

GEOLOGICAL SURVEY OF NEW JERSEY

GASTEROPODA AND CEPHALOPODA

OF THE

RARITAN CLAYS AND GREENSAND MARLS

OF

NEW JERSEY

BY

ROBERT P. WHITFIELD



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LETTER OF TRANSMITTAL.

GEOLOGICAL SURVEY OF NEW JERSEY,
New Brunswick, New Jersey, July 1, 1889.

SIR: I have the honor herewith to transmit to you the text and drawings of the Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. They have been prepared by Prof. Robert P. Whitfield for the Geological Survey of this State, and include all species of this geological division which are known to have been found within its bounds. The book will constitute the second volume of the series, which is intended to include descriptions of all the fossil invertebrates found in the above named formations. It is a monument to the patience and intelligent skill of Prof. Whitfield which have produced so good a work from these long known but imperfectly preserved fossils. Like its predecessor, I esteem it worthy of a place among the monographs of the United States as well as of this State, and as such transmit it to you for publication.

I am, with high respect, your obedient servant,

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

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

LETTER OF TRANSMITTAL.

NEW YORK, *October 1, 1888.*

SIR: I herewith transmit to you descriptions and illustrations of the Gasteropoda and Cephalopoda of the Greensand Marls and accompanying beds of New Jersey, which will form a second part of the report on the fossil remains of the State.

In presenting this second report, I wish again to express my thanks for the aid which you have so often given me in the selection and examination of material from the many collections under your charge; and also to express through you my thanks for the kindness and courtesy with which my many demands have been met by the officers of the Academy of Natural Sciences of Philadelphia, Pennsylvania, and especially to thank their curator, Prof. Angelo Heilprin, who has kindly selected and sent me many specimens from the collection under his charge. I have also been greatly favored by the use of specimens from the cabinet at the School of Mines of Columbia College in New York, through the kind offices of Dr. J. S. Newberry and Dr. N. L. Britton. I have also been allowed to use and figure very many specimens from the collection at the American Museum of Natural History, New York City, for which I must express my thanks to the trustees of that institution. There are also several private collections to which I am indebted, through yourself, for the use of valuable material and for which I here wish to express my thanks.

Yours, very truly,

R. P. WHITFIELD.

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

GASTEROPODA AND CEPHALOPODA OF THE RARITAN CLAYS AND GREENSAND MARLS OF NEW JERSEY.

BY ROBERT P. WHITFIELD.

PRELIMINARY REMARKS.

In offering the following descriptions and illustrations of the Gasteropoda and Cephalopoda of the New Jersey marl beds to the public and to scientific workers in similar fields, it is perhaps only just to add a word of apology for the use of such meager material as is here presented, and that apology must necessarily be that it is all there is to present, being the best material possessed. In studying these remains I have had the same difficulties to encounter as those spoken of in the "preliminary remarks" to the volume on the Brachiopoda and Lamellibranchiata;¹ but in an extremely exaggerated form, as the Gasteropods are represented in the several formations only by casts, much more exclusively than are the Brachiopods and Lamellibranchs, and the Cephalopods largely by fragments. This, however, is not the only difficulty encountered, for these casts are far more imperfect and consequently more difficult to understand. Among the bivalves there is often the chance of obtaining the hinge structure and muscular markings from impressions of single valves, and very commonly imprints of the exterior show all the essential surface markings. This is not the case, however, with casts of Gasteropods, for these usually represent only a small portion of the shell, as the apical portion of the spire is almost invariably absent, that space not having been filled by sediment before the shell was dissolved, and when present having often become solid from deposits of shelly matter in these parts during the life of the animal.

¹ Mon. U. S. Geol. Survey, Vol. 9, and Geol. Survey, N. J., Paleontology of the Cretaceous and Tertiary, Vol. 1.

Besides the absence of these parts, which often present important generic features in the embryonic nucleus, there is an almost total absence of the anterior beak and front of all shells, which so generally possess important generic features. Occasionally the casts retain to some extent the surface markings of the species. This is particularly the case in the Eocene marls, but in the Cretaceous beds it is a rare feature; consequently it has been necessary to resort to various methods for determining the generic relations. For specific differences the student is compelled to rely chiefly upon the form of the volutions and upon the proportions of parts, such as the compactness of the coil; the differences in the apical angle; the size and strength of the axis of the shell or columella, which is ascertained from the size and form of the cavity left by its removal; the imprints of folds left upon that part of the matrix which has rested against the columella, and various other features according to the conditions of the specimens. In some cases where much doubt of generic relations has been felt, resort has been had to artificial casts made by filling the interior of recent shells with plaster and dissolving away the shell by means of acid to procure the cast of the interior. I have thus used every means within my reach to render the generic determinations of these casts as reliable as possible. Concerning many of these I am somewhat in doubt, but as a general thing they may be relied upon with a considerable degree of certainty.

In regard to the authenticity of localities assigned to the several species, the remarks made in the previous volume¹ hold good here, as the same collections which furnished material for that volume have been drawn on as largely for the material in this. I have used the types of all previously described species wherever I could find them, even to fragments preserving the least particle of character. The species of Gasteropoda are much better represented by individuals in the collections used than were the Lamellibranchiates, although of many of them there is but a single example known in the collections to which I have had access. The illustrations of many of the species are necessarily quite restricted and meager in quantity. Many species have been recognized, but not used, simply because of the

¹ *Ibid.*, p. xviii.

poorness of the material at hand, which, although sufficiently perfect to be readily distinguished by a practiced eye familiar with the associated forms, is not good enough to permit figures of them to be made which would enable others to identify them. Consequently this monograph can not be said to be entirely complete.

In dealing with the different species and genera previously described, I have endeavored to ascertain their true nature as far as possible from the type specimens when they could be found, and have adopted them wherever it seemed reasonable. Comments on many of them will be found in the text of the volume, where I give my reasons for adopting or rejecting them.

GASTEROPODA.

MON XVIII—2

17

SECTION I.

CRETACEOUS GASTEROPODA OF THE LOWER MARL BEDS OF NEW JERSEY.

PALEONTOLOGICAL HORIZONS OF THE MARL BEDS.

In working over the molluscan remains described and figured in this and the volume on the Lamellibranchiates, I find indications of several distinct zoological horizons. In the first place, in the Raritan Clays, in the northeastern extension of them, there appears an estuary fauna represented by only a few species of bivalve estuary shells, but nevertheless indicating very clearly a fauna entirely distinct from any of those above mentioned. Secondly, in the clay beds near Camden, New Jersey, at Fish House, an entirely fresh-water fauna is found, which has yielded the twelve different species representing two distinct genera of the *Unionidae*, which are described in the volume on Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey. Above this again we have the fauna of the Lower Marl beds, a distinctly marine fauna, which comprises the great bulk of all the fossil remains known within the State.

