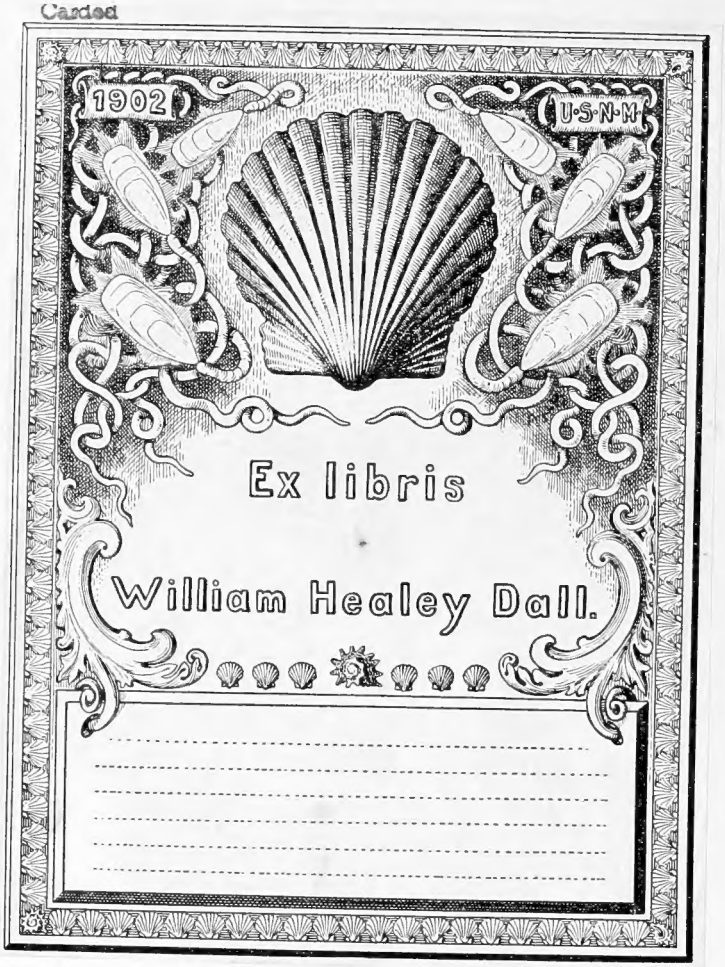

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VOLUME XXIV

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1894

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J. W. POWELL, DIRECTOR

MOLLUSCA AND CRUSTACEA

OF THE

MIOCENE FORMATIONS OF NEW JERSEY

BY

ROBERT PARR WHITFIELD

WASHINGTON
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1895-

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ILLUSTRATIONS.

LETTER OF TRANSMITTAL.

NEW BRUNSWICK, N. J., *September 1, 1889.*

SIR: I have the honor to transmit herewith to you, for publication and distribution under the arrangements for cooperation which prevail, Prof. Robert P. Whitfield's text and drawings of the Mollusca and Crustacea of the Miocene formations of New Jersey. The book has been prepared with great industry and care, and is deemed worthy of a place among those valuable monographs of the United States Government which are written and published under your supervision and direction. It is important to all who are interested, either theoretically or practically, in the geology of the State. Neighboring States are of course sharers in the fruits of this prolonged investigation, and the relation of the paleontology of New Jersey to the structural conditions prevailing in other parts of the United States makes this in every sense a national work.

I am, with high respect, your obedient servant,

GEO. H. COOK,
State Geologist of New Jersey.

HON. J. W. POWELL,
Director U. S. Geological Survey.

LETTER OF TRANSMITTAL.

NEW YORK, *May 28, 1889.*

DEAR SIR: I herewith transmit to you the descriptions and illustrations of the Mollusca and Crustacea of the Miocene formations of New Jersey, which will form Vol. III of the Paleontology of New Jersey.

In presenting this volume of the report I wish to express my thanks to you for the manner in which you have furthered my efforts to obtain material for the volume, and also to Dr. N. L. Britton for his kind offices in collecting and furnishing specimens and information. To Dr. W. H. Dall, of the Smithsonian Institution and National Museum at Washington, I am under special obligation, as he not only obtained for me the loan of all New Jersey material at the National Museum, but also sent Mr. Frank Burns into the field in New Jersey, where he made extensive collections and transmitted them to me for use. Had it not been for this generous act I should have had but a very meager showing of species for this report. To the National Museum I am thus indebted for the loan of material and the expenses incurred in collecting. To Prof. Angelo Heilprin and to the Academy of Natural Sciences of Philadelphia, from which I had the loan of all their collections of New Jersey material through Prof. Heilprin's good offices, embracing the types of many of the species previously described, I also wish particularly to express my thanks.

Yours, very truly,

R. P. WHITFIELD,
Geologist.

Prof. GEORGE H. COOK,
State Geologist of New Jersey.

MOLLUSCA AND CRUSTACEA OF THE MIOCENE FORMATIONS OF NEW JERSEY.

By Robert Parr Whitfield.

PRELIMINARY REMARKS.

The fossils of the Miocene beds of New Jersey, like those of the Cretaceous and Eocene beds, have never until now been systematically studied or recorded. Many of them which are as yet peculiar to the deposits of the State have, however, been described haphazard, as it were, by different writers, with scarcely any other object in view than that of describing the species which happened to fall into their hands. In this way a few of the most prominent forms have become known, but very few species are mentioned in any of the lists of Miocene fossils as pertaining to the New Jersey fauna. In Mr. F. B. Meek's list of Miocene fossils published in "Smithsonian Miscellaneous Collections" there are only seventeen species mentioned as from New Jersey: two forms of Bryozoans, two Oysters, one Spondylus, one Crassatella, two Carditamera, one Astarte, one Venus, one Periploma, a Corbula, a Saxicava, and four Gasteropods. A detailed list of these is given in Prof. Cook's Geology of New Jersey for 1868, p. 297. Prof. Heilprin in his "Tertiary Geology of the Eastern and Southern United States" enumerates twenty-seven species, seventeen of which he gives as peculiar to the State; and in an article on "The Miocene Mollusca of the State of New Jersey"[1] he enumerates thirty species as known at the time of publication. On page 398 he adds to the list from collections obtained on excursions to the marl pits at Shiloh, N. J., giving fifty species from this one locality. On pages 402–404 he gives a summary of the known molluscan fauna of the State up to that date (1887), amounting to eighty-two species, and he describes among them three new species and one variety.

[1] Proceedings of the Acad. Nat. Sciences of Philadelphia for 1887, p. 397.

This appears to be a complete summary of all knowledge possessed concerning the Miocene molluscan fauna of the State up to that time. Among the species given in his most complete list there are a few mentioned of which I have seen no representatives, namely *Anomia ephippium* (?) L. (*Mysia*) sp.? *Saxicava incita* (?) and *Teredo* sp. (?). Several others there enumerated, the fragments of which were examined, I have differently interpreted. These will be found mentioned in the synonyma of the species at the heads of descriptions, and they can be traced from the names given in the index hereto. In the present work one hundred and four species are recognized, which, with the four species given in Prof. Heilprin's list, and the two species of Bryozoans given in Mr. Meek's list would carry the number to one hundred and ten species, including the one Balanus.[1] There is no doubt that many more species might be obtained were the beds more thoroughly examined and other localities explored. As yet the examination has been very limited, being confined to the workings for marl for agricultural purposes, and to the material taken from the borings of wells at Atlantic City and Cape May. At the latter locality only three recognizable forms of shells were obtained, namely, *Buccinanops variabilis*, *Terebra inornata*, and the elongate variety of *Tritia trivittattoides*. Fragments of a few bivalve shells were also obtained, but of too indefinite a character for identification. At the Atlantic City boring a large number of species were obtained.

Besides the molluscan remains enumerated, there have been some foraminiferous bodies recognized in the examination of a few ounces of the marls obtained from the interior of some of the shells. Mr. Anthony Woodward, of the American Museum of Natural History, New York City, has given me the following list of those found in marls from Shiloh, N. J.:

Miliolina seminulum L. sp.
Cristellaria cultrata Montf. sp.
Italica Defrance sp.
Polymorphina gibba D'Orb.
oblonga D'Orb.
Uvigerina Canariensis D'Orb.
Discorbina rosacea D'Orb. sp.
Truncatulina lobatula W. & J. sp.
Anomalina ammonoides Rens. sp.
Pulvinulina elegans D'Orb. sp.
Rotalia soldanii D'Orb. sp.
Polystomella striato-punctata F. & M. sp.

[1] In Tuomey and Holmes's Pliocene Fossils of South Carolina, Introduction, p. IX, they state that one hundred and seven species of fossils are known from the corresponding beds of New Jersey, but as they give no list, we are left in doubt as to what the species may be, and as to their authenticity.

And in the marls from Jericho, N. J., the following were obtained:

Clavulina communis D'Orb.
Truncatulina lobatula Walker and Jacobs sp.

From the very small amount of the marls examined this would indicate a somewhat prolific field for the investigation of these minute bodies, and I have deferred for the present the illustration of these species and the Bryozoans and a single coral of the Miocene deposits, hoping to be able to insert them at an early day in a volume embracing the Corals, Echinoderms, and other invertebrate remains of the Cretaceous and Eocene marls of the State.

The geological horizon of the Miocene marls of New Jersey would hardly be considered as differing from those of the more southern States—Maryland, Virginia, and the Carolinas—whatever the geological age of those deposits may be, Miocene proper, or Mio-Pliocene, as some are disposed to call it. No living forms have been found in the New Jersey deposits that are not also known to occur in some of the more southern localities, and no very close representatives of living species are seen among those which so far are found in New Jersey only. Of this latter group there are thirty-six species, as given in the following list. (*Triforis terebrata* may be identical with *T. moniliferum* H. P. Lea, in which case there would be only thirty-five.)

Species as yet known from New Jersey only.

Spondylus inornatus W.
Plicatula densata C.
Lithophaga subalveata C.
Astarte distans C.
Thomasi C.
Carditamera aculeata C.
Crassatella melina C.
Mysia parilis C.
Venus Ducateli C.
Mercenaria cancellata G.
Tellina peracuta C.
(Tellinella) capillifera C.
Amphidesma Burnsi W.
Periploma alta C.
Corbula elevata C.
subcontracta W
Saxicava myæformis C.
parilis C.
Murex Shilohensis Heilp.
var. Burnsi W.
Fasciolaria Woodi G.
Busycon scalarispira C.
Cantharus Cumberlandiana G.
Tritia trivittatoides W.
var. elongata W.
Buccinanops variabilis W.
Erato Emmonsi W.
Terebra inornata W.
Drillia pseudeburna H.
subflexuosa W.
Lunatia hemicrypta G.
Trichotropis Dalli W.
Cumberlandiana C.
secta C.
? Triforis terebrata H.
Actæon Shilohensis W.

Of the remaining species several are found in what has been considered the typical Miocene of this country, while very few, except the forms living at the present time, are known to occur in the later beds given as post-Pliocene by Tuomey and Holmes in South Carolina and the neighboring territory.

The fossils obtained from the borings for water at Cape May and at Atlantic City are somewhat different in character from those found at Shiloh and Jericho, in Cumberland County, and may possibly indicate a distinct zoological horizon. The occurrence in the Atlantic City well-boring of several of the larger species of Arca which are not known from the Shiloh or Jericho beds might indicate a somewhat different geological level, but local difference might produce this change. Two or three feet, or some times even as many inches, will serve for a change of this character, within the limits of beds of the same geological age, so that I should not deem them of a different age without positive stratigraphical evidence.

In the section of formations at Shiloh, Jericho, and the neighboring region there are three different phases shown in the material of the deposits containing fossils: the dark brown or chocolate-colored clay, with fossils, which lies next below the "glass sand;" the stony layer of gray marl, filled with shells of Ostrea and other forms; and below this, the loose sandy gray marl with fossils. In the black or chocolate-colored marls the following species have been recognized among the few specimens sent for identification:

Pecten Madisonius.
Modiola inflata.
Perna torta.
Plicatula densata.
Axinea lentiformis.
Nucula proxima.
Cardium craticuloides.
Crassatella melina.
Chama congregata.
Saxicava parilis.
bilineata.
Turritella Cumberlandiana.
æquistriata.
Crepidula fornicata.
Trochita perarmata.
Crucibulum costatum.
Fissurella Griscomi.
Balanus proteus.

In the stony layer below the chocolate-colored clay the list of species has not been made out, but nearly all of those found in the shell-sand or marl below are recognized. So there does not appear to be much reason

zoologically to consider these three phases as more than local changes in conditions during the continuance of the same epoch.

Below I give a table of the species found in New Jersey, as recognized in this work; it shows also those which had been recognized by Prof. A. Heilprin in his list above referred to, and in Meek's list. The third, fourth, and fifth columns show in what collection the specimens used in this volume may be found, and the last one, the species which are as yet known only as from New Jersey:

Classified list of the species found in New Jersey, showing also those previously cited as New Jersey species, and the collections in which the specimens here used may be found.

	Heilprin's list.	Meek's list.	Rutgers College.	Academy Natural Sciences, Philadelphia.	National Museum.	New Jersey only.
BRACHIOPODA:						
Discina lugubris Conrad	×		×	×	×	
LAMELLIBRANCHIATA:						
Ostrea Virginiana, Gmel	×	×	×		×	
var. procyon, Tuomey			×			
percrassa Conrad	×	×			×	
Pecten Madisonius Say			×	×	×	
vicenarius Conrad	×?			×		
Vola Humphreysi Conrad	×		×	×	×	
Spondylus inornatus Whitf					×	
Plicatula densata Conrad	×	×	×		×	×
Perna torta Say.=P. maxillata Say	×		×		×	
Mytiloconcha incrassata Con	×				×	
Modiola inflata T. & H. sp	×				×	
Lithophaga subalveata Con	×				×	
Arca (Striarca) centenaria Con.	×		×		×	
(Scapharca) callipleura Con.				×		
lienosa? Say	×?			×		
(Scapharca) subrostrata Con	×			×		
(Latiarca?) idonea Con	×?			×		
Barbatia Marylandica Con	×				×	
Axinea lentiformis Con					×	
Nucula proxima Say			×		×	
Yoldia limatula Say	×				×	
Astarte cuneiformis Con				×		
distans Con	×					
symmetrica Con						
Thomasi Con	×					
Cardita granulata Say	×					
Carditamera arata Con	×	×	×			
aculeata Con	×					×
Crassatella melina Con	×	×	×		×	×
Mysia parilis Con	×				×	×
Lucina acclinis? Con					×	
crenulata Con	×		×		×	
trisulcata Con	×?					

Classified list of the species found in New Jersey, etc.—Continued.

	Heilprin's list.	Meek's list.	Rutger's College.	Academy Natural Sciences, Philadelphia.	National Museum.	New Jersey only.
LAMELLIBRANCHIATA—Continued.						
Chama congregata Con	×		×		×	
Cardium (Cerastoderma) craticuloides Con	×		×		×	
Venus Ducateli Con	×				×	×
Mercenaria cancellata Gabb[1]	×			×		×
plena Con	×			×		
Artena staminea Con.[2]			×		×	
Dosinia acetabulum Con	×			×		
Dione Marylandica Con				×		
Sayana Con	×			×		
Tellina peracuta Con	×					×
(Angulus) declivis Con	×	×		×		
(Tellinella) capillifera Con	×			×		×
(Peronæoderma) producta Con				×		
Donax variabilis Say	×			×		
Amphidesma Burnsi Whitf					×	×
Abra æqualis Say					×	
Syndosmya nuculoides Con					×	
Mactra lateralis Say	×			×		
delumbis Con				×		
Rangia (Perissodon) minor Con					×	
Periploma alta Con	×	×		×		×
Corbula elevata Con	×	×		×	×	×
idonea Con	×			×		
subcontracta Whitf					×	×
Saxicava myæformis Con	×	×		×	×	×
paralis Con.[1]	×			×		×
bilineata Con. =? S. rugosa					×	
Panopæa Goldfussi Wagner					×	
GASTEROPODA:						
Murex Shilohensis Heilp.[3]	×					×
var. Burnsi Whitf					×	×
Fasciolaria Woodi Gabb	×			×		
(Lyrosoma) sulcosa Con					×	?
Busycon carica Linn			×			
scalarispira Con	×	×			×	×
Cantharus Cumberlandiana Gabb	×		×		×	×
Tritia trivittatoides Whitf	×				×	×
var. elongata Whitf			×		×	×
bidentata Emmons					×	
Buccinanops variabilis Whitf			×			×
Erato Emmonsi Whitf					×	×
Oliva Carolinensis Con					×	
Amycla communis Con	×			×	×	
Strombina (Amycla) lævis Whitf					×	
Cancellaria alternata Con	×			×	×	
Terebra curvilineata Con	×				×	
inornata Whitf			×			×

[1] Species originally described from New Jersey, but not referred to the State in Meek's Check List; not otherwise known to occur elsewhere.

[2] Am. Mus. Nat. Hist.

[3] Miss Watts's property.

Classified list of the species found in New Jersey, etc.—Continued.

	Heilprin's list.	Meek's list.	Rutger's College.	Academy Natural Sciences, Philadelphia.	National Museum.	New Jersey only.
GASTEROPODA—Continued.						
Drillia pseudeburnea Heilp.[1]						×
elegans Emmons					×	
subflexuosa Whitf					×	×
Surcula parva Con					×	
Natica (Lunatia) hemicrypta Gabb	×		×	×	×	×
(Lunatia) heros Say	×		×		×	
Tuomeyi Whitf					×	×
Neverita duplicata Say					×	
Crucibulum costatum Say	×		×	×	×	
Trochita perarmata Con	×		×	×	×	
Scalaria multistriata Say			×		×	
Trichotropis Dalli Whitf					×	×
Turritella æquistriata Con.[2]	×		×		×	×
Cumberlandia Con	×	×	×			×
secta Con	×	×			×	×
(Mesalia) plebia Say	×			×		
Anguinella Virginiana Con					×	
Triforis terebrata Heilp.[3]	×					×
Monilea (Leiotrochus) eboreus Wagner	×				×	
Fissurella Griscomi Con	×	×	×	×	×	
Actæon Shilohensis Whitf					×	×
CRUSTACEA, CIRRIPEDIA:						
Balanus proteus Con			×			

[1] Private property of Miss Holmes.

[2] Species originally described from New Jersey, but not referred to the State in Meek's Check List; not otherwise known to occur elsewhere.

[3] Miss E. Tyndall.

BRACHIOPODA.

SECTION I.

BRACHIOPODA OF THE MIOCENE MARLS OF NEW JERSEY.

A single species only of this group of shells has been obtained or noticed from these formations within the limits of the State. The form, a Discina, appears to be quite abundant in the marls at several of the localities, but so far none but upper valves have been obtained, not the least part of a lower valve being found so far as could be detected. The absence of this class of animal life in these Miocene deposits is not so remarkable when one takes into consideration the fact that there is almost as complete an absence of them in all the American Atlantic Tertiary deposits, and but very few even in the older Cretaceous deposits over the same areas. To be sure, in the Cretaceous there is, through a portion of New Jersey, a superabundance of individuals of two of the species—*Terebratula Harlani* and *Terebratella plicata*—but in species even these deposits are remarkably deficient, only six species probably being known in the Cretaceous within the State, one of which, *T. Atlantica*, is quite doubtfully of Cretaceous age.

Class BRACHIOPODA.

Order INARTICULATA.

Family DISCINIDÆ.

Genus DISCINA Lamarck.

DISCINA LUGUBRIS.

Plate 1, figs. 1–3.

Capulus lugubris Conrad: Jour. Acad. Nat. Sci., vol. 7, p. 143.
Orbicula lugubris Conrad: Medial Tert. Foss., p. 75, Pl. XLIII, fig. 2.
Discina lugubris (Conrad) Meek: Smith. Check list, p. 3.

Shells obtained from New Jersey and known only by the upper valves, small, scarcely exceeding half an inch in diameter, subcircular in outline, usually very little longer than wide and broadest below the middle of the length. Usually, however, somewhat irregular. Apex of the dorsal valve rather elevated and obtusely pointed, situated at about one-fourth of the whole diameter from the dorsal margin. Surface of the shell strongly lamellose over the outer half of most specimens and often to near the apex. In most cases, however, the apex and umbo are smooth and polished, except for the very fine radiating lines which are visible under a glass over much of the surface under the lamellæ, or show on the expansions as wrinkles, most especially on the short side of the apex. The substance of the shell is thick and entirely corneous, and the muscular scars on the inside usually well marked.

Localities: I have received specimens only from near Shiloh and Bridgeton, N. J , both from the collections at Rutgers College and from the National Museum

LAMELLIBRANCHIATA.

SECTION II.

LAMELLIBRANCHIATA OF THE MIOCENE MARLS OF NEW JERSEY.

ASIPHONIDA.

MONOMYARIA.

Family OSTREIDÆ.

Genus OSTREA Linnæus.

OSTREA VIRGINIANA.

Plate II, Figs. 1–7.

Ostrea Virginiana (Gmel.) and of authors.

Ostrea Mauricensis Gabb: Jour. Acad. Nat. Sci. Phil., vol. 4, 2d ser., p. 376, Pl. LXVII, Fig. 26. Meek in Check List Mioc. Foss., p. 3. C. A. White.

Besides the narrowly elongated wedge-form variety of the oyster, the ordinary form of it occurs under many variations. I have figured several specimens showing some of these variations, and I see no reason for considering the small flat upper valve figured by Mr. Gabb under the name *O. Mauricensis* as anything more than a specimen of this very variable species. One of those which I have figured from the collection of the Academy of Natural Sciences is fully 8 inches in length, even in its imperfect condition, and I think must have been when entire fully 1 inch longer. Among almost any lot of oysters seen in our markets, one may select all the forms which are found in the marls near Shiloh, or at Elwell's pits, near Jericho, N. J., except the narrow wedge-form variety. This one I do not recollect having noticed in the markets, although it is found living commonly along the coast of New Jersey. I presume its small size, or perhaps its isolated habits, may have prevented its use in this manner. The

large individual figured presents a more distinctly rayed surface than the most of those examined, but this is probably only an individual feature, and certainly very many of those we obtain in the markets are far more distinctly marked in this manner than is this one. Considering these facts I see no reason for separating these Miocene shells from the living ones simply because they lived in a past age, as they have continued down to the present time without material change.

Ostrea Virginiana var. procyon.

Pl. I, figs. 4–6.

Ostrea Virginiana var. *procyon* Tuomey and Holmes: Pliocene Foss. S. Carolina, p. 20, Pl. v, figs. 6–9. Holmes, P. P. Foss. S. Car. p. 10, Pl. 2, fig. 9*a*.

Shell differing from the ordinary form of *O. Virginiana* Gmel. in being more elongate and narrower, the beak often attenuated, and the sides of the valves subparallel on the anterior half of the shell's length. The upper valve is usually quite flat and without any depth on the inside; in fact often quite convex; while the lower one is rounded on the outside and trough-shaped within, the ligamental groove being narrow and deep, and often from an inch to an inch and a quarter in length. The surface of the lower valve is usually marked by fine, raised, rounded, and generally distant radiating ribs, seldom visible on the posterior half of the shell.

Specimens are found varying in form from the very narrow ones with nearly parallel sides, and having a length of 4 or more inches, to those presenting nearly the same form as the ordinary specimens of *O. Virginiana*. Also of the narrow forms from those with a perfectly straight beak, to forms having the beak curved almost at right angles to the general axis of the shell. The same form and variety is now living commonly on the seacoast of the State, and I have gathered them in quantities along the beaches at the inlet north of Atlantic City. It is not distinguishable either by any constant feature so far as I can observe from large numbers of *O. glabra* Meek, found at many points in the Laramie group of the west, and as figured by both Mr. Meek in his volume on Invertebrate Palæontology in the Geological Survey of the Territories, and by Dr. C. A.

White, in his Non-Marine Molluscan Fauna of the West,[1] and in his work on the Fossil Ostreidæ of the United States.

Formation and locality: Fossil in the Miocene near Shiloh and at Elwell's marl pits at Jericho, N. J.

Ostrea percrassa.

Pl. III, figs. 1–4.

Ostrea percrassa Conrad: Medial Tert. Foss., p. 58, Pl. XXV, fig. 1. Meek, Smith Check List, p. 3. White, Fam. Ostreidæ; p. 313, Pl. LXVIII, fig. 3.

Shell rather large, very thick and heavy in appearance; subcircular in outline, or obscurely broad subovate, being widest in front of the middle of the length; the lower valve often highly convex on the outside and deep within. Hinge-area large and strongly lamellose, striate transversely; ligamental groove broad and deep. Upper valve less deep than the lower, also less convex on the outer surface. Muscular scars very large, semi-lunate or semi-elliptical; extending far beneath the shell at the back edge, forming a deep cavity beneath it. Margin of the shell outside of the pallial area smooth. Substance of the shell very strongly lamellose, the lamellæ being separated by a minutely vesiculose interlamellar substance, as in *Gryphæa vesicularis* Lam.

The New Jersey forms of this shell which have come under my notice are not nearly so large and ponderous as those which I have seen from South Carolina. Mr. Conrad's figure given in his Medial Tertiary fossils is a very fair representation of the general run of the examples from New Jersey. While many of those from the more southern localities have grown longer with advanced age, but not wider in the same proportion, still one or two examples from the Santee River in South Carolina, now in the collection of the American Museum of Natural History in New York, are very broad and not so thickened; while the outer surface of the upper valve is almost flat and comparatively smooth. A peculiar feature of this species, seen in the New Jersey specimens but not in those from South Carolina, is the finely vesicular, interlamellar structure, which, when the upper layer of pearly shell is removed from the one beneath, presents a very fine froth-like

[1] Fourth Annual Rept. U. S. Geol. Surv.

structure. This can readily be seen anywhere on the broken edges of the shell between the lamellæ. This latter portion also is thick and very brittle; differing in this character from that of the ordinary oysters. Many of the shells also present much the appearance of *Gryphæa vesicularis* as it is found in New Jersey, Alabama, and Texas, and the upper valves sometimes are so like the upper valves of that species that they might readily escape detection were they accidentally placed among them. So striking, in fact, is this resemblance that it readily suggests the inquiry whether they may not be the lineal descendants of that shell over this area.

Locality: Those which I have seen have been from near Shiloh, Cumberland County, N. J., and in the near vicinity of Jericho. Mr. Conrad gives Stow Creek as the locality for his shell, which is the stream upon which Shiloh village is situated.

Family PECTENIDÆ.

Genus PECTEN Müll.

Pecten Madisonius.

Pl. IV, fig. 1–5, and Pl. II, fig. 8.

Pecten Madisonius Say: Jour. Acad. Nat. Sci., Phil., 1st Ser., vol. 4, p. 134; Conrad Mioc. Foss., p. 48, Pl. XXIV, fig. 1; Proc. A. N. Sci., Phil., 1862, p. 581; Meek Check List, Miocene Foss., p. 4; Heilprin Proc. Acad. Nat. Sci., Phil., 1887, pp. 400–402.

Say's description of this species is as follows: "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.

"Length rather more than four inches and a half; breadth four inches and four-fifths."

There is one important feature of this shell not mentioned in Say's description, that of squamose, longitudinal striæ in the depressions between

the ribs and on their sides. This feature becomes very conspicuous on the larger specimens. Besides this, the lower valve is much more depressed or flattened than the upper. The number of ribs on the more convex valve is sometimes seventeen or even eighteen, showing considerable variation. I have not seen any very large individuals from the New Jersey localities, and few of more than 1½ inches in diameter. Some of the casts from the brown clays, however, indicate shells much larger than this, and some fragments of valves from near Shiloh, in the collection at Rutgers College, indicate shells of fully 4 inches in width, but no specimens showing more than one-sixth part of the entire valve have been collected.

The species bears some resemblance to *Pecten Jeffersonius* Say, but is very readily distinguished by the more numerous and smaller ribs and by their squamose, almost spinose striæ.

Formation and localities: The New Jersey examples, all quite fragmentary except the very young individuals, are from the gray Miocene marls near Shiloh and Jericho, and as casts from the brown marly clays near the same places in New Jersey. The species is quite common and of larger size in the Miocene at Yorktown, Petersburg and vicinity, in Virginia; it also occurs in South Carolina.

Pecten vicenarius?

Not figured.

Pecten vicenarius Conrad: Proc. Acad. Nat. Sci. Phil., vol. 1, 1st series, p. 306; op. cit. 1862, p. 582; Meek, Check List Mioc. Foss., p. 4.

Pecten vicenarius Con: Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 400 and 402.

"Suborbicular, inequivalve, the upper valve ventricose, the inferior plano-convex; ribs about twenty, somewhat flattened on the back; ribs of the superior valve narrow and more distant than those of the inferior valve; surface of both with crowded, regular concentric wrinkles; ears equal, moderate in size, sinus of inferior valve not profound." (Conrad.)

A number of small fragments of a pectenoid shell of small size, which were obtained from the well boring at Mr. L. Woolman's, at Atlantic City, form the basis for the citation of the above species as a probable New Jersey shell. I should consider the fragments as pertaining to two distinct

species, as several of them have ribs distinctly alternating in size and quite unequal, with probable implantations or bifurcations, while others have ribs of an even size and simple. I do not think they could well have been opposite valves of the one species. The specimens are too poor and meager to illustrate, but I do not think they represent *P. vicenarius* as above described, and as the species has never been figured, there is nothing but the description to guide one in determining it. The types were from Wilmington, N. C. I do not recognize these fragments as pertaining to any described form, unless possibly the simple ribbed form might represent *P. micropleura* of H. C. Lea,[1] though some of them have not had a sufficient number of ribs. Or they may be related to *P. tricenarius* of Conrad,[2] but they are too imperfect for determination.

Genus VOLA Klein.

Vola Humphreysi.

Pl. IV, figs. 6–9.

Pecten Humphreysii Conrad: Proc. Nat. Institute (2d Bulletin), p. 194, Pl. II, fig. 2; Cat. Miocene Foss., Proc. Acad. Nat Sci. Phil., Dec. 1862, p. 582; Meek, Check List Smith. Inst., p. 4; Heilprin, Mioc. Moll. State of New Jersey, Proc. A. N. S. Phil., 1887, p. 297 et seq.; Heilprin, Cont. Tert. Geol. & Pal. U. S., p. 8.

Vola Humphreysii Conrad: Cat. Mioc. Foss, Proc. A. N. S. Phil., 1862, p. 582.

Mr. Conrad's description of this species is as follows: "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." In his observations he states that, "Of two specimens in the collection of the college at Annapolis, the largest measures 3 inches from beak to base."

Prof. Angelo Heilprin in a recent paper[3] proposes the varietal name *Woolmani* for the New Jersey specimens of the species, considering them

[1] Trans. Am. Phil. Soc. Penn., vol. 9, p. 19; pl. 35, fig. 32.

[2] Miocene Foss., p. 74; Pl. 42, fig. 2.

[3] Proc. Acad. Nat. Sci. Phil., 1887, p. 405.

as differing from the normal type "in the greater elevation of the ears and the more distinct quadrangulation of the ribs of the convex valve." As regards the elevation of the ears, they both appear to have the hinge line on a level with the point of the beak; and as to the extension laterally of the ears, I should judge from Mr. Conrad's figures that they were closely similar; although I have never seen a complete valve from New Jersey, there are some with perfect ears, and I can see no important difference between these and the figures given by Mr. Conrad. The difference in the form of the ribs, if we can rely on Conrad's figures, is quite a marked one, as the New Jersey specimens have the furrows deep and the edges extremely abrupt on the convex valves.

The New Jersey examples seem to have attained a much larger size than those from Maryland. I have before me imperfect individuals which measure almost 3 inches across the ears, and of which the valves must have measured over 5 inches in width when perfect. The general form has been nearly equilateral and orbicular in outline, with large ears on each valve; one valve nearly flat or but slightly convex, the other moderately convex The flat valve has the ears depressed below the general level and a considerable space around or below the beak concave and somewhat depressed, but not to a level of the surface of the ears. Each lateral margin forms a broad convex rib which is longitudinally striated; besides these, there are seven sharply elevated, prominent, and narrow ribs, a central one and three on each side; the surface of the ears is also obscurely radiated, while the entire surface is marked by fine, concentric, lamellose lines, strongly elevated. The convex valve has three broad very slightly convex ribs on each side of the central groove and a broad flattened space outside of these. The ears are slightly convex on their surfaces and are distinctly separated from the body of the shell by a depressed line. The right ear, when the shell is held with the convex side up, has a moderate constriction above the body of the shell, and the opposite one is very slightly extended along the shell in the same place. The entire surface of the valve, ears, lateral borders, and ribs is finely striated longitudinally and also concentrically. In the interior of the valves the ribs are profoundly marked, on the flat valve by deep narrow grooves and in the convex valve by broad rounded

ribs, much broader than the grooves on its opposite surface. Ligamental pit in each valve large and deep. On a fragment of a convex valve, one of the lateral ribs and its corresponding furrow measure barely less than $1\frac{1}{4}$ inches on the margin of the valve. The young shells, at least the convex valve, might readily be considered as a distinct species, as from its great rotundity and the very narrow grooves between the broad flattened ribs it appears like an adult shell.

Locality: The shell would appear to have been not very uncommon in the marls near Shiloh, N. J.; but among all those obtained no entire valves have been seen except very small ones. I have specimens from the collections at Rutgers College, New Brunswick; from the National Museum, and from the Academy of Natural Sciences at Philadelphia.

Family SPONDYLIDÆ.

Genus SPONDYLUS Lamarck.

SPONDYLUS INORNATUS, n. sp.

Pl. v, figs. 1 and 2.

A single upper valve of either a young specimen or of a small species of this genus is found among the collections from Shiloh, N. J. The valve is subcircular in outline and depressed convex on the surface. It is comparatively free from ornamentation, having concentric lines of growth and a somewhat obscurely scabrous surface, with a tendency to radiation in the arrangement of the pustules. In the interior the hinge is well developed, the teeth being moderately large and very divergent, but the ligamental pit is quite small and obscure. The adductor muscular scar is subcentral, and consists of two very broadly ovate scars of nearly equal size, the outer overlapping the inner about one-third of its diameter. Lower valve unknown.

I know of no true Spondylus in the Atlantic Miocene beds; otherwise I should have hesitated to designate this by name. The want of either true rays or spines on this shell is its most conspicuous feature.

Locality: Shiloh, N. J. From the collection of the National Museum.

Genus PLICATULA Lamarck.

PLICATULA DENSATA.

Pl. v, figs. 3–8.

Plicatula densata Conrad: Proc. Acad. Nat. Sci. Phil., vol. I, p. 311; Miocene Fossils, p. 75, pl. 43, fig. 6; Cat. Miocene Foss. Atlantic Slope, Proc. A. N. Sciences, p. 582; Meek, Check List, Mioc. Foss., p. 4; Heilprin, Cont. Tert. Geol. and Paleont. U. S., p. 8.

"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.)

The form of this shell is extremely diversified, as much so as any species of the genus I have ever examined. The lower valve has usually been fixed to some foreign substance, sometimes by the smallest portion of the apex and at others by the entire under surface of the valve, showing plications only along the edge, and all degrees between these extremes are readily found. The upper valve is not uncommonly entirely destitute of plications and strongly lamellose, resembling the valve of an oyster; this more commonly where the lower valve has been attached over almost its entire surface. In others the upper valve is as strongly plicated nearly to the beak, as is the lower, and with the plications fully as angular, though generally they are rounded, while those of the lower are sharply angular. In number of plications they vary as much accordingly as the shells do in form, those of the lower valve often being as many as twenty, counting those on the margin, and others having as few as seven or eight. The surface of the valves is strongly rugose-lamellose, often marked by strong points. The substance of the shell is quite thick and dense, and the muscular imprints usually elevated. The shells are almost as diverse in outline as numerous in individuals. Teeth but slightly divergent and strongly interlocking, so as to separate with difficulty or by fracture only.

Localities: I have seen specimens of this species from Shiloh, Jericho,

and nearly all the localities of Miocene fossils throughout that part of the State of New Jersey. They appear in the gray marls and in the limestone, and also in the brown clay.

HETEROMYARIA.

Family AVICULIDÆ=Pteriidæ.

Genus PERNA Bruguiére.

PERNA TORTA.

Plate v, figs. 12 and 13.

Perna torta Say: Am. Jour. Sci. and Arts., 1st series, vol. 2, p. 38.
Perna maxillata Conrad: Miocene Foss., p. 51, pl. 27; (non Lam.)
Perna Conradi D'Orb.: Prodrome, vol. 3, p. 127.
Isognomon torta (Say sp.) Conrad: Cat. Miocene Foss., Phil. Acad. Nat. Sci., 1862, p. 579.
Melina torta (Say sp.) Meek: Check List Miocene Foss., p. 6.

Shell very large, attaining a length of 7 inches, and a width of at least $3\frac{1}{2}$ inches. Form obliquely ovate, pointed at the beak, which is directed forward Anterior and posterior margins subparallel and the lower margin rather sharply rounded. Hinge line very oblique to the axis in the young stages of growth, but less distinctly so in the larger individuals, and its margin somewhat arched. General surface moderately convex. Ligamental area broad and as long as the shell, extending from the beak to the posterior margin of the valves; vertically marked by ligamental grooves, which extend the entire width and number from fifteen to near twenty according to the size and age of the shell, and equal in size on the two valves, so far as can be seen in the best preserved individuals. Substance of the shell, very thick, strongly lamellar, and highly nacreous. Muscular pits deeply marked.

I have never seen a specimen of this species which was anything like entire, and the New Jersey specimens are always very imperfect. A single partial cast, measuring about $3\frac{1}{4}$ inches in length, but almost entirely coated with a thin layer of shell, gives nearly the whole outline, and shows it to correspond very closely to the form given by Mr. Conrad for a Maryland specimen. It is a little more sinuate at the byssal opening only. The larg-

est individual I have seen from New Jersey is a fragment showing the area and byssal border, with a small part of the body of the shell, and appears to have been about the size of Conrad's figure. The specimens are all so fragile that the different layers shell out one from the other, so that it is very difficult to handle them, and the one above mentioned is evidently imperfect both on the inside and outside. In fact, I have never seen the external portions of one, other than that of the area and the byssal margin. The shell is sometimes fully an inch in thickness even in this imperfect condition. In the number of ligamental grooves the shells vary, of course, with the age; while the grooves also vary in size, depth, and shape. In other respects the species appears to be very constant in its characters.

Localities: From New Jersey I have received specimens from Shiloh and Jericho, in Cumberland County. They represent the gray marls, and the marly limestones, and are seen as casts in the brown clays. Specimens are present from both the collections at Rutger's College and that of the U. S. National Museum. Mr. Conrad says, in his remarks on the species, that the European species figured by Goldfuss is certainly identical with the American specimens, while Deshayes thought those from Italy, which are certainly closely allied, represented a distinct species, and gave it the specific name *Soldani*. The species is a very abundant form in the limestone, and also in the gray marls, at Jericho, N. J., and Mr. Conrad states that it is "vastly abundant in the blue clay" in Maryland.

Family MYTILIDÆ.

Genus MYTILOCONCHA Conrad.

Mytiloconcha Conrad: Proc. Acad. Nat. Sciences, Philadelphia, 1862, p. 290.
Mytiloconcha (Conrad) Tryon: Structural and Systematic Conch., vol. 3, p. 262.

"Subfalcate, thick; perlaceous, laminated; hinge thick, elongated; pointed at the apex; an oblique tooth or ridge and parallel furrow throughout the entire length of the hinge area." (Conrad.)

