15	*Pleurotoma (Hemipleurotoma)*	26-125	Cedar Keys	Barbados	..	..	..	..	..	†	†*	..	†*	..	..	..
16	*Pleurotoma (Hemipleurotoma) albida* Perry	26-125	Cedar Keys	Barbados	..	..	..	..	..	†	†*	..	†*	..	..	..
17	*Mangilia*	0-2620	Arctic Seas	Brazil	†*	†	†*	†*	†*	†*	†*	†*	†*	*	†*	*
18	*Mangilia parva* (Conrad)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
19	*Mangilia (Glyphostoma)*	15-447	East Florida	Barbados	..	..	..	..	†	†*	†*	..	†	..	..	..
20	*Drillia*	3-1920	Rhode Island	Bahia	†	..	†*	†*	†*	†*	†*	*	†*	..	..	..
21	*Drillia whitfieldi* Martin	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
22	*Drillia pseudeburnea* Whitfield	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
23	*Cancellaria*	3-49	Hatteras	Guadalupe	..	..	*	*	*	*	*	*	*	..	..	..
24	*Cancellaria alternata* Conrad	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
25	*Cancellaria (Trigonostoma)*	18-49	Hatteras	Yucatan	..	..	*	..	..	*	*	*	*	..	..	..
26	*Oliva*	0-73	Hatteras	Brazil	..	..	*	*	*	*	*	*	†*	*	..	..
27	*Oliva litterata* Lamarck	0-2	Hatteras	Vera Cruz	..	..	*	*	*	*	*	*	..	..	..	..
28	*Marginella*	0-1002	Rhode Island	Brazil	†	*	†*	†*	†*	†*	†*	†*	†*	*	*	*
29	*Marginella minuta* Pfeiffer	5-294	Fernandina	Barbados	..	..	..	†	..	*	*	..	†*	..	*	*
30	*Marginella denticulata* Conrad	5-294	Hatteras	Barbados	..	..	†	†	..	*	*	..	†*	..	..	..
31	*Scaphella*	10-509	Hatteras	Cuba	..	..	†*	†	†	†*	†*	..	†	..	..	..
32	*Scaphella (Aurinia)*	34-509	Hatteras	Cuba	..	..	†	†	†	†*	†*	..	†	..	..	..
33	*Scaphella (Aurinia) mutabilis* (Conrad)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
34	*Scaphella (Aurinia) obtusa* (Emmons)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
35	*Scaphella trenholmii* (T. & H.)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
36	*Mitra*	7-640 ?	Cape Lookout	Bahia	..	..	†*	..	*	†*	†*	†*	†*	*	..	*
37	*Fulgur*	0-50	Beverly, Mass.	St. Thomas	*	*	†*	*	*	*	*	*	*	..	..	..
38	*Fulgur alveatum* (Conrad)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
39	*Chrysodomus*	10-2083	Arctic Seas	Jamaica	†	†	†	†	†	†	..	..	..	†	†*	..
40	*Pisania*	22-25	Hatteras	Brazil	..	..	*	..	*	*	*	*	*	*	..	..
41	*Ptychosalpinx*	338-966	Florida Sts.	Jamaica	..	..	..	..	†	†	..	..	†	..	..	..
42	*Ptychosalpinx altilis* (Conrad)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
43	*Ptychosalpinx lienosa* (Conrad)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
44	*Ilyanassa (?) (Paranassa) porcina* Con.	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
45	*Nassa*	0-191	Nova Scotia	Bahia	*	*	†*	†*	*	†*	*	*	†*	*	..	..
46	*Nassa trivittatoides* (Whitfield)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
47	*Nassa trivittata* Say	0-40	Nova Scotia	St. Augustine	*	*	†*	†*	..	..	..	..	..	..	..	..
48	*Bulliopsis integra* Conrad	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
49	*Columbella*	0-1537	Arctic Seas	Maldonado	†*	*	†*	†*	†*	†*	†*	*	†*	*	†*	*
50	*Columbella (Astyris)*	0-1255	Arctic Seas	Pernambuco	†*	*	†*	†*	†*	†*	†*	*	†*	..	*	*
51	*Columbella (Astyris) communis* (Con.)	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands.	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Gualiava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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	SPECIES.	Recent. Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Gastropoda.—*Continued.*															
52	*Murex*	2-450	Hatteras	Venezuela			†*	†*	†*	†*	†*	*	†*			
53	*Murex (Pterorhytis) conradi* Dall	......														
54	*Typhis*	127-400	Gulf of Mexico	Cuba						†			†			
55	*Muricidea*	0-95	Cape Fear	St. Thomas			*	*	*	*	*	†*	*		*	
56	*Muricidea shilohensis* (Heilprin)	......														
57	*Trophon*	14-2033	Rhode Island	Barbados	†		†*			*	†	*	†*	*	†*	
58	*Urosalpinx*	0-938	Nova Scotia	Key West	*	*	†*	*		†*	*					*
59	*Urosalpinx rusticus* (Conrad)	......														
60	*Ecphora quadricostata* (Say)	......														
61	*Ecphora tampaënsis* (Dall)	......														
62	*Coralliophila*	0-878	Hatteras	Barbados			†*	†		†*	†*	*	†*		*	
63	*Coralliophila cumberlandiana* (Gabb)	......														
64	*Scala*	0-940	Arctic Seas	Brazil	†*	†*	†*	†*	†*	†*	†*	*	†*	*	*	*
65	*Scala sayana* Dall	......	Virginia	Brazil		*	*			*	*	*				
66	*Scala marylandica* Martin	......														
67	*Scala (Opalia)*	8-294	Rhode Island	Martinique	†		†	†		†*			†*		*	
68	*Eulima*	11-1062	Norway	West Indies	†	†	†*	†*		†*	*	†*	†*		†*	
69	*Eulima eborea* Conrad	......	North Carolina	Florida Keys			*	*		*	*		*			
70	*Niso*	7-116	Hatteras	Barbados			†*			†	†*		*			*
71	*Niso lineata* Conrad	......														
72	*Pyramidella*	......	Hatteras	Barbados			*	*		*	*	*	*			
73	*Odostomia*	2-200	Norway	Brazil	*	*	†*	*	†*	*	*	*				
74	*Odostomia conoidea* (Brocchi)	......	Hammerfest	Gulf of Mexico												
75	*Eulimella*	6-168	Norway	Barbados			†*	†		*	†		*			
76	*Turbonilla*	1-1582	Nova Scotia	Brazil	†	*	†*	*	*	†*	†*	†*	†*		*	
77	*Turbonilla (Chemnitzia)*	......	Nova Scotia	Brazil			†		*			*	*			
78	*Turbonilla (Chemnitzia) nivea* Stimpson	......	Nova Scotia	Brazil			†		*			*	*			
79	*Turbonilla (Pyrgiscus)*	2-107	Nova Scotia	Barbados			†			*	*	*	†		*	
80	*Turbonilla (Pyrgiscus) interrupta* (Totten)	2-107	Nova Scotia	Barbados			†			*	*	*	†		*	
81	*Tritonium*	3-121	Hatteras	Bahia			†*		*	†*	*	†*	†*	*	*	*
82	*Pyrula*	......	North Carolina	West Indies			*	*	*	*	*	*	*			
83	*Cassis*	......	Hatteras	Brazil			†*	*	†	†*	†*	*	†*	*		
84	*Erato*	0-63	Hatteras	Colon			†*			*	*	*				
85	*Seila*	0-20	Mass. Bay	Haiti	*		*			*	*	*	*	*	?*	
86	*Seila adamsii* (H. C. Lea)	......	Mass. Bay	Jamaica										*		
87	*Cerithiopsis*	2-1181	Pr. Edward Isl'd	Brazil			†*	†*	†*	†*	†*	*	†*	*	†*	
88	*Cerithiopsis subulata* Montague	2-5	Cape Cod	Grenada	*		*				*	*	*			
89	*Cæcum*	2-63	Cape Cod	Brazil	*		†*			*	*	*	*		*	
90	*Vermetus*	37-805	Gulf of Mexico	Bahia						†*	†*		†*			
91	*Vermetus graniferus* (Say)	......														
92	*Vermetus virginicus* (Conrad)	......														
93	*Turritella*	3-640	Hatteras	Carthagena			†*			†*	†*	†*	†*			
94	*Turritella indenta* Conrad	......														
95	*Turritella aequistriata* Conrad	......														
96	*Turritella plebeia* Say	......														
97	*Turritella variabilis var. cumberlandia* Con.	......														
98	*Littorina*	......	Arctic Ocean	Forn'do Noronha	*		*	*	*	*	*	*	*	*	*	*
99	*Littorina irrorata* (Say)	......	Rhode Island	Jamaica	*		*	*	*		*	*	*			
100	*Fossarus*	15-294	Rhode Island	Jamaica	†	†	†	*		†*			†*			
101	*Fossarus (Isipis)*	294	Fernandina	Jamaica				*					*			
102	*Fossarus (Isipis) dalli* (Whitfield)	......														

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands.	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Gualava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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																															101
							50, 83																			*					102

	SPECIES.	Recent. Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	Mollusca. Gastropoda.—*Continued.*															
103	*Solarium*	22–310	Rhode Island	Barbados	†?	..	†*	†	†	†	..	*	†*	..	..	*
104	*Rissoa*	0–1290	Arctic Seas	Brazil	†*	..	†*	†	†	†	†*	†	†	..	†*	..
105	*Adeorbis*	10–1290	Norway	Brazil	†?	..	*	..	..	*	*	*	†*	..	†*	..
106	*Adeorbis supranitidus* S. Wood	15–25	North Atlantic	Cedar Keys	..	..	*	..	..	..	*	*	..	..	†*	..
107	*Crucibulum*	3–231	Nova Scotia	Barbados	*	..	*	..	..	†*	*	*	*	..	..	..
108	*Crucibulum costatum var. pileolum* (H. C. Lea)	......	....	Antilles	..	..	..	..	..	..	..	..	..	..	..	..
109	*Crucibulum constrictum* Conrad	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
110	*Crucibulum multilineatum* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
111	*Calyptræa*	6–52	Hatteras	Brazil	..	..	*	..	*	*	*	..	*	..	..	..
112	*Calyptræa aperta* (Solander)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
113	*Calyptræa centralis* (Conrad)	......	Hatteras	Sts. of Magellan	..	..	..	..	..	..	..	..	..	..	..	..
114	*Crepidula*	0–487	Nova Scotia	Montevideo	*	*	*	*	*	*	*	*	*	*	..	..
115	*Crepidula fornicata* (Linné)	0–15	Pr. Edward Island	Cartagena	*	*	*	*	*	*	*	*	*	..	..	..
116	*Crepidula plana* Say	0–487	Pr. Edward Island	Bahia	*	*	*	*	*	*	*	*	*	*	?	..
117	*Amalthea*	50–373	Key West	Bahia	..	..	..	..	..	†*	..	..	†*	..	..	*
118	*Xenophora*	14–274	Hatteras	Barbados	..	..	*	..	..	†*	†	*	†	*	..	..
119	*Xenophora conchyliophora* Born	14–250	Hatteras	Guadalupo	..	..	*	..	..	†*	†	*	†	*	..	..
120	*Polynices*	0–640	Arctic Seas	Brazil	†*	*	†*	†*	†*	†*	*	†*	†*	*	..	..
121	*Polynices (Neverita)*	140–200	Mass. Bay	Barbados	*	*	*	*	*	†*	*	*	†	..	..	..
122	*Polynices (Neverita) duplicatus* (Say)	......	Mass. Bay	Vera Cruz	*	*	*	*	*	*	*	*	..	..	..	..
123	*Polynices (Lunatia)*	0–1356	Arctic Seas	St. Vincent	*	*	†*	†	†*	†	*	†	†*	?	..	..
124	*Polynices (Lunatia) hemicryptus* (Gabb)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
125	*Polynices (Lunatia) heros* (Say)	0–238	Labrador	Virginia	*	*	†*	?	..	..	..	..	..	..	..	..
126	*Sigaretus*	54–84	New York	Brazil	*	*	†*	..	*	†*	†*	*	†*	..	..	..
127	*Calliostoma*	3–805	Rhode Island	Brazil	†	†	†*	*	†*	†*	†*	†*	†*	†	..	..
128	*Calliostoma bellum* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
129	*Calliostoma philanthropus* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
130	*Calliostoma virginicum* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
131	*Calliostoma distans* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
132	*Calliostoma eboreum* (Wagner)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
133	*Calliostoma humile* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
134	*Calliostoma reclusum* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
135	*Teinostoma*	3–310	Hatteras	Barbados	..	†*	†*	†*	†	*	†*	..	†*	..	..	..
136	*Cochliolepsis*	......	South Carolina	Gulf of Mexico	..	..	*	..	..	*	*	..	..	..	..	..
137	*Cochliolepsis striata* Dall	......	Tampa	Gulf of Mexico	..	..	..	..	..	..	*	..	..	..	..	..
138	*Molleria*	10–294	North Atlantic	Fernandina	..	..	..	†	..	..	..	..	..	..	†*	..
139	*Fissuridea alticosta* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
140	*Fissuridea griscomi* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
141	*Fissuridea nassula* (Conrad)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
142	*Fissuridea redimicula* (Say)	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..
143	*Emarginula*	6–640	Britain	Bahia	..	..	†	†	..	†*	..	†	†*	*	†*	..
	Mollusca. Amphineura.															
1	*Chætopleura*	0–30	Cape Cod	Rio Janeiro	*	*	*	*	*	*	*	..	*	..	..	..
2	*Chætopleura apiculata* (Say)	0–30	Cape Cod	Haiti	*	*	*	*	*	*	*	..	*	..	..	..
	Mollusca. Scaphopoda.															
1	*Dentalium*	2–1785	Arctic Seas	Brazil	†	†	†*	†	†	†*	†*	†*	†*	†	†	†
2	*Dentalium attenuatum* Say	......	....	....	..	..	..	..	..	..	..	..	..	..	..	..

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands.	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Guallava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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	SPECIES.	Recent.														
		Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Scaphopoda.—*Continued.*															
3	*Dentalium danai* Meyer															
4	*Cadulus*	7-1608	Nantucket	Barbados	†	†	†*	†*	†	†*	*	†*	†		†	
5	*Cadulus thallus* (Conrad)															
6	*Cadulus newtonensis* M. & A.															
	MOLLUSCA. Pelecypoda.															
1	*Pholas*		Hatteras	Brazil			*	*	*	*	*	*	*			
2	*Pholas (Thovana) producta* Conrad															
3	*Barnea*		Maine	Brazil	*	*	*	*	*	*	*	*	*		*	*
4	*Barnea (Scobina) arcuata* (Conrad)															
5	*Martesia*	1-12	Britain	Trinidad	*	*	*	*	*	*	*	*	*	*	*	?
6	*Panopea whitfieldi* Dall															
7	*Panopea goldfussi* Wagner															
8	*Panopea americana* Conrad															
9	*Saxicava*	0-100	Arctic Seas	Barbados	*	*	*	*	*	*	*		†		*	*
10	*Saxicava arctica* (Linné)	0-100	Arctic Seas	Barbados	*	*	*	*	*	*	*		†		*	*
11	*Corbula*	2-450	Cape Cod	Brazil	*	*	†*	†	*	†*	†*		†*	†		
12	*Corbula (Corbula) idonea* Conrad															
13	*Corbula (Aloidis) elevata* Conrad															
14	*Corbula (Cuneocorbula) inaequalis* Say															
15	*Corbula (Cuneocorbula) cuneata* Say															
16	*Mya*	0-40	Arctic Seas	Maine	*	*	*	*							*	*
17	*Mya producta* Conrad															
18	*Sphenia dubia* (H. C. Lea)															
19	*Paramya*	12-31	Hatteras	Tampa			*				*					
20	*Paramya subovata* Conrad	12-31	Hatteras	Tampa			*				*					
21	*Ervilia*	0-124	Hatteras	Brazil			†*	*		*	*			*	*	
22	*Ervilia planata* Dall															
23	*Mactra*		Labrador	Brazil	*	*	*	*	*	*	*	*	*			
24	*Spisula (Hemimactra) delumbis* (Conrad)															
25	*Spisula (Hemimactra) marylandica* Dall															
26	*Spisula (Hemimactra) curtidens* Dall															
27	*Spisula (Hemimactra) confraga* (Conrad)															
28	*Spisula (Hemimactra) subparilis* (Conrad)															
29	*Labiosa*		New Jersey	Brazil	*	*	*	*	*	*	*	*	*			
30	*Ensis*	0-25	Labrador	Florida Keys	*	*	*	*	*	*	*	*				
31	*Ensis directus* (Conrad)	0-25	Labrador	Florida Keys	*	*	*	*	*	*	*					
32	*Ensis ensiformis* Conrad															
33	*Psammobia*		Charlotte Harbor	Trinidad							?*		?*			
34	*Asaphis*		Charlotte Harbor	Brazil						*	*	*	*			
35	*Asaphis centenaria* (Conrad)															
36	*Semele*	2-124	Virginia	Bahia		*	†*			*	*	*	*	*		
37	*Semele carinata* (Conrad)															
38	*Semele carinata var. compacta* Dall															
39	*Semele subovata* (Say)															
40	*Abra*	14-1467	Arctic Seas	Brazil	†	†	†*	*	*	†*	†*	*	†*		†	
41	*Abra longicallus* (Scacchi)	50-1467	Arctic Seas	Granada	†	†				†	†		†		†	
42	*Cumingia*	0-50	Pr. Edward Isl'd	Caracas	*	*	*			*	*	*	*			
43	*Cumingia medialis* Conrad															
44	*Tellina*	0-640	Gaspé	Brazil	*	*	†*	*	*	*	*	*	†*	*	*	*

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands.	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Guallava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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	SPECIES.	Recent.														
		Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Pelecypoda.—*Continued*															
45	*Tellina (Merisca) æquistriata* Say		North Carolina	Brazil												
46	*Tellina (Angulus) declivis* Conrad															
47	*Tellina (Angulus) producta* Conrad															
48	*Tellina (Angulus) dupliniana* Dall															
49	*Tellina (Angulus) umbra* Dall															
50	*Metis biplicata* Conrad															
51	*Macoma*	2-100	Arctic Seas	Brazil	*	*	*	*	*	*	*	*	*	*		
52	*Macoma lenis* (Conrad)															
53	*Petricola*	0-70	Pr. Edward Island	Brazil	*	*	*	*	*	†*	*	*	*			
54	*Petricola (Rupellaria) harrisii* Dall															
55	*Meretrix*	2-200	Pr. Edward Island	Bahia	*	*	†*	*	*	†*	†*	†*	†*			
56	*Collocardia (Agriopoma) sayana* (Conrad)	2-63	Pr. Edward Island	Tampa	*	*	†*									
57	*Macrocallista marylandica* (Conrad)															
58	*Venus*	0-300	Nova Scotia	Brazil	*	*	†*	*	*	†*	*	†*	†*	*	*	
59	*Venus ducateli* Conrad															
60	*Venus mercenaria* Linné		Nova Scotia	Yucatan	*	*	*	*	*	*	*	*			*	
61	*Cytherea (Antigona) staminea* (Conrad)															
62	*Dosinia*		Cape May	Brazil		*	*	*	*	*	*	*	*			
63	*Dosinia acetabula*															
64	*Isocardia*	117		Trinidad									†			
65	*Isocardia fraterna* Say															
66	*Cardium*	0-300	Arctic Seas	Cape Good Hope	?	*	†*	*	†*	†*	†*	*	†*	*		
67	*Cardium (Cerastoderma) laqueatum* Con.															
68	*Cardium (Cerastoderma) craticuloide* Con.															
69	*Cardium (Fragum)*	2-15	Cape Lookout	Brazil			*	*		*	*		†*			
70	*Cardium (Fragum) medium* Linné	2-15	Cape Lookout	Brazil			*	*		*	*		†*			
71	*Cardium (Lævicardium)*	0-5	Nova Scotia	Brazil			*	*	*		*					
72	*Cardium (Lævicardium) mortoni* Conrad	0-5	Nova Scotia	Brazil			*	*	*		*	*	*			
73	*Solecardia (Spaniorinus) cossmanni* Dall															
74	*Sportella whitfieldi* Dall															
75	*Sportella pelex* Dall															
76	*Sportella petropolitana* Dall															
77	*Hindsiella acuta* Dall															
78	*Bornia triangula* (H. C. Lea)															
79	*Kellia*	8-15	Arctic Seas	Hatteras	?		†						?			
80	*Aligena æquata* Conrad															
81	*Aligena pustulosa* Dall															
82	*Diplodonta*	2-294	Rhode Island	Brazil	†		†*	†	†	*	*	*	†*	*		
83	*Diplodonta acclinis* Conrad															
84	*Diplodonta shilohensis* Dall															
85	*Diplodonta (Sphærella) subvexa* Conrad															
86	*Lucina*	0-683	Arctic Seas	Brazil	†	†*	†*	*	†*	†*	†*	*	†*	*	*	
87	*Lucina trisulcata* Conrad	0-18	Hatteras	Cape St. Roque			*			*	*		*			
88	*Lucina crenulata* Conrad	15-124	Cape Henry	Brazil		*	†*		*	*	*	*	*			
89	*Chama*	0-287	Hatteras	Brazil			†*	*		†*	*	*	†*	*		
90	*Chama congregata* Conrad	0-52	Hatteras	Brazil			*				*		*	*		
91	*Carditamera protracta* Conrad															
92	*Venericardia*	3-435	Arctic Seas	Charlotte Harbor	†	†	†*	†			*				†	†*
93	*Venericardia borealis var. granulata* Say	50-435	Rhode Island	Hatteras			†*									
94	*Crassatellites melinus* (Conrad)															
95	*Astarte*	5-1568	Nova Scotia	Barbados	*		†*	†		†*	†*		†*			

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands.	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Gualiava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
			64	87					99											5, 15			*		*	*		*			45
		65			82		83		71, 89															*	*	*					46
									71																	*					47
				41, 101					55, 60, 108																*	*					48
		65		41, 101	18				55, 60, 108															*	*	*					49
					18 ?																				?						50
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				93	18, 102		83		32, 108																*	*					83
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							50, 83		64, 87, 99														*			*					90
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							83																			*					94
																															95

	SPECIES.	Recent														
		Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Pelecypoda.—*Continued.*															
96	*Astarte cuneiformis* Conrad															
97	*Crassatellites (Crassinella) galvestonensis* Hs.															
98	*Pandora*	0-124	Arctic Seas	Florida Straits	*		†*			†	*	†*	†		*	*
99	*Periploma*	10-1255	Labrador	Trinidad	*		†*	*	†	†*	*	*	†*		†	
100	*Thracia*	3-50	Labrador	Honduras	*		†*			*	*	†*	†*		*	
101	*Thracia conradi* Couthouy	3-15	Labrador	Hatteras	*		*									
102	*Mytilus*		Arctic Seas	Brazil	*	*	*	*	*	*	*	*	*	*	*	*
103	*Mytilus conradinus* d'Orbigny															
104	*Mytilus (Mytiloconcha) incurvus* Conrad															
105	*Lithophaga*		Florida Straits	Brazil			*	*		*	*		*	*		
106	*Lithophaga subalveata* Conrad															
107	*Crenella*	5-124	Arctic Seas	Barbados	*	†	†*			*	*		†*		*	*
108	*Modiolus*	0-1000	Arctic Seas	Brazil	†*	*	†*	*	*	†*	†*	*	†*	*	†*	*
109	*Modiolus ducatelii* Conrad															
110	*Modiolus virginicus* (Conrad)															
111	*Modiolaria*	0-100	Arctic Ocean	New Grenada	*		*			*	*		*	*	*	*
112	*Anomia*	0-640	Arctic Ocean	Martinique	*	*	*	*	*	*	*	*	*	*	*	
113	*Anomia simplex* d'Orbigny	0-12	Cape Sable	Martinique	*	*	*	*	*	*	*	*	*	*		
114	*Anomia aculeata* Gmelin	0-640	Arctic Ocean	Cape Fear	*	*	*								*	
115	*Lima*	15-1450	Arctic Seas	Brazil		†*	†*	*	†	†*	†*		†*	*	†*	*
116	*Plicatula*		Hatteras	Brazil	*	*	*	*	*	*	*	*	*			
117	*Plicatula densata* Conrad															
118	*Ostrea*		Pr. Edward Isl'd	Brazil	*	*	*	*	*	*	*	*	*	*		*
119	*Ostrea trigonalis* Conrad															
120	*Ostrea carolinensis* Conrad															
121	*Ostrea percrassa* Conrad															
122	*Pecten*	1-1813	Arctic Seas	Patagonia	†*	†*	†*	†*	†*	†*	†*	*	†*	†*	†	*
123	*Pecten (Amusium)*	30-1591	Bermuda	Barbados							†*		†	†		
124	*Pecten (Amusium) mortoni* Ravenel	30-60	Gulf of Mexico	Haiti							†*		†	†		
125	*Pecten (Pseudamusium)*	22-1750	Arctic Seas	Patagonia	†		†*	†		†	†		†		†	?
126	*Pecten (Pseudamusium) cerinus* Conrad															
127	*Pecten (Chlamys) rogersi* Conrad															
128	*Pecten (Chlamys) clintonius* Say															
129	*Pecten (Chlamys) marylandicus* Wagner															
130	*Pecten (Chlamys) madisonius* Say															
131	*Pecten (Chlamys) jeffersonius* Say															
132	*Pecten (Chlamys) jeffersonius var. edgecomensis* Conrad															
133	*Pecten (Chlamys) jeffersonius var. septenarius* Say															
134	*Pecten (Pecten)*	1-1356	Labrador	Brazil	†*	†*	†*	†*	*	†*	†*	*	†*	*	†*	*
135	*Pecten (Pecten) humphreysii* Conrad															
136	*Melina maxillata* (Deshayes)															
137	*Atrina harrisii* Dall															
138	*Arca*	0-2021	Norway	Brazil	†*	*	†*	†*	*	†*	†*	†*	†*	*	†*	*
139	*Arca (Scapharca)*	2-40	Cape Cod	Brazil	*	*	*	*	*	*	*	*	*			
140	*Arca (Scapharca) subrostata* Conrad															
141	*Arca (Scapharca) staminea* Say															
142	*Arca (Scapharca) idonea* Conrad															
143	*Arca elisea* Dall															

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentated Miocene	Oak Grove Sands.	Orthaulex Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Guallava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene.	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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		76							99														*	*		*					114
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							50, 83			67		4	12					24	7	15	68					*	*	*	*		117
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									23 40 48 57 58																	*					128
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							50, 83		23, 40, 52, 71, 86, 94																	*					130
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								10	102																	*					141
								5																		*					142
								63	102																	*					143

	SPECIES.	Recent.														
		Range in Depth.	Northern Range.	Southern Range.	New Jersey.	Virginia.	Hatteras.	Georgia.	East Florida.	Florida Keys.	West Florida.	Texas.	West Indies.	Bermuda.	Europe.	Western America.
	MOLLUSCA. Pelecypoda.—*Continued.*															
144	*Arca (Noëtia)*	......	Cape Cod	Brazil	*	*	*	*	*	*	*	*	*	*	..	..
145	*Arca (Noëtia) incile* Say	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
146	*Arca (Barbatia)*	0-169	Hatteras	Brazil	..	..	*	*	..	*	*	*	†*	..	..	..
147	*Arca (Barbatia) centenaria* Say	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
148	*Arca (Barbatia) marylandica* Conrad	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
149	*Arca (Barbatia) virginiæ* Wagner	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
150	*Glycymeris*	......	Hatteras	Sarasota Bay	..	..	*	..	..	..	*	..	..	..	..	..
151	*Leda*	2-2620	Arctic Seas	Trinidad	†*	†*	†*	†*	†	†*	†*	†*	†*	†	†*	*
152	*Leda concentrica* Say	3-	Texas	Trinidad	..	..	..	..	..	..	*	*	*	..	..	..
153	*Yoldia*	2-2020	Arctic Seas	Gulf of Mexico	†*	†*	†*	†	†	†	†	†	†	†	†*	*
154	*Yoldia lævis* (Say)	....	......	......	..	..	..	..	..	..	..	..	..	..	..	..
155	*Nucula*	2-2033	Arctic Ocean	Brazil	†*	†*	†*	†	†	†	†*	†	†	..	†*	*
156	*Nucula proxima* Say	2-100	Nova Scotia	Charlotte Harbor	†*	*	†*	..	..	..	*	..	..	..	..	..
157	*Nucula sinaria* Dall	......	......	......	..	..	..	..	..	..	..	..	..	..	..	..
158	*Nucula taphria* Dall	......	......	......	..	*	..	..	..	..	..	..	..	..	..	..

Pleistocene.			Pliocene.				Miocene.			Transitional Beds of Dall.	Oligocene.										Eocene.	Cretaceous.	GEOLOGICAL RANGE.								
Simmons Bluff Beds.	Sankaty Beds.	Undifferentiated Pleistocene.	Croatan Beds.	Waccamaw Beds.	Caloosahatchie Beds.	Undifferentiated Pliocene.	Calvert Formation.	Undifferentiated Chesapeake.	Undifferentiated Miocene.	Oak Grove Sands,	Orthaulax Beds.	Chipola Beds.	Silex Beds.	Tampa Beds.	Chattahoochee Beds.	Undifferentiated Chipolan.	Shell Bluff Group.	Guallava Beds.	Undifferentiated Vicksburgian.	Undifferentiated Oligocene.	Eocene.	Cretaceous.	Recent.	Pleistocene.	Pliocene.	Miocene	Transitional Beds of Dall.	Oligocene.	Eocene.	Cretaceous.	
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									28 30 31 60 71																	*					145
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							83		23, 40, 71, 110																	*					147
							83					5	12													*		*			148
									99																	*					149
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		42							18														*	*		*					152
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									31, 104																	*					154
																															155
		85					16, 50, 83		31, 110						18, 82								*	*		*		*			156
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THE RELATIONS OF THE MIOCENE OF MARYLAND TO THAT OF OTHER REGIONS AND TO THE RECENT FAUNA

BY

WILLIAM HEALEY DALL.

The Director of the Maryland Geological Survey having requested me to prepare a chapter reviewing some of the relations of the Miocene in Maryland to that of other regions and to the recent fauna, and the permission of the Director of the U. S. Geological Survey having been kindly given, the following considerations are submitted. In pronouncing judgment upon them it should always be borne in mind that the stratigraphical relations of the more southern Miocene adjacent to that of Maryland, especially that of Virginia and the Carolinas, are still very imperfectly known, although the faunas of certain particular outcrops have been quite fully enumerated.

Before proceeding to the consideration of the local Miocene it will be well to recall the origin and scope of this term and what it stands for in European discussions of Tertiary Geology.

In the subdivisions of the Tertiary instituted by Lyell and Deshayes those faunas were denominated as Miocene which contain from 17 to 20 per cent of species which survive to the recent fauna. This definition, corresponding to the idea of evolution in the characteristic faunas, still lies at the foundation of our ideas of what constitutes a Miocene fauna, though to a greater or less extent modified by differences of opinion as to what constitutes a distinct species, and by a wider knowledge of modifications of faunas due to temperature, migration and the various factors which, taken together, form that group of influences which is denominated the environment. Since the modification of faunas not interfered with by catastrophic changes of temperature and environment must always be gradual, the exact limitation of the different series of which the Tertiary is made up has of late been expressed in terms of dynamic changes to which the terrains concerned have been subjected. The division of the Tertiary time into two great systems has been generally accepted by geologists. The first, which embraces all the recognized Eocene and nummulitic beds, has been called Eogene, and contains the Eocene and Oligocene series. The second, or Neogene, comprises the remainder of the Tertiary, the Miocene and Pliocene series, and was inaugurated and is limited by important dynamic changes in the earth's crust.[1]

According to De Lapparent with the Miocene were ushered in important changes in the geography and topography of Europe. First in order of importance, as the work of the Miocene period was the elevation of the Alps, or rather of that great zone of elevated plications which, extending from Morocco to Indo-China, the result of successive movements in elevation, forms the southern border of what has been called Eurasia. This immense upheaval was accompanied by the gradual draining of the great lakes which covered much of France and central Europe during the Oligocene, and, isostatically, by the sinking of other parts of the preexisting land. Following the latter the sea penetrated into the heart of Europe, carrying its fauna with it. Coincidently the denudation of the elevated area gave rise to extended sedimentary deposits radiating from it. Subsequently the communications with the sea were cut off, the eastern basin of the Mediterranean separated from the Atlantic became less saline and the extension of brackishness in the sea to the northward made gradual progress westward, reaching Corsica and the valley of the Rhone, finally becoming in part a series of lakes, around which the great herbivorous mammals of the period found a pasturage. The termination of the Miocene and the beginning of the Pliocene in Europe was marked by a movement in depression of the Mediterranean axis, opening the strait of Gibraltar, giving the Atlantic access to the Mediterranean, where the subtropical members of the marine fauna were replaced by

[1] Cf. De Lapparent, Traité de Géologie, éd. IV, pt. III, pp. 1409, 1513, *et seq.*, 1900.

those of a more temperate type while the climate of the temperate zone, indicated by the land animals and vegetation became noticeably cooler than it had been during the Miocene epoch.

Having thus indicated the salient characteristics of the Miocene epoch as understood by European geologists, it becomes possible to compare them with those of the epoch referred to the Miocene in North America. The differentiation of faunas was well established before the beginning of the Tertiary, and Eogene faunas in America show American characteristics clearly, as compared with those of Europe. Other differences, suggesting migrations, occur in the relative time of appearance of certain groups; as, for instance, in America, the first influx of Nummulites is in the upper beds of the lower Oligocene just as they were about to disappear from the European fauna, where they had flourished in myriads at an earlier epoch though then unknown west of the Atlantic. Thus we may expect and shall find, on an inspection of the American Miocene, both differences and points of agreement. As in Europe, so in America, the Miocene was a period of elevation, of plication of the earth's crust with its attendant vulcanism, of denudation of the recently elevated areas, and the formation of extended areas of sediment, formed chiefly of clays, sands and marls, either consolidated into shales and sandstones, or remaining less compacted. The elevation of Middle America and the Antillean region, in harmony with that of southern Europe seems to have been more or less constant, since no marine Miocene beds have been definitely recognized in this area, and the antecedent Oligocene sediments were elevated several thousand feet, North and South America were united, the island of Florida became attached to the Georgian mainland, and the continent of North America on the whole assumed approximately its present outlines. Some modification of the coast line or sea-bottom, supposedly in the vicinity of the Carolinas or possibly connected with the elevation of the Antilles, diverted the warm currents corresponding to the present Gulf Stream so far off-shore in the early part of the Miocene as to permit of the invasion of the southern coast lines by a current of cold water from the north, bringing with it its appropriate fauna and driving southward or exterminating the pre-existent subtropical marine fauna of these shores. This resulted in the most marked faunal change which is revealed by the fossil faunas of the

Atlantic coast of America subsequent to the Cretaceous. A cool-temperate fauna for the time replaced the subtropical one normal to these latitudes, and has left its traces on the margin of the continent from Martha's Vineyard Island in Massachusetts south to Fort Worth inlet in East Florida, and westward to the border of the then existing Mississippi embayment. This seems to have been the limit of effectual invasion by the northern marine fauna since, though no outcrops occur, the Galveston artesian well-borings show two thousand feet of Miocene sediments west of the Mississippi, including a marked remnant of the Pacific fauna, cut off from its allies by the elevation of Middle America and barely surviving on this coast until the upper Miocene time. The preceding Oligocene fauna has left traces as far north as southern New Jersey, but denudation so accompanied the Miocene elevation that little sediment of this epoch has survived *in situ* north of Georgia, and even the Miocene sediments between northern Florida and North Carolina are represented chiefly by isolated patches in sheltered areas. The deep embayment of the Chesapeake region in Maryland and Virginia has retained the largest and least disturbed area of the marine Miocene sediments and given its name to them, as typical, on the Atlantic coast, of the faunal remains of this character, which they contain. Contrary to the conditions existing in Europe, in America no marked invasions by the sea or extensive depressions of continental land are characteristic of Miocene time, though in special localities the Miocene sediments transgress the remnants of the Eocene. In the western region some analogy may be found for the brackish water deposits of Europe, in the Miocene lake beds and their vertebrate remains. Between the upper Oligocene of the John Day beds of the West and the typical Chesapeake (Loup Fork) Miocene, Scott has recognized in the Deep River vertebrates a fauna strictly analogous to that of Sansans (Gers) in France, placed by Depéret, Gaudry and De Lapparent with the Helvétien. The latter author recognizes in the Miocene of Europe the following stages:

1. Burdigalien.—This group has been the occasion of more or less controversy, and is introductory to the fully typical subsequent stages. Whether it is really a consistent whole, is, and has been for some time, a debateable matter. It is not improbable that some part of the beds included in this stage by many European geologists correspond to part

of the series grouped in later American classifications with the upper Oligocene. It has been united by Suess with the Oligocene Aquitanien. Being a matter in which nomenclature rather than geology is concerned its consideration may well be adjourned until a more thorough knowledge of the supposed American equivalents is available. The European characteristics of this stage comprise the earlier part of the period of elevation during which the disappearance of the inland lakes and the inception of fluviatile drainage were in progress.

2. HELVÉTIEN.—This corresponds more exactly to the American definition of the Miocene of Maryland and Virginia, being the period of uplifts and of culmination of the invasion of the southern sea into the resulting isostatic depressions.

3. TORTONIEN.—During this period the most extreme elevation of the uplifts was attained and with this some diminution of the marine transgression and of the apparent sea-temperatures. It is probable that this stage should be united with the preceding, as it is in a number of cases only indicated by a *facies,* and barely distinguishable from the Helvétien. It should be noted that the arms of the Mediterranean sea which deposited the marls of the Vienna Basin, the Mollasse of Switzerland, and the Miocene of Southern France, were inhabited by a fauna derived from the south, and of a subtropical character; hence in no case strictly comparable with a fauna, like that of the American Chesapeake, derived from cool-temperate seas. It is to the fragmentary Miocene of North Germany and Denmark that we should look, if at all, to find the time-analogues of our Chesapeake species.

4 and 5. SARMATIEN and PONTIEN or PANNONIEN.—During these stages, which might well be united, the Mediterranean sea became separated from its eastern inland extensions, which gradually lost their salinity and deposited the remarkable *Congeria* beds and other brackish water sediments or lake beds, with the formation of which European geologists regard their Miocene as having terminated.

In America, speaking broadly, as stated by Dr. Clark, the Miocene appears at its inception unconformably and suddenly upon the surface of the Eocene which in certain localities it transgresses. In the northern part of its range the Eogene strata seem to have suffered much more from denudation than in the corresponding series at the south on the

Gulf Coast. While faint traces remain, in the mechanically mixed marls of southern New Jersey, of the former presence of Oligocene sediments, it is only by the occurrence of a few Oligocene species, mixed with much more numerous Chesapeake forms, that this may be detected. South of New Jersey no trace of the whole Oligocene series may be recognized, as far as now known, north of Georgia. Nor is there described any remnant of the uppermost Eocene as represented in the Gulf column of formations. The beginnings of the Chesapeake in Maryland and Virginia are marked by the prevalence of beds of diatomaceous earth. Otherwise there is little that is distinctive in the successive beds of clay, sand and gray or bluish marl which make up the bulk of the series, divided, on the basis of its fauna, into three formations in Maryland, known as the Calvert, Choptank and St. Mary's. In Virginia we are greatly in need of more stratigraphical information but it is believed that the older beds in the main lie to the north and west, dipping southeasterly 8 to 10 feet per mile, and, as at Petersburg, are practically similar to the Maryland deposits. Passing to the southeast, beds higher in the scale are encountered, though the fauna is still very similar to that of Maryland. Finally on the southeastern border at the sea, along the York river and at various other localities we find beds of marl of a much lighter color, tinted yellow by the presence of iron oxide, and containing a larger proportion of recent forms, together with a still notable proportion of those which occur in the Maryland beds. These newer sediments culminate near Suffolk and about the upper Nansemond river district in the most recent beds of all, on the top of which, in the basin of the Great Dismal Swamp, have been collected mixed with unconsolidated Miocene marl, a few characteristic species of the Southern Pliocene. In Virginia and Maryland we appear to have the basis of material necessary to trace the development of a normally evolving fauna of a single origin, but when we reach North Carolina we come upon an association of species in the upper or Duplin Miocene, in which the introduction of a new factor is manifest. This is a change of fauna due (as in the recent fauna of the coast) not to earlier or later development, but to modifications due to temperature and the environment, which have produced an assemblage, perhaps simultaneously existing with that of Suffolk, Virginia, but of an obviously more southern character. At present the promontory of

Cape Hatteras serves as a landmark indicating the mutual boundary between the northern temperate and southern subtropical mollusk faunas of the present Atlantic coast; and it would seem as if in Miocene time a similar arrangement prevailed.

The upper surface of the Chesapeake in Virginia has been extensively denuded, and the equivalent, if any, of the Duplin beds has been removed over a great portion of the Miocene area. The dip of the remaining deposits, according to Darton, in the northeastern or older portion of the beds, is about ten feet to the mile; in the Nomini section about 7.7 feet to the mile; and in the newest, or Suffolk region, about 6.5 feet to the mile. The beds, as a whole, retain at most about 560 feet of their original thickness. The diatomaceous bed, when present, as is usually the case, lies at the base of the series, on the denuded surface of the Eocene, and if there were earlier deposits which should normally be associated with the Chesapeake, neither in New Jersey nor in Virginia do we find any trace of them remaining. In all cases and throughout its extent the fauna has the characteristics of a shallow-water assembly, without any marked littoral elements, but which might well have existed in the immediate vicinity of low, nearly level, muddy or sandy shores, and have extended off-shore to a distance more or less indefinite, but which did not include any area subject to the influences of an open and unsheltered ocean.

In Florida we first find, in passing southward from the North Carolina deposits, an extended area of undisturbed and little denuded Chesapeake sediments, and where, as at Alum Bluff on the Chattahoochee river and localities on the Chipola river, they have been carefully examined, they present, with some slight admixture of warmer water forms, a fauna essentially like that of the more northern deposits. Eliminating the species peculiar to the Florida beds alone, of the remainder about forty per cent are common to the Chesapeake of Maryland and fifty-seven per cent common to Florida and North Carolina. Since the northern fauna must have become well established before it could have, as a body, invaded the Florida province with the incursion of cold currents previously described, it is probable that the Alum Bluff Miocene represents in time a period somewhat subsequent to that of the Maryland beds, though in point of evolution of organic life nearly identical. About fourteen per cent of the Alum Bluff species have survived to the present time. Beyond the Mississippi embayment, though no Miocene beds have been observed outcropping at the surface, the artesian well at Galveston has penetrated over 1800 feet of strata containing many fossils, evidently of upper Miocene age. This assembly is strongly tinctured with elements characteristic of the Miocene of the Pacific coast which have not survived in the present fauna of the Gulf. These forms are probably the remnant of those cut off from the Pacific waters by the elevation of Middle America in the early Miocene, which for a short time survived on the Gulf side. Owing to these peculiarities there seems no special reason for instituting extended comparisons between the Texas beds and those of Maryland and Virginia.

We may now proceed to consider somewhat more in detail the relations between the Miocene faunas of Maryland, (1) among themselves, (2) to the Miocene faunas of adjacent States, and (3) lastly to the fauna of the European Miocene. Since the molluscan quota of the fauna is much the largest and that with which the writer is most familiar the local comparisons which are made will be chiefly based upon it.[2]

The three horizons into which the Maryland Chesapeake has been divided contain altogether about three hundred and sixty-four species of mollusks, of which 14 per cent are peculiar to the Calvert formation, 9 per cent to the Choptank formation and 10 per cent to the St. Mary's formation, so that altogether one-third of the molluscan fauna of the Maryland Chesapeake is peculiar to it. Ten per cent survive to the present fauna. Of the whole, one hundred and forty-two species occur in only one of the three subsidiary formations, while two hundred and twenty-two are common to more than one of the three horizons, and quite a number of Calvert species are absent from the Choptank but reappear in the St. Mary's formation. Of those species which are

[2] The authors of the systematic lists in this volume have in large part followed in their work the arrangement and determinations made in my Tertiary Fauna of Florida and the collections of the U. S. Geological Survey in the U. S. National Museum. There are naturally some differences due to the use of additional material and to personal equation, which, in the following discussion, will be ignored, as they will in any case hardly affect the percentages. The list as herein contained will be accepted for statistical purposes, except that mere varieties will be left out of consideration; though on some points I might still hold to my original opinion.

common to more than one of the Maryland horizons 17 per cent are also common to the Chesapeake of Florida at Alum Bluff and the Chipola river.

For reasons which have already been specified, the Miocene fauna of southern New Jersey is regarded by me as mixed with foreign elements which have been mechanically incorporated with it during the progress of denudation or by current action. Eliminating the doubtfully indigenous forms the remainder has much the aspect of the Calvert fauna of Maryland with which, on stratigraphic grounds, there is much reason to assimilate it.

In making comparisons with Virginia horizons we are met at once with the difficulty that no good modern lists of Virginia Miocene mollusks are available. To remedy this deficiency I have had the identified species from Virginia localities in the National Museum collection listed and have used them in making the following comparisons. Though these Virginia species comprise little more than half of those which occur in the horizons listed (many being yet unidentified), yet the numbers seem sufficiently large to ensure the approximate accuracy of the percentages derived from them. The lists comprise 71 species from Petersburg, 55 from the James river, 118 from the York river near Yorktown, and 57 from the newest beds of the Miocene near Suffolk, Va. The order in which they are cited is that of their relative age beginning with the oldest. The following table shows the proportion of surviving species in each of the mentioned horizons:

Virginia—Petersburg horizon	8.5	per cent
Maryland—Calvert formation	9.3	" "
Virginia—James river beds	11.0	" "
Maryland—Choptank formation	11.4	" "
Maryland—St. Mary's formation	12.1	" "
New Jersey—Shiloh marls (mixture of faunas)	13.0	" "
Florida—Alum Bluff horizon	14.0	" "
Virginia—Yorktown beds	17.0	" "
Virginia—Suffolk beds	19.0	" "
North Carolina—Duplin beds	20.0	" "

It is likely that complete collections from each of the Virginia localities might bring about a change of one or two per cent in the proportion of surviving species, so that too much stress should not be laid on small differences of this kind; also, that, in the warmer regions, the probabilities of survival among the smaller species are greater than in colder waters. Making allowances for these factors it is probable that the age (in descending order), of the several horizons, as measured by their percentage of surviving species, would not differ greatly from the following scheme:

Duplin.
Suffolk.
Yorktown.
Alum Bluff.
St. Mary's.
$\left\{\begin{array}{l}\text{Choptank.}\\ \text{James River.}\end{array}\right.$
$\left\{\begin{array}{l}\text{Calvert.}\\ \text{Petersburg.}\end{array}\right.$

Taking the three subsidiary horizons of the Maryland Miocene, the percentage of species in each of the cited Virginia horizons common to each of the Maryland horizons is as follows:

Virginia.	Maryland.		
	Calvert.	Choptank.	St. Mary's.
Suffolk	37%	33%	33%
Yorktown	34	35	27
James River	27	24	27
Petersburg	34	34	33

From this it may be concluded that the connection between the Maryland and Virginia Miocene, as well as between the several horizons in each state, is very intimate, and while the groups may be divided the divisions are less fundamental than the general unity of the Chesapeake as a whole compared with, for instance, the Duplin Miocene, which has in common with the Suffolk beds only ten per cent of common species, while of the non-peculiar species of the far more distant Chesapeake of Florida 39 per cent are common to the Chesapeake of Maryland.

We may, in considering the fauna of the Maryland Chesapeake, find the analogy of its location under present conditions in either of two ways. We may consider the present geographical distribution of the genera represented in it, or we may take the surviving species and consider their present distribution on our coasts. The latter is the most definite method leaving less to the judgment of the statistician. From twenty to twenty-five species survive from each of the Maryland horizons. Of these eleven at present extend from the existing boreal fauna to the subtropical waters of Florida, and therefore afford no more precise indication. Of the remainder seventy per cent now live in the fauna existing from Hatteras southward, while only thirty per cent are confined to the region from Hatteras northward. We may therefore conclude, (1) that the temperature conditions governing the fauna of the Maryland Chesapeake were those of the temperate rather than the boreal or subtropical faunas of the present coast; and, (2) that the temperature of the Chesapeake embayment was on the whole somewhat warmer than at present. This is what the genera represented also indicate. Between the several horizons of the Maryland Chesapeake there is but very slight indication of any temperature difference; so far as there is any, it points toward a progressive but slight cooling of the water from the Calvert to the St. Mary's; while the subsequent Pliocene was doubtless accompanied by a change in the opposite direction, a rise of temperature being indicated by the changes in the fauna.

It has been shown[3] that the shell-bearing mollusk fauna of the cool-temperate zone comprises normally about 400 species in any reasonably diversified area. When thoroughly done, collecting from marl beds will give much better results as regards completeness than can be had from any dredging in the actual sea, because the marl is so much more accessible than the seabottom. In the Maryland Miocene, omitting varieties, about three hundred and sixty-four species are recorded. It may be supposed that about forty species remain to be discovered in the Maryland beds.

Of the species known about ten per cent are supposed to survive. This small number is partly the result of the rather restricted limits

[3] U. S. Geological Survey, Bulletin 84, pp. 25-31, 1892.

adopted for species by the authors of this part of the volume, as compared with the views prevalent in the time of Lyell. However, about 13 per cent of the New Jersey species survive, and 14 per cent of the Floridian Chesapeake, so the estimate is not far from normal for the lower American Miocene. For the upper Miocene of Duplin about 20 per cent are estimated to survive, and 19 per cent in the Suffolk district of Virginia. The intermediate Yorktown beds have about 17 per cent of survivors.

I have already called attention to the fact that the Miocene of South Europe is of a more tropical character than that of our typical Chesapeake, and that a more appropriate comparison in detail may be had with the Miocene of Northern Europe, Belgium, North Germany and Denmark. Even the latter is less boreal or apparently lived in warmer waters than the species of the Maryland beds. It would seem that, in America, the change at the end of the Miocene was marked by a slight elevation and a distinctly warmer water fauna which pushed its way northward at least as far as Virginia, and possibly to Martha's Vineyard, where the genus *Corbicula,* a distinctly southern form, has been detected. From a survey of the available literature it would seem, however, that, on the continent of Europe, the Pliocene fauna which made its way southward was of a somewhat more northern type than the Miocene which it succeeded. If a change in the ocean currents corresponding to our present Gulf Stream, took place at the end of the Miocene, by which the tropical waters were directed over a longer extent of the Atlantic coast than was the case during the Chesapeake epoch, and hence became more or less cooled off before making the transit of the North Atlantic, the temperature conditions necessary to account for this difference in the faunas, would have been provided.

Of five hundred species of gastropods enumerated by Hoernes from the Vienna basin 20.6 per cent are regarded as surviving to the present epoch; a number without doubt too great from the standpoint of the average modern estimate of what constitutes a species. But it would carry us too far to attempt to rectify this estimate in detail.

In the work of Nyst (1843) on the Tertiary of Belgium the Diestien of Dumont and the fauna of the Bolderberg were referred to the Pliocene and the Oligocene. This view was afterward corrected by von Koenen[4] who showed that the Diestien and part of the Bolderien were a westward extension of a fauna which he identified with that of the North German Middle Miocene.

Of eighty-nine species of this Belgian fauna Nyst regarded 19 per cent as surviving, an estimate which must be materially reduced to bring it into harmony with modern views. Much more reliable from this standpoint is the estimate of von Koenen, who regarded out of one hundred and forty-two species of gastropods 11 per cent as identical with recent forms, a result practically agreeing with our estimates for the middle Chesapeake of Maryland and Virginia. Of these North German species 43 per cent are common to the fauna of the Vienna basin, 12 per cent are also known from the German Oligocene and 38 per cent from the Pliocene of South Europe. The relations with the Crag of Britain are less intimate, the latter being characterized by a rather colder water fauna.

In a general comparison of the European and American Miocene we find, among other things which may be cited as parallelisms: in land vertebrates the Sansans and Deep River mammals, and among cetaceans the presence of *Squalodon, Balaena, Priscodelphinus* and other dolphins. Among the sharks may be cited *Carcharodon megalodon, Hemipristis serra* and *Notidanus primigenius. Oxyrhina, Carcharias, Galeocerdo* and various rays were abundant in the sea bordering the western continent during this period.

In Europe Corals are rare except at the south; in Maryland *Astrohelia* and *Septastrea* represent the group, the waters of Chesapeake time in this region having been too cold for reef corals and too shallow for the deep sea forms.

The Echinoids of the Miocene are as a rule few in species and profuse in individuals; *Clypeaster, Scutella* and *Spatangus* being the most prominent of European, *Amphidetus* and *Scutella* of American forms.

Among the Vermes *Spirorbis* is conspicuous, and *Balanus* among the Crustaceans.

[4] Das Miocäen Norddeutschlands und seine Molluskfauna. Schr. ges. Naturw. zu Marburg, X, 3te Abtb., pp. 139-143, 1872.

Among the Foraminifera nummulites are absent, and, in America, *Orbitoides*. *Amphistegina, Ehrenbergia, Cassidulina,* and *Ellipsoidina* are prominent in Europe; *Polystomella, Planorbulina, Rotalia, Textularia, Polymorphina,* and *Uvigerina* in America. *Lithothamnion* is a common fossil in the marine Miocene of both continents.

There are left the Mollusca, which we may examine a little more closely.

Cephalopods are rare in the Miocene. The *Aturia* which in America does not persist beyond the middle of the Oligocene, in Europe is said to linger a little longer. *Nautilus* is known from both the east and west coasts of America in the Miocene.

In America, among the Toxoglossate gastropods, *Terebra* (represented by species of the subgenera *Hastula* and *Oxymeris*) is notable, there are many Pleurotomoids, the cones are few and coarse, *Cancellaria* is represented by a notable number of species. The same remarks apply almost equally to the North German Miocene.

American Rhachiglossa are numerous. A species of *Oliva* and one of *Scaphella* at least appear in both America and North Germany. *Busycon* in the former region is represented by *Tudicla* in the latter. *Fusus* is more abundant in Europe than in America but the peculiarly characteristic Miocene subgenus of *Chrysodomus, Ecphora,* is represented in North Germany by a form almost intermediate between the American *E. quadricostata* and *Chrysodomus decemcostatus*. *Ancilla, Murex, Purpura* and *Tritia* are conspicuous in the Miocene faunas of Europe, *Ptychosalpinx, Ilyanassa* and *Tritia* in America. The *Melanopsis* of Europe is paralleled by the *Bulliopsis* of America.

Among the Tænioglossa, *Turritella* is conspicuous in both continents, a form of *Cassis* (*Cassidaria* or *Sconsia*) is equally present. *Cypræa* is more numerous in Europe but represented in both regions; *Pyrula* occurs in both, more abundantly in Europe; as do the various types of *Tritoniidæ*, such as *Septa, Lotorium* and *Ranella*. *Pyrazus* is more abundant in Europe and the *Calyptræidæ* in America.

Among the Rhipidoglossa, *Calliostoma* is more representative in America and *Gibbula* in Europe.

Turning to the bivalves we find an equally noticeable parallelism. In Europe *Glycymeris, Barbatia* and *Scapharca* are very characteristic, as they are in America. *Ostrea* is large and numerous, large *Pectens* occur, though the latter are perhaps less characteristic of the Miocene than in America.

The conspicuous place of the *Cardiums* in our Miocene is hardly filled by the species in the European faunas, where also we find a notable number of *Isocardia*. *Mactra* in Europe is represented by *Spisula* in America. *Panopea* is about equally conspicuous in both, *Cardita* more so in Europe, *Astarte* in America. *Corbula* and *Saxicava*, are equally common to both regions. The very characteristic *Mytiloconcha* occurs in both. A host of uncharacteristic forms, such as *Nuculidæ, Abra, Tellina, Ensis, Macrocallista, Timoclea, Lima, Phacoides, etc.*, are common to both, but in Europe *Venerupis, Paphia, Eastonia, Lutraria, Cardilia, Pecchiolia, Congeria* and *Adacna* are found with no American Miocene equivalents. *Crassatellites, Crassinella, Agriopoma, Rangia, Mulinia, Melina,* occupy the same, or nearly the same, position on the western continent, where the giant species of *Venus* make their first appearance.

In a general way, allowing for local peculiarities, the Miocene fauna of North Germany compares well and agrees closely with that of Maryland, while the Mediterranean Miocene finds a closer analogue in the more tropical fauna of the Duplin beds of the Carolinas. We have not in America any equivalent, faunally, of the *Congeria* beds of the upper Miocene of Eastern Europe.

Characteristic Species of North American Miocene.

Deeming it interesting to know what species, as distinguished from genera, are characteristic of the North American Miocene I have carefully inspected the lists. By characteristic are meant the species which occur only in the Miocene, and occur in it from top to bottom, or, to exemplify, in the beds from Alum Bluff to Duplin, in the South, or from the Calvert to Yorktown or Suffolk, in Maryland or Virginia. It is not meant that they occur at every horizon or zone, but that they have existed throughout the Miocene somewhere, and disappear with the inauguration of the Pliocene.

The following list comprises the species so defined, and is to some extent a surprise, both by the presence of some species and the absence of others, the latter chiefly those which survived into the Pliocene. Some of the groups which are peculiar to a portion of the Miocene and do not occur throughout the system will be particularly missed. Doubtless the more thorough exploration of the southern Miocene will furnish material for modifying the list to some extent, but as far as our present knowledge goes it is emphatically characteristic of the epoch.

Drillia limatula Conrad.
Cancellaria carolinensis Emmons.
Scaphella trenholmii (Tuomey and Holmes).
Fasciolaria rhomboidea Rogers.
Busycon coronatum Conrad.
Busycon incile (Conrad).
Ecphora quadricostata (Say).[5]
Fusus exilis Conrad.
Anguinella virginica Conrad (worm tube?).
Cassis (*Sconsia*) *hodgei* Conrad.
Crucibulum constrictum Conrad.
Polynices (*Lunatia*) *perspectivus* (Rogers).
Polynices (*Neverita*) *percallosus* (Conrad).
Calliostoma philanthropus (Conrad).
Dentalium carolinense Conrad.
Dentalium attenuatum Say.
Cadulus thallus (Conrad).
Yoldia lævis (Say).
Arca (*Barbatia*) *centenaria* Say.
Arca (*Scapharca*) *scalaris* Conrad.
Arca (*Scapharca*) *subrostrata* Conrad.
Arca (*Noëtia*) *incile* Say.
Atrina harrisii Dall.
Pecten madisonius Say.
Modiolus ducateli Conrad.
Margaritaria abrupta (Conrad).
Pandora (*Clidiophora*) *crassidens* Conrad.

[5]Including all the varieties and excluding the *Rapana* which has been too hastily united with it.

Crassatellites melinus (Conrad).
Crassatellites undulatus (Say).
Crassatellites psychopterus Dall.
Astarte obruta Conrad.
Astarte undulata Say.
Phacoides anodonta (Say).
Phacoides cribrarius (Say).
Solecardia cossmanni Dall.
Bornia triangula Dall.
Cardium acutilaqueatum Conrad.
Cardium laqueatum Conrad.
Isocardia fraterna Say.
Venus tridacnoides (Lamarck).
Chione ulocyma Dall.
Callocardia (Agriopoma) subnasuta (Conrad).
Macrocallista reposta (Conrad).
Dosinia acetabulum Conrad.
Tellina (Angulus) producta Conrad.
Semele subovata (Say).
Cumingia medialis Conrad.
Asaphis centenaria (Conrad).
Ensis ensiformis Conrad.
Spisula delumbis (Conrad).
Spisula subparilis (Conrad).
Spisula curtidens Dall.
Spisula marylandica Dall.
Mulinia milesii Holmes.
Mulinia congesta (Conrad).
Sphenia dubia (H. C. Lea).
Panopea reflexa Say.
Panopea goldfussi Wagner.
Discinisca lugubris (Conrad).

SYSTEMATIC PALEONTOLOGY

OF

THE MIOCENE DEPOSITS OF MARYLAND

BY

E. C. CASE, C. R. EASTMAN, G. C. MARTIN, E. O. ULRICH, R. S. BASSLER, L. C. GLENN, W. B. CLARK, T. W. VAUGHAN, R. M. BAGG, Jr., ARTHUR HOLLICK and C. S. BOYER

SYSTEMATIC PALEONTOLOGY

MIOCENE

MAMMALIA .... E. C. Case.
AVES .... E. C. Case.
REPTILIA .... E. C. Case.
PISCES .... C. R. Eastman.
ARTHROPODA.
  MALACOSTRACA .... G. C. Martin.
  CIRRIPEDIA .... G. C. Martin.
  OSTRACODA .... E. O. Ulrich and R. S. Bassler.
MOLLUSCA.
  CEPHALOPODA .... G. C. Martin.
  GASTROPODA .... G. C. Martin.
  AMPHINEURA .... G. C. Martin.
  SCAPHOPODA .... G. C. Martin.
  PELECYPODA .... L. C. Glenn.
MOLLUSCOIDEA.
  BRACHIOPODA .... G. C. Martin.
  BRYOZOA .... E. O. Ulrich and R. S. Bassler.
VERMES .... G. C. Martin.
ECHINODERMATA .... W. B. Clark.
COELENTERATA.
  HYDROZOA .... E. O. Ulrich.
  ANTHOZOA .... T. W. Vaughan.
PROTOZOA.
  RADIOLARIA .... G. C. Martin.
  FORAMINIFERA .... R. M. Bagg, Jr.
PLANTÆ.
  ANGIOSPERMÆ .... Arthur Hollick.
  THALLOPHYTA-DIATOMACEÆ .... C. S. Boyer.

VERTEBRATA.

Class MAMMALIA.

Order CETACEA.

The order Cetacea exhibits within itself forms of the widest divergence. Conforming in general to the fish-like form of body, the members show variations in size between *Balaenoptera sibbaldii*, 85 to 90 feet long, and *Platanista* about 4 feet; in dentition from the carnivorous form of *Orca* to the baleen plates of the Right Whale or the almost toothless *Monodon.* The superficial fish-like characters of the body are generally regarded as degenerative adaptations to the aquatic habitat. The almost total loss of the hair, the equally complete loss of the hind limbs, the flipper-form of the fore limbs and the development of hyperphalanges; the position of the external nostrils on the upper part of the skull; all these are found in general in animals originally terrestrial in habit, that have become aquatic. To these characters should be added the broad, flat tail developed in the horizontal instead of the vertical direction and devoid of bony support.

The following features of the skull have been mentioned by Beddard[1] as characteristic of the Cetacea:

"The separation of the two parietals by the intervention of the supra-occipital, or their concealment by its overlapping.

"The overlapping of the muzzle generally by the premaxillae.

"The loose attachment between the various bones surrounding or connected with the organ of hearing.

"The absence or feeble development of the coronary process of the lower jaw."

The scattered locations and the fragmentary condition of the material

[1] A Book of Whales. Putnam & Sons, New York, 1900. This book contains a most valuable semi-popular account of the Cetacea.

described in the following pages rendered impossible a complete revision of the forms. All that has been attempted is to place the known material in the most available form.

The classification of the CETACEA is in a very unsettled condition so that no one scheme can be said to be the correct one. The scheme here given follows that of Flower and Lydekker.[1]

Suborder ARCHAEOCETI.

Animals most nearly approaching the land-living ancestors of the group; the skull elongate with well-developed nasal bones and the teeth differentiated into an anterior, incisor series and a posterior, molar series. These teeth, especially the molars, are extended in the antero-posterior direction and have tuberculated cutting edges; the anterior series is single-rooted and the posterior two-rooted. The body was elongated and adapted to an aquatic life but the attachment of the ribs, the structure of the palatal region and other portions of the body are very seal-like in their relations.

There is but a single family, the ZEUGLODONTIDAE, which is confined to the Eocene formations. In the United States they are most abundantly found in the deposits of Alabama, Louisiana, and Mississippi.

Suborder ODONTOCETI.

Forms in which the skull has lost many of the typical mammalian features retained in the previous suborder, especially in the facial region; the external nares have retreated until they are simple openings on the top of the head, descending almost vertically through the skull just anterior to the front wall of the brain case. The retreat of the nares has driven the nasal bones back until they are mere nodules in the posterior wall of the upper portion of the nares. The nose is extended into a rostrum that may reach great length and slender proportions; the teeth are variable, in some forms they are quite similar to those of the preceding suborder, in others they are simple and conical; either present in large number or reduced to a single tooth in each half of the mandible. The vertebrae in the neck are, in the most

[1] Mammals Living and Extinct. Flower and Lydekker. London, 1890.

highly developed of the forms, anchylosed together in a short mass of bone, this leaves the animal with no apparent neck; in other forms the cervical vertebrae are all separate and the head and body are separated by a well-defined constriction. All forms show a distortion of the anterior portion of the skull, which in some reaches a high degree. The suborder has four families: SQUALODONTIDAE, PLATANISTIDAE, DELPHINIDAE, and PHYSETERIDAE.

Following is a scheme given by Cope[1] for the determination of the various families:

I. Teeth of two types, one and two-rooted.
  Neck longer; teeth in both jaws.................... *Squalodontidae.*
II. Teeth uniformly one-rooted.
  a. Ribs nearly all two-headed.
    Teeth in both jaws; neck generally longer........... *Platanistidae.*
    Teeth in lower jaw only; neck short.................. *Physeteridae.*
  aa. Four or five anterior ribs only two-headed.
    Teeth in both jaws; neck short........................ *Delphinidae.*

In the same article he speaks of the characters here selected to designate the different families. He says: "All the above characters are those of divergence from the principal mammalian stem, and have relations to the conditions of aquatic life. Thus the posterior position of the nostrils permits inspiration without the elevation of the muzzle above water level, which is rendered difficult, if not impossible in the most specialized types, by reason of the extreme flatness and inflexibility of the cervical vertebrae. The absence of teeth is appropriate to the habits of the types which lack them." (The confinement of the diet of the MYSTICOCETI to soft bodied animals.) "The disarticulation and the disappearance of the heads of the ribs in the MYSTICOCETI is appropriate to the support which all the viscera derive from the fluid medium in which these large animals live." Again, "The line of the successional modification of the CETACEA is found in the changes in (1) the shape of the skull; (2) the extinction of the dentition; (3) the shortening of the cervical vertebrae; and (4) in the separation of the ribs from articulation with the vertebral centra. The modification of the shape of the skull is related to the gradual transfer of the external nostrils to more and more posterior positions."

[1] Amer. Nat., vol. xxiv, 1890, p. 602.

Family SQUALODONTIDAE.

This family is peculiar in its group in that it possesses teeth of two kind as in the ARCHEOCETI; the anterior teeth are simple and conical while the posterior or molar teeth are more complex and are two-rooted (there are teeth in the premaxillary). The skull, however, presents the characters of the ODONTOCETI. There are no living members of this family.

Genus SQUALODON Grateloup.

SQUALODON ATLANTICUS Leidy.

Plate X, Figs. 1, 2, 3.

Macrophoca atlanticus Leidy, 1856, Proc. Acad. Nat. Sci. Phila., vol. viii, p. 220.
Squalodon atlanticus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 132, 144, 151, 153.
Squalodon atlanticus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 416, pl. xxviii, figs. 4–7; pl. xxx, fig. 18.
Basilosaurus (?) *atlanticus* Cope, n. n.

Description.—The original specimens described as *M. atlanticus* consisted of three molar teeth from Cumberland county, New Jersey. They were described as follows by Leidy in 1856: "Crowns of the molar teeth broader than the length; laterally compressed conical; the anterior and posterior borders acute, the former with a series of acute two, and the latter with four conical tubercles having denticulated borders; inner and outer surfaces exceedingly roughened, especially toward the base, by longitudinally acute and broken ridges. Root composed of an antero-posterior pair of fangs confluent half their length.

"Length of largest tooth 2¼ inches; length of crown 10 lines, breadth 12 lines."

Cope in 1867 described a second specimen from Charles county, Maryland. "At least four of the most posterior molars were inserted in oblique alveolae, overlapping by their anterior fang the inner face of the posterior fang of the tooth in front, anterior to these the alveolae are less oblique, and separated by spaces. The palatal face is moderately convex, while the external surface is divided into two plane faces by an angulated line, which is strong posteriorly, vanishing anteriorly." The fragments are said to indicate a cranium about 30 inches long. The teeth "are longitudinally wrinkled and present a thick anterior and posterior cutting edge. The serrulations stand from behind, 3-2, 2-2, 3-2, 3-2, the anterior two of the last being very weak. The cutting edge of all these is serrulate. Not only in the number of the crests, but in the more elevated conic apex, do these teeth differ from those of *S. holmesii.*"

A specimen in the Museum of the Philadelphia Academy of Sciences bears the name *Basilosaurus atlanticus* and purports to come from the Miocene of Maryland. No trace can be found of any description of such a species of *Basilosaurus* nor does the genus *Basilosaurus* occur in the Miocene. The label is by Cope and it is probable that it was intended for *Squalodon atlanticus.* The strong resemblance of the specimens to the teeth of the latter genus bears out this supposition.

Occurrence.—Calvert Formation.[1] Charles county near the Patuxent river.

Collections.—The type specimen is in the Museum of the Philadelphia Academy of Natural Sciences.

Squalodon protervus Cope.

Plate X, Figs. 4, 5.

Cynorca proterva Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 144, 152.
Cynorca proterva Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 185.
Squalodon protervus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 151.
Squalodon protervus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, pp. 384–423, pl. xxviii, figs. 18–19.

Description.—In 1869 Cope gave the following description of this species: "This species is represented in the collection by a single canine tooth, which presents the usual small crown and broad fang of the Cetacea. The fang is, however, shorter than in the '*Colophonodon* and *Stenodon,*' and, with the crown very much compressed in one plane. A shallow groove extends on each side of it to the narrowed and flattened truncate base. The tooth is widest at the middle of the fang; the crown is rapidly acuminate, narrow lenticular in section, and furnished with a rather thickened postero-internal cutting edge. The anterior or external aspect is worn away by the attrition of a corre-

[1] The mollusca collected by Cope at this time and from this locality and described by Conrad were from the Calvert formation.

sponding tooth, but was obtuse, and furnished with a longitudinal ridge on each side at the base of the crown. The surface of the enamel is rugose, more minutely on one side than on the other. The tooth is considerably curved. While the enamel is polished the fang is roughened and opaque.

Total length on middle 1 in. ....10.5 lines (48 mm.)
Length of crown ....
Width at base of crown .... 4.5 lines (9 mm.)
Width at middle of fang .... 5.25 lines (10.5 mm.)"

Occurrence.—CALVERT FORMATION. Charles county, near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Family PLATANISTIDAE.

The teeth are undifferentiated, conical and single-toothed; the premaxillary is without teeth; the nose is extended into a long and slender rostrum and in the lower jaw the symphysis is very long. Zittel says that it is at least half as long as the jaw. The cervical vertebrae are all separate and the ribs, except the most posterior, are two-headed. Noteworthy living members of this group are *Platanista* of the Ganges which is entirely fluvatile in its habits, never going into salt water, and *Pontoporia* of the South American coast which is found near the mouth of the La Plata river but has never been found in the fresh water of the river. This last form serves as a connecting link in habits between the PLATANISTIDAE and the succeeding family which is confined to salt water. Most of the fossil forms of ODONTOCETI described from Maryland belong to the PLATANISTIDAE.

Cope has given the following scheme[1] for the determination of the genera of the family PLATANISTIDAE:

I. Teeth with roots extended transversely.
   Teeth with lateral basallobes; lumbar diapophyses wide......*Inia.*
II. Teeth with cylindrical roots.
   a. Caudal vertebrae plano-convex.
      No caudal diapophyses ....*Cetophis.*
   aa. Caudal vertebrae plane.

[1] Amer. Nat., vol. xxiv, 1900, p. 603.

β. Lumbar diapophyses spiniform.
Lumbar and caudal vertebrae slender .... *Zarachis.*
Lumbar and caudal vertebrae short .... *Ixacanthus.*
ββ. Lumbar diapophyses wide, flat.
Muzzle elongate, slender; cervical vertebrae long... *Priscodelphinus.*
Muzzle slender, cervical vertebrae, shorter .... *Pontoporia.*

III. Teeth with longitudinally flattened roots.
Teeth in entire length of maxillary bone; symphysis connate .... *Stenodelphis.*
Teeth in all the jaws; symphysis not connate; an erect osseus crest on posterior part of the maxillary .... *Platanista.*
Teeth at the base of the maxillary only; muzzle produced into a subcylindrical beak .... *Rhabdosteus.*

IV. No teeth; an alveolar groove; muzzle depressed, elongate.... *Agabelus.*

The genus *Lophocetus* is not included in this scheme and it seems impossible to insert it as only the skull is known. Certainly it belongs in the second section; "forms with cylindrically rooted teeth."

Genus PRISCODELPHINUS Cope.

PRISCODELPHINUS GABBI Cope.

Plate X, Fig. 6.

Delphinapterus gabbi Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 191.
Tretosphys gabbi Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 191.
Tretosphys gabbi Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, pp. 7, 8.
Tretosphys gabbi Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 434.
Priscodelphinus gabbi Cope, 1890, Amer. Nat., vol. xxiv, p. 615.

Description.—Described from a single caudal vertebra. "It has pertained to a species of not more than half the length of *T. grandaevus*, and is less strongly constricted everywhere and especially below. In a caudal of near the same position, the ridges and chevron articular surfaces are much more elevated, especially those on the anterior part of the centrum. They embrace a very deep groove in this, a shallow one in the *T. gabbi*. An additional longitudinal ridge on each side the inferiors in front is wanting in *T. gabbi*. Both have a delicate one above the diapophyses in front, the *T. grandaevus* behind also. There is no posterior zygapophysis in the *T. gabbi*. The caudal of the latter is also relatively shorter.

Length centrum ....2 in. (50 mm.)
Depth articular face anterior.....1 in., 5.7 lines (11.4 mm.)
Width articular face anterior.....1 in., 7 lines (14 mm.)"

Occurrence.—CALVERT FORMATION. Charles county, near the Patuxent river.

Collection.—The type specimen is in the Museum of the Academy of Natural Sciences of Philadelphia. It bears the label "Tretosphys gabbi Cope (Delphinapterus, Cope, type). Caudal vertebra, E. D. Cope, Charles Co., Md."

PRISCODELPHINUS RUSCHENBERGERI Cope.

Plate X, Figs. 7, 8.

Delphinapterus ruschenbergeri Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 189.

Tretosphys ruschenbergeri Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, pp. 7–9.

Tretosphys ruschenbergeri Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 434 (mention only).

Priscodelphinus ruschenbergeri Cope, 1890, Amer. Nat., vol. xxiv, p. 615.

Description.—This species was about the size of *Ixacanthus stenus.* "They (the vertebrae) are also of a slender form, more so than in any species of the last genus (*Ixacanthus*). What distinguishes it generally, is that instead of the slender diapophyses of the caudal it has the broad ones of the true Dolphins, though broader even than is usual in these, and it is perforated a little on one side of the middle by the foramen seen among the whales and dolphins generally.

"Articular faces transversely oval; centrum slightly constricted with an obtuse keel along the median line. The two inferior keels of the caudal vanish on the middle part of the centrum.

Length of centrum	1 in. 9 lines	(68 mm.)
Height of centrum	10.3 lines	(20.6 mm.)
Width of centrum	12.5 lines	(25 mm.)
Width neural canal	5.2 lines	(10.4 mm.)
Width basis diapophysis lumbar	10.5 lines	(21 mm.)
Width basis diapophysis caudal	10 lines	(20 mm.)"

The type specimen consists of two vertebrae, a lumbar and a caudal vertebra.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

PRISCODELPHINUS LACERTOSUS Cope.

Delphinapterus lacertosus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 190.
Tretosphys lacertosus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 189.
Delphinapterus hawkinsi Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 190.
Tretosphys lacertosus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 7.
Tretosphys lacertosus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 434.
Priscodelphinus lacertosus Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.
Priscodelphinus lacertosus Cope, 1890, Amer. Nat., vol. xxiv, p. 615.

Description.—This species is described as "much the largest species of the genus. It is based on two lumbar vertebrac which have been united by exostosis and then separated. They are quite elongate and have broad diapophyses so far as their bases indicate. The articular faces are about as broad as deep, and slightly pentagonal in outline, not ovoid or discoid as in other species. The lower surface presents an obtuse median angle, with slightly concave sides."

There were two specimens; one from the mouth of the Patuxent river in Maryland consisting of a single vertebrae, and five others from the marl pits near Shiloh in Cumberland county, New Jersey. The type is in the museum of the Academy of Natural Sciences of Philadelphia. One of the vertebrae so preserved is labeled, on the specimen, *Delphinapterus lacertosus*, but the accompanying case label is "Tretosphys lacertosus Cope. (Delphinapterus lacertosus, Cope.)" Another specimen in the same lot bears the label "Delphinapterus Hawkinsi = Delphinapterus lacertosus, Cope."

Measurements of a vertebrae of *T. lacertosus.*

Length centrum	3 in. 5.5 lines (85.5 mm.)
Height articular surface	2 in. 2.5 lines (55 mm.)
Width articular surface	2 in. 4.5 lines (59 mm.)
Width neural canal	7.5 lines (15 mm.)
Width base diapophysis	1 in. 9 lines (45 mm.)

Occurrence.—ST. MARY'S (?) FORMATION. Mouth of the Patuxent river. CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

PRISCODELPHINUS (?) CRASSANGULUM n. sp.

Plate XI, Figs. 1a, 1b, 2, 3a, 3b.

Description.—An imperfect skull collected by the Maryland Geological Survey may belong to this genus. The teeth are all lost but the alveoli seem to indicate that the roots were very slightly flattened, if at all; in the anterior part of the series the alveoli seem to run together and to form an imperfect alveolar groove. If the teeth prove to have the cylindrical roots the form must be considered as a species of *Priscodelphinus* and only the discovery of vertebrae in connection with the skull can determine whether it is a new species or belongs to one already described. If the roots are found to be more flattened longitudinally it must be considered as a new form near to *rhabdosteus* but distinguished by the presence of teeth in the whole length of the jaw.

Rostrum very long and tapering gently, the sides straight. Superior portion of the upper jaw overlapping the lower, so that the alveoli of the teeth are on the inferior side of the angle at the side of the jaw; the upper surface of the jaw formed by the joined maxillaries and premaxillaries; the under surface marked by a deep straight groove which corresponds to a similar groove on the superior surface of the upper jaw; the opposed surfaces of the two jaws almost flat. The teeth were not opposed but extended out and forward from the sides of the jaw even in the posterior portion of the series; the teeth were simple and conical in form. The maxillaries did not extend posterior to the orbit, they were greatly expanded posteriorly in thick wing-like extensions that gave the base of the rostrum a considerable width, and passed gradually into the slender portion. Between the posterior portions of the maxillaries the vomer appears very slightly on the inferior surface. Above, the vomer is seen to be a rather short V-shaped bone, the posterior ends of which clasp the nodular and very rugose anterior end of the mesethmoid; the cartilaginous extension of this forward was of considerable extent. The premaxillaries were very long and slender, posteriorly they became flattened and thin; from a point just anterior to the nares they diverged as they retreated; anteriorly they were slender and rod-like, anchylosed to the maxillaries but seemingly separate in the median line. The frontal appeared at the posterior end of the maxillaries as a heavy flattened process overhanging the orbit, the outer edge of which was thick and depressed in the vertical direction. The basisphenoid has strong descending lateral processes that carry backward the pterygoid ridges, thus giving to the base of the skull much the appearance of the modern dolphins. The occipital condyle stood well out from the body of the bone; the occipital bone joined the squamosal at a very large angle so that the posterior edge of the zygomatic portion is almost as far back as any part of the skull; this gives a very wide back to the skull with a rather sharp angle between the sides and the back. The tympanic is rather simple in form. It is especially characterized by the slender trough-like extension of the anterior edges of the lips; the posterior side shows a wide shallow groove quite rugose on the sides and bottom.

Measurements:

From end of snout (incomplete) to posterior end of symphysis	.445 m.
Posterior end of symphysis to posterior end of ramus	.199 m.
Width between posterior ends rami	.14 m.
Width jaw at symphysis	.05 m.
Width of jaw at about half the length	.03 m.
Width jaw at anterior end, as preserved	.01 m.
Number of teeth in five centimeters	3

Occurrence.—CALVERT FORMATION. ¾ mile north of Governor's Run.
Collection.—Maryland Geological Survey.

PRISCODELPHINUS URAEUS Cope.

Tretosphys uraeus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, pp. 7, 8.
Tretosphys uraeus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).
Priscodelphinus uraeus Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.
Priscodelphinus uraeus Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—The species is founded upon a single lumbar from New Jersey with which Cope associated a single caudal from the mouth of the Patuxent river. The vertebrae are elongate as in the genus

Zarhachis but not to the extent reached in that genus. The articular face of the lumbar was injured "but evidently has been as deep as wide and perhaps nearly round. The median impression is punctiform and remarkably strong. The profile of the inferior outline is concave and constituted by an obtuse keel, on each side of which is a short longitudinal depression. The diapophyses have been broken off but their bases are both broad and deep, slightly filling the concavity of the infero-lateral face. The supero-lateral face strongly concave in both directions.

Length centrum	39	lines (78 mm.)
Length of basis of neurapophysis........	28.5	lines (57 mm.)
Length of basis of diapophysis	20	lines (40 mm.)
Width neural canal	4	lines (8 mm.)"

"Caudal has broad diapophyses and a band-like impression passing in front of them, and converging at center of median line below; a character seen in many of the species of the genus. The points of attachment of the chevron bones are well marked; they entirely disappear on the middle portion of the centrum. The articular face is similar to that of the lumbar, but is a little broader than high. These surfaces are everywhere concave and are not marked by any longitudinal ridges.

Total length	39	lines (78 mm.)
Length basis neurapophysis	25	lines (50 mm.)
Length basis diapophysis	24	lines (48 mm.)
Width neural canal	2.6	lines (5.2 mm.)
Width articular face	25.5	lines (5.1 mm.)
Depth articular face	21.3	lines (42.6 mm.)

"This is probably the second of the genera in length, and the third in bulk."

Occurrence.—St. Mary's Formation. Mouth of Patuxent river.

Collection.—The location of the type specimen is unknown. It was loaned to Cope by Tyson, then the State Agricultural Chemist of Maryland.

PRISCODELPHINUS GRANDAEVUS Leidy.

Plate XII, Figs. 1a, 1b, 1c.

Priscodelphinus grandaevus Leidy, 1851, Proc. Acad. Nat. Sci. Phila., vol. v, p. 327.
Priscodelphinus grandaevus Cope, 1890, Amer. Nat., vol. xxiv, p. 605, figs. 2a, 2b, 3a, 3b, 3c.

Description.—An atlas vertebrae corresponds very closely in size and appearance to the figures of *Priscodelphinus grandaevus* Leidy, published by Cope. The anterior face is deeply concave. The articular faces for the occipital condyles are concave, broader above than below and inclined obliquely outward. The opening is roughly triangular. The upper surface is thin and there is no elevation of the neural arch; the top of the arch is marked by a low spine and on either side of this is a large foramen. On the sides the transverse processes are bifurcate, a broader process pointing upward and outward and a narrower one outward and downward, the two processes are connected by a sharp ridge and on either side of this are several small foramina for nutritive vessels. The posterior face shows strong articular faces for the axis and the lower surface of the inside of the ring shows an articular face for a broad odontoid process; the articular surface covers about two-thirds of the inner face of the lower portion of the ring and is marked off from the anterior portion by a low rugose line. The lower face is marked by a strong peg-like rugosity pointing backwards. There is no trace of a tendency to coalescence of the cervical vertebrae.

Measurements:

Breadth across anterior face	75 mm.
Height anterior face	45 mm.
Breadth across transverse processes	91 mm.

Occurrence.—CALVERT FORMATION. ½ mile south of Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus IXACANTHUS Cope.

This genus was described with *I. coelospondylus* Cope as the type. The original generic description is as follows: "This genus is similar to the next (*Priscodelphinus*) in the cylindric spinous character of the diapophyses of the caudal and lumbo-sacral vertebrae, but differs from it and all other DELPHINIDAE with which I am acquainted in the manner of the attachment of the epiphyses of the vertebrae. Instead of being nearly plane and thin discs, they are furnished with two oblique faces above, which are capped by a projecting roof formed by the floor of the neural canal, while their central portion forms a knob which fits a corresponding shallow pit of the centrum."

IXACANTHUS CONRADI (Leidy).

Delphinus conradi Leidy, 1852, Proc. Acad. Nat. Sci. Phila., vol. vi, p. 35.
Delphinus conradi Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 144 (mention only).
Priscodelphinus conradi Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 188.
Priscodelphinus conradi Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 433 (mention only).
Belosphys conradi Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.
Ixacanthus conradi Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—The species was described by Leidy in 1852 from a single lumbar vertebra. "The epiphysial extremities of the vertebrae are pentahedral.

Length of vertebral body ....$2\frac{1}{8}$ inches (55 mm.)
Breadth of epiphysial extremities ....$1\frac{3}{4}$ inches (43 mm.)
Breadth of base of transverse process....$1\frac{3}{4}$ inches (43 mm.)"

In 1868 Cope added from additional material: "Its affinities are apparently nearer the last mentioned species (*P. harlani*) than any other."

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—The type specimen was probably placed in the museum of the Academy of Natural Sciences of Philadelphia but seems to be lost. Cope's specimens are there.

IXACANTHUS STENUS Cope.

Plate XIII, Figs. 1a, 1b.

Priscodephinus stenus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 188.
Priscodephinus stenus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p 433 (mention only).
Belosphys stenus Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.
Ixacanthus stenus Cope, 1890, Amer. Nat., vol xxiv, p. 614.

Description.—The species was described from two lumbar vertebrae. "They indicate both the smallest and the most slender species of the genus. A section of the vertebrae would have an almost pentagonal form, though the articular faces are sub-round, and, what occurs in no other species, a little deeper than wide. The neural arch preserved in elevated and possesses a weak pair of zygapophyses. The bases of the broken diapophyses indicate that they are very wide. The lower face of the centrum has a strong median longitudinal angle, stronger than in any other species, and not prolonged into a keel. . . . The planes of the centra are mostly straight."

"Length centrum	1 in. 7.2 lines	(39.4 mm.)
Height	1 in. .5 lines	(26 mm.)
Width	1 in. .5 lines	(26 mm.)
Width neural canal	5.8 lines	(11.6 mm.)
Width basis diapophysis	10 lines	(20 mm.)
Height neural canal	6 lines	(12 mm.)
Height zygapophysis	8.2 lines	(164 mm.)"

COPE, 1868.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

IXACANTHUS SPINOSUS Cope.

Plate XIII, Figs. 2, 3a, 3b, 4.

Priscodelphinus spinosus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, pp. 187, 188.

Priscodelphinus spinosus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., vol. vii, p. 433 (mention only).

Belosphys spinosus Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.

Ixacanthus spinosus Cope, 1890, Amer. Nat., vol. xxiv, p. 603, fig. 1, p. 615.

Description.—The vertebrae are described as "about as broad as long, with articular faces transversely oval and general form depressed; sides of centrum nearly plane to a well marked obtuse median keel."

Length centrum lumbar	1 in. 9 lines	(43 mm.)
Width articular face	1 in. 7.5 lines	(40 mm.)
Height	1 in. 6 lines	(37 mm.)
Length diapophysis	2 in.	(50 mm.)
Width neural canal of } Posterior lumbar	3 lines	(6 mm.)
Whole height of .... } Posterior lumbar	3 in. 8 lines	(91 mm.)
Length diapophysis of } Posterior lumbar	1 in. 6.5 lines	(38 mm.)

This specimen consisted of 2 cervicals, 3 dorsals, and 8 lumbars; the lumbars are characterized by the long spinous transverse processes. Cope says of this species, "this is the type of the genus, for in it the peculiar form of the diapophyses extends much farther forward on the series of vertebrae than in any other." COPE, 1868.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

IXACANTHUS ATROPIUS Cope.

Plate XIII, Figs. 5a, 5b, 6.

Priscodelphinus atropius Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, pp. 187, 188.

Priscodelphinus atropius Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 433 (mention only).

Belosphys atropius Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.

Ixacanthus atropius Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—"The diapophysis of the caudal is short and spinous, as in the last species (*P. spinosus*), and the last lumbar has had a nearly similar process. The centra of all are very slightly compressed and constricted medially. The dorsals are broadly rounded in section without inferior carina; on the last lumbar the lateral face below becomes, as in other species, slightly concave."

"Length of dorsal (1)	2 in. 2 lines	(54 mm.)
Width articular face	1 in. 11.5 lines	(48 mm.)
Depth articular face	1 in. 7 lines	(39 mm.)
Height neural canal (2)	9.7 lines	(44.4 mm.)
Length diapophysis (1)	1 in. 4 lines	(33 mm.)"

COPE, 1868.

This species differs from *P. harlani* in that the dorsals are less depressed, stouter and lack the inferior keel. There were three specimens considered in the formation of the species, representing among them vertebrae from the dorsal, lumbar and caudal regions.

Occurrence.—Calvert Formation. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Ixacanthus coelospondylus Cope.

Plate XIV, Figs. 1, 2.

Ixacanthus coelospondylus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, pp. 159, 187.

Ixacanthus coelospondylus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).

Ixacanthus coelospondylus Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—In the report of his verbal communication Cope stated that the "form was allied to *Priscodelphinus* in its slender and pointed diapophyses of the lumbar and caudal vertebrae, but differed in the concave centrum, with four processes clasping the epiphysis."

The specific description is as follows: "Extremities of the centra deeply concave when epiphyses are removed; length of vertebrae less than breadth.

Length of centrum lumbar	2 in.	4.5 lines	(59 mm.)
Width centrum lumbar	2 in.	6.5 lines	(63 mm.)
Elevation centrum lumbar	2 in.	4 lines	(58 mm.)
Width neural canal on dorsal....	1 in.		(25 mm.)
Width neural canal on lumbar ...		.45 lines	(.9 mm.)
Length caudal vertebrae	2 in.	6 lines	(62 mm.)
Transverse diameter	2 in.	3 lines	(56 mm.)
Width diapophysis at base		6 lines	(12 mm.)
Lumbar, elevation of body and spine to anterior zygapophyses.	4 in.	9.5 lines	(119 mm.)"

In the American Naturalist, Vol. XXIV, 1890, Cope remarks that this species was short and robust; about the size of the White whale (*Beluga*).

There are mentioned as belonging to this form 3 dorsals, 9 lumbosacrals and 1 caudal, not necessarily belonging to the same individual; of these only a portion are preserved in the museum of the Academy of Natural Sciences of Philadelphia. The others seem to be lost.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Genus ZARHACHIS Cope.

ZARHACHIS FLAGELLATOR Cope.

Plate XIV, Fig. 3.

Zarhachis flagellator Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 189.
Zarhachis flagellator Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 9.
Zarhachis flagellator Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).
Zarhachis flagellator Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—In 1869 Cope gave the following description of the genus: "This genus is established on vertebrae which bear a general resemblance to those of *Priscodelphinus*, but differ in the essential point of having flat and broad diapophyses of the caudals. It is therefore intermediate between that genus and *Delphinapterus*. The posterior caudals in our museum exhibit a narrowing of the diapophyses, as in certain of the lumbars do in *Priscodelphinus*.

"All these vertebrae are of a greater length as compared to the diameter than in any cetacean known by me except the great *Basilosaurus*. The lumbars, when compared with those of *T.* (*Tretosphys*) *lacertosus*, differ in their broadly obtuse median line, which offers distinct traces of two keels. An anterior caudal either exhibits unusually broad diapophyses, which are directed downwards, or else is a lumbar with two keels, and a median groove below, which is not seen in any other species. The caudals exceed in length those of any other species. One of these, from a large individual, resembles *P. atropius* in the narrow basis of the diapophysis, which is probably narrow, and not perforate. The length of the vertebra is nearly double the vertical depth of the articular faces. The diapophysis is nearly median; the basis of each neurapophysis is one-half the length of the centrum and median.

Length lumbar (epiphysis hypothetical)	3 in.	6.3 lines	(87.6 mm.)
Depth	2 in.	2 lines	(54 mm.)
Width	2 in.	3 lines	(56 mm.)
Width neural canal	2 in.	8 lines	(66 mm.)
Length caudal (one epiphysis supplied)	3 in.	10.5 lines	(96 mm.)
Depth caudal	2 in.	4 lines	(58 mm.)
Distance between inferior keels		10.5 lines	(21 mm.)
Width basis diapophysis		10.5 lines	(21 mm.)"

In 1869 the characters here given were corrected. "It was stated to differ from *Priscodelphinus* in that, while some caudals had spinous diapophyses, others possessed them flat, but imperforate. A vertebra supposed to indicate the latter characters I am now compelled to refer to another species and probably genus. Other vertebra assigned to *Z. flagellator* must be referred elsewhere. A lumbar vertebra represents another species of probably the same genus, while a third has evidently pertained to still a third species. The genus will be characterized by the extraordinary length and slenderness of the lumbar vertebrae, and similar, though slightly abbreviated form of the caudals. The latter have spinous diapophyses, and in one species the former also. While the width of the articular faces of the centra of these vertebrae in the typical *Priscodelphinus* is but few lines less than the length, in the species of this genus the diameter of the same is only from four-sevenths to one-half of the length. The nearest approach is made by *Priscodelphinus stenus,* where this diameter is six-sevenths of the length."

In the same article as the last quoted Cope gave a synopsis of the characters of the species of this genus.

" I. Median or anterior caudal with a strong longitudinal keel above the diapophysis—which is therefore probably present on the distal lumbars.
Epiphysis thicker, larger .... *Z. flagellator.*

II. No longitudinal keel on lumbars, Diapophyses broad, flat; epiphyses thin, large .... *Z. tysonii.*

III. Diapophyses narrow, subspinous; epiphyses thin, small ..... *Z. velox.*"

The species *velox* has not been reported from Maryland.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

ZARHACHIS TYSONII Cope.

Zarhachis tysonii Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 9.

Zarhachis tysonii Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).

Zarhachis tysonii Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—This species was based on one posterior lumbar. "The attenuated form characteristic of the genus is accompanied by broad diapophyses showing that, as in *Priscodelphinus,* the species differ in the number of posterior vertebrae which exhibit the contraction of the diapophyses.

"The specimen preserved belonged to an adult animal. It was apparently one of the posterior lumbars, as there are two feeble longitudinal ridges beneath, whose interval is again obtusely ridge and perforated by several foramina. The inferior outline is strongly concave in longitudinal section, and all the planes are concave in transverse section. The articular faces are a little wider than deep. The neurapophyses occupy a base of .75 the length of the centrum. The diapophyses are about equidistant between them and the nearest inferior ridge.

Total length of centrum	48 lines	(96 mm.)
Transverse diameter articular face	29 lines	(58 mm.)
Vertical diameter articular face	27 lines	(54 mm.)
Width neural canal (internal)	5 lines	(10 mm.)
Width between inferior ridges	8 lines	(16 mm.)"

Occurrence.—ST. MARY'S FORMATION. Near the mouth of the Patuxent river.

Collection.—Reported in the Museum of the Philadelphia Academy of Natural Sciences.

Genus CETOPHIS Cope.

CETOPHIS HETEROCLITUS Cope.

Plate XIV, Fig. 4.

Cetophis heteroclitus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 185.
Cetophis heteroclitus Leidy, 1869, Jour. Acad. Nat. Sci., 2nd ser. vol. vii, p. 431 (mention only).
Cetophis heteroclitus Cope, 1890, Amer. Nat., vol. xxiv, pp. 603, 606.

Description.—This genus and species were founded upon caudal vertebrae. "They present an approximation to *Basilosaurus* in the great thickness of their epiphyses. In the more elongate vertebrae each epiphysis will measure the third in length of the centrum deprived of them; in the less elongate, they measure one-half the same; in the shortest, more than half the remaining centrum. One extremity of the vertebra is flat, the other strongly convex, and none have any trace of diapophyses." . . . "In two vertebrae, the longest and the shortest, the foramina which usually pierce the sides of the centra vertically, issue below, within the basal groove and above, below and outside the basis of the neurapophysis. In another specimen the foramen opens outside the inferior sulcus, and in one there is no foramen at all."

The original description of the species is as follows: "The longer or proximal caudal is subhexagonal in section, the median depressed and the smallest round in section. The larger median is nearly round in section. The epiphysis instead of retreating before a process of the centrum opposite the four apophyses, as in *Ixacanthus*, advances on the centrum at these points. The inferior groove is deep on the first and shallower on the succeeding; obsolete on the last.

Length smallest	2 in.	1	line	(49 mm.)
Length without epiphyses		11	lines	(22 mm.)
Height flat extremity	1 in.	10.5	lines	(45 mm.)
Width flat extremity	1 in.	11	lines	(46 mm.)"

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Only one specimen of the type the smallest vertebrae is preserved. It is in the Museum of the Academy of Natural Sciences of Philadelphia.

Genus RHABDOSTEUS Cope.

RHABDOSTEUS LATIRADIX Cope.

Plate XV, Figs. 1, 2, 3a, 3b, 4a, 4b, 5.

Rhabdosteus latiradix Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 132 (report of verbal communication), and pp. 144, 145.

Rhabdosteus latiradix Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).

Rhabdosteus latiradix Cope, 1890, Amer. Nat., vol. xxiv, p. 607, fig. 4, p. 615.

Description.—In the report of the verbal communication of Cope we find the following: "*Rhabdosteus latiradix* Cope was a peculiar genus near the DELPHINIDAE, allied to *Priscodelphinus* Leidy, and perhaps *Platanista* of the Ganges. Characteristic of it was a muzzle formed of the usual elements but entirely cylindrical, the alveolar series approximated underneath, and ceasing near the middle. Beyond this the muzzle was prolonged like a cylindrical beak of a sword-fish, or *Coelorhynchus,* and probably much farther than the mandible. Alveolae longitudinal. Fragmentary specimens of this muzzle have been found by the discoverer 2.5 feet in length."

On page 145 of the same volume Cope gives the generic and specific description of the form. "This genus is either referable to a family not yet characterized, allied to the PLATANISTIDAE and DELPHINIDAE, or belongs to the first named of these recent families.

"Premaxillary and maxillary bones forming a cylinder, bearing teeth on its proximal portion, and prolonged in its distal portion into a slender straight beak. Teeth with the enlarged crown separated from the fang by a constriction."

The original description of the species is as follows: "A portion of the muzzle of this species which is preserved, measures 12 inches 7.5 lines in length, 12.5 lines in transverse, and 11 lines in vertical diameter at the base.

"The superior edge of the maxillary bone forms the external outline, while the remainder of this element is entirely inferior. The palatine face is convex, and the alveolar series approximated. The alveolae themselves are longitudinal, two in .75 of an inch, and separated from each other by spongy septa. The vomer does not appear in the portion of the muzzle at my disposal.

Width of premaxillary	6 lines	(12 mm.)
Width superior face of maxillary.....	4.75 lines	(9.50 mm.)
Width palatine face of maxillary	4.5 lines	(9 mm.)

"Three teeth are referred with much probability to this species. The fangs are from equal to twice the length of the crowns, and are much compressed, widening downwards, and more or less prolonged at one inferior angle, in the same plane. The crown, compressed transversely to the root, and expanded above the base, straight or slightly curved in the direction of its plane. Enamel smooth, edges obtuse. The compressed fang corresponds to the longitudinal alveolus while the transverse dilatation of the crown is similar to the form of those of *Platanista*.

Length of the longest specimen.........	12 lines	(24 mm.)
Length of the crown	5 lines	(10 mm.)
Width of fang	3 lines	(6 mm.)"

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—The type specimen is preserved in the Museum of the Academy of Natural Sciences of Philadelphia.

Genus LOPHOCETUS Cope.

"Temporal fossa truncated by a horizontal crest above, prolonged backward and bounded by a projecting crest, which renders the occipital plane concave. The same crest prolonged upward and thickened, each not meeting that of the opposite side, but continued on the inner margins of the maxillary bones, turning outwards and ceasing opposite the nares. Front, therefore, deeply grooved. Premaxillaries separated by a deep groove. Teeth with cylindrical roots." Cope, 1867.

The genus was regarded as belonging very close to the living genera *Pontoporia* and *Inia*. "The resemblance to *Inia* is the closest. The only feature which renders a generic distinction certain is the cylindric form of the posterior alveolae, which renders it probable that the teeth were not furnished with lobes as in *Inia*."

Lophocetus calvertensis (Harlan).

Plate XVI, Figs. 1a, 1b, 1c.

Delphinus calvertensis Harlan, 1842, Proc. Nat. Inst., Bull. ii, p. 195, figs. 1-4.
Delphinus calvertensis Dekay, 1842, Nat. Hist. of New York, Zool., pt. i, p. 136.
Pontoporia calvertensis Cope, 1866, Proc. Acad. Nat. Sci. Phila., vol. xviii, p. 297.
Lophocetus calvertensis Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 144-146.
Lophocetus calvertensis Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 435 (mention only).
Lophocetus calvertensis Cope, 1890, Amer. Nat., vol. xxiv, pp. 606, 615.

Description.—"In *Lophocetus calvertensis* the nasal bones are separated by a deep fissure. The maxillaries exhibit, on each side in front of the external nares, two oval roughened surfaces, which converge behind the nares. These appear to be insertions, perhaps for cartilaginous crests, comparable to the bony roofs of *Platinista*, less probably, for muscles connected with the external meatus.

"The form of the muzzle is not elongate, as in the known species of *Pontoporia*, and it is much expanded, proximally, instead of contracted, as in the latter."

On page 196 of Harlan's paper appears the following description: "The occipital and frontal ridges are strongly developed, indicating muscular strength, especially of the jaws. We find similar indications in the remains of the teeth, which have been large and robust. There are ten sockets remaining on the right side, with the teeth broken off at the rim. These organs approximate each other. The ten sockets include a line four and a half inches long. There has been about one and a half inches of the snout broken off, which would afford room for two or three more teeth, making twelve or thirteen, in all, on each side. The pyramidal eminence, anterior to the posterior nares, on the palatine surface, is strongly pronounced. It terminates opposite the last tooth. The excavations or longitudinal grooves, on each side of the upper portion of this eminence, are unusually deep. The palatine surface is slightly convex transversely. Above, the head is narrower across the occipital ridges than other allied species, and narrower than the transverse diameter of the base of the skull. The *ossa nasi* are longer than broad, and convex. The atlas vertebra adheres to the occiput, above the condyles. It measures, across the transverse processes, five inches; transverse diameter, three inches; and the ring is about one inch thick.

Dimensions:

Total length of head, from the temporal crest to the presumed extremity of the jaw	17 in.	(425 mm.)
From the anterior borders of the spiracles to the presumed extremity of snout	11.5 in.	(287.5 mm.)
Breadth of skull above, across the occipital crests.	5 in.	(125 mm.)
Breadth at base, between the temporal bones	6.5 in.	(162.5 mm.)
Longest diameter of largest tooth at the socket..	3.5 in.	(87.5 mm.)"

In the Museum of the Academy of Natural Sciences of Philadelphia there is a tray of vertebrae, one of which is labelled in ink *T.* (*Tretosphys*) *pseudogrampus*, over this there has evidently been pasted a paper label which is now lost. Three other vertebrae in the same tray bear pasted paper labels *Delphinapterus tyrannus*. There is a loose label in the tray marked "*Delphinus calvertensis* Harlan (Fossil Dolphin) Miocene, Calvert Cliffs, Md." This makes the identification of the specimens rather difficult. However, I have found no mention of the discovery of vertebrae belonging to *Lophocetus* (*Delphinus*) *calvertensis* and am inclined to believe that the last is a misplaced label.

Occurrence.—CALVERT (possible CHOPTANK) FORMATION. Calvert Cliffs.

Genus DELPHINODON[1] Leidy.

"The most characteristic tooth, represented in figures 7 and 8, plate xxx, supposed to be a premolar, is very unlike the corresponding teeth, so far as we are acquainted with them, in the distinct species of *Squalodon*. The crown of this tooth is subtrihedral conical, as broad

[1] This and the following genus, founded on teeth, are regarded by Cope as belonging to the PLATANISTIDAE but by Zittel as possibly belonging in the anterior series of some member of the SQUALODONTIDAE. The discovery of a more complete dentition, only, can settle this question. Cope's classification seems the most probable.

as it is long, ovoid in section at the base, and with a slight twist inwardly. The inner and outer surfaces are very unequal, and separated by linear, rugulose ridges. The back of the crown forms, at its basal half, a thick convex tubercle crossed by the posterior dividing ridge and bounded near the base by a short embracing ridge. The anterior dividing ridge of the crown pursues a sigmoid course from the summit postero-internally to the base antero-internally. The inner and outer surfaces of the crown are conspicuously wrinkled and the former has, in addition, an irregular curved ridge, terminating in a basal tubercle and dividing off the anterior more wrinkled third of the inner face of the crown, from the posterior two-thirds of the same surface. The fang is more than three times the length of the crown, strongly curved backward, slightly gibbous near the crown and compressed near the front.

"Length of the crown 6 lines (12 mm.); breadth 6 lines (12 mm.); thickness 4¾ lines (9.5 mm.)" Leidy, 1869.

Delphinodon mento Cope.

Plate XVII, Figs. 1, 2.

Cetacean Wyman, 1850, Amer. Jour. Sci., vol. x, ser. ii, pp. 230–232, figs. 4–7.
Squalodon mento Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 132, 144, 152.
Delphinodon mento Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 424, pl. xxx, figs. 7–9.
Delphinodon mento Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Description.—The species is "characterized from four molar teeth which were between two and three times as large as those belonging to *Squalodon wymani* (*Phoca* of Leidy) with similar short incurved crowns, but much more rugose. One molar had a smooth compressed fang, which was a little curved and with a groove on each side. The fangs of others were weathered, not grooved, curved and acute." Cope, 1867.

Occurrence.—Calvert Formation. Charles county near the Patuxent river.

Collections.—The type is in the Museum of the Academy of Natural Sciences of Philadelphia.

DELPHINODON LEIDYI (Hay).

Plate XVI, Figs. 3, 4, 5.

Phoca wymani Leidy, 1856, Proc. Acad. Nat. Sci. Phila., vol. viii, p. 265.
Squalodon wymani Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 151, 152 (*not* p. 132).
Delphinodon wymani Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 425, pl. xxx, fig. 10.
Delphinodon wymani Cope, 1890, Amer. Nat., vol. xxiv, p. 614.
Delphinodon leidyi Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 591.

Description.—"One of the teeth (pl. xxx, fig. 10) bears a resemblance to the first described of the large species (*mento*).

"Its crown is proportionately longer, and the posterior tubercle and internal curved ridge of the crown are rudimental, but it has the same general form, with the abrupt curvature and slight twists of the summit backward and inward. The ridges defining the inner and outer surfaces of the crown are alike in their course and the enamel is likewise wrinkled.

"The fang has the same form but is comparatively less curved.

"Length of fang 5 lines (10 mm.); breadth 3¾ lines (7.5 mm.); thickness 3 lines (6 mm.)"

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—The type is in the Museum of the Academy of Natural Science of Philadelphia.

Family DELPHINIDAE.

This family differs from the foregoing in the anchylosis of the cervical vertebrae; in the shortness of the nose which is never developed into a rostrum of any length; in the shortness of the symphysis which never exceeds one-third the length of the jaw. The teeth are usually simple and very numerous in both jaws but may be reduced to a single greatly elongated tooth in the upper jaw as in the male of the Narwhal (*Monodon*). To this family belong the common Porpoise (*Phocoaena*), the Dolphin (*Delphinus*), the Killer Whale (*Orca*) and many other living forms.

No members of this family have been described from the Miocene beds of Maryland.

Family PHYSETERIDAE.

Teeth entirely absent in the upper jaw and quite variable in the mandible, either numerous as in the sub-family PHYSETERINAE, or reduced even to a single tooth in each jaw as in some of the ZIPHIINAE. In both of these families the bones of the cranium posterior to the nares form an elevated crest that converts the facial region into a considerable concavity, it is in this concavity that the oily material from which spermaceti is refined finds lodgement. *Physeter, Mesoplodon* and *Hyperoodon* are living members of this family.

Genus HYPOCETUS Lydekker.[1]

"The genus *Paracetus* has recently been proposed by Lydekker[2] to include members of this family (PHYSETERIDAE) which possess a well developed series of teeth in the (?) premaxillary and maxillary bones. It is up to the present time represented by one species, the *Paracetus pouchetii* Moreno, of the Santa Cruz beds of eastern Patagonia, of the district of Chebut. The present species is apparently not distinctly related to that one. . . ." Cope, Proc. Amer. Philos. Soc., pp. 135-155, 1895.

HYPOCETUS MEDIATLANTICUS (Cope).

Plate XVII, Figs. 6a, 6b.

Paracetus mediatlanticus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 270.
Hypocetus mediatlanticus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 596.

Description.—" Char. Specif. As the posterior border of the skull and the extremity of the muzzle of the specimen are broken off, an exact idea of its outline cannot be given. However, the form was probably much as in the *P. pouchetii*, and more elongate than in the species *Cogia*. This form is subtriangular, with the base border convex, and the two lateral ones concave. The muzzle is probably, however, produced into a rostrum, as the maxillary borders are parallel at the point where it is broken off. On the right side, where the maxil-

[1] This genus is called *Hypocetus* in his Catalogue of the Fossil Vertebrata of North America.

[2] Anales del Museo de la Plata; Paleontologia Argentina; II, Cetacean Skulls from Patagonia, p. 8, pl. iii.

lary bone is best preserved, there are eight alveoli; the teeth are lost. The lateral border of the maxillary bone overhangs the tooth line considerably in front, and spreads away from it outwards and backwards in a gradually thinner edge to the deep notch which bounds the supraorbital region anteriorly. The rise of the anterior border of the facial basin is within this notch, and not without it, as in the species of *Cogia;* and is gradual, attaining a considerable elevation immediately in front of the temporal fossa, and a little within the vertical plane of the supraorbital border. The premaxillary bones are separated by the deep vomerine channel which they partially overroof on each side, and are separated posteriorly by the prenarial part of the vomer posteriorly. The latter forms an elevated crest directed forwards and unsymmetrically to the right. The premaxillaries spread gradually outwards posteriorly to a thin margin, and are concave opposite to the vomerine crest which separates them, that of the left hand descending to the narial orifice. The skull is broken off at the blowholes, so that it is difficult to affirm positively whether the right blowhole existed or not. It was apparently present, but smaller and posterior in position to the right one. The inferior surface of the maxillaries slopes upwards and outwards, leaving the inferior face of the vomer quite prominent below. The vomer forms the half of a circle in transverse section above, and extends as far anteriorly as the specimen extends.

"There is a large supraorbital foramen between the preorbital notch and the rising edge of the facial crest, as in the sperm whale; and there is a smaller one in a direct line posterior to it just exterior to a more elevated part of the crest, within a line above the posterior part of the supraorbital border. A longitudinal groove anterior to the supraorbital foramen is pierced in its fundus by two foramina. Anterior to the groove a depressed foramen pierces the maxillary bone near the premaxillary border. Anterior and interior to the corresponding foramen of the left side a depressed foramen pierces the premaxillary bone. This foramen is absent from the right side. On the other hand, the right premaxillary is pierced near the anterior part of the vomerine crest by a large round foramen, which is wanting from the left side.

A large foramen pierces the inner side of the lateral crest half-way to the superior border, and opposite the middle of the left blow-hole.

"The dental alveoli are subround, and are separated by narrow septa. They are not deep, the deepest equalling 50 mm., so that the teeth have been easily lost.

Measurements.

Length of fragment on middle line	800 mm.
Width of skull at supraorbital notch; left side restored	800
Width of muzzle where broken off	172
Width of right premaxillary at middle of length	100
Width of left premaxillary at middle of length	150
Width of right premaxillary at vomerine keel	100
Width of left premaxillary at vomerine keel	170
Elevation of lateral crest above orbit (apex broken off)	310
Length of series of eight teeth	165"

Cope, 1895.

Occurrence.—St. Mary's Formation. Drum Point.

Collection.—Johns Hopkins University.

Genus ORYCTEROCETUS Leidy.

Cope in 1867 thus characterizes the genus. "*Orycterocetus* Leidy. This genus differs from *Physeter* in the extensive pulp cavity of the teeth, and the absence of the surface cementation."

Orycterocetus crocodilinus (?) Cope.

Plate XVII, Fig. 7.

Orycterocetus cornutidens Leidy, 1856, Proc. Acad. Nat. Sci. Phila., vol. viii, p. 255.
Orycterocetus cornutidens Emmons, 1858, Rept. N. Car. Geol. Survey, p. 211, fig. 33.
Orycterocetus crocodilinus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 144.
Orycterocetus cornutidens Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 437.

Description.—"This species is based on a tooth belonging to an individual of one-third or one-fourth the size of the known species, *O. cornutidens* Leidy, but nevertheless adult, as attested by the obliquely worn apex of the crown. The general form is that of an elongate curved cone, with flattened sides, and a broad convex face within the curve, and a narrower one on the outside. The tooth is marked by numerous irregular transverse lines, similar to those frequently marking growth, and by longitudinal shallow grooves. The pulp-cavity extends for two-thirds the length of the tooth, being thus relatively deeper than in the known species, and is also very large, thinning the external wall out to an open basis. In the known species the walls are relatively thicker, and for a considerable distance parallel to each other. The form of the tooth is in some degree similar to the crown of the canines of some crocodiles. There is no enamel on the teeth of Cetaceans of this genus.

"Total length, 2 inches, 5 lines; long diameter at base, 8.25 lines; diameter at middle, 6 lines." Cope, 1867.

In 1869 Leidy repeats the characters of *O. cornutidens:* "conical, strongly curved, and proportionately much broader approaching the base than in the preceding species [*O. quadratidens*]; nor does it assume a quadrate appearance, but is nearly circular or ovoidal in transverse section. The deep conical pulp cavity is defined by a sharp edge at the periphery of the base."

In this article Leidy remarks that Cope's *O. crocodilinus* is most likely a young individual of *O. cornutidens,* also he says that in the light of the great variability in the teeth of the PHYSETERIDAE in general that he regards it as very possible that all three species, described from teeth, belong to the same species.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Cope's type of *O. crocodilinus* is in the Museum of the Academy of Natural Sciences of Philadelphia.

Suborder MYSTICOCETI.

In this suborder the teeth are never developed beyond an embryonic condition. Rudimentary teeth which disappear before birth are interesting indications of the ancestry of the forms. The upper jaws are greatly arched and from their lower sides depend the great plates of baleen, "whale-bone," which give to the animal its characteristic appearance; the lower jaws are greatly arched in a horizontal plane. The combination of these two give an enormous extent to the cavity of the mouth. The external nares are located on the top of the head but do not extend vertically downwards as in the ODONTOCETI, they extend more backwards and downwards and are roofed by plate-like nasal bones. The ribs are loosely articulated to the bodies of the vertebrae by a single head only. By some these members of this suborder are divided into two families, the BALAENIDAE and BALAENOPTERIDAE, founded mostly on external characters, but Flower and Lydekker consider that intermediate forms have rendered the division an unnecessary one. *Balaena*, the common Right Whale, and *Balaenoptera*, the Rorqual, are the best known of the living forms.