This bed, if properly examined, might possibly be separable into two zoological horizons, the lower indicated at Crosswicks Creek, near New Egypt, and at Haddonfield, by the dark-colored micaceous clays which lie at the base or, more properly, below the base of the Lower Marl bed, and also in the more northern portions of the State by ironstone nodules, bearing fossils usually found in the upper layers of the Raritan Clays and in loose pieces scattered over the surface where the upper layers of the clay have been denuded by the action of the weather. The fossils in these nodules are usually the same as those from the Crosswicks and Haddonfield

micaceous beds, and, although several are apparently identical with forms occurring in the Lower Marls, yet many of them are peculiar to these beds as far as represented in New Jersey.

Above the Lower Marls come the Middle Marl beds, characterized by the yellow lime sands, filled in many places with *Terebratula*, and above this the layers at the base of the Upper Green Marls, which contain a fauna entirely distinct from those below, but still Cretaceous in its character. Again, at the summit of the Upper Green Marls we find another distinct fauna, representing the Eocene epoch of the more southern States and affording many species identical with those from Claiborne, Alabama. These mark six distinct zoological horizons, and if we divide the Lower Marls from the Crosswicks and Haddonfield beds, as will possibly be done when they are properly examined and studied, seven distinct horizons, six of which may be classed as Cretaceous and one as Eocene.

These zoological horizons conform very closely, if not exactly, to certain stratigraphical lines which were long since established by the State geologist under the names of Raritan Clays, Camden Clays, Lower, Middle, and Upper Marls, the last bed being mollusk-bearing only near the lower and upper portions, which are respectively Cretaceous and Eocene. The details of these beds can be found in the different annual reports of the State survey, particularly in that of 1868, and in that on the clays of New Jersey.

Although between these zoological horizons there is little, and, indeed almost no interchange of fossils, the faunas being almost entirely distinct, the geological sequence is continuous, except between the Eocene or Upper layers of the Upper Green Marls and the beds immediately below, where there is a very slight unconformity, noticeable by close inspection, over a very limited area only, and consisting principally of a slight denudation of the top of the beds immediately below, before the deposition of the Eocene Marls.

It is not necessary here to consider in detail the structure of the layers further than to mention that these different beds which are fossiliferous, or mollusk bearing, consist at the base of the section of beds of clay of

different kinds, and above of beds of Green Marls separated by strata of lighter colored quartz sand, which are unfossiliferous.

In the Raritan Clays, at about one-third of their thickness from the base, there occurs a bed of fossil plants, prolific in genera and species, which Dr. J. S. Newberry has stated to be of Cretaceous age, and at a very little distance above the plant bed occur the estuary fossils above mentioned. These consist of bivalve shells, and are all of forms known to inhabit brackish water, showing them to be inhabitants of an estuary or land-locked bay into which fresh-water streams flowed, and making it probable that there existed at the time of their deposit a body of brackish water representing the present New York Harbor, but at a somewhat higher level as compared with the surrounding land. These fossils being of estuary forms and entirely of new species do not aid us materially in the determination of the age of the strata in which they are found. Those already known are figured and described in the previous volume, and are illustrated on Pl. II. They represent four different genera and five species, as follows:

	Species.
Genus <i>Astarte</i>	1
Genus <i>Corbicula</i>	2
Genus <i>Gnathodon</i>	1
Genus <i>Ambonicardia</i>	1

The features of this latter genus, which is new to science, are more nearly like some of the Jurassic forms of Europe, such as *Homomya* Ag., than any of the known Cretaceous types either of America or of Europe. No Gasteropods have yet been obtained from these beds.

No other Molluscan remains are known to occur in these clays except near the top, or perhaps in the uppermost layers. At about this horizon the numerous ironstone nodules before mentioned are supposed to occur, but they are always loose, having been weathered out or washed from the clays, and found scattered over the surface. These nodules are well filled with fossil remains of both bivalve and univalve shells, in the condition of casts and impressions. They are mostly such forms as are found near the base of the Lower Green Marls, or in the Crosswicks and Haddonfield Micaceous Clays.

The next zoological horizon is that of the Lower Green Marls proper, in which are found by far the most of the Cretaceous fossils yet recognized within the State. The number of species so far exceed those of any of the other beds named above as scarcely to bear comparison, the number of Mollusca alone being 303 species out of a total for all formations of 441. These fossils are, however, like those of the other beds, found mostly in the condition of internal casts, or casts representing partially the interior cavity, but they also carry on them the imprint of the external markings to a partial extent. Very few of the specimens preserve even a replacement of the original substance. The *Ostreidæ* and *Spondylidæ* are notable exceptions to this rule, being generally found with the substance of the shell entirely preserved, but so friable as to be easily destroyed after collection. In the Micaceous Clays of the Crosswicks Creek and Haddonfield beds, however, the substance of the shells is entirely preserved, both of bivalve and univalve species.

In the Middle Marls a fauna almost entirely distinct from that below presents itself, *Gryphæa vesicularis*, and two species of naticoid shells being all that are yet known to pass into it from below; even the *Gryphæa* is here presented under a varietal form not common in the Lower Marls. In this bed some of the species are represented by great numbers of individuals, the *Teredo*, *Gryphæa* and *Terebratula* being the most abundant.

At the base of the Upper Marls another entirely distinct fauna is found, still presenting Cretaceous features. In this layer also few species are represented, and, so far as I am aware, no locality has yet been found where they occur in any abundance; and no species have yet been observed in it that are common to either of the others below. Above this fossiliferous layer at the base of the Upper Marls occurs a series of beds of considerable thickness in which no molluscan remains have been detected. Many vertebrate fossils have been discovered, however, showing a quite remarkable break in the molluscan life in the seas of the New Jersey area, extending to the top of the Upper Marls, where occurs the Eocene layer. This contains a fauna entirely distinct from that of either of the beds below, being composed not only of different species, but largely of different genera,

and even several families not represented in the lower strata make their appearance. The molluscan remains found in this formation at Shark River, Farmingdale, and Squankum, are also in the condition of casts, like those in the Cretaceous, even the *Ostreidae* seldom preserving the least vestige of the shell substance.

In these Eocene beds the species again become quite numerous. Although not as abundant as in the Lower Green Marls, they far outnumber those of the intermediate beds. Considering the few localities and the slight thickness of the beds examined they have been prolific, having yielded a total of 79 molluscan species, of which 23 are Lamellibranchiates, 52 are Gasteropods and two Cephalopods, besides fragments of some eight or ten other Gasteropods, the specimens of which are not sufficiently well preserved for description and illustration. The following tables present more readily the numbers of families, genera and species of molluscan remains occurring in the several formations, and the relative proportions known from each bed. Table No. 1 shows the number of genera and species of Lamellibranchiates represented under each family in each bed except the Crosswicks Creek and Haddonfield bed, which are included in the Lower Green Marls, while Table No. 2 shows the same features pertaining to the Gasteropods and Cephalopods.

TABLE NO. 1.—Showing the number of genera and species of Lamellibranchiata under each family occurring in each of the several marl beds in New Jersey.