Mr. Conrad proposed this genus for two species of mytiloid shells which are peculiar to the Atlantic coast Miocene, one of which has a broad

and somewhat flattened area, not very unlike that of an oyster, marked throughout its length by a median parallel groove and ridge. The other has a much smaller area, but possesses the groove and ridge in a modified form. The shells are very much thickened, in which feature they differ greatly from most of the mytiloid forms. The muscular system, so far as I have been able to observe it, is like that of Mytilus; consequently the stability of the genus rests entirely on the great thickness of the shell and the peculiar hinge area; but these are so very marked that they cannot well be misunderstood, and the genus appears to be a valid one.

MYTILOCONCHA INCRASSATA.

Plate V, figs. 10 and 11, and Pl. VI, figs. 1 and 2.

Mytilus incrassatus Conrad: Am. Jour. Sci., vol. 41, p. 347; Mioc. Foss., p. 74, Pl. XLII, fig. 4; Heilprin: Proc. Acad. Nat. Sci., Phil., 1887, p. 402; Tuomey and Holmes: Plioc. Foss., S. P., p. 32, Pl. XIV, figs. 1 and 2; Emmons' Geol., N. C., p. 283, fig. 203a.

Mytiloconcha incrassata Conrad: Proc. Acad. Nat. Sci., 1862, pp. 290 and 579; Meek: Check List Mioc. Foss., 7.

"Thick, much inflated; anterior margin slightly incurved above the middle; hinge thick with slightly prominent robust teeth." (Conrad.)

I have seen only the apical portions of valves of this species among the New Jersey collections. The shells have apparently been of moderate size, but the outer parts have scaled off from the inner layers, leaving only a very small part of the valves with a portion of the hinge-plate preserved; they show, however, the curvature of the shell and the characteristics of the hinge sufficiently well to identify them as of this species rather than of *M. incurva*, as the ribs forming the teeth are continued on the inner part of the hinge-plate, and the external parts are covered by the callus and rounded—quite different from the flattened and grooved plate of *M. incurva*. I have figured an example from South Carolina to aid in the identification of other specimens.

Locality: Those which I have for use are from Shiloh, N. J., and are from the collection of the National Museum. The larger specimen figured from South Carolina is from the American Museum of Natural History.

Genus MODIOLA Lamarck.

MODIOLA INFLATA.

Pl. VI, figs. 3 and 4.

Mytilus inflatus Tuomey and Holmes; Plioc. Foss. South Car., p. 33, Pl. XIV, fig. 3; Heilprin, Cat. Mioc. Moll. of N. Jersey, Proc. Acad. Nat. Sci. Phil., 1887, pp. 397, 398, and 402; Tert. Geol. U. S., p. 8.

Perna (*Mytilus*) *inflata* (T. and H.) Conrad; Proc. Acad. Nat. Sci. Phil., 1862, p. 579.

Volsella inflata (T. and H.) Meek, Check List Mioc. Foss., p. 7.

Shell of moderate size and very oblique, the axis of the body of the valve forming an angle of about 45 degrees with the line of the cardinal border. Hinge line about two-thirds as long as the body of the shell measured from the beak to the postero-basal angle. Beaks large and inflated, projecting considerably beyond the line of the hinge and distant from the anterior extremity of the shell. Body of the shell inflated, and marked by a very distinct and rather sharp sulcus from the beak to the antero-basal margin, which is somewhat sinuate. Posterior border oblique and the extremity rounded. Surface of the valves marked by pretty strong concentric lines of growth. In the interior the hinge is marked by a thickened rib a little within the margin, which gives on the internal cast the appearance of a flattened hinge-plate, sometimes nearly or quite an eighth of an inch wide. There are no teeth or septum beneath the beak, however.

The shell bears considerable resemblance to the recent shell, *M. tulipa*, of our southern coast, in its general appearance, and might be readily classed with it under the same specific name, so far as can be seen from the two single valves which I have before me.

Locality: The shells used are from greenish-gray marls and are said to come from Shiloh, N. J. I have seen several fragments of the species and some other casts or partial casts from the harder stony layers of marl at the same locality. Also, several internal casts have been sent me in collections from the dark brown marls near Bridgeton, N. J. The first are from the Academy of Natural Sciences, Philadelphia, and the second from New Brunswick, N. J., and the National Museum at Washington.

Genus LITHOPHAGA Bolten.

LITHOPHAGA SUBALVEATA.

Pl. v, fig. 9.

Lithophaga subalveata Conrad: Am. Jour. Conch., vol. 2, p. 73, Pl. iv, fig 4.
Lithodomus subalveatus Heilprin: Proc. Acad. Nat. Sci. Phil., 1887, pp. 397 and 402.

"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, op. cit.).

This is one of the few species described from New Jersey which I have not personally seen. Mr. Conrad says that "a single specimen was found penetrating the shell of *Ostrea percrassa*, Conrad." And Prof. Heilprin cites, in one of his lists, a form of Lithodomus sp.?. I have seen a few of the cavities in *O. percrassa* Conrad, from New Jersey, which I suppose may have been the burrows of this species, but no shells were in them. Consequently I have, in this case as in others, copied Mr. Conrad's figures of the species.

Locality: Mr. Conrad gives "Shiloh, Cumberland County, N. J.," as the locality.

HOMOMYARIA.

Family ARCIDÆ.

Genus STRIARCA Conrad.

Striarca Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 290.

Mr. Conrad describes the genus in the following language: "Equivalve, radiately striate, closed; hinge area transversely striated, and also the epidermis above it; hinge line dilated and curved at the ends; teeth divided into oblique hollow cross plaits." *Arca centenaria* Say, is mentioned as the type. He further states that "the remarkable teeth of this genus distinguishes it from all other genera of the Arcidæ; the plaits are hollow with parallel laminar sides."

Mr. F. B. Meek, in his revision of the genus Barbatia,[1] further describes and characterizes the genus as follows: "Shell transversely oblong-ovate, with rounded extremities and a deeply sinuous basal margin; surface radiately striate; area moderate; cartilage furrows very small, crowded, and crossing the area at right angles to the cardinal margin; hinge rather distinctly arched, with denticles hollow."

There have been so many generic divisions of this group of shells that it has become extremely difficult to say to which of several any certain form must properly belong, and in the present instance it is somewhat difficult to say wherein the present genus differs from some others; particularly Breviarca of the same author, except in the hollow teeth-like denticles. Mr. Meek ranges Striarca as a section under Barbatia of Gray, and Mr. Tryon ranges Breviarca as a section under Lamarck's genus Cucullæa; on what grounds, however, they are to be so separated I do not quite see, as *Striarca centenaria*, the typical species, has the muscular impressions elevated and margined to a much greater extent than any Breviarca I have ever seen. In general form, perhaps, there may be some more reason for the separation than in the internal structure, as in the present genus the body of the shell is sulcated along the middle, but as Conrad states its basal margin is "*closed*," not having a "small gape," as Mr. Tryon supposes, while that of Breviarca is full and rounded. Still, I do not think this ought to be considered as of generic importance. Perhaps the hollow teeth in this case might safely be taken as of generic importance, but so far as I know it is a species by itself yet, no other one having been recognized as possessing this peculiarity. So far, however, it would only be a specific feature, and no general feature distinguishing the two can readily be found.

[1] Invert. Paleont., vol. 9, U. S. Geol. Surv. of the Terr., p. 78.

ARCA (STRIARCA) CENTENARIA.

Plate VI, figs. 5–7.

Arca centenaria Say: Jour. Acad. Nat. Sci., Phil., vol. 4, 1st series, p. 138, Pl. x, fig. 2; Conrad, Foss. Shells Tert. Form., p. 16, Pl. I, fig. 4; Miocene Foss., p. 55, Pl. 29, Fig. 4; Tuomey and Holmes, Plioc. Foss. So. Car., p. 37, Pl. XV, figs. 11 and 12: Emmons's Geol. N. Car., pp. 284, 205.

Striarca centenaria(Say) Conrad: Cat. Miocene Foss., Phila. Acad. Nat. Sci., 1862. p. 580; Phil., Meek, Check List Miocene Fossils, p. 6.

Mr. Say's original description and diagnosis of this species is as follows: "Shell transversely-oval, subrhomboidal, obtusely contracted at base, with numerous alternate longitudinal striæ. * * * Striæ from 100 to 180 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 margins* not very distinctly crenated; *muscular impressions* elevated, and forming a broad line each side, from the cavity of the beak to the margin."

All the specimens of this shell which I have seen from the New Jersey marls are greatly dwarfed in size, specimens of an inch and a quarter being of very large size, while most of them are below three-fourths of an inch in length. With this exception they are pretty close representatives of the shells from Maryland and Virginia. The striæ on the New Jersey shells are most beautifully crenulated, even on very small specimens, where it requires a lens to see them; and on the larger ones proportionally distinct. The striæ are seen to constantly increase in size with the increased growth of the shell, consequently their number will be variable according to the size of the specimens. The hinge line is strongly striated vertically, but few show the usual diverging ligamental grooves, seen on other Arcas. None of those examined show proper crenulations of the margin, but merely a few points dependent on the surface striæ, but which are oblit-

erated by the subsequent deposit from the interior by additional growth of the shell.

Localities: The only specimens seen from New Jersey are from Shiloh and vicinity. The species is abundant at many localities in Maryland, Virginia, and in North and South Carolina. Collection at Rutgers College and National Museum.

ARCA (SCAPHARCA) CALLIPLEURA.

Plate VI, figs. 8 and 9.

Arca callipleura Conrad: Miocene Foss., p. 54, Pl. XXIX, fig. 2.
Scapharca callipleura Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 579.
Scapharca callepleura (Conrad) Meek: Check List Mioc. Foss., p. 6.

"Shell subtrigonal, profoundly ventricose, thick, posterior area flattened and very wide; posterior end oblique, emarginate; ribs little elevated, flattened, with an impressed line in the middle of each, and another fine line on each side of the central one; the ribs are beautifully granulated; beaks very prominent and distant; inner margin with narrow very prominent teeth."

Mr. Conrad states that of this species he has seen but a single valve; it therefore might be considered a rare species. Still among the specimens obtained in the well boring at Mr. L. Woolman's, at Atlantic City, quite a large fragment occurs which can not be referred to any other than this shell, and at the same time leaves scarcely any doubt that it pertains to this species. The fine line on each side of the medial impressed line of the ribs can not be detected, but the shell has been subject to some action in the bed, so as to leave the impress of the grains of sand on the surface, and thus obscure any finer markings which may have existed. I have figured the fragment as perfectly as it will permit, and I think it leaves no doubt as to its relations to the figure given by Mr. Conrad, and also copied on the plate here.

The specimen belongs to the Academy of Natural Sciences at Philadelphia.

Arca (Scapharca) lienosa?.

Plate VI, figs. 10 and 10a.

Arca lienosa Say: Am. Conchology, Pl. 36; Tuomey and Holmes, Plioc. Foss. S. Car., p. 41, Pl. XV, Figs. 2 and 3; Emmons's Geol. N. Car., 1852, p. 284, Fig. 204; ? Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 400 and 402.

Scapharca lienosa (Say) Conrad: Proc. Acad. Nat. Sci. Phil., 1862, p. 579; Meek Check List Mioc. Foss., p. 6.

"*Shell* rather thin, transversely oblong; ribs about 40, somewhat flattened and much broader than the intervening spaces which are very narrow, and with a longitudinal impressed line, particularly on those of the posterior margin, which are almost bifid; and with numerous slightly elevated transverse lines, which being divided by the longitudinal striæ appear granulated; *beak* but little prominent, and nearly opposite to the posterior third of the length of the hinge margin; *area* narrow and elongated; *hinge margin* rectilinear, angulated at each extremity; teeth numerous, small; *posterior margin* obliquely rounded inwards, no part of it extending further backwards than the angle; *anterior margin* obliquely truncate; *inner margin* crenate." (Say in Am. Conch.)

This species also comes represented by several fragments, which are somewhat questionable in character, and may possibly not have belonged to the species above cited. The fragments are all quite small, and although they represent different parts of the margin of the shell, they are too indefinite to be relied upon as conclusive.

The specimens are from the well boring at Atlantic City, N. J., collected by Mr. L. Woolman, and are from the cabinet of the Academy of Natural Sciences at Philadelphia.

SCAPHARCA SUBROSTRATA.

Plate VI, Figs. 11–13.

Arca subrostrata Conrad: Mioc. Foss., p. 58, Pl. XXX, fig. 7; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 400 and 402.

Scapharca subrostrata Conrad: Proc. Acad. Nat. Sci. Phil. 1862, p. 580; Meek, Check List Miocene Foss., p. 6.

"Ovate, profoundly ventricose, ribs about thirty, little prominent, flat, longitudinally sulcated in the middle, and with from one to three impressed lines on some of the ribs; the lines more numerous and distinct towards the umbonial slope; posterior side cuneiform, extremity acutely rounded or subangular; umbonial slope rounded below, angulated on the umbo; posterior slope depressed, flattened; beaks distant, summits prominent; series of cardinal teeth narrow, inflected towards the posterior extremity.

"A variable shell. The young are proportionally more elevated, and not produced posteriorly, and the left valve has crenulated ribs. It is slightly inequivalved. Generally occurs in single valves." (Conrad Miocene Fossils.)

Two small fragments of this species have been obtained from the well-boring at Atlantic City, N. J.; and noticed by Prof. A. Heilprin. The specimens preserve enough of the surface plications to make their specific identity quite sure, as the character of the flattened striated ribs render it easy of determination. One of the fragments is from the middle portion of the basal margin of a valve and the other from near the anterior end of a left valve, and shows quite well the crenulations of the ribs spoken of in Mr. Conrad's descriptive remarks in the second paragraph quoted above. The ribs are flattened on top with three longitudinal depressed lines on each, the middle one of which is deeper and wider, giving the feature which Mr. Conrad describes as "longitudinally sulcated in the middle." The depressions between the ribs are not more than half as wide as the ribs, and are also flattened in the bottom.

Formation and locality: In the deep well-boring at Atlantic City, N. J. From the collection of the Academy of Natural Sciences at Philadelphia.

Genus LATIARCA Conrad.

Latiarca Conrad: Proc. Acad. Nat. Sci. Phil. 1862, p. 289.

"Triangular, thick, capacious; hinge line narrow medially, broad and thick on the sides; cardinal plates granular and laterally striated, towards the ends in short oblique series; cardinal area wide with obliquely diverging grooves.

"*L. (Cucullæa) gigantea* Con., *L. idonea* Con., *C. ononchela* Rogers, *C. transversa* Rogers. (Eocene.)"

I have serious doubts as to the identity, generically, of *Arca idonea* Conrad, with the *Cucullæa gigantea* —, and *C. onochela* of Rogers (not *ononchela*). The first one has a very strong internal muscular ridge which always shows deeply on the internal casts, which none of the specimens of *A. idonea* which I have seen possess; while *C. onochela* of Rogers possesses a hinge structure so entirely different from *A. idonea* that it can not properly be considered as pertaining to the same group. Rogers's species presents exactly the hinge features of Conrad's cretaceous genus Idonearca, and the shell only lacks the strong muscular ridge on the interior to make it exactly identical. In all other respects, both in the external surface features, the ventricose form, wide area, thickened shell, and in the general shape, they agree exactly; but *A. idonea* Conrad is entirely different; it neither presents the hinged features, the finer striated exterior, nor the dense and thickened shells of the Cretaceous forms; and I think it wrong to classify it with them. The Idonearcas are all Cretaceous; the *C. gigantea*, *C. onochela*, and *C. transversa* (which presents the same features as the *C. onochela*) are Eocene; while *A. idonea* has not been recognized out of the Miocene deposits so far as I am aware. I think Mr. Conrad must have been convinced of the error in this reference of *A. idonea* to Latiarca before writing his list of Miocene fossils, in the later pages of the same volume in which he describes Latiarca, as he there refers it to Scapharca, where it more properly belongs. The shells, however, show a very beautiful transition from those of the Cretaceous Idonearcas, through the Eocene forms, with and without the muscular ridge and finely striated surface, and strong teeth, to those of the Miocene where the features are intermediate between those and the present forms of our coast.

ARCA (LATIARCA?) IDONEA?.

Plate VII, fig. 1.

Arca idonea Conrad: Foss. Shells of the Tert. Form., p. 15, Pl. I, fig. 5; Miocene Foss., p. 55, Pl. XXIX, fig. 3; Emmons, Geol. N. Carolina, 1858, p. 285.

Latiarca idonea Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 289.

Arca idonea? Heilprin: Proc. Acad. Nat. Sci., Phil., 1887, pp. 400 and 402.

Scapharca idonea Conrad: Proc. Acad. Nat Sci., Phil., 1862, p. 579; Meek, Check List Miocene Foss., p. 6.

Arca stillicidium Conrad: Foss. Shells Tert. Form., Pl. I, fig. 3; Miocene Foss., p. 55.

"Shell subtrigonal, thick, diameter equal to about seven-eighths of the length; ribs about thirty, flattened on the back and angulated on the sides, those on the anterior side with a longitudinal furrow; ribs of the right valve crenulated over the whole disk; of the left valve distinctly crenulated only on the anterior side; crenulations largest on the right valve; beaks distant and very prominent; cardinal line short, a little decurved at the ends; teeth irregular and some of them angulated in the middle; inner margin profoundly crenate." (Conrad, Mioc. Foss., p. 55.)

Two small fragments of shell, presenting much more the characters of a Cardium than of an Arca, come to me among the material from the well-boring at Atlantic City, and are the foundation for the citation of the above species made in the Proceedings of the Academy of Natural Sciences, Philadelphia, 1887, pp. 400 and 402. The distance of the ribs from each other is equal to their own diameter and they are rounded on the top, more so than in *Arca idonea*, from the amount of sand wearing which these fragments show, while one of them shows a nodose character of the ribs more characteristic of a Cardium than of an Arca. I may be wrong in my suspicions that they are not fragments of the species to which they are referred, for it is very difficult to assert positively the relations of such small fragments of water-worn shells.

The specimens are the property of the Academy of Natural Sciences at Philadelphia, Pa.

Genus BARBATIA Gray.

Barbatia Marylandica.

Plate VII, figs. 2–4.

Byssoarca Marylandica Conrad: Miocene Foss., p. 54, Pl. XXIX, fig. 1.

Barbatia Marylandica Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 580; Meek, Check List Miocene Foss, p. 6.

Arca Marylandica Heilprin: Proc. Acad. Nat. Sci., Phil., 1887, pp. 398 and 402.

"Shell oblong, compressed, thin, with very numerous radiating granulated striæ; beaks not prominent; base much contracted or emarginate anterior to the middle; posterior side dialated, 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."

This seems to have been a not very abundant species over the region of New Jersey, as there are but two specimens of it among the collections sent me; one small and one fully grown left valve, the latter imperfect. When young it somewhat resembles *Striarca centenaria* of the same size; but may be distinguished by its less depth, more emarginate basal margin, longer posterior hinge alation, and by the narrower hinge plate and less distinct teeth. In the adult stage the differences are so great that no mistake can be made. The striæ on the posterior portion of the shell, especially those along the umbonal slope, are very generally duplicate in character and those on the anterior end are more distant than on any other part. On well-preserved surfaces the granulations of the striæ on the anterior portions of the shell become distinct asperities.

Locality: From the gray marls at Shiloh, N. J. Both of the specimens mentioned are from the collections of the National Museum.

Genus AXINÆA Poli.

AXINEA LENTIFORMIS?.

Plate VII, figs. 5 and 6.

Pectunculus lentiformis Conrad: Foss. Shells Tert. formations U. S., p. 36; Miocene Foss., p. 64, Pl. XXXVI, fig. 1; Tuomey & Holmes, Pliocene Foss. S. C., p. 48, Pl. XVII, fig. 2; Emmons, Geol. N. Car., p. 286; Heilprin, Acad. Nat. Sci. Phil., 1887, p. 402.

Axinea lentiformis Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 580; Meek, Check List, p. 5.

Conrad gives a description of this species in his Fossils of the Median Tertiary, p. 64, as follows: "Lentiform, thick and ponderous, with fine, closely arranged, radiating lines, and distant more profound lines, giving the shell a slightly ribbed aspect; valves widest above or across the base of the umbones, where the margins are rather obtusely rounded; umbo large, and the summit prominent; dorsal margins oblique, curved; cardinal plate dilated, the teeth very large and oblique; marginal crenæ rather narrow and approximate."

The specimens of Axinea which have come to me from the New Jersey beds are all small, young individuals; the largest being scarcely more than five-eighths of an inch in width—so small in fact that they scarcely show the true specific features, and I am somewhat in doubt as to which of these species to refer them, *A. lentiformis*, *A. parilis*, or *A. passa*. The shells are more circular in outline than any of the three except *A. parilis*, while the teeth more nearly resemble those of *A. lentiformis* than of either of the others, being proportionally large and very distinct, while the inner extremities are very slightly inclined. In *A. parilis* and in *A. passa*, the teeth are shorter than in the other, and are each more distinctly bent when the shells are fully grown; but in young specimens from Yorktown it is nearly impossible to distinguish the specific features. The surface of the New Jersey specimens more closely resembles that of *A. parilis* than of any of the others, as the ribs are flat, with a simply impressed line dividing them, with about five longitudinal striæ on each; while in the other species they are usually more rounded and prominent. Taking all these features

into consideration, I have considered these as more nearly related to *Axinea lentiformis* than to either of the other species.

Locality: Specimens have come to me from near Shiloh and Jericho, from the soft gray marls, and from near Bridgeton, N. J., in the light gray stony layers. Imprints also occur in the dark chocolate marly clays near Shiloh. I have received the specimens from the State survey collections and from those of the National Museum.

Family NUCULIDÆ.

Genus NUCULA Lamarck.

NUCULA PROXIMA.

Plate VII, fig. 7–10.

Nucula proxima Say: Jour. Acad. Nat. Sci. Phil., first ser., vol. 2, p. 270; Say's Conch. (Binney), p. 94; Tuomey and Holmes Plioc. Foss. S. C., p. 53, Pl. XVII, Figs. 7 and 8; Emmons' Geol. N. C., p. 287, Fig. 208*b*; Conrad's Cat. Mioc. Foss., Proc. Acad. Nat. Sci., Phil., 1862, p. 581; Meek, Check List, p. 5.

? Nucula obliqua (Say) Heilprin; Proc. Acad. Nat. Sci., Phil., 1887, pp. 398, 402.

"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 arquated; umbo placed far back; within perlaceous; polished, edge crenulated; teeth of the hinge robust, the posterior series very distinct and regular.

"Greatest length parallel with the posterior margin, three-tenths of an inch. Breadth less than two-fifths of an inch.

"Very much resembles *N. nucleus*, but is proportionally wider, and the posterior series of teeth is more regular and distinct. It may probably prove to be only a variety when numerous specimens are carefully examined and compared."

The above is Mr. Say's original description of *Nucula proxima*, as given in the Journal of the Academy of Natural Sciences of Philadelphia, first series, vol. 2, p. 270; and also in the Conchology, p. 94, Binney's edition. It agrees so exactly with the fossil shells from New Jersey, as do also the living specimens from different parts of the coast, except perhaps in size, that I can see no valid reason for considering them distinct.

I have not been able to compare these New Jersey specimens with authentic specimens of *Nucula obliqua* of Say, so can not say positively wherein it differs. The figures given by Mr. Conrad of that species would answer equally well for many of the larger individuals of this one, and I presume it may be from those figures that Mr. Heilprin made the identification cited above. Mr. Conrad remarks under his description of *N. obliqua*, in his Miocene Fossils, p. 57, that it may be a variety of the recent *N. proxima*, which, judging from his figures, I should think more than probable.

Localities: It occurs in fair numbers at Shiloh, Jericho, and near Bridgeton, N. J.

Genus YOLDIA Moller.

YOLDIA LIMATULA.

Plate VII, figs. 11 and 12.

Nucula limatula Say: Am. Conch., Pl. XII; Tuomey and Holmes Pliocene Foss. S. Car., p. 52, Pl. XVII, Fig. 3; Conrad, Mioc. Foss., p. 57, Pl. XXX, fig. 4.

? Nucula lævis Say: Jour. Acad. Nat. Sci., 1st ser., vol. 4. p. 141, Pl. X, fig. 5.

? Yoldia lævis (Say) Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 581; Meek, Check List Miocene Foss., p. 5.

Yoldia limatula (Say's sp.) Heilprin, Tert. Geol. U. S., p. 8; Proc. Acad. Nat. Sci. Phil., 1887, pp. 397, 398, and 402.

The specimens of Yoldia which are found in the Miocene marls of New Jersey present to me too many similarities and too few variations from the living species, *Y. limatula* of Say, to be considered as specifically distinct, or even as a variety. I have not seen any specimens of it which present quite the features of the hinge line shown in Mr. Say's figures of *Nucula lævis*,[1] from any of the American localities, the pectination always terminating much earlier than there represented. Still that may be an error of Say's illustration only, and as the feature is not mentioned in his description, it must remain in uncertainty. The only differences which I can find between the New Jersey fossil specimens and the recent ones of the same size, from along the coast near New Jersey, are, that in the fossil form the valves are perhaps a little more convex; a trifle more slender posteriorly and a very little more recurved than in the living ones. These I do not

[1] Vol. 4, 1st series of the Jour. Acad. Nat. Sci. Phil.

think are sufficient to warrant the adoption of a distinct name. Mr. Conrad originally considered the fossil forms as the same as the living ones, and so gives it in his Miocene fossils. But in his list of Miocene fossils given in the Proceedings of the Academy of Natural Sciences, Philadelphia, for 1862, he appears to drop the name *Nucula limatula* and use that of *Yoldia lævis* instead, and is followed by Mr. F. B. Meek, in the Smithsonian Institution check list, and I do not find any explanation of the change anywhere given, so presume they had considered all the fossil forms as distinct from the *N. (Yoldia) limatula* as now existing, which I do not consider as correct.

The species, as found in New Jersey, attain a length of rather more than 1 inch and differs from the living ones only in the features above mentioned.

Localities: I have seen small specimens of it from near Jericho and Shiloh, Cumberland County, N. J. The figured example, with some others, are from the collection of the Academy of Natural Sciences, Philadelphia, and are contained in a greenish-gray marl, resembling that from near Shiloh. But there is no positive evidence that they are from Shiloh, other than a fragment of newspaper in the tray, with the pencil mark "Shiloh, T. A. C," which has not been copied on the label used for the specimen, that bearing only the mark "N. J."

SIPHONIDA.

INTEGRIPALLIATA.

Family ASTARTIDÆ.

Genus ASTARTE Sowerby.

ASTARTE CUNEIFORMIS.

Plate VIII, figs. 8–10.

Astarte cuneiformis Conrad: Miocene Foss., p. 42, Pl. XX, fig. 9; Proc. Acad. Nat. Sci., Phil., 1862, p. 578; Meek, Check List Miocene Foss., p. 7.

Astarte perplana? (Con.) Heilprin: Proc. Acad. Nat. Sci., Phil., 1887, p. 402.

? Astarte obruta (Conrad) Heilprin: Proc. Acad. Nat. Sci., Phil., 1887, p. 402.

"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, cunei-

form, acutely rounded at the extremity; cardinal teeth long and rather slender; margin crenulated.

"This species approaches the *A. perplana*, but is proportionally much longer, and the lunule much more profound."

Among the specimens from the well-borings at Atlantic City, there are the apical parts of two single valves which I take to belong to the above species. From these fragments alone it is difficult to determine between this and *Astarte obruta*, but in this species the umbones are said to be flat, while in *A. obruta* they ought to be prominent. On these fragments they are flat and the edges of the valves are sharp, and the lunule very deep and short. Owing to these features alone I have concluded that the fragments belong to *A. cuneiformis* rather than to *A. obruta*.

Formation and locality: From the well-borings of Mr. Woolman, at Atlantic City, N. J. The specimens belong to the Academy of Natural Sciences, Philadelphia.

ASTARTE DISTANS.

Plate VII, figs. 13–17.

Astarte distans Conrad: Proc. Acad. Nat. Sci., Phil., 1862, p. 288 and p. 578; Am. Jour. Conch., vol. 2, p. 72, Pl. IV, fig. 14; Meek, Check List Miocene Foss., p. 7; Heilprin, Miocene Moll. of New Jersey, Proc. Acad. Nat. Sci., 1887, pp. 397, 398, and 402.

Astarte undulata Heilprin: Cont. to the Tert. Geol. and Pal. of the U. S., p. 8.

"Triangular, convex-depressed, with four broad, concentric undulations; concentric lines unequal; umbo flattened, with prominent, small, concentric ribs; inner margin minutely crenulated." (Conrad in American Journal of Conchology, vol. 2, p. 72.)

This shell is of medium size, triangular in outline, slightly inequilateral, the posterior end being generally a little the longest; disk of the valves very compressed convex and marked by a few strong, distant, concentric undulations, with finer concentric lines on and between them. Near the beak the concentric undulations are close and crowded, five or six in number; but on the body of the shell there are three or four broad and strong folds. On the larger shells the space near the margin is often nearly plain, or marked only by the finer lines. Lunule and escutcheon narrow and abrupt,

their margins sharply angular. Hinge plate wide below the beak, and the teeth large and strong, coarsely but faintly crenulated on the sides. Muscular imprints well defined, but not deeply marked; pallial line distinct; margin of the valves very distinctly crenulated.

This is a very abundant species, and is a very close relative of *Astarte undulata* Say, from the more Southern outcrops of the Miocene beds. It does not attain so great a size, however, and is almost destitute of the hunch-backed character of the posterior slope of that one. Were it not for this one feature it might readily be mistaken for a young or immature form of that shell; as it corresponds so nearly in character to the earlier two-thirds of the growth of it. It also has considerable resemblance to *A. perplana* Say, as given by Mr. Conrad in his Foss. Medial Tert., Pl. xxi, Fig. 3, in general form, but the undulations are much more distant than on that one.

Localities: The species has been obtained from Shiloh, Jericho, and Bridgeton, N. J.; in the gray marls and in the chocolate clay marls as well. In Meek's Check List of Miocene Fossils he gives the locality Maryland? I do not think, however, it has ever been obtained beyond the limits of New Jersey.

Astarte symmetrica.

Plate viii, figs. 1 and 2.

Astarte symmetrica Conrad; Jour. Acad. Nat. Sci. Phil., 1st ser., vol. 7, p. 134; Medial Tert. Foss., p. 44, Pl. xxi, fig. 7; Proc. Acad. Nat. Sci. Phil., 1862, p. 578; Meek, Check List Miocene Foss., p. 7.

"Shell subtriangular, convex, with concentric impressed lines or undulations; anterior, posterior, and basal margins regularly rounded; apex rather prominent, acute, nearly central; lunule concave, ovate-acute; cardinal teeth very prominent, striated; margin crenulated. Length three-fourths of an inch; height rather less.

"This species may be distinguished from *A. vicina* Say, by the lunule, which is much less excavated, and the shell is also less convex than in the latter species." (Conrad, Jour. Acad. Nat. Sci., Phil.)

A single valve of a specimen of this species only has been obtained from the well-boring of Mr. Woolman, at Atlantic City, N. J., and is pre-

served in the Academy of Natural Sciences at Philadelphia. The specimen is considerably waterworn, so that the teeth and the marginal crenulations are worn away, but the exterior markings of the shell are still plainly visible, leaving no doubt of the specific identity.

Astarte Thomasi.

Plate VIII, Figs. 3–7.

Astarte Thomasi Conrad; Proc. Acad. Nat. Sci., Phil., 1855, p. 267; Am. Jour. Conch., vol. 2, p. 72, Pl. IV, Fig. 16; Proc. Acad. Nat. Sci. Phil., 1862, p. 578; Meek, Check List Miocene Foss., p. 7; Heilprin, Cont. Tert. Geol. and Pal. U. S., p. 8; Proc. Acad. Nat. Sci., 1887, pp. 400 and 402.

? Astarte exaltata Heilprin; Cont. Tert. Geol. and Palaeont. U. S., p. 8.

"Triangular, not ventricose, inequilateral; ribs concentric, robust, recurved; concentric lines more or less marked, minute; toward the posterior ends the ribs suddenly become obsolete; extremity truncated, nearly direct, or sloping inwards; inner margin crenulated; lunule large, ovate, acute, deeply excavated." (Conrad in Proc. Acad. Nat. Sci. Phil., vol. 7, p. 267.)

This species somewhat closely resembles the recent *Astarte castanea* of our own coast, but is somewhat smaller generally, and less arcuate. The shell is ovately triangular, longer than high, and moderately convex; the beaks prominent pointed and well directed forward. The concentric ribs, 15 to 20 in number, are rounded on the surface or slightly arched backwards, and are concentrically striate on their surfaces. The lunule is deep, elongate-ovate in form, and pointed below; the escutcheon is deep and narrowly lanceolate in form, both being somewhat variable in different individuals. The substance of the shell is thick and heavy, and the muscular imprints in the interior are large and strongly marked. Hinge plate small and narrow, crenulations of the inner border rather coarse and deeply marked.

The species is most nearly allied to *A. exaltata* Con. (Medial Tert., p. 66, Pl. XXXVII, Fig. 6) of any fossil form of the Miocene deposits, but it is more triangular, less rounded on the base, and not so deeply arcuate anterior to the beak. The surface structure, however, is quite distinct; that one

being marked with narrow, distant, impressed lines, while on this one the ribs are prominent and rounded, with sharp narrow sulci between. The feature, mentioned by Mr. Conrad, of the ribs suddenly becoming obsolete toward the posterior margin, is only partially correct, as but few of the specimens show it distinctly enough to be a pronounced feature.

Locality: Mr. Conrad gives near Mullica Hill, N. J., as the only locality, and I have seen no specimens which I could identify with it from any other place. Those used are all from the cabinet of the Academy of Natural Sciences, Philadelphia, and are presumed to be the originals of Conrad's description.

Genus CARDITA Brug.

CARDITA GRANULATA.

Plate IX, figs. 1–4.

Cardita granulata Say; Jour. Acad. Nat. Sci. Phil., 1st ser., vol. 4, p. 142, Pl. XII, fig. 1; Conrad Miocene Foss., p. 12, Pl. VII, fig. 1; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, p. 403.

Cardita (*Actinobolus*) *granulata* (Say) Conrad; Proc. Acad. Nat. Sci. Phil., 1862, p. 578.

Cardita tridentata Emmons?; N. Car. Geol. Surv., 1858, p. 302, Fig. 236a.

Venericardia (*Cardiocardites*) *granulata* (Say); Meek, Check List Miocene Foss., p. 7

"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 *decussate* and more oblique." (Say in Jour. Acad. Nat. Sci.)

The specimens obtained from New Jersey are all below the adult size, the largest having a height of less than five-eighths of an inch. They are all single valve and nearly all show evidences of much trituration on the beach before imbedding, some to the extent of having the deep crenulations

of the inner margin entirely worn away. Some of them, however, show the surface very perfectly preserved, and the hinge and other characters beautifully distinct. The plications of the exterior surface are low-rounded, but still very distinct, and the transverse strial fine, rather even, and well marked, the entire characters corresponding well with those of shells of the species from the Yorktown, Va., and Maryland beds, except in the smaller size. The shells are evidently only partially grown.

Formation and locality: All those observed are from the artesian well of Mr. Woolman, at Atlantic City, N. J., and are from the cabinet of the Academy of Natural Sciences, Philadelphia.

Genus CARDITAMERA Conrad.

CARDITAMERA ARATA.

Plate IX, figs. 5 and 6.

Carditamera arata Conrad: Foss. Shells of the Tert. Form., p. 20, Pl. V, fig. 1; Foss. Med. Tert., p. 11, Pl. VI, fig. 2; Cat. Miocene Foss. Atlantic Slope. Proc. A. N. S. Phil., 1862, p. 579; Meek, Check List Miocene Foss., p. 7.

Compare *C. aculeata* Con.: Am. Jour. Conch., vol. 2, p. 73, Pl. IV, fig. 5.

Mr. Conrad's description of this species in the Fossils of the Median Tertiary Formations is as follows: "Shell trapezoidal, with about fifteen ribs, profoundly prominent, and crossed with crowded, arched, and somewhat squamose striæ; three of the ribs on the posterior side larger than the others; dorsal margin slightly declining, straight; posterior margin obliquely truncated; extremity rounded; the margin dilated at the extremity of the three large ribs; margin within profoundly dentate posteriorly."

The specimen which he figures is probably from Maryland, or some more southern locality. There are some features of the New Jersey specimens which, although coming within the limits of his description, do not correspond to his figure, and the number of plicæ do not agree with either. His figure gives the hinge line and base as parallel, although his description says the "dorsal margin slightly declining." On the New Jersey shells the dorsal margin declines considerably, and the shell has eighteen to twenty ribs, generally twenty. The New Jersey shells, so far as I have seen them, are all much narrower in proportion from beak to base than his figure, and

agree very well indeed with his species *C. protracta.* There is one feature of this species in which it appears to differ materially from *C. protracta,* viz, the "dilation" of the extremity of the three large ribs of the posterior end. Among the specimens which I have examined this is generally a marked feature. The three ribs which occur on the umbonal ridge project beyond the others so as to prolong the margin of the valve; and the three, or generally four, small ribs above them, on the posterior slope, contract the posterior truncated margin by their smaller size. The disk of the valves is usually broadly sinuate or depressed from behind the beak to the base of the shell, although the ribs gradually increase in size from the most anterior to the one which runs along the umbonal ridge. The surface of the ribs are very strongly crenulated by the coarse concentric striæ of growth, and near the posterior cardinal border are often prolonged into short, recurved, spinose processes. In the older specimens the inner margin is strongly denticulated and the muscular imprints strongly marked. The hinge plate, however, is rather slight and narrow.

Localities: In New Jersey the species has been found at Shiloh, Jericho, and Bridgeton. At Jericho it does not appear to be uncommon, although seldom of large size. From the collections of the National Museum principally. A few also from those at Rutgers College.

Carditamera aculeata.

Plate IX, figs. 7 and 8.

Carditamera aculeata Conrad: Proc. Acad. Nat. Sci. Phil., 1862, p. 585; Am. Jour. Conch., vol. 2, p. 73, Pl. IV, fig 5; Meek, Check List Miocene Foss., p. 7; Heilprin, Tert. Geol. U. S., p. 8; Miocene Moll. New Jersey, Proc. Acad. Nat. Sci. Phil., 1887, pp. 397, 398, and 403.

Comp. *C. arata* Con. in the young stages of growth.

In Conrad's original description of this species he says: "Trapezoidal; umbonal slope inflated; base emarginate; ribs on anterior side crenulated, on the anterior side subspinose." His second description is as follows: "Trapezoidal inequilateral; umbonal slope ventricose; base emarginate in the middle; disk contracted in the middle; ribs very large over the umbonal slope; anterior ribs crenulated; the larger ribs and the dorsal submargin with prominent scales."

Mr. Conrad says under the second description that he found only one valve of the above species. What is supposed to be that one I have now before me. It is badly broken and some portions from the middle of its length gone; so that to make any very positive statement in regard to its affinities might lead to some misunderstanding. Still I do not believe it to be specifically distinct from the many specimens of Carditamera of much larger size that are found in the Miocene marls at Shiloh, N. J., the locality from which Mr. Conrad's specimen was obtained. I have before me also specimens which I have referred to *C. arata* Con. of sizes from about half the length of Conrad's *C. aculeata* to that of the large one which I have figured as *C. arata*, and I can find no evidence of any specific distinction among them, and can see no reason to suppose them distinct from the *C. arata* as it occurs farther south. At the time Mr. Conrad described *C. arata* he distinctly stated that it occurs in Cumberland County, N. J., and there is no doubt that he at that time considered them all as identical with the Virginia, North Carolina, and Maryland specimens. These remarks are of course based upon the specimen which is supposed to be his type. I would not, however, make the same remarks had I only Mr. Conrad's figure, given in the American Journal of Conchology, to judge from. The figure shows a form somewhat different, especially in the broad, rounded posterior end, and more deeply sinuate basal border; but I have seen no specimen which corresponds in these particulars, and should not suppose the figure could have been made from the shell which comes to me under the name *C. aculeata*. In all respects except the outline the specimen might answer to the figure, but in this feature as well as in the general characters it agrees with *C. arata*, and I shall consequently retain the name *C. aculeata* provisionally as a species not recognized except by Conrad's figure and descriptions.