Family BALAENIDAE.

In 1895, Cope[1] described several new members of the family BALAENIDAE. He prefaced his descriptions with a summary of the characters and relations of the Neocene members of the family which it seems valuable to repeat here. He said: "I have remarked that the Mysticete with its single family, the Balænidæ[2] 'would seem to have derived their descent from some form allied to the Squalodontidæ, since their nasal bones are more elongated than those of the Odontoceti, and in Plesiocetus' (Cetotherium) 'the superior cranial bones show some of the elongation of that family.' This elongation of the superior cranial wall is not seen in the genus Squalodon, but is moderately developed in the genus Prosqualodon of Lydekker, founded on the *P. australis* Lydd. from Patagonia. It is exhibited in a still more marked degree by the genus Agorophius g. n. Cope, which is represented by the *Zeuglodon pygmæus* of Müller, which was referred to Squalodon by Leidy. The form of the skull in this genus approaches distinctly that of Cetotherium of the Balænidæ, and the permanent loss of the teeth would probably render it necessary to refer it to the Mystacocete.

"Stages of transition from some such genus as Agorophius to the typical whalebone whales are represented by several genera from the Yorktown beds. Theoretically the loss of teeth *by failure to develop* would be accompanied by the loss of the interalveolar walls, leaving the dental

[1] Proc. Amer. Philos. Soc., vol. xxxiv, 1895, p. 139.

[2] "On the Cetacea," Amer. Nat., vol. xxiv, 1890, p. 611.

groove continuous and separate from the dental canal. A genus displaying these characters has not been discovered, but I have no doubt that it will be. The new genus Siphonocetus Cope exhibits the groove roofed over by ossification of the gum, and distinct from the dental canal. The genus Ulias indicates that a still farther degeneracy took place, in the fusion of the dental groove and dental canal, while the groove remained open. In Tretulias the same condition persists with the addition that the gingival passages and foramina are present, as in the genus Siphonocetus, and in the later genera. In Cetotherium and in later Balænidæ the groove and canal are fused, the gingival roof is complete, and it is perforated. It would appear, then, that Ulias may be descended from the undiscovered genus above mentioned, while Tretulias is descended from Siphonocetus. The exclusively Neocene genera may be tabulated as follows:

I. Alveolar groove and dental canal distinct.
  Alveolar groove open.................................Not discovered.
  Alveolar groove roofed over and perforate........*Siphonocetus* Cope.
II. Alveolar groove and dental groove confluent in a gingivodental canal.
  Gingivodental canal open; no gingival canals............*Ulias* Cope.
  Canal open; gingival canals at one side.............*Tretulias* Cope.
  Canal with complete and perforate roof........*Cetotherium* Brandt."

Genus METOPOCETUS Cope.

"*Char. gen.* Lateral occipital crests continuous with anterior temporal crests which diverge forwards. Frontal bone elongate, not covered posteriorly by the maxillary, coössified with the nasals. Nasals short, coössified with each other, not projecting anterior to frontals.

"Accompanying the cranial fragment on which this genus is founded is a piece of a premaxillary bone of appropriate size, which presents the character of that of a whalebone whale. The true position of this genus is probably between Cetotherium and Agorophius. It is probably a mysticete which approximates the ancestral zeuglodont type which is represented in our present knowledge by the genus Agorophius. It is connected with Cetotherium by the new genus Cephalotropis, which is described below. The three genera form a group, which may be properly referred to the Balænidæ, which is characterized by the elongation of the frontal and parietal bones on the superior walls of the skull. They differ as follows:

A temporal ridge; maxillaries little produced posteriorly; nasals not produced beyond frontal, coössified with the frontal and with each other .... *Metopocetus* Cope.
A temporal ridge; maxillaries much produced posteriorly; nasals free from frontals and from each other, produced well anteriorly. *Cephalotropis* Cope.
No temporal ridge; maxillaries much produced posteriorly; nasals free from frontals and from each other, well produced forwards........ *Cetotherium* Brandt.

"The specimen on which the genus Metopocetus is founded is quite mature, so that the sutures are coössified. The frontomaxillary and frontopremaxillary sutures are, however, distinct, as they appear to me, and they are remarkable for their position. They extend but little posterior to the external narial openings. The latter are, in relation to the supraoccipital crest, anterior, but in relation to the position of the nasals, posterior. The nasals are short for a Balænid, although they enter wedge-like into the frontals for a considerable distance.

"The position of the genera Metopocetus and Cephalotropis may be similar to that of the genera Ulias and Tretulias, which are known from mandibular rami only. One or both of the former may be identical with one or both of the latter; but of this there is as yet no evidence." Cope, 1896.

METOPOCETUS DURINASUS Cope.

Plate XVIII, Figs. 1, 2a, 2b.

Metopocetus durinasus Cope, 1896, Proc. Amer. Philos. Soc., vol. xxxv, p. 141, pl. xi, fig. 3.

Description.—"The specimen which represents the *Metopocetus durinasus* is a cranium posterior to the nares, lacking the left exoccipital and squamosal regions, and the right zygomatic process. Both occipital condyles are preserved, and the basicranial region as far as the anterior nares.

"The supraoccipital extends well forwards and its lateral crests present a moderate concavity outwards and forwards. Its apex is represented by a semicircular mass, posterior to which it is deeply concave, and the concavity is divided by a longitudinal median crest. The temporal fossæ approach together on the median line, forming a short sagittal crest, which is about as wide as it is long. From this the temporal ridges diverge abruptly, and these extend in a nearly straight line forwards, diverging from the line of the axis of the skull at an angle of about twenty-five degrees. Between it and the lateral occipital crest the temporal fossa is concave to the line of the anterior border of the squamosal bone. At the latter point the line of the suture presents an angle, which extends downwards, outwards and forwards. Between it and the posterior temporal crest the surface is concave above.

"The exoccipital is flat vertically, and extends a little posterior to the transverse line of the occipital condyles. The postglenoid face of the squamosal is vertical, and it projects laterally beyond the exoccipital. The postglenoid crest is not conspicuous, and the glenoid cavity presents downwards, and very little forwards. The posterior temporal crest bounds a groove of the superior face of the part of the squamosal that lies posterior to it. The latter face is quite wide, and its external bounding angle is a right angle. It is continued as the superior face of the zygomatic process.

"The petrous bone has a peculiar form. Its mastoid portion presents externally a nearly discoid outline between the exoccipital and squamosal. Its inferior portion descends as a process which forms the short stem of a half-tubular horizontal portion, which opens downwards and posteriorly, forming a partial meatus auditorius.

"The lateral descending borders of the basioccipital are so prominent as to enclose a deep groove between them. The posterior nares are about opposite to the anterior border of the foramen lacerum.

"The frontal region at its posterior apex is convex from side to side. As it widens it presents three subequal faces, two lateral and one median. The median plane is separated from the laterals by a shallow groove on each side, which become deeper anteriorly, and turn abruptly outwards at the narial border. They appear to be the outlines of the nasal bones. Anteriorly the lateral planes become thickened longitudinally just external to these grooves. The entire anterior portion of the external planes is a sutural surface, with longitudinal grooves for a length averaging 40 mm. This surface can relate to nothing but the premaxillary and maxillary elements. This point of attachment is, however, anterior to that of any known genus of Mysticete; and is anterior to that in the *Agorophius pygmæus* Müll. In not extending so far posteriorly as the nasal bones, it leaves the frontals to embrace the latter anteriorly to an unusual extent. This is on the supposition that the indistinct grooves on each side of the middle line really represent the lateral borders of the nasal bones, which is not certain, except as to their anterior portions.

Measurements.

	mm.
Width of skull at exoccipitals	406
Width of skull at postglenoid angles	570
Width of occipital condyles	150
Width of foramen magnum	65
Width of sagittal crest	17
Width of anterior border of nasal bones	90
Width of skull at sagittal crest	170
Width of sphenoid at middle of for. lacerum	135
Anteroposterior diameter of glenoid surface	115
Length of nasal canal	250
Length from occipital condyles to anterior nares	450
Length from foramen magnum to posterior end of sagittal crest (oblique)	210
Length of sagittal crest	15
Length from sagittal crest to anterior nares	195"

Cope, 1896.

Occurrence.—St. Mary's Formation. Near the mouth of the Potomac river.

Collection.—Museum of the Woman's College of Baltimore.

Genus CEPHALOTROPIS Cope.

"*Char. gen.* Parietal bone separating supraoccipital and frontal by a considerable space and presenting a sagittal crest. Frontal extensively overlapped by the maxillaries, premaxillaries and nasals. Nasal elongate, distinct from the adjacent elements. Frontals presenting divergent temporal angles . . . . differ from Metopocetus in the free elongate nasal bones." Cope, 1896.

Cephalotropis coronatus Cope.

Plate XIX, Fig. 1.

Cephalotropis coronatus Cope, 1896, Proc. Amer. Philos. Soc., vol. xxxv, No. 151, p. 143, pl. xi, fig. 2.

Description.—" The specimen which represents this species is a portion of the cranium which includes the elements which surround the brain except the occipital, the superior part of the latter remaining; together with the posterior parts of the maxillaries, premaxillaries and the greater part of the nasals, and the basisphenoid and presphenoid in part, and a considerable portion of the left temporal. The sutures distinguishing the several elements are distinct, so that the boundaries of the latter can be readily distinguished. In describing this fragment I will compare it especially with the *Metopocetus durinasus* and *Cetotherium megalophysum,* where the corresponding parts are preserved.

" The supraoccipital angle is produced further anteriorly than in either of the species named, and the sagittal crest is longer than in either. The summit of the smooth occipital surface forms a transverse border, which cuts off the apex of the occiput, thus bounding posteriorly a triangular area, of which the sides are a little longer than the base. This triangle has a low, median keel, on each side of which the surface is concave, and is marked with numerous irregular fossæ. The surface has been evidently the seat of the insertion of something; but whether it was entirely of a ligamentous character or whether some tegumentary structure had its basis there I do not know. The superior border of the temporal fossa is regularly concave towards the middle line, and regarding the sagittal crest as restricted to the parietal bone, its truncate edge is wider at the extremities than at the middle. The narrowest portion of the crest is nearer the frontoparietal than the parieto-occipital suture. The temporal ridge is in regular continuation of the edge of the sagittal crest, and becomes transverse in direction towards the orbital border of the frontal bone. This border is broken off.

"The vertical temporoparietal suture does not run along a ridge as in the *M. durinasus,* but its superior portion is on a low, obtuse angle. The frontoparietal suture extends posteriorly from the sagittal crest downwards, much posterior to the direction it presents in the *C. megalophysum,* where its direction on each side is a trifle anterior to transverse. Across the front the suture is coarsely serrate, differing from the sutures of the anterior border of the frontal bone, which are closely and deeply interdigitate, as in the *C. megalophysum.* The superficial median part of the frontal is about one-third as long as the corresponding part of the parietal. The nasomaxillary suture with the frontal is short in the transverse direction, not reaching the temporal ridge on each side. The frontomaxillary suture then becomes nearly longitudinal for a distance of 50 mm. and then turns outwards for 25 mm. On the opposite side the posterior border of the maxillary is more oblique and extends from the transverse median portion divergent from the line of the temporal ridge, forwards and outwards. The latter is probably the normal direction of the suture. The nasal bones are very narrow, but expand gradually anteriorly. They do not terminate posteriorly in an acute angle as they do in the *C. megalophysum* and *M. durinasus* (apparently), but are truncate. The premaxillaries are also narrow at this point. Their posterior extremities are broken off. The glenoid cavity presents downwards. The presphenoid is plane below anteroposteriorly and transversely posteriorly, but is slightly convex below anteriorly. It is hollow.

Measurements.

	mm.
Length of supraoccipital triangle to occipitoparietal suture	80
Length of parietal on middle line	60
Length of frontal on middle line	25
Width of supraoccipital at base of supraoccipital triangle	124
Width of base of cranium opposite supraoccipital triangle	115
Width of sagittal crest	18
Width of nasals at base	28
Width of nasals 140 mm. anterior to base	50

"In the interstices of the specimen portions of matrix remain which have the color and character of the material of the Yorktown formation. Embedded in this at certain points are fragments of Mollusca of the genera Pecten, Lucina and Turritella. It was probably derived from the Chesapeake region." Cope, 1896,

Occurrence.—CHESAPEAKE GROUP. Probably from Maryland.

Collection.—Johns Hopkins University.

Genus CETOTHERIUM Brandt.

CETOTHERIUM MEGALOPHYSUM Cope.

Plate XX, Fig. 1.

Cetotherium megalophysum Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 146.
Cetotherium megalophysum Cope, 1896, Proc. Amer. Philos. Soc., vol. xxxv, pp. 143, 146, pl. xi, fig. 1.

Description.—"This species is established on a cranium which is complete from the condyles to near the anterior extremity of the nasal bones inclusive. The apices of the zygomatic processes of the squamosal bones and the left auricular bulla are wanting. The presence of the right bulla in the specimen enables comparisons to be made with species in which this part is preserved and where the cranium is wanting. The skull has lain in the water for a considerable time, as numerous barnacles and oysters have attached themselves to it. The matrix has been generally removed from it by the action of the water.

"The cranium presents the characters of the genus in the close approximation of the temporal fossæ on the middle line and the elongation of the frontals anterior to this point. Portions of premaxillaries and maxillaries remain at positions much posterior to that of the external nares. The glenoid surface is separated by a sharp angle from the temporal fossa. The sphenoid and presphenoid are keeled on the median line. The vomer is visible between the palatines on the middle line below.

"The lateral occipital crests form with a line connecting the exoccipital processes across the foramen magnum, an isosceles triangle with straight sides, each of which is rather shorter than the base-line mentioned. The apex of the supraoccipital is not elevated, and is well produced forwards, so that the length of the cranium from the posterior border of the frontal bone is one and one-half times as long as the depth of the cranium at the same point.

" The tympanic bulla has the general form characteristic of species of this genus, but presents specific characters of its own. The part anterior to the posterior boundary of the external process is half as long again as the length posterior to it. The two measurements are equal in the *C. hupschii,* according to Van Beneden. The two ridges of the internal border unite 19 mm. posterior to the anterior extremity, forming a single acute angle. This character is not described by authors as occurring in any other species of this genus. The anterior extremity is squarely truncate, and is semicircular in outline, as the superior side is flat and the inferior convex. In *C. brialmontii,* according to Van Beneden, the bulla is not truncate in front nor is there a single acute edge on the inner side in front; the portions of the bulla anterior and posterior to the internal process are of equal transverse width; in the *C. megalophysum* the anterior portion is considerably narrower than the posterior portion. In *Mesocetus agramii,* according to Van Beneden, there is a single acute internal ridge on the bulla, but it is much longer than in the *Cetotherium megalophysum* and the anterior extremity of the bulla is rounded and not truncate in the former. The bulla in the species now described presents an angle posteriorly, as viewed from below, instead of the rounded outline seen in several species.

" The form of the skull differs from that of several species where that region is known. Thus in the *C. burtinii,* according to Van Beneden, the occipital bone is broadly rounded in outline instead of triangular. In *C. dubium* this region is triangular, but is much more elevated and less produced forwards than in the *C. megalophysum.* It is more elevated than the length from the frontal bone posteriorly, instead of being only two-thirds as high as long. In the *C. morenii,* from Chubut, Patagonia, Lydekker states that the lateral occipital crests are more elevated than the apex of the occipital bone, giving a cordate outline to the posterior profile. This does not occur in any known northern species. The tympanic bulla of this species is also quite different. The occipital region of the *C. hupschii* resembles that of the *C.*

megalophysum more nearly than that of any other species as far as known. In the *C. capellinii* Van Ben., according to the descriptions and figures of Capillini, the frontal is more elongate and narrower on the middle line and the tympanic bulla has not the posterior median angle when viewed from below such as exists in the *C. megalophysum.*

"Comparison with the species described by Brandt from Russia and Italy, discloses numerous important differences.[1] The frontoparietal region in the *C. priscum* Br. is materially shorter than in the *megalophysum.* The auricular bullæ of *C. priscum, C. meyerii* and *C. klinderii* are gradually acuminate to an acute apex, when viewed from the inner side, and are without the convexity of the lower side and the truncation of the apex characteristic of our species. The bulla of *C. rathkei* is a little more like that of the Chesapeake form, but it is nevertheless specifically distinct. It is, when viewed from above, broadly and subequally rounded at both extremities, instead of being truncate at the one and angulate at the other. The extremities are of subequal width, while the anterior portion is much narrower in the *C. megalophysum.*

"Finally the bulla of the *C. megalophysum* is of relatively larger size than in any of the species noticed above.

Measurements.

	m.
Length of fragment below	.565
Width of fragment	.515
Width of glenoid region from bulla	.150
Length of glenoid from bulla (least)	.100
Width of sphenoid between foramina lacera	.105
Length of tympanic bulla below	.100
Width of tympanic bulla in front of external process	.53
Width of tympanic bulla behind external process	.67
Width at exoccipital processes	.400
Length anterior to parietals above	.225
Length of occipital from base of foramen magnum to apex (on curve)	.290
Width of occipital condyles and foramen	.140

[1] Memoires Acad. Imp. Sci , St. Petersburg, 1873, vol. xx, p. 143.

"The mandible of this species is unknown. The size is not far from that of the *Cetotherium pusillum* and *Siphonocetus expansus* of Cope. Should either of these turn out, on the discovery of the skull, to be Cetotheriform, it will become necessary to compare them with the present species. The total length of the animal was about twenty or twenty-five feet." Cope, 1895.

Occurrence.—St. Mary's Formation. Cove Point.

Collection.—Johns Hopkins University.

Cetotherium parvum Trouessart.

Plate XXV, Fig. 1.

Belaenoptera pusilla Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 159.
Eschrichtius pusillus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 191.
Eschrichtius pusillus Cope,1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 11.
Cetotherium pusillum Cope, 1890, Amer. Nat., vol. xxiv, p. 616.
Cetotherium pusillum Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 145, pl. vi, fig. 6.
Cetotherium parvum Trouessart, 1898, Catalogus Mammalium, p. 1071.
Cetotherium parvum Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 599.

Description.—In 1868 Cope said of this form that it was the smallest known fin whale, being about 18 feet long. In 1895 he says: "The fragment of the ramus of this species above referred to is longer than any that have come under my observation, which now number five individuals. Its length is 723 mm., and the diameters at a fracture near the middle are as follows: vertical, 71 mm.; transverse, 47 mm. It is a little larger than those I have seen hitherto, but agrees with them in every respect."

Occurrence.—St. Mary's (?) Formation. Near the mouth of the Patuxent river.

Collection.—Johns Hopkins University.

Cetotherium cephalum Cope.

Plate XXI, Fig. 1; Plate XXII, Figs. 1a, 1b, 2a, 2b; Plate XXIII, Figs. 1, 1a, 1b; Plate XXV, Figs. 8, 13.

Eschrichtius cephalus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, pp. 131, 144, 148.
Eschrichtius cephalus Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 195 (mention only).

Eschrichtius cephalus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, pp. 10, 11 (mention only).

Eschrichtius cephalus Leidy, 1869, Jour. Acad. Nat. Sci., Phila., 2nd ser., vol. vii, p. 442.

Cetotherium cephalus Cope, 1890, Amer. Nat., vol. xxiv, pp. 612-615, figs. 7, 8; pl. xxii.

Cetotherium cephalus Cope, 1896, Proc. Amer. Philos. Soc., vol. xxxv, p. 146, pl. xii, figs. 2, 3.

Description.—The description given for this form by Cope in 1867 is as follows: "The mandibular rami measure 9 feet 4 inches and were referred to an individual 31 feet long. They were compressed, and with a narrow superior ridge, without nutritive foramina. The hitherto known Miocene Whales—*Balaena prisca* and *B. palaeatlantica* of Leidy—founded on portions of the mandibular rami, were much less compressed, were furnished with numerous marginal nutritive foramina, and the *B. prisca* was without superior ridge."

In 1890 he added: "The ear bulla is noticeably compressed, somewhat incurved, and with a nearly parallelogrammic outline from the side."

Occurrence.—Calvert Formation. Charles county near the Patuxent river, shore of Chesapeake Bay.

Collections.—Philadelphia Academy of Natural Sciences. Johns Hopkins University.

Genus SIPHONOCETUS Cope.

Siphonocetus expansus Cope.

Plate XXV, Fig. 3.

Megaptera expansa Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 193.

Eschrichtius expansus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 11.

Eschrichtius expansus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. vii, p. 422.

Cetotherium expansum Cope, 1890, Amer. Nat., vol. xxiv, p. 614.

Siphonocetus expansus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 140, pl. vi, fig. 5.

Description.—The specimen was originally referred (1868) to *Megaptera* because of a supposed difference between the cervicals and those of *Eschrichtius.* In 1869 the jaw was discovered to have the typical form of *Eschrichtius.* The following is the description given of the jaw: It presents "for a marked distance on the proximal portion, a flat plane on the upper face, instead of the usual angulate ridge, which is equally distinct from the outer and inner faces. In *E. priscus* the superior plane is only a continuation of the outer convex face, and accordingly the external series of nutritious foramina extends along it. The plane is occupied on the other hand, in the *E. expansus,* by the inner series.

"The inferior margin is a rather obtuse angle; the general form is not compressed, nor much convex externally, as in *E. priscus.*

Measurements.

Depth ramus	2.75 in.	(68 mm.)
Thickness	1.65 in.	(41 mm.)
Foramina (internal) two in	2.50 in.	(75 mm.)"

Cope, 1869.

Occurrence.—ST. MARY'S (?) FORMATION. Mouth of the Patuxent river. The type came from Nomini cliffs.

Collection.—Johns Hopkins University. There are two rami said to be preserved in the Tyson collection in the Maryland Academy of Sciences.

SIPHONOCETUS PRISCUS (Leidy).

Plate XXV, Fig. 5.

Balaena prisca Leidy, 1851, Proc. Acad. Nat. Sci. Phila., vol. v, p. 308.
Balaenoptera prisca Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xx, pp. 144, 147.
Balaenoptera prisca Cope, 1868, Proc. Acad. Nat. Sci. Phila., vol. xx, p. 192.
Eschrichtius priscus Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 11.
Eschrichtius priscus Leidy, 1869, Jour. Acad. Nat. Sci. Phila., 2d ser. vol. vii, p. 441
Cetotherium priscum Cope, 1890, Amer. Nat., vol. xxiv, p. 616.
Siphonocetus priscus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 140, pl. vi, fig. 3.

Description.—Leidy gave the following description on the species in 1851: "The fragment of lower jaw, fourteen inches long, is of much more slender proportions than that of the preceding [*Balaena palaeatlantica*], it is also more uniform in its breadth and depth, and has a strong curve downwards as in B. rorqual, Lac. It is very nearly flat internally and demi-cylindrical externally. The upper margin is angular but not prominent, and forms the boundary between the inner and outer side. The gingival foramina, five in number in the specimen, are placed below the upper margin internally, are about one line in diameter, and open very obliquely forward into grooves almost horizontal, from half an inch to one inch long. The labial foramina, of which there are the remains of seven in the specimen, are about half an inch external to the upper margin, about two lines in diameter, and open very obliquely forward.

Vertical diameter ....3 inches [75 mm.]
Transverse diameter ....2 inches [50 mm.]"

In 1869 Cope described *Eschrichtius priscus* as intermediate in size between *E. cephalus* and *E. leptocentrus* and *E. expansus* and *E. pusillus.*

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river. (*Fide* Cope.)

Collection.—Philadelphia Academy of Natural Sciences.

SIPHONOCETUS CLARKIANUS Cope.

Plate XXV, Fig. 4.

Siphonocetus clarkianus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 140, pl. vi, fig. 4.

Description.—Described from fragment of mandibular rami. "The cranium of this genus is unknown, but it is probably similar in character to that of the Cetotherium of Brandt. This genus differs from Balænoptera in having the elements between the supraoccipital and the nasals much elongated, so that there is a sagittal crest of greater or less length, and in the non-union of the dia- and parapophyses into a vertebral canal,[1] in which it agrees with Eschrichtius of Gray. Some of the rami described belong possibly to species of Balænoptera, and it remains for future discoveries to ascertain which these are. . . . .

"In dimensions it . . . . is only exceeded by . . . . *Cetotherium leptocentrum* and *C. cephalus.* It compares more closely in dimensions with the *C. polyporum* from the Chesapeake group of North Carolina. From

[1] See American Naturalist, vol. xxiv, 1890, p. 611, where these genera are characterized: but Van Beneden's name, *Plesiocetus*, is used for *Cetotherium*, and the latter name for *Eschrichtius* of Gray.

the last named, and from the *C. cephalus,* it differs in the robust form of the ramus, resembling in this respect rather such species as *C. palæatlanticum, S. priscus* (Leidy), and *S. expansus.*

"The fragment representing the *S. clarkianus* is from the part of the ramus anterior to the base of the coronoid process, and is about 350 mm. in length. Both faces are convex, but the external is more strongly so than the internal. The superior part of the latter is, however, not horizontal as in the *S. priscus,* nor is the internal face subhorizontal as in *S. expansus.* The two faces unite above at an obtuse angle, which if perfect, would be nearly right. The inferior edge is on the contrary a ridge which would be acute were it not rounded. The section of the ramus is therefore lenticular, with one side more convex than the other. Posteriorly the external convexity becomes greater, and the internal convexity rises towards the base of the coronoid, leaving a gentle concavity above the inferior border. The external foramina are large, distant, and only a little further below the superior ridge than those of the inferior internal row. The latter are in two series; those of the superior smaller and quite near the superior edge; the others larger and situated lower down, and separated by intervals of about 40 mm. No trace of Meckelian or alveolar grooves.

Measurements.

		mm.
Diameters at distal end	vertical	95
	transverse	72
Diameters near coronoid	vertical	114
	transverse	99

"The presence of two internal series of foramina distinguishes this species from any of those known to me. The rami are less compressed than those of the *C. pusillum,* while the external position of the external foramina distinguishes it from the *S. priscus* (Leidy). The presence of an acute-angled ridge below distinguishes it strongly from the *C. palæatlanticum.* The species was larger than the *Cetotherium megalophysum* above described, having probably attained a length of forty feet." Cope, 1895.

Occurrence.—St. Mary's Formation. Chesapeake Bay near Point-no-Point (the specimen was dredged up from the bottom of the bay)

Collection.—Johns Hopkins University.

The following characters of the genus *Siphonocetus* (*Eschrichtius*) were given by Cope in 1869:

"Characters of the mandibular rami. Much compressed, outer face little convex; superior margin a narrow ridge without truncation; with a series of foramina on each side; the inner extending for a very short distance only; no marginal groove; inferior edge narrow.

Very large...*S. cephalus.*

Upper edge broad, with *outer* series of foramina, and meeting inner edge at a right angle, which is the highest line, and with inner series of foramina just below it; most convex externally.

Large ....*S. priscus.*

Upper edge broad behind only, and there bearing only the *inner* series of foramina. Elsewhere with a median ridge and rows of foramina below on each side; much decurved; less convex externally.

Medium ....*S. expansus.*

Upper edge nowhere broad, and with a deep or shallow groove below it on the inside; less decurved; less convex externally.

Small ....*S. pusillus.*

To this list may be added the following brief analysis of the characters of *S. clarkianus.*

Upper surface a low ridge formed by the meeting of the outer and inner faces at almost a right angle; section of jaw lenticular; inner and outer faces convex, the external the most so; outer series of foramina large; inner series double, the superior are the smallest and situated quite near the superior edge.

Genus ULIAS Cope.

"*Char. gen.* Mandible with the gingivodental canal open throughout most of its length, closed only near its apex. Gingival foramina represented by a few orifices on the alveolar border near the distal extremity.

"This form is of much interest as representing in adult life a stage which is transitional in typical Balænidæ. The alveolar groove is continuous with the dental canal, and is permanently open. It is probable then that this genus possessed teeth during a longer period than the existing Balænidæ, and that they were retained in place by a gum so long that the canal could not close, as is the case in the latter. The absence of the long series of mental foramina characteristic of the true whales is further evidence to this effect." Cope, 1895.

ULIAS MORATUS Cope.

Plate XXIV, Figs. 1a, 1b; Plate XXV, Fig. 6.

Ulias moratus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 141, pl. vi, fig. 1.

Description.—"This species is founded on a nearly entire right mandibular ramus. The condyle and angle are wanting, as is also a piece from the proximal part of the distal third of the length. This piece was found with the rest of the specimen, but has been, for the present at least, mislaid.

"The ramus is moderately curved horizontally, but is not decurved except towards the angle. A slight convexity of the inferior margin exists at the anterior part of the proximal two-fifths of the length. The superior border is occupied with the widely open alveolar groove, which gradually contracts in transverse diameter distally, so as to be closed for the terminal fourth of the length. On this region two or three large foramina issue from it on the middle line above, and the terminal mental foramen issues at the superior extremity of the distal end, a little below the internal ridge on the external side of it. Of the borders of the alveolar groove the internal is much lower than the external on the proximal sixth of the length. The edges are then equal for a short distance, and are acute. The internal then becomes the more elevated, and continues so until its point of union with the external. The internal wall of the groove is at first narrow, and its superior edge from being acute becomes narrowly rounded, but becomes more obtuse distally as the wall becomes thicker. The internal side of the ramus is very little convex. The external side of the ramus is strongly convex in vertical section, hence it is that the external edge of the groove becomes wider as it becomes lower, until at the beginning of the distal third of the length it forms a plane distinct from the convex external face. This external convexity growing rapidly less, the superior edge becomes proportionally narrower, and at the extremity of the ramus is about as wide as the internal superior ridge.

The extremity of the ramus is, in profile, truncated obliquely backwards and downwards to the obtuse angle at which it meets the slight rise in the outline of the inferior margin. The external plane is slightly concave. The internal face exhibits two surfaces, a superior convex portion which widens downwards and backwards, and an inferior wider flat portion separated from the superior by a straight ledge. The inferior border of the ramus is represented by an angle of about 70° for the greater part of the length. Below the region where the alveolar borders are equal the angle is more nearly right owing to the increased convexity of the external face. It is rounded below the coronoid process (which is broken off) and widens towards the angle. It is rounded on the distal third, becoming narrower rapidly towards the distal extremity.

Measurements.

Length of ramus restored; on curve	1.900 m.
Length of proximal fragment	.790
Length of distal fragment	.390
Transverse diameter near condyle	.070
Transverse diameter where alveolar borders are equal	.060
Transverse diameter at distal end of long fragment	.057
Vertical diameter where alveolar edges are equal	.073
Vertical diameter at distal end of long fragment	.074
Vertical diameter at proximal end of distal fragment	.079
Transverse diameter at proximal end of distal fragment	.049
Vertical diameter of extremity	.065

"Besides the general characters, the *Ulias moratus* presents various specific differences from the various species of Balænidæ which are known. The flatness of the internal face and the lack of decurvature distinguishes it from several of them; and the absence of fissure at the distal mental foramen separates it from others. I know of no species which has only one series of foramina and that one on the median line, on the distal fourth, except the present one. The size of the ramus resembles that of the *Cetotherium palæatlanticum* of Leidy, and represents a species of about twenty-five feet in length." Cope, 1895.

Occurrence.—CHESAPEAKE GROUP. Maryland or Virginia.

Collection.—Johns Hopkins University.

Genus TRETULIAS Cope.

Dental canal obliterated, and dental groove without osseous roof. Gingival canals and foramina present at one side of the alveolar groove.

TRETULIAS BUCCATUS Cope.

Plate XXV, Fig. 2.

Tretulias buccatus Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 143, pl. vi, fig. 2.

Description.—" This species is represented by parts of the mandibular rami of two individuals. . . One of these measures 607 mm. in length, and is in fairly good preservation; the other is a shorter fragment, and is considerably worn. They agree in all respects.

" The longer fragment is gently curved both inwards and downwards. It is compressed anteriorly, and more depressed posteriorly, so as to be but little deeper than wide. The external face is very convex, more so posteriorly than anteriorly, so that that part of the superior wall which is developed is horizontal, as in the *Siphonocetus priscus* Leidy. The internal face is little convex, and is slightly concave on a line near to and parallel to the inferior border. Generally this angle is obtuse, and is a little more than right; anteriorly, near the extremity it becomes more ridge-like. Posteriorly the section of the ramus represents more than a half-circle, the base being the internal face. The internal basal concavity referred to disappears posteriorly, but its place is occupied by a Meckelian fissure, which extends along the bottom of the groove, disappearing at the end of the terminal two-fifths of the length.

" The gingival canals are very oblique, extending horizontally forwards and outwards. The internal foramina issue at spaces of one and two inches, and they are not connected by a superficial groove. The superior (external) series are equally oblique, extending forwards and opening obliquely upwards. Only two of these canals are present on the specimen, and these are on the posterior two-fifths of the length. They are not complete on the external side, and are therefore only grooves. The common canal is open external to them, and separates the superior from the external face of the ramus. It has not the form of the section of the ramus as in other species, but is shallow, and with its long axis oblique to that of the section, and parallel to that of the superior oblique part of the external face. It is shallower than in the *Ulias moratus,* and the species of Cetotherium, and is separated by a wide osseous space from the inferior border. That this form is descended from one with a larger canal is indicated by the fact that the fractures of the ramus display a closed fissure extending from the floor of the canal vertically downwards. The canal is overhung on the inner side by a narrow free border of the superior perforate wall.

Measurements.

		m.
Length of fragment		.607
Diameters posteriorly	vertical	.077
	transverse	.078
Diameters more anteriorly	vertical	.070
	transverse	.065
Diameters near distal extremity	vertical	.073
	transverse	.056

"For a length of 200 mm. from the anterior extremity the borders of the gingivodental groove are sufficiently well preserved to demonstrate that it was not closed. The edges posterior to this are more or less worn, so that the roof might be supposed to have been broken away in the absence of other evidence. This is, however, forthcoming, for the internal border is so far preserved near the posterior extremity for a space of 135 mm. as to show that no roof has existed.

"Omitting consideration of the generic characters, the following comparisons with other species may be made. In the *Ulias moratus* the gingivodental groove is deeper and narrower, and the inner edge is much narrower. The external face is not so convex. The *Siphonocetus priscus* of Leidy resembles it more nearly in form, but the superior (external) foramina are not so far inwards, and the two canals taken together conform nearly to the outline of the ramus in section, which is far from being the case in the *Tretulias buccatus.* There is no Meckelian groove. In the *Cetotherium palæatlanticum* Leidy, the external face is not so convex, and the internal gingival canals are, according to Leidy, 'directed upward and moderately forward.' In the *T. buccatus* they are directed forwards horizontally, and very little upwards." Cope, 1895.

Occurrence.—CHESAPEAKE GROUP. Maryland or Virginia.

Collection.—Johns Hopkins University.

Genus BALAENOPTERA Dacep.

BALAENOPTERA SURSIPLANA Cope.

Plate XXIV, Fig. 2.

Balaenoptera sursiplana Cope, 1895, Proc. Amer. Philos. Soc., vol. xxxiv, p. 151.

Description.—In describing this species Cope says: "On comparison with the Balænopteræ described by Van Beneden, it is to be observed that they [the tympanic bones] all differ from the present form in the convexity of superior face, where the dense layer or lip has a different chord or face from that of the space which separates it from the internal longitudinal marginal angle. In the *B. sursiplana* there is but one superior plane from the eustachian orifice to the internal edge, which is absolutely flat. In all these species also the dense layer of the lip is reflected on the superior edge of the external thin wall at its anterior end. In the present species this layer is reflected in a very narrow strip underneath the free border, which overhangs it. In all these species also the anterior extremity, as viewed from above or below, is angulate, the angle marking the end of the inner border of the dense layer or lip. In *B. sursiplana* the anterior extremity, viewed in the same way, is truncate. The species which appears to approach nearest is the *B. definita* Owen, which is figured by Lydekker.[1] This otolite appears to be flatter above than the species described by Van Beneden although the figure is not clear in this respect. It has the oblique upwards and backwards looking face at the posterior extremity, which is a conspicuous feature of the *B. sursiplana,* although it is not so sharply defined by a strong transverse convexity of the superior surface, as in the latter. Nor is there as strong a bevel of the anterior extremity of the superior face when viewed from within, as in *B. definita.* An

[1] Quar. Jour. Geol. Soc., London, 1887, vol. xliii, p. 11, pl. ii, fig. 3.

equally conspicuous difference is to be seen in the form of the inferior wall. According to Lydekker, this surface, when the bulla is viewed from within, consists of three planes separated by rounded angles, of which the median is longer than those at the ends. In the *B. sursiplana* this surface is regularly convex from end to end. In size this species is like that of the large Balænopteræ, including the *B. definita*.

Measurements.

	mm.
Axial length of bulla	98
Width at posterior extremity of anterior hook at superior border	71
Width at anterior extremity of orifice	35
Width at posterior extremity of orifice	53
Depth at middle (about)	55
Greatest depth of lip	38"

Cope, 1895.

Occurrence.—CHESAPEAKE GROUP. Maryland or Virgina.

Collection.—Johns Hopkins University.

Genus BALAENA Dinn.

BALAENA AFFINIS Owen.

Balaena affinis Owen, 1846, A History of the British Fossil Mammals and Birds, London, p. 530, fig. 221.

Description.—In describing several specimens of ear bones of whales from the English Tertiary the author says: "One of the most complete of the fossil tympanic bones, which measures five inches in length, resembles the *Bal. antarctica* in the slight elevation of the outer part of the involuted convexity, and its gradual diminution to the Eustachian end of the cavity; it resembles both *Balænæ* in its traceable continuation to that end, and in the gradual continuation of the concave outer wall from the involuted convexity; this convexity is indented also, as in both recent Balænæ, by vertical fissures narrower than the marked indentation which distinguishes the *Bal. mysticetus*. . . . The upper surface of the bone maintains a more equable breadth from the posterior to the anterior end, the outer angle of which, being well marked in the fossil, is rounded off in the recent specimen; the under and outer surfaces of the timpanic bone meet at an acute angle." Owen, 1846.

In a summary of the species described [plate to face page xlvi] occurs the statement that while the specimen has been described as *Balaena* it is very probable that the ear bones belong with certain teeth that the author has described as *Balaenodon*. However, the name *Balaena* is the one used and it has been shown that the teeth and ear bones do not go together.

This is one of the most common of the Miocene Mysticocetes and has a very general distribution.

Occurrence.—CHESAPEAKE GROUP. Maryland.

Collection.—Johns Hopkins University.

CETACEAN (?)

Plate XXIV, Figs. 3a, 3b.

A natural cast in sandy marl, shows the shape of the brain cavity of some small member of the group. The general characters are shown in the figures.

Occurrence.—CHESAPEAKE GROUP. Maryland.

Collection.—Johns Hopkins University.

Order SIRENIA.

Family MANATIDAE.

Genus TRICHECHUS Linné.

TRICHECHUS GIGANTEUS (?) (De Kay).

Plate XXVI, Fig. 1.

Manatus sp. Harlan, 1835, Med. and Phys. Res. p. 385.
Manatus giganteus DeKay, 1842, Nat. Hist. N. Y. Zoology, vol. i, p. 123.

Description.—The latter of these references gives only the name and the fact that the specimen was discovered on the western shore of Maryland. The original description mentions the presence of "a cervical and a caudal vertebra of a gigantic species of fossil *Manatus;* the vertical diameter of the former is nine inches and a half; the transverse diameter of the former is nine inches and a half; the transverse diameter eleven inches." There is no further description and there are no figures.

In the collection of the Maryland Geological Survey there is a radius and ulna of what was evidently a small species of *Trichechus*, and a single isolated rib has much the appearance of belonging to the same genus.

Occurrence.—CALVERT FORMATION. Fairhaven.

Collection.—Maryland Geological Survey.

With the earliest Miocene the ODONTOCETI appear in considerable numbers, all the families and many of the genera being found in deposits of that age. The MYSTICOCETI appeared only later and reached their highest development in the Pleiocene and the recent.

The ancestry of the SIRENA is as little known as that of the CETACEA but the earliest known form has not reached quite such a high state of specialization as the earliest CETACEA. In *Prorastomus* from the Eocene of the Island of Jamaica, the single genus of the family PRORASTOMIDAE, the teeth are of the angulate type and are present in complete series in both the upper and the lower jaws. In the MANATIDAE the incisor and canine teeth are wanting and the cheek teeth are similar, while in the HALICORIDAE there is a large pair of incisor teeth which may be absent. In outward form the SIRENIA have taken on the fish-like form which is best adapted to the environment but there remains an imperfectly developed pelvis and the rudiments of the femoral bone.

The origin of the CETACEA and of the other aquatic order, the SIRENIA remains one of the most puzzling questions of phylogeny. To the first is generally accorded an origin from some primitive and generalized member of the carnivorous stem, and to the latter an equally obscure origin from the ungulates. The necessary connecting links to prove these suppositions are, however, sadly lacking. Beddard, in his recent book on Whales, would accord to the CETACEA an ungulate ancestry, but this he does with much diffidence. He says (page 99): "It is to be feared that nothing can be done except, and that vaguely, to suggest an Ungulate-like ancestor." Albrecht would assign to the

Cetacea a very primitive position, making them the ancestral form of the mammals.[1] This idea has gained little credence. The settlement of the question must await further discoveries. Certain it is that the earliest forms that we know have already reached a very high degree of specialization, so high as to command a belief in an earlier origin than the fossils so far found would indicate.

Class AVES.

Order STEGANOPODES

Family SULIDAE (Gannets).

Genus SULA Briss

Sula loxostyla Cope.

Plate XXVI, Fig. 2.

Sula loxostyla Cope, 1871, Trans. Amer. Philos. Soc., vol. xiv, pp. 236, 237, fig. 53.

Description.—"This species is established on a single coracoid bone which I found at the foot of the Miocene cliffs in Calvert Co., Maryland. The furcular articular surface is broken off, as well as the exterior half of the posterior or sternal articular extremity. The extremity of the scapular surface is also injured. Sufficient of the bone remains to furnish many characteristic peculiarities, and to indicate its affinity to the totipalmate family of the Gannets or Sulidæ.

"The bone is stout, and indicates a bird of strong flight. The shaft proper is rather short, and subcylindric, with a trihedral tendency. This form, with the expanded distal extremity, indicates its wide distinction from the coracoid of the Gallinaceæ. Its subcylindric shaft marks considerable difference from the Lamellirostres and many other aquatic types. Its lack of inner subclavicular ala and foramen, distinguishes the type from Raptores, the majority of the Longipennes and many Grallæ. The presence of a marginal groove or rabbett distinguishes it not only from most Psittaci and Insessors, but from many Natatores also. After a study of the large collection of bird skeletons in

[1] Ueber die Cetoide Natur der Prommammalia, Anatomischer Anzeiger, 1, p. 338, 1886.

the Museum of the Academy [of] Natural Sciences, aided by the Oissaux Fossiles of A. Milne Edwards, I find it resembles closely the genus Sula.

"The glenoid articular face descends to opposite the proximal third of the length; it is transversely concave, and its inferior boundary is raised to separate it from the longitudinal concavity which extends to the head of the bone. A longitudinal angle separates this from the interior part of the inferior face. The anterior extremity is curved upwards and is thinned by a strong rabbett, which follows the convex margin. This margin is slightly obtuse. The outline is abruptly contracted below the glenoid surface. The inner outline is obtuse, and without trace of the intermuscular ridge, on subclavicular ala. The margin expands inwards to the distal articular extremity, remaining almost equally obtuse. The distal extremity is far less expanded towards the median line of sternum than in Sula bassana. It is also everted, the outer (inferior) projecting border, being turned out (down) from the line of the shaft. In Sula bassana this marginal rim appears, from Edwards' plate, to be in the plane of the shaft. The articular surface is divided by this rim into a narrow marginal external (inferior) and a very much wider, strongly concave inner portion. The latter is wider at the median end, where its inner (superior) margin is very convex; it then contracts abruptly, leaving the remaining portion only one-half as wide. The very slight prominence of the dividing angulate projecting margin distinguishes this genus from Sula bassana.

"There are three pneumatic foramina of no great size, in a short series commencing just within the head of the bone. I am only able to compare this bone with the figure of the same element of the Sula bassana given by Edwards, as our museum does not possess a skeleton referable to this genus.

"As compared with the above, the glenoid articular face descends more posteriorly (lower), and the superior (proximal) margin is more transverse. The shaft viewed from before (below), contracts gradually towards the distal expansion. The same contraction is visible when viewed from the inner side. On the same view we observe that the clavicular articulation is rather more posterior (lower down), and the distal articular marginal edge is far less prominent and acute. The inferior (outer) narrower articular margin is much narrower than in *S. bassana.*

Length to inner distal angle	2.02 in. (50 mm.)
Length to posterior basis of scapular articulation	.78 in. (1.56 mm.)
Width of head last point	.57 in. (1.14 mm.)
Width of glenoid cavity	.25 in. (.50 mm.)
Width of shaft	.23 in. (.46 mm.)
Width of distal extremity to middle line of shaft produced	.43 in. (86 mm.)
Thickness distal extremity	.38 in. (76 mm.)

"This gannett was somewhat smaller than the S. bassana of our northern coasts, and approached more nearly those of the tropical seas."

Occurrence.—CALVERT (possibly CHOPTANK) FORMATION. Calvert Cliffs.

Collection.—American Museum of Natural History.

Order TUBINARES.

Family PROCELLARIDAE (Shearwaters).

Genus PUFFINUS Briss.

PUFFINUS CONRADI Marsh.

Plate XXVI, Figs. 3, 4.

Puffinus conradi Marsh, 1870, Amer. Jour. Sci., ser. ii, vol. xlix, pp. 212, 213.

Description.—"The collection of the Academy of Natural Sciences in Philadelphia has for many years contained the distal half of a left humerus, and the lower portion of a right ulna, of an aquatic bird, which were discovered in the Miocene of Maryland by T. A. Conrad, Esq. A brief mention of these specimens, and of some other ornithic remains from the United States, has already been made by Professor Leidy,[1] but no description of them has yet been published. The specimens are

[1] Proc. Acad. Nat. Sci. Phila, vol. xviii, 1866, p. 237.

so well preserved, and so characteristic, especially the humerus, that the affinities of the species they indicate can be determined with tolerable certainty. The most marked feature of the humerus is the transverse obliquity of its shaft and distal extremity. Both are much compressed, and so turned that the common plane of their longer diameters, instead of being nearly vertical, as in the brachium of most birds, is here highly inclined inward and downward. Among the other characters of importance may be mentioned, the unusually small size of the ulnar condyle, the very deep, oval impression for the attachment of the anterior brachial muscle, and the presence of an elongated, compressed apophysis, extending outward and upward from the exterior margin of the distal end, just in front of the radial condyle.

"This humerus has the following dimensions:

	mm.
Length of portion preserved	49.0
Vertical diameter of distal extremity	13.2
Transverse diameter of radial condyle	8.6
Transverse diameter of ulnar condyle	3.8
Length of impression of anterior brachial muscle	5.6
Breadth of impression of anterior brachial muscle	3.8
Longer diameter of shaft where broken	7.4
Shorter diameter of shaft where broken	5.0

"A comparison of the present fossils with the corresponding parts of recent birds readily shows that the nearest allies of this extinct species must be sought in the Auk family, or among the Petrels; as it is only in these groups of birds, that the peculiar obliquity of the humerus, noticed above, exists. In the *Alcidæ,* however, this oblique compression is greater than in the present specimen. The latter has, moreover, on its outer edge above the radial condyle, the long, pointed projection, which is not seen in the Auks, although present in the Petrels, Gulls, and some of the wading birds. The difference in size between the ulnar and radial condyles, and the remarkably deep, oval impression for the attachment of the anterior brachial muscle show unmistakably that this humerus belongs to one of the Shearwaters, and apparently should be placed in the genus *Puffinus,* with which it corresponds in all essential particulars. In size and general features it apparently resembles most nearly the brachium of the Cinereous Petrel (*Puffinus cinereus* Gmelin), of the Pacific coast, but there are some points of difference between them which clearly imply that the species are distinct. The flat apophysis on the outer edge of the distal extremity is in the fossil specimen more pointed; the impression, on the lower surface, of the anterior brachial muscle is deeper, and its outline more sharply defined, which is also the case with the small epicondylar depressions for the attachment of the muscles of the forearm. The bone indicates, moreover, a somewhat smaller bird.

"The distal half of the right ulna, which was found with the humerus, apparently belonged to a bird of the same species, although its size would seem to indicate that it pertained to a smaller individual." Marsh, 1870.

Occurrence.—Chesapeake Group. Maryland.

Collection.—Philadelphia Academy of Natural Sciences.

Class REPTILIA.

Order CHELONIA.

Suborder TRIONYCHIA.

Genus TRIONYX Geoffroy.

Trionyx cellulosus Cope.

Trionyx cellulosus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 142.

Description.—Known from a small part of the carapace. "The surface is marked by numerous closely placed pits, which are remarkably deep, producing the vesicular appearance of scoria. The resemblance is heightened by the irregular size of the pits. Edges of the septa rounded. The fragments are unusually thick, indicating species of large size.

Width of free portion of rib at origin	7.5 lines.
Depth of portion of carapace	4.33 lines.

Cope, 1867.

Occurrence.—Calvert Formation. Charles county near the Patuxent river.

Collection.—Formerly in the Philadelphia Academy of Natural Sciences.

TRIONYX sp.

Trionyx sp. Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.

Description.—"An uncharacteristic portion of the carapace, which exhibits larger and more regular pits [than *T. cellulosus*], separated by wider partitions. The pits at one extremity are larger than those of the other, and the septa narrower." Cope, 1867.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Formerly in the Philadelphia Academy of Natural Sciences.

Suborder CRYPTODIRA.

Family CHELONIDAE.

Genus CHELONE Linné.

CHELONE, sp.

Chelone sp. Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.

Description.—"A proximal portion of the costal plate has a thickness of three lines, but rapidly thins out. Its surface exhibits transverse rugæ at its proximal extremity; elsewhere the rugæ are longitudinal, and more distinct on one side than the other." Cope, 1867.

Occurrence.—CALVERT FORMATION. Near the Patuxent river in Charles county.

Collection.—Formerly in the Philadelphia Academy of Natural Sciences.

CHELONE sp.

Chelone sp. Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.

Description.—"Two fragments of the carapace of a large and convex species, each with a strongly marked groove for the margin of the dermal shields. The surface is without sculpture." This specimen was found with the one previously described.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Formerly in the Philadelphia Academy of Natural Sciences.

CHELONE sp.

Plate XXVI, Fig. 5.

Description.—A fragment of the proximal portion of the scapula of a very large specimen; badly weathered but showing the scapular part of the humeral cotylus and the region of attachment of the coracoid.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Order CROCODILIA.

Suborder EUSUCHIA.

Family CROCODILIDAE.

Genus THECACHAMPSA Cope.

Thecachampsa Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.
Thecachampsa Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 11.
Thecachampsa Cope, 1882, Amer. Nat., vol. xvi, p. 983.

In the original description the form is separated from *Crocodilus* by "the entire hollowness of the external stratum of the crowns of the teeth, and their composition of closely adherent concentric cones. These internal cones, which number at least three, may be homologous with the included crowns of the successional teeth of other Crocodilia, but they must be regarded as functional in a physiological sense, since they compose the bulk of the crown of the tooth within."

In 1869 Cope says: "Further investigation shows that this genus is gavial-like, and that the peculiarity which characterizes its dentition also belongs to Plerodon Meyer, of the European Miocene."

In 1882 he says, under the head *Crocodilus:* "A peculiarity of the composition of the crowns of some of the species has been noticed, on account of which I proposed a genus *Thecachampsa.* In this type the crown is composed of concentric hollow cones, one within the other. I have not been able to separate the crowns of the recent crocodiles into such bodies, and they are generally too thin to display more than a few such layers, were they so separable. This character was first observed in some species of the Atlantic Coast, e. g., *C. antiquus* Leidy, and *C. squankensis* Marsh; and the two Eastern Miocene species, *C. sericodon* Cope (type of *Thecachampsa*) and *C. sicaria* Cope."

Later, about 1895, Cope was again of the opinion that the genus *Thecachampsa* should stand. In consultation with Dr. W. B. Clark in regard to the preparation of the latter's Bulletin on the Eocene deposits of the Middle Atlantic States he was, according to Dr. Clark, "distinctly of mind that the genus should be called *Thecachampsa* instead of *Crocodilus*."

In the same article in which *T. sicaria* was described, Cope gave the following synopsis of the species of *Thecachampsa:*

"Crowns of teeth not compressed, with short cutting edges ....*T. antiquus* (*C. antiquus L.*)
Crowns cylindric, curved, with long and delicate cutting edges..*T. sericodon.*
Crowns compressed, with very long crenulate cutting edges, on a marginal base ....*T. sicaria.*"

THECACHAMPSA (?) SERICODON Cope.

Plate XXVII, Figs. 1, 2.

Thecachampsa ? sericodon Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.
Thecachampsa sericodon Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 12.
Thecachampsa sericodon Cope, 1869, Amer. Nat., vol. iii, p. 91.
Thecachampsa sericodon Cope, 1871, Trans. Amer. Philos. Soc., vol. xiv, p. 64, pl. v, figs. 7 and 8. (Pp. 1-104 appeared in 1869.)
Thecachampsa sericodon Cope, 1875, Proc. Amer. Philos. Soc., vol. xiv, p. 363.
Thecachampsa (*Crocodilus*) *sericodon* Cope, 1882, Amer. Nat., vol. xvi, p. 984.
Thecachampsa sericodon (?) Case, 1901, Md. Geol. Survey, Eocene, p. 95, pl. x, fig. 3.

Description.—This species was based "on a number of specimens of elongate conic crowns, which resemble to a considerable extent those of *Crocodilus antiquus* Leidy, of the same epoch. They differ from *T. contusor* in their more compressed and elongate form, the presence of a subacute ridge on the apical three-fifths of the crown, the absence of the lateral grooves, and the chevron structure. They are, on the contrary, minutely striate, and possess a silky lustre.

"Length of the medium specimen 16.5 lines (23 mm.); base of the crown 9 lines (18 mm.)."

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collections.—The type specimens, two teeth, are in the museum of the Academy of Natural Sciences of Philadelphia.

THECACHAMPSA (?) SICARIA Cope.

Plate XXVII, Figs. 3, 4, 5.

Thecachampsa sicaria Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 12.
Thecachampsa sicaria Cope, 1869, Amer. Nat., vol. iii, p. 91.
Thecachampsa sicaria Cope, 1871, Trans. Amer. Philos. Soc., vol. xiv, pp. 63, 64, pl. v, figs. 6, 6a, 6b. (Pp. 1-104 appeared in 1869.)
Thecachampsa (*Crocodilus*) *sicaria* Cope, 1882, Amer. Nat., vol. xvi, p. 984.

Description.—Described from teeth "with much compressed crowns of the tooth with prominent cutting edges." The specimens were loaned to Cope by Mr. P. T. Tyson, the State Geologist of Maryland.

Occurrence.—ST. MARY'S (?) FORMATION. "Near the mouth of the Patuxent River."

Collection.—Not known.

THECACHAMPSA (?) CONTUSOR Cope.

Plate XXVII, Figs. 6a, 6b.

Thecachampsa contusor Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.
Thecachampsa contusor Case, 1901, Md. Geol. Survey, p. 96, pl. x, fig. 4.
Crocodylus antiquus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 512. (In part.)

Description.—This species is of very doubtful value, it probably belongs with *Th. antiqua.* It was described from a single tooth, "remarkable for its short conic form. The basis is circular, and its diameter is three-fifth the length of the tooth. The apex is rather acute and circular in section, it is directed to one side, and the tooth is slightly flattened on the inside of the curve. This face is bounded by a low obtuse ridge on each side, for the basal two-thirds of the crown, which are not distinguishable from a series of ridges which mark, at a distance of a line, the basal three-fifths of the crown; they are less distinct on the convex aspect, and are separated by concave surfaces. Instead of the cutting ridges of *Crocodilus,* the apex is provided with a narrow flattened plane on each side. The surface of this portion and much of the convex, is marked by a minute decussation or chevroned structure.

"Vertical length 14.5 lines (29 mm.); diameter of the base of the crown 8.5 lines (17 mm.)."

Cope says in Trans. Amer Philos. Soc., vol. xiv, 1871, p. 64: "The peculiar form of the tooth on which *T. contusor* was based is due, I find, to attrition and partial destruction of the enamel."

Occurrence.—CALVERT FORMATION.—Charles county near the Patuxent river.

Collection.—Formerly in the Philadelphia Academy of Natural Sciences.

THECACHAMPSA (?) ANTIQUA (Leidy).

Plate XXVII, Figs. 7, 8, 9.

Crocodilus antiquus Leidy, 1851, Proc. Acad. Nat. Sci. Phila., vol. v, p. 307.
Crocodilus antiquus Leidy, 1852, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. ii, pp. 135–138, pl. xvi, figs. 1–5.
Crocodilus antiquus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 215, fig. 35b.
Thecachampsa contusor Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 143.
Thecachampsa antiqua Cope, 1869, Proc. Acad. Nat. Sci. Phila., vol. xxi, p. 12.
Thecachampsa antiqua Cope, 1869, Trans. Amer. Philos. Soc., vol. xiv, p. 64, fig. 16.
Thecachampsa (*Crocodilus*) *antiqua* Cope, 1882, Amer. Nat., vol. xvi, p. 983.
Crocodylus antiquus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 512. (In part.)

Description.—The description given by Leidy is as follows: "One of the teeth, represented in Fig. 1, Plate XVI, is a little less in breadth than the first anterior inferior tooth of the adult *Crocodilus biporcatus.* In the specimen the lower part of the fang has been broken away, but the tooth appears to have been as long, or nearly so, as that referred to of *C. biporcatus.* It is slightly less curved than that of the latter, and the crown, though as long, is much less robust, more slender, less curved, and more pointed at the summit. The enamel is more finely and sharply striated and at the apex of the crown is not so rugous, and its lateral carinated ridges are not so elevated and extend but a relatively short distance below the point of the tooth; upon one side disappearing entirely nine lines from the commencement, and on the other after five lines only. The fang is simply cylindrical and invested by a thin lamina of osteo-dentine continuous with the basal edge of the enamel. The large conoidal pulp cavity of the tooth extends to within eight lines of the summit of the crown. Within this cavity, in the specimen which was not at all worn off from use, was already formed a young tooth, represented in Fig. 2, closely corresponding in form with the half inch of the summit of that which ensheathed it, a circumstance, however, which is the ordinary one in the living species of Crocodile.

"The second specimen of the teeth, represented in Fig. 3, consists of a crown only, which is as long as that of the former tooth but slightly more slender, and the enamel is a little smoother, and its ridges, though not so elevated, are longer.

"The color of the dentinal substance and osteo-dentine of the teeth is umbreous brown or chocolate; the enamel is lighter colored, glistening, and delicately undulating and interruptedly striate.

Measurements.

First specimen:	
Thickness of the broken edge of the pulp cavity, three inches below the summit of the crown.	1¼ lines (3 mm.)
Probable length of the tooth in its perfect condition, if the parietes of the pulp cavity decreased in thickness at the same rate as a corresponding tooth of Crocodilus biporcatus	5 inches (125 mm.)
Length of crown laterally	1½ inches (37 mm.)
Lateral diameter of base of crown	10 lines (20 mm.)
Transverse diameter of base of crown	9¼ lines (18 mm.)
Lateral diameter of fang	12 lines (24 mm.)
Transverse diameter of fang	10½ lines (21 mm.)
Second specimen:	
Length of crown laterally	1½ inches (37 mm.)
Lateral diameter at base of crown	9 lines (18 mm.)

"Dr. Wyman[1] has described and figured the crown of a tooth of a Crocodile from the Miocene, at Richmond, Virginia, which corresponds to the above descriptions, and probably belong to the same species.

"In relation to the specimens of the concavo-convex vertebrae, their size indicates a species of crocodile probably no less than eighteen feet in length.

"One of the specimens represented in Fig. 4, I judge to be an anterior dorsal, probably the second; the other is a posterior dorsal, or a lumbar vertebra.

[1] Amer. Jour. Sci., ser. ii, vol. x, 1850, p. 233, figs. 8a and 8b.

"In the former, the spinous process excepting its base, the transverse processes, the articular or oblique processes excepting part of the right anterior and left anterior, and right anterior margin of the body, with the corresponding lateral tubercle, are broken away. In form and general proportions, it bears a great resemblance to the corresponding vertebra of the *Crocodilus gangeticus*, and the most striking difference is observable in the spinal canal, which in the former is cordiform or trilateral with rounded angles and the apex downwards, while in the latter it is reversed. Judging from its base, the inferior spinous process has been relatively thicker and not so broad as in *Crocodilus gangeticus* or *Alligator lucius*. The junction of the body is hemispherical. The lateral tubercle for the head of the lob is formed upon a relatively broad base.

Measurements.

Length of the body from the bottom of the concavity to the summit of the convexity......	3 inches (75 mm.)
Length laterally, exclusive of the convexity......	3 inches (75 mm.)
Depth of concavity	10 lines (20 mm.)
Vertical diameter of concave extremity has been about	3 inches (75 mm.)
Transverse diameter of concave extremity.......	3 inches (75 mm.)
Vertical diameter of convexity at base..........	2 in. 2 l. (54 mm.)
Transverse diameter of convexity at base........	2½ inches (62 mm.)
Transverse diameter of body at middle from one suture to the other	3 inches (75 mm.)
Antero-posterior breadth of base of spinous process	22 lines (44 mm.)
Vertical diameter of spinal foramen	14 lines (28 mm.)
Transverse diameter of spinal foramen..........	1 inch (25 mm.)

"The other vertebra, represented in Fig. 5, consists of the body only with the abutments of the neural arch and a small portion of the right anterior articular process. It is more compressed at the sides than in *Crocodilus gangeticus*, and therefore appears relatively deeper and narrower.

Measurements.

Length of the body from the bottom of the concavity to the summit of the convexity	3¼ inches (81 mm.)
Length laterally, exclusive of the convexity, has been about	3¼ inches (81 mm.)
Vertical diameter of convexity has been about	3 inches (75 mm.)
Transverse diameter of convexity has been about.	3 inches (75 mm.)
Transverse diameter of body at middle from one lateral suture to the other	2¼ inches (56 mm.)

"The fragment of rib consists of the vertebral third of one of the posterior ribs. It is thick and strong in accordance with the size of the animal, but presents nothing peculiar.

"The ungual phalanx appears, so far as I can ascertain from comparison with those of *Alligator lucius,* to be the first of the thumb. It is of large size and very robust. Its base is trilateral with rounded angles, and presents a transverse concave articulating surface. The depressions for the lateral ligaments just above the condyles are remarkably deep. Just postero-superiorly to one of the depressions is an oval tubercle for tendinous attachment.

Measurements.

Length of phalanx	2¼ inches (56 mm.)
Greatest breadth at base	15 lines (30 mm.)
Greatest depth of base	13 lines (26 mm.)
Breadth of condyles	10½ lines (21 mm.)

"For the species to which the fragments of the skeleton described belonged, I propose the name *Crocodilus antiquus.*"

Occurrence.—CHESAPEAKE GROUP. High Cliffs of the Potomac river, 40 miles above the mouth of the river in Westmoreland county, Virginia.

Collection.—The specimens consist of two teeth, two vertebrae, a fragment of a rib and an ungual phalanx. They are in the Museum of the Academy of Natural Sciences of Philadelphia.

CLASS PISCES.

Subclass ELASMOBRANCHII.

Order SELACHII.

Suborder TECTOSPONDYLI.

Family SQUATINIDAE.

Genus SQUATINA Duméril.

A single characteristic tooth of the "Angel-fish," *Squatina*, without lateral denticles and having a small median downward prolongation of the crown upon the front of the root below the large cone, was obtained by the Survey from the Calvert formation at Plum Point. The species appears to be distinct, and is interesting as being the first to be definitely recognized from this continent. It is probable, however, that the small undetermined teeth figured by Leidy in the Post-Pleiocene Fossils of South Carolina (Plate XXV, Figs. 9-13), also belong to *Squatina*.

SQUATINA OCCIDENTALIS n. sp.

Plate XXVIII, Figs. 1a, 1b.

Description.—Crown erect and comparatively stout, convex on both faces, and with sharp cutting edges. Enamel forming a blunt projection in front below the base of the crown, and extending as far as the lateral extremities of the root on the outer face. Root with a flat triangular inferior surface, and nutrient foramen situated in a slight median depression; upper surface of root elevated into a prominent transverse fold extending from the base of the crown to the innermost angle of the root. Total height of tooth in the type-specimen 6 mm.; length of base 9 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Family RAJIDAE Müller and Henle.

Genus RAJA Cuvier.

It is customary to assign either to this genus or to *Trygon* the majority of detached dermal tubercles found in the Tertiary of various European localities. The teeth of these genera are sufficiently distinctive, but in the case of their dermal armor, including caudal spines, the determinations are necessarily very doubtful.

Raja (?) dux Cope.

Plate XXVIII, Fig. 2.

Raja dux Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 141.

Description.—This "species" was founded by Cope on a large and much abraded dermal tubercle from Charles county, the original description of which is as follows:

"This species is represented by a dermal plate, which was originally covered by enamel, and probably supported a spine; the latter, and a considerable portion of the former, have been lost. The form is unsymmetrically subpentagonal, longer than broad. One extremity truncate, the other obtusely narrowed. Inferior surface concave-flattened; superior rising to a small median plane, edges thin. Greatest elevation near the narrow extremity, where the spine stood; a groove extends from the position of the latter to the margin. Surface indistinctly ribbed at right angles to the margin. Enamel with slight wavy ribs, those near the centre much coarser than those near the circumference. Length of plate 15 lines; greatest width 12.75 lines; greatest depth 4 lines. A second plate, perhaps of the same species, differs in its narrower form; it is without enamel. This ray was larger than any described from the European Tertiary."

The type-specimen, of which a figure is given in the present volume for the first time, is preserved in the Museum of the Philadelphia Academy of Natural Sciences. Similar but smaller dermal tubercles from the Miocene of Wurtemberg are assigned by various authors[1] to the genera *Raja, Trygon, Acanthobatis* and even *Acipenser.*

Occurrence.—Calvert Formation. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

[1] J. Probst, Beiträge zur Kenntniss der fossilen Fische aus der Molasse von Baltringen (Württ. Jahresb., vol. xxxiii, 1877, pp. 97–99, pl. ii).—O. Jaekel, Ueber tertiäre Trygoniden (Zeit. d. deutsch. geol. Gesell., vol. xlii, 1890, p. 365).—Idem, Die eocänen Selachier vom Monte Bolca, p. 140, Berlin, 1894.

Family MYLIOBATIDAE Müller and Henle.

Genus MYLIOBATIS Cuvier.

The best account of the dentition of this genus, with valuable suggestions for the determination of fossil teeth, is given by A. S. Woodward.[1] The development of young teeth has also deen studied by Jaekel,[2] and the dentition of some hitherto misunderstood fossil forms correctly interpreted by him.

It is stated in the report on the Eocene of Maryland, pp. 264 and 265, that the "anterior end" of the large dental pavement of *Myliobatis magister* Leidy is shown uppermost in the figures, but as these were inadvertently turned upside down, the statement should be amended so as to read *posterior* end. In most cases the orientation of Myliobatid dental plates can be readily determined. Traces of wear, due to the comminution of food during life, occur always at the anterior end; the transverse sutures of the median teeth are usually curved posteriorly along the lateral margins; and the superficial striae or wrinkels (when the gano-dentine layer is unabraded) always radiate outwards on passing from front to back. A longitudinal section shows that the median teeth are not only closely appressed against one another throughout their height, but they overlap in a tectiform manner, each tooth sloping obliquely backward.

Two species of *Myliobatis* have been described by Cope from the Eocene marls of New Jersey, which seem to have escaped general notice. These are *M. glottoides*[3] and *M. rectidens*.[3] *M. serratus* Leidy, founded on much abraded teeth from the same horizon and locality, is renamed *M. leidyi* by O. P. Hay,[4] the former specific title being preoccupied.

Myliobatis gigas Cope.

Plate XXVIII, Figs. 3a, 3b; Plate XXIX, Figs. 1a, 1b.

Myliobatis gigas Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 140.
Myliobatis vicomicanus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 140.

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[1] Ann. Mag. Nat. Hist. [6], vol. i, (1888) pp. 36–47; Proc. Geol. Assoc., vol. xvi, (1899), p. 3.

[2] Die eocänen Selachier vom Monte Bolca, pp. 129–131, and 150–159. Berlin, 1894.

[3] Proc. Amer. Philos. Soc., vol. xi, 1870, pp. 293, 294.

[4] Amer. Nat., vol. xxxiv, 1899, p. 785.

Myliobatis gigas Leidy, 1877, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii, p. 241, pl. xxxiii, fig. 4.

Myliobatis vicomicanus Leidy, 1877, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii p. 242, pl. xxxiii, fig. 5.

Description.—Dentition large but comparatively thin, the smooth coronal contour nearly flat in the lower jaw and but slightly arched from side to side in the upper. Longitudinal superficial striae well-marked, regularly deflected outwards on passing posteriorly. Median teeth in the adult about nine times broader than long, more arched at the sides than in the middle; lateral teeth longer than broad. Transverse sutures of median teeth slightly recurved posteriorly along the sides, and to a lesser extent (in the lower dentition) also in the middle.

This species is remarkable for the great tenuity of the tesselated pavement in proportion to its size, just as *M. pachyodon* is remarkable for its excessive thickness. These differences are best understood by a comparison of the cross-sections given on Plate XXVIII, Fig. 3b, and Plate XXIX, Figs. 1b, of this volume, with Plate XIII, Fig. 1a, of the Eocene volume. The lower dental pavement is relatively narrower than the upper, and its median teeth are shorter. In the type-specimen of the so-called "*M. vicomicanus*," shown in Plate XXIX, Fig. 1, the median teeth are fully nine times as broad as they are long. Cope's types of this species have already been figured by Leidy, although for some unexplained reason certain fragments belonging to the left-hand side of the upper dentition in front were omitted by the artist.

The transverse sutures, especially those of the lower dental pavement and the longitudinal superficial striae, are curved similarly to those of *M. magister* from the Eocene Phosphate Beds of South Carolina; but the median teeth are shorter, flatter and much thinner than in the Eocene species. The lower dental pavement exhibits a shallow longitudinal depression along the median line, in which the transverse sutures are gently curved posteriorly. In this respect the lower dentition resembles that of *M. magister* Leidy, *M. dixoni* Agassiz, and some other species, while it is exactly opposite to the condition presented in the upper dentition of *M. fastigiatus* Leidy.

The total length of the series of eleven median teeth in the lower dental pavement shown in Plate XXIX, Fig. 1, (type of *M. vicomicanus*) is 8 cm. and the width of the largest tooth 6 cm. The extreme length of the upper dental pavement measured in a straight line antero-posteriorly is rather more than 10 cm. or along the arc of its curved surface 12 cm. Its largest median tooth has a width of 8 cm. and a length of 1.1 cm.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

MYLIOBATIS PACHYODON Cope.

Plate XXIX, Figs. 2a, 2b.

Myliobatis pachyodon Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 140.
Myliobatis pachyodon Leidy, 1877, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii, p. 242, pl. xxxii. fig. 6.

Description.—Dentition large and massive, the median teeth being unusually thick in proportion to their size. Except as regards thickness, the median teeth are shaped similarly to those of *M. gigas* Cope and the transverse sutures are similarly curved. The species is intermediate in character between the accompanying *M. gigas* and *M. magister* from the Eocene, the latter having longer median teeth and more strongly curved transverse sutures. The type of the present species, which appears to be unique, exhibits only the left half of four anterior median teeth and portions of three elongate lateral teeth. The median teeth have a length of 1.1 cm. and thickness of 2.1 cm. If, as indicated by the cross-section and longitudinal striae, the pavement is preserved for rather more than one-half its width, the median teeth must have been at least 6 cm. wide.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

MYLIOBATIS FRANGENS n. sp.

Plate XXIX, Fig. 3.

Myliobatis sp. Leidy, 1877, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii, p. 243, pl. xxxii, figs. 7, 7a.

Description.—Lower dental pavement nearly flat and relatively very thin, in cross-section resembling *M. gigas* Cope. Median teeth about nine times broader than long, and with nearly straight transverse sutures.

The specimen upon which the above diagnosis is based was recognized by Leidy as belonging probably to a distinct species, its most obvious characteristic being the nearly straight course of the transverse sutures. The latter are not curved posteriorly at the sides nor in the middle, as in *M. gigas,* nor is there a median longitudinal depression, as in that and various other species. The median teeth are also relatively longer than in the lower dentition of *M. gigas,* but the cross-section is much the same in both.

In the specimen under consideration, which appears to be unique, the superficial layer of gano-dentine has been entirely removed, so that the triturating surface presents a punctate appearance where the numerous nutrient tubules are exposed. Indications of wear are very conspicuous on the three anterior teeth, as shown in the figure. Owing to the great amount of attrition which the median teeth have undergone, their thickness is nowhere more than 1 cm. The width of the second median tooth counting from the front may be safely estimated at 5 cm., and its length 0.9 cm. No significance is to be attached to the slight irregularities in the course of two of the transverse sutures.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Genus AËTOBATUS Blainville.

AËTOBATIS ARCUATUS Agassiz.

Plate XXIX, Fig. 5.

Aëtobatis arcuatus Agassiz, 1843, Poiss. Foss., vol. iii, p. 327.

Aëtobatis arcuatus Eastman, 1901, Md. Geol. Survey, Eocene, p. 102, pl. xiii, figs. 3a, 3b, 8.

Aëtobatis arcuatus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 321.

This species is tolerably abundant in various Miocene localities of Maryland, Virginia, North Carolina and New Jersey, but the teeth invariably occur singly in the detached condition, and are more or less water-worn or otherwise abraded. An examination of the type-specimens of Cope's *A. profundus,* described from the Miocene of

Charles county, corroborates Leidy's opinion that these are only the worn anterior teeth of the species under consideration.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Charles county near the Patuxent river.

Collections.—Philadelphia Academy of Natural Sciences, Maryland Geological Survey, Museum of Comparative Zoology.

Suborder ASTEROSPONDYLI Haase.

Family NOTIDANIDAE Bonaparte.

Genus NOTIDANUS Müller and Henle.

Remains of this genus are uncommon in the American Tertiary formations. A single specimen assigned to *N. primigenius* is recorded by Gibbes from the Eocene (?) of Richmond, Virginia, and the same form is mentioned by Cope as occurring in the Miocene of New Jersey, Maryland and North Carolina. According to A. S. Woodward, the stout, awl-shaped teeth from the "marls of New Jersey," described by Leidy[1] under the name of *Xiphidolamia ensis*, are referable to the symphysis of the upper jaw of *Notidanus*. The same author also remarks the evolution of the multicuspidate teeth in this genus is analogous to that observed in the grinders of the elephant, there being in both cases a multiplication of similar parts when they occur in series.[2]

Notidanus primigenius Agassiz.

Plate XXIX, Figs. 6a, 6b.

Notidanus primigenius Agassiz, 1843, Poiss. Foss., vol. iii, p. 218, pl. xxvii, figs. 6–8, 13–17 (? figs. 4, 5).

Notidanus primigenius Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 195, pl. xxv, fig. 95.

Notidanus primigenius Wyman, 1850, Amer. Jour. Sci., ser. ii, vol. x, p. 234.

Notidanus plectrodon Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 141.

Notidanus primigenius Woodward, 1886, Geol. Mag. [3], vol. iii, pp. 205, 253, 525.

Heptranchias primigenius Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 300.

Description.—Principal cone of lower lateral teeth relatively large, with prominent anterior serrations on its basal half diminishing in size

[1] Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii (1877), p. 252, pl. xxxiv., figs. 25–30.

[2] Nat. Sci., vol. i (1892), p. 674.

downwards; secondary cones usually six in number, all acutely pointed, and attached to a deep, laterally compressed root, beveled on its outer face. Principal teeth of the upper jaw less laterally elongated and with fewer cusps than those of the lower jaw. Lower median tooth with a well defined cusp.

The teeth of this species are intermediate in character between those of *N. serratissimus*, which are usually smaller, and *N. gigas*, which are longer and have a larger number of secondary cones. The average length attained by the lateral teeth is about 3 cm. Cope states of his so-called *N. plectrodon* that "it presents fewer denticles than any other species, and thus approaches distantly the *N. recurvus* of Agassiz." Comparisons show, however, that both of these species are founded on teeth referable to the upper jaw of *N. primigenius*. About a score of specimens have been obtained in all from the Miocene of Charles county, Plum Point and Fairhaven. The root is unfortunately injured in the specimen shown in Plate XXIX, Fig. 6.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river, Plum Point, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

Family LAMNIDAE Müller and Henle.

Genus ODONTASPIS Agassiz.

ODONTASPIS CUSPIDATA (Agassiz).

Plate XXX, Figs. 1a, 1b.

Lamna cuspidata Agassiz, 1843, Poiss. Foss., vol. iii, p. 290, pl. xxxvii a, figs. 43–50.

Odontaspis cuspidata Eastman, 1901, Md. Geol. Survey, Eocene, p. 105, pl. xiv, figs. 1a, 1b, 6a, 6b.

Lamna cuspidata Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 302.

This species occurs with rather less frequency in the Miocene than in the Eocene of this state, and is found principally at Plum Point and Fairhaven. All the examples observed are of the anterior dentition, and in the majority of cases are more or less water-worn.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river, Plum Point, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

ODONTASPIS ELEGANS (Agassiz).

Plate XXX, Figs. 2a, 2b, 3.

Lamna elegans Agassiz, 1843, Poiss. Foss., vol. iii, p. 369, pl. xl. *b*, fig. 24, (*non* pl. xxxv, figs. 1–7, *nec* pl. xxxvii *a*, figs. 58–59).
Odontaspis elegans Eastman, 1901, Md. Geol. Survey, Eocene, p. 104, pl. xiv, figs. 2a, 2b, 2c, 3a, 3b, 3c.
Lamna elegans Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 303.

Notwithstanding this is the most abundant of all sharks' teeth in the Eocene of Maryland and adjoining states, it is extremely uncommon in the Miocene. It is recorded by Cope from the Miocene of Charles county in this state, and from Cumberland county, New Jersey, but no examples are preserved in the Museum of the Philadelphia Academy of Natural Sciences with the rest of the Thomas Collection, which formed the basis of Cope's report. The dozen or so of specimens obtained by the Survey are all from Plum Point, and were found commingled with teeth of the preceding species.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus OXYRHINA Agassiz.

This genus is distinguished from *Lamna* by the prevailing absence of lateral denticles in the teeth, and as shown by several nearly complete skeletons from the Upper Cretaceous of this country and Italy, has remained practically constant from Mesozoic time to the present.

OXYRHINA DESORII Agassiz.

Plate XXX, Fig. 4.

Oxyrhina desorii Agassiz, 1843, Poiss. Foss., vol. iii., p. 282, pl. xxxvii, figs. 8–13.
Oxyrhina desorii Gibbes, 1847, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 267.
Oxyrhina desorii Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 203, pl. xxvii, figs. 169–171.
Oxyrhina wilsoni Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 203, pl. xxvii, figs. 172, 173.
Oxyrhina desorii Emmons, 1858, Rept. N. Car. Geol. Survey, p. 236, fig. 67.
Isurus desorii Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 305.

Description.—"Anterior teeth narrow, much elevated, and robust; crown much curved inwards, the outer coronal face nearly flat, the inner very convex; root with two elongated branches diverging at an acute angle. Lateral teeth more compressed, with a shorter root having more divergent branches; crown narrow, the cutting-edges in most cases gradually diverging to the extremities of the base, and the apex rarely reflexed."—Woodward.

The original of Plate XXX, Fig. 4, is an average-sized specimen of the anterior series of teeth; it belongs to the Museum of the Philadelphia Academy of Natural Sciences.

Occurrence.—CALVERT FORMATION. Plum Point, Charles county near the Patuxent river.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

OXYRHINA HASTALIS Agassiz.

Plate XXX, Figs. 5a, 5b, 6a, 6b, 6c.

Oxyrhina hastalis Agassiz, 1843, Poiss. Foss., vol. iii, p. 277, pl. xxxiv, (*excl.* figs. 1, 2, ? 14).
Oxyrhina hastalis Eastman, 1895, Palaeontogr., vol. xli, p. 178 (complete literature references and syonymy).
Oxyrhina hastalis Clark, 1895, Johns Hopkins Univ. Circ., vol. xv, p. 4.
Oxyrhina hastalis Clark, 1896, Bull. 141, U. S. Geol. Survey, p. 42.
Isurus hastalis Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 306.

Description.—"Teeth attaining a large size, broad, thin, compressed; outer coronal face flat or concave, rarely with vertical wrinkles; root short, the branches very divergent, usually blunt and abbreviated. Anterior teeth large, triangular and relatively broad, the crown only gently curved outwards at the apex; coronal edges of the lateral teeth gradually curving to the extremities of the base, the apex often bent slightly outwards."—Woodward.

The teeth of this species are rather more abundant than those of *O. desorii,* which accompany it at Plum Point and in Charles county. The example figured is from the former locality, and is one of the largest lateral teeth in the collection, its total height being very nearly 6 cm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Flag Pond. CALVERT FORMATION. Plum Point, Fairhaven, Charles county near the Patuxent river.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

OXYRHINA SILLIMANI Gibbes.

Plate XXX, Fig. 7.

Oxyrhina sillimani Gibbes, 1847, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 268.
Oxyrhina sillimani Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 202, pl. xxvii, figs. 165–168.
Isurus sillimani Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 307.

Description.—Teeth attaining a total height of about 3 cm., and exhibiting much uniformity. Distinguished from *O. hastalis* by the greater thickness of the crown, which is slightly convex on its outer surface, and by having a deeper and more expanded root with divergent branches. Coronal apex sometimes curved backwards, but never bent out of the vertical plane.

This species occurs in about equal frequency with *O. desorii*, which it accompanies. The example figured is one of the lateral teeth and shows the characteristic form of the root which serves to distinguish this species from *O. hastalis*.

Occurrence.—CALVERT FORMATION. Plum Point, Fairhaven, Charles county near the Patuxent river.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

OXYRHINA MINUTA Agassiz.

Oxyrhina minuta Agassiz, 1843, Poiss. Foss., vol. iii, p. 385, pl. xxxvi, figs. 36–39.
Oxyrhina minuta Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 202, pl. xxvii, figs. 161–163 (non fig. 164).
Isurus minutus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 306.

It is doubtful if the imperfect teeth from the Eocene of South Carolina assigned to this species by Gibbes properly belong here, and it is practically certain that the species is wrongly recorded by Cope as occurring in the Miocene of Maryland and New Jersey. The specimens so determined by him appear to be young examples of *O. sillimani* and *O. desorii,* together with some that are clearly referable to *Carcharias.*

Genus OTODUS Agassiz.

OTODUS OBLIQUUS Agassiz.

Plate XXX, Figs. 8, 9.

Otodus obliquus Agassiz, 1843, Poiss. Foss., vol. iii, p. 267, pl. xxxi, pl. xxxvi, figs. 22–27.

Otodus obliquus Eastman, 1901, Md. Geol. Survey, Eocene, p. 106, pl. xv.

This species, so abundant in the Eocene, occurs very sparingly in the Miocene of this State, the few examples known having been obtained from Charles county, and forming part of the Thomas Collection.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Genus CARCHARODON Agassiz.

CARCHARODON MEGALODON (Charlesworth).

Plate XXXI, Figs. 1a, 1b, 1c, 2, 3, 4a, 4b.

Carcharias megalodon Charlesworth, 1837 (*ex* Agassiz MS.), Mag. Nat. Hist. n. s., vol. i, p. 225, woodc. fig. 24.

Carcharodon megalodon Agassiz, 1843, Poiss. Foss., vol. iii, p. 247, pl. xxix.

Carcharodon megalodon Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 143, pl. xviii, pl. xix, figs. 8, 9.

Carcharodon rectus Agassiz, 1856, Rept. Pac. R. R. Explor. and Surv., vol. v, p. 314, pl. i, figs. 29–31.

Carcharodon rectus Agassiz, 1856, Amer. Jour. Sci., ser. ii, vol. xxi, p. 274.

Carcharodon megalodon Emmons, 1858, Rept. N. Car. Geol. Survey, p. 227, fig. 50.

Carcharodon ferox Emmons, 1858, Rept. N. Car. Geol. Survey, p. 229, figs. 52–54.

Carcharodon triangularis Emmons, 1858, Rept. N. Car. Geol. Survey, p. 232, fig. 59.

Carcharodon megalodon Leidy, 1877, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. viii, p. 253.

Description.—Teeth attaining a very large size, comparatively broad and robust, the outer coronal face flat or slightly convex, the apex sometimes gently curved outwards; distinct lateral denticles absent.

The teeth of *Carcharodon,* which are such a conspicuous feature in the Eocene of South Carolina and other states, appear to diminish in abundance proceeding northward, and ascending in the geological series.

They are extremely rare in the Maryland Eocene, and are not at all common in the Miocene. The lateral tooth from Fairhaven, shown in Plate XXXI, Fig. 3, is one of the largest found in this state, although it is exceeded in size by some of the same species from South Carolina, California and Peru. Those from Plum Point are mostly of small size, comparatively speaking, and have thinner and flatter crowns, as shown in Plate XXXI, Fig. 2. These agree with the teeth described by Agassiz as a distinct species under the name of *C. productus*, but now regarded as a variety of the present form. "*Carcharodon angustidens*" (= *C. auriculatus* Agassiz) is recorded from Charles county by Cope, but no examples exist in the collection.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river, Plum Point, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Family CARCHARIIDAE Müller and Henle.

It is a noteworthy fact that the gradual decline of the LAMNIDAE during Tertiary time was accompanied by a remarkable increase in importance of the genera included under the CARCHARIIDAE, and evidence is not lacking to show the latter have been able to displace the LAMNIDAE by means of their more efficient organization. Although their dentition does not appear formidable in comparison with the gigantic teeth of *Carcharodon*, it is in reality more durable, making up in structure what it lacks in size. In the teeth of this family the nutrient canals are concentrated into a central pulp-cavity, and the greater part of the crown consists of vasodentine. Not only is there much variation among the teeth of the upper and lower jaws, but it often happens that teeth of the upper jaw in one species have the same form as those of the lower jaw in a different species, thus rendering the determination of isolated fossil teeth very uncertain.[1]

[1] Bei den Carchariden erschwert jene Verschiedenheit der Zähne in Ober- und Unterkiefer die specifische Bestimmung einzelner Zähne ungemein, weil häufig die Zahnformen des einen Kiefers einer Art im entgegengesetzten Kiefer einer nahe verwandten Art wiederkehren. Man muss sich infolge dessen zunächst immer klar zu

Genus CARCHARIAS Cuvier.

CARCHARIAS (PRIONODON) EGERTONI (Agassiz).

Plate XXXII, Fig. 1.

Corax egertoni Agassiz, 1843, Poiss. Foss., vol. iii, p. 228, pl. xxxvi, figs. 6, 7.
Glyphis subulata Gibbes, 1847, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 268.
Galeocerdo egertoni Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 192, pl. xxv, figs. 66–69.
Glyphis subulata Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 194, pl. xxv, figs. 86, 87.
Galeocerdo egertoni Emmons, 1858, Rept. N. Car. Geol. Survey, p. 238, fig. 90.
Carcharhinus (Prionace) egertoni Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 312.

Description.—"Upper teeth broad, triangular, prominently serrated, both margins slightly concave. Lower teeth probably narrower than the upper, robust and prominently serrated."

This species occurs in about equal abundance with the teeth of *Galeocerdo contortus* and *Sphyrna prisca,* which accompany it at Plum Point, Fairhaven, Charles county, and other Maryland localities. Water-worn examples often show the characteristic hollow crowns.

Occurrence.—CALVERT FORMATION. Fairhaven, Charles county near the Patuxent river, Chesapeake Beach.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

CARCHARIAS LAEVISSIMUS (Cope).

Plate XXXII, Fig. 2.

Galeocerdo laevissimus Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 141.
Galeocerdo laevissimus Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 311.

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machen suchen, ob man es mit einen oberen oder einem unteren Zahne zu thun hat. Eine Entscheidung hierüber ist zwar nicht immer möglich, aber im Allgemeinen machen sich doch die Zähne des Unterkiefers durch einen gedrungenen, kräftigen Ansatz der Krone kenntlich.

Auf die Kerbung der Seitenkanten hat man unstreitig einen viel zu hohen systematischen Werth gelegt, indem man allein daraufhin *Carcharias* in Untergattungen trennte. Es liegt auf der Hand, dass eine solche Differenzierung überall und sehr leicht eintreten kann, und dass es vielfach nicht möglich sein wird, einen sehr schwach gekerbten Rand von einem ungekerbten Principiell zu unterscheiden . . . Wichtiger ist schon in systematischer Hinsicht das Vorkommen von Nebenzähnchen, weil ihre Ausbildung eine längere Differenzierung voraussetzt.—O. Jaekel, *Die eocänen Selachier vom Monte Bolca* (1894), p. 164.

Description.—A species only distinguished from *C. egertoni* by the absence of serrations on the coronal edges. Some teeth have the form of *Galeocerdo latidens* and *G. aduncus*, except that there are no denticulations.

At first sight these teeth might appear to be only worn examples of *C. egertoni*, or even of *Galeocerdo* (although the posterior notch is never conspicuous), but a study of numerous specimens shows that in all probability the species is well founded. It is found at the same localities as the preceding form. The original of Plate XXXII, Fig. 2, is one of Cope's type-specimens, and the first of this species to be figured.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river, Fairhaven.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

CARCHARIAS COLLATA n. sp. (*ex* Cope MS.)

Plate XXXII, Figs. 3a, 3b, 4a, 4b, 5.

Description.—A species of moderate size, the teeth comparatively stout, with a narrow, usually erect crown, strongly convex on its inner and slightly so on its outer face; apex sometimes slightly curved inwards or backwards; coronal edges with extremely minute serrations disappearing toward the base. The enamel at base of crown extends much lower down in the middle of the outer than on the inner face. The root is considerably elongated, large and symmetrical.

The Thomas Collection belonging to the Philadelphia Academy of Natural Sciences contains about forty teeth of *Carcharias* which were evidently regarded by Cope as indicating a new species, since they bear his MS. label "*Sphyrna collata*," a title which is now made valid by the above description. Fifteen other teeth are preserved in the same collection under a different specific title, also unpublished, but a careful examination fails to reveal any important character by which they may be distinguished from the first lot. All of these specimens are from Charles county.

Under the name of *Prionodon antiquus*, two teeth of *Carcharias*, one with serrated and the other with unserrated edges, were described by Louis Agassiz[1] from the Tertiary of California, and ascribed by him to the upper and lower jaws of one and the same species. As far as can be determined from the published figures, this association does not appear to be justified, and the evidence of *Carcharias egertoni* and *C. collata* would go to show that two distinct species are represented. If such a division were to be made, the form with serrated edges shown in Agassiz's Plate I, Fig. 15, should be selected as the type of *C.* (*Prionodon*) *antiquus*, while the others with sharp narrow crowns like that shown in Fig. 16 of the same plate should be transferred to *C. collata*, which they closely resemble, or else should receive a new specific name.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge. CALVERT FORMATION. Charles county near the Patuxent river, Plum Point, Fairhaven, Chesapeake Beach.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

CARCHARIAS MAGNA (Cope).

Plate XXXII, Figs. 6a, 6b, 7a, 7b.

Sphyrna magna Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 142.
Sphyrna magna Hay, 1902, Bull. 179, U. S. Geol. Survey, p. 314.

Description.—Teeth of comparatively large size, attaining a total height of nearly 2 cm., and distinguished from *C. collata* by their wider, Oxyrhina-like crown and shorter root. Coronal edges sharp, non-serrated, or only slightly crimped at the base; enamel at base of crown much extended laterally over the root, which is short and considerably thickened on the inner face.

This species is established on three somewhat dissimilar teeth from the Miocene of Charles county, which are remarkable for their large size as compared with other species of *Carcharias* and *Sphyrna*. Owing to the width of the crown and the extension of its basal portion over the root, a certain resemblance to the teeth of *Oxyrhina* is to be noted, but the nearest affinities are evidently with the foregoing species. As

[1] Rept. Pac. R. R. Explor. and Surv., vol. v (1856), p. 314, pl. i, figs. 15, 16.

in that form, the root extends high up on the inner face, but is low on the outer.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

CARCHARIAS INCIDENS n. sp.

Plate XXXII, Fig. 8.

Description.—Teeth robust, triangular, prominently serrated along the entire coronal margin on both sides. Posterior margin only slightly concave, the anterior nearly straight. Root deep, not produced beyond the base of the crown on either side.

The unique example on which this species is founded resembles in general form certain species of *Corax* from the Cretaceous, and is readily distinguished from other teeth pertaining to *Carcharias,* the roots of which are expanded and the coronal margins less prominently and completely serrated. The form under consideration also bears some resemblance to that described by Noetling as *Galeocerdo dubius,* from the Prussian Eocene.[1] Both faces of the crown are convex, the inner more so than the outer. The total height of the tooth is 14 mm., the width 15 mm., and thickness of the crown at the middle of the base 4 mm.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus GALEOCERDO Müller and Henle.

GALEOCERDO CONTORTUS Gibbes.

Plate XXXII, Figs. 9a, 9b.

Galeocerdo contortus Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 193, pl. xxv, figs. 71–74.

Galeocerdo contortus Clark, 1895, Johns Hopkins Univ. Circ., vol. xv, p. 4.

Galeocerdo contortus Clark, 1896, Bull. 141, U. S. Geol. Survey, p. 62.

Description.—" A species of moderate size. Teeth very robust, with elevated crown; the apex above the posterior notch elongated, produced

[1] Abh. geol. Specialk. Preussen u. Thüriug. Staaten, vol. vi, pt. 3 (1885), p. 97, pl. v, fig. 6.

to a sharp point, more or less twisted; anterior margin arched, somewhat sinuous, and finely serrated; margin below the posterior notch short, with comparatively small serrations."

The teeth of this species are quite abundant in the Eocene of South Carolina, Alabama and Virginia, and occur somewhat plentifully in the Miocene of Maryland and adjoining states. The illustration given in Plate XXXII, Fig. 9, is of an average-sized individual.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION. Charles county near the Patuxent river, Fairhaven, 3 miles south of Chesapeake Beach, Plum Point.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

GALEOCERDO LATIDENS Agassiz.

Plate XXXII, Fig. 10.

Galeocerdo latidens Agassiz, 1843, Poiss. Foss., vol. iii, p. 231, pl. xxvi, figs. 22, 23 (? figs. 20, 21).

Galeocerdo latidens Eastman, 1901, Md. Geol. Survey, Eocene, p. 109, pl. xiv, fig. 8.

This species is of rare occurrence in the Maryland Tertiary, only a single example being known from the Nanjemoy formation (Eocene) of Woodstock, and scarcely a dozen from the Miocene of Fairhaven and Charles county. The teeth exhibit considerable variation in form, some of them approaching closely to the type of *G. aduncus* except that they are more strongly serrated on the posterior margin (*cf.* Plate XXXII, Figs. 10, 11).

Occurrence.—CHOPTANK FORMATION. Governor Run. CALVERT FORMATION. Fairhaven, Charles county near the Patuxent river.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

GALEOCERDO ADUNCUS Agassiz.

Plate XXXII, Fig. 11.

Galeocerdo aduncus Agassiz, 1843, Poiss. Foss. vol. iii, p. 231, pl. xxvi, figs. 24-28.

Galeocerdo aduncus Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 191, pl. xxv, figs. 54-58.

Galeocerdo productus Agassiz, 1856, Rept. Pac. R. R. Expl. and Surv., vol. v, p. 314, pl. i, figs. 1–6.

Galeocerdo productus Agassiz, 1856, Amer. Jour. Sci., ser. ii, vol. xxi, p. 273.

Galeocerdo latidens Emmons (*errore*) 1858, Rept. N. Car. Geol. Survey, p. 239, fig. 68 (*non* fig. 69; cuts 68 and 69 interchanged).

Description.—"A species with the dentition very similar to that of the existing *G. arcticus* but of smaller size. Anterior coronal margin much arched and finely serrated; the apex above the posterior notch short, broad, and sharply directed backwards; margin below the posterior notch relatively short in the principal teeth, with large serrations."—A. S. Woodward.

The teeth of this species occur with rather more frequency than those of *G. latidens,* but are by no means abundant. The specimen shown in Plate XXXII, Fig. 11, is an average-sized specimen of one of the principal teeth.

Occurrence.—Calvert Formation. Charles county near the Patuxent river, Plum Point, Fairhaven.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

Galeocerdo triqueter n. sp. (*ex* Cope MS.).

Plate XXXII, Fig. 12.

Description.—Teeth very robust, with elevated crowns, smaller and less twisted than those of *G. contortus,* and more faintly serrated along the coronal edges. Anterior margin only slightly arched, posterior notch inconspicuous. Root similar to that of *G. contortus,* and general aspect suggestive of *Oxyrhina macrorhiza* from the Lower Cretaceous. Height of crown in median line on outer face of the type-specimen 9 mm., on the inner face 6 mm., thickness of crown at its base 3.5 mm., thickness of root 5 mm.

The somewhat worn specimen upon which this species is founded appears to be unique, nothing like it having been found since the Thomas Collection, of which it forms a part, was first brought together. The trivial title adopted for it is taken from a manuscript label of Cope's attached to the specimen, which bears witness that he regarded it as a distinct species, although its description was for some reason omitted. Possibly this is the same specimen which is listed as "*Galeocerdo* ? sp. aff. *contorto*" in connection with his description of *G. laevissimus.*[1] What species is meant by his citation in the same place of the *nomen nudum*, "*Galeocerdo appendiculatus Ag.*" cannot now be even conjectured, as there are no specimens in the collection bearing that designation.

Occurrence.—CALVERT FORMATION. Charles county near the Patuxent river.

Collection.—Philadelphia Academy of Natural Sciences.

Genus HEMIPRISTIS Agassiz.

HEMIPRISTIS SERRA Agassiz.

Plate XXXII, Figs. 13a, 13b, 14a, 14b, 14c.

Hemipristis serra Agassiz, 1843, Poiss. Foss., vol. iii, p. 237, pl. xxvii, figs. 18-30.

Hemipristis serra Gibbes, 1849, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, p. 193, pl. xxv, figs. 75-85.

Lamna (Odontaspis) hopei Gibbes (*non* Agassiz), 1849, Jour. Acad. Nat. Sci. Phila. 2nd ser., vol. i, p. 198, pl. xxvi, figs. 120-123.

Hemipristis heteropleurus Agassiz, 1856, Rept. Pac. R. R. Explor. and Survey, vol. v, p. 315, pl. i, fig. 14.

Hemipristis heteropleurus Agassiz, 1856, Amer. Jour. Sci., ser. ii, vol. xxi, p. 274.

Hemipristis serra Emmons, 1858, Rept. N. Car. Geol. Survey, p. 235, fig. 63.

Hemipristis crenulatus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 235.

Description.—"Marginal serrations in the broad upper teeth large, extending almost to the apex, which is gently curved backwards. Cutting edges of the anterior lower teeth very sharp distally. Inner face of the root bulging inwards, with a deep cleft."

This easily recognized species occurs in considerable abundance in the Eocene of South Carolina and Miocene of more northernly regions, extending as far as the cliffs of Gay Head on Martha's Vineyard. The lateral teeth are broad-based, strongly elevated along the middle of the inner face, and prominently serrated along the lateral edges. The serrations are oblique, rather more prominent on the posterior cutting-edge than on the anterior, and increase in size from the base of the crown to a point near the apex, where they cease altogether.

[1] Proc. Acad. Nat. Sci. Phila., vol. xix. 1867, p. 141.

The anterior teeth (Plate XXXII, Fig. 13) are stout and narrow, convex on both faces, between 3 and 4 cm. in total height, and with fewer and more irregular serrations than the lateral teeth. Many of these piercing teeth have the serrations reduced to slender cusps, more or less separated, and confined principally to the basal portion of the crown. The latter are obviously of different nature and origin from lateral denticles, properly so called, being merely retrogressive modifications of the cutting edge, and hence only of secondary importance, whereas lateral denticles represent the serial multiplication of entire crowns. Worn specimens of the anterior teeth are readily distinguished from *Lamna* and other forms by the pronounced swelling on the inner face of the root.

A large series of teeth has been collected from Charles county and other well-known Miocene localities in this and adjoining states. As is true also of *Oxyrhina desorii* and *Carcharodon megalodon*, the Eocene examples from South Carolina seem to have attained a somewhat larger size than their Miocene successors.

Occurrence.—CALVERT FORMATION. Plum Point, Fairhaven, Popes Creek, Charles county near the Patuxent river.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Genus SPHYRNA Rafinesque.

SPHYRNA PRISCA Agassiz.

Plate XXXII, Fig. 15.

Sphyrna prisca Agassiz, 1843, Poiss. Foss., vol. iii, p. 234, pl. xxvi *a*, figs. 35–50.
Sphyrna denticulata Emmons, 1858, Rept. N. Car. Geol. Survey, p. 241, fig. 84*a*.
Sphyrna prisca Eastman, 1901, Md. Geol. Survey, Eocene, p. 110, pl. xiv, fig. 7.

The small, pointed and finely serrated teeth of this "Hammerhead shark" are met with quite frequently in the principal Miocene localities of this and adjoining states. It is very abundant in the Eocene of South Carolina, but the specimens figured under this name by Gibbes[1] have the appearance of belonging to *Carcharias* rather than to *Sphyrna*. Only two or three teeth of this species have been obtained from the Eocene of Maryland.

[1] Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. i, 1849, pl. xxv, figs. 88–90.

Occurrence.—Calvert Formation. Plum Point, Charles county near the Patuxent river, Chesapeake Beach.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology.

UNDETERMINED SELACHIAN REMAINS.

Under this head a brief reference may be made to detached vertebrae and fragments of Selachian armor, such as dermal tubercles and spines, which are occasionally met with in Miocene strata. As a rule, the partially calcified vertebrae are not well preserved, and worn examples are quite impossible to determine. An exceptionally perfect centrum from the Calvert formation at Plum Point is represented in Plate XXXI, Figs. 4a, 4b, and this appears referable with tolerable certainty to the genus *Carcharodon.* Although the presence of *Raja, Trygon, Myliobatis,* etc., is indicated by other remains, no vertebrae of the Batoid type have been found in this state, and even Teleostome vertebrae are rare.

The spine shown in Plate XXIX, Fig. 4, has already been noticed in the discussion of *Myliobatis* remains (*v. supra,* p. 73). Less perfect spines of equally large size from the Miocene of Richmond, Virginia, are described by Leidy,[1] and referred by him rather doubtfully to the genera *Trygon* and *Myliobatis.* This author also describes in the same place, and from the same locality as the last, a dermal scute of *Acipenser ornatus,* and jaw-fragments of *Protautoga conidens,* but neither of these forms are known to occur in Maryland.

Subclass TELEOSTOMI.

Order ACTINOPTERYGII.

The only species of bony fishes recorded from the Miocene of this state is "*Sphyræna speciosa* Leidy,"[2] represented by a single laniary tooth from Charles county, of which a figure is given in Plate XXXII, Fig. 16. This and an allied form described by Cope under the name of *Sphyrænodus silovianus* occur in the Miocene of New Jersey in com-

[1] Contrib. Extinct Vert. Fauna W. Territ. (Rept. U. S. Geol. Surv. Territ., vol. i, 1873, p. 353, pl. xxxii, figs. 52–55).

[2] E. D. Cope, Proc. Acad. Nat. Sci. Phila., vol. xix, 1867, p. 142.

pany with three other Actinopterygians, as follows: *Phyllodus curvidens* Marsh, *Crommyodus irregularis* Cope, and *Phasganodus gentryi* Cope. The Eocene and Miocene of Virginia combined yield scarcely a half-dozen species of bony fishes, and this group is represented with equal meagreness in North and South Carolina. In all these states, however, and especially in the Eocene of Alabama and Mississippi, Teleostome otolites (Plate XXXII, Figs. 17, 18, 19) occur in considerable abundance and variety; and it happens that these insignificant appearing objects are the only record that remains of a once flourishing fish-fauna, which can be but inadequately reconstructed in imagination. Many of the Miocene otolites occurring in this state are indistinguishable from those figured under a variety of titles from the Eocene of Alabama and Mississippi by Koken.[1]

The problematical genus *Ischyrhiza,* to which attention was directed in the Eocene volume, may be dismissed with the statement that Cope's[2] reiterated assertion that "this or an allied genus is quite abundant in the Miocene of Maryland" remains up to the present time entirely uncorroborated. It is evident that this remark of Cope's applies only to the fused caudal fans, since he states immediately afterwards that "the teeth of the species have not been obtained." As for the tooth described by Leidy from North Carolina under the name of *I. antiqua,* Cope suggests it may have been a derived fossil of Cretaceous age, instead of Miocene. There is accordingly some reason for doubt whether either the teeth or the fans really continue into the Miocene, although they are unquestionably present in the Eocene. As already set forth in the preceding volume on the Eocene, the theoretical association of these teeth and fans under a single genus appears decidedly improper, and unwarranted by any facts. The name *Ischyrhiza* should be restricted to include only the teeth such as were first described by Leidy; and as for the fans, since they in all likelihood belonged to some of the Sword-fish tribe, they may be provisionally assigned to the genus *Xiphias.*

[1] E. Koken, Neue Untersuchungen an tertiären Fisch-Otolithen (Zeit. d. deutsch. geol. Gesell., vol. xliii, 1891, p. 77).

[2] E. D. Cope, Vert. Cret. Formation West (Rept. U. S. Geol. Survey Territ., vol. ii, 1875, p. 280).

ARTHROPODA.

CLASS CRUSTACEA.

Superorder MALACOSTRACA.

Order DECAPODA.

Family CANCROIDEA.

Description.—Claws belonging to an indeterminate genus of the CANCROIDEA are abundant at many localities. They indicate an animal of considerable size and abundance. The remains are largest and most abundant in the Choptank formation.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Jones Wharf, Governor Run, 2 miles south of Governor Run, Dover Bridge, Cordova, Trappe Landing, Peach Blossom Creek, Greensboro. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Superorder CIRRIPEDIA.

Order THORACICA.

Family BALANIDAE.

Genus BALANUS Lister.

BALANUS CONCAVUS Bronn.

Plate XXXIII, Figs. 1-6; Plate XXXIV, Figs. 1-7.

Balanus concavus Bronn, 1831, Italicus Tertiar-Gebilde.

Balanus finchii Lea, 1833, Contrib. to Geol., p. 211, pl. vi, fig. 222.

Balanus proteus Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, p. 134.

Balanus proteus Conrad, 1845, Fossils of the Medial Tertiary, No. 4, p. 77, pl. xliv, fig. 1.

Balanus proteus Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 184, 187.

Balanus concavus Darwin, 1854, A Monograph of the Fossil Balanidæ and Verrucidæ of Great Britain, p. 17, pl. i, figs. 4a–4p.

Balanus concavus Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.

Balanus proteus Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 141, pl. xxiv, figs. 18–23.

Description.—This species which, because of its great variability and wide geographical and geological distribution, has been referred to under many names, was very fully described by Darwin. This description although written almost fifty years ago is more complete than anything which has since been published, and little can be added to it even now.

Darwin says: " Parietes and basis, but not the radii, permeated by pores; shells longitudinally striped with white and pink, or dull purple; sometimes wholly white; scutum finely striated longitudinally; internally, adductor ridge very or moderately prominent. . . . .

General Appearance.—Shell conical (fig. 4a), often steeply conical (fig. 4c), but sometimes depressed and smooth (fig. 4d); orifice generally rather small, varying from rhomboidal to trigonal, with the radii narrow, and generally in the fossil specimens very oblique; surface generally smooth, sometimes rugged, and in the Coralline Crag specimens commonly ribbed longitudinally, the ribs being narrow. . . . .

Scuta: These in young and moderately-sized specimens are striated longitudinally (fig. 4l), sometimes faintly, but generally plainly, causing the lines of growth to be beaded; but in large and half-grown specimens, the lines of growth are often extremely prominent, and being intersected by the radiating striæ, are converted into little teeth or denticuli. As the striæ often run in pairs, the little teeth frequently stand in pairs, or broader teeth have a little notch on their summits, bearing a minute tuft of spines. In very old and large specimens, the prominent lines of growth are generally simply intersected by deep and narrow radiating striæ (tab. I, fig. 4p). In one case, a single zone of growth in one valve was quite smooth, whilst the zones above and below were denticulated. The valve varies in thickness, which I think influences the prominence of the lines of growth and the depth of the striæ. These striæ often affect the internal surface (fig. 4h) of the basal margin, making it bluntly toothed. The articular ridge (fig. 4n) is rather small, and moderately reflexed. The adductor ridge (as already stated) varies remarkably; in most of the recent Panama specimens (fig. 4n), and in the fossils from Portugal, it is extremely prominent, and extends down to near the basal margin; in other specimens it is but slightly prominent, as in those from the Crag (4f); it is short, but rather prominent in the specimens (4h) from Maryland; whereas it is very slightly prominent in the specimens from Virginia. The cavity for the lateral depressor, also, varies greatly; it is often, as in recent specimens, bounded on the side towards the occludent margin by a very slight straight ridge, which occasionally folds a little over, making almost a tube; this, at first, I thought an excellent specific character, but far from this being the case, the cavity often becomes, in recent specimens as well as in the Crag specimens (4f), wide, quite open, and shallow. The whole valve in the Crag specimens (fig. 4e) is apt to be more elongated than in the recent or Portuguese specimens (fig. 4l), and especially than in the Maryland (fig. 4h) specimens.

Terga very slightly beaked; the surface towards the carinal end of the valve, in some of the fossil specimens, is feebly striated longitudinally. There is either a slight depression (fig. 4k), or more commonly a deep longitudinal furrow (fig. 4g, 4o) with the edges folded in and touching each other, extending down the valve to the spur, and causing the latter to vary in width relatively to its length. When the furrow is closed in, the spur is about one-fourth of the entire width of the valve, and has its lower end obliquely rounded, and stands at about its own width from the basi-scutal angle: when there is only a slight depression and no furrow (as is the case with young specimens, and in the specimens (4k) from Maryland), the spur is broader, equalling one-third of the width of the valve, with its lower end almost truncated, and standing at about half its own width from the basi-scutal angle. But the absolute length of the spur also varies considerably in the Coralline Crag specimens; it is often very long, (fig. 4g) compared to the whole valve. In many Italian specimens (4o) it is long and broad. The basal margin of the valve on the carinal side of the spur is sometimes slightly hollowed out; and when the longitudinal furrow is closed, this side slopes considerably towards the spur. Internally, the articular ridge and the crests for the tergal depressor muscles are moderately prominent.

Parietes.—The longitudinal septa sometimes stand near each other, making the parietal pores small. The *radii* have oblique summits, but to a variable degree; their septa are unusually fine, and are denticulated on their lower sides; the interspaces are filled up solidly. The *alæ* have their summits very oblique, with their sutural edges nearly or quite smooth. In most of the fossil specimens (Tab. I, fig. 4b, r), and slightly in some of the recent specimens, the surface of the sheath presents an unusual character, in a narrow longitudinal, slightly raised border, running along the sutures, on the rostral side of each suture.

Basis thin, porose; sometimes with an underlaying cancellated layer."

The best development of this species in Maryland, both in abundance and in size of the individuals, is in the Choptank formation. The Calvert forms are dwarfs and the exterior of the shell is strongly corrugated. The form described by Lea as *B. finchii* was a young individual. *B. proteus* Conrad is a typical *concavus* as was long ago established by Darwin, whose monograph is based largely on Maryland material.

The individuals in the Choptank and St. Mary's formations grow in clusters on Pectens and other large Molluscan shells.

This species occurs in the Miocene of the entire Atlantic Coast. It is very abundant in the Miocene and Pliocene of Europe. It is interesting to note that Darwin regards it as recent only in the Pacific, where it occurs on the coasts of California, South America, the Philippines, and Australia.

Basal diameter, 73 mm.; height, 52 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Pocomoke City (well 53-63 feet deep). Choptank Formation. Jones Wharf, Pawpaw Point, Flag Pond, Turner, St. Leonards Creek, Cordova, Governor Run, 2 miles south of Governor Run, Greensboro, Sand Hill, Peach Blossom Creek, Trappe Landing, Dover Bridge. Calvert Formation. Plum Point, Truman's Wharf, Chesapeake Beach, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Superorder OSTRACODA.

Family CYTHERIDAE.

Genus CYTHERE Müller.

CYTHERE CLARKANA n. sp.

Plate XXXV, Figs. 1-10.

Description.—Carapace rather irregular in outline but usually elongate-ovate, about 1.30 mm. in length, 0.65 mm. high and 0.6 mm. thick. Valve well rounded, the greatest convexity towards the posterior end, unequal, the left overlapping the right at the cardinal angles and in turn overlapped by the right along the ventral edge. Position of anterior hinge teeth marked by an oblique dorsal swelling. Hinge straight, the length being about three-fifths that of the entire carapace. Left valve obliquely rounded posteriorly, most prominent in the lower half; ventral edge straight or slightly arcuate; the posterior edge rather narrowly rounded, the curve generally straightened in the upper half, and the junction with the extremity of the hinge line sometimes obtusely angular. In the right valve the ends are more equal in breadth and curvature, although the ventral half of the anterior is also more strongly curved, and the ventral outline is faintly sinuate instead of arcuate. Surface of both valves coarsely reticulate, the meshes arranged somewhat concentrically about a subcentral point. The ridges forming the raised part of the network bear, especially at their junction angles, spines, the size and number of which vary with age. In the old condition, the surface is quite rough with these spines, the ridges thicker and the reticulation less obviously concentric. The lower two-thirds of the anterior and posterior margins of the left valve bear a series of small spines but on the right valves such spines have been observed only on the anterior edge and they are often wanting even there. Edge view lanceolate with the ends a little blunt or truncate. Hingement consists of a rather large anterior lateral tooth connected by a bar with a somewhat smaller posterior tooth and corresponding sockets in each valve.

This striking and characteristic fossil is very abundant in the Calvert formation at Plum Point. We know of no American species with which it might be confounded. Compared with European forms, *Cythere striatopunctata* (Roemer), *C. scrobiculata* (Münster), *C. nystiana* and *C. angulatopora* Bosquet as figured by Bosquet,[1] are more or less closely allied but it is so easily distinguished from each of those mentioned by differences in outline and surface markings that we have no doubt of its distinctness.

The specific name is given in honor of Professor William Bullock Clark, the State Geologist of Maryland.

Occurrence.—CALVERT FORMATION. Plum Point.[2] CHESAPEAKE GROUP. Yorktown, Pa.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE CLARKANA VAR. MINUSCULA n. var.

Plate XXXV, Figs. 11-14.