	Genera.	Species.	Lower or plastic clays.		Camden clays.		Lower marls.		Middle marls.		Base of upper marls.		Eocene marls.	
			Genera.	Species.	Genera.	Species.	Genera.	Species.	Genera.	Species.	Genera.	Species.	Genera.	Species.
Class LAMELLIBRANCHIATA.														
Order ASIAPHONIDÆ.														
Suborder <i>Monomyaria</i> .														
Family Ostroideæ.....	4	17					3	9	2	3	2	2	2	3
Anomilidæ.....	3	5					3	5						
Pectinidæ.....	4	13					4	11					1	2
Spondylidæ.....	4	6					4	6						
Suborder <i>Heteromyaria</i> .														
Family Mytilidæ.....	3	8					3	5	1	2	1	1		
Pteriidæ.....	4	12					4	11						1 ¹
Pinnidæ.....	1	2					1	1	1	1				
Suborder <i>Dimyaria</i> .														
Family Arcidæ.....	8	21					8	17	1	2	1	1	1	1
Nuculidæ.....	4	14					4	11					3	3
Isocardiidæ.....									1	1				
Trigonidæ.....	1	3					1	3						
Unionidæ.....	2	12			2	12								
Order SIPHONIDÆ.														
Suborder <i>Integropallata</i> .														
Family Astartidæ.....	2	6	1				2	6			1	1	2	4
Crassatellidæ.....	4	19					2	7			1	4	1	2
Lucinidæ.....	1	2					1	2						
Chamidæ.....	1	1					1	1						
Cardiidæ.....	7	15					8	13			1	1	1	1
Cyprinidæ.....	4	11	1	1			2	8	1	1	1	1		
Cyrenidæ.....	1	2	3	2										
Suborder <i>Sinнопallata</i> .														
Family Veneridæ.....	6	12					5	10			1	1	1	1
Petriculidæ.....	1	1									1	1		
Tellinidæ.....	6	7					5	7						
Donacidæ.....	1	1					1	1						
Maclridæ.....	2	6	1				1	3			1	1	1	1
Anatidæ.....	3	5					3	4			1	1		
Corbulidæ.....	2	5					1	3					2	2
Saxicavidæ.....	1	2					1	1			1	1		
Solenidæ.....	4	5					4	5						
Pholadidæ.....	3	4					2	3					1	1
Teredidæ.....	1	3					1	1	1	1			1	1
Gastrochaonidæ.....	2	2					1	1	1	1				
	89	222	5		12		155		11		16			23

¹ Probably fragment of a Gasteropod.

Summary of the foregoing table.

	Families.	Genera.	Species.				
Plastic clays	4	4	5				
Camden clays	1	2	12				
Lower marls.....	27	76	155				
Middle marls	8	9	11				
Base of upper marls	12	13	16				
Eocene marls	12	17	23				
	Families.	Genera.	Species.	Lower marls.	Middle marls.	Base of upper marls.	Eocene marls.
Brachiopoda:							
Terebratulidæ.....	1	3	7	2	2	1	2 ¹
Lamellibranchiata.....	31	89	222	155	11	16	23
Gasteropoda	30	80	190	127	7	7	52
Cephalopoda.....	3	13	24	19	3	2
				303	23	24	79

¹ Probably fragment of a Gasteropod.

TABLE NO. 2.—Showing number of *Gasteropoda*, genera and species under each family, occurring in the several beds.

	Total genera.	Total species.	Lower marls.		Middle marls.		Base of up per marls.		Eocene.	
			Genera.	Species.	Genera.	Species.	Genera.	Species.	Genera.	Species.
Class GASTEROPODA.										
Subclass PROSABRANCHIATA.										
Order PECTINIBRANCHIATA.										
Family Muricidae	7	24	5	21	1	1			2	2
Tritonidae	2	5	2	4					1	1
Purpuridae	1	1							1	1
Fusidae	3	13	2	3					2	10
Fasciolaridae	3	13	2	10					1	3
Buccinidae	3	3	3	3						
Turbinellidae	3	7	3	4			1	1	1	2
Volutidae	4	17	3	6	1	1	2	2	2	8
Mitridae	1	3	1	3						
Cancellariidae	3	9	3	8					1	1
Pleurotomidae	4	11	2	3			1	1	3	7
Conidae	1	1							1	1
Strombidae	5	14	4	12			1	1	1	1
Cypræidae	2	2	1	1					1	1
Cassidae	1	1							1	1
Doliidae	2	3	2	2					1	1
Naticidae	4	11	4	10	1	2			1	1
Onustidae	2	3	2	2					1	1
Solaridae	1	1							1	1
Scalariidae	2	6	2	4	1	1			1	1
Turritellidae	5	11	4	9			1	1	1	1
Eulimidae	1	1	1	1						
Pyramidellidae	1	1	1	1						
Littorinidae	1	1	1	1						
Order SCUTIBRANCHIATA.										
Suborder Podophthalma.										
Family Trochidae	2	2	2	2						
Pleurotomariidae	4	7			2	2	1	1	2	4
Suborder Edriophthalma.										
Family Patellidae	1	1	1	1						
Subclass OPISTHOBRANCHIATA.										
Order TECTIBRANCHIATA.										
Family Tornatellidae	7	12	5	9					3	3
Bullidae	1	2	1	1			1	1		
Class SCAPHOPODA.										
Family Dentalidae	3	4	3	4						
Totals (30 families)	80	190	60	125	6	7	8	8	20	52
Class CEPHALOPODA.										
Order TETRABRANCHIATA.										
Family Nautilidae	3	3	1	1	2	2			2	2
Ammonitidae	8	18	8	17	1	1				
Order DIBRANCHIATA.										
Family Belemnitidae	1	1	1	1						
Total (3 families)	12	22	10	19	3	3			2	2

This gives for the molluscan fauna of New Jersey, including the Brachiopoda:

	Cretaceous.	Eocene.	Total.
Brachiopoda.....	5	2	7
Lamellibranchiata.....	199	23	222
Gasteropoda.....	136	52	188
Cephalopoda.....	22	2	24
Total.....	362	79	441

Giving a total of 441, or deducting the two naticas and gryphaea, which are counted also in the Middle Marls, a total of 428 described species. Were the localities critically examined many others would undoubtedly be obtained, as a number of casts are already recognized as distinct from any of the described forms, both in the Cretaceous and Eocene beds.

Of the Brachiopoda above enumerated the *Terebratulina Harlani* and *Terebratulina lachryma* are also known to occur in South Carolina, and *T. floridana* is common at some localities in Alabama. Of the Lamellibranchiata of the Lower Marls, three species are known in Europe, and the number attributed to certain American States are as follows:

	Species.
Alabama.....	41
Tennessee.....	21
Mississippi.....	21
Texas.....	6
North Carolina.....	20
Dakota.....	4

A large number are found in States not here mentioned. Six of those from the Middle Marls also occur in other States, and but one species from the Eocene layers, *Crassatella alta*, is known to occur outside of New Jersey. In Table No. 3, the species which have been thus cited are given under the States wherein they are found, and the succeeding table, No. 4, gives the same for the Gasteropoda and Cephalopoda, few only of which have been recognized beyond the State.