Family CRASSATELLIDÆ.

Genus CRASSATELLA Lamarck.

CRASSATELLA MELINA.

Plate VIII, figs. 11–13.

Crassatella melina Conrad; Foss. Shells of the Tert. Form. N. A., p. 23, Pl. IX, fig. 2; Medial Tert. Form., p. 22, Pl. XII, fig. 2; Meek, Smith. Check List, p. 7.

Mr. Conrad describes this shell originally from Cumberland County, N. J., as follows: "Shell subovate, convex-depressed; umbones with a few regular rather wide sulci; umbonal slope nearly rectilinear, angular; dorsal margin very slightly concave; extremity obliquely truncated; anterior margin regularly rounded." In his observations he says it differs from *C. undulata* in being proportionally much shorter, and more widely truncated at the extremity, while the dorsal margin is less concave; and from the *C. Marylandica* in "being thinner and more compressed."

The shells, as I find them, are broadly subovate, much the widest anteriorly, with the apex of the valves at about two-fifths of the entire length from the anterior end. The posterior cardinal margin slopes rapidly, and with but little concavity, from the beak to the posterior end which is usually about half as high as the shell from the beak to the basal margin opposite. The body of the shell is rather convex, especially in old thickened specimens. The umbonal ridge is somewhat angular and the posterior umbonal slope rather abrupt. Mr. Conrad states that it is thinner than *C. Marylandica.* If by this is understood the thickness or weight of the shell, some of the specimens before me would not bear out the observation, as they are greatly thickened, and in comparison to the size of the shell would appear to be heavier than any individuals of that species I have noticed. Or if he referred to the general convexity of the valves, many of them are very rotund; although the majority are perhaps rather depressed convex. The hinge of the shell is very strong, and usually quite wide, but the teeth are comparatively thin and slender, while the ligamental pit is broad and well defined. The muscular imprints are large and deeply marked. A peculiar feature noticeable among the shells is a tendency of the surface to exfoliate

in lines, leaving narrow raised ridges at regular intervals, parallel to the margin of the valve, which present the appearance of strong raised varices. So prominent and constant a feature is this that it might readily be mistaken for a specific feature of the shells and as indicating a second species. The lunule and escutcheon are both proportionally deep and narrow, with very sharply raised edges.

I have seen the species as yet only from near Shiloh, N. J.

Family UNGULINIDÆ.

Genus MYSIA Leach.

MYSIA PARILIS.

Plate IX, figs. 9–13.

Mysia parilis Conrad; Am. Jour. Conch., vol. 2, p. 71, Pl. IV, fig. 1; Heilprin, Tert. Geol. U. S., p. 8; Proc. Acad. Nat. Sci., Phil., 1887, pp. 397, 403.

"Equilateral, nearly circular, ventricose, thin, and fragile; basal and anterior margin regularly rounded." (Conrad.)

Shell small, nearly circular in outline, being very slightly longer than high, and as shown by a single specimen, a little more than two-thirds as thick as long. Beaks very small, rising but little above the cardinal line, the umbones, however, becoming a little more prominent, the beaks situated a very little forward of the middle of the valve; disk of the valves regularly rounded throughout, and the surface smooth or marked only by fine lines of growth.

A single imperfect valve forms the typical material of this species. It is imbedded in marl and is much broken at the apical portions, some of which, including the beak, have been lost. From it the characters of the interior can not, therefore, be obtained. A smaller left valve, and a fragment of a right valve from another collection, show the shell to be thin and the hinge narrow, with two teeth in each valve. In the left valve the anterior tooth is elevated, deeply bifid, and recurved, the posterior being single, low, and very oblique; the space between occupied by a deep pit. In the right valve the anterior tooth is single, oblique, and inconspicuous, and the posterior very small, short, and distinctly bifid; the pit between

smaller and deeper than in the left valve. The muscular imprints are proportionally large, narrow, and elongated, much resembling those of Lucina; the posterior imprint being also the largest

The two valves from which the above features are taken appear to belong together, although they were separated when they came into my hands, and the right one only in fragments, with parts missing. The hinge portions, however, are present, although fractured. As they fit each other, the features as given from them may be considered as reliable for the species.

Locality: Mr. Conrad's type specimen, which is the largest, is labeled in his own handwriting as "Shiloh, N. J.," and is from the cabinet of the Academy of Natural Sciences, Philadelphia. The others are from Bridgeton, N. J., near Shiloh, and belong to the National Museum at Washington, D. C.

Family LUCINIDÆ.

Genus LUCINA Brug.

LUCINA ACCLINIS?

Plate x, figs. 5 and 6.

Lucina acclinis Conrad; Foss. Tert. Form. N. A., p. 21, Pl. vi, fig. 2.
Mysia Americana Conrad; (not Defr.) Miocene Foss., p. 30, Pl. xvi, fig. 2.
Lucina Americana Conrad; (not Defr.) D'Orb., Prod., vol. 3, p. 117, No. 2191.
Mysia acclinis Conrad; Proc. Acad. Nat. Sci., Phil., 1862, p. 577. Meek, Check List, p. 8.

Mr. Conrad describes his *Mysia Americana* in Miocene Fossils, p. 30, as follows: "Shell suborbicular or lentiform, a little oblique, with strong lines of growth; hinge with two diverging teeth in each valve; posterior tooth of the right valve bifid; anterior muscular impression not profoundly elongated."

I have seen only one fragment, about half of a left valve, of the shell which I suppose to be identical with this species; but I can feel little hesitation about its identification. The only point of difference between it and Mr. Conrad's figure, is the lack of a posterior sulcus in the figure, while there is a faintly marked sulcus on the specimen. The hinge plate, as far as seen, corresponds, as do all the features which are visible on the speci-

men. The species, however, can not be a true Mysia, as it has a broad posterior hinge plate, a thickened shell, and much larger muscular scars than exist in shells of that genus. It appears to me to be much nearer the true Lucinæ.

The shell, so far as can be ascertained from the fragment, is circular in outline, or nearly so; only moderately convex and much thickened in substance; outer surface with thickly crowded, lamellose, concentric lines, and a posterior sulcus moderately well marked. In the interior the hinge plate is wide behind the beak, and the posterior lateral tooth obsolete; muscular scar on the posterior side moderately large, and bordered by a deep sulcation corresponding to the sulcus on the exterior.

Locality: The specimen is among the shells from Shiloh, N. J.; and belongs to the collections of the National Museum at Washington, D. C.

Lucina crenulata.

Plate x, figs. 7–15.

Lucina crenulata Conrad; Miocene Foss., p. 39, Pl. xx, fig. 2; Proc. Acad. Nat. Sci. Phil., 1862, p. 577; Meek, Check List, p. 8; Tuomey and Holmes, Plioc. Foss. S. C., p. 60, Pl. xviii, fig. 14; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, p. 403.
Compare *L. lens* H. C. Lea: Trans. Am. Phil. Soc., vol. 9, p. 14, Pl. xxxiv, fig. 19.

"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.)

The larger individuals of this species which I have seen from the Miocene beds of New Jersey do not exceed one-fourth of an inch in diameter. The shell is subcircular in outline, moderately ventricose and deeply excavated in front of the small, pointed and subcentral beaks. The surface of the valves is strongly lamellose with faint radiating striæ, corresponding to the crenulations on the inner margins of the shell. The features of the interior are distinct, especially the lateral teeth, which are proportionally strongly developed, and the muscular scars very well marked. In very many of the shells the radiating striæ are distinctly marked on the interior of the valves.

The shell is quite variable in its general outline, being sometimes much longer than high, in which case the prolongation is mostly anteriorly, making the hinge line appear proportionally short, and throwing the beak farther back.

Locality: All the specimens which I have seen are from Jericho, N. J., and are from the National Museum collection.

LUCINA TRISULCATA.

Plate x, figs. 1–4.

Lucina trisulcata Conrad: Am. Jour. Sci., vol. 41, 1st ser., p. 346; Miocene Foss., p. 71, Pl. xi, fig. 5; Proc. Acad. Nat. Sci. Phil., 1862, p. 577; Meek, Check List Miocene Foss., p. 8; Heilprin, Proc. Acad. N. Sci. Phil., 1887, pp. 400 and 403.

"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 in Journal of the Academy of Natural Sciences of Philadelphia.)

In the Miocene Fossils Mr. Conrad gives the following description: "Ovate, convex, elevated, with two or three remote concentric furrows and numerous concentric lines; anterior side rather longer than the posterior; posterior margin subtruncated; beaks prominent; lunule cordate and very profound; inner margin crenulated; cardinal and lateral teeth distinct."

The only specimens which I have seen from New Jersey are two valves from the well-boring at Atlantic City, which, while differing very materially from the figure given by Mr. Conrad, and, in some of their features, from the descriptions, still possess characters that ally them specifically with those from more southern localities. One of the principal differences that I find is in the less convexity of these New Jersey specimens, which are quite flat as compared with specimens from the Neuse River in North Carolina. They are also more coarsely marked concentrically, the lines being thicker and more recurved, while one of them is entirely destitute of any indication of the deep concentric furrows. The shells are also thinner on the hinge, and the teeth much less pronounced; while the lunule in both examples is very small and quite the opposite from "very profound," as

stated by Conrad. In the North Carolina specimens this feature is much more pronounced. These features and differences are so marked that were there more individuals showing constant characters I should be inclined to doubt their specific identity.

The shells belong to the collection of the Academy of Natural Sciences, Philadelphia.

Family CHAMIDÆ.

Genus CHAMA Linnæus.

CHAMA CONGREGATA.

Pl. IX, figs. 14–18.

Chama congregata, Conrad; Am. Jour. Sci., vol. 23, first ser., p. 341; Medial Tert. Foss., p. 32, Pl. XVII, fig. 2; Tuomey and Holmes, Pli. Foss. S. Car., p. 23, Pl. VII, figs. 7–10; Conrad's List of Miocene Foss. Atlantic Slope, p. 576; Meek, Check List, Smith. Inst., p. 8, etc.

Shell small, dextrally coiled, lower valve deep, subangular along the umbonal ridge; upper valve depressed convex, surface of the shell strongly lamellose, the lamellæ often expanded into moderately wide fringe-like leaves, and marked by numerous small radiating plicæ, which are most distinct on the expanded portions of the lamellæ, where they often form subspinose processes or small granulose expansions, especially near the spine. The radiating plicæ, on the upper valve, are generally finer and more crowded than on the other valve, and the lamellæ more erect and exsert. Muscular imprints large and distinct, very slightly elevated above the general surface of the interior, and distinctly striated. Margins of the valves finely crenulated.

This species does not differ from *C. corticosa*, Conrad, in any essential feature, other than in being coiled in the opposite direction. Where they are found associated this one is usually somewhat smaller, but many of the New Jersey specimens attain a very fair size as compared with those of *C. corticosa*.

Localities: At Shiloh, Jericho, and other places in Cumberland County, N. J., and in Maryland, Virginia, and the Carolinas abundantly. Collections at Rutgers College and the National Museum, at Washington.

Family CARDIIDÆ.

Genus CARDIUM Linn.

CARDIUM (CERASTODERMA) CRATICULOIDES.

Pl. x, figs. 16–19.

Cardium craticuloides, Conrad: Mioc. Foss., p. 66, Pl. xxxvii, fig. 3.

C. (Cerastoderma) craticuloides, Conrad: Proc. Acad. Nat. Sci. Phil., 1862, p. 576; Meek, Check List Miocene Foss., p. 8.

? C. laqueatum, Heilpin: Proc. Acad. Nat. Sci. Phil., pp. 398, 400, 403.

"Suborbicular, ventricose; ribs about twenty-nine, 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.)

The few fragments of Cardium which have been collected from the New Jersey localities are not very satisfactory for study. They are all small, and only fragments of the larger size shells showing the development of the character of the ribs are found. The small specimens which show the apical portion appear to be mostly only the inner shells of the specimens, the outer layers being apparently removed by some process, so that the ribs do not present the true features of the species. After a deal of study I have come to the conclusion that they do not represent *C. laqueatum*, as has generally been supposed; but that they are more properly referable to *C. craticuloides* Conrad. The number of the ribs, their direction, and their form, as seen on the larger fragments, and the want of the posterior flattening of the posterior slope, as seen in *C. laqueatum*, and lack of obliquity, show this to be the case. I have figured the best fragments which I have examined, and feel certain from the characters there presented that others will agree in this decision.

Locality and formation: All the fragments seen are from the gray marly layers of the Miocene near Shiloh, or from the more stony layers near Bridgeton, N. J., and are from the collections at Rutgers College or the National Museum.

SINUPALLIA.

Family VENERIDÆ.

Genus VENUS Linnæus.

VENUS DUCATELI.

Plate XI, figs. 1–7.

Venus Ducateli, Conrad: Miocene Foss., p. 8, Pl. IV, fig. 2; Proc. Acad. Nat. Sci., 1862, p. 574; Meek Check List, p. 9; Heilprin, Tert. Geol. U. S., p. 8; Acad. Nat. Sci., Phil., 1887, pp. 397 and 403.

"Shell suborbicular, convex, thick; disk 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." (Conrad.)

Mr. Conrad's type specimens, a very imperfect right valve and two fragments, are before me. I have also several other valves, and one pair of valves, which appear to me to belong to the same species, but they differ mostly in the outline form and in the character of the surface. This latter feature, however, is one on which no reliance can be placed, as the true surface characters have been denuded or removed by the action of weather or by corrosion. The surface in their present condition is very rugose, being marked by heavy elevated ridges which are left standing separate, by the removal of the adjoining ribs, or of intermediate portions of the outer layers of the shell; still they do not show evidences of having ever possessed the structure now seen on Mr Conrad's specimens. Yet I have no doubt they originally possessed it to a greater or less extent. They present very close resemblances to *Venus mercenaria* in many respects, but are thicker on the margin, rather more ventricose, shorter posteriorly, and lack the slight flattening between the middle of the valves and the posterior umbonal ridge which so generally marks specimens of that species. In the interior the anterior cardinal tooth of the left valve is generally bifid as well as the other, which in *V. mercenaria* is not the case, and the posterior tooth is placed at a different angle, being

directed more nearly in the line of the longitudinal axis of the shell. How far these features might prove constant among a larger number of specimens I can not say; they appear to exist among the few specimens I have in hand. Were it not for the surface features of the types I should have been inclined to consider all the others as only varieties of *V. mercenaria*, as I see on them no other features by which they could possibly be distinguished; the surface as shown on the type, however, is very distinctive.

Localities: Mr. Conrad gives the locality of his specimens as "Cumberland County, N. J." Those which I have in hand are from Jericho, and near Shiloh, in the same county, and belong to the collection of the National Museum at Washington, D. C.

Genus MERCENARIA Schumacher.

MERCENARIA CANCELLATA.

Plate XII, figs. 2 and 3.

Mercenaria cancellata Gabb: Jour. Acad. Nat. Sci. Phil., 2d series, vol. 4, p. 376, Pl. LXVII, fig. 25; Meek Check List, Smith. Inst., p. 9.

M. (Venus) cancellata (Gabb) Conrad: Acad. Nat. Sci., Phil., 1862, p. 574; Heilprin, Tert. Geol. U. S., p. 8; Proc. Acad. Nat. Sci., 1887, pp. 397, 398, and 403.

Compare *V. capax* Conrad: Miocene Foss., p. 68, Pl. XXXIX, fig. 4, (by error Pl. XXXVIII).

"Convex beaks inclined anteriorly; umbones prominent and rounded; cardinal margin slightly curved, anterior extremity and basal margin rounded, posterior extremity subangular at its junction, both with the basal and cardinal margin; surface marked by numerous small angular ribs crossed by fine, radiating, impressed lines; anterior muscular impression semilunar, posterior larger and irregular; pallial sinus small and angular." (Gabb.)

The specimen from which the above description was taken is quite imperfect, but enough of it remains to show that it is distinct from any of the species of the genus known to our coast, or as fossils in the Miocene or later beds. A little more than half of the surface retains its natural features; the rest has the outer parts removed and the inner layers considerably weathered, while the interior is in very fair condition, except the hinge, the cardinal and posterior portions of which have been quite destroyed.

The form is more inequilateral than that of *Venus mercenaria*, and the valve is more inflated and proportionally longer anteriorly. The same remarks apply equally well to its relations to *M. Ducateli* Conrad, which is much more nearly related to *V.* (*Mercenaria*) *mercenaria* than is this one. Besides the difference in form and ventricosity, the surface of this shell is quite distinct from that of *V. mercenaria*, being marked by rather small, appressed, and somewhat wrinkled concentric ridges, with very narrow interspaces. These are crossed and cancellated by less distinct, radiating impressed lines, which are closest and most distinct on the anterior part of the shell and crenulate the margin. On the older, thickened part of the shell, bordering the margin, the concentric lines are small and very much crowded, presenting a distinctly old-age feature. Beyond the difference in outline, the greater rotundity, and the surface markings there are no features to distinguish it, as the interior, aside from the features of the hinge, do not present differences from our common clam of the markets.

Locality: The specimen, which is marked on the inside in ink, with the name, is also marked "Type" and "Miocene, N. J." But under the description of the species Mr. Gabb refers back to other species found with this specimen, where we find the locality given as "Shiloh, Cumberland County, N. J." It is somewhat strange that among the other collections made in that vicinity no fragment of it even has been noticed; consequently it may be inferred that it is a very rare form.

Mercenaria plena.

Plate XII, figs. 4–6.

Mercenaria plena Conrad; Am. Jour. Conch., vol. 5, p. 100.
Venus plena (Con.) Heilprin; Tert. Geol. U. S., p. 8; Acad. Nat. Sci. Phil., 1887, pp. 397 and 403.

"Cordate, inequilateral, ventricose, oblique, with close concentric rugose lines; posterior side subcuneiform; lunule ovate; inner margin densely crenulated." (Conrad).

In his observations on this shell Mr. Conrad says: "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."

I have seen only two single valves of this species. These come to me from the cabinet at Philadelphia, and are accompanied by an old label which credits them to the Miocene of New Jersey, and one of the valves, the right one, is marked in pencil "N. J." The type specimens were from the "Eastern shore, Md.," according to Mr. Conrad, so these can not be the types. There is much discrepancy between the form of the shell as given in the observations following Mr. Conrad's description and that shown by these specimens themselves, in the length of the shell principally. He states that it is "shorter" than *M. capax;* but also, that "the pallial sinus is deeper and more angular," which could hardly follow in a shorter shell; while in the description he states that the posterior side is "subcuneiform." In *M. capax* as given by his own figure the form is subcircular, short behind. So I can only think that the term "shorter" as used in the observations referred to, was meant to apply to *M. capax* instead of to this shell, and that this species is rightly identified as *M. plena.*

It would be a comparatively easy matter to select from a group of half grown *Mercenaria mercenaria*, specimens to correspond very nearly, in outline and other principal features, to this shell. But the slightly greater ventricosity of the valves, a much greater thickness of the substance of the shell and a peculiar roughness of the surface, in which it differs from small specimens of that species, are features which mark it as a distinct variety at least. The shell, as compared with that species, can not be said to differ materially in outline from the elongated or cuneiform variety of it in any particular whatever, and might readily be mistaken for a dwarfed and thickened individual, except for the features mentioned and the shorter and broader, or rounder lunule; and may with great propriety be considered only as a variety of that species.

Prof. Heilprin has classed it in his lists as Venus. If Mercenaria is to be retained at all, there certainly is no reason for removing this species from where Mr. Conrad placed it, for it is as much a Mercenaria as the type of the genus.

Locality: The specimen appears to have no more definite locality than "N. J."; but is credited to the "Miocene."

Genus ARTENA Conrad.

Am. Jour. Conch., vol. 6, 1870, p. 76.

"Triangular, thick; surface with acute, concentric, prominent ribs; hinge with three cardinal teeth in the right valve, two of them diverging, distant, the anterior one under the apex, robust, direct, curved; left valve with three diverging distant teeth; lateral tooth very small, pyramidal; pallial sinus very small and angular.

"*Cytherea staminea* Conrad, Miocene Foss., Pl. xxi, fig. 1.

"This genus is readily distinguished from the other genera of the family by one thick anterior tooth in the right valve instead of two approximate teeth as in Meretrix, Caryatis, etc., and by two distant, thick, nearly equal teeth of the opposite valve, and also by the very small pallial sinus, the exterior ribs, etc."

The above is Conrad's description of this genus given in the Am. Jour. Conch., 1871, being copied literally by Tryon in his Systematic and Structural Conchology, where he gives the orthography of the name Artenia and dates it 1870. A specimen of *A. staminea* which is probably from South Carolina, and is fully grown and much thickened, shows the teeth well developed. Those of the right valve are as Mr. Conrad describes them, except perhaps that the one opposite or beneath the beak is not "curved." It is "direct;" but it would be difficult to interpret it as curved in any sense. The anterior tooth in the right valve is small and the posterior one large, while in the left valve the reverse is the case. As to the merits of the genus, it appears to me that all the features of it are fully embraced in those of Anaitis of Roemer, as shown in *Venus plicata* Gmelin, and that the separation was not necessary. Furthermore, the typical species, *A. staminea* Conrad, is much more nearly allied to Venus than to Cytherea, under which it is placed by Tryon.

Venus (Artena) staminea.

Plate xiii, Figs. 3–10.

Cytherea staminea Conrad; Miocene Foss., Pl. xxi, fig. 1; Am. Jour. Conch., vol. 6, p. 76.

Dione (Cytherea) staminea Conrad; Proc. Acad. Nat. Sci. Phil., 1862, p. 575.

Dione staminea (Conrad); Meek Check List, Miocene Foss., p. 10.

? Venus latilirata (Con.) Heilprin; Proc. Acad. Nat. Sci. Phil., 1887, p. 403.

The only description given of the species by Mr. Conrad which I have been able to find is that in vol. 6, p. 76, of the Am. Jour. Conch., where he says: "The species is triangular, very ventricose, slightly contracted posteriorly, and between the ribs are close, minute, rugose, concentric lines [;] umbonal slope terminal, angular; posterior slope depressed, lunule cordate."

Two single valves of small size are all that represent this species among the collections from New Jersey. These are triangular in outline, with deep valves, and the surface is marked with three and four strong, concentric, recurved, lamellar folds, and the shells are less than half an inch in their greatest diameter. A large entire individual from South Carolina, however, serves to give the true adult features. This shell is triangularly circular in outline and very ventricose; the beaks are rather small and somewhat appressed, but strongly incurved, directed forward, and placed in advance of the median line; base of the shell very gibbous with a strong constriction just in front of the umbonal margin; anterior end rounded and the posterior umbonal margin strongly arched; lunule large, deeply marked, and broadly cordate; posterior slope incurved and depressed below the umbonal margin; posterior end slightly produced. Disk of the valve ventricose, with a strongly marked sulcus just anterior to the umbonal margin. Surface marked by distant, strongly elevated, lamellose, concentric ribs and by very fine rugose lines between. Shell substance thick. In the interior the hinge plate is broad with strong teeth separated by deep pits; muscular scars distinct and the pallial sinus small and angular; margins of the valve finely crenulated.

The specimen from which this description is taken is more fully grown than that figured by Mr. Conrad in his Miocene fossils, and shows the posterior sulcus, just in front of the terminal umbonal ridge very decidedly.

This feature, with its extreme ventricose form, broad incurved postero-cardinal area and large distinctly marked lunule, are features which will separate it very readily from any other shell in the Miocene deposits.

Locality: The New Jersey specimens, which are very young shells, are from near Shiloh, N. J,, and belong, one to the State collection at New Brunswick and the other to the National Museum. The large South Carolina specimen is in the American Museum of Natural History, New York City, and from the Holmes collection, but not marked with locality.

Genus DOSINIA Scopoli.

Dosinia acetabulum.

Plate XIII, fig. 2.

Artemis acetabulum Conrad: Foss. Shells Tert. Form., p. 20, Pl. VI, fig. 1; Miocene Foss., p. 29, Pl. XVI, fig. 1; Heilprin: Proc. A. N. S., Phil. 1887, pp. 401 and 403.
Dosinia acetabulum Conrad: Proc. Acad. Nat. Sci. Phil. 1862, p. 575; Meek, Check List Miocene Foss., p. 10.

"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 in Miocene Foss.)

I have seen only a few fragments of this species, but of very characteristic features. They come from the well-boring at Atlantic City, and represent three and probably four different individuals; two of them are of right valves, and two probably of left valves, all of pretty well grown specimens. The specimens being entirely too poor for description or illustration, I have copied both Conrad's description and figure.

The specimens are the property of the Academy of Natural Sciences at Philadelphia.

Genus DIONE Gray.

DIONE MARYLANDICA.

Plate XIII, fig. 1.

Cytherea Marylandica Conrad: Am. Jour. Sci., vol. 23, 1st ser., p. 343; Miocene Foss., p. 15, Pl. IX, fig. 1.

Dione Marylandica Conrad: Proc. Acad. Nat. Sci. Phil. 1862, p. 575; Meek, Check List Miocene Foss., p. 9.

"Shell subtriangular, inequilateral, thick and ponderous, ventricose; summits prominent, obtuse, posterior side subcuneiform; posterior slope concave above, flattened inferiorly; posterior extremity rounded; lunule large, oblong ovate, defined by a slightly impressed line; basal margin regularly arcuate; cardinal teeth three in each valve; anterior tooth pyramidal and very thick." (Conrad in Miocene Foss.)

In the observations following the above description Mr. Conrad says further: "A remarkably thick species, but is easily broken, and always with the disk more or less imperfect. The anterior cardinal tooth of the right valve is very prominent, and somewhat fan-shaped, and slightly crested."

Two fragments of the hinge part of a shell accompany the fragment of *Mactra delumbis*, in the collection from the well-boring at Atlantic City, N. J., which have shelled one from within the other, and which when put together appear to represent the above species much more nearly than they do any other species known from the Atlantic Miocene beds. It has been a remarkably thick shell and is evidently a Cytherea-like species. The posterior umbonal ridge is very angular and somewhat excavated on the upper side while the surface of the beak has been flattened or compressed, unlike that which would result from a Venus-like shell. The fragment has been greatly worn by trituration on the beach and much of the surface worn away. There is but one feature of it which destroys its resemblance to *D. Marylandica*—the narrowness of the hinge plate, which in that species is very wide; but so much wearing has taken place on this fragment, that it may well have belonged to that species. Still some specimens of that show a hinge plate almost as narrow according to the thickness of the shell, and on close comparison with that and other Miocene species, none show so great a resemblance as *D. Marylandica*. So I think there is no reason to doubt that it was an inhabitant of the Miocene seas of this part of the coast.

DIONE SAYANA Conrad.

Plate XII, fig. 1.

Cytherea convexa Say; Jour. Acad. Nat. Sci. Phil., 1st ser., vol. 4, p. 149, Pl. XII, fig. 2.

Cytherea Sayana Conrad; Miocene Foss., p. 13, Pl. VII, fig. 3, reprint of Say's plate; Tuom. and Holmes, P. F. South Carolina, p. 83, Pl. XXI, fig. 9; Emmons, Geol. N. C., p. 294, fig. 1; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 401 and 403.

Dione Sayana Conrad; Proc. Acad. Nat. Sci. Phil., 1862, p. 575; Meek Check List, Miocene Foss., p. 10.

Below I give the descriptions of this shell by both Dr. Say and Mr. Conrad, as they differ somewhat. Mr. Say's description is: "*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."

Mr. Conrad's gives the following characters: "Shell subcordate, ventricose, rather thin, concentrically wrinkled, inequilateral; umbo prominent; posterior extremity rounded; lunule dilated, cordate, marked by a simple line; anterior cardinal tooth pyramidal, robust.

It is very evident that the latter description has been written with the former before the author, as much of the same language is used. Conrad's statement that the shell is "rather thin" I have not found to be correct in any of those I have examined; on the contrary they appear to be generally rather the opposite. I have not seen specimens from any other New Jersey localities than the well-boring of Mr. Woolmans at Atlantic City, and there are only two fragments retaining the hinge portion of the valve, and these have been much waterworn before being reembedded; consequently none of the features can be seen except the general form. I think there is no question as to the identity of the shell, but the specimens are altogether too poor for figuring and for the determination of the species by others, so I have copied Mr. Say's original copperplate figure.

The specimens are the property of the Academy of Natural Sciences at Philadelphia.

Family TELLINIDÆ.

Genus TELLINA Linnæus.

TELLINA PERACUTA.

Plate XIV, fig. 7.

Tellina peracuta Conrad; Am. Jour. Conch., vol. 2, p. 71, Pl. IV, fig. 11; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 397 and 403.

"Elliptical, subequilateral; posteriorly rostrated and acute.

"A small species, allied to *T. polita* Say, but longer in proportion, and more acute." (Conrad, loc. cit.)

I have seen no specimens of this species that I could fully recognize; a few fragments of shell which may possibly have been derived from it have been noticed in the loose marl, but none sufficiently entire to show any of the features. Above I have given Mr. Conrad's description, and I copy his figure as nearly as possible. Mr. Conrad gives "Shiloh, Cumberland County, N. J.," as the locality.

TELLINA (TELLINELLA) CAPILLIFERA.

Plate XIV, figs. 8–10.

Tellina (Tellinella) capillifera, Conrad; Am. Jour. Conch., vol. 2, p. 71, Pl. IV, fig. 2.
Tellina Shilohensis, Heilprin (not Conrad); Proc. Acad. Nat. Sci. Phil., 1887, pp. 397 and 403; Cont. to the Tert. Geol. and Pal. of the U. S., p. 8.

Mr. Conrad describes this species as follows: "Triangular, inequilateral, very thin in substance; umbonal slope of right valve slightly carinated, submarginal, straight, bounded posteriorly by a slightly impressed line, end subtruncated, much above the line of the base; surface with minute, close, hair-like, concentric lines on the anterior side; lateral teeth prominent; left valve ventricose."

The shell figured by Mr. Conrad under the above name comes to me labeled "*Tellina Shilohensis* Conrad," but I can find no reference to such a name in any catalogue except that by Mr. Heilprin referred to above, or in any paper by Mr. Conrad; and I presume the error has been caused by a

label provisionally left with the specimen previous to the description and name as published. The shell may be characterized as follows:

Shell small, barely exceeding 1 inch in length by scarcely two-thirds of an inch in height, and extremely delicate in texture; very depressed convex and very slightly bent posteriorly; beak small, appressed, and nearly subcentral, being a little nearest to the posterior end. General outline transversely subovate, widest anteriorly and broadly rounded, the posterior end narrower and obtusely pointed, postero-cardinal margin more rapidly declining than the anterior. A faint postero-umbonal ridge exists a little within the margin of the shell. Surface of the valve marked by fine concentric lines of growth parallel to the margin of the shell. In the interior the muscular markings are quite faint, the scars very light, and only of moderate size; pallial line very faint, somewhat deeply excavated. Hinge narrow, two small slender teeth under the beak; laterals moderately large, the antero-lateral quite distinct.

Locality: As stated above, there is only the one single authentic valve known; this is labeled Shiloh, N. J., and I have seen no evidence of its existence from any of the other Miocene localities within the State or elsewhere. The specimen is from the collection of the Academy of Natural Sciences at Philadelphia. Externally the shell bears a striking resemblance to *Tellina lusoria* Say, from the Miocene beds at Yorktown, Va., but the lateral teeth in this are very pronounced, especially the anterior one.

TELLINA (ANGULUS) DECLIVIS.

Plate XIV, figs. 4–6.

Tellina declivis Say: Jour. Acad. Nat. Sci., 1st ser., vol. 7, p. 131; Conrad, Mioc. Foss., p. 35, Pl. XIX, fig. 1; Heilprin: Proc. Acad. Nat. Sci., 1887, pp. 401 and 403.

Tellina (*Angulus*) *declivis* ~~(Say)~~ Conrad: Proc. Acad. Nat. Sci. Phil., 1862, p. 573; Meek, Check List Miocene Foss., p. 10.

"Shell triangular, convex, thin, with minute, regular concentric lines; anterior side rather long, and very regularly rounded at the extremity; posterior side short; umbonial slope straight, oblique, angulated; posterior extremity obtusely angulated; lateral teeth distinct, but minute." (Conrad.)

A few imperfect shells of this species have been observed among the collections from within the State. They are so extremely delicate and fragile that they are usually broken in the sandy marl before they can be removed, so that only a single valve has been obtained in a condition to serve the purpose of illustration. The form is irregularly ovate, the anterior portion forming three-fifths of the whole length, and the end rounded; posterior extremity rather sharply pointed and the cardinal line abruptly and obliquely sloping from the beak. Surface marked with very fine lines of growth, and an indistinct furrow along the umbonal portion. In the interior the sinus is very large and deep and muscular imprints very faint.

Formation and locality: In the gray sandy marls at Shiloh, N. J. In the collection of the Academy of Natural Sciences.

TELLINA (PERONÆODERMA) PRODUCTA.

Plate XIV, figs. 1–3.

Tellina producta Conrad: Mioc. Foss., p. 36, Pl. XIX, fig. 5.
Tellina (Peronæoderma) producta Con.: Proc. Acad. Nat. Sci. Phil., 1862, p. 573; Meek, Check List Miocene Foss., p. 10.
Tellina declivis (Con.) Heilprin: Proc. Acad. Nat. Sci. Phil., 1887, p. 403.

"Shell narrow-elliptical, compressed; posterior side pointed, extremity obtuse; fold submarginal, obscure; basal margin straight opposite the beak; lateral teeth none." (Conrad.)

The shells of this species are small, very fragile, and have a polished surface; the form is elongate, triangularly elliptical, the anterior end being about once and a half as long as the posterior, rounded at the end and along the basal line; the posterior end is more pointed and the dorsal margin rapidly sloping; beaks minute; hinge very slender; teeth small; pit small and triangular; lateral tooth on the anterior side very slender, not very remote from the beaks.

Formation and locality: The specimens are from the well-boring at Atlantic City, N. J., and are in the cabinet of the Academy of Natural Sciences at Philadelphia.

Genus DONAX Linnæus.

DONAX VARIABILIS.

Plate XIV, figs. 19 and 20.

Donax variabilis Say: Jour. Acad. Nat. Sci., 1st ser., vol. 2, p. 305; Tuom. and Holmes, Plioc. Foss. S. Car., p. 96, Pl. XXIII, fig. 6; ? Conrad, Proc. Acad. Nat. Sci. Phil., 1862, p. 573; Heilprin, Proc. Acad. Nat. Sci. Phil., 1887, pp. 401 and 403.

Say's description of this species is given as follows: "*Shell* triangular; *anterior margin* obliquely truncate, cordate, suture a little convex; *posterior hinge margin* nearly rectilinear, suture indented; base a little prominent, beyond a regular curve near the middle; *valves* longitudinally striated with numerous equal, parallel, regular, impressed lines, hardly visible to the unassisted eye, and obsolete on the posterior margin; basal edge within crenate."

The description given by Tuomey and Holmes is in nearly the same language as the above and similarly expressed, and was evidently written with Say's description before them. The only specimen which I have seen from the Miocene of New Jersey is an imperfect water-worn right valve, but as far as the characters are preserved it accords perfectly well with the recent shells found on our coast.

Formation and locality: The specimen comes from the well-boring of Mr. Woolmans, at Atlantic City, N. J., and is the property of the Academy of Natural Sciences, Philadelphia.

Family AMPHIDESMIIDÆ.

Genus AMPHIDESMA Lamarck.

AMPHIDESMA BURNSI, n. sp.

Plate XIV, figs. 16–18.

Shell small, compressed, and very thin in substance, transversely elliptical in outline with nearly central beaks, which are small but somewhat elevated or pointed; cardinal margins moderately sloping from the beaks both anteriorly and posteriorly, the anterior side scarcely excavated in front of the beaks; basal margin broadly curved and the extremities of the shell nearly equally rounded, the posterior end being just perceptibly wider than

the other. Hinge in the left valve with a small triangular tooth beneath the beak, which is nearly direct, and a very distinct ligamental pit which is much elongated and very oblique.

Only two specimens of this shell, both left valves and both imperfect, have been observed. The length is less than half an inch. I have been unable to identify it with any described species, recent or fossil.

Locality: In the gray marls of the Miocene at Shiloh, N. J. From the cabinet of the National Museum.

ABRA AEQUALIS.

Plate XIV, figs. 11–15.

Amphidesma aequalis Say: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 2, p. 307; Am. Conch., Pl. XXVIII; Conrad, Miocene Foss., p. 76, Pl. XLIII, fig. 9; Tuomey and Holmes, Plioc. Foss. S. Car., p. 93, Pl. XXIII, fig. 3.

Abra aequalis (Say) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 574; Meek, Check List Miocene Foss., p. 11.

"*Shell* orbicular, slightly oblique, polished, white, with very minute and numerous concentric wrinkles near the margin, which are obsolete on the disk and umbo; lateral teeth none, *primary teeth* two in the left valve and one in the other; *interior ligament cavity* subfusiform, as long as the exterior ligament." (Say's description of recent shell.)

A few very perfect specimens of this species have been obtained, the characters of which are so perfectly similar to those of the living shell as to leave no question of their identity. They vary somewhat among themselves in regard to the relative position of the beaks, but the recent forms present the same differences. The shells are thin and fragile, and only moderately convex, of a broad-ovate form in outline, the beaks at about one-third of the length from the anterior end, small and inconspicuous, with a low inconspicuous ridge passing from them to the antero-basal margin, and the surface marked by very fine, concentric, somewhat wrinkled lines or ridges. In the interior the cardinal tooth is small, and the laterals rather large, ligamental pit narrow, very oblique and of moderate length. It is a very neat and pretty shell, and moderately abundant.

Formation and locality: The specimens are from Jericho, N. J., and belong to the National Museum collection.

Genus SYNDOSMYA Reclus.

SYNDOSMYA? NUCULOIDES.

Plate XV, figs. 7–9.

Amphidesma nuculoides Conrad: Am. Jour. Sci., 1st. ser., vol. 41, p. 347; Miocene Foss., p. 73, Pl. XI, fig. 6.

Abra nuculoides Con.: Acad. Nat. Sci. Phila., 1862, p. 574; Meek, Check List, p. 11.

"Ovate, convex, very inequilateral, with very regular minute concentric lines, posterior side subcuneiform; extremity acutely rounded; lateral teeth obsolete." (Conrad.)

The specimen which I have referred to this species is about one-half larger than Mr. Conrad's figure, but in other respects closely resembles it in outline and general features. 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 pallial sinus shallow and obscure. It is not an Abra, as there are no lateral teeth.

Locality: Shiloh, N. J. From the collection of the National Museum; but only a single right valve observed.

Family MACTRIDÆ.

Genus MACTRA Linnæus.

MACTRA (MULINIA?) LATERALIS.

Plate XV, figs. 1–3.

Mactra lateralis Say: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 2, p. 309; Tuomey and Holmes, Plioc. Foss. S. C., p. 97, Pl. XXIII, fig. 9; Emmons, Geol. of N. Carolina, p. 298, fig. 226, probably by displacement of figures for 227 under the name *Donax*; Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, pp. 398, 401 and 403.
Standella lateralis (Say's) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 573.
Mulinia lateralis (Say's) Meek, Check List Miocene Foss., p. 11.

"*Shell* triangular, very convex, of a smooth appearance, but with very minute transverse wrinkles; *lateral margins* flattened, cordate, with a rectilinear, sometimes concave profile, one margin rounded at the tip, the other longer and less obtuse; *umbo* nearly central, prominent." (Say.)