Description.—The form for which we propose the above subordinate name is not uncommon in association with *C. clarkana,* yet, despite its very similar aspect, we have not observed any satisfactory connecting links proving it to be, as we believed at first, merely the young of the larger form. For the present therefore we assume that it represents a variety sufficiently distinct to deserve a name. So far as known it is distinguished by its much smaller size and relatively wider anterior end. The latter difference is noticeable in particular when right valves are compared.

Occurrence.—CALVERT FORMATION. Plum Point. CHESAPEAKE GROUP. Yorktown, Va.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE PLANIBASALIS n. sp.

Plate XXXVIII, Figs. 1-3.

Description.—Valves ovate subtetragonal, dorsal margin rather short, straight, ventral margin gently convex; ends unequal, the anterior edge

[1] Desc. des Entomostraces Fossiles des Terrains Tertiares de la France et de la Belgique. Mem. Couron. Acad. Belg., Tome xxiv, 1851.

[2] The OSTRACODA described from this locality were picked by the writers from a small part (about a half pint) of extensive washings secured by Mr. Frank Burns for the United States National Museum. The figured specimens will be preserved in the National Museum, while a duplicate set, as nearly complete as possible, has been selected for the collection of the Maryland Geological Survey.

oblique, most produced about the middle of the lower half; posterior end narrower, the edge strongly curved, most produced about midway of the height, with three or four small spines beneath this point; cardinal angles moderately distinct, subequal in the right valve but in the left the posterior one probably more pronounced than the anterior and more nearly terminal than in the right valve; lower half of anterior margin with a row of small granules or spines. A well defined flattened, unpitted border encloses the ends and ventral side, very narrow in front and below but gaining considerably in width as it passes around the posterior end. Ventral edge very thick and nearly flat, the most prominent portion of the surface being on this side. From this abrupt ventral elevation, which is crowned by a row of blunt spines, the surface descends gradually to the dorsal edge and more rapidly to the anterior and posterior ventral margins. Surface markings consisting of large pits and internodes, the latter increasing in size and prominence toward the crest of the ventral ridge-like elevation. Pits generally occurring in furrows but without any definite order of arrangement except on the ventral edge where they are elongate and arranged longitudinally.

Length of a right valve 1.15 mm., greatest height of same 0.60 mm., greatest thickness of same 0.30 mm.

In a side view this species resembles *C. clarkana* greatly, but may be distinguished at once by its flattened ventral edge. It is probably more closely allied to *C. angulatopora* (Reuss) as figured by Bosquet, but differs slightly in outline and surface markings, and in the greater thickness of the ventral edge. In Reuss' species the surface pits are more regularly arranged in concentric series, and their are no nodes between them, but there is a low submedian swelling, the like of which has not been observed in *C. planibasalis.*

Occurrence.—Chesapeake Group. James River, Va. Probably also in the Calvert or Choptank Formation in Maryland.

Collection.—U. S. National Museum.

Cythere calverti n. sp.?

Plate XXXVIII, Figs. 11-13.

Comp. *Cythere angulatopora* (?Reuss) Bosquet, 1852, Desc. d. Entomostr. foss. d. Terr. Tert. de la France et Belgique, p. 68, pl iii, figs. 5, a, b, c, d; also *Cythere nystiana* Bosquet, op. cit., p. 65, pl. iii, figs. 3, a, b, c, d.

Description.—The valves of this species are oblong and obscurely trapesoidal in outline, with the dorsal and ventral margins subparallel, the former straight or very gently concave, the latter straight or very slightly convex, the ends subequal but converging dorsally so that the ventral half is longer than the dorsal half. Rim of valves distinct, double on the anterior end and narrow, growing almost obsolete about the middle of the ventral edge and wider again in the postventral region, near which also the surface has its greatest convexity. In the posterodorsal angle there is a well defined submarginal node, and just in front of the center of the valves a less distinctly defined small swelling. Excepting the marginal rims, which are smooth, the entire surface is covered with subangular pits, which occasionally present an irregular concentric arrangement. No marginal spines have been observed.

Length of a left valve 0.86 mm., height of same 0.46 mm., thickness of same 0.22 mm.

It is difficult to decide from the few left valves before us whether the relations of this species are nearer *C. angulatopora* (Reuss) Bosquet[1] or *C. nystiana* Bosquet. In having no marginal spines it corresponds with the latter and differs from the former, but when this feature is left out of consideration the relations are reversed. In most respects our species occupies an intermediate position between the two European Ostracoda with which we have compared it, yet as it seems to possess a few characters not shared by either of them it has been deemed advisable to refer to the American form provisionally under a new name.

Occurrence.—Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere inæquivalvis n. sp.

Plate XXXV, Figs. 15-17.

Description.—Carapace elongate, the outline approaching that of a parallelogram, very inæquivalved, 1.1 mm. to 1.2 mm. in length, 0.5 mm.

[1] According to Jones and Sherborn the *C. angulatopora* of Bosquet is not the same species to which Reuss applied that name. They have therefore proposed the new name *C. bosquetiana* for Bosquet's species.

to 0.55 mm. in height, and with the thickness about the same as the height. Valves moderately convex, the most prominent point being a little in front of the postventral fourth, and just beneath the posterior end of a single or double and more or less well defined longitudinal depression. Left valve obliquely rounded in front, the outline here being most produced in the lower half, and merging very gradually into the long dorsal edge, posterior margin also oblique, though less so and with the greatest prominence in the upper half; dorsal and ventral margins nearly straight and parallel, the slight curvature in both being upward; posteriorly a wide and rather sharply defined flattened border, narrowing ventrally, and a rather obscurely defined one anteriorly. Right valve smaller than the left and quite different in outline, the latter being due to two excisions at the extremities of the hinge, the anterior one of which is slight, the posterior one deep. Hingement strong, normal for the genus. Surface with scattered pits, sometimes obscure, often restricted to the broad, subcentral, longitudinal furrow or furrows.

We know of no described species with which this need be closely compared. It is probably nearest our *C. plebeia*, but the median furrow and the well developed posterior border of the left valve are both lacking in that species.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE PLEBEIA n. sp.

Plate XXXV, Figs. 20-29.

Description.—The carapace of this species closely simulates that of *C. inæquivalvis* in outline of both valves, the differences between them being chiefly in their surface markings. Thus, the valves of *C. plebeia* are more evenly convex and show no sign of the broad, subcentral longitudinal furrows characterizing *C. inæquivalvis* nor of the flattened border that is developed, particularly along the posterior edge of the left valve, in that species. The surface pits also are smaller and less irregular, and generally the pits exhibit the peculiarity of occurring in pairs. Comparing outlines of the left valves of the two species, it will be noticed that in *C. plebeia* the ends are more sharply curved, and the anterior margin often obliquely subtruncate, with the greatest prominence nearer the ventral edge. Finally, the posterior extremity of the right valve is narrower and a less oblique.

Length 1.1 mm. to 1.15 mm., height 0.54 mm. to 0.57 mm., thickness 0.5 mm. to 0.52 mm.

Occurrence.—CALVERT FORMATION. Plum Point. CHESAPEAKE GROUP. James River and Yorktown, Va.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE PLEBEIA VAR. MODICA n. var.

Plate XXXV, Figs. 18, 19.

Description.—This variety, of which only left valves are known, is distinguished from the typical form of the species by its shorter and more ovate form. The surface pits also constitute a more conspicuous feature.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE PLEBEIA VAR. CAPAX, n. var.

Plate XXXV, Figs. 30-33.

Description.—This variety is distinguished from the typical variety by its greater height and finer surface pitting. The latter, in all the specimens seen, is restricted to the postcentral region of the valves. The outline of the right valve, furthermore, is more arcuate in its ventral and dorsal portions, while the posterior extremity is no less sharply rounded.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE BURNSI n. sp.

Plate XXXVI, Figs. 34-39.

Description.—This well marked species agrees in many respects with the associated *C. inæquivalvis* and *C. plebeia,* the dorsal half of the outline, especially of the left valve, being much as in the former, while the ventral half is as in the latter. It differs from both in having the surface punctæ arranged in longitudinal lines between more or less well developed ridges, in the greater width and more uniform curve of the posterior end of the valves, this difference being more particularly apparent when right valves are compared; and in the greater development of the cardinal teeth and thinner connecting bar in the right valve. Compared further with *C. inæquivalvis* it will be found that the carapace is higher, the ventral outline distinctly arcuate, instead of straight or sinuate, the ends of the left valve broader, the projection of the posterior extremity of the left valve beyond the posterior hinge tooth less, and the excision of the outline just behind this tooth also less. Finally, there is no sign of the broad subcentral longitudinal furrows characterizing that species. Continuing the comparison with *C. plebeia* and its varieties, we find that the dorsal outline of the right valve is much straighter and longer, and its ventral outline either faintly arcuate or straight in the middle but never sinuate, while the posterior end of this valve, as has been stated already, is wider and more obtuse. The posterior end of the left valve also is more obtuse and more uniformly curved, and usually is paralleled by a flattened border, while the postdorsal angle is more prominent and the whole dorsal outline straighter.

As in the cases of the preceding species, we have failed to find any exact match for *C. burnsi* among described Tertiary and recent species. A good many species of *Cythere* have been described and the fossil species, as a rule, are widely distributed in Europe, but so far as our investigations of American Tertiary Ostracoda permit of coming to a conclusion on the point it appears that the number of new forms is far from being exhausted and the species are nearly always distinguishable from their European congeners.

Length about 1.15 mm., height 0.57 mm., thickness about 0.54 mm.

The specific name is given in honor of the veteran collector, Mr. Frank Burns, of the U. S. Geological Survey, who collected the material from which many of the Ostracoda described in this volume were picked.

Occurrence.—Choptank Formation. Pawpaw Point. Calvert Formation. Plum Point. Chesapeake Group. Yorktown, Va.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE PAUCIPUNCTATA n. sp.

Plate XXXVIII, Figs. 7-9.

Description.—Carapace rather large, strongly convex, subelliptical in outline. Left valve with the ends subequal, slightly oblique, the curve of the anterior edge being a little sharper in the ventral half than in the upper, while the latter merges very gently into the straight dorsal outline; posterior margin with its greatest prominence and curve just above the mid-height, below passing gradually into the convex ventral outline, above turning more rapidly forward to the distinct though obtusely angular junction with the hinge line; ventral edge tumid, slightly overhanging the contact margin. Surface smooth except on the most convex portion, which lies a little behind the center of the valve. Here there are three rows of rather large and sometimes not very closely defined pits, three to five in each row. Right valve unknown, probably narrower than the left and varying similarly in shape as in related species.

Length of an average left valve 1.15 mm., height of same 0.61 mm., greatest thickness of same 0.32 mm.

This and several of the preceding species, notably *C. burnsi* and *C. plebeia,* are American representatives of the well marked section of the genus of which the common European Tertiary *C. jurinei* Münster is a good type. *C. paucipunctata* is distinguished from all the other Tertiary species of the section by slight peculiarities in its outline, greater convexity, and the limited number of surface pits.

Occurrence.—CHOPTANK FORMATION. Peach Blossom Creek, 3 miles southwest of Easton.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE TUOMEYI n. sp.

Plate XXXVIII, Figs. 4-6.

Description.—Carapace moderately convex, subovate; anterior end considerably wider than the posterior, somewhat oblique, with the greatest prominence and curve in the lower half, the upper half merging more gradually into the straight dorsal margin; posterior margin rounded; cardinal angles obtuse, the anterior one, especially in the right valve, barely distinguishable. A wide, smooth, depressed border encloses the ends, grows narrow along the dorsal edge and appears to die out entirely, in a lateral view, along the ventral edge. Remainder of surface moderately tumid and marked by rather large pits arranged in lines, those in the posterior and central parts longitudinal, those along the ventral and anterior sides irregularly concentric and those on the dorsal slope somewhat obscurely radial. Just above and in front of the center of the valves there is sometimes a slight swelling which may cause more or less local irregularity in the arrangement of the pits.

Length of a left valve 0.65 mm., greatest height of same 0.33 mm., length of a right valve 0.62 mm., greatest height of same 0.32 mm.

A number of living and European Tertiary species of this type are known, but we could not satisfy ourselves that the exact specific match of *C. tuomeyi* has been described heretofore. Of American species the closest allies known to us are figures on Plate XXXVI. Among these *C. nitidula* and *C. calvertensis* are probably nearer than *C. porcella* and *C. burnsi,* agreeing better in their outlines and size, and in having a flattened border at their ends. They exhibit, however, appreciable differences even in the points of outline and surface contour, and a more obvious one in their surface ornamentation. In the last respect *C. tuomeyi* agrees rather better with *C. burnsi,* but that species commonly attains a much larger size and has nearly equal instead of decidedly unequal ends.

Occurrence.—CHOPTANK FORMATION. Peach Blossom Creek, 3 miles southwest of Easton. CHESAPEAKE GROUP. Yorktown, Va.

Collection.—U. S. National Museum.

CYTHERE PORCELLA n. sp.

Plate XXXVI, Figs. 26-33.

Description.—Carapace rather full and often appearing quite smooth, somewhat obliquely acuminate ovate, the anterior outline more or less produced below, the posterior outline much narrower, most prominent about the middle, and with the projection emphasized by usually three, occasionally four or even five minute marginal spines; length about 0.85 mm., greatest height about 0.45 mm. Right valve with the hinge line very gently arcuate and the dorsal angles generally obtuse and sometimes scarcely distinguishable. Left valve with the dorsal half of the outline more arcuate than the ventral, the latter sometimes being even a trifle sinuate near the middle. Posterior extremity of both valves generally with a rather faintly defined border. Surface porcellaneous and sometimes appearing quite smooth, but when the preservation is obviously good it usually exhibits numerous minute punctures, generally arranged in four to six curved series, over the post-central region of each valve. A small central spot, often slightly depressed, is usually distinguishable by its darker color. Hinge teeth rather strong in right valve, the anterior one the weaker. In the left valve here is a large socket only at the posterior end of the hinge and a small tooth and socket at the anterior extremity.

The small size and shape of the valves of this very common species are so distinctive when compared with associated species of the genus that little trouble is likely to be experienced in their recognition. Some of the species of *Cytheridae,* especially *C. subovata* of this report, might be confused with *Cythere porcella,* but it will require only a glance at the hingement to see that they have no true relation to each other.

Occurrence.—CALVERT FORMATION. Plum Point. Also at Yorktown, Va., in the CHESAPEAKE GROUP.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE NITIDULA n. sp.

Plate XXXVI, Figs. 21-23.

Description.—This neat species is not nearly so common as *C. porcella,* and at present the typical variety is known only from five or six left valves. These, however, are very constant in their peculiarities so that we cannot doubt they represent a distinct specific type. Compared with *C. porcella,* which they resemble more than any other species known to us, they are distinguished by the constant development of a well defined flattened border margining both ends. Then the posterior outline is blunter and differs particularly in the postcardinal region which is more prominent. Finally, the posterior margin is not spiniferous. The punctæ in the five or six centrally situated surface striæ are very fine, and the test unusually fragile.

Length about 0.87 mm., height of left valve about 0.48 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere nitidula var. calvertensis n. var.

Plate XXXVI, Figs. 24-25.

Description.—This variety or closely related species differs from the typical form of *C. nitidula* in being a little more elongate and in the coarser pattern of the surface punctation. The test also is stronger and the anterior border narrower. While the three rows of surface puncture, on the left valve, occur in a flattened area defined below by a faint ridge. The outline approaches more nearly to that of *C. porcella* but is still clearly distinguished by the greater prominence of the dorsal third of the posterior curve.

The right valve represented by Plate XXXVI, fig. 25, is believed to belong to a variety of *C. nitidula* rather than to *C. porcella,* principally because of the slight arcuation of the ventral outline. The corresponding portion of the outline of right valves of *C. porcella* is always a trifle sinuate.

Length 0.8 mm., height 0.42 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere punctistriata n. sp.

Plate XXXVIII, Figs. 22-24.

Description.—Carapace compressed convex, subrhomboidal in outline; anterior margin obliquely subtruncate, narrowly rounded below; posterior end, in the left valve especially, somewhat acuminate, sinuate above, convex and curving rapidly forward beneath the extremity; dorsal and ventral margins subparallel, the former gently convex, the latter very slightly sinuate. Posterior end with a wide, flattened border, anterior and ventral sides with a narrow one. Surface of valves having the greatest convexity just behind and a little beneath the center, the anterior and dorsal slopes appearing rather flat. Surface ornament consisting of single or double rows of minute punctæ situated in five or six shallow grooves, having their best development in the posterior half and so arranged that they converge toward the anteroventral angle. Most of the grooves and punctæ, however, become obsolete before reaching that point. Marginal spines wanting.

Length of a right valve 0.62 mm., greatest height of same 0.33 mm., greatest thickness of same 0.15 mm.

C. punctistriata might be compared with a number of European species, but we are at a loss to say to which of a dozen or more it is most allied. Under the circumstances it may suffice to express our conviction that it is specifically distinct from all previously described species of which we have seen either specimens or good figures. The next species, *C. vaughani*, is probably a nearer ally than any other known to us.

Occurrence.—Choptank Formation. Peach Blossom Creek, 3 miles southwest of Easton. Calvert Formation. Church Hill.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere vaughani n. sp.

Plate XXXVIII, Figs. 25-27.

Description.—Valves subacuminately produced posteriorly, oblique anteriorly, this end being rounded below and subtruncate above, also much wider than the other; dorsal outline wavy on account of the surface ornament, convex on the whole, with the cardinal angles fairly distinct in the right valve; left valve not seen; dorsal half of posterior edge sinuate, as is also the ventral outline; lower half of anterior rim and posterior two-thirds of ventral edge with a fringe of minute spines. Surface with four longitudinal ridges, of which the first forms the anterior half of the dorsal outline; the second begins at the postcardinal angle and extends forward beneath the first to a point under the anterocardinal angle where it is lost; the third begins a little in front of the postcardinal angle, near which it is very prominent, and extends quite across the valve to about the middle of the anterior rim; the fourth likewise extends nearly the full length of the valve, beginning at the posterior extremity and running parallel with and close to the ventral edge until it becomes obsolete near the anteroventral angle, attaining its greatest altitude in front of the midlength of the valve. The furrows separating the first and second and the second and third ridges are each occupied by a row of large pits, each pit of the second row being divided into two compartments. The middle third of the space between the third and fourth ridges contains three or four strong cross bars, the depressed spaces between these being taken up by small pits. The anterior third is divided longitudinally by a small ridge separating a row of large pits above from a row of smaller ones beneath. Between the posterior half of the ventral ridge and the ventral edge the steep slope is occupied by four pits decreasing in size posteriorly, while in front of these the slope carries several rows of much smaller pits. Between the ventral ridge and the postcardinal border there is a large depressed space.

Length of a right valve 0.81 mm., greatest height of same 0.39 mm., greatest thickness of same 0.29 mm.

Although related to our *C. punctistriata,* the differences between their respective surface markings are so striking that they cannot be confused. A closer ally perhaps is found in *C. truncata* (Reuss), a Tertiary fossil of Austria and France, but *C. vaughani* is more elongate and more acuminate posteriorly and differs also quite obviously in its surface markings.

Named for Mr. T. Wayland Vaughan, of the U. S. Geological Survey in appreciation of the excellent work he is doing on the Tertiary corals.

Occurrence.—CHESAPEAKE GROUP. James River, Va. Probably also in Maryland.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE FRANCISCA n. sp.

Plate XXXVIII, Figs. 19-21.

Description.—Valves moderately and rather uniformly convex, acuminate-ovate in outline, the posterior extremity small, subacute, compressed, the anterior end broad, with a slightly oblique margin, curving most in the lower half, the upper portion turning very gradually into the dorsal outline; posterocardinal angle very obtuse; ventral outline long, nearly straight in the middle, though on the whole gently convex. Anterior end with a narrow border that continues on around the ventral side, but in a side view appears to die out before reaching half the distance to the posterior extremity. A similar but superimposed border encloses the postventral portion of the valve, while just within is a thin, raised line that above the posterior extremity forms a distinct margin to the anterodorsal region. Excepting the marginal portions and the compressed part of the posterior end, the entire surface is covered with minute pits, arranged more or less regularly in lines, many of them disposed in a concentric manner.

Length of a right valve 0.50 mm., greatest height of same 0.27 mm., thickness of same 0.11 mm.

A search of the literature has failed to reveal any described species to which this very neat little form might be referred. Of a number of related species those which seem to offer the greatest degree of resemblance are two of the species described in this contribution, viz., our *C. punctistriata* and *C. subovalis.* As may be seen by comparing the figures of the three species on Plate XXXVIII, *C. francisca* is longer and much more delicately pitted than *C. subovalis,* and further that it has narrow rim-like borders that do not occur in that species. From *C. punctistriata* it differs decidedly in outline, the difference being particularly evident when the comparison is restricted to the anterior halves. Then the surface ornamentation occupies a raised field in that species and the pits, instead of occurring in concentric or irregular rows, are placed in shallow, diverging furrows.

The specific name is intended as a small tribute to Miss Francisca M. Wieser, who has shown rare ability and care in her work on the illustrations of the OSTRACODA described in this volume.

Occurrence.—CHOPTANK FORMATION. Peach Blossom Creek, 3 miles southwest of Easton.

Collection.—U. S. National Museum.

CYTHERE SUBOVALIS n. sp.

Plate XXXVIII, Figs. 14-15.

Description.—Left valve moderately convex, with blunt edges, acuminate-ovate in outline, the posterior end small, the anterior end broad, scarcely oblique, and almost uniformly curved; ventral margin gently convex, the dorsal edge more arcuate, though the anterior extremity of the hinge seems to be about midway between the obtuse posteardinal angle and the anterior extremity of the valve. Surface with pits of moderate size, rather widely separated and with no very evident arrangement.

Length of a left valve 0.88 mm., greatest height of same 0.55 mm., greatest thickness of same 0.26 mm.

Of this species we have seen only a single left valve, but as it is a Maryland fossil and from an horizon from which comparatively few OSTRACODA are known, and as other specimens of it will almost certainly occur in our unpicked washings, we considered ourselves justified in proposing a new name for it and offering a brief description in this work.

In its general aspect this species reminds of *Cytheridae,* and to a less extent of *Xestoleberis,* rather than *Cythere,* but on account of the shape of its posterior end, in which it agrees with the two preceding species, it has seemed best to refer it, at least provisionally, to the same genus. For comparisons with other species see under *C. shattucki.*

Occurrence.—CHOPTANK FORMATION. Pawpaw Point.

Collection.—U. S. National Museum.

CYTHERE MARTINI n. sp.

Plate XXXVI, Figs. 11-15.

Description.—Carapace small, suboblong, widest anteriorly though the difference between the heights of the two ends is variable and sometimes does not exceed the difference between five and six. Right valve with a long, straight dorsal edge, terminating anteriorly and posteriorly in rather distinct angles; anterior edge with a thick border, obliquely subtruncate, and usually with a fringe of short spines in the middle and lower thirds; posterior outline sometimes uniformly curved, backward from the anterodorsal angle and then forward again into the nearly straight ventral margin, the curve into the latter being gradual. More commonly, however, especially when the posterior fringe of five or six spines is well developed, there is a small excision in the upper third of the outline. Often a small prominence is noticeable about the middle of the ventral edge. Left valve generally a little higher than the right, which it overlaps ventrally, and enclosed, except along the dorsal edge, by a thick rim, heaviest anteriorly and barely distinguishable in the anteroventral region. Usually there are no marginal spines at either end of this valve. Both valves exhibit a broad swelling, occupying the greater part of the anterior half, but it is nearly always more conspicuous on the left valves. The surface of the right valves, on the contrary, seems to be more protuberant near the posterior margin than the left. Occasionally the right valve bears also a small central protuberance. Surface of both valves reticulate or simply pitted, the pattern, as shown by the illustrations, being somewhat variable.

Length 0.75 mm. to 0.8 mm., height 0.39 mm. to 0.42 mm.

Named for Dr. G. C. Martin, of the Maryland Geological Survey.

Occurrence.—Choptank Formation. Pawpaw Point, Peach Blossom Creek. Calvert Formation. Plum Point. Also at Yorktown, Va., in the Chesapeake Group.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere dorsicornis n. sp.

Plate XXXVI, Fig. 16.

Description.—Of this species we have two varieties, both apparently rare. The Calvert form, with its single conical node or spine near the middle of the posterior half of the dorsum, should be considered as the typical variety. The general aspect of the valves of these two varieties is greatly like that of the associated *C. martini.* Still they may be distinguished even without taking into consideration the conical nodes which are wanting in that species. Thus, in *C. dorsicornis* the swelling of the anterior half of the valves is a little larger and moreover is divided into two parts by a curved sulcus. Next the posterior extremity is more produced and compressed while the length of the valve is proportionately less and the height of the anterior end slightly greater. Finally, the arrangement of the surface pits varies from that generally obtaining in *C. martini.* These differences are all of subordinate value and we were inclined at first to rank the Calvert form as a variety under that much more abundant species. When, however, the second variety was secured it seemed a better plan to regard the two as representing a distinct though closely related species. Perhaps it is worth while to add that *C. dorsicornis* is a trifle smaller than average specimens of *C. martini.*

Length of a left valve 0.68 mm., height of anterior end 0.39 mm., height of posterior end 0.27 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—U. S. National Museum.

CYTHERE DORSICORNIS VAR. BICORNIS n. var.

Plate XXXVIII, Figs. 32, 33.

Description.—This variety differs from the typical form of the species (1) in having two instead of a single spine, the second one being situated near the opposite border of the valve; (2) in having fewer surface pits, these being restricted to the central part of the valve and mostly to the posterior half; (3) in having two low and inconspicuous swellings on the depressed portion of the dorsal slope between the dorsal spine and the anterocardinal node; and (4) in being smaller.

Length 0.47 mm., greatest height 0.28 mm.

This form and, in a smaller degree, the typical variety of the species, as well, exhibits certain features that are more strongly developed in *C. baccata,* Jones and Sherborn, from the Pliocene of England. Our species probably is more intimately related to this English species than appears at first sight, but their specific distinctness is too obvious to be questioned.

Occurrence.—CHOPTANK FORMATION. Pawpaw Point.

Collection.—U. S. National Museum.

CYTHERE LIENENKLAUSI n. sp.

Plate XXXVIII, Fig. 31.

Description.—This very pretty and on the whole well marked species seems to be more closely related to our *C. martini* than to any other known to us. It occurs associated with that species at Plum Point, but is a much less common and even smaller fossil. The left valve, which is usually a little higher than the other in species of this type, is a trifle more elongate than the same valve of *C. martini,* but the principal difference lies in the marginal ridge which in that species is generally confined to the ends. In the present species, however, the ridge is distinguishable also along the ventral side, and moreover it is a double ridge, to outer division gradually turning into a narrow flattened border and thickening up again as it passes along the posterior edge. The inner division starts at a small knob in the anterodorsal angle and passes downward in a course paralleling the anterior edge into the ventral region where it bifurcates, the lower division continuing on and remaining parallel with the margin to the postcardinal angle, a second bifurcation occurring as it passes the postventral angle. The inner divison of the first bifurcation diverges at first slowly and then more rapidly in its course to a point lying a short distance in front of the postcardinal angle where it joins the upper extremity of the more nearly vertical inner part of the second bifurcation. A rather distinct though low and broad swelling of the surface occurs on the anterior half of the surface and behind this a second but smaller elevation is distinguishable. Between the dorsal edge and the marginal ridge, and also between the bifurcations of the latter, the surface is distinctly pitted, the pits being small and elongate and exhibiting a tendency to longitudinal arrangement.

Length of a left valve 0.60 mm., greatest height of same 0.31 mm., height of posterior extremity 0.20 mm.

Named for Mr. E. Lienenklaus, of Osnabrück, Germany, whose "Monographie der Ostrakoden des nordwest-deutschen Tertiärs" is a very capable piece of work.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Cythere producta n. sp.

Plate XXXVI, Fig. 17. Plate XXXVIII, Figs. 28-30.

Description.—This species agrees in its more important characters rather closely with *C. martini* and its allies, but is distinguished from them all by its much greater proportional length, more nearly parallel ventral and dorsal edges, in having marginal spines at both ends of the left valve as well as the right and in being at least one-fifth larger. Compared further with average specimens of *C. martini*, the posterior extremity is much more produced and compressed, while the marginal spines are coarser. The surface markings are also coarser, but the anterior swelling is relatively smaller. The specimens exhibit some variety in the relative height of the posterior end, but as a rule it is nearly or quite as great here as across the middle of the valve.

Bosquet figures several related European Tertiary species but none is deemed close enough to require more than ordinary care in discriminating our species. It appears to be one of the most elongate of its section of the genus. In this respect as well as in its outline it is almost matched by *C. venustula* described by Jones and Sherborn from the Eocene of England, but in all other external features the two forms are very different, so that it is doubtful even that they have any close genetic relations.

Length of left valve 1.05 mm., greatest height of same 0.47 mm., length of right valve 0.90 mm., greatest height of same 0.40 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE MICULA n. sp.

Plate XXXVI, Figs. 18-20.

Description.—This species also may be said to be rather closely related to *C. martini*, but it is very constant in its peculiarities and clearly deserves specific recognition. Closely compared with that species it is found to be constantly of much smaller size, with the posterior end relatively narrower, the marginal rim much thinner, causing the surface of the valves to appear more uniformly convex, and the pitting of the surface much finer. Furthermore, the surface swellings are relatively broader and so placed that a slight central depression is left that has no parallel in *C. martini.* Both ends of the left valve bear an extremely delicate fringe of spines. Such spines, however, have not been observed on the right valve.

This is the smallest species of the genus known to us, and on this account, though not uncommon, easily overlooked.

Length 0.5 mm. to 0.58 mm., height 0.27 mm. to 0.3 mm.

Occurrence.—CALVERT FORMATION. Plum Point. Also in the CHESAPEAKE GROUP of Virginia, on the James River and at Yorktown.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE EXANTHEMATA n. sp.

Plate XXXVI, Figs. 1-5.

Description.—Carapace oblong subquadrate or elongate subovate, obliquely rounded at the ends, the greater curvature and prominence in both cases being in the ventral half. Entire outline, excepting the straight or slightly concave ventral edge, fringed with flattened spines, those along the dorsal edge being of larger size than those on the ends. Posterior end compressed and carrying a double series of spines, the outer row sometimes occupying a low marginal ridge. Anterior end with a thick border or marginal ridge within the spiny fringe, but this ridge also breaks up into node-like spines in its lower third. Surface of valves between these two end ridges covered with fifteen to eighteen large irregular blunt spines or excrescences. These spines may at first sight seem to be arranged wholly without regard to any system, but on closer inspection they arrange themselves into three longitudinal rows, a rather irregular one projecting over the dorsal line, a second regular series beginning with the nodes on the lower end of the anterior marginal ridge and continuing in an increasing curve across the ventral and posterior slopes, and a third and much less regular row lying between the other two. Several of the nodes of the middle series are grouped on the summit of a broad anterior swelling of the valves. Hingement strong, typical for the genus. The interior marginal plate is usually wide.

This extremely nodose and spiny carapace belongs to a section of the genus of which one extreme is represented by our *C. martini* and *C. producta* and the other led up to by numerous Tertiary species figured by Bosquet and ending in species that Jones has included in his subgenus *Cythereis.* We believe, however, that *Cythereis* should be restricted to the *C. ceratoptera section,* of which our *C. cornuta var. americana* is a good example, and the *C. exanthemata* section left with *Cythere* until the time shall have arrived when a thorough revision of the family is possible. The monographic work upon which the writers are engaged, it is hoped, may result in a more natural and serviceable classification of the fossil species than the one now in use.

There is no described American species with which *C. exanthemata* might be compared. Of numerous European allies, among which *C. aculeata* and *C. formosa* of Bosquet are perhaps the closest, none is so coarsely tuberculated.

Dimensions of an average left valve: greatest length 0.9 mm., greatest height of anterior half 0.5 mm., height just beneath postcardinal angle 0.38 mm.

Occurrence.—CHOPTANK FORMATION. Pawpaw Point. CALVERT FORMATION. Plum Point. Also in the CHESAPEAKE GROUP, on the James River, and at Yorktown.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE RUGIPUNCTATA n. sp.

Plate XXXVIII, Figs. 16-17.

Description.—This species is too much like the preceding *C. exanthemata* to require detailed description. Compared with that species it is distinguished at once by its peculiar surface marking, which is a combination of irregular, twisted or wrinkled plications, commonly arranged vertically across the posterior half of the valves—and unequal though usually rather large pits between the plications. Another striking difference is brought out in comparing the outlines of the valves of the two species. In *C. exanthemata* all of the margins except the central part of the ventral portion, or it may be its greater part, is lined with a row of spines producing a dentate outline. In *C. rugipunctata*, on the contrary, marginal spines occur only at the ends of the valves, the posterior end having three or four and the anterior margin about the same number.

Length of a left valve 0.71 mm., height at anterodorsal angle 0.38 mm., height at posterodorsal angle 0.31 mm., thickness of single valve 0.20 mm.

Occurrence.—CHESAPEAKE GROUP. James River, Va. Probably also in Maryland.

Collection.—U. S. National Museum.

Cythere evax n. sp.

Plate XXXVI, Figs. 6-8.

Description.—Right valves somewhat obliquely subovate, the middle halves of the dorsal and ventral edges nearly straight or very slightly arcuate, the cardinal angles rounded. Left valves differ in having more pronounced cardinal angles, the anterior one especially being much more prominent and thicker, and in the greater length and straightness of the dorsal margin. Both valves are decidedly narrower behind than in front. Entire surface of valves coarsely spinulose and pitted between the spines. The middle of the valves exhibits a more or less distinct vertical depression, separating an undefined swelling just in front of it from two more ridge-like prominences lying just behind it. Of the latter the lower one is the longer, and usually is prolonged anteriorly beneath the broader anterior swelling. Between this ridge and the ventral edge there is a furrow.

The only described species known to us, having close relations to *C. evax* is the *C. lyelliana* Bosquet, from the Eocene of Belgium. The typical form of our species, however, is much shorter and differs decidedly in the character, form, and marking of the swellings occupying the central part of the valves. The following *var. oblongula* agrees much better in its outline with the Belgian species, but differs, like the typical variety, in the lesser development of the anterior swelling and in the extension of the spinous surface ornament over the swelling. Bosquet represents the latter as perfectly smooth.

Length of a left valve 0.78 mm., greatest height of same 0.49 mm. In an average right valve of the same length the height is about 0.46.

Occurrence.—Calvert Formation. Plum Point. Also in the Chesapeake Group at Yorktown, Va.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cythere evax var. oblongula n. var.

Plate XXXVI, Figs. 9-10.

Description.—This variety is distinguished from the typical form of *C. evax* by the much greater length of its valves and in the more nearly equal height of their two ends, this greater equality of the ends being particularly striking when right valves are compared. In consequence of these differences the whole outline assumes a different shape so that it would be described as oblong subquadrate instead of subovate. The surface swelling and ornament are about the same in the two varieties.

Length of right valve 0.84 mm., greatest height of same 0.42 mm., length of left valve 0.90 mm., greatest height of same 0.48 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERE SPINIPLICATA n. sp.

Plate XXXVIII, Fig. 18.

Description.—Valves moderately convex, subovate, the anterior end somewhat oblique and a fifth or only a sixth wider than the posterior end; entire outline, excepting the central part of the ventral edge, denticulate, the anterior edge being provided with a double row of flattened spines; surface roughly echinulate, the spines irregularly disposed or covering the sides and crests of very irregular but on the whole vertically arranged plications. In certain lights the latter appear twice interrupted, this appearance being due to a low longitudinal central ridge and two narrow sulci defining it that in other lights are obscured by the plications.

Length of a right valve 0.90 mm., greatest height of same (across anterior end) 0.49 mm., thickness of same about 0.25 mm.

The rough surface and general aspect of this species is such that it could not for a moment be confounded with any of the known American forms, excepting possibly our *C. evax oblongula.* There are, however, several species in Tertiary and later deposits of Europe with which it might be compared, notably *C. scabropapulosa* Jones, from the Eocene of England, and *C. scabra* Münster, from the Miocene of Germany and France. Still, our species seems sufficiently distinct to render detailed comparisons unnecessary. In *C. evax* the surface ornament is not the same, though somewhat similar, and the central ridge is more prominent and broken up into two parts. Beneath it there is another ridge that has no counterpart in *C. spiniplicata.*

Occurrence.—CALVERT FORMATION. Plum Point (Rare).

Collection.—U. S. National Museum.

CYTHERE (?) SHATTUCKI n. sp.

Plate XXXVIII, Fig. 10.

Description.—Valves rather strongly convex in the ventral portion, subtrapezoidal in outline, the dorsal angles very obtuse, the anterior margin obliquely rounded and somewhat truncate, the posterior end smaller, drawn out below so that the extremity is very sharply rounded and the outline from that point to the postdorsal angle only very slight convex; dorsal margin short, nearly straight, ventral edge long and straight excepting a slight protrusion just behind the mid-length; anterior end with a narrow flattened border; no spines of any sort. Surface somewhat tumid in the median ventral region, slightly depressed centrally and posteriorly, sloping more gradually toward the anterior and dorsal margins. Ornament consisting of small, widely separated pits.

Length of a left valve 0.63 mm., greatest height of same 0.32 mm., greatest thickness of same 0.17 mm.

This species resembles several of the species referred to *Cytherideis* in this work, and when the hinge, which is not clearly shown in the specimens so far obtained, is better known it may become necessary to remove it to that or one of the other genera of the family—perhaps *Cytheropteron.* Comparing *C. shattucki* with our *Cytherideis ashermani* and *C. longula* it may be distinguished at once by its ventral swelling. From the former it differs further in its more acuminate posterior extremity, and from the latter by its shorter form. The surface punctæ, finally, are smaller and more distant than in either of the species that, so far as we know, resemble it most.

Named for Dr. George Burbank Shattuck, of the Maryland Geological Survey.

Occurrence.—CHOPTANK FORMATION. Pawpaw Point.

Collection.—U. S. National Museum.

Genus CYTHEREIS Jones.

CYTHERE CORNUTA (Roemer).

Cytherina cornuta Roemer, 1838, Neues Jahrb. f. Minerl., p. 518, pl. vi, fig. 31;—Reuss, 1845, Verstein. böhm. Kreideform., I, p. 105, pl. 24, fig. 20.

Cythere cornuta Bosquet, 1850, Desc. d. Entomost. Foss. d. Terr. Tert. de la Fr. et Belg., p. 117, pl. vi, figs. 4a, b, c, d, Reuss, 1855; Egger, 1858; Speyer, 1863; Lienenklaus, 1894.

Cythereis cornuta Jones, 1856, Monog. Tert. Entomost, Paleontogr. Soc., p. 39, pl. iv, fig. 19, and pl. v, figs. 15a, 15b.

CYTHEREIS CORNUTA VAR. AMERICANA n. var.

Plate XXXVII, Figs. 29-33.

Description.—Carapace obliquely subquadrate, the dorsal margin straight and equaling a little more than half the entire length, the ventral edge straight in the middle and at the ends, curving more rapidly into the anterior margin, which is most prominent in the lower half, than into the posterior outline. The latter is the most prominent at a point about a third of the height of the left valve beneath the line of the dorsal edge, and from this point the outline turns anteriorly, at first at a right angle, then with a gentle upward curve on to the well defined post-cardinal angle. The anterocardinal angle is sometimes indistinct and always blunter than the posterior angle. The right valve differs from the left principally in this, that both of the cardinal angles are indistinct. Both valves bear a fluted crest, always divided about its mid-length, along the cardinal margin; and a ventral ridge that begins about the middle of the anterior margin with a gradually coalescing series of spines and continues to rise posteriorly until it terminates in a prominent sharp spine, projecting obliquely downward and backward, about one-third of the length of the valve from the posterior extremity. The inner slope of this ridge is fluted like the dorsal crest. From the terminal spine the ridge turns upward toward the postcardinal angle, gradually growing obsolete before reaching it. Two-thirds of the distance intervening between the two points are marked by prominences, the first being a rather prominent node, the second much more obscure. The compressed posterior end terminates in a series of strong spines, six on the left valve and five on the right, while a fringe of smaller spines forms the anteroventral edge. Surface of valves smooth and depressed between the marginal ridges, the valves being on the whole very shallow.

Length of a relatively short left valve 1.10 mm., greatest height of same 0.60 mm.; length of a proportionally long valve 1.20 mm., greatest height of same 0.58 mm. Height at posterior and anterior angles of cardinal margin respectfully as nine is to twelve, or four is to five.

These American specimens are too near the common European Tertiary *C. cornuta* (Roemer) to be distinguished specifically, but they exhibit sufficient minor differences to justify the subordinate name above proposed.

Occurrence.—CALVERT FORMATION. Plum Point. CHESAPEAKE GROUP. James River and Yorktown, Va.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHEREIS ALARIS n. sp.

Plate XXXVIII, Figs. 34-36.

Description.—Carapace rather elongate, somewhat acuminate-subovate, the anterior half about one-third wider than the posterior; dorsal and ventral margins nearly straight, anterior outline broadly rounded, the dorsal angle indefinite; posterior edge most prominent near the middle, the lower half rounding regularly up from the ventral margin, the upper half distinctly concave and sloping strongly forward to the obtusely angular posterocardinal angle. Excepting the dorsal halves of both the anterior and posterior edges the rest of the outline is fringed with flattened spines, of which those along the dorsal edge and one on each side of the middle of the ventral edge are much larger than the others. Of the five or six spines along the dorsal edge the one just in front of the postcardinal angle is the largest and most prominent, especially in a view of the back. Valves on the whole appearing compressed, but exhibiting a broad swelling that takes up most of the anterior half of the surface, while behind it and beneath its center there is a wing-like ridge the crest of which is broken up into four or five unequal spines directed obliquely downward and forward. Posterior fourth of surface depressed, with a small tubercle near the postdorsal angle. Surface smooth.

Length of a left valve 0.34 mm., greatest height of same 0.50 mm., thickness at anterior swelling 0.18 mm., to summit of ventral ridge 0.22 mm.

The low swelling of the anterior half of the valves brings this well-marked species into comparison with Bosquet's *Cythere dumontiana,* with which it agrees rather closely also in outline and in the length of the spiny ventrolateral alation. That species, however, differs in wanting the marginal spines on the ventral and anterior edges, and in this respect our species agrees very closely with *C. fimbriata* Münster, which Lienenklaus says is the same as *Cythere ceratoptera* Bosquet. *C. alaris* therefore appears to occupy an intermediate position between the two European species mentioned.

Occurrence.—CHESAPEAKE GROUP. James River, Va. Probably also in Maryland.

Collection.—U. S. National Museum.

Genus CYTHERIDEA Bosquet.

CYTHERIDEA SUBOVATA n. sp.

Plate XXXVII, Figs. 1-8.

Description.—Carapace apparently somewhat variable in outline, subovate, a little narrower posteriorly than anteriorly; the ventral outline less arcuate than the dorsal. Right valve narrower than the left, both its ventral and dorsal edges being overlapped; lower half of anterior margin usually carrying six to eight small spines, diminishing in size downwardly, while only three or four similar spines occur on the post-ventral corner. No spines have been observed on the left valve. Surface of valves usually nearly evenly convex and appearing quite smooth, but on close inspection a few very small scattered punctæ may be observed.

The specimens before us indicate two varieties that, should they prove constant enough, may later on be distinguished. Of the one we have seen only the right valve shown in fig. 1 on plate XXXVII. This differs from the typical form in the more uniform curve and relative bluntness of the posterior outline, and in the obtusely conical instead of almost uniformly convex elevation of the surface.

The second variety seems to be normal in all respects save that the left valves, which alone we have observed, are considerably narrower.

The crenulated hinge, as well as all other characters of the valves of this species, very clearly indicate *Cytheridea,* but it does not appear to have very close affinities with any of the described species of the genus. In a broad way these fall into two groups, the first, including such forms as *C. mülleri, C. debilis* and *C. sorbyana,* being characterized by an acuminate posterior extremity, while the second, embracing such species as *C. perforata, C. pinguis* and *C. incrassata,* the posterior end is blunt and the anterior end so wide that the outline is subtriangular, *C. subovata* evidently occupies an intermediate position though its affinities probably are with the second group rather than the first.

Length of a typical left valve 0.58 mm., height of same 0.50 mm., length of a typical right valve 0.93 mm., height of same 0.50 mm., thickness of perfect carapace 0.40 mm., length of left valve of a narrow variety 0.90 mm., height of same 0.47 mm., length of right valve of the short variety 0.78 mm., height of same 0.47 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERIDEA (?) CHESAPEAKENSIS n. sp.

Plate XXXVII, Fig. 9.

Description.—Right valve ovate-subtriangular, obtusely acuminate posteriorly, the dorsum arcuate and curving gradually into the anterior outline, which is rather narrowly rounded in the lower half; ventral margin straight in the anterior half and gently arcuate posteriorly. Surface rather strongly convex in the posterior half, sloping more gently forward. Ornament, consisting of small pits arranged in six or seven curved longitudinal rows, almost confined to the postventral third. Posterior extremity with a fringe of five or six small spines. Anterior edge with a narrow but sharply defined flat border. Test very thin. Hingement not satisfactorily determined, but it is certainly not like that of a true *Cythere.* The cardinal edge looks like that of a *Cytheridea,* but we failed to make out the denticles if these are really present. Possibly the species belongs to *Cytherideis.* Left valve unknown.

We are not entirely satisfied that the valve above described may not turn out to be the right valve of a species of *Cythere* like our *C. porcella,* but as the hinge, which appears to be in good condition, presented not a sign of the terminal teeth and sockets observed in that and all other species of *Cythere,* we felt obliged to classify the specimen in accordance with its known characteristics.

Length of a right valve 0.8 mm., greatest height of same 0.43 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Genus CYTHERIDEIS Jones.

Cytherideis ashermani n. sp.

Plate XXXVII, Figs. 10-16.

Description.—Carapace moderately elongate, considerably wider posteriorly than anteriorly; ventral outline nearly straight, ends narrowly rounded and most prominent beneath the midheight, above curving toward the cardinal edge which is more gently arcuate. Ventral edge of right valve slightly sinuate. Surface rather coarsely punctate, the punctæ having no very striking arrangement though they often form irregular rows on the dorsal slope. On the longer specimens they constitute less of a feature than on the smaller examples.

Hingement consisting of a slight central overlap by the right valve and thin terminal bars that fit into corresponding sulci in the cardinal edge of the left valve.

This species compares perhaps best with *Cytherideis trigonalis* Jones, but is readily distinguished by its smaller size, more elongate form, more obtuse cardinal angles, and coarser markings.

The specific name is derived from that of Mr. George Asherman, of Cincinnati, Ohio, who has for years spent much time in the collection of these minute crustacea and to whom we are indebted for disinterested aid in the laborious task of picking specimens from our washings.

Length of a very large and unusually elongate right valve 0.94 mm., greatest height of same 0.44 mm., corresponding dimensions of a small right valve 0.62 mm. and 0.31 mm., length of a rather large left valve 0.80 mm., greatest height of same 0.41 mm., thickness of a complete carapace, having a length of 0.85 mm., about 0.3 mm.

Occurrence.—Calvert Formation. Plum Point. Also in the Chesapeake Group at Yorktown, Virginia.

Collections.—U. S. National Museum, Maryland Geological Survey.

Cytherideis cylindrica n. sp.

Plate XXXVII, Fig. 17.

Description.—Carapace very frail, elongate, cylindrical, with rounded and nearly equal ends; ventral outline straight, dorsal very gently arcuate. A narrow marginal rim on the ends. Surface finely reticulate.

This is the most fragile of the Ostracoda occurring in the Plum Point washings. Its valves are always separated and they are not only difficult to mount without breaking, but, on account of the approximate quality of their ends, it is also difficult to distinguish the right from the left. The obtuse, subequal ends, the cylindrical form fragile test and reticulate ornament constitute a combination of characters not possessed by another species of the genus known to us. It is probably nearest our *Cytherideis longula.*

Length 0.9 mm., greatest height 0.37 mm.

Occurrence.—CALVERT FORMATION. Plum Point. (Not common.)

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERIDEIS SUBÆQUALIS n. sp.

Plate XXXVII, Fig. 28.

Description.—Carapace elongate subreniform, with rounded, approximately equal ends, distinctly arcuate dorsum and slightly sinuate ventral outline. Left valve overlapping the right along the ventral margin. Test strong, surface sparsely pitted.

The general aspect of the closed carapace of this species is decidedly like that of a *Bythocypris,* and we deem it quite possible that its relations are with that family rather than the *Cytheridæ.* Still, considering the rather close agreement in external characters exhibited between it and the following two species, whose hingement is known to be in accordance with that of *Cytherideis,* we have considered ourselves justified in assuming provisionally that the same type of hingement pertains also to *C. subæqualis.* Compared with described Tertiary species there is none known to us from which it may not be distinguished with ease.

Length 0.88 mm., height 0.37 mm., thickness 0.35 mm.

Occurrence.—CALVERT FORMATION. Plum Point (Rare).

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERIDEIS SEMICIRCULARIS n. sp.

Plate XXXVII, Figs. 18-20.

Description.—Carapace nearly semicircular in outline, the ventral border straight, the ends abruptly rounded. Left valve the larger, forming a slight dorsal and a longer ventral overlap. Greatest thickness of carapace just behind and a little below the middle. Surface closely pitted.

Distinguished by its semicircular outline.

Length of entire carapace 0.84 mm., greatest height of same 0.40 mm., thickness of same 0.37 mm., length of a right valve 0.75 mm., height of same 0.35 mm.

Occurrence.—CHOPTANK FORMATION. On Peach Blossom Creek, 3 miles southwest of Easton. CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

CYTHERIDEIS LONGULA n. sp.

Plate XXXVII, Figs. 21-27.

Description.—Carapace elongate, subcylindrical, slightly curved, the ventral outline straight, the dorsal gently arcuate, the ends rounded, the posterior one much narrower than the anterior. Right valve the smaller, more arcuate dorsally than the left and very gently sinuate ventrally. Left valve with a sharply defined though narrow marginal rim on the anterior end; right valve with a similar flattened border on both ends. Surface pitted or reticulated, some variation in the size and distribution of the pits being shown among the abundant specimens before us. Hingement as demanded by the genus.

Distinguished from *C. subæqualis* by its greater length, unequal ends and marginal rims. *C. semicircularis* is shorter, a little thicker and differently outlined in lateral and ventral views. *C. cylindrica* has wider and more equal ends, a finer surface reticulation, and a less arcuate dorsal edge. The general aspect of *C. longula* is also very similar to that of the Eocene *Bythocypris parilis* Ulrich, but there are recognizable differences in their respective outlines, the dorsum of the *Bythocypris* being more arcuate and its ends more equal and without the flattened borders which are always present on the valves of *C. longula.* The reticulation or pitting of the surface also is a more conspicuous feature in the latter.

Length of entire carapace 0.90 mm., greatest height of same 0.36 mm., thickness of same 0.33 mm., length of a left valve 0.95 mm., greatest height of same 0.37 mm., length of a right valve 0.90 mm., greatest height of same 0.34 mm.

Occurrence.—Choptank Formation. On Peach Blossom Creek, 3 miles southwest of Easton. Calvert Formation. Plum Point and Church Hill.

Collection.—U. S. National Museum.

Genus CYTHEROPTERON G. O. Sars.

Cytheropteron nodosum n. sp.

Plate XXXVIII, Figs. 37-40.

Description.—Of this remarkable species a single right valve only has been observed. It is strongly but very irregularly convex, with a low and broad swelling in the anterior half, another large protuberance in the postcardinal fourth, a third smaller node just within the depressed and somewhat produced posterior extremity, and a fourth, wing-like prominence, that attains a greater altitude than the other nodes, on the posterior end of a well-defined ventral ridge. In addition to these there is a small spine near the posteroventral angle and a small knob just within the anterodorsal angle. The outline is elongate, subtrapezoidal, the ends subequal, with the anterior slightly the wider, obliquely truncate, converging dorsally. The ventral outline is gently convex and slightly overhung by the posterior third of the ventral ridge. The dorsal outline is slightly concave, the concavity being due chiefly to the projection of the postcardinal node. The central part of the surface is depressed, forming a broad though not sharply defined sulcus. A sharply outlined, bevelled border encloses the ends, the posterior border continuing forward to about the middle of the ventral edge where the bevel is reversed and turned inward to form the small concave area that is more or less readily distinguishable on the majority of the Ostracoda of this family. The anterior border does not meet the border coming from the opposite end but passes on above it as an impressed line which gradually becomes obsolete a short distance behind the middle of the ventral side. The surface ornament consists of somewhat scattered pits of moderate size.

Length of a right valve 0.68 mm., height of both ends each about 0.30 mm., greatest thickness about 0.25 mm.

The rudely nodose or hummocky surface of the valves of this species will serve, we believe, in distinguishing it from all other described forms of the genus. Corresponding protuberances are indicated in two of Lienenklaus' species from the Miocene and Upper Oligocene of Germany, viz., in *C. denticulatum* very faintly, in *C. caudatum* more distinctly. This indication, however, consists of little more than what may be produced by the development of a median sulcus, so that there is still left a considerable gap between them and *C. nodosum.* Some resemblance is noted in comparing *C. nodosum* with *Cythere harrisiana* Jones, but we are not prepared to say that it indicates genetic relationship. However that may be, there can be no question concerning the specific distinctness of the two forms.

Occurrence.—Chesapeake Group. James River, Va. Probably also in Maryland.

Collection.—U. S. National Museum.

Subkingdom MOLLUSCA.

Class CEPHALOPODA.

Subclass TETRABRANCHIATA.

Order NAUTILOIDEA.

Suborder ORTHOCHOANITES.

Family NAUTILIDÆ.

Genus NAUTILUS Linné.

Nautilus (?) sp.

Plate XXXIX, Fig. 1.

A single fragment representing the peripheral portion of a septum of a large Nautiloid form has been found.

Length, 30 mm.; width, 25 mm.; depth, 6 mm.; thickness, 1.3 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Cornell University.

Class GASTEROPODA.

Subclass EUTHYNEURA.

Order OPISTHOBRANCHIATA.

Suborder TECTIBRANCHIATA.

Family ACTÆONIDÆ.

Genus ACTÆON Montfort.

ACTÆON OVOIDES Conrad.

Plate XXXIX, Fig. 2.

Acteon ovoides Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 227, pl. ix, fig. 24.
Actæon ovoides Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 186.
Actæon ovoides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.
Actæon ovoides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 13.
Tornatella ovoides Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.
Actæon ovoides Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 28. Not *Actæon ovoides* Whitfield (*A. ovoidea* Gabb) = *Avellana ovoidea*.

Description.—" Shell ovate, smooth, polished, transversely striated; spire short and conical; aperture more than half the length of the shell; suture deeply impressed. The striæ are about twenty in number on the large whorl, and are impressed; the aperture is long and moderately wide, and the fold large." Conrad, 1830.

The shell is oblong-ovate, the most slender of our Maryland Actæons. The revolving lines alternate in strength, extend quite to the suture, and are punctate. There are sometimes as many as thirty revolving lines on the body whorl, and usually eight or ten on the earlier whorls.

Length, 10.5 mm.; diameter, 5.5 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River, Langley's Bluff. CHOPTANK FORMATION. Jones Wharf, Governor Run (lower bed), Greensboro. CALVERT FORMATION. Church Hill, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University, Wagner Free Institute of Science.

ACTÆON PUSILLUS (Forbes).

Plate XXXIX, Fig. 3.

Tornatella pusilla Forbes, 1843, Rep. Brit. Assoc. Adv. Sci., p. 191.

Description.—" Shell ovate-globose, whitish; whorls 4, regularly and deeply punctate-striate; aperture oblong. Length 4, breadth 2 mm." Forbes, 1843.

This species does not seem to have ever been figured, and until authentic specimens have been seen the identification cannot be certain. The essential characters of the Maryland specimens are a short ovate-globose shell with a much depressed spire and with uniform, distant, regularly spaced revolving lines with faint punctæ.

Length, 4.5 mm.; diameter, 3 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

ACTÆON SHILOHENSIS Whitfield.

Plate XXXIX, Fig. 4.

Actæon punctostriatus Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 14. (In part.)

Actæon Shilohensis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 137, pl. xxiv, figs. 15–17.

Description.—" Shell of about medium size, subglobular or broadly ovate, the transverse diameter being to the height about as three to five; spire short, the apical angle about 70 degrees. Volutions six, short in the spire, abruptly rounded on the top, giving an almost impressed suture line, and presenting a step-like appearance to the spire, rounded and full below; aperture moderately large, somewhat effuse below, the outer lip sharp; columella short and the fold very distinct and defined. Surface polished, with nearly equidistant impressed lines, except on the upper third of the height or on the exposed portion in the spire, where they are obsolete; lines generally clean, or free from punctæ or dots. Some of the interspaces on the lower part of the volution marked by an intermediate finer line.

" This species differs from several forms known in the Eocene formation in being more globular, and in having a shorter spire." Whitfield, 1894.

The specimens here referred to this species may be characterized as follows:

Shell twice as long as broad; mouth one-half the length of the shell; spire one-third the length of the shell; spire turreted, the later whorls regularly increasing in height; surface polished; lines of growth faint, slightly but uniformly convex toward the mouth; impressed revolving lines increasing in width and proximity toward the base of the whorl, with an intermediate revolving line most prominent in the middle of the whorl, principal revolving lines strongly punctate because of narrow raised longitudinal lines (of growth ?) which cross them.

The essential characteristics are that the striæ are alternate and are obsolete above the middle of the whorl. It differs from *A. punctostriatus* in being larger, more slender, and in having a larger part of the surface covered with the revolving striæ.

The type of *A. shilohensis* has a strongly turreted spire and no punctæ in the revolving striæ. If this is constant it makes the species distinct. *Actæon semistriatus* Férussac has a strong resemblance to this form and is possibly identical with it. If so, Férussac's name will have priority. This question cannot be decided without authentic specimens.

Length, 10.5 mm.; diameter, 5.5 mm.

Occurrence.—St. Mary's Formation. Cove Point, Langley's Bluff. Calvert Formation. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Actæon calvertensis n. sp.

Plate XXXIX, Fig. 5.

Description.—Shell small, ovate and somewhat globose, loosely coiled, almost umbilicate, five-whorled; body whorl with about fourteen broad, almost flat, revolving ribs with narrower deeply-set grooves between them; lines of growth distinct and regular; surface polished.

Length, 4.5 mm.; diameter, 3 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Cornell University.

Family TORNATINIDÆ.

Genus VOLVULA Adams.

VOLVULA IOTA (Conrad).

Plate XXXIX, Figs. 6, 7, 8, 9.

Bulla acuminata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 210.
Bulla acuminata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 186.
Ovula iota Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 309.
Amphiceras iota Conrad, 1854, Proc. Acad. Nat. Sci. Phila., vol. vii, p. 31.
Volvula iota ? Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.
Not *Volvula acuminata* Sowerby.

Description.—" Narrow-elliptical, with minute spiral lines towards the base; inner margin regularly arched above the middle of the shell, where the aperture is very narrow, widening a little towards the apex; aperture gradually expanding from the middle to the base; labrum very slightly rounded; labium reflected. Length, quarter of an inch." Conrad, 1843.

There are four varieties of *Volvula* in the Miocene of Maryland, some or all of which may be entitled to specific rank. It is very doubtful to which of these varieties Conrad intended the name *iota* to be applied. The original specimens came from Plum Point.

VOLVULA IOTA VAR. MARYLANDICA n. var.

Plate XXXIX, Fig. 6.

This is the form which Conrad referred to *acuminata*. It differs from the *acuminata* of the European authors in lacking a columella fold, and in being less elongate. It is distinguished from our other varieties by its sharp spire.

Length, 2.5 mm.; diameter, 1 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff. CHOPTANK FORMATION. Paw Paw Point. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

VOLVULA IOTA VAR. DIMINUTA n. var.

Plate XXXIX, Fig. 7.

This form is long and slender and has a blunt spire. It is cylindrical and of nearly uniform diameter. It is to this form that Conrad applied the catalogue name " *diminuta*."

Length, 4.7 mm.; diameter, 1.8 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

VOLVULA IOTA VAR. CALVERTA n. var.

Plate XXXIX, Fig. 8.

This form also is cylindrical but differs from *var. diminuta* in being of much greater proportional diameter.

Length, 3.5 mm.; diameter, 1.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

VOLVULA IOTA VAR. PATUXENTIA n. var.

Plate XXXIX, Fig. 9.

This form is somewhat shorter proportionally than *diminuta* and also differs from it in being much wider below than above. The sides are nowhere flat in profile but are gently rounded throughout.

In the National Museum are specimens from Duplin Co., N. C., which are identical with this variety, and which are labeled *V. oxytata Bush.* I have not seen authentic specimens of that species, but from the figures this would not seem to be the typical form.

Length, 5.5 mm.; diameter, 2 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run, 2 miles south of Governor Run.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University.

Genus RETUSA Brown.

Subgenus CYLICHNINA Monterosato.

RETUSA (CYLICHNINA) MARYLANDICA n. sp.

Plate XXXIX, Fig. 10.

Description.—Shell small, nearly cylindrical, slightly smaller at the apex and with a suggestion of a constriction in the middle; surface covered with fine crowded longitudinal lines. This species resembles *Retusa sulcata* but is not as slender as that species.

Length, 3.5 mm.; diameter, 1.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

Retusa (Cylichnina) conulus (Deshayes).

Plate XXXIX, Fig. 11.

Bulla conulus Deshayes, 1824, Desc. Coquilles Fossiles des Env. de Paris, vol. ii, p. 41, pl. v, figs. 34–36.

Description.—" Testâ ovato-conicâ, basi tenuissimè striatâ; columellâ subuniplicatâ, aperturâ supernè angustissimâ, basi dilatatâ; spirâ inclusâ, minimè perforatâ.

" Sa forme conique, son ouverture très-étroite, sa columelle marginée et qui offre un pli presque complet, sa petitesse, la finesse de ses stries et sa lèvre droite un peu sinueuse et souvent épaissie, sont de très-bons caractères. Les plus grands individus sont longs de cinq à six millimètres et larges de deux et demi à la base." Deshayes, 1824.

This is the first recognition of the occurrence of this widely distributed European Tertiary species on this side of the Atlantic.

Length, 5 mm.; diameter, 2 mm.

Occurrence.—Calvert Formation. Plum Point, Church Hill, Centreville Well at depth of 170 feet.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

Retusa (Cylichnina) subspissa (Conrad).

Plate XXXIX, Fig. 12.

Bulla subspissa Conrad, 1848, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 20, pl. i, fig. 29.

Bulla subspissa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.

Bulla subspissa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 13.

Description.—" Oblong-oval, thick, ventricose in the middle; labium rounded or ventricose; margin of labrum straight above; base minutely umbilicated." Conrad, 1848.

This form is very rare. Perhaps it should be called a variety of *C. conulus,* to which it is most nearly related.

Length, 4 mm.; diameter, 2.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Family SCAPHANDRIDAE.

Genus CYLICHNA Loven.

CYLICHNA (?) GREENSBOROËNSIS n. sp.

Plate XXXIX, Fig. 13.

Description.—Small, slender, tapering anteriorly, surface everywhere non-cylindrical; sculpture absent; mouth widest below.

There is a specimen in the National Museum from Plum Point which apparently belongs to this species.

Length, 3.5 mm.; diameter, 1.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION (?). Plum Point (?).

Collections.—Maryland Geological Survey, U. S. National Museum.

CYLICHNA CALVERTENSIS n. sp.

Plate XXXIX, Figs. 14, 15.

Description.—Shell small, cylindrical, without sculpture; spire hidden; spiral end nearly flat; proportional length variable.

Length, 3 mm.; diameter, 1.3 to 1.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

Subclass STREPTONEURA.

Order CTENOBRANCHIATA.

Suborder ORTHODONTA.

Superfamily TOXOGLOSSA.

Family TEREBRIDÆ.

Genus TEREBRA Adanson.

TEREBRA UNILINEATA Conrad.

Plate XL, Figs. 1-2.

Cerithium unilineatum Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 345, pl. ii, fig. 4.
Cerithium unilineatum Conrad, 1843, Trans. Assoc. Amer. Geol. and Nat., p. 108, pl. v, fig. 4.
Acus unilineata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 137, pl. xxviii, fig. 7.
Terebra unilineata Emmons, 1858, Rept. N. Car. Geol. Survey, p. 258, fig. 129.
Terebra (Acus) unilineata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.

Description.—"Slightly turrited; volutions with each a spiral impressed line above the middle; space between this line and suture with oblique plicæ." Conrad, 1841.

"Shell thick, elongate bands alternate, acute, tapering gradually to a point; whirls many, seventeen or eighteen, and ornamented by revolving impressed lines, and passing just above the middle of the whirl; the upper part of the spire is also marked by short longitudinal ribs, which are interrupted by spiral lines. Oblique lines of growth are usually conspicuous. In old specimens, the ribs are obsolete." Emmons, 1858.

The body whorl of Emmons' figured specimen is proportionately longer than indicated in his figure.

We have a single fragment, the body whorl and part of the next. The sculpture is somewhat obsolete.

Length of fragment, 22 mm.; diameter, 13 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Subgenus ACUS Adams.

TEREBRA (ACUS) CURVILINEATA Dall.

Plate XL, Figs. 3, 4, 5, 6, 7.

Terebra curvilirata Heilprin, 1887, Proc. Acad. Nat. Sci. Phila., vol. xxxix, p. 399.
Terebra simplex, small var. Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.
Terebra curvilineata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 113, pl. xx, figs. 14-17. (In part.)
Terebra (Acus) curvilineata Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii, p. 36.
Not *Terebra (Acus) curvilineata* Meek.

Description.—" Shell acute-conic, solid, with 12 to 14 moderately convex whorls; early whorls more flatsided, with numerous narrow, transverse, slightly waved riblets extending from suture to suture, with about equal interspaces; suture very distinct; sutural band formed by a vaguely limited constriction, not a groove; a short distance in front of the suture the ends of the ribs thus delimited from the rest have a tendency to coronate the whorl; on the later whorls the ribs become less regular and somewhat less prominent; aperture longer than wide; outer lip simple; pillar elongated, twisted, smooth; siphonal fasciole very distinct. Longitude, 27; maximum diameter, 9.5 mm. in a specimen of 14 whorls." Dall, 1895.

The range of variation covered by Dr. Dall's type specimens (which include Whitfield's) and by his description is very considerable and several varieties may safely be recognized.

The name "*Terebra curvilineata*" first appeared as the result of a misprint, being used by Meek in his "Check List" for *T. curvilirata* Conrad. Whitfield then used the name for the New Jersey forms, ignorant both that Conrad's name was not "*curvilineata*" and that his own specimens were not the same as Conrad's. Whitfield's specimens belong to the varieties *whitfieldi* and *dalli* as here established. Heilprin had already listed the New Jersey forms as *curvilirata* Conrad. A year after Whitfield's paper appeared Dall described the species *curvilineata* as new, basing it upon Whitfield's figured specimens together with material from Greensboro which is here placed in the variety *dalli.* Associated at Plum Point with the varieties above mentioned is a third, below named *calvertensis,* which is as closely related to *dalli* and *whitfieldi* as they are to each other.

The occurrence and further description is given below under each variety.

Terebra (Acus) curvilineata var. whitfieldi n. var.

Plate XL, Figs. 3, 4.

Terebra curvilineata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, pl. xx, figs. 15–17.

Description.—Shell elongated, tapering slowly; whorls with a slight constriction below the suture (in the mature individuals) above which the longitudinal ribs are very slightly tuberculate. In the young shells the longitudinal ribs are continuous, without interruption or undulation, from suture to suture. Between the ribs are fine but sharp revolving striæ.

The young of this variety bears a very strong resemblance to *Terebra* (*Hastula*) *venusta* Lea, of the Claibornian Eocene, and probably *venusta* is the ancestral form. The resemblance is so close that if the characters did not change so much in the adult we would have to refer some of our young specimens to the Eocene species.

This variety occurs in the Calvert Formation at Jericho, N. J., and is represented by figures 15 to 17 of Whitfield's report.

Length (of fragment), 16 mm.; diameter, 5.7 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Terebra (Acus) curvilineata var. dalli n. var.

Plate XL, Fig. 5.

Terebra simplex, small var. Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Terebra (*Acus*) *curvilineata* Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii. [No. 1035], p. 36. (In part.)

Description.—Shell acute; whorls flat-sided or very slightly convex; ribs becoming obsolete on the later whorls, usually continuous—never entirely cut by a subsutural band; a slight subsutural constriction is sometimes present, but it produces merely a slight undulation in the ribs; revolving lines extremely faint or entirely absent.

This variety includes all those forms referred by Dall to *curvilineata* except the specimen with sharp revolving lines which Whitfield had previously figured as "figs. 15-17." This variety is probably the predecessor of *T. simplex,* to which it has a strong resemblance.

Length, 27 mm.; diameter, 9.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro, Jones Wharf, Sand Hill (?). CALVERT FORMATION. Plum Point, Church Hill, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

TEREBRA (ACUS) CURVILINEATA VAR. CALVERTENSIS n. var.

Plate XL, Figs. 6, 7.

Description.—Shell elongate, tapering slowly; whorls constricted about one-third of the way below the suture by a distinct groove above which the ribs are strongly tuberculate; ribs straight, regular, distant; no spiral sculpture.

Length (of fragment), 17 mm.; diameter, 5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

TEREBRA (ACUS) CURVILIRATA Conrad.

Plate XL, Fig. 8.

Terebra curvilirata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 327.

Terebra curvilirata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.

Terebra (Acus) curvilineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 18.

Terebra curvilineata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 113. (In part.)

Terebra (Acus) curvilirata Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii [No. 1035], p. 37.

Not *Terebra curvilirata* Heilprin.

Description.—"Subulate, whorls with a revolving impressed line below and near the suture; beneath this line the whorls are convex; ribs longitudinal, curved, acute, dislocated by the impressed line; revolving lines minute, crowded, obsolete; columella sinuous. Length one and a quarter inches.

"Differs from *Cerithium dislocatum,* Say, in wanting the distinct revolving lines, and the small dislocated portion of the ribs are not of a tubercular form; the aperture is longer and narrower." Conrad, 1843.

"The shell is small, not exceeding 30 mm. in length, with rather swollen whorls constricted narrowly above, much as in *Pleurotoma* of the section *Cymatosyrinx*. The ribs are about 12 to the whorl and most prominent at the periphery; their posterior ends are constricted off near the suture without any distinct groove or incised line; they are strongly curved in front of the constriction; the surface has extremely faint, obsolete spiral sculpture, only visible with the aid of a lens; the pillar thin, simple, and twisted, rather short; the nucleus is conical, of four smooth whorls like a small, very much elevated *Calliostoma*, except that the whorls are rounded. A specimen 15 mm. long had ten whorls, exclusive of the nucleus, and a maximum diameter of 4.75 mm." Dall, 1895.

Length, 27 mm.; diameter, 7 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Wagner Free Institute of Science, Cornell University.

Terebra (Acus) sincera Dall.

Plate XL, Fig. 9.

Terebra (Acus) sincera Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii [No. 1035], p. 37.

Description.—"Shell small, thin, acute-conic, flat-whorled, with feeble sculpture; whorls ten, without the nucleus; anterior half of the whorls, with fine, feeble, spiral threading overrunning the ribs, posterior half without spirals, but divided into two equal parts by a spiral groove visible between the ribs; transverse sculpture of fine, low, even, narrow, arched riblets, with wider interspaces, extending clear across the whorls; suture distinct, sutural band obscure, not swollen; aperture longer than wide, outer lip thin, arched in harmony with the ribs; pillar short, smooth, or faintly excavated; canal recurved, not contracted. Longitude, 22; maximum diameter, 5 mm.

"When superficially eroded the ribs are more prominent, as is the succeeding whorl at the suture, and the whorls may have a slightly turrited appearance." Dall, 1895.

This form is most closely related to *T. curvilirata,* from which it differs in lacking distinct subsutural tubercles and in possessing strong spiral threading.

Length, 22 mm.; diameter, 5 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, U. S. National Museum, Wagner Free Institute of Science.

Subgenus HASTULA H. & A. Adams.

TEREBRA (HASTULA) SIMPLEX Conrad.

Plate XL, Fig. 10.

Terebra simplex Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 226, pl. ix, fig. 22.

Terebra simplex Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 185, 187.

Terebra simplex Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.

Terebra (Acus) simplex Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 18.

Terebra (Subula) simplex Conrad, 1868, Amer. Jour. Conch., vol. iv, p. 68, pl. v, fig. 5.

Terebra simplex Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 28.

Terebra simplex Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii [No. 1035], p. 34.

Description.—"Shell elongate conical, smooth, with plain undivided whorls; sides straight; the lines of growth are very distinct, and the large whorl slopes abruptly towards the base; the aperture is rather large." Conrad, 1830.

"Subulate; volutions 10 to 12, sides nearly straight, slightly depressed above the middle; on the whorls toward the apex this depression is more like an impressed line near the suture; lines of growth distinct and curved; body whorl rather abruptly rounded at base." Conrad, 1868.

Length, 45 mm.; diameter, 12 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Wagner Free Institute of Science, Cornell University.

TEREBRA (HASTULA) SIMPLEX VAR. SUBLIRATA Conrad.

Plate XL, Fig. 11.

Terebra sublirata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565. (Name only.)

Terebra (Acus) sublirata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 18.

Description.—General form like *simplex;* suture more distinct; whorls somewhat turreted; faint longitudinal lirations extend from suture to suture; an impressed subsutural line sometimes appears on the body whorl at about one-fourth the distance to the base.

Length, 38 mm.; diameter, 10 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

TEREBRA (HASTULA) INORNATA Whitfield.

Plate XL, Figs. 12, 13.

Terebra inornata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 114, pl. xx, figs. 11–13.

Terebra (Hastula) inornata Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii [No. 1035], p. 35.

Description.—" Shell below medium size and very slender, consisting of twelve or more volutions; spire attenuated; volutions sloping abruptly for about one-third of their exposed surface below the suture, below which point their sides are vertical, parallel, and destitute of ornamentation other than fine lines of growth, except on a few of the apical volutions; where, when perfect, there are faint vertical ridges; aperture narrow, elongate, forming about three-fifths of the height of the body volution at its margin; outer lip thin and sharp; columella twisted, slightly excavated on its face, and marked by a thickened spiral rib near the base; channel slight." Whitfield, 1894.

" Shell small, slender, nearly smooth, without any sutural band or spiral sculpture, and with about a dozen whorls; early whorls with a few obsolete transverse riblets, other whorls with no sculpture except the somewhat irregular incremental lines; whorls rather flat, suture distinct, closely oppressed; aperture longer than wide; outer lip thin; nearly straight, simple; pillar short, simple, twisted; the canal moderately wide; base rounded, without a carina. Longitude, 18; maximum diameter, 4 mm." Dall, 1895.

This species does not occur at Shiloh, N. J., as Dr. Dall believed. Whitfield recorded his New Jersey specimens as from the Cape May well, where they are associated with other St. Mary's species.

Length, 21 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Terebra (Hastula) patuxentia n. sp.

Plate XL, Fig. 14.

Description.—Shape like *inornata,* except that the sides of the whorls are flat. Entire shell covered with fine, close, distinct spiral lines. On the younger whorls are many narrow ribs running straight from suture to suture. On the lower whorls these become obsolete and irregular, remaining most distinct immediately below the suture.

Length (restored), 13 mm.; diameter, 3 mm.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Family CONIDÆ.

Genus CONUS Linné.

Conus diluvianus Green.

Plate XL, Figs. 15, 16, 17.

Conus Deluvianus Green, 1830, Trans. Albany Institute, vol. i, p. 124.
Conus diluvianus Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.
Conus diluvianus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.
Not *Conus diluvianus* Tuomey and Holmes or Emmons.

Description.—"Shell conical, and somewhat elongated; spire elevated and rather acute; whorls slightly grooved and concave; base of the columella slightly twisted inwards; length three inches and less than half as broad. A few transverse impressed lines may be seen in the aperture. It has some resemblance to the Marylandicus but differs from that shell in the spire not being carinated; in the whorls being concave, and in the general contour of the shell." Green, 1830.

Length, 67 mm.; diameter, 33 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

Conus marylandicus Green.

Conus Marylandicus Green, 1830, Trans. Albany Institute, vol. i, p. 124, pl. iii, fig. 2.
Conus diluvianus Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 132, vol. xxvii, fig. 15.
Conus diluivianus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 263, fig. 143.
Conus marylandicus Dall, 1895, Proc. U. S. Nat. Museum, vol. xviii [No. 1035], p. 42.

Description.—"Shell conical, pyriform, with 8 or 10 deep grooves at the base. In some specimens, upon a very close examination, impressed transverse lines may be discovered on the upper half of the body whorl; spire elevated and acute; the whorls channeled and carinated on their lower edges: length an inch and a half, and half as broad." Green, 1830.

There is nothing further to indicate that this species occurs in Maryland.

Family PLEUROTOMIDÆ.

Genus PLEUROTOMA Lamarck.

Subgenus HEMIPLEUROTOMA Cossmann.

Pleurotoma (Hemipleurotoma) albida Perry.

Plate XLI, Fig. 1.

Pleurotoma albida Perry, 1811, Conch., expl. pl. xxxii, fig. 4.
Pleurotoma albida Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 28, pl. iv, fig. 8a.

Description.—Shell elongate, eight-whorled, spire and beak attenuate, spire sloping uniformly from the shoulder of the body-whorl; each whorl of the spire with one strong revolving rib in the center, with a secondary one on each side of it, and several intermediate ones between; body whorl with several ribs below those represented on the spire; notch on the shoulder (central rib), and marked rugose lines of growth.

Length (restored), 25 mm.; diameter, 8 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge.

Collection.—Maryland Geological Survey.

PLEUROTOMA (HEMIPLEUROTOMA) COMMUNIS Conrad.

Plate XLI, Figs. 2, 3.

Pleurotoma communis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 224, pl. ix, fig. 23.

Pleurotoma communis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 186.

Pleurotoma communis Emmons, 1858, Rept. N. Car. Geol. Survey, p. 264.

Surcula communis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula communis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Pleurotoma communis Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 28.

Description.—"Shell subfusiform, smooth, with one obtuse carina revolving in the middle of each whorl, except the last, which has three; the lowest one obsolete; beak attenuated and slightly recurved.

"This is a numerous species of the locality at St. Mary's River." Conrad, 1830.

The sides of each whorl are straight or nearly so, and the medial carina is sharply elevated. The siphonal notch is not deep but is on the shoulder of the whorl.

Length, 25 mm.; diameter, 7 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

PLEUROTOMA (HEMIPLEUROTOMA) COMMUNIS VAR. PROTOCOMMUNIS n. var.

Plate XLI, Figs. 4, 5, 6.

Description.—Shell fusiform, elongate, of thick substance, nine-whorled; spire high; body whorl short, beak attenuate, straight; whorls constricted at the suture and obtusely angular and sometimes carinated in the center; whorls with a minor carina at the suture and usually 8 or 10 revolving lines on each whorl of the spire; body whorl strongly striate.

Length, 33 mm.; diameter, 10 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, U. S. National Museum.

Pleurotoma (Hemipleurotoma) choptankensis n. sp.

Plate XLI, Fig. 7.

Description.—Shell subfusiform, nine-whorled; whorls moderately convex with sometimes a subsutural band which is flat or concave; lines of growth strong, sometimes developing oblique costæ on the shoulder; notch moderately deep, situated at or slightly above the shoulder; surface polished, and with faint impressed spiral lines, with slightly convex interspaces, on the lower part of the body whorl; anterior canal of moderate length, slightly curved.

This species is very abundant at Jones Wharf.

Length, 15 mm.; diameter, 4 mm. (maximum diameter, 7 mm.).

Occurrence.—Choptank Formation. Jones Wharf, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Pleurotoma (Hemipleurotoma) bellacrenata Conrad.

Plate XLI, Figs. 8, 9.

Pleurotoma bellacrenata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.

Pleurotoma bellacrenata Conrad, 1842, Jour. Acad. Nat. Sci. Phila, vol. viii, 1st ser., p. 185.

Pleurotoma bellacrenata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 181.

Surcula bella-crenata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula bella-crenata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Pleurotoma bellacrenata Harris, 1894, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—"Fusiform; whorls much contracted below the middle, with obsolete spiral lines, and crenate above the suture and on the shoulder of body whirl; body whirl with five or six strong spiral striæ, and an intermediate fine line; back finely striated. Length $1\frac{1}{8}$ inch." Conrad, 1841.

The siphonal notch is on the shoulder of the whorl and is very distinct. The lines of growth bend sharply at the base of the sinus.

The beak is very short and somewhat twisted at the end, the twist extending upward on the columella.

Length (restored), 45 mm.; diameter, 13 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

PLEUROTOMA (HEMIPLEUROTOMA) CALVERTENSIS n. sp.

Plate XLI, Figs. 10, 11.

Pleurotoma calvertensis ? Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24. (Name only.)

Description.—Shell subfusiform, slender, eight-whorled; upper third of each whorl flat, with two or three impressed spiral lines; lower part strongly convex, with rounded oblique costæ which are sometimes recurved at the upper end, and are usually crossed by about four faint, regular, impressed spiral lines and another stronger one above the suture; body whorl with about fifteen distinct impressed spirals below the costated shoulder; lines of growth strong, sweeping in broad curves around the notch which is on the shoulder; surface polished; suture impressed; beak short and slightly twisted.

There is a specimen in the National Museum which differs from the normal forms in having the longitudinal ribs almost obsolete, and in having a deep impressed revolving groove a short distance below the suture.

Length, 21 mm.; diameter, 6 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

Genus SURCULA H. and A. Adams.

SURCULA RUGATA Conrad.

Plate XLI, Figs. 12a, 12b.

Surcula rugata Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 285.
Surcula rugata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.
Surcula rugata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Description.—"Fusiform, turriculate; whorls 10, lower half obtusely ribbed, upper half concave, subangular, with much curved, rugose lines of growth; beneath the suture whorls obtusely subcarinated, distinct revolving lines over the ribbed portion, minute and obsolete above it; suture profound; body whorl and beak striated; beak slightly curved." Conrad, 1862.

The sinus is in the middle of the subsutural concavity. It is very deep and distinct but gently rounded.

Length, 32 mm.; diameter, 12 mm.

Occurrence.—Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Surcula marylandica Conrad.

Plate XLI, Fig. 13.

Pleurotoma Marylandica Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.
Pleurotoma Marylandica Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st. ser., p. 185.
Pleurotoma Marylandica Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 182.
Surcula Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.
Surcula marylandica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.
? *Pleurotoma marylandica* Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.
Pleurotoma marylandica Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—" Fusiform, with spiral wrinkled lines; upper half of whorls of spire concave, the lower convex, and with oblique ribs. Length $2\frac{1}{2}$ inches." Conrad, 1841.

The spire and beak are attenuate, and the beak straight. The whorls are covered with distinct revolving spirals. The siphonal notch is above the shoulder, making the ribs oblique where they cross the shoulder. This species is distinguished by its oblique ribs, faint sculpture, and long, straight beak.

Length, 50 mm.; diameter, 16 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

SURCULA BISCATENARIA Conrad.

Plate XLI, Fig. 14.

Pleurotoma catenata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 223, pl. ix, fig. 13.

Pleurotoma biscatenaria Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 140.

Pleurotoma biscatenaria Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 186.

Surcula biscatenaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula biscatenaria Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Not *Pleurotoma catenata* Lamarck.

Description.—" Shell subfusiform; with two approximate chainlike or nodose carinæ on each whorl; the large whorl with strong revolving and intervening finer striæ; spire elevated, conical; whorls concave on the upper part; beak slightly recurved.

" The carinæ upon the whorls of the spire are placed nearest the base: the old shells of this species become quite thick, and have the right lip much arcuated; the spire occupies about half the length of the shell." Conrad, 1830.

This species has the deep, narrow, sharply incised notch of a true *Pleurotoma,* but the notch is distinctly above the shoulder near the center of the subsutural concavity.

There are specimens in the National Museum which probably belong to this species, although they may represent a variety. The only difference of these forms is that the notch is somewhat less sharply incised.

Length, 40 mm.; diameter, 15 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point (?).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

SURCULA ENGONATA Conrad.

Plate XLI, Fig. 15.

Surcula engonata Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 285.

Surcula engonata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Not *Cochlespira engonata* Conrad, 1865.

Description.—" Fusiform; whorls 8, turrited, nodulose on the angle, very minute revolving lines above the angle, distinct below it; one line more prominent near and below the suture; labrum margin rounded; body whorl with obsolete revolving lines." Conrad, 1862.

The subsutural band is deeply concave and the shoulder is very prominent and strongly nodular. The sinus is deep and gently rounded and is in the center of the subsutural band. The body whorl is as long as the spire, and the beak is attenuated and somewhat twisted.

Length, 16 mm.; diameter, 5 mm.

Occurrence.—St Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Surcula rotifera Conrad.

Plate XLI, Fig. 16.

Pleurotoma rotifera Conrad, 1830, Jonr. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 224, pl. ix, fig. 9.

Surcula rotifera Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula rotifera Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Description.—"Shell subfusiform; spire with an elevated crenulated carina on each whorl; two approximate carinæ near the middle of the large volution; sinus profound." Conrad, 1830.

The "*elevated crenulated carina*" occupies the middle of each whorl of the spire, and the shoulder of the body whorl. Below this, on the body whorl, are about ten elevated revolving lines, not carinated. The spire is coiled upon the second and most prominent of these. The sinus is deep and gently rounded and is situated half way between the shoulder and the suture.

Length, 25 mm.; diameter, 9 mm (8 whorls).

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Surcula mariana n. sp.

Plate XLI, Fig. 17.

Description.—Shell six-whorled; whorls strongly convex and deeply constricted at the suture, each with three or four smooth revolving ridges; carinal ridge much stronger than the rest, next ridge closely above it and much smaller, and between that and the suture the surface is smooth save for faint, gently incurving lines of growth, which are obsolete elsewhere.

Length, 10 mm.; diameter, 4.5 mm.

This is referred to *Surcula* with considerable doubt, as the lip is broken and the growth lines almost obsolete.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Genus MANGILIA Risso.

Mangilia parva (Conrad).

Plate XLII, Figs. 1, 2.

Pleurotoma parva Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 225, pl. ix, fig. 18.

Surcula parva Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula parva Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Pleurotoma parva Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 24, 28.

Surcula parva ? Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 117, pl. xxi fig. 1.

Description.—" Shell subfusiform, transversely striated, with oblique longitudinal ribs; upper part of the whorls concave and plain." Conrad, 1830.

Shell, small, seven- to nine-whorled; spire attenuate; beaks short, slightly curved; entire surface marked with fine, regular revolving lines; each whorl with about ten longitudinal ribs which terminate on the shoulder in obtuse nodes; above the shoulder is a concave constriction which extends to the suture and contains the siphonal notch.

Length, 10 mm.; diameter, 3 mm.

Occurrence.—St Mary's Formation. Cove Point, St. Mary's River, Langley's Bluff. Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Mangilia parvoidea n. sp.

Plate XLII, Fig. 3.

Description.—Shell small, fusiform, seven-whorled; whorls very convex, with numerous faint oblique longitudinal ribs and almost obsolete closely set spiral striæ; apex of spire obtuse.

This species has somewhat the general appearance of *M. parva,* with which it is associated and has been confused. It is less slender than *parva* (very much so in the spire), less constricted at the suture, and has less prominent ribs. It also lacks the abrupt angularity of that species and is generally larger.

Length, 10 mm.; diameter, 4 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University.

Mangilia cornelliana n. sp.

Plate XLII, Fig. 4.

Description.—Shell small, slender, fusiform, eight-whorled; whorls moderately convex; body whorl with about twelve obtuse longitudinal ribs; near the center of each whorl are two equally prominent raised revolving ribs with a very fine one between them, and on either side of them about four other spiral ribs intermediate in size between them and the medial one; lines of growth faint; sinus not deep; beak short, slightly curved, and strongly striated.

Length, 8 mm.; diameter, 2 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Cornell University.

Mangilia patuxentia n. sp.

Plate XLII, Fig. 5.

Description.—Shell small, fusiform, five-whorled (without the two-whorled nucleus); later whorls strongly rugose, with 9 to 11 sharply elevated costæ crossed by two or three elevated revolving lines on each whorl of the spire and by many more on the body whorl; revolving lines obsolete between the ribs; ribs terminated below the suture by a narrow smooth band, above which is a strong revolving line which margins the suture; mouth $\frac{3}{5}$ the length of the shell, nearly uniform in width for the greater part of its length, but widening slightly near the upper end; beak slightly curved; nucleus two-whorled, globose, smooth for a whorl and a half, then with faint reticulate markings.

Length, 8 mm.; diameter, 2 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Subgenus GLYPHOSTOMA Gabb.

MANGILIA (GLYPHOSTOMA) OBTUSA n. sp.

Plate XLII, Fig. 6.

Description.—Shell short, six-whorled, spire $\frac{1}{3}$ the length of the shell; later whorls with about eight obtuse nodes; entire shell covered with faint raised revolving striæ of which there are two very distinct ones on the line of nodes; lines of growth faint; mouth narrow; labium with a large serrated callosity at the posterior end and about nine small denticles along the columella; labrum thickened, and with about eight denticles along its inner face.

Length, 10 mm.; width, 4 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Genus DRILLIA Gray.

DRILLIA INCILIFERA (Conrad).

Plate XLII, Fig. 7.

Pleurotoma gracilis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 225, pl. ix, fig. 10.

Pleurotoma incilifera Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 140.

Pleurotoma gracilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Surcula gracilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Surcula gracilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Not *Pleurotoma gracilis* Brander.

Description.—" Shell subfusiform; spire and beak attenuated; whorls with two revolving rows of tubercles on each, divided by a striated sulcus; whorls strongly striated at the base; suture undulated; large whorl with strong distant revolving and intervening finer striæ. A variety occurs with only one row of tubercles on each whorl, and an impressed line beneath." Conrad, 1830.

Outline as shown in the figure, spire attenuate, beak of normal length for a *Drillia;* ten to fourteen oblique longitudinal ribs on each whorl, an impressed revolving line on the crest of the whorl divides them into two rows of tubercles. There are other impressed revolving lines, especially on the body whorl.

The specimens from St. Mary's River have a more attenuate spire and are more angular than those from Cove Point. They also grade in their character toward *var. distans.*

Length 16 mm., diameter 5.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Cornell University.

Drillia incilifera var. angulata n. var.

Plate XLII, Fig. 8.

Description.—Spire pyramidal and sharply pointed; body whorl short, angular on the shoulder; beak short, curved; sculptured like that of *var. distans.*

Length, 16 mm.; diameter, 5-7 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Drillia incilifera var. distans (Conrad).

Plate XLII, Fig. 9.

Pleurotoma gracilis var. Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 225.

Drillia distans Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 285.

Drillia distans Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv., p 562.

Drillia distans Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Description.—"A variety" [of *D. incilifera*] "occurs with only one row of tubercles on each whorl, and an impressed line beneath." Conrad, 1830.

"Turriculate, whorls 6, scalariform, with distant obtuse ribs on the lower half; suture waved, with an impressed line above it; body whorl with an impressed revolving line above and four raised revolving lines inferiorly; upper sinus of labrum deep and rounded, lower obselete." Conrad, 1862.

The outline is very variable as the figures show.

Length, 20 mm.; diameter, 8 mm. Length, 15 mm.; diameter, 4 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Cornell University.

Drillia whitfieldi n. sp.

Plate XLII, Fig. 10.

Drillia elegans Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 115, pl. xxi, figs. 2–4.

Not *Pleurotoma elegans* Emmons.

Description.—"The features described by the author * are, perhaps, a little more pronounced on the New Jersey specimens than they would appear to have been on the specimens which he figures, while the line of nodes occurring above the sinus constriction are neither figured nor mentioned. Still, a species constructed according to his figure and description would scarcely fail to possess them. On the New Jersey specimens they are very conspicuous, while in all other features the specimens correspond well.

"There is much variation among the different individuals before me, especially in the comparative increase in the diameter of the shell in proportion to its length, to the amount of nearly or quite one-fourth of the whole diameter; also in the proportional strength and size of the nodes above the sutural band and in the strength of the spiral lines.

"The aperture of the shell is narrow and elongated and equal to more than one-third of the entire length of the shell. The outer lip appears to have been thickened, although all the specimens are too imperfect for positive statement. The inner lip has a decided callus at its upper end, while the notch is distinct but not deep. The longitudinal plicæ

* Whitfield refers to Emmons.

are nearly vertical and on the body whorl extend to near the lower end. The spiral lines are numerous and mark the entire volution below the sutural band, but are often stronger on the lower part than above." Whitfield, 1894.

The spire is attenuate and the beak short and very slightly curved; suture indistinct; below the suture is a line of tubercles, separated by a concave band from the lower, obliquely ribbed portion of the whorl; sinus below the line of tubercles; surface marked with obsolete, raised spiral lines which override the ribs and are much more distinct on the lower half of the whorl.

Emmons' species is entirely distinct from this, being more elongate and entirely lacking the subsutural line of tubercles.

Length, 14 (?) mm.; diameter, 5 mm.

Occurrence.—Calvert Formation. Church Hill.

Collection.—Maryland Geological Survey.

Drillia calvertensis n. sp.

Plate XLII, Fig. 11.

Description.—Shell small, slender, nine-whorled; spire high, tapering sharply; body whorl short, with ten to thirteen oblique longitudinal ribs terminating in a concave, subsutural constriction; raised revolving lines fine and close in the constriction, larger and more distant with many finer intermediate ones on the ribbed portion of the whorl; suture distinct, younger whorls overlapping the older; sinus deep, lines of growth sharp.

Length, 13 mm.; diameter, 4 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Section CYMATOSYRINX Dall.

Drillia limatula Conrad.

Plate XLII, Figs. 12, 13.

Pleurotoma limatula Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 224, pl. ix, fig. 12.

Drillia limatula Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Drillia limatula Meek, 1864, Miocene Check List, Smith. Misc. Coll (183), p. 21.

Description.—"Shell subfusiform, glabrous, with short oblique longitudinal ribs; whorls concave above and plain; left lip reflected over the columella with a callus at its superior termination." Conrad, 1830.

The specimens from Jones Wharf have impressed revolving lines on the base of the body whorl. Those from Plum Point are intermediate between *limatula* and *lunata* of H. C. Lea. They might be considered as a variety of either species.

Length, 40 mm.; diameter, 11 mm. (Plum Point). Length, 22 mm.; diameter 7 mm. (St. Mary's River).

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf, Flag Pond. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Drillia limatula var. dissimilis Conrad.

Plate XLII, Figs. 14, 15.

Pleurotoma dissimilis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 224, pl. ix, fig. 11.

Drillia dissimilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

Drillia dissimilis Meek, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Description.—"Shell conical, smooth; spire with obsolete oblique nodules joining the suture at the base of each volution; suture impressed; left lip with a callus at its superior termination; columella truncated; a slight sinus at the base of the right lip." Conrad, 1830.

This differs from *limatula* only in that the nodular ribs are more nearly obsolete.

Length, 21 mm.; diameter, 7 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Drillia limatula var. pyramidalis n. var.

Plate XLII, Fig. 16.

Description.—Spire pyramidal, variable in acuteness; shoulder of body whorl angular; beak short, slightly curved at extremity; columella straight.

This variety differs from *limatula* as *angulata* does from *incilifera.*

Length, 14 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Drillia pseudeburnea (Whitfield).

Plate XLII, Fig. 17.

Pleurotoma pseudeburnea Heilprin, 1887, Proc. Acad. Nat. Sci. Phila., vol. xxxix, p. 404.

Pleurotoma (Drillia) pseudeburnea Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 114, pl. xxi, figs. 8–12.

Description.—" Spire elevated, of about ten volutions; apex papillate; whorls convex, porcellanous, strongly ribbed, somewhat impressed on the shoulder; ribs numerous, deflected, those of the several whorls alternating in position. No revolving lines.

" Aperture about one-third the length of shell; canal slightly deflected; columellar lip well defined.

" Length, slightly exceeding a half inch." Heilprin, 1887.

This species differs from *limatula* in being more slender, less angular about the body whorl; the longitudinal ribs are longer, less nodose, not terminating abruptly at the concave subsutural band but sometimes continuing from suture to suture. I have not seen the revolving lines which Whitfield mentions.

Length, 20 mm.; diameter, 6 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Genus CANCELLARIA Lamarck.

Subgenus CANCELLARIA s. s.

CANCELLARIA ALTERNATA Conrad.

Plate XLIII, Figs. 1, 2, 3.

Cancellaria alternata Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 155.
Cancellaria alternata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.
Cancellaria alternata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
Cancellaria alternata Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 67, pl. iv, fig. 7.
Cancellaria alternata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 112, pl. xx, figs. 5-10.
Merica alternata Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 15.

Description.—" Shell short subfusiform; whorls six, with nine or ten thick, longitudinal, oblique costæ, with prominent spiral and finer intermediate striæ; spire subconical; aperture less than half the length of the shell; labium with three plaits, decreasing in size inferiorly, as in Mitra; aperture semilunar. Length, half an inch." Conrad, 1834.

" Whorls 6, rounded, with nine or ten prominent ribs, and prominent revolving distant striæ, and an intermediate fine line; spire conical; aperture less than half the length of the shell, sub-ovate; columella 3-plaited, plaits decreasing in size towards the base; umbilicus small; summits of volutions flattened; 5 of the larger revolving lines on the penultimate whorl." Conrad, 1866.

" Very many specimens show six or seven prominent spiral striæ, while others have only the five mentioned in the description. Most of them show from four to six fine raised lines on the summit of the whorl, a feature not mentioned in either description, and all have several other lines below the prominent ones mentioned. The form of the aperture of course varies with the proportional length of the shell." Whitfield, 1894.

This species is very variable as the above descriptions show. Conrad's type, which was from the Choptank formation, and the New Jersey specimens have a distinct umbilicus. This feature is almost always absent in the other Maryland specimens. The Jones Wharf specimens differ from the others in being uniformly short, thick-set, strongly ribbed, and not constricted at the suture. The specimens from the St. Mary's formation approach *C. lunata* very closely (through intermediate forms), but are separated by their greater strength of ribbing and lack of flat tops on the whorls. The intermediate line is not a constant character.

Length, 16 mm.; diameter, 10 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River. CHOPTANK FORMATION. Jones Wharf, Greensboro, Sand Hill (?), "Choptank River" (Conrad). CALVERT FORMATION. Plum Point, Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

CANCELLARIA ENGONATA Conrad.

Plate XLIII, Fig. 4.

Cancellaria engonata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Cancellaria engonata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 188.
Cancellaria engonata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.
Cancellaria engonata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
Cancellaria engonata Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 68, pl. iv, fig. 8.
Cancellaria engonata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—"Short fusiform, with strong spiral prominent lines; and numerous longitudinal costæ, not so distinct as the transverse lines; spire scalariform, volutions 4; columella with three plaits, the middle one very oblique; submargin of labium with prominent transverse lines. Length, ⅝ inch." Conrad, 1841.

"Short-fusiform, longitudinally ribbed, with prominent revolving lines, about 12 in number, from the shoulder to the base; whorls 5; spire conical, scalariform; aperture lunate; columella three-plaited, the middle one very oblique." Conrad, 1866.

Conrad's specimens were immature and his figure and descriptions are not characteristic. The species may be re-defined as follows:

Shell subfusiform, six-whorled; whorls very convex, deeply constricted at the suture, and widest about one-third the distance from the top; top of the whorl flat, slightly domed, or concave; whorls of the spire with twelve strong, raised, revolving ribs with wider interspaces; body whorl with twelve ribs below the shoulder, and nearly as many smaller ones above; longitudinal costæ variable in distribution and development, often entirely absent; mouth widest above; labrum strongly crenulated; columella with three plaits, of which the upper is the largest, the middle the most oblique, and the lower is obsolete in the whorls of the spire.

This species differs from *C. lunata* in being much more constricted at the suture, and in having less distinct longitudinal ribs.

Length, 23 mm.; diameter, 13 (?) mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Cancellaria lunata Conrad.

Plate XLIII, Fig. 5.

Cancellaria lunata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 222, pl. ix, fig. 4.
Cancellaria lunata Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 421.
Cancellaria lunata Lyell, 1846, Proc. Geol. Soc. London, vol. iv, p. 555.
Cancellaria lunata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.
Cancellaria lunata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
Cancellaria scalarina Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 68, pl. iv, fig. 17.
Cancellaria (Solatia) lunata Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 12.
Not *Cancellaria scalarina* Lamarck.

Descripition.—"Shell turreted, with longitudinal oblique ribs; transversely sulcated; whorls of the spire narrowed at the base and flattened on the summit; apex acute; right lip regularly toothed within; columella with three plaits, the upper one large and distant, and the last plait uniting with the base of the columella; aperture lunate." Conrad, 1830.

Some individuals resemble *C. alternata.* This species differs from *alternata* essentially in being proportionally longer, having a sharper spire, thinner shell, longitudinal ribs not as strong, and the tops of the whorls somewhat flat. In these characters it is intermediate between *alternata* and *engonata* but is sharply separated from both.

Conrad could not have intended his figure and description for *C. scalarina* Lamarck, which is a *Trigonostoma* somewhat resembling *T. biplicifera.* Conrad's description of *scalarina* applies to our specimens of *lunata* as well as does his original description of the latter species, while the figure is much better.

Length, 20 mm.; diameter, 11 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Cancellaria prunicola n. sp.

Plate XLIII, Figs. 6a, 6b.

Description.—Shell turreted, nearly as broad as long, six-whorled; with broad, flat tops (concave on some specimens), and straight sides perpendicular to the tops; longitudinal ribs, small, distinct, and numerous, with many fine, sharp, intermediate lines of growth; broad, raised spiral striæ five in number on the side of each whorl except the body whorl which has twelve; tops of whorls almost without spirals; ribs and spirals at the same distance and of about the same prominence, giving a reticulate appearance; columella with three strong plaits; umbilicus small.

Length (restored), 24 mm.; diameter, 16 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Cancellaria reticulatoides n. sp.

Plate XLIII, Fig. 7.

Description.—Shell small, oval, four-whorled without the nucleus; nucleus four-whorled, smooth, depressed-naticoid, with its axis somewhat inclined to the left; spire with about five narrow-raised revolving ribs on each whorl, and with regular longitudinal ribs which become fainter on the later whorls; body whorl with about fifteen revolving ribs and almost obsolete longitudinal ones; columella with three plaits, the largest above and nearly horizontal, the others nearly horizontal to the aperture, then bending sharply down the columella, below the largest plait are two small, oblique denticles on the columella; labrum with about six denticles; umbilicus small. The general form of this species is much like that of *C. reticulata*.

Length, 13 mm.; diameter, 8 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Subgenus ADMETE Moller.

Cancellaria (Admete) marylandica n. sp.

Plate XLIII, Fig. 8.

Description.—Shell small, slender, subfusiform, fragile, five-whorled; whorls convex and somewhat angular in the middle; body whorl with fourteen weak longitudinal ribs perpendicular to the suture, and with numerous raised spiral striæ which have a tendency to alternate in size; mouth less than half the length of the shell; columella plaits small, especially at the mouth.

Length, 10 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Subgenus TRIGONOSTOMA Blainville.

Cancellaria (Trigonostoma) perspectiva Conrad.

Plate XLIII, Fig. 9.

Cancellaria perspectiva Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 136.

Cancellaria perspectiva Hodge, 1841, Amer. Jour. Sci., vol. xli, p. 343.

Cancellaria perspectiva Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.

Cancellaria perspectiva Meck, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.

Cancellaria perspectiva Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 67, pl. iii, fig. 6.

Description.—"Shell subglobose, with irregular oblique prominent distant ribs, and obtuse prominent spiral lines, alternated in size; spire very short, conical; whorls profoundly channeled above; aperture obovate, rather more than half the length of the shell; labrum striated within; columella with three compressed plaits; the superior one very prominent; umbilicus wide, striated within; exhibiting the volutions to the apex." Conrad, 1834.

The only specimen known from Maryland is young and badly broken. Length, 12 mm.; diameter, 8 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Wagner Free Institute of Science.

Cancellaria (Trigonostoma) biplicifera Conrad.

Plate XLIII, Fig. 10.

Cancellaria biplicifera Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 31.

Cancellaria biplicifera Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 187.

? *Cancellaria antiqua* Wagner, 1848, plate iii, fig. 3 (plates privately distributed).

? *Cancellaria antiqua* Bronn, 1848, Hand. Gesch. Nat., Index Pal., pt. i, p. 208.

? *Cancellaria antiqua* Bronn, 1849, Hand. Gesch. Nat., Index Pal., pt. ii, p. 465.

Cancellaria (Trigonostoma) biplicifera Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.

Cancellaria (Trigonostoma) biplicifera Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.

Cancellaria biplicifera Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 67, pl. iii, fig. 4.

? *Cancellaria antiqua* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. v, pt. ii, p. 11, pl. iii, fig. 3.

Description.—" Turrited, with thick longitudinal ribs, and spiral rather distant impressed lines; on the body whirl an occasional [" intermediate," 1841] fine line; space below the suture widely and deeply channelled; shoulder coronated; umbilicus small; columella concave, and with two plaits. Length 1½ inch." Conrad, 1842.

" Subovate, with rather thick, prominent ribs, and revolving, broad striæ, and an intermediate fine line; ribs slightly convex; summits of the whorls widely and deeply channelled; shoulder coronated; umbilicus small; columella concave, biplicate." Conrad, 1866.

This is the largest of the Miocene species of *Cancellaria* and one of the rarest.

There is little doubt that the form figured by Wagner but never described is of this species. The rest of his Miocene fossils were from Jones Wharf, which is the locality where this species occurs most abundantly and best developed.

Length, 57 mm.; diameter, 37 mm.

Occurrence.—Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Subgenus SVELTIA Jousseaume.

CANCELLARIA (SVELTIA) PATUXENTIA n. sp.

Plate XLIII, Figs. 11a, 11b.

Description.—Shell small, slender, fragile, five-whorled; whorls deeply constricted at the suture, and strongly and regularly convex; body whorl with about 30 regular equidistant, raised spiral striæ, and with eight or nine strong, longitudinal ribs which are more prominent on the upper part of the whorl, and thus mask the regular convexity of the whorls, giving them the appearance of being flat on top, widest near the top, and sloping gently to the suture below; whorls of the spire with fifteen to twenty spiral striæ; protoconch depressed naticoid in shape, two whorled; mouth ovate; columella with two strong plaits above, and a very weak one below; labium thick, reflected; labrum broken in type.

Length, 10.5 mm.; diameter, 5.5 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

CANCELLARIA (SVELTIA) CALVERTENSIS n. sp.

Plate XLIII, Fig. 12.

Description.—Shell small, five-whorled; whorls of the spire regularly and strongly convex, with eight or nine strong, raised, longitudinal ribs, and about fourteen raised, revolving ribs; sutures deep and distinct; umbilicus small; columella with three plaits increasing in size above; labrum dentate.

This species resembles *C. patuxentia* but is more elongate.

Length, 8.5 mm.; diameter, 4 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—U. S. National Museum.

CANCELLARIA (SVELTIA) sp.

Description.—Shell small, slender, fragile; columella plaits, two, both very oblique; no umbilicus; longitudinal ribs small, distant; each whorl with eight or ten raised spiral striæ, with much broader interspaces.

This form has a general outline like *C. patuxentia,* but differs from that species in the characters noted above, and also in being less deeply constricted at the suture, and in having smaller and more distant longitudinal ribs.

The only specimen has been badly broken, so no attempt is made to name or illustrate the species.

Length, 7 mm.; diameter, 3 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Subgenus CANCELLARIELLA n. sub-g.

Shell small, depressed, Nerita-like. Mouth strongly canaliculate, with a deep anterior siphonal notch. Columella concave, with four plaits, of which there are two close together at the base, the upper being the strongest, one still stronger at the middle of the columella and one at the top which does not extend far in. Between the two middle ones is a deep concavity which, within, becomes a deep furrow overhung by the plaits. Back from the mouth all but the two medial plaits become obsolete. Umbilicus broad and prominent. Spire much depressed.

Type *Cancellaria* (*Cancellariella*) *neritoidea* Martin.

No other species has come to my notice which would fall in this subgenus.

CANCELLARIA (CANCELLARIELLA) NERITOIDEA n. sp.

Plate XLIII, Figs. 13a, 13b.

Description.—Whorls three; body whorl very large in proportion to the size of the shell; spire depressed; ornamentation consists of about twenty broad, impressed, revolving lines with broader, gently arched interspaces; lines of growth prominent; surface wrinkled by irregular varix-like undulations which are most prominent toward the suture; suture deeply impressed; ornamentation of the spire entirely destroyed if any ever existed; umbilicus long, crescent shaped, strongly wrinkled by lines of growth; mouth broadly subovate, and wider below than above; notch for the anterior canal very deep.

Length, 8 mm.; width, 8 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

CANCELLARIA CORBULU Conrad.

Cancellaria corbulu Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 308.

Description.—"Short, subovate; whorls subscalariform, ribs 8 or 9 on the body whorl, prominent, flattened laterally, and crossed by prominent, alternate striæ, the larger ones rather distant and elevated; columella with three plaits, rectilinear; base subumbilicated; aperture nearly half the length of the shell. Length half an inch." "Loc. Maryland." Conrad, 1843.

No other reference has ever been made to this species, and the description is insufficient to identify it.

Superfamily RHACHIGLOSSA.

Family OLIVIDÆ.

Genus OLIVA Bruguiere.

OLIVA LITTERATA Lamarck.

Plate XLIV, Figs. 1a, 1b.

Oliva litterata Lamarck, 1810, Ann. du. Mus., vol. xvi, p. 315.
Oliva litterata Lamarck, 1822, Anim. sans Vertebr., vol. vii, p. 425.
Oliva litterata Lamarck, 1822, Tabl. Encyclop. et Meth., vol. iii, p. 651, pl. 362, figs. 1a, 1b.
Oliva sp. Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 126.
Oliva litterata Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 345, pl. ii, fig. 1.
Oliva litterata Conrad, 1843, Trans. Amer. Assoc. Geol. and Nat., p. 108, pl. v, fig. 1.
Strephona literata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 140, pl. xxviii, fig. 13.
Oliva literata Emmons, 1858, Rept. N. Car. Geol. Survey, p. 259, fig. 30.
Dactylus Carolinensis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, pp. 563, 584.
Oliva carolinensis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.
Oliva litterata Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 44.
Oliva Carolinensis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 109, pl. xix, fig. 8.
Oliva (Neocylindrus) carolinensis Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 46, pl. ii, figs. 20, 24.

Description.—"O. cylindraceâ, elongatâ, cinereo fulvoque undatâ; fasciis duabus characteribus castaneo-fuscis inscriptis; spirâ acutâ." Lamarck, 1822.

Shell cylindroid, somewhat inflated above the middle of the body whorl thick, polished; spire short, obtuse, about $\frac{1}{6}$ or $\frac{1}{7}$ of the length of the shell; suture deeply canaliculate; columella plaited throughout.

Conrad's description of *O. carolinensis* is as follows: "Cylindrical; spire short, conical; whorls concave or angulated; columella strongly plaited throughout; substance of shell very thick at base." Whitfield's specimen is too fragmentary to determine the species with certainty.

Length, 28 mm.; diameter, 11 mm.

Occurrence.—St. Mary's Formation. St. Mary's River (*fide* Say). Choptank Formation. Greensboro, St. Leonard's Creek. Calvert Formation. Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Oliva harrisi n. sp.

Plate XLIV, Figs. 2, 3.

Oliva literata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xl, p. 24.
Not *Oliva litterata* Lamarck.

Description.—Shell elliptical, narrow, elongate, fragile; spire high, pointed, about $\frac{1}{4}$ or $\frac{1}{5}$ the length of the shell; body whorl gently inflated above, sides uniformly rounded; lower end of the columella strongly callous.

This species differs from *O. litterata* in having a higher spire, in being proportionally narrower throughout, and in having the greatest inflation of the body whorl at a greater distance from the suture.

Length, 37 mm.; diameter, 14.5 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Family MARGINELLIDÆ.

Genus MARGINELLA Lamarck.

Marginella minuta Pfeiffer.

Plate XLIV, Fig. 4.

Marginella minuta Pfeiffer, 1840, Archiv für Naturgeschichte, vol. vii, p. 259.
Marginella conulus H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia (Abst.),* p. 12.

* As all the forms in which this paper appeared are not generally known it may be well to call attention to the matter here.

A paper entitled "*Description of some new Fossil Shells from the Tertiary of Peters-*

Marginella conulus H. C. Lea, 1846, Trans. Amer. Philos. Soc., vol. ix, p. 273, pl. xxxvii, fig. 102.

Porcellana conulus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.

Marginella (Volutella) conulus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Marginella minuta Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 57.

Description.—"Testa ovata, glabra, alba; spira brevissima; anfract. 3; columella subquadriplicata; apertura augustissima. Long. 1, diam. $\frac{2}{3}$ lin." Pfeiffer, 1840.

"Shell subovate, conoidal, thick, smooth, polished; spire conical, obtuse; sutures nearly obsolete; whorls three, flat; last whorl rounded; base smooth; mouth long, very narrow; columella with three folds near the base; outer lip thickened, rounded smooth." Lea, 1846.

The Maryland specimens have been compared with Lea's type and show no difference. Dr. Dall is authority for the equivalence of Lea's species with Pfeiffer's. The latter was described from Cuba and is recent, but also occurs in the Pliocene of North Carolina and Florida.

Great care has to be taken in separating this species from the young of *Erato perexigua* which occurs associated with it at Plum Point.

Length, 3.5 mm.; width, 2 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Greensboro. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, U. S. National Museum.

MARGINELLA DENTICULATA Conrad.

Plate XLIV, Fig. 5.

Marginella denticulata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 225, pl. ix, fig. 21.

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burg, Virginia," was read by Henry C. Lea before the American Philosophical Society on May 29, 1843. An abstract of this paper is contained in the Proceedings of the American Philosophical Society, vol. iii, p. 162, published in 1843, which contains merely a list of species with descriptions of the new genera. In the library of the Philadelphia Academy of Natural Sciences is a pamphlet entitled "*Abstract of a Paper read before the American Philosophical Society, May* 29, 1843, *entitled 'Description of some new Fossil Shells, from the Tertiary of Petersburg, Virginia,' by Henry C. Lea, Philadelphia*," which contains twelve pages octavo (numbered "1–12") of Latin diagnoses of the new genera and species without figures, remarks or foot-notes. On the first page is written "*Issued Oct. 19th*, 1843." In 1845 there appeared a quarto excerpt which was identical with the final publication in vol. ix, of the Transactions of the American Philosophical Society, except that it had a pagination of its own. Vol. ix in which the article made its final appearance was published in 1846.

Marginella denticulata Conrad, 1845, Fossils of the Medial Tertiary, pt. iv, p. 86, pl. xlix, fig. 10.

Porcellana (Glabella) denticulata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 564.

Marginella denticulata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Marginella denticulata Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 51, pl. v, fig. 8.

Marginella (Eratoidea) denticulata Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 88.