TABLE NO. 3.—Showing Lamellibranchiates of New Jersey formations recognized in other localities.

	Alabama.	Tennessee.	Mississippi.	Texas.	Dakota.	North Carolina.	Arkansas.	Europe.
SPECIES FROM THE LOWER MARL BEDS.								
<i>Ostrea crenulimarginata</i> , Gabb		×						
<i>plumosa</i> , Morton	×	×	×			×		
<i>subpatulata</i> , Lyell and Forbes	×		×	×				
<i>tecticosta</i> , Gabb		×						
<i>larva</i> , Lam	×	×	×	×				×
<i>Gryphaea vesicularis</i> , Lam	×	×	×	×				×
<i>Exogyra costata</i> , Say	×	×	×	×		×		×
<i>Anomia argentaria</i> , Morton	×	×	×			×		
<i>tellinoides</i> , Morton	×		×			×		
<i>Pecten (Amusium) simplicum</i> , Conrad	×	×	×					
<i>Neithea quinqueradiata</i> , Sow	×		×	×				
<i>Plicatula urtica</i> , Morton						×		
<i>Radula acutillineata</i> , Conrad	×	×						
<i>reticulata</i> , Lyell and Forbes	×	×						
<i>denticulicostata</i> , Lyell						×		
<i>Lithodomus Ripleyanus</i> , Gabb			×					
<i>Gervillioopsis ensiformis</i> , Conrad	×					×		
<i>Inoceramus Barabini</i> , Morton	×			×	No. 4	×		
<i>sagensis</i> , Owen					No. 4	×		
<i>Vanuxemi</i> , Tuomey	×				No. 4	×		
<i>Pinna laqueata</i> , Conrad	×		×					
<i>Nemodon Eufaulensis</i> , Gabb	×					×		
<i>brevifrons</i> , Conrad						×		
<i>Breviarca Saffordi</i> , Gabb		×			No. 5	×		
<i>Trigonarca cuneiformis</i> , Conrad						×		
<i>Idonearca Tippiana</i>	×					×		
<i>antrosa</i> , Morton	×							
<i>Nucula percrassa</i> , Conrad	×		×			×		
<i>peruqualis</i> , Conrad	×	×	×					
<i>Nuculana protexta</i> , Gabb		×						
<i>longifrons</i> , Conrad	×		×					
<i>Perissonota protexta</i> , Conrad						×		
<i>Trigona Eufaulensis</i> , Gabb	×	×	×					
<i>Crassatella cuneata</i> , Gabb	×	×						
<i>Monmouthensis</i> , Gabb	×	×						
<i>subplana</i>	×							
<i>vadosa</i> , Morton	×		×					
<i>Astarte octolirata</i> , Gabb		×						
<i>crenulata</i>	×	×						
<i>Cardium Eufaulensis</i> , Gabb	×					×		
<i>Ripleyanum</i> , Conrad	×							
<i>Criocardium multiradiatum</i> , Gabb	×							
<i>dumosum</i> , Conrad						×		
<i>Leiopistha protexta</i> , Conrad	×							
<i>Cymella Meekianum</i>					No. 4	×		

TABLE NO. 3.—Showing Lamellibranchiates of New Jersey formations recognized in other localities - Continued.

	Alabama.	Tennessee.	Mississippi.	Texas.	Dakota.	North Carolina.	Arkansas.	Europe.
SPECIES FROM THE LOWER MARL BEDS—cont'd.								
Veniella Conradi, Morton.....						X		
trapezoidea, Conrad.....	X		X					
Aphrodina Tippiana, Conrad.....	X		X					
Cyprimeria depressa, Conrad.....	X		X			X		
Tellimera sborea, Conrad.....	X		X					
Linearia metastrata, Conrad.....	X					X		
Zenona Eufaulensis, Conrad.....	X							
Pholadomya occidentalis, Morton.....			X				X	
Corbula crassiplicata, Gabb.....		X				X		
subcompressa, Gabb.....		X						
Leptosolen biplicata, Conrad.....	X							
Legumen planulata, Conrad.....	X							
appressa, Conrad.....	X	X				X		
Teredo irregularis, Gabb.....	X							
	41	21	21	6	5	20	1	3
MIDDLE BED.								
Gryphæa vesicularis, Lam.....	X	X		X				X
vomer=Exog. lateralis.....					X			X
Isocardia Conradi, Gabb.....	X							
Gastrochæna Americana, Gabb.....	X							
	3	1		1	1			2
	44	22	21	7	6	20	1	5
EOCENE MARLS.								
Gryphæa vesicularis, Lam.....	X							X
Crassatella alta, Conrad.....	X							

TABLE NO 4.—*New Jersey Cretaceous Gasteropods and Cephalopods recognized at other localities.*

	North Carolina	Alabama.	Mississippi.	Tennessee.	Texas.	Dakota.
<i>Perissolax octolirata</i> , Con.....		×	×			
<i>Pyropsis perlata</i> , Con.....			×			
<i>Richardsoni</i> , Tuomey.....		×				
<i>Rapa trochiformis</i> , Tuomey.....		×				
<i>Turbinopsis Hilgardi</i> , Con.....		×	×			
<i>Alaria rostrata</i> , Gabb.....	×					
<i>Anchura arenaria</i> , Mort.....		×				
<i>pennata</i> , Mort.....		×				
<i>Natica abyssina</i> , Mort.....		×			×	
<i>Gyrodes crenata</i> , Con.....			×			
<i>Xenophora leprosa</i> , Mort.....		×				
<i>Endoptygma umbilicata</i> , Young.....		×	×			
<i>Scalaria Sillimani</i> , Mort.....		×				
<i>Turritella encrinoidea</i> , Mort.....		×	×			
<i>Hardimanensis</i> , Gabb.....				×		
<i>pumilia</i> , Gabb.....				×		
<i>vertebroides</i> , Mort.....		×	×			
Total Gasteropods.....	1	12	7	2	1	
<i>Nautilus Dekayi</i>		×			×	×
<i>Ammonites complexus</i> , Meek.....						×
<i>dentato-carinatus</i> , Roemer.....					×	
<i>Placenticeras placenta</i> , Gabb.....		×	×	×	×	×
<i>Sphenodiscus lenticularis</i> , Owen.....	×	×	×			×
<i>Scaphites nodosus</i> , Owen.....		×	×			×
<i>Baculites oratus</i>		×	×		×	×
<i>asper</i>		×	×		×	×
Total Cephalopods.....	1	5	5	1	5	7

Of the Eocene Gasteropoda the following species occur in Alabama:

<i>Pseudoliva retusta</i> , Con.	<i>Volutilithes Sayana</i> , Con.
<i>Neptunea staminea</i> , Con.	<i>Calyptrophorus</i> , Con.
<i>Clavella raphanoides</i> , Con.	<i>Cassidaria carinata</i> , Lamk.
<i>Caracella pyruloides</i> , Con.	<i>Ficus penitus</i> , Con.
<i>Voluta Newcombiana</i> , Whitf.	

and a single species, *Conus subsauridens*, Con., occurs in South Carolina.¹

¹ These citations are taken mostly from Mr. Gabb's Synopsis of the Mollusca of the Cretaceous Formations, from Meek's, Check Lists, Cretaceous and Jurassic, in the Smithsonian Reports, and from some of Mr. T. A. Conrad's writings.