A single entire right valve and parts of hinge portion of three others occur in the material from the well-boring at Atlantic City. They show a much greater thickening of the shell and a proportional broader hinge-plate than most of those found recent in Long Island Sound and along the coast. Otherwise there is no apparent difference between these fossil shells and the living form. There is some doubt as to the proper generic relations of the species; but it appears to be as near Mulinia as to any described form, and not distinct enough to warrant separation.

The specimens are from the cabinet of the Academy of Natural Sciences at Philadelphia.

MACTRA (SCHIZODESMA) DELUMBIS.

Plate XV, fig. 10.

Mactra delumbis, Conrad: Foss. Shells of the Tert. Form., p. 26, Pl. XI, fig. 1; Miocene Foss., p. 27, Pl. XV, fig. 1; Meek, Check List Miocene Foss., p. 11.
M. (*Scissodesma*) *delumbis* Con.: Proc. Acad. Nat. Sci. Phila., 1862, p. 572.
Mactra ponderosa? (Conrad) Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, pp. 401 and 403.

"Shell subtrigonal, slightly ventricose, thin and fragile, subequilateral, the beaks being rather posterior to the middle, prominent; posterior margin with a distinct fold; posterior slope rather deeply depressed, narrow, the

extremity rounded; cardinal and lateral teeth very prominent and compressed." (Conrad, in Miocene Foss.)

A small fragment of the hinge part of a valve of what I consider as this species has been obtained from the deep well-boring at Atlantic City, N. J., and catalogued and cited by Prof. A. Heilprin as *Mactra ponderosa?* From the compression of the beak and the thin and delicate shell and narrowness of the teeth, as far as preserved, I do not think it can have belonged to *M. ponderosa*; it more nearly represents *M. delumbis.* Of course I can only give my own individual impression. Still I think I am right in this reference. There is not enough of the shell preserved to give a figure of, so I have copied Mr. Conrad's figure from his Miocene Fossils.

Genus PERISSODON Conrad.

The first mention I find of this name by Mr. Conrad is its use for a subgenus under Rangia Desmoulins in his Catalogue of the Miocene Shells of the Atlantic Slope, published in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1862, p. 573, where he places under it *Gnathodon clathrodonta* (*G. Grayi* of the Medial Tertiary Fossils) and *Mactra minor*, Conrad. The name is placed at the head of the genus, but without any reference to date or description, and no characters are given. It also occurs in connection with the same two species in Meek's Check List of Miocene Fossils, and also in Mr. Tryon's Structural and Systematic Conchology, as a division under Rangia, though without characterization, but *R. clathrodonta* Conrad is given as a typical form. It does not occur in any list or in any of Mr. Conrad's subsequent writings, so far as I can ascertain after diligent search, and is nowhere described. Considering *Rangia clathrodonta* Conrad as the type, I can find no features on which to separate it from *R. cuneata* of our southern coast. The anterior lateral tooth and pit may be said to be proportionally smaller and the posterior ridge and groove more strongly developed, and the entire shell thinner and the hinge plate narrower, but otherwise no difference appears. I shall use the name for the second species mentioned (*R. minor*), as it has been recognized by Mr. F. B. Meek and Mr. G. W. Tryon, but do not consider it as a good division.

Genus RANGIA Desmoulins.

RANGIA (PERISSODON) MINOR?

Plate XV, figs. 4–6.

Gnathodon minor Conrad: Am. Jour. Sci., vol. 41, 1st ser., p. 60, Pl. II, fig. 14; Miocene Foss., p. 69, Pl. XXXIX, fig. 6; Tuomey and Holmes, Plioc. Foss. S. C., p. 99, Pl. XXIII, fig. 2.

Rangia minor Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 573.

Rangia (*Perissodon*) *minor* (Conrad), Meek: Check List Miocene Foss., p. 11.

"Subtriangular, convex-depressed, inequilateral; posterior extremity truncated and nearly direct; umbonal slope angulated.

"The hinge resembles that of *M.* [*G.*] *grayi*. The shell is proportionally shorter and less ventricose, and is distinguished by the more direct posterior margin." (Conrad, in Miocene Fossils.)

I have seen but a single valve (right) that I can refer to this species, and I am in considerable doubt in regard to that one. The form of the shell closely resembles Mr. Conrad's figure, both in outline and convexity, as in size; but as he has not figured the interior, and as I have not seen the type, I can only judge of its internal features by the statement that it resembles *Gnathodon Grayi* in this respect, which it does only very distantly. The specimen is of a triangular or triangularly ovate form, moderately convex, umbonal angle distinct, and the slope abrupt. The posterior end is slightly arcuate and the anterior rounded. Surface smooth and semipolished. In the interior the hinge has a single thin and almost sharp central tooth, with a small pit on each side. On the anterior side a moderately well-developed lateral tooth is distinctly shown, with two supplementary teeth, and also a supplementary tooth on the posterior side. These are exceedingly thin and small, and the doubling of the one on the anterior side may be an accidental feature. The muscular imprints are small but distinct and the pallial sinus is wide and shallow. The shell is not a true Mactra, neither is it a true Rangia, but it differs too much from the hinge features of Conrad's type of Perissodon, *Gnathodon Grayi* (= *G. clathrodonta*), to render it entirely safe to place it in that genus. So I have placed it under Rangia provisionally.

Locality: The specimen used is from Shiloh, N. J., and belongs to the National Museum collection.

Family ANATINIDÆ.

Genus PERIPLOMA Schumacher.

PERIPLOMA (?) ALTA.

Plate XVI, figs. 7 and 8.

Periploma alta Conrad: Proc. Acad. Nat. Sci. Phil. 1862, p. 585; Cat. Mioc. Fossils; ibid., p. 572; Am. Jour. Conch., vol. 2, 1866, p. 70, Pl. IV, fig. 10; Meek, Check List Miocene Foss., p. 11.

Anatina alta (Con.) Heilprin: Mioc. Foss., New Jersey, Proc. Acad. Nat. Sci. Phil., pp. 397 and 403; Cont. Tert. Geol. and Pal. of the U. S., p. 8.

Compare *Raeta alta* Con.: Append. to Kerr's Rept., N. C., p. 19, Pl. III, fig. 3.

Mr. Conrad's description of this species in the Proceedings of the Academy of Natural Sciences, Philadelphia, is as follows: "Suborbicular, subinequilateral, anterior side subrostrated, and truncated, direct; basal margin profoundly rounded medially and posteriorly; anterior obliquely truncated or very slightly emarginate. * * * A much larger species than *P. (Anatina) papyracea* Say, but closely allied." In the American Journal of Conchology, as cited above, his description is somewhat different. He says of it: "Obtusely ovate in the adult; substance thin; suborbicular when young; posteriorly ventricose; anterior side subrostrated, compressed; the end truncated, direct, much above the base line, which is profoundly rounded; anterior submargin of the right valve with a slightly raised line, anterior to which the valves are suddenly contracted."

The first description corresponds much more nearly with the specimens received from the Academy of Natural Sciences at Philadelphia, which are supposed to be those used by Mr. Conrad, than does the second, and the figure given with the later description in the American Journal of Conchology does not at all correspond to the specimen from which it is supposed to have been drawn. His later description was evidently drawn from the young specimen figured by him at that time. The specimens are somewhat suborbicular in outline, and moderately convex, but extremely thin and fragile in texture, while in the specimens in hand it is entirely impossible to say if they have been inequivalve or not, as they are both so crushed, in the only one showing both valves, as to render it uncertain. In

the specimen showing the interior both extremities would appear to have been slightly gaping, but not widely so; the anterior end is broadly and obliquely truncated, the truncation extending for nearly two-thirds of the height from the dorsal line, and the gape has been throughout this distance. Below the truncation the anterior end is sharply rounded and the base and posterior end unite into one broad, nearly regular, curve. Surface of the shell marked by fine concentric lines of growth and stronger undulations of the surface. In the interior the spoon-shaped process of the hinge is proportionally large and very thick, and the posterior ridge strong and well marked, although the muscular markings are not traceable.

It is entirely impossible to say if this is truly a Periploma or if it should be classed with Anatina, as Prof. Heilprin has done. It appears to me, however, that by its form it would come as near the one as the other, and the right to either name will rest entirely on the equality or inequality of the valves, and the apparent gaping of the shell at its extremities.

Locality: It has only been found at Shiloh, N. J. Mr. Conrad says it is an abundant species; although among two quite large collections from that place, it is entirely unrepresented; the specimens borrowed from the Academy of Natural Sciences are the only ones I have seen.

Family CORBULIDÆ.

Genus CORBULA Brug.

CORBULA ELEVATA.

Pl. XV, figs. 15–19.

Corbula elevata Conrad: Miocene Foss., p. 7, Pl. IV, fig. 3; Catalogue in Proc. Acad. Nat. Sci. Phil. 1862, p. 572; Meek, Check List Miocene Foss., p. 12; Heilprin, Tert. Geol. U. S., p. 8; Miocene Moll. New Jersey, Proc. Acad. Nat. Sci. Phil. 1887, pp. 397, 401, 403.

Corbula levata (Con.) Meek: Miocene List, Geol. New Jersey, 1863, p. 297 (typographical error).

"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 in Miocene Fossils, p. 7.)

The specimens of this species which I have seen are generally of small size, the largest one being within half an inch in height, and of less length. The form is triangularly ovate in outline, slightly inequilateral, and much inflated, both valves being quite ventricose; the beaks are large and very gibbous, that of the deeper valve much the largest. Umbonal ridge distinct in each valve, but not strongly marked. Surface of the valves variable in their markings, usually with impressed concentric lines, but sometimes developing concentric ridges more or less rounded, but indistinct on the umbonal slope. Some of the best preserved and larger specimens show obscure radiating lines on the surface of the larger valve, but I have not observed them on any of the smaller valves. Most of the examples have lost the external layer of shell. In the interior the ligamental pit of the larger valve is very large and deep, excavating the inner face of the beak in most instances. The tooth is also very large and strong.

I am somewhat in doubt as to the existence of the "concentric impressed lines" on the external surface of the shell of this species mentioned by Mr. Conrad. They undoubtedly exist, but I think only on the inner layers. I have seen but one valve which appears to me to possess the external layer, and that has rounded folds like the majority of the species of Corbula. The species is remarkable for the elevated form of the shell, which is usually considerable higher than long, and often nearly equilateral. Mr. Gabb's *C. Texana*, from the Eocene of Texas, somewhat resembles it in its triangular form, but is neither so elevated nor so short in proportion.

Locality: Mr. Conrad's type specimens were obtained on Stow Creek, near Shiloh, N. J. I have specimens from near the same locality from the National Museum collection, as well as what are supposed to be the types from the Academy of Natural Sciences, Philadelphia.

Corbula idonea.

Plate xv, fig. 20.

Corbula idonea Conrad: Am. Jour. Sci., 1st ser., vol. 23, p. 341; Miocene Foss., p. 6, Pl. x, fig. 6; Proc. Acad. Nat. Sci. Phila., 1862, p. 572; Meek, Check List, p. 12; Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, p. 403.

"Shell triangular, ventricose, thick, with irregular impressed concentric lines on the inferior valve; superior valve with obsolete concentric undulations; the posterior submargin terminal, rectilinear, obtusely carinated, and marked posteriorly by a longitudinal furrow; inferior valve with the posterior extremity subrostrated, flexuous, the submargin obtusely carinated, and rough with transverse striæ; tooth very thick and profoundly elevated." (Conrad, Miocene Fossils, p. 6.)

This is one of the largest of the American species of the genus, and is a very heavy and much thickened shell, and one not easily mistaken. The specimen recognized by Prof. A. Heilprin among the borings of the artesian well at Atlantic City, N. J., is a fragment of the larger thick valve and represents less than one-third of the shell; still it is sufficient to identify the species and prove its occurrence in the Miocene within the State limits. The specimen is in the cabinet of the Academy of Natural Sciences at Philadelphia.

Corbula subcontracta, n. sp.

Pl. xv, figs. 11–14.

Shell small, the largest individual yet observed being rather less than one-fourth of an inch in length and about one-sixth of an inch in height; subovate in outline, widest and shortest anteriorly, the beaks moderately large, and the valves very ventricose; posterior end pointed, the postero-cardinal slope narrow and very abrupt, and the umbonal ridge sharp. Surface of the valves marked by a few strong concentric ridges, which are round and abrupt, and are not continued on the postero-cardinal slope. Substance of the shell proportionally thick. In the interior the muscular imprints are well marked, while the cardinal tooth is only moderately developed, but has a very distinct ridge extending from its base parallel to the margin of the valve and a little below it, both on the anterior and posterior sides.

The species is a very close neighbor to *C. contracta* Say, now common on our coast, but is much smaller. When compared with small specimens of that shell it is seen to be much heavier, also shorter, with a larger beak, but differs principally in the surface markings; the concentric ridges being two to three times as heavy as on any dwarfed or young specimen, of corresponding size, which I have seen among those examined from many localities. The small variety from Beaufort, N. C., approaches it most nearly. They also show radii in the young state, which this does not possess.

Locality: The specimens are from near Shiloh, N. J., from the greenish gray marls, and belong to the National Museum collections.

Family SAXICAVIDÆ.

Genus PANOPÆA Menard.

PANOPÆA GOLDFUSSI.

Pl. XVI, figs. 9–13.

Panopea Goldfussii Wagner: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 8, p. 52, Pl. 1, fig. 3.

Panopæa Goldfussii (Wag.) Meek: Check List Miocene Foss., p. 12.

The following is Wagner's description of this species: "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 the base by the nymph, short and not very prominent."

"Allied to *Panopea reflexa* Say, from which it differs in being proportionally more elongated, and without reflected margin, in being nearly closed anteriorly, and in having a straight dorsal line."

Mr. Wagner's specimens of this species were from the Meherrin River in North Carolina, but judging from his figures I do not think there can be any specific distinction between them and the New Jersey shells, although there is some slight difference in the proportional dimensions of the parts. In the New Jersey specimens the posterior extremity is proportionally

shorter and not quite so attenuate, while the umbos are larger and more rounded and prominent. The anterior end of the shell is so little gaping that it can hardly be said to be a feature, at least when examining the separated valves it is scarcely apparent; but the posterior side is very distinctly so. The greatest difference which I have noticed between Mr. Wagner's description and the features of the New Jersey shells lies in the great prominence of the teeth in the latter, whereas he says they are not prominent in his specimen. Still I do not think this of much importance, but only probably an individual difference. The resemblance to *P. reflexa* Say is too slight to need comparison here. The other nearest approach to this one is seen in *P. porrecta* Conrad (Miocene Fossils, p. 71, Pl. XLI, fig. 2), but here the posterior end is still more elongate and narrowed, and the teeth more slender and smaller. Still I think it probable they may be only variations of the one species. In the interior of this shell the sinus is very large and much deeper than in *P. reflexa* or *P. Americana*, but the line is not broken into dots or patches, as is required in the genus Glycimeris of Klein, consequently I retain it under Panopæa.

Formation and locality: In the gray marly beds of the Miocene at Jericho, N. J. From the collection of the National Museum.

Genus SAXICAVA Bellevue.

SAXICAVA MYÆFORMIS.

Plate XVI, figs. 4 and 5.

Saxicava myæformis Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 585; Meek, Check List Miocene Foss., p. 12.

Thracia myæformis Conrad: Am. Jour. Conch., vol. 2, p. 70, Pl. IV, fig. 3.

Thracia myæformis Heilprin: Tert. Geol. U. S., p. 8; Miocene Mollusca of New Jersey, Proc. Acad. Nat. Sci. Phila., 1887, pp. 397 and 403.

"Ovate, thin and fragile, inequilateral; extremities rounded; surface marked with fine rugose concentric lines; cardinal teeth small, two in the right valve." (Conrad in Proc. Acad. Nat. Sci., Phila., 1862, p. 585.) In the American Journal of Conchology, loc. cit., Mr. Conrad describes the same shell as follows: "Ovate, inequilateral; posterior side somewhat pro-

duced, compressed, much reflexed; the end acutely rounded." In his observations on it he says the figure there given "is only approximate to the true outline, as the shell is slightly crushed." It is true the figure is only approximate to the outline of the specimen, but the crushing has been so very slight that it forms but little excuse for the imperfection of the outline. There is but a single (right) valve of the species for the basis of the above descriptions, and no specimen of it has turned up in other collections. I can see no reason for the removal of the species from the genus Saxicava to Thracia, as the shell does not present the features requisite to the latter genus, being entirely destitute of the projecting crescentic ossicle characteristic of it. It appears, however, to possess the hinge features of Saxicava so far as can be seen from the specimen, which has been cleared out around the hinge for the determination of these features. I can, however, find no evidence whatever of the two small cardinal teeth in the right valve spoken of in Mr. Conrad's first description. There may possibly have been one very minute tooth, but if so it has been destroyed, and what may have been mistaken for a second is only a fracture and slight displacement of the shell. The valve may be characterized as follows:

Shell small, only the right valve known, which is moderately convex and transversely ovate in outline; the beak, which is proportionally large, being situated at about one-third of the length of the valve from the anterior end. Anterior end rounded below and obliquely sloping from the beak to near the middle of the height on the upper side. Posterior end narrower, rounded below and sloping above, a short part of the cardinal border near the beak being nearly straight and parallel to the basal margin. Base very broadly rounded. Body of the valve gibbose from the beak to the base for the anterior half, but recurved posteriorly. Surface marked with distinct concentric lines. The hinge is narrow and obscure, but shows a short narrow ligamental area of attachment posterior to the apex of the shell, and a depressed false groove anterior to the beak.

The hinge of this valve is an exact counterpart of that shown on most of the distinctly marked examples of *Saxicava rugosa*, as seen in both recent and post-Pliocene fossil specimens, and shows a very close generic affinity with that species. The internal characters of the other portions of the valve

I have not been enabled to see, as it is attached to marl which it might not be safe to remove.

Locality: The specimen, which is the type of the species, is from the greenish-gray marls at Shiloh, N. J., and belongs in the cabinet of the Academy of Natural Sciences at Philadelphia.

SAXICAVA PARALIS.

Plate XVI, fig. 6.

Saxicava paralis Conrad: Am. Jour. Conch., vol. 2, p. 70, Pl. IV, fig. 6; Heilprin, Miocene Moll. New Jersey, Proc. Acad. Nat. Sci. Phil., 1887, pp. 397 and 403.
Saxicava (?) paralis Heilprin: Tert. Geol. U. S., p. 8.

"Sub-oval, ventricose, equilateral, very thin in substance, end margins nearly equally rounded, summit prominent, lines of growth minute." (Conrad, loc. cit.)

Only a single very imperfect right valve of this species is known, that from which the above description and the figure in the American Journal of Conchology was taken. The beak is absent, and a large part of the posterior cardinal portion of the shell. The form of the shell is transversely triangularly-ovate in outline, and nearly equilateral, the beak, which has been prominent and almost inflated, being a very little nearer to the anterior than to the posterior extremity of the valve. Cardinal margins very slightly arcuate and sloping toward the extremities, which are nearly equally rounded, the longest part of each being a little below the middle of the height of the valve. Disc of the shell somewhat highly ventricose, the anterior umbonal slope the most abrupt. Basal line broadly arched. Surface marked by comparatively strong concentric lines of growth. The interior of the valve is unkown, but just the central part of the hinge is exposed, showing the features of Saxicava as far as they can be traced. It is, however, very obscure on this part. The general expression of the shell is that of a large Sphærium, but what is seen of the hinge contradicts this expression.

Locality: From the greenish-gray marls of the Miocene at Shiloh, N. J. The specimen is from the collection of the Academy of Natural Sciences at Philadelphia.

SAXICAVA BILINEATA.

Plate XVI, figs. 1–3.

Saxicava bilineata Con.: Miocene Foss., p. 18, Pl. x, fig. 4; Cat. Proc. Acad. Nat. Sci. Phil., 1862, p. 571; Meek, Check List, p. 12.

S. arctica (Linn.) and *S. bicristata* (Sandb.) Otto Meyer: Proc. Acad. Nat. Sci. Phil., 1884, pp. 108 and 109.

S. arctica Linn. var *bicristata* Conrad (error for Sandberger?) O. Meyer: Proc. Am. Phil. Soc., 1888, p. 137.

"Shell irregular in form; lines of growth profound; posterior side bicarinated, the intervening space being a slightly concave furrow; posterior extremity direct, emarginate; right valve with two small diverging teeth." (Conrad.)

I have seen but few specimens of this shell, and those single valves only, except one very young individual. The general form would appear to be an oblong or trapezoid, with parallel dorsal and basal margins; but from this they deviate in almost every direction. The anterior end is short and the posterior narrow or wide, and the body of the shell extremely variable, the only constant feature which I have seen being the two carinæ of the posterior cardinal margin; these are distinct and angular, with the intermediate space concave, and the crests of the carinæ subnodose or subspinose in many cases, though in others they are only roughened by the concentric lines where they cross. A single strong curved tooth and a deep pit is present in each valve. I have not seen them with the "two small diverging teeth" in the right valve.

Locality: In the marls at Shiloh and at Jericho, N. J.

GASTEROPODA.

SECTION III.

GASTEROPODA OF THE MIOCENE DEPOSITS OF NEW JERSEY.

Class GASTEROPODA.

Order PECTINIBRANCHIATA

Family MURICIDÆ.

Genus MUREX Linnæus.

MUREX SHILOHENSIS.

Plate XVII, fig. 1.

Murex Shilohensis Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 404.
? Murex sp.? Heilprin: List, Proc. Acad. Nat. Sci., loc. cit.

"Whorls about seven, angular, flattened on the shoulder, which is crossed diagonally by the variceal ridges; varices about eight on the body-whorl, subequal, spinosely elevated on the shoulder angulation, and crossed by four subequal 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 the shell, key-hole shaped, with the canal broadly reflected. Length nearly .75 inch."

The type specimen of this species has the spines on the angle of the volution so strongly marked and tube-like as to give the shell very much the character of the genus Typhis, still they do not appear to be quite in the nature of tubes, but seem to be deflected backwards, and open more decidedly on the anterior side than behind; enough so at least to induce one to place it rather with Murex than in Typhis. As only a single individual has been observed, it is somewhat difficult to say how far it may have varied in this particular.

Locality: The specimen is from Mr. Ayers' pits in the Miocene marls, near Shiloh, N. J., and belongs to Miss Emma Walter, of Philadelphia, from whom it was borrowed through Prof. Heilprin.

MUREX SHILOHENSIS var. BURNSI n. var.

Plate XVII, fig. 2.

Shell resembling *Murex Shilohensis* Heilp. in the principal features, but is shorter and broader proportionally, with a broader, flatter shoulder, and having but six varices on the whorl instead of eight, as in that one. The upper volutions appear to have been not only shorter but much more angular, and the body-whorl less rounded, the canal shorter, and the columella more angular and tortuous. The varices, besides being more distant though less in number, are narrower and more abruptly elevated on the sides, while the spines at their upper end retain the forms and features of those of that one. The revolving or spiral ridges are the same in number, namely four, exclusive of that on the upper angle, and the entire surface, ridges, and intermediate spaces is marked by finer spiral lines. At the base of the volution, or properly on the beak, there is a proportionally long, sharply recurved spine on each varix, a little above the lower end, which does not appear on the type of *M. Shilohensis*. Considering these differences I do not feel satisfied of its specific identity with that one.

Locality: The specimen, imperfect at the apex, is in collection from Jericho, N. J., made for the National Museum by Mr. Frank Burns.

Family FASCIOLARIIDÆ.

Genus FASCIOLARIA Lamarck.

FASCIOLARIA WOODI.

Plate XVII, figs. 7 and 8.

Fasciolaria Woodi Gabb; Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 4, p. 375, Pl. LXVII, fig. 7; Conrad, Proc. Acad. Nat. Sci. Phila., 1862, p. 561; Meek, Check List Miocene Foss., p. 21.

Turbinella Woodi Heilprin; Proc. Acad. Nat. Sci. Phila., 1887, pp. 397, 398, 401, and 403.

"Fusiform; whorls four or five, flattened so as to make the sides of the spire nearly straight; outer lip plain; columella with one prominent fold; canal moderate, umbilicus nearly obsolete; surface marked by

numerous revolving ribs which exhibit a slight tendency to alternate in size." (Gabb.)

The specimen which I have figured on the plate is the type from which Mr. Gabb drew his description. As he gives only a back view of the specimen it is difficult to tell whether it is in the same condition now as when he used it. There is nothing of the outer lip showing at the present time, and the columella is also very imperfect; the columellar fold shows imperfectly and is quite oblique. The spiral or "revolving ribs" are very fine, and would be as well designated as impressed striæ as ribs; they are very variable in size, and on the lower side of the whorl are flattened on the surface with a faint secondary line, giving the tendency to alternation mentioned. The substance of the shell is quite thick and the shell generally of a heavy character. The transverse striæ in crossing the spiral lines check them and give a rugose surface when seen under a glass. The species seems to have been somewhat uncommon. Mr. F. B. Meek in his Check List cites this species as from Texas. Under Mr. Gabb's description he gives the locality as "with the above," which is *Cantharus Cumberlandiana*, stated to be from Shiloh, N. J. So far as I can ascertain the species has not been recognized from any other locality than New Jersey.

Formation and locality: In the Miocene marls near Shiloh, N. J. From the collection at the Academy of Natural Sciences at Philadelphia.

Genus LYROSOMA Conrad, 1862.

Proc. Acad. Nat. Sci. Phila., 1862, p. 286.

"Subpyriform; ribbed, beak narrow and produced, slightly recurved; one long, very oblique plait at the angle of the columella. *Fasciolaria* (*Fusus*) *sulcosa* Conrad, Fossils Medial Tertiary."

The above is Mr. Conrad's description and citation of type of this genus. The species for which the genus was proposed is a pyriform shell of small size, with a somewhat rounded spire and cancellated body, the strong spiral lines being crossed by vertical lines of growth, which divide the surface into quadrangular spaces, so as to present this checkered appearance. The only point that I can see which would warrant a separation from many of the forms of Fasciolaria, is the existence of a single fold on

the columella. This feature Mr. Conrad describes as occurring at the bending of the columella. On the specimens which I have seen it is distinctly above the bend of the columella, and in the figure given by Mr. Conrad in vol. 3, Pl. XXIII, fig. 3, American Journal of Conchology, it is distinctly thus figured. In Mr. Tryon's figure in his Structural and Systematic Conchology this important feature is entirely omitted, as also is the *kneed* character of the columella, the only generic feature.

FASCIOLARIA (LYROSOMA) SULCOSA.

Plate XVII, figs. 9 and 10.

Pyrula sulcosa Conrad: Jour. Acad. Nat. Sci. Phila., vol. 6, 1st ser., p. 220, Pl. IX, fig. 8.

Fasciolaria sulcosus Conrad: Miocene Foss., p. 86, Pl. XLIX, fig. 7.

Fasciolaria (Lyrosoma) sulcosa Con.: Proc. Acad. Nat. Sci. Phila., 1862, p. 561; Am. Jour. Conch., vol. 3, p. 267, Pl. XXIII, fig. 3; Meek, Check List Miocene Foss., p. 21.

"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.)

A single individual of this species has been obtained in a recognizable condition, and that one of small size, while the body whorl of a second specimen, with the outer coating entirely removed and of about the size of Mr. Conrad's type, is in the collection, but would probably not have been recognized as pertaining to the species had it not been for the presence of the smaller shell. The characters of the shells agree perfectly with the description given above, except that the columella has a single oblique fold a little above the angle, and in the top of the volution being less flattened, and the suture less channeled than one might suppose, though both features exist. On both of the specimens four of the spiral ridges, much larger and more prominent than the others, occupy the larger part of the body whorl, which gives a somewhat angular appearance to the volution, while the spaces between are occupied by very much more subdued ridges. The vertical ridges which give the "longitudinally sulcated" char-

acter mentioned in the description are much less marked on the smaller specimen, and consist merely of very rugose lines of growth, scarcely breaking up the surface into the squares shown on Mr. Conrad's figures. On the exfoliated specimen, however, this feature is very distinct.

Formation and locality: In the micaceous Miocene marls at Jericho, N. J. From the collections of the National Museum.

Family BUCCINIDÆ.

Genus BUSYCON Bolten.

BUSYCON CARICA.

Pl. XVIII, fig. 1.

Murex carica Linn.: Gmelin; Martini, Knorr, etc.
Pyrula carica Brug.: Encycl. Method; Lamarck, Adams, Gould, and others, as a recent shell.
Pyrula carica? Tuomey and Holmes: Plioc. Foss. S. Car., p. 145, Pl. XXIX, fig. 1.
Fulgur carica Conrad: Proc. Acad. Nat. Sci. Phila., vol. 7, p. 319.
Busycon carica Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 560; Meek, Check List Miocene Foss., p. 21.

Shell large, pyriform, with a low conical spire, the volutions in which are margined on the periphery by a row of distant, somewhat flattened, tubercular spines, and are coiled upon each other so as to leave scarcely any of the surface below the spines exposed; upper surface of the volutions scarcely, or barely concave, between the suture and spines; apical angle variable, but always nearly 90 degrees. Aperture large; anterior canal broad and open; columella thick and heavy, strongly bent near the middle of the length, and together with the inner lip of the shell broadly coated with a thin, polished enamel. Surface of the shell marked by transverse lines of growth, with often stronger ridges leading from the tubercles of the spire; also by faint or obsolete spiral lines.

A single large individual of this species, somewhat imperfect, has been sent me, which measures nearly 9 inches in length. The tubercles are not as strong as in many specimens of the living shell found along the coast, although the shells seldom attain such dimensions. In all other respects I can find no difference between it and the living shells. The species would

appear somewhat uncommon in the deposits of this period within the State, as only some two or three fragments of it have been found beyond this one specimen, and its name does not appear in many of the lists of Miocene shells of New Jersey.

Locality: The specimen is from Heislerville, Cumberland County, N. J., and belongs to the collections sent from Rutgers College, New Brunswick, N. J.

BUSYCON SCALARISPIRA.

Plate XVII, figs. 11 and 12.

Busycon scalarispira Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 584; Catalogue, ibid., p. 561; Meek, Smith. Check List Miocene Foss., p. 22.
Fulgur scalarispira Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 403.
Fulgur scalariformis Heilprin: ibid., pp. 397 and 398; Tert. Foss. U. S., p. 8.

"Subfusiform; spire moderate, turreted, sides above the angle oblique; angle subcarinated, with numerous approximate subcompressed tubercles; whorls striated transversely. * * * Allied to *B. rugosum*, but differs in wanting the channel round the base of the whorls." (Conrad, Phil. Acad. Nat. Sci., 1862, p. 584.)

I have seen only small and imperfect examples of this shell. It seems to have been somewhat rare over the region of these deposits. The largest fragment which I have seen is but little more than one inch in diameter, and retains three and a half volutions outside of the mamillated nucleus; but it shows the broken ridge of another full volution beyond these, which would have given it a width of probably fully two inches across the spire. The spire is decidedly scalariform, the elevation of the inner above the outer volutions rapidly increasing in the outer whorls, with the sides of the whorl nearly vertical above those outside of it, and the surface marked by very fine distinct spiral lines throughout, which are wavy on the outer surface below the compressed nodes that line the outer angle of the spire. These nodes are at first very small near the nuclear apex of the spire, and increase both in size and distance as the shell increases in size, becoming large and conspicuous on the outer volutions.

This shell is near *B. coronatum* Con., but differs in that the volutions of the spire are flat on the top instead of rapidly sloping, and the nodes are

smaller and more numerous. It resembles, in the form of the exposed portions of the inner volutions, *B. canaliculatum* most nearly, but is entirely destitute of any channel between the volutions, as in that species.

Locality: The only examples which I have seen are from the gray marls near Jericho, N. J., and belong to the collection of the National Museum. I have not seen Mr. Conrad's type.

Genus CANTHARUS Bolten.

Cantharus Cumberlandianus.

Plate XVII, figs. 3–6.

Cantharus Cumberlandiana Gabb: Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 4, p. 375, Pl. LXVII, fig. 6; Heilprin: Proc. Acad. Nat. Sci., 1887, pp. 398 and 403.

? Cronia (Purpura) tridentata (F. and H.) Conrad: Cat. Mioc. Foos. Proc. Acad. Nat. Sci. Phila., 1862, p. 563.

Comp. *Fusus exilis* Emmons: Geol. N. Car., 1858, p. 351, fig. 111a, not *F. exilis* Conrad: Miocene Foss., Pl. XLIX, fig. 1; and Proc. Acad. Nat. Sci. Phila., 1862, p. 560.

Mr. Gabb describes this species at some length, as follows: "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 eighteen or twenty 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."

The specimen which comes to me from the collection of the Academy of Natural Sciences of Philadelphia, supposed to be the type, is about one-fourth longer than the figure, given by Mr. Gabb to illustrate the species. It also possesses a smaller number of longitudinal ribs, but agrees with his description, however, in this particular. I can find no evidence whatever of the "rudimentary tooth" which he says occurs on the upper end of the columella near the suture. The specimen has been mutilated and repaired, the outer lip having been broken off and replaced. In doing this a fracture is left at the upper angle of the aperture, which leaves the thickened junc-

tion of the outer lip attached to the columella in such a way as to be easily mistaken for a protuberance; and this is possibly what has given rise to the idea of a rudimentary tooth at the upper end of the columella. None of the other examples which I have examined show any evidence of any rudimentary tooth. In other respects the description copied above corresponds with the features as presented by other individuals. The species differs from the requirements of the genus Cantharus in the absence of the canal at the upper end of the aperture. Of this there is not the slightest evidence on any of the examples examined. The outer lip joins the body whorl with but very slight angularity, and the shell is continued across and thickened at the junction. I can scarcely think this can be the same as *Purpura tridentata* Tuomey and Holmes: Plioc. Foss. S. Car., p. 137, Pl. XXVIII, fig. 9. That species is figured with a decided posterior notch, which I do not think this one ever possessed. I strongly suspect that Emmons's *Fusus exilis*, Geol. N. Car., 1858, p. 251, fig. 111a, may be this same species, although there is no possibility of that one being the same as Conrad's *F. exilis* figured in his Miocene Foss., Pl. XLIX, fig. 1, as cited by him under his *F. exilis* in his catalogue given in the Proceedings of the Academy of Natural Sciences Philadelphia, 1862, p. 560. If I am correct in considering this species the same as that of Dr. Emmons, then its name should be *Cantharus exilis* Emmons sp.

Locality: The type specimen is from Shiloh, N. J. Others are from near Shiloh and Jericho, N. J. In the collection at Rutgers College and that of the National Museum.

Family NASSIDÆ.

Genus TRITIA Risso.

TRITIA TRIVITTATOIDES, n. sp.

Pl. XIX, figs. 1–3.

?Nassa trivittata (Say), Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, pp. 398 and 403.

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 chan-

neled 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 body whorl, and the vertical lines eighteen or twenty, exclusive of the lip and varix. Volutions above the last not possessing lip-like varices. This species closely resembles *Tritia trivittata*, Say in its general appearance, but when examined in detail presents several very important differences which at once separate it from that well-known species of our coast. In the first place, it is universally smaller in size; then the suture is not channeled or grooved, or perhaps better expressed by the statement that the upper side of the volutions does not possess the depressed groove of that species; the outer lip of this shell when entire is distinctly thickened, forming a round, raised, varix-like thickened rim, with a lip-like varix somewhere within the limit of the last whorl on all the larger individuals seen, a feature not possessed by *T. trivittata*. The inner surface of both outer and inner lip is denticulated more distinctly than is usual with *T. trivittata*. These points of distinction have decided me in separating it as a distinct species.

Formation and localities: In the gray marls of the Miocene, at Shiloh and Jericho, N. J. In the collection of the National Museum. I have not seen the specimens from the well-boring at Atlantic City, N. J., identified by Prof. Heilprin as *T. (Nassa) trivittata*, so can not say if they are the same as the above.

TRITIA TRIVITTATOIDES, var. ELONGATA, new var.

Pl. XIX, figs. 4–6.

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.*

Formation and locality: In the gray Miocene marls, at Shiloh and Jericho, N. J. From the collection of the National Museum.

Tritia bidentata.

Pl. xix, fig. 7.

Buccinum bidentatum Emmons: N. Car. Geol. Surv., 1858, p. 257, fig. 126.
Tritia bidentata Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 562. Meek, Check List Miocene Foss., p. 20.

"Shell quite small, thick, robust; whorls about five, two upper smooth, the others are ornamented with ribs and spiral bands; aperture oval, acute behind, outer lip furnished with two rather prominent teeth or short ridges; canal wide and very short." (Emmons.)

This shell differs from the two others of this type occurring with it in its size and proportions, this one being shorter and more robust than either of the others, the volutions more inflated and ventricose and often six in number, and the teeth in the aperture several. As compared with *T. trivittatoides*, the size alone is quite sufficient to distinguish it, but when compared with the elongated variety, which is more nearly like this in size, the rotundity of the volutions and its short broad form needs examination. In this one the longitudinal folds are stronger and rounder,

and the spiral lines more distinctly elevated, while the aperture bears a much greater proportion to the length of the shell than in that one. In this one it is about two-fifths of the whole length, and in that one between one-third and one-fourth of the whole length. And the texture of the shell is here finer and more beautiful. I have frequently seen specimens of a shell quite similar to this among collections from the extreme southern coast and the West Indian seas, but usually about twice its size. I can now find no specimens of these for comparison; nor do I know any name for the recent species, but think it very probable they may be nearly or quite identical.

Formation and locality: From the gray micaceous marls of the Miocene, at Shiloh, N. J. In the collection of the National Museum.

Genus BUCCINANOPS D'Orb.

Buccinanops variabilis n. sp.

Pl. xvii, figs. 13–18.

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.

I had been inclined to consider this shell identical with Mr. Conrad's *Bulliopsis quadrata*, from the inspection of his figure and description given in the Am. Jour. Conch., vol. 2, p. 65, Pl. iii, fig. 1; but upon examining his original figure in the Jour. Acad. Nat. Sci., 1st ser., vol. 6, Pl. ix, fig. 16, I have come to the conclusion that it would be better to risk a new name as

less likely to cause confusion. His specimens have been very much more robust in the spire, which is much longer than these when perfect and not so attenuated; nor do the inner volutions of this shell ever present the vertical portion of the volution to view, as shown both in the original and later figures given of that species. I think, however, that they are generically identical, and should prefer to place them as a division of Bullia rather than with Melanopsis, as was done both by Mr. Conrad and Mr. Tryon. But I see no reason why they should not be included under Dr. Orbigny's genus Buccinanops.

Formation and locality: Quite a large number of the shells were obtained from an artesian-well boring at Cape May, N. J., at a depth ranging from 320 to 350 feet from the surface. They are associated with Terebra and *Tritia trivittatoides*, var. *elongata*, herein described, and are from the collections at Rutgers College.

Family MARGINELLIDÆ.

Genus ERATO Risso.

ERATO EMMONSI n. s.

Pl. XIX, figs. 9–11.

Erato lævis? (Loven), Emmons: Geol. South Carolina, 1852, pp. 261 and 262, fig. 139.
Erato (?) *lævis* (Emmons), Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 564; Meek Check List Miocene Foss., p. 19.
Not *Erato lævis*, Loven's species.
Marginella sp.?, Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 404.

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 ridges or teeth, the lower one of which is the most distinct. The surface of the shell has been polished when perfect.

Dr. E. Emmons referred this species to *E. lævis* from the inspection

of figures only, but with some doubt. On comparison with authentic specimens of that species it differs materially in the dentitions of the columellar lip, that one having only very slight crenulations on the lower end, and only one, the lowest, that might be called a ridge. The crenulations of the outer lip are also stronger and less numerous.