Description.—"Shell smooth, polished, spire conical; columella four plaited, the three lower plaits oblique; right lip denticulate within; aperture rather more than half the length of the shell." Conrad, 1830.

"Subovate, polished; spire conical; columella 4-plaited; labrum denticulate within, straight, rather more than half the length of the shell." Conrad, 1845.

Dr. Dall, in the paper referred to above, has discussed the synonomy and characteristics of this species in great detail.

Length, 6.5 mm.; diameter, 3 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Marginella calvertensis n. sp.

Plate XLIV, Fig. 6.

Description.—Shell elongate, solid, surface highly polished, and with faint longitudinal ribs; whorls about five; spire about the length of the body whorl; whorls strongly convex, with a marked subsutural constriction which gives the spire a turreted appearance; inner lip with a slight callus; outer lip thick and flaring; plates four, lower three very oblique, the posterior the strongest and least oblique.

Length, 10 mm.; diameter, 4 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family VOLUTIDÆ.

Genus SCAPHELLA Swainson.

SCAPHELLA SOLITARIA (Conrad).

Plate XLIV, Fig. 7.

Voluta solitaria Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 218, pl. ix, fig. 7.
Voluta solitaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.
Voluta solitaria Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.
Scaphella solitaria Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 80.
Scaphella solitaria Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—" Shell ovate oblong, smooth; spire with the whorls concave above, and straight at the sides, having the angles tuberculated; aperture dilated at the base; columella four plaited.

" The large whorl is obsoletely striated at the base, and the plaits on the columella are oblique and subequal." Conrad, 1830.

There are a few important characteristics not noted in the original description. Dr. Dall states that the color pattern is the same as on the recent *S. junonia* Hwass, which is the type of the genus. The nucleus is very obtuse with no elevated point and its second whorl is marked by four deeply impressed, regularly spaced, revolving grooves which die out as the shoulder becomes tuberculate.

The specimens from Plum Point have a much more angular and more strongly tuberculate shoulder, with a deeper concavity above it, than those from the younger beds, and the body whorl is more strongly striate at the base. One specimen from Plum Point has faint revolving striæ above the shoulder of the body whorl. The specimens from St. Mary's River frequently have the shoulder entirely free from tubercles and not at all angular; this is especially true of the later whorls.

Length, 43 mm.; diameter, 23 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Subgenus AURINIA Adams.

SCAPHELLA (AURINIA) MUTABILIS (Conrad).

Plate XLIV, Figs. 8, 9.

Voluta Lamberti Morton, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 119.

Fasciolaria Lamberti Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 210.

(Not *Voluta lamberti* Sowerby.)

Fasciolaria mutabilis Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 135.

Fasciolaria mutabilis Conrad, 1841, Amer. Jour. Sci., vol. xli, pp. 343, 346, pl. ii, fig. 7.

Fasciolaria mutabilis Conrad, 1843, Trans. Amer. Assoc. Geol. and Nat., p. 109, pl. v, fig. 7.

Voluta mutabilis Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 421.

Voluta mutabilis Lyell, 1846, Proc. Geol. Soc. London, vol. iv, p. 555.

Voluta mutabilis Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 128, pl. xxvii, figs. 5, 6.

Voluta mutabilis Emmons, 1858, Rept. N. Car. Geol. Survey, p. 262.

Voluta (*Volutifusus*) *mutabilis* Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.

Voluta (*Volutifusus*) *mutabilis* Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Scaphella (*Aurinia*) *mutabilis* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 80.

Scaphella (*Aurinia*) *mutabilis* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 227.

Scaphella (*Aurinia*) *mutabilis* Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 129.

Description.—" Shell fusiform; spire conical with the whorls slightly contracted above, and the convex portion with longitudinal undulations, becoming obsolete in old shells; apex somewhat papillated; labrum arcuated; columella with two very oblique not much elevated folds, sometimes obsolete; beak slightly recurved; aperture more than two thirds the length of the shell. Length about four inches." Conrad, 1834.

Surface marked by very faint, wavy, revolving striæ; beak usually straight with the plaits almost or quite invisible at the mouth but rapidly becoming stronger within; but the beak is sometimes much bent and then the plaits show strongly at the mouth.

Length (restored), 180 mm.; diameter, 60 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

SCAPHELLA (AURINIA) TYPUS (Conrad).

Plate XLIV, Fig. 10.

Voluta mutabilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 182.
Volutifusus typus Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 67, pl. iii, fig. 2.
Volutifusus typus Tryon, 1882, Manual of Conchology, vol. iv, p. 77, pl. iii, fig. 31.
Scaphella (Aurinia) virginiana Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 80.
Scaphella (Aurinia) virginiana Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 227.
Scaphella typus Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.
Scaphella (Aurinia) virginiana Cossmann, Essais de Paléoconch. Comp., vol. iii, p. 128, pl. vi, fig. 3.

Description.—" Fusiform, thick in substance; whorls 6, besides the initial one, slightly concave above, with an angle near the suture, obscurely plicated; labrum thick near the summit, with an acute margin; columella with two distinct, little prominent folds; beak sinuous." Conrad, 1866.

This species shows great variation in proportional dimensions, curve of the beak, and size of the columella plaits. The plaits are much stronger on the specimens from Jones Wharf than on those from Plum Point. They stop abruptly on reaching the mouth. The surface is covered with faint revolving striæ.

Dr. Dall says that the name *typus* is "inapplicable," "misleading," "contrary to fact," and "cannot be retained." I do not recognize that a well-established and accepted specific name can be changed for the reasons quoted above; but if it can, the name *virginiana* is equally "misleading," "inapplicable," etc., when applied to a fossil which has been reported only from Maryland and North Carolina, and must also be rejected. In that case I propose the name *Conradiana.*

Length, 85 mm.; diameter, 40 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

SCAPHELLA (AURINIA) OBTUSA (Emmons).

Plate XLIV, Fig. 11.

Voluta obtusa Emmons, 1858, Rept. N. Car. Geol. Survey, p. 263, fig. 141.
Voluta obtusa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.

Voluta obtusa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Scaphella (*Aurinia*) *obtusa* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 80, pl. vii, fig. 7.

Scaphella (*Aurinia*) *obtusa* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 227.

Scaphella (*Aurinia*) *obtusa* Cossmann, 1899, Essais de Paléoconch. Comp., vol. iii, p. 129.

Description.—"Shell fusiform, contracted above the body-whirl, and forming thereby a sub-cylindrical spire; spire obtuse apex papillated and hooked; body-whirl plaited longitudinally at its top; columellar lip furnished with only two plaits." Emmons, 1858.

The body whorl is covered with fine, closely-set, revolving striæ, and the shoulder is tuberculate. Aside from the size of the nucleus there is no great difference between our Maryland specimens and the young of *S. typus*.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Plum Point.

Collections.—Philadelphia Academy of Natural Sciences, U. S. National Museum.

Turbinella (?) demissa Conrad.

Turbinella demissa Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 136.

Not *Caricella demissa* Conrad.

Description.—"Shell fusiform, with very obscure spiral striæ; whorls slightly contracted above, the convex part having obscure longitudinal undulations; suture impressed; spire elevated; columella with three profound thickened plaits; the superior one shortest and most thickened; beak produced, recurved. Length, two and a half inches.

"Locality, Choptank river, Md." Conrad, 1834.

This species has never since been found, nor referred to in the literature, nor has any gastropod of this size or at all of this general description been found on the Choptank. But this same bed contains at Jones Wharf and Governor Run *Scaphella typus* which answers exactly to the above description except that it has two folds on the columella instead of three.

In the collections of the Philadelphia Academy of Natural Sciences is a specimen labelled "*Voluta sinuosa miocene*," which may be the type of this lost species. Only part of the body whorl is present and the external markings are not well shown, but the plaits and the beak are exactly as in the description of *demissa*. The matrix is a coarse, yellow, indurated sand.

SCAPHELLA TRENHOLMII (Tuomey and Holmes).

Voluta Trenholmii Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 128, pl. xxvii, figs. 7, 8.

Scaphella Trenholmii Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 88.

Dr. Dall records this species from Maryland without locality.

Family MITRIDÆ.

Genus MITRA Lamarck.

MITRA MARIANA n. sp.

Plate XLIV, Fig. 12.

Description.—Shell small, solid, six-whorled; mouth half the length of the shell; labium with a callosity at the upper end; columella three-plaited, strongest plait above; sutures distinct; whorls slightly convex; surface with regular impressed revolving lines and longitudinal ribs, both of which are nearly obsolete on the body whorl; lines of growth faint.

Length, 8 mm.; diameter, 3 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Wagner Free Institute of Science, Cornell University.

Family FASCIOLARIDÆ.

Genus FULGUR Montfort.

FULGUR SPINIGER (Conrad) var.

Plate XLV, Figs. 1a, 1b.

Fusus spiniger Conrad, 1848, Jour. Acad. Nat. Sci. Phila., vol. i, 2nd ser., p. 117, pl. xi, fig. 32.

? *Busycon striatum* Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 584.

? *Busycon striatum* Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 69, pl. iii, fig. 8.

Fulgur spiniger Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 109.

Description.—"Fusiform, with revolving lines, and a series of elevated acute spines on the angle of the large whorl; the series continued on the whorls of the spire near the suture; two upper whorls entire; sides above the tubercles flattened, with the revolving lines fine and indistinct; volutions seven; beak produced; labrum striated within." Conrad, 1848.

This species, which originated and flourished abundantly during the Oligocene, has evidently survived on through the lower and middle Miocene. At the close of the middle (Choptank) Miocene it apparently disappeared, leaving three descendants in the upper (St. Mary's) Miocene. These are *F. fusiforme*, *F. tuberculatum* and *F. fusiforme var.* It is possible the *F. scalaspira* Conrad represents this form. If not it represents another variety of *F. spiniger* or a transitional form between that species and *F. coronatum.*

Length, 80 mm.; diameter, 40 mm.

Occurrence.—Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Fulgur fusiforme Conrad.

Plate XLV, Figs. 2, 3a, 3b.

Fulgur carica Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 130. (Reprint, Bull. Amer. Pal., No. 5, 1896, p. 36.)

Pyrula carica Morton, 1829, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 118.

Pyrula carica Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.

Fulgur fusiformis Conrad, 1840?, Fossils of the Medial Tertiary, No. 2 (cover). (Reprint, 1893, cover of No. 2, p. [80].)

Fulgur fusiformis Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 183, 187.

Fulgur fusiformis Conrad, 1853, Proc. Acad. Nat. Sci. Phila., vol. vi, p. 318.

Busycon fusiforme Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 82, pl. xlvi, fig. 3. (Reprint, 1893.)

Busycon fusiforme Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xlv, p. 561.

Busycon fusiforme Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Fulgur fusiformis Gill, 1867, Amer. Jour. Conch., vol. iii, p. 146.

Busycon fusiforme Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 267, pl. xxiii, fig. 4.

Description.—"Shell fusiform, with spiral striæ, obsolete, except on the inferior half of the body whorl, where they are prominent, wrinkled, and alternated in size; spire elevated, whorls with obtuse little prominent tubercles at the angle, which is situated near the suture, and is obtuse." "Allied to *F. carica.*" Conrad, 1840, 1853, 1861.

This species shows great variation in all its characters. The typical *fusiforme* is intermediate both in its genetic relationship and in its morphologic character between *spiniger* and *caricum.* It differs from the former in usually possessing a more depressed spire and in having the spiral striæ on the upper part of the body whorl more nearly obsolete. It is practically indistinguishable from the young of the latter, as would be expected of the ancestral form; but differs from the adult in not attaining as great size and in lacking in general those characters which distinguish the adult from the young of that species. Considering the extremely variable Calvert and Choptank descendants of *F. spiniger* as merely surviving varieties of that Oligocene species, the first appearance of *F. fusiforme* is in the St. Mary's Miocene. Here it shows considerable variation ranging on one hand to the short rugose form with a carinated shoulder which Conrad named *F. tuberculatum,* and on the other to a more elongate form with a smooth, rounded, somewhat polished shoulder which is here treated as an unnamed variety and figured (plate XLV, fig. 3).

The former died out without descendants at the end of the St. Mary's Miocene; and the latter did likewise, unless *F. maximum* of the Yorktown and Duplin Miocene and *F. rapum* of the Pliocene be considered descendants.

The typical form of the species, as stated above, is a link between *F. spiniger* and *F. carica,* and left in the Yorktown Miocene *F. filosum* as a descendant, either from which, or contemporaneously with which, appeared the Pliocene to Recent *F. carica.*

Length, 70 mm.; diameter, 36 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

Fulgur tuberculatum Conrad.

Plate XLV, Figs. 4a, 4b.

Fulgur tuberculatus Conrad, 1840 ?, Fossils of the Medial Tertiary, No. 2, cover. (Reprint, 1893, cover of No. 2, p. [80].)

Fulgur tuberculatus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185.

Fulgur tuberculatum Conrad, 1853, Proc. Acad. Nat. Sci. Phila., vol. vi, p. 317.

Busycon tuberculatum Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 82, pl. xlvi, fig. 2. (Reprint, 1893.)

Busycon tuberculatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Busycon tuberculatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p 22.

Fulgur tuberculatus Gill, 1867, Amer. Jour. Conch., vol. iii, p. 146.

Busycon tuberculatus Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 266, pl. xxiii, fig. 1.

Description.—"Shell fusiform with spiral striæ, obsolete on the upper part of the body whorl; spire elevated, whorls with a carinated line at the angle and compressed prominent tubercles; suture impressed and margined by an obtuse slightly prominent line." Conrad, 1840.

"Fusiform, with revolving striæ; spire elevated; angle of the whorl carinated and crowded with prominent tubercles; body whorl ventricose.

"Allied to *F. fusiformis,* but is more ventricose, proportionally shorter. It may readily be distinguished by the carina of the volutions, which is very strongly marked towards the apex." Conrad, 1853.

This variety, as stated above, is a descendant of the Calvert and Choptank varieties of *F. spiniger* and survived only during the St. Mary's Miocene. It was never numerically abundant, nor were its characteristics constant.

Length, 75 mm.; diameter, 42 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Cornell University.

Fulgur coronatum Conrad.

Plate XLVI, Figs. 1a, 1b.

Pyrula canaliculata var. Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 220.

Fulgur coronatus Conrad, 1840 ?, Fossils of the Medial Tertiary No. 2, cover. (Reprint, 1893, cover of No. 2, p. [80].)

Fulgur coronatum Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 183, 187.

Fulgur coronatum Conrad, 1853, Proc. Acad. Nat. Sci. Phila., vol. vi, p. 317.

Busycon coronatum Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 82, pl. xlvi, fig. 1. (Reprint, 1893, p. 82, pl. 46, fig. 1.)

Busycon coronatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.

Busycon coronatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Sycotypus coronatus Gill, 1867, Amer. Jour. Conch., vol. iii, p. 149.

Sycotypus coronatus Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 267, pl. xxiv, fig. 1.

Fulgur coronatum Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 24, 28.

Description.—"Shell fusiform, ventricose, with crowded fine spiral wrinkles; spire short; whorls flattened above, and having elevated compressed tubercles or spines on the angle, which is somewhat salient; suture canaliculate and margined by an obtuse carinated line." Conrad, 1840?

"Very distinct from the recent *canaliculatum,* being less ventricose and having prominent tubercles in all stages of growth." Conrad, 1853.

The species as here restricted is characterized by having distant, elevated tubercles and fine, revolving lines. It is sometimes difficult to separate the following variety and it is not essential that it should be done.

Length, 130 mm.; diameter, 75 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point (?).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Fulgur coronatum var. rugosum Conrad.

Plate XLVI, Figs. 2a, 2b.

Fulgur canaliculatus var. Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 129. (Reprint, Bull. Amer. Pal., No. 5, 1896.)

Pyrula canaliculata Morton, 1829, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 118.

Fulgur canaliculatus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Fulgur rugosus Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 307.

Fulgur rugosus Conrad, 1853, Proc. Acad. Nat. Sci. Phila., vol. vi, p. 317. (In part.)

Fulgur canaliculatum Lyell, 1855, Manual of Geology, p. 182, fig. 164.

Busycon rugosum Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 82, pl. xlvi, fig. 4. (Reprint, 1893.)

Busycon rugosum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.

Busycon rugosum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Sycotypus rugosus Gill, 1867, Amer. Jour. Conch., vol. iii, p. 149.

Sycotypus rugosus Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 267, pl. xxiv, fig. 24.

Description.—"Pyriform, with rather coarse rugose revolving lines, disposed to alternate in size, and very distinct numerous lines of growth; whorls scalariform, with a tuberculated carina, the margin of which presents a waved outline, the tubercles being obtuse; spire prominent, profoundly channelled at the suture, the margin of the channel carinated in young shells. Length, 3 inches. Conrad, 1861.

"Compared with *F. coronatus*, this species, when adult, is comparitively shorter and more inflated, with a shorter spire, much coarser revolving lines, which with the more numerous, more obtuse tubercles, give the shell a very different appearance from the *coronatus*. In an adult specimen of the latter species there are 13 spiniform tubercles on the body whorl. In the allied species, when adult, there are 17 much less elevated, more irregular, and more obtuse tubercles." Conrad, 1843.

This variety stands intermediate, as regards the development of tubercles between the typical *coronatum* and *canaliculatum*. The first four whorls of the latter species are indistinguishable from those of *rugosum*. This caused the confusion of the species so evident in the early literature. In the later stages of development there was a tendency for the tubercles to disappear, and some of the Miocene forms show in the adult an approximation to this character of their descendants. The species is perfectly distinct from the adult of *canaliculatum*.

Length, 170 mm.; diameter, 90 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point. Choptank Formation. Jones Wharf, Greensboro. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Fulgur alveatum (Conrad).

Busycon alveatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 583.
Busycon alveatum Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 68, pl. iii, fig. 7.
Fulgur pyrum var. incile, Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 112.

Description.—"Fusiform; spire prominent, scalariform; angle of whorls situated much above the middle, not tuberculated; summits channelled and margined with a carina, which is most conspicuous on the body whorl, and beneath it is a flattened space. Length 3¼ inches, width 1½.

"Locality, St. Mary's River, Md.

"A single specimen only was found, which appears to be a mature shell, and is most nearly allied to *B. canaliculatum.* The spire is more elevated than in that species, and differs also in being without tubercles." Conrad, 1862.

This species has been found at the St. Mary's River by no one else and so the occurrence is considered doubtful.

Genus LIROSOMA Conrad.

Lirosoma sulcosa Conrad.

Plate XLVII, Fig. 1.

Pyrula sulcosa Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 220, pl. ix, fig. 8.

Fusus sulcosus Conrad, 1832, Fossil Shells of the Tertiary No. 1, p. 18, pl. iii, fig. 3. (Reprint, 1893, p. 18 (p. 32).)

Fusus sulcosus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Fasciolaria sulcosa Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 86, pl. xlix, fig. 7.

Fasciolaria (Lirosoma) sulcosa Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 286.

Fasciolaria (Lyrosoma) sulcosa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 561.

Fasciolaria (Lyrosoma) sulcosa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 21.

Lirosoma sulcosa Conrad, 1867, Amer. Jour. Conch., vol. iii, p. 267, pl. xxiii, fig. 3.

Lirosoma sulcosa Tryon, 1881, Manual of Conchology, vol. iii, p. 50, pl. xix, fig. 53.

Not *Fasciolaria (Lyrosoma) sulcosa* Whitfield, 1894.

Lirosoma sulcosa Cossmann, 1901, Essais de Paléoconch. Comp., vol. iii, p. 79, pl. iv, fig. 4.

Description.—"Shell pyriform; ventricose; transversely ribbed, and longitudinally sulcated; summit of the whorls flattened, and subcanaliculate; right lip striated within; channel much contracted; beak straight or slightly recurved at the base." Conrad, 1830.

"Pyriform, body whorl rounded; spire short; summit of the volutions flattened, subcanaliculate; ribs prominent, revolving, crossed by longitudinal curved lines; labrum striated within; beak straight or slightly recurved at the base; channel much contracted; columella with a fold at base." Conrad, 1861.

Length, 25 mm.; diameter, 15 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

Family BUCCINIDÆ.

Genus CHRYSODOMUS Swainson.

CHRYSODOMUS PATUXENTENSIS n. sp.

Plate XLVII, Figs. 2, 3.

Description.—Shell small, fusiform, five-whorled; spire short, body whorl ⅗ the length of the shell; whorls carinated at about the middle by a broad revolving ridge, flat and straight below the ridge, slightly sloping above it—thus giving the whorls a strongly turreted appearance; whorls of the spire with one raised revolving line immediately below the suture, one or two fainter ones between that and the shoulder, and two stronger ones above the suture; body whorl with the same revolving lines and 12–18 additional revolving lines below them and on the beak; entire surface covered with numerous fine, sharp, regular lines of growth which bend at the shoulder; beak long, slightly bent; columella concave; aperture narrowing below.

There is great variation in the relative prominence of the different revolving ribs, and in the angularity at the shoulder. This is especially true of the Plum Point specimens.

Length, 16 mm.; diameter, 8 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Cornell University.

Genus BUCCINOFUSUS Conrad.

This genus was established by Conrad in 1868 with *Fusus parilis* as the type. Among the species which Conrad referred to it at that time is *F. berniciensis* King which is the type of *Troschelia* Mörch, 1876, and *Boreofusus* Sars, 1878. It is difficult to understand on what ground Fischer considers *Buccinofusus* a synonym of *Troschelia.*

BUCCINOFUSUS PARILIS Conrad.

Plate XLVII, Fig. 4.

Fusus cinereus Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., pp. 211. 223.

Fusus parilis Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 18, pl. iv, fig. 2. (Reprint, 1893.)

Fusus parilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 183, 185 (?), 187.
Fusus parilis Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 85, pl. xlix, fig. 5.
Neptunea parilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.
Neptunea parilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.
Buccinofusus parilis Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 264.
Buccinofusus parilis Tryon, 1881, Manual of Conchology, vol. iii, p. 47, pl. xxviii, fig. 40.
Buccinofusus parilis Cossmann, 1901, Essais de Paléoconch. Comp., vol. iv, p. 33, pl. i, fig. 10.

Description.—" Fusiform, elongated, with longitudinal ribs or undulations, and rather distant revolving subacute ribs, between which are 6 or 7 fine, minutely crenulated or wrinkled striæ; beak produced and slightly reflected." Conrad, 1832.

Length, 112 mm.; diameter, 57 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Wagner Free Institute of Science, Cornell University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Genus SIPHONALIA Adams.

Siphonalia devexa (Conrad).

Plate XLVII, Figs. 5, 6.

? *Fusus parilis* Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185.
Fusus devexus Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 309.
Fusus devexus Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 86, pl. xlix, fig. 8.
Neptunea devexa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.
Neptunea devexa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.
Fusus devexus Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—" Fusiform, with obtuse longitudinal ribs, obsolete near the upper margin where the whorls are somewhat contracted; ribs on the body whorl disappear just below the angle; above which the whorl is flattened, wide and profoundly declining; surface with robust, prominent and fine intermediate spiral lines: aperture more than half the length of the shell: beak sinuous. Length, two inches." Conrad, 1843.

Length, 85 mm.; diameter, 38 mm.

Occurrence.—Choptank Formation. Jones Wharf, Pawpaw Point. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

SIPHONALIA MIGRANS (Conrad).

Plate XLVII, Figs. 7, 8.

Fusus migrans Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 309.

Fusus migrans Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 85, pl. xlix, fig. 6.

Tritonifusus migrans Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Fusus migrans Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.

Description.—"Fusiform, elongated; surface with crowded unequal impressed spiral lines, and strong arched lines of growth; whorls contracted above, rounded towards the suture; whorls near the apex longitudinally ribbed; aperture half the length of the shell; beak much recurved. Length, three inches and a half." Conrad, 1843.

This species differs from *S. devexa* in lacking the longitudinal ribs on the later whorls, and in lacking the angulated shoulder of that species.

Length, 70 mm.; diameter, 30 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Philadelphia Academy of Natural Sciences.

SIPHONALIA MARYLANDICA n. sp.

Plate XLVIII, Figs. 1a, 1b.

Description.—Fusiform, elongate; whorls seven, strongly and regularly convex; longitudinal undulations (as in *Buccinofusus parilis*) on the earlier whorls, but becoming obsolete, and entirely absent on the body whorl; body whorl and spire with about twenty broad rounded revolving ribs; earlier whorls with about six, alternating with these striæ are smaller ones, with sometimes a pair of still finer ones on either side of them; columella concave above. sharply bent at the beginning of the canal, with almost a plate; canal contracted, of the same width throughout; labrum only slightly sulcate, not flaring below; labium with a thick callosity.

This differs from *Buccinofusus parilis* in that its whorls are more strongly convex, its suture more distinct, the revolving ribs rounded instead of sharp, not having the fine sharp intermediate lines or the longitudinal ribs on the body whorl; the columella is callous and more sharply bent, the canal narrower, especially at the base, where it is bent down and slightly back; the canal and mouth more sharply separated, the body whorl is contracted at the base where it joins the beak.

Length, 100 mm.; diameter, 47 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Cornell University, Wagner Free Institute of Science.

Siphonalia(?) calvertana n. sp.

Plate XLVIII, Fig. 2.

Description.—Shell subfusiform, slender; whorls three+, lower part of each straight, upper part sloping at an angle of about 45° with the lower part, angle of the whorl not marked by any distinct shoulder; mouth long, widest above and narrowing rapidly below into a long slightly bent canal; columella smooth, slightly twisted; body whorl with about 40 longitudinal ribs which become obsolete below, and about 10 broad revolving ribs with narrower interspaces, together giving the whorl a strongly reticulate appearance; beak with about 10 finer revolving ribs and with no longitudinal ones; spire with less distinct sculpture, the longitudinal ribs passing into crowded rugose lines of growth; first whorl of the nucleus smooth and depressed, second whorl elevated, angular, and differing from the succeeding whorls of the spire only in having very feeble sculpture.

Length, 10 mm.; diameter, 4 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, U. S. National Museum.

Genus PISANIA Bivona.

Subgenus CELATOCONUS Conrad.

The name *Celatoconus* was used by Conrad and by Meek as noted below but was not defined by them. The first diagnosis is that given by Dall, in 1892, when he established the subgenus with *C. protractus* Conrad as the type.

Pisania (Celatoconus) protractus (Conrad).

Plate XLVIII, Figs. 3a, 3b, 4.

Buccinum protractum Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 308.
Celatoconus protractus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566.
Celatoconus protractus Meck, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
Cœlatoconus protractus Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 267, pl. xx, fig. 6.
Pisania (Celatoconus) protractus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iiv, pt. ii, p. 235.
Metula (Celatoconus) protracta Cossmann, 1901, Essais de Paléoconch. Comp., vol. ii, p. 166.

Description.—" Subfusiform, elevated; with robust flattened spiral ribs about as wide as the interstices, both ribs and furrows crossed by distinct prominent longitudinal lines; aperture long and elliptical; labrum with short, submarginal prominent lines; beak slightly recurved. Length, one inch and a third." Conrad, 1843.

Conrad's description is fully adequate for the recognition of the species as there is nothing in the American Tertiary even generically resembling it except *Celatoconus nux* Dall from the Miocene of North Carolina.

There is a slight tendency for the revolving ridges to become alternating in size on the later whorls; the labrum is always denticulate, and the shell is generally less elongated than Conrad's figure indicates.

Length, 35 mm.; diameter, 15 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Genus PTYCHOSALPINX Gill.

Ptychosalpinx altilis (Conrad).

Plate XLVIII, Fig. 5.

Buccinum altile Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 19, pl. iv, fig. 6.
Ptychosalpinx altilis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 237.
Cominella (Ptychosalpinx) altilis Cossmann, 1901, Essais de Paléoconch. Comp., vol. iv, p. 150, pl. vi, fig. 19.

Description.—" Subovate, with numerous longitudinal undulations and obtuse spiral striæ; body whorl rather ventricose; spire conical; apex obtuse." Conrad, 1832.

As is stated below (p. 191) the forms here and by Dall referred to *P. altilis* possibly are normal forms of the species figured by Say as *Buccinum porcinum* and *Buccinum aratum*. This possibility is suggested by the fact that Say's species have never since then been found at the St. Mary's River, while the forms here figured, which are by no means rare, were not distinguished by the early workers.

Length, 30 mm.; diameter, 18 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Cornell University, U. S. National Museum.

Ptychosalpinx multirugata Conrad.

Plate XLVIII, Fig. 6.

Buccinum multirugatum Conrad, 1841, Amer. Jour. Sci, vol. xli, p. 345.
Tritia multirugata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.
Tritia multirugata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.
Ptychosalpinx multirugata Gill, 1867, Amer. Jour. Conch., vol. iii, p. 154.
Ptychosalpinx multirugata Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 262.
Ptychosalpinx multirugata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 237.
Cominella (*Ptychosalpinx*) *multirugata* Cossmann, 1901, Essais de Paléoconch. Comp., vol. iv, p. 151.

Description.—"Ovato-conical, with numerous wrinkled spiral lines, coarser and more distant near the suture and at base of the body whirl; base bicarinated and subumbilicated; columella with a thick fold at base." Conrad, 1841.

This is the rarest species of *Ptychosalpinx* from the Maryland Miocene. When more material is collected it will probably be found to grade into the *lienosa-fossulata* series.

Length, 36 mm.; diameter, 22 mm.

Occurrence.—Choptank Formation. Dover Bridge. Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Ptychosalpinx lienosa Conrad.

Plate XLVIII, Fig. 7.

Buccinum lienosum Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 308.
Buccinum bilix Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 308. (In part).
Buccinum fossulatum Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 308.
Tritia fossulata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.
Tritia fossulata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Ptychosalpinx fossulata Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 262.

Ptychosalpinx lienosa Conrad, 1868, Amer. Jour. Conch., vol. iii, pp. 262, 263, pl. xix, fig. 9.

Ptychosalpinx fossulata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 237.

Ptychosalpinx lienosum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 237.

Cominella (*Ptychosalpinx*) *lienosa* Cossmann, 1901, Essais de Paléoconch. Comp., vol. iv, p. 151.

Description.—" Obovate, with distant spiral flattened, not very prominent lines, between which are usually 3 lines, the middle one largest; whorls of the spire slightly convex; body whorl ventricose; lines of growth distinct; columella with two distant plaits, the inferior one at the angle which is prominent." Conrad, 1843.

It seems highly probable that when more material belonging to this genus is collected from the Calvert formation, this species will be found to be connected with *P. multirugata* by such a complete gradation series that but a single species can be recognized. Then both *fossulata* and *lienosa* will have to be considered synonyms of *multirugata*, or else *lienosa* used as a variety.

Length, 45 mm.; diameter, 26 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Philadelphia Academy of Natural Sciences.

? Family NASSIDÆ.

? Genus ILYANASSA Stimpson.

Subgenus PARANASSA Conrad.

Ilyanassa? (Paranassa) porcina (Say).

Plate XLVIII, Figs. 8, 9.

Buccinum porcinum Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 126, pl. vii, fig. 3. (Reprint, Bull. Amer. Pal., No. 5, 1896, p. 32, pl. vii, fig. 3.)

? *Buccinum aratum* Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 126, pl. vii, fig. 4. (Reprint, Bull. Amer. Pal., No. 5, 1896, p. 33, pl. vii, fig. 4.)

Buccinum porcinum Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 19, pl. iv, fig. 4.

Buccinum porcinum Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 133, pl. xxviii, fig. 1.

Buccinum porcinum Emmons, 1858, Report N. Car. Geol. Survey, p. 256, fig. 122.

Tritia porcina Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

? *Tritia arata* Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

Tritia porcina Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

? *Tritia ovata* Meek, 1864, Miocene Check List, Smith Misc. Coll., (183), p. 20. (No. 668, not No. 689.)

? *Tritia arata* Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.
Ptychosalpinx porcina Gill, 1867, Amer. Jour. Conch., vol. iii, p. 154.
Ptychosalpinx (*Paranassa*) *porcina* Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 262.
? *Ptychosalpinx* (*Paranassa*) *arata* Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 262.
Ilyanassa (*Paranassa*) *porcina* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 238.

Description.—"Subovate, acute, slightly undulated, and spirally striated; labrum toothed.

"*Shell* with numerous, subequal, slight undulations, disappearing on the body whorl, and about seventeen transverse, little elevated striæ: *whorls* nearly six, but little convex: *suture* very narrow, consisting of a mere indented line: *apex* acute: *aperture* moderate, rather more than half the length of the shell: *labium* covering the columella, concave: *labrum* not thickened; on the inner submargin with striæform teeth.

"Length one inch and a quarter, breadth rather more than three-fourths of an inch.

"This is shorter than the *reticosum* of Sowerby, the suture is not so deeply impressed, the undulations are not so obvious, and the concavity of the labium is much more profound." Say, 1824.

Say and Dall are the only ones who have recorded *porcina* or *arata* from Maryland, and Dall gave them on the authority of Say. It is of course possible that Finch found them while all later collectors have missed them. But considering the amount of material collected since then, it seems more probable either that Finch's specimens (of these species) came from Virginia, or that Say's figures are extremely bad representations of aberrant forms of the species here and by Dall referred to *Ptychosalpinx altilis* Conrad. Say's figure of *arata* is extremely bad in any case, and because of this reason and of the possibilities stated above, the references to *arata* are with query grouped in the above synonomy under *porcina*.

Occurrence.—St. Mary's Formation. St. Mary's River(?).

Family NASSIDÆ.

Genus NASSA Lamarck.

Nassa calvertensis n. sp.

Plate XLIX, Fig. 1.

Description.—Shell short, globose, six-whorled; body whorl large, rotund, or with a subangular shoulder; about 25 closely-set raised revolving lines with narrower interspaces and 25 curved longitudinal ribs on the body whorl; varices 270° apart, earlier ones obsolete; mouth subquadrate; anterior canal broad and short; labium with a thick callosity; columella very concave, with a sharp plait at the base, a large tooth immediately above the plait and a small tooth in the center of the concavity; labrum thick, lirate; spire short but sharp with concave sides; whorls of the spire with more angular shoulder and stronger longitudinal ribs than the body whorl.

Length, 8 mm.; diameter, 6 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

NASSA GUBERNATORIA n. sp.

Plate XLIX, Fig. 2.

Description.—Shell small, slender, thick, seven-whorled, body whorl with about 15 broad, uniform, raised, revolving lines with interspaces half as wide, and very faint irregular longitudinal undulations; mouth small; anterior canal broad and very short; labium strongly callous, with a large tooth at the top; labrum very thick, with about five strong lirations extending far in.

Length, 9 mm.; diameter, 4 mm.

Occurrence.—Choptank Formation. Governor Run (lower bed).

Collection.—Maryland Geological Survey.

NASSA TRIVITTATOIDES (Whitfield).

Plate XLIX, Figs. 3, 4.

Tritia trivittatoides Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 104, pl. xix, figs. 1–3.

Tritia trivittatoides, var. elongata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 105, pl. xix, figs. 4–6.

Description.—" Shell small, elongate-ovate or pupæform, not exceeding half an inch in total length, and few examples reaching that size. Whorls about seven in number, including the mammillar apical one, convex and moderately increasing in diameter with increased number; sutures distinct but not channeled or grooved. Aperture less than one-third of the entire length, the outer lip thickened and varix-like externally, and somewhat also internally, and marked by several tooth-like lines on the inner side. Inner lip also distinct and somewhat thickened with several tooth-like striæ, the posterior end of the aperture being slightly channeled and the front strongly so; beak distinctly constricted at its junction with the body whorl. Surface granularly cancellated with nearly direct vertical lines or ridges and raised spiral lines, forming granules or asperities at their intersection, and the last whorl having a single lip-like varix. Spiral lines eight or nine in number on the boly whorl, and the vertical lines eighteen or twenty, exclusive of the lip and varix. Volutions above the last not possessing lip-like varices." Whitfield, 1894.

Whitfield described the variety *elongata* as follows:

"A number of specimens of full growth, having many of the features of *T. trivittatoides* above described, occur in the collection. They vary from one-fourth of an inch to five-sixteenths of an inch in length, and are proportionally much more slender than are those of that species. They also possess a greater number of vertical lines, and two additional spiral lines on the body whorl. The surface features are much like those of that species, but on many of them the spiral lines are more distinctly raised ribs, and the line of nodes below the suture more distinctly separated from and proportionally larger than those below. The thickened outer lip is the same as on that shell, as also is the lip-like varix within the limit of the body whorl, but the teeth-like ridges on the columella and on the inside of the outer lip appear on most specimens somewhat stronger in proportion to the size of the shell, while the proportional length of the spire, as compared to that of the body whorl, is considerably greater. These features are so marked as to render it unsafe to include these specimens under the same specific head with *T. trivittatoides*." Whitfield, 1894.

It is impossible to decide definitely here of the value of the *var. elongata* for the New Jersey fossils. The differences upon which it was established appear to be slight and the Maryland specimens which apparently represent both forms cannot be divided.

Length (restored), 14 mm.; diameter, 6 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

NASSA GREENSBOROËNSIS n. sp.

Plate XLIX, Figs. 5a, 5b.

Description.—Shell small, narrow, elongate, six-whorled; whorls convex, separated by very distinct sutures; sculptured by faint longitudinal undulations which are overridden by about ten fine spiral striæ on each whorl; striæ separated by interspaces of the same width as the striæ; aperture broadly ovate; outer lip with four beads.

Length, 7 mm.; diameter, 3.3 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collection.—Maryland Geological Survey.

NASSA MARYLANDICA n. sp.

Plate XLIX, Figs. 6, 7, 8.

Description.—Shell small, solid, elongate (except as noted below), eight-whorled; body whorl with 9 to 15 distant raised longitudinal ribs which extend to the suture without any constriction or subsutural tubercles, and with 25 to 30 faint revolving lines of uniform strength which never override the ribs; whorls of the spire with about 10 revolving lines.

This species differs from *N. peralta,* with which it is associated, in being generally smaller (and more elongated), in having a less distinct suture, in having constantly fewer and more distant ribs which are never overridden by the revolving lines and which extend from suture to suture without constriction.

Associated with this species are two forms which further study may show to be entitled to separate names, but at present it seems best to include them here as aberrant forms of this species. One is very short and globose (fig. 8), while the other has a distinct notch near the lower end of the labrum (fig. 7). Otherwise they have all the characteristics of this species.

Length, 14 mm.; diameter, 6 mm.

Occurrence—ST. MARY'S FORMATION. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

NASSA PERALTA (Conrad).

Plate XLIX, Figs. 9, 10.

Nassa trivittata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.
Buccinum trivittatum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 186.
Buccinum trivittatum Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 421.
Buccinum trivitatum Lyell, 1846, Proc. Geol. Soc. London, vol. iv, p. 555.
Tritia trivitata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.
Ptychosalpinx (Tritiaria) peralta Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 264, pl. xix, fig. 5.
Ptychosalpinx (Tritaria) peralta Tryon, 1882, Manual of Conchology, vol. iv, p. 8, pl. iii, fig. 31.
Nassa trivittata Heilprin, 1884, U. S. Tertiary Geology, pp. 58, 61.
Nassa (Tritia) trivittata Clark, 1888, Johns Hopkins Univ. Circ., vol. vii, p. 66.
Nassa trivittata Clark, 1891, Johns Hopkins Univ. Circ., vol. x, p. 107.
Nassa peralta Harris, 1891, Amer. Geol., vol. viii, p. 174.

Description.—"Elongate turrited, whorls 8, longitudinally ribbed and with revolving impressed lines, about 5 in number on the penultimate volution; above near the suture on all the whorls there is a broader impressed line, which divides the ribs and forms a tuberculous ridge around the summits of the whorls; ribs narrow, numerous; spire acuminate." Conrad, 1868.

The body whorl is often much more expanded than any of the other whorls. The number of ribs on the body whorl (20-25) is characteristic of the species. The suture is deeply impressed.

The synonomy of this species has been the subject of an article by Professor Harris (see above), in which the bibliographic history of the species has been discussed in great detail.

Length, 20 mm.; diameter, 9 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University, Wagner Free Institute of Science.

NASSA PERALTOIDES n. sp.

Plate XLIX, Fig. 11

Description.—Shell small, six-whorled; whorls gently convex; suture very distinct; labium with a thick callosity and with a tooth at the upper end; labrum sometimes lirate; body whorl with eighteen longitudinal ribs terminating in a subsutural row of tubercles, and with about sixteen sharply impressed spiral lines with much broader interspaces, the spiral lines (except the subsutural one) not crossing the longitudinal ribs; spire regularly pyramidal.

This species most closely resembles *N. peralta,* of which it is probably the ancestor. It differs from it in being much smaller, in having a less expanded mouth, and in not having the longitudinal ribs crossed by the spiral lines.

Length, 11 mm.; diameter, 5.5 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run (lower bed), Greensboro, Trappe Landing. CALVERT FORMATION. Plum Point, Church Hill, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

NASSA TRIVITTATA Say.

Plate XLIX, Fig. 12.

Nassa trivittata Say, 1822, Jour. Acad. Nat. Sci. Phila, vol. ii, 1st ser., p. 231.

This species has been repeatedly listed from the Miocene of Maryland, but it has been supposed that in every case it was a misdetermination of *Nassa peralta* Conrad. The Johns Hopkins collection contains 8 undoubted specimens of this species which were in a tray of *N. peralta* from St. Mary's river. Probably they came from the Pleistocene at Cornfield Harbor (where they occur abundantly), and were mixed with the Miocene specimens by accident. Several quarts of specimens of *N. peralta* collected by the Maryland Geological Survey and by the Cornell and Wagner Institute expeditions have been carefully searched without finding a single specimen of *N. trivitatta.* In all probability the species is entirely post-Miocene. It is hoped that future collectors will give this question their careful attention.

Occurrence.—ST. MARY'S FORMATION (?). St. Mary's River (?).

Collection.—Johns Hopkins University.

Genus BULLIOPSIS Conrad.

BULLIOPSIS INTEGRA Conrad.

Plate L, Figs. 1, 2.

Buccinum integrum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 194, pl. ii, fig. 5.

Buccinum pusillum H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 12.

Buccinum pusillum H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 272, pl. 37.

Bullia (Bulliopsis) ovata Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 287.

Tritia (Bulliopsis) integra Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

Tritia (Bulliopsis) ovata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

Tritia (Bulliopsis) integra Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Tritia (Bulliopsis) ovata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Nassa (Bulliopsis) integra Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 66, pl. iii, fig. 5.

Nassa (Bulliopsis) integra var. ovata Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 66, pl. iii, fig. 4.

Melanopsis integra Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 259.

Buccinanops variabilis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 107, pl. xvii, figs. 13–18.

Description.—" Shell short, subfusiform or elliptical; smooth; destitute of ribs or striæ; spire conical, the volutions convex; aperture elliptical, about half the length of the shell; columella thick; labium reflected." Conrad, 1842.

Whitfield named some young shells from the St. Mary's formation in a deep well at Cape May, "*Buccinanops variabilis*," describing the species as follows:

" Shell rather small, not exceeding five-eighths of an inch in total length; the body of a somewhat subcylindrical form, sometimes wider below than above, and sometimes the reverse; spire short-obtuse, or subturreted; volutions of the spire round scalariform, with deep distinct sutures, the apical ones often quite pointed and attenuated, with a small, rounded, mammillary nucleus; aperture from half to three-fourths as long as the shell, according to the length of the spire, channeled at each extremity and constricted just below the suture on the body whorl, leaving the upper edge of the volution protruding fold-like, the lip expanding again below; inner lip extending upon the inner volution, forming a callosity which is thickened above, bordering the posterior canal; lower canal channeling the base of the columella within. Surface smooth, polished when entire, but generally eroded, showing under a glass fine lines of growth." Whitfield, 1894.

His specimens do not differ at all from young of *B. integra* from the Maryland localities.

Length, 23 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Bulliopsis quadrata Conrad.

Plate L, Fig. 3.

Nassa quadrata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., pp. 211, 226, pl. ix, fig. 16.

Buccinum quadratum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Bullia (Bulliopsis) quadrata Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 287.

Tritia (Bulliopsis) quadrata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.

Tritia (Bulliopsis) quadrata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Nassa (Bulliopsis) quadrata Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 65, pl. iii, fig. 1.

Nassa (Bulliopsis) subcylindrica Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 66.

Melanopsis quadrata Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 259.

Description.—"Shell turreted; spire with the whorls rather square, and slightly projecting at the angles; left lip reflected over the columella, and thickened above." Conrad, 1830.

Length, 23 mm.; diameter, 1 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Bulliopsis marylandica Conrad.

Plate L, Fig. 4.

Bullia (Bulliopsis) Marylandica Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 287.

Tritia (Bulliopsis) Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 562.

Tritia (Bulliopsis) marylandica Meek, 1864, Miocene Check List, Smith. Misc Coll. (183), p. 20.

Nassa (Bulliopsis) Marylandica Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 65, pl. iii, fig. 3.

Melanopsis Marylandica Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 259.

Description.—" Oblong-ovate, entire; whorls 6, slightly convex or subtruncated laterally; suture impressed; aperture about half the length of the shell; columella profoundly callous above, the callus extending beyond the lip." Conrad, 1862.

The surface is frequently marked with obsolete revolving lines.

Length, 32 mm.; diameter, 14 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point,

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Family COLUMBELLIDÆ.

Genus COLUMBELLA Lamarck.

Subgenus ASTYRIS Adams.

Columbella (Astyris) communis (Conrad).

Plate L, Figs. 5, 6, 7.

Nassa lunata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211. (Not of Say.)

Buccinum lunatum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Amycla (Astyris) communis Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 287.

Amycla (Astyris) communis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 564,

Columbella (Astyris) communis Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii. pt. i, p. 138.

Astyris communis Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 28.

Amycla communis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 110, pl. xix, figs. 12-15.

Description.—" Small, whorls six or seven, smooth and polished; spire rather elevated; body whorl abruptly rounded in the middle, or subangular; submargin of labrum minutely dentate." Conrad, 1862.

Whorls slightly convex, covered with minute spiral lines visible only through a lens; beak with from 8 to 12 distinct impressed revolving lines; labrum sometimes straight, sometimes rounded; usually smooth within, often strongly dentate; labium usually somewhat callous, sometimes dentate. The callous dentate labrum occurs only in specimens from the St. Mary's Formation and most typically in those from Cove Point.

There occurs rather abundantly at Greensboro in association with this species a small form ranging in length from 2.5 mm. to 3.5 mm. This may represent *C. lunata* (Say), which has not hitherto been recognized in the Miocene of this region.

Length, 14 mm.; diameter, 6 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf, Governor Run (lower bed), Greensboro. Calvert Formation. Plum Point, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Columbella calvertensis n. sp.

Plate L, Fig. 8.

Description.—Shell thick, elongate, eight-whorled; spire elevated; whorls slightly convex; body whorl with about twenty-four narrow revolving grooves with flat interspaces about four times as wide; whorls of the spire with about six grooves; lines of growth very faint; mouth narrow; labrum thick, with about fourteen coarse teeth; canal short, slightly curved.

Length, 16 mm.; diameter, 6.5 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Family MURICIDÆ.

Genus MUREX Linné.

Subgenus PTERORHYTIS Conrad.

Murex (Pterorhytis) conradi Dall.

Plate L, Figs. 9a, 9b.

Cerostoma umbrifer Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, expl. pl. xxviii, fig. 14. (Not p. 141.)

Murex (*Pterorhytis*) *Conradi* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 143, pl. xii, fig. 11.

Ocenebra (*Pterorhytis*) *conradi* Cossmann, 1903, Essais de Paléoconch. Comp., vol. v, p. 43, fig. 3.

Description.—"This fine species has, like most of the species of this genus, only four varices. The spire is much shorter than in *M. umbrifer* and the form of the varices is different." Dall, 1890.

Shell of moderate size, very solid, five-whorled; varices four, broad, thick, reflexed, intervarical spaces with low, rounded, revolving ribs, and distant obscure lines of growth; central part of the whorl strongly carinated; face of the last varix with wavy lines caused by the edges of the laminæ; umbilicus small; canal barely closed, slightly reflexed.

Length, 36 mm.; diameter, 25.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—U. S. National Museum.

Genus TYPHIS Montfort.

Typhis acuticosta Conrad.

Plate LI, Figs. 1, 2, 3.

Murex acuticosta Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., pp. 211, 217, pl. ix, fig. 1.

Typhis acuticosta Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Typhis acuticosta Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 83, pl. xlviii, fig. 1.

Typhis acuticosta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.

Typhis acuticosta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Typhis acuticostata Conrad, 1868, Amer. Jour. Conch., vol. iv, p. 64, pl. v, fig. 6.

Typhis acuticosta Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 151.

Murex acuticostata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xiv, p. 30.

Description.—"Shell with four or five acute foliated varices ending above in a pointed, compressed spire, alternating with four shorter rounded varices ending above in a tube; aperture oval and entire; margin reflected; beak closed, and slightly recurved." Conrad, 1830.

Length, 21 mm.; diameter, 11 mm.

The form from Plum Point may be a distinct variety or species. It is very elongate, having a six-whorled spire and long spines and canal.

Length, 18 mm.; diameter, 8.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Cornell University, U. S. National Museum.

Genus MURICIDEA Swainson.

MURICIDEA SHILOHENSIS (Heilprin).

Plate LI, Figs. 4, 5, 6.

Murex Shilohensis Heilprin, 1887, Proc. Acad. Nat. Sci. Phila., vol. xxxix, p. 404.
Murex shilohensis Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 141.
Murex Shilohensis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 97, pl. xvii, fig. 1.

Description.—"Whorls about seven, angular, flattened on the shoulder, which is crossed diagonally by the variceal ridges; varices about eight on the body-whorl, sub-equal, spinosely elevated on the shoulder angulation, and crossed by four sub-equal revolving ridges, which appear double on the crests of the varices; only two such ridges on the whorls above the body-whorl.

"Aperture somewhat more than half the length of shell, key-hole shaped, with the canal broadly deflected. Length nearly .75 inch." Heilprin, 1887.

Dr. Dall notes that the type of this species is suspiciously like *Muricidea spinulosa.*

Length, 17 mm.; diameter, 9 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, U. S. National Museum.

Genus TROPHON Montfort.

TROPHON TETRICUS Conrad.

Plate LI, Figs. 7a, 7b.

Fusus tetricus Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 18, pl. iii, fig. 6.
Fusus tetricus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.
Fusus tetricus Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 84, pl. xlviii, fig. 4.
Trophon tetricus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.
Trophon tetricus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Description.—"Fusiform; with longitudinal acute ribs, terminating above in short spines; whorls angular and flattened above; beak long and recurved." Conrad, 1832.

A feature which Conrad does not mention in his descriptions, but which shows distinctly, is the occurrence of three or four raised revolving ribs on the body whorl.

The shell is seldom perfect, the spines and the long beak being very easily broken off. The number of varices on the body whorl varies from 9 to 12.

Length, 18 mm.; diameter, 8 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Cornell University.

TROPHON TETRICUS VAR. LÆVIS n. var.

Plate LI, Fig. 8.

Fusus tetricus Conrad (In part).

Description.—Shell six-whorled; body whorl with 9 to 13 varices; lower part of the body whorl almost or quite smooth, one of the four revolving ribs of *T. tetricus* sometimes faintly showing.

Conrad's description of *T. tetricus* applies exactly to this variety; but his figures show the character by the lack of which this variety is distinguished, i. e., four raised revolving ribs on the body whorl.

Length (restored), 27 mm.; diameter, 12 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University.

TROPHON CHESAPEAKEANUS n. sp.

Plate LI, Figs. 9, 10.

Description.—Shell small, fusiform, six-whorled; spire elongate, pyramidal; body whorl much expanded above, constricted below into a long, narrow beak; shoulder of the whorl with about sixteen obtuse elongated nodes which die out immediately above the shoulder, leaving a smooth, slightly concave subsutural constriction; mouth wide, contracted suddenly below into a narrow, somewhat reflexed canal; columella bent near the lower end of the mouth, and somewhat callous at the angle; lines of growth irregular.

This species is very abundant at the St. Mary's River. At Plum Point a small, very elongated variety occurs.

Length, 10 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Langley's Bluff. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science, Cornell University.

Trophon sp.

A single specimen of Trophon was found at Greensboro which does not belong to either of the afore-described species, but as the specimen is immature it will not be given a name.

The specimen possesses five whorls. The body whorl has seven varices and has about twelve revolving ribs distributed from the shoulder to the base of the beak.

Length, 8 mm.; diameter, 4 mm.

Occurrence.—Choptank Formation. Greensboro.

Collection.—Maryland Geological Survey.

Genus SCALASPIRA Conrad.

The name *Scalaspira* was used by Conrad in 1862 and subsequently by Meek in 1864 in their Check Lists. Each time it was used as a subgenus under *Fusus;* and neither time was the subgenus defined. *Fusus strumosus* Conrad was the only species included under it. As this species is surely not a true *Fusus* and cannot be with certainty assigned to any other genus, the name may be retained for a new genus defined as follows:

Shell fusoid, with angular cancellated whorls; anterior canal long, narrow; columella bent at the beginning of the canal, and somewhat callous; nucleus depressed, with faint revolving ridges and transverse striations.

Type *Fusus strumosus* Conrad.

Fischer considers *Scalaspira* a synonym of *Hanetia* of Jousseaume which he places as closely related to *Urosalpinx,* while Tryon and Cossmann consider it a synonym of *Urosalpinx.*

Scalaspira strumosa Conrad.

Plate LI, Figs. 11, 12, 13.

Fusus strumosus Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 18, pl. iii, fig. 4.

Fusus strumosus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Fusus strumosus Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 85, pl. xlix, fig. 3.

Fusus (Scalaspira) strumosus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.

Fusus (Scalarispira) strumosus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Urosalpinx strumosus Tryon, 1880, Manual of Conchology, vol. ii, p. 152, pl. lxx, fig. 431.

Urosalpinx strumosus Cossmann, 1903, Essais de Paléoconch. Comp., vol. v, p. 49.

Description.—" Fusiform; cancellated; body whorl subquadrangular, with revolving tuberculated ribs, alternated in size; whorls of the spire striated, and tuberculated at the angle; beak straight." Conrad, 1832.

Length, 26 mm.; diameter, 13 mm. (specimen from Yorktown, Va.).

Length, 18 mm.; diameter, 9 mm. (specimen from Cove Point, Md.).

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus UROSALPINX Stimpson.

UROSALPINX CINEREUS (Say) ?.

Plate LI, Figs. 14, 15.

Fusus cinereus Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 236. (Fig'd. 1830, Amer. Conch., pl. xxix.)

Fusus cinereus var. Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 129, (Reprinted, 1896, Bull. Amer. Pal., No. 5, p. 35.)

Not *Fusus cinereus* Conrad, 1830, Jour. Acad. Nat. Sci. Phila, vol. vi, 1st ser., pp. 211, 223.

Fusus cinereus Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 19, pl. iv, fig. 3.

Fusus cinereus Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 183, 187.

? *Urosalpinx cinereus* Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.

Description.—" *Volutions* cancellate, the transvere costæ eleven, robust; revolving lines filiform, irregularly alternately smaller, crenulating the edge of the exterior lip, which is acute, and alternating with the raised lines of the fauces; *fauces* tinged with chocolate colour; *beak* short, obtuse, not rectilinear; *labrum* not incrassated." Say, 1822.

The fossil which is here referred to *cinereus* often differs considerably from the typical specimens of that form in proportional length, character of sculpture, and straightness of beak; but it nevertheless grades into it so that a consistent separation is impossible. On the other hand the separation from its stratigraphic associate, *U. rustica,* though sometimes difficult, is much more distinct.

The St. Mary's fossil which Conrad referred to *cinereus* (*Fusus cinereus* Conrad, 1830) must from its size have been *Buccinofusus parilis,* then unnamed by him. There is considerable doubt as to the identity of the Miocene fossils referred by Say and by Meyer to *cinereus.*

Length, 38 mm.; diameter, 40 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point. Choptank Formation. Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Urosalpinx rusticus (Conrad).

Plate LI, Figs. 16, 17.

Fusus errans Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 223, pl. ix, fig. 2. (Not *F. errans* Sowerby.)

Fusus rusticus Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 230.

Fusus rusticus Conrad, 1832, Fossil Shells of the Tertiary, No. 1, p. 18, pl. iv, fig. 1.

Fusus rusticus Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 185, 187.

Fusus subrusticus Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 84, pl. xlviii, fig. 5.

Neptunea rustica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 560.

Neptunea rustica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 22.

Siphonalia rustica Conrad, 1869, Amer. Jour. Conch., vol. iv, p. 249.

Urosalpinx trossulus Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 148. (In part.)

Fusus rusticus Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 30.

Streptochetus rusticus Cossmann, 1901, Essais de Paléoconch. Comp., vol. iv, p. 30, pl. iv, fig. 20.

Description.—" Shell subfusiform, transversely striated, with short longitudinal ribs or undulations on the large whorl; spire conical, costated; upper part of the whorls concave and plain; right lip toothed within, and plicated on the margin; beak recurved. The striæ in general are alternately larger and smaller." Conrad, 1830.

Length, 42 mm.; diameter, 24 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Cornell University, U. S. National Museum.

Family PURPURIDÆ.

Genus ECPHORA Conrad.

Ecphora Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 310.
? *Stenomphalus* Sandberger, 1853.
Ecphora Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 75.
Rapana Tryon, 1882, Manual of Conchology, vol. ii, p. 202. (In part.)
Stenomphalus Zittel, 1885, Handbuch der Paleontologie, Abth. 1[2], p. 270. (In part.)
Rapana Fischer, 1887, Manuel de Conchyliologie, p. 644. (In part.)
Ecphora Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. 1, p. 124.
Rapana Cossmann, 1903, Essais de Paléoconch. Comp., vol. v, p. 63.

Careful study of large collections of material from the entire Atlantic slope has shown that this genus, formerly considered as most constant in its characteristics and most easy to recognize, should really be divided into several distinct species, the generic position of some of which are not at first sight apparent.

The difficulty encountered in assigning these forms to a satisfactory generic position can be seen from the great diversity of opinion already recorded in the synonomy of the genus itself and in that of the several species. This diversity of opinion becomes more evident when one notes the different positions assigned to the various genera in which the species have been included.

The recognition of *tampaënsis* as a member of the genus makes it very evident the genus itself belongs to the *Purpuridæ* and is very closely related to *Rapana*, rather than to the *Fusidæ*.

The European species *"Pyrula" jauberti* Grateloup from the Tertiary of Bordeaux, and *"Trophon" cancellata* Thomæ from the Tertiary of Mainz have been referred to this genus.

ECPHORA QUADRICOSTATA (Say).

Plate LII, Figs, 1, 2, 3.

——— Lister, 1685, Historia Conchyliorum, pl. 1059, fig. 2.
Buccinum scala Dillwyn, 1823, Index of 3rd Edit. of Lister's Historia Conchyliorum.
Buccinum scala ? var. Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 128.
Fusus 4-costatus Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 127, pl. vii, fig. 5. (Reprinted, 1896, Bull. Amer. Pal., No. 5, p. 33, pl. vii, fig. 5.)
Fusus quadricostatus Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.
Fusus quadricostatus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187 (not p. 185).
Ecphora quadricostata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 310.

Colus quadricostatus Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 149, pl. xxx, fig 4.

Fusus quadricostatus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 250, fig. 10.

Ecphora quadricostata Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 83, pl. xlviii, fig. 2.

Ecphora 4-costatus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563.

Ecphora quadricostata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 20.

Rapana quadricostata Tryon, 1882, Manual of Conchology, vol. iv, p. 202, pl. lxli. fig. 341.

Ecphora quadricostata Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 125.

Ecphora quadricostata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 28. (Not pp. 24, 27.)

Rapana (Ecphora) quadricosta Cossmann, 1903, Essais de Paléoconch. Comp., vol. v, p. 64, pl. iii, fig. 14.

Description.—"Ovate-ventricose; with a dilated umbilicus, and four much elevated belts, which are more dilated at their tops.

"*Spire* short, the volutions with but two belts, the others being concealed by the succeeding whorls: *body whorl* with four belts, which are equidistant, much elevated, wider at top than at the junction with the whorl, and with one or two deeply impressed lines; intervening spaces wrinkled, the wrinkles extending over the belts: *aperture* suboval: *canal* short and contracted: *labrum* with a groove corresponding with each of the exterior ribs: *umbilicus* dilated, large, not visibly penetrating to the inner summit; the exterior margin prominent and deeply dentated." Say, 1824.

The essential characters of this species as here restricted are: four revolving costæ, which in the adult are of equal prominence and T-shaped in cross section. The adult is more depressed than the young, and with this depression comes the flattening of the costæ, the flaring of the umbilicus, and a looser coiling of the whorls.

This species is apparently the only one at Cove Point and St. Mary's River and in the states south of Maryland. It has not been found at other Maryland localities than those mentioned above. Tuomey and Holmes' figure is so imperfect that it is impossible to state whether it represents the typical form of the species or the following variety.

Length, 120 mm.; diameter, 105 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

ECPHORA QUADRICOSTATA VAR. UMBILICATA (Wagner).

Plate LII, Fig. 4.

Fusus umbilicus Wagner, 1839, Plate 2, fig. 2.
Fusus quadricostatus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185.
Fusus quadricostatus Bronn, 1848, Hand. Gesch. Nat., Index Pal., pt. i, p. 517.
Fusus quadricostatus var. umbilicatus Bronn, 1849, Hand. Gesch. Nat., Index Pal., pt. ii, p. 455.
Ecphora quadricostata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 27. (Not pp. 24, 28.)
Ecphora quadricostata var. Dall, 1898, Trans. Wagner Free Inst. Sci., vol. v, No. 2, p. 9.

Description.—This variety differs from the typical forms of the species in having a thinner shell, a more flaring umbilicus, more loosely coiled whorls, and ribs which are not T-shaped. Because of the thinner shell, the looser coiling, and the lithologic character of the formation in which the variety occurs, perfect specimens are far rarer than those of the typical *quadricostata* and the distinctness of the variety has not been generally recognized. The figure prepared by Wagner in 1839 was on one of those plates which were not regularly published until 1898, but of which a few copies were distributed with manuscript names attached.[1] Apparently no description of *var. umbilicata* has ever been published till now.

There are specimens of this variety in the National Museum from Alum Bluff, Fla. (upper bed).

Length, 70 mm.; diameter, 60 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge, 2 miles south of Governor Run (lower bed), Governor Run (lower bed), Flag Pond, Pawpaw Point, Governor Run (upper bed), Greensboro, Cordova.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

ECPHORA TRICOSTATA n. sp.

Plate LII, Figs. 5, 6, 7, 8.

Description.—Shell of moderate size, thin, chitinous, loosely coiled, six-whorled; nucleus smooth, elevated, conical, three-whorled; spire sharp,

[1] Dall, Trans. Wagner Free Inst. Sci., vol. v, No. 2, p. 9.

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closely wound on the lower and smaller of three prominent elevated revolving ribs; longitudinal wrinkles most prominent on the early whorls; body whorl large, with three very prominent elevated revolving ribs with a fourth rudimentary one below it on the largest specimens; spaces between the elevated ribs and below them with many impressed revolving lines between which the surface is gently convex; umbilicus widely flaring in the largest specimens, almost absent in the young.

Length, 40 mm.; diameter, 36 mm.

Occurrence.—Calvert Formation. Plum Point, Truman's Wharf, Chesapeake Beach, 3 miles south of Chesapeake Beach, Fairhaven, White's Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

Ecphora tampaënsis (Dall).

Plate LII, Figs. 9, 10.

Rapana tampaënsis Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 153.

Rapana tampaënsis var ? Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 244, pl. xx, fig. 14.

Fasciolaria (Lyrosoma) sulcosa Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 100, pl. xvii, figs. 9, 10. (Not of Conrad.)

Rapana (Ecphora) tampaënsis Cossmann, 1903, Essais de Paléoconch.Comp., vol.v, p. 65.

Description.—" Shell rather small, short-spired; last whorl much the largest; spiral sculpture of eight or nine primary ridges, elevated and square-sided, of which one is near the suture, two others (a little larger) with subequal interspaces in front of the first, then an interspace of greater width with the strongest spiral in front of it, then the peripheral interspace, twice as wide as the strongest spiral, then another strong spiral followed by a narrower channel, and three more basal spirals with diminishing interspaces on the base, and three or four rather obscure and less elevated spiral cords on the canal; of secondary spirals much smaller than the primaries, there are one or two in the wide peripheral channel, and sometimes a single one elsewhere; lastly, the whole surface is more or less sculptured by fine, incised spiral lines. The transverse sculpture is of fine wrinkles, in harmony with the incremental lines, which cover most of the shell; the ribs are slightly but irregularly undulated in some places; aperture ovate, pillar-lip with a thin, smooth callus; edge of the outer lip undulated by the sculpture, the interior lirate, with about ten sharp, prominent liræ disposed somewhat in pairs; canal very narrow and deep, shorter than the aperture, umbilicus flaring, variable in diameter, deep, bounded by the rounded edge of the fasciole, within axially striated, but not otherwise sculptured. Lon. of shell —(?); of last whorl from the suture at the aperture forward 20.0; diam. of last whorl 21.5; of the umbilicus in two specimens 5.0 and 6.5 mm. respectively." Dall, 1890.

The variation which this species shows is amazing. In the material from Jones Wharf there are forms which one could hardly hesitate to refer to *Ecphora quadricostata*. These, by an increasing uniformity in the prominence of the ribs, a narrowing of the umbilicus, and the gradual appearance and increasing prominence of internal liræ on the labrum, grade into forms like that from Church Hill which Dall figured as *Rapana tampaënsis*. Another gradation consists in the appearance of a small fold on the columella. It was a specimen with this characteristic which Whitfield referred to *Fasciolaria* (*Lyrosoma*) *sulcosa*. In other specimens the ribs have become somewhat obsolete.

Length, 38 mm.; diameter, 25 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge, Pawpaw Point, Trappe Landing. CALVERT FORMATION. Church Hill, Plum Point (?).

Collections.—Maryland Geological Survey, U. S. National Museum.

Family CORALLIOPHILIDÆ.

Genus CORALLIOPHILA Adams.

CORALLIOPHILA CUMBERLANDIANA (Gabb).

Plate LI, Figs. 18, 19, 20.

Cantharus Cumberlandiana Gabb, 1860, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. iv, p. 375, pl. lxvii, fig. 6.

Cronia ? tridentata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 563. (In part. Not *Purpura tridentata* T. and H.)

Coralliophila cumberlandiana Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 130.

Cantharus Cumberlandianus Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 103, pl. xvii, figs. 3-6.

Description.—" Fusiform; whorls five, prominent; spire not as long as the mouth; outer lip thick, with about eight teeth on its inner margin, inner lip smooth and thin, a large plate of enamel on the columella and a rudimentary tooth on the upper end near the suture; umbilicus distinct but imperforate; canal moderate and slightly curved; surface marked by about ten rounded, prominent, longitudinal ribs, crossed by 18 or 20 revolving lines between some of which exist traces of finer lines, the latter visible only on well preserved specimens. There are also visible the usual lines of growth." Gabb, 1860.

Length, 24 mm.; diameter, 14 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Suborder STREPTODONTA.

Superfamily PTENOGLOSSA.

Family SCALIDÆ.

Genus SCALA Humphrey.

Scala sayana Dall.

Plate LIII, Figs. 1, 2.

Scalaria clathrus Conrad, 1830, Jour. Acad. Nat Sci. Phila., vol. vi, 1st ser., p. 211.
Scalaria clathrus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.
Scala sayana Dall, 1889, Bull. Mus. Comp. Zool., Har., vol. xvlii, p. 308.
Scala sayana Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 122, pl. l, fig. 10.
Scala Sayana Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 158.

Description.—"A white shell with nine well-marked varices continuous to the apex, which has a smooth, translucent, pale brown nucleus of about three whorls. . . . The interstices are polished, smooth, with occasional faint microscopic spiral striæ." Dall, 1889.

Shell elongate, ten-whorled; varices 7 to 11, usually 9, somewhat carinated; mouth elliptical. No spiral sculpture is visible on any of the Miocene specimens.

Length, 16 mm.; diameter, 5.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf, Governor Run (lower bed), Turner, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science, Cornell University.

SCALA MARYLANDICA n. sp.

Plate LIII, Fig. 3.

Scalaria multistriata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 126, pl. xxiii, fig. 5. Not *Scalaria multistriata* Say.

Description.—Shell small, smooth, moderately slender, eight-whorled, regularly conical; whorls round, firmly in contact but with a deep suture; varices 12 to 18 in number on the body whorl, slightly carinated, each made up of 4 lamellæ; mouth round or slightly elliptical: nucleus smooth, elevated, three-whorled.

This species differs from *S. multistriata* Say in being destitute of spiral sculpture; from *S. sayana* in having more varices, in being smaller, and in having a rounder mouth; and from *S. teres* in having fewer varices and in being less elongate.

Length, 10 mm.; diameter, 4 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Greensboro, Dover Bridge, Cordova, Trappe Landing, 2 miles south of Governor Run, Turner. CALVERT FORMATION. Plum Point, Chesapeake Beach, 2 miles south of Chesapeake Beach, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, U. S. National Museum.

Subgenus OPALIA Adams.

SCALA (OPALIA) CALVERTENSIS n. sp.

Plate LIII, Fig. 4.

Description.—Shell solid, elongated, many-whorled; whorls very convex, covered with fine revolving lines; varices about ten on each whorl; very broad and closely set, somewhat carinated, covered with very fine impressed longitudinal lines which appear to break up its surface into laminæ; intervarical spaces very narrow so that the spiral lines are frequently hidden; base with a spiral cord and axial fasciole as on *S. De Bouryi* Dall; mouth round.

Length (of two-whorled fragment), 19 mm.; diameter, 12 mm.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, U. S. National Museum.

SCALA (OPALIA) RETICULATA n. sp.

Plate LIII, Fig. 5.

Description.—Shell small, slender, about ten-whorled; whorls convex and very closely set; varices very small but numerous, about 35 on the body whorl, and decreasing in number but increasing in size toward the apex; intervarical spaces with six rounded, raised, revolving lines with finer intermediate ones, both sets being absent above the suture for about twice the ordinary interval of the larger ones; mouth round; base flattened, covered with obsolete revolving lines. Over the greater part of the surface of the shell the varices and revolving ribs are of about equal prominence and at equal distances, thus giving a very noticeable reticulate appearance.

Length, 9 mm.; diameter, 3 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Cornell University, U. S. National Museum.

SCALA (OPALIA) PRUNICOLA n. sp.

Plate LIII, Fig. 6.

Description.—Shell of medium length and acuteness, with about eight whorls; whorls strongly and regularly convex, except at the periphery of the body whorl where there is a sharp angle; revolving ribs obtuse, irregular in distance, six in number; interspaces gently concave, marked with very fine, closely-set, revolving threads; entire surface of the shell covered with very fine, closely-set, longitudinal threads which cross the revolving ribs; varices small, irregular; base with fine radiating, and finer concentric lines.

This species has a superficial resemblance to *S. reticulata,* but differs in lacking distinct and regular varices, in possessing very fine revolving and longitudinal sculpture, and in having more distant and more acute revolving ribs.

A single specimen has been found.

Length (of fragment), 10 mm.; diameter, 5.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Subgenus STHENORHYTIS Conrad.

SCALA (STHENORHYTIS) EXPANSA Conrad.

Plate LIII, Fig. 7.

Scalaria expansa Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 187, 194, pl. ii, fig. 3.
Scala (Sthenorhytis) expansa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.
Scala (Sthenorhytis) expansa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 18.

Description.—" Shell acutely ovate, moderately thick, with numerous robust recurved ribs, twelve in number, counting from the summit of the aperture to the reflected lip, inclusive; whirls profoundly ventricose at the sides, somewhat flattened above; four or five in number." Conrad, 1842.

Obsolete impressed spiral lines are sometimes visible between the varices. The number of whorls is sometimes seven.

Length, 19 mm.; diameter, 16 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CHOPTANK FORMATION. Jones Wharf.

Collections.—Wagner Free Institute of Science, Cornell University.

SCALA (STHENORHYTIS) PACHYPLEURA Conrad.

Plate LIII, Fig. 8.

Scalaria pachypleura Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.
Scalaria pachypleura Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 186.
Scalaria pachypleura Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 181.
Scala (Sthenorhytis) pachypleura Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.
Scala (Sthenorhytis) pachypleura Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 18.
Scalaria (Sthenorhytis) pachypleura Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 259, pl. xxi, fig. 4.
Scala pachypleura Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 25.

Description.—" Turrited; short in proportion to its width; volutions 6 or 7, rapidly diminishing in size; ribs very thick, prominent, reflected, terminating above in prominent angles. Length five-eighths of an inch." Conrad, 1842.

The mouth is round or very slightly elliptical. A very distinct basal cingulum extends from the upper end of the mouth around the body whorl to the last varix, being slightly displaced by each of the varices. It is this character which distinguishes the species from *S. expansa*.

Length, 17 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Superfamily GYMNOGLOSSA.

Family EULIMIDÆ.

Genus EULIMA Risso.

Eulima eborea Conrad.

Plate LIII, Figs. 9, 10.

Eulima eborea Conrad, 1848, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 20, pl. i, fig. 21.
? *Eulima conoidea* Kurtz and Stimpson, 1851, Proc. Boston Soc. Nat. Hist., vol. iv, p. 115.
Eulima lævigata Emmons, 1858, Rept. N. Car Geol. Survey, p. 269, fig. 157. (Not *Eulima lævigata* H. C. Lea.)
Eulima eborea Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566. (In part.)
Eulima eborea Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
Eulima eborea Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.
? *Eulima conoidea* Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 159, pl. v, fig. 11.

Description.—"Subulate, whorls 9; suture slightly defined; aperture somewhat oblique, ovate-acute." Conrad, 1848.

Shell slender, varying in outline between the extremes figured, thirteen whorled; right side of the body whorl straight from the suture to the middle of the labrum, then rapidly curving; left side of the body whorl straight not quite to a point opposite the upper end of the mouth, then curving gently and uniformly to the extremity of the shell.

Length, 11 mm.; diameter, 3 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Plum Point, Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science, Philadelphia Academy of Natural Sciences, Cornell University, U. S. National Museum.

EULIMA LÆVIGATA (H. C. Lea).

Plate LIII, Fig. 11.

Pasithea lævigata H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst. p. 6.

Pasithea lævigata H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 252, pl. xxxv, fig. 47.

Not *Eulima lævigata* Emmons.

Eulima eborea Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566. (In part).

Description.—" Shell elevated-conical, acuminate, imperforate, thick, smooth, ivory-like, shining; spire attenuate, conical, acute; sutures linear, very small, whorls flat; last whorl somewhat angular; base smooth; aperture obliquely quadrilateral, acutely angular above and below; effuse." Lea, 1845.

Sides straight to the line of continuation of the suture around the middle of the body whorl, here they are obtusely angular then curve to the extremity of the shell.

Length, 10 mm.; diameter, $2\frac{1}{2}$ mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University, Wagner Free Institute of Science, U. S. National Museum.

EULIMA MIGRANS Conrad.

Plate LIII, Fig. 12.

? *Turbo subulata* Donovan, 1803, The Natural History of British Shells, vol. v, expl. pl. clxxii.

Eulima migrans Conrad, 1846, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 20, pl. i, fig. 22.

Eulima subulata Emmons, 1858, Rept. N. Car. Geol. Survey, p. 269, fig. 158.

Eulima migrans Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 266.

Eulima migrans Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.

Description.—" Subulate, very narrow or slender, suture indistinct; aperture direct, oblong-ovate, acute." Conrad, 1846.

" Shell subulate, tapering, pale flesh-color, glossy, fasciated with testaceous-brown. Aperture oval." Donovan, 1803.

This form resembles the original figures of *Eulima subulata* Donovan, and those given by Wood[1] and by Hoernes.[2] Till comparison can be made with authentic specimens of that species it is best to retain the American name.

Length, 7.5 mm.; diameter, 1 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Governor Run (lower bed). Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Genus NISO Risso.

Niso lineata Conrad.

Plate LIII, Fig. 13.

Bonellia lineata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Bonellia lineata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 188.
Bonellia lineata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 183.
Bonellia lineata Conrad, 1848, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 21, pl. i, fig. 23.
Niso lineata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566. (in part.)
Niso lineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.
? *Niso lineata* Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 69, pl. iv, fig. 13.
Niso lineata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 245, pl. xx, fig. 4. (In part.)
Niso lineata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xiv, p. 25.

Description.—"Subulate, polished, with obsolete spiral lines, distinctly visible only on the body whirl; a spiral line margins the suture at base of each volution, causing the suture to appear profound; this line is continued on the middle of the body whirl." Conrad, 1841.

Conrad published two figures supposed to be of this species. The first is good and makes the species absolutely certain even if the description were insufficient. The second figure is bad and led Dall (who overlooked the earlier one) to suggest that H. C. Lea's name, *simplex*,[3] should

[1] A Monograph of the Crag Mollusca, vol. i, p. 97, pl. xix, fig. 3.

[2] Die Fossilien Mollusken des Tertiaer-Beckens von Wien, Band i, p. 547, Taf. xlix, fig. 20.

[3] *Actæon simplex* H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 32, pl. xxxvi, fig. 62.

be used instead of *lineata*. If Lea's figure represented this species it would be worse than Conrad's second one. But it is not this species or even a *Niso,* for according to the description there is a fold on the columella. Conrad's second figure probably represents still another species.

Length, 21 mm.; diameter, 8 mm.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Family PYRAMIDELLIDÆ.

Genus ODOSTOMIA Fleming.

ODOSTOMIA CONOIDEA (Brocchi).

Plate LIV, Figs. 3, 4.

Turbo conoideus Brocchi, 1814, Conchiologia Fossile Subapennina, Tome ii, p. 660, pl. xvi, fig. 2.

Odontostomia conoidea Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 250.

Description.—"Testa conica, glabra, anfractubus planiusculi, infimo subcarinato, aperta ovali, columella uniplicata."

"Questa conchiglia è terrestre o lacustre, ed appartiene al genere *Auricularia* di Lamarck. La sua lunghezza è di circa una linea e mezzo; ha una forma conica acuta, ed è composta di cinque anfratti perfettamente lisci ed appena alquanto convessi. L'inferiore di essi è lungo più di tuttigli altri presi insieme, e forma presso la base un angolo molto ottuso a guisa di carena. L'apertura è ovale, ed il labbro destro si unisce superiormente senza interruzione col sinistro. Nel mezzo della columella vedesi una piega acuta che si perde nella cavità interna." Brocchi, 1814.

The first recorded occurrence of this species in the American Miocene was made by Dall who found the species in the Calvert formation at Shiloh, N. J. The most abundant occurrence of the species in the Maryland Miocene is in the Choptank formation, especially at Jones

Wharf. The specimens from St. Mary's River are elongate and may belong to a distinct variety or species.

Length, 3.5 mm.; diameter, 1.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf, Governor Run.

Collections.—Maryland Geological Survey, Wagner Free Institute of Science.

Subgenus CHRYSALLIDA Carpenter.

Odostomia (Chrysallida) melanoides (Conrad).

Plate LIV, Fig. 1.

Acteon melanoides Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., pp. 207, 226, pl. ix, fig. 19.

Odostomia granulatus Holmes, 1859, Post-Pleiocene Fossils of South Carolina, p. 86, pl. xiii, figs. 11, 11a, 11b. Not *Acteon granulatus* H. C. Lea.

Actæon melanoides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Actæon melanoides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 13.

Description.—" Shell conical, with about six volutions, strongly striated transversely; the striæ are three or four in number on the upper whorls, and the last has about eight; the aperture is ovate, with a fold in the centre." Conrad, 1830.

Shell small, conical, six-whorled; whorls of the spire with four equally distinct, raised, revolving ribs and with numerous (about 30) equally spaced and equally prominent longitudinal ribs which granulate the revolving ribs at their intersection, and finer intermediate longitudinal striæ; base of the body whorl with about eight additional revolving ribs which are not crossed by the more prominent longitudinal ones of the spire, but between which the finer striæ are very distinct; mouth elongate; fold near the upper end of the columella, prominent.

This species is most closely related to *Pyramidella* (*Chrysallida*) *granulata* (H. C. Lea), of which a figure is here given (Plate LIV, Fig. 2), and from which it differs only in being much less elongate.

Length, 3.5 mm.; diameter, 1.5 mm.

Occurrence.—St. Mary's Formation (?). St. Mary's River.

Collection.—Cornell University.

Subgenus EVALEA A. Adams.

Odostomia (Evalea) mariana n. sp.

Plate LIV, Fig. 5.

Description.—Shell small, elongate-conical, six-whorled; whorls gently convex, marked with faint impressed revolving striæ; sutures very distinct; plait small, near the upper end of the columella.

Length, 2.8 mm.; diameter, 1 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Cornell University.

Subgenus SYRNOLA Adams.

Odostomia (Syrnola) marylandica n. sp.

Plate LIV, Fig. 6.

Description.—Shell elongate, pyramidal, twelve-whorled; sutures not deep; whorls nearly flat; surface polished; lines of growth faint; spiral striæ irregular and often obsolete; base rounded; plait weak at the mouth, stronger within, situated near the upper end of the columella.

Length, 9 mm.; diameter, 3 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Cornell University.

Subgenus PYRGULINA A. Adams.

Odostomia (Pyrgulina) calvertensis n. sp.

Plate LIV, Figs. 7, 8.

Description.—Shell small, pyramidal, twice as long as the basal diameter, five-whorled; whorls slightly convex, with many very fine, closely-set revolving lines and about twenty (on the body whorl) longitudinal ribs which are not overridden by the revolving lines; plait prominent, situated very high on the columella.

Length, 2.8 mm.; diameter, 1.3 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Genus EULIMELLA Forbes.

Subgenus ANISOCYCLA Monterosato.

EULIMELLA (ANISOCYCLA) MARYLANDICA n. sp.

Plate LIV, Figs. 9, 9a.

Description.—Shell small, elongate, ten-whorled; whorls slightly convex; sutures distinct; surface highly polished; longitudinal ribs absent; sculpture consisting of about twelve sharp incised revolving grooves at somewhat variable intervals.

This species resembles the English species *Eulimella nitidissima,* which is the type of *Anisocycla,* but is much larger.

Length, 7 mm.; diameter, 2 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science, Cornell University.

Genus TURBONILLA Risso.

Subgenus CHEMNITZIA d'Orbigny.

TURBONILLA (CHEMNITZIA) NIVEA Stimpson.

Plate LIV, Fig. 10.

? *Turritella laqueata* Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 221, pl. ix, fig. 17.

? *Pasithea exarata* H. C. Lea, 1843, New Fossil Shells from the Tertiary, of Virginia, Abst. p. 6.

? *Pasithea exarata* H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 251, pl. xxxv, fig. 44.

Chemnitzia nivea Stimpson, 1851, Proc. Boston Soc. Nat. Hist., vol. iv, p. 114.

Turbonilla nivea Holmes, 1859, Post-Pleiocene Fossils of South Carolina, p. 83, pl. xiii, figs. 3, 3a, 3b.

Turbonilla nivea Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 255.

Description.—"Shell aciculate, sub-cylindrical, white, shining; whorls eleven, flattened, longitudinally plicate; folds straight, interstices perfectly smooth." Stimpson, 1851.

It is possible, and perhaps even probable that this species was described by Conrad, in 1830, under the name of *Turritella laqueata.* Conrad's type is not in existence and the description and figure are not sufficient to identify the species with absolute certainty. There does not seem to be any other species at the St. Mary's River for which the description could have been intended. Conrad described the form as follows:

"Shell turreted, smooth, polished, longitudinally ribbed; whorls slightly convex; suture impressed; aperture ovate. One-fifth of an inch in length. It has some resemblance to the *Turbo simillimus* of Montagu, but the ribs are more numerous, and it is also a larger species."

"Pasithea" exarata H. C. Lea is a *Turbonilla* which differs from this in having elevated rounded ribs which are somewhat curved. It is probably a distinct species or at least a variety. If intermediate forms bridging the gap between *nivea* and *exarata* should be found, Lea's name would of course have priority. The material now at hand does not justify us in uniting the species.

The Maryland forms are exactly like those from the Pliocene and Pleistocene of the Carolinas which Dr. Dall referred to Stimpson's species, but they do not agree very closely with Stimpson's description. For example, instead of having the "raised longitudinal ribs" which Stimpson describes, the Miocene specimens have impressed longitudinal grooves with narrower interspaces. The grooves cease at the periphery of the whorl but the general level of the interspaces is maintained beyond on the base of the whorl.

Length, 6 mm.; diameter, 1½ mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Turbonilla (Chemnitzia) nivea Stimpson var.

Plate LIV, Figs. 11, 12.

Description.—Shell small, slender, varying in acuteness of spire; whorls, seven to ten gently convex; spiral sculpture absent; body whorl with about thirty irregular, sometimes obsolete longitudinal ribs which die out near the periphery of the body whorl; base rounded, mouth elongate.

Length, 5 mm.; diameter, 1 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Subgenus PYRGISCUS Philippi.

TURBONILLA (PYRGISCUS) INTERRUPTA (Totten).

Plate LIV, Figs. 13, 14.

Turritella interrupta Totten, 1835, Amer. Jour. Sci., vol. xxviii, p. 352, pl. i, fig. 7.
Turbonilla interrupta Holmes, 1859, Post-Pleiocene Fossils of South Carolina, p. 83, pl. xlii, figs. 4, 4a, 4b.
Turbonilla interrupta Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 259.

Description.—" *Shell,* small, subulate, brownish: *volutions* about ten, almost flat, with about twenty-two transverse, obtuse ribs, separated by grooves of equal diameter, and with about fourteen sub-equal, impressed, revolving lines, which are arranged in pairs, and entirely interrupted by the ribs: below the middle of the body whirl, the ribs become obsolete, and the revolving lines continuous: *sutures,* made quite distinct by a slight shoulder to each volution: *apertures,* ovate, angular above, regularly rounded below, about one-fifth the length of the shell: right lip, sharp, indistinctly sinuous." Totten, 1835.

The form described by H. C. Lea as *Pasithea subula* has some resemblance to this species but differs from it in having the spiral lines finer, and the body whorl less angular with the longitudinal ribs extending to near the base and dying out gradually instead of ending abruptly on the angle.

Length, 11 mm.; diameter, 2½ mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Langley's Bluff. CHOPTANK FORMATION. Jones Wharf, Greensboro. CALVERT FORMATION. Plum Point, Reeds, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Subgenus TRAGULA Monterosato.

TURBONILLA (TRAGULA) GUBERNATORIA n. sp.

Plate LIV, Fig. 15.

Description.—Shell small, short, conical, thick, six-whorled; whorls gently convex, with sixteen gently curved longitudinal ribs; lower half of the whorl with several impressed revolving lines which do not cross the longitudinal ribs; plait small, oblique, situated near the middle of the columella.

Length (of fragment), 2 mm.; diameter, 0.8 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run (lower bed).

Collection.—Maryland Geological Survey.

Superfamily TÆNIOGLOSSA.

Family TRITONIDÆ.

Genus TRITONIUM Link.

TRITONIUM CENTROSUM (Conrad).

Plate LV, Figs. 1, 2.

Bursa centrosa Con. sp. nov. Cope, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 139. (Name only.)

Bursa centrosa Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 264, pl. xxi, fig. 10.

Description.—"Turrited; spire elevated; whorls with granulated revolving unequal lines, and a series of rounded, prominent, closely arranged nodes on the angle which is situated below the middle of the whorls; body whorl with three distant nodular revolving ribs; the lower one small; columella with transverse irregular plaits." Conrad, 1868.

The first four or five whorls are polished, and shaped like a *Natica.* Then the sculpture abruptly begins. This sculpture consists of many granulated revolving lines, which override one to three revolving rows of nodes on and below the shoulder of the whorl, and which are in turn overridden by a series of microscopic, closely set, revolving lines and lines of growth.

Length, 28 mm.; diameter, 15 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Charles county, near the Patuxent river (*fide* Cope).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Family DOLIIDÆ.

Genus PYRULA Lamarck.

PYRULA HARRISI n. sp.

Plate LV, Fig. 3.

Pyrula n. sp. Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 25.

Description.—Shell globose, thin, five-whorled; spire low, whorls slightly convex, suture not deep; body whorl large, inflated; surface covered with raised revolving ribs with broader interspaces and with sometimes one or more narrow intermediate ribs; revolving ribs exceeding 65 on the body whorl, absent on a narrow band below the suture; lines of growth fine, closely set, occasionally rugose; mouth large, widest near the center, somewhat callous at the upper end; canal broad, short.

Fragments of this species are very abundant but it is seldom that good specimens can be found.

Length, 33 mm.; diameter, 25 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

Family CASSIDÆ.

Genus CASSIS Lamarck.

CASSIS CÆLATA Conrad.

Plate LV, Fig. 4.

Cassis cœlata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211. (Name only.)

Cassis cælata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 218, pl. ix, fig. 14.

Cassis cœlata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Semicassis cælata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 564.

Semicassis cœlata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Description.—" Shell with transverse tuberculated ribs, and intervening striæ; whorls of the spire longitudinally ribbed; right lip toothed within; columella granulate and wrinkled.

" The transverse striæ of the grooves between the ribs are very distinct, and between each of the tubercles a longitudinal raised line crosses the grooves, giving the shell somewhat of a cancellated appearance." Conrad, 1830.

Length, 38 mm.; diameter, 28 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

Family CYPRÆIDÆ.

Genus ERATO Risso.

Erato perexigua (Conrad).

Plate LV, Fig. 5.

Marginella perexigua Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Marginella perexigua Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 189.
? *Erato lævis*[1] ? Emmons, 1858, Rept. N. Car. Geol. Survey, p. 262, fig. 139.
? *Erato Maugeriæ* Emmons, 1858, Rept. N. Car. Geol. Survey, "Additions and Corrections."
Volutella sp. Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 226.
Volutella sp. nov. Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 24.
Erato Emmonsi Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 108, pl. xix, figs. 9–11.

Description.—"Very small, obtusely ovate; labrum profoundly thickened, the margin minutely crenulated; labium with 4 plaits; spire depressed; volutions concealed.

"A small species very much like a Cypræa in form. Length one-eighth inch." Conrad, 1842.

Whitfield describes the form from the New Jersey Miocene as follows:

"Shell small, strongly obovate, swollen or inflated above, and contracted in the lower part; spire short or very obtuse, slightly coated so as to render the suture indistinct; aperture narrow, not quite as long as the body of the shell. Outer lip thickened outwardly and in the medial portion of its length on the inside and below, but scarcely so above; strongly crenulated over all the thickened parts, bearing ten distinct ridges on the only perfect example seen. Inner lip bearing four distinct

[1] Emmons' species has been generally known by this name. Everyone seems to have overlooked the fact that Emmons himself in the "*Additions and Corrections*" at the end of the volume changed the determination to *Erato Maugeriæ*.

ridges or teeth, the lower one of which is the most distinct. The surface of the shell has been polished when perfect."

There is little doubt that it is the same as the Maryland form. The identity of Emmons' species is a different question.

Length, 9 mm.; diameter, 6 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum, Cornell University.

Family CERITHIOPSIDÆ.

Genus SEILA A. Adams.

SEILA ADAMSII (H. C. Lea).

Plate LV, Fig. 6.

Cerithium Emersonii var. C. B. Adams, 1839, Boston Jour. Nat. Hist., vol. ii, p. 285.
Cerithium terebrale C. B. Adams, 1840, Boston Jour. Nat. Hist., vol. iii, p. 320, pl. iii, fig. 7.
? *Cerithium clavulus* H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia (Abst.), p. 11.
Cerithium Adamsii H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 268.
Cerithium annulatum Emmons, 1858, Rept. N. Car. Geol. Survey, p. 269, fig. 161.
Cerithiopsis annulatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566.
Cerithiopsis annulatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183). p. 17.
Seila Adamsii Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 267.

Description.—"Granules obsolete, with simple, broad, elevated, revolving lines, the middle one on several of the lower whorls as prominent as the outer ones." Adams, 1839.

"*Shell* small, elongated, brown, frequently with a white band, with rather slight incremental striæ; *whorls* eleven or twelve, flattened; *spire* seven-eighths of the length of the shell, five-sixths of its bulk, its opposite sides containing an angle of about 20°, conic, with four elevated, obtuse, revolving lines on each whorl, of which the first and second, and third and fourth are equidistant; the space between the second and third is obviously less on the upper whorls, but approaches to an equality with the other spaces, in the growth of the shell; the first three ridges are equal, and the fourth small and depressed, so as to lie almost wholly beneath the first of the succeeding whorl; the *suture* consequently appears on the upper side of the first ridge, and is moderately impressed; spaces between the ridges crossed by more or less elevated irregular lines, or coarse striæ of growth; *last whorl* on the upper half, sculptured as the spiral whorls with a fifth smaller revolving line on the lower part; *aperture* ovate, one-eighth of the length of the shell, the line of its length making an angle of about 25° with the axis of the shell; *labrum* thin; *canal* rather more than a third as long as the aperture, turning to the left." Adams, 1840.

The question as to the name of this has been discussed in detail by Dr. Dall, but the question is further complicated by the possible equivalency of *Cerithium clavulus* H. C. Lea. If the Virginia Miocene species, *clavulus,* is the same as the recent species, *terebrale* Adams *non* Lamarck, then *clavulus* will have priority, as it dates from 1843, while the footnote in which Lea proposed *adamsii* as a substitute for *terebrale* Adams was omitted from the 1843 edition of Lea's paper and did not appear until two years later.

Length, 8 mm.; diameter, 2.5 mm.

Occurrence.—CHOPTANK FORMATION. Dover Bridge, Greensboro, Cordova, Jones Wharf. CALVERT FORMATION. Plum Point, Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

Genus CERITHIOPSIS Forbes and Hanley.

CERITHIOPSIS CALVERTENSIS n. sp.

Plate LV, Fig. 7.

Description.—Shell small, elongate, pyramidal, fragile, many-whorled; suture distinct, deep; four broad revolving ridges with broader interspaces crossed by about thirty raised longitudinal ribs which granulate the spirals at their intersection; the lower revolving ridge hidden by the succeeding whorl of the spire; base smooth, except for lines of growth.

This species may be readily distinguished from the following by having four revolving ridges almost equal in size instead of only two prominent ones, and by having the ridges less strongly nodular.

Length, 8 mm.; diameter, 2.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

CERITHIOPSIS SUBULATA (Montagu).

Plate LV, Fig. 8.

Murex subulatus Montagu, 1808, Test. Brit. Suppl., p. 115, pl. xxx, fig. 6.

Cerithiopsis (Eumeta ?) subulata Dall, 1889, Bull. Mus. Comp. Zool. Har., vol. xviii, p. 252, pl. xx, fig. 4.

Cerithiopsis (Eumeta) subulata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 268.

Description.—Shell small, pyramidal, twelve-whorled; whorls with two large and two small revolving ribs alternating in position, spire wound on the lower and smaller rib half concealing it; larger ribs with twenty-two large regular nodes; smaller rib between the two larger ones obsolete except on the later whorls; base smooth; canal short, sharply bent.

This species occurs very abundantly at Greensboro. The specimens have a very close resemblance to those from the Caloosahatchie river.

Length, 8 mm.; diameter, 2.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family PLEUROCERATIDÆ.

Genus GONIOBASIS Lea.

GONIOBASIS MARYLANDICA n. sp.

Plate LV, Fig. 9.

Description.—Shell thin, five-whorled; spire pyramidal, wound slightly below the shoulder of the whorl; sutures distinct but not deep; surface marked by low, narrow revolving ribs with much wider interspaces; revolving ribs about twelve on the body whorl and five on each whorl of the spire; lines of growth irregular; mouth large, widest below; columella concave; labium callous and marked by faint longitudinal striations. A single specimen of this interesting form has been obtained.

Length, 15 mm.; diameter, 6.5 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Family CÆCIDÆ.

Genus CÆCUM Fleming.

CÆCUM CALVERTENSE n. sp.

Plate LV, Fig. 10.

Description.—This species is marked by very fine, closely-set, irregular annulations, and no other sculpture.

Length of segment, 4 mm.; diameter (maximum), 0.8 mm.

Occurrence.—CALVERT FORMATION. Church Hill, 3 miles west of Centerville.

Collection.—Maryland Geological Survey.

CÆCUM PATUXENTIUM n. sp.

Plate LV, Figs. 11, 12.

Description.—The only sculpture consists of from 30 to 40 strong, regular, closely-set annulations.

This species bears a strong superficial resemblance to *C. floridanum* Stimpson, but differs from it in possessing no longitudinal markings.

Length of segment, 2.2 mm.; diameter, 0.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro, Dover Bridge, Cordova, Peach Blossom Creek, Jones Wharf, Governor Run (lower bed).

Collection.—Maryland Geological Survey.

CÆCUM GREENSBOROËNSE n. sp.

Plate LV, Fig. 13.

Description.—Shell apparently smooth and highly polished, but under high magnification showing irregular, almost obsolete annulations which are strongest at the ends of the segments.

Length of segment, 3 mm.; diameter, 0.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collection.—Maryland Geological Survey.

Family VERMETIDÆ.

Genus VERMETUS Adanson.

VERMETUS GRANIFERUS (Say).

Plate LV, Figs. 14, 15.

Serpula granifera Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 154, pl. viii, fig. 4. (Reprint, 1896, Bull. Amer. Pal., No. 5.)

Serpulorbis granifera Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 303.

Anguinella virginiana Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 132, pl. xxiv, figs. 1-5.

Description.—" Covered with longitudinal, contiguous, slightly elevated, granulated striæ.

" Shell subcylindric, contorted, inferior side flat; the whole surface is composed of very numerous, small, contiguous striæ, each consisting of a single row of granules; these series are alternately smaller.

" Diameter of the larger end three-tenths of the largest specimen two-fifths of an inch. The continuity of the tube within is interrupted by oblique diaphragms. It sometimes approaches the spiral form, and one specimen has three complete volutions of much regularity." Say, 1824.

Length of tube (longest observed fragment), 160 mm.; diameter of same tube, 8 mm.; maximum diameter, 15 mm.

Occurrence.—ST. MARY'S FORMATION.—St. Mary's River. CHOPTANK FORMATION. Jones Wharf, Governor Run (lower bed), Greensboro. CALVERT FORMATION. Plum Point, Chesapeake Beach, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

VERMETUS VIRGINICUS (Conrad).

Plate LV, Fig. 16.

Serpula virginica Conrad, 1839, Fossils of the Medial Tertiary, cover of No. 1, p. 3, Reprint, 1893, p. [51].

Anguinella virginiana Conrad, 1845, Fossils of the Medial Tertiary, p. 77, pl. xliv, fig. 4.

Anguinella virginiana Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.

Anguinella virginiana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.

Vermetus ? (*Anguinella*) *virginica* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 306.

Not *Anguinella Virginiana* Whitfield.

Description.—" Shell terete, slender, adhering in large groups, occasionally angulated, with sessile spiral convolutions; surface with acute prominent transverse wrinkles." Conrad, 1839.

" Terete, slender, adhering, with strong annular wrinkles; toward the apex are contiguous volutions, somewhat angular or subcarinated; the whorls with obsolete revolving lines and subcarinated near the base; internally furnished with vaulted septa." Conrad, 1845.

This species differs from *V. graniferus* in being less intricately coiled and in being destitute of all sculpture except annular wrinkles and lines of growth.

Diameter of tubes, 3 mm.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Jones Wharf, Greensboro, Cordova. Calvert Formation. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family TURRITELLIDÆ.

Genus TURRITELLA Lamarck.

Turritella indenta Conrad.

Plate LVI, Figs. 1, 2.

Turritella indenta Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Turritella indenta Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 188.
Turritella indenta Conrad, 1842, Proc. Nat. Inst., Bull, ii, pp. 182, 183.
Turritella indenta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Turritella indenta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.
Turritella indenta Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 258, pl. xxi, fig. 3.
Turritella indenta Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 308.
Turritella indenta Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 24, 25.

Description.—" Subulate, whirls about 15, contracted or indented above the middle, and with obsolete spiral striæ; suture profound, the lower margin obtusely carinated by the indentation; the upper margin also subcarinated; basal margin acutely angulated; base flat or slightly concave." Conrad, 1842.

" Broad at base; whorls each with two revolving obtuse lines, the inferior one largest, subtuberculated and margins the suture, and an impressed line marks its upper margin; the other revolves on the upper margin of the whorls; suture profoundly excavated, sides of volution slightly concave; revolving lines rugose, minute." Conrad, 1868.

Length, 62 mm.; diameter, 19 mm.

Occurrence.—Choptank Formation. 2 miles south of Governor Run, Greensboro (?). Calvert Formation. Truman's Wharf, Lyon's Creek, Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, Reed's, Skipton, "Huntingtown" (*fide* Conrad).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Turritella æquistriata Conrad.

Plate LVI, Fig. 3.

Turritella æquistriata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, pp. 567, 584.

Turritella æquistriata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.

Turritella æquistriata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 128, pl. xxiii, figs. 12–14.

Description.—"Subulate, volutions 14, bicarinate, carinæ distant with a concave interval, the lower carina near the suture; surface covered with nearly equal fine closely-arranged striæ, with a minute intermediate line; aperture longer than wide." Conrad, 1862.

Length, 44 mm.; width, 12 mm.

Occurrence.—Calvert Formation. Church Hill, Evans Farm near Church Hill, 3 miles west of Centerville, Plum Point, between McKendree and Pindell, Wye Mills.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Turritella plebeia Say.

Plate LVI, Figs. 4, 5, 6, 7, 8, 9.

Turritella plebeia Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 125, pl. vii, fig. 1. (Reprint, Bull. Amer. Pal., 1896, No. 5.)

Turritella plebeia Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.

Turritella octonaria Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 144.

Turritella plebeia Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 182, 187.
Turritella plebeia Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Turritella octonaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Turritella plebeia Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.
Turritella octonaria Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.
Turritella plebeia Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xiv, pp. 25, 26, 27, 28.
Turritella (Mesalia ?) plebeia Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 130, pl. xxiii, figs. 6–8.

Description.—"Whorls convex, hardly flattened in the middle, with about twelve revolving elevated striæ, the middle ones alternately somewhat smaller; transverse wrinkles distinct." Say, 1824.

The forms which have been referred to *plebeia* are considerably varied in character and Say's description will not apply to them all. The name is here used in a broad sense to cover all those Turritellas from these beds whose whorls are more or less convex; are covered with fine, uniform or uniformly alternating, raised, revolving striæ; and are not carinated. The typical form with very convex whorls, not flattened, occurs throughout the Miocene, but is the only form in the St. Mary's formation. A form (*var. A*) with almost flat whorls and an indistinct suture occurs in the Choptank and Calvert formations. The striæ are very uniform and closely set. At Plum Point the most abundant form (*var. B*) has deep sutures and flat-topped whorls. It is smaller than the typical form.

The variety which Conrad described as *Turritella octonaria* is characterized by having about eight prominent irregular revolving ribs with intermediate ones. It occurs only in the Choptank formation at Dover Bridge.

Length, 47 mm.; diameter, 13 mm. (*Typical form*).

Length, 22 mm.; diameter, 7 mm. (*var. A*).

Length, 35 mm.; diameter, 10 mm. (*var. B*).

Length, — mm.; diameter, 13 mm. (*var. octonaria*).

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Greensboro, Cordova, Peach Blossom Creek, Dover Bridge, Flag Pond, Governor Run (upper and lower beds), 2 miles south of Governor Run, Jones Wharf, Pawpaw Point, Calvert Formation. Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Turritella variabilis Conrad.

Plate LVII, Fig. 1.

Turritella variabilis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 221, pl. x, fig. 3.

Turritella variabilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Turritella variabilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.

Turritella variabilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.

Description.—"Shell subulate, turreted, tapering to an acute apex; whorls flattened in the middle, with from two to five smooth ribs on each, and transversely striated; suture impressed.

"The ribs are generally three in number, but a variety occurs with two only, or the intermediate one becomes obsolete. The largest specimens, which much exceed the figure in size, sometimes have five ribs on each whorl." Conrad, 1830.

This species is extremely variable and has been described under many names. The varieties described below with the synonyms quoted under each include all the names which have been applied to Maryland specimens. These varieties can be clearly recognized in the adult specimens, but the young cannot be separated.

The name *T. variabilis* has been applied only to specimens from St. Mary's River and the typical form of the species is here regarded as restricted to that horizon. It is distinguished by its moderately but uniformly convex whorls with many revolving ribs, from two to five of which are larger than the rest, uniformly distributed over the whorl, and of equal prominence.

Length (restored), 80 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

TURRITELLA VARIABILIS VAR. ALTICOSTATA Conrad.

Plate LVII, Fig. 2.

Turritella alticostata Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 144.
Turritella alticostata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.
Turritella terebriformis Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 30.
Turritella terebriformis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 311 (in part).

Description.—" Shell much elongated, subulate, whorls twelve to fourteen, each profoundly carinated near the base, and with prominent spiral striæ." Conrad, 1834.

This variety includes those forms from the Choptank formation which are characterized by the presence of very large revolving ribs on the lower half of the whorl. This condition was well developed only on the later whorls of large individuals.[1]

Length, unknown; diameter, 21 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro, Dover Bridge, Peach Blossom Creek, Cordova, Flag Pond, Governor Run, 2 miles south of Governor Run, Pawpaw Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

TURRITELLA VARIABILIS VAR. CUMBERLANDIA Conrad.

Plate LVII, Figs. 3, 4.

Turritella variabilis var. Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 221.
Turritella Cumberlandia Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, pp. 567, 584.
Turritella cumberlandia Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.
Turritella cumberlandia Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 129, pl. xxiii, figs. 9–11.

Description.—" Elongated, tapering gradually; volutions 24, bicarinated, carinæ nearly equal, distant; revolving lines unequal, wrinkled; sides of whorls concave between the carinæ, somewhat channeled beneath the lower one, and rounded at the base. Length $2\frac{5}{8}$." Conrad, 1862.

[1] Dr. Dall referred to his *T. terebriformis* specimens from the Chipola beds, from the Miocene of Virginia (collected by Conrad) and Harris' specimen from Greensboro (not Yorktown, Va.). The last is identical with *alticostata*. The species *terebriformis* may still be valid if the Maryland specimens are eliminated.

This variety includes all those forms from the Choptank and Calvert formations which are characterized by the presence of two revolving ribs, approximately equal in size and equally distant from the upper and lower sutures of the whorls, with a somewhat smooth concave band between them.

This variety represents an archaic condition retained longest in the individuals from the Calvert formation, but almost always present on the early whorls of individuals from the Choptank formation, and occasionally seen on those from the St. Mary's formation.

Length, 70 mm.; diameter, 12 mm.

Occurrence.—Choptank Formation. Greensboro, Dover Bridge, Peach Blossom Creek, Flag Pond, Governor Run, 2 miles south of Governor Run, Trappe Landing, Jones Wharf, Turner, Pawpaw Point. Calvert Formation. Church Hill, Reed's, Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Turritella variabilis var. exaltata Conrad.

Plate LVII, Fig. 5.

Turritella exaltata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Turritella exaltata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 188.
Turritella exaltata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 182.
Turritella exaltata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 567.
Turritella exaltata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16
Turritella exaltata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 24, 25.

Description.—"Subulate, profoundly elongated; whirls convex, with spiral striæ; base of each with a slight groove, and carinated line which margins the suture; waved longitudinal rugæ robust." Conrad, 1842.

This variety includes all those forms in the Calvert formation which have convex whorls with a revolving rib near the base. It differs from *var. alticostata* in having a single revolving rib which is placed nearer the suture than is the more prominent rib of that variety.

Length, 140 mm.; diameter, 14 mm.

Occurrence.—Calvert Formation. Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

TURRITELLA VARIABILIS VAR.

Plate LVII, Figs. 6, 7, 8.

In addition to the varieties already described, there are in the Calvert formation several other forms which perhaps would be as worthy of retaining names as those already discussed. But the variation in this species is so extreme that it seems unwise to give additional names without stronger reasons than at present exist.

Var. A.—Much elongate, whorls with an elevated carination near the lower suture, surface concave on either side of the carination. There is a peculiar form from Skipton in the U. S. National Museum which resembles this, and which is labelled "*T. terstriata* Rogers."

Var B.—Much elongated, whorls strongly convex, sculpture almost obsolete.

Var. C.—Whorls flat, sculpture obsolete.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, Truman's Wharf, White's Landing, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Genus TACHYRHYNCHUS Mörch.

TACHYRHYNCHUS PERLAQUEATUS (Conrad).

Plate LVII, Fig. 9.

Turritella perlaqueata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 32.
Turritella perlaqueata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 189.
Turbonilla perlaqueata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566.
Turritella perlaqueata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.

Description.—"Subulate; whirls convex at base, longitudinally ribbed or fluted, with very fine spiral striæ, most profound towards the base of the larger volution. Length rather more than half an inch." Conrad, 1841.

Length, 13.5 mm.; diameter, 4.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Philadelphia Academy of Natural Sciences, U. S. National Museum.

Family LITTORINIDÆ.

Genus LITTORINA Férussac.

LITTORINA IRRORATA (Say).

Plate LVIII, Fig. 1.

Turbo irroratus Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 239.
Litorina irrorata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 320.

Description.—"*Shell* thick, greenish or pale cinereous, with numerous revolving, elevated, obtuse, equal lines, which are spotted with abbreviated brownish lines; *suture* not indented; *spire* acute; *labium* incrassated, yellowish-brown; *labrum* within white and thick, at the edge thin, and lineated with dark brownish; *throat* white; *columellâ* with an indentation; *operculum* coriaceous." Say, 1822.

A single somewhat worn specimen of this species has been found. This is the first record of it in the Miocene.

Length (restored), 14 mm.; diameter, 11 mm.

Occurrence.—CHOPTANK FORMATION. Choptank River.

Collection.—U. S. National Museum.

Family FOSSARIDÆ.

Genus FOSSARUS Philippi.

Subgenus ISAPIS H. and A. Adams.

FOSSARUS (ISAPIS) DALLI (Whitfield).

Plate LVIII, Fig. 2.

Carinorbis (Delphinula) globulus Heilprin, 1887, Proc. Acad. Nat. Sci. Phila., vol. xxxix, p. 404.
Not *Delphinula globulus* H. C. Lea.
Trichotropis dalli Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 127, pl. xxiii, figs. 1–4.

Description.—"Shell rather small, obliquely ovate, ventricose; body volution forming nearly the entire bulk, very ventricose on the side and below, and somewhat flattened on the shoulder. Volutions about four in number, the apex slightly mammillated; aperture round-oval, nearly as wide as long, the peristome entire, in contact with the preceding volution on the upper inner side, but not coalescent; umbilicus small but distinctly open. Surface marked by six strong, elevated, spiral ridges, with flattened interspaces, the upper ridge being a little the strongest. These spiral ridges often appear double on the surface, from the effect of weathering, but when perfect they are rounded. There are also finer but distinct transverse raised lines, which cross the spiral ridges, and are distinct on the interspaces, but faint or even obsolete on the spiral ridges. Inner margin of the lip faintly marked by depressions corresponding to the spiral lines." Whitfield, 1894.

Length, 16 mm.; width, 11 mm.

Occurrence.—CALVERT FORMATION. Church Hill, Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family SOLARIIDÆ.

Genus SOLARIUM Lamarck.

SOLARIUM TRILINEATUM Conrad.

Plate LVIII, Figs. 3a, 3b, 3c.

Solarium trilineatum Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 31.

Solarium trilineatum Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 186.

Solarium trilineatum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 181.

Architectonica (Phillipia) trilineata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 566.

Architectonica (Phillipia) trilineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 17.

Architectonica trilineata Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 260, pl. xx, fig. 5.

Solarium trilineatum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 327.

Solarium trilineatum Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xiv, p. 25.

Description.—"Depressed, conical; whirls with obsolete spiral lines, and fine transverse striæ, an impressed line below the suture; whirls carinated at base; suture deeply impressed; periphery carinated, and margined above and beneath by a carinated line; umbilicus profound, crenate on the margin, and with a submarginal impressed line, striæ radiating from the umbilicus, becoming obsolete towards the periphery. Width ½ inch." Conrad, 1841.

Height, 9 mm.; diameter, 14 mm.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

SOLARIUM AMPHITERMUM Dall.

Plate LVIII, Figs. 4a, 4b.

Solarium amphitermum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 330, pl. xxii, figs. 16, 16a.

Description.—" Shell moderately elevated, large, solid, with a blunt periphery and about seven whorls; nucleus sinistral, overturned and immersed in the succeeding coil; upper surface with a transverse sculpture of regularly spaced, impressed lines in harmony with the flexuous lines of growth; periphery marked by a strong, broad, blunt rib cut by the impressed lines so as to carry squarish nodulations. This is separated from a similar but less pronounced rib behind by a deep, very narrow groove; the surface hence to the suture may have one or two fine obsolete spiral raised lines, or may show merely the transverse impressed lines which sometimes gather at the appressed suture; base flattened, inside the rounded edge of the peripheral rib is a small beaded spiral; umbilicus small, bordered by a stout rib with about twelve denticles, outside of which is a smaller, undulated, flattish rib with a deep, narrow groove on each side; between this and the peripheral cord the surface is nearly smooth, or with a few fine obsolete raised lines transversely sculptured with impressed radiating lines strongest near the umbilicus; aperture subquadrate, wider than high, the end of the umbilical rib, when perfect, grooved and guttered. Max. diam. of shell 18.5; of umbilicus 5.0; alt. of shell, 10.0 mm. . . . .

" *S. trilineatum* . . . . . is . . . . . smaller, proportionately more elevated and has a sharp periphery." Dall, 1892.

Height, 10 mm.; diameter, 18.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collections.—Maryland Geological Survey, U. S. National Museum.

Family RISSOIDÆ.

Genus RISSOA Fréminville.

Subgenus ONOBA Adams.

RISSOA (ONOBA) MARYLANDICA n. sp.

Plate LVIII, Fig. 5.

Description.—Shell small, fragile, elongate, five-whorled; whorls convex; surface polished, with faint lines of growth and numerous fine revolving striæ which are most distinct at the base of the whorl; mouth wide; umbilicus distinct.

The specimens from the Calvert formation differ from the type which is from Cove Point in having a more solid shell, finer revolving striæ, and a smaller umbilicus.

Length, 4.5 mm.; diameter, 2.5 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CALVERT FORMATION. Plum Point, Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University.

RISSOA SP.

A single fragment evidently represents a new species but is too imperfect to figure or to receive a name. The shell is elongate with very convex whorls which are sculptured by distinct revolving ridges with broader interspaces in which the lines of growth are very distinct.

Length (of fragment), 2½ mm.; diameter, 1 mm.

Occurrence.—CALVERT FORMATION. 3 miles west of Centerville.

Collection.—Maryland Geological Survey.

Family ADEORBIDÆ.

Genus ADEORBIS S. Wood.

ADEORBIS SUPRANITIDUS S. Wood.

Plate LVIII, Figs. 6a, 6b, 6c.

Adeorbis supra-nitidus S. Wood, 1842, Catalogue of Crag shells, Ann. and Mag. Nat. Hist., vol. ix, p. 530.

Adeorbis supra-nitidus S. Wood, 1848, Mollusca of the Crag, pt. i, p. 137, pl. xv, figs. 5a, 5b.

Adeorbis supranitidus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 344.