PALEONTOLOGICAL EQUIVALENTS OF THE NEW JERSEY GREEN MARLS.

Of the 222 species of Lamellibranchiates described in Vol. I, 74 are new species, and of the 190 species of Gasteropods 107 are therein described for the first time; 70 of these new forms are Cretaceous and 37 are Eocene. These new species of course are of no stratigraphic value at the present time; further than their generic relations have weight. It will be seen, however, from tables Nos. 3 and 4, that the New Jersey Lower Marls must be equivalents of the Cretaceous beds found so extensively throughout the Southern States, notwithstanding the great difference in their lithological character, as so large a proportion of the species have been recognized as common to one or more of those localities, 66 species of these classes being known from Alabama and other States, as shown in the list below.

New Jersey fossils common to Alabama and—

State.	Lamelli-branchiates.	Gastero-pods.	Cephalo-pods.
Tennessee	15	0	1
Mississippi	18	4	4
North Carolina	11	0	1
Texas	7	1	4

While of New Jersey fossils found in other States and not in Alabama there are—

State.	Lamelli-branchiates.	Gastero-pods.	Cephalo-pods.
Tennessee	6	2	1
Mississippi	2	2	1
North Carolina	7	1	0
Texas	0	0	1

In all probability many more Gasteropods may prove common to New Jersey and other States when the casts from those places shall have been critically compared. It will be seen, therefore, that no reasonable question can be entertained of the near equivalency of these beds. Nor can there be any question as to the relationship existing between the Crosswicks

Creek and Haddonfield Micaceous clays at the base of or below the Lower Green Marls and the Eufaula, Alabama, and Tippah, Mississippi, beds of Messrs. Conrad and Gabb, for many of the species are identical, and even the lithological characters of the beds and conditions of preservation of the fossils are so nearly alike as to render it almost impossible to distinguish them apart. With the western Cretaceous formations there is, however, a much less similarity, although the generic resemblance is still very striking, many of the genera being the same in both, while the species are often very close representatives of those at the West found in the Fort Pierre group, No. 4, or perhaps more properly in Nos. 4 and 5 of Meek and Hayden's Upper Missouri section. Still there can be no question as to the very close relationship of the Lower Marl beds of New Jersey and the Crosswicks and Haddonfield beds to the Fort Pierre group, No. 4, of the Upper Mississippi section.

This reference of the New Jersey Marls to Nos. 4 and 5 of the Upper Missouri section is by no means a new feature in their study, for it has been made by several paleontologists and geologists in the past, so that it has become generally understood. But heretofore it has been done collectively, or as a whole, as far as concerns the New Jersey formations; while the fossils are here for the first time separated according to the different beds in which they occur, and studied separately, and consequently this study more positively confirms these previous classifications. Yet it proves impossible clearly to separate the New Jersey formations to correspond to the different numbers and strata recognized at the West, they having rather the expression of the two beds Nos. 4 and 5 combined.

DESCRIPTIONS OF SPECIES.

MOLLUSCA.

Class GASTEROPODA.

Subclass PROSOBRANCHIATA.

Order PECTINIBRANCHIATA.

Family MURICIDÆ.

Genus TUDICLA Bolton.

TUDICLA PLANIMARGINATA, n. sp.

Plate 1, Figs. 1-3.

Shell small or somewhat below a medium size, very ventricose, with a very low spire composed of but little more than two entire volutions in the cast; outer volution large, forming the great bulk of the shell and having a diameter considerably greater than the entire height, including the short beak and canal. Volutions marked on the periphery by a flattened, vertical band, bordered above and below by an angulation; a second angulation also marking the upper surface midway between the top of the vertical flattening and the suture line, and still another on the under side of the volution near the base of the beak; columellar cavity only of medium size, with aperture large, wider or about as wide as high, but little modified on the inner side by the preceding volution; lip slightly expanded; surface unknown.

The species somewhat resembles in its general appearance *Pyropsis trivolvis* Gabb, from the Middle Marls; but it has a much lower spire, composed of fewer volutions, and the anterior beak has been quite short.

There is no *Tudicla* in the Cretaceous to which it bears any great resemblance.

Formation and locality: Lower Green Marls, at Crosswicks Creek, New Jersey. In the collection at Rutgers College.

Genus PYROPSIS Conrad.

Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 288.

Mr. Conrad describes this genus as follows: "Spire very short, apex not papillated; labrum without striæ within, thick; columella without a fold;" and places it as a subgenus under *Tudicla* Bolton. Immediately following the generic description he describes *T. (Pyropsis) perlata*, Pl. XLVI, Fig. 39, which, although not cited as the type, ought naturally, from its position in connection with the generic description, to be considered such. This shell possesses close affinities with the *Muricide*, and with the *Haustellum* group, having a long, slender canal and beak, with the inner lip of the aperture strongly reflected over the body whorl and columella, leaving an open space between itself and the columellar portion of the beak, but not a true umbilical cavity. The canal is entirely open, however, and the whorls are without varices, although there appears to be a tendency to form spines on the periphery. The absence of striæ within the aperture and want of ridge or tubercle at the base of the posterior angle of the aperture on the inner lip separate it from the genus *Tudicla*, with which in nearly all other characters it agrees. It is somewhat difficult to determine satisfactorily, among the casts with which I have to deal, which should be placed under this genus and which may belong to Mr. Gabb's genus *Perissolax*, as Mr. Gabb's type of this genus, *P. trivolva*, is so very closely related to this one.

There appears to be little difference between the two genera if the types alone are considered, but a part of those herein referred to *Pyropsis*, which would seem to be properly referable to it, depart considerably from the type in the greater height of the spire, the rounding of the volutions, and probably in the shorter canal, and appear to form a connection between this genus and *Pyrifusus* Conrad. But this latter genus has never been properly understood, owing to the improper figuring of the type species, the original of which I have examined. (See description of that genus elsewhere in this volume, p. 48.)

PYROPSIS ELEVATA.

Plate I, Figs. 11-13.

Rapa elevata Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 301,

Pl. XLVIII, Fig. 12, Meek, Geol. N. J., Newark, 1868, p. 730.

Tudicla elevata Gabb: Synopsis, pp. 74-85; Meek, Check List Cret. and Jur. Foss., p. 23; Geol. N. J., Newark, 1868, p. 730.

Pyropsis perlata Conrad: Am. Jour. Conch., vol. 4, p. 248.