Formation and locality: The specimens used are from the gray micaceous marls of the Miocene at Jericho, N. J., and belong to the National Museum collections. Dr. Emmons's specimens were from Cape Fear River, North Carolina.

Family OLIVIDÆ.

Genus OLIVA Brug.=DACTYLUS Klein.

Oliva Carolinensis.

Pl. xix, fig. 8.

Oliva litterata Conrad (not Lamarck): Am. Jour. Arts and Sci., vol. 41, p. 345, Pl. II, fig. 1; Emmons, Geol. North Carolina, 1852, p. 259, fig. 130.

Strephona litterata Tuom. and Holmes: Plioc. Foss. South Carolina, p. 140, Pl. xxviii, fig. 13.

Dactylus Carolinensis Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 584.

"Cylindrical; spire short, conical; whorls concave or angulated; columella strongly plaited throughout; substance of shell very thick at base."

A fragment of the outer volution of a two-thirds grown specimen of an Olive occurs among the collections, which I suppose belongs to the above-named species. The shell, being from a partially grown specimen, is not so thickened as it might have become at an older stage, and in its present condition shows no features that might not readily exist on specimens of *Oliva litterata*. In fact I can see no reason for separating the Miocene form found in the more Southern States from the shells living along the Atlantic coast.

Locality: The fragment comes from the Miocene marls at Jericho, N. J., and belong to the collections of the National Museum.

Family COLUMBELLIDÆ.

Genus AMYCLA H. and A. Adams.

AMYCLA COMMUNIS.

Plate XIX, Figs. 12–15.

Amycla (*Astyris*) *communis* Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 287 and p. 564.

Columbella lunata (Say.) Tuomey and Holmes: Plioc. Foss. South Carolina.

Columbella communis (Con.) Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, pp. 398 and 403.

"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.)

The largest individual of this species which I have seen from New Jersey is scarcely three-eighths of an inch long. It is a somewhat robust shell, with the spire, above the aperture, once and a half as long as the aperture itself. The volutions are but slightly convex between the sutures, being flattened in the direction of the spire, the last one being quite angular at the upper part of the aperture. The outer lip is thickened and swollen externally, and denticulate within when complete, some specimens showing as many as eight ridges; the columellar lip is also sometimes slightly callous, and often shows a small tubercular callus at the upper angle, while below and on the beak portion of the last volution there are distinct spiral impressed lines. General surface smooth and semipolished. Nucleus slightly tubercular, although seldom seen. On quite a number of the specimens color lines are distinctly observed. These are vertical, brownish in color, narrow, with the intervening spaces about twice as wide as the line, the line being continuous and vertical and but slightly wavy, and not interrupted by spiral bands as in *C. lunata* Say, from which it differs very materially in general form and in being much larger.

Formation and locality: In the gray micaceous marls of the Miocene at Shiloh and Jericho, N. J., and given by Tuomey and Holmes from South Carolina. The specimens used are from the collections of the National Museum.

Genus STROMBINA Mörch.

STROMBINA (AMYCLA) LÆVIS, n. sp.

Plate XX, Figs. 1–4.

Shell rather less than a medium size for the genus, consisting of eight volutions; spire elevated, apical angle about 30 degrees; volutions slightly convex between sutures and smooth, except for the fine lines of growth, the last one subangular at the middle and constricted below, to form the short beak; aperture narrow, a little oblique, rather more than half as long as the entire body whorl as seen on the front; outer lip thickened externally, forming a distinct, prominent ridge on the outside, inside slightly thickened, denticulate, having six or eight internal ridges; inner lip slightly callous at the upper angle of the aperture; lower channel or canal distinct, deep, slightly reflected on the outer basal rim; beak strong, and marked externally by from twelve to fifteen close, rounded, spiral ridges. Under a magnifier the surface of the volutions show irregular contorted spiral lines which are neither quite parallel to the sutures nor to each other, but which appear like fine threads placed somewhat irregularly, and broken, beneath the enamel of the surface.

This species does not quite meet the requirements of the genus Strombina, but still is more distant from those of Amycla, while presenting the prevailing features of both genera. The only entire individual seen, the one figured, barely exceeds half an inch in total length, and shows a mamillar apex; and is a very neat and beautiful shell; but so far as I can learn it has never before been noticed. Another imperfect individual has been about five-eighths of an inch long.

Formation and locality: In the gray micaceous Miocene marls at Jericho, and a single one from Shiloh, N. J. From the collections of the National Museum, and a single individual has also been recognized among collections from South Carolina in the American Museum of Natural History.

Family CANCELLARIDÆ.

Genus CANCELLARIA Lamarck.

CANCELLARIA ALTERNATA.

Plate XX, figs. 5–10.

Cancellaria alternata Conrad: Jour. Acad. Nat. Sci. Phila., vol. 7, p. 155; Am. Jour. Conch., vol. 2, p. 67, Pl. IV, fig. 7; Proc. Acad. Nat. Sci. Phila., 1862, p. 567; Meek, Check List Miocene Foss., p. 17.

Cancellaria sp.? Heilprin: Proc. Acad. Nat Sci. Phila., 1887, p. 404.

"Whorls six, 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, subovate; columella three-plaited, plaits decreasing in size toward the base; umbilicus small; summits of volutions flattened; five of the larger revolving lines on the penultimate whorl." (Conrad in Am. Jour. Conch.)

The above description differs in no important feature from the original one given in the first series of the Journal of the Academy of Natural Sciences, but contains some additional features, and is accompanied by a figure of the species. The shells from New Jersey, which I have identified with it, are somewhat variable in form, and present some features not mentioned in either of the descriptions. Still the correspondence is so great that I can not hesitate in considering it the same as the Maryland specimens. Those now under consideration vary much in their comparative length, especially in the spire, and the shoulder of the volution is flattened on some and on others is distinctly rounded. On some the vertical ribs are thick, with narrow interspaces, and others have them narrow with broad interspaces. 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. The species is a very beautiful one and appears to have been very abundant, judging from the proportionate number of them in the collection.

Formation and localities: Mr. Conrad's original specimens are cited as from the Choptank River, in Maryland. In New Jersey they appear to come from Shiloh, Jericho, and near Bridgeton, and at the two former localities are common. I have received them from the collection at Rutgers College and from the National Museum—the latter having been collected by Mr. Frank Burns.

Family TEREBRIDÆ.

Genus TEREBRA Brug.

TEREBRA CURVILINEATA.

Plate XX, figs. 14–17.

Terebra (*Acus*) *curvilineata* Conrad: Proc. Acad. Nat. Sci. Phila., vol. 1, p. 327; ibid vol. 1862, p. 565; Meek, Check List Miocene Foss., p. 18.

Terebra curvilineata (Conrad) Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 403.

"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, $1\frac{1}{4}$ inches.

"Differs from *Cerithium dislocatum* Say, in wanting the distant revolving lines, and the small dislocated portion of the ribs are [have] not a tubercular form; the aperture is longer and narrower." (Conrad.)

The resemblance between this and *T. dislocata* Say is so great as to require a close scrutiny to distinguish between them. The difference between the "revolving [spiral] lines" of Say's species and the extremely fine spiral lines of this one being the most important distinction; while the dislocation of the vertical ridges here can hardly be said to amount to an interruption, as it often does in Say's species.

Formation and locality: Only four specimens of this form have been obtained in the collections from the Miocene marls at Jericho, N. J. These belong to the National Museum collections.

TEREBRA INORNATA, n. sp.

Plate XX, figs. 11–13.

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.

A number of this species have been obtained, but are mostly corroded and dissolved by the action of water, so that all the upper volutions have been destroyed; in which condition they are more rapidly tapering and present a less number of volutions. In fact most specimens present none of the original surface, except on the lower one or two volutions. It differs in its surface characters from any known species, in the sloping of the upper third of the exposed part of the volution, and the vertical space below, and in want of ornamentation.

Locality and formation: Obtained from a well-boring at Cape May, N. J., at a depth of from 320 to 360 feet. From the collection at Rutgers College, New Brunswick, N. J.

Family PLEUROTOMIDÆ.

Genus PLEUROTOMA Lamarck.

PLEUROTOMA (DRILLIA) PSEUDEBURNEA.

Plate XXI, figs. 8–12.

Pleurotoma pseudeburnea Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 404.

"Spire elevated, of about ten volutions; apex papillated; 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 the shell; canal slightly deflected, columellar lip well defined.

"Length slightly exceeding a half inch." (Heilprin.)

This species closely resembles *Pleurotoma elegans* Emmons, Geol. Surv. N. Car., 1858, p. 265, fig. 146, but is more slender, more obsoletely striate, and has the aperture much shorter in proportion to the entire length of the shell. Prof. Heilprin describes it as having "no revolving lines." On most of the specimens in hand there are fine spiral lines near the base of the shell distinctly visible under a glass, but not to the naked eye.

Locality and position: In the gray sandy marls of the Miocene at both Shiloh and Jericho, N. J. From the collection of the National Museum, and in that of Miss Mary S. Holmes, of Philadelphia, the latter one being the type of the species, but received too late to figure.

Genus DRILLIA Gray.

DRILLIA ELEGANS.

Plate XXI, figs. 2–4.

Pleurotoma elegans Emmons: Geol. Surv. N. Carolina, 1858, p. 265.

Drillia elegans (Emmons) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 562; Meek, Check List Miocene Foss., p. 21.

"Shell small, subturreted; whorls about nine, constricted above, ornamented by numerous longitudinal ribs, and traversed by many fine raised spiral lines, which become very distinct upon the pillar lip.

"The spiral lines are very regular and equidistant The body whorl has about sixteen ribs."

I have not seen the type specimens of the above species and am only able to judge of its characters from the figures given and the description which accompanies it, consequently can not positively affirm that the specimens which I here refer to it are specifically identical. Still I think there is no reasonable doubt of the correctness of the reference. 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 con-

striction 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 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.

Formation and locality: All the specimens of this shell observed from New Jersey are from the gray sandy Miocene marls at Jericho, and belong to the collections of the National Museum.

Drillia subflexuosa n. sp.

Plate xxi, figs. 5–7.

Shell small, slender, rather thick, with a turreted spire which forms about three-fifths of the entire length. Whorls convex, obliquely plicated, constricted above; constriction concave, forming about one-third of the exposed part of the volution. Plications very distinct and rounded, not extending below the middle of the principal volution. Aperture about one-third the length of the shell, narrow, terminating below in a short narrow canal; outer lip thickened, distinctly striated within, and deeply notched at the upper extremity; columellar lip callous at the upper end, striated below, and bent near the lower end. Surface marked by strong, elevated, spiral lines marking all the shell except the concave constriction at the upper side of the volution.

This shell somewhat resembles *Pleurotoma flexuosa* Emmons, Geol. Surv. N. Carolina, 1858, p. 265, fig. 148, but is much more slender in proportion to the entire length, besides being covered with spiral lines, of which there is no mention in the description of that species.

Formation and locality: In the gray Miocene marls at Shiloh, N. J. From the collections of the National Museum.

Genus SURCULA H. and A. Adams.

SURCULA PARVA?.

Pl. XXI, fig. 1.

Pleurotoma parva, Conrad: Jour. Acad. Nat. Sci. Phila., vol. 6, p. 225, Pl. IX, fig. 18.
Surcula parva, Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 561; Meek, Check List Miocene Foss., p. 21.

"Shell subfusiform, transversely striated, with oblique longitudinal ribs; upper part of the whorls concave and plain."

A single imperfect individual, referred with some doubt to this species, is among the collections from Jericho, N. J. The shell is quite small, still somewhat larger than the figure given by Mr. Conrad; the spire has been acute, the volutions somewhat convex, with a strong concave constriction at the upper part, and are longitudinally plicated; plications about eleven, rounded and distinct. Aperture elongated and narrow; beak moderately long; inner lip not callous; entire surface of the shell below the constriction marked by fine, rather even, raised, spiral lines with flat interspaces.

Formation and locality: In the gray sandy marls of the Miocene at Jericho, N. J. From the collection of the National Museum.

Family NATICIDÆ.

Genus NATICA Lamarck.

NATICA (LUNATIA) HEMICRYPTA.

Pl. XXII, figs. 1–5.

Natica hemicrypta Gabb: Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 4, p. 375, Pl. LXVII, fig. 5; Heilprin, Proc. Acad. Nat. Sci. Phila., pp. 399 and 404.

Not *N. hemicrypta* Conrad, cited as a synonym of *N. Caroliniana*, Proc. Acad. Nat. Sci. Phila., 1862, p. 564.

Mr. Gabb describes this species in the following language: "Globose; whorls four, rounded; spire elevated, suture faint; mouth rounded; callosity small, partly covers the umbilicus, which is deep, surface smooth."

Mr. Gabb had only small specimens of this species, and gives an enlarged figure of one of them. Specimens occur which are fully as large as his enlarged figure, or of nearly half an inch in height. The spire is elevated as described above, but the aperture is more properly semilunate, and somewhat narrowed above and the base rounded. The callus is wholly confined to the upper half of the umbilicus, and the perforation narrow and deep. The surface is without other markings than the fine lines of growth. A single individual which I think may be identical is very much larger, having been fully five-eighths of an inch high by half an inch in diameter. The spire is imperfect, and the umbilicus rather larger in proportion than in any of the other specimens, creating some doubt as to its identity.

Mr. Conrad cites this species as identical with his *N. Caroliniana*, I think wrongly. His original figure of that species is certainly a very distinct shell from this one, as may readily be seen by the nature of the callus as there shown; and it is properly described in his words "umbilicus large, with a central rounded prominent thick carina;" while the umbilicus is open above the carina as well as below it, which is not the case in the New Jersey shells; the upper part always being covered, or more properly closed. Messrs. Tuomey and Holmes figure a specimen in their Pliocene Foss. of South Carolina, Pl. XXV, fig. 18, which is most probably identical with the New Jersey shell; while they almost copy Mr. Conrad's description of *N. Caroliniana*, and identify their shell with that species incorrectly.

Formation and locality: In the fine gray micaceous Miocene marls near Shiloh, N. J., but more abundantly near Jericho, N. J., in the same position. From the collections at the National Museum and at New Brunswick, N. J.

NATICA (LUNATIA) HEROS.

Pl. XXII, figs. 9 and 10.

Natica heros Say: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 2, p. 248; Am. Jour. Conch.; Emmons, Geol. Surv. N. Carolina, 1852, p. 267, fig. 149, and p. 265.

Not *N. heros* Tuomey and Holmes, Plioc. Foss. S. Carolina, p. 114, Pl. XXV, fig. 15, of Gould and other authors.

? Lunatia catenoides (Wood) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 565; Meek, Check List Miocene Foss., p. 19; Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, pp. 397 and 404.

Mr. Say's original description of his *Natica heros*, as given in the Journal of the Academy of Natural Sciences, Philadelphia, is as follows: "*Shell* suboval, thick, rufo-cinereous; *within* whitish; *columella* incrassated; *callous* not continued over the lower 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."

Among the naticoid shells from the New Jersey Miocene there are several which have so precisely the aspect of the young shells of *L. heros* of our Atlantic coast that it is impossible to distinguish between them. And if it is considered that in taking specimens of that shell of similar size from a number of localities, as I have done, and that they vary greatly in their characters, it becomes all the more difficult to draw any line of distinction between the fossil shells under question and the living forms. It is true that specimens of *L. heros* often are less oblique than the New Jersey fossil forms, and that others may be found having the upper volutions more distinct and rounded above, but there are many others where the obliquity of the volutions pass on the other side of those of the fossil specimens, so that in examining *L. heros* from a large number of localities I have reached the conclusion that no specific distinction exists.

Mr. Conrad, in his list of Miocene fossils, Proceedings of the Academy of Natural Sciences, Philadelphia, 1862, adopts the name *L. catenoides*,

Wood, for the fossil forms usually considered as *L. heros.* In this he has been followed by F. B. Meek and Prof. Heilprin with a question. In comparing the New Jersey forms with the figures given of that English species, by its author, I find a much greater difference than exists between these fossil shells and the living specimens of *L. heros.* Therefore I am the more inclined to differ from Conrad's decision and to consider these as the fossil representatives of the common species of our own coast. Mr. Conrad also cites *Natica heros*, given by Messrs. Tuomey and Holmes in their Pliocene Foss. of South Carolina, as identical with *L. catenoides*, Wood. In this I also think him quite in error; as Tuomey and Holmes's figure represents a very much more upright or vertical shell, with an open umbilicus and rounded conspicuous volutions up to the apex of the spire. Although *L. heros* often possesses very ventricose volutions, those of the spire are much more subdued and more deeply inserted than those of the South Carolina shell. From New Jersey I have two small individuals, having exactly the characters shown in Tuomey and Holmes's figure, and consider it as an entirely distinct species, and it is herein described as such.

Formation and locality: The specimens representing *L. heros* are from near Shiloh and Jericho, N. J., and belong to the collection of the National Museum and that at New Brunswick, N. J.

Natica (Lunatia) tuomeyi, n. sp.

Pl. xxii, figs. 6–8.

Natica heros Tuomey and Holmes: Plioc. Foss. S. Carolina, p. 114, Pl. xxv, fig. 15; not *N. heros* of Say and others.

Shell small to medium size, very ventricose or subglobose, with full rounded volutions and deep distinct sutures; spire moderately elevated and the entire shell upright and vertical in its axis. Aperture large, semicircular or subovate, oblique, rounded below and rather pointed above; inner lip coating the inner volution for the upper two-fifths of the extent, leaving an open umbilicus below, which is clear and deep. Surface of the shell polished when perfect, but marked with fine lines of growth parallel to the margin of the lip; and also under a magnifier showing faint spiral lines.

Somewhat resembles *L. heros* Say, but has a more vertical axis, with rounder, more exsert inner volutions, giving a proportionally higher spire. The specimens figured as *Natica heros* Say, by Tuomey and Holmes, Pliocene Foss. South Carolina, Pl. xxx, fig. 15, I consider as also pertaining to this species, although being very much larger than the New Jersey examples from which this description is taken.

Formation and locality: In the gray micaceous marls of the Miocene at Jericho, N. J. In the collections of the National Museum.

Genus NEVERITA Risso.

Neverita duplicata.

Pl. xxi, figs. 13–16.

Natica duplicata Say: Jour. Acad. Nat. Sci., Phila., vol. 2, 1st ser., p. 247; Tuomey and Holmes, Plioc. Foss. S. C., p. 114, Pl. xxv, fig. 16; Emmons, Geol. N. C., 1852, p. 266, fig. 150.

Neverita duplicata Conrad: Proc. Acad. Nat. Sci., Phila., 1862, p. 564; Meek, Check List Miocene Foss., p. 19.

"*Shell* thick, subglobose, 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.)

There are a number of small individuals in the collections made within the State that are unmistakably of this species, although none of them exceed five-eighths of an inch in diameter, and all are more or less imperfect from breakage or the removal of the surface. They are quite readily recognizable as identical with the form now common on the Atlantic coast, and can not be said to differ in any respect. One feature of many of them, common, however, to other associated species, is, that from weathering and decay the callous portion bordering the suture breaks away, leaving the spire more exsert than in the entire form, and also presenting a flattened rim on top of each volution bordering the suture, thus giving them the same structure along the suture so commonly seen on the Cretaceous genus Gyrodes. It is plainly seen, however, to be only the effect of decay in these shells, as it

frequently shows on part of a volution only, while on the remaining parts the callous portion is preserved. In the form and proportion of the callus in the umbilicus the same variations are seen that show on the living shells.

Formation and locality: In the gray micaceous marls of the Miocene at Shiloh and Jericho, N. J. From the collections of the National Museum.

Family CALYPTRÆIDÆ.

Genus CRUCIBULUM Schum.

Crucibulum costatum.

Pl. XXII, figs. 11–14.

Calyptræa costata Say: Am. Jour. Sci., 1st. ser., vol. 2, p. 40.

Dispotæa costata Say: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 4, p. 132; Conrad, Miocene Foss. p. 79, Pl. XIV, fig. 2.

Crucibulum (*Dispotæa*) *costatum* Conrad: Proc. Acad. Nat. Sci., Phila., 1862, p. 568, where he cites Silliman's Journal, vol. 11, p. 40, instead of vol. 2, p. 40, typographical error by using figures in place of Roman numerals.

Crucibulum costatum Meek: Check List Miocene Foss., p. 15; Heilprin, Proc. Acad. Nat. Sci., Phila., 1887, pp. 399 and 404.

Calyptræa pileolus H. C. Lea: Trans. Am. Phil. Soc., vol. 9, 22, Pl. XXXV, fig. 38.

Crucibulum dumosum Tuomey and Holmes, Plio. Foss. S. Carolina, p. 109, Pl. XXV, fig. 6, and not their *C. costatum*.

? Hipponyx Bullii Tuomey and Holmes, loc. cit., p. 112, Pl. XXV, fig. 13 and 13a. Inner cup only.

"Oval, convex, with numerous slightly elevated, equal equidistant costæ, and crowded obtuse, concentric lines, which are regularly undulated by the costæ; apex mamillated inclined 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 apex of the shell." (Say in American Journal of Science, loc. cit.)

Different specimens of this shell vary greatly in the degree of elevation, in the number and strength of their ribs, in size and in the form of the inner cup or process. This latter feature is perhaps the most perplexing one of the species, being in some cases a complete cup attached along a narrow

line extending from the apex to the base of the shell; and in others a free lamella on one side only; while fully one-half of the entire diameter is firmly soldered to the inside of the shell; all grades between these two extremes may be found among them.

There is but little question as to *Calyptræa pileolus* of H. C. Lea being the young of this shell, and I think *Hipponyx Bullii* of Tuomey and Holmes is only the separated cup of this species. Among the shells from New Jersey there are several of the inner cups of the species which have been broken from the outside shell, and they present precisely the features of their figures given under the above name.

Formation and localities: The species seems to have been pretty generally distributed in the Miocene of Maryland and Virginia. In New Jersey it is found at Shiloh, Jericho, and Bridgeton in the gray marly material, and also in the Brown clays, and is quite abundant. I have in hand specimens from Rutgers College and the National Museum—the latter in collections made by Mr. Frank Burns.

Crepidula fornicata?.

Crepidula fornicata Say? Conrad: Say, Jour. Acad. Nat. Sci., Phila., vol. 2, 2d ser. p. 225; Tuomey and Holmes, Plioc. Foss. S. Carolina, p. 110, Pl. xxv, fig. 9; Emmons, Geol. Surv. N. Carolina, p. 276, Fig. 194(?); Conrad, Miocene Foss., Pl. xlv, fig. 10; Heilprin, Proc. Acad. Nat. Sci., Phila., 1887, p. 404.

Crypta fornicata Conrad.: Proc. Acad. Nat. Sci., 1862, p. 569; Meek, Check List Miocene Foss., p. 15.

Among the fossils of the New Jersey Miocene beds I have seen only a single imperfect cast that I could refer to this well-known living species. The form is that of a broad, much curved, and rather shallow individual, such as are the most abundant along our Atlantic shores. As the specimen represented only the internal cast, and none of the external features were preserved, I can not tell what these features were, or how they may have differed from those recent forms. In it the plate appears to be developed about as in the living form, and the size and curvature about as is represented by Mr. Conrad's figure given in the Miocene Foss., Pl. xlv, fig. 10.

The specimen is in the chocolate-colored clay marls from near Bridgeton, N. J., and belongs to the National Museum collection.

Crepidula plana?.

Crepidula plana Say: Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 2, p. 226; Tuomey and Holmes, Pliocene Foss. S. Carolina, p. 3, Pl. xxv, fig. 12; Emmons, Geol. N. Carolina, 1858, p. 276, fig. 195; Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, p. 404.

Crypta plana? (Say) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 569; Meek, Check List Miocene Foss., p. 16.

A single fragment of this species was detected among the sand from the inside of a small specimen of *Busycon scalarispira*, which had been entirely crushed in packing—so that the entire mass was pulverized. The specimen of *C. plana* represents the rostral half of the shell, enough to show the entire septum, and the form of the beak and exterior of the shell preserves the straight, uncurved form peculiar to the specimens of this species, and it had apparently taken up its abode on the inner face of the Busycon in the manner so prevalent among the living representatives of the species. The shell was too poor for illustration.

This, like the example of *C. fornicata*, belongs to the collection of the National Museum, but the specimen was from the soft gray marly sands at Shiloh, N. J.

Genus TROCHITA Schumacher.

Trochita perarmata.

Pl. xxii, figs. 15–19.

Infundibulum perarmatum Conrad: Proc. Acad. Nat. Sci. Phila., vol. 1, p. 31; Miocene Foss., p. 80, Pl. xiv, fig. 6 (by error fig. 4 in text).

Trochita (*Infundibulum*) *perarmata* Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 569.

Trochita perarmata (Con.) Meek: Check List, p. 15.

? Trochita centralis Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, pp. 399 and 404.

"Trochiform; whorls convex, armed with numerous erect foliated spines.

"Allied to *T. trochiformis* Lam., but is less variable in form and has larger spines." (Conrad, Proc. Acad. Nat. Sci., vol. 1, p. 31.)

In Conrad's Miocene Foss. he adds to the above characters, "Apex prominent, acute, remote from the center." The only examples of this form which I have observed from New Jersey are casts and imprints in the brown clays and imperfect upper portions of the shells from the gray marls. The

features as obtained from the casts by means of gutta-percha impressions show a shell of about 1 inch in diameter, having a height of a little more than half an inch, and consisting of three volutions, exclusive of the nuclear apex. The upper half of the shell, counting the whorls, is smooth or with growth lines, while the lower half is marked by oblique rows of foliated spines, the rows following the growth lines, or parallel to the margin of the aperture of the shell, and on the outer volution are about an eighth of an inch apart. The spines are hollow on the face and slightly recurved. The volutions are moderately convex on the upper surface and the suture lines distinct. On the under surface the volutions are rather distinctly concave, the outer lip strongly receding between the outer edge and the columella, and being marked only by lines of growth parallel to the margin of the aperture.

There can be no reasonable doubt of the proper identification of the forms which show the surface marked with spines, with Conrad's figure of *T. perarmata* in his Miocene fossils, but there might perhaps of the fragmentary shells, chiefly the upper two volutions only, found in the sandy marls, were it not for the imprints in the clays. When, however, the two are examined together one is led to look for the spines of the larger ones on the imperfect shells. On very many of them under a glass the bases of the spines are quite readily observed, showing their relations to the imprints of the more perfect ones in the clays. This leads one to the conclusion that the specimens identified as *T. centralis* by Prof. Heilprin in his lists of the fossils of the New Jersey Miocene, were only imperfect examples of this shell, as no such specimen of *T. centralis* has been observed in any of the collections.

Localities and formation: In the gray sandy marls at Shiloh and Jericho; in the stony layers at Bridgeton, and in the clays near Bridgeton, N. J. From the collection at Rutgers College and the National Museum; the latter collected by Mr. Frank Burns.

Family SCALARIIDÆ.

Genus SCALARIA Lamarck.

SCALARIA MULTISTRIATA.

Plate XXIII, fig. 5.

Scalaria multistriata Say: Am. Conch., Pl. XXVII; Tuomey and Holmes, Plioc. Foss. S. Car., p. 120, Pl. XXVI, fig. 14?; Emmons, Geol. N. Car., 1858, p. 271, fig. 165.
Scala multistriata? (Say) Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 565; Meek, Check List Miocene Foss., p. 18.

"*Shell* conic, turreted, tapering to an acute apex, white, immaculate, imperforate; *whorls* about eight, in contact; *costæ* regular, simple, not reflected, equidistant, moderately elevated; *spaces between* the *costæ*, with very numerous approximate, equidistant, impressed lines; *suture* well impressed; *body whorl* with about sixteen costæ." (Say's description of recent shell.)

A single small specimen of this species has been collected, which is about two-thirds as large as the recent shells. So far as the characters are preserved, it agrees well with recent specimens, but as the shell is denuded of the surface layer over the entire surface the fine spiral striæ can not be observed. The specimen contains four and a half volutions, having lost two or more at the apex, and in consequence of the loss of surface shows a small umbilical opening. The volutions are very round and full, with the sutures deep and strongly marked; aperture very nearly circular, being barely longer than wide; body whorl with eighteen longitudinal ribs, which are directed backward in crossing from above to the lower side, but the external features of the ribs are not preserved.

Formation and locality: In the gray micaceous marls of the Miocene at Jericho, N. J. From the National Museum collection.

Family TRICHOTROPIDÆ.

Genus TRICHOTROPIS Broderip.

TRICHOTROPIS DALLI n. sp.

Plate XXIII, figs. 1–4.

Carinorbis (*Delphinula*) *globulus* (H. C. Lea) Heilprin, Acad. Nat. Sci. Phila., 1887, p. 404.

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 mamillated; 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.

This species somewhat resembles *T. borealis* Sow., from the Newfoundland coast, but differs in its shorter, broader form, being only about two-thirds as high proportionally; also in the much stronger spiral ridges. Prof. Heilprin has sent me, for examination, the specimen which he had identified as *Carinorbis* (*Delphinula*) *globulus* H. C. Lea, from the collection of Miss Tyndall, of Philadelphia. I find it to be a young shell, about an eighth of an inch long, of this species. The spire is very much higher than is represented in Mr. Lea's figure, which represents a shell nearly twice as wide as high, while this young shell is nearly twice as high as wide, with the columella nearly under the apex, instead of at the edge of the penultimate whorl, as in Lea's figure. *Delphinula globula* Lea is the same as *Carinorbis lata* Conrad. The present species might be referred to Isapis.

Formation and localities: In the Miocene marls at Shiloh and at Jericho, N. J. In the collection of the National Museum.

Family TURRITELLIDÆ.

Genus TURRITELLA Lamarck.

TURRITELLA ÆQUISTRIATA.

Plate XXIII, figs. 12–14.

Turritella æquistriata Conrad; Proc. Acad. Nat. Sci. Phila., 1862, p. 584; Cat. Mioc. Foss. Atlantic slope, in Proc. Acad. Nat. Sci., 1862, p. 567; Meek, Check List Miocene Foss., p. 16.

"Subulate, volutions fourteen, bicarinate, carina 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."

The above is Mr. Conrad's description of this species. The shell is extremely variable in the rate of increase in size in different individuals, and also somewhat so in the general expression of the volutions, owing to the comparative distance between the two principal carina, and their distance from the suture. But they all agree by having the carinæ much nearer the lower part of the exposed surface of the volution than to the upper, which gives a long slope from the upper one to the suture line above; usually greater than the distance between the two carinæ; while the space below the lower carina is not more than half as wide as that between the carinæ. In the fine lines covering the surface they are very uniform, although the small intermediate line does not always appear. The lower edge of the volution is either obtusely carinate or rounded, and the lower surface covered with fine lines, as is the surface. In older shells the carinæ are less distinctly marked. The aperture is subquadrate and the apex, as seen in very perfect specimens, would appear to have been open and filled from within.

Localities: All the specimens yet seen have been from Shiloh, N. J. Mr. Conrad's types were from the same place. Collections at Rutgers College, N. J., and National Museum, Washington, D. C. Mr. Meek gives it as from North Carolina.

Turritella Cumberlandia.

Plate xxiii, figs. 9–11.

Turritella Cumberlandia Conrad; Proc. Acad. Nat. Sci. Phila., 1862, p. 584; Cat. Mioc. Foss.; ibid, p. 567; Meek, Check List Miocene Foss., p. 16.

Mr. Conrad describes this species as follows: "Elongate, tapering gradually; volutions twenty-four, bicarinated, carina nearly equal, distant; revolving lines unequal, wrinkled; sides of whorls concave between the carinæ, somewhat channelled beneath the lower one and rounded at the base. Length, $2\frac{3}{8}$."

This species differs from either of the others herein described in having a comparatively rounded volution in the larger part of the shell and in having the carinæ almost or quite equidistant from the sutures, with the space between them of nearly the same distance as that above or below the carinæ. The shell is proportionally slender, and on the upper part the carinæ are prominent and the sutures only slightly marked, while on the larger parts the sutures are deeply sunken, which gives a rounded volution. The revolving lines are usually quite obscure and are often obsolete, though sometimes well marked, irregular in size, and numerous. The transverse lines, when well marked, are seen to form a strong retral sinus in crossing the middle of the volutions. Aperture round. The shells are always imperfect in collections, but when a larger and a smaller one are fitted together, as in the long specimen figured, a specimen measuring two inches and an eighth in length possesses twenty-one volutions.

Locality: All the examples which I have seen appear to have come from Shiloh, N. J. Mr. Conrad's examples were from the same place. Collections at Rutgers College and the National Museum.

Turritella secta.

Plate xxiii, figs. 15–17.

Turritella secta Conrad: Proc. Acad. Nat. Sci. Phila., vol. 7, 1855, p. 268; Cat. Miocene Foss. Atlantic Slope, Proc. Acad. Nat. Sci., 1862, p. 568; Meek, Check List Miocene Foss., p. 16.

Mr. Conrad describes this species as follows: "Turreted; volutions flattened or plano-convex at the sides, with minute obsolete revolving lines, a

few of which are larger than the others and remote; whorls subcarinated near the base and profoundly excavated beneath toward the suture."

The shells which I have identified as this species closely resemble in their general form a species from the Eocene sands of Claiborne, Alabama, described by Mr. Isaac Lea as *T. carinata;* but differ in the surface striæ. The volutions have but one prominent carina, situated near the base of the volution as exposed. It is, in fact, the lower angle of the volution, the one beneath being coiled a little below the lower angle of the preceding volution. Above the angulation there are several (seven to nine) spiral lines, nearly all differing in strength from each other. In the single carina and in the irregularity and much smaller number of spiral lines it differs from *T. æquistriata*, which it closely resembles in general form, except that it possesses as maller number of volutions in shells of the same length, a specimen of that species possessing eleven volutions being of about the same length as one of this having only eight; and the rate of increase is also somewhat greater in this one.

All the specimens of this species which I have seen present the appearance of having been waterworn or triturated in sand before embedding; consequently the surface markings are faint. I judge that Mr. Conrad's specimens were the same as he describes them, as having "minute obsolete revolving lines."

Localities: Mr. Conrad gives as the locality "near Mullica Hill, N. J." The specimens in my hands are from "Cumberland County, N. J., and came to me named *T. Cumberlandia*, from which they differ greatly. Collection at Rutgers College, New Jersey.

Turritella (Mesalia?) plebeia.

Plate xxiii, figs. 6–8.

Turritella plebeia Say: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 4, p. 125, Pl. vii, fig. 1; Conrad, Proc. Acad. Nat. Sci. Phila., 1862, p. 568; Meek, Check List Miocene Foss., p. 16; Heilprin, Proc. Acad. Nat. Sci., 1887, pp. 401 and 404.

"Whorls convex, hardly flattened in the middle, with about twelve revolving elevated striæ, the middle ones alternately somewhat smaller; transverse wrinkles distinct." (Say, in Jour. Acad. Nat. Sci.)

Judging from the condition of the remains of this species I think it may have been a rather thin and fragile shell, as the specimens are flattened and crushed almost out of shape. The volutions have been highly convex and rather short, somewhat more so than would be indicated by Mr. Say's figure above cited, while the striæ would seem to have had flattened interspaces, the striæ themselves being distinctly raised lines of nearly equal width with the interspaces. I should suppose from the specimens seen that it would properly belong to the genus Mesalia Gray.

Formation and locality: In a dark micaceous clay marl of the Miocene from the well-boring of Mr. L. Woolman, at Atlantic City, N. J. From the collection of the Academy of Natural Sciences at Philadelphia.

Family VERMETIDÆ.

Genus ANGUINELLA Conrad.

Miocene Fossils, pp. 77 and 78.

It does not appear that any description of this genus was ever published by Mr. Conrad. The nearest approach to one is the simple comparison with Serpula and Petaloconchus of Lea, made on p. 78 of the Miocene Fossils, which is as follows: "This genus differs from Serpula in having septa, and from Petaloconchus Lea in wanting the revolving plates." The bodies to which he applied the name are contortedly coiled tubes, closely resembling those of Serpula, or are like those of Vermetus, except that they do not form regular volutions during the earlier stages of their growth, as do those shells. They appear to have been adherent to foreign bodies, and to have formed straight tubes, or to have had a laterally spiral form for a time, after which they grew in an irregularly coiling manner. The distinguishing feature, however, is that of having the tube divided into chambers as it advanced in length, by deeply concave or "vaulted septa" at irregular distances. The first impression one receives of the shell is that it belonged to an annelid, and not to a true mollusk. This would appear

to have been the general opinion of authors, as it is seldom found in catalogues of Mollusca. The genus might be characterized as follows:

Shell tubular, irregularly coiled like Vermetus Adamson, but sinistrally, adherent in its earlier stages; smooth or variously ornamented externally; internally divided at irregular intervals by transverse partitions.

The substance of the shell is readily divided into two distinct layers, but I fail to find a third, as is usual in the Vermetidæ; the shell is lamellar and not vesiculose. In a single small specimen attached to a larger tube, the spiral nucleus is distinctly seen; so I am inclined to think it a mollusk and not an annelid.

In regard to the validity of the genus I am not satisfied. It would appear to rest principally upon the septate character of the tube, but as this is not unfrequent among the Vermetidæ, it would appear to be of doubtful value, and I must leave others to judge for themselves as to its right to a place, since the name has long ago entered into the literature of the Mollusca.

Anguinella Virginiana.

Plate xxiv, figs. 1–5.

Anguinella Virginiana Conrad: Miocene Foss., p. 77, Pl. xliv, fig. 4; Proc. Acad. Nat. Sci. Phila., 1862, p. 568; Meek, Check List, Miocene Foss., p. 16.

"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."

The specimens of this form which I have received are all of small size, and represent only the apical portions of the shell. The earlier volutions are more regularly coiled than below, but never appear to form regular volutions, as do most species of Vermetus, being laterally divergent. The surface of the shell is marked with fine longitudinal, but irregular and often broken striæ, which on the lower, or adherent side of the tube, are spiny or strongly granulose, but more regular on the upper side; also by very irreg-

ular annulations, scarcely distinct enough on many of the specimens to be recognized. Internally the shell is polished and smooth, but frequently interrupted by deeply concave partitions, like those of a cephalopod, and readily to be found by cutting off the surface of the tube for a short distance. The habits of the tube throughout are much more like that of a Serpula than of a Molluscan, but the texture of the shell is Molluscan.

Formation and locality: In the gray micaceous marls of the Miocene at Jericho, N. J. From the collection of the National Museum.

Family CERITHERIIDÆ.

Genus TRIFORIS Deshayes.

TRIFORIS TEREBRATA.

Plate XXIV, fig. 6.

Triforis terebrata Heilprin: Proc. Acad. Nat. Sci. Phila., 1887, p. 405; also *Triforis* sp. nov., in list, p. 403.

Comp. *T. monilifera=Cerithium moniliferum* H. C. Lea: Trans. Am. Philo. Soc., 1843, p. 43, Pl. XXXVII, 1887, p. 405.

"Spire gradually tapering, nearly parallel sided; whorls flat, ornamented (on the body whorl) with two prominently beaded lines, and two alternating lines of smaller beads; on the whorl above the body whorl the lowest line is indistinct, or entirely covered over; transverse lines connect the beads of the different series; columella smooth, arcuate." (Heilprin, loc. cit.)

The type of the species is a fragment only, consisting of two and a half volutions, embracing in the last one the aperture, the outer lip of which is also imperfect, having lost nearly one-third of a volution from its edge. The columella is slightly twisted and its lower end slightly channeled. From the appearance of the upper of the two volutions present I should suppose there had been only the three lines of beads; the upper and lower one of large size and the intermediate one much smaller; still on the body whorl there are four distinct lines. It has been a pretty species and quite distinctly ornamented, but is very closely related to *Cerithium moni-*

liferum H. C. Lea, if not identical. The sutures are, however, much more distinct, an inconstant feature, but the only difference easily seen.