Description.—"Shell depressed, small, smooth, glossy, and naked above, with from one to three sharp carinæ, the upper one small, often wanting; volutions 3-4, with a depression or subcanal near the suture; umbilicus large, open, coarsely striated within; peritreme sharp, slightly interrupted by the body whorl.

"*Diameter*, $\frac{1}{8}$ of an inch; *altitude*, $\frac{1}{2}$ the diameter." Wood, 1848.

This form, which is very rare at the single Maryland locality where it has been found, has a wide distribution in the Miocene and Pliocene of the Atlantic coast of the United States, the Pliocene of Europe, and is living on both shores of the Atlantic.

Height, 1 mm.; diameter, 2 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Wagner Free Institute of Science, Cornell University, U. S. National Museum.

Family CALYPTRÆIDÆ.

Genus CRUCIBULUM Schumacher.

Crucibulum costatum (Say).

Plate LVIII, Figs. 7a, 7b.

Calyptræa costata Say, 1820, Amer. Jour. Sci., vol. ii, p. 40. (Reprint, 1896, Bull. Amer. Pal., No. 5.)

Dispotæa costata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 132. (In part.)

Not *Dispotæa costata* Conrad and others.

Dispotæa grandis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185. Not of Say.

Description.—"Oval, convex, with numerous slightly elevated, equal equidistant costæ, and crowded obtuse, concentric lines, which are regularly undulated by the costæ; *apex* mamillated inclining to one side; *inner valve* patelliform, dilated, attached by one side to the side of the shell, acutely angulated at the anterior junction, and rounded at the posterior junction, and rapidly tapering to an acute tip, which corresponds with the inner apex of the shell." Say, 1820.

The original locality of this species as given by Say is Upper Marlboro and the fossils which he mentioned as associated with it are all Calvert forms. Undoubtedly the material came from one of the numerous Miocene outliers in the vicinity of Upper Marlboro. Both the original locality and the original description clearly show that this is a Calvert and Choptank form and very distinct from the St. Mary's form, which all later authors and probably Say himself regarded as identical with it.

Height, 21 mm.; length, 43 mm.; width, 33 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run, 2 miles south of Governor Run, Flag Pond, Peach Blossom Creek, Cordova, Sand Hill, St. Leonard Creek. CALVERT FORMATION. Plum Point, Chesapeake Beach, Church Hill, 3 miles west of Centerville, Wye Mills.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

CRUCIBULUM COSTATUM VAR. PILEOLUM (H. C. Lea).

Plate LVIII, Figs. 8a, 8b, 9a, 9b, 10.

Dispotœa costata Conrad, 1842, Proc. Nat. Inst., Bull ii, p. 187.
Calyptræa pileolus H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst. p. 6.
Calyptræa Pileolus H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 248, pl. xxxv, fig. 38.
Dispotœa costata Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 79, pl. xlv, fig. 2.
Crucibulum costatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Crucibulum costatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Crucibulum auricula var. costatum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 349.

Description.—"Shell irregularly conical, thick, sulcate; sulci radiating, large, irregular; concentric striæ minute, small; apex smooth, twisted into two whorls; aperture sub-rotund; cyathus large, wide, angular." H. C. Lea, 1845.

"Somewhat conical, with profound irregular ribs, and very coarse concentric wrinkles; apex not central, prominent, obliquely inclined, margin profoundly scalloped; diaphragm ovate, profound, the margins free." Conrad, 1845.

This variety includes all the strongly costate forms with a cup free at the periphery in the adult.

Height, 25 mm.; length, 50 mm.; width, 42 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Crucibulum constrictum Conrad.

Plate LVIII, Fig. 11.

Dispotœa constricta Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 194, pl. i, fig. 2.
Dispotœa constricta Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 80, pl. xlv, fig. 4.
Crucibulum constrictum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Crucibulum constrictum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Crucibulum constrictum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 350.

Description.—" Shell irregular, elevated; laterally compressed, marked with simple lines of growth; apex prominent, with one or two minute volutions; diaphragm very profound." Conrad, 1842.

" Very irregular, elevated, laterally compressed; transversely rugose; apex submedial, very prominent, obliquely inclined, and with 1 or 2 minute volutions; diaphragm extremely profound, adhering by nearly half the circumference of the margin." Conrad, 1845.

Height, 10 mm.; length, 12 mm.; width, 8 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Crucibulum multilineatum Conrad.

Plate LVIII, Figs. 12a, 12b.

Dispotœa multilineata Conrad, 1842, Amer. Jour. Sci., vol. xli, p. 346, pl. ii, fig. 7.
Dispotœa multilineata Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 80.
Crucibulum multilineata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 107, pl. xxv, fig. 7.
Crucibulum multilineatum Emmons, 1858, Rept. N. Car. Geol. Survey, p. 276, fig. 192.
Crucibulum multilineatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.
Crucibulum multilineatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Crucibulum multilineatum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 351.

Description.—"Subovate, depressed; apex prominent; one side with squamose lines, the opposite with finer ramose lines destitute of scales; diaphragm contracted." Conrad, 1842.

Height, 7 mm.; length, 30 mm.; width, 25 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run, 2 miles south of Governor Run, Flag Pond, Dover Bridge, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CALYPTRÆA Lamarck.

CALYPTRÆA APERTA (Solander).

Plate LIX, Fig. 1.

Trochus apertus Solander, 1766, Foss. Haut., p. 9, figs. 1, 2.
Calyptræa trochiformis Lamarck, 1804, Ann. Mus. d'Hist. Nat., vol. i, p. 385, pl. xv, fig. 3.
? *Infundibulum gyrinum* Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 134.
Infundibulum perarmatum Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 31.
Infundibulum perarmatum Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 186.
Infundibulum perarmatum Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 182.
Infundibulum perarmatum Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 80, pl. xlv, fig. 6.
Trochita perarmata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.
Trochita perarmata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Calyptræa trochiformis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 352.
Infundibulum perarmatum Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 24, 25.
Trochita perarmata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 124, pl. xxii, figs. 15–19.

Description.—"Trochus (*apertus*) testa gibboso-conica exasperata obliquata subtus concava, apertura augustata.

"Primo intuitu *Patellis* assimilatur illisque quæ *Labio interno* instructæ sunt, cfr. Linn. Syst. nat. n. 654-658. Specimina autem perfecta *spiram* ostendunt completam, *aufractus* licet pauciores quam in congeneribus; *Apertura* etjam magis contracta est.

"Testa magnitudine Juglandis sed depressior, sæpeque minor; tabulæ imposita conum formans gibbosiusculum, quo etjam a congeneribus differt; externe scabra, subtus lævis, concava.

"Apertura augustata, lateribus magis roduntatis quam in reliquis hujus generis." Solander, 1766.

Height, 20 mm.; diameter, 35 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION. Church Hill, 3 miles west of Centerville, Reed's, Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, White's Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

CALYPTRÆA CENTRALIS (Conrad).

Plate LIX, Figs. 2a, 2b, 2c.

Infundibulum centralis Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 348.

Infundibulum concentricum H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 6.

Infundibulum centralis Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 80, pl. xlv, fig. 5.

Calyptræa (Infundibulum) concentricum H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 249, pl. xxxv, fig. 39.

Trochita centralis Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 109, pl. xxv, fig. 8.

Trochita centralis Emmons, 1858, Rept. N. Car. Geol. Survey, p. 276, fig. 139.

Trochita centralis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.

Trochita concentrica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 568.

Trochita centralis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Trochita concentrica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Calyptræa centralis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 353.

Description.—"Obtusely ovate, with fine concentric irregular lines; apex central." Conrad, 1841.

"Suborbicular or obtusely ovate, tumid above, marked with transverse wrinkles; apex medial, minutely spiral, prominent, acute." Conrad, 1845.

This species is distinguished by the entire absence of spines and the presence of the irregular spiral lines or wrinkles, and also by a peculiar reflected lip on the septum, under which is an umbilicus on the columella.

Height, 10 mm.; diameter, 18 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

CALYPTRÆA GREENSBOROËNSIS n. sp.

Plate LIX, Figs. 3a, 3b.

Description.—Shell small, depressed, globose, very eccentric, three-whorled; sutures indistinct, especially on the later whorls; whorls convex; surface covered with irregular, closely-set, beaded, vermicular riblets; subseptal umbilicus large and flaring.

Height, 5 mm.; length, 11 mm.; width, 9 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CREPIDULA Lamarck.

CREPIDULA FORNICATA (Linné).

Plate LIX, Figs. 4a, 4b.

Patella fornicata Linné, 1758, Syst. Nat., ed. x, p. 781.

Crepidula fornicata Lamarck, 1801, Anim. sans Vert., vol. vii, p. 641.

Crepidula fornicata ? var. Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 225.

Crepidula densata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. l, p. 311.

Crepidula ponderosa H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 6.

Crepidula cornucopiæ H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 6.

Crepidula cymbæformis Conrad, 1844, Proc. Acad. Nat. Sci. Phila., vol. ii, p. 173.

Calyptræa (Crepidula) ponderosa H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 249, pl. xxxv, fig. 40.

Calyptræa (Crepidula) cornucopiæ H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 250, pl. xxxv, fig. 41.

Crypta fornicata Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 110, pl. xxv, fig. 9.

Crepidula fornicata Emmons, 1858, Rept. N. Car. Geol. Survey, p. 276, fig. 194.

Crypta cymbæformis Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 81, pl. xlv, fig. 7.

Crypta densata Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 81, pl. xlv, fig. 9.

Crypta fornicata Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 81, pl. xlv, fig. 10.

Crypta cornucopia Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Crypta cymbæformis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Crypta densata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Crypta fornicata ? Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Crypta cornucopia Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Crypta cymbiformis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Crypta densata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Crypta fornicata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Crepidula rostrata Conrad, 1870, Amer. Jour. Conch., vol. vi, p. 77.

Crepidula virginica Conrad, 1870, Amer. Jour. Conch., vol. vi, p. 78.

Crepidula recurvirostra Conrad, 1870, Amer. Jour. Conch., vol. vi, p. 78.

Crepidula fornicata Meyer, 1888, Proc. Acad. Nat. Sci. Phila., vol. xl, p. 170.

Crepidula fornicata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 356.

Crepidula fornicata ? Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 123.

Description.—" P. testa integra ovali postice oblique recurva, labio postico concavo." Linné, 1758.

This species shows great variability, as is testified by the synonyms cited above.

Length, 28 mm.; width, 22 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point. CHOPTANK FORMATION. Jones Wharf, Greensboro, St. Leonard Creek, Sand Hill. CALVERT FORMATION. Plum Point, 3 miles west of Centerville.

Collection.—Maryland Geological Survey.

CREPIDULA PLANA Say.

Plate LIX, Figs. 5a, 5b.

Crepidula plana Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 226.

Crepidula lamina H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 6.

Calyptræa (Crepidula) lamina H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 250, pl. xxxv, fig. 42. (*Fide* Dall.)

Crypta plana Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 111, pl. xxv, fig. 12.

Crepidula plana Emmons, 1858, Rept. N. Car. Geol. Survey, p. 276, fig. 195.

Crypta plana ? Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Crypta plana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 16.

Crepidula plana Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 358.

Crepidula plana ? Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 124.

Description.—" *Shell* depressed, flat, oblong oval, transversely wrinkled, lateral margins abruptly deflected; *apex* not prominent, and constituting a mere terminal angle, obsolete in the old shells; *within* white; *diaphragm* occupying half the length of the shell, convex, contracted in the middle and at one side.

" Length 1 and 1-10 of an inch." Say, 1822.

The forms from Plum Point differ from the other Maryland forms in possessing a very thick shell.

Length, 25 mm.; width, 16 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family AMALTHEIDÆ.

Genus AMALTHEA Schumacher.

AMALTHEA MARYLANDICA n. sp.

Plate LIX, Figs. 6a, 6b, 6c, 6d.

Description.—Shell small, irregular in shape; apex very posteriorly situated (overhanging the margin), elevated, arched, and dextrally twisted; surface with irregular lines of growth, and numerous, closely-set, alternating, granulated ribs; base irregular; margin smooth.

Height, 3 mm.; length, 9 mm.; width, 7.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro, Jones Wharf.

Collection.—Maryland Geological Survey.

Family XENOPHORIDÆ.

Genus XENOPHORA Fischer.

XENOPHORA CONCHYLIOPHORA (Born).

Plate LIX, Figs. 7a, 7b, 7c.

Trochus conchyliophorus Born, 1780, Testacea Musei Cæsarei Vindobonensis, p. 333, pl. xii, figs. 21, 22.

Xenophora humilis Dall, 1890, Trans. Wagner Free Inst. Sci., vol. iii, pt. i, p. 182, pl. iv, figs. 10, 10a. (Not of Conrad.)

Xenophora conchyliophora Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 360.

Description.—"Testa convexo-conica, tenuis, sub-pellucida, testis Zoophytorum & Testaceorum adglutinatis onerati; Anfractibus declivis, imbricati, plicato-rugosi; Apertura compressa, subquadrangularis; Labrum integerrimum, falcatum; Labium horizontale, reflexum, imperforatum; Color albus, radiis obliquis curvatis luteis." Born, 1780.

This species has survived without essential change from the Cretaceous to the Recent.

Height, unknown; diameter, 43 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run (lower bed). CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family NATICIDÆ.

Genus POLYNICES Montfort.

Subgenus NEVERITA Risso.

POLYNICES (NEVERITA) DUPLICATUS (Say).

Plate LX, Fig. 1.

Natica duplicata Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 247.

Natica duplicata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.

Natica duplicata Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 185, 186.

Natica (Neverita) duplicata ? Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 564.

Neverita duplicata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Polynices (Neverita) duplicatus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 368.

Natica duplicata Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 25, 26, 28.

Neverita duplicata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 121, pl. xxi, figs 13–16.

Description.—" *Shell* thick, sub-globose, cinereous, with a black line revolving on the spire above the suture, and becoming gradually diluted, dilated, and obsolete in its course; within brownish-livid; a large incrassated callus of the same color extends beyond the columella, and nearly covers the umbilicus from above; *umbilicus* with a profound sulcus or duplication." Say, 1822.

Height, 45 mm.; diameter, 52 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff. CHOPTANK FORMATION. Dover Bridge, Greensboro, Peach Blossom Creek, Jones Wharf, Governor Run, 2 miles south of Governor Run. CALVERT FORMATION. Plum Point, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Subgenus LUNATIA Gray.

POLYNICES (LUNATIA) HEMICRYPTUS (Gabb).

Plate LX, Fig. 2.

Natica hemicrypta Gabb, 1860, Jour. Acad. Nat. Sci. Phila., vol. iv, 2nd ser., p. 375, pl. lxvii, fig. 5.

Polynices (Lunatia) hemicryptus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 371.

Natica (Lunatia) hemicrypta Whitfield, 1894, Mon. xxiv, p. 118, pl. xxii, figs. 1–5.

Not *Natica hemicrypta* Conrad.

Description.—" Globose; whorls four, rounded; spire elevated, suture faint; mouth rounded; callosity small, partly covers the umbilicus, which is deep, surface smooth." Gabb, 1860.

Height, 15 mm.; diameter, 11 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, Church Hill, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

POLYNICES (LUNATIA) HEROS (Say).

Plate LX, Figs. 3, 4.

Natica heras Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 248.

Natica interna Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 125, pl. vii, fig. 2. (Reprint, Bull. Amer. Pal., No. 5.)

Natica heros Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.

Natica heras Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185.

Natica (Lunatia) catenaides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565. (Not of Wood.)

Natica (Lunatia) interna Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.

Lunatia catenoides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19. (Not of Wood)

Lunatia interna Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Lunatia catenaides ? Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 258, pl. xxiii, fig. 5.

Polynices (Lunatia) internus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 372, pl. xx, fig. 7.

Polynices (Lunatia) perspectivus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 373.

Polynices (Lunatia) heros Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 373.

Natica heras Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 25, 27, 28.

Natica (Lunatia) heras Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 119, pl. xxii, figs. 9, 10.

Description.—" *Shell* suboval, thick, rufo-einereous; *within* whitish; *columella* incrassated; *callous* not continued over the upper part of the umbilicus, hardly extending beyond a line drawn from the base of the columella to the superior angle of the labrum; *umbilicus* free, simple." Say, 1822.

Dr. Dall says in regard to this species as restricted by him: " This species is somewhat variable, and the difference between the sexes is very marked. In a pair from Nova Scotia having each a height of 50 mm.

the male measured 40 mm. in maximum diameter and the female 45 mm. The difference in form is even greater than these measurements would imply. The deep-water specimens are thin but growing to a very large size. This species is especially subject to decortication in the fossil state, and when so mutilated is difficult to recognize. Perfect adult specimens can usually be identified by their globose form, rounded but not turreted whorls, small ribless umbilicus and feeble callus. The young resemble *L. interna,* but want the umbilical rib, though it is sometimes quite difficult to separate immature specimens."

Dr. Dall also recognized *interna* Say and *perspectiva* Rogers as distinct species occurring in the Maryland Miocene. In regard to the former he says: "*Lunatia interna* may be discriminated by its low spire, its full and rounded whorls, and by the characters of the umbilicus, which shows a marked sulcus ascending spirally below a thickened, obscure rib, which are respectively indicated in mature and perfect specimens by an emargination and a callus on the pillar-lip. It has six or eight whorls, and attains a breadth of 26 and a height of 28 mm."

He defines *perspectiva* as follows:

"This is *N. heros* Conrad, *ex parte, non* Say, and *N. hemicrypta* Conrad, *ex parte,* not of Gabb. The species is much the same shape as *L. triserialis* Say, of the recent fauna, but is larger, heavier, and with a different umbilicus. It may be recognized by its smoothly arched spire, in which the rotundity of the whorls is not marked and the suture is smoothly appressed, as in a male *Neverita duplicata* of the elevated variety; by its umbilicus, which is wide below and obscurely spirally striate, with near the top of the umbilical wall a sharp, narrow spiral rib, which terminates between two obscure notches on the columellar callus. It is a narrower, heavier and smaller shell than the average adult *L. heros,* though decorticated specimens such as abound in the marls are difficult to recognize."

After a very careful study of large collections from all the Maryland horizons and localities it has been impossible to separate the material into the species recognized and re-defined by Dr. Dall, and it appears best for the present at least to refer all the fossil forms to *L. heros.*

Height, 65 mm.; diameter, 60 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff. CHOPTANK FORMATION. Jones Wharf, Governor Run, 2 miles south of Governor Run, Pawpaw Point, Flag Pond, Dover Bridge, Sand Hill. CALVERT FORMATION. Plum Point, 3 miles west of Centerville, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Genus Sigaretus Lamarck.

SIGARETUS FRAGILIS Conrad.

Plate LX, Figs. 5a, 5b.

Natica fragilis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 222, pl. ix, fig. 3.

Sigaretus fragilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 181.

Natica aperta H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 7.

Natica aperta H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 254, pl. xxxvi, fig. 51.

Natica fragilis Emmons, 1858, Rept. N. Car. Geol. Survey, p. 267, fig. 153.

Sigaretus (*Naticina*) *fragilis* Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 565.

Sigaretus fragilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 19.

Sigaretus fragilis Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 25.

Description.—" Shell ovate, thin, fragile, smooth, with fine revolving impressed striæ; spire very small; apex acute; aperture extending about four-fifths of the length of the shell; columella much narrowed and arcuated, exhibiting the internal volutions." Conrad, 1830.

Height, 22 mm.; width, 18 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point. CHOPTANK FORMATION. Governor Run (lower bed). CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Superfamily RHIPIDOGLOSSA.

Family TROCHIDÆ.

Genus CALLIOSTOMA Swainson.

CALLIOSTOMA BELLUM (Conrad).

Plate LXI, Fig. 1.

Trochus bellus Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 137.
Zizyphinus bellus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.
Zizyphinus bellus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Calliostoma bellum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 395.

Description.—"Shell conical, with prominent beaded spiral striæ; whorls slightly contracted above; periphery rounded; base with about eight large beaded elevated spiral striæ. Length half an inch." Conrad, 1834.

Height, 16 mm.; diameter, 14 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Wagner Free Institute of Science, Cornell University.

CALLIOSTOMA PHILANTHROPUS (Conrad).

Plate LXI, Figs. 2, 3.

Trochus philanthropus Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 137.
Trochus philantropus Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 117, pl. xxvi, fig. 2.
Trochus philantropus Emmons, 1858, Geology of North Carolina, p. 272, fig. 167.
Zizyphinus philanthropus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.
Zizyphinus philanthropus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.
Calliostoma philanthropus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 390, pl. xviii, fig. 9a.

Description.—"Shell subconical, with the whorls slightly angular near their base; and with prominent spiral beaded lines, alternating in size; striæ on the base nearly smooth, not crenulated; subumbilicated; aperture obliquely quadrangular." Conrad, 1834.

This is one of the commonest and most variable of all the species of *Calliostoma* in the Atlantic Coast Miocene. The typical forms have three prominent beaded spirals with sometimes intermediate smaller spirals without beads. The periphery is square and sometimes somewhat concave. The base has about six broad spirals and additional smaller ones in the umbilical region which is always imperforate though sometimes slightly excavated.

The species is subject to considerable variation, which consists usually in the loss of the beads on some of the spirals.

Height, 12 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Jones Wharf, Governor Run (lower bed), 2 miles south of Governor Run, Pawpaw Point, Greensboro. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

Calliostoma philanthropus var.

Plate LXI, Fig. 4.

Description.—Earlier whorls with three spirals, the one below the suture coarsely beaded, the medial one with smaller, more closely set beads, the lower over-ridden by several revolving ribs which are each finely beaded; finer imbedded spirals on all except the earliest whorls; periphery of the body whorl with a revolving concavity between the lowest spiral described above and a slightly less prominent one which is hidden on all except the body whorl; base of the body whorl with seven broad spirals.

Later investigation may show that this is a distinct species, but as a single specimen is all that has been found, its distinctness or relationships cannot now be decided.

Length, 10 mm.; diameter, 9 mm.

Occurrence.—Choptank Formation. Jones Wharf, Pawpaw Point.

Collection.—Maryland Geological Survey.

Calliostoma virginicum (Conrad).

Plate LXI, Fig. 5.

Zizyphinus virginicus Conrad, 1875, Rept. N. Car. Geol. Survey, vol. 1, Appendix A, p. 22, pl. iv, fig. 4.

Calliostoma virginicum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 396, pl. xviii, fig. 2.

Description.—"Trochiform; spire and last volution equal in height; 2 prominent revolving lines on last volution immediately above the aperture, the upper one having a slight channel where it joins the volution, another line near the suture and only two lines on each of the other volutions at top and base; suture carinated; base with four large revolving lines on ribs and other unequal finer lines; subumbilicated." Conrad, 1875.

Shell of moderate size, solid, six-whorled; sculpture consisting of fine lines of growth, of numerous elevated closely-set revolving striæ and of three pronounced revolving ribs—one basal on which the whorl is wound and two equally distant from the sutures and with about half the width of the whorl between them; base with about nine broad raised flat-topped revolving ribs with narrower interspaces between them.

Height, 10 mm.; diameter, 10 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Wagner Free Institute of Science, Cornell University.

Calliostoma distans (Conrad).

Plate LXI, Fig. 6.

Leiotrochus distans Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 288.

Monilia (Leiotrochus) distans Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Monilea (Leiotrochus) distans Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Zizyphinus punctatus Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 257, pl. iii, fig. 5.

Zizyphinus bryani Conrad, 1868, Amer. Jour. Conch., vol. iii, p. 258, pl. xxi, fig. 9.

Calliostoma (Eutrochus) distans Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 402.

Description.—"Trochiform; volutions 4; suture subcanaliculate near the apex; revolving lines, a few distant, distinct, impressed, the others very fine; periphery rounded; base convex-depressed, with six distant impressed revolving lines and very fine intermediate lines; umbilicus narrow, profound; subcarinated at base." Conrad, 1862.

Height, 10.5 mm.; diameter, 11 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, U. S. National Museum.

CALLIOSTOMA EBOREUM (Wagner).

Plate LXI, Fig. 7.

Trochus eboreus Wagner, 1839, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 52, pl. ii, fig. 5.

Monilia (*Leiotrochus*) *eborea* Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Monilea (*Leiotrochus*) *eborea* Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Turbo eboreus Heilprin, 1887, Proc. Acad. Nat. Sci. Phila., vol. xxxix, pp. 399, 404.

Calliostoma eboreum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 398.

Monilea (*Leiotrochus*) *eborea* Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 135, pl. xxiv, figs. 7-10.

Description.—"Shell smooth and slightly polished; spire short, conical; whirls flattened laterally, margined above by a very obtuse obsolete carina; spiral lines obsolete; periphery sharply angulated, subcarinated; base flattened; subumbilicated columella grooved; aperture half the length of the shell." Wagner, 1839.

Dr. Dall says in regard to this species: "This species is a typical *Calliostoma,* with a rather angular periphery which forms a line over the suture below it, a polished surface, mostly smooth, with a few fine but distinct, elevated spiral threads, rather irregularly disposed and sometimes absent. The base is generally smooth, flattish, imperforate, with the usual arched pillar ending in an obscure projection (common to the genus) and a few spiral threads about the umbilical region. Old specimens have the last whorl less angular at the periphery, the base rounded and the aperture less quadrate than in smaller specimens. The threading is irregular and occasionally profuse or entirely absent."

This species may readily be confused with *C. wagneri* and *C. aphelium.* It is possible that the latter is the normal form of the adult.

Height, 6 mm.; diameter, 6.5 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. 3 miles south of Chesapeake Beach, Reed's, Westcott Farm near Church Hill.

Collections.—Maryland Geological Survey, U. S. National Museum, Wagner Free Institute of Science.

Calliostoma wagneri Dall.

Plate LXI, Fig. 8.

Calliostoma (eboreum Wagner *var. ?) Wagneri* Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 399, pl. xxi, fig. 3.

Description.—"Shell small, rather depressed, with a rather large, smooth nucleus and five subsequent whorls; surface of the shell smooth except for lines of growth; whorls at the periphery flattened, with two well-separated keels, the upper the more prominent; the suture in the earlier whorls is applied to the upper keel, but gradually recedes from it and runs about midway between them; immediately in front of the suture the whorl shows a narrow, rounded ridge parallel with the suture; between this ridge and the upper peripheral keel the surface of the whorl is excavated or impressed to an extent varying in different specimens; base smooth, umbilical region with a wrinkled callus, sometimes bounded by one or two spiral grooves, but often without them; pillar short, thick, with an obscure denticle; aperture subquadrate, outer lip simple, throat not lirate." Dall, 1892.

Height, 8.5 mm.; diameter, 10 mm.

Occurrence.—Choptank Formation. Greensboro, Governor Run (lower bed).

Collections.—Maryland Geological Survey, U. S. National Museum.

Calliostoma aphelium Dall.

Plate LXI, Figs. 9, 10a, 10b, 11.

Calliostoma aphelium Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 400, pl. xxii, fig. 29.

Description.—"Shell small, somewhat depressed, with five whorls; suture impressed, not channelled; upper surface of the whorls smooth except for lines of growth and nearly invisible obsolete spiral markings, somewhat flattened; periphery prominent, almost carinated; base slightly rounded, without sculpture; umbilicus represented by a deep imperforate pit; umbilical fasciole strong, callous, irregularly vertically striated; aperture subquadrate, outer lip simple, sharp; inner lip broad, with a callous knob upon it; body with a thin wash of callus." Dall, 1892.

There is a subsutural row of white spots, and another row in the center of the base.

Height, 10 mm.; diameter, 11 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run (lower bed), 2 miles south of Governor Run, Cordova.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Wagner Free Institute of Science.

CALLIOSTOMA PERALVEATUM (Conrad).

Plate LXI, Fig. 12.

Trochus peralveatus Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.

Trochus peralveatus Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 186.

Trochus peralveatus Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 182, 183.

Trochus peralveatus Conrad, 1846, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 21, pl. i, fig. 25.

Zizyphinus peralveatus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Zizyphinus peralveatus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Description.—" Volutions 5 or 6, with each a deep groove near the base; space below the suture profoundly and widely channelled; upper margin of whirls acutely carinated; base with 5 profound grooves. Length, 1⅝ inch." Conrad, 1842.

Length, 13 mm.; diameter, 12 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

Section EUTROCHUS A. Adams.

CALLIOSTOMA HUMILE (Conrad).

Plate LXI, Figs. 13a, 13b, 13c.

Trochus humilis Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser. p. 219, pl. ix, fig. 5.

Trochus humilis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

? *Trochus lens* H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 10.

? *Trochus lens* H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 265, pl. xxxvii, fig. 83.

Zizyphinus humilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Zizyphinus humilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Calliostoma (Eutrochus) humile Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 405. (In part.)

Description.—"Shell depressed, with very fine transverse striæ; sides straight: whorls with a very slight obtuse elevation revolving immediately above the suture; apex acute; aperture rhomboidal; umbilicated.

"The specimen from which the above description was taken exhibits part of the original markings; a band of light-colored minute spots revolves near the suture on the large whorl; and another band of similar, but larger spots revolves near the middle of the same volution; the striæ are very strong on the base, particularly near the umbilical margin." Conrad, 1830.

The color pattern referred to by Conrad has been observed on a number of specimens. A specimen belonging to the Wagner Free Institute of Science has three rows of spots, one just below the suture and two near the center of the whorl.

This is the most abundant species at St. Mary's River.

C. conus H. C. Lea differs from this species in being more elevated, in having more convex whorls, and a rounded basal margin.

Height, 13 mm.; diameter, 20 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Calliostoma reclusum (Conrad).

Plate LXI, Figs. 14a, 14b, 14c.

Trochus reclusus Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 219, pl. ix, fig. 6.

Trochus reclusus Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Zizyphinus reclusus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 569.

Zizyphinus reclusus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 15.

Calliostoma (Eutrochus) humilis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 405. (In part.)

Description.—"Shell much depressed; transversely striated; whorls flattened on the summit, with straight sides; aperture transversely ovate; umbilicus profound, carinated and slightly funnel-shaped.

"The carina within the umbilicus is visible on the two last whorls." Conrad, 1830.

This species is distinguished from *C. humile* by the flat-topped, beaded shoulder of the whorls.

Height, 15 mm.; diameter, 20 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, Wagner Free Institute of Science, Cornell University.

Calliostoma marylandicum n. sp.

Plate LXI, Figs. 15a, 15b.

Description.—Shell small, depressed, umbilicate; spire much depressed, domed; body whorl large; mouth round; top of the whorl with six sharply incised revolving lines; lines of growth faint; body whorl with faint oblique streaks of color.

Height, 7 mm.; diameter, 5.4 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Calliostoma calvertanum n. sp.

Plate LXI, Figs. 16a, 16b, 16c.

Description.—Shell small, much depressed, umbilicate; spire conic; periphery with a concave groove above, below which the whorl is wound; earlier whorls with three revolving ribs which gradually become obsolete; surface of later whorls smooth, highly polished, marked only by very fine closely-set lines of growth and still finer revolving striæ; base slightly convex; umbilicus large and deep; umbilical periphery angular; mouth subquadrate.

Height, 3.5 mm.; diameter, 6 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family UMBONIIDÆ.

Genus TEINOSTOMA Adams.

Teinostoma nanum (Lea).

Plate LXII, Figs. 1a, 1b, 1c, 2a, 2b, 2c.

Rotella nana Lea, 1833, Contrib. to Geology, p. 214, pl. vi, fig. 225.

Rotella umbilicata H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst. p. 10.

Rotella umbilicata H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 264, pl. xxxvi, fig. 80.

Description.—"Shell orbicular, flattened above, smooth, margin rounded; substance of the shell rather thin; spire nearly concealed; outer lip sharp; callus impressed in the centre, bounded by a fine impressed line; mouth nearly round." Lea, 1833.

This species may be readily distinguished from the other Teinostomas of the Maryland Miocene by its smooth, highly-polished shell, and by the thick smooth callus which fills the umbilicus and which is bounded by a faint impressed revolving line.

Height, 1 mm.; maximum diameter, 2 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, Cornell University.

TEINOSTOMA CALVERTENSE n. sp.

Plate LXII, Figs. 3a, 3b, 3c.

Description.—Shell small, solid, much depressed; body whorl large, gently convex on top; spire small, domed; umbilicus small; mouth round; surface marked by rather strong, somewhat irregular lines of growth.

This species resembles *T. nanum* more closely than it does any other Maryland species. It differs from *nanum* in having an open umbilicus and in being much more depressed.

Height, 0.5 mm.; diameter, 1.5 mm.

Occurrence.—Choptank Formation. Jones Wharf, Governor Run, Calvert Formation. Plum Point, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

TEINOSTOMA LIPARUM (H. C. Lea).

Plate LXII, Figs. 4a, 4b, 4c.

Delphinula lipara H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 9.

Delphinula lipara H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 261, pl. xxxvi, fig. 71.

Description.—"Shell orbicular, depressed, somewhat flattened, rather thick, smooth, shining; spire very short, rounded; sutures impressed; whorls five, convex, polished; last whorl rounded; base smooth; umbilicus very wide, deep; mouth round." Lea, 1845.

Height, 1 mm.; maximum diameter, 3 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point, Langley's Bluff. Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science, Cornell University.

Teinostoma greensboroënse n. sp.

Plate LXII, Figs. 5a, 5b, 5c.

Description.—Shell small, depressed, umbilicate; spire small, prominent; suture distinct; body whorl large, convex on top; periphery acute; mouth circular; umbilicus deep; surface with fine oblique revolving striæ and oblique radiating undulations which are very prominent on the sides and base of the body whorl.

This species resembles *T. undula* Dall.

Height, 0.6 mm.; diameter, 2 mm.

Occurrence.—Choptank Formation. Greensboro, Cordova, Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus COCHLIOLEPIS Stimpson.

Cochliolepis striata Dall.

Plate LXII, Figs. 6a, 6b, 6c.

Cochliolepis striata Dall, 1889, Rept. Blake Gastr., Bull. Mus. Comp. Zool. Harvard, vol. xviii, p. 360.

Cochliolepis striata Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 419, pl. xxiii, figs. 16, 17.

Description.—"A second species, larger and fewer whorled, has strong spiral striæ like a minute *Sigaretus perspectivus*, and was named *C. striata* by Stimpson in his manuscripts. It is about 6.5 mm. in greatest diameter and 1.5 mm. high. It has two whorls and a globular nucleus almost enveloped by the last whorl, and a very wide perverse umbilicus." Dall, 1889.

This species is very rare at Plum Point, and has not been found at any other locality at as low a geological horizon or as far north as this. Dr. Dall records it as living in Tampa Bay, and occurring fossil in the younger Miocene of North Carolina.

Maximum diameter, 4.6 mm.; height, 1.2 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—U. S. National Museum.

Family CYCLOSTREMATIDÆ.

Genus MOLLERIA Jeffreys.

MOLLERIA MINUSCULA Dall.

Plate LXII, Fig. 7.

Molleria minuscula Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 421.

Description.—"Shell very small, with the general form of *Lunatia interna* Say, turbinate, fully rounded, with two and a half whorls; surface smooth, suture distinct, not deep; base rounded; umbilicus very small; aperture rounded, hardly thickened, the margin internally with a perceptible ledge for the edge of the operculum." Dall, 1892.

No specimen except the type has been found, but the species is so small that very careful search should be made for it.

Height, 0.7 mm.; diameter, 1.0 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—U. S. National Museum.

Superfamily ZYGOBRANCHIA.

Family FISSURELLIDÆ.

Subfamily EMARGINULINÆ.

Genus FISSURIDEA Swainson.

FISSURIDEA ALTICOSTA (Conrad).

Plate LXIII, Figs. 1a, 1b.

Fissurella alticosta Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 142.

Fissurella alticosta Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78, pl. xliv, fig. 7.

Fissurella alticosta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Fissurella alticostata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.

Fissuridea redimicula var. alticosta Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 425.

Description.—" Shell ovate, elevated, cancellated, with about seventeen elevated ribs and intermediate prominent striæ; the middle one largest; apex inclined, not nearly central; fissure regularly oval." Conrad, 1834.

" Subovate, with very prominent remote narrow ribs, about 18 or 20 in number, with intermediate unequal striæ, the middle one largest; foramen large, subovate; inner margin crenulated, angulated at the ends of the ribs." Conrad, 1845.

Height, 18 mm.; length, 35 mm.; width, 18 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Wagner Free Institute of Science, Philadelphia Academy of Natural Sciences.

FISSURIDEA GRISCOMI (Conrad).

Plate LXIII, Figs. 2a, 2b, 3a, 3b.

Fissurella Griscomi Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 143.

Fissurella Griscomi Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78, pl. xliv, fig. 8.

Fissurella Griscomi Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Fissurella Griscomi Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.

Fissuridea Griscomi Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 425.

Fissurella Griscomi Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 136, pl. xxiv, figs. 11-14.

Description.—" Shell ovate-oval, compressed, rather elevated, cancellated; radiating ribs crowded, somewhat alternated in size; fissure oblong, inclined, nearest to the anterior end; within somewhat thickened on the margin which is crenulated; an impressed submarginal line." Conrad, 1834.

" Subovate, elevated, laterally compressed, with alternate radiating robust striæ, and strong prominent transverse lines; foramen narrow, subovate; inner margin crenulated." Conrad, 1845.

Height, 10 mm.; length, 24 mm.; width, 14.5 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Pawpaw Point. CALVERT FORMATION. Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University.

FISSURIDEA MARYLANDICA (Conrad).

Plate LXIII, Figs. 4a, 4b.

Fissurella Marylandica Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 31.
Fissurella Marylandica Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 187.
Fissurella marylandica Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 182, 183.
Fissurella Marylandica Conrad, 1845, Fossils of the Medial Tertiary, No. 4, p. 79, pl. xlv, fig. 1.
Fissurella Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.
Fissurella marylandica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.
Fissuridea catilliformis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 425. (In part.)
Not *F. catilliformis* Rogers.
Fissurella marylandica Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 25.

Description.—" Elevated, with numerous striæ, alternated in size and minutely granulated by fine crowded concentric lines crossing them; foramen large, regularly oval. Length 1 inch.

" Closely allied to *F. Griscomi,* but is readily distinguished by a much larger foramen, finer concentric lines, in not being laterally compressed, &c." Conrad, 1841.

Height, 20 mm.; length, 43 mm.; width, 29 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum.

FISSURIDEA NASSULA (Conrad).

Plate LXIII, Figs. 5a, 5b.

Fissurella nassula Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78, pl. xliv, fig. 6.
Fissurella nassula Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.
Fissurella nassula Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.
Fissuridea catilliformis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 425. (In part.)
Not *F. catilliformis* Rogers.

Description.—" Subovate, not elevated; sides flattened, cancellated with numerous closely-arranged unequal ribs and prominent transverse striæ; foramen subovate, rather large; inner margin crenulated." Conrad, 1845.

Height, 19 mm.; length, 48 mm.; width, 34 mm.

Occurrence.—St. Mary's Formation (?). "St. Mary's River" (*fide* Conrad). Choptank Formation. Jones Wharf, Governor Run, 2 miles south of Governor Run, Greensboro, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Fissuridea redimicula (Say).

Plate LXIII, Fig. 6.

Fissurella redimicula Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 132, pl. viii, fig. 1. (Reprint, 1896, Bull. Amer. Pal., No. 5.)

Fissurella redimicula Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78.

Not *Fissurella redimicula* Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 113, pl. xxv, fig. 14.

Fissurella redimicula Emmons, 1858, Rept. N. Car. Geol. Survey, p. 277, fig. 196.

Fissurella redimicula Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Fissurella redimicula Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.

Fissuridea redimicula Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 425.

Description.—"Ovate-oval a little oblong, conic-convex, with approximate longitudinal striæ; foramen ovate-oval, inclined.

"Longitudinal striæ slender, numerous, granulated, approximate; the granulations of the striæ give the appearance of concentric obsolete lines: *aperture,* inner margin crenate; thickened inner margin of the foramen truncate at one end." Say, 1824.

The typical form of this species, with uniform sculpture is not authentically known from Maryland, although the type is supposed to have come from the St. Mary's River. Possibly *F. alticosta* Conrad should be considered a variety or a synonym of this species.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—British Museum.

Genus EMARGINULA Lamarck.

Emarginula marylandica n. sp.

Plate LXIII, Figs. 7a, 7b.

Description.—Shell small, moderately thick, depressed; apex slightly posterior to the center; base oval; anterior slope broadly and regularly convex; posterior slope shorter, strongly concave above, straight for the lower two-thirds; sculpture consisting of about 30 raised rounded radiating ribs with intermediate smaller ones toward the periphery of the posterior end, and with rugose irregular lines of growth; notch nearly medial; interior smooth; margins of the notch thickened; the thickening extending nearly to the apex in a belt which is slightly depressed in the center; periphery slightly thickened.

Height, 2.5 mm.; length, 6.5 mm.; width, 5.5 mm.

Occurrence.—Choptank Formation. Greensboro.

Collection.—Maryland Geological Survey.

Class AMPHINEURA.

Order POLYPLACOPHORA.

Suborder MESOPLACOPHORA.

Family ISCHNOCHITONIDÆ.

Genus CHÆTOPLEURA Shuttleworth.

Chætopleura apiculata (Say).

Plate LXIV, Figs. 1a, 1b, 2a, 2b, 2c.

Chiton apiculatus Say, 1834 (?), American Conchology, Appendix.

Chiton transenna H. C. Lea, 1843, New Fossil Shells from the Tertiary of Virginia, Abst., p. 5.

Chiton transenna H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 246, pl. xxxv, fig. 35.

Description.—"Valves eight; dorsal triangles with series of elevated points; lateral triangles with scattered elevated points.

"Inhabits the coast of South Carolina.

"Whitish; oval-oblong, convex, subcarinated; eight-valved; anterior valve with numerous, separate, elevated, equal, subequidistant, points; the six following valves have on their dorsal triangles from twenty to thirty longitudinal series of equal, elevated, approximate rounded points; their lateral triangles with elevated points, as on the anterior valve; posterior valve at base like the dorsal triangles, its broad margin with the points like those of the anterior valve. Length nearly half an inch." Say, 1834.

This species which is living on the Atlantic coast from Cape Cod to

Florida, was described by H. C. Lea from the Miocene of Petersburg, Virginia, as *Chiton transenna* n. sp. Lea's types which consist of a tail valve and several medial valves, show the identity of the Virginia form with the recent species and with the Maryland fossils.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, U. S. National Museum.

CLASS SCAPHOPODA.

Order SOLENOCONCHIA.

Family DENTALIIDÆ.

Genus DENTALIUM Linné.

DENTALIUM ATTENUATUM Say.

Plate LXIV, Fig. 3.

Dentalium attenuatum Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 154, pl. viii, fig. 3. (Reprint, 1896, Bull. Amer. Pal., No. 5.)

Dentalium attenuatum Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 211.

Dentalium dentalis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187. (Not of Lamarck.)

Dentalium dentale Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78, pl. xliv, fig. 9.

Dentalium attenuatum Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 105, pl. xxv, fig. 1.

Dentalium attenuatum Emmons, 1858, Rept. N. Car. Geol. Survey, p. 274, fig. 188.

Dentalium attenuatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Dentalium attenuatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.

Dentalium attenuatum Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 439.

Description.—"Arcuated; surface marked with from twelve to sixteen rounded ribs, intervening grooves simple; lines of growth numerous, distinct; aperture orbicular." Say, 1824.

Length, 39 mm.; diameter, 3.5 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Langley's Bluff. CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

DENTALIUM DANAI Meyer.

Plate LXIV, Fig. 4.

Dentalium Danai Meyer, 1885, Amer. Jour. Sci., ser. iii, vol. xxix, p. 462.
Dentalium Danai Meyer, 1886, Ala. Geol. Survey, Bull. i, pt. ii, p. 64, pl. iii, figs. 2, 2a.
Dentalium Danai Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 439.

Description.—" Smooth, section circular; smaller aperture with additional tube; margin distinctly notched on the convex side of the shell; slightly emarginate on the concave side." Meyer, 1886.

Length, 68 mm.; diameter, 4 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Cornell University.

DENTALIUM CADULOIDE Dall.

Plate LXIV, Figs. 5a, 5b.

Dentalium caduloide Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 442, pl. xxiii, fig. 25.

Description.—" Shell small, thin, slightly curved, smooth but not polished, marked only with incremental lines which cross the tube somewhat obliquely; shell cylindrical, posterior orifice small, circular, the margin without notch or sulcus, rarely even perceptibly deviating from a circle except when worn or chipped." Dall, 1892.

Length, 12 mm.; diameter (maximum), 1.3 mm., (minimum) 0.5 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River, Cove Point, Langley's Bluff. CHOPTANK FORMATION. Greensboro, Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Genus CADULUS Philippi.

CADULUS THALLUS (Conrad).

Plate LXIV, Fig. 6.

Dentalium thallus Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 142.

Dentalium thallus Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 78, pl. xliv, fig. 5.

Dentalium thallus H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 230.

Dentalium thallus Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 106, pl. xxv, fig. 3.

Dentalium thallus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 274, fig. 190.

Dentalium thallus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 570.

Dentalium ? thallus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 14.

Cadulus thallus Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 445.

Description.—" Shell slightly curved, smooth, highly polished; swelling below the middle; aperture very regularly oval." Conrad, 1834.

" Subulate, slightly curved, smooth, polished, tumid below the middle." Conrad, 1845.

Length, 7 mm.; diameter, 1.5 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Dover Bridge, Pawpaw Point, Peach Blossom Creek, Greensboro, Governor Run (lower bed), Trappe Landing, Jones Wharf. CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

CADULUS NEWTONENSIS Meyer and Aldrich.

Plate LXIV, Fig. 7.

Cadulus Newtonensis Meyer and Aldrich, 1886, Cin. Jour. Nat. Hist., vol. ix, No. 2, p. 40, pl. ii, figs. 3a, 3b.

Cadulus newtonensis Dall, 1892, Trans. Wagner Free Inst. Sci., vol. iii, pt. ii, p. 444.

Description.—" Two depressed fragments from Newton show an aperture which is different from the other known apertures of Cadulus of the Southern Eocene. Two distant deep notches on the convex side, and two less distant emarginations on the concave side of the shell divide the margin of the elliptical aperture into four appendages, of which the two small opposite ones are equal, the two larger ones, however, very unequal." Meyer and Aldrich, 1886.

Length, 7.5 mm.; diameter, 1.1 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collections.—Maryland Geological Survey, U. S. National Museum.

Class PELECYPODA.

Order TELEODESMACEA.

Superfamily ADESMACEA.

Family PHOLADIDÆ.

Subfamily PHOLADINÆ.

Genus PHOLAS (Linné) Lamarck.

Subgenus THOVANA Gray.

PHOLAS (THOVANA) PRODUCTA Conrad.

Plate LXV, Fig. 1.

Pholas oblongata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 103, pl. xxiv, fig. 5.
Not *Pholas oblongata* Say.
Pholas producta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Pholas producta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Pholas (*Thovana*) *producta* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 815.

Description.—"Shell oblong-ovate, inflated, transversely and longitudinally striated; striæ muricated, and elevated on the buccal side into ribs; buccal margin acutely rounded; anal margin compressed; dorsal margin anteriorly reflexed, forming a cavity; hinge callous, minutely striated transversely and longitudinally, and with about twelve cells." Tuomey and Holmes, 1856.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collection.—Maryland Geological Survey.

Genus BARNEA (Leach MS.) Risso.

Subgenus SCOBINA Bayle.

BARNEA (SCOBINA) ARCUATA (Conrad).

Plate LXV, Figs. 2, 3.

Pholas arcuata Conrad, 1841, Fossils of the Medial Tertiary, p. 3 of cover of No. 2.
Pholas acuminata Conrad, 1845, Fossils of the Medial Tertiary, p. 77, pl. xliv, fig. 2.

Pholas arcuata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Pholas arcuata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Barnea (Scobina) arcuata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 816.

Description.—" Shell oblong-ovate, with numerous ribs, elevated on the posterior side, and concentric wrinkled striæ, lamelliform on the anterior side; ribs squamose; base arcuated." Conrad, 1841.

This species differs from *P. costata* found so abundantly at Cornfield Harbor by being smaller, by having a longer umbonal reflection, and by being thicker and stronger. We have only a few broken valves.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Genus MARTESIA Leach.

Section ASPIDOPHOLAS Fischer.

Martesia ovalis (Say).

Plate LXV, Figs. 4, 5, 6, 7, 8, 9.

Pholas ovalis Say, 1820, Amer. Jour. Sci., vol. ii, p. 39.
Martesia (?) *ovalis* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 820, pl. xxxvi, fig. 5.

Description.—" Tube equal, entire and rounded at base, and gradually attenuated towards the anterior termination. Shell subovate, dehiscent; valves with crowded, acute, elevated, transverse lines, somewhat decussate with longitudinal slightly indented ones, a more conspicuous longitudinal indented line before the middle, posterior basal margin smooth; within equal, the posterior basal margin distinguished by a slight undulation." Say, 1820.

Shell small, oval, elevated, thin, and fragile; a radial furrow extends obliquely across the shell from the beak to a point on the ventral margin slightly posterior to the middle, from this point a fine curved line extends diagonally forward and upward to the upper part of the anterior margin, thus dividing the surface into three portions, the anterior one being smooth, extremely thin and usually entirely broken off, the middle one being covered with fine, close, distinct, minutely crimped lamellæ running parallel to the curved line, bounding them anteriorly; the posterior portion with only rather coarse, irregular, concentric growth lines: umbonal reflection small, heavy, standing almost vertically and curved posteriorly: within, chondrophore long, curved, narrow; posterior ligament area distinct, elongated, oval; median furrow showing as a slight ridge: umbonal area covered by a large, elongated oval or hour-glass shaped protoplax extending forward to below the middle of the anterior margin, backward nearly to the ends of the valves and covering a third of the side of the shell, being sometimes laterally contracted into a somewhat hour-glass outline: shell enclosed in a calcareous tube or siphonoplax lining the burrow, thin anteriorly, thickened and contracted posteriorly: other accessory plates absent.

This interesting little shell is found often riddling the valves of *Melina maxillata.* There can be no doubt of its identity with Say's species. *M. rhomboidea* H. C. Lea is, as remarked by him in describing it, not just identical with *M. ovalis,* although the differences are slight and may not be of specific value,—still it is thought best not to unite them without examining a series of specimens of Lea's species.

Length, 16 mm.; height, 10 mm.; diameter, 5.5 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Jones Wharf, Pawpaw Point, St. Leonard Creek, Governor Run (lower bed), Cordova. Calvert Formation. Plum Point, White's Landing, Reeds.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Superfamily MYACEA.

Family SAXICAVIDÆ.

Genus PANOPEA Ménard.

Panopea whitfieldi Dall.

Plate LXV, Fig. 10.

Panopæa Goldfussii Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 89, pl. xvi, figs. 9–13.
Not *Panopea Goldfussii* Wagner, 1838.
Panopea Whitfieldi Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 829.

Description.—Shell elongate-ovate; beaks approximate, not prominent; anterior and posterior portions of the valves almost equal; anterior portion not or but slightly expanded; posterior not or but slightly contracted and produced; surface with irregular, concentric undulations, more or less strongly marked and sometimes lamellar.

It differs from *P. goldfussii* Wagner in being more equilateral, less expanded anteriorly and less contracted and produced posteriorly.

Length, 90 mm.; height, 51 mm.; diameter, 8 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run (lower bed). CALVERT FORMATION. Plum Point, Lyon's Creek, White's Landing, Wye Mills, Fairhaven, New Town (?).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

PANOPEA GOLDFUSSII Wagner.

Plate LXVI, Fig. 1.

Panopea Goldfussii Wagner, 1839, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 52, pl. i, fig. 3. Probably published privately in 1838.
Panopæa porrecta Conrad, 1842, Fossils of the Medial Tertiary, p. 71, pl. xli, fig. 2.
Glycimeris Goldfussii Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Panopæa Goldfussii Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Panopæa porrecta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Panopea Goldfussii Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv. p. 829.

Description.—"Shell oblong, subovate, ventricose; disks with concentric, unequal, shallow grooves; lines of growth coarse and prominent; anterior extremity slightly gaping; anterior margin rounded, anterior dorsal margin elevated; posterior side narrowed, somewhat produced, not reflected; posterior dorsal margin nearly rectilinear; cardinal teeth obliquely compressed, united at base to the nympha, short and not very prominent." Wagner, 1839.

Length, 117 mm.; height, 58 mm.; diameter, 21 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River. CHOPTANK FORMATION. Governor Run (lower bed), Jones Wharf, Pawpaw Point. CALVERT FORMATION. Plum Point, Wye Mills, New Town(?).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Panopea americana Conrad.

Plate LXVI, Fig. 2.

Panopæa Americana Conrad, 1838, Fossils of the Medial Tertiary, p. 4, pl. ii, fig. 1.
Glycimeris Americana Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Panopæa Americana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Panopea americana Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 830.

Description.—" Shell rhomboidal, flexuous, profoundly gaping at both extremities; surface undulate with coarse lines of growth; anterior margin obliquely truncated, nearly parallel with the posterior margin, which is also oblique and truncated; basal margin contracted in the middle; cardinal process very prominent and slender; nympha profound and very thick, its upper surface transversely striated; right valve with a wide and profound cardinal fosset." Conrad, 1838.

This species is very abundant, large, and well preserved in the Choptank formation.

Length, 190 mm.; width, 102 mm.; diameter, 34 mm.

Occurrence.—Choptank Formation. Governor Run (upper and lower beds), 2 miles south of Governor Run (upper and lower beds), Flag Pond, St. Leonard Creek, Jones Wharf, Turner, Pawpaw Point, Peach Blossom Creek, Cordova, Greensboro. Calvert Formation. 3 miles south of Chesapeake Beach, Reeds, Wye Mills, Lyon's Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus SAXICAVA Fleuriau de Bellevue.

Saxicava arctica (Linné).

Plate LXVI, Figs. 3, 4, 5, 6.

Mya arctica Linné, 1767, Syst. Nat., 12th Edit., p. 1113.
Mya arctica Fabricius, 1780, Fauna Grönlandica, p. 407.
Saxicava distorta Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 318.
Saxicava bilineata Conrad, 1838, Fossils of the Medial Tertiary, p. 18, pl. x, fig. 4.
Saxicava distorta Gould, 1841, Invert. Mass., p. 61, fig. 40.
Saxicava bilineata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Saxicava bilineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Saxicava insita Conrad, 1869, Amer. Jour. Conch., vol. v, p. 40.
Saxicava incita Conrad, 1869, Amer. Jour. Conch., vol. v, p. 101.
Saxicava arctica Gould (Binney's), 1870, Invert. Mass., p. 89.
Saxicava arctica Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 834.

Description.—This shell varies extremely according to age and position and has received many names; for much fuller synonymy see Binney and Dall (*cit. supra*).

As most frequently found in Maryland the shell is roughly quadrilateral in outline; inequivalve, the right valve overlapping; beak nearly terminal; from it two ridges extend backward, one near the superior dorsal margin and the other, usually more prominent, to the posterior basal angle; exterior surface irregularly undulated and coarsely marked by lines of growth; anterior and posterior margins often almost squarely truncated; anterior basal margin at times contracted; teeth obsolete or at times one in either valve.

Instead of being quadrilateral, the outline may be very greatly modified by the production or curving of some portion of the margin. The ridges running back from the beak are perhaps the most constant character.

Length, 19 mm.; height, 9 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Governor Run (upper and lower beds), 2 miles south of Governor Run (upper and lower beds), Flag Pond, Jones Wharf, Turner, Pawpaw Point, St. Leonard Creek, Dover Bridge, Greensboro. Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, White's Landing, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family CORBULIDÆ.

Genus CORBULA (Bruguière) Lamarck.

Section CORBULA ss.

Corbula idonea Conrad.

Plate LXVII, Figs. 1, 2, 3.

Corbula idonea Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 341.
Corbula idonea Conrad, 1838, Fossils of the Medial Tertiary, p. 6, pl. x, fig. 6.
Corbula idonea Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Corbula idonea Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Corbula idonea Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 88, pl. xv, fig. 20.
Corbula (Corbula) idonea Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 852.

Description.—" Shell subtriangular, convex, thick, obscurely undulated; with a fold on the posterior submargin and the extremity angular; basal margin acute; cardinal tooth very thick and elevated. Length, one inch." Conrad, 1833.

Surface of left valve with obsolete concentric undulations, angular posteriorly; right valve with irregular, concentric undulations, beak more prominent and strongly curved than in lower valve; posterior submargin ridged, tooth massive.

Length, 34 mm.; height, 29 mm.; diameter, 13 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Cuckold Creek, Turner, Pawpaw Point, Dover Bridge, Peach Blossom Creek, Trappe Landing, Cordova, Greensboro, Skipton. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Reeds.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Section ALOIDIS Megerle von Mühlfeld.

CORBULA ELEVATA Conrad.

Plate LXVII, Figs. 4, 5.

Corbula elevata Conrad, 1838, Fossils of the Medial Tertiary, p. 7, pl. iv, fig. 3.
Corbula elevata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Corbula elevata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Corbula curta Conrad, 1867, Amer. Jour. Conch., vol. iii, p. 269, pl. xxi, figs. 6–8.
Corbula (Aloidis) elevata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 852.

Description.—" Shell triangular, equilateral, height greater than the length; inferior valve ventricose, with regular numerous concentric impressed lines, which disappear on the posterior slope; umbo profoundly elevated; posterior slope with an obtuse furrow descending from the beak; extremity narrowed, slightly emarginate." Conrad, 1838.

Length, 12 mm.; height, 12.5 mm.; diameter, 4.5 mm.

Occurrence.—CALVERT FORMATION. Fairhaven, Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Lyon's Creek, Truman's Wharf, White's Landing, Reeds, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Section CUNEOCORBULA Cossmann.

CORBULA INÆQUALIS Say.

Plate LXVII, Figs. 6, 7, 8, 9, 10, 11, 12, 13, 14.

Corbula inæquale Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 153, pl. xiii, fig. 2;—not of Conrad, 1838, Fossils of the Medial Tertiary, p. 6.

Corbula cuneata Conrad, 1838, Fossils of the Medial Tertiary, p. 5 (excl. diag.), pl. iii, fig. 2.

Corbula inæquale Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 76, pl. xx, fig. 12.

Corbula inæqualis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.

Corbula subcontracta Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 88, pl. xv, figs. 11–14.

Corbula cuneata Harris, 1896, Bull. Amer. Pal., No. 5, pp. 329, 346, pl. xiii, fig. 2;—not of Say, 1824.

? *Corbula (Cuneocorbula) Whitfieldi* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 849, pl. xxxvi, fig. 18.

Corbula (Cuneocorbula) inæqualis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 853.

Corbula (Cuneocorbula) subcontracta Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 854.

Description.—" Shell convex, transversely ovate-trigonal, rough, with unequal coarse wrinkles: anterior margin with a very acute but short rostrum at its inferior termination, separated from the disk by an acute line: base rounded and a little contracted near the anterior angle: umbones not prominent." Say, 1824.

This species is somewhat variable in size, outline, thickness of shell, and strength of ornamentation. Specimens from Church Hill are quite small and agree with the types of *C. subcontracta.* The upper posterior angle in Whitfield's fig. 11 is not characteristic, his fig. 12 is much more typical. Between the larger Church Hill specimens, some from Plum Point, and specimens of *C. whitfieldi,* there seems to be very little, if any, essential difference. Specimens from the Jones Wharf horizon are often more finely striated than those from the Calvert formation, while those from the St. Mary's formation are largest, thickest and have the most rounded base. All agree in having rather coarse, irregular, concentric undulations.

Length, 10.5 mm.; height, 7 mm.; diameter, 2.6 mm.—St. Mary's River specimen.

Occurrence.—ST. MARY'S FORMATION. Cove Point, Langley's Bluff, St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Pawpaw Point, Dover Bridge, Peach Blossom Creek, Trappe Landing, Cordova. CALVERT FORMATION. Fairhaven, Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Lyon's Creek, White's Landing, Truman's Wharf, Wye Mills, 3 miles west of Centerville, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

CORBULA CUNEATA Say.

Plate LXVII, Figs. 15, 16, 17, 18, 19.

Corbula cuneata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 152, pl. xiii, fig. 3.

Corbula inæquale Conrad, 1838, Fossils of the Medial Tertiary, p. 6, pl. iii, fig. 3, (left hand one), (diagn. and remarks excluded.)

Corbula cuneata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.

Corbula (Cuneocorbula) cuneata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 854.

Description.—" Shell transversely ovate-trigonal, acutely angulated or somewhat rostrated before, and depressed on the anterior slope, which is separated from the disk by a subacute line: surface of both valves similarly striate with equal, elevated, equidistant lines, forming grooves between them; the striæ on the smaller valve are rather more distant: umbones not prominent." Say, 1824.

It may be distinguished from *C. inæqualis* by having striæ that are much finer and more close set, equal, and equidistant than in *C. inæqualis*. It is also much less common. When found at all it is more commonly at the Jones Wharf horizon.

Length, 12 mm.; height, 7.5 mm.; diameter, 2.5 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Pawpaw Point, Turner, Trappe Landing, Greensboro, Cordova. CALVERT CORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family MYACIDÆ.

Genus MYA (Linné) Lamarck.

Mya producta Conrad.

Plate LXVIII, Figs. 1a, 1b, 2.

Mya producta Conrad, 1838, Fossils of the Medial Tertiary, p. 1, pl. i, fig. 1.
Mya prælonga Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185,—name only.
Mya producta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Mya producta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Mya producta Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 858.

Description.—"Shell profoundly elongated, elliptical, flexuous; surface coarsely wrinkled; beaks prominent, flattened posterior to the middle; base emarginate, corresponding to the furrow on the disk; left valve with obsolete radiating striæ; cardinal tooth profoundly dilated." Conrad, 1838.

"This is a fine and remarkably elongated species, gaping at both extremities, and very rare."

We have but one imperfect valve.

Length, 123 mm.; height, about 50 mm.; diameter, 14 mm.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Genus SPHENIA Turton.

Sphenia dubia (H. C. Lea).

Plate LXVIII, Figs. 3, 4, 5, 6.

Panopæa dubia H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 236, pl. xxxiv, fig. 9.
Glycimeris dubia Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Panopæa dubia Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Sphenia dubia Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 859.

Description.—"Shell quadrately elliptical, transverse, inequilateral, posteriorly truncate, anteriorly rounded, somewhat inflated, rather thick, striate; striæ concentric, regular; basal margin straight; beaks prominent; nymphæ large, exserted, very long; hinge with a small fosset." Lea, 1845.

The shape is quite variable according to the conditions of growth; shell moderately or markedly convex, produced and truncated or attenuated posteriorly; striæ not regular but somewhat irregular and changing into shallow undulations, those on the dorsal and posterior slopes meeting at nearly a right angle; left valve with a flat tooth internally smooth, externally slightly grooved and fitting into a well marked fosset in the right valve, which is bounded anteriorly by a slight ridge.

A remarkably fine large specimen from Jones Wharf measures in length, 18 mm.; height, 11 mm.; diameter, 4 mm.

Occurrence.—Choptank Formation. Governor Run, Jones Wharf, Pawpaw Point, Greensboro. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus PARAMYA Conrad.

Paramya subovata Conrad.

Plate LXVIII, Figs. 7, 8.

Myalina subovata Conrad, 1845, Fossils of the Medial Tertiary, p. 65, pl. xxxvi, fig. 4.

Paramya subovata Conrad, 1860, Proc. Acad. Nat. Sci. Phila., vol. xii, p. 232.

Paramya subovata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.

Paramya subovata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.

Paramya subovata Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 70.

Paramya subovata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 861.

Description.—" Subovate, inequilateral, ventricose over the umbonal slope, slightly flattened from beak to base; surface with irregular concentric lines; ligament and basal margins straight, parallel; a spoon-shaped fosset in each valve, the lateral margins of which are carinated; fosset emarginate at base." Conrad, 1845.

Basal and ligament margins not parallel but divergent posteriorly. Quite rare.

Length, 5.5 mm.; height, 4 mm.; diameter, 1 mm.

Occurrence.—Choptank Formation. 2 miles south of Governor Run, Jones Wharf. Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Superfamily MACTRACEA.

Family MESODESMATIDÆ.

Subfamily MESODESMATINÆ.

Genus MESODESMA Deshayes.

MESODESMA MARIANA n. sp.

Plate LXIX, Figs. 1, 2, 3.

Description.—Shell ovate, depressed, inequilateral; anterior end much the longer; beak very low; anterior side straight; anterior end acutely rounded and much above the line of the base; base a regular curve continuous with curve of anterior end; posterior side and end bluntly curved, meeting the base at an angle on the line of the base; posterior adductor scar compact, oval; anterior scar elongated and largest below; pallial line distinct; pallial sinus moderately deep, rounded; exterior surface somewhat polished with some irregular fine concentric growth lines.

Length, 9.75 mm.; height, 6.5 mm.; diameter, 1.8 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Subfamily ERVILIINÆ.

Genus ERVILIA Turton.

ERVILIA PLANATA Dall.

Plate LXIX, Figs. 4, 5, 6.

Ervilia planata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 915.

Description.—"Shell small, subtriangular, flattened, smooth or obscurely concentrically ridged, subequilateral; the beaks low, calyculate; the dorsal slopes slightly rounded, subequal; the base evenly arched, not projecting; hinge well developed, the marginal grooves in the right valve almost as long as the dorsal margins; pallial sinus small, rounded in front, falling considerably short of the vertical from the beaks. Lon. 3.25, alt. 2.25, diam. 1.5 mm." Dall, 1898.

Occurrence.—CALVERT FORMATION. Church Hill.

Collection.—Maryland Geological Survey.

Family MACTRIDÆ.

Subfamily MACTRINÆ

Genus MACTRA (L.) Lamarck.

MACTRA CLATHRODON Lea.

Plate LXIX, Figs. 7, 8, 9.

Mactra clathrodon Lea, 1833, Contrib. to Geology, p. 212, pl. vi, fig. 223.
Mactra subcuneata Conrad, 1838, Fossils of the Medial Tertiary, p. 28, pl. xv, fig. 3.
Mactra clathrodon Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 892.

Description.—"Shell subtriangular, thin, inequilateral, obscurely and transversely striate; beaks somewhat pointed; lateral teeth crossed by equidistant minute striæ; excavation of the pallial impression small and rounded; anterior and posterior cicatrices scarcely visible; cavity of the shell somewhat deep; cavity of the beaks rather deep." Lea, 1833.

Lea's type specimens are the young of the same species whose adult form Conrad later described as *M. subcuneata.*

Length, 33 mm.; height, 25 mm.; diameter, 7 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, Langley's Bluff, St. Mary's River. CALVERT FORMATION. Plum Point, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus SPISULA Gray.

Subgenus HEMIMACTRA Swainson.

Section MACTROMERIS Conrad.

SPISULA (HEMIMACTRA) DELUMBIS (Conrad).

Plate LXIX, Fig. 10.

Mactra delumbis Conrad, 1832, Fossil Shells of the Tertiary, p. 26. pl. xi.
Mactra delumbis Conrad, 1838, Fossils of the Medial Tertiary, p. 27, pl. xv, fig. 1.
Mactra delumbis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Mactra delumbis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Mactra Virginiana Conrad, 1867, Amer. Jour. Conch., vol. iii, pp. 188, 269, pl. xxii, fig. 4.
Mactra (Schizodesma) delumbis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 82, pl. xv, fig. 10.
Spisula (Hemimactra) delumbis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 897, pl. xxvii, fig. 26.

Description.—"Suboval, thin and fragile, with a fold on the posterior submargin; umbo prominent; beaks nearly central, approximate; lunule much elongated, lanceolate, slightly impressed." Conrad, 1832.

Surface nearly smooth, teeth prominent, fosset large, pallial sinus acutely rounded, distinguished from *S. marylandica* by having but one elevated line on upper posterior slope. No specimens obtained were perfect enough to measure.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Governor Run, Jones Wharf. Calvert Formation. Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Spisula (Hemimactra) marylandica Dall.

Plate LXIX, Fig. 11.

Spisula (Hemimactra) marylandica Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 897, pl. xxviii, fig. 5.

Description.—"Shell large, suboval, thin, inflated, with a nearly smooth surface, marked chiefly by incremental and obsolete radiating lines; beaks high, subcentral, adjacent; anterior end excavated above, rounded in front, posterior sloping to a bluntly pointed end behind; anterior dorsal area smooth and deeply impressed; posterior area somewhat depressed, striated, flexuous, with three obscure, elevated lines, extending from the umbo to the margin outside of the area; base arcuate; pallial sinus rather narrow, extending nearly to the middle of the shell, bluntly pointed in front; hinge strong, with a large oblique chondrophore, very short, smooth lateral laminæ, and the anterior arm of the right cardinal tooth coalescent with the ventral lamina.

"This fine species is at once differentiated from *S. delumbis* by its more equilateral and inflated shell, and by having instead of only one three elevated lines radiating backward from the beak." Dall, 1898.

Length, 90 mm.; height, 67 mm.; diameter, 40 mm. (Dall).

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Spisula (Hemimactra) curtidens Dall.

Plate LXIX, Figs. 12, 13.

Spisula (Hemimactra) curtidens Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 898, pl. xxvii, figs. 2, 24.

Description.—" Shell large, not heavy, subtrigonal, with low, narrow, rather pointed beaks, the anterior being markedly longer than the posterior end; surface smooth or striated by incremental lines, and near the base by fine, obscure, irregular longitudinal wrinkles; valves moderated, inflated; anterior end produced, depressed above, rounded in front; posterior end short, flattened in front of the beaks, posterior dorsal area impressed and bounded by a rounded ridge which extends from the beak to the margin; anterior dorsal area impressed, with a somewhat flexuous surface; hinge with a large but not projecting chondrophore; in the right valve the dorsal laminæ are very short and smooth, the cardinal tooth quite compressed. Lon. (of young shell) 22, alt. 17, diam. about 9 mm.; but judging from the fragments found, the species reaches when adult a height and length of 90 mm.

" This fine *Spisula* is sharply distinguished from any other American species by its high and triangular form, short, excavated hinge-plate, and the inequilaterality of the shell." Dall, 1898.

Occurrence.—Choptank Formation. Dover Bridge (Dall). Calvert Formation. Burch's (Dall).

Collection.—U. S. National Museum.

Spisula (Hemimactra) subponderosa (d'Orbigny).

Plate LXX, Figs. 1, 2, 3, 4.

Mactra ponderosa Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 228, pl. x, fig. 5,—not of Eichwald, 1830, Nat. Skizze von Lith., p. 207.
Mactra ponderosa Conrad, 1838, Fossils of the Medial Tertiary, p. 25, pl. xiv, fig. 1.
Mactra subponderosa d Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 100.
Mactra ponderosa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Mactra ponderosa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Mactrodesma ponderosa Conrad, 1869, Amer. Jour. Conch., vol. iv, p. 247.
Spisula (Hemimactra) subponderosa Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 899, pl. xxvii, figs. 3, 16.

Description.—" Shell subtriangular, convex, thick, concentrically undulated; anterior margin depressed, with an obtuse plication at the angle; beaks nearest the posterior margin.

"Three and a quarter inches in length and four and a quarter inches in breadth. The cardinal pit is large, thick, and subcordate, and the lateral teeth are short and very robust; when the valves are closed, the depression on the anterior slope forms a slightly concave area." Conrad, 1830.

Length, 108 mm.; height, 86 mm.; diameter, 28 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Spisula (Hemimactra) confraga (Conrad).

Plate LXX, Figs. 5a, 5b.

Mactra confraga Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 340, not spelled *confragosa.*
Mactra fragosa Conrad, 1838, Fossils of the Medial Tertiary, p. 26, pl. xiv, fig. 2.
Mactra incrassata Conrad, 1838, Fossils of the Medial Tertiary, p. 24, pl. xiii, fig. 2.
Mesodesma confraga Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Mesodesma incrassata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Spisula confragosa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Spisula confragosa Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 900.

Description.—"Shell subtriangular; narrow, somewhat thick, with coarse concentric lines; umbo oblique; beaks a little elevated, approximate; posterior side longer and less obtuse than the anterior; fosset large cordate, oblique; lateral teeth strong; muscular impressions large. Length two inches." Conrad, 1833.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Governor Run, Jones Wharf, Cordova, Sand Hill. Calvert Formation. Chesapeake Beach. Reed's.

Collections.—Philadelphia Academy of Natural Sciences, Maryland Geological Survey, Johns Hopkins University.

Spisula (Hemimactra) subparilis (Conrad).

Plate LXX, Figs. 6a, 6b.

Mactra subparilis Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 346, pl. ii, fig. 12.
Mactra subparilis Conrad, 1845, Fossils of the Medial Tertiary, p. 69, pl. xxxix, fig. 4.
Standella subparilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 573.
Standella subparilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Spisula (Mactromeris) subparilis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 900.

Description.—" Triangular, elongated, moderately thick, convex-depressed; posterior side cuneiform; apex hardly oblique, subcentral; fosset wide; lateral teeth transversely striated." Conrad, 1841.

Only young specimens have been obtained in Maryland.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Pawpaw Point. CALVERT FORMATION. 3 miles south of Chesapeake Beach, Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

SPISULA (HEMIMACTRA ?) CHESAPEAKENSIS n. sp.

Plate LXXI, Fig. 1.

Description.—Shell large, thin, not inflated, subtrigonal, anterior and posterior sides nearly equal, surface smooth; anterior end well rounded, posterior end rather more sharply rounded; anterior hinge line straight, posterior hinge line gently convex, just posterior to the beak, otherwise straight; angle between anterior and posterior hinge lines about 105°; basal margin strongly curved anteriorly and posteriorly; hinge area broad; lateral teeth prominent; chondrophore long, narrow, triangular, oblique.

A single right valve of this magnificent species has been obtained. It is in the form of a cast, with a portion of the shell substance preserved and the outline and main hinge features easily distinguishable. It is much larger than any of the other Miocene Spisulas; *S. subponderosa* is nearest it in size, but is smaller, much heavier, more elevated, and has a curved posterior hinge line and a broader, shorter chondrophore.

Length, 130 mm.; height, 95 mm.

Occurrence.—CALVERT FORMATION. 3 miles north of Plum Point.

Collection.—Maryland Geological Survey.

Genus LABIOSA (Schmidt) Moller.

Subgenus RAËTA Gray.

LABIOSA (RAËTA) SP.

Description.—At Reed's marl pit have been found numerous fragments of a *Labiosa* showing an undular concentric sculpturing much stronger than *R. alta,* in fact as strong as *L. canaliculata.* As this latter species is known only in the Pleistocene and Recent it is very probable that the fragments found at Reed's belong to a new species. It is best not to attempt to name or describe a new species from the broken material at hand, but the presence of a species in the Miocene at this locality should be noted in the hope that some later investigator may be fortunate enough to secure material suitable for specific characterization.

Occurrence.—CALVERT FORMATION. Reed's.

Collection.—Maryland Geological Survey.

Superfamily SOLENACEA.

Family SOLENIDÆ.

Genus ENSIS Schumacher.

ENSIS DIRECTUS (Conrad).

Plate LXXI, Figs. 2, 3.

Solen ensis Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 191; not of Linné.

Solen directus Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 325.

Solen magnodentatus H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 236, pl. xxxiv, fig. 8.

Solen ensis Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 101, pl. xxiv, fig. 3.

Solen americanus Gould (Binney's), 1870, Invert. Mass., p. 42.

Ensatella americana Verrill, 1872, Amer. Jour. Sci., ser. iii, vol. iii, pp. 212, 284.

Ensatella americana Verrill, 1874, Rept. Invert. An. Vin. Sound, p. 674, pl. xxxii, fig. 245.

Ensis americana Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 72, pl. liii, fig. 4; pl. lv, figs. 4, 5.

Ensis directus Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 954.

Description.—"Linear, straight, except towards the summit, where it is slightly recurved, gradually widening from the hinge downwards; basal margin rounded slightly towards the posterior extremity; anterior margin obliquely truncated, not reflected; cardinal teeth, one in the right valve, compressed, in the opposite valve two, the superior one very small and near the extremity, the other somewhat distant, elevated, robust, slightly recurved. Length, four inches." Conrad, 1843.

It is distinguished from *E. ensiformis* by being larger and by its more squarely truncated posterior end. It is almost impossible to secure more than broken pieces in the Maryland deposits.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Ensis ensiformis Conrad.

Plate LXXI, Figs. 4, 5, 6.

Solen ensiformis Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 326.
Solen ensiformis Conrad, 1845, Fossils of the Medial Tertiary, p. 76, pl. xliii, fig. 8.
Ensis ensiformis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 571.
Ensis ensiformis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Ensis ensiformis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 955.

Description.—"Linear, slightly curved, gradually narrowed from the middle to the posterior extremity, which is subcuneiform; anterior margin obliquely subtruncated." Conrad, 1845.

Shell thin, fragile; teeth two in left valve, separated by a very narrow deep cleft, in right valve one; anterior extremity flaring; posterior extremity tapered, rounded and gaping.

Although quite abundant at Cove Point, it is almost impossible to obtain it except in fragments.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Jones Wharf, Sand Hill, Greensboro. Calvert Formation. Fairhaven, Plum Point, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Superfamily TELLINACEA.

Family PSAMMOBIIDÆ.

Genus PSAMMOBIA Lamarck.

Subgenus PSAMMOBIA s. s. Dall.

Psammobia gubernatoria n. sp.

Plate LXXI, Figs. 7a, 7b.

Description.—Shell long-ovate, thin, fragile, depressed or flat, inequilateral; anterior end being broader and longer than the posterior one; beak very low; anterior side slightly curved and for some distance from the beak nearly parallel with the base; anterior end regularly rounded and broad; posterior side with broad projecting hinge plate; posterior side declining; posterior end rounded and more nearly on line of base than anterior end; base only slightly curved; lateral teeth none, cardinals in right valve two; posterior adductor scar oval, anterior one larger and somewhat elongated, both distinct; pallial sinus profound, rounded, faint; exterior semi-polished with faint concentric growth lines discernible; dorsal and posterior slopes meeting in an abrupt curve running from beak to base and becoming less marked near the base.

Length, 35 mm.; height, 17 mm.; diameter, 3.5 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, Jones Wharf. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus ASAPHIS Modeer.

ASAPHIS CENTENARIA (Conrad).

Plate LXXI, Figs. 8, 9.

Petricola centenaria Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 341.
Petricola centenaria Conrad, 1838, Fossils of the Medial Tertiary, p. 17, pl. x, fig. 1.
Psammocola regia H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 234, pl. xxxiv, fig. 17.
Psammocola pliocena Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 91, pl. xxii, fig. 8.
Pliorytis centenaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.
Asaphis centenaria Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 981.

Description.—"Shell oblong oval, with numerous prominent radiating striæ, and concentric wrinkles; lunule small, cordate, profoundly impressed; hinge with two teeth in one valve and three in the opposite, the middle one bifid. Length, two inches." Conrad, 1833.

Shell somewhat variable in outline and in proportion of length to altitude; irregular surface undulations quite marked or almost absent; the fine radial ridges usually somewhat undulating and often more distant on the anterior slope; left valve with but two teeth, the anterior one bifid and bounded anteriorly by a deep socket; a well-marked groove backward from the beak across the posterior hinge area; pallial sinus profound and rounded anteriorly; shell slightly gaping posteriorly.

Length, 53 mm.; height, 35 mm.; diameter, 10 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, St. Leonard Creek, Jones Wharf, Pawpaw Point, Dover Bridge, Peach Blossom Creek, Greensboro. CALVERT FORMATION. Fairhaven, Plum Point, Lyon's Creek, Magruder Ferry.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family SEMELIDÆ.

Genus SEMELE Schumacher.

SEMELE CARINATA (Conrad).

Plate LXXII, Figs. 1, 2, 3.

Amphidesma carinata Conrad, 1830, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 229, pl. ix, fig. 25.

Amphidesma carinata Conrad, 1838, Fossils of the Medial Tertiary, p. 37, pl. xix [1st ed.], fig. 7; [2nd ed.], fig. 11, 1840.

Sinodesmia carinata d'Orbigny, 1852, Prod. Pal., vol. iii, p. 101, No. 1890.

Sinodesmia carinata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 93, pl. xxiii, fig. 2.

Abra carinata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.

Abra carinata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.

Abra Holmesii Conrad, 1875, Rept. N. Car. Geol. Survey, vol. i, app. A, p. 19, pl. iii, fig. 8.

Semele carinata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 988, pl. xxxvi, figs. 23, 26.

Description.—"Shell transversely ovate, with concentric, rather distant, elevated, acute striæ; intervals transversely striated; anterior side with a slight fold; beaks rather prominent, with the apex acute; lateral teeth none." Conrad, 1830.

Fine concentric striæ between the distant, elevated ones; posterior side with a slight fold; posterior basal margin obliquely truncated; lateral laminæ in left valve small, in right valve lateral laminæ and sockets distinct; muscle impressions subequal; pallial sinus profound.

Length, 22 mm.; height, 16 mm.; diameter, 4 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River. CHOPTANK FORMATION. Cordova. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

SEMELE CARINATA VAR. COMPACTA Dall.

Plate LXXII, Figs. 4, 5a, 5b.

Semele carinata var. compacta Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, pp. 988, 989, pl. xxxvi, figs. 23, 26.

Description.—This variety, to which the figures given by Dr. Dall for *S. carinata* (cited above) more directly belong, is discriminated by him from the *S. carinata* by having "a somewhat more elongated form and more uniform and close-set sculpture, especially over the posterior dorsal area. The size of those collected is also smaller than that of the full-grown Miocene specimens."

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Semele subovata (Say).

Plate LXXII, Figs. 6, 7, 8.

Amphidesma subovata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 152, pl. x, fig. 10.
Amphidesma subovata Conrad, 1840, Fossils of the Medial Tertiary, p. 36.
Syndosmya subobliqua Conrad, 1854, Proc. Acad. Nat. Sci. Phila., vol. vii, p. 29.
Abra ovalis Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 288.
Abra subovata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Abra subovata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Semele subovata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 990.

Description.—"Shell transversely ovate-oval, with somewhat prominent and regular concentric striæ.

"Shell compressed; beaks rather before the middle, but little prominent; anterior submargin with an obsolete, obtuse undulation; lunule lanceolate; cardinal and lateral teeth prominent." Say, 1824.

This species may be distinguished from *S. carinata* by having all of its concentric striæ of about equal prominence and by having a somewhat more elongated and thinner shell. Lateral teeth in left valve not prominent, in the right prominent.

Length, 20.5 mm.; height, 14 mm.; diameter, 3 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Governor Run, 2 miles south of Governor Run, Jones Wharf, Peach Blossom Creek, Dover Bridge, Greensboro, Cordova. Calvert Formation. Fairhaven, 3 miles west of Centerville, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus ABRA Leach.

ABRA LONGICALLUS (Scacchi).

Plate LXXII, Figs. 9a, 9b.

Tellina longicallus Scacchi, 1836, Notizie intorno alle Conchiglie ed a zoofiti fossili, p. 16, pl. i, fig. 7.

Description.—Shell ovate, thin, convex or vaulted; beak not prominent; anterior and posterior sides straight, meeting at an angle; anterior end broad and regularly rounded; posterior end very acutely rounded, much above the line of the base and gaping; base regularly curved; posterior adductor scar rounded; anterior one elongated; pallial sinus long and irregularly curved; in right valve the lateral lamina on either side rather short and bordered by a moderately deep groove; cardinals two, minute; chondrophore elongated, narrow, oblique, closely grown to the posterior hinge line; exterior surface smooth.

Length, 11.5 mm.; height, 7.1 mm.; diameter, 2 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Cornell University.

ABRA MARYLANDICA n. sp.

Plate LXXII, Fig. 10.

Description.—Shell small, compact, stout, vaulted; anterior end produced and rounded; posterior end shorter, more pointed; and nearer the line of the base; anterior and posterior dorsal margins nearly straight, anterior one nearly parallel to the basal margin, posterior one much more declining; beak not prominent, but angular; exterior polished and smooth except for a few feeble concentric growth lines near the margin, muscle impressions and pallial line faint, interior polished; in left valve a narrow fosset directed posteriorly and close set against the posterior margin; anterior to it is a small triangular cardinal tooth, posterior to it the margin is slightly raised as if into a faint lamina and slightly flaring or reflexed near the beak.

Length, 7 mm.; height, 4.5 mm.; diameter, 1.6 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus CUMINGIA Sowerby.

CUMINGIA MEDIALIS Conrad.

Plate LXXII, Figs. 11, 12.

Cumingia tellinoides Conrad, 1838, Fossils of the Medial Tertiary, p. 28, pl. xv, fig. 4.
Not *Cumingia tellinoides* Conrad, 1831.
Anatina tellinoides H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 237, pl. xxxiv, fig. 12.
Lavignon tellinoides d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 101, No. 1891.
Lavignon tellinoides Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 92, pl. xxiii, fig. 1.
Cumingia tellinoides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Cumingia tellinoides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Cumingia medialis Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 106.
Cumingia medialis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 999.

Description.—"Shell ovate-trigonal, thin, with numerous prominent concentric wrinkled striæ; anterior side ventricose; the posterior side contracted, subcuneiform; the base near the extremity slightly emarginate; cardinal fosset large; lateral teeth very prominent." Conrad, 1838.

The anterior side is inflated, the posterior side depressed, this depression extending to the base and producing a slight emargination near the posterior extremity; within, chondrophore prominent, projecting, spoon-shaped. Two left valves in some material belonging to the Johns Hopkins University are labeled from Jones Wharf, but their state of preservation and coloration makes it seem more probable that they are from Virginia.

Length, 25 mm.; height, 18 mm.; diameter, 5.5 mm.

Occurrence.—CHOPTANK FORMATION (?). Jones Wharf (?).

Collection.—Johns Hopkins University.

Family TELLINIDÆ.

Genus TELLINA (Linné) Lamarck.

Section MERISCA Dall.

TELLINA ÆQUISTRIATA Say.

Plate LXXII, Fig. 13.

Tellina æquistriata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 145, pl. x, fig. 7. Reprint, Bull. Amer. Pal., vol. i, No. 5, p. 321, pl. xxix, fig. 7.
Tellina (Merisca) æquistriata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1020.

Description.—"*Shell* transversely ovate-orbicular, with an elevated line or fold on the anterior margin: *surface* with fine, somewhat elevated, concentric, nearly equal, numerous striæ, forming grooves between them: *apex* nearly central, acute: *cardinal teeth* deeply grooved: *lateral teeth* two; edge within, simple.

"Length seven-tenths, breadth nineteen-twentieths of an inch.

"In general outline, this species has a resemblance to *T. ostracea,* Lam. In one specimen the apex is central, and in another it is placed before the middle." Say, 1824.

This is one of Finch's collection, purporting to be from Maryland, but some of which were undoubtedly from Virginia. I am inclined to believe the reference of this species to Maryland probably incorrect, but give it on Finch's uncertain authority. A specimen in the collection of Johns Hopkins University labelled "Jones Wharf" is stained like the Yorktown, Va., material, and I think is most likely from there.

Occurrence.—CHOPTANK FORMATION (?). Jones Wharf (?).

Collection.—Johns Hopkins University.

Subgenus ANGULUS Megerle.

TELLINA (ANGULUS) DECLIVIS Conrad.

Plate LXXII, Fig. 14.

Tellina declivis Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 131.
Tellina declivis Conrad, 1840, Fossils of the Medial Tertiary, p. 35, pl. xix, fig. 1.
Tellina declivis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 573.
Tellina [Angulus] declivis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.
Tellina (Angulus) declivis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1029.

Description.—"Shell somewhat elliptical, with the anterior side short, and the margin obliquely truncated; posterior end regularly rounded; beaks hardly prominent; lateral teeth distinct.

"It resembles in outline the *Amphidesma subreflexa,* nobis; and might, viewing the exterior only, be mistaken for that shell." Conrad, 1834.

The posterior dorsal margin of this species is more abruptly or angularly declining than in *T. producta.* The anterior dorsal margin is also less nearly parallel to the base, and hence the beak is more prominently angular.

Length, 13.4 mm.; height, 8 mm.; diameter, 1.95 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

TELLINA (ANGULUS) PRODUCTA Conrad.

Plate LXXII, Figs. 15, 16.

Tellina producta Conrad, 1840, Fossils of the Medial Tertiary, p. 36, pl. xix, fig. 5.

Tellina (Peronæderma) producta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 573..

Tellina (Peronæoderma) producta Meek, 1864, Smith. Misc. Coll. (183), p. 10.

Tellina (Angulus) producta Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1029.

Macoma (Psammacoma ?) producta Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1054.

Description.—" Shell narrow-elliptical, compressed; posterior side pointed, extremity obtuse; fold submarginal, obscure; basal margin straight opposite the beak; lateral teeth none." Conrad, 1840.

Anterior dorsal margin is more nearly parallel to the base than in *A. declivis* and posterior portion is more produced, posterior dorsal margin being less declining.

Length, 11 mm.; height, 6.4 mm.; diameter, 1.4 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River (Meek; *fide* Dall). CALVERT FORMATION. Plum Point, Blake's (*fide* Dall).

Collections.—U. S. National Museum, Maryland Geological Survey.

TELLINA (ANGULUS) DUPLINIANA Dall.

Plate LXXIII, Fig. 1.

Tellina (Angulus) dupliniana Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1032, pl. xlvi, fig. 17.

Description.—" Shell small, solid, rather convex, inequilateral, dorsal margins rectilinear, diverging at an angle of about one hundred and eight degrees, anterior end longer, rounded evenly into the base, which is nearly parallel with the anterior dorsal margin; posterior end much shorter, pointed, the terminal angle slightly decumbent and the basal margin in front of it slightly incurved; beaks inconspicuous, hinge normal, the right adjacent lateral short and the anterior hinge-margin in front of it grooved for the edge of the opposite valve; middle of the disk smooth, the beaks, posterior dorsal area, and the portions of the disk near the basal margin more or less concentrically striated; interior with the pallial sinus rising to a small angle under the umbo, then descending in a somewhat wavy line to a point on the pallial line considerably short of the anterior adductor scar; in the left valve the sinus is not angulated above and extends somewhat nearer the adductor; the interior is marked with some faint radiations near the adductors, but no thickened ray appears.

"There is some little difference in the proportional height in different individuals, in the amount of inflation, and in the arcuation of the posterior dorsal margin; the posterior fold, or ridge bounding the posterior dorsal area, is not strongly marked. Compared with *T. tenella* Verrill, this species is a heavier and higher shell, with the posterior end more pointed and decurved. The dorsal margin of the right valve is not grooved in *T. tenella,* and the adjacent lateral is longer than in *T. dupliniana* of the same size." Dall, 1900.

Length, 12.5 mm.; height, 8 mm.; diameter, 4 mm.

Occurrence.—CALVERT FORMATION. Plum Point (*fide* Dall).

Collection.—U. S. National Museum.

TELLINA (ANGULUS) UMBRA Dall.

Plate LXXIII, Fig. 2.

Tellina (Angulus) umbra Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1033, pl. xlvi, fig. 13.

Description.—"Shell small, solid, markedly flexuous, moderately convex, inequilateral, nearly equivalve; anterior end longer, rounded; posterior end shorter, attenuated, bluntly pointed; beaks inconspicuous; whole surface covered with close-set, regular, even, concentric threads; hinge normal, right anterior lateral short and stout, posterior lateral small but prominent; pallial sinus long, slightly convex above, reaching to the anterior ray (which is obviously thickened), nearly similar in both valves, and wholly confluent below.

"This species is nearest to *T. sybaritica* Dall, but is a larger and less slender shell, with a less angular posterior end. It is doubtless the precursor of that species." Dall, 1900.

Length, 12.5 mm.; height, 6.5 mm.; diameter, 3.5 mm. (Dall).

Occurrence.—St. Mary's Formation. St. Mary's River (*fide* Dall). Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Genus METIS H. and A. Adams.

Metis biplicata Conrad.

Plate LXXIII, Figs. 5, 6.

Tellina biplicata Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 152.
Tellina biplicata Conrad, 1840, Fossils of the Medial Tertiary, p. 36, pl. xix, fig. 4; not of Tuomey and Holmes or Emmons.
Metis biplicata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 573.
Metis biplicata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Metis biplicata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1042.

Description.—" Shell suboval, inequivalve, slightly ventricose, with obscure radiating lines, and prominent filiform striæ, much elevated over the folds of the posterior side; folds two, one on each valve angular; cardinal teeth two in the right valve, much compressed, posterior one profoundly bifid; one similar bifid tooth in the opposite valve; hinge margin profoundly sulcated posteriorly; lateral teeth none." Conrad, 1834.

Length, 60 mm.; height, 51 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Cuckold Creek, St. Leonard Creek, Jones Wharf, Sand Hill, Dover Bridge, Cordova. Calvert Formation. Plum Point, White's Landing, Wye Mills.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus MACOMA Leach.

Macoma lenis (Conrad).

Plate LXXIII, Figs. 3, 4.

Tellina lenis Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 306.
Tellina lenis Conrad, 1845, Fossils of the Medial Tertiary, p. 72, pl. xli, fig. 9.
Tellina (Peronæderma) lenis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 573.
Tellina (Peronæoderma) lens Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10 (typ. er.).
Macoma lenis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1047.

Description.—" Subelliptical: beaks medial; anterior margin obliquely truncated, the extremity acutely rounded; dorsal margins equally oblique; posterior basal margin obliquely subtruncated; basal margin nearly straight in the middle and towards the anterior extremity where it is arched; the extremity considerably above the line of the base; posterior side with an oblique narrow fold." Conrad, 1843.

Shell very thin; surface crossed by fine concentric lines of growth; within, a well-defined ridge extending from the beak obliquely backward to the lower part of the posterior margin and there becoming obsolete.

Length, 50 mm.; height, 32 mm.; diameter, 7.5 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf (rare). CALVERT FORMATION. Three miles south of Chesapeake Beach, Lyon's Creek (?).

Collection.—Maryland Geological Survey.

MACOMA MARYLANDICA n. sp.

Plate LXXIII, Fig. 7.

Description.—Shell very thin and fragile; basal and anterior dorsal margins nearly parallel; anterior side produced and anterior end rounded; anterior basal margin regularly arched; posterior dorsal margin declining and meeting basal margin much above the line of the base; anterior portion of shell convex and capacious, especially under the beak and anterior dorsal margin; posterior portion of shell contracted and somewhat pointed and posterior end gaping; exterior smooth except for faint growth lines; cardinal teeth two; beak not prominent.

Length, 15 mm.; height, 7.9 mm.; diameter, 1.8 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Superfamily VENERACEA.

Family PETRICOLIDÆ.

Genus PETRICOLA Lamarck.

Section RUPELLARIA Fleuriau.

PETRICOLA HARRISII Dall.

Plate LXXIII, Figs. 8, 9.

Petricola (Rupellaria) Harrisii Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1060, pl. xliii, fig. 1.

Description.—" Shell solid, ovate, distorted more or less by the irregularities of its *situs;* posterior end blunt, longer; anterior end shorter, rounded; sculpture of fine, nearly uniform radial rounded threads with wider interspaces, crossed by fine, rounded, slightly elevated incremental lines; beak moderately elevated, hinge short, with, in the left valve, one strong, apically grooved cardinal between two simple narrow diverging teeth; ligamentary nymph short, strong, deeply grooved; basal margin feebly crenulated by the external sculpture; pallial sinus wide, shallow." Dall, 1900.

Length, 20 mm.; width, 23 mm.; diameter, 7 mm.

Occurrence.—Choptank Formation. Governor Run, 2 miles south of Governor Run, Jones Wharf, Dover Bridge.

Collection.—Maryland Geological Survey.

Section PETRICOLARIA Stoliczka.

PETRICOLA CALVERTENSIS Dall.

Plate LXXIII, Figs. 10, 11, 12.

Petricola (Petricolaria) calvertensis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1060, pl. xliv, fig. 14.

Description.—" Shell elongate-oval, with the beaks near the anterior third, solid, closely regularly sculptured with fine radiating threads, the interspaces wider, the threads a little stronger towards the ends of the shell, concentric sculpture only of fine somewhat irregular incremental lines; beaks rather elevated; shell moderately inflated, more or less irregular from nestling among rocks, sculpture near the beaks quite faint; hinge short, a spur from the lunular region extending over and past the cardinal teeth behind the beaks; hinge normal; margins entire; pallial sinus deep and rounded." Dall, 1900.

Height, 9 mm.; width, 17 mm.; diameter, 3.5 mm.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Jones Wharf, Calvert Cliffs (Burns and Harris).

Collections.—Maryland Geological Survey, U. S. National Museum.

Family VENERIDÆ.

Subfamily VENERINÆ.

Genus VENUS (Linné) Lamarck.

VENUS DUCATELLI Conrad.

Plate LXXV, Figs. 7, 8.

Venus Ducatelli Conrad, 1838, Fossils of the Medial Tertiary, p. 8, pl. iv, fig. 2.
Venus Ducatellii Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Venus Ducatellii Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.
Venus Ducateli Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 67 (in part), pl. xi, figs. 1–3.
Venus Ducateli Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1309.

Description.—" Shell suborbicular, convex, thick; disks with numerous approximate, recurved ribs, laminar and much elevated towards the posterior margin; extremity obtuse; beaks distant from the anterior margin; umbo not inflated; lunule defined by an impressed line, not very profound; posterior margin rectilinear; two of the cardinal teeth in the left valve remote, thick, bifid; anterior tooth much compressed.

" This shell is related to *V. Mortoni,* but is much smaller, less ventricose, and has more prominent ribs. It is obtained in fragments only, but those are abundant. It is named in compliment to the state Geologist of Maryland, Professor Ducatel." Conrad, 1838.

Length, 70 mm.; height, 56 mm.; diameter, 20 mm.

Occurrence.—CALVERT FORMATION. Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

VENUS RILEYI Conrad.

Plate LXXVI, Figs. 4, 5.

Venus Rileyi Conrad, 1838, Fossils of the Medial Tertiary, p. 9, pl. vi, fig. 1.
Venus Rileyi Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 78, pl. xxi, fig. 8.
Venus Rileyi Emmons, 1858, Rept. N. C. Geol. Survey, p. 292.
Mercenaria Rileyi Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Mercenaria Rileyi Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.
Venus tridacnoides var. Rileyi Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, pp. 1310, 1311.

Description.—" Shell obliquely ovate, slightly ventricose, thick, very inequilateral; disks with small crowded reflected concentric ribs; anterior side narrowed; umbo very oblique, prominent; posterior margin arcuate; inner margin deeply crenulated.

"This shell has probably been confounded with *V. tridacnoides,* but it is much thinner, not undulate on the disk, and the cardinal teeth are much less robust. Its narrowed and compressed anterior side will distinguish it from the other fossil species, and its ribs from the recent *V. mercenaria.* Young shells are compressed or plano-convex. The disks are generally worn, showing the radiating striæ common to all these large fossil species when the surface becomes decomposed. It is named in compliment to my scientific friend, Dr. William Riley of Baltimore." Conrad, 1838.

This species as found at Plum Point is not notably thick. The hinge area is narrow, and the teeth rather small. The umbo can scarcely be considered prominent. The great proportionate length of the shell distinguishes this species readily from the others of the Miocene. None of the Plum Point specimens show the great thickening or undulations on the disk so characteristic of the *tridacnoides* as found at numerous Virginia localities. For this reason, and because the Virginia beds in which thickened shells are found are much higher stratigraphically in the Miocene than the Plum Point beds the writer prefers to retain the name *rileyi* for a distinct species.

Length, 115 mm.; height, 80 mm.; diameter, 22 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

VENUS MERCENARIA Linné.

Plate LXXVIII, Figs. 1, 2.

Venus mercenaria Linné, 1758, Syst. Nat., Edit. x, p. 686.

Venus mercenaria Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 81, pl. xxi, fig. 6.

Venus mercenaria Emmons, 1858, Rept. N. Car. Geol. Survey, p. 292.

Mercenaria violacea Holmes, 1858, Post-Pleiocene Fossils of South Carolina, p. 33, pl. vi, fig. 11.

Mercenaria mercenaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.

Venus mercenaria Gould (Binney's), 1870, Invert. Mass., p. 133, fig. 445.

Mercenaria concellata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 68, pl. xii, figs. 2-3.

Venus mercenaria Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1311.

Description.—Shell solid, ovate cordate; beak curved well forward, not very prominent; outer surface with close-set, concentric lamellæ; lunule marked, cordate; hinge area rather short, broad; cardinal teeth strong, two in right valve strongly bifid; posterior margin arched; a broad, shallow impressed area or groove from beak to posterior margin just above its point of meeting with the base; muscle impressions large and distinct; pallial sinus acutely angular; inner margin crenulated.

Length, 96 mm.; height, 79 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

VENUS PLENA (Conrad).

Plate LXXIX, Figs. 1, 2.

Mercenaria plena Conrad, 1869, Amer. Jour. Conch., vol. v, p. 100.

Venus Ducateli Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 67 (in part), pl. xi, figs. 4–7.

Mercenaria plena Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 69, pl. xii, figs. 4–6.

Venus plena Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1309.

Description.—" Cordate, inequilateral, ventricose, oblique, with close concentric rugose lines; posterior side subcunciform; lunule ovate; inner margin densely crenulated.

" . . . It approximates *M. capax* Conrad, but is shorter, less ventricose, more oblique; the hinge character differs, and the pallial sinus is deeper and more angular." Conrad, 1870.

In the type specimen the shell is rather thin and very convex or vaulted. The posterior end is not blunted as in *V. capax.* The hinge area in large specimens becomes broad and bears a striking resemblance to that of *V. cuneata,* as does also the general outline of the shell. It may be only the immature form or a variety of *V. cuneata.*

Length, 90 mm.; height, 78 mm.; diameter, 27 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Pawpaw Point, Peach Blossom Creek, Dover Bridge, "Eastern Shore" (Cope). CALVERT FORMATION. Plum Point (Dall).

Collections.—Maryland Geological Survey, Johns Hopkins University, Academy of Natural Sciences of Philadelphia (type).

VENUS CAMPECHIENSIS VAR. TETRICA (Conrad).

Plate LXXX, Fig. 2, Plate LXXXI, Fig. 2.

Venus tetrica Conrad, 1838, Fossils of the Medial Tertiary, p. 7, pl. iv, fig. 1.
Mercenaria tetrica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Mercenaria tetrica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.
Venus campechiensis Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, pp. 1315, 1317, 1318 (in part).

Description.—"Shell triangular, cordate, ventricose, moderately thick, with crowded concentric very prominent laminæ; posterior side subcuneiform, extremity angulated; summits very prominent; lunule defined by a deeply impressed line.

"This shell has nearly the outline of *V. mercenaria,* but may be distinguished by its very prominent laminæ of nearly equal elevation on every portion of the disk." Conrad, 1838.

Length, 122 mm.; height, 100 mm.; diameter, 27 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

VENUS CAMPECHIENSIS VAR. MORTONI (Conrad).

Plate LXXVII, Figs. 1, 2.

Venus Mortoni Conrad, 1837, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 251.
Venus Mortoni Conrad, 1838, Fossils of the Medial Tertiary, p. 8, pl. v, fig. 1.
Venus submortoni d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 108.
Mercenaria Mortoni Holmes, 1858, Post-Pleiocene Fossils of South Carolina, p. 34, pl. vi, fig. 12.
Mercenaria submortoni Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.
Mercenaria submortoni Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.
Venus campechiensis Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, pp. 1315, 1317, 1318 (in part).

Description.—"Shell cordate, inflated, thick and ponderous, with prominent recurved concentric laminæ, more elevated on the anterior and posterior margins; ligament margin arcuate; umbones prominent; lunule large, cordate, defined by a deep groove; posterior extremity slightly emarginate; cavity of the cartilage profound; teeth large, prominent, grooved; muscular impressions very large; inner margin regularly crenulated." Conrad, 1837.

The shape and width of the hinge area and the elevation of the beak and general shape of the shell are much like *var. cuneata* of the older deposits at Jones Wharf.

Length, 88 mm.; height, 78 mm.; diameter, 27 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Venus campechiensis var. cuneata (Conrad).

Plate LXXXII, Fig. 3, Plate LXXXIII, Fig. 2.

Mercenaria cuneata Conrad, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 139 (name only).

Mercenaria cuneata Conrad, 1868, Amer. Jour. Conch., vol. iv, p. 278, pl. xx, fig. 1.

Venus campechiensis Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, pp. 1315, 1317, 1318 (in part).

Description.—"Subtriangular, ventricose medially, slightly flattened or contracted above the umbo; outline of the disk nearly straight below the middle; surface with coarse concentric lines; posterior side cuneiform, lower half of posterior margin nearly rectilinear, extremity subacute; inner margin minutely crenulated.

"This species may be distinguished from *M. mercenaria* in being less oblique, proportionally shorter and more acute at the posterior extremity, and in having a more elongated anterior cardinal tooth." Conrad, 1868.

This species is readily distinguished by its short, massive and broad hinge area, its great proportionate height, its massiveness, and its nearly symmetrical triangular outline. The dorsal and posterior slopes meet in an abrupt curve.

Length, 112 mm.; height, 102 mm.; diameter, 37 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Pawpaw Point, Peach Blossom Creek, Dover Bridge, Greensboro, Cordova. Calvert Formation (?). Charles county (*fide* Cope).

Collections.—Maryland Geological Survey, Johns Hopkins University.

Venus campechiensis var. capax (Conrad).

Plate LXXX, Fig. 1, Plate LXXXI, Fig. 1.

Venus capax Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 324.

Venus capax Conrad, 1845, Fossils of the Medial Tertiary, p. 68, pl. xxxviii, fig. 4.

Mercenaria capax Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.

Mercenaria capax Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Venus campechienses Dall, 1903, loc. cit. supra.

Description.—"Cordate, suborbicular, ventricose, with concentric lamelliform prominent lines; posterior margin curved, extremity truncated, direct, and remote from the line of the base; basal margin profoundly curved; lunule dilated, cordate, defined by a groove, and not distinctly impressed; inner margin finely crenulated.

"This shell is of a more rotund, tumid form than any of the species allied to *V. mercenaria,* and much more capacious; the lunule is shorter and wider." Conrad, 1843.

The markedly anterior position of the beak, the compact, rounded outline and the prominent, square truncation of the posterior extremity serve to distinguish this from other forms.

This variety is probably the ancestor of *var. mortoni* of the St. Mary's formation as it is practically indistinguishable from the young of that form.

Length, 62 mm.; height, 43 mm.; diameter, 18 mm.

Occurrence.—Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Pawpaw Point, Peach Blossom Creek, Cordova, Greensboro, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CHIONE Megerle von Mühlfeld.

Chione latilirata (Conrad).

Plate LXXVII, Figs. 3, 4, 5, 6.

Venus latilirata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 28

Not *Venus latilirata* Tuomey and Holmes, 1856.

Venus latilirata Conrad, 1845, Fossils of the Medial Tertiary, p. 68, pl. xxxviii, fig. 3.

Circumphalus latiliratus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.

Chione (Lirophora) latilirata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Chione (Lirophora) latilirata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1298, pl. xlii, fig. 3.

Description.—"Trigonal, convex depressed, ribs concentric, about 5 or 6 in number, flattened, reflected, irregular, one of them generally very wide; ribs irregularly sulcated on the posterior slope; inner margin finely crenulated. Smaller than *V. alveata,* and with broader, less prominent ribs, which do not diminish in size on the posterior margin." Conrad, 1841.

Often the reflected portion is broadly adherent or well plastered to the valve, and has a comparatively small groove beneath the reflected edge; ribs quite irregular in size and variable in number, usually about five.

Length, 23 mm.; height, 18 mm.; diameter, 6.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION. Fairhaven, Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Lyon's Creek, Reed's, Jewell.

Collections.—Maryland Geological Survey, Johns Hopkins University.

CHIONE PARKERIA n. sp.

Plate LXXVI, Figs. 9, 10, 11.

Description.—Shell triangular, depressed, posteriorly somewhat cuneiform, anteriorly rounded; beaks projecting, acute, approximate; lunule distinct, cordate; base posteriorly emarginate; dorsal surface with about five to eight concentric ribs so perfectly flattened and closely appressed to the valve and each other as to become almost obsolete and be marked only by faint undulations and fine concentric impressed or laminated lines; ribs crossed from beak to base by numerous distinct, regular, radiating lines; cardinal teeth three in each valve; laterals none; muscle impressions deep; pallial sinus a slight notch; margin minutely crenulated. This species seems to be closely related to *C. ulocyma* Dall.

Length, 29 mm.; height, 23 mm.; diameter, 8 mm.

Occurrence.—CALVERT FORMATION. Parker Creek, 2 miles south of Parker Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University.

CHIONE ALVEATA (Conrad).

Plate LXXVI, Figs. 1, 2, 3.

Venus alveata Conrad, 1831, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 264, pl. xi, figs. 14, 15.

Venus alveata Conrad, 1838, Fossils of the Medial Tertiary, p. 9, pl. v, fig. 2.

Circumphalus alveatus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.

Chione (Lirophora) alveatus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Chione (Lirophora) alveata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1298.

Description.—" Shell subtriangular, thick, with about six, much elevated, very thick and profoundly reflected concentric ribs, remote, and becoming smaller towards the posterior end; margin crenulated." Conrad, 1831.

Ribs well spaced, almost uniformly thin, but not uniformly recurved; deeply grooved beneath the recurved portion; beak profoundly curved anteriorly; muscle impressions small, subequal; pallial sinus a mere notch; marginal crenulation minute.

Length, 29 mm.; height, 26 mm.; diameter, 10 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Subfamily MERETRICINÆ.

Genus MACROCALLISTA Meek.

Macrocallista marylandica (Conrad).

Plate LXXIV, Figs. 1, 2.

Cytherea Marylandica Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 343.

Cytherea Marylandica Conrad, 1838, Fossils of the Medial Tertiary, p. 15, pl. ix, fig. 1.

Dione Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.

Dione marylandica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Dione Marylandica Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 74, pl. xiii, fig. 1.

Macrocallista albaria Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1253 (in part?).

Macrocallista (*Chionella*) *marylandica* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1255.

Description.—"Shell obtusely ovate, smooth, thick; umbo obtusely rounded posteriorly; lunule ovate-acute and slightly impressed; hinge with the anterior tooth very robust." Conrad, 1833.

Shell thick, ponderous, moderately inflated; surface polished, crossed by faint concentric undulations; anterior extremity gently rounded, posterior extremity acutely rounded; hinge area ponderous; anterior muscle impression profound; pallial margin distinct; pallial sinus not profound.

The young of this species is much thinner, flatter and longer in proportion to the height than the adult forms, having in fact the shape of *M. albaria,* and in Maryland at least has often been called *M. albaria.* Whether *M. albaria* from Virginia be really merely the young of *M. marylandica* or not I have no means of telling. I know of no authentic specimens of *M. albaria* from Maryland.

Length, 112 mm.; height, 90 mm.; diameter, 34 mm.

Occurrence.—ST. MARY'S FORMATION (?). Cove Point (?). CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Cuckold Creek, St. Leonard Creek, Dover Bridge, Peach Blossom Creek, Greensboro. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CALLOCARDIA A. Adams.

Subgenus AGRIOPOMA Dall.

CALLOCARDIA (AGRIOPOMA) SUBNASUTA (Conrad).

Plate LXXV, Figs. 1, 2, 3.

Cytherea subnasuta Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 28.
Cytherea subnasuta Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 183.
Cytherea subnasuta Conrad, 1845, Fossils of the Medial Tertiary, p. 72, pl. xli, fig. 3.
Venus subnasuta d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 108, No. 2024.
Venus subnasuta Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 80, pl. xxi, fig. 3.
Dione subnasuta Conrad, 1863, Proc. Acad. Nat. Sci. Phila, vol. xiv, p. 575.
Dione subnasuta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.
Callocardia (Agriopoma) subnasuta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1264.

Description.—"Trigonal, thin, ventricose; anterior side narrowed, slightly produced and subangulated at the extremity; surface with rather prominent concentric wrinkles; posterior margin obliquely arched; beaks distant from anterior extremity, and not nearly central; length $1\frac{1}{8}$ inch. Allied to *C. Sayana,* but is proportionally longer, less ventricose, narrowed, and more produced anteriorly." Conrad, 1841.

See also remarks under *C. sayana* for additional distinctions between the two species.

Length, 30 mm.; height, 24 mm.; diameter, 8.5 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, Langley's Bluff, St. Mary's River. CHOPTANK FORMATION. Jones Wharf, Dover Bridge, CALVERT FORMATION. 3 miles south of Chesapeake Beach, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Callocardia (Agriopoma) prunensis n. sp.

Plate LXXV, Figs. 4, 5, 6.

Description.—Shell small, oval, convex or vaulted; beak elevated, projecting; anterior side nearly straight; anterior end regularly rounded; posterior side gently convex; posterior end somewhat more acutely rounded than the anterior end; base regularly arched; teeth normal; cardinal area rather broad; ligament impressions and pallial sinus distinct; exterior polished, with a few shallow, concentric growth striæ here and there.

It differs from *C. elevata* H. C. Lea in its shape, in being polished and in lacking the gentle, irregular undulations or slight ridges characteristic of the *elevata.*

Occurrence.— Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Callocardia (Agriopoma) sayana (Conrad).

Plate LXXIII, Figs. 13a, 14.

Cytherea convexa Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 149, pl. xii, fig. 3; not of Brogniart, 1811.

Cytherea Sayana Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 345.

Cytherea Sayana Conrad, 1838, Fossils of the Medial Tertiary, p. 13, pl. vii, fig. 3.

Cytherea convexa Gould, 1841, Invert. Mass., p. 84, fig. 49.

Venus Sayana d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 108, No. 2011.

Venus Sayana Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 83, pl. xxi, fig. 9.

Cytherea Sayana Emmons, 1858, Rept. N. Car. Geol. Survey, p. 294, fig. 221.

Dione Sayana Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.

Dione Sayana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.

Cytherea convexa Gould (Binney's), 1870, Invert. Mass., p. 131, fig. 444.

Dione Sayana Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 75, pl. xii, fig. 1.

Callocardia (Agriopoma) sayana Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1261, pl. lvi, fig. 16.

Description.—"*Shell* subcordate; elevated convex, concentrically wrinkled, inequilateral; posterior tooth and fosset not striated; edge not crenated; umbo rather prominent; lunule dilated, cordate, marked by a simple line." Say, 1824.

As compared with *C. subnasuta,* the only species with which it is apt to be confused, the *sayana,* has a thicker shell, is more highly convex, has a more projecting and more acute beak, is somewhat more acutely triangular in outline and within has a much more massive cardinal area and larger teeth.

Length, 40 mm.; height, 34 mm.; diameter, 12 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Jones Wharf, Peach Blossom Creek.

Collection.—Maryland Geological Survey.

Genus CYTHEREA Bolton.

Subgenus ANTIGONA Schumacher.

Cytherea (Antigona) staminea Conrad.

Plate LXXVI, Figs. 6, 7, 8.

Cytherea staminea Conrad, 1838, Fossils of the Medial Tertiary, p. 46 (name only).
Cytherea staminea Conrad, 1839, Fossils of the Medial Tertiary, cover of No. 1, p. 3, pl. xxi, fig. 1.
Dione staminea Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.
Dione staminea Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.
Artena staminea Conrad, 1871, Amer. Jour. Conch., vol. vi, p. 76.
Venus (Artena) staminea Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 72, pl. xiii, figs. 3-10.
Cytherea (Artena) staminea Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1279.

Description.—"Shell subtriangular, thick, with about ten very prominent acute slightly reflected concentric ribs, with an intermediate carina, and crowded minute lamellar striæ; anterior tooth very small; margin crenulated. Length 1 inch." Conrad, 1839.