Pyrula Richardsonii (Tuomey) Conrad: *ibid.*

Pyropsis elevata Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 284.

Shell rather large, broadly turbinate, with a very low spire, in which the volutions scarcely rise above each other beyond the general slope of the upper surface of the outer one; whorls about three in number, the outer one large and biangular in the upper part, the upper surface sloping from the suture to the periphery, forming only a very slight angle with the axis of the shell on all the inner parts, but more rapidly declining on the outer part of the last one; periphery of the last volution nearly vertical between the upper and lower angles, but very rapidly contracted in the lower part to form the short, obtuse, anterior canal; aperture very large, fully four-fifths of the entire height of the shell, strongly biangular on the outer side, and modified on the upper inner portion by the body of the preceding volution; axis as shown on the cast, large, destitute of columellar folds; surface of the shell seemingly marked by revolving ridges, but not very deeply, as the cast shows only very faint traces of them, scarcely sufficient to afford grounds for a positive assertion that they really existed, yet pretty positive indications of lines of growth exist on the summit of the outer volution, and also of stronger folds or varices at somewhat regular distances, probably indicating six or eight on the last whorl.

There may be some question as to the identity of this species with Conrad's *Pyropsis perlata*. This matter has been discussed by Messrs. Gabb and Conrad¹ without any very satisfactory results. There certainly is a great resemblance between the type specimen of this species and the cast which I have referred doubtfully to Mr. Conrad's species; but I am not so sure of its identity with the shell originally figured by Conrad

¹ Am. Jour. Conch., vol. 4, p. 428, and Proc. Acad. Nat. Sci., Phila., 1876, p. 284.

as *P. perlata*. Perhaps if larger individuals of that form were examined the volutions might show a much greater angulation than does his figure cited above, and also, if the shell of this one were obtained, the anterior canal might be found prolonged as it is in the southern shell; but in their present condition I should think them more probably distinct.

Formation and locality: Lower Green Marls in Burlington County, New Jersey. Collection Acad. Nat. Sci., Phila.

PYROPSIS OCTOLIRATA.

Plate II, Figs. 8-10.

Ficus octoliratus Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 3, p. 332; Pl. xxxv, Fig. 6; Gabb, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 27.6
Perissolax octolirata (Con.) Gabb: Synopsis, p. 67; Meek, Check List Cret. and Jur. Foss., p. 23; Geol. N. J., Newark, 1868, p. 730.

Shell of small size, globular or subpyriform in general outline; composed of about three very ventricose volutions; spire low-conical, apex apparently not mammillated; volutions marked by from six to nine spiral ridges or costæ, which are usually strongly marked on the casts and are crossed by vertical ridges at about an equal distance or slightly more distant than the spiral lines, and which divide the surface into a number of square depressed spaces; rostrum short and pointed, apparently straight, and, as seen from the aperture side, about half as long as the diameter of the last volution; aperture elongate, pointed at each extremity, and scarcely more than half as wide as long. In the casts the suture line is distinct and often very strongly marked.

The New Jersey specimens of this species differ from Mr. Conrad's figure of the type, which was a Tippah County, Mississippi, specimen, in being marked by vertical lines, which that specimen does not show nor does Mr. Conrad mention them as occurring, unless it may be inferred that his statement that the costæ are "inclined to be square" may have meant this, which, however, I infer to have applied to spaces between the ridges being flat instead of being concave as in those from New Jersey. This feature (the vertical costæ) is a very marked one on these specimens, and I am strongly inclined to consider it a specific distinction, as on a single

fragment of the Tippah County specimen in the Am. Mus. Nat. Hist. no such vertical markings are seen. Among the collections from Haddonfield, New Jersey, in the collections of the Acad. Nat. Sci., Phila., there is an imperfect example of a small individual which I suppose to belong to this species, with shell preserved, and in which the rostrum is seen to be about equal in length to the rest of the shell, including the aperture, and to have been apparently very slightly twisted.

Formation and locality: In the Lower Marls at Upper Freehold and Wahnford, from the sand under the Lower Marls at Backmans pits, near Middleton, and from the clays below the marls at Haddonfield, New Jersey.

PYROPSIS PERLATA?

Plate I, Figs. 8-10.

Tudicla (Pyropsis) perlata Conrad?: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 288, Pl. XLVI, Fig. 39; Gabb, Synopsis, p. 85; Meek, Check List Cret. and Jur. Foss., p. 23.

Rapa elevata Gabb, and *Pyrula Richardsonii?* Tuomey, Conrad: Am. Jour. Conch., vol. 4, p. 248.

Pyropsis Richardsonii (Tuomey) Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 284.
Tudicla (Pyrula) trochiformis Tuomey, Gabb: Synopsis, p. 85, foot note.

Shell, as shown by internal casts of moderate size, broadly turbinate, with a low, almost flat spire, and short rostral beak; volutions about three in number, strongly angular on the upper part, nearly flat on the summit and rapidly increasing in size with increased growth; sutures very strongly marked, the inner whorls having been embedded in the upper part of the outer ones; aperture comparatively large, ovate, wide and angular above and pointed below. Umbilical cavity of the cast very large, indicating a very strong and thickened columella and short rostral beak; no evidence of spiral ridges or striae is shown on the casts examined.

I am by no means certain that this form, as seen in the New Jersey beds, is identical with *T. perlata*, Conrad; the specimens do not furnish positive characters by which the question can be determined. Conrad's shell, as figured, would have left very much such a cast as this one, as far as the casts could be preserved, except, perhaps, in the extension of the rostral

beak. Among the specimens of the species examined there is no evidence preserved showing the exact length of this part; but the evidence furnished is in favor of a short beak, as the rapid thinning of the cast at this part would not favor the opposite opinion. How much reason there may be for the assertion that the New Jersey form is identical with Tuomey's *T. Richardsonii* I can not say, as I have not seen Dr. Tuomey's type specimens, which were never figured; but there are casts of three or four species before me from New Jersey, some of which accord with his description more nearly in the "angle" of the volution being "rounded" than does this one. I would, therefore, rather retain this under Mr. Conrad's name than refer it haphazard to that one. It is distinguished from all the other New Jersey species by the shorter form and greater angulation of the volution.

Formation and locality: In the Lower Marl beds at Upper Freehold, New Jersey, from collections made by the State Geological Survey.

PYROPSIS RETIFER.

Plate II, Figs. 1-4.

Fusus retifer (Gabb) Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 301, Pl. XLVIII, Fig. 11—Synopsis, p. 52.

Fusus [?] *retifer* (Gabb) Meek, Check List Cret. and Jur. Foss., p. 22.

Perissolax retifer (Gabb) Meek, Geol. N. J., Newark, 1868, p. 730.