Locality: The specimen is from Mr. Ayers's marl pits, near Shiloh, N. J., and is the property of Miss Ella Tyndall, of Philadelphia, from whom it was borrowed through Prof. Heilprin.

Family TROCHIDÆ.

Genus LEIOTROCHUS Conrad.

Proceedings Acad. Nat. Sci. Phila., 1862, p. 569.

"Polished, entire, without umbilicus; base of columella with two denticles."

The above is Mr. Conrad's description of this genus given as cited above, and is the only reference or description I can find. He classes four species under it in the list in which the above description is embodied, namely: *Monilea distans* Conrad, *Trochus eboreus* Wagner, *Turbo caperatus* Conrad, and *Monodonta kiawahensis* Tuomey and Holmes. Of the four there is not one which agrees entirely with the characters embraced in the diagnosis, as *Trochus eboreus* Wag. has but one denticle on the columella, but otherwise agrees; *Monodonta kiawahensis* T. and H. has a large umbilicus, and agrees very well otherwise with the genus *Monilea; Monilea distans* Conrad, according to his own description of the species, has the "umbilicus narrow, profound;" while *Turbo caperatus* Conrad, in his own language, has the "columella slightly swelling near the center," so it would not show the two denticles required by the generic diagnosis. The species *T. eboreus* Wagner is the species which approaches the nearest and would require that the description should be emended so as to read *columella obsoletely denticulate*, if it is to be used at all—for which there seems but little reason. The diagnosis would then read: *Polished, entire, without umbilicus; columella obsoletely denticulate.*

Genus MONILEA Swainson.

MONILEA (LEIOTROCHUS) EBOREA.

Plate XXIV, figs. 7–10.

Trochus eboreus Wagner: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 8, p. 52, Pl. I, fig. 5.

Monilea (Leiotroch) eborea, Conrad: Proc. Acad. Nat. Sci. Phila., 1862, p. 569; Meek, Check List Miocene Foss., p. 15.

Turbo eboreus, Heilprin: Proc. Acad. Nat. Sci. Phila., 1877, pp. 398 and 404.

"Shell smooth and slightly polished; spire short, conical; whorls 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, loc. cit.)

This is one of the most beautiful fossil shells of the New Jersey Miocene formation. It is of small size, being not more than three-eighths of an inch in height, and having the greatest transverse diameter a little exceeding the height. The form is broadly conical, the spiral angle being always within ninety degrees, but sometimes almost reaching that angle. Volutions six in number, in the largest specimens, including the nuclear whorl, their surfaces polished and flattened in the direction of the spire, the last one being a little convex; periphery subangular with a slightly raised keel just above it, which shows as a raised band above the sutures of the upper volutions. There are also four or five raised spiral lines on the last two volutions and sometimes appearing even above that point; also fine transverse lines of growth mark the surface. Faint spiral lines also appear sometimes on the lower surface, which is very moderately convex. Aperture transverse, oblique, columella curved and thickened, with a single obsolete denticle near the base. Umbilicus closed.

Formation and locality: Dr. Wagner's specimens came from the Miocene deposits along the Patuxent River, Maryland. The New Jersey specimens are from the gray marls of the same deposits at Jericho, N. J., where the shell appears to have been moderately common in comparison with most of the species. The specimens used are from the collections at the National Museum, and were collected by Mr. Frank Burns.

Order SCUTIBRANCHIATA.

Family FISSURELLIDÆ.

Genus FISSURELLA Lamarck.

Fissurella Griscomi.

Plate XXIV, figs. 11–14.

Fissurella Griscomi, Conrad: Jour. Acad. Nat. Sci. Phila., 1st ser., vol. 7, p. 143; Miocene Foss., p. 78, Pl. XLIV, fig. 8; Proc. Acad. Nat. Sci. Phila., 1862, p. 570; Meek, Check List Miocene Foss., p. 14; Heilprin, Proc. Acad. Nat. Sci. Phila., 1887, pp. 397, 399, and 404; Tert. Geol. U. S., p. 8.

"Shell ovate-oval, compressed, rather elevated, cancellated; radiating ribs crowded, somewhat alternate in size; fissure long, inclined, nearest to the anterior end; within somewhat thickened on the margin, which is crenulated; an impressed submarginal line." (Conrad: Jour. Acad. Nat. Sci., vol. 7, p. 143.)

"Subovate, elevated, laterally compressed, with alternating radiating robust striæ, and strong prominent transverse lines; foramen narrow, subovate; inner margin crenulated." (Conrad in Miocene Fossils.)

This species is among the most abundant forms in the New Jersey Miocene marls, and attains a very fair size, one individual before me measuring almost 1½ inches in length, nearly 1 inch in its greatest width across the base, and seven-eighths of an inch in height. The form is elongate-ovate on the margin, widest below the center; surface highly conical, moderately convex on the long side of the apex and very gently concave on the short side; apex broadly perforated in the older shells, the perforation often keyhole-shaped in half grown specimens, but more often elliptical, and usually bordered by a flattened callus internally. Surface with very numerous raised radiating lines, more or less alternating in size and rounded; these are crossed by strong concentric lines of growth and firm ornamental lines which crenulate the radii. Inner margin strongly crenulated.

Among the numerous specimens present in the collections there is no one feature of the shell that does not show considerable variation. In some the striæ are strongly alternating in size; on others they are very even. On two different individuals of about the same dimensions, in the space

occupied by six radii on one, there are ten in the other; one of these has the striæ strongest on the narrow end and the other on the broad end. There are equal variations in the arcuation of the back of the shell, and in the size and the form of the fissure. The general outline of the base in its elongate-ovate form is perhaps the most constant feature of the species. Considering the degree of variation it is not surprising that there should be some discrepancy between the two descriptions quoted from Mr. Conrad, written at different times and probably from different individuals.

Formation and localities: The species has been recognized from the gray marls at both Shiloh and Jericho; and in the stony layers near Bridgeton and in the brown clay near Shiloh, N. J. In collections from Rutgers College, the National Museum, and the Academy of Natural Sciences at Philadelphia.

Order TECTIBRANCHIATA.

Family TORNATELLIDÆ=ACTÆONIDÆ.

Genus ACTÆON Montfort.

ACTÆON SHILOHENSIS, n. sp.

Plate XXIV, figs. 15–17.

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.

Formation and locality: In the gray marls of the Miocene at Shiloh, N. J. From the collection of the National Museum.

CRUSTACEA.

SECTION IV.

CRUSTACEA (BALANIDÆ) OF THE MIOCENE MARLS OF NEW JERSEY.

Class CRUSTACEA.

Order CIRRIPEDIA.

Family BALANIDÆ.

Genus BALANUS.

BALANUS PROTEUS.

Plate XXIV, figs. 18–23.

Balanus proteus Conrad: Jour. Acad. Nat. Sci. Phila., ser. I, vol. 7, p. 134; Miocene Foss., p. 77, Pl. XLIV, fig. 1; Meek, Check List Miocene Foss., p. 23.

"Shell subconical; with strong prominent ribs, varying from one to three on each valve; aperture ovate. Length, 2 inches; height, 1½ inches.

"A very common species, modified in form by whatever surface it may be attached to; it is either ribbed, striate, or rugose; on a plane surface it is smooth, with a few strong ribs." (Conrad in Jour. Acad. Nat Sci., vol. 7.)

"Conical, with profound irregular ribs, and fine longitudinal and strong transverse wrinkles; ribs unequal in length and prominence, smooth; interstitial plates narrow, longitudinally striated; aperture acutely ovate, moderate." (Miocene Fossils.)

No entire individual of this species has been obtained from the New Jersey deposits, so far as I am aware; but numerous separated plates are in the collection at Rutgers College. Specimens from Virginia and other Southern States are common and often of large size, and are found in large and dense masses. The form is similar to that of the common Balanus of our coast, being rather broadly conical, with the sides covered with

strong, coarse, rounded, vertical ridges; very irregular and uneven in size, and with deep constrictions between. The ribs are frequently bifurcated, and not uncommonly one may be seen to divide and form a cluster of six or seven at the base in large specimens. The rostrum plate is proportionally large and the rostro-lateral also, while the carina and carino-laterals are small and narrow, although longer than the others; but the number of ribs on each is so variable that it is not possible to say what the prevailing number on any plate would be. The alæ and radii are very narrow, the latter often obsolete on the carinal plates, as far as seen on the exterior of the body. This causes the shells after death to separate and fall asunder with little movement. Hence the separated plates in the New Jersey deposits. The transverse striæ or wrinkles, mentioned in the description, are widely separate, very prominent, although very fine and thread-like, and are readily seen under a glass.

Formation and locality: The specimens used come to me from near Shiloh, N. J., and are from the collection at Rutgers College.

PLATES.

PLATE I.

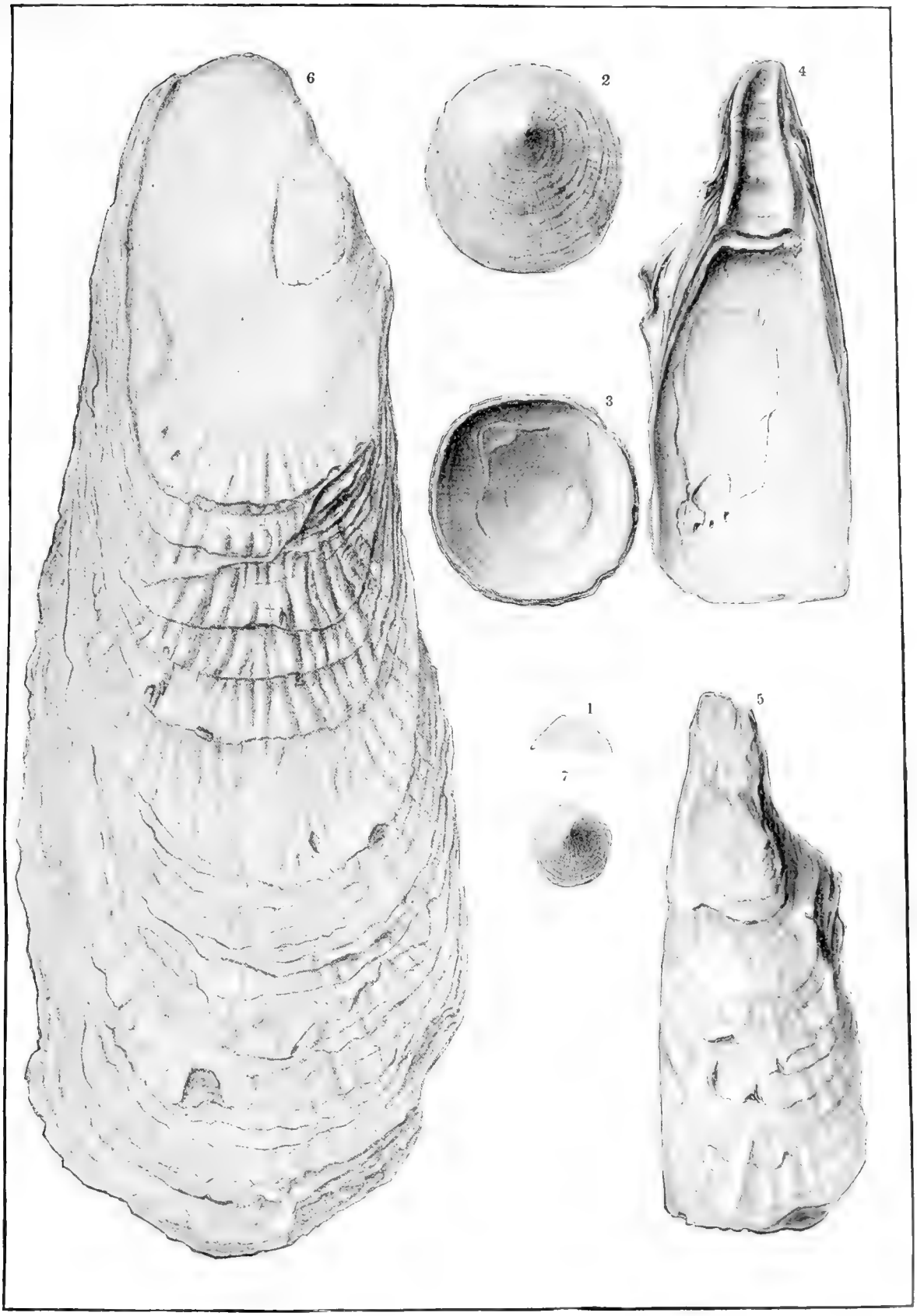
EXPLANATION OF PLATE I.

DISCINA LUGUBRIS Conrad (p. 23).

FIG. 1. Upper valve, natural size, and profile outline.
2. Exterior surface, enlarged.
3. Interior, showing muscular imprints.

OSTREA VIRGINIANA Gmel. var. PROCYON, Tuom. and Holmes (p. 28).

FIGS. 4, 5. Inner and outer surfaces of a lower valve, of the usual size and form.
6. Exterior of a large valve, the apical portion lost.



BRACHIOPODA AND OSTREIDÆ.

PLATE II.

EXPLANATION OF PLATE II.

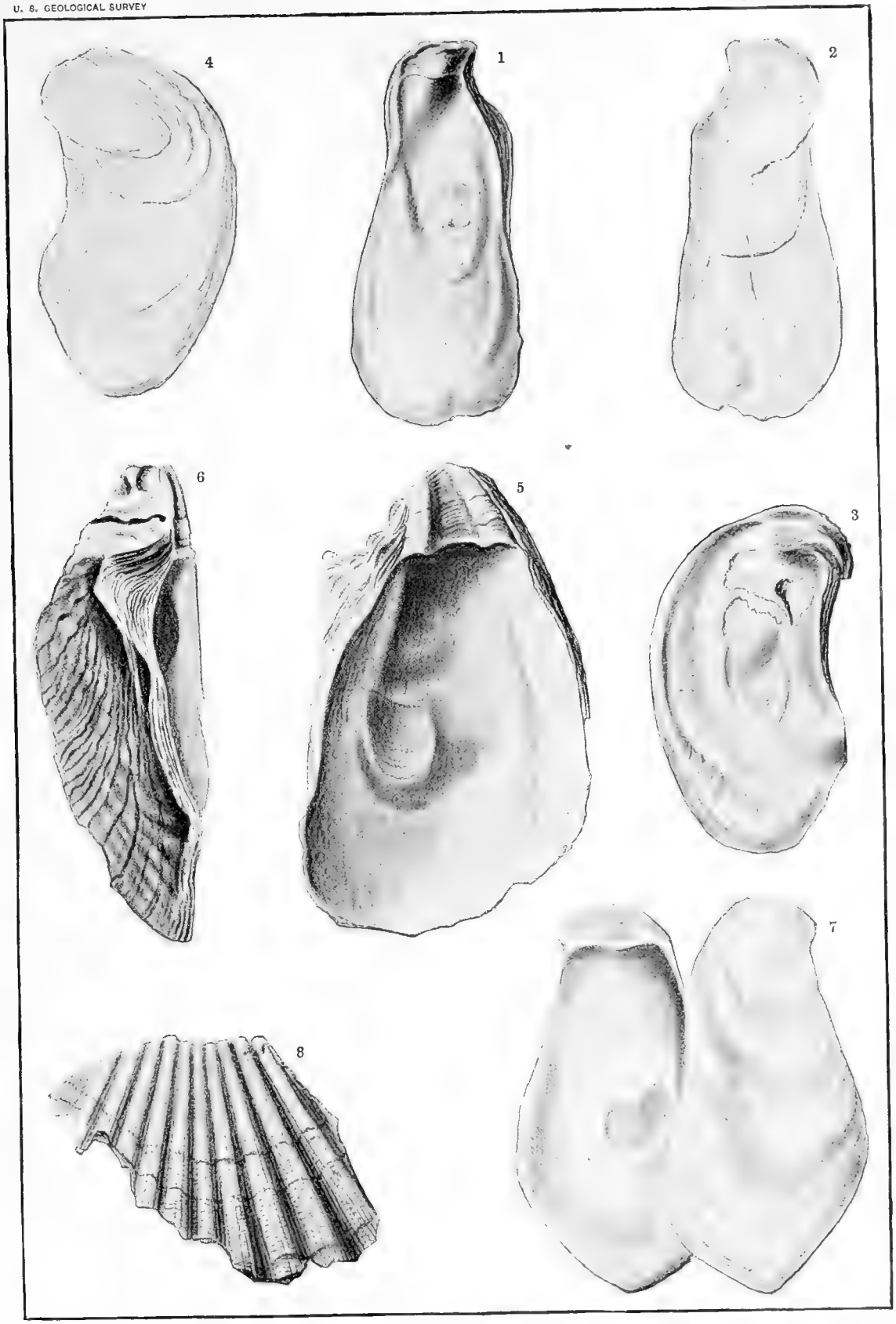
OSTREA VIRGINIANA Gmel. (p. 27).

FIGS. 1, 2. Inner and outer surfaces of a narrow form. Upper valve.
3, 4. Similar views of a curved form of upper valve.
5, 6. Interior and profile views of a lower valve of the ordinary form.
7. Copy of Mr. Gabb's figure of *O. Mauricensis* from vol. 4, Jour. Acad. Nat. Sci., Pl. 67.

PECTEN MADISONIUS Say (p. 30).

FIG. 8. View of a fragment from a large shell.

(See other figures on Pl. IV.)



OSTREIDÆ.

PLATE III.

EXPLANATION OF PLATE III.

OSTREA PERCRASSA Con. (p. 29).

FIGS. 1, 2. Interior and lateral views of an upper valve.
3, 4. Interior and lateral views of a lower valve of small size. Fig. 4 shows the great thickness.

OSTREIDÆ.

PLATE IV.

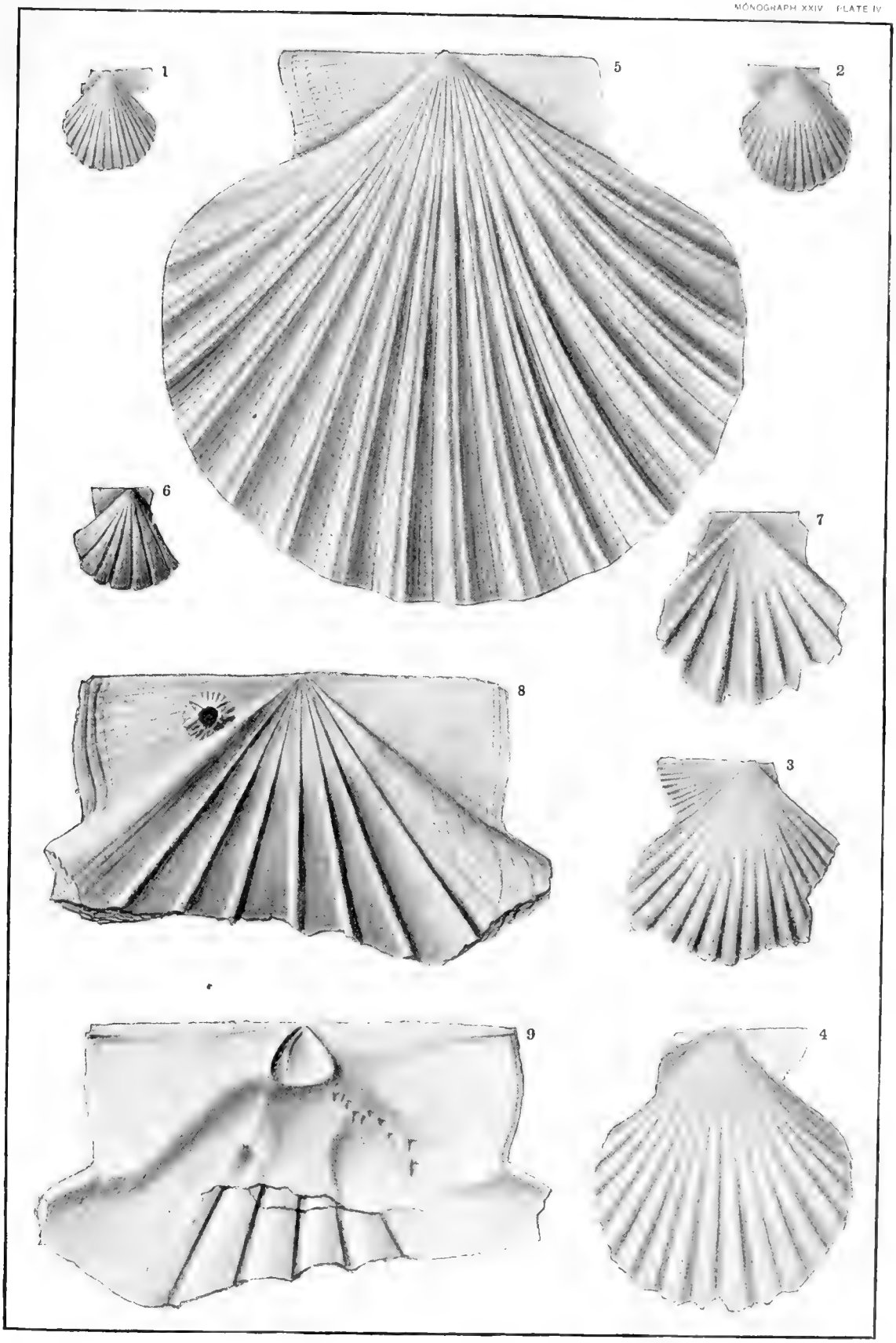
EXPLANATION OF PLATE IV.

PECTEN MADISONIUS Say (p. 30).

FIGS. 1, 2. Views of young right and left valves.
3. Fragment of a larger valve.
4. A still larger shell with the anterior ear lost.
5. A copy of Conrad's figure of this species, taken from his Miocene Foss., Pl. XXIV.

VOLA HUMPHREYSI Conrad (p. 32).

FIG. 6. View of a small lower valve.
7. A larger upper valve.
8, 9. Outer and inner faces of a fragment of a large upper valve.



PECTINIDÆ.

PLATE V.

EXPLANATION OF PLATE V.

SPONDYLUS INORNATUS Whitf. (p. 34).

FIGS. 1, 2. Views of the outer and inner faces of the only specimen observed.

PLICATULA DENSATA Conrad (p. 35).

FIGS. 3, 4, 5. Views of the exterior of three different specimens, showing variations in form and surface.
6. Profile view of the specimen shown in fig. 5.
7, 8. Interiors of a lower and an upper valve.

LITHOPHAGA SUBALVEATA Conrad (p. 40).

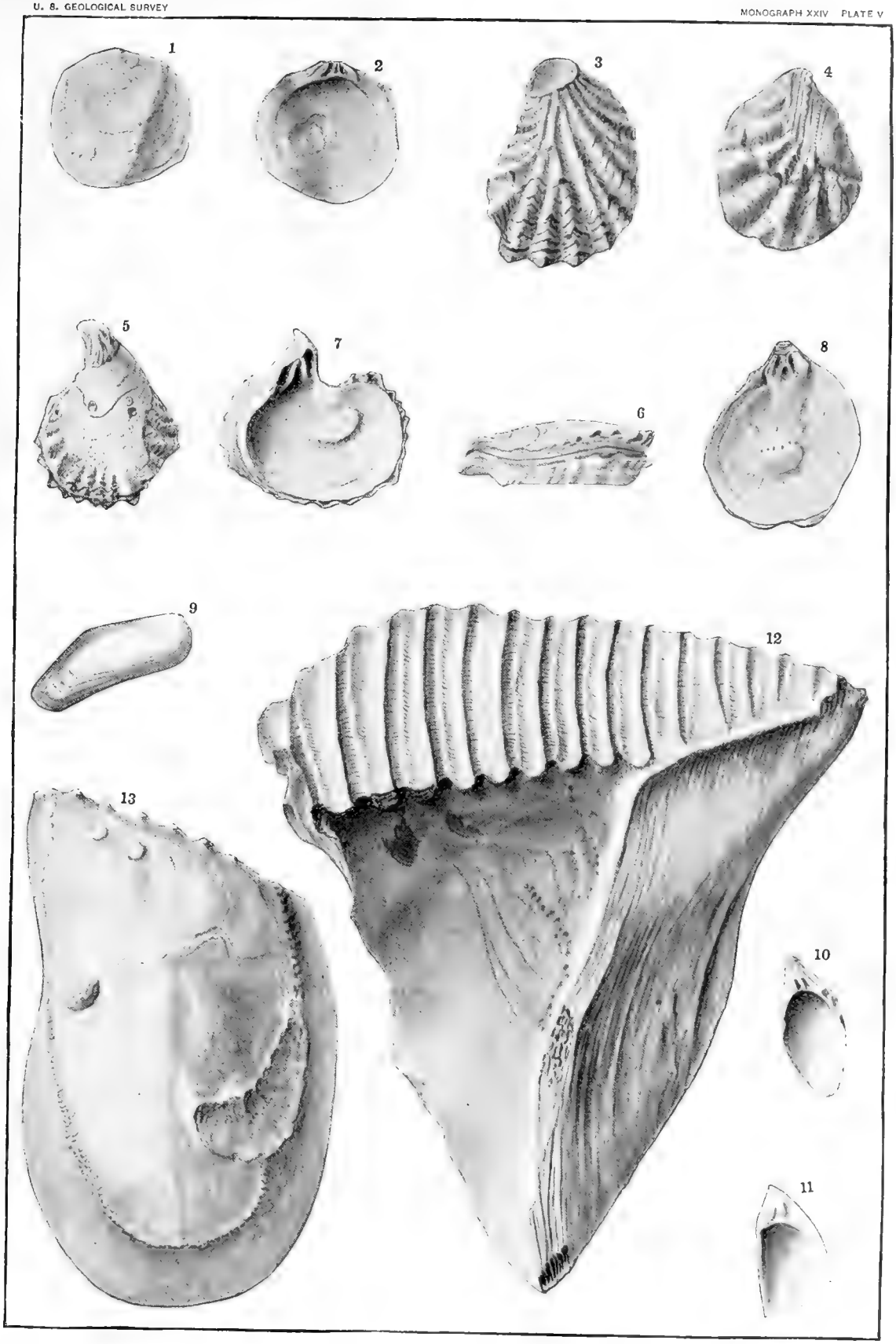
FIG. 9. Copy of Mr. Conrad's original figure, no specimen of it being found in any of the collections examined.

MYTILOCONCHA INCRASSATA Conrad (p. 38).

FIGS. 10, 11. Views of the apices of two fragments of shells, all that usually remains of the specimens.

PERNA TORTA Say (p. 36).

FIG. 12. View of the inner surface of a very heavy thickened fragment, the largest piece of the species found.
13. A cast of a small entire specimen, showing the complete form.



SPONDYLIDÆ, AVICULIDÆ, AND MYTILIDÆ.

PLATE VI.

EXPLANATION OF PLATE VI.

MYTILOCONCHA INCRASSATA Conrad (p. 38).

FIGS. 1, 2. Views of a specimen from South Carolina, introduced to show the general form. [Am. Mus. Nat. Hist.]

MODIOLA INFLATA Tuomey and Holmes (p. 39).

FIG. 3. View of the right side of a well-preserved specimen.

4. View of a distorted internal cast from the Brown clays.

ARCA (STRIARCA) CENTENARIA Conrad (p. 42).

FIGS. 5, 6. Exterior and interior views of a specimen of small size, although the largest perfect one seen from the State.

7. Enlarged view of the hinge, showing the peculiar structure of the teeth.

ARCA (SCAPHARCA) CALLIPLEURA Conrad (p. 43).

FIG 8. A copy of Mr. Conrad's figure, Miocene Foss., Pl. XXIX, fig 2.

9. View of the only fragment seen from New Jersey.

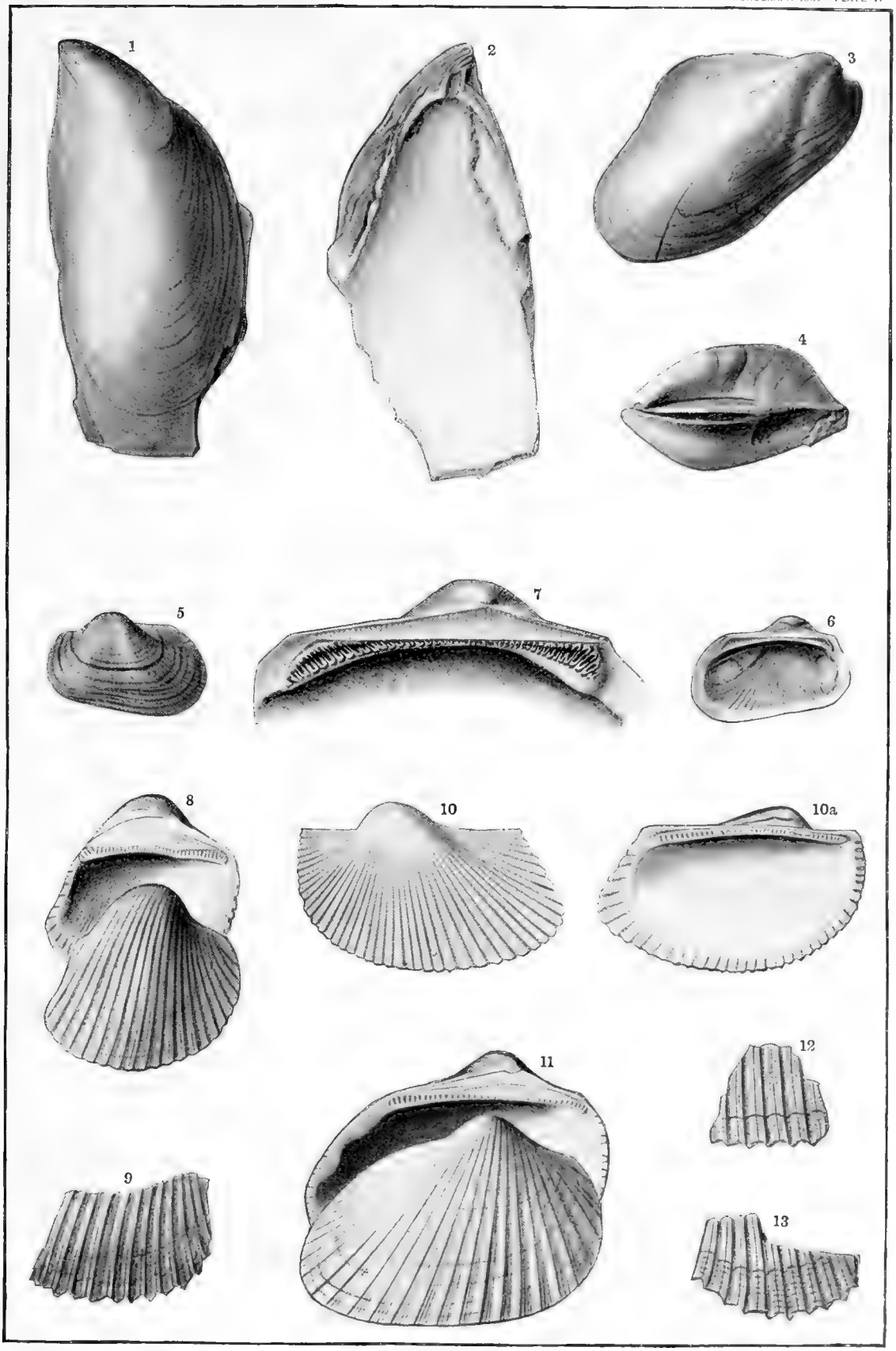
ARCA (SCAPHARCA) LIENOSA Say (p. 44).

FIGS. 10, 10*a*. A copy of Say's original figure, no fragments from New Jersey being perfect enough to figure.

ARCA (SCAPHARCA) SUBROSTRATA Conrad (p. 45).

FIG. 11. Copy of Conrad's figure, Miocene Foss., Pl. XXX, fig. 7.

12, 13. Two of the fragments obtained from the well-boring at Atlantic City, N. J., where the remains of the above two species were also obtained.



MYTILIDÆ AND ARCIDÆ.

PLATE VII.

EXPLANATION OF PLATE VII.

ARCA (LATIARCA) IDONEA Conrad (p. 47).

FIG. 1. Copy of Conrad's figure of the species, Miocene Foss., Pl. XXIX, fig. 3, no fragment from New Jersey being perfect enough to figure.

ARCA (BARBATIA) MARYLANDICA Conrad (p. 48).

FIGS. 2, 3. Exterior and interior of the largest fragment observed.
4. Copy of Conrad's original figure, Miocene Foss., Pl. XXIX, fig. 1.

AXINEA LENTIFORMIS Conrad (p. 49).

FIGS. 5, 6. Two views of the largest specimen observed.

NUCULA PROXIMA Say (p. 50).

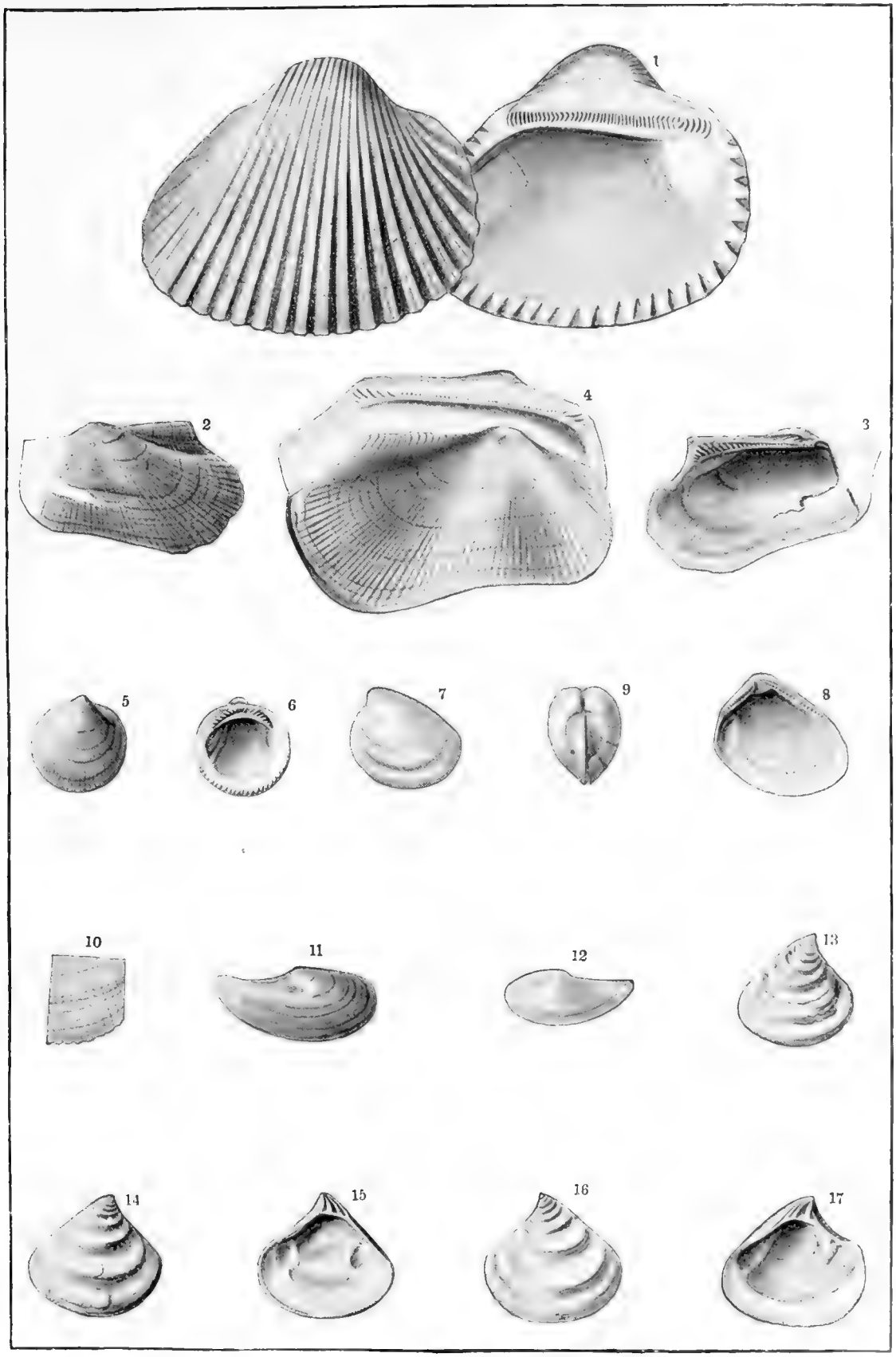
FIGS. 7, 8, 9. Three views of specimens of the species, enlarged two diameters.
10. Further enlargement of the surface.

YOLDIA LIMATULA Say (p. 51).

FIGS. 11, 12. Views of two valves of the species, the first enlarged two diameters.

ASTARTE DISTANS Conrad (p. 53).

FIG. 13. Exterior of a small specimen showing crowded undulations.
14, 15. Opposite views of a right valve.
16, 17. Similar views of a left valve.



ARCIDÆ, NUCULIDÆ, AND ASTARTIDÆ.

PLATE VIII.

EXPLANATION OF PLATE VIII.

ASTARTE SYMMETRICA Conrad (p. 54).

FIGS. 1, 2. Outer and inner surfaces of a water-worn specimen.

ASTARTE THOMASI Conrad (p. 55).

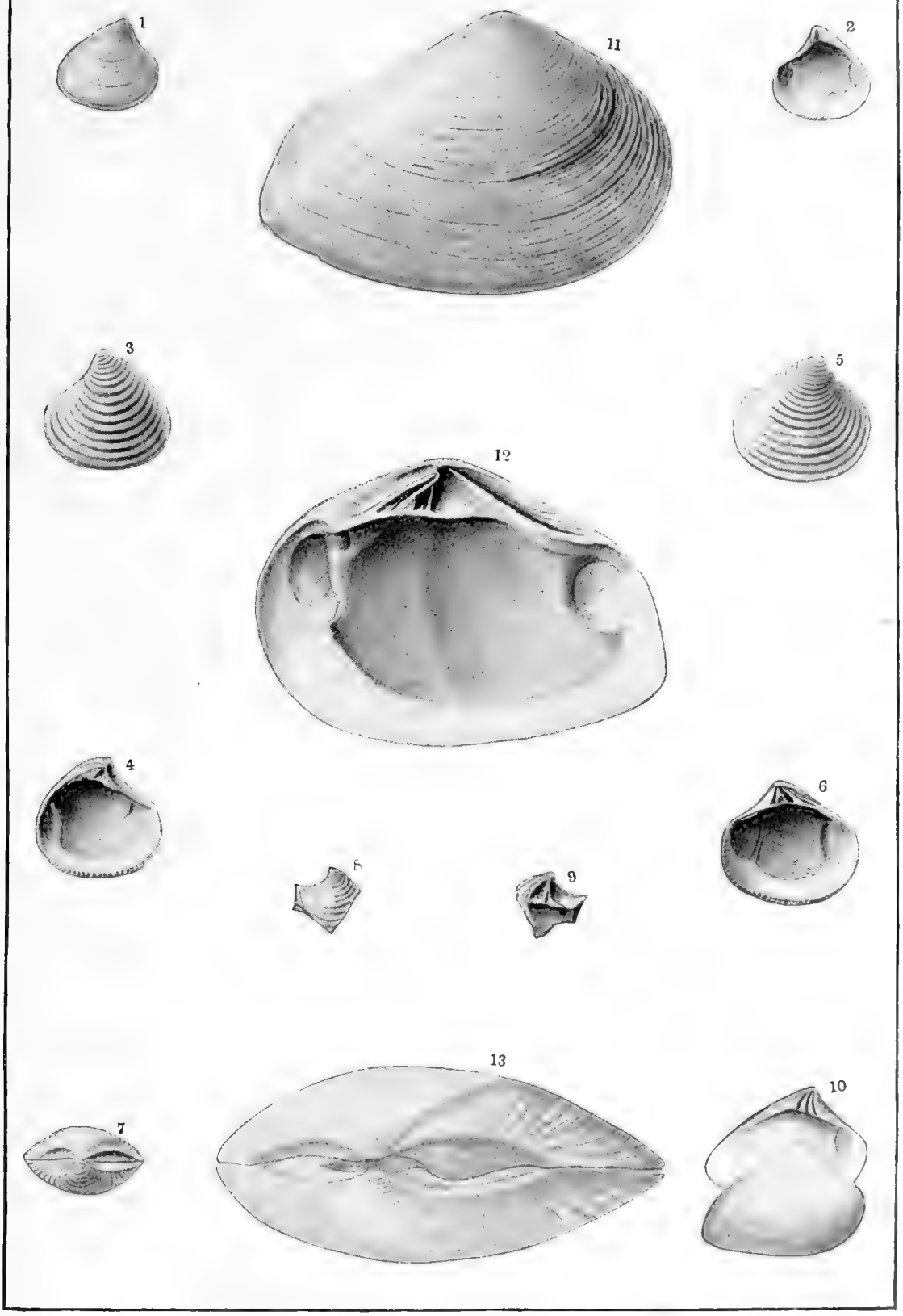
FIGS. 3, 4. Opposite surfaces of a left valve.
5, 6. Similar views of a right valve.
7. Cardinal view of two valves in position.