Form compact, rounded, triangular; valves convex; beak not prominent; ribs perpendicular to the surface and at times as many as sixteen; posterior edge of dorsal slope often marked by a slight ridge causing a slight posterior basal emargination; cardinal teeth three in each valve; anterior lateral tooth in left valve very small and rounded and fitting into a correspondingly small socket in right valve; muscular impressions subequal; pallial sinus a mere notch.

Length, 27 mm.; height, 22 mm.; diameter, 8.5 mm.

Occurrence.—Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Lyon's Creek, Reed's, Church Hill.

Collection.—Maryland Geological Survey.

Subfamily DOSINIINÆ.

Genus DOSINIA Scopoli.

DOSINIA ACETABULUM Conrad.

Plate LXXXIII, Fig. 1, Plate LXXXIV, Fig. 1.

Artemis acetabulum Conrad, 1832, Fossil Shells of the Tertiary, p. 20, pl. vi, fig. 1.
Artemis acetabulum Conrad, 1838, Fossils of the Medial Tertiary, p. 29, pl. xvi, fig. 1.
Dosinia acetabulum Conrad, 1863, Proc. Acad. Nat. Sci. Phila, vol. xiv, p. 575.
Dosinia acetabulum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.
Dosinia acetabulum Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 73, pl. xiii, fig. 2.
Dosinia (*Dosinidia*) *acetabulum* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1230.

Description.—" Lentiform, with numerous concentric striæ, which are rather sharp and elevated on the anterior and posterior sides; cardinal fosset large, oblong, profound; with age, almost obliterating the posterior tooth; right valve with three teeth, the posterior one long and sulcated longitudinally; two anterior teeth approximate; left valve with four teeth, three of them distant; the anterior tooth somewhat pyramidal and entering a groove formed by two slight elevations in the opposite valve." Conrad, 1832.

Length, 76 mm.; height, 77 mm.; diameter, 22 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, Langley's Bluff, St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Pawpaw Point, St. Leonard Creek, Sand Hill, Cordova, Greensboro, Trappe Landing, Peach Blossom Creek, Dover Bridge. CALVERT FORMATION. 3 miles south of Chesapeake Beach, Plum Point, White's Landing, Lyon's Creek, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CLEMENTIA Gray.

CLEMENTIA INOCERIFORMIS (Wagner).

Plate LXXXII, Figs. 1, 2.

Venus inoceriformis Wagner, 1839, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 51, pl. i, fig. 1.
Venus inoceriformis Conrad, 1845, Fossils of the Medial Tertiary, p. 70, pl. xl, fig. 1.
Clementia inoceriformis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 575.
Clementia inoceriformis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 10.

Description.—" Shell oblique, suborbicular, thin and fragile, ventricose; disks with unequal, concentric undulations, forming prominent angulated carinæ; concentric striæ numerous, prominent; beaks prominent; no distinct lunule; cardinal teeth lamellar." Wagner, 1839.

Posterior hinge area marked by an angular ridge, posteriorly cuneiform and overlapping a deep, narrow groove and a shallow furrow running backward from the beak; concentric undulations prominent in interior of young thin shells; but obsolescent or obsolete in older thickened shells; pallial sinus large, profound and acutely terminated.

Length, 61 mm.; height, 64 mm.; diameter, 19 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River (*fide* Wagner). Choptank Formation. Governor Run, Sand Hill. Calvert Formation. Hollin Cliff, Wye Mills, Plum Point (Dall).

Collections.—Maryland Geological Survey, Cornell University.

Superfamily ISOCARDIACEA.

Family ISOCARDIIDÆ.

Genus ISOCARDIA Lamarck.

Isocardia markoëi Conrad.

Plate LXXXIV, Figs. 2, 3.

Isocardia Markoëi Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 193, pl. ii, fig. 1 (right hand figures only and diagnosis in part).

Isocardia Markoei Conrad, 1845, Fossils of the Medial Tertiary, p. 70, pl. xl, fig. 2 (right hand figures only and diagnosis in part).

Bucardia Markoei Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Glossus Markoei Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Isocardia Markoei Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1067.

Description.—" Suborbicular; length and height nearly equal; inflated; umbo very prominent, and the beaks profoundly incurved; posterior margin direct, arched above, nearly straight below, and obtusely angulated at its junction with the base; base regularly, not profoundly arched; posterior slope slightly sinuous." Conrad, 1842.

Conrad has figured in each case cited above two forms that on comparison of a number of specimens show constant differences, and his description applies partly to one and partly to the other. It becomes necessary, therefore, to restrict his name, and as the remarkable elevation and profound incurvature of the beaks seem to have been perhaps the most prominent characteristics in his mind—just as they produce the more striking of the two forms—the name *I. markoëi* will here be used to designate the species with highly elevated, narrow, prolonged, profoundly incurved beaks, a feature well represented in the right hand drawing of each of his figures. It is about as high as long; posterior margin quite or almost entirely arched; dorsal slope crossed by two or three broad, deep, concentric undulations marking resting stages during growth.

Length, 48 mm.; height, 46 mm.; diameter, 27 mm.

Occurrence.—CALVERT FORMATION. Plum Point (rare).

Collection.—Maryland Geological Survey.

ISOCARDIA MAZLEA n. sp.

Plate LXXXIV, Figs. 4, 5.

Isocardia Markoëi Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 193, pl. ii, fig. 1 (left hand drawing only and diagnosis in part).

Isocardia Markoei Conrad, 1845, Fossils of the Medial Tertiary, p. 70, pl. xl, fig. 2 (left hand drawing only and diagnosis in part).

Description.—Shell rounded, inflated; length greater than height; umbo elevated, broad, short, only moderately incurved, not strongly projecting; dorsal slope crossed by several shallow and at times indistinct concentric undulations; posterior margin curved above, straight below and meeting the base at an obtuse angle to which there extends a flattened ridge which is bordered on the posterior slope by a broad, gently depressed or grooved area. See also remarks under *I. markoëi.*

Length, 52 mm.; height, 46 mm.; diameter, 27 mm.

Occurrence.—CALVERT FORMATION. Plum Point (rare).

Collection.—Maryland Geological Survey.

ISOCARDIA FRATERNA Say.

Plate LXXXV, Figs. 3, 4.

Isocardia fraterna Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 143, pl. xi, fig. 1 a and b.

Isocardia rustica Conrad, 1838, Fossils of the Medial Tertiary, p. 20, pl. xi, fig. 1.

Isocardia Conradi d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 121.

Glossus rusticus Conrad, 1854, Proc. Acad. Nat. Sci. Phila., vol. vii, p. 29.

Bucardia fraterna Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Glossus fraterna Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Isocardia fraterna Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1066.

Description.—" Cordate-globose, slightly oblique, with rather large concentric wrinkles, and lines of growth; an elevated undulation on the anterior submargin, marking the greatest length of the shell; *umbones* not very prominent, apex rather suddenly incurved, acute; impressed space behind the beaks, dilated and rather profound; anterior tooth striated externally, and placed on the middle of the anterior margin." Say, 1824.

Say had the anterior and posterior ends transposed so that for each reference to direction in the above description the opposite direction is to be understood. From the drawing and description, Say's large specimen was very probably a Virginia form. Specimens from Maryland are smaller and less rounded and have a more pronounced ridge and a basal angle where the dorsal and posterior slopes and margins meet. These differences seem constant but are not deemed of sufficient importance to justify separating the Maryland forms from those from Virginia.

Length, 73 mm.; height, 59 mm.; diameter, 29 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point (?), St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Pawpaw Point. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

ISOCARDIA IGNOLEA n. sp.

Plate LXXXV, Figs. 1, 2.

Description.—Shell oval, moderately elevated anteriorly, gently depressed posteriorly; beak depressed, moderately incurved; surface of shell with numerous gentle, somewhat irregular, close-set, concentric undulations most prominent on the marginal two-thirds of the surface; meeting of posterior and umbonal slopes marked by a ridge, of posterior and basal margins by an angle; posterior margin bluntly rounded; a cardinal and a posterior lateral tooth in left valve, two cardinals in right valve; ligament area curved, ridged, and grooved; interior smooth; muscle impressions and pallial margin distinct.

It is unfortunate that the locality from which this species comes is in some doubt. The only specimens—the two valves of the same individual—were found in a case of University material from Cove Point, but the color of the weathering, state of preservation, and incrusting material seem more characteristic of Plum Point than of Cove Point, so that while I am inclined to believe them to be from the latter place, the matter must be left undecided until further search shall perhaps reveal other specimens at one locality or the other.

Length, 67 mm.; height, 47 mm.; diameter, 26 mm.

Occurrence.—St. Mary's Formation. Cove Point (see above).

Collection.—Johns Hopkins University.

Superfamily CARDIACEA.

Family CARDIIDÆ.

Genus CARDIUM Linné.

Subgenus CERASTODERMA Mörch.

Cardium (Cerastoderma) laqueatum Conrad.

Plate LXXXVI, Fig. 1.

Cardium laqueatum Conrad, 1831, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 258.

Cardium laqueatum Conrad, 1838, Fossils of the Medial Tertiary, p. 31, pl. xvii, fig. 1.

Cardium ingens Wagner, 1839, Dall, 1898, Trans. Wagner Free Inst. Sci., vol. v, p. 10, pl. iii, fig. 2.

Cardium (Cerastoderma) laqueatum Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Cardium (Cerastoderma) laqueatum Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Cardium (Cerastoderma) laqueatum Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1092.

Description.—" Shell cordate, ventricose, thin, with about 33 subtriangular, transversely wrinkled ribs; umbones prominent; lunule not profoundly impressed and somewhat lanceolate; cardinal tooth subulate." Conrad, 1831.

The ribs vary in number from thirty-three to thirty-six. The number given in description published in 1838 (forty-three) is doubtless an error in copying. Cardinal tooth prominent, lateral teeth distinct; anterior and posterior muscle impressions and pallial line distinct; margin strongly dentate in harmony with the ribbing; shell almost always broken and so perfect specimens are rare.

Length, 116 mm.; height, 97 mm.; diameter, 38 mm.

Occurrence.—St. Mary's Formation. Cove Point, Langley's Bluff, St. Mary's River. Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Pawpaw Point, Cuckold Creek, St. Leonard Creek, Dover Bridge, Greensboro, Sand Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Cardium (Cerastoderma) leptopleurum Conrad.

Plate LXXXVI, Fig. 2.

Cardium leptopleura Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 29.

Cardium leptopleura Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 184.

Cardium leptopleura Conrad, 1845, Fossils of the Medial Tertiary, p. 66, pl. xxxvii, fig. 5.

Cardium (Cerastoderma) leptopleura Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Cardium (Cerastoderma) leptopleura Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 9.

Cardium (Cerastoderma) leptopleura Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, 1095.

Description.—"Subtrigonal, ventricose; ribs about 31, prominent, distant, angular, carinated; umbo prominent, oblique; lateral teeth very prominent; inner margin widely and deeply crenate." Conrad, 1841.

Ribs vary in number from twenty-eight to thirty-one; in transverse section, profile of each rib rounded and as broad across the base as tall, becoming in older specimens even broader and more flatly rounded or even flat; distance from beak to base rather short as compared with length of shell; hinge line proportionally long.

Length, 48 mm.; height, 47 mm.; diameter, 17 mm.

Occurrence.—Calvert Formation. Plum Point, near Jewell (rare).

Collections.—Maryland Geological Survey, U. S. National Museum.

Cardium (Cerastoderma) craticuloide Conrad.

Plate LXXXVI, Fig. 3.

Cardium craticuloides Conrad, 1845, Fossils of the Medial Tertiary, p. 66, pl. xxxvii, fig. 3.

Cardium (Cerastoderma) craticuloides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Cardium (Cerastoderma) craticuloides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Cardium (Cerastoderma) craticuloides Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 66, pl. x, figs. 16–19.

Description.—" Suborbicular, ventricose; ribs about 29, very much compressed, profoundly elevated, the summits reflected on both sides, consequently the ribs are as wide on the back as at base; summit of the umbo very prominent.

" Remarkable for the compressed form and great elevation of the ribs which are most remote on the anterior side; ribs not very regular, but somewhat sinuous." Conrad, 1845.

Ribs sometimes as many as thirty-two, in transverse section angular, very narrow, highly elevated, and wider on top than just beneath; distance from beak to base proportionally greater as compared with length than in *C. leptopleurum;* hinge line proportionally short; shell thin, easily broken; beaks approximate.

Length, 52 mm.; height, 62 mm.; diameter, 18 mm.

Occurrence.—Calvert Formation. 3 miles south of Chesapeake Beach, Plum Point (rare).

Collection.—Maryland Geological Survey.

Cardium (Cerastoderma) calvertensium n. sp.

Plate LXXXVI, Fig. 4.

Description.—Shell elevated, rounded; beak prominent; ribs seventeen to twenty-two, rounded, rather distant, the interspaces as broad as, or broader than, the ribs; on anterior and posterior dorsal submargin ribs small to almost obsolete; entire interior of shell strongly grooved in harmony with the ribbing; cardinal and lateral teeth small, not prominent.

It may be readily distinguished from other species by its much fewer ribs, rounded form, strong internal grooving and small teeth. It is abundant as casts in the basal clays, but is very rare in the later deposits of the Miocene.

Length of shell broken along growth line, 37 mm.; height, 38 mm.; diameter, 14 mm.

Occurrence.—Calvert Formation. Fairhaven, Plum Point, Governor Run (at base of cliff), White's Landing.

Collection.—Maryland Geological Survey.

CARDIUM (CERASTODERMA) PATUXENTIUM n. sp.

Plate LXXXVI, Fig. 5.

Description.—Shell large, moderately thick, elevated; beak elevated, prominent; ribs fine, rounded to flattened, close set and separated by a narrow groove, normally fifty-two or somewhat more—one specimen with but forty-five; cardinal tooth strong, elevated; lateral teeth prominent; interior smooth; interior margin not known.

This species may be easily distinguished by its large number of ribs.

Approximate measurements are: length, 55 mm.; height, 50 mm.; diameter, 20 mm.

Occurrence.—CALVERT FORMATION. Truman's Wharf, White's Landing (as well-preserved casts of the exterior in the siliceous beds), New Town, Wye Mills.

Collection.—Maryland Geological Survey.

Subgenus FRAGUM Botten.

CARDIUM (FRAGUM) MEDIUM Linné.

Plate LXXXVI, Figs. 6a, 6b.

Cardium medium Linné, 1758, Syst. Nat., ed. x, p. 678.

Cardium medium Linné, 1768, Syst. Nat., ed. xii, p. 1122.

Hemicardium columba Heilprin, 1887, Trans. Wagner Free Inst. Sci., vol. i, p. 93, pl. xi, fig. 26.

Cardium (Fragum) medium Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1101.

Description.—"C. testa subcordata subangulata; valvulis angulatis sulcatis lævibus." Linné, 1758.

This species is distinguished by the amount of impression of the posterior area and the elevation of the upper part of the posterior margin projecting from the central part of the depression of the closed valve. The amount of depression varies very much and the range of variation is so complete that this characteristic is difficult to rely upon.

The Pliocene form of this species was described by Professor Heilprin as *Hemicardium columba*. He had only two specimens and they happen to be end members of the gradation series.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—U. S. National Museum.

Subgenus LÆVICARDIUM Swainson.

CARDIUM (LÆVICARDIUM) MORTONI Conrad.

Plate LXXXVI, Figs. 7a, 7b.

Cardium Mortoni Conrad, 1831, Jour. Acad. Nat. Sci. Phila., vol. vi, 1st ser., p. 259, pl. x, figs. 5, 6, 7.

Cardium Mortoni Gould, 1841, Invert. Mass., p. 91.

Liocardium Mortoni Stimpson, 1860, Check List E. Coast Shells, p. 2.

Lævicardium Mortoni Perkins, 1869, Proc. Bost. Soc. Nat. Hist., vol. xiii, p. 150.

Liocardium Mortoni Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 54, pl. lviii, fig. 8.

Cardium (*Lævicardium*) *Mortoni* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1111.

Description.—" Shell subovate, oblique, slightly ventricose, thin, destitute of ribs or radiating striæ; white, covered with a pale brown epidermis darker towards the base and wrinkled at the ends; within striated, and of a yellow colour; margin entire or obsoletely serrated, whitish, with generally an oblong black or dark purple spot on the posterior side.

" This shell has not the polish nor distinctly serrated margin of *C. serratum* to which it is nearly allied; the striæ are occasionally obsolete or only slightly serrate; the margins towards the anterior end, and the young shells are marked with angular fulvous spots, similar to the young of *C. lævigatum* and several other shells." Conrad, 1831.

Occurrence.—CHOPTANK FORMATION. Jones Wharf (*fide* Dall).

Collection.—U. S. National Museum.

Superfamily LEPTONACEA.

Family GALEOMMATIDÆ.

Genus SOLECARDIA Conrad.

Subgenus SPANIORINUS Dall.

SOLECARDIA (SPANIORINUS) COSSMANNI Dall.

Plate LXXXVII, Figs. 1, 1a, 2, 3, 4.

Solecardia (*Spaniorinus*) *Cossmanni* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1125, pl. xlv, figs. 27, 27a.

Description.—" Shell thin, nearly equilateral, rounded at both ends, the posterior end blunter, shorter, and higher than the anterior; surface with rather irregular obvious incremental lines, smoother near the beaks; base nearly straight, posterior dorsal slope arcuate, descending; anterior arcuate, beaks low, inconspicuous; right valve with the tooth narrow, slender, in a transverse vertical plane, the anterior dorsal margin expanded slightly just in front of it, the scar of the resilium strong, narrow, oblique; left valve with the tooth flattened in a horizontal plane, the anterior part longer; interior with faint, obsolete radiations; adductor scars rather large, ovate; margins entire." Dall, 1900.

Length, 8 mm.; height, 5 mm.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. 2 miles south of Governor Run. Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Family SPORTELLIDÆ.

Genus SPORTELLA Deshayes.

Sportella whitfieldi Dall.

Plate LXXXVII, Figs. 5a, 5b.

Syndosmya ? nuculoides Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 81, pl. xv, figs. 7–9; not of Conrad.

Sportella Whitfieldi Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1128.

Description.—"The shell is rather elongate-ovate, and moderately convex, and extremely thin and delicate in texture. The beak is small, situated rather within the anterior third of the length, behind which the shell is narrowed, the posterior end being more narrowly rounded than the anterior; basal and cardinal margins subparallel; surface with very fine concentric lines only, and with a very faintly defined, oblique, mesial sulcus. Internally there is a single, moderately strong, direct tooth beneath the beak, with a deep, wide pit in front, in the right valve, and a slight projecting lamellar tooth near its extremity. No appearance of a posterior lateral tooth can be seen. Muscular imprints very faint, and a pallial sinus shallow and obscure. It is not an Abra, as there are no lateral teeth." Whitfield, 1894.

Length, 7.9 mm.; height, 5 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Sportella pelex Dall.

Plate LXXXVII, Fig. 6.

Sportella pelex Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1131, pl. xliv, fig. 10.

Description.—"Shell small, solid, compressed, inequilateral, the posterior side quite short and blunt; beaks low, surface sculptured with fine, regular incremental lines, of which a few at wide intervals are more conspicuous; basal margin nearly straight, anterior end produced, rounded, posterior bluntly rounded; left valve with a strong hinge, the anterior lamella obsolete, but the one behind it prominent and strong, socket of the resilium deep, the hinge plate above it obscurely thickened, a narrow but distinct groove for the external ligament; interior polished, the adductor scars rather high up, the disk faintly radially striated, the margin entire.

"This species has a good deal the shape of a small *Mesodesma* and is nearest to *S. yorkensis*, compared with which it is higher and more inequilateral and with a more oblique anterior dorsal slope." Dall, 1900.

Length, 7.3 mm.; height, 5.5 mm.; diameter, 2 mm. (Dall).

Occurrence.—St. Mary's Formation. St Mary's River.

Collection.—Maryland Geological Survey.

Sportella petropolitana Dall.

Plate LXXXVII, Fig. 7.

Sportella petropolitana Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1130, pl. xlv, fig. 10.

Description.—"Shell small, oblong, subequilateral, moderately convex, the dorsal slopes evenly arched, the base nearly straight, and the ends rounded; beaks low and inconspicuous; outer surface nearly smooth or sculptured with incremental lines; hinge with the cardinal tooth single, smooth and conical, the pit small, triangular, and the ligamentary ridge obscure. Lon. 5.75, alt. 3.75, diam. 2 mm." Dall, 1900.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

SPORTELLA RECESSA n. sp.

Plate LXXXVII, Figs. 8, 9, 10.

Description.—Shell blunted-ovate, not greatly inflated; inequilateral, anterior part the longer; beak slightly projecting; anterior dorsal margin nearly straight, posterior one curved; posterior end more blunted than anterior one; basal margin gently curved; pallial line faint; adductor scars very faint, anterior one elongated, posterior one more rounded; external surface with fine, irregular, concentric, incremental lines.

Length, 4.6 mm.; height, 3.7 mm.; diameter, 1.1 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CALVERT FORMATION. Reed's.

Collection.—Maryland Geological Survey.

SPORTELLA PATUXENTIA n. sp.

Plate LXXXVII, Fig. 11.

Description.—Shell triangular, depressed, thick, inequilateral; anterior side the longer; anterior side declining, slightly curved; anterior end acutely rounded; posterior side very short; posterior end bluntly rounded; teeth strong; muscle impressions distinct; anterior one elongated and narrow, posterior one rounded; pallial line distinct, ragged, somewhat irregular; exterior surface with irregular concentric lines or grooves.

Length, 8 mm.; height, 6 mm.; diameter, 1.75 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point.

Collection.—Maryland Geological Survey.

Genus HINDSIELLA Stoliczka.

HINDSIELLA ACUTA Dall.

Plate LXXXVII, Figs. 12a, 12b, 13.

Hindsiella acuta Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1138, pl. xlv, fig. 9.

Description.—"Shell small, cuneate, inflated, subequilateral, the posterior side broader and rounded, the anterior narrower, more pointed and decurved; anterior dorsal margin declining, posterior arcuate;

middle of the base conspicuously insinuate; surface sculptured with crowded, rather prominent incremental lines, feebler towards the anterior end, which shows some faint radial markings; hinge-plate narrow, left valve with a prominent subumbonal tooth and a feeble lamella a little in front of it, a strong resiliary scar, and a minute, obsolete, very distant posterior lamella; right valve with an arcuate, short, umbonal lamina, a deep pit for the opposite cardinal above it, and a short, distant, sharp groove corresponding to the posterior lamella of the opposite valve; interior of the valves polished, faintly radially striate, the adductor scars rather low down.

"This species is especially characterized by its relatively acute anterior end, which, in all the individual variations noted, is still preserved." Dall, 1900.

Length, 6 mm.; height, 4 mm.; diameter, 3 mm (Dall).

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Family LEPTONIDÆ.

Genus ERYCINA Lamarck.

Erycina calvertensis n. sp.

Plate LXXXVII, Fig. 16

Description.—Shell nearly ovate, base well arched and meeting posterior margin in a curve above the line of the base; anterior side slightly produced, beak rather prominent; anterior and posterior dorsal margins declining from the beak at an obtuse angle; teeth prominent; interior with muscle impressions and pallial line distinct; exterior smooth; shell depressed, thin.

Length, 4 mm.; height, 3 mm.; diameter. 0.8 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Erycina pruna n. sp.

Plate LXXXVII, Fig. 17.

Description.—Shell small, short, ovate, depressed; beak slightly projecting; inequilateral, anterior end the longer; anterior and posterior sides and ends forming with the base regular curves; anterior end more acutely rounded and narrower than posterior one; lateral lamellæ short, strong and standing out from the hinge area well into the interior of the shell; lateral grooves short and deep; ligament impressions high up and elongated, the posterior being the larger and broader; pallial line indistinct; outer surface with light, uneven concentric lines and here and there a deeper, stronger groove marking, perhaps, a resting stage.

Length, 4.5 mm.; height, 3.8 mm.; diameter, 0.9 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Erycina marylandica n. sp.

Plate LXXXVIII, Figs. 1, 2, 3.

Description.—Shell small, ovate, depressed, beak very low; anterior and posterior sides straight near the beak and meeting in an angle there; anterior end regularly rounded; posterior end blunted; base regularly arched; lateral lamellæ distinct, rather long; posterior adductor scar rounded and not so high up as the narrower, elongated anterior one; pallial line well away from the margin; outer surface with irregular, concentric grooves or undulations here and there stronger than elsewhere.

Length, 3.9 mm.; height, 3.1 mm.; diameter, 0.9 mm.

Occurrence.—Calvert Formation. 3 miles south of Chesapeake Beach, Plum Point.

Collection.—Maryland Geological Survey.

Erycina rickardia n. sp.

Plate LXXXVIII, Figs. 4a, 4b.

Description.—Shell ovate-quadrate, thick, depressed; beak low but projecting slightly; very inequilateral, the anterior side being much the longer; anterior side concave near the beak; anterior end bluntly rounded, its curve being continuous with the base; posterior side and end a regular curve meeting the base at an angle and on a line with the base lateral laminæ and grooves quite prominent; adductor scars distinct, the anterior one the higher up; pallial line rather broad and remote from the basal margin; outer surface ornamented with fine, regular, close set concentric grooves, the narrow ridges between being rounded.

Length, 6.25 mm.; height, 5.1 mm.; diameter, 1 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Cornell University.

Erycina speciosa n. sp.

Plate LXXXVIII, Fig. 5.

Description.—Shell almost elliptically rounded, save for the slight projection of the beak; anterior end slightly longer; anterior basal margin slightly prolonged before curving upward; shell flattened with a lenticular slope or surface curvature near margins; teeth very strong and prominent, projecting; exterior smooth; interior polished.

Length, 4 mm.; height, 3.2 mm.; diameter, 0.9 mm.

Occurrence.—Choptank Formation. Governor Run. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

Subgenus PSEUDOPYTHINA Fischer.

Erycina (Pseudopythina?) americana Dall.

Plate LXXXVII, Figs. 14, 15.

Erycina (Pseudopythina ?) americana Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1146, pl. xliv, figs. 21, 25.

Description.—" Shell large, moderately convex, inequilateral, rounded at both ends, the posterior side shorter; beaks low, surface sculptured only with rather conspicuous incremental lines; anterior dorsal margin nearly parallel with the base, posterior dorsal margin arcuate; hinge-margin narrow, feebly channelled, edentulous, adductor scars small, narrow, high up; pallial line wide and radially striated." Dall, 1900.

Length, 16 mm.; height, 10.5 mm.; diameter, 7 mm.

Occurrence.—Calvert Formation. "Calvert Cliffs" (= Plum Point?), (Burns).

Collection.—U. S. National Museum.

Genus BORNIA Philippi.

BORNIA MACTROIDES (Conrad).

Plate LXXXVIII, Figs. 6, 7, 8.

Lepton mactroides Conrad, 1834, Jour. Acad. Nat. Sci. Phila. vol. vii, 1st ser., p. 151.
Lepton mactroides Conrad, 1838, Fossils of the Medial Tertiary, p. 19, pl. x, fig. 5.
Lepton mactroides Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Lepton mactroides Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Bornia mactroides Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1150.

Description.—"Shell triangular, subequilateral, thin, convex, smooth and polished; beaks prominent; central; basal margin straight; posterior extremity less obtusely rounded than the anterior. Length less than half an inch." Conrad, 1834.

Length, 10 mm.; height, 7.2 mm.; diameter, 2 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Jones Wharf, Peach Blossom Creek, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University.

BORNIA TRIANGULA Dall.

Plate LXXXVIII, Figs. 9a, 9b.

Kellia triangula H. C. Lea, MS., in Coll. Acad. Nat. Sci. Phila.
Bornia triangula n. sp. ? Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1151.

Description.—Shell compact, elevated, triangular; anterior and posterior dorsal margins declining at an obtuse angle from the beak; beak distinctly prosocœlous and situated anterior to the middle of the shell; anterior and posterior margins rounded; shell inflated just beneath the beaks but mesially compressed near the basal margin; teeth distinct, shell thin, polished; faint growth lines visible.

Length, 5 mm.; height, 4.45 mm.

Occurrence.—CALVERT FORMATION. 3 miles west of Centerville.

Collection.—Maryland Geological Survey.

BORNIA MARYLANDICA n. sp.

Plate LXXXVIII, Fig. 10.

Description.—Shell triangular depressed; inflated dorsally; gently compressed mesially near basal margin; beak low, very markedly prosocœlous; anterior dorsal margin direct, declining; posterior dorsal margin strongly arched or rounded; anterior side rounded cuneate; posterior side longer, more inflated and ovate; posterior end slightly truncate; teeth prominent; muscle impressions and pallial line distinct; interior radial striæ distinct, especially near basal margin; exterior polished; basal margin direct.

Length, 8 mm.; height, 7 mm.; diameter, 1.7 mm.

Occurrence.—Choptank Formation. Greensboro. Calvert Formation. Plum Point (U. S. National Museum).

Collections.—Maryland Geological Survey, U. S. National Museum.

Bornia depressa n. sp.

Plate LXXXVIII, Fig. 11.

Description.—Shell rounded ovate; anterior side slightly produced; anterior end somewhat more sharply rounded than posterior end; base very gently curved; beak not prominent, rising very little above profile of dorsal margin; shell thin and only moderately convex; outer surface smooth, inner surface with very distinct muscle impressions and pallial line; teeth prominent, anterior one set almost transverse to hinge line, posterior one more declining.

Length, 4.6 mm.; height, 3.2 mm.; diameter, 0.9 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Genus KELLIA Turton.

Kellia rotundula n. sp.

Plate LXXXVIII, Figs. 12, 13.

? *Kellia sp. indet.* Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1154.

Description.—Shell delicate, rounded, elliptical; highly inflated; beak almost medial, not prominent; posterior end slightly truncated squarely; hinge area prominent; teeth distinct, moderately stout; muscle impressions and pallial line faint; faint interior radial markings visible; exterior polished, smooth.

Length, 7 mm.; height, 6 mm.; diameter, 1.4 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, Dover Bridge (?) (Dall).

Collections.—Maryland Geological Survey, U. S. National Museum (?).

Genus THECODONTA A. Adams.

Subgenus DICRANODESMA Dall.

THECODONTA (DICRANODESMA) CALVERTENSIS n. sp.

Plate LXXXVIII, Figs. 14, 15, 16, 17, 18.

Thecodonta ? (Dicranodesma) calvertensis (Glenn) Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1157, pl. xlv, figs. 23, 24, listed.

Description.—Shell compact, stout, ovate-triangular, vaulted, very inequilateral; beak acute, slightly projecting and very far anterior; anterior side and end continuous, nearly straight above but meeting the base in a regular curve; posterior side slightly convex; posterior end rounded; base gently curved; muscle impressions rounded, small, nearly equal in size and situated high up; pallial line broad and ragged; exterior polished, with fine, faint, irregular, concentric growth striæ or with stronger, more remote, concentric undulations; hinge strong, broad; teeth, anterior conical, posterior flattened.

Length, 4.6 mm.; height, 3.5 mm.; diameter, 1.2 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus MONTACUTA Turton.

MONTACUTA MARIANA Dall.

Plate LXXXVIII, Fig. 19.

Montacuta mariana Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1173, pl. xlv, fig. 18.

Description.—"Shell small, ovate, moderately convex, sculptured chiefly by incremental lines and faint concentric wrinkles; beaks conspicuous, showing the prodissoconch, but not high, nearly central, the dorsal margin sloping almost equally each way from the beaks, the ends rounded, the base evenly arcuate; hinge with a single, small, subtrigonal anterior lamina in each valve, a small, oblique submarginal sulcus in each valve behind the beaks; interior of the valves smooth, muscular impressions faint but normal." Dall, 1900.

Length, 4 mm.; height, 3.25 mm.; diameter, 1.5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Genus ALIGENA H. C. Lea.

Aligena æquata (Conrad).

Plate LXXXVIII, Figs. 20, 21; Plate LXXXIX, Figs. 1, 2a, 2b, 3.

Amphidesma æquata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 307.

Amphidesma æquata Conrad, 1845, Fossils of the Medial Tertiary, p. 65, pl. xxxvi, fig. 5.

Aligena striata H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 238, pl. xxxiv, fig. 13.

Amphidesma æquata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 95, pl. xxiii, fig. 5.

Abra æquata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 574.

Abra æquata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.

Aligena æquata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, pl. xxiv, figs. 8, 8a, 8b.

Aligena æquata Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1175.

Description.—" Longitudinally oval, convex, with about 17 laminated concentric striæ; anterior and posterior margins nearly equally rounded; basal margin very regularly rounded; beaks slightly prominent; one cardinal tooth in the right valve, and no lateral teeth. Length less than one-third of an inch." Conrad, 1843.

The strong concentric laminæ stand nearly perpendicular to the surface, are somewhat inequidistant and between them are numerous fine, close set striæ; main and subordinate striæ at times of nearly equal strength; within smooth, pallial margin and muscle impressions often, though not always, distinct; shell fragile.

Length, 12 mm.; height, 9.8 mm.; diameter, 3.4 mm.

Occurrence.—Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Turner, Jones Wharf, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Aligena æquata var. nuda Dall.

Plate LXXXIX, Fig. 4.

Aligena æquata var. nuda Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1175–6, (*in forme*).

" Occasional specimens [of *A. æquata*] are found in which the laminæ fail to develop, forming the variety *nuda*, Dall." Dall, 1900.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Aligena pustulosa Dall.

Plate LXXXIX, Figs. 5a, 5b.

Aligena pustulosa Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 928, pl. xxxiii, figs. 18, 22.

Aligena pustulosa Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1176.

Description.—" Shell small, thin, subtrigonal, moderately inflated, subequilateral, with small, pointed, inconspicuous beaks; valves with a well-marked carina extending downward and forward to the anterior angle of the basal margin, in front of which keel the surface is slightly impressed; surface sculptured with feeble incremental lines, along which are irregularly distributed, small, pointed, pustular elevations; beaks anteriorly twisted with a minute obscure tooth below them on the cardinal margin; ligamentary sulcus long and well marked; scars and pallial line much as in *Diplodonta;* margin entire, inner surface faintly radially striated. Alt. 6, lat. 5.2, diam. 4 mm." Dall, 1900.

Occurrence.—Calvert Formation. "Calvert Cliffs" (= Plum Point?).

Collection.—U. S. National Museum.

Superfamily LUCINACEA.

Family DIPLODONTIDÆ.

Genus DIPLODONTA Brown.

Diplodonta acclinis Conrad.

Plate LXXXIX, Figs. 6a, 6b.

Lucina acclinis Conrad, 1832, Fossil Shells of the Tertiary, p. 21, pl. vi, fig. 2.

Mysia americana Conrad, 1838, Fossils of the Medial Tertiary, p. 30, pl. xvi, fig. 2.

Diplodonta acclinis Conrad, 1858, Proc. Acad. Nat. Sci. Phila., vol. ix, p. 166.

Mysia acclinis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.

Mysia acclinis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Diplodonta acclinis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, pl. xxviii, figs. 2, 13.

Diplodonta acclinis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1186.

Description.—" Suborbicular, or lentiform, a little oblique, with strong lines of growth; hinge with 2 diverging teeth in each valve; posterior tooth of the right valve bifid; anterior muscular impression not profoundly elongated." Conrad, 1832.

Length, 33 mm.; height, 31 mm.; diameter, 8 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Dover Bridge, Greensboro. CALVERT FORMATION. Church Hill, Reed's, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University.

DIPLODONTA SHILOHENSIS Dall.

Plate LXXXIX, Figs. 7, 8.

Mysia parilis Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 71, pl. iv, fig. 1.
Not *Mysia parilis* Conrad, 1860, 1865.
Mysia parilis Whitfield, 1895, Mon. xxiv, U. S. Geol. Survey, p. 61, pl. ix, figs. 9–13.
Diplodonta shilohensis Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1184.

Description.—"Equilateral, nearly circular, ventricose, thin and fragile; basal and anterior margin regularly rounded." Conrad, 1866.

Beaks not prominent, situated just slightly anterior to the middle of the valve; shell very globular; curvature of margin very nearly circular; curvature of surface almost spherical.

Length, 10 mm.; height, 9 mm.; diameter, 4 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Section SPHÆRELLA Conrad.

DIPLODONTA SUBVEXA (Conrad).

Plate LXXXIX, Figs. 9, 10.

Sphærella subvexa Conrad, 1838, Fossils of the Medial Tertiary, p. 18, pl. x, fig. 2.
Erycina subconvexa d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 115.
Sphærella subvexa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Sphærella subvexa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Diplodonta (Sphærella) subvexa Dall, 1900, Trans. Wagner Free Inst. Sci., vol. iii, pt. v, p. 1186.

Description.—"Shell globose, thin and fragile; disk with fine lines of growth; umbo very prominent, slightly oblique, nearly central; lunule undefined; margins rounded." Conrad, 1838.

Shell nearly hemispherical, length slightly greater than height; cardinal teeth small, projecting, in right valve three, in left valve two, ligament area narrow; muscular impressions sometimes indistinct; external surface nearly smooth. Rare and very difficult to obtain entire.

Length, 34 mm.; height, 32 mm.; diameter, 14 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, Flag Pond, Jones Wharf. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family LUCINIDÆ.

Genus PHACOIDES Blainville.

Subgenus PSEUDOMILTHA Fischer.

PHACOIDES (PSEUDOMILTHA) FOREMANI (Conrad).

Plate XC, Figs. 1, 2.

Lucina Foremani Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 29.
Lucina Foremani Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 184.
Lucina Foremani Conrad, 1845, Fossils of the Medial Tertiary, p. 71, pl. xl, fig. 4.
Lucina Foremani Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Lucina foremani Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Phacoides (*Pseudomiltha*) *Foremani* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1378.

Description.—"Orbicular, ventricose, moderately thick; surface with irregular shallow grooves, and rather distant prominent striæ, with intermediate, fine, concentric lines; posterior margin subtruncated obliquely outwards; beaks prominent, not central; hinge edentulous. Length, 1½ inch." Conrad, 1841.

It may be distinguished from *P. anodonta* by being smaller and much more convex; as found in Maryland, the interior, prismatic portion of the shell is often badly decayed, while the exterior portion is usually well preserved; it is at times quite thick.

Length, 35.5 mm.; height, 34 mm.; diameter, 8.5 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run. CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

PHACOIDES (PSEUDOMILTHA) ANODONTA (Say).

Plate XC, Figs. 3, 4.

Lucina anodonta Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, p. 146, pl. x, fig. 9.
Lucina anodonta Conrad, 1840, Fossils of the Medial Tertiary, p. 39, pl. xx, fig. 4.
Lucina anodonta Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 55, pl. xviii, fig. 2.
Lucina Americana Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Lucina Americana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Phacoides (*Pseudomiltha*) *anodonta* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1378.

Description.—" Orbicular, slightly transverse, compressed; teeth obsolete.

"*Shell* with elevated wrinkles; orbicular, a little transverse, with a very slight impressed longitudinal line on the *anterior* margin; *anterior* and *posterior* ends equally curved; *apices* not prominent beyond the general curve of the shell, with a very short, deep emargination behind them; *teeth* obsolete; both the cardinal and lateral ones are generally altogether wanting; lunule short, cordate, profound. . . .

" The impressed line on the anterior part of the shell is hardly visible in many specimens, and is sometimes only a very slight undulation, not observable but on close inspection. . . ." Say, 1824.

Distinguished readily by its being flat, toothless and usually thick, with distinct pallial line and muscle impressions.

Length of very large specimen, 69 mm.; height, 65 mm.; diameter, 10 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Dover Bridge, Peach Blossom Creek. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Subgenus HERE Gabb.

Section CAVILUCINA Fischer.

PHACOIDES (HERE) TRISULCATUS (Conrad).

Plate XC, Figs. 7, 8, 9.

Lucina trisulcata Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 346.
Lucina trisulcata Conrad, 1845, Fossils of the Medial Tertiary, p. 71, pl. xl, fig. 12.

Lucina trisulcata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 62, pl. xviii, figs. 18, 19.

Lucina trisulcata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.

Lucina trisulcata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Lucina trisulcata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 64, pl. x, figs. 1-4.

Lucina crenulata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 63, pl. x, figs. 7-15 (not of Conrad).

Phacoides (Cavilucina) trisulcatus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1369.

Description.—" Obovate, convex; with concentric lines, and two or three distinct concentric furrows; lunule profound. Differs from *L. alveata* of the lower tertiary in being less ventricose, and in the much more profoundly impressed lunule; the cardinal teeth are also very different." Conrad, 1841.

Shell inequilateral, being somewhat produced anteriorly; beak, consequently not medial; moderately convex or more usually rather flattened, especially anteriorly; a small, flattened groove or depressed band extending from the beak backward along the posterior submargin; the two or three concentric furrows very distinct or, again, very indistinct or entirely wanting; or at times only one furrow present, being either distinct or indistinct; margin crenulated.

Specimens that are rather elevated and ornamented by fine concentric ridges only approach rather closely to the form of *P. crenulatum,* but may be distinguished from it by having a heavier hinge area and a more profound lunule and by being somewhat produced anteriorly and not quite so elevated. Whitfield has figured as *P. crenulatum* the smoother form of *P. trisulcatum* from New Jersey.

Length of large specimen, 8 mm.; height, 8.5 mm.; diameter, 2 mm.

Occurrence.—Choptank Formation. Greensboro, Cordova. Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, 3 miles west of Centerville, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Subgenus LUCINOMA Dall.

PHACOIDES (LUCINOMA) CONTRACTUS (Say).

Plate XC, Figs. 5, 6.

Lucina contracta Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 145, pl. x, fig. 8.
Lucina contracta Conrad, 1840, Fossils of the Medial Tertiary, p. 40, pl. xx, fig. 5.
Lucina subplanata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 29 (young).
Lucina subplanata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 184.
Lucina contracta Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 54, pl. xviii, fig. 1.
Lucina contracta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Lucina subplanata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.
Lucina contracta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Lucina subplana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.
Phacoides (*Lucinoma*) *contractus* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1380.

Description.—"*Shell* convex, suborbicular, with numerous, concentric, regular, equidistant, elevated, membranaceous striæ, and intermediate smaller transverse lines: *umbones* not very prominent: *apices* proximate, nearly central: *anterior hinge margin* rectilinear, to an obtuse angle near the middle of the anterior margin: *anterior submargin* with a very slightly impressed line: *posterior margin* rounded: *cardinal teeth* one in the left valve, and two in the right, the posterior one of which is subbifid at tip: *lateral teeth* none: *within* obsoletely striated towards the margin: *posterior muscular impression* perfectly rectilinear, elongated, and oblique." Say, 1824.

Easily distinguished by the elevated, concentric lamellæ. An impressed line extends from the beaks to the posterior margin; shell thin and rather fragile.

Length, 42 mm.; height, 39 mm.; diameter, 5.9 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Pawpaw Point, Jones Wharf, Greensboro, Cordova. CALVERT FORMATION. Fairhaven, Lyon's Creek, 3 miles south of Chesapeake Beach, Plum Point, Jewell.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Subgenus PARVILUCINA Dall.

PHACOIDES (PARVILUCINA) CRENULATUS (Conrad).

Plate XC, Figs. 10, 11, 12.

Lucina crenulata Conrad, 1840, Fossils of the Medial Tertiary, p. 39, pl. xx, fig. 2.

Lucina lens H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 240, pl. xxxiv, fig. 19.

Lucina crenulata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 60, pl. xviii, figs. 14, 15.

Lucina crenulata Emmons, 1858, Rept. N. C. Geol. Survey, p. 291, fig. 217 (fig. poor).

Lucina crenulata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 577.

Lucina crenulata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Not *Lucina crenulata* Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 63, pl. x, figs. 7–15.

Phacoides (Parvilucina) crenulatus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1383, pl. lii, fig. 12.

Description.—" Shell lenticular, with numerous concentric laminæ; a submarginal fold on the posterior side; posterior extremity truncated; cardinal line straight, oblique; beaks central; cardinal and lateral teeth distinct; margin minutely crenulated." Conrad, 1840.

Shell orbicular in outline and highly convex or elevated; usually rather thin; hinge area not heavy or broad; anterior side not produced. For distinction from *P. trisulcatus* see remarks under that species.

Whitfield has figured as *L. crenulata* some of the smoother and more rounded forms of *P. trisulcatus*.

Length, 6.2 mm.; height, 6 mm.; diameter, 1.8 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point, Langley's Bluff, St. Mary's River. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Pawpaw Point, Trappe Landing, Peach Blossom Creek, Dover Bridge, Greensboro, Cordova. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University.

PHACOIDES (PARVILUCINA) PRUNUS Dall.

Plate XC, Fig. 13.

Phacoides (Parvilucina) prunus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1384, pl. lii, fig. 8.

Description.—" Shell resembling *P. crenulatus* but flatter, more inequilateral, with thicker and more regular concentric ribs, no radial sculpture, the inner margins more finely crenulate or even smooth, lunule shorter and wider, and the posterior dorsal area narrower and more ventrical than in *P. crenulatus.* Alt., 6.5, lon., 7.0, diam., 4.0 mm.

"The beaks are much more prominent and more recurved over the small globular lunule, the ribs are wider than their interspaces, and the radial structure is seen only when the shell is decoricated." Dall, 1903.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Subgenus LUCINISCA Dall.

Phacoides (Lucinisca) cribrarius (Say).

Lucina cribraria Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 147, pl. xiii, fig. 1.

Lucina cribraria Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187.

Phacoides (*Lucinisca*) *cribrarius* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1372.

Description.—The type specimen of this species has been generally thought to come from St. Mary's County, Maryland. The author knows of no authentic specimen from Maryland in any collection, notwithstanding the extensive collections which have been made by the Maryland Geological Survey. He is of the opinion that Say's type really came from Virginia.

Occurrence.—St. Mary's Formation. St. Mary's River. (Conrad).

Genus DIVARICELLA von Martens.

Divaricella quadrisulcata (d'Orbigny).

Plate XCV, Fig. 8.

Tellina divaricata Dillwyn, 1817, Cat. Rec. Sh., i, p. 102 (*ex parte*), and of many other authors.

Lucina quadrisulcata d'Orbigny, 1846, Voy. Am. Mér., p. 584.

Divaricella quadrisulcata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1389, pl. li, fig. 1.

Description.—This species has been listed from Maryland but the author knows of no authentic specimen in any collection and has failed to find it himself. Say's specimen of this species is also believed to have come from Virginia.

Dr. Dall says of it: "The chief characteristics of this species are the long, narrow, somewhat sinuous lunule, the straight hinge-line with the shell margin at its ends subangulate, the fine crenulation of the margin of the valves, and the absence dorsally of the rude denticulation due to the surface sculpture from which *D. dentata* Wood derives its name.

Occurrence.—CALVERT FORMATION. "Prince George County and elsewhere." (Dall).

Collection.—U. S. National Museum.

Superfamily CHAMACEA.

Family CHAMIDÆ.

Genus CHAMA Linné.

CHAMA CONGREGATA Conrad.

Plate XCI, Figs. 1, 2, 3.

Chama congregata Conrad, 1833, Amer. Jour. Sci., vol. xxiii, p. 341.

Chama congregata Conrad, 1838, Fossils of the Medial Tertiary, p. 32, pl. xvii, fig. 2.

Chama congregata Tuomey and Holmes, 1855, Pleiocene Fossils of South Carolina, p. 23, pl. vii, figs. 7–10.

Chama congregata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 576.

Chama congregata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 8.

Chama congregata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 65, pl. ix, figs. 14–18.

Chama congregata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1400.

Description.—"Shell sessile, dextral; superior valve a little convex, with numerous, erect, elevated, arched scales; beaks occasionally rostrated; apex subspiral; scales on the inferior valve broader and more elevated; inner margin crenulated." Conrad, 1833.

The shape of the lower valve is more or less modified by the surface to which it is attached; within, anterior and posterior muscle impressions and pallial line distinct. The curving of the beak to the right as well as the smaller size and much less massive character of the shell, readily separate it from *C. corticosa.*

Length, 32 mm.; height, 33 mm.; diameter, 12 mm.

Occurrence.—CALVERT FORMATION. Church Hill, abundant, and rare at the following localities: 3 miles west of Centerville, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Superfamily CARDITACEA.

Family CARDITIDÆ.

Genus CARDITA (Bruguière) Lamarck.

Section CARDITAMERA Conrad.

CARDITA PROTRACTA (Conrad).

Plate XCI, Figs. 4, 5, 6.

Carditamera protracta Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 305.
Carditamera protracta Conrad, 1845, Fossils of the Medial Tertiary, p. 65, pl. xxxvii, fig. 2.
Cardita protracta d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 114, No. 2134.
Carditamera protracta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.
Carditamera aculeata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., pp. 578, 585.
Carditamera protracta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Carditamera aculeata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Carditamera recta Conrad, 1869, Amer. Jour. Conch., vol. iv, p. 279, pl. xx, fig. 2.
Carditamera aculeata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 58, pl. ix, figs. 7, 8.
Cardita (Carditamera) recta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1413.
Cardita (Carditamera) protracta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1414.

Description.—"Trapezoidal, elongated, compressed, widely contracted from beak to base; dorsal and basal margins nearly parallel; ribs about 15, the middle ones triangular and crenated; posterior ribs rounded and having distant, arched, squamose, coarse striæ; summit of the beaks scarcely prominent above the hinge line." Conrad, 1843.

There seems to be no sufficient ground for separating the Maryland Miocene *Carditameras.* They show a gradual decrease in the number of ribs from forms with about nineteen to twenty-one in the earlier deposits, as at Church Hill, to forms with fifteen to seventeen in later deposits, as at Jones Wharf. Occasionally a specimen is rather prolonged, or slightly thicker, or is not so widely contracted from beak to base, but these variations all seem too slight to be considered of even varietal value. The *C. aculeata* is merely a young form. *C. recta* is not more prolonged than many a Governor Run specimen of *C. protracta. C. carinata,* first described from Newbern, N. C., is listed by Conrad from Dover Bridge—the Choptank near Easton. If his identification were not wrong, then it is probable that *C. carinata* should be united with *C. protracta* and take precedence of the latter name.

C. arata was described by Conrad from Newbern, N. C. and from Dover Bridge (near Easton), Md. The figure and description fit the stouter, shorter southern Miocene species with its fewer ribs and short hinge-line, but does not fit the forms found by the writer at Dover Bridge or any other Maryland Miocene horizon. He believes that the Maryland forms referred by Conrad in 1832 to *C. arata* were different from the common Carolina form, *C. arata,* of which *C. carinata* is a synonym merely, and belonged to the then undifferentiated species *C. protracta* which occurs abundantly at Dover Bridge and was first described by Conrad in 1843. The latter is proportionally longer, thinner, with more numerous ribs and has more nearly linear and parallel dorsal and ventral margins.

Length, 39 mm.; height, 18 mm.; diameter, 7 mm.

Occurrence.—Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Dover Bridge, Greensboro. Calvert Formation. Fairhaven, Plum Point, Magruder's Ferry, Church Hill, 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus VENERICARDIA Lamarck.

Venericardia granulata Say.

Plate XCI, Figs. 7, 8, 9, 10.

Venericardia granulata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 142, pl. xii, fig. 1.

Cardita granulata Conrad, 1835, Amer. Jour. Sci., vol. xxviii, p. 110.

Cardita granulata Conrad, 1838, Fossils of the Medial Tertiary, p. 12, pl. vii, fig. 1.

Cardita granulata Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 66, pl. xix, figs. 7, 8.

Cardita tridentata Emmons, 1858, Rept. N. C. Geol. Survey, p. 302, fig. 236a; not of Say, 1826,

Actinobolus (Cardita) granulata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.

Venericardia (Cardiocardites) granulata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.

Venericardia borealis var. granulata Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 46.

Cardita granulata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 56, pl. ix, figs. 1–4.

Venericardia (Cyclocardia) granulata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1431.

Description.—" Suborbicular, with about twenty-five convex ribs, and wrinkled across; inner margin crenate.

"*Beaks* nearly central, a little prominent, curved backward: ribs granulated on the umbones, and transversely wrinkled near the base, convex: *apices* somewhat prominent beyond the general curve of the shell: *inner margin* and *edge* crenate: *cardinal* teeth two.

" Length from the apex to the base four-fifths of an inch, breadth nearly the same.

" Rather proportionally longer than the *decussata* and more oblique." Say, 1824.

None of the Maryland specimens have as many as twenty-five ribs. Those from the Calvert formation have eighteen to twenty-one, those from the Choptank formation sixteen to eighteen, and those from St. Mary's formation, seventeen to nineteen. They approach *V. granulata,* therefore, in number of ribs.

From Calvert formation, length, 16 mm.; height, 17 mm.; diameter, 6.5 mm. From St. Mary's River, length 26 mm.; height, 28 mm.; diameter, 9.5 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River. Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Cuckold Creek. Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Academy of Natural Sciences of Philadelphia.

Venericardia castrana n. sp.

Plate XCI, Figs. 11, 12.

Description.—Outline suborbicular, beaks acute, prominent, curved forward; shell depressed or flattened; ribs twenty-four to twenty-seven, finely granulated and slightly convex near the beak and without granulations but crossed by fine concentric wrinkles or growth lines over the rest of the shell; the impressed lines between the ribs distinct near the beak but almost obsolete on the outer part of the shell; ribs almost perfectly flat on outer part of shell; teeth strong; muscle impressions and pallial line distinct; inner margin crenated.

The much greater flatness of the shell, the absence of granulations on the ribs except very near the umbo, the very slight convexity of the ribs themselves giving the surface an almost smooth appearance, as well as the number of the ribs, readily distinguish this species from any of the Maryland specimens of *Venericardia granulata.*

Length, 20 mm.; height, 21 mm.; diameter, 4.5 mm.

Occurrence.—CALVERT FORMATION. Church Hill, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Superfamily ASTARTACEA.

Family CRASSATELLITIDÆ.

Genus CRASSATELLITES Kruger.

CRASSATELLITES MELINUS (Conrad).

Plate XCII, Figs. 1, 2.

Crassatella melina Conrad, 1832, Fossil Shells of the Tertiary, p. 23, pl. ix, fig. 2.
Crassatella melina Conrad, 1838, Fossils of the Medial Tertiary, p. 22, pl. xii, fig. 2.
Crassatella melina Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Crassatella melina Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Crassatella melina Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 60, pl. viii, figs. 11–13.
Crassatellites (Scambula) melinus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1473.

Description.—"Ovate, thick, not compressed; anterior margin obtusely rounded; posterior margin oblique and angular; dorsal margin nearly straight; concentric lines coarse; umbonial slope subangular and scarcely curved; beaks with concentric grooves; inner margin entire." Conrad, 1832.

This species, as found in Maryland, is more properly described as subovate, convex-depressed, and rather thin except in old specimens, which are somewhat thicker and more convex. It is somewhat more produced posteriorly and hence is proportionally narrower along the obliquely truncated posterior margin than is represented in Conrad's figure. The dorsal slope has regular, well marked, angular, concentric undulations near the beak that become obsolete during later stages of growth; posterior and dorsal slopes separated by a distinctly angular line; posterior slope somewhat flattened; posterior dorsal margin but slightly concave; hinge area rather narrow, not massive; muscular impressions and pallial margin very distinct.

Length, 88 mm.; height, 47 mm.; diameter, 15 mm.

Occurrence.—Calvert Formation. Fairhaven, Lyon's Creek, Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Crassatellites marylandicus (Conrad).

Plate XCIII, Figs. 1, 2, 3.

Crassatella Marylandica Conrad, 1832, Fossil Shells of the Tertiary, p. 22, pl. viii, fig. 1.

Crassatella Marylandica Conrad, 1838, Fossils of the Medial Tertiary, p. 21, pl. xii, fig. 1.

Crassatella Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.

Crassatella marylandica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.

Crassatellites (*Scambula*) *marylandicus* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1473 (in part).

Description.—" Ovate oblong, thick and ponderous; posterior side narrowed and produced, with the extremity angular or obtusely rounded; umbonial slope subangular; inner margin entire." Conrad, 1832.

Shell convex; umbo elevated and prominent; regular concentric undulations on umbonal slope very slightly developed or obsolescent; surface marked by somewhat irregular growth lines; posterior basal margin often slightly emarginate; posterior and dorsal slopes meet in an angular line or ridge; posterior slope crossed by a slightly obtuse ridge extending from the beak to the upper end of the obliquely truncated posterior margin; posterior dorsal margin deeply concave, anterior one straight; hinge area broad; teeth robust; muscular impressions deep; pallial line distinct.

The young are convex, thick and massive also, with prominent beaks and but slightly produced posterior extremity, giving the shells a triangular outline. The regular, concentric undulations on the umbonal slope are small and not profound and are confined to the portion of the surface in the immediate vicinity of the umbo.

This species is likely to be confused in the adult stage with *C. turgidulus,* with which it is doubtless closely related. For distinctions between the two, see remarks under *C. turgidulus.*

Length, 84 mm.; height, 57 mm.; diameter, 17 mm.

Occurrence.—Choptank Formation. Governor Run (upper bed only), Flag Pond (upper bed only), Turner, Peach Blossom Creek, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Crassatellites turgidulus (Conrad).

Plate XCII, Figs. 3, 4, 5.

Crassatella turgidula Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 307.
Crassatella turgidula Conrad, 1845, Fossils of the Medial Tertiary, p. 69, pl. xxxix, fig. 7.
Crassatella turgidula Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Crassatella turgidula Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7
Crassatellites (Scambula) marylandicus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1473 (in part).

Description.—" Oblong-ovate, slightly ventricose; surface with coarse lines of growth, and concentric undulations obsolete except on the umbones, where they are strongly marked and wide; beaks submedial; umbones flattened; anterior dorsal margin straight; posterior extremity truncated and nearly direct, more oblique in young shells; basal margin swelling a little anteriorly, posteriorly straight to the extremity which is obliquely angulated." Conrad, 1843.

Shell thick, convex, and not strongly produced posteriorly; umbo not prominently elevated; posterior dorsal margin slightly concave or nearly straight; hinge area broad; teeth robust; muscular impressions deep; pallial line distinct.

The young are long-ovate in outline, thin and flat; surface with very prominent, regular, angular, concentric undulations on the umbonal slope and extending over a large portion of the entire surface of the shell; posterior dorsal margin straight or convex.

This species is likely to be confused with *C. marylandicus,* but may be separated in the adult stage by having a less prominent, broader, and more flattened umbo and a more profoundly and widely undulated umbonal slope, by being less produced posteriorly and by having a much less concave posterior dorsal margin. The young of the two species are quite distinct and need never be confused with each other.

This species seems to be confined to the lower of the two fossiliferous beds at Governor Run, Jones Wharf and that horizon elsewhere, and characterizes it just as the *C. marylandicus* seems confined to, and is characteristic of, the upper of these fossiliferous beds.

Length, 87 mm.; height, 55 mm.; diameter, 17 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run (lower bed), 2 miles south of Governor Run (lower bed), Flag Pond (lower bed), Jones Wharf, Pawpaw Point, Cuckold Creek, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

CRASSATELLITES UNDULATUS (Say).

Crassatella undulata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 142, pl. xli, fig. 2.

Crassatella undulata Conrad, 1832, Fossil Shells of the Tertiary, p. 23, pl. ix.

Crassatellites (Scambula) undulatus var. cyclopterus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1474.

Description.—This species is believed to be another of the Virginia forms given to Say by Finch and erroneously described as coming from Maryland. No authentic Maryland specimens of this species are known by the writer.

Occurrence.—" Maryland " (Dall).

Subgenus CRASSINELLA Guppy.

CRASSATELLITES (CRASSINELLA) DUPLINIANUS Dall.

Plate XCIV, Fig. 12.

Crassatellites (Crassinella) duplinianus Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1478, pl. l, figs. 5, 6.

Description.—" Shell small, subtriangular, solid, with markedly acute beaks, which incline backward; anterior slope convexly arcuate, long; posterior slope nearly a straight or slightly concave line, shorter; lunule and escutcheon extending the whole length of their respective slopes, long and narrow, the latter more excavated than the former and wider;

both are smooth; base arcuate; disk sculptured with rather close-set, regular, subequal, flattish, concentric ridges with narrower interspaces; these are sometimes feebly elevated, but preserve their general close-set, regular character; hinge well developed, the posterior cardinal in the left valve often conspicuous. Height, 3.2, breadth, 3.2, diameter, 1.7 mm.

"This species is especially characterized by the closeness, regularity, and smoothness of its concentric ridges and the long and narrow lunule and escutcheon." Dall, 1903.

Length, 3.4 mm.; height, 3.24 mm.; diameter, 0.75 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION. Plum Point (U. S. Nat. Mus.).

Collections.—Maryland Geological Survey, U. S. National Museum.

CRASSATELLITES (CRASSINELLA) GALVESTONENSIS (Harris).

Plate XCIV, Figs. 13, 14.

Eriphyla galvestonensis Harris, 1895, Bull. Amer. Pal., vol. i, p. 90, pl. i, figs. 2, a, b.
Crassatellites (Crassinella) galvestonensis Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1478, pl. xlix, fig. 14.

Description.—"Form as indicated by the figures; hinge as in *E. lunulata;* exterior smooth, slightly undulating concentrically near the beaks; beaks, as in many species of *Astarte* and *Crassatella,* slightly flattened at the very apex but very gibbous just below." Harris, 1895.

Length, 7.2 mm.; height, 6.65 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Family ASTARTIDÆ.

Genus ASTARTE Sowerby.

ASTARTE VICINA Say.

Plate XCIII, Figs. 10, 11.

Astarte vicina Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 151, pl. ix, fig. 6.
Astarte vicina Conrad, 1840, Fossils of the Medial Tertiary, p. 41.
Astarte exaltata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 29.
Astarte exaltata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 185.
Astarte exaltata Conrad, 1845, Fossils of the Medial Tertiary, p. 66, pl. xxxvii, fig. 6.

Astarte vicina Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte exaltata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte vicina Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte exaltata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte vicina Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1489.
Astarte exaltata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1489.

Description.—" Trigonal, with a distant, somewhat regular, impressed line; lunule much excavated; apices acute.

"Apices prominent: lunule dilated, deeply excavated, subcordate, separated from the disk, particularly near the beaks, by a subacute angle: beaks prominent, approximate, acute, curved backwards: ligament margin concave: umbones convex." Say, 1824.

Margin posterior to the beak nearly straight, anterior to the beak profoundly concave. The sulcations of the umbo gradually change into obscure undulations over the rest of the surface. Margin crenulated or smooth. The anterior, basal, and posterior margins form a nearly symmetrical curve. Umbonal region thick; cardinal teeth strong.

Length, 18 mm.; height, 18 mm.; diameter, 5 mm.

Occurrence.—St. Mary's Formation. St. Mary's River. Calvert Formation. 3 miles south of Chesapeake Beach, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Astarte thomasii Conrad.

Plate XCIV, Figs. 1, 2.

Astarte Thomasii Conrad, 1855, Proc. Acad. Nat. Sci. Phila., vol. vii, p. 267.
Astarte Thomasii Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte Thomasii Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte Thomasii Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 72, pl. iv, fig. 16.
Astarte Thomasii Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 55, pl. viii, figs. 3–7.
Astarte Coheni Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1489 (in part).

Description.—" Triangular, not ventricose, inequilateral; ribs concentric, robust, recurved; concentric lines more or less marked, minute; toward the posterior end the ribs suddenly become obsolete; extremity truncated, nearly direct, or sloping inwards; inner margin crenulated; lunule large, ovate, acute, deeply excavated." Conrad, 1855.

Shell rather thick and solid, especially in the umbonal region; cardinal teeth well developed; margin crenulated or smooth.

Length, 22 mm.; height, 19 mm.; diameter, 6 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Lyon's Creek (rare).

Collections.—Maryland Geological Survey, Johns Hopkins University, Academy of Natural Sciences of Philadelphia.

ASTARTE CALVERTENSIS n. sp.

Plate XCIV, Figs. 3, 4.

Astarte calvertensis (Glenn) Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, pp. 1492, 1494 (listed).

Description.—Triangular; shell nearly flat, with about forty-five regular, nearly equal concentric lines; apex moderately prominent, right angled or obtuse; anterior side shorter than posterior; lunule not deeply excavated; anterior basal margin a well rounded curve, posterior basal margin straight or slightly emarginate; posterior extremity above the line of the base and sharply rounded; posterior side straight; ligament areas impressed; teeth moderately prominent; basal margin crenate or smooth.

This species differs from *A. bella*, *A. concentrica* and *A. compsonema* (all three synonymous?) to which it seems most closely related by being thinner, much flatter, less equilateral, more emarginate posteriorly and with less prominent and less projecting beaks.

Length, 25 mm.; height, 20 mm.; diameter, 4.5 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

ASTARTE SYMMETRICA Conrad.

Astarte symmetrica Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser. p. 134.

Astarte symmetrica Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1488.

Description.—This species has not been found by the author among Maryland materials.

Occurrence.—ST. MARY'S FORMATION (?). St. Mary's River.

Collection.—U. S. National Museum.

ASTARTE CUNEIFORMIS Conrad.

Plate XCIII, Figs. 4, 5, 6.

Astarte cuneiformis Conrad, 1840, Fossils of the Medial Tertiary, p. 42, pl. xx, fig. 9.
Astarte varians Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 29.
Astarte varians Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 184.
Astarte varians Conrad, 1845, Fossils of the Medial Tertiary, p. 67, pl. xxxvii, fig. 7.
Astarte cuneiformis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte cuneiformis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte varians Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte cuneiformis Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 52, pl. viii, fig. 10 only.
Astarte (*Ashtarotha*) *cuneiformis* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1494.

Description.—" Shell trigonal, much compressed; umbo flat, with distant, shallow undulations, and acute little prominent ridges; apex very acute; lunule very profound, with a sharply carinated margin; posterior side produced, cuneiform, acutely rounded at the extremity; cardinal teeth long and rather slender; margin crenulated." Conrad, 1840.

This shell is quite variable. The undulations near the beak may be either coarse or quite fine and may extend over a good portion of the surface, or they may be almost obsolete. The posterior side may be much produced and acutely rounded, giving the shell a distinctly cuneiform shape; or it may be only very slightly, if at all, produced, when the shell becomes more compact and triangular in outline. This shortening may continue until some specimens approach *A. vicina* in outline. The inner margin may be smooth. The base may be regularly arched or may be emarginate posteriorly.

Length, 33 mm.; height, 23 mm.; diameter, 6 mm.

Occurrence.—CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, Lyon's Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Academy of Natural Sciences of Philadelphia, Cornell University.

ASTARTE CASTRANA n. sp.

Plate XCIII, Figs. 7, 8, 9.

Astarte (*Ashtarotha*) *obruta* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1490 (in part).

Description.—Shell triangular, nearly equilateral, with rounded base; beak acute, turned slightly forward; shell flat or depressed; outer surface with small, shallow concentric grooves near the beak, slightly undulated over the rest of the shell by obscure and irregular growth lines, or in some specimens almost perfectly smooth over this outer part; teeth robust; ligament areas impressed; pallial line distinct; margin smooth or crenulated.

This species is doubtless the ancestor of *Astarte thisphila* from which it may be readily separated by its much smoother surface, much flatter form and thinner shell, as well as by its lacking the flattening or depression near the umbo so characteristic of *thisphila.* It has a less prominent beak, is flatter, less symmetrically rounded, thinner and much less smooth on the surface than *Astarte obruta.* It is found only at a lower horizon than either of the other two species mentioned above.

Length, 25 mm.; height, 21 mm.; diameter, 4 mm.

Occurrence.—Calvert Formation. Plum Point, Church Hill, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Astarte obruta Conrad.

Plate XCIV, Figs. 5, 6.

Astarte obruta Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 150.
Astarte obruta Conrad, 1840, Fossils of the Medial Tertiary, p. 43, pl. xxi, fig. 2.
Astarte obruta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte obruta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte (Ashtarotha) obruta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1490 (in part).

Description.—"Shell triangular, convex, smooth, with a few obsolete undulations; beaks prominent, sulcated, margin crenulated. . . .

"Allied to *A. undulata* Say, but is more convex and not profoundly undulated; the umbo is not flattened." Conrad, 1834.

Shell nearly equilateral, moderately thick; the sulcations on the beak usually not prominent and extending but a very short distance from the tip of the beak; the rest of the gently convex surface smooth except for a few broad, almost obsolete, undulations; surface occasionally crossed from beak to base by exceedingly faint, slightly impressed, radial lines; beak projecting, acute, with its very tip curved somewhat forward.

The gently rounded outline, and moderately convex, almost smooth surface serve to distinguish this species from any other. It is characteristic of the horizon of the upper fossiliferous bed at Governor Run, having been found, so far, at no other horizon.

Length, 27.5 mm.; height, 23.5 mm.; diameter, 6 mm.

Occurrence.—Choptank Formation. Governor Run (upper bed), 2 miles south of Governor Run (upper bed), Flag Pond (upper bed), Turner, Dover Bridge, Peach Blossom Creek, Trappe Landing, Sand Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, Academy of Natural Sciences of Philadelphia.

Astarte thisphila n. sp.

Plate XCIV, Figs. 7, 8, 9.

Astarte undulata Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 185 (listed only); not of Say, 1824.

Astarte undulata Conrad, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 139 (listed only).

Astarte obruta var. Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, pp. 26, 27 (listed only).

Astarte (Ashtarotha) undulata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1491 (in part).

Description.—Shell triangular; moderately thick, convex, but depressed or flattened near the beak; angular undulations on the beak prominent, becoming broader farther from the beak and extending well toward, or in some cases entirely to, the basal margin; tip of beak curved forward, producing a convex curve or shoulder on the dorsal margin just posterior to the apex; anterior margin regularly rounded; basal margin rounded anteriorly, straight or slightly emarginate posteriorly; posterior extremity above the line of the base and obtusely rounded; interior smooth except in quite young specimens, when it is sometimes slightly undulated; teeth strong.

This species is quite common at the horizon of yellowish sands so well exposed at Jones Wharf and has often been listed as *A. undulata* or as *A. obruta,* or *A. obruta var.* It differs from *A. undulata* Say by being usually less convex, by having coarser, broader undulations and a greater flattening near the beak, by being much less variable in its proportion of length to height—the height being less than the length while in *undulata* it is often greater—and by having a much more curved basal margin than the *undulata.*

It differs from the *A. obruta* by having a less symmetrically curved surface and outline, by being strongly undulated and by the characteristic convex curve or shoulder just posterior to the tip of the beak. Stratigraphically its occurrence is distinct from that of *obruta* since it has only been found in beds lower in the Miocene series than those containing the *obruta*.

It differs from *A. distans* by being thicker and more convex, by having more numerous and more angular undulations, by having a beak that is less acute and prominent and more abruptly and strongly curved forward. The *A. distans* cannot, moreover, be considered as the young of this species.

The few specimens obtained from Plum Point agree with the typical ones from Jones Wharf except that they have a somewhat less strongly undulated surface. They were found at Plum Point only in a very sandy stratum close to tide level. From this sand-loving characteristic it receives its name.

Length, 30 mm.; height, 26 mm.; diameter, 7 mm.

Occurrence.—Choptank Formation. Governor Run (lower bed), 2 miles south of Governor Run (lower bed), Flag Pond (lower bed), Jones Wharf, Pawpaw Point, Cuckold Creek, Cordova, Greensboro. Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Astarte perplana Conrad.

Plate XCIV, Figs. 10, 11.

Astarte perplana Conrad, 1840, Fossils of the Medial Tertiary, p. 43, pl. xxi, fig. 3.
Astarte planutata [sic.] Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 187, (listed only).
Astarte perplana Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte planulata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 578.
Astarte perplana Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte planulata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.
Astarte (*Ashtarotha*) *perplana* Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1493.

Description.—"Shell triangular, inequilateral, much compressed; disks coarsely wrinkled and obscurely undulated; posterior side subcuneiform; extremity rounded; beaks prominent, acute, with angular grooves; lunule long, elliptical; inner margin crenulated." Conrad, 1840.

The strength of the undulations is somewhat variable; shell rather thick and solid; inner margin crenulated or smooth.

Length, 36 mm.; height, 29 mm.; diameter, 6 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geologieal Survcy, Johns Hopkins University, U. S. National Museum.

Astarte parma Dall.

Plate XCIV, Fig. 15.

Astarte (Ashtarotha) parma Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1493, pl. lvii, fig. 22.

Description.—" Shell very flatly compressed, inequilateral, rostrate, the beaks at the anterior third low, acutely pointed, slightly recurved; lunule narrow, deeper than wide; escutcheon, narrow, deep, as long as the posterior slope, which is almost straight; sculpture of the beaks with about five small, fine ribs, close together, followed by three or four very distant, much wider ripples, obsolete towards the ends and ventral margin, with a few irregularly spaced linear concentric sulci beyond; posterior dorsal profile slightly arcuate, basal margin slightly emarginate behind; anterior end rounded, posterior end pointed; inner ventral margins crenate; hinge-plate broad and flat with two long, narrow cardinals in each valve. Height, 25.0, length, 28.5, diameter, 7.0 mm.

"This curious form differs from *perplana* by its more compressed, flatter, and more acutely pointed valves, and by its umbonal sculpture." Dall 1903.

Occurrence.—Calvert Formation. Skipton, Plum Point.

Collection.—U. S. National Museum.

Order ANOMALODESMACEA.

Superfamily ANATINACEA.

Family PANDORIDÆ.

Genus PANDORA Hwass.

Subgenus CLIDIOPHORA Carpenter.

Pandora (Clidiophora) crassidens Conrad.

Plate XCV, Figs. 1, 2.

Pandora crassidens Conrad, 1838, Fossils of the Medial Tertiary, p. 2, pl. 1, fig. 2.
Pandora crassidens Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Pandora crassidens Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.

Description.—"Shell perlaceous, concentrically wrinkled; the large valve extending much beyond the posterior base of the lesser; anterior side very short, margin widely subtruncate; posterior obtusely rounded inferiorly, terminating above in a very short and obtuse rostrum; dorsal submargin of the larger valve with two approximate carinæ; lesser valve with only one distinct carina placed very near the margin; anterior cardinal tooth of the larger valve very long, thick, and slightly oblique, the posterior one very near the dorsal line, sulcate or fosset shaped; the middle one short and linear; in the flat valve, two oblique, very thick and prominent teeth, anterior to which is a shallow groove, bounded anteriorly by a rudimentary linear tooth; muscular impressions impressed; pallial impression punctate." Conrad, 1838.

Length, 20 mm.; height, 15 mm.; diameter, 4 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River.

Collection.—Maryland Geological Survey.

Subgenus KENNERLEYIA Carpenter.

Pandora (Kennerleyia) lata Dall.

Plate XCV, Fig. 7.

Pandora (Kennerleyia) lata Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1520, pl. lvii, fig. 18.

Description.—"Shell small, left valve very convex, patulous below behind, with a rather broad escutcheon bounded by a strong carina; anterior area short, posterior area very narrow; rostrum very short and blunt, slightly recurved; surface concentrically striated; hinge-teeth short and small; lunule very deep, compressed, so as to appear linear; right valve slightly concave, concentrically striated, with traces of the usual impressed radiating lines. Length 19.0, height 10.5, diameter 3.5 mm.

This species is shorter and thicker than *P. arenosa* and much less acute. Its exact provenance is not known, as it was received from the old National Institute, but the specimens have the livid purple color characteristic of many of the St. Mary's fossils, and it is possible it was collected in that region." Dall, 1903.

Occurrence.—St. Mary's Formation (?). St. Mary's County (?).

Collection.—U. S. National Museum. (National Institute Collection).

Family PERIPLOMATIDÆ.

Genus PERIPLOMA Schumacher.

PERIPLOMA PERALTA Conrad.

Plate XCV, Fig. 3.

Periploma alta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, pp. 572, 585. Not *Anatina alta* C. B. Adams, 1852.
Periploma alta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 11.
Periploma alta Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 70, pl. iv, fig. 10.
Periploma peralta Conrad, 1867, Amer. Jour. Conch., vol. iii, p. 188.
Periploma peralta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1529.

Description.—"Suborbicular, subequilateral, anterior side subrostrated, end truncated, direct; basal margin profoundly rounded medially and posteriorly; anteriorly obliquely truncated or very slightly emarginate.

"A much larger species than *P.* (*Anatina*) *papyracea*, Say, but closely allied." Conrad, 1863.

Shell large, depressed, thin; valves subcircular; external surface minutely pustulose.

Length, 63 mm.; height (of fragment), 55 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point.

Collection.—Maryland Geological Survey.

Family THRACIIDÆ.

Genus THRACIA Leach.

THRACIA CONRADI Couthouy.

Plate XCV, Fig. 4.

Thracia declivis Conrad, 1831, Amer. Mar. Conch., p. 44, pl. ix, fig. 2; not of Pennant, 1777, Brit. Zool., vol. iv, p. 15; nor of Donovan (*fide* Couthouy) Conrad's synonymy excluded.
Thracia Conradi Couthouy, 1839, Bost. Jour. Nat. Hist., vol. ii, p. 153, pl. iv, fig. 2.
Thracia Conradi Gould, 1841, Invert Mass., p. 50.
Thracia Conradi DeKay, 1843, Nat. Hist. N. Y., Zoology vol. i, p. 237, pl. xxviii, fig. 284.
Thracia Conradi Gould (Binney's), 1870, Invert. Mass., p. 69, fig. 384.
Thracia Conradi Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 64, pl. lxix, fig. 9.
Thracia Conradi Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1524.

Description.—"Shell transversely ovate, ventricose, very light, brittle and thin, rather faintly diaphanous by reason of its want of thickness, subequilateral, slightly gaping at both extremities, inequivalve, the right valve being the more convex, its whole margin projecting considerably beyond that of the left; beaks protuberant, large and cordiform, inclining a little backwards, the summit of the right one excavated or emarginate to receive the opposing one; incremental striæ numerous and distinct, occasionally forming feeble concentric ridges; the anterior portion of the shell is regularly rounded and its superior margins very thin; the posterior extremity is rather narrower and somewhat truncated, with an obtuse carination extending obliquely from the beaks to the angle of the basal and posterior margins; between this carination and the superior and posterior margins the shell is slightly compressed. The basal margin is sinuous, curving outwardly in its central portion, correspondent to the most convex part of the shell. Ligament externally very prominent, and prolonged in a thin membrane the whole length of the corselet which is strongly marked and extends from the beaks to the extremity; the internal portion of the ligament is attached to a strong, thick nymphal callosity, projecting obliquely along the cardinal edge in each valve, wider toward the beaks and having its surface but slightly hollowed. Hinge destitute of a cardinal ossiculum. External color a pale, ashy-white surface covered with a thin, light, cinereous epidermis, strongly adherent and forming numerous irregular, minute corrugations at the extremities, especially on the posterior one, but not shagreened as in *T. corbuloides.* Interior color a chalky white, not glassy, but somewhat inclining to nacre near the cardinal edge. Muscular impressions tolerably large, remote, the anterior narrow, elongated, contracted and tapering to a point towards the hinge margin; the posterior subtriangular or pyriform; pallial impression very superficial, like the others, with a profound, subangular excavation posteriorly.

"Length two and eighteen-twentieths, height two and four-twentieths, diameter one and six-twentieths inches." Couthouy, 1839.

The fossil shell seems usually to be larger than Couthouy's living ones. Although often abundant, all specimens the writer has seen have been more or less broken and flattened. Because of this distortion their exact shape is difficult to determine and the writer prefers to retain until more perfect material is obtainable the name *conradi.* When such material is secured it will very probably show the fossil to be at least varietally different from the living species. In this event Dr. Dall's proposed varietal name *harrisi* will apply.

Length, 75 mm.; height, 60 mm.; diameter, about 14 mm.

Occurrence.—CALVERT FORMATION. Fairhaven, Lyon's Creek, Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

Family PHOLADOMYACIDÆ.

Genus MARGARITARIA Conrad.

MARGARITARIA ABRUPTA (Conrad).

Plate XCV, Figs. 5, 6.

Pholadomya abrupta Conrad, 1832, Fossil Shells of the Tertiary, p. 26, pl. xii.
Pholadomya abrupta Conrad, 1838, Fossils of the Medial Tertiary, p. 3, pl. i, fig. 4.
Pholadomya abrupta Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 101, pl. xxiv, fig. 2.
Pholadomya abrupta Emmons, 1858, Rept. N. Car. Geol. Survey, p. 300, fig. 231.
Pholadomya (Margaritaria) abrupta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 572.
Margaritaria abrupta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 12.
Margaritaria abrupta Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1532.

Description.—" Oblong oval, much compressed, with from three to five subacute distant ribs or ridges diverging from the apex; one side rather thick and strong, rounded at the extremity; the opposite side extremely thin, and reflected, with a truncated margin; muscular and pallial impressions distinct." Conrad, 1832.

The shell is pearly and fragile and is readily identified by the radial ridges crossing the dorsal portion of the shell from the beak to the base. The Survey possesses only some fragments.

Occurrence.—ST. MARY'S FORMATION. Cove Point, St. Mary's River. CALVERT FORMATION. White's Landing.

Collection.—Maryland Geological Survey.

Order PRIONODESMACEA.

Superfamily MYTILÆEA.

Family MYTILIDÆ.

Genus MYTILUS Bolten.

MYTILUS CONRADINUS d'Orbigny.

Plate XCVI, Figs. 1a, 1b.

Mytilus incrassatus Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 347; not of Deshayes 1830.

Mytilus incrassatus Conrad, 1845, Fossils of the Medial Tertiary, p. 74, pl. xlii, fig. 4.

Mytilus Conradinus d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 127.

Mytilus incrassatus Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 32, pl. xiv, figs. 1, 2.

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

Mytiloconcha incrassata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xlv, p. 579.

Mytiloconcha incrassata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.

Mytilus Conradinus Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 787.

Description.—"Thick, much inflated; anterior margin slightly incurved near the middle; basal margin not obtusely rounded; hinge thick, with slightly prominent robust teeth." Conrad, 1841.

A remarkably large and almost perfect left valve from Plum Point shows the following characters: Shell highly convex, apically acute, laterally curved and posteriorly rounded in outline; external surface marked by distinct, inequidistant, concentric undulations with finer subordinate ones between; dorsal margin a convex curve; ventral margin a gently concave curve; beak heavy, solid; posterior portion of shell moderately thin; interior dull pearly; hinge or tooth ridge long, narrow, curved and prolonged on the beak as a marginal groove; beak not medially grooved.

The apical portions are usually the only part preserved. When young and badly worn, as is often the case, it becomes very difficult to separate *M. conradinus* from *M. incurvus.*

Length, 180 mm.; width, 78 mm.; diameter, 34 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, Flag Pond, Jones Wharf, Peach Blossom Creek, Dover Bridge, Greensboro. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Subgenus MYTILOCONCHA Conrad.

MYTILUS (MYTILOCONCHA) INCURVUS Conrad.

Plate XCVI, Figs. 2, 3, 4.

Myoconcha incurva Conrad, 1839, Fossils of the Medial Tertiary, p. 3 of cover of No. 1; p. 52, pl. xxviii, fig. 1, 1840.

Mytilus incurvus Conrad, 1854, Proc. Acad. Nat. Sci. Phila., vol. viii, p. 29.

Mytilus (*Myoconcha*) *incurvus* Conrad, 1861, Fossils of the Medial Tertiary, No. 4, p. 88.

Mytiloconcha incurva Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 291.

Mytiloconcha incurva Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.

Mytiloconcha incurva Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.

Mytiloconcha incrassata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 38, pl. v, figs. 10, 11; not of Conrad.

Mytilus (*Mytiloconcha*) *incurvus* Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 789.

Description.—"Shell incurved, thick, narrowed towards the apex; posterior side with a submarginal furrow; hinge with a narrow straight groove for the cartilage, and a broad furrow on the posterior side." Conrad, 1839.

This shell is heavier, more sharply curved, has a longer and more massive cardinal area and more nearly equidistant dorsal and ventral margins than *M. conradinus;* teeth strong, two in left and one in right valve, becoming obsolete in old age. As the cardinal area increases in length with growth the teeth are prolonged apically as ridges with a furrow on each side; area otherwise flat except for a marginal ligament groove extending along the posterior side of the area to the apex.

Length of imperfect valve, 120 mm.; width, about 35 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro, Cordova, near Skipton, Dover Bridge (Dall). CALVERT FORMATION. Church Hill, Truman's Wharf. Also at an unknown horizon in Calvert County (Conrad).

Collections.—Maryland Geological Survey, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Genus LITHOPHAGA Bolten.

LITHOPHAGA SUBALVEATA Conrad.

Plate XCVII, Fig. 1.

Lithophaga subalveata Conrad, 1866, Amer. Jour. Conch., vol. ii, p. 73, pl. iv, fig. 4.
Lithophaga subalveata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 40, [pl. v, fig. 9.

Description.—" Oblong, very thin and fragile, ventricose, posterior side produced, a slight wide furrow marks the umbonal slope, on and behind which are concentric grooves and lines; basal line slightly emarginate or contracted." Conrad, 1866.

A single broken valve shows a produced posterior side with a slight, wide, flat furrow on the umbonal slope crossed by concentric grooves with posterior end narrow and somewhat bluntly rounded. From a comparison with Conrad's broken and poorly patched type in the Academy of Natural Sciences, the two shells seem to be the same.

Occurrence.—CALVERT FORMATION. 3 miles west of Centerville.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

LITHOPHAGA IONENSIS n. sp.

Plate XCVII, Figs. 2, 3.

Description.—Shell very thin and fragile, anterior end rounded, posterior region broadened, posterior end rounded; external surface either smooth or concentrically wrinkled across the umbonal slope; ventral margin slightly convex; dorsal margin straight to the posterior end of the hinge line, then rounded and declining; within, a slight submarginal dorsal thickening or ridge just beneath, and extending the length of, the hinge and minutely grooved for the ligament; beak not prominent; no sulci.

Some specimens are less inflated and posteriorly broadened and more cylindrical with nearly straight ventral margin, and dorsal margin at posterior end of hinge line more angular than the type. These differences, however, do not seem to be of enough value to warrant varietal distinction. Specimens are found in the shells of *Melina, Ostrea* and *Pecten,* at times riddling these shells by their boring.

Length, 13 mm.; width, 6 mm.; diameter, 2 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge, Greensboro, Cordova.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Genus CRENELLA Brown.

CRENELLA VIRIDA n. sp.

Plate XCVII, Fig. 4.

Description.—Shell very small, thin, delicate, of pearly gray luster, elongated ovate in shape, elevated; beak projecting and sharply rounded; margins gracefully curved; radial scupture of fine, close-set, narrow, rounded, raised lines, their number increasing by dichotomy and by intercalation between older lines.

As compared with *C. dupliniana* this species is more elongated, less elevated, less robust, has coarser sulcations and these sulcations are more branching than in *C. dupliniana.*

Length, 1.65 mm.; width, 1.25 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro.

Collection.—Maryland Geological Survey.

CRENELLA GUBERNATORIA n. sp.

Plate XCVII, Fig. 5.

Description.—Shell small, stout, rounded ovate, anteriorly broadened; shell depressed; beak rounded and projecting very slightly; radial sculpture prominent and coarse, ridges flattened and with narrow interspaces, some being dichotomous, other added ribs are intercalated between previously existing ones.

This is a less elevated, more rounded, more coarsely sculptured and stouter species than *C. virida.*

Length, 1.72 mm.; width, 1.5 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run.

Collection.—Maryland Geological Survey.

Genus MODIOLUS Lamarck.

MODIOLUS DUCATELII Conrad.

Plate XCVII, Figs. 6, 7.

Modiola Ducatellii Conrad, 1840, Fossils of the Medial Tertiary, p. 53, pl. xxviii, fig. 2.

Perna Ducatellii Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.

Volsella Ducatellii Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 7.

Modiolus Ducatelii Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 793.

Description.—" Shell profoundly elongated, ventricose, valves contracted obliquely from the apex to the middle of the basal margin; lines of growth coarse and prominent; extremity of hinge line salient and rounded; posterior extremity regularly rounded; anterior extremity rather prominent and pointed." Conrad, 1840.

This shell is rarely found entire. But its identification should give no difficulty, especially if the beak is present.

Length, 133 mm.; width, 55 mm.; diameter, 21 mm.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Jones Wharf, Turner, Dover Bridge, Cordova. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Reed's.

Collections.—Maryland Geological Survey, Johns Hopkins University, Maryland Academy of Science, U. S. National Museum.

Section GREGARIELLA Monterosato.

MODIOLUS VIRGINICUS (Conrad).

Plate XCVII, Figs. 8a, 8b.

Modiolaria virginica Conrad, 1867, Amer. Jour. Conch., vol iii, p. 267, pl. xxii, fig. 3.

Modiolaria virginica Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 806.

Description.—" Oblong, subarcuate, ventricose anterior side without radiating lines; umbonal slope raised, rounded with close, crenulated, radiating lines, extending to the posterior margin and disposed to bifurcate towards the base; beaks nearly terminal." Conrad, 1867.

In front of the smooth area extending from the umbonal area to the ventral margin there is a small area near the beak with radiating crenulated lines; edge of valve finely beaded; dorsal margin not angular but curved.

There seem to be no good generic grounds for separating *M. virginicus, M. dalli* and *M. ionensis* from each other, and hence, largely from the pronounced Gregariella features of *M. ionensis,* it has seemed best to place the three species under that section of *Modiolus* rather than to consider them under *Modiolaria.*

Length, 7.5 mm.; width, 4 mm.; diameter, 2.3 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Modiolus dalli n. sp.

Plate XCVII, Figs. 9, 10.

Description.—Shell small, thin, delicate, somewhat perlaceous, vaulted, elongated; posterior dorsal margin subangulated at end, rest of margin rounded, posterior margin and posterior portion of basal margin strongly crenulated, anterior and dorsal margins partly faintly crenulated, mid-basal margin smooth; ligament groove narrow, straight; interior of shell smooth; posterior and anterior areas of outer surface of shell sculptured with fine rounded radial threads reticulated or granulated by concentric lines, near posterior basal margin additional fine radial lines produced by branching or by intercalation between longer lines; posterior slope rudely undulose, especially in its superior portion; slope from beak to posterior basal margin distinctly elevated and ridged, anterior to which the surface is depressed or almost grooved at junction of sculptured and smooth areas; smooth area crossed by irregular concentric growth striæ; anterior radial sculpturing faint.

This species is much more produced, is thinner and more finely and delicately sculptured than *M. virginicus,* which is a compact, stout and somewhat coarsely sculptured species. It is named in honor of Dr. W H. Dall.

Length, 8.9 mm.; height, 4.5 mm.; diameter, 2 mm.

Occurrence.—Choptank Formation. Pawpaw Point.

Collection.—Maryland Geological Survey.

Modiolus ionensis n. sp.

Plate XCVII, Figs. 11, 12.

Description.—Shell small, exceedingly thin and fragile, highly perlaceous, translucent to nearly transparent, elongated, narrowed and curved, moderately inflated; beak depressed, not prominent; posterior portion of shell made oblique by strong arching of dorsal margin and incurving of basal margin; marginal crenulations entire except on a part of the basal margin; those just anterior to the beak especially strong and almost like teeth; ligament groove very narrow, shallow and inconspicuous; interior of shell showing exterior radiating sculpture; exterior with broad area extending from beak to emarginate base and smooth except for faint concentric growth lines, this smooth area separating anterior and posterior radially sculptured areas; radial sculptured lines crossed by irregular concentric lines producing irregular granulation; umbonal slope back to posterior basal margin highly elevated; medial smooth area flattened.

This species is more produced, much more delicate and fragile, and has a much more strongly incurved basal margin than *M. dalli.*

Length, 7 mm.; height, 3 mm.; depth, 1 mm.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Genus MODIOLARIA Beck.

Modiolaria curta n. sp.

Plate XCVII, Fig. 13.

Description.—Shell small, thin, fragile, pearly, short and compactly rounded, highly vaulted; radial sculpturing on dorsal and posterior portions very distinct, ridges broader than interspaces and flattened somewhat on top; sculpturing just beneath beak distinct; from beak to mid-basal margin a broad area without radial sculpturing, but with concentric growth lines visible; beak high and slightly projecting; interior showing external radial ridging very distinctly.

Length, 3.8 mm.; height, 2.9 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Cornell University.

Superfamily ANOMIACEA.

Family ANOMIIDÆ.

Genus ANOMIA (Linné) Müller.

Anomia simplex d'Orbigny.

Plate XCVIII, Fig. 1.

Anomia simplex d'Orbigny (1845, Spanish ed.), 1853, Moll. Cubana, vol. ii, p. 367, pl. xxxviii, figs. 31–33.

Anomia ephippium var. Conrad, 1845, Fossils of the Medial Tertiary, p. 75, pl. xliii, fig. 4.

Anomia Conradi d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 134, pl. xxv, fig. 30.

Anomia ephippium Tuomey and Holmes, 1855, Pleioeene Fossils of South Carolina, p. 18, pl. v, fig. 4.

Anomia ephippium Holmes, 1858, Post-Pleiocene Fossils of South Carolina, p. 11, pl. ii, fig. 11.

Anomia ephippium Emmons, 1858, Rept. N. Car. Geol. Survey, p. 277.

Anomia Conradi Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.

Anomia Conradi Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Anomia simplex Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 32, pl. liii, figs. 1, 2.

Anomia simplex Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 784.

Description.—Shell thin, translucent, irregularly circular in outline; superior valve strongly convex or inflated; exterior surface with very faint irregular concentric growth striations or, more commonly, smooth; within, byssal scars distinct, subequal, close; lower valve irregularly flat, with irregular concentric growth striæ.

Length, 15 mm.; width, 15 mm.; diameter, 6 mm. (small upper valve).

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Anomia aculeata Gmelin.

Plate XCVIII, Figs. 2, 3, 4, 5.

Anomia aculeata Gmelin, 1792, Syst. Nat., t. vi, p. 3346.

Anomia aculeata Gould, 1841, Invert. Mass., p. 139, fig. 90.

Anomia aculeata Gould (Binney's), 1870, Invert. Mass., p. 204, fig. 498.

Anomia aculeata Verrill, 1873, Rept. U. S. Fish Com. for 1871–2, p. 697, pl. xxxii, figs. 239–240a.

Anomia aculeata Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 32, pl. liii, figs. 5–8.

Anomia aculeata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 784.

Description.—Shell irregularly rounded; upper valve irregularly and moderately convex, beak but slightly prominent and very near the margin, the external surface ornamented near the beak with fine, radiating, undulated lines of minute scales which become rounded pustules nearer the margins; within almost smooth: lower valve flat, smooth except for slight, irregular, concentric growth lines.

The shape varies according to the position occupied during growth but is usually irregular. A magnificent specimen of an upper valve from Plum Point, with beak broken, is very thick, symmetrical and profoundly and regularly elevated, being in height 45, width 46, and diameter 13 mm. At several localities young specimens have been found that in some cases show the ornamentation of *A. aculeata* and have been referred to it, while in others no ornamentation has developed and they are considered as indeterminate, though most probably they are also the young of *A. aculeata.*

Height, usually about 37 mm.; width, 35 mm., but see preceding description.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point (?). Choptank Formation. Jones Wharf, Trappe Landing (?). Calvert Formation. Plum Point, 3 miles south of Chesapeake Beach (?).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Superfamily PECTINACEA.

Family LIMIDÆ.

Genus LIMA (Bruguière) Cuvier.

Lima papyria Conrad.

Plate XCVIII, Fig. 6.

Lima papyria Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.
Lima papyria Conrad, 1845, Fossils of the Medial Tertiary, p. 76, pl. xliii, fig. 7.
Lima papyria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Lima papyria Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Description.—"Obliquely obovate, thin and fragile, inflated; with prominent radiating lines, distant towards the anterior margin; anterior margin angulated at base of the ear, truncated or slightly concave below, and abruptly rounded where it joins the basal margin; ears small. . . ." Conrad, 1841.

This species has very rarely been collected. It seems confined to a thin band found here and there at an elevation of three or four feet above tide in the cliff just south of Plum Point. It is very fragile and difficult to obtain entire.

Height, 25 mm.; width, 21 mm.; diameter, 7 mm.

Occurrence.—Calvert Formation. Plum Point.

Collection.—Maryland Geological Survey.

Family SPONDYLIDÆ.

Genus PLICATULA Lamarck.

Plicatula densata Conrad.

Plate XCVIII, Figs. 7, 8, 9.

Plicatula densata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 311.
Plicatula densata Conrad, 1845, Fossils of the Medial Tertiary, p. 75, pl. xliii, fig. 6.
Plicatula densata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Plicatula densata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.
Plicatula densata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 35, pl. v, figs. 3–8.
Plicatula densata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 763.

Description.—"Ovate, thick, profoundly and irregularly plicated; inferior valve ventricose; ribs acute, with arched spiniform scales; cardinal teeth large, curved, laterally striated, crenulated on the margins; larger cardinal tooth in each valve slightly bifid, broad; muscular impression prominent. . . . The valves have about ten folds, and the lower valve closely resembles a variety of *Ostrea Virginiana*." Conrad, 1843.

This species is distinguished from the *P. marginata* Say, by its broader, rounder, flatter form, more irregular and less prominent as well as finer plications and greater tendency to lateral curvature of the beaks.

Length, 37 mm.; width, 31 mm.; diameter, 6 mm.

Occurrence.—Calvert Formation. Church Hill.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Family PECTINIDÆ.

Genus PECTEN Müller.

Subgenus PECTEN ss.

PECTEN (PECTEN) HUMPHREYSII Conrad.

Plate XCVIII, Figs. 10, 11, 12.

Pecten Humphreysii Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 194, pl. ii, fig. 2.
Vola Humphreysii Conrad, 1863, Proc. Acad. Nat. Sci. Phila, vol. xiv, p. 582.
Pecten Humphreysii Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.
Vola Humphreysii Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, pp. 32–34, pl. iv, figs. 6–9.
Pecten (Pecten) Humphreysii Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, pp. 720, 721.

Description.—" Suborbicular, inferior valve convex; superior flat, and with about seven remote, narrow, convex ribs, and concentrically wrinkled; towards the apex is a concave depression; ears equal, sides direct and straight; inferior valve with the ribs wide, approximate, plano-convex and longitudinally striated; one of the ears emarginate at the base." Conrad, 1842.

The inferior valve has usually seven or eight broad elevated ribs, one with eleven ribs, however, was much less convex, showing probably that the requisite strength having been obtained by an increase in the ribbing, the marked convexity characteristic of the seven ribbed valves was no longer necessary. Fine concentric striæ are very characteristic of the upper valve and are simulated by the concentric growth lines of the lower one.

Length, 110 mm.; width, 125 mm.

Occurrence.—CALVERT FORMATION. Fair Haven, Lyon's Creek, Chesapeake Beach, Plum Point, Truman's Wharf, White's Landing, Reed's, Centerville, Burch (Dall), (not abundant).

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Subgenus AMUSIUM Bolten.

PECTEN (AMUSIUM) MORTONI Ravenel.

Plate XCIX, Fig. 1.

Pecten Mortoni Ravenel, 1844, Proc. Acad. Nat. Sci. Phila., vol. ii, p. 96.
Pecten Mortoni Tuomey and Holmes, 1855, Pleiocene Fossils of South Carolina, p. 27, pl. x, figs. 1, 2.

Pecten Mortoni Emmons, 1858, Rept. N. Car. Geol. Survey, p. 281.
Amusium Mortoni Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Amusium Mortoni Meek, 1864, Miocene Check List, Smith. Misc Coll. (183), p. 4.
Pecten (Amusium) Mortoni Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 757.

Description.—" Orbicular, thin, both valves moderately convex, one more so than the other—outside, with numerous concentric obsolete striæ; inside,—with from eighteen to twenty-four radiating double ribs, slightly elevated; ears large, subequal, striated externally." Ravenel, 1844.

This large, thin, flattened species is rarely obtained entire. It is quite rare in Maryland, the Survey having no specimens. A few broken pieces in the National Museum are labelled "Fairhaven and Cove Point." These specimens are probably from Cove Point and the reference to Fairhaven a mistake, since the two localities are separated geographically by about thirty miles and stratigraphically by about almost the entire Maryland Miocene column, rendering it unlikely that through accidental admixture part of the material came from one place and part from the other. The character of the shell substance in the specimens is sound and not unlike that found at Cove Point; while in the Fairhaven cliffs all the shells have entirely lost their shell substance through decay and exist only as casts, except *Ostrea percrassa,* in which the shell substance is still present but very badly decayed, and *Discinisca lugubris* which is here as everywhere else still fresh and polished.

Length,—the fragments indicate a length of about 160 mm.

Occurrence.—St. Mary's Formation. Cove Point.

Collection.—U. S. National Museum.

Subgenus PSEUDAMUSIUM H. and A. Adams.

PECTEN (PSEUDAMUSIUM) CERINUS Conrad.

Plate XCIX, Fig. 2.

Pecten cerinus Conrad, 1869, Amer. Jour. Conch., vol. v, p. 39, pl. ii, fig. 2.
Pecten (Pseudamusium) cerinus Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 753.

Description.—" Subovate, extremely thin, compressed; ears equal; right valve radiately ribbed; ribs very slightly raised and rounded; surface ornamented by minute, close divaricating lines, left valve without ribs." Conrad, 1869.

"Shell small, thin, polished, compressed; left valve more convex, with about twenty faint, flat, rather irregular obsolete ribs, separated by narrower, shallow sulci, the whole surface with minute Camptonectes striation; right valve with concentric incremental lines and a few faint threads near the beaks and anterior submargin; ears small, subequal; ctenolium present; cardinal and auricular crura developed; interior of left valve faintly fluted, but without liræ. . . .

"In some of the specimens there are a few feeble concentric undulations near the beak of the left valve." Dall, 1898.

Length, 19 mm.; width, 18 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, Charles county near the Patuxent river (*fide* Cope). (Very rare and quite small.)

Collections.—Maryland Geological Survey, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Subgenus CHLAMYS Bolten.

Section CHLAMYS ss.

PECTEN (CHLAMYS) COCCYMELUS Dall.

Plate XCIX, Fig. 3.

Pecten (*Chlamys*) *coccymelus* Dall, 1898, Trans. Wagner Free Inst., vol. iii., pt. iv, p. 741, pl. xxxiv, fig. 1.

Description.—"Shell small, ovate, inflated, strongly sculptured, with unequal ears; disk with eighteen narrow, high compressed ribs, with wider interspaces, which near the basal margin carry one or two very small radial threads; the backs of the ribs support numerous high, evenly spaced, distally guttered, small spines; in the interspaces only transverse sculpture of wavy incremental lines; submargins small, narrow, with fine, beaded radial threads, which in the left valve also extend over the ears; hinge line short, the cardinal crura developed, sharply cross-striated; auricular crura present; interior of the disk fluted in harmony with the external ribs. . . .

"A single left valve of this elegant species was obtained. From the young of *P. Madisonius,* which sometimes approach it, it is easily distinguished by its more oval and inflated form, nearly smooth interspaces, and compressed ribs." Dall, 1898.

Gradient forms show a close genetic relationship with *P. madisonius* as found in the Calvert formation.

Length, 30 mm.; width, 25 mm.; diameter, 5 mm.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Section NODIPECTEN Dall.

PECTEN (CHLAMYS) ROGERSI Conrad.

Plate XCIX, Fig. 4.

Pecten Rogersii Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 151.
Pecten Rogersii Conrad, 1840, Fossils of the Medial Tertiary, p. 45, pl. xxi, fig. 9.
Pecten Rogersi Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.
Pecten Rogersi Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.
Pecten (Nodipecten) Rogersi Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 730.

Description:—" Shell ovate, compressed; with four very large and broad convex ribs and numerous radiating lines; ears small. Length and height, one inch and one-eighth." Conrad, 1834.

" Shell with four large and two smaller lateral simple ribs; internally lirate; submargins narrow, minutely scabrous, not radiated; the rest of the disk entirely covered with fine, squared, elevated, minutely scaly radial threads; ears subequal, finely radiated; sinus well-marked; ctenolium and cardinal crura developed." Dall, 1898.

Length, about 13 mm., specimen broken and young.

Occurrence.—CHOPTANK FORMATION (?). Near Skipton.

Collection.—U. S. National Museum.

Section PLACOPECTEN Verrill.

PECTEN (CHLAMYS) CLINTONIUS Say.

Plate XCIX, Fig. 5.

Pecten Clintonius Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 135, pl. ix, fig. 2.
Pecten Clintonius Conrad, 1840, Fossils of the Medial Tertiary, p. 47, pl. xxiii, fig. 1.
Pecten Clintonius Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.
Pecten Clintonensis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.
Pecten (Placopecten) Clintonius Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 725.

Description.—"Auricles equal; surface with from one hundred and forty to one hundred and eighty elevated longitudinal lines.

"Shell suborbicular, compressed, with very numerous, regular, elevated striæ, which are muricated with minute scales formed by transverse wrinkles, that are sparse in the middle of the length, and crowded each side of the shell; the intervening spaces are regularly concave, and in parts very distinctly wrinkled: auricles equal, striated like the general surface: within simple, margin striated." Say, 1824.

This flattened, thin, finely striated shell is very rare in Maryland. It is given on the authority of Dr. Foreman who gave no locality, however. No other one has reported it from the State.

Length, about 100 mm.; width, rather more (Say).

PECTEN (CHLAMYS) MARYLANDICUS Wagner.

Plate XCIX, Fig. 6.

Pecten Marylandicus Wagner, 1839, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 51, pl. [2], fig. 2. (Possibly printed privately in 1838.)

Pecten tenuis H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 246, pl. xxxv, fig. 33.

Pecten Marylandicus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pecten tenuis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pecten marylandicus Meek 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Pecten tenuis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Pecten (Placopecten ?) marylandicus Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 728.

Description.—"Shell ovate, compressed; ribs numerous, consisting of narrow, nearly smooth striæ, disposed in pairs; interstitial spaces each with a carinated line; ears unequal; inferior valve very slightly convex; ribs similar to those of the opposite valve; inner margin of the valve with profoundly elevated lines.

"This Pecten is allied to *Pecten Madisonius* Say, but can readily be distinguished by its want of broad, elevated ribs, and a surface destitute of scales...." Wagner, 1839.

A comparison of numerous specimens shows that the lower valve is more convex than Wagner's description would indicate. The upper valve is but slightly convex, and its ear has the byssal notch well marked. The interior of each valve is gently fluted in harmony with the external ribs.

Length, 69 mm.; width, 67 mm.; diameter, 11 mm.

Occurrence.—CHOPTANK FORMATION. Governor Run, 2 miles south of Governor Run, Flag Pond, St. Leonard Creek, Jones Wharf, Dover Bridge. CALVERT FORMATION. White's Landing, near Friendship in railway cutting.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences.

Section LYROPECTEN Conrad.

PECTEN (CHLAMYS) MADISONIUS Say.

Plate C, Fig. 1.

Pecten Madisonius Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 134.

Pecten Madisonius Conrad, 1840, Fossils of the Medial Tertiary, p. 48, pl. xxiv, fig. 1.

Pecten Madisonius Emmons, 1858, Rept. N. Car. Geol. Survey, p. 282, fig. 200.

Pecten Madisonius Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pecten Madisonius Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Pecten Madisonius Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 30, pl. iv, figs. 1–5; pl. ii, fig. 8.

Pecten (Lyropecten) Madisonius Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 724.

Description.—"Much compressed, with about sixteen striated ribs.

"*Shell* rounded, much compressed; the whole surface covered with scaly striæ: *ribs* elevated, rounded, with about three striæ on the back of each; intervening grooves rather profound: *ears* equal, sinus of the ear of the superior valve profound, extending at least one-third of the length of the ear." Say, 1824.

The ribs are usually about sixteen or seventeen, but occasionally as few as twelve; lower valve convex, upper one nearly flat. The young from the Calvert formation often have but one prominent elevated spinose line on the back of each rib, with a faintly marked one on either side especially near the margin of the shell. A series of intermediate specimens from here shows a close relationship with *P. coccymelus* found at the same horizon. Another series of intermediate forms from the Choptank formation suggests a relationship to the *P. marylandicus* found at that horizon. From *P. madisonius* is probably descended *P. jeffersonius,* the offshoot occurring in the St. Mary's formation probably, so that the transitional forms found here render the discrimination of the two species difficult at this horizon. For criteria for this discrimination see remarks under *P. jeffersonius.*

Length, 160 mm.; width, 200 mm.; diameter, 40 mm.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River, Langley's Bluff (Dall). Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Cuckold Creek, St. Leonard Creek, Turner, Pawpaw Point, Sand Hill, Dover Bridge, Trappe Landing, Peach Blossom Creek, Cordova, Greensboro (Md. Geol. Sur.); near Skipton (Dall). Calvert Formation. Fairhaven, Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, Church Hill, 3 miles west of Centerville, Reed's, White's Landing, Wye Mills, Lyon's Creek, Magruder's Ferry.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Pecten (Chlamys) jeffersonius Say.

Plate C, Fig. 2.

Pecten Jeffersonius Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 133, pl. ix, fig. 1.

Pecten Jeffersonius Conrad, 1840, Fossils of the Medial Tertiary, p. 46, pl. xxii, fig. 1.

Pecten Jeffersonius Emmons, 1858, Rept. N. Car. Geol. Survey, p. 282, fig. 199.

Pecten Jeffersonius Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pecten Jeffersonius Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Pecten (Lyropecten) Jeffersonius Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 722.

Description.—" Subequivalve, with from nine to eleven striated ribs.

" Shell rounded, convex, not quite equivalved, one of the valves being a little more convex than the other; the whole surface covered with approximate scaly striæ: ribs elevated, rounded, with six or seven striæ on the back of each; intervening grooves profound: ears equal; sinus of the ear of the superior valve, not profound, being barely one-eighth part of the length of the ear: within with broad rounded flattened ribs." Say, 1824.

This species is very probably a descendant of *P. madisonius* and is at times hard to distinguish from it. In general, *jeffersonius* is the more convex, the upper and lower valves being nearly equi-convex; while in *madisonius* the upper valve is flatter than the lower. The ribs of *jeffer-*

sonius are broader and the radial threads finer and more numerous. The best criterion, however, for their separation is found in the character of the byssal ear. "In *Jeffersonius* it is sculptured with fine, uniform, numerous threads, and the notch is shallow and leaves an inconspicuous fasciole. In *Madisonius* the upper part of the ear is provided with comparatively few and coarse threads, and the notch is wide and deep with a broad and well marked fasciole." Dall, *loc. cit.*

Length, 130 mm.; width, 140 mm.; diameter, 25 mm., though often found considerably larger.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Pecten jeffersonius var. edgecombensis (Conrad).

Plate C, Fig. 3.

Pecten Edgecomensis Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 291.
Pecten edgecomensis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.
Pecten Jeffersonius var. edgecomensis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 722.

Description.—"Suborbicular; height not quite equal to the length; lower valve-ribs 16 to 17, prominent, but not elevated, square or convex-depressed, not quite as wide as the intervening spaces, radiately lined with finely squamose striæ, most conspicuous towards the margins, interstices of ribs carinated, in the middle squamose and finely striated; ears with fine close unequal squamose radiating lines, the larger ones prominent on the posterior side; margins of ligament pit carinated." Dall, 1898.

The number of ribs in this variety varies from twelve to seventeen or occasionally more. In the middle of the spaces between the ribs the fine radial striæ become somewhat larger.

Length, 170 mm.; width, 185 mm.; diameter, 30 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Langley's Bluff.

Collections.—Maryland Geological Survey, U. S. National Museum.

Pecten jeffersonius var. septenarius Say.

Plate C, Fig. 4.

Pecten septenarius Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 136, pl. ix, fig. iii.

Pecten septemnarius Conrad, 1840, Fossils of the Medial Tertiary, p. 47, pl. xxii, fig. 2.

Pecten septenarius Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 31, pl. xiii, figs. 1–4.

Pecten septenarius Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pecten septenarius Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 4.

Pecten Jeffersonius var. septenarius Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 722.

Description.—" Shell convex, suborbicular: auricles subequal: surface with numerous slightly scaly striæ, and about seven remote ribs, of which the three intermediate ones are much elevated, rounded or slightly flattened on the top.

" The striæ are equally distinct on the ribs, and in the intermediate spaces. The scales are rather thick, very small, and not confined to the striæ, but are also observable in the spaces between the striæ." Say, 1824.

In the young the ribs are flat-topped, transversely angular, and as broad across the top as at the base or even broader. In the old the ribs become more rounded transversely. Number of ribs seven or eight.

Height, 90 mm.; width, 93 mm.; diameter, 21 mm.

Occurrence.—St. Mary's Formation(?). St. Mary's River(?).

Collections.—Maryland Geological Survey, U. S. National Museum.

Superfamily OSTRACEA.

Family OSTREIDÆ.

Genus OSTREA Lamarck.

OSTREA SELLÆFORMIS VAR. THOMASII (Conrad).

Plate C, Figs. 5a, 5b.

Ostrea thomasii Conrad, 1867, Proc. Acad. Nat. Sci. Phila., vol. xix, p. 139 (listed only).

Description.—Shell small, thin to moderately thick, fan-shaped to pear-shaped in outline; beaks laterally curved; ligament groove excavated; ribs on lower valve fifteen to twenty, of thin imbricated scales somewhat elevated; each margin in the lower valve just backward from the hinge line marked by a short punctate impressed line; upper valve thin, slightly convex, surface concentrically marked by the edges of the thin flat lamellæ; margins near the beak transversely denticulated or striated.

This is one of the species named by Conrad and published by Cope (*loc. cit.*) that has never been described. The original specimens from Charles county are in the Academy of Natural Sciences in Philadelphia.

This shell is closely allied to the upper Oligocene varieties of *O. sellæformis* and may be considered an early Miocene variety of the same species.

Length, 58 mm.; width, 43 mm.; diameter, 15 mm.

Occurrence.—Calvert Formation. Charles county near the Patuxent river (Cope); Plum Point, Truman's Wharf, Chesapeake Beach, 3 miles south of Chesapeake Beach.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Ostrea trigonalis Conrad.

Plate CI, Figs. 1a, 1b.

Ostrea trigonalis Conrad, 1854, Wailes' Rept. Agric. and Geol. Miss., p. 289, pl. xiv, fig. 10 (name and figure only).
Ostrea trigonalis Conrad, 1855, Proc. Acad. Nat. Sci. Phila., vol. vii, p. 259.
Ostrea trigonalis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 681.

Description.—"Triangular, flat, surface irregular, with some indistinct radiating lines; muscular impression obliquely suboval, situated nearer the summit than the base; margin somewhat ascending, submargin carinated." Conrad, 1855.

"The species is wide spread and recognized by its flat upper valve, few-ribbed lower valve, straight hinge line, flat hinge area, with excavated central channel and the peculiar vermicular sculpture of the submargin on each side near the hinge line." Dall, 1898.

Length, 90 mm.; width, 70 mm.

Occurrence.—Choptank Formation. Jones Wharf, Greensboro (rare in Maryland).

Collections.—Maryland Geological Survey, U. S. National Museum.

Ostrea carolinensis Conrad.

Plate CI, Figs. 2, 3, 4.

Ostrea Carolinensis Conrad, 1832, Fossil Shells of the Tertiary, p. 27, pl. xiv, fig. 1.
Ostrea carolinensis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 686.