Shell of small size, pyriform in outline or subequal above and below the point of greatest diameter; volutions about three, very ventricose and rapidly increasing in size, full and rounded above and in the middle, but rapidly contracted below, forming a short, pointed beak, even in the cast; spire low-conical, sutures very marked in the cast; aperture large, semicircular on the outer margin and forming nearly or quite two-thirds of the entire length of the shell; columellar cavity very narrow, indicating a slender, straight beak; surface marked by closely arranged, spiral ridges, placed at nearly equal distances and numbering twelve or more on the body volution; also by vertical lines, which, although faintly marked, appear to have been nearly the same distance apart as the spiral ridges or much more closely arranged, as seen on different individuals.

This species is somewhat obscure in its generic features. Mr. Gabb's figure is somewhat longer than the specimen from which it was made, the spire being rather high and the beak less prolonged. I am not at all sure that it is not properly referable to the genus *Perissolax*, but it is, perhaps, as safe to leave it here as to venture another reference without a more positive knowledge of the shell itself, nothing but casts having yet been seen. I have only two casts in hand which I have referred to the species, and they differ considerably from each other in the proportional gibbosity of the body whorl and somewhat in the proportional length of the body of the shell.

Formation and locality: In the Lower Green Marls at Wainford, New Jersey, at Mr. C. Bruere's pits, and the sand under the Lower Marls at Mr. Backman's pits, near Middletown, New Jersey. Mr. Gabb's specimen came from the same horizon at Mullica Hill, New Jersey.

PYROPSIS RICHARDSONII ?

Plate 1, Figs. 14-16.

? *Pyrula Richardsonii*, Tuomey: Proc. Acad. Nat. Sci., Phila., 1855, p. 169; Conrad, Am. Jour. Conch., vol. 4, p. 248.

Pyropsis Richardsonii (Tuomey) Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 284.

Perissolax [?] *Richardsonii* (Tuomey) Gabb: Gabb, Synopsis, p. 67; Meek, Check List Cret. and Jur. Foss., p. 23.

The casts which I have considered as most nearly allied to Dr. Tuomey's species, so far as I can judge of its characters from his description, are broadly pyriform and but slightly convex on the top, the inner volutions scarcely rising above the surface of the body whorl, in this feature agreeing with his statement, "spire depressed, almost flat." The form of the outer volution is depressed convex above, but not flat, the surface slightly sloping in some individuals from the suture to near the point of greatest diameter, and regularly rounded on the sides and below, but extended into a long, slightly curved beak and wide open canal in front when perfect, which is very rarely the case. Only a single individual has been found preserving this portion of the cast entire among all this group of shells seen from New Jersey. The volutions are about three in num-

ber and increase very rapidly in size, with wide sutures in the cast, indicating a thickened shell; aperture large, semilunate above, but contracted below to form the canal; the columellar cavity in the cast rather large, without any evidence of fold or twisting; surface of the casts usually smooth, the markings of the shell not transmitted to its inner surface, but often marked on the inner face of the whorls; the shell as shown on two different individuals, one preserving a portion of the substance, the other retaining a part of the matrix, has been covered by very strong, nodose spiral bands or ridges, with sometimes smaller secondary lines between. These have even existed on the columella and the beak, and very closely resemble the markings of *P. trochiformis*, from which it differs, however, in the flattened upper surface of that species and the strong fold on its columella.

Formation and locality: In the Lower Green Marls at Freehold and Crosswicks Creek and at the Neversink Hills, New Jersey, and in iron nodules from the plastic clays near Freeport, New Jersey. Collections at Rutgers College.

PYROPSIS? OBESA, n. sp.

Plate III, Figs. 12, 13.

Shell of moderate size, very ventricose, with very round, full, short volutions, and short obtuse spire, the body volution being produced below to form a short beak of almost insignificant proportions, as shown by the cast; apical angle about 80 degrees; volutions about three in number, very short and compact; smooth on the surface, except on the last one, where spiral lines are shown to have existed on the shell and to have left their imprint; only about five or six of these traceable, and those on the lower side; aperture moderately large, obliquely ovate, rounded above and pointed below; columella rather strong, somewhat flexuose, judging from the axial cavity left in the cast, and apparently marked by a single, rather prominent oblique ridge in its lower part.

This cast presents the general features of a *Pyropsis*, but differs in the possession of the columellar fold or ridge, and I am at a loss to place it satisfactorily under any known genus. Perhaps the matrix might show its

true relations, but unfortunately such material has not been considered of value by collectors and does not often appear to exist in a condition to be preserved.

Formation and locality: In the ferruginous layers of the Lower Marl Beds at Mullica Hill, New Jersey. In the collection Am. Mus. Nat. Hist., New York city.

PYROPSIS TROCHIFORMIS (?)

Plate I, Figs. 4-7.

Pyrrula trochiformis Tuomey: Proc. Acad. Nat. Sci., Phila., 1855, p. 169.

Tudicla trochiformis (Tuomey) Gabb: Gabb, Synopsis, p. 85; Meek, Check List Cret. and Jur. Foss., p. 22.

? *Pyropsis trochiformis* (Tuomey) Gabb: Proc. Acad. Nat. Sci., 1876, p. 285.

Shell pyriform, with a nearly flat spire; volutions three or four, very rapidly increasing in size, ventricose and subangular above, but rapidly contracted below and forming a short anterior canal; aperture semilunate, subangular above and contracted below; surface covered by very strong spiral lines, which leave their imprint on the cast, those on the body of the shell strong and coarse, but those below gradually becoming more slender toward the base, of which the larger volution probably had twelve or fourteen.

This shell, as shown by the internal casts, if properly identified, is very closely allied to *P. Richardsonii* of the same author; but the revolving ridges are more distinctly marked and the form of the volution is shorter, and more rapidly contracted below, making the beak more marked and distinct from the body of the volution than in that one.

Formation and locality: The examples which I have referred to Dr. Tuomey's species are from the collections of the Acad. Nat. Sci., Phila., where I find them under the name *Pyropsis trochiformis*, in Mr. Gabb's handwriting, I judge. There are several fragments of large casts, but only two small ones, which I have considered in the description. The locality on the label is marked "Cret., N. J.," only, like so very many of the specimens from this State, but one of these specimens is evidently from Mullica Hill; the other I can not refer to any definite locality. The lot is credited to Col. Bryan, but I think they are from several localities, and probably all from the Lower Marl Beds.

PYROPSIS REILEYI, n. sp.

Plate II, Figs. 11-20.

Shell of medium size, subglobular or globularly ovate in general form, with a moderately elevated spire and subventricose volution which are somewhat rapidly enlarged outwardly; volution about three in number, the last one forming the principal bulk of the shell, and regularly rounded from the suture line to the beginning of the very slightly extended anterior beak; the inner volution nearly on a level with each other, but the outer one dropping more rapidly below the inner, giving the greater height to the spire; volution regularly rounded, without any angulation in the upper part, especially on the last one; aperture large, semilunate, modified above on the inside by the projection of the inner volution; cavity left in the cast by the removal of the columellar axis very large and marked on the surface by a series of circular protuberances which gradually increase in size with the growth of the shell; the inner one of four, which can be seen on one cast, and which is situated at the inner limit of the last volution, is only about a twelfth of an inch in diameter, while the outer one is rather more than one-fourth of an inch across; the surface of the shell marked by several strong, coarse, revolving ridges, which have left their imprint only very slightly on the surface of the cast; the outer lip of the shell seems also to have been slightly expanded, at least near the upper part of the aperture.