ASTARTE CUNEIFORMIS Conrad (p. 52).

FIGS. 8, 9. Opposite sides of the most perfect fragment obtained.
10. Copy of Mr. Conrad's figure of the species, showing the entire form.

CRASSATELLA MELINA Conrad (p. 60).

FIGS. 11, 12. Two views of a right valve of a large specimen.
13. Cardinal view of an entire shell.



ASTARTIDÆ AND CRASSATELLIDÆ.

PLATE IX.

EXPLANATION OF PLATE IX.

CARDITA GRANULATA Say (p. 56).

FIGS. 1, 2. Opposite sides of a left valve, natural size.
3, 4. Two views of a right valve, natural size and enlarged.

CARDITAMERA ARATA Conrad (p. 57).

FIGS. 5, 6. Opposite sides of the largest valve observed.

CARDITAMERA ACULEATA Conrad (p. 58).

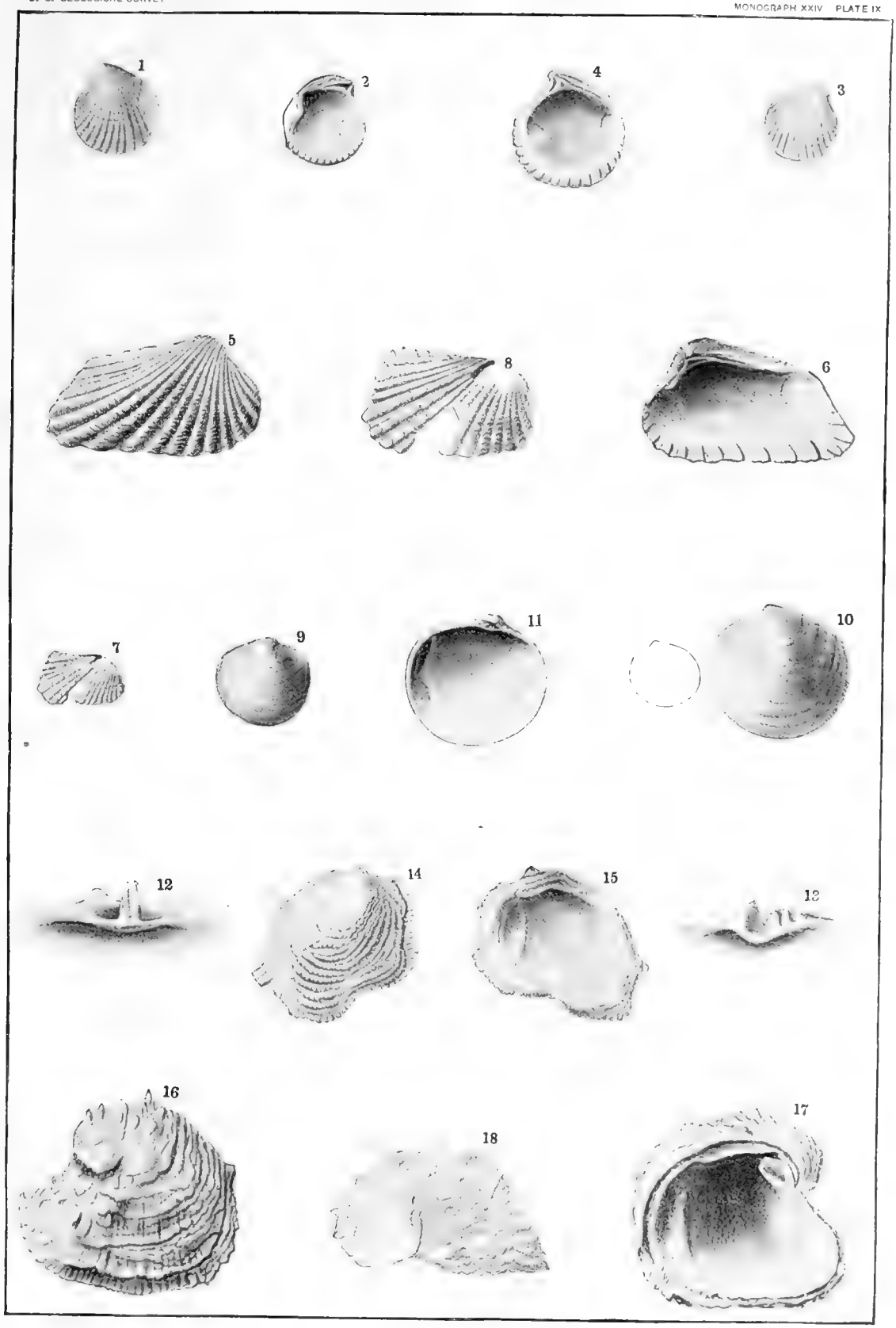
FIGS. 7, 8. View of the type specimen, natural size and enlarged.

MYSIA PARILIS Conrad (p. 61).

FIG. 9. View of the original type specimen.
10, 11. Two views, enlarged, of another specimen.
12. View of the hinge of the left valve, looking at the inner edge to see the elevation of the teeth, enlarged.
13. A similar view of the hinge of a right valve, greatly enlarged.

CHAMA CONGREGATA Conrad (p. 65).

FIGS. 14, 15. Opposite sides of an upper valve.
16, 17, 18. Three views of a lower valve.



ASTARTIDÆ, UNGULIDÆ, AND CHAMIDÆ

PLATE X.

EXPLANATION OF PLATE X.

LUCINA TRISULCATA Conrad (p. 64).

FIGS. 1, 2. Opposite views of a left valve, enlarged; the outline shows the natural size.
3, 4. Similar views of a right valve enlarged.

LUCINA ACCLINIS Conrad (p. 62).

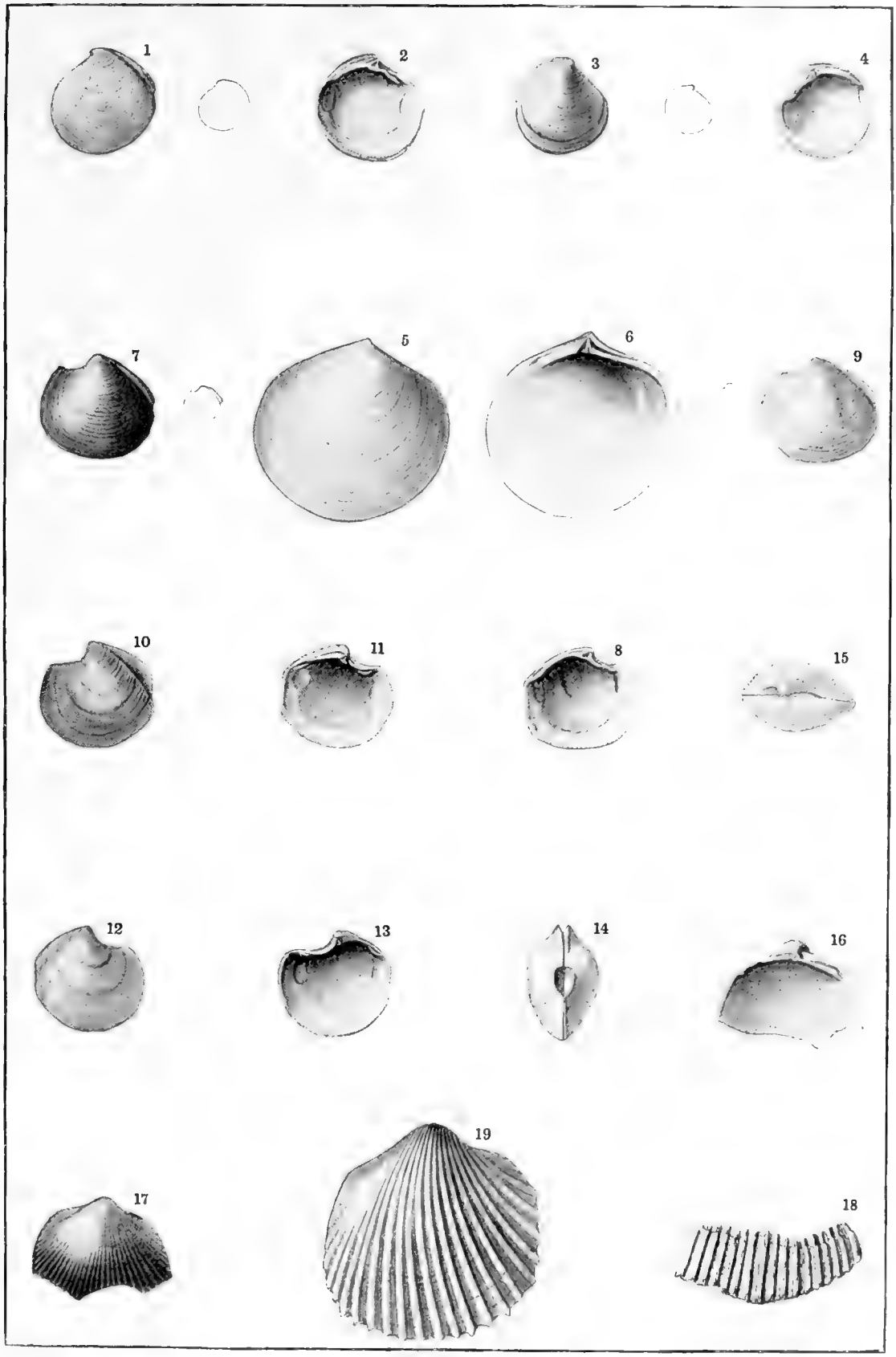
FIGS. 5, 6. Copies of Mr. Conrad's figures, Miocene Foss., Pl. XVI, fig. 2, none of the New Jersey examples being perfect enough to figure.

LUCINA CRENULATA Conrad (p. 63).

FIGS. 7, 8, 9. View of shells with the umbonal sulcus near the cardinal margin. Enlarged.
10, 11. Views of a valve with a wider border.
12, 13. View of a shell with a longer anterior end.
14, 15. Cardinal views of the valves in conjunction.
All figures enlarged three diameters.

CARDIUM (CERASTODERMA) CRATICULOIDES Conrad (p. 66.)

FIGS. 16, 17. Opposite views of the most perfect valve obtained.
18. View of a fragment of a larger valve, showing the character of the narrow ribs.
19. Copy of Mr. Conrad's figure, showing the entire form of a valve; Miocene Foss., Pl. XXXVII, fig. 7.



LUCINIDÆ AND CARDIIDÆ.

PLATE XI.

EXPLANATION OF PLATE XI.

MERCENARIA DUCATELI Conrad (p. 67).

FIGS. 1, 2. Exterior of the type specimen of the species and the hinge of the same. The remainder of the shell is filled with shell rock which could not be removed.

3. View of another fragment preserving the surface features.

4, 5. Exterior and interior of an elongated specimen referred to this species with doubt.

6. Anterior view of the valves in conjunction, showing the general form.

7. Interior of a short form which presents the same kind of surface as fig. 4.

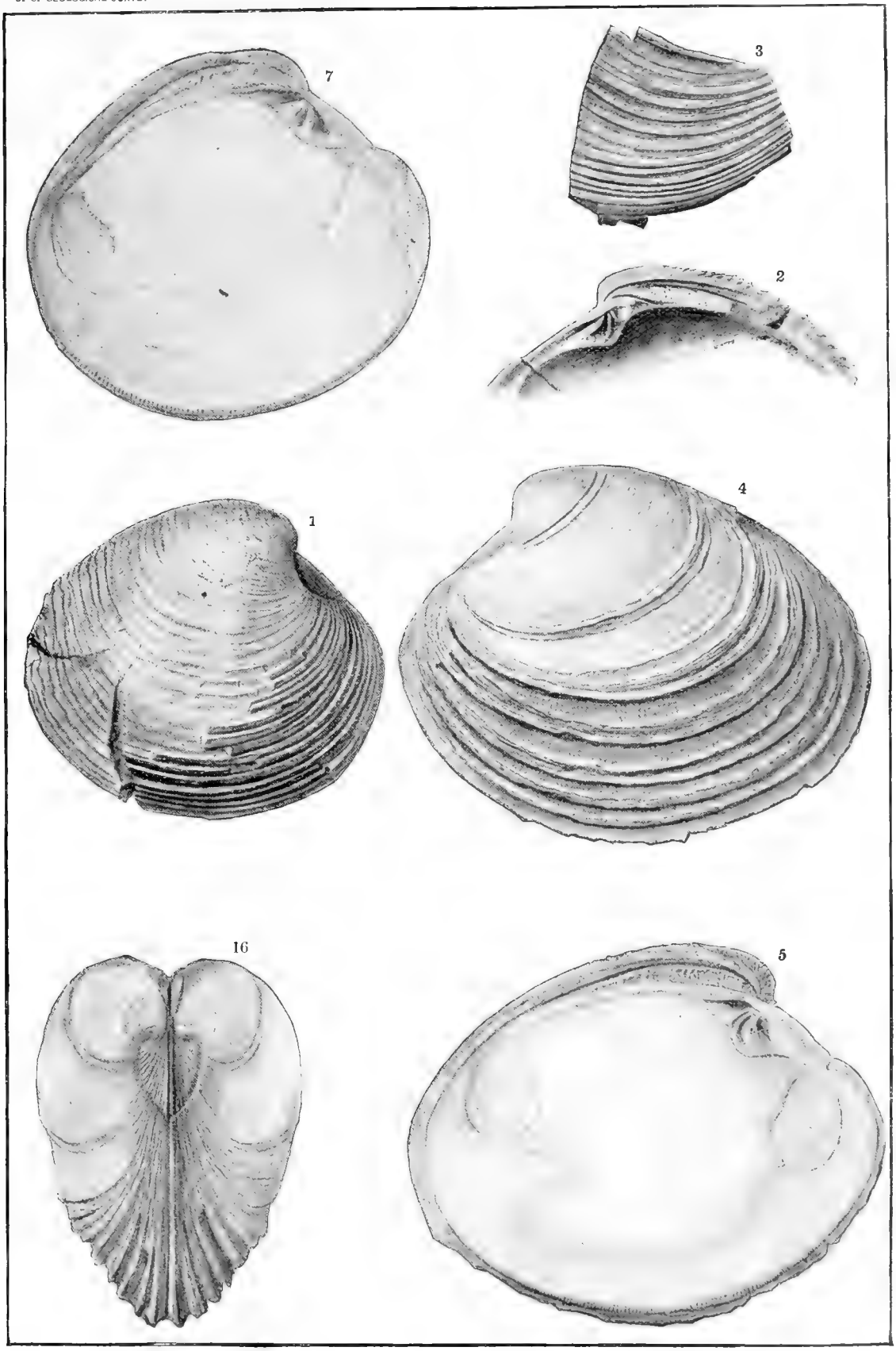

7
3
2
1
4
16
5

PLATE XII.

EXPLANATION OF PLATE XII.

DIONE SAYANA Conrad (p. 75).

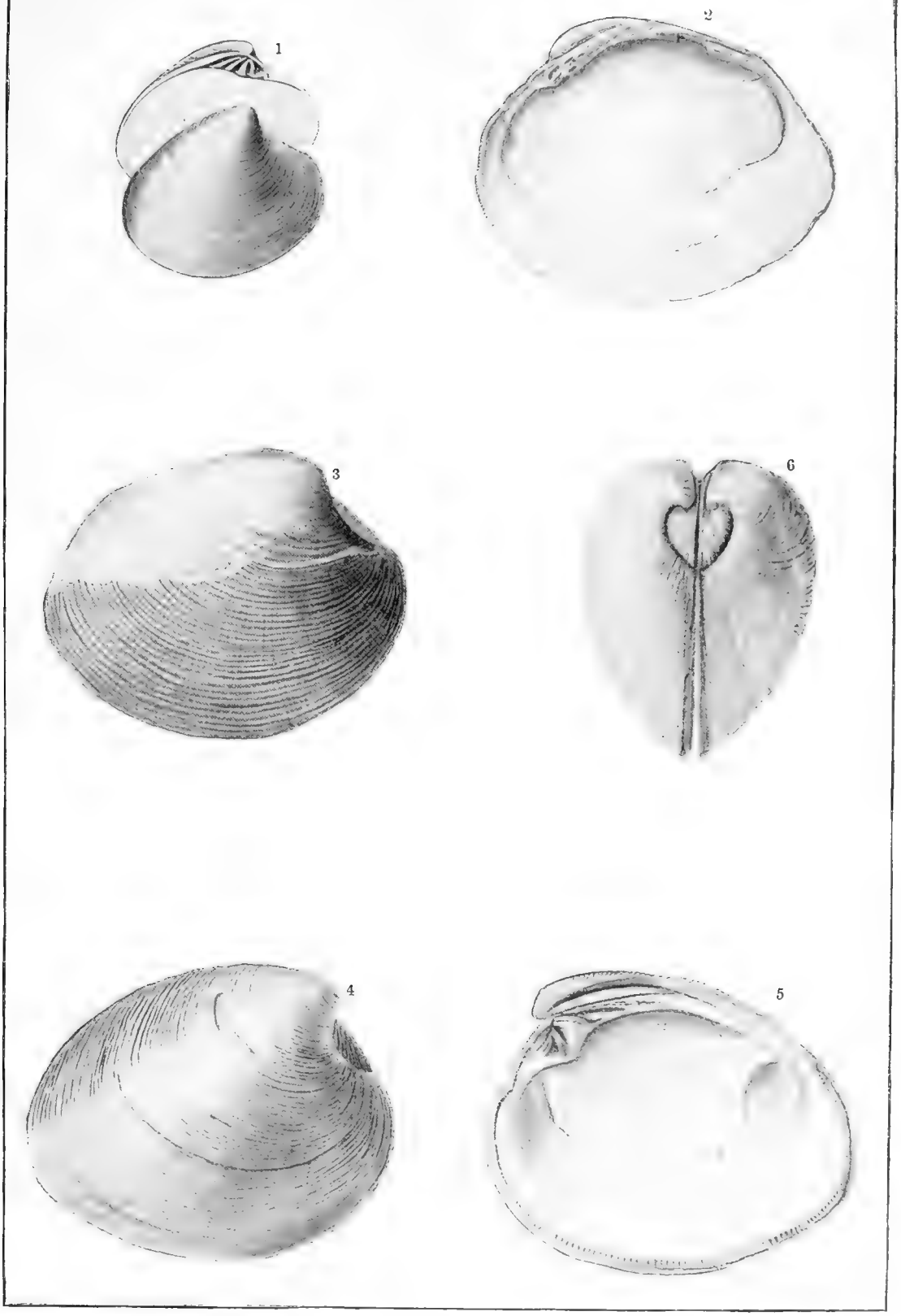
FIG. 1. A copy of Conrad's figure of this species, nothing but fragments of the cardinal portion being obtained from New Jersey, too poor for illustration.

MERCENARIA CANCELLATA Gabb (p. 68).

FIGS. 2, 3. View of the interior, the hinge imperfect, and of the exterior of the type specimen of the species, none other having been obtained.

MERCENARIA PLENA Conrad (p. 69).

FIGS. 4, 5. Exterior and interior of a right valve.
6. Anterior profile view of the valves in conjunction.



VENERIDÆ.

PLATE XIII.

EXPLANATION OF PLATE XIII.

DIONE MARYLANDICA Conrad (p. 74).

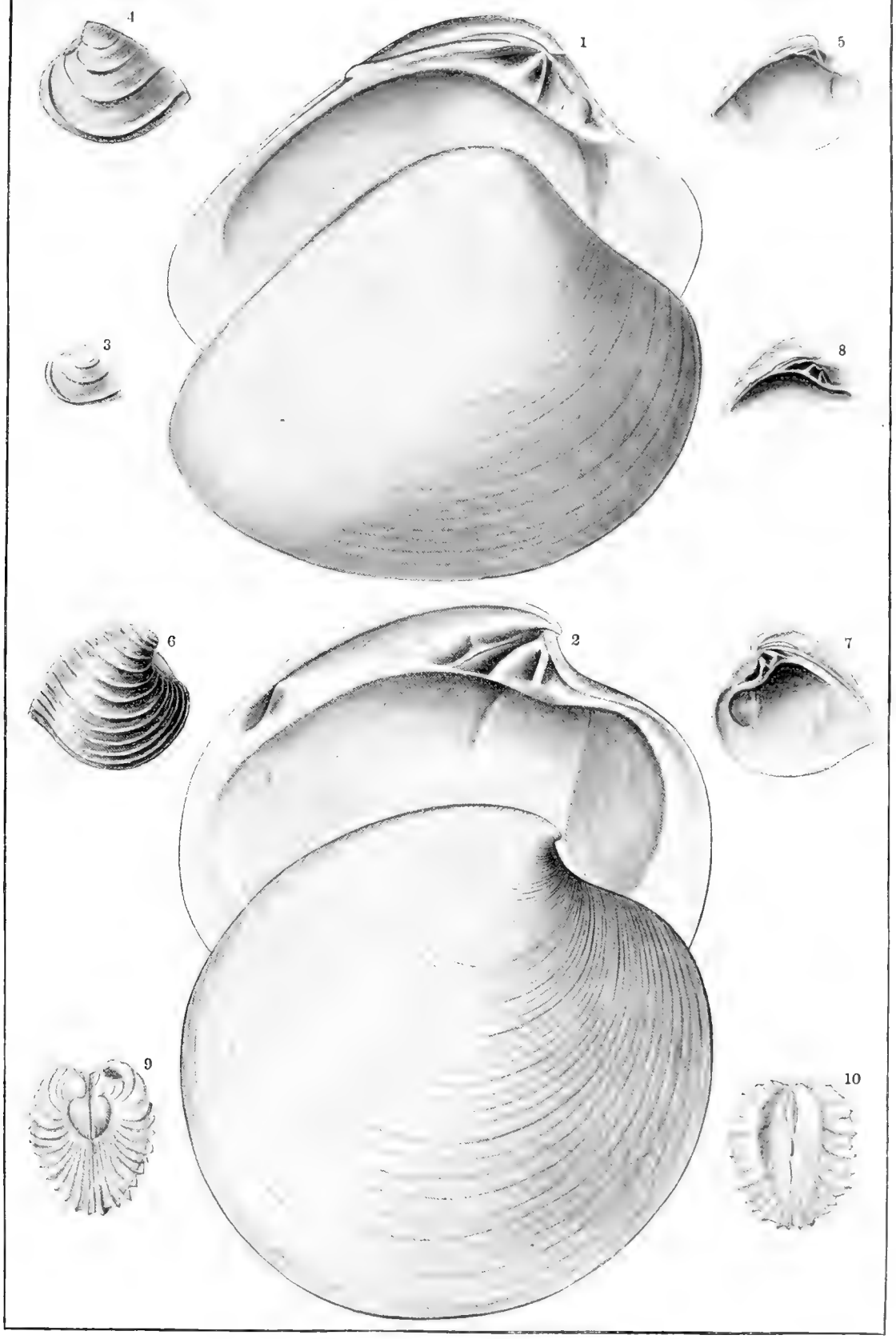
FIG. 1. Copy of Mr. Conrad's figure of the species from the Miocene Foss., Pl. IX, fig. 1.

DOSINIA ACETABULUM Conrad (p. 73).

FIG. 2. Copy of Mr. Conrad's figure of the shell from Miocene Foss., Pl. XVI, fig. 1.

ARTENIA STAMINEA Conrad (p. 72).

FIGS. 3. View, natural size, of a small left valve.
4, 5. Two views of the same shell, twice enlarged.
6, 7. Opposite sides of a mature right valve, natural size.
9, 10. Two views of the valves together, figs. 6 and 7 being of one of them.



VENERIDÆ.

PLATE XIV.

EXPLANATION OF PLATE XIV.

TELLINA PRODUCTA Conrad (p. 78).

FIGS. 1, 2. Opposite views of an imperfect valve, twice enlarged.
3. Enlargement of the hinge.

TELLINA (ANGULUS) DECLIVIS Conrad (p. 77).

FIGS. 4, 5, 6. Outline, natural size, and enlarged views of the opposite sides of an imperfect valve.

TELLINA PERACUTA Conrad (p. 76).

FIG. 7. View, natural size, of the only specimen seen.

TELLINA CAPILLIFERA Conrad (p. 76).

FIGS. 8, 9. Opposite views of a valve which is imperfect on the edge.
10. Enlargement of the hinge.

ABRA ÆQUALIS Conrad (p. 80).

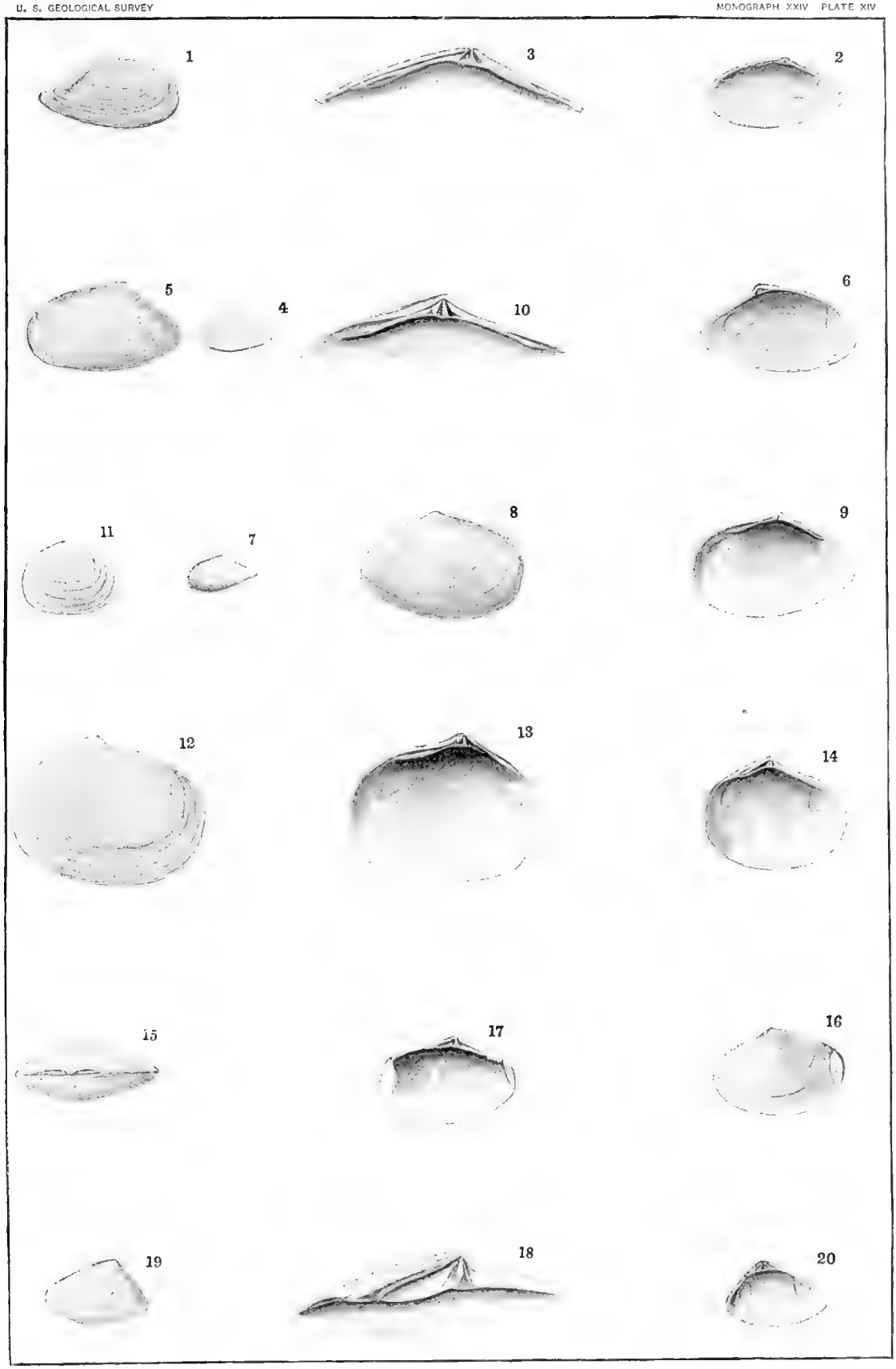
FIGS. 11, 12, 13. Exterior of a valve, natural size, and the exterior and interior views enlarged twice.
14. Interior of the opposite, valve twice enlarged.
15. Cardinal view, twice enlarged.

AMPHIDESMA BURNSI Whitf. (p. 79).

FIGS. 16, 17. Exterior and interior views of an imperfect valve of this species, twice enlarged.
18. Further enlargement of the hinge.

DONAX VARIABILIS Say (p. 79).

FIGS. 19, 20. Two views of right valve.



TELLINIDÆ AND AMPHIDESMIDÆ.

PLATE XV.

EXPLANATION OF PLATE XV.

MACTRA LATERALIS Say (p. 82).

FIGS. 1, 2. Opposite sides of a right valve.
3. Enlargement of the hinge, showing the structure.

RANGIA (PERISSODON) MINOR Conrad (p. 84).

FIGS. 4, 5. Opposite views of a right valve, twice enlarged.
6. Further enlargement of the hinge.

SYNDOSMYA NUCULOIDES Conrad (p. 81).

FIGS. 7, 8. Opposite views of a right valve, imperfect at the posterior end, twice enlarged.
9. Further enlargement of the hinge.

MACTRA (SCHIZODESMA) DELUMBIS Conrad (p. 82).

FIG. 10. Copy of Mr. Conrad's figure of this species given in his Miocene Foss., Pl. XV, fig. 1.

CORBULA SUBCONTRACTA Whitf. (p. 88).

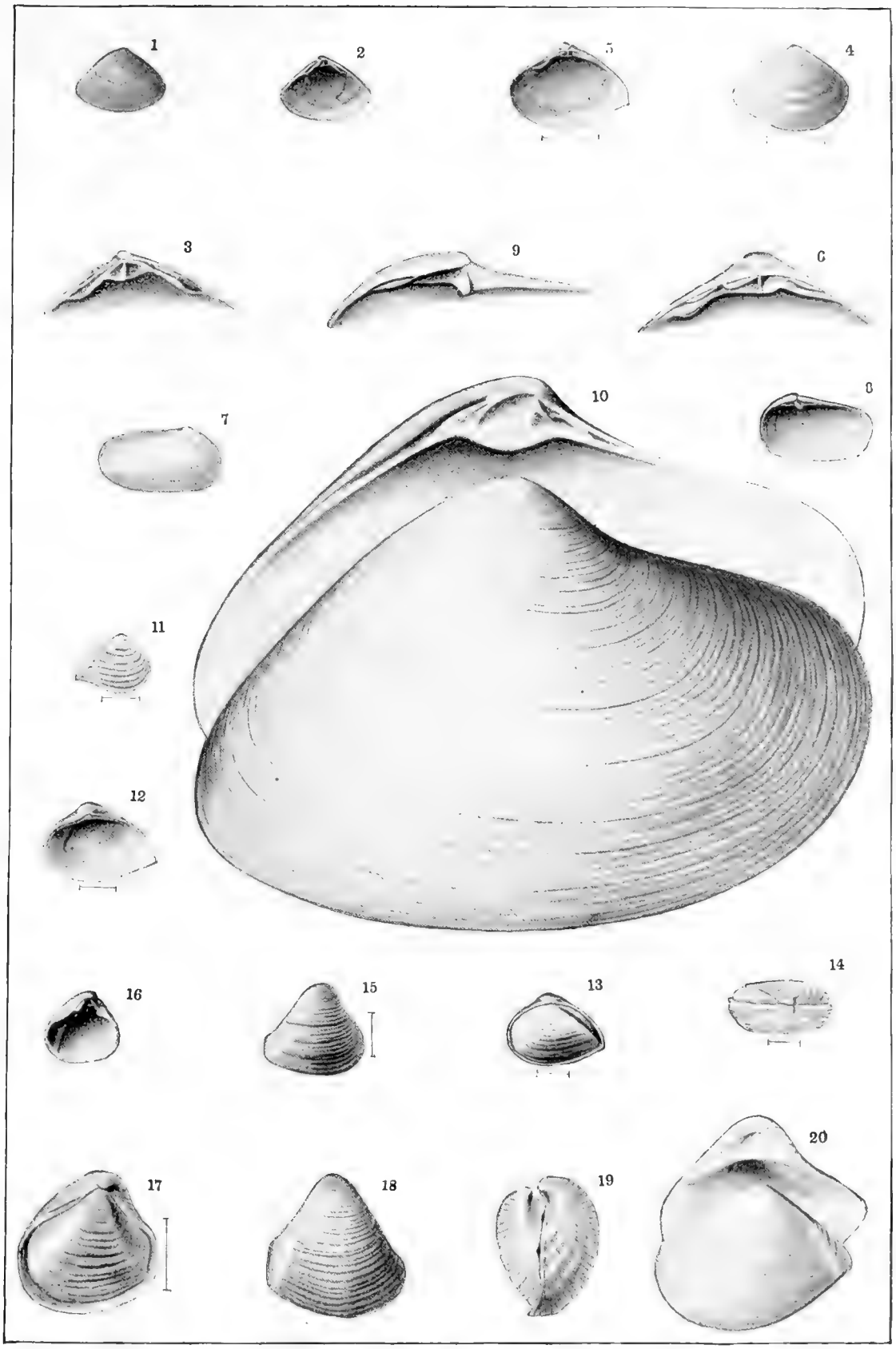
FIGS. 11, 12. Two views of a right valve, enlarged.
13, 14. Upper and cardinal views of a specimen retaining the valves in position, enlarged.

CORBULA ELEVATA Conrad (p. 86).

FIG. 15. Enlarged view of a right valve.
16. Interior of a right valve, natural size.
17, 18, 19. Three views of a specimen retaining the valves in position; twice enlarged.

CORBULA IDONEA Conrad (p. 88).

FIG. 20. Copy of Conrad's figure, Miocene Fossils, Pl. X, fig. 6; none of the New Jersey specimens being sufficiently perfect to illustrate.



MACTRIDÆ AND CORBULIDÆ.

PLATE XVI.

EXPLANATION OF PLATE XVI.

SAXICAVA BILINEATA Conrad (p. 93).

FIGS. 1, 2. Exterior natural size and enlarged interior view of a short broad form.
3. View of an imperfect right valve of an elongate form = *S. rugosa* L.

SAXICAVA MYÆFORMIS Conrad (p. 90).

FIGS. 4, 5. Exterior of the shell, natural size, and enlargement of the hinge. Type specimen.

SAXICAVA PARILIS Conrad (p. 92).

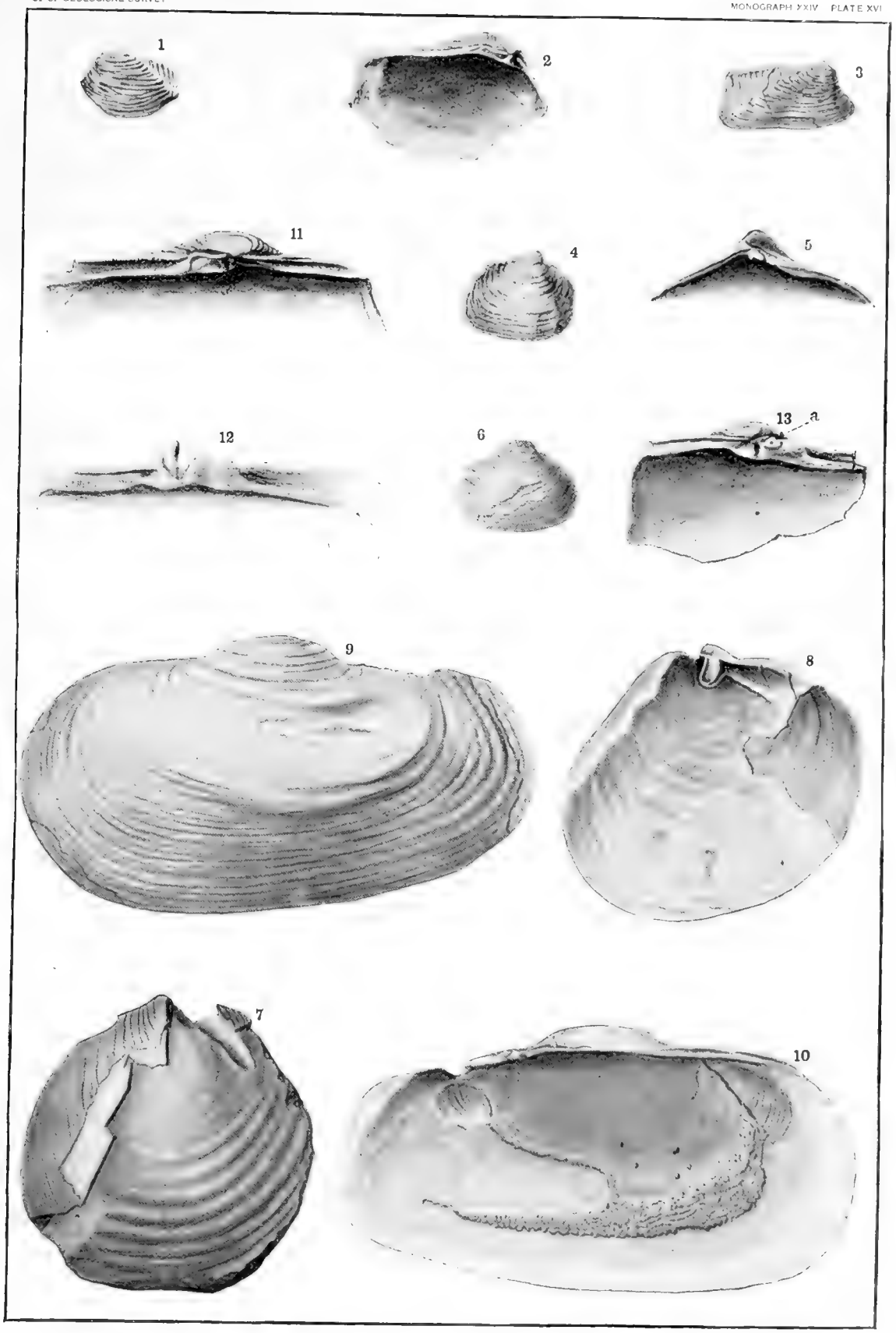
FIG. 6. View of the type specimen, natural size.

PERIPLOMA ALTA Conrad (p. 85).

FIGS. 7. Exterior view of a specimen, showing the imprint of the internal rib on the right of the beak.
8. Interior of Conrad's type specimen, showing hinge structure.