Description.—" Obovate, oblique, thick, compressed; superior valve flat; inferior valve convex, with concentric imbricated lamellæ which are transversely plicated; beaks broad and prominent; fosset large and defined by broad prominent lateral ridges." Conrad, 1832.

The Maryland specimens are smaller and usually thinner than the original Carolina ones. The ribs are fine and regular on some, on others irregular. The submargin of the upper valve near the beaks is transversely striated. This species is often very abundant.

Length, 100 mm.; width, 75 mm.; diameter, 25 mm.

Occurrence.—St. Mary's Formation. St. Mary's River(?). Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Turner, Cuckold Creek, St. Leonard Creek, Peach Blossom Creek, Dover Bridge.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Ostrea percrassa Conrad.

Plate CII, Figs. 1, 2.

Ostrea percrassa Conrad, 1840, Fossils of the Medial Tertiary, p. 50, pl. xxv, fig. 1.
Ostrea percrassa Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Ostrea percrassa Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 3.
Ostrea percrassa Heilprin, 1884, 4th Ann. Rept. U. S. Geol. Survey, p. 313, pl. lxvii, fig. 3.
Ostrea percrassa Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 29, pl. iii, figs. 1-4.
Ostrea percrassa Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 683.

Description.—" Shell extremely thick and ponderous; hinge very broad; cartilage fosset wide and shallow; muscular impression exhibiting a very profound cavity." Conrad, 1840.

Lower valve convex exteriorly, deeply concave within; upper valve more nearly flat; shell substance of innumerable fine lamellæ, often the home of boring forms.

Length, 110 mm.; width, 95 mm.; diameter, 40 mm.

Occurrence.—Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Hollin Cliff, Magruder Ferry, White's Landing, Reed's, Fairhaven, near Friendship, Milltown Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, Cornell University.

OSTREA sp.

In addition to the above described species of *Ostrea* some indeterminate valves were obtained at Church Hill, Skipton, and three miles west of Centerville.

Superfamily PTERIACEA.

Family MELINIDÆ.

Genus MELINA Retzius.

MELINA MAXILLATA (Deshayes).

Plate CII, Fig. 3; Plate CIII, Fig. 1.

Perna maxillata Lamarck, 1819, An. sans Vert., vi, i, p. 142, (syn. excl.): ed. Deshayes, 1836, vii, p. 78 (*fide* Dall).
Perna torta Say, 1820, Amer. Jour. Sci., vol. ii, p. 38.
Perna maxillata Conrad, 1840, Fossils of the Medial Tertiary, p. 52, pl. xxvii, fig. 1.
Isognomon torta Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.
Melina torta Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Perna torta Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 36, pl. v, figs. 12, 13.
Melina maxillata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 667.

Description.—Shell angularly pointed and slightly curved anteriorly, posteriorly ovate, surface moderately convex, with irregular shallow concentric undulations marking growth lines; ventral edge thickened and somewhat inrolled; ligament area broad with fifteen to twenty shallow transverse grooves; exterior covered by a thin prismatic layer, interior layer pearly, thick, composed of many thin shelly laminæ, interior surface nacreous.

This shell is very rarely obtained entire. The prismatic layer is almost always gone entirely, and of the shelly, pearly portion, only the heavy anterior part is usually preserved. The shell is very often bored by *Martesia ovalis* and other burrowing forms. Perfect valves are very rare but may be obtained at Plum Point, Jones Wharf or Pawpaw Point at water level.

Length, 165 mm.; width, 90 mm.; diameter, 17 mm., though fragments of larger individuals are often found.

Occurrence.—ST. MARY'S FORMATION (?). Cove Point (?). CHOPTANK FORMATION. Governor Run, Jones Wharf, Pawpaw Point, Dover Bridge, Greensboro, Cordova, Skipton, St. Leonard Creek. CALVERT

Formation. Church Hill, 3 miles west of Centerville, Chesapeake Beach, Plum Point, Hollin Cliff, Reed's, White's Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Family PINNIDÆ.

Genus ATRINA Gray.

Atrina harrisii Dall.

Plate CIII, Figs, 2, 3.

Atrina Harrisii Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 663, pl. xxix, fig. 11.

Description.—"Shell rather thick (the fibrous layer lost in the specimens), ovately rounded behind, moderately convex; hinge line straight, ventral margin slightly incurved; the surface of the pearly layer shows the dorsal region with numerous fine longitudinal elevated lines, below which the shell is at first nearly smooth, then the ventral region is sculptured with numerous close-set concentric riblets. Length of portion preserved about 150, max. width 60, diam. 32 mm." Dall, 1898.

More perfect specimens show the hinge line to be slightly convex; the fine lines dorsally become obsolete toward the posterior end, the prismatic layer there showing only faint irregular concentric growth riblets that become stronger on the ventral slope; prismatic layer thin; ventral margin thickened and angularly incurved.

Length, about 170 mm.; width, 85 mm.; diameter, 28 mm.

Occurrence.—Choptank Formation. Pawpaw Point, Jones Wharf. Calvert Formation. Plum Point, Truman's Wharf, Chesapeake Beach, White's Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Atrina piscatoria n. sp.

Plate CIV, Fig. 1.

Description.—Pearly layer of shell thin, prismatic layer thick; moderately convex, rounded posteriorly; hinge line nearly straight; ventral margin incurved; ventral and dorsal margins forming an angle of about

45 degrees with each other; dorsal region smooth; ventral region sculptured by rather distant irregularly spaced concentric riblets.

This is much larger and broader and less acute anteriorly than *A. harrisii,* and is without the fine parallel lines characteristic of the dorsal region in that species. The specimen had been flattened so that the diameter given below is less than the true diameter.

Length, about 200 mm.; maximum width, about 120 mm.; diameter, 25+mm.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Superfamily ARCACEA.

Family ARCIDÆ.

Subfamily ARCINÆ.

Genus ARCA (Linné) Lamarck.

Subgenus SCAPHARCA (Gray) Dall.

Section ANADARA Gray.

ARCA (SCAPHARCA) SUBROSTRATA Conrad.

Plate CIV, Figs. 2, 3a, 3b.

Arca subrostrata Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 30.
Arca subrostrata Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 185.
Arca subrostrata Conrad, 1845, Fossils of the Medial Tertiary, p. 58, pl. xxx, fig. 7.
Scapharca subrostrata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.
Scapharca subrostrata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Scapharca tenuicardo Conrad, 1869, Amer. Jour. Conch., vol. v, p. 39, pl. ii, fig. 4.
Scapharca subrostrata Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 45, pl. vi, figs. 11-13.
Scapharca (Anadara) subrostrata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 655.

Description.—"Ovate; profoundly ventricose; ribs about 30, little prominent, flat, longitudinally sulcated; posterior side produced, cuneiform; rounded at the extremity; hinge linear in the middle, teeth obsolete, except towards the extremities; within slightly sulcated; crenulations of the margin sulcated in the middle." Conrad, 1841.

Cardinal area grooved with numerous somewhat irregular, though nearly parallel grooves; posterior umbonal slope angulated near the umbo, rounded near the base; ribs sulcated by a strong median groove, supplemented usually by a finer groove on either side of the median one; posterior side flattened, ribs there but slightly prominent.

Length, 53 mm.; height, 34 mm.; diameter, 15 mm.

Occurrence.—CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, White's Landing, Church Hill, 3 miles west of Centerville, Reed's, Wye Mills, near Skipton.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

ARCA (SCAPHARCA) ELNIA n. sp.

Plate CIV, Figs. 4a, 4b.

Description.—Shell large, moderately thick, but slightly elongated, not inflated, with prominent prosocœlous beak; cardinal area wide, with numerous irregular, zigzag, longitudinal grooves, bounded by a single deep curved groove from the beak to the ends of the hinge line; hinge line narrow; teeth small, obsolete medially, tending to become irregular at both ends of the series; right valve with about thirty-one low ribs hardly as wide on anterior dorsal slope as intervening spaces, broader and more elevated on posterior dorsal slope; each rib mesially sulcated by a groove with one or more subordinate grooves on either side; growth lines distinct; margin a continuous curve from anterior end of hinge line to posterior end of base, there sharply curved; posterior margin oblique to hinge line; interior margin crenulated; dorsal and posterior slopes meet in an angle that becomes rounded near the basal margin.

This species seems to be intermediate between *A. staminea* and *A. subrostrata,* being perhaps more nearly related to the latter.

Length, 60 mm.; height, 48 mm.; diameter, 22 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, lower bed at Governor Run, 2 miles south of Governor Run.

Collection.—Maryland Geological Survey.

ARCA (SCAPHARCA) CLISEA Dall.

Plate CV, Fig. 1.

Scapharca (Anadara) clisea Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 657, pl. xxxiii, fig. 25.

Description.—" Shell large, heavy, inflated, short, with small, high, somewhat prosocœlous beaks, the two halves of the wide cardinal area inclined to one another in the adult at an angle of about forty-five degrees; left valve with about thirty strong, flattened subequal radial ribs with narrower interspaces; in the young the ribs are furnished with small transverse nodulations, which gradually become obscure in the adult; the only transverse sculpture is of the ordinary incremental lines; the ribs in the adult are flat-topped and rarely show any tendency to mesial sulcation, and when present it appears only on a few of the anterior ribs near the margin; the anterior end is obliquely rounded to the base, the posterior end a little produced basally; the cardinal area is exceptionally wide, with a single impressed line joining the beaks and six or seven concentric lozenges defined by sharp grooves; a deep groove also bounds the area; hinge line straight with numerous small vertical teeth, becoming much larger distally and tending to break up into granules at both ends of the series in the senile shell. . . ." Dall, 1898.

This shell seems more closely related to *A. idonea* than to any other.

Length, 51 mm.; height, 53 mm.; diameter, 53 mm.

Occurrence.—St. Mary's Formation. St. Mary's River, Crisfield well at depth of 140 feet (U. S. National Museum).

Collections.—Maryland Geological Survey, U. S. National Museum.

Section SCAPHARCA ss.

ARCA (SCAPHARCA) STAMINEA Say.

Plate CV, Figs. 2, 3, 4, 5, 6.

Arca staminea Say, 1832, Amer. Conch., pl. xxxvi, fig. 2.
Arca elevata Conrad, 1840, Fossils of the Medial Tertiary, No. 1, 2d p. of cover.
Arca callipleura Conrad, 1840, Fossils of the Medial Tertiary, p. 54, pl. xxix, fig. 2.
Arca triquetra Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 305.
Arca triquetra Conrad, 1845, Fossils of the Medial Tertiary, p. 59, pl. xxxi, fig. 2.
Scapharca callipleura Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.
Scapharca triquetra Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.
Scapharca callipleura Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Scapharca triquetra Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Arca (Scapharca) callipleura Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 43, pl. vi, figs. 8, 9.
Scapharca (Scapharca) staminea Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 642.

Description.—"Shell thick prominently convex; with about twenty-eight ribs which are rounded and narrower than the intervening spaces, excepting on the anterior side, where they are broader, and simply wrinkled, those of the anterior part of the disk have one or two longitudinal impressed lines; they are crossed by numerous transverse, elevated lines, which are hardly more distant from each other than their own width; intervening spaces wrinkled: beaks distant, curved a little backward, and the tip a little behind the hinge margin: area flattened, a little curved, rather spacious, with obvious impressed, oblique lines: hinge margin rectilinear, with small, numerous teeth: posterior margin regularly arcuated: base subrectilinear, very deeply crenated: anterior margin oblique, rectilinear: anterior side abruptly compressed." Say, 1832.

Shell very elevated and ventricose; umbonal and posterior slopes forming almost a right angle, near which the ribs are striated instead of granulated; basal margin regularly curved or in the more elongated specimens slightly incurved posteriorly.

A careful comparison of what are doubtless the type specimens of *A. callipleura* shows that it is but a short, elevated, thickened and well sculptured form of *A. staminea.*

Length, 44 mm.; height, 38 mm.; diameter, 21 mm.

Occurrence.—Choptank Formation. Governor Run, 2 miles south of Governor Run, Flag Pond, Jones Wharf, Cuckold Creek, Turner, Dover Bridge, Peach Blossom Creek, Greensboro.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

Arca (Scapharca) arata Say.

Plate CV, Figs. 7a, 7b.

Arca arata Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 137, pl. x, fig. 1.
Arca arata Conrad, 1845, Fossils of the Medial Tertiary, p. 58, pl. xxx, fig. 6.
Scapharca arata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.
Scapharca arata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Scapharca (Scapharca) arata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 643.

Description.—"Shell transversely oblong, subrhomboidal, with about twenty-six longitudinal ribs; basal edge nearly parallel to the hinge margin, which latter terminates anteriorly in an angle.

"*Ribs* somewhat flattened, as wide or rather wider than the intervening spaces; the whole surface concentrically wrinkled: *umbones* not remarkably prominent: *apices* remote, the intervening space rhomboidal, with continued indented lines, arcuated under the apices: *hinge margin* perfectly rectilinear, angulated at the extremities, the anterior one a little projecting: *teeth* with a continued, uninterrupted line, parallel, excepting at the two extremities of the line, which decline a little, and the teeth are there decidedly longer and oblique with respect to the others of the range: *posterior end* obliquely rounded to the base: *base* nearly rectilinear and parallel to the hinge margin, and deeply crenated on the inner margin: *anterior end* produced below the middle, and rounded, and a little contracted near the superior angle." Say, 1824.

Length, 55 mm.; height, 34 mm.; diameter, 16 mm.

Occurrence.—St. Mary's Formation. St. Mary's River (quite rare).

Collections.—Maryland Geological Survey, U. S. National Museum.

Arca (Scapharca) idonea Conrad.

Plate CVI, Figs. 1, 2.

Arca idonea Conrad, 1832, Fossil Shells of the Tertiary, p. 16, pl. i, fig. 5.

Arca stillicidum Conrad, 1832, Fossil Shells of the Tertiary, p. 15, pl. i, fig. 3 (young).

Arca idonea Conrad, 1840, Fossils of the Medial Tertiary, p. 55, pl. xxix, fig. 3.

Arca stillicidum Conrad, 1840, Fossils of the Medial Tertiary, p. 55.

Arca idonea Emmons, 1858, Rept. N. Car. Geol. Survey, p. 285.

Latiarca idonea Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 289.

Scapharca idonea Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 579.

Scapharca idonea Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.

Arca (Latiarca ?) idonea ? Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 47, pl. vii, fig. 1.

Scapharca (Scapharca) idonea Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 639.

Description.—"Cordate, inequivalve, ventricose, and slightly sinuous; ribs about 25, narrow and crenulated; the crenulations most distinct on the larger valve; beaks very prominent and distant; area with undulated grooves; hinge with the series of teeth contracted in the center, and a little decurved at the ends." Conrad, 1832.

The shell is thick and large with a more or less sharply angular slope from the beak to the posterior extremity of the base. Near this angulation the ribs of both valves are finely striated. The more angular variety resembles *A. staminea,* its probable progenitor. The ribs vary from twenty-five to thirty-one, twenty-eight or twenty-nine being quite common. The teeth are fine, narrow, close set and tend to become irregular at the anterior and posterior ends of the dental area.

Length, 68 mm.; height, 55 mm.; diameter, 28 mm.

Occurrence.—St. Mary's Formation. Cove Point, Langley's Bluff, St. Mary's River.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Subgenus NOËTIA Gray.

Arca (Noëtia) incile Say

Plate CVI, Figs. 3, 4.

Arca incile Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 139, pl. x, fig. 3.
Arca incile Conrad, 1832, Fossil Shells of the Tertiary, p. 16, pl. ii, fig. 1.
Arca incile Conrad, 1840, Fossils of the Medial Tertiary, p. 56, pl. xxix, fig. 5.
Arca incile Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 35, pl. xiv, figs. 6, 7, 18.
Arca incile Emmons, 1858, Rept. N. Car. Geol. Survey, p. 284.
Anomalocardia incile Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.
Anadara incile Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.
Noëtia protexta Conrad, 1875, Rept. N. Car. Geol. Survey, vol. i, app. A, p. 19, pl. iii, fig. 5 (*fide* Dall).
Arca (Noëtia) incile Dall, 1898, Trans. Wagner Free Inst. Sci , vol. iii, pt. iv, p. 632.

Description.—"Shell transversely rhomboidal, with about twenty-seven ribs; anterior hinge margin compressed and angulated.

"*Disk* prominent from the beaks to the anterior part of the base: *ribs* with transverse granules; those anterior to the middle alternating with very slender and but little prominent lines, and with a groove on each: *anterior margin* longer to the base than the posterior end, and contracted in the middle: *series of teeth* nearly rectilinear, entire; interval between the teeth and the apices with a few transverse lines or wrinkles; a single oblique groove from the apex to a little before the middle, and six or seven narrow ones from the teeth outwards behind the apices: *beaks* placed very far backward: *inner margin* crenated: *muscular impressions* a little elevated, posterior one short: *basal margin* not parallel with the hinge margin." Say, 1824.

In Say's description above the two ends have been transposed, so that for anterior, posterior, before, behind, etc., read the opposite term. The very anterior position of the beak, the longer line of finer, narrower teeth and smaller size of the shell distinguish it from *A. limula.*

Length, 40 mm.; height, 22 mm.; diameter, 11 mm.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Dover Bridge (rare and small).

Collection.—U. S. National Museum.

Subgenus BARBATIA (Gray) Adams.

Section STRIARCA Conrad.

ARCA (BARBATIA) CENTENARIA Say.

Plate CVI, Figs. 5, 6.

Arca centenaria Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 138, pl. x, fig. 2.

Arca centenaria Conrad, 1832, Fossil Shells of the Tertiary, p. 16, pl. i, fig. 4.

Arca centenaria Conrad, 1840, Fossils of the Medial Tertiary, p. 55, pl. xxix, fig. 4.

Arca centenaria Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 37, pl. xiv, figs. 11, 12.

Arca centenaria Emmons, 1858, Rept. N. Car. Geol. Survey, p. 285, fig. 205.

Striarca centenaria Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.

Striarca centenaria Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.

Arca (Striarca) centenaria Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 42, pl. vi, figs. 5–7.

Barbatia (Striarca) centenaria Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 628.

Description.—"Shell transversely-oval, subrhomboidal, obtusely contracted at base, with numerous alternate longitudinal striæ.

"Striæ from one hundred to one hundred and eighty and more in number; disappearing on the hinge margin; with hardly obvious transverse minute wrinkles, and larger, remote, irregular ones of increment; beaks but little prominent, not remote; base widely but not deeply contracted, nearly parallel with the hinge margin; anterior and posterior margins obtusely rounded; series of teeth rectilinear, uninterrupted, decurved at the tips; space between the beaks with numerous grooves proceeding from the teeth; inner margin not very distinctly crenated; muscular impressions elevated, and forming a broad line each side, from the cavity of the beak to the margin." Say, 1824.

Length, 20 mm.; height, 12 mm.; diameter, 6 mm.

The Virginia specimens are often twice these dimensions or larger.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. Rare and small. CALVERT FORMATION. Church Hill, Fairhaven.

Collection.—Maryland Geological Survey.

Section CALLOARCA Gray.

ARCA (BARBATIA) MARYLANDICA Conrad.

Plate CVI, Fig. 7.

Byssoarca marylandica Conrad, 1840, Fossils of the Medial Tertiary, p. 54, pl. xxix, fig. 1.

Barbatia Marylandica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.

Barbatia marylandica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 6.

Barbatia Marylandica Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 48, pl. vii, figs. 2–4.

Barbatia (Calloarca) marylandica Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 623.

Description.—"Shell oblong, compressed, thin, with very numerous radiating granulated striæ; beaks not prominent; base much contracted or emarginate anterior to the middle; posterior side dilated, the superior margin very oblique and emarginate; extremity angulated, and situated nearer to the line of the hinge than to that of the base; cardinal teeth minute, except toward the extremities of the cardinal line where they are comparatively very large and oblique; inner margin entire." Conrad, 1840.

It may be readily identified by its general shape, or when found in fragments, as is usually the case, by the granulations of the striæ.

Length, 30 mm.; height, 27 mm.

Occurrence.—CALVERT FORMATION. "Cliffs of Calvert" (Conrad), 3 miles west of Centerville, Plum Point, Centerville.

Collections.—Maryland Geological Survey, U. S. National Museum.

Section GRANOARCA Conrad.

ARCA (BARBATIA) VIRGINIÆ Wagner.

Plate CVI, Fig. 8.

Arca virginiæ Wagner, 1839 ?—See Dall, below.

Arca virginiæ Bronn, 1848, Hand. Gesch. Nat., Index Pal., pt. i, p. 99.

Arca virginiæ Bronn, 1849, Hand. Gesch. Nat., Index Pal., pt. ii, p. 283.

Arca virginiæ Dall, 1898, Trans. Wagner Free Inst. Sci., vol. v, pt. ii, p. 9, pl. i, fig. 3.

Barbatia (Granoarca) virginiæ Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, p. 627, pl. xxxii, fig. 23.

Description.—"*Arca virginiæ* is a large, solid, elongated shell, equivalve but very inequilateral, the beaks being situated near the anterior fifth of the length, low and prosogyrate, distant and separated by a wide cardinal area with numerous (nine) slightly angular longitudinal concentric grooves; sculpture of about twenty-five strong radial ribs, smaller on the posterior dorsal area, somewhat flattened, and on the posterior part with a shallow, wide mesial furrow, hinge line $\frac{11}{17}$ as long as the shell; teeth vertical, in two series, beginning mesially very small, distally larger, and with a tendency to break up or become irregular; muscular impressions deep; margin fluted in harmony with the ends of the ribs. . . ." Dall, *op. cit.*, vol. iii, p. 628.

Two imperfect and much worn shells from the St. Mary's River, 48 and 34 mm. in length, respectively, probably belong to this species.

Length, 83 mm.; height, 52 mm.; diameter, 42 mm.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collections.—Maryland Geological Survey, Wagner Free Institute of Science.

Subfamily PECTUNCULINÆ.

Genus GLYCYMERIS Da Costa.

Glycymeris parilis (Conrad).

Plate CVII, Figs. 1, 2.

Pectunculus lentiformis Conrad, 1842, Proc. Nat. Inst., Bull. ii, pp. 181, 183 (listed only).

Not *Pectunculus lentiformis* Conrad, 1837, Fossil Shells of the Tertiary, 2nd. Edit., p. 36.

Pectunculus parilis Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 306.

Pectunculus parilis Conrad, 1845, Fossils of the Medial Tertiary, p. 64, pl. xxxvi, fig. 2.

Pectunculus parilis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 580.

Pectunculus parilis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.

Glycymeris parilis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 609.

Description.—"Orbicular, slightly oblique; height and length equal; posterior superior margin obliquely subtruncated; ribs defined by slightly impressed narrow radii; radiating striæ minute and obsolete; marginal teeth prominent." Conrad, 1843.

This is the common species of the Calvert formation. Conrad has caused some confusion by listing in 1842, as *P. lentiformis,* some specimens from the Calvert formation at Hance's and Wilkinson's, that must have been the then undiscriminated *P. parilis.* I know of no true *P. lentiformis* specimens that have been found in Maryland.

Height, 90 mm.; width, 88 mm.; diameter, 23 mm.

Occurrence.—St. Mary's Formation. St. Mary's River (Dall). Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf, Church Hill, Wye Mills, Reed's, Tilghman's Station, Skipton (Dall).

The St. Mary's River reference is probably a mistake. No one else has listed it from there. Careful search has failed to find it there, and no specimens from St. Mary's River could be found in the National Museum.

Collections.—Maryland Geological Survey, Johns Hopkins University, Philadelphia Academy of Natural Sciences, U. S. National Museum, Cornell University.

Glycymeris subovata (Say).

Plate CVII, Figs. 3, 4.

Pectunculus subovatus Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 140, pl. x, fig. 4.

Pectunculus subovatus Conrad, 1832, Fossil Shells of the Tertiary, p. 17, pl. x, fig. 3.

Pectunculus subovatus Conrad, 1845, Fossils of the Medial Tertiary, p. 62, pl. xxxiv, fig. 1.

Pectunculus subovatus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 286, fig. 207.

Pectunculus subovatus Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Pectunculus subovatus Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.

Glycimeris subovata Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 611.

Description.—"Longitudinally short ovate, with about thirty longitudinal impressed acute lines, the intervals a little convex.

"*Shell* increasing in width by a slightly curved line from the apex to beyond the middle: *lateral curvatures* equal: *apices* separate, small, central; intervening space with but little obliquity to the plane of the shell, with obsolete angulated lines: *teeth* forming a regularly and much arcuated series, which is rectilinearly truncated above so as to leave in that part a mere edentulous elevated line: *within* destitute of striæ: *margin* with elevated angular lines: *exterior surface* with about thirty longitudinal, impressed, acute lines, the intervals a little convex." Say, 1824.

The specimens in the Philadelphia Academy of Natural Sciences labelled "Md." are similar in color to ones from the Yorktown, Va., region and have material between the teeth and in some holes in the shell very suggestive of the same locality. I very much doubt their having come from Maryland.

Height, 33 mm.; width, 36 mm.; diameter, 11 mm. This is less than usual size as found in Virginia and elsewhere.

Occurrence.—CHOPTANK FORMATION. Greensboro, Davis's Mill on Choptank, near Skipton.

Collections.—Maryland Geological Survey, U. S. National Museum.

Superfamily NUCULACEA.

Family LEDIDÆ.

Genus LEDA Schumacher.

LEDA LICIATA (Conrad).

Plate CVII, Figs. 5, 6, 7, 8.

Nucula liciata Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. i, p. 305.
Nucula liciata Conrad, 1845, Fossils of the Medial Tertiary, p. 64, pl. xxxvi, fig. 3.
Nucula liciata Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.
Nucula liciata Meek, 1864, Miocene Check List, Smith Misc. Coll. (183), p. 5.
Leda acrybia Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 590.
Leda phalacra Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 592.

Description.—"Ovate-acute, ventricose, with about fifteen concentric lamelliform striæ; posterior side much shorter than the anterior; anterior side slightly recurved, with an oblique slight submarginal furrow, causing a slight emargination of the base near the extremity." Conrad, 1843.

The above is Conrad's original description. His specimens are in the Philadelphia Academy of Natural Sciences. A study of abundant material shows that the concentric striæ vary from fifteen, or fewer, to well-nigh thirty, becoming at the same time finer and more indistinct over the umbonal slope and partially or entirely obsolete near the margin. In other specimens a larger and larger portion of the surface in this way becomes smooth, until they finally grade over into perfectly smooth polished forms. One having but a few valves belonging to different portions of the series would naturally consider them distinct species.

Leda acrybia is a typical *L. liciata* and stands at one end of the series. *L. phalacra* is one of the intermediate forms with the striæ partially obsolete, while *L. amydra* is the smooth, polished variety forming the other end member of the series. It has not been practicable to separate the intermediate forms from the *liciata.* They are accordingly grouped together, while the smooth polished end member, *L. amydra,* has been retained as a variety.

Length, 10.5 mm.; height, 6.1 mm.; diameter, 2.5 mm.

Occurrence.—CHOPTANK FORMATION. Greensboro. CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

LEDA LICIATA VAR. AMYDRA Dall.

Plate CVII, Figs. 9, 10.

Leda amydra Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, pp. 591, 592.

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

" This shell is remarkably like a small *Leda* from the Claiborne sands which I have without a name, but is more rounded behind. More material is needed to establish its exact relations." Dall, 1898.

Dr. Dall's description was from a single valve found at Plum Point. It is but a variety of *L. liciata* and distinguished from the other members of the series of which it is an end member, by its smooth, polished surface.

Length, 11.5 mm.; height, 6 mm.; diameter, 2.3 mm.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

LEDA CONCENTRICA (Say).

Plate CVIII, Figs. 1, 2.

Nucula concentrica Say, 1824, Jour. Acad. Nat. Phila., vol. iv, 1st ser., p. 141.
Nucula concentrica Say, 1831, Amer. Conch., pl. xii.
Nucula concentrica Conrad, 1845, Fossils of the Medial Tertiary, p. 57, pl. xxx, fig. 3.
Nucula eborea Conrad, 1846, Proc. Acad. Nat. Sci. Phila., vol. iii, p. 24, pl. i, fig. 4.
Not *Yoldia eborea* Conrad, 1860, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. iv, p. 295, pl. xlvii, fig. 26; nor Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581; nor Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.
Nucula concentrica Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.
Nucula concentrica Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.
Leda concentrica Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 588.

Description.—"Transversely clongate-subovate, rostrated, concentrically striated.

"*Shell* convex; *rostrum* considerably narrowed towards the tip: *surface* concentrically striated with numerous, regular, equidistant, rounded lines: *beaks* rather behind the middle: *ligament margin* a little concave: *series of teeth* angulated at the beaks....

"The regularly striated surface gives this shell a very pretty appearance. In outline it has some resemblance to the *rostrata*." Say, 1824.

Length, 6 mm.; height, 4 mm.; diameter, 1.1 mm.

Occurrence.—ST. MARY'S FORMATION. St. Mary's County (Say); Pocomoke City at a depth of 53 to 75 feet in a well boring where it may be later than Miocene.

Collections.—Maryland Geological Survey, Johns Hopkins University, Wagner Free Institute of Science.

Genus YOLDIA Moller.

YOLDIA LÆVIS (Say).

Plate CVIII, Figs. 3, 4.

Nucula lævis Say, 1824, Jour. Acad. Nat. Sci. Phila., vol. iv, 1st ser., p. 141, pl. x, fig. 5.
Nucula lævis Say, 1831, Amer. Conch., pl. xii.

Nucula limatula Conrad, 1845, Fossils of the Medial Tertiary, pp. 57, 58, pl. xxx, fig. 4.

Nucula limatula Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 52, pl. xvii, figs. 13–15 (not of Say).

Yoldia lævis Conrad, 1863, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 581.

Yoldia lævis Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 5.

Yoldia lævis Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 596.

Description.—"Transversely elongate-subovate, rostrated, nearly smooth.

"Shell compressed, thin, fragile, polished, smooth, slightly wrinkled toward the base; beaks nearly central, hardly prominent beyond the hinge margin, rounded, approximate; series of teeth subrectilinear, a little arcuated behind; teeth prominent; hinge margin exteriorly both before and behind the beaks rather abruptly compressed; posterior margin rounded; anterior margin somewhat rostrated, the anterior hinge margin rectilinear, very little reflected at tip; inner margin simple." Say, 1824.

This species has often been confused with the Pleistocene and Recent *Y. limatula,* of which it is doubtless the ancestor. "It differs from the latter by its proportionally larger chondrophores, smaller and more numerous teeth, somewhat more pointed posterior end and less compressed escutcheon." Dall.

Casts from three miles north of Plum Point reach a very large size, being 5 cm. in length and 2 cm. in height. Specimens from other places are a half to a third these dimensions.

Occurrence.—St. Mary's Formation. Cove Point, St. Mary's River, Langley's Bluff. Choptank Formation. Jones Wharf, Sand Hill. Calvert Formation. Church Hill, Fairhaven, Parker Creek, 3 miles north of Plum Point, Lyon's Creek, White's Landing.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Family NUCULIDÆ.

Genus NUCULA Lamarck.

Nucula proxima Say.

Plate CVIII, Figs. 5, 6.

Nucula obliqua Say, 1820, Amer. Jour. Sci., vol. ii, p. 40; not of Lamarck, 1819.

Nucula proxima Say, 1822, Jour. Acad. Nat. Sci. Phila., vol. ii, 1st ser., p. 270

Nucula proxima Tuomey and Holmes, 1856, Pleiocene Fossils of South Carolina, p. 53, pl. xvii, figs. 7–9.

Nucula proxima Emmons, 1858, Rept. N. Car. Geol. Survey, p. 287, fig. 208B.

Nucula proxima Dall, 1889, Bull. xxxvii, U. S. Nat. Mus., p. 42, pl. lvi, fig. 4.

Nucula proxima Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 50, pl. vii, figs. 7–10.

Nucula proxima Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 574.

Description.—" Shell subtriangular, oblique, concentrically wrinkled, and longitudinally marked with numerous, hardly perceptible striæ; posterior margin very short and very obtusely rounded, a submarginal impressed line; anterior margin very oblique and but slightly arcuated; umbo placed far back; within perlaceous, polished, edge strongly crenated; teeth of the hinge robust, the posterior series very distinct and regular.

" Very much resembles *N. nucleus,* but is proportionally wider, and the posterior series of teeth is more regular and distinct. It may possibly prove to be only a variety, when numerous specimens are carefully examined and compared." Say, 1822.

Those from Church Hill are much larger than those from the other localities given below, the measurements being: length, 12 mm.; height, 10.5 mm.; diameter, 4 mm.; and length, 6.5 mm.; height, 5.3 mm.; diameter, 2.1 mm., respectively.

Occurrence.—CHOPTANK FORMATION. Dover Bridge, Cordova. CALVERT FORMATION. Church Hill, 3 miles west of Centerville, Fairhaven, 3 miles south of Chesapeake Beach, Plum Point, Truman's Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

NUCULA SINARIA Dall.

Plate CVIII, Figs. 7, 8.

Nucula sinaria Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 575, pl. xxxii, fig. 7.

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

"This species differs from the preceding [*N. chipolana*] by its more trigonal, heavy, and pearly shell, its wider and proportionately heavier hinge, and its impressed instead of merely flattened escutcheon. The Maryland specimens are usually larger and more worn than the types from West Florida; both retain a purplish tint in their nacre." Dall, 1898.

Length, 4.75 mm.; height, 4 mm.; diameter, 2.5 mm. (Dall).

Occurrence.—St. Mary's Formation. Cove Point, Langley's Bluff, St. Mary's River. Choptank Formation. Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

Nucula taphria Dall.

Plate CVIII, Figs. 9, 10, 11.

Nucula taphria Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 576, pl. xxxii, fig. 14.

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

"This interesting species is related to the recent *N. delphinodonta* Mighels, which is a more rounded and less oblique shell, without the strong concentric grooves of *N. taphria*." Dall, 1898.

Length, 2.9 mm.; height, 2.25 mm.; diameter, 1.5 mm. (Dall).

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

NUCULA PRUNICOLA Dall.

Plate CVIII, Figs. 12, 13, 14.

Nucula prunicola Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 576, pl. xxxii fig. 9.

Description.—" Shell small, inflated, polished, very inequilateral; surface with obsolete, obscure radial striæ, strong where they cross between the concentric ridges and near the ventral margin; beaks, dorsal slopes, escutcheon, and the posterior two-thirds of the sides of the shell smooth or nearly so; on the anterior third sculpture of moderately elevated concentric lamellæ separated by wider radially grooved interspaces; these lamellæ break off abruptly anteriorly, and posteriorly become gradually obsolete in front of the middle of the shell; they are strongest in front and near the margin; lunular area lanceolate, large, not impressed, marked by the cessation of the lamellæ; escutcheon roundly cordate, impressed; the margins pouting in the middle; there is no circumscribing line; beaks turgid, recurved; interior brilliantly pearly, the basal margin strongly crenulate, the muscular impressions feeble; base arcuate, ends rounded; chondrophore narrow, not prominent, anteriorly directed; the anterior line of teeth long, slightly arched, the posterior meeting it at nearly a right angle, short, straight; anterior teeth about twenty; posterior six or seven. . . ." Dall, 1898.

This species may be readily distinguished by the concentric ridges or raised lamellæ on the anterior third of the shell.

Length, 6 mm.; height, 4.5 mm.; diameter, 3.7 mm.

Occurrence.—CALVERT FORMATION. Chesapeake Beach, 3 miles south of Chesapeake Beach, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum.

MOLLUSCOIDEA.

CLASS BRACHIOPODA.

Order NEOTREMATA.

Superfamily DISCINACEA.

Family DISCINIDÆ.

Genus DISCINISCA Dall.

DISCINISCA LUGUBRIS (Conrad).

Plate CIX, Figs. 1a, 1b, 2a, 2b, 3.

Capulus lugubris Conrad, 1834, Jour. Acad. Nat. Sci. Phila., vol. vii, 1st ser., p. 143.
Orbicula lugubris Hodge, 1841, Amer. Jour. Sci., vol. xli, p. 344.
Orbicula lugubris Courad, 1842, Proc. Nat. Inst., Bull. ii, pp. 182, 183, 185.
Orbicula lugubris Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 75, pl. xliii, fig. 2.
Orbicula lugubris var. A Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 75.
Orbicula multilineata Conrad, 1845, Fossils of the Medial Tertiary, No. 3, p. 75, pl. xliii, fig. 3.
Capulus lugubris H. C. Lea, 1845, Trans. Amer. Philos. Soc., vol. ix, p. 230.
Orbicula lugubris Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 17, pl. v, fig. 1.
Orbicula multilineata Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 18, pl. v, fig. 2.
Orbicula lugubris Emmons, 1858, Rept. N. Car. Geol. Survey, p. 274, fig. 187.
Orbicula lugubris Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Orbicula multilineata Conrad, 1862, Proc. Acad. Nat. Sci. Phila., vol. xiv, p. 582.
Discina lugubris Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 3.
Discina multilineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 3.
Discina lugubris Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 21.
Discina "*acetabula*" [misprint for *lugubris*] Harris, 1893, Amer. Jour. Sci., ser. iii, vol. xlv, p. 25.
Discina lugubris Whitfield, 1894, Mon. xxiv, U. S. Geol. Survey, p. 23, pl. i, figs. 1–3.
Discinisca lugubris Schuchert, 1897, Bull. 87, U. S. Geol. Survey, p. 219.
Discinisca multilineata Schuchert, 1897, Bull. 87, U. S. Geol. Survey, p. 219.
Discinisca lugubris Dall, 1898, Trans. Wagner Free Inst. Sci., vol. v, p. 9, pl. i, fig. 2, A, B.
Discinisca lugubris Dall, 1903, Trans. Wagner Free Inst. Sci., vol. iii, pt. vi, p. 1534, pl. lxiii, fig. 13.

Description.—"Shell irregular, suboval, depressed, laminated; with radiating crenulating striæ; apex slightly prominent; nearly terminal. Length, half an inch." Conrad, 1834.

"Suborbicular, irregular, with radiating rugose lines, obsolete or wanting except on the space anterior to the apex, where they are distinct.

"*Var. A.* Apex remote from the margin; lines distinct over the whole disk, and reticulated by fine wrinkles." Conrad, 1845.

"Suboval, compressed; surface uneven, with radiating rugose closely-arranged lines." Conrad, 1845. (Description of *Orbicula multilineata.*)

Dorsal valve subcircular to oval, usually deep but sometimes almost flat; substance cornaceous, thick; apex prominent, varying in position from terminal to very slightly eccentric, nearer the center in the thinner, flatter, more nearly circular valves; external surface with very distinct concentric lines of growth, and with very variable radiating vermicular threads which are often obsolete on part or all of the valve; muscular scars very prominent; anterior scars large, elongate, not varying much in width from one end to the other, nearest together at the center of the valve, increasing in distance posteriorly; posterior scars small, distant, very prominent, somewhat elevated: ventral valve thin, flat or shaped by the surface to which it adheres; septum small, narrow, elevated; longitudinal fissure small, broad.

Dorsal valves are very abundant as their composition makes them more easily preserved than any other species in this fauna. Ventral valves are, however, very rare. They are so thin that they are never preserved, except when they have remained attached to some foreign object with the dorsal valve still in position. The ventral valve here figured, which is apparently the only one which has been found in Maryland, was attached to the exterior of a large *Ecphora quadricostata*.

There is great variation within this species due chiefly to the object of attachment and other conditions of environment. In addition to the typical form which was described from Stow Creek, New Jersey, and which was characterized by having semiobsolete radiating lines and a marginal apex, Conrad recognized an unnamed variety, from St. Mary's county (probably from Jones Wharf), which had a subcentral apex and distinct radiating lines, and a supposedly distinct species *multilineata* which had a depressed dorsal valve with a subcentral apex and very rugose radiating sculpture.

As has already been pointed out, the thickness of the shell and the depth of the valve increase, while the amount of sculpture decreases with the eccentricity of the apex. There is such complete gradation throughout the series that the separation of two species seems impossible. The individuals from the Calvert formation appear to be almost or quite restricted to the typical form. In the Choptank formation where the species attains its maximum development there is extreme variation in form. The St. Mary's formation has yielded few specimens. It will be in material from this formation, and probably in Virginia or the Carolinas, that *multilineata* will, if ever, be recognized as a valid species.

Length, 25 mm.; width, 25 mm.; height, 6.5 mm.

Occurrence.—St. Mary's Formation. Cove Point, near Great Mills. Choptank Formation. Jones Wharf, Governor Run, 2 miles south of Governor Run, Pawpaw Point, Turner, St. Leonard Creek, Trappe Landing, Dover Bridge, Cordova, Peach Blossom Creek. Calvert Formation. Chesapeake Beach, 3 miles south of Chesapeake Beach, Truman's Wharf, Lyon's Creek, Fairhaven.

Collections.—Maryland Geological Survey, Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences, Cornell University.

Class BRYOZOA Ehrenberg.

Order CYCLOSTOMATA Busk.

Family IDMONEIDÆ Busk.

Genus IDMONEA Lamouroux.

Idmonea (?) expansa n. sp.

Plate CIX, Figs. 6, 7, 8.

Description.—Zoarium adnate, beginning with a single zoœcium to which others are added rapidly until an irregular flabellate expansion is produced that with further growth becomes more or less lobate. In the older examples the lobes are seen to be due to the development of the zoœcia in systems composed of two pinnate series of transverse rows springing alternately from the opposite sides of a zigzag or wavy median line. In the rows the zoœcial apertures, which are rounded quadrate in shape and elevated, are in contact, with four to six in each row and this greater number in about 0.8 mm. The furrows between the rows of apertures are often irregular, and where this is the case the rows themselves are not continuous. When the arrangement is normal the average width of the furrows is a little less than that of the rows of apertures, allowing about four of the latter to come within the space of 1.0 mm. The growing margins of the expansions are occupied by numerous crowded angular cells, decreasing in size toward the extreme edge. Zoœcial walls minutely porous.

Young zoaria have the aspect of a short-celled *Tubulipora,* but we believe the pinnate arrangement of the zoœcia shown in maturer examples is a surer indication of the true affinities of the species. Compared with other species of *Idmonea* we know of none having anything like a flabellate zoarium, all being strictly ramose.

Pergens[1] retains d'Orbigny's *Reptotubigera,* 1852, for the adnate section of the genus *Idmonea* as currently understood, but since Lamouroux's type of *Idmonea* (*I. triquetra* Lamx., 1821) is also the type of *Reptotubigera,* it seems to us d'Orbigny's name has absolutely no claim to recognition. Besides the separation of *Idmonea* into two genera, the one comprising adnate forms the other erect, seems to find no sufficient justification in either nature or convenience.

Occurrence.—St. Mary's Formation. Cove Point (on *Pecten madisonius*).

Collection.—Maryland Geological Survey.

Genus CRISINA d'Orbigny.

It seems to us there should be no question of the desirability of this generic or subgeneric division. It is certainly convenient and as natural as the difficulties of a genetic classification of the Cyclostomata will permit. As we see it, precisely the same kind of difference separates *Crisina* from *Idmonea* as that which distinguishes *Truncatula* Hagenow from *Osculipora* d'Orbigny, *Plethopora* Hag. from *Cyrtopora* Hag., *Unicytis* d'Orb. from *Frondipora* Imperato, and *Corymbosa* Michelin from *Fasciculipora* d'Orb.

[1] Revision des Bryozoaires du Cretacé figurés par d'Orbigny, Bull. Soc. Belge de Géol., 1890, p. 338–340.

CRISINA STRIATOPORA n. sp.

Plate CXVII, Figs. 1, 2, 3, 4.

Description.—Zoarium erect, ramose, probably not exceeding 1 cm. in height, dividing dichotomously at intervals of about 1.5 mm.; branches subovate in cross-section, thickest, uniformly convex and traversed longitudinally by from sixteen to twenty punctate striæ on the reverse side, narrower and carrying alternating series of zoœcial apertures on the obverse side. Zoœcial apertures rarely three usually four in each series, in contact laterally, the inner one of each series largest, most prominent, and subcircular, the outer one smallest, drawn out distally and apparently grading into the pores lying between the longitudinal ridges of the reverse side. Series of zoœcia curving first forward then slightly backward, separated by a deep interspace averaging about 0.2 mm. in width; about five rows in 2.0 mm. Over the basal part of the zoarium the zoœcial apertures are covered one after the other by the growth of the striato-punctate dorsal integument.

This handsome species is readily distinguished from all others known to us having the character of *Crisina,* by the frequent dichotomization of the branches. Differences in cross-sections of the branches and in other respects also are to be observed when compared with most of the species.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Family FASCIGERIDÆ.

Genus THEONOA Lamouroux.

THEONOA GLOMERATA n. sp.

Plate CIX, Figs. 4a, 4b, 4c, 5a, 5b.

Description.—Zoarium cake-shaped when young and growing irregular with age, the under side covered with a concentrically wrinkled epitheca, the upper side with short or broken irregularly arranged celluliferous ridges separated by deep interspaces. Ridges abruptly elevated, their flattened summits usually exhibiting a double row of subangular zoœcial apertures. Here and there, probably through confluence of two or more ridges, considerable clusters of apertures occur, while other groups may not contain more than three or four cells. Occasionally an irregular radial arrangement of the ridges is apparent. About four zoœcial apertures in 1.0 mm.

The ridges or as they may be more appropriately called, the elevated bundles of zoœcial apertures, are smaller and more interrupted, and the deep interspaces relatively greater than in any other species of *Theonoa* known to us. Excepting that the radial arrangement of the ridges is much less apparent and the zoarium thicker, *T. glomerata* presents considerable resemblance to *Kololophos terquemi* (Haime) Gregory, and it would not require any very essential modification of Gregory's proposed genus to receive it. But as there is some question in our minds as to the necessity of *Kololophos* and less doubt concerning the intimate relations of our species to *Theonoa* we have thought it better, for the present at least, to place it into the old genus rather than to modify the new genus in a direction probably not acceptable to its founder.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Order CHILOSTOMATA Busk.

Family MEMBRANIPORIDÆ.

Genus MEMBRANIPORA Blainville.

MEMBRANIPORA OBLONGULA n. sp.

Plate CX, Figs. 2, 3, 4, 5.

Description.—Zoarium incrusting, forming delicate expansions often of considerable extent over shells of mollusca and other foreign objects; occasionally in superimposed layers. Zoœcial apertures arranged in longitudinal series, usually elongate, occupying the entire opesium, the length often nearly or quite twice the width; when normally developed, elongate, ovate or subquadrate but contingencies of growth and development cause many variations without, however, ever seriously affecting the general plan of the specific characteristics; measuring longitudinally 10 or 11 in 5 mm., transversely the average is about 10 in 3 mm. Wall varying in thickness, usually about two-thirds the width of the opesium, rarely less, and often much thicker, the extremes observed being shown in the illustrations; surface of wall with delicate transverse striæ, usually sharply rounded or angular in the middle, but when very wide the median line is depressed. Numerous thin spines project from the walls into the apertures but they are usually confined to the posterior half or two-thirds of the opening.

This extremely abundant and despite its variations, really very constant species apparently belongs to the group of *M. membranacea,* which is characterized by the absence of both avicularia and ovicells. It has close relations to several European Tertiary and to certain living species, but does not appear to be identical with any of the described forms. Whatever rank it may be given when the MEMBRANIPORIDÆ are finally revised, its importance as a highly characteristic species of the American Miocene demands recognition. There is no associated species with which it might be confounded.

Canu[1] erects a new genus for the reception of *M. membranacea* L. with which as above indicated we believe the affinities of *M. oblongula* lie. We have not thought it wise, however, to employ the new genus until our studies of the whole family arrive at a stage where we have confidence in the generic grouping.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Peach Blossom Creek, Greensboro, Dover Bridge, Governor Run. CALVERT FORMATION. Plum Point, Reed's, Chesapeake Beach.

Collections.—Maryland Geological Survey, U. S. National Museum.

MEMBRANIPORA FOSSULIFERA n. sp.

Plate CX, Fig. 1.

Description.—Zoarium forming a thin expansion upon foreign bodies. Zoœcia oblong, subquadrate, sometimes obscurely hexagonal, arranged in regular longitudinal and diagonally intersecting rows, with about 11 in 5 mm., measuring lengthwise, 9 to 10 in 3 mm., diagonally, and 11 to 13 of the longitudinal rows in 3 mm. Opesium elongate oval, generally about twice as long as wide. Walls nearly always a little less than half

[1] Bull. Soc. Géol. de France, 3rd ser., xxviii, p. 348, where the spelling is *Nistchina* and p. 380 as *Nichtina* although the genus is presumably named after Nitsche.

the width of the opesium, with a median channel, the ring-like elevation enclosing the opesium uniformly elevated except across the anterior end where it is higher and obliquely arched and elevated beneath, probably to form a cover for an oœcium, and is usually surmounted by a transverse rib terminating at each end in a small rounded prominence. Rarely the space of an ordinary zoœcium is taken up by a cell having a thicker wall and a smaller aperture varying from elongate to nearly circular, while in one instance, a small cell with an oblique opening, narrowed distally, is wedged in between three zoœcia.

This species probably belongs to the group of *M. corbula* as defined by Waters. Compared with described fossil species *M. fenestrata* Reuss, from the Miocene of Austria, seems the nearest. However, there are good specific distinctions between them, the shape of the zoœcia being somewhat different, and the transverse depressed line between their ends deeper and the ovicells less exsert in the Maryland species.

Occurrence.—Calvert Formation. Reed's.

Collection.—Maryland Geological Survey.

Membranipora caminosa n. sp.

Plate CXI, Figs. 3, 4.

Description.—Zoarium adnate, forming a thin, single sheet of indefinite extent. Zoœcia arranged quincuncially, 6½ measuring longitudinally and 7½ to 8½ diagonally, in 3 mm. Opesia subcircular, separated by one-half to two-thirds their diameter; when the oœcium is wanting, a rim-like border encloses the anterior half of the opening. Oœcia very high, with a rib across the top, and just in front of the latter a prominent chimney-like tube or hollow spine projecting obliquely over the zoœcium next above. When the oœcium is broken away a semi-ovate or quadrangular concave space is uncovered between the ends of following zoœcia. The hollow tubule behind the zoœcial aperture is always present but it is usually worn down so as to appear as merely a thick-rimmed pore. Where the zoœcial arrangement is irregular or changed, a second, or even a third tubule, each directed forward, may occur between three zoœcia.

This species has a rather peculiar aspect, and we are at a loss to point out its more intimate alliances. Possibly it may fall under Canu's subgenus *Rhynchotella,* but not without considerable modification of his definition. An undescribed species occurring in the Cretaceous of New Jersey is nearer than any other known to us.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Membranipora germana n. sp.

Plate CXI, Figs. 8, 9.

Description.—Zoarium forming a delicate crust upon foreign bodies, the largest seen being less than 1 cm. in diameter. Zoœcia shallow, arranged in curved radiating lines in which about 6 occur in 3 mm.; measuring transversely, 11 to 12 of the rows in the same space. Opesia large, more or less elongate-ovate, the length and width usually as 3 is to 2, separated laterally from their neighbors by about half their width, enclosed by a ring-like thickening formed by a furrow separating adjoining zoœcia. At somewhat irregular intervals, the interzoœcial space widens and is occupied by a rounded cell that may have lodged some kind of avicularium. These cells vary greatly in size but are always considerably smaller than the true zoœcia. Occasionally the front margin of the zoœcium is more elevated than the rest of the circumference. No ovicells observed.

This species is probably closely related to *M. plebeia* Gabb and Horn from the Cretaceous of New Jersey, the two having zoœcia very similar in shape and size but the older species exhibits a well marked difference in its numerous and equal sized interzoœcial pores (? avicularia). There are several European fossil species and living forms with which it might be compared but none matches it exactly.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Dover Bridge.

Collection.—Maryland Geological Survey.

Membranipora parvula n. sp.

Plate CXI, Figs. 1, 2.

Description.—In its general zoarial and zoœcial characters this species resembles *M. germana* and *M. plebeia* Gabb and Horn, but it is readily distinguished by the smaller size and less elongate form of its zoœcia. The walls also are relatively thicker while the longitudinal arrangement of the zoœcia is more pronounced. Measuring longitudinally, 8 zoœcia occur in 3 mm. and transversely 12 may be counted in the same space.

Occurrence.—Calvert Formation. Reed's.

Collection.—Maryland Geological Survey.

Membranipora bifoliata n. sp.

Plate CXII, Figs. 2, 3, 4.

Description.—Zoarium forming small, bifoliate, undulating fronds, the two halves of which separate readily. Zoœcia squarish-hexagonal on the front face, oblong-quadrate on the basal or inner side where the slightly curved end-walls show through the longitudinally fluted basal lamina, and where the ratio of length and breadth of the under side of the zoœcia varies from 3 to 2 to 4 to 2, respectively; arranged in longitudinal and diagonally intersecting rows, of which the former are the more conspicuous and regular. Measuring longitudinally about six zoœcia, rarely only five, occur in 3 mm.; diagonally six or seven and transversely eight or nine may be counted in the same distance. Opesia large, usually varying from narrow to broad-ovate, rarely subcircular. Walls nearly equally thick all around, usually with a narrow median furrow, and the apertural rims finely granulose or transversely striated, the striæ becoming stronger and the median furrow obscure with age. One or two small pits, with their mouths directed obliquely forward, generally present in the posterior angle or angles of each zoœcium. Occasionally a small node is associated with these pits or may take the place of one. No ovicells nor avicularia observed.

Of American fossil species the only one that may be considered as at all related is the *M. rimulata* Ulrich, from the Eocene at Upper Marlboro, Md. In that species, however, the zoœcia are more hexagonal and the zoarium adnate and not erect and bifoliate. It also has large vicarious avicularia of which no trace has been discovered in *M. bifoliata.*

Three of d'Orbigny's Cretaceous Biflustras, *B. emarginata, B. papyracea* and *B. cyclopora,* the first two of which Canu identifies with d'Orbigny's *B. ovalis,* are perhaps closely related to our species, but we are satisfied that the latter is not strictly identical with any. Reuss' *M. subtilimargo,* as figured, also shows resemblances, but as that species has been compared by competent observers with *M. lacroixii,* to which *M. bifoliata* certainly is not related, we have no doubt of its specific distinction.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

MEMBRANIPORA NITIDULA n. sp.

Plate CXII, Fig. 1.

Description.—Zoarium apparently erect, bifoliate. Zoœcia oblong, subquadrate, the length twice the width, arranged rather regularly in longitudinal and diagonally intersecting series, rarely four, usually five in three mm. lengthwise, about seven diagonally, and ten or eleven transversely in the same space. Opesia elongate-elliptical, separated transversely by an obtusely ridge-shaped wall generally equalling about half their width; longitudinal interspaces about twice as great as the transverse, medially ridged with a crescentic ovicellar excavation below (i. e. in front of each opesium) and usually a small pore-like depression at each end of the ridge. Very minute spines or granules on inner slope of walls.

This species resembles several of d'Orbigny's Cretaceous Biflustras, especially *B. prolifica,* which Canu, in his revision of d'Orbigny's CHILOSTOMATA, unites, together with several other forms that also look very different in d'Orbigny's figures, with *M.* (*Biflustra*) *lachrymopora* (d'Orb.). In this case, at least, we believe Canu has gone too far in his zealous endeavor to reduce the Cretaceous bryozoa to reasonable specific limits for we can neither believe that any species can exhibit the degree of variability indicated by him for *M. lachrymopora* nor that d'Orbigny's illustrations are so utterly unreliable. As figured by Canu, *M. lachrymopora* differs decidedly in the character of its longitudinal interspaces from *M. nitidula,* and as we have found no other that matches the Maryland species any better, we have been obliged to propose the above new name for it.

Occurrence.—CHOPTANK FORMATION. Pawpaw Point.

Collection.—Maryland Geological Survey.

MEMBRANIPORA FISTULA n. sp.

Plate CXII, Fig. 5.

Description.—Zoarium so far as observed forming small, hollow, subcylindrical stems, about 1.5 mm. in diameter, composed of twelve to fifteen longitudinal rows of zoœcia. Walls about as wide as the zoœcial openings, obtusely carinate, the carinæ between the ends of the cells high and bent forward so as to impart a slightly imbricating appearance to successive cells. Opesial opening elongate elliptical; immediately behind it a minute pore is occasionally noticeable. Measuring longitudinally about 8 zoœcia in 5.0 mm. No avicularian nor vibracular cells observed.

Though numerous allied species, chiefly among those assuming the bifoliate mode of growth, are known, none is sufficiently close to cause us to think that *M. fistula* may be but another zoarial phase of it. For the present then we consider ourselves justified in proposing a new name and further in assuming that the zoarial characters above described are normal for the species. The cylindrical stems of *Flustrellaria texturata* Reuss, from the Miocene of Austria are very similar, the principal differences being that their apertures are shorter and rounder. With a large series of specimens *M. fistula* may prove to be but a variety.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

Genus AMPHIBLESTRUM Gray.

AMPHIBLESTRUM CONSTRICTUM n. sp.

Plate CXV, Figs. 6, 7.

Description.—Zoarium forming crusts of small extent upon shells, the types growing on a *Pecten.* Zoœcia arranged in rather irregular rows, 6 to 8 in 3 mm. Aperture subovate, more or less constricted in front of the midlength, enclosed a sloping and finely striated border, widest posteriorly. Frontal lamina very little developed forming the sloping and transversely striated border just mentioned. Ovicells abundant, large, moderately convex, the middle portion distinguished by being minutely pitted or porous. Avicularia of moderate size, usually one, rarely two to each zoœcium, of the same type as in *A. flemingi* but with the apex more prominent.

This species is closely related to *A. flemingi* (Busk) and *A. trifolium* (Wood), both living in the seas of to-day and known also as fossils from late Tertiary beds of England and Italy. It is distinguished from both by the lesser development of the frontal lamina. The constriction of the aperture is usually more pronounced in *A. constricta*.

Occurrence.—St. Mary's Formation. Cove Point.

Collection.—Maryland Geological Survey.

Amphiblestrum agellus n. sp.

Plate CXII, Figs. 7a, 7b.

Description.—Zoarium forming small patches upon molluscan shells. Zoœcia irregularly subrhomboidal, sharply defined, 9 or 10 in 3 mm. Aperture distinctly bilobed, the posterior lobe the wider; anterior lobe enclosed by a distinct rim, terminating at the constriction in a small hollow node; length of aperture scarcely exceeding half that of the entire zoœcium. Lamina well developed, sloping inward, smooth. Ovicells few, known only in the broken condition, when it appears as a large shallow depression in front of the aperture. Posterior end of zoœcium usually with a rather large, subcircular pore (? avicularium).

This is a very neat form, comparing very well in most of its characters with the typical species of *Amphiblestrum*, but it differs markedly from them in its avicularia, if the round pores near the posterior ends of the zoœcia are really of that nature. The zoœcia are considerably smaller also than in any of the species which it resembles in other respects.

Occurrence.—St. Mary's Formation. Cove Point.

Collection.—Maryland Geological Survey.

Family MICROPORIDÆ.

Genus CUPULARIA Lamouroux.

Cupularia denticulata (?) (Conrad).

Plate CXII, Fig. 6.

Lunulites denticulata Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 348.
Lunulites depressa Conrad, 1841, Amer. Jour. Sci., vol. xli, p. 348.
Lunulites denticulata Lonsdale, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 503
Discoporella denticulata Gabb and Horn, 1862, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. v, p. 242, fig. 25.

Description.—A single imperfect discoidal zoarium probably referable to this common Miocene species occurs in the Maryland bryozoa before us. It is ovate in outline, the largest and smallest diameters being respectively about 5.0 mm. and 3.5 mm. Concave under-surface marked by irregular impressed radial lines with the surface between them granulose. Convex surface celluliferous, the zoœcial arrangement rather obviously radial, though here and there an approach to the quincuncial arrangement, that is more apparent than the radial in typical specimens of the species, is perceptible. The zoœcial covers are gone, but remains of them occur in nearly all the cells as two or three blunt spines on each side of the aperture. Vibracular cell situated between the ends of the zoœcial apertures, large, sometimes attaining a length nearly half that of a zoœcium, usually rounded, though often with one side less curved than the other and sometimes nearly straight. The latter are oblong and vary between subquadrate and obscurely hexagonal. Four and a half to five occur in one of the radial rows in 2.0 mm. Walls thick, obtusely ridged. Where the exterior portion of the zoœcia is removed the inner part is seen to be thin walled and each zoœcium rounded rhomboidal in shape, while their arrangement here is decidedly quincuncial.

We cannot agree with Pergens[1] in placing Conrad's *Lunulites denticulata* as a synonym under *Cupularia umbellata* (Defrance). Its zoœcial apertures are always more hexagonal than rhomboidal, causing the radial arrangement to be more pronounced, while the walls are thicker.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Family MICROPORELLIDÆ.

Genus MICROPORELLA Hincks.

Microporella præciliata n. sp.

Plate CX, Fig. 6; Plate CXIII, Fig. 3.

Description.—Zoarium adnate, forming patches of two or three centimeters in diameter, composed, so far as observed, of but a single layer. Zoœcia subrhomboidal or hexagonal, the average length and breadth

[1] Pliocäne Bryozoen von Rhodos, Ann. K. K. Nat. Hofm., Bd. ii, p. 30, 1887.

respectively as three is to two, arranged in rather irregular diagonally intersecting series, along which about five may be counted in the space of 2.0 mm. The arrangement of the cells is more irregular in zoaria containing numerous ovicells, and the upper surface of the zoœcia is often nearly flat, and always less convex than in specimens having few or no ovicells. Upper or front wall of zoœcia abundantly and rather coarsely punctate. Orifice somewhat transverse, with the posterior angles rounded, enclosed by a thickened border, semielliptical in outline, its proximal side nearly straight, the distal portion curved and carrying seven or eight minute hollow granules or spines. Immediately behind the proximal border is a pore, usually elliptical, and also enclosed by a thickened border. Avicularia large, acuminate ovate, with an elevated border and divided into two portions by a delicate septum; usually one to each zoœcium and situated nearly always near either the right or the left lateral angle. Ovicells large, prominently convex, punctate.

This is probably one of the ancestors of the living type of the genus, *M. ciliata,* but is readily distinguished by its cribrose instead of granulose zoœcia. *Lepralia pleuropora* and *L. inamœna* Reuss from the Miocene of Austria, are both closely allied, but have smaller avicularia and ovicells.

Occurrence.—St. Mary's Formation. Cove Point. Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Microporella inflata n. sp.

Plate CX, Fig. 7.

Description.—This species agrees in its more essential features closely with *M. præciliata* excepting that the surface appears smooth, the ovicells even more inflated, the orifice set more obliquely in the front slope and its border less thickened and without oral spines, the pore behind it set further back and more elevated, and the avicularia smaller. The size of the zoœcia also is a trifle less. Under favorable light a faint reticulation of the surface of the zoœcia and ovicells may be detected. We know of no other species near enough to require comparison.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Microporella (?) bifoliata n. sp.

Plate CXIII, Figs. 6, 7, 8.

Description.—Zoarium erect, bifoliate, not known to branch. Zoœcia subquadrate or hexagonal, arranged in regular longitudinal and diagonally intersecting series, four longitudinally and five diagonally in 2.0 mm. Appearance of surface varying greatly with age. In young examples the zoœcia are more or less convex and separated, especially transversely, by an impressed line containing one or more rows of pores; the orifice is somewhat transverse and subovate with the proximal side straightened, the peristome but little elevated, the front sparsely punctated, the avicularia, of which there is usually one to each zoœcium placed some distance beneath and to one side of the orifice, rather large, subcircular and divided into two nearly equal parts by a thin partition. In old examples the oral part is sunken and the rest of the surface abundantly punctate, while the avicularia have been somewhat reduced in size. Immediately behind the orifice there is always a small (? peristomial) pore. Ovicells large, rather strongly convex, punctate.

We know of no satisfactorily classified species that may be regarded as closely related to the form under consideration, and there is therefore some doubt as to its generic position. Possibly it would have been nearer the truth to call it a *Porina*.

Occurrence.—Choptank Formation. Cordova.

Collections.—Maryland Geological Survey, U. S. National Museum.

Genus ADEONELLOPSIS Macgillivray.

Adeonellopsis umbilicata (Lonsdale).

Plate CXIII, Figs. 4, 5; Plate CXIV, Fig. 5.

Cellepora umbilicata Lonsdale, 1845, Quar. Jour. Geol. Soc. London, vol. i, p. 507.
Reptocelleporaria umbilicata d'Orbigny, 1851, Pal. France, vol. v, p. 423.
Multiporina umbilicata Gabb and Horn, 1862, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. v, p. 145, fig. 27.

Description.—Zoarium forming irregular nodose masses, composed of numerous layers, growing over foreign bodies. Zoœcia of successive layers usually directly over each other so as to appear to form tabulated tubes. At the surface the zoœcia are irregular in shape and arrangement, with the central and anterior portion more or less elevated and the outline marked usually by two rows of small pores, one on each of the adjoining zoœcia. Mouths of pores direct and simple in young expansions, but drawn out inwardly into short radially disposed furrows in old specimens. Orifice anterior but not terminal, transverse, semielliptical, but with the angles rounded. Border more or less thickened and elevated, especially at the proximal margin just behind which there is nearly always a peculiar, generally prominent, avicularian cell. Further back, and near the middle of the proximal half of the zoœcium, is a well marked, usually semilunate pore. When slightly worn, the orifice, avicularian cell and the semilunate pore form a series of which the first usually is the largest, the second a little smaller and the third the least. Measuring transversely about six zoœcia occur in 2.0 mm.; lengthwise, four to five occur in the same space. Gonœcia like the zoœcia except that they have no avicularia and in the place of the orifice have numerous small pores like those around the border of the cells.

This abundant and easily recognized bryozoan probably is a close ally of *Cumulipora transylvanica* (Reuss) Manzoni,[1] though distinguished readily enough by the larger size of its avicularian cell and in wanting the row of pores within the marginal series that characterizes the Austrian species. Another related species is the late Tertiary and recent *Microporella violacea* (Johnston) Hincks.

Concerning the generic position of the species we are not fully satisfied that it belongs to *Adeonellopsis.* Still this genus affords a more natural association for the species than it had in previous arrangements and probably will serve as well as any other until the classification of the CHILOSTOMATA is more settled.

Occurrence.—CHESAPEAKE GROUP. Petersburg, Va. (common). CHOPTANK FORMATION. Maryland (doubtfully identified).

Collection.—U. S. National Museum.

[1] Denkschr. d. k. Akad. Wiss. Wien., Bd. xxxvii, Abth. ii, p. 53, Taf. ii, fig. 7, 1877.

Family SCHIZOPORELLIDÆ.

Genus SCHIZOPORELLA Hincks.

SCHIZOPORELLA INFORMATA (Lonsdale).

Plate CXIV, Figs. 6-10.

Cellepora informata Lonsdale, 1845, Quar. Jour. Geol. Soc. London, vol. i, p. 505.
Reptocelleporaria informata d'Orbigny, 1852, Pal. France, vol. v, p. 422.
Reptocelleporaria informata Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 15, pl. iv, figs. 11, 12.
Reptocelleporaria informata Gabb and Horn, 1862, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. v, p. 132.

Description.—Zoarium forming irregular, generally botryoidal or nodulose masses by the superposition of layer after layer of zoœcia; average size of masses between two and four centimeters. Zoœcia often developed in direct sequence, and as they separate easily from their neighbors, vertical fractures generally exhibit a columnar structure. In each of the layers they are arranged more or less irregularly, the degree of irregularity being as a rule in proportion to the relative unevenness of the surface. Normally developed, they are oblong subquadrate or hexagonal with the sides slightly rounded or obtusely angular, the relation of length to breadth being as four is to three, or eight to five; average length about 0.5 mm. When crowded they take any suitable shape, some being wider than long, others much narrower than the normal form. Orifice terminal, subcircular though always somewhat transverse, in the same plane as the upper surface, surrounded by a distinct though but little elevated peristome; proximal notch narrow, deep, sharply defined. Surface of zoœcia convex, very distinctly punctate, except on a small spot a short distance beneath the orifice that is often raised into a low tubercle. Avicularia not often present, though a few may be detected on most specimens examined, of medium size, divided into two compartments, and situated on either side close to the proximal angle of the orifice.

Ovicells abundant in some specimens, rare or wanting in others, of an unusual type, consisting of subglobular, punctate inflations covering a whole zoœcium; usually broken as shown on Plate CXII, Fig. 10.

The peculiarities of the ovicell distinguish this species from all others of the genus known to us. Otherwise it is not far removed from

S. unicornis and its varieties, the most striking of the differences being the relatively unimportant one of having much fewer avicularia.

Occurrence.—CHESAPEAKE GROUP. Very common at Petersburg, Va., and at localities in South Carolina. CHOPTANK FORMATION (?). Maryland (?). (The specimens have been mislaid, and we cannot now verify its occurrence in the state.)

Collection.—U. S. National Museum.

SCHIZOPORELLA SUBQUADRATA[1] n. sp.

Plate CXIV, Fig. 1; Plate CXVIII, Figs. 5, 6.

Description.—Zoarium consisting of a single layer attached to foreign bodies. Zoœcia subquadrate, usually about a third longer than wide, averaging 0.7 mm. in length, arranged in rather regular radial and less regular concentric rows. Surface convex, punctate. Orifice subterminal, slightly transverse, enclosed by a thin peristome, widest and elevated only on the lower side; notch wide, occupying about a third of the straightened proximal outline of the orifice. Avicularia rather large, usually one, rarely two, to each zoœcium, situated on either side of the orifice, acuminate and prominent above.

Excepting that the oral sinus or notch is much wider than shown in Reuss' figures of his variety *tetragona* of *S. unicornis* (Johnston), *S. subquadrata* agrees almost exactly with it. Our species probably should be ranked as only another variety of *S. unicornis,* which as figured by Hincks[2] agrees better in the form of the orifice with the American fossils than does the Austrian variety.

Occurrence.—CHOPTANK FORMATION. Governor Run. (The label showing the exact locality of the specimen figured has been mislaid, but it is certainly from the Miocene of the southeastern states, and probably from the horizon of the Choptank formation.)

Collections.—U. S. National Museum, Maryland Geological Survey.

[1] Compare *Lepralia ansata* var. *tetragona* Reuss, 1874, Die foss. Bry. d. Öster.-Ungar. Miocäns, p. 19, pl. vii, figs. 1–3. Also *Schizoporella unicornis* (Johnston) Hincks. For full synonymy see Miss Jelly's Synonymic Catalogue of Marine Bryozoa.

[2] British Marine Polyzoa, 1880, pl. xxxv, figs. 1–5.

SCHIZOPORELLA LATISINUATA n. sp.

Plate CXIV, Figs. 2, 3, 4.

Description.—Zoarium forming thin parasitic expansions over foreign bodies. Zoœcia sharply distinguished from each other, rather irregularly arranged, often subrhomboidal, four or five in 2.0 mm.; surface coarsely punctate. Orifice terminal, directed somewhat obliquely forward, subcircular, broadly sinuate proximally, enclosed by a slightly elevated peristome. Avicularia rather small, prominent, one on either or both sides of the orifice, rarely wanting, situated close to the peristome; apparently not divided by a septum. Ovicells not observed.

The species, with its broad and very shallow oral sinus, scarcely gives one the impression of a true *Schizoporella,* but as the sinus is unusually wide also in our specimens of *S. unicornis* var. *tetragona* and in *S. doverensis,* and the other characters are very similar to several typical species of the genus, we deemed it preferable to name it as above rather than to place it under *Lepralia.*

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

SCHIZOPORELLA DOVERENSIS n. sp.

Plate CXVII, Fig. 1.

Description.—Zoarium a thin sheet on foreign bodies, the figured specimen growing on the reverse of *Retepora doverensis.* Zoœcia well distinguished from each other but with the surface rather flat; irregularly arranged, though their elongate form gives some prominence to the longitudinal rows; average length 0.6 mm., width 0.35 to 0.40 mm. Orifice terminal, slightly transverse, broadly notched on the proximal side, on the whole nearly circular. Surface reticulate, only slightly convex, the central portion appearing flattened. Avicularia of moderate size, usually one to each zoœcium, situated close to either side of the orifice. Ovicells not observed.

Occurrence.—CHOPTANK FORMATION. Dover Bridge.

Collection.—Maryland Geological Survey.

Schizoporella cumulata n. sp.

Plate CXVII, Fig. 7.

Description.—Zoarium probably massive, composed of layers of zoœcia arranged very irregularly and piled upon each other much as in *Cellepora*. Zoœcia of irregular shapes, often broad ovate, convex, large, 0.5 mm. or 0.6 mm. in length and nearly 0.5 mm. in width. Orifice rounded, slightly transverse, the proximal side broadly notched; peristome somewhat elevated, thick. Surface distinctly and abundantly punctate. Avicularia rather variable in size, situated on only one or on both sides of the orifice, the acuminate end of the aperture elevated and turned outwardly. Ovicells not observed.

The general aspect of this bryozoan is decidedly like that of a *Cellepora,* and we can scarcely doubt that it is related to some of the species still referred to that genus. We have placed it under *Schizoporella,* not because we are satisfied that it really belongs there, but for the reason that its zoœcial orifices and the avicularia are almost exactly as in other species (*e. g., S. subquadrata* and *S. latisinuata*) that we have referred to this genus. From these it is distinguished principally by the extremely irregular arrangement and piling up of the zoœcia.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Genus RETEPORA Lamarck.

Retepora doverensis n. sp.

Plate CXI, Figs. 5-7; Plate CXV, Figs. 1-5.

Description.—Zoarium reticulate, fenestræ of variable size, averaging 0.8 mm. long and about 0.4 mm. wide. Branches varying from 0.2 mm. to 1.0 mm. wide, usually about 0.6 mm.; reverse solid, the surface generally smooth, occasionally minutely granulose, divided into irregular angular spaces by fine impressed or raised lines that may or may not correspond with the bases of the zoœcial walls Zoœcia immersed, with oblique imbricating and slightly flaring mouths, and a narrow notch in the elevated and angular proximal border. The appearance of the celluliferous surface varies greatly in different specimens, the difference being due chiefly to the presence or absence and number of the avicularia and ovicells. The latter appear as bulbous inflations with a slit running from the center to one edge. When they occur at all it is usually in abundance. Of avicularia there are at least two sets, the larger ones occurring on the front of the zoœcia, forming its highest part and causing it to appear inflated. Those of the smaller set occur in the depressed spaces, usually close beside the zoœcial orifice, and rarely on the reverse of the branches.

This common species of the Choptank formation apparently belongs to the *Retepora-cellulosa* group of Waters. Though resembling several of the species of the group rather closely we could not decide that it was any nearer to one than to another. Still, having found it difficult to make thoroughly satisfactory comparisons, we will not be greatly surprised should future study prove *R. doverensis* to belong to some previously described species.

Occurrence.—Choptank Formation. Dover Bridge, Jones Wharf.

Collections.—Maryland Geological Survey, U. S. National Museum.

Family LEPRALIIDÆ.

Genus LEPRALIA Johnston.

Lepralia maculata n. sp.

Plate CXV, Figs. 8, 9; Plate CXVIII, Fig. 7.

Description.—Zoarium beginning as a thin sheet on shells of small gastropoda to which other layers are added until masses as much as two inches in diameter result. Surface of masses generally exhibiting more or less distinct, usually elevated, clusters of zoœcia slightly larger than those occupying the intermediate spaces. Zoœcia convex, subovate, not sharply separated nor exhibiting any obvious plan of arrangement; when in rows about six occur in 2.0 mm. Orifice not terminal but situated in the anterior half, rounded and expanded above, contracted below the middle where there is a small denticle on each side, and nearly straight or curved slightly outward on the lower side; peristome simple, not elevated. Surface punctate, excepting over a space just beneath the orifice that is smooth and elevated into a conical or obtuse umbo. Avicularia of two kinds and sizes, both sets very irregularly distributed. Those of the smaller set are ovate and less than half the size of the zoœcial orifice, and situated in one of the corners of a zoœcium; those of the larger set occupy each the place of a zoœcium, have a triangular or acuminate ovate aperture considerably larger than the zoœcial orifice and have the pointed end or side strongly elevated. Ovicells immersed, somewhat smaller than the zoœcia, convex, smooth centrally, punctate marginally, often with an eccentric smooth oval space distinguished from the rest of the surface by an impressed line.

This very common and characteristic species of the Calvert formation is closely related to *L. edax* Busk, and like that species had the power of absorbing the shell of certain univalves upon which it grew. Carefully compared *L. maculata* will be found to differ in having no distinct marginal line separating adjoining zoœcia, in having the surface of the cells more abundantly punctate and not radially furrowed, in the less acuminate mucro, and the acuminate ovate instead of spatulate form of the opening of the large avicularia, and in having the pointed end of these strongly elevated.

Like all the following species referred to *Lepralia,* we doubt very much that *L. edax* and *L. maculata* are strictly congeneric with the species commonly adopted as the type of the genus, but considering the present almost chaotic condition of the classification of the CHILOSTOMATA it would be nothing less than folly to attempt generic revisions in a work like the one in hand. We have therefore contented ourselves with placing our species into the more or less firmly established genera to which they seemed to us to present the greatest affinities, leaving their final disposition for some more pretentious work of the future.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—U. S. National Museum, Maryland Geological Survey.

LEPRALIA MONTIFERA n. sp.

Plate CXVI, Fig. 5.

Description.—Zoarium parasitic, in one or more layers. Zoœcia not regularly arranged, subovate, averaging 0.5 mm. or a trifle more in length and about 0.35 mm. in width. Orifice oblique, depressed in front, transversely subovate, broadly sinuate below; peristome scarcely thickened. Central portion of surface very high, the slopes traversed by rows of large punctures in radially disposed furrows. Ovicells not observed; nor avicularia, unless certain elongate-acuminate, curved depressions, with a pore at the broader lower extremity, that sometimes may be observed close to the rim of the orifice, are of that nature.

This rather highly ornamented form reminds in certain respects of *Cribrilina*, but on the whole it agrees better with *Lepralia*. The strikingly monticular elevation and strongly puncto-radiate marking of the surface of the zoœcia will, we believe, serve very well in distinguishing the species.

Occurrence.—St. Mary's Formation. St. Mary's River.

Collection.—Maryland Geological Survey.

Lepralia marylandica n. sp.

Plate CXVII, Fig. 2.

Description.—Zoarium forming small patches on shells. Zoœcia oblong subquadrate, averaging 0.5 mm. long and only half as wide, arranged in irregular radial series; impressed border line between adjoining cells not sharply defined; surface coarsely punctate, very moderately convex. Orifice terminal, transverse, semielliptical to subquadrate, the lower border nearly straight, thick, and generally with a small central tubercle, the anterior rim usually a little depressed. Surface punctures variable, generally of smaller size for some distance behind the orifice, but sometimes consisting of two concentric rows of which those making up the inner row are quite as large as those in the outer row. Avicularia small, constantly one on each side of the orifice, the acuminate and more or less elevated anterior extremity pointing somewhat obliquely outward and forward. Ovicells not very numerous, a little larger than the zoœcial orifice, moderately convex, minutely punctate.

This species probably will not be allowed to remain under *Lepralia* when the classification of the Bryozoa has been advanced to an approximately final stage. At present, however, we cannot suggest a more natural arrangement, the species with which it seems to agree best being now classified under *Lepralia*. Of these *L. labiosa* and *L. subplana* Ulrich, from the Eocene of this state, are perhaps the nearest. In both species, however, the zoœcia are shorter and have a flatter and less coarsely punctate surface.

Occurrence.—St. Mary's Formation. Cove Point.

Collection.—Maryland Geological Survey.

Lepralia (?) reversa n. sp.

Plate CXIII, Figs. 1, 2.

Description.—Zoarium forming parasitic patches, several centimeters in diameter and composed of a single layer, on shells. Zoœcia oblong quadrate or subhexagonal, generally arranged in rather regular longitudinal and diagonally intersecting rows, each about 0.5 mm. in length and 0.3 mm. in width. Orifice rather large, rounded-quadrate, enclosed by a peristome of moderate thickness and elevation. Peristomes divided into two parts, anterior and posterior, the former either straight or slightly arcuate and not so prominent as the horseshoe-shaped portion enclosing the sides and proximal margins of the orifice. Distal extremities of the latter portion of the peristome often a little thickened and projecting slightly inward. Just behind the proximal border of the orifice there is constantly a rather small but prominently elevated and thick-walled avicularium, opening obliquely forward. Remainder of front of zoœcia with from one to three rows of large pores. Frequently adjoining zoœcia are separated by a thin raised line. Ovicells moderately convex, rather large, with a central pore and one or two somewhat radially disposed marginal rows of smaller pores. When broken they leave a sharply defined concave space in front of the orifice, slightly exceeding the latter in size.

The division of the peristome into two parts as described is unusual and produces the probably false appearance of a reversal of the ends of the operculum that has suggested the specific name. If it could be proved that the hinge of the operculum was really on the distal side of the orifice instead of the proximal, then this species would be distinct enough to justify the erection of a new genus for its reception; but until this unusual condition can be demonstrated we think it well to regard it as related to such species as *Lepralia pallasiana.* We know of none resembling it closely enough to require unusual care in its discrimination.

Occurrence.—ST. MARY'S FORMATION. Cove Point (on *Pecten madisonius*).

Collection.—Maryland Geological Survey.

Genus PALMICELLARIA Alder.

PALMICELLARIA CONVOLUTA n. sp.

Plate CXVI, Figs. 2, 3, 4.

Description.—Zoarium erect, forming loose masses 3 cm. or more in diameter, consisting of broad, bifoliate, convoluted, anastomosing leaves, 1.0 mm. or more in thickness. Zoœcia prominent, distinct, oval, rhomboidal or hexagonal, arranged in irregular quincunx, averaging between 0.9 mm. and 1.0 mm. in length, and about 0.45 mm. in width; surface rather coarsely punctured; orifice terminal, the proximal edge overhung by a prominent mucro containing an avicularium the sagittate opening of which is divided into two unequal parts by a septum and lies on the abrupt distal slope of the mucro so as to be nearly or entirely concealed in a front view. When the apex of the mucro is worn or broken away the cavity of the avicularium is exposed to view as a cell immediately behind the orifice and almost equalling it in size. Ovicells small, transverse, bulbous, closely united to the cell next above.

The mucro and avicularium may be absent on many cells of a zoarium, but more of these cells are further peculiar, as shown in fig. 4 on plate CXVI, in having no orifice. The nature of these cells is doubtful. Possibly they are gonœcia.

This seems to be a true *Palmicellaria,* and of the few species of the genus known *P. cribraria* (Johnston), which is the only other one described having the surface of its zoœcia punctate, is perhaps the nearest to *P. convoluta.* Unfortunately, Johnston's species is rare and not well known, and as we have no reliable figures with which to compare our species we cannot now say how close the relationship between them may be. Of other species, Hinck's variety *foliacea* of *P. skenei* (Ellis and Solander) agrees rather closely in its zoarial characters with *P. convoluta,* but there are good specific differences in their respective zoœcia.

Occurrence.—Calvert Formation. Reed's.

Collection.—Maryland Geological Survey.

Palmicellaria punctata n. sp.

Plate CXVI, Fig. 1.

Description.—Of this species we have seen only the fragment of a bifoliate zoarium here figured. It has punctate zoœcia, with a subcircular orifice and a mucro like the preceding, but its zoœcia are much smaller and the mucro less prominent. The ovicells, on the other hand, are relatively larger and longer.

Occurrence.—Calvert Formation. Reed's.

Collection.—Maryland Geological Survey.

Family CELLEPORIDÆ.

Genus CELLEPORA (Fabricius) Hincks.

Cellepora massalis n. sp.

Plate CXVII, Figs. 3, 4.

Description.—Zoarium massive, composed of many layers, often nodose, always rough. Zoœcia erect, very irregularly arranged, four or five in 2.0 mm.; orifice circular, with a thin raised peristome. Generally the peristome of each zoœcium bears upon its inferior side a prominent rostrum containing a large avicularium pointing obliquely upward and outward. Surface of zoœcia, excepting the peristome, coarsely punctate. Ovicells not observed.

Though a common fossil, well-preserved specimens are rather rare. As a rule the surface of the masses appears merely cellulose or spongy and the zoœcia quite characterless. Several excellent examples, however, show that the species is closely related to *C. pumicosa* Linnæus, the adopted type of the genus, but we believe it is sufficiently distinguished by the punctate instead of smooth walls of its zoœcia to deserve another name.

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Greensboro. Calvert Formation. Plum Point, Chesapeake Beach.

Collections.—Maryland Geological Survey, U. S. National Museum.

Cellepora cribrosa n. sp.

Plate CXVII, Figs. 5, 6.

Description.—Zoarium forming small irregular compressed masses. Zoœcia very irregularly disposed, some erect, others prostrate, 0.5 mm. to 0.7 mm. long, by 0.4 mm. to 0.6 mm. wide; surface strongly punctate; orifice rounded, the normal form showing a slight constriction a little below the middle, where a small tooth projects into the cavity from each side; peristome thick and more or less elevated, ring-like. Avicularia of moderate size, more or less acuminate ovate, attached to and projecting beyond the plane of the inferior side of the peristome; rarely absent. Ovicells few, known only in the broken condition in which they appear as deep semicircular excavations in front of the zoœcial orifices.

Though doubtless new as an American fossil, we are not by any means satisfied that this form has not been before described. It is like many other species now referred to *Cellepora,* but so far as we could learn not identical with any.

In its general aspect there is much to remind of our *Schizoporella cumulata,* but when carefully compared the zoœcial orifices and avicularia prove to be quite different.

Occurrence.—Calvert Formation. Reed's.

Collection.—Maryland Geological Survey.

VERMES.

Class ANNELIDA.

Subclass CHÆTOPODA.

Order POLYCHÆTA.

Suborder TUBICOLA.

Genus SPIRORBIS Daudin.

Spirorbis calvertensis n. sp.

Plate CXVIII, Fig. 18.

Description.—Tubes small, thin, spirally coiled, attached by flat under side to molluscan shells; surface with indistinct somewhat irregular annulations which are most distinct on the tops of the younger coils; coils somewhat sharply ridged on top.

Diameter of coils, 1.3 mm.; diameter of tube, .4 mm.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, U. S. National Museum.

ECHINODERMATA.

Class ECHINOIDEA.

Order SPATANGOIDEA.

Family SPATANGIDÆ.

Genus ECHINOCARDIUM Gray.

Echinocardium orthonotum Conrad.

Plate CXIX, Figs. 1a, 1b, 1c.

Spatangus Orthonotus Conrad, 1843, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 327.
Amphidetus virginianus Forbes, 1845, Quart. Jour. Geol. Soc. London, vol. i, pp. 425, 426, 3 figures.
Amphidetus virginianus Forbes, 1846, Proc. Geol. Soc. London, vol. vi, pp. 559, 560, 3 figures.

Amphidetus orthonotus Conrad, 1846, Am. Jour. Sci., ser. ii, vol. i, p. 220.
Amphidetus orthonotus McCrady, 1855, in Pleiocene Fossils of South Carolina, pp. 6, 7, pl. ii, figs. 1, 1a, 1b, 1c.
Echinocardium virginianum Desor, 1858, Syn. des Échinides Fossiles, p. 408.
Amphidetus virginianus Emmons, 1858, Rept. N. Car. Geol. Survey, p. 310, fig. 245 a, b, c.
Echinocardium orthonotus Conrad, 1865, Proc. Acad. Nat. Sci. Phila., p. 75.
Echinocardium pennatifidum (?) A. Agassiz, 1872–1874, Revision of Echini, Cat. Mus. Comp. Zool., No. vii, pp. 111, 351.
Amphidetus virginianus Schlüter, 1899, Zeit. d. Deutsch. geol. Gesell., Bd. li, p. 113.

Description.—"Ovate, convex-depressed; truncated at each end, more elevated anteriorly than posteriorly; dorsal line of the suture a little elevated, and curved gradually to the mouth of the anterior half; on the posterior, straight to the margin and parallel to the base; canal very wide and slightly impressed on the back, margined by an obtuse carinated line and slight furrow; on the periphery the canal is deep and angular; ambulacra rapidly expanding from the extremities toward the dorsal suture; pores disunited; in the middle of the back a slight furrow crosses obliquely each of the anterior ambulacra at its termination; base plano-convex; anus large and remote from the margin; granulations on the back minute and very closely arranged, in the canal much larger and unequal in size; base with large tubercles, becoming gradually smaller and more closely arranged towards the margins. Length, two inches and three-eighths; diameter, two inches and an eighth; height, one inch and an eighth." Conrad, 1843.

The "slight furrows" crossing the "anterior ambulacra" and the "slight furrow at the margin of the wide and slightly impressed canal" were probably parts of the shield shaped internal fasciole characteristic of the species.

"Body broadly ovate; elevated and truncate posteriorly. Back oblique; dorsal impression lanceolate-scutate, are a very slightly excavated; ambulacral spaces broad, triangular, depressed; interambulacral spaces slightly convex. Anteal furrow broad, shallow; sides slightly gibbous; subanal impression broadly obcordate; postoral spinous space broadly lanceolate.

"Dimensions of the smaller but more perfect specimen: Lon., unc. 1 11-12; lat., 1 8-12; alt., 1. Number of pairs of ambulacral pores:[1]

[1] In another specimen the number was found to be Ant. lat. dors. amb. 8 + 13. Post. lat. dors. amb. 11 + 11. And four pairs additional on each side of the ovarian holes.

Ant. lat. dors. amb. 8 + 10. Post. lat. dors. amb. 13 + 8." Forbes, 1845.

This form is quite rare, the single specimen which is figured being apparently the only well-preserved one found since the days of Conrad and Forbes. The specimens of both Conrad and Forbes were found near Coggin's Point on the James River, Virginia; that of Forbes being secured by Lyell. The locations of the types are not known, but Forbes' figures are very good, as are also those of *Amphidetus orthonotus* given by McCrady in Tuomey and Holmes' Pleiocene Fossils of South Carolina, and there can be little doubt that the Maryland specimen represents the species.

Occurrence.—Choptank Formation. Jones Wharf. Chesapeake Group. Coggin's Point, Virginia (Conrad, and Lyell and Forbes).

Collection.—Maryland Geological Survey.

Order CLYPEASTEROIDA.

Family SCUTELLIDÆ.

Genus SCUTELLA Lamarck.

Scutella aberti Conrad.

Plate CXIX, Figs. 2, 2a; Plate CXX, Figs. 1a, 1b, 2a, 2b.

Scutella aberti Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 194.
Scutella alberti Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 2.

Description.—"Discoidal, orbicular, very much depressed, but swelling towards the middle, and depressed at the apex; diameter five and a half inches." Conrad, 1842.

This large and abundant form has never been figured, but there is no doubt as to its identity. Perfect individuals are very rare, although fragments are extremely abundant in the thin bed to which it is restricted.

Length, 160 mm.; width, 150 mm.

Occurrence.—Choptank Formation. Jones Wharf, Governor Run, Dover Bridge.

Collections.—Johns Hopkins University, Maryland Geological Survey.

Indeterminate Echinoid Spines and Plates.

Echinoid spines and fragments of plates are abundant at many localities in all of the Miocene formations of Maryland. They certainly represent several other species in addition to those here described, but are not sufficiently well preserved for identification.

Class OPHIUROIDEA.

Order OPHIUREÆ.

Genus OPHIODERMA Müller and Troschel.

OPHIODERMA (?) SP.

Plate CXX, Fig. 3.

Fragments of the arms of an Ophiurian occur in the indurated ledge just above sea level along St. Mary's River. It is impossible to determine the relations of the form with accuracy, but it is probably an *Ophioderma.* The fragments were found in the interior of the shells of large gastropods.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River.

Collection.—Maryland Geological Survey.

COELENTERATA.

Class HYDROZOA Huxley.

Order TUBULARIÆ Allman.

Genus HYDRACTINIA v. Beneden.

HYDRACTINIA MULTISPINOSA[1] n. sp.

Plate CXXI, Figs. 1-9.

Description.—Skeleton laminated, forming crusts varying in thickness from 0.2 mm. to 2.5 mm. over the shells of gastropoda; invested shell often wholly absorbed and replaced by the growing coral. Surface rough, studded with closely and rather regularly arranged conical tubercles or

[1] Cfr. *Hydractinia circumvestiens* Wood, 1844, as figured and described by Nicholson, 1886, Monog. Brit. Stromatoporoids, Palæontographical Society, vol. for 1885, p. 68, pl. vi, figs. 7-13; also *H. pliocæna* Allman, 1872, Geol. Mag., No. 98, p. 337, and Carter, 1877, Ann. & Mag. Nat. Hist., vol. xix, 4th ser., p. 52, pl. viii, figs. 7-10; and *H. michelini* Fischer, 1857, Bull. Soc. Géol. France, vol. xxiv, p. 689 (= *Cellepora echinata* Michelin, 1847, Iconographie Zoophytologique, p. 74, pl. 15, fig. 4).

spines, usually six or seven in 5.0 mm., rarely five or six in the same space. Spines usually about their own diameter (0.4 to 0.5 mm.) in height, and nearly the same distance apart; when perfect often showing a small apical pit; when worn two or three may show. Interspaces flat or slightly concave, covered with minute, often confluent, granules or spines, generally arranged in numerous radiating rows on the slopes of the large spines. Between these granules the mouths of numerous small tubes half again as large as the granules surrounding them, may be seen, but it is difficult to detect them except in worn examples or those slightly etched with acid. Finally the surface may exhibit, but never as a conspicuous feature, delicate branching grooves—astrorhiza—traversing the middle of the spaces between the large spines.

A rough vertical fracture shows that the skeleton is traversed by numerous approximately vertical but more or less irregular tubules. The skeleton shows further an irregular lamination, due to the presence of interlaminar spaces or chambers occupying the spaces between the large spines and placed in roughly horizontal series. Small spines, representing the small superficial spines of previous layers, project from the lower floor of these chambers. The inner part of the skeleton, representing the portion that has replaced the shell of the gastropod, is not chambered, but appears to be made up wholly of minute irregular vertical fibers and tubules. Similar tissue, but arranged in somewhat concentric manner, makes up the thick walls of the large surface spines; which, apparently, are not continuous from layer to layer.

This extremely abundant hydrozoan evidently is a true member of the calcareous section of *Hydractinia.* When it first came to hand, I regarded it as probably the same species as *H. pliocæna* Allman, which must be very near, if not specifically identical with *H. circumvestiens* (Wood) and *H. michelini* Fisher. Careful comparisons with the published figures and descriptions of that and other European species, however, have shown that the Maryland specimens are characterized by much smaller and more closely arranged spines, so that I find myself somewhat reluctantly obliged to propose a new name for them. As a rule the large spines of *H. multispinosa* are but half the size, and twice as numerous in a given space, as those studding the surface of *H. circum-*

vestiens. Carter's two calcareous species, *H. calcarea* and *H. vicaryi,* also differ too obviously in this and in other respects to require comparison.

Occurrence.—CALVERT FORMATION. Plum Point, 3 miles south of Chesapeake Beach.

Collections.—U. S. National Museum, Maryland Geological Survey, Johns Hopkins University.

Order HYDROCORALLINÆ Moseley.

Genus MILLEASTER n. gen.

Encrusting (? or subramose) polyparia, composed of one or more layers. Upper surface rough, exhibiting two sets of large, more or less irregularly distributed pores, the one (? dactylozooids) with elevated margins and stellate orifices, the other (? gastrozooids) fewer in number and occupying the depressed spaces between the elevated apertures, being a little larger, irregularly rounded in shape and the centers from which the astrorhizal grooves diverge. A third set of pores, in this case rounded in form and less than half the size of the other sets, occurs scattered among the granules of the interspaces. No columella nor tabulæ observed. Septa of the elevated pores strong, not very regular, usually six in number, but varying from four to seven; sometimes joining laterally so as to leave but a minute central opening. Cœnenchyma cancellate, granulose at the surface. Skeleton calcareous, apparently composed of a loose network of fibers. Astrorhizal grooves always present, but conspicuous only on such portions of the surface where the zooidal pores are either wanting or more widely separated than usual.

This genus has much in common with *Hydractinia,* but differs radically in the character of its zooidal pores and really looks very different under a glass. The pseudo-septate pores are much more like those of the STYLASTERIDÆ, but are without the columella characterizing members of that family. From the latter *Milleaster* is further distinguished by having two distinct sets of large pores and a third smaller set, besides astrorhiza. Excepting the well-developed pseudo-septa of the elevated zooidal pores, *Milleaster* compares probably best with *Millepora,* and it is between this genus and the STYLASTERIDÆ that I believe the affinities of the new genus lie. *Hydractinia* is farther removed, though doubtless also related. Again, I think it possible that some relationship to the PORITIDÆ may be detected when fuller comparisons than are now possible can be made.

MILLEASTER INCRUSTANS n. sp.

Plate CXXI, Fig. 10.

Description.—Polyparium encrusting, growing on shells of gastropoda, over which it forms thin, rough, scabrous expansions, 1 mm. or less in thickness, that may be separated cleanly from the invested host, the shell showing no trace of being absorbed by the coral. Surface exhibiting irregularly distributed, elevated and thick-lipped pores, the mouths of which are distinctly, though often rather irregularly, stellate. Pseudo-septa strong, usually six in number, but varying from four to seven, usually leaving but a narrow space between them to form the rays of the stellate orifice, and sometimes even joining laterally so that nothing but a minute central opening remains. Greatest diameter of elevated rim enclosing this set of zooidal pores averaging about 0.25 mm.; where closest and most regularly disposed about four occur in 2.0 mm., but not infrequently the depressed interspaces may attain a width of fully 1.0 mm. In these interspaces usually somewhat larger and fewer openings occur. These are irregularly rounded and not septate like the elevated pores, though their apertures may appear to be irregularly stellate because of the astrorhizal grooves which empty into them. The latter, though always present, are never conspicuous, and where the elevated pores are abundantly developed may even be overlooked. The small rounded openings of a third set of pores are scattered among the granular surface terminations of the cœnenchymal tissue. The surface granules of the latter are usually separate, but may be confluent.

This hydrozoan is associated with *Hydractinia multispinosa* and like it apparently always grows on shells of gastropoda. But, so far as observed, it never absorbs the shell of its host. Aside from being much less common—indeed, it must be counted among the rare fossils—its peculiarities are so striking and distinctive that it should be recognized at once when found.

Occurrence.—St. Mary's Formation. St. Mary's River, Cove Point. Calvert Formation. Plum Point.

Collections.—U. S. National Museum, Maryland Geological Survey.

Milleaster (?) subramosus n. sp.

Plate CXXI, Figs. 11a, 11b.

Description.—Polyparium attached apparently loosely to foreign bodies and consisting of several short branches or mere lobes springing from a slightly expanded base. Zooidal pores of the larger size almost confined to the growing extremities of the branches and lobes, their sides and the expanded base being occupied chiefly by cœnenchymal tissue the surface of which exhibits, besides numerous granules or spines, numerous small pores and is traversed by strong astrorhizal grooves. The stellate pores have only moderately elevated margins and, on the ends of the branches, these are in contact. Within their apertures the septa are nearly as well developed as in *M. incrustans.* The larger of the two sets of non-septate pores occurring in the spans between the septate pores in that species has not been certainly observed, but the smaller set is abundantly represented.

Vertical fractures of the basal expansion exhibit interlaminar chambers and small vertical tubuli very much like those occurring in *Hydractinia multispinosa* and shown in fig. 8 on Plate CXXI. Where one of the branches has been broken away the fracture shows, besides the tubulate interspaces, only transverse sections of septate pores looking much as they do at the surface. There is some evidence of tabulæ, but it is not conclusive.

In placing this species of *Milleaster* I rely principally upon the presence of a set of septate pores. Excepting that there are no large spines, the basal part of the polyparium is very much as in *Hydractinia,* but the septate pores on the ends of the branches have no parallel in that genus. These same septate pores forbid placing the species under *Millepora,* which is suggested by the generality of the other characters. Unfortunately the material at hand is too scanty to permit working out all the details of structure and until more is found the above provisional arrangement must suffice.

Occurrence.—Calvert Formation. Plum Point.

Collection.—U. S. National Museum.

Class ANTHOZOA.

Order ACTINIÆ.

Suborder SCLEACTINIÆ.

Family CYATHOPHYLLIDÆ Verrill.

Genus PARACYATHUS Milne-Edwards and Haime.

Paracyathus vaughani Gane.

Plate CXXII, Figs. 1, 2, 3.

Paracyathus vaughani Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 9.

Paracyathus vaughani Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii, pl. xv, figs. 4–6.

Description.—Corallum small, broad and low, with the calice about the same diameter as the base, above which the wall is somewhat constricted. Wall thin, costulate to its base. Costæ low, unequal, finely granular, more prominent near the calicular margin where they are considerably thicker than their corresponding septa. Calice circular in the young, slightly oval in the adult individual; fossa broad, moderately deep. Septa in six systems of five cycles, lacking part of the sixth order of the last cycle; in individuals of medium size only four cycles are present. Primaries and secondaries subequal, thick and stout, with summits more broadly rounded and more strongly exsert than those of the remaining thin and slender septa; sides coarsely granulated, upper margins of all septa entire, the inner portion of the margins of the higher cycles crenately dentate. Pali granular, consisting of several small lobes, becoming confused with the papillæ of the columella, present before all the septa but those of the last cycle, excepting in the most mature forms, where they may be lacking before a part of the fourth as well as before all of the fifth cycle of septa. Columella papillose, well developed.

In polishing down the base of the coral, the rings marking the existence of previous outer walls are clearly seen. In one specimen no less than eight appear, showing the growth of the coral and its relation to the development of its septa.

The individuals of this form generally occur alone attached to some shell, but occasionally they are found in clusters, being in close contact with one another at their sides or the outer edge of their bases.

Height of largest specimen, 4 mm.; breadth of calice, 11 mm.

Description modified from the one given by Gane, 1900.

Occurrence.—CHESAPEAKE GROUP. Carter's Landing, James River, and Yorktown, Virginia, and the Upper Miocene of Wilmington, North Carolina.

Collections.—U. S. National Museum (type), Wagner Free Institute of Science, Johns Hopkins University.

Family OCULINIDÆ Milne-Edwards and Haime.

Genus ASTRHELIA Milne-Edwards and Haime.

ASTRHELIA PALMATA (Goldfuss).

Plate CXXIII, Figs. 1-4.

Madrepora palmata Goldfuss, 1826-1833, Petrefaeta Germaniæ, pt. i, p. 23, pl. xxx, figs. 6, a, b.

Oculina palmata Ehrenberg, 1834, Abh. Berlin Akad. Wiss. for 1832, pp. 305, 344.

Madrepora palmata de Blainville, 1834, Man. Act. ou Zooph., p. 390.

Madrepora palmata Lamarck, 1836, Hist. Nat. An. sans Vert., 2d ed., vol. ii, p. 450.

Oculina palmata Bronn, 1848, Hand. Gesch. Nat., Index Pal., pt. i, p. 835.

Astrhelia palmata Milne-Edwards and Haime, 1849, Compte Rendus Ac. Sci., xxix, p. 68.

Astrhelia palmata Milne-Edwards and Haime, 1850, British Fossil Corals Introd., p. 20.

Astrhelia palmata Milne-Edwards and Haime, 1850, Ann. Sci. Nat., 3d ser., vol. xiii, p. 74.

Astrhelia palmata Milne-Edwards and Haime, 1851, Archiv Mus. Hist. Nat. Paris, vol. v, p. 37.

Astrhelia palmata d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 146.

Astrhelia palmata Bronn, 1853-1856, Lethaæ Geognostica, pt. vi, p. 307.

Astrohelia palmata Milne-Edwards and Haime, 1857, Hist. Nat. des Corall., vol. ii, p. 111.

Astrohelia palmata de Fromentel, 1861, Introd. Étud. Polyp. Foss., p. 178.

Astrohelia palmata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 1.

Astrohelia palmata Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 9.

Astrohelia palmata Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii [No. 1193], pp. 185, 186.

Description.—*Corallum* presents three forms of growth; one, as irregular nodose branches, which may exceed 120 mm. in length; a second, as flattened coalescing branches; a third, as palmate branches.

Corallites, circular or subelliptical in cross-section, diameter from 2.25 to 5.25 mm. The corallites of young colonies are often larger than those of older ones, the usual diameter for what may be considered a fully developed corallum is about 3 mm.; separated by solid cœnenchyma excepting on young coralla, the usual distance apart is about 2.5 mm., though it may occasionally be as much as 5 or 7 mm. In some corallites there is considerable basal calcareous deposit, but it does not seem that a cavity is ever completely filled. In young specimens the calicular margins may be considerably elevated; but on old coralla there is only a slightly elevated calicular rim.

Cœnenchymal surface. In young specimens the cœnenchymal surface is costate, costæ corresponding to all septa, subequal in size, flattish or rounded above and frequently extending directly from one calice to the next, granulations are densely distributed over the surfaces of the costæ. In older coralla the costæ are usually, though not always, well marked around the calicular openings, and often may continue for some distance across the cœnenchymal surface. In addition to the costæ there may be fine striæ. Both costæ and striæ may be flexuous. In places there are neither costæ nor striæ, but densely crowded granulations.

Septa, straight or curved, not exsert, in three complete cycles; those of the first and second cycles; of the same size and *reach* the columella space, those of the third, much shorter and thinner, their inner edges unusually free, but sometimes joined to the sides of the member of the second cycle. The thickness of the septa is variable; they may be fairly thick or may be weak, but are always thick in the thecal ring. There is no appreciable thickening around the columella. The calices are fairly deep, especially on young specimens, and are widely open. The septal laminæ are narrow at the calicular margin and increase in width as the columella is approached. The septal margins are dentate. The dentations are more or less jagged or may be fine; they are irregular in size, form and number. Septal faces possess rather coarse granulations.

Dissepiments numerous, usually thick.

Columella, false, weak, poorly developed, formed by the loose fusion of the inner ends of a few principal septa in the corallite axis.

Very large suites of specimens of this species have been studied. Mr.

Frank Burns, of the U. S. Geological Survey, obtained many hundred specimens and fragments from Plum Point, and the Maryland Geological Survey possesses a fine collection gathered from many localities. Some specimens (ten altogether) from David Kerr's place, Talbot county, collected by P. T. Tyson, differ somewhat from the Plum Point and Jones Wharf specimens. The calices are usually smaller, 2 to 2.5 mm. being a frequent diameter, the septa and dissepiments are thinner, the costæ are less developed and the cœnenchymal surface more granulate. However, it does not appear that the two sets of specimens can be specifically differentiated.

Occurrence.—CHOPTANK FORMATION. 2 miles south of Governor Run, Dover Bridge, Flag Pond, Cordova, Jones Wharf, Turner, David Kerr's in Talbot county. CALVERT FORMATION. Church Hill, Skipton, Southeast Creek, Truman's Wharf, Reed's, Plum Point, 3 miles west of Centerville.

Collections.—U. S. National Museum, Maryland Geological Survey, Johns Hopkins University.

Family ASTRANGIDÆ Verrill.

Genus ASTRANGIA Milne-Edwards and Haime.

ASTRANGIA LINEATA (Conrad).

Plate CXXIV, Figs. 1-4.

Lithodendron lineatus Conrad, 1835, Trans. Geol. Soc. Penn., vol. i, pt. 2, p. 340, pl. xiii, fig. 4.
Anthophyllum lineatum Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 424.
Anthophyllum lineatum Lonsdale, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 495, fig. a.
Caryophyllia lineata Conrad (Manuscript label), 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 495.
Lithodendrum lineatum Conrad, 1846, Amer. Jour. Sci., ser. ii, vol. i, p. 220.
Anthophyllum lineatum Bronn, 1848, Hand. Gesch. Nat. Index Pal., pt. i, p. 83.
Cladocora ? lineata Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 1.
Astrangia lineata Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 9.
Astrangia lineata Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii, p. 187.

Description.—The following description is modified from that given by Gane (op. sup. cit.):

Colony encrusting, consisting of conical or cylindrical corallites, the largest sometimes rising a centimeter above the surface of the basal expansion. Individual corallites divergent, but usually touching at their bases. Walls very thin at their calicular edge, thicker below. Epitheca extremely thin, finely granulated and in some forms showing parallel, somewhat sinuous, flat, broad striæ, corresponding to the costæ and extending to the base. Costæ distinct just below the calicular edge, not very prominent, alternately larger and smaller, sometimes slightly crested. Calices deep, as a rule circular, at times considerably compressed, 5 to 8 mm. in diameter. Septa thin, much narrowed at the top, in mature corallites in four complete cycles; septa of the last cycle much thinner and narrower than those of the preceding, often merely rudimentary; in the younger individuals septa but thirty-six; there is a tendency for the younger septa to turn toward and unite with the next older; inner edges strongly dentate, teeth frequently truncated or rounded, slightly coarser near the columella; sides granulated, though not stoutly so. Columella small, false, composed of more or less interlocking or twisted processes from the inner ends of the septa. Multiplication by budding chiefly from basal expansions, although it may take place well up on the side of the parent corallite.

Occurrence.—Chesapeake Group. Bellefield, Yorktown, Carter's Landing, and City Point, Virginia.

Collections.—Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Sciences, Wagner Free Institute of Science.

Subgenus CŒNANGIA Verrill.

Astrangia (Cœnangia) conradi n. sp.

Plate CXXV, Figs. 1, 2.

Astræa bella Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 1, pl. i, figs. 1, 1a.

Cœnangia bella Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 9.

Cœnangia bella Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii, p. 189.

Astrangia (Cœnangia) bella Vaughan, 1901, Bull. U. S. Fish Com. for 1900, vol. ii, p. 299.

Astrea bella Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 33.

Description.—The following description is the one published by Gane for *Cœnangia bella,* somewhat modified:

Colony encrusting. Corallites thin walled, closely united. Calices irregularly prismatic, quite deep, with their fossæ narrow at the bottom;

breadth 3 to 6 mm. Septa in three complete cycles, the third less stout and usually curved toward and united, near the columella, to those of the preceding cycle; occasionally part of a fourth cycle is developed. Septa thin, with free edges sharply and roughly denticulated throughout; sides somewhat coarsely granulated, frequently granules are also present on the inside wall of the calice. Columella moderately developed, spongy, composed of contorted processes originating from the inner margins of the septa. Gemmation takes place in the interspaces between the corallites, and around the edge of the colony.

Gane identified the coral here named *Astrangia conradi* with Conrad's *Astrea bella.* I have been unable to determine Conrad's type in the collections of the Academy of Natural Sciences of Philadelphia, his description is not sufficient for identification, but he gives the locality of his type specimen as Newberne, North Carolina. We have many specimens from the Neuse River, below Newberne. The geologic horizon is Pliocene, and as only one species of coral, *Septastrea crassa* (Holmes), has been found there, it is most probable that Conrad's *Astrea bella* is the encrusting young of that species. I have therefore renamed Gane's *Cœnangia bella,* calling it *Astrangia conradi.*

The *Astrea bella* of Tuomey and Holmes (op. et loc. sup. cit.) and the *Astræa bella* of Holmes[1] are two entirely distinct species, as the study of the original specimens kindly loaned me by the American Museum of Natural History of New York has shown. The former is from the Miocene of the Darlington District, South Carolina, and is probably *Astrangia conradi* of Conrad; while the latter is a synonym of *Astrangia astreiformis* M. Edw. & H.

The type specimen is in the Wagner Free Institute of Science.

Occurrence.—CHESAPEAKE GROUP. Carter's Landing on James River, and Prince George county, Virginia.

Collections.—Wagner Free Institute of Science, U. S. National Museum.

Family ORBICELLIDÆ Vaughan.

This family was originally characterized as follows: "Calcareous tissues normally imperforate, except in the columellar region. Corallites

[1] Pleiocene Fossils of South Carolina, p. 1, pl. i, fig. 2.

grouped into rounded, gibbous, or digitiform masses. Septal margins dentate. Reproduction normally by gemmation between the corallites, occasional abnormal reproduction by fission." [1]

Type genus *Orbicella* Dana.

Genus SEPTASTREA d'Orbigny.

SEPTASTREA MARYLANDICA (Conrad).

Plate CXXVI, Figs. 1a, 1b, 2; Plate CXXVII, Figs. 1-3; Plate CXXVIII, Figs. 1, 2; Plate CXXIX.

Astrea sp. W. B. and H. D. Rogers, 1837, Trans. Amer. Philos. Soc., vol. v, p. 338.

Astrea marylandica Conrad, 1841, Proc. Acad. Nat. Sci. Phila., vol. i, p. 33.

Astrea marylandica Conrad, 1842, Jour. Acad. Nat. Sci. Phila., vol. viii, 1st ser., p. 189.

Columnaria (?) *sexradiata* Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, pp. 416–424.

Astrea hirtolamellata (?) Lyell, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 424.

Columnaria (?) *sexradiata* Lonsdale, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 497, figs. a, h.

Astrea hirtolamellata Lonsdale, 1845, Quart. Jour. Geol. Soc. London, vol. i, p. 500, fig. (?)

Astræ marylandica Conrad, 1846, Amer. Jour. Sci., ser. ii, vol. i, p. 220.

Columnaria (*Astroites* ?) *sexradiata* Dana, 1846, Amer. Jour. Sci., ser. ii, vol. i, p. 221.

Pleiadia or *Astroites hirtolamellata* Dana, 1846, Amer. Jour. Sci., ser. ii, vol. i, p. 221.

Astroites sexradiata Dana, 1846, Zooph. Wilkes Expl. Exped., p. 722.

Columnaria (?) *sexradiata* Lonsdale, 1847, Amer. Jour. Sci., ser. ii, vol. iv, p. 358.

Astræa marylandica Lonsdale, 1847, Amer. Jour. Sci., ser. ii, vol. iv., p. 359.

(Allied to *Caryophyllia* family) Dana, 1847, Amer. Jour. Sci., ser. ii, vol. iv, p. 361.

? *Astræa marylandica* Tuomey, 1848, Report Geol. South Carolina, pp. 182, 208.

Dipsastræa hirtolamellata (?) Bronn, 1848, Hand. Gesch. Nat., Index Pal., p. 126.

Columnaria (?) *sexradiata* Bronn, 1848, Hand. Gesch. Nat., Index Pal., p. 321.

Septastrea subramosa (*nom. nud.*) d'Orbigny, 1849, Note sur des Polyp. Foss., p. 9.

Septastrea forbesi Milne-Edwards and Haime, 1849, Ann. Sci. Nat. Zool., 3rd ser., vol. xii, p. 164.

Septastrea forbesi Milne-Edwards and Haime, 1851, Archiv Mus. Hist. Nat. Paris, vol. v, p. 115.

Septastrea subramosa d'Orbigny, 1852, Prod. Pal. Strat., vol. iii, p. 146.

Astrea marylandica Tuomey and Holmes, 1857, Pleiocene Fossils of South Carolina, p. 2, pl. i, figs. 2, 2a.

Septastræa forbesi Milne-Edwards and Haime, 1857, Hist. Nat. Corall., vol. ii, p. 450.

Astrangia (?) *marylandica* Milne-Edwards and Haime, 1857, Hist. Nat. Corall., vol. ii, p. 615.

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[1] Bull. U. S. Fish Com. for 1900, vol. ii, p. 300, 1901.

Astrangia ? bella (*pars*) Milne-Edwards and Haime, 1857, Hist. Nat. Corall., vol. ii, p. 615.

Septastræa forbesi de Fromentel, 1861, Introduction Étude Polyp. Foss., p. 175.

Astrangia ? bella (*pars*) de Fromentel, 1861, Introduction Étude Polyp. Foss., p. 237.

Astrea [?] *Marylandica* Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 1.

Septastrea (?) *sexradiata* Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 1.

Septastrea forbesi Meek, 1864, Miocene Check List, Smith. Misc. Coll. (183), p. 1.

Astrangia (*Cœnangia*) *marylandica* Verrill, 1870, Trans. Conn. Acad. Sci., vol. i, pt. 2, p. 530.

Astrea sp. W. B. and H. D. Rogers, 1884, Reprint Geology of the Virginias, p. 667.

Glyphastræa forbesi Duncan, 1886, Abstract Proc. Geol. Soc. London, No. 495, p. 18.

Glyphastræa forbesi Duncan, 1887, Quart. Jour. Geol. Soc. London, vol. xliii, p. 29, pl. iii.

Glyphastræa sexradiata Duncan, 1887, Quart. Jour. Geol. Soc. London, vol. xliii, p. 30.

Septastræa forbesi Hinde, 1888, Quart. Jour. Geol. Soc. London, vol. xliv, p. 218, pl. ix, figs. 1–5, 7–15, 17.

Septastræa sexradiata Hinde, 1888, Quart. Jour. Geol. Soc. London, vol. xliv, p. 219, pl. ix, figs. 6, 16.

Cœnangia marylandica Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 10.

Septastræa sexradiata Gane, 1895, Johns Hopkins Univ. Circ., vol. xv, No. 121, p. 10.

Cœnangia marylandica Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii, p. 190.

Septastræa sexradiata Gane, 1900, Proc. U. S. Nat. Museum, vol. xxii, p. 194.

Septastrea sexradiata Vaughan, 1901, U. S. Fish Commission, Bulletin for 1900, vol. ii, p. 299.

Description.—Corallum possesses an encrusting base from which rise more or less compressed stems with short rounded branches, or large flattened masses with lobate and digitiform expansions.

Corallites, externally hexagonal or pentagonal in cross-section, the walls of adjacent individuals are closely applied but are separate; internally, more or less cylindrical. The diameter varies from about 3 to 8.5 mm., with an average width of 5 or 6 mm. In immature specimens the walls are thin, but they become secondarily very much thickened by basal calcareous deposit. In the mature coralla the walls are thick, occasionally as much as 2 mm. The line of fusion between adjoining corallites is indicated by a distinct shallow furrow. Minute granules, densely crowded, occur over the surface of the wall, between and over the septa and on the columella. Internally below the calices the corallites are often completely filled by basal deposit.

Septa, in normal adult calices twelve large subequal septa that extend inward from the wall and meet in the axial area. The septa are narrow above the level of the columella but become wide below its upper surface. There is usually between each pair of large septa a small one. The smaller ones curve in pairs toward an included larger one, a member of the second cycle. The presence of members of the third cycle is not constant in the same specimen, thus destroying the basis used by Hinde for differentiating two species. In young calices there may be only one or two septa (Gane says there may be none). On the other hand, in very large calices there may be from eight to twelve members of the fourth cycle. The septal margins are distinctly dentate in places on the coralla where no great amount of basal deposit has been laid down. The dentations are not especially prominent and later are obscured by the basal deposit. Small granulations occur over the whole surface of the calice, over the septal faces and the septal margins.

Endotheca: Dissepiments abundant, usually rather thick, 1 to 1.5 mm. apart. The uppermost dissepiment is near the level of the upper surface of the columella and forms a base upon which the basal deposit is formed.

Calices, shallow, widely open.

Columella, false, at first weak, being originated by the loose fusion of the principal septa in the axial area, subsequently it becomes compacted and enlarged by basal deposit, forming a solid dome-shaped elevation in the bottom of the calice.

Asexual reproduction, normally by budding in the angle between the calices, also by dissepimental budding, i. e., a dissepiment is formed across one side of a calice, cutting off a peripheral portion, which forms another individual. This process of forming new individuals and its stages are represented on plate CXXVII, fig. 1. Fission occurs, plate CXXVIII, fig. 2, illustrates it. Plate CXXVII, fig. 3, exhibits budding in the angle between adjoining corallites.

Dr. G. J. Hinde, in a memoir entitled "On the History and Character of the Genus Septastræa d'Orbigny (1849), and the Identity of its Type Species with that of Glyphastræa Duncan (1887),"[1] has given an elaborate discussion of this species. Gane in his "Some Neocene Corals of the United States,"[2] has made an additional contribution of value.

[1] Quart. Jour. Geol. Soc. London, vol. xliv (1888), pp. 200–227, pl. ix.
[2] Proc. U. S. Nat. Mus., vol. xxii, 1900, pp. 194–196.

Hinde provisionally recognized two species, *S. forbesi* Milne-Edwards & Haime, and *S. sexradiata* (Lonsdale), the latter being characterized by possessing a greater development of the third cycle of septa. Gane pointed out that this character was not constant, and merged the two. The *Astrangia marylandica* (Conrad) is clearly only the young of *Septastrea sexradiata;* in every essential character they are identical. Gane has intimated that they may be the same. As the name used by Conrad is the first one that was given to the species I have adopted it.

The only known specimen of this species from Maryland is in the Philadelphia Academy of Natural Sciences. The type (according to Hinde) is in the museum of King's College, London.

Occurrence.—St. Mary's Formation. St. Mary's River; Miocene of Bellefield, Yorktown and many points on the James River, Virginia; upper bed at Alum Bluff, Appalachicola River, Florida; Darlington District, South Carolina (as *Astrea marylandica, fide* Tuomey and Holmes).

Collections.—Johns Hopkins University, U. S. National Museum, Philadelphia Academy of Natural Sciences.

PROTOZOA.

Class RHIZOPODA.

Order RADIOLARIA.

Suborder PHEODARIA.

Superfamily PHÆOCYSTINA.

Family CANNORHAPHIDA.

The following forms which belong in this family are distinguished from the less highly specialized Radiolaria which make up by far the larger part of the Tertiary species, by not having a single complete skeleton, but instead an incomplete skeleton composed of many individual and entirely separated pieces which are scattered loosely around in the calymma and never radially arranged. The fossil forms are hence known only from the separate skeletal units and never as individuals. Inasmuch as the fossil species are still living in recent seas the morphology of the individuals is well known and complete identification is possible from a single skeletal unit.

Genus DISTEPHANUS Stöhr.

This genus consists of those CANNORHAPHIDA which have a skeleton composed of pileated pieces, which are truncated pyramids with a single girdle of meshes, on the summit of which is a simple apical ring.

DISTEPHANUS CRUX (Ehrenberg).

Plate CXXX, Figs. 1, 2.

Dictyocha crux Ehrenberg, 1840, Monatsberichte d. k. Akad. d. Wiss. Berlin, p. 207.
Dictyocha crux Ehrenberg, 1854, Mikrogeologie, pl. xviii, fig. 56; pl. xx, fig. 46, a, b, c; pl. xxxiii, Nr. xv, fig: 9.
Distephanus crux Haeckel, 1887, Chal. Rept., vol. xviii, pt. ii, p. 1565.

Description.—" D. cellulis quinque in formam quadratam ocello medio instructam conjunctis, angulis spinescentibus. Diam. $\frac{1}{52}'''$." Ehrenberg, 1840.

Each pileated piece of the skeleton consists of one square central mesh around which are four lateral pentagonal meshes. There are two parallel quadrilateral rings, which are connected by four beams each of which passes from a corner of the smaller ring to the middle of one side of the larger ring. From the corners of the latter are four spines radiating from a center within the space enclosed by the rings and bars but nearer the larger ring. The larger ring is subsquare, the smaller is oval and its size varies greatly in proportion to the size of the larger ring. The spines are of variable and unequal length. There is no regularity in the distribution of the various sizes. Three of them (and sometimes all) are roughly of the same size, the fourth is usually longer.

This is one of the most abundant RADIOLARIA in the Miocene of Maryland, but does not usually occur abundantly in association with other species.

Occurrence.—CALVERT FORMATION. Popes Creek, Boston Bay, Fairhaven, Claiborne, Cambridge Artesian Well (192 to 335 feet), Crisfield Artesian Well (485 to 500 feet).

Collections.—Maryland Geological Survey, Johns Hopkins University.

DISTEPHANUS SPECULUM (Ehrenberg).

Dictyocha speculum Ehrenberg, 1837, Monatsberichte d. k. Akad. d. Wiss. Berlin, p. 150.

Dictyocha speculum Ehrenberg, 1854, Mikrogeologie, pl. xviii, fig. 57; pl. xix, fig. 41; pl. xxi, fig. 44; pl. xxii, fig. 47.

Dictyocha speculum Stöhr, 1880, Palæontographica, vol. xxvi, p. 120, pl. vii, fig. 8.

Distephanus rotundus Stöhr, 1880, Palæontographica, vol. xxvi, p. 121, pl. vii, fig. 9.

Distephanus speculum Haeckel, 1887, Chal. Rept., vol. xviii, pt. ii, p. 1565.

Description.—Each pileated piece of the skeleton is composed of two parallel hexagonal rings, from the corners of the smaller of which six bars descend to meet the middle of each side of the larger ring. Six radiating spines project from the corners of the latter. Two opposite spines are usually about twice as long as the rest. Each set of spines contains members of equal length.

Occurrence.—CALVERT FORMATION. Popes Creek.

Collection.—Johns Hopkins University.

Genus DICTYOCHA Ehrenberg.

DICTYOCHA FIBULA (?) Ehrenberg.

Plate CXXX, Fig. 3.

Dictyocha fibula Ehrenberg, 1838, Abhand. d. k. Akad. d. Wiss. Berlin, p. 129.

Dictyocha fibula Ehrenberg, 1839, Abhand. d. k. Akad. d. Wiss. Berlin, p. 149, pl. iv, fig. xvi.

Dictyocha fibula Ehrenberg, 1854, Mikrogeologie, pl. xviii, fig. 54, a, b, c; pl. xix, fig. 43; pl. xx, fig. 45; pl. xxi, fig. 42.

Dictyocha fibula Haeckel, 1887, Chal. Rept., vol. xviii, pt. ii, p. 1561.

Description.—"Cellulis quaternis inæqualibus planis, totidem apiculis armatis." Ehrenberg, 1838.

"D. cellulis quaternis in formam concavam rhomboidem aut quadratam conjunctis, angulis spinosis."

"Die Form dieser Art wechselt in dem Verhältniss der Grösse der Zellen zu einander. Gewöhnlich sind 2 Zellen kleiner und diese durch einem Steg in der Mitte verbunden. Auch die Stacheln an den Ecken wechseln in der Länge. Bei der lebenden Form sind die Stacheln meist länger, doch besitze ich fossile Examplare von Caltanisette die auch darin völlig übereinstimmen. Der weiche Thierkörper trägt dieses Gerüst von Kieselstäbchen wie ein Rückenschild über sich und ist farblos. Ortsveränderung war nicht zu kennen.—Durchmesser $\frac{1}{96}'''$–$\frac{1}{48}'''$." Ehrenberg, 1839.

Haeckel described this species as follows:—

"Each pileated piece of the skeleton stirrup-shaped, with two pairs of meshes, and a square basal ring, the four corners of which are prolonged into four perradial spines. Between the latter four interradial beams arise from the sides in pairs, and the two pairs are connected by a diagonal arch. Therefore the two opposite meshes are larger and pentagonal, the other two meshes (alternating with these) are smaller and square. No vertical spine on the apex.

"Diameter of the basal square ring (diagonal) 0.01 to 0.02, of the meshes 0.005."

A single specimen of this species has been found in Maryland.

Occurrence.—Calvert Formation. Cambridge Artesian Well (192 to 335 feet).

Collection.—Johns Hopkins University.

Suborder NASSELLARIA.

Superfamily CYRTOIDEA.

Family LITHOCAMPIDA.

Genus LITHOCAMPE Ehrenberg.

Lithocampe marylandica n. sp.

Plate CXXX, Fig. 4.

Description.—Shell smooth, hyaline, spindle-shaped, with four distinct joints and a constricted mouth; joints of different lengths = 7 : 10 : 12 : 34; third and fourth joints nearly equal in breadth; pores large, somewhat irregular in size and shape; three rows of pores in each of the first three joints, and seven rows in the fourth joint.

Occurrence.—Calvert Formation. Lyons Creek.

Collection.—Maryland Geological Survey.

Genus EUCYRTIDIUM Ehrenberg.

Eucyrtidium calvertense n. sp.

Plate CXXX, Fig. 5.

Description.—Shell smooth, spindle-shaped, with five joints (and possibly a sixth broken away); cephalis subspherical, with a very short horn; proportional lengths of joints = 3 : 5 : 8 : 8 : 8 + ?; cephalis with a few scattered pores, second joint with numerous irregular pores, third joint with seven rows, fourth joint with six rows, and fifth joint with seven rows (+ ?) of large regular pores.

Occurrence.—CALVERT FORMATION. Lyons Creek.

Collection.—Maryland Geological Survey.

Genus STICHOCAPSA Haeckel.

STICHOCAPSA MACROPORA Vinassa.

Plate CXXX, Figs. 6, 7.

Stichocapsa macropora Vinassa, 1900, Mem. d. R. Accad. d. Sci. d. Istit. d. Bologna, ser. v, vol. viii, p. 253, pl. iii, fig. 47.

Description.—" Guscio assai grande e spesso, scabroso. Capo sferico perforato. Torace conico poco rigonfio; terza loggia slargata, quarta ed ultima grande, tondeggiante in basso. Pori ampi, circolari, non molto fitti, regolarmente alternanti." Vinassa, 1900.

Shell rough, pear-shaped, with two or three more or less distinct strictures and three annular septæ; cephalis small, subspherical; joints (except the cephalis) of approximately equal length; third joint broadest; pores quite large, irregular in size and shape.

The individuals here referred to Vinassa's species show considerable variation both among themselves and from Vinassa's figure. It is possible that further study will lead to the recognition of several species among the Maryland forms.

Occurrence.—CALVERT FORMATION. Popes Creek, Plum Point. CHESAPEAKE GROUP. Richmond, Va.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Family ANTHOCYRTIDA.

Genus ANTHOCYRTIUM Haeckel.

ANTHOCYRTIUM DORONICUM Haeckel.

Plate CXXX, Fig. 8.

Anthocyrtium doronicum Haeckel, 1887, Chal. Rept., vol. xviii, pt. ii, p. 1276, pl. lxii, fig. 18.

Description.—" Shell rough, with sharp collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 3. Cephalis hemispherical, with small, circular pores and a stout conical horn of twice the length. Thorax campanulate, subcylindrical, with regular circular, quincuncial pores, three to four times as broad as the bars. Mouth scarcely constricted, with twenty-four to thirty vertical, nearly parallel, little curved feet, which are about half as long as the shell, broad, lamellar, rectangular, and in close contact with their edges.

"*Dimensions.*—Cephalis 0.025 long, 0.035 broad; thorax 0.12 long, 0.1 broad." Haeckel, 1887.

The single specimen here figured and referred to this species is incomplete, the feet being entirely missing. There is consequently some doubt as to the identification. But inasmuch as no other known species agrees with the specimen in as many essentials and as the specimen disagrees with this species in no observable characteristic, it is felt that the identification is reasonably sure.

Occurrence.—CALVERT FORMATION. Popes Creek, Lyons Creek, Breton Bay.

Collections.—Maryland Geological Survey, Johns Hopkins University.

Suborder ACANTHARIA.

Superfamily ACANTHOMETRA.

Family CHIASTOLIDA.

This family, according to Haeckel's definition, includes all those RADIOLARIA whose skeleton grows from the center, is organic (made of acanthin), and consists of a variable number of simple radial spines which are grown together in pairs, each pair forming a single diametral spine. Two genera are included by Haeckel, one of which includes those forms with thirty-two and the other those with twenty radial spines. Another form has been discovered which possesses only ten radial (or five diametral) spines. This would seem to add another genus to the family. This form has already been described by Ehrenberg as *Lithasteriscus radiatus*. Other species of *Lithasteriscus* were described by Ehrenberg which evidently do not belong here, so perhaps a new name should be used for the third genus of the CHIASTOLIDA. The author has not, however, been able to find the definition of *Lithasteriscus* and prefers to retain the name, for the present, in this new position.

Genus LITHASTERISCUS Ehrenberg.

LITHASTERISCUS RADIATUS Ehrenberg.

Plate CXXX, Fig. 9.

Lithasteriscus radiatus Ehrenberg, 1844, Monatsberichte d. k. Akad. d. Wiss. Berlin, p. 89.

Lithasteriscus radiatus Ehrenberg, 1854, Mikrogeologie, pl. xviii, fig. 113.

Description.—" L. minor subglobosus superficie tuberculis elongatis acutis aut subacutis undique radiata. Diam. — $\frac{1}{75}'''$." Ehrenberg, 1844.

This species is so simple in form that a very few words of description suffice. The ten radial spines are apparently similar in form and size. They are smooth and acutely conical.

Occurrence.—CALVERT FORMATION. Crisfield Artesian Well (790 feet).

Collection.—Johns Hopkins University.

Suborder SPUMELLARIA.

Superfamily DISCOIDEA.

Family SPONGODISCIDA.

Genus SPONGASTERISCUS Haeckel.

SPONGASTERISCUS MARYLANDICUS n. sp.

Plate CXXX, Fig. 10.

Description.—Arms at equal distances, of approximately the same size, club-shaped, three times as long as broad at the outer end, four times as long as broad at the inner end; two concentric rings in the central disk; central disk surrounded by the suggestion of a patagium.

Occurrence.—CALVERT FORMATION. Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Genus DICTYOCORYNE Ehrenberg.

DICTYOCORYNE PROFUNDA Ehrenberg.

Plate CXXX, Figs. 11, 12, 13.

Dictyocoryne profunda Ehrenberg, 1860, Monatsberichte d. k. Akad. d. Wiss. Berlin, p. 767. (Name only.)

Dictyocoryne profunda Ehrenberg, 1872, Monatsberichte d. k. Akad. d. Wiss. Berlin, p. 307.

Dictyocoryne profunda Ehrenberg, 1872, Abhand. d. k. Akad. d. Wiss. Berlin, pl. vii, fig. 23.

Dictyocoryne profunda Haeckel, 1887, Chal. Rept., vol. xviii, pt. i, p. 592.

Description.—"Forma obtuse triangularis triactis, radiis clavatis subæqualiter sine ordine cellulosis, connecticulo membranacco laxius celluloso, cellulis sæpe subquadratis. Long. Max. $\frac{1}{16}'''$, radii a medio $\frac{1}{16}'''$. Cellulæ in capitulo transversæ fere 15." Ehrenberg, 1872.

Arms approximately of equal size and equidistant, club-shaped, from $2\frac{1}{2}$ to 3 times as broad at the ends as in the narrowest part, broadest part twice the diameter of the central disk, length $2\frac{1}{2}$ to 3 times the diameter of the central disk; central disk with three or four concentric rings; patagium reaching almost or quite to the ends of the arms.

The forms here referred to this species show considerable variation within themselves, and if they all remain here will make it necessary to broaden the descriptions given by Ehrenberg and by Haeckel. With the material now at hand it seems better to broaden the species than to describe new ones. The three figures show the range of variation observed in the Maryland forms.

It may be seen from the figures that the arms are not absolutely equidistant as they are supposed to always be in this genus. The maximum variation in this respect is shown in Fig. 11 where the angles between the arms are 105°, 122° and 133°. This does not invalidate the reference of this form to *Dictyocoryne* for Ehrenberg's figure of the type of the genus shows the arms as being at angles of 113°, 123° and 124°.

Occurrence.—CALVERT FORMATION. Lyons Creek, Popes Creek, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Genus RHOPALODICTYUM Ehrenberg.

RHOPALODICTYUM MARYLANDICUM n. sp.

Plate CXXX, Fig. 14.

Description.—Arms club-shaped, of different sizes, and at unequal distances; lengths of arms in proportion of 23 : 23 : 26; angles of arms = 100°, 130°, 130°; the longest arm opposite one of the larger angles; arms 2 times as long as the breadth at the end, breadth at the end $2\frac{1}{2}$ times the breadth in the narrowest part; central disk $\frac{3}{8}$ as wide as the end of an arm; two concentric rings in the central disk.

Occurrence.—CALVERT FORMATION. Popes Creek, Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

RHOPALODICTYUM CALVERTENSE n. sp.

Plate CXXX, Fig. 15.

Description.—Arms short, club-shaped, with large subspherical ends, greatest width of the arms seven-eighths the length, least width one-fourth the length; lengths of arms in the proportions 18 : 19 : 20; angles of the arms = 129°, 119° and 112°; greatest angle opposite the shortest, least angle opposite the longest, and medium angle opposite the medium arm; central disk with three concentric rings.

Occurrence.—CALVERT FORMATION. Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Family PORODISCIDA.

Genus PORODISCUS Haeckel.

PORODISCUS CONCENTRICUS (Ehrenberg).

Plate CXXX, Fig. 16.

Flustrella concentrica Ehrenberg, 1838, Abhand. d. k. Akad. d. Wiss. Berlin, p. 132.

? *Flustrella concentrica* Ehrenberg, 1854, Mikrogeologie, pl. xix, fig. 61; pl. xx, fig. 42; pl. xxi, fig. 51; pl. xxxvi, fig. 29.

Trematodiscus concentricus Haeckel, 1862, Mon. d. Radiol., p. 493.

Flustrella concentrica Ehrenberg, 1875, Abhand. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xxii, fig. 13.

Trematodiscus concentricus Stöhr, 1880, Paleontographica vol. xxvi, p. 108.

Porodiscus concentricus Haeckel, 1887, Chal. Rept., vol. xviii, pt. i, p. 492.

Description.—" FLUSTRELLA concentrica, microscopica cellularum minutissimarum lævium seriebus concentricis, interdum spiralibus, apertura singularum parva rotunda." Ehrenberg, 1838.

" All rings of the disk circular, concentric of equal breadth, connected by numerous piercing radial beams. Chambers different in size, increasing from the center towards periphery. Pores regular, circular, one and a half to two on the breadth of each ring.

" *Dimensions.*—Diameter of the disk (with eight rings) 0.16; breadth of each ring 0.01; pores 0.003.

" Habitat.—Fossil in many Tertiary rocks—Barbados, Sicily, Greece, etc." Haeckel, 1887.

Occurrence.—CALVERT FORMATION. Popes Creek, Plum Point, Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Family PHACODISCIDA.

Genus PHACODISCUS Haeckel.

PHACODISCUS CALVERTANUS n. sp.

Plate CXXX, Fig. 17.

Description.—Disk rather smooth, three times as broad as the outer and seven times as broad as the inner medullary shell; pores regularly circular, three or four times as broad as the bars; margin of the disk rounded.

Occurrence.—CALVERT FORMATION. Lyons Creek.

Collection.—Maryland Geological Survey.

Superfamily PRUNOIDEA.

Family CYPHINIDA.

Genus CANNARTIDIUM Haeckel.

CANNARTIDIUM sp.

Plate CXXX, Fig. 18.

Description.—The specimen on which the accompanying figure was based and which was intended to be used as the type of a new species of

Cannartidium was crushed before the drawing was completed. Under the circumstances it seems best not to attempt to name or describe the form, although it is undoubtedly an undescribed species of *Cannartidium*. The figure possibly does not adequately represent the species.

Occurrence.—Calvert Formation. Popes Creek.

Collection.—Maryland Geological Survey.

Genus CANNARTISCUS Haeckel.

Cannartiscus amphicylindricus Haeckel.

Plate CXXX, Fig. 19.

Cannartiscus amphicylindricus Haeckel, 1887, Chal. Rept., vol. xviii, pt. i, p. 373.

Description.—"Cortical shell thick walled, rough, with subregular, circular pores, twice to four times as broad as the bars; six to seven on the half meridian, ten to twelve on the half equator of each chamber. Polar tubes cylindrical, on the distal end open (broken off?) nearly as long as the main axis, somewhat narrower than the spherical medullary shell. Pores of the tubes much smaller than those of the chambers.

"Dimensions.—Main axis (without tubes) 0.17, greatest breadth 0.12; pores 0.006 to 0.012, bars 0.003. Length of the polar tubes 0.15, breadth of them 0.03; pores 0.003, bars 0.002.

"Habitat.—Pacific, central area, Station 268, 29,000 fathoms; the same occurs fossil in the rocks of Barbados." Haeckel, 1887.

Occurrence.—Calvert Formation. Popes Creek, Plum Point, Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Cannartiscus marylandicus n. sp.

Plate CXXX, Fig. 20.

Description.—Cortical shell thick walled, rough, with an indistinct medial constriction; pores subcircular, irregular in size, two to five times as wide as the bars; polar tubes very rough and irregular in shape.

Occurrence.—Calvert Formation. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Superfamily SPHÆROIDEA.

Family ASTROSPHÆRA.

Genus ACANTHOSPHÆRA Haeckel.

ACANTHOSPHÆRA PARVULA Vinassa.

Plate CXXX, Fig. 21.

Acanthosphæra parvula Vinassa, 1900, Mem. d. R. Accad. d. Sci. d. Istit. d. Bologna, ser. v, vol. viii, p. 234, pl. i, fig. 29.

Description.—" Sfera piccola, sottile, levigata, con pori numerosi, grandi, assai fitti, rotondi e tutti uguali. Aculei brevi conici, poco numerosi, irregolarmente sparsi.

" Diametro della sfera: mm. 0,065; altezza degli aculei: mm. 0,62." Vinassa, 1900.

This species may be at once distinguished from the other Radiolaria which have been observed in these beds by the presence of the small spines radiating in all directions. Its size also is characteristic.

Occurrence.—CALVERT FORMATION. Popes Creek.

Collection.—Maryland Geological Survey.

Family CUBOSPHÆRIDA.

Genus HEXALONCHE Haeckel.

HEXALONCHE MICROSPHÆRA Vinassa.

Plate CXXX, Fig. 22.

Hexalonche microsphæra Vinassa, 1900, Mem. d. R. Accad. d. Sci. d. Istit. d. Bologna, ser. v, vol. viii, p. 233, pl. i, fig. 23.

Description.—" Sfera corticale assai grande e spessa, scabrosa; pori ovali o rotondi, non molto grandi e profundi. Sfera midollare levigata, piccolissima, munita di piccoli pori rotondi, unita alla corticale da sotilli processi, quasi filiformi. Aculei conici, assai lunghi, acuti, non carenati.

" Diametro della sfera interna: mm. 0,02; della esterna: mm. 0,12; altezza degli aculei 0,056." Vinassa, 1900.

Cortical shell rough; pores circular or subcircular, not varying much in size, diameter slightly greater than the width of the bars, or about 1/12 the diameter of the cortical shell; medullary shell about 2/7 the diameter of the cortical shell; spines triangular-pyramidal, twisted, as long as the radius of the cortical shell, basal diameter ⅜ the diameter of the medullary shell.

Occurrence.—CALVERT FORMATION. Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Genus HEXASTYLUS Haeckel.

HEXASTYLUS SIMPLEX Vinassa.

Plate CXXX, Fig. 23.

Hexastylus simplex Vinassa, 1900, Mem. d. R. Accad. d. Sci. d. Istit. d. Bologna, ser. v, vol. viii, p. 232, pl. i, fig. 20.

Description.—"Sfera grande, molto spessa, seabrosa, a pori rotondi, assai radi. Aculei muniti di una carena mediana, appuntiti.

"Ha qualche somiglianza coll' *H. marginatus* Hekl. (*Report on the Radiolaria*) figurato a tav. XXI, fig. 10, ma ha i pori assai meno numerosi e gli aculei molto meno lunghi;

"Diametro della sfera: mm. 0,15; lunghezza degli aculei: mm. 0,06." Vinassa, 1900.

Occurrence.—CALVERT FORMATION. Lyons Creek.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Genus CENOSPHÆRA Ehrenberg.

CENOSPHÆRA POROSISSIMA Vinassa.

Plate CXXX, Figs. 24, 25.

Cenosphaera porosissima Vinassa, 1900, Mem. d. R. Accad. d. Sci. d. Istit. d. Bologna, ser. v, vol. viii, p. 229, pl. i, fig. 3.

Description.—"Guscio assai grande, non molto spesso, scabroso, con numerosi pori rotondi, equidistanti e fittissimi.

"Diametro della sfera: mm. 0,125." Vinassa, 1900.

Shell somewhat rough, pores regular and circular (or almost so), two to four times as broad as the bars, six to eight on the quadrant.

Occurrence.—CALVERT FORMATION. Lyons Creek, Plum Point.

Collections.—Maryland Geological Survey, Johns Hopkins University, Rev. Edward Huber.

Order FORAMINIFERA.

Suborder VITRO-CALCAREA.

Family NUMMULINIDÆ.

Genus NONIONINA d'Orbigny.

The genus *Nonionina* is so closely related to *Polystomella* that some authors consider that it should be allowed to lapse or at best be considered as only a subgeneric group of the true *Polystomella* type. Typically the shell is convolute with equilateral compression as in *Anomalina* so that it presents a symmetrical nautiloid form in which the final volution embraces all the others. The umbilicus is either depressed, flush, or filled with exogenous substance as in *N. asterizans,* and the septal markings are more or less depressed though the amount of depression varies with every species. The shell substance is hyaline, and distinctly perforate, often finely so. The aperture is situated on the inner margin of the ultimate segment and is either an arched fissure or subdivided into a number of porous openings as by some *Polystomellæ.* The genus does not seem to be recorded prior to the beginning of the Tertiary. At the present time it occurs at all depths and is cosmopolitan in distribution occurring in every latitude.

NONIONINA SCAPHA (Fichtel and Moll).

Plate CXXXI, Figs. 1, 2, 3.

Nautilus scapha Fichtel and Moll, 1803, Test. Microsc., p. 105, pl. xix, figs. d–f.
Nonionina scapha Brady, 1884, Chal. Rept., vol. ix, p. 730, pl. cix, figs. 14, 15 (and 16 ?).
Nonionina scapha Bagg, 1898, Bull. Amer. Pal., No. 10, p. 41, pl. iii, figs. 4a, 4b.

Description.—Test free hyaline, finely perforated, elongate, rather strongly compressed, peripheral margin broadly rounded, chambers numerous, narrow, long, rapidly increasing in size toward the ultimate chamber and separated by nearly straight septal lines; sutural limbations becoming more marked towards the ultimate chamber which is the largest and longest and extends fully two-thirds the length of the entire shell. Septal plane broadly oval or cordate; convolutions about three, twelve to fourteen chambers in the final volution; aperture a small concentric slit situated on the inner margin of the ultimate chamber.

This species is a common form in the Maryland and Virginia Miocene. Seguenza records it in the Miocene of Calabria and d'Orbigny described it from the Vienna Basin Miocene. It becomes more abundant in the later Tertiary.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus POLYSTOMELLA Lamarck.

The shells of this beautiful and delicate genus consist of regular, equilateral, nautilus-shaped, convolute type in which but the final convolution is visible externally. The complex structure of the interior of the chambers is admirably worked out and portrayed by Dr. Carpenter in his Introduction to the Study of the FORAMINIFERA. Prof. Brady in the Challenger Report briefly but clearly defines the genus as follows: "The test of *Polystomella* is, as a rule, of lenticular or discoidal form. In the weaker modifications (e. g., *Polystomella striatopunctata*) the segments are more or less inflated, and the external furrows by which they are separated are bridged over at intervals by extensions of the inner margins of the segments, leaving rows of depressions or 'fossettes' to mark the septal lines. These marginal extensions of the segments are called 'retral processes' or in connection with their external shelly investment 'septal bridges' and throughout a considerable section of the genus their presence to a greater or less extent is the only advance in structure upon that of the *Nonioninæ*." This author adds that in more typical forms the septa are limbate externally and the retral processes develop into a series of transverse ridges which almost or completely connect the septa of contiguous chambers. It is this feature which characterizes the Miocene forms of the Maryland deposits. Dr. Uhlig records it as early as the Middle Jurassic but it is not well represented until late Tertiary time. We have but one specimen from the Miocene of Maryland but in the overlying Pleistocene of Cornfield Harbor further southward it becomes the most abundant foraminifera of the region.

POLYSTOMELLA STRIATOPUNCTATA (Fichtel and Moll).

Plate CXXXI, Fig. 4.

Nautilus striatopunctata Fichtel and Moll, 1803, Test. Microsc. p. 61, pl. iv, figs. a–c.

Description.—Test rounded, convolute, both sides equally compressed as in *Nonionina* types, peripheral margin obliquely rounded, becoming somewhat lobulated near the ultimate chamber; segments triangular, twelve in the last volution, separated by nearly straight septal depressions in the form of bridges which mark the retral processes of the shell. Septal plane is nearly round and the aperture is in the form of a series of pores or openings along the inner margin of the ultimate segment.

Its earliest occurrence is from the Eocene of the Paris Basin (Terquem).

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Family ROTALIDÆ.

Genus DISCORBINA Parker and Jones.

The typical test of *Discorbina* consists of a trochoid spire with nearly flat base and sharp margin. Parker and Jones suggested a grouping of the various forms under three heads, namely, the conical, the vesicular and the outspread, complanate forms. The shell is hyaline and in larger forms is coarsely perforate though often small specimens and certain species have small pores. The superior surface is usually raised into a spire which shows the entire chambering of the shell and the arched septa, while the inferior face is quite flat or even depressed and only the final convolution is visible. The margin is generally well defined and sharp though by some few species it assumes the rounded or even squarely set borders found in other types. The aperture is usually protected by an overhanging fringe and is sometimes not apparent, while tubercles occur very rarely as in Asteriginæ types.

The genus does not make its appearance until near the close of Cretaceous time. In existing seas it is found in every clime being dredged from Davis Strait, to the Equator and from the Equator to Magellans Strait. It is more usually found in shoal waters and is quite scarce below 200 fathoms.

Discorbina orbicularis (Terquem).

Plate CXXXI, Fig. 5.

Rosalina orbicularis Terquem, 1876, Anim. sur la Plage de Dunkerque, p. 75, pl. ix, fig. 4, a, b.

Description.—Test minute, trochoid, consisting of several rotaliform convolutions; marginal keel sharp, angular; superior surface conical, inferior, depressed and approximately flat. The chambers are remarkably curved and overlap in such a way as to make it rather difficult to clearly mark the several volutions. The septa are visible as graceful curved lines but are not depressed and the shell is finely porous in our specimens.

As a fossil we find it recorded in the Miocene of southern Italy and in the Upper Pliocene sands of Rome. At the present time it is best known, according to Brady, as a coral reef species but it is not confined to reefs. It ranges in depth from the littoral zone to about 400 fathoms.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Genus PLANORBULINA d'Orbigny.

The genus *Planorbulina* occupies a close relationship with two other generic types, namely, *Truncatulina* and *Anomalina.* It is typically characterized by its wide spreading flattened form, with coarse perforate shell and it is subject to great variation in aperture, marginal fringe, limbation of sutures and in sometimes possessing exogenous tubercles. It is at the present time common to seas of all latitudes and occurs from the littoral zone down to depths of 3000 fathoms. As a fossil it is known as early as the Carboniferous, is rare in the Lias, common again in the Cretaceous and is well represented throughout Tertiary time.

Planorbulina mediterranensis d'Orbigny.

Plate CXXXI, Fig. 6.

Planorbulina mediterranensis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 280, pl. xiv, figs. 4-6; Modele No. 79.

Description.—Test much flattened, wide-spread, consisting of a number of irregular vaulted chambers with depressed umbilical center. Margin is lobulated and no two specimens are identical in contour, number of chambers, etc.; all showing more or less variation as in *Truncatulina variabilis.*

D'Orbigny records the form from the Vienna Miocene; Seguenza, Parker and Jones mention it from the later Tertiaries of Italy and Sicily, and it is known in the English Crag and the Post Tertiary of Norway as well as in many other localities of Tertiary age.

It is commonest in depths of less than 50 fathoms at the present time and is not confined to any zone.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus TRUNCATULINA d'Orbigny.

The genus *Truncatulina* finds its typical representation in the species *T. lobatula* in which the superior surface is flat or nearly so and all the segments are visible, while the inferior surface is somewhat vaulted and the form is so involute that only the last chambers of the final convolution become apparent. The amount of vaulting and even the flat superior surface is subject to considerable variation and in *Truncatulina variabilis* no two specimens are alike.

Under the group of *Planorbulinæ* forms belong a large number of species described under the names of *Planorbulina, Anomalina, Rosalina, Rotalia,* etc. It is one of the most abundant of all living species and is common in fossil deposits of later geologic age though its earliest appearance is in rocks of Carboniferous age.

TRUNCATULINA LOBATULA (Walker and Jacob).

Plate CXXXI, Fig. 7, 8.

Nautilus lobatulus Walker and Jacob, 1798 (*fide* Kanmacher's Ed.), Adam's Essays Microsc., p. 642, pl. xiv, fig. 36.

Truncatulina lobatula Brady, 1884, Chal. Rept., vol. ix, p. 660, pl. xcii, fig. 10; pl. xciii, figs. 1, 4, 5; pl. cxv, figs. 4, 5.

Truncatulina lobatula Bagg, 1898, Bull. Amer. Pal., No. 10, p. 35.

Truncatulina lobatula Bagg, 1901, Md. Geol. Survey, Eocene, p. 252, pl. lxiv, fig. 3.

Description.—Test plano-convex, moderately vaulted, last volution consisting of seven, eight, or nine chambers with slightly depressed septa;

septal lines being more curved on the superior surface; aperture a small neatly shaped arch at the inferior margin of the ultimate segment.

These characters are subject to considerable variation and when the forms become highly convex the species grade over into the *Truncatulina refulgens* type, while those forms more flattened constitute *Truncatulina wuellerstorfi*. Those regularly and symmetrically developed constitute *Truncatulina boueana* d'Orbigny and the less regular form the *Truncatulina variabilis* of the same author. Both of these forms *T. lobatula* and *T. variabilis* are abundant in the Atlantic coast Miocene deposits.

As a fossil it is one of the most abundant types and is very widely distributed over existing oceans. It is also of great range bathymetrically speaking, occurring at all depths down to 3000 fathoms.

Its geological appearance dates from the Carboniferous period.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Pawpaw Point, Governor Run, Peach Blossom Creek. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

TRUNCATULINA VARIABILIS d'Orbigny.

Plate CXXXI, Figs. 9, 10.

Truncatulina variabilis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 279, No. 8.

Truncatulina variabilis Terquem, 1878, Mém. Soc. Geol. France, ser. 3, vol. ii, Mem. iii, p. 1, figs. 18–25.

Truncatulina variabilis Bagg, 1898, Bull. Amer. Pal., No. 10, p. 36, pl. ii, fig. 5.

Description.—Test consisting of a depressed, plano-convex, exceedingly variable form, the segments of which are never uniform or regular in arrangement as in *Truncatulina lobatula* but are more or less evolute and vary also in the amount of compression and form. The shell is coarsely perforate. The aperture is a wide gaping arch extending along the inner margin of the final convolution.

This species is very abundant in the Miocene deposits of Maryland and Virginia. Its first recorded appearance as a fossil is from the Eocene of the Paris basin though it is probably of much earlier occurrence.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Pawpaw Point, Governor Run, Peach Blossom Creek. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus ANOMALINA d'Orbigny.

The genus *Anomalina* embraces a small section of *Planorbulinæ* forms which become so symmetrically convoluted that both sides of the shell are similar and the type becomes a true umbilicated nautiloid organism. This perfect symmetry does not always attain and d'Orbigny used the word to apply to two different types, one of which was a nearly equilateral compressed, subnautiloid *Planorbulina* while the other was plano-convex with sunken umbilicus. The forms are closely allied to *Truncatulina* and the distinction between the two is not very clear. It is unfortunate to still retain the name, but as it has some difference in method of growth, perhaps it is well to use the name making it to include all truly nautiloid forms which are symmetrical and with centrally located aperture.

ANOMALINA GROSSERUGOSA (Gümbel).

Plate CXXXI, Fig. 11.

Truncatulina grosserugosa Gümbel, 1868, Abhand. d. k. bayer. Akad. Wiss., ii, cl, vol. x, p. 660, pl. ii, fig. 104, a, b.

Description.—Test nautiloid, very coarsely porous; pores larger and more numerous upon the inferior surface; both sides convex; umbilici distinct; peripheral margin round; chambers large, inflated, septal lines nearly straight, depressed, aperture situated on inner margin, medial.

Gümbel's specimens were from the Eocene of the Bavarian Alps. In present oceans the species seems to occur sporadically at different localities and at various depths down to 2000 fathoms.

Occurrence.—CHOPTANK FORMATION. Peach Blossom Creek. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus ROTALIA Lamarck.

The genus *Rotalia* forms but a small division of the series of ROTALIDÆ forms. The walls of the test are finely perforate while the allied genus *Planorbulina* has coarsely perforate walls.

The general type is that of a turbinate spire which in typical forms like *R. beccarii* is nearly equally convex on both sides. Again by some the superior surface is trochoid while the inferior remains nearly flat and again the lower side becomes the arched and the superior the depressed area. In the normal Rotaliform arrangement of chambers the whole of the segments appear upon the superior surface and only those of the last volution on the lower aspect. Prof. Brady states that while the umbilicus is sometimes depressed more usually there is an exogenous deposit of shell substance over it. The aperture is normally a curved fissure on the inferior face of the final segment.

The present distribution of the genus is in tropical and temperate zones, and it is typically developed in shallow waters of tropical seas. Its first geological occurrence is in the Gault of England.

ROTALIA BECCARII (Linné).

Plate CXXXI, Figs. 12, 13.

Nautilus beccarii Linné, 1767, Syst. Nat., 12th ed., p. 1162; 1788, Syst. Nat., 13th (Gmelin's) edit., p. 3370, No. 4.

Description.—Test trochoid, shell wall finely porous and the form built into a compact low nearly circular spire; peripheral margin lobulated, obtusely rounded, chambers numerous, ten to forty, somewhat inflated, about ten in the final convolution. Septal lines depressed below and nearly straight; curved above and the whole number of chambers visible on the superior side. Convolutions about three, inferior surface thickened, and often beaded with exogenous granules at the umbilicus. Aperture a notched subdivided opening or a series of pores at the inner margin of the ultimate chamber. This foraminifer rare in the Miocene becomes plentiful in the Pleistocene of Cornfield Harbor, Md. Its fossil form begins with the middle Tertiary.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

ROTALIA BECCARII VAR. BRŒCKHIANA Karrer.

Plate CXXXI, Fig. 14.

Rotalia brœckhiana Karrer, 1878, Drasche's Geol. d. Insel Luzon, p. 98, pl. v, fig. 26.

Description.—This variety of the *Rotalia beccarii* is only a thickened form of the type species and differs from the latter in the more convex spire and inferior surfaces. It seems to lack the surface umbilical tubercles and is somewhat more compactly built than the larger forms of the type. Only a few forms were dredged by the Challenger expedition from off the Ki Islands at a depth of 500 fathoms.

Occurrence.—CHOPTANK FORMATION. 1 mile north of Governor Run, Peach Blossom Creek.

Collection.—Maryland Geological Survey.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA d'Orbigny.

D'Orbigny in his "Tableau Methodique" describes the genus as follows: "Test free, trochoid, irregular; spire confused, formed of spherical chambers more or less distinct; aperture in the form of a more or less depressed hollow situated near the axis of the spire in the umbilical angle."

The shell substance is porous and the shell walls hyaline, and the several chambers connect with each other by the opening at the umbilical vestibule. The number of segments varies from three to as many as twenty. The genus is one of the most cosmopolitan known and exists in every latitude, and at every depth, but the forms are all found living at the surface of the sea except *G. pachyderma.* It dates from the Jurassic age in the fossil world and became so abundant in the Cretaceous as to form extensive beds of chalk of great thickness.

GLOBIGERINA BULLOIDES d'Orbigny.

Plate CXXXII, Figs. 1, 2.

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 277, No. 1—Modele No. 17 (young) and No. 76.

Globigerina bulloides Brady, 1884, Chal. Rept., vol. ix, p. 593, pl. lxxvii, lxxix, figs. 3–7.

Globigerina bulloides Bagg, 1898, Bull. Amer. Pal., No. 10, p. 33.

Globigerina bulloides Bagg, 1901, Md. Geol. Survey, Eocene, p. 250, pl. lxiii, figs. 15, 16, 16a.

Description.—"Test spiral, subtrochoid; superior face convex, inferior more or less convex but with deeply sunken umbilicus, periphery rounded, lobulated; adult specimens composed of about seven globose segments, of which four form the outer convolution; the apertures of the individual chambers opening independently into the umbilical vestibule. Diameter, sometimes 1-40th inch (0.63 mm.), but oftener much less." Brady, 1884.

This species is not uncommon in the Maryland Miocene. Its first geological appearance dates from the Cretaceous epoch. At the present time it exists in seas of all latitudes and at all depths.

Occurrence.—Choptank Formation. Jones Wharf, Peach Blossom Creek. Calvert Formation. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

Globigerina cretacea d'Orbigny.

Plate CXXXII, Fig. 3.

Globigerina cretacea d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv, p. 34, pl. iii, figs. 12–14.

Description.—Test rotaliform but strongly depressed; superior surface flattened or but slightly convex, inferior side depressed toward the center and excavated at the umbilicus; periphery obtuse and lobulated; shell typically composed of three fairly distinct convolutions; the outermost consisting of from five to seven segments, the later relatively small, subglobular; the aperture opening into the umbilical vestibule.

This species, which is most abundant in the Cretaceous deposits of the globe, is very rare in our Maryland Miocene. Brady in the Challenger Report states that he never found typical forms of this species in any localities examined by the Challenger, but a few stoutly built modifications exist.

Occurrence.—Calvert Formation. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Family TEXTULARIDÆ.

Genus TEXTULARIA Defrance.

"The shell of *Textularia* essentially consists of a binary series of segments arranged symmetrically on the two sides of a longitudinal axis; the segments of one side alternating with those of the other, and each segment communicating with the segments anterior and posterior to it on the opposite side. As the size of the segments usually increases progressively, the outline of the shell is generally more or less triangular, the apex of the triangle being formed by the first segment, and its base by the last two." (Carpenter, Introduction to the Study of the Foraminifera.) The shells of this genus show great variation in structure, shape, and composition of the shell substance. Typical forms are hyaline with large, closely set pores, but the larger varieties are often composed of arenaceous grains and either have a siliceous base or calcareous matrix. The best examples come from shallow waters of temperate and tropical seas, but the genus is very widespread and is found at considerable depths. Its geological distribution is interesting since it is one of the earliest types we find developed and it is known from the Paleozoic deposits.

TEXTULARIA ABBREVIATA d'Orbigny.

Plate CXXXII, Fig. 4.

Textularia abbreviata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 249, pl. xv, figs. 9–12 (error for 7–12).

Textularia abbreviata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 18.

Description.—Test short and thick, sharply pointed at the posterior end, rapidly enlarging above, laterally compressed, but not strongly so, being broadly elliptical in outline, with narrowly rounded margins approaching angularity. The chambers are narrow and increase in size rapidly towards the ultimate chamber; septal lines straight, apparent as fine lines, not depressed; aperture a semilunar arch on interior margin of final segment.

Occurrence.—CHOPTANK FORMATION. Governor Run.

Collection.—Maryland Geological Survey.

TEXTULARIA AGGLUTINANS d'Orbigny.

Plate CXXXII, Fig. 5.

Textularia agglutinans d'Orbigny, 1839, Foram. Cuba, p. 136, pl. i, figs. 17, 18; 32–34.

Textularia agglutinans Bagg, 1898, Bull. Amer. Pal., No. 10, p. 19.

Description.—Test agglutinous, elongated, tapering but slightly; of a dull gray color; laterally convex; peripheral margin lobulated, rounded;

chambers numerous, nine or ten in each series; septa somewhat curved, short. It is the most common variety of the *Textulariæ*. As a fossil it dates back to the Cretaceous period. It occurs at all depths and latitudes at the present time and is one of the most widely distributed of the Foraminifera.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, 1 mile north of Governor Run. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA ARTICULATA d'Orbigny.

Plate CXXXII, Figs. 6, 7.

Textularia articulata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 250, pl. xv, figs. 16–18.

Textularia articulata Bagg, 1898, Bull Amer. Pal., No. 10, p. 19.

Description.—Test rather broad and laterally compressed; tapering only slightly towards the posterior end, which is somewhat rounded; peripheral margin sharp, provided with a marginal keel encircling the sides of the entire shell; chambers numerous, about ten in each series, separated by nearly straight depressed septal lines. Aperture a small median opening along the inner margin of the final segment. This species is closely related to *T. carinata* but differs in not possessing the marginal spines and irregularity and the sutures and is not quite so limbate.

Some of the specimens assume irregular shapes and are more or less bent or deformed.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA GRAMEN d'Orbigny.

Plate CXXXII, Figs. 8, 9.

Textularia gramen d'Orbigny, 1846, Foram. Fossiles Vienne, p. 248, pl. xv, figs. 4–6.

Textularia gramen Bagg, 1898, Bull. Amer. Pal., No. 10, p. 19.

Description.—Test arenaceous, rough, stoutly built, laterally compressed; margin subangular; five to seven wide chambers in each series; very slightly convex; posterior end neatly rounded, general outline similar to *Textularia hauerii* d'Orb. but distinguished from that species by its more angular lateral edges, and differing from *Textularia abbreviata* d'Orb., which it also resembles, in being less short and thick.

Occurrence.—CHOPTANK FORMATION. Governor Run, Jones Wharf.

Collection.—Maryland Geological Survey.

TEXTULARIA CARINATA d'Orbigny.

Plate CXXXII, Fig. 10.

Textularia carinata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 247, pl. xiv, figs. 32-34.

Description.—Test arenaceous, rather stoutly built and somewhat compressed, but tapering rather narrowly at the posterior end so that it is almost acuminate. The lateral margins are strongly carinate as in *Textularia articulata,* from which it is with difficulty distinguished, and it may well be doubted whether it is wise to separate the two as d'Orbigny has done. It has somewhat strongly marginal extensions, however, and these extensions are more broken and the sutures are less depressed. It is closely allied to *Textularia marginata* but differs from it in the flanged sides.

D'Orbigny's specimens were from Nussdorf, Austria.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA SAGITTULA Defrance.

Plate CXXXII, Figs. 11, 12.

Textularia sagittula Defrance, 1824, Dict. Sci. Hist., vol. xxxii, p. 177; vol. liii, p. 344; Atlas Conch., pl. xiii, fig. 5.

Textularia sagittula Bagg, 1898, Bull. Amer. Pal., No. 10, p. 20.

Textularia sagittula Bagg, 1901, Md. Geol. Survey, Eocene, p. 234, pl. lxii, fig. 2.

Description.—Test elongated, strongly compressed with sharp-angled peripheral margins; chambers numerous, closely set, separated by short, straight septal lines visible externally but not depressed. The aperture is linear, terminal. Its geological distribution is from the Cretaceous to the present time.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA SUBANGULATA d'Orbigny.

Plate CXXXII, Fig. 13.

Textularia subangulata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 274, pl. xv, figs. 1-3.

Textularia subangulata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 20.

Description.—Test consisting of a relatively small number of chambers which increase very rapidly in size from the posterior to the anterior end; peripheral margins sharp-angled. The sides of the shell are laterally compressed and parallel, only their extremities forming the sharp periphery. The posterior end is acuminate, anterior broad, obtusely rounded; ultimate chamber much elevated and larger than any other segment. The aperture is a median arched slit situated on the inner margin of the final segment.

Occurrence.—CHOPTANK FORMATION. Governor Run.

Collection.—Maryland Geological Survey.

Genus BOLIVINA d'Orbigny.

The genus *Bolivina* possesses the biserial or Textulariform development of its chambers, but it never loses the elongation and inversion of its lip so characteristic of the Bulimine type and this aperture is usually somewhat oblique. While possessing characters similar to both Textulariform and Bulimine types as above mentioned it also is allied closely with the genus *Valvulina* which has the same segment arrangement. Its earliest occurrence as a fossil is in the Cretaceous and it becomes more frequent in subsequent deposits. At the present time the genus is very evenly distributed over every latitude and Prof. Brady states that it is found at from a few to 2000 fathoms, but usually on bottoms of less than 300 or 400 fathoms.

BOLIVINA BEYRICHII VAR. ALATA Seguenza.

Plate CXXXII, Fig. 14.

Valvulina alata Seguenza, 1862, Atti dell' Accad. Gioenia, ser. ii, vol. xviii, p. 113, pl. ii, figs. 5, 5a.

Description.—This species is a modification of *B. beyrichii* and is closely related to *B. gramen* (*Valvulina gramen* d'Orb.). The former is, however, more slender and somewhat narrower and has greater depth and subtriangular outline of its later chambers. In the variety "*alata*" there is a well defined wing or keel around the periphery and the test is rather more flattened than in the *Bolivina beyrichii* types.

The prolongation of the aperture, together with its marginal keel, furnishes a sure key to the identification of the species. It is found in existing seas at depths from 50 to 800 fathoms.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Family LAGENIDÆ.

Subfamily NODOSARINÆ.

Genus CRISTELLARIA Lamarck.

The genus *Cristellaria* is represented in its typical form by a planospiral lenticular shell with the aperture always at the outer margin of the periphery. Sometimes, however, the later chambers of the shell become enlarged and drawn out so that the shell becomes very oblong and when the primary chambers are very small and the later ones extremely developed it resembles the Nodosarian type. The genus makes its first appearance in the Triassic. It is very widespread at the present time and occurs at all depths but is most common at depths of less than 300 fathoms.

CRISTELLARIA CULTRATA (Montfort).

Plate CXXXII, Fig. 15.

Robulus cultratus Montfort, 1808, Conch. Syst., vol. i, p. 214, 54th genre.
Cristellaria cultrata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 26.

Description.—Test circular, biconvex, smooth and glistening; margin sharp and broadly keeled; chambers seven to eleven in the last volution, somewhat convex, either smooth or costate; aperture radiate. The width of the marginal keel is very variable, though always more or less developed, and this constitutes the essential feature of the species.

Occurrence.—ST. MARY'S (?) FORMATION. Crisfield Well (776 feet).

Collection.—Maryland Geological Survey.

Cristellaria wetherellii (Jones).

Plate CXXXII, Fig. 16.

Marginulina wetherellii Jones, 1854, Morris's Cat. Brit. Foss., Ed. 2, p. 37.
Cristellaria wetherellii Brady, 1884, Chal. Rept., vol. ix, p. 537, pl. cxiv, fig. 14.
Cristellaria wetherellii Bagg, 1898, Bull. Amer. Pal., No. 10, p. 27.

Description.—Test elongate, compressed, pod-like, primordial segments more or less involute, ultimate segments extending into a straight or nearly straight series. The surface of the shell ornamented externally by raised tubercles more or less regularly arranged between the septal lines of some of the chambers and also upon the septal lines. Transverse sections are elliptical and show in some forms an angular periphery and when so they approach *Cristellaria decorata* Reuss in outline.

Occurrence.—St. Mary's (?) Formation. Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

Subfamily POLYMORPHINÆ.

Genus POLYMORPHINA d'Orbigny.

The genus *Polymorphina* shows remarkable variation in its biserial arrangement of lageniform chambers. Usually the segments are arranged somewhat oblique to the principal axis and the segments are prolonged and overlap each other in such a manner as to render the whole shell very unsymmetrical. Sometimes the chambers are flattened, at other times they are nearly round and their surface decoration is equally varied.

The genus is closely related to *Textularia* in its method of growth, but it also presents strong affinities to *Uvigerina* and *Nodosaria*. The aperture is typically a radiating fissure.

It is most common at the present time in shoal waters and is known in waters of the arctic, temperate and tropical zones. Its earliest appearance as a fossil is in the Trias and it is especially plentiful in Tertiary strata. In the Maryland Miocene, however, it does not seem to be at all abundant and but few specimens occur.

POLYMORPHINA COMPRESSA d'Orbigny.

Plate CXXXIII, Fig. 1.

Polymorphina compressa d'Orbigny, 1846, Foram. Fossiles Vienne, p. 233, pl. xii, figs. 32–34.

Polymorphina compressa Bagg, 1898, Bull. Amer. Pal., No. 10, p. 29, pl. iii, figs. 1a, 1b.

Polymorphina compressa Bagg, 1901, Md. Geol. Survey, Eocene, p. 246, pl. lxiii, fig. 10.

Description.—" Shell oblong, inequilateral, compressed, more or less fusiform; chambers numerous, arranged in two inequal series, somewhat inflated; septal lines depressed; surface smooth or faintly striated; aperture variable, usually simple, circular, coronate; sometimes labyrinthic, or porous." Brady, Parker and Jones.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, 1 mile north of Governor Run. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

POLYMORPHINA COMPRESSA VAR. STRIATA n. var.

Plate CXXXIII, Fig. 2.

Description.—Test similar in size, amount of compression, arrangement of chambers and in their number to *P. compressa,* but it differs from the latter in having a number of definite costæ running over every chamber. There would be some doubt about the validity of this variety were it not for the fact that the amount of striation is so great and so entirely different from the common *P. compressa.* It is no doubt easy to find in Brady's illustrations of the species indications of costæ, but when these become constant and well-defined there is good reason to regard the forms as a variety.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run.

Collection.—Maryland Geological Survey.

POLYMORPHINA ELEGANTISSIMA Parker and Jones.

Plate CXXXIII, Fig. 3.

Polymorphina elegantissima Parker and Jones, 1865, Philos. Trans. of Roy. Soc., vol. clv, table x, p. 438.

Description.—Test ovoidal, anterior end acute, posterior obtusely rounded; chambers four or five, elongate, arranged in an inequilateral biserial manner and overlapping in such a way that while one side remains nearly flat the opposite is more or less irregularly vaulted and shows all the chambers in parallel arrangement; final segment broad below, embracing, and bearing the mammillate aperture upon the anterior end. Shell surface smooth; finely perforate. *Polymorphina anceps* Reuss, and *P. problema var. deltoidea* Reuss are probably identical with this species. The same species is found in the Eocene at Woodstock, Virginia.

Occurrence.—Calvert Formation. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Polymorphina gibba (d'Orbigny).

Plate CXXXIII, Fig. 4.

Globulina gibba d'Orbigny, 1846, Foram. Foss. Vienne, p. 227, pl. xiii, figs. 13, 14.
Polymorphina gibba Bagg, 1901, Md. Geol. Survey, Eocene, p. 248, pl. lxiii, fig. 12.

Description.—Test subglobular, apex slightly produced, base obtusely rounded, consisting of from two to four chambers compactly joined and overlapping. The surface is smooth, unmarked by any septal constriction. Septa visible as fine oblique lines. In transverse section the shell appears almost circular. The aperture is mammillate and the specimens we have are rather small. It occurs in the Eocene of Maryland but is never a common species.

Occurrence.—Calvert Formation. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Polymorphina lactea (Walker and Jacob).

Plate CXXXIII, Figs. 5, 6.

Serpula lactea Walker and Jacob, 1798 (*fide* Kanmacher's Ed.), Adams Essays, Microsc., p. 634, pl. xiv, fig. 4.
Polymorphina lactea Bagg, 1898, Bull. Amer. Pal., No. 10, p. 31.
Polymorphina lactea Bagg, 1901, Md. Geol. Survey, Eocene, p. 248, pl. lxiii, fig. 13.

Description.—This rather common form of *Polymorphina* has an ovate or subpyriform test, only slightly compressed and has but three or four chambers with flush sutures and faint septal lines. The aperture is terminal, radiate. It occurs as a fossil as early as the Jurassic and is present from there on with increasing numbers.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

POLYMORPHINA REGINA Brady, Parker and Jones.

Plate CXXXIII, Fig. 7.

Polymorphina regina Brady, Parker and Jones, 1870, Trans. Linn. Soc. London, vol. xxvii, p. 241, pl. xii, fig. 32, a, b.

Description.—The external ornament of closely set, regular longitudinal costæ serve to separate this species from its congenitors, *P. problema* and *P. oblonga.* There are six or seven chambers clustered about a central axis and with deeply depressed septal lines. Species of striate *Polymorphina* are comparatively rare and but few occur. In present oceans this species is confined to shallow waters near islands in the Pacific.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus UVIGERINA d'Orbigny.

The essential features of the genus *Uvigerina* consist of an elongated spire of irregular shaped chambers arranged in three series and terminating in an elongated tubular neck upon which is situated the everted lip around the aperture. The normal triserial arrangement is not always adhered to and biserial forms occur as well as those with more than three chambers in one series. The surface of the shell is also variously ornamented and in other cases the chambers are smooth.

Morphologically it is related to the *Polymorphinæ* but the aperture alone is sufficient to distinguish the two. It dates from the Eocene period and exists in present oceans at all depths and over all seas.

UVIGERINA CANARIENSIS d'Orbigny.

Plate CXXXIII, Fig. 8.

Uvigerina canariensis d'Orbigny, 1839, Foram. Canaries, p. 138, pl. i, figs. 25–27.
Uvigerina canariensis Bagg, 1898, Bull. Amer. Pal., No. 10, p. 31.

Description.—The test of *Uvigerina canariensis* is recognized by its smooth surface although faint indications of striæ are sometimes seen here and in the form described by d'Orbigny under the name of *U. urnula* which is apparently the same species. The shell is of triserial arrangement of unequal lengths and chambers and ends in the characteristic tubular neck. The segments are more or less globose and distinct with definite suture with flaring aperture.

Occurrence.—ST. MARY'S FORMATION (?). Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

UVIGERINA PYGMÆA d'Orbigny.

Plate CXXXIII, Fig. 9.

Uvigerina pygmæa d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 269, pl. xii, figs. 8, 9; Modele No. 67.

Uvigerina pygmæa Bagg, 1898, Bull. Amer. Pal., No. 10, p. 32.

Description.—Test more or less broadly ovate, stoutly built, with thick shell wall. The chambers are numerous, large and globose, separated by depressed septal lines. The surface is marked by a number of prominent longitudinal costæ which are less numerous and larger than in the longer and more tapering *Uvigerina tenuistriata* Reuss. The primordial end is rounded and the anterior extended into a short tubular neck with flaring aperture. This interesting little species occurs quite frequently in the well-boring at Crisfield. Its geological range is from the Miocene to Recent.

Occurrence.—ST. MARY'S (?) FORMATION. Norfolk well (645 feet).

Collection.—Maryland Geological Survey.

UVIGERINA TENUISTRIATA Reuss.

Plate CXXXIII, Fig. 10.

Uvigerina tenuistriata Reuss, 1870, Sitzungsb. d. k. Akad. Wiss. Wien, vol. lxii, p. 485, pt. 1.

Uvigerina tenuistriata von Schlicht, 1870, Foram. Septar. Pietzpuhl, pl. xxii, figs. 34–37.

Uvigerina tenuistriata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 32.

Description.—Test much more finely striate than *Uvigerina pygmæa,* more slender, tapering to a small well-rounded end below and gradually increasing in size above. The chambers are not so globose and the septa are not so depressed as in *Uvigerina pygmæa.* The aperture at the end of a tubular neck as in typical *Uvigerina* forms. The species is less common than its near relative above referred to. Its geological range is from the Upper Oligocene to Recent.

Occurrence.—St. Mary's (?) Formation Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

Genus SAGRINA d'Orbigny.

D'Orbigny first used the generic term *Sagrina* for a biserial variety of *Uvigerina* with longitudinal costæ. Later he placed under the same a rough dimorphous Textularian which was distinguished from the genus *Gaudryina* in possessing a terminal raised aperture.

Parker and Jones have more recently applied the name *Sagrina* to a group of dimorphous *Uvigerinæ* which are typically textulariform in their primordial segments and nodosariform in their later ones. This dimorphous character is, however, not always followed and Brady has shown in the Challenger Report a number of forms wholly nodosarian in their growth. The shell is hyaline, perforate, and the exterior is subject to great variation of surface decoration. The aperture is in the form of a tubular raised neck with an everted phialine neck.

In existing oceans Brady says the genus is common in shallow waters of tropical seas. As a fossil it is not known prior to the Miocene epoch.

Sagrina spinosa n. sp.

Plate CXXXIII, Fig. 11.

Description.—This peculiar and interesting species somewhat resembles *S. raphanus* Parker and Jones, but differs from the latter in several particulars. The surface ridges in our specimen end in a series of projecting points which at the distal end become definite spines, though these are short and stubby. Again there are arched cross ridges between these costæ which while they may not indicate the internal structure of the chambers serve to mark their location. The aperture ends in a neatly raised phialine everted lip with central rounded orifice.

Occurrence.—Choptank Formation. Jones Wharf.

Collection.—Maryland Geological Survey.

Suborder PORCELLANEA.

Family MILIOLIDÆ.

Genus MILIOLINA Williamson.

"Shell free; convoluted; inequilateral; usually oblong; consisting of numerous segments, each of which in turn extends over the entire length of the shell. Convolutions not disposed in the same plane, but constantly changing their direction, so that parts of from three to six visible segments contribute in various proportions to form the external surface of the shell. Septal orifice large, alternately occupying opposite extremities of the shell; furnished with an appendicular tooth." Williamson.

MILIOLINA SEMINULUM (Linné).

Plate CXXXIII, Fig. 12.

Serpula seminulum Linné, 1767, Syst. Nat., 12 edit., p. 1264, No. 791; 13 edit. (Gmelin's), 1788, p. 3739, No. 2.

Miliolina seminulum Williamson, 1858, Rec. Foram. Gt. Brit., p. 85, pl. vii, figs. 183–185.

Miliola Marylandica Lea, 1833, Contrib. to Geol., p. 215, pl. 6, fig. 227.

Miliolina seminulum Bagg, 1898, Bull. Amer. Pal., No. 10, p. 23.

Description.—Test free, calcareous, imperforate; elliptical or oblong in outline; consisting of five visible elongate, smooth segments. The segments are arranged in an inequilateral manner around a *Miliolina* axis. The two outer ones extend the entire length of the shell with ends overlapping and the aperture in the extremity of the larger segment forms a horseshoe-shaped opening with appendicular tooth in its center.

This species does not extend back prior to the Eocene. It is in existing oceans one of the most cosmopolitan species, extending from the extreme Arctic regions through the equator to the Antarctic region in the south and it is present at all depths from shallow pools to 3000 fathoms.

It is more abundant in Virginia than in Maryland. This species of *Miliolina* was the first foraminifer described from the Maryland Miocene. It was figured and described by Isaac Lea under the name *Miliola marylandica* in his "Contributions to Geology." From his description and figure there can be no doubt about the species referred to as a typical example of *M. seminulum.*

Occurrence.—St. Mary's Formation. St. Mary's River. Choptank Formation. Jones Wharf, Governor Run.

Collection.—Maryland Geological Survey.

Genus SPIROLOCULINA d'Orbigny.

In the genus *Spiroloculina* the segments are arranged in one plane and the chambers extend the entire length of the shell in alternating series with the aperture successively changing from end to end as the form enlarges. This fact of the appearance of all the chambers upon both sides of the shell serves to distinguish the genus from *Miliolina* types of two or more overlapping chambers and the *Biloculina* type in which only two chambers ever appear externally. The genus is subject to considerable variation and the symmetry of the shell is not always followed. The genus inhabits shallow waters of tropical and temperate zones and is rarely met with at depths beyond 600 fathoms. As a fossil the genus is known from the several portions of the Lias and it has been recognized in almost every succeeding formation.

Spiroloculina grata Terquem.

Plate CXXXIII, Fig. 14.

Spiroloculina grata Terquem, 1878, Mém. Soc. géol. France, ser. iii, vol. i, p. 55, pl. x, figs. 14–15.

Description.—Test broadly oval or almost circular in outline; chambers, four, Milioline, covered with definite striations upon their outer surface which is the chief characteristic of the species. The umbilical region is depressed and the outer chambers are somewhat enlarged towards their margin, suggesting a thickening of the shell as well as an increase in size. The surface striations are in our specimen nearly parallel to the several chambers, but Brady mentions the fact that these are sometimes oblique and often irregular. While in typical forms the aperture ends in an elongated neck. In our specimen it appears broken so that this feature is not apparent.

The only specimen we have of this peculiar tropical form is from the sands at Chesapeake Beach, where the Foraminifera are best developed in the Maryland beds. It is a coral reef species in existing seas and is a shallow water form. It is not known before the middle Tertiary.

Occurrence.—Calvert Formation. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Spiroloculina tenuis (Czjzek).

Plate CXXXIII, Fig. 13.

Quinqueloculina tenuis Czjzek, 1847, Haidinger's Naturw. Abhandl., vol. ii, p. 149, pl. xiii, figs. 31-34.

Description.—The test of *Spiroloculina tenuis* is in small delicate specimens Spiroloculine from beginning to end, but in larger forms it shows a thickening at the center on account of the earliest segments not being set in one plane, and it is probably on this account that the species has so often been grouped with *Quinqueloculina.* It has a rather broadly oval contour in our Miocene specimen and the several chambers are smooth and run in alternate series from end to end.

Fossil specimens are met with throughout the European Tertiaries and in existing seas it inhabits all great ocean basins and according to Brady it is especially abundant in the South Pacific. It occurs at all depths and good specimens are met with at considerable depths.

Occurrence.—Choptank Formation. Pawpaw Point.

Collection.—Maryland Geological Survey.

PLANTÆ.

PHANEROGAMIA.

Class ANGIOSPERMÆ.

Subclass DICOTYLEDONEÆ.

Order FAGACEÆ.

Genus QUERCUS Linné.

Quercus lehmanii n. sp.

Description.—Leaves small, narrow, about 1.3 in. long by 0.5 in. maximum width, irregularly lobed; lobes short, acuminate or wedge-shaped, resembling coarse teeth; apex acuminate; base wedge-shaped (?); midrib straight; secondary nerves slender and somewhat flexuous, forming acute angles with the midrib, each terminating in the extremity of a lobe, except the lowest ones, which curve upward sub-parallel to the margin. This species closely resembles some forms of the living *Q. emoryi* Torr. It is represented in the collection by a number of imperfect specimens. Named after the collector, Mr. W. V. Lehman.

Occurrence.—CALVERT FORMATION. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

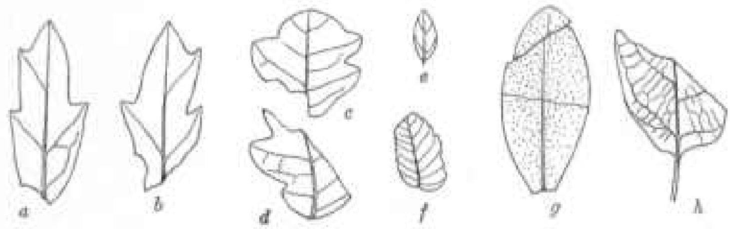

FIG. 1.—FOSSIL LEAVES FROM GOOD HOPE HILL, PRINCE GEORGE'S COUNTY.

Figs. *a*, *b*. Quercus lehmanii n. sp.
Figs. *c*, *d*. Rhus milleri n. sp.
Figs. *e*. Cæsalpinia ovalifolia n. sp.
Fig. *f*. Ulmus basicordata n. sp.
Fig. *g*. Picris scrobiculata n. sp.
Fig. *h*. Phyllites sp.?

Order ULMACEÆ.

Genus ULMUS Linné.

ULMUS BASICORDATA n. sp.

Description.—Leaf very small, 0.5 in. long by 0.3 in. wide, inequilateral, somewhat curved towards the narrower side, serrate; base cuneate-cordate; secondary nerves numerous, about 8 on each side, simple or the lower ones once-forked, irregularly disposed, forming varying angles with midrib, all curving upward and terminating in the serrations of the margin.

This little leaf has considerable resemblance to some of the forms of *Planera ungeri* Ett. (Fos. Fl. Wein., p. 14, pl. ii, figs. 5-18) especially to fig. 12, l. c., but in ours the base is more prominently and distinctly rounded and cordate. It differs from this figure, however, far less than Ettingshausen's figures differ between themselves.

Occurrence.—Calvert Formation. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

Genus CAESALPINIA Linné.

Caesalpinia ovalifolia n. sp.

Description.—Leaf very small, about 7/20 in. long by 3/20 in. maximum width, ovate-laceolate, slightly unsymmetrical, entire, tapering to an acute tip and to a somewhat rounded base, very short petioles; midrib slightly curved; secondary nerves forming acute angles with the midrib and curving upward.

This specimen apparently represents a leaflet of some compound leguminous leaf and it may be compared with a number of fossil forms described under the genera *Leguminosites, Caesalpinia,* etc. It resembles *C. townshendi,* Heer (Fl. Tert. Helvet., vol. iii (1859), p. iii, pl. cxxxvii, figs. 26-37) especially fig. 9, l. c.

Occurrence.—Calvert Formation. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

Order ANACARDIACEÆ.

Genus RHUS Linné.

Rhus milleri n. sp.

Description.—Leaves small, broad, about 9/10 in. long by 4/5 in. maximum width, irregularly lobed; lobes short, rounded or bluntly wedge-shaped; apex broad and obtuse; base rounded or cuneate; midrib somewhat curved; secondary nerves slender, slightly flexuous, forming obtuse angles with the midrib, the principal ones extending to the extremities of the lobes, the upper ones to the margin, the lower ones and others of intermediate rank apparently thickening out and anastomosing.

This species is one of the commonest in the locality where found. It closely resembles the leaflets of *R. mysurensis* Heyne, from the East Indies and also small forms of *R. toxicodendron* L., both of which are living species. There does not seem to be any recognized fossil form with which it may be compared. Named for Dr. B. L. Miller, who first collected it.

Occurrence.—Calvert Formation. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

Genus PIERIS Don.

Pieris scrobiculata n. sp.

Description.—Leaf about 1.3 in. long by 0.6 in. wide at middle, ellipsoidal, narrowed to the base and rounded to an obtuse apex, entire; surface thickly punctate or pitted (?); midrib straight; secondary nervation not visible.

This leaf, represented in the collection by the single specimen figured, was apparently of a coriaceous texture, similar to many of our Ericaceous shrubs, and it was either rough or beset with hirsute appendages, which have given an appearance of punctation to the surface; or possibly this appearance may be due to the presence of some fungoid growth and not to any character of the leaf. Similar markings on fossil leaves have been described and figured under the genera *Sphæria* or *Sphærites* (*S. vaccinii* Sep., Fl. Foss. d'Aix, pt. i, p. 6, pl. i, fig. 5; *S. palæolauri*, Ett., Foss. Fl. Leoben, pt. i, p. 5 [265], pl. i, fig. 6 etc.) The leaf is similar, in general appearance, to those of the living *P. nitida* (Bartr) Beuth and Hook.

Occurrence.—Calvert Formation. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

Genus PHYLLITES Brongniart.

Phyllites sp. (?)

Description.—This specimen is too imperfect for either accurate comparison or adequate description, but the basal characters are so well preserved that it was thought advisable to depict it, pending the possible future discovery of more complete material.

Occurrence.—Calvert Formation. Good Hope Hill Road.

Collection.—Maryland Geological Survey.

CRYPTOGAMIA.

THALLOPHYTA.

Class ALGÆ.

Order DIATOMACEÆ.[1]

Tribe RAPHIDIEÆ.

Family CYMBELLEÆ.

Genus CYMBELLA, C. Azardk.

CYMBELLA CISTULA (Hemprick).

Family NAVICULEÆ.

Genus NAVICULA Bory.

NAVICULA PRAETEXTA Ehrenberg.

NAVICULA SCHAARSCHMIDTII Pantocsek.

NAVICULA SCHULTZEI Kain.

NAVICULA KENNEDYI Wm. Smith.

NAVICULA LYRA Ehrenberg.

Genus DIPLONEIS Ehrenberg.

DIPLONEIS MICROTATOS VAR. CHRISTIANII CLEVE.

Plate CXXXV, Fig. 5.

Rhapidodiscus marylandica Christian, 1887, The Microscope, vol. vii, p. 67.
Rhapidodiscus Christianii Gascoyne, 1887, The Microscope, vol. vii, p. 67.
Rhapidodiscus Febigerii Christian, 1887, The Microscope, vol. vii, pp. 66, 67. figs.
Diploneis microtatos var. *Christianii* Cleve, 1894, Naviculoid Forms, pt. i, p. 96, pl. ii, fig. 1.

Description.—Valve orbicular. Diam. .039 mm. Rows of alveoli radiating from the median line, indistinct in the middle. "Median line with distant central pores, and ending at a considerable distance from the

[1] The most common and important diatoms are alone figured and described. The undescribed forms have been determined by the author from several collections placed at his disposal.

margin. Furrows broad; their outer margins enclosing an elliptical space half as broad as the valve." Cleve, 1894.

This *Diploneis*, originally named *Rhapidodiscus* because when found it had been accidentally enclosed, as was proved later, in the rim of a *Melosira*, is of interest by reason of its orbicular form, although otherwise naviculoid. The *Naviculeae* appear to be introduced in the Miocene deposits by this genus, several forms of which are rather common, while *Navicula* proper is scarcely seen until a later period.

Occurrence.—Calvert Formation. Plum Point, Cambridge Well (rare).

Collection.—Maryland Geological Survey.

Diploneis crabro var. limitana Schmidt.
Diploneis didyma (Ehrenberg).
Diploneis prisca Schmidt.

Genus PINNULARIA Ehrenberg.

Pinnularia peregrina Ehrenberg.

Genus PLEUROSIGMA Wm. Smith.

Pleurosigma normanii Wm. Smith.
Pleurosigma normanii var. marylandica (Grunow).

Tribe PSEUDO-RAPHIDIEÆ.

Family FRAGILLARIEÆ.

Genus DIMEROGRAMMA Ralfs.

Dimerogramma fossile Grunow.
Dimerogramma fulvum (Gregory).
Dimerogramma novae-caesarae Kain and Schültze.

Genus RHAPHONEIS Ehrenberg.

Rhaphoneis gemmifera Ehrenberg.

Plate CXXXV, Fig. 11.

Rhaphoneis gemmifera Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 87.
Rhaphoneis gemmifera Van Heurck, 1881, Syn. Diat. Belg., pl. xxxvi, fig. 31.

Description.—Valve rhombic-lanceolate, with large, rounded granules in longitudinal rows. L. of v. .095 mm.

Variable in size and outline, as are all the species of this genus. Intermediate forms are frequent, and some approach *Sceptroneis gemmata* which, also, in some forms is near *Sceptroneis caduceus*.

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

RHAPHONEIS AMPHICEROS Ehrenberg.

RHAPHONEIS FUSUS Ehrenberg.

RHAPHONEIS LANCETTULA Grunow.

RHAPHONEIS LINEARIS (Grunow).

RHAPHONEIS RHOMBUS Ehrenberg.

RHAPHONEIS SCALARIS Ehrenberg.

Genus SCEPTRONEIS Ehrenberg.

SCEPTRONEIS CADUCEUS Ehrenberg.

Plate CXXXV, Fig. 12.

Sceptroneis caduceus Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 264.
Sceptroneis caduceus Ehrenberg, 1856, Mikrogeologie, pl. 33, xvii, fig. 15.
Sceptroneis caduceus Van Heurck, 1881, Syn. Diat. Belg. pl. xxxvii, fig. 5.

Description.—Valve lanceolate, larger at the middle and usually with one end more or less capitate. Surface with rounded granules in transverse lines. L. of v. .122 mm.

This species is variable in size and outline and appears to pass into *S. gemmata.*

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

SCEPTRONEIS GEMMATA Grunow.

Genus SYNEDRA Ehrenberg.

SYNEDRA LINEA Ehrenberg.

Family TABELLARIEÆ.

Genus GRAMMATOPHORA Ehrenberg.

GRAMMATOPHORA STRIATA VAR. FOSSILIS Grunow.

Tribe CRYPTO-RAPHIDIEÆ.

Family CHÆTOCEROS.

Genus DICLADIA Ehrenberg.

DICLADIA CAPREOLUS Ehrenberg.

Genus HERCOTHECA Ehrenberg.

HERCOTHECA NEAMMILARIS Ehrenberg.

Genus PERIPTERA Ehrenberg.

PERIPTERA TETRACLADIA Ehrenberg.

Genus CHÆTOCEROS Ehrenberg.

CHÆTOCEROS DIPLONEIS Ehrenberg.

Genus DITYLIUM Bailey.

DITYLIUM UNDULATUM Ehrenberg.

Genus STEPHANOPYXIS Ehrenberg.

STEPHANOPYXIS APICULATA Ehrenberg.

STEPHANOPYXIS CORONA (Ehrenberg).

Plate CXXXV, Fig. 13.

Systephania corona Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 272.
Systephania corona Ehrenberg, 1856, Mikrogeologie, pl. 33, xv, fig. 22, etc.
Stephanopyxis corona Van Heurck, 1881, Syn. Diat. Belg. pl. lxxxiii, ter. figs. 10, 11.

Description.—Valves circular, dissimilar. Surface flat or convex, closely reticulate, the cells equal. A dense row of spines is placed near the margin. The valves differ from each other in convexity and in the nearness of spine to the margin. Diam. .072 mm.

Occurrence.—Calvert Formation. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

Stephanopyxis limbata Ehrenberg.

Stephanopyxis turris (Greville).

Genus PARALIA Heiberg.

Paralia sulcata (Ehrenberg).

Plate CXXXV, Fig. 9.

Gallionella sulcata Ehrenberg, 1840, Abhand. Berl. Akad., pl. iii, fig. 5.

Melosira sulcata Kützing, 1844, Bacill. p. 55, pl. ii, fig. 7.

Gallionella sulcata Ehrenberg, 1856, Mikrogeologie, pl. 33, xiv, fig. 13; xvi, figs. 12, 15.

Orthosira marina Wm. Smith, 1856, Brit. Diat., vol. ii, p. 59, pl. liii, fig. 338.

Paralia sulcata Cleve, 1894, Arctic Diat., p. 7.

Paralia sulcata Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. clxxvi, figs. 35–37, 39.

Melosira sulcata Van Heurck, 1881, Syn. Diat. Belg., pl. xci, figs. 16–18.

Description.—Valves circular, the frustule attached in cylindrical filaments. Border of valve coarsely cellular, the central part depressed with delicate striæ covering from the ring forming the junction of the frustules, but not always reaching the center. Diam. .049 mm. (av).

Extremely abundant in all deposits. Occurs living and in fossil deposits in all parts of the world, especially in the Miocene.

Occurrence.—Calvert Formation. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

Genus STEPHANOGONIA Ehrenberg.

STEPHANOGONIA POLYGONA Ehrenberg.

STEPHANOGONIA QUADRANGULA Ehrenberg.

Family BIDDULPHIÆ.

Genus BIDDULPHIA Gray.

BIDDULPHIA ACUTA (Ehrenberg).

Plate CXXXIV, Fig. 6.

Triceratium acutum Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 272.
Triceratium acutum Brightwell, 1853, Quart. Jour. Roy. Mic. Soc., vol. i, p. 251, pl. iv, fig. 16.
Triceratium acutum Van Heurck, 1881, Syn. Diat. Belg., pl. cviii, fig. 1.
Biddulphia acuta Boyer, 1901. Proc. Acad. Nat. Sci. Phila., vol. lii, p. 706.

Description.—" Valve triangular, sides slightly convex and processes at the angles somewhat acute. Surface flat, reticulated, cells hexagonal, 2 in .01 mm. at the centre, 3 in .01 mm. at the border, not radiate. L. of s. .04 mm. to .122 mm." Boyer, 1901.

Biddulphia acuta resembles *Biddulphia favus* (Ehrenberg) which does not occur in the Miocene deposits but is abundant in later deposits and is found living along the coast. The former is, probably, therefore, to be considered as the original or type form.

Occurrence.—CALVERT FORMATION. Marriott Hill, God's Grace Point. Not common.

Collection.—Maryland Geological Survey.

BIDDULPHIA AMERICANA (Ralfs).

BIDDULPHIA AURITA (Lyngbye).

BIDDULPHIA CONDECORA (Ehrenberg).

Plate CXXXIV, Fig. 7.

Triceratium condecorum Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin p. 272.
Triceratium condecorum Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxxvi, fig. 28 (not 27 as given).
Biddulphia condecora Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 720.

Description.—Valve triangular with nearly straight sides and obtuse angles. Surface flat or slightly depressed at the center, with rounded puncta arranged in rows which radiate in undulating lines from the center. L. of s. .145 mm.

The form as figured represents a well-developed specimen, but irregular and much smaller forms are frequent. It differs from *B. americana* (Ralfs) in the pearly character of the puncta and in the undulations of their rows. It is typical of the entire Miocene deposits of the eastern states and occurs rarely in the deposits of Oawain, New Zealand and in the *var. neogradense* Grunow has been noticed in the Hungarian deposits.

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

BIDDULPHIA COOKIANA Kain and Schultze.

BIDDULPHIA DECIPIENS Grunow.

Plate CXXXIV, Fig. 8.

Biddulphia decipiens Van Heurck, 1881, Syn. Diat. Belg., pl. c, figs. 3, 4.
Amphitetras (Biddulphia) altenans, H. L. Smith, 1887, The Microscope, p. 67 (with fig.).
Biddulphia decipiens Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 716.

Description.—Valve rhomboidal, with the sides turgid and produced, giving, therefore, a cruciform outline. Surface rising suddenly from near the margin into an ellipsoidal elevation, the major diameter of which is at right angles to the major axis of the valve, with hexagonal reticulations, about 5 in .01 mm., at the center, from which they radiate toward the processes and rounded angles of the sides where they are about 9 in .01 mm. Processes inflated at the base, small and obtuse. At the margin of the elevation, placed obliquely on each side, a strong spine projects. The figure represents a smaller but more common form.

Occurrence.—CALVERT FORMATION. Marriott Hill, God's Grace Point, 1 mile north of Jones Point. Not uncommon.

Collection.—Maryland Geological Survey.

BIDDULPHIA GRANULATA Roper.

BIDDULPHIA INTERPUNCTATA (Grunow).

Plate CXXXIV, Fig. 9.

Triceratium interpunctatum Grun., Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxxvi, fig. 7.

Biddulphia interpunctata Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 722.

Description.—Valve triangular with straight sides and rounded angles. Surface flat with rounded puncta, 3 in .01 mm. with much smaller puncta at intervals. L. of s. .075 mm. to .115 mm. Color blue, under low powers.

Occurrence.—CALVERT FORMATION. ½ mile north of Forest Wharf, 1 mile north of Jewell, 1 mile northwest of West River, 1 mile south of Chesapeake R. R. Bridge, 1 mile north of Jones Point. (Rather common.)

Collection.—Maryland Geological Survey.

BIDDULPHIA MOBILIENSIS Bailey.

BIDDULPHIA QUADRICORNIS (Grunow).

BIDDULPHIA RETICULUM (Ehrenberg).

BIDDULPHIA SEMICIRCULARIS (Brightwell).

Plate CXXXIV, Fig. 10.

Triceratium semicirculare Brightwell, 1853, Quart. Jour. Roy. Mic. Soc. vol. i, p. 252, pl. iv, fig. 21.

Triceratium obtusum Ehrenberg, 1856, Mikrogeologie, pl. xviii, fig. 49 (in part).

Triceratium semicirculare Van Heurck, 1881, Syn. Diat. Belg., pl. cxxvi, fig. 20.

Biddulphia semicircularis Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii p. 726.

Description.—Valve lunate, appearing as if divided half-way between the center and the obtuse ends by two very faint costate lines. Surface elevated at the center and at the ends, with rounded puncta, about 3 in .01 mm., concentric and radiating from a hyaline center, smaller at the ends. L. of s. av. .099 mm.

Occurrence.—CALVERT FORMATION. ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

BIDDULPHIA RETICULOSA Grunow.

BIDDULPHIA SUBORBICULARIS Grunow.

Plate CXXXIV, Fig. 11.

Triceratium orbiculatum Shadbolt, 1854, Trans. Roy. Mic. Soc. London, p. 14, pl. 1, fig. 6.

Biddulphia angulata Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. cxli, figs. 7, 8.

Biddulphia suborbicularis Grun., Van Heurck, 1881, Syn. Diat. Belg. pl. c, figs. 15, 16.

Biddulphia suborbicularis Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 705.

Description.—Valve suborbicular, frequently with several irregular, angular projections. Processes often unequal, inflated at the base and truncate. Surface elevated half-way between the processes and center, at which a depression occurs with reticulations from 5 to 8 in .01 mm., increasing in size toward the circumference and radiating in slightly undulating lines. Two, rarely three or four, stout spines are placed obliquely opposite half-way between center and circumference. L. of s. .089 mm.

Occurrence.—CALVERT FORMATION. 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

BIDDULPHIA SUBROTUNDATA Schmidt.

BIDDULPHIA TESSELLATA (Greville).

Plate CXXXIV, Fig. 12.

Triceratium tessellatum Greville, 1861, Trans. Roy. Mic. Soc. London, vol. ix, p. 71, pl. viii, fig. 14.

Triceratium robustum Greville, 1861, Trans. Roy. Mic. Soc. London, vol. ix, pl. viii, fig. 15.

Triceratium amoenum Greville, 1861, Trans. Roy. Mic. Soc. London, vol. ix, p. 75, pl. lx, fig. 7.

Triceratium secernendum Schmidt, Atlas der Diatomaceen-kunde, pl. lxxvi, fig. 34.

Biddulphia tessellata Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 723.

Description.—Valve triangular, with straight or slightly concave sides and rounded angles. Surface usually somewhat convex at the center, with rounded, elliptical, hexagonal or subquadrate reticulations about 3 in .01 mm., but smaller at the center, arranged in more or less concentric rows and much smaller at the extremities of the angles which appear hyaline under low magnification, where they are from 8 to 15 in .01

mm. Small puncta occasionally occur scattered among the larger. L. of s. .049 mm. to .099 mm. Variable.

Occurrence.—Calvert Formation. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

Biddulphia tridens Ehrenberg.

Genus TERPSINOË Ehrenberg.

Terpsinoë americana (Bailey).

Genus ANAULUS Ehrenberg.

Anaulus birostratus (Grunow).

Genus HEMIAULUS Ehrenberg.

Hemiaulus bifrons Ehrenberg.

Hemiaulus polycistuiorum Ehrenberg.

Hemiaulus solenoceros (Ehrenberg).

Genus PLOIARIA Pautocsek.

Ploiaria petasiformis Pautocsek.

Genus GRAYA Grove and Brun

Graya argonauta Grove and Brun.

Plate CXXXV, Fig. 8.

Graya argonauta Grove and Brun, 1896, Van Heurck, in Treatise on the Diatomaceae, (Baxter's translation), p. 458, fig. 187.
Graya argonauta Boyer, 1901, Proc. Acad. Nat. Sci. Phila., vol. lii, p. 742.

Description.—Valve elliptical. Surface elevated at the center and ends, subtly punctate near the margin, the puncta becoming more prominent along the longitudinal axis, where they are about 7 in .01 mm., radiating from a nodular center. Zonal view quadrangular. L. of s. .099 mm. to .181 mm.

Occurrence.—Calvert Formation. 1 mile east of Marriott Hill, 1 mile north of Jewell, Lyons Creek, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge.

Collection.—Maryland Geological Survey.

Genus ENCAMPIA Ehrenberg.

ENCAMPIA ZODIACUS Ehrenberg.

Genus DISCOPLEA Ehrenberg.

DISCOPLEA GRANULATA Ehrenberg.

Family EUPODISCEÆ.

Genus AULISCUS Ehrenberg.

AULISCUS CABALLI Schmidt.

AULISCUS PRUNOSUS Bailey.

Genus PSEUDAULISCUS Leuduger-Fortmorel.

PSEUDAULISCUS SPINOSUS (Christian).

Plate CXXXV, Fig. 10.

Auliscus spinosus Christian, 1887, The Microscope, fig. p. 68.
Pseudauliscus spinosus Rattray, 1888, Quart. Jour. Roy. Mic. Soc., London, vol. ii, p. 44.

Description.—Valve suborbicular, with a broad border nearly half the radius in width, separated from central part by a well-defined line. Markings about 10 in .01 mm., irregular at the center and radiating in curved lines toward the circumference, alternate rows on the border more evident, curving inwards near the ocelli. Margin striated. Ocelli circular, near the edge. A number of small spurs are found outside of the intermediate ring. On opposite sides half-way between the ocelli one or two small spines are seen. Diam. .056 to .171 mm.

Occurrence.—CALVERT FORMATION. Fairhaven, 1 mile northwest of West River, Cambridge Artesian Well. Rare. In the artesian well deposit of Mays Landing, New Jersey, the valves are quite large and not uncommon.

Collection.—Maryland Geological Survey.

PSEUDAULISCUS RADIATUS (Bailey).

PSEUDAULISCUS RALFSIANUS (Greville).

Genus AULACODISCUS Ehrenberg.

AULACODISCUS ROGERSII (Bailey).

Plate CXXXIV, Fig. 5.

Podiscus Rogersii Bailey, 1844, Amer. Jour. Sci., vol. xlvi, p. 137, pl. iii, figs. 1, 2.
Aulacodiscus Rogersii Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. cvii, fig. 3.
Aulacodiscus Rogersii Rattray, 1888, Quart. Jour. Roy. Mic. Soc., London, ser. ii, vol. viii, pl. 372.

Description.—Valve circular, flat at center and then rising to near the margin toward which it slopes abruptly. Surface coarsely reticulate and punctate. Processes, three to seven. Diam. av. .181 mm.

Occurrence.—Calvert Formation. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

Aulacodiscus crux Ehrenberg.

Aulacodiscus margaritaceus var. mölleri Grunow

Aulacodiscus sollittanus Norman.

Genus EUPODISCUS Ehrenberg.

Eupodiscus inconspicuus Rattray.

Plate CXXXV, Figs. 6, 7.

Eupodiscus inconspicuus Rattray, 1888, Trans. Roy. Mic. Soc. London, vol, ix, p. 911.

Description.—Valve circular with flat surface. Markings in irregular rows, hexagonal, finely punctate, 1½ to 2 in .01 mm., on the larger forms, smaller near the margin. Ocelli 3 to 11 on the narrow hyaline border. Diam. .171 mm. (of larger forms). Rattray's description applies to small forms only with 4 ocelli.

This form may possibly be *Eupodiscus radiatus* var. *antiqua* J. D. Cox (Ms.). Rattray states that "it shows no close affinity" to *E. radiatus*. The larger forms, however, approach very nearly in appearance, except in the number of ocelli, to the form known as *radiatus* so abundant along the southern coast of the United States.

Occurrence.—Calvert Formation. Near Parker Creek, Plum Point, Flag Pond, Fairhaven, Chesapeake Beach, God's Grace Point. (Not common.)

Collection.—Maryland Geological Survey.

Family ACTINOPTYCHEÆ.

Genus ACTINOPTYCHUS Ehrenberg.

ACTINOPTYCHUS HELIOPELTA Grunow.

Plate CXXXIV, Fig. 3.

Actinoptychus heliopelta Grunow.
Heliopelta Metii Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 268.
Heliopelta Leeuwenhockii Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 268.
Heliopelta Euleri Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss, Berlin, p. 268.
Heliopelta Leeuwenhockii Ehrenberg, 1856, Mikrogeologie, pl. 33, xviii, fig. 5.
Heliopelta eulери Ehrenberg, 1856, Mikrogeologie, pl. 33, xviii, fig. 6.
Actinoptychus heliopelta Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. cix, fig. 2.
Actinoptychus heliopelta Van Heurck, 1881, Syn. Diat. Belg., pl. cxxiii, fig. 3.

Description.—Valve circular, divided into sectors, from six to twenty, alternately elevated and depressed. Central space stellate, hyaline. Border with numerous spine-like processes. Surface reticulate and granular. Diam. .297 mm. (av.).

This is the most elegant of all the American diatoms. Its presence in an undisturbed deposit is an undoubted indication of the lower horizon in which it is found.

The specific names quoted above, with numerous others, distinguished forms which differed from each other chiefly in the number of sectors or divisions of the valve.

Occurrence.—CALVERT FORMATION. 1 mile east of Marriott Hill, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile north of Jewell, 1 mile north of Jones Point.

Collection.—Maryland Geological Survey.

ACTINOPTYCHUS PRAETOR Schmidt.

ACTINOPTYCHUS SPLENDENS Shadbolt.

ACTINOPTYCHUS UNDULATUS Kützing.

Plate CXXXIV, Fig. 4.

Actinocyclus sp. Bailey, 1842, Amer. Jour. Sci., vol. xlii, p. 105, pl. ii, figs. 9, 10, 11.
Actinocyclus undulatus Kützing, 1844, Bacill., p. 132, fig. xxiv.
Actinoptychus undulatus Ralfs, 1861, in Pritchard's Infusoria, p. 839, pl. v, fig. 88.

Description.—Valve circular, divided into six sectors, alternately elevated and depressed. Surface cellular and punctate. Processes three, at the margin of alternate sectors. Central space hexagonal, hyaline. Diam. quite variable.

This species is widely distributed both recent and fossil and is especially abundant in the Maryland Miocene. It appears to take the place in the middle and upper beds of *A. heliopelta* with which it may be connected by the variety *versicolor* Brun.

Occurrence.—

Collection.—Maryland Geological Survey.

ACTINOPTYCHUS VULGARIS VAR. VIRGINIAE Grunow.

Genus SCHNETTIA De Toni.

SCHNETTIA AMBLYOCEROS (Ehrenberg).

Family ASTEROLAMPREÆ.

Genus MASTOGONIA Ehrenberg.

MASTOGONIA ACTINOPTYCHUS Ehrenberg.

MASTOGONIA CRUX Ehrenberg.

MASTOGONIA SEXANGULATA Ehrenberg.

Genus ASTEROLAMPRA Ehrenberg.

ASTEROLAMPRA MARYLANDICA Ehrenberg.

ASTEROLAMPRA DALLASIANA Greville.

Family COSCINODISCEÆ.

Genus CRASPEDODISCUS Ehrenberg.

CRASPEDODISCUS COSCINODISCUS Ehrenberg.

Plate CXXXV, Fig. 3.

Craspedodiscus Coscinodiscus Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 266.
Craspedodiscus coscinodiscus Ehrenberg, 1856, Mikrogeolgie, pl. 33, xvi, fig. 8.
Craspedodiscus microdiscus Ehrenberg, 1856, Mikrogeologie, pl. 33, xvii, fig. 84.
Craspedodiscus coscinodiscus Ralfs, 1861, Pritchard's Infusoria, p. 832.
Craspedodiscus coscinodiscus Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxvi, figs. 3, 4.

Description.—Valve circular, with sharply defined border equal in width to the semi-radius. Central part with small central space and somewhat indistinct hexagonal markings, 7 in .01 mm. Markings of border hexagonal, 3 in .01 mm. Diam. .132 mm.

Occurrence.—CALVERT FORMATION. Fairhaven, Nomini Bay, God's Grace Point, ½ mile north of Forest Wharf, 1 mile north of Jewell, 1 mile south of Chesapeake R. R. Bridge. Found also in the Barbadoes deposit and at Moron, Spain, Trinidad, and Nicobar Islands.

Collection.—Maryland Geological Survey.

CRASPEDODISCUS ELEGANS Ehrenberg.

Plate CXXXV, Fig. 4.

Craspedodiscus elegans Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 266.
Craspedodiscus elegans Bailey, 1845, Amer. Jour. Sci., vol. xlviii, pl. iv, fig. D.
Craspedodiscus elegans Ehrenberg, 1856, Mikrogeologie, pl. 33, xviii, fig. 2.
Craspedodiscus elegans Ralfs, 1861, Pritchard's Infusoria, p. 832.
Craspedodiscus elegans Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxvi, fig. 1.

Description.—Valve circular with well-defined border equal in width to one-fourth the radius, its markings quadrate in oblique rows $1\frac{1}{2}$ in .01 mm. Central part undulating, markings hexagonal, 2 to 3 in .01 mm., larger at the center and near the semi-radius, rather coarsely punctate as are those of the border. Diam. .300 mm.

This appears to be exclusively a Maryland form found only in the lower or "Nottingham"[2] deposit, where, however, in certain cleanings, it is rather common.

Occurrence.—CALVERT FORMATION. 1 mile east of Marriott Hill, 1 mile south of Chesapeake R. R. Bridge, 1 mile north of Jewell.

Collection.—Maryland Geological Survey.

[2] Note on the "Bermuda" deposits. Professor J. W. Bailey of the U. S. Military Academy at West Point, published in Silliman's Journal, in 1845, an article entitled "Notice of Some New Localities of Infusoria, Fossil and Recent." On page 323 one of the localities is referred to as the "Bermuda Islands", certain material labelled "Tripoli from Bermuda" having been received from a correspondent, Mr. Tuomey. Professor Bailey believed that the deposit probably came from the Bermuda Islands, although he says that it is "remarkable that a deposit so silicious could be found among the coralline isles of Bermuda", and he sent a quantity of the earth to Ehrenberg who published in the Monatsberichte of the Berlin Academy in 1844 numerous descriptions of new genera and species which he had found. The locality given by Bailey and Ehrenberg, in mistake, has been, and still is, repeated so often by European diatomists that it may be well to state that a complete explanation has been given in the American Journal of Microscopy, (1877), pp. 141 and 157. It has been suggested that a district known as Bermuda Hundred, in Virginia, not far from Richmond, was the locality intended, but several observers have claimed that no such deposit occurs there. The conclusion has been reached that the material received by Bailey, containing, as it does, so many characteristic forms, must have come from Maryland. Certain of the forms are found nowhere else, not even in the Richmond deposit. Conspicuous outcrops occur near the village of Nottingham on the Patuxent river and the author is of the opinion that Bailey's and Ehrenberg's material came from this point.

Genus HYALODISCUS Ehrenberg.

HYALODISCUS LAEVIS Ehrenberg.

HYALODISCUS STELLIGER Bailey.

Genus ACTINOCYCLUS Ehrenberg.

ACTINOCYCLUS EHRENBERGII Ralfs.

ACTINOCYCLUS ELLIPTICUS Grunow.

Plate CXXXIV, Fig. 1.

Actinocyclus ellipticus Van Heurck, 1881, Syn. Diat. Belg., pl. cxxiv, fig. 10.
Actinocyclus ellipticus Rattray, 1890, Jour. Quekett Club, ser. ii, vol. iv, p. 192.

Description.—Valve rhombic-elliptical. Markings granular, 6 in .01 mm., irregular at the center and radiating toward the border where they are about 12 in .01 mm. Apiculi at irregular intervals. Pseudo-nodule small at or near the end of minor diameter. Diam. .066 mm. Smaller end with more minute markings than *Coscinodiscus lewisianus* for which it might be mistaken.

Occurrence.—CALVERT FORMATION. 1 mile north of Jones Point, Marriott Hill. (Not common).

Collection.—Maryland Geological Survey.

ACTINOCYCLUS FACISCULATUS Castracane.

ACTINOCYCLUS MARYLANDICUS Rattray.

ACTINOCYCLUS MONILIFORMIS Ralfs.

Plate CXXXIV, Fig. 2.

Actinocyclus moniliformis Ralfs, 1861, Pritchard's Infusoria, p. 834.
Actinocyclus ehrenbergii Ralfs *var.* (*fide* Rattray).
Actinocyclus moniliformis Schmidt, 1874, Diat. Nordsee, pl. iii, fig. 31.
Actinocyclus moniliformis Van Heurck, 1881, Syn. Diat. Belg., pl. cxxiv, fig. 9; pl. cxxv, fig. 1.
Actinocyclus moniliformis Rattray, 1890, Jour. Quekett Club, ser. ii, vol. iv, p. 182.

Description.—Valve circular with striated border. Markings rounded in fasciculate rows, separated by hyaline lines showing more crowded near the circumference where the shorter rows are parallel. Central space rounded with a few scattered granules. Pseudo-nodule distinct. Apiculi opposite the hyaline spaces along each of which extends a single row of markings.

This form is by some authors united to *A. ehrenbergii* into which it passes by intermediate forms, and from which it differs chiefly in the less crowded arrangement of the granules and in the moniliform rows which radiate from the center. *A. ehrenbergii* is very common in most of the deposits, especially in the lower, where it occurs with large and brilliantly colored valves, while *A. moniliformis* is less common and not so highly colored. The diameter of both is quite variable.

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

ACTINOCYCLUS PARTITUS (Grunow).

Genus LIRADISCUS Greville.

LIRADISCUS ELLIPTICUS Greville.

Genus STICTODISCUS Greville.

STICTODISCUS KITTONIANUS Greville.

Genus XANTHIOPYXIS Ehrenberg.

XANTHIOPYXIS CONSTRICTA Ehrenberg.

XANTHIOPYXIS GLOBASA Ehrenberg.

XANTHIOPYXIS OBLONGA Ehrenberg.

Genus COSCINODISCUS Ehrenberg.

COSCINODISCUS APICULATUS Ehrenberg.

Plate CXXXIV, Fig. 13.

Coscinodiscus apiculatus Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 77.
Coscinodiscus apiculatus Ehrenberg, 1856, Mikrogeologie, pl. xviii, fig. 43.
Coscinodiscus apiculatus Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxiv, figs. 5–10.
Coscinodiscus apiculatus Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi., p. 122.

Description.—Valve circular, convex. Surface with markings angular and compressed over part of the valve and rounded and separated over the other. Smaller toward the border. Central space minute, irregular. Border variable in width, coarsely striate. Diam. av. .108 mm.

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

COSCINODISCUS ASTEROIDES Truan and Witt.

Plate CXXXIV, Fig. 14.

Coscinodiscus asteroides Truan and Witt, 1888, Die Diatomaceen der Polycystinkreide von Jérémie in Hayti, p. 13, pl. iii, fig. 2.
Coscinodiscus asteroides Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi, p. 24.

Description.—Valve circular, flat. Markings hexagonal, arranged in spiral rows, large at the center, suddenly decreasing and then gradually increasing to near the border where they are smaller.

In specimens from Jérémie, Hayti, "a ring of ten to twelve depressions in the middle of the valve" is seen, whence the specific name. In the Maryland forms these star-like depressions are scarcely, if at all, discernible.

Occurrence.—CALVERT FORMATION. "Cove, Calvert County" (Greville), Plum Point, "Nottingham" (Rattray).

Collection.—Maryland Geological Survey.

COSCINODISCUS ARGUS Ehrenberg.
COSCINODISCUS ASTEROMPHALUS VAR. OMPHALANTHA Grunow.
COSCINODISCUS BULLIEUS Schmidt.
COSCINODISCUS BIANGULATUS Schmidt.
COSCINODISCUS BIRADIATUS Greville.
COSCINODISCUS BOREALIS Bailey.
COSCINODISCUS COMPOSITUS Rattray.
COSCINODISCUS CENTRALIS Ehrenberg.
COSCINODISCUS CONCINNUS Wm. Smith.
COSCINODISCUS DURNISCULUS Schmidt.

COSCINODISCUS EXCENTRICUS Ehrenberg.

COSCINODISCUS ELEGANS Greville.

COSCINODISCUS EXCAVATUS VAR. GENNINA Grunow.

COSCINODISCUS GAZELLAE Janisch.

COSCINODISCUS GIGAS Ehrenberg.

COSCINODISCUS GRANDIVEUS Schmidt.

COSCINODISCUS HETEROMORPHUS Schmidt.

COSCINODISCUS HETEROPORUS Ehrenberg.

Plate CXXXIV, Fig. 15.

Coscinodiscus heteroporus Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 265.

Coscinodiscus heteroporus Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxi, fig. 4.

Coscinodiscus heteroporus Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi, p. 92.

Description.—Valve circular, with striated border. Markings hexagonal, increasing towards the semi-radius where they are about 2 in .01 mm., and then decreasing towards the border to 6 in .01 mm. "Diam. .072 to .112 mm." Differs from *C. bullieus* which, as Rattray remarks, is "somctimes confounded" within its larger size and the more uneven distribution of the lager cells near the semi-radius.

Occurrence.—CALVERT FORMATION. 1 mile east of Marriott Hill, 1 mile northeast of West River, 1 mile north of Jones Point.

Collection.—Maryland Geological Survey.

COSCINODISCUS LEWISIANUS Greville.

Plate CXXXIV, Fig. 16.

Coscinodiscus lewisianus Greville, 1866, Trans. Roy. Mic. Soc. London, vol. xiv, p. 78, pl. viii, figs. 8-10.

Coscinodiscus lewisianus Schmidt, 1875, Atlas der Diatomaceen-kunde pl. lxvi, fig. 12.

Coscinodiscus lewisianus Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi, p. 150.

Description.—Valve elliptical, occasionally rhombic-elliptical. Markings, 3 in .01 mm. at center, irregular, or when central space is present somewhat radiating and becoming more or less parallel to major axis. Border sharply defined, usually broad, with oblique striae 8 to 10 in .01 mm. Diam. .072 to .087 mm.

A form at Wildwood, New Jersey, shows produced ends. In the Hungarian deposits the central dots are more evident. Found also at Moron, Spain, California, and Trinidad.

Occurrence.—Calvert Formation. Marriott Hill, God's Grace Point, 1 mile north of Jones Point. (Not common).

Collection.—Maryland Geological Survey.

Coscinodiscus lineatus Ehrenberg.

Plate CXXXV, Fig. 1.

Coscinodiscus lineatus Ehrenberg, 1838, Abhand. d. k. Akad. d. Wiss., Berlin, p. 129.
Coscinodiscus lineatus Ehrenberg, 1856, Mikrogeologie, pl. xviii, fig. 33.
Coscinodiscus lineatus Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lix, figs. 29, 30; pl. cxiv, fig. 13.
Coscinodiscus lineatus Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi, p. 24.

Description.—Valve circular with a narrow border of minute granules 7 in .01 mm. Surface nearly flat, with hexagonal markings, 3 in .01 mm., arranged in almost straight parallel rows. Diam. .105 mm.

Occurrence.—Calvert Formation. ½ mile north of Forest Wharf, Lyons Creek, God's Grace Point, 1 mile north of Jones Point, 1 mile west of Tracy Landing.

Collection.—Maryland Geological Survey.

Coscinodiscus marginatus Ehrenberg.
Coscinodiscus nottinghamensis Grunow.
Coscinodiscus oculus-iridis Ehrenberg.
Coscinodiscus radiatus Ehrenberg.
Coscinodiscus symbolophorus Grunow.
Coscinodiscus secernendus Schmidt.
Coscinodiscus subtilis Ehrenberg.

Coscinodiscus perforatus Ehrenberg.

Plate CXXXV, Fig. 2.

Coscinodiscus perforatus Ehrenberg, 1844, Monatsb. d. k. Akad. d. Wiss., Berlin, p. 78.
Coscinodiscus perforatus Ehrenberg, 1856, Mikrogeologie, pl. xviii, fig. 46.
Coscinodiscus perforatus Schmidt, 1875, Atlas der Diatomaceen-kunde, pl. lxiv, figs. 12-14.
Coscinodiscus perforatus Rattray, 1890, Proc. Roy. Soc. Edinburgh, vol. xvi, p. 123.

Description.—Valve circular. Surface flat; markings angular, sometimes granular toward the border, larger at the semi-radius, with distinct central dots. Border narrow, striated. Central space large, irregular. Diam. av. .105 mm.

Distinguished from *C. apiculatus* by its more evident central dots, its narrow border and larger central space. In its size and the character of its markings the two are often similar.

Occurrence.—CALVERT FORMATION. Flag Pond, ¾ mile south of Parker Creek, 3 miles north of Parker Creek, Plum Point, ½ mile north of Forest Wharf, Nomini Bay, Chesapeake Beach, God's Grace Point, Fairhaven, 1 mile west of Tracy Landing, 1½ miles southeast of Marriott Hill, 1 mile north of Jewell, 1 mile north of Jones Point, 1 mile south of Chesapeake R. R. Bridge, 1 mile northwest of West River, 1 mile east of Marriott Hill.

Collection.—Maryland Geological Survey.

ERRATA.

Page cvi, No. 171, for *Solarium amphiterinum* read *Solarium amphitermum.*

Page cx, No. 61, for *Cythere* (*Antigona*) *staminea* read *Cytherea* (*Antigona*) *staminea.*

Page cxi, column 39, omit *at depth of 776 feet.*

Page cxvi, No. 2, for *Milleaster incurstans* read *Milleaster incrustans.*

Page 6, line 21, omit *acute* in "*series of acute two.*"

Page 7, lines 21, 24, for *1869* read *1867;* for *vol. xxi* read *vol. xix.*

Page 8, last line, for *1900* read *1890.*

Page 9, line 2, for *Zarachis* read *Zarhachis.*

Page 10, line 17, for *Ixacanthus* read *Zarhachis;* and for *generally* read *generically.*

Page 16, lines 16, 37, for *614* read *615.*

Page 16, line 22, for *1¾* read *1⅓.*

Page 19, line 14, for *614* read *615.*

Page 19, line 26, for *45 lines* read *4.5 lines.*

Page 20, line 16, for *1869* read *1868.*

Page 20, line 23, insert "The specific description is as follows."

Page 23, line 25, after *groove* insert *of the centrum.*

Page 28, line 14, for *front* read *point.*

Page 29, line 19, for *fang* read *the crown.*

Page 44, line 31, for Plate XXIII, Figs. 1, 1a, 1b, read Plate XXIII, Figs. 1, 2.

Page 57, lines 2, 3, strike out from "of" to "diameter" inclusive.

Page 65, line 28, after *on* insert "*each side.*"

Page 65, line 29, for *structure* read *sculpture.*

Page 66, line 27, for *of the crown* read *round the crown.*

Page 66, line 31, read "*of much of the convex face, is marked by a minute decussating or chevroned sculpture.*"

Page 69, line 3, for *left anterior* read *left posterior.*

Page 69, line 11, add "*with the neural arch is still indicated by suture in the specimen. The posterior convex head of the body.*"

Page 72, line 18, for *slight wavy ribs* read *slightly wavy ribs.*

Page 79, line before last, insert "*Oxyrhina desorii* Woodward, 1889, Cat. Fos. Fishes, Brit. Mus., pt. 1, p. 383."

Page 80, line 18, insert the following: "*Oxyrhina hastalis* Woodward, 1889, Cat. Fos. Fishes, Brit. Mus., pt. 1, p. 386."

Page 87, line 28, add "*Galeocerdo contortus* Woodward, 1889, Cat. Fos. Fishes, Brit. Mus., pt. 1, p. 443."

Page 89, line 5, add "*Galeocerdo aduncus* Woodward, 1889, Cat. Fos. Fishes, Brit. Mus., pt. 1, p. 445."

Page 90, line 24, add "*Hemipristis serra* Woodward, 1889, Cat. Fos. Fishes, Brit. Mus., pt. 1, p. 450."

Page 99, line 10, for *Yorktown, Pa.*, read *Yorktown, Va.*

Page 121, line 31, for *Cythere cornuta* read *Cythereis cornuta.*

Page 415, line 29, add "Plate CXVIII, Fig. 11."

GENERAL INDEX

Figures in *italics* indicate principal discussion.

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PALEONTOLOGICAL INDEX

Figures in *italics* indicate principal discussion.

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