~~MYA~~ PANOPÆA Goldfussi (p. 89). Wagner

FIGS. 9, 10. Exterior and interior views of the best valve obtained; the hinge broken.
11. Hinge of a fragment of a left valve.
12. Hinge of a right valve, looking parallel to the plane of the valve.
13. Hinge of a right valve; the tooth broken away at *a*.



SAXICAVIDÆ AND ANATINIDÆ.

PLATE XVII.

EXPLANATION OF PLATE XVII.

MUREX SHILOHENSIS Heilprin (p. 97).

FIG. 1. Front view of the type specimen, enlarged.

MUREX SHILOHENSIS var. BURNSI Whitf. (p. 98).

FIG. 2. View of specimen described, enlarged.

CANTHARUS CUMBERLANDIANUS Gabb (p. 103).

FIGS. 3, 4. Front and back views of an imperfect specimen, the beak of which had been injured during life.

5. Back view of a more elongated individual.

6. Front view of Mr. Gabb's type specimen.

FASCIOLARIA WOODI Gabb (p. 98).

FIGS. 7, 8. Two views of the type specimen, natural size.

FASCIOLARIA (LYROSOMA) SULCOSA Conrad (p. 100).

FIGS. 9, 10. Two views of a small imperfect specimen, twice enlarged.

BUSYCON SCALARISPIRA Conrad (p. 102).

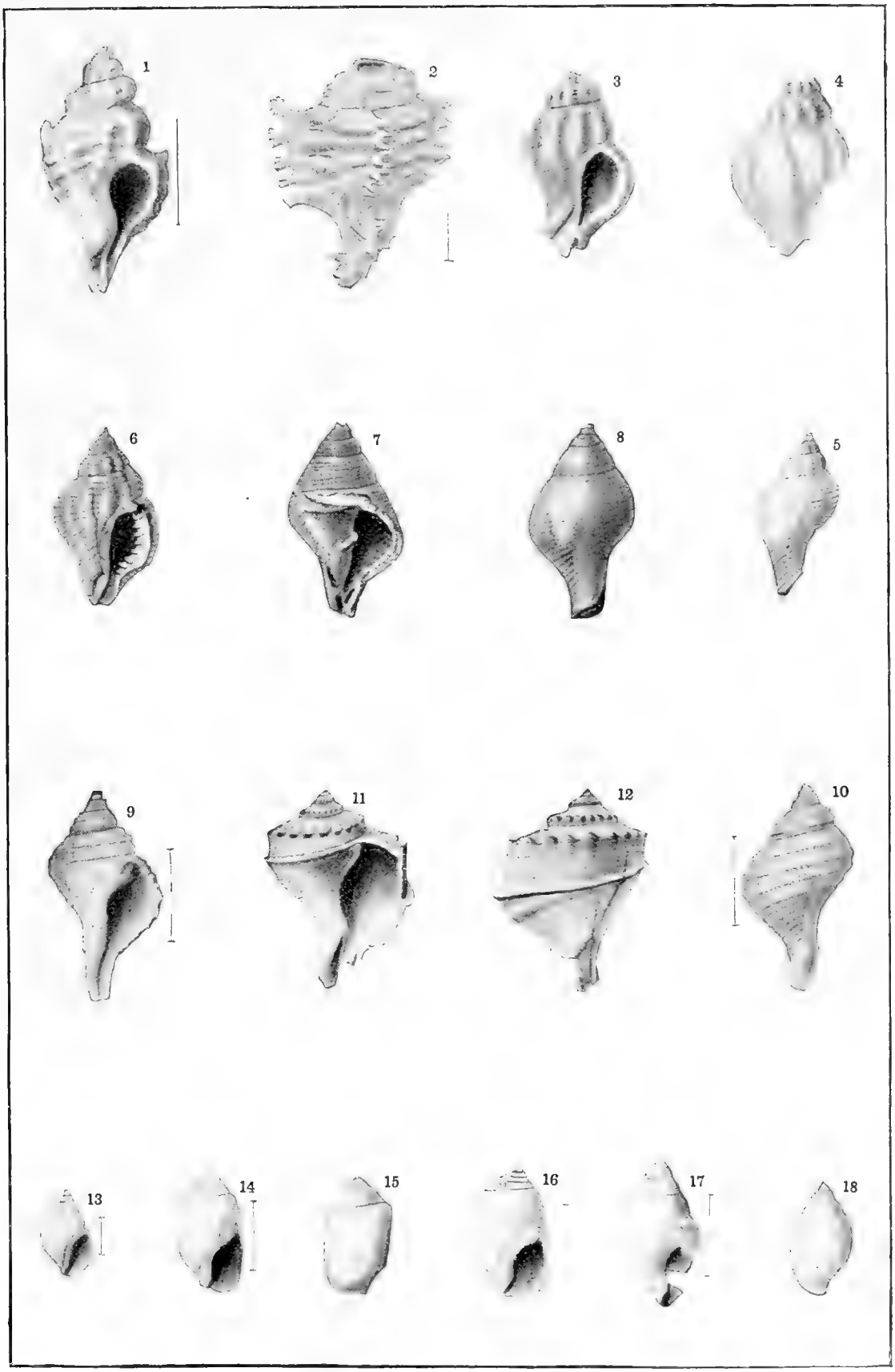
FIGS. 11, 12. Two views of the most perfect specimen observed.

BUCCINANOPS VARIABILIS Whitf. (p. 107).

FIGS. 13. View of a young specimen.

14, 15. Two views of a larger specimen.

16, 17, 18. Views of three other specimens, showing variations of form; all figures enlarged.



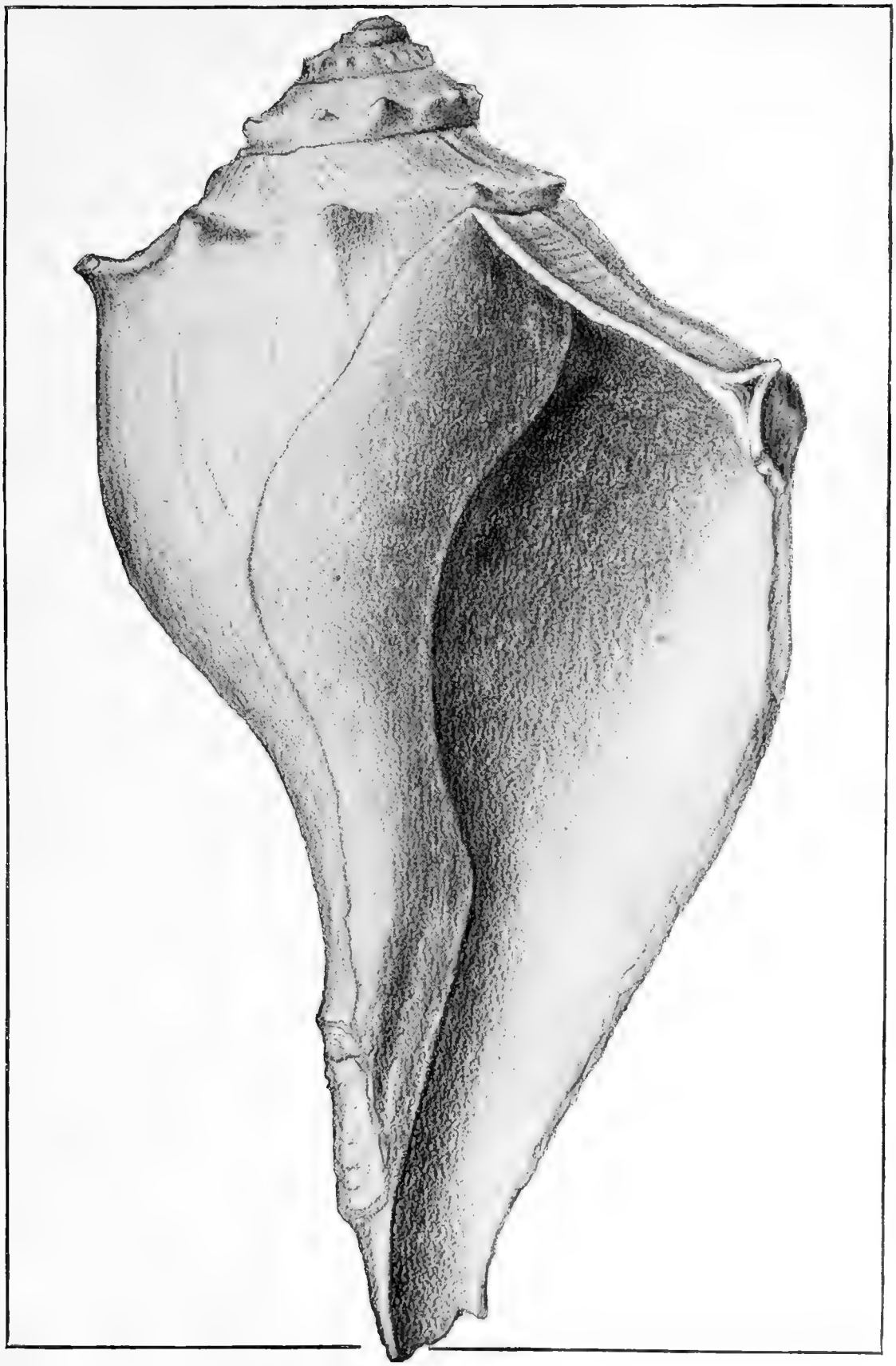
MURICIDÆ TO BUCCINIDÆ.

PLATE XVIII.

EXPLANATION OF PLATE XVIII.

BUSYCON CARICA Linn. (p. 101).

Front view of a large imperfect individual.



BUCCINIDÆ.

PLATE XIX.

EXPLANATION OF PLATE XIX.

TRITIA TRIVITTATOIDES Whitf. (p. 104).

FIGS. 1, 2. Enlarged views of two different specimens; one without the varix, the other having it.
3. Surface still further enlarged.

TRITIA TRIVATTATOIDES var. ELONGATA (p. 105).

FIGS. 4, 5. Two views of a specimen. The figures are too broad in proportion to their length.
6. View of another specimen, showing more nearly the true proportions, enlarged.

TRITIA BIDENTATA EMMONS sp. (p. 106).

FIG. 7. Enlarged view of a large individual of the species.

OLIVA CAROLINENSIS Conrad (p. 109).

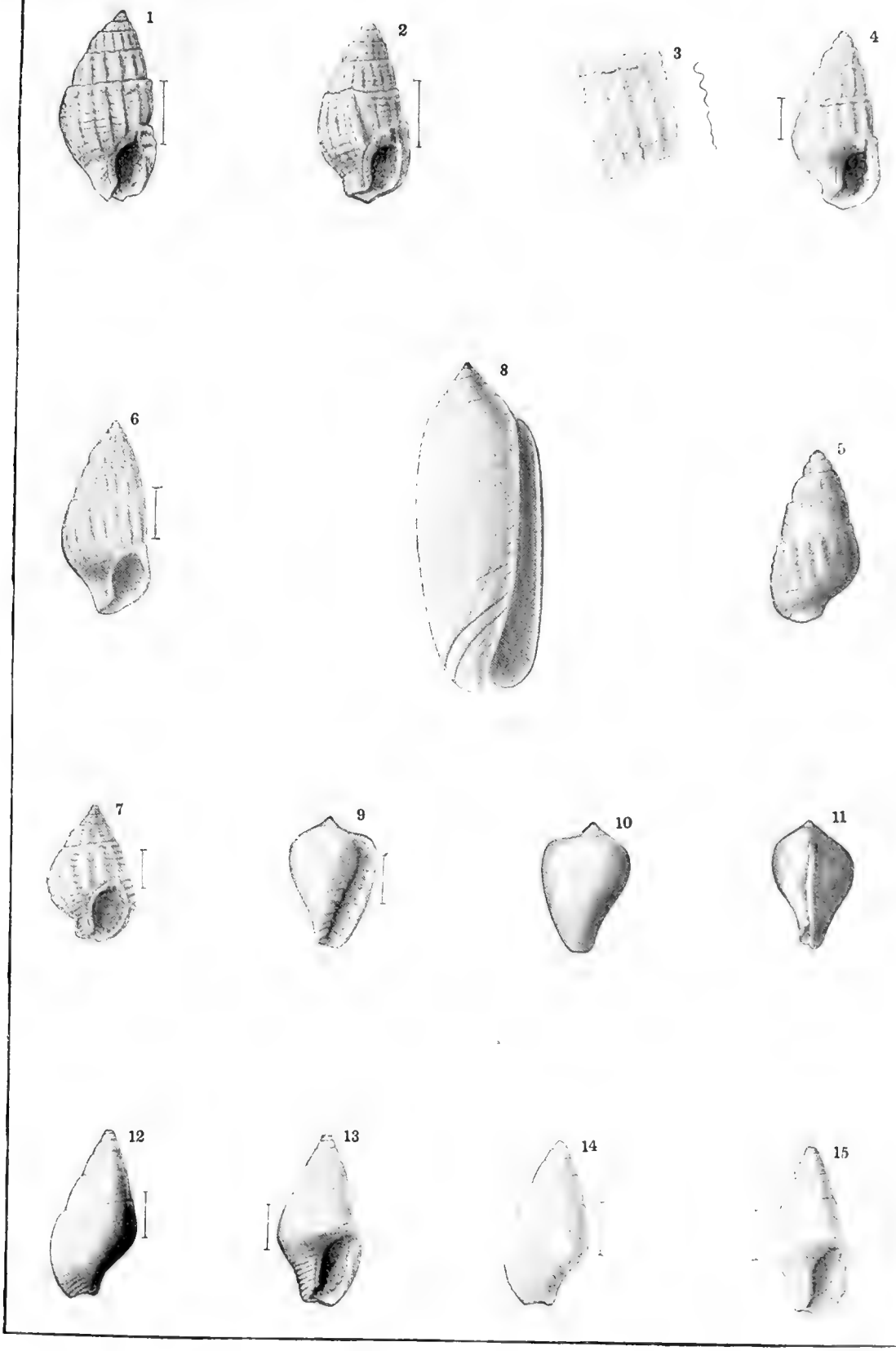
FIG. 8. Copy of Mr. Conrad's figure from the American Journal of Science and Arts, vol. 41, 1st ser., Pl. II, fig 1.

ERATO EMMONSI Whitf. (p. 108).

FIGS. 9, 10, 11. Three views of the only perfect specimen found, enlarged.

AMYCLA COMMUNIS Conrad (p. 110).

FIGS. 12, 13. Two views of one of the larger specimens, enlarged.
14, 15. Similar views of another individual which shows color lines on part of the shell.



BUCCINIDÆ TO COLUMBELLIDÆ.

PLATE XX.

EXPLANATION OF PLATE XX.

STROMBINA (AMYCLA) LEVIS Whitf. (p. 111).

FIGS. 1, 2, 3. Three views of a very perfect shell.
4. View of a specimen which shows linings.

CANCELLARIA ALTERNATA Conrad (p. 112).

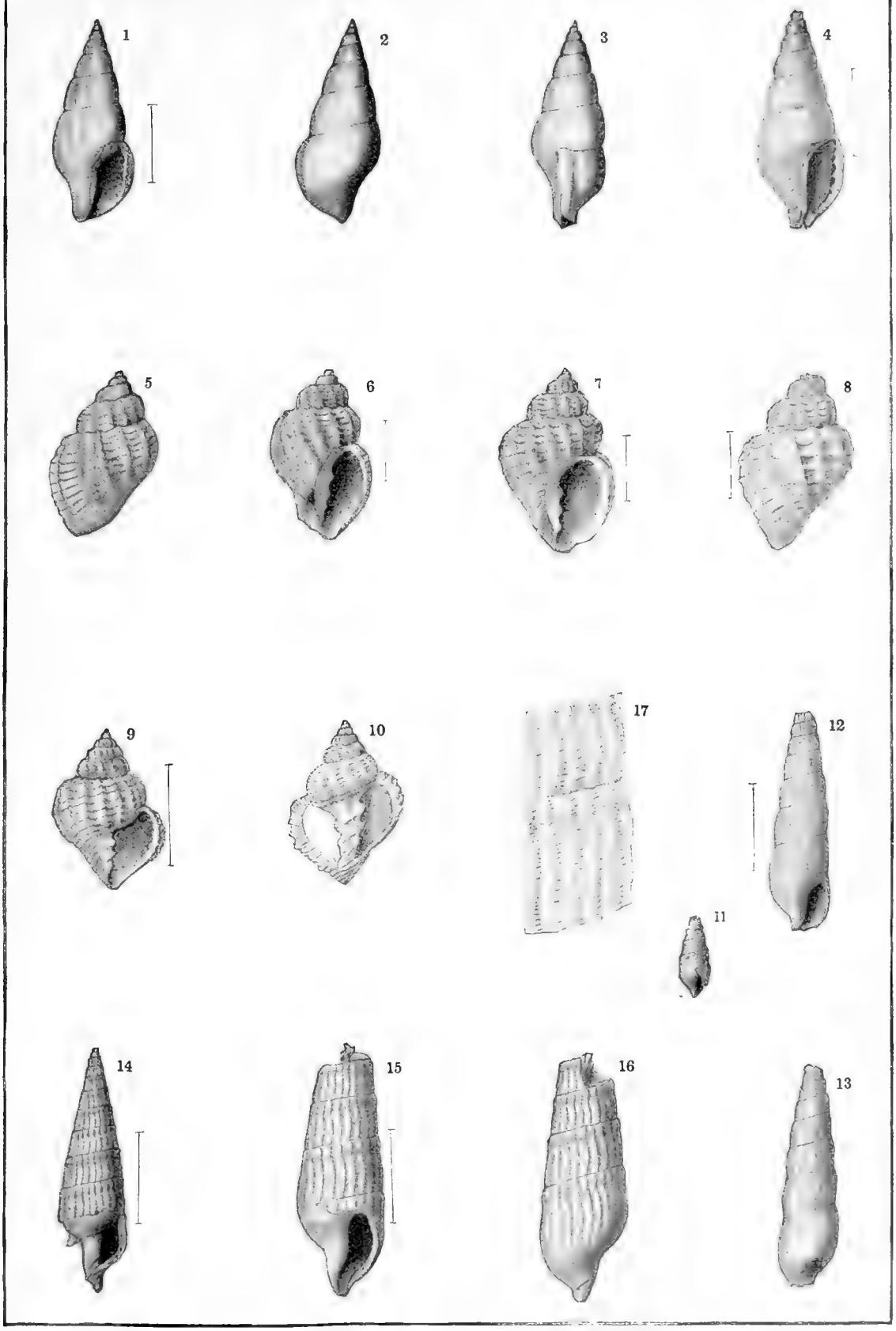
FIGS. 5, 6. Two views of an elongated specimen, enlarged three diameters.
7, 8. Similar views of a somewhat broader one.
9, 10. A still broader and larger individual, the back of which is broken and shows the plicæ of the columella, enlarged two diameters.

TEREBRA INORNATA Whitf. (p. 114).

FIG. 11. View of an eroded specimen, natural size, showing the condition in which they are mostly found.
12, 13. Two views of a specimen imperfect at the apex, but retaining the true features on the parts preserved, enlarged two diameters.

TEREBRA CURVILINEATA Conrad (p. 113).

FIGS. 14. View of the apical portion of a shell, twice enlarged.
15, 16. Two views of a specimen preserving only the lower volutions; the aperture still imperfect, enlarged two diameters.
17. A still further enlargement to show the spiral lines.



COLUMBELLIDÆ, CANCELLARIIDÆ, AND TEREBRIDÆ.

PLATE XXI.

EXPLANATION OF PLATE XXI.

SURCULA PARVA Conrad (p. 117).

FIG. 1. View of the only fragment which I have observed, enlarged 2½ diameters.

DRILLIA ELEGANS Emmons (p. 115).

FIGS. 2. View of a fragment which preserves only the lower volution and a half.
3, 4. Two views of a more perfect specimen, but still imperfect in the spire.
All twice enlarged.

DRILLIA SUBFLEXUOSA Whitf. (p. 116).

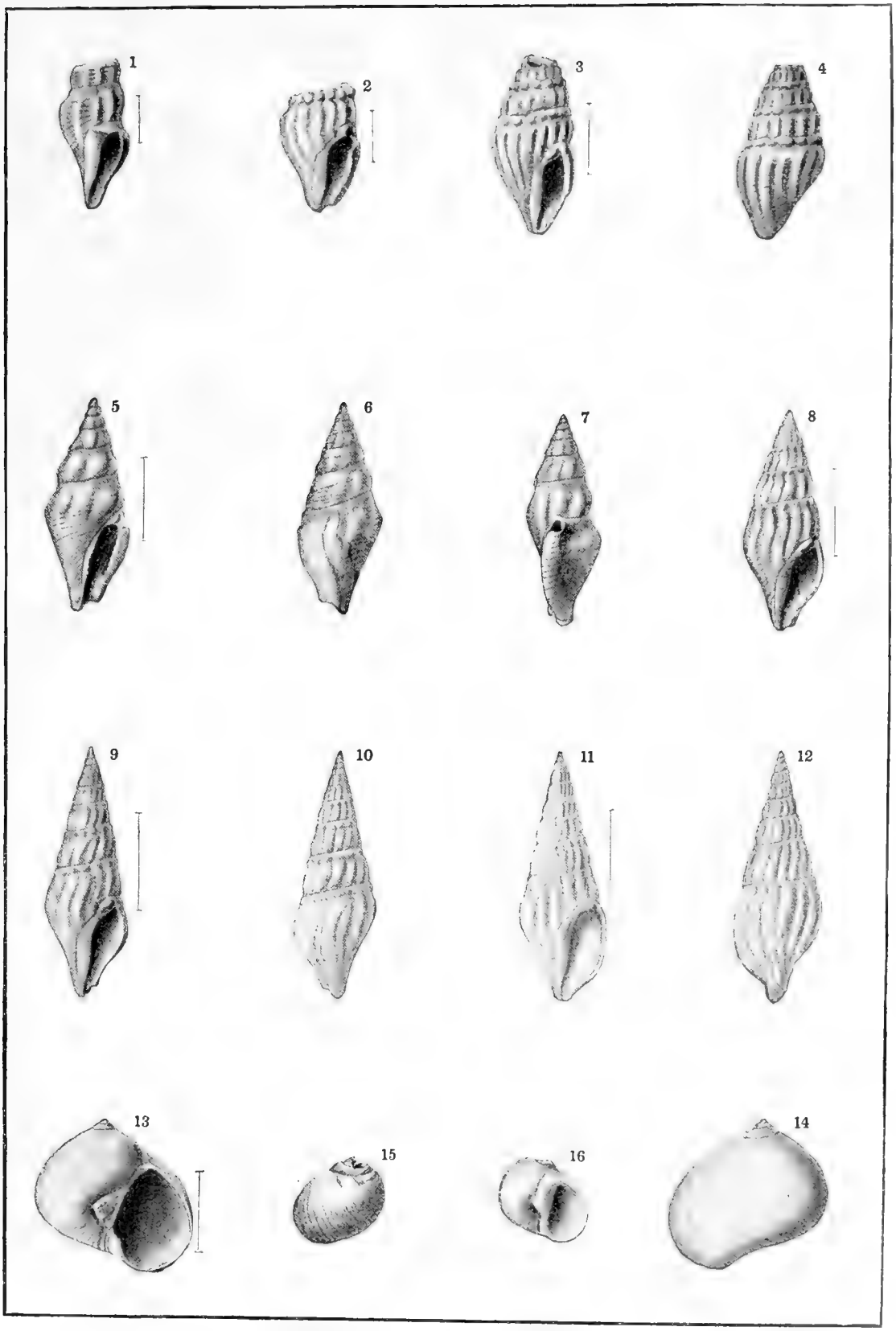
FIGS. 5, 6, 7. Three views of a very perfect shell, twice enlarged.

DRILLIA PSEUDEBURNEA Heilprin sp. (p. 114).

FIG. 8. View of a short, broad specimen.
9, 10. Two views of a more slender form.
11, 12. Two views of Prof Heilprin's type specimens.
All figures rather more than twice the natural size.

NEVERITA DUPLICATA Say (p. 121).

FIGS. 13, 14. Two views of a nearly entire shell, showing the usual umbilical callosity, twice natural size.
15, 16. Two views of another imperfect specimen having the callus extending to the upper margin of the lip, natural size.



PLEUROTOMIDÆ AND NATICIDÆ.

PLATE XXII.

EXPLANATION OF PLATE XXII.

NATICA (LUNATIA) HEMICRYPTA Gabb (p. 118).

FIG. 1. View of a specimen with the aperture obliqne.
2, 3. Two views of one having the aperture more upright.
4, 5. Similar views of one having a slit in the inner lip and a smaller umbilical opening.
All figures somewhat less than twice natural size.

N. (LUNATIA) TUOMEYI Whitf. (p. 120).

FIG. 6. Back view of a small individual.
7, 8. Two views of a larger specimen, twice natural size.

N. (LUNATIA) HEROS Say (p. 119).

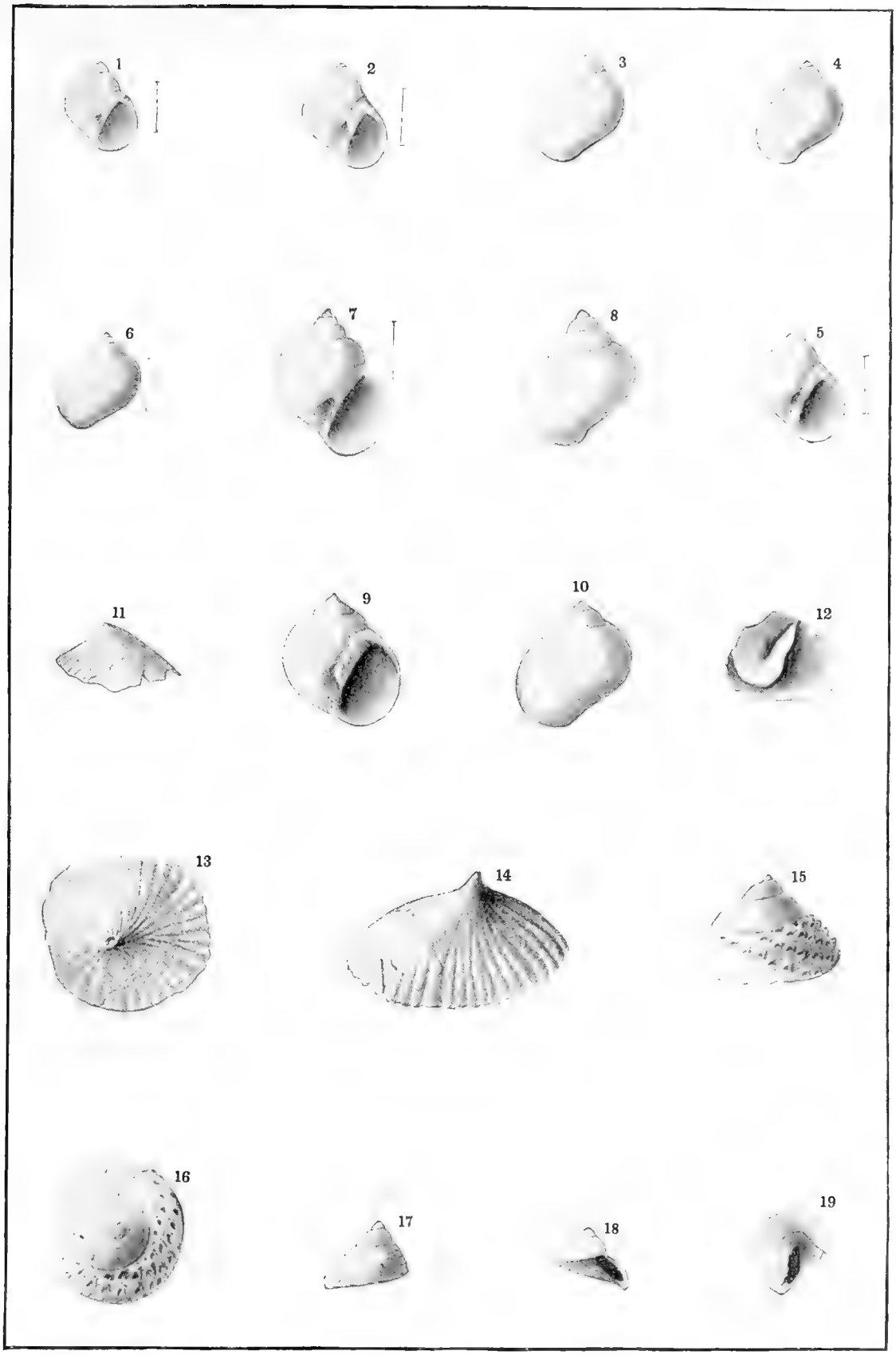
FIGS. 9, 10. Two views, natural size, of the individual used in description.

CRUCIBULUM COSTATUM Say (p. 122).

FIGS. 11, 12. Exterior and interior views of an imperfect specimen, the latter figure showing the inner plate.
13. Vertical view of a broad, flat specimen.
14. Lateral view of a large crushed specimen.

TROCHITA PERARMATA Conrad (p. 124).

FIGS. 15, 16. Two views of a gutta-percha cast from a natural mold in the brown clays.
17. Lateral view of an exfoliated specimen of the usual size found.
18, 19. Other views of a similar form.



NATICIDÆ AND CALYPTERIDÆ.

PLATE XXIII.

EXPLANATION OF PLATE XXIII.

TRICHOTROPIS DALLI Whitf. (p. 127).

FIGS. 1, 2. Two views of a small specimen.
3, 4. Similar views of one of the larger shells.
All twice natural size.

SCALARIA MULTISTRIATA Say (p. 126).

FIG. 5. View of the only shell observed; the surface is entirely exfoliated; enlarged two diameters.

TURRITELLA (MESALIA) PLEBEIA Say (p. 130).

FIGS. 6, 7. Views of two fragments.
8. Enlargement of the lower volution of the last, showing the surface striation.

TURRITELLA CUMBERLANDIA Conrad (p. 129).

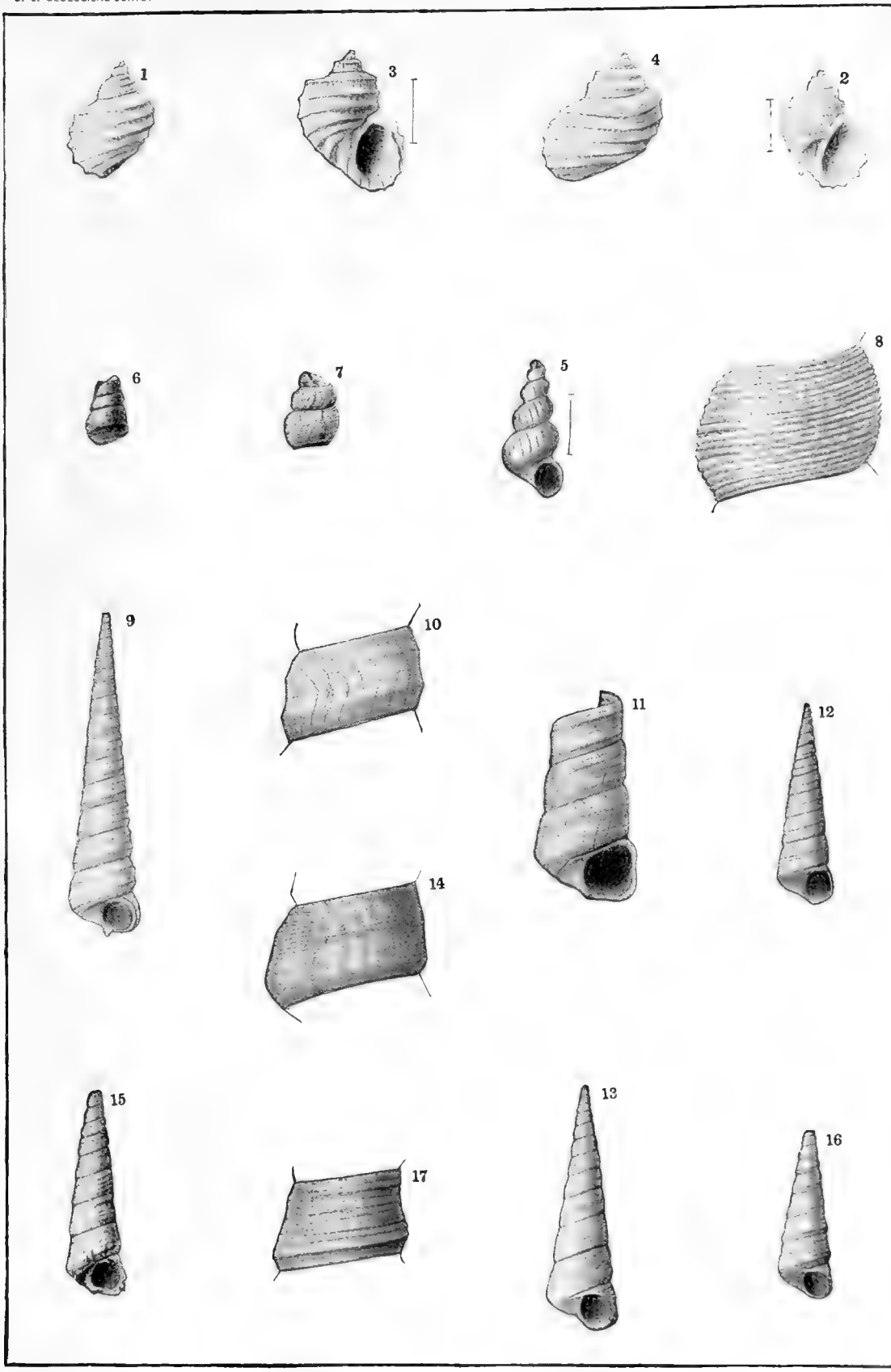
FIGS. 9, 10. View of a specimen showing the upper part of the shell and an enlargement to show striæ.
11. View of an older fragment, natural size.

TURRITELLA ÆQUISTRIATA Conrad (p. 128).

FIGS. 12, 13. Views of two specimens presenting slight variations in rate of increase.
14. Enlargement from fig. 13 to show striæ.

TURRITELLA SECTA Conrad (p. 129).

FIGS. 15, 16. Views of two specimens, the latter preserving the striae in fairly good condition.
17. Enlargement from fig. 16.



TRICHOTROPIDÆ, SCALARIIDÆ, AND TURRITELLIDÆ

PLATE XXIV.

EXPLANATION OF PLATE XXIV.

ANGUINELLA VIRGINIANA Conrad (p. 132).

FIG. 1. View of a small specimen which shows the spines on the exterior surface.
2, 3. Two views of a specimen spirally coiled.
4. View of a specimen cut to show the septa, three of which are seen.
5. A minute specimen, showing the spiral nucleus, greatly enlarged.

TRIFORIS TEREBRATA Heilprin (p. 133).

FIG. 6. Enlargement of the type, the only fragment known, greatly enlarged.

MONILEA (LEIOTROCHUS) EBOREA Wagner (p. 135).

FIGS. 7, 8, 9. Views of three specimens, showing some slight variations of form and umbilical features.
10. Under surface of specimen, fig. 9.
Figures twice enlarged.

FISSURELLA GRISCOMI Conrad (p. 136).

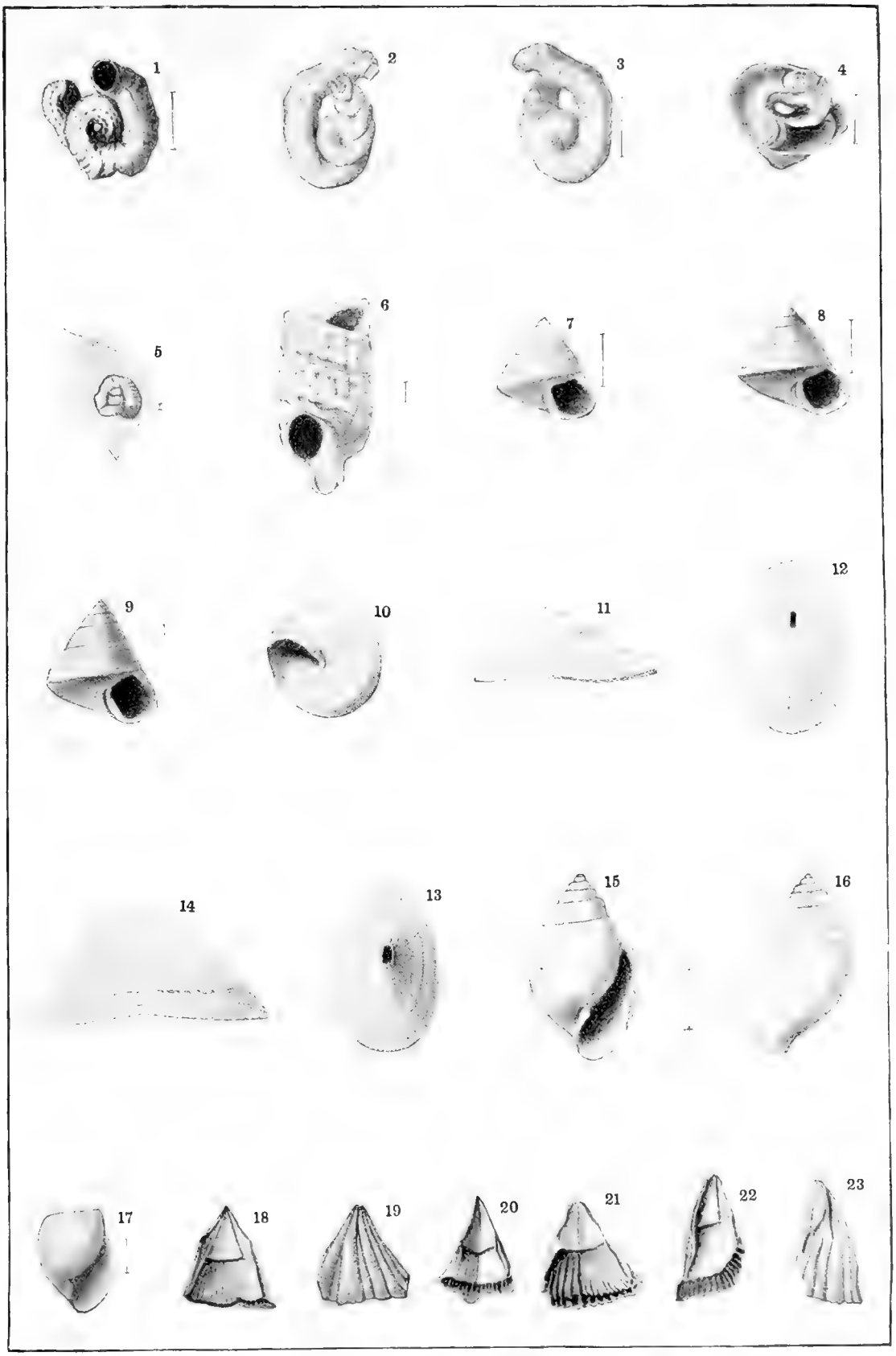
FIGS. 11, 12. Two views of a specimen of medium size.
13. Vertical view of a shell having fine radii.
14. Side view of a large individual.

ACTEON SHILOHENSIS Whitf. (p. 137).

FIGS. 15, 16. Two views of the only entire individual observed.
17. View showing the aperture of a smaller specimen.
Figures enlarged three times

BALANUS PROTEUS Conrad (p. 141).

FIGS. 18, 19. Opposite sides of a rostral plate.
20. Inner surface of a carinal plate.
21. Inner face of a rostro-lateral plate.
22, 23. The opposite sides of a carino-lateral plate. All natural size.



TURRITELLIDÆ, TROCHIDÆ, FISSURELLIDÆ, ACTEONELLIDÆ, AND CRUSTACEA—BALANIDÆ.

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