This shell, as shown by the internal casts, differs from the other species herein described in its more elevated spire and rounded but less gibbous and less ventricose volution, especially the outer one. The axis has also been much stronger in proportion to the size of the specimen, and the anterior canal shorter and less distinct. The peculiar flattened nodelike protuberances on the columellar lip may be the result of accident. Indeed, it would seem almost impossible for the animal to have purposely formed and retained such protuberances, as they are not continuous or connected but are each one isolated from the others, but their gradual increase in size as the shell has developed is a peculiar feature and gives them a meaning which they otherwise would not possess. The shell, however, is specifically distinct from the others, entirely independent of this peculiarity.

Formation and locality: In the Lower Green Marls at Holmdel, New Jersey. Collected by the Rev. Dr. Reiley, and now in the collection at Rutgers College.

PYROPSIS NATICOIDES, n. sp.

Plate II, Figs. 5-7.

Small, obliquely ventricose, broadly naticoid in form, with a low spire and rapidly increasing volutions, the last one of which is more rapidly deflected downwards than the earlier ones and forms the great bulk of the cast, appearing in its outer third almost as if detached from the inner volutions of the shell, caused probably by the excessive thickening of the shell at the suture; the columella has been small and the aperture proportionally quite large, and of a semicircular form, more pointed below than above; volutions not more than two and a half in number; surface of the cast smooth, with the exception of a few faintly marked vertical folds or wrinkles which show only on the inner or smaller third of the outer volutions, and may have been caused by closely arranged varices of growth, but they resemble the folds on a regularly plicated shell.

The species is peculiar in its naticoid form and in the rapid deflection of the outer portion of the last volution. Had it not been for the form of the aperture and columellar cavity, the cast would be naturally looked upon as that of a *Natica* or *Gyrodes*. The appearance of vertical folds would scarcely answer for *Natica*, but as they occur on only a small area of the outer volution they may be deceptive in their meaning. The cast might answer equally well for that of a species of *Rhizocheilus*, and the deflections of the last whorl would also agree with some species of that genus, but I am not aware that any species of that form has been recognized as low down as the Cretaceous. It might also answer quite well for a species of *Rapa*. Dr. Stoliczka figures species of *Rapa*¹ which are quite strongly marked with vertical folds, which would show on an internal cast much more strongly than do these.

Formation and locality: The specimen bears no label of locality, but possesses all the features of casts from the ferruginous layers of the Lower

¹ Ind. Geol. Surv. Pal. Indica, Cret. Fauna South Ind., vol. 2, Pl. XIII.

Marl Beds at Mullica Hill, New Jersey, and I have no doubt of its having come from that place. Collection Acad. Nat. Sci., Phila.

PYROPSIS (RAPA ?) SEPTEMLIRATA.

Plate III, Figs. 4-8.

Cancellaria septemlirata Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 10; Gabb, Synopsis, p. 42.

Cancellaria ? septemlirata (Gabb) Meek, Check List Cret. and Jur. Foss., p. 19, Geol. N. J., Newark, 1868, pp. 729.

Pyropsis septemlirata Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 285.

Shell, as shown by the internal casts, depressed globular or broadly oblate in general outline, the volutions being very ventricose, and the spire low, the inner volutions rising but very little above the outer ones, and the base in the casts being quite short; volutions probably not more than three and a half or four in number, and very rapidly expanding, so that the last one forms nearly the entire bulk of the shell, the outer one being slightly angular in the upper part; aperture large, semilunate or semielliptical, as wide as or wider than high, modified on the inner upper half by the preceding volution, and slightly extended below by the projection of the short columella, upon which there appears to have been a strong, angular ridge; surface marked by very strong, angular, spiral ridges with concave interspaces; seven or eight of these may be counted below the angulation of the outer volution, including the angle itself, and two or three smaller ones above this point on large specimens; those below the angulation gradually decrease in distance and become more and more oblique as they approach the columella. On a single large distorted specimen which I find in the collection of the Acad. Nat. Sci. Phila., identified apparently by Mr. Gabb, there appears to have been rather strong, irregular, transverse marks of growth crossing the spiral lines, possibly only an individual character, but I think probably organic and a specific feature.

In its general form this species is somewhat similar to *P. octolirata* Con., but differs in its much greater size, lower spire, and shorter canal, as well as in the slight angulation of the body whorl, which that one never shows. I do not think it probable that this shell was congeneric with those upon

which the genus *Pyropsis* was originally founded, on account of the existence of a ridge-like feature on the columella near the base of the aperture, which indicates a projection of the shell at this point and the oblique truncation of the anterior ends of the casts, features which would appear to ally this and the following species with *Rapa papyracea* Lam., and I strongly suspect that is where they both belong.

Formation and locality: In the Lower Marls of New Jersey, at Mullica Hill and Holmdel. The specimens are invariably in a very poor state of preservation.

PYROPSIS (RAPA ?) CORRINA, n. sp.

Plate III, Figs. 1-3.

Shell of medium size, turbate, with a nearly flat spire, consisting of two and a half to three volutions, and with a short base; volutions rounded above, and separated by deep, wide sutures in the casts, increasing very rapidly with the increased growth of the shell, broadly rounded on the periphery and angulated at the base, with a projecting border around the extremely wide and open umbilical cavity of the cast; aperture large, obliquely subovate, rounded above and on the outer side, straightened or strongly modified on the inner margin and pointed below; columella strong, or else hollow and formed by a free inner lip like that of *Rapa*; marked on the lower part by a strong angulation, which has projected into the aperture like a knee a short distance above the base; surface of the cast smooth, showing no evidence of spiral or transverse lines or ridges.

I at first included this species among those referred to *Pyropsis trachyformis* Tuomey, but was compelled subsequently to change its position from the evidence afforded by the knee-like projecting ridge of the columella, which I think allies this shell, and also *P. septemlirata* Gabb, with *Rapa*, deeming them closely allied to shells like *R. papyracea* Lam.; but from want of sufficient evidence I leave them in their present place doubtfully.

Formation and locality: In the Lower Green Marls at Holmdel, New Jersey. From Prof. Reiley's collection.

GENUS PERISSOLAX Gabb.

Synopsis of the Mollusca of the Cretaceous formations, by W. M. Gabb, 1861, p. 66.

The genus *Perissolax* was founded upon a group of shells, found in the Cretaceous formations, which are characterized by a low spire, rather large, globose or pyriform body volution, and a rather long anterior beak and canal, which is straight or but very little curved, and a columella without plaits or folds. Mr. Gabb cites as types *P. (Fusus) longirostris* D'Orb., from Chili, South America, and *P. (Fusus) trivolvis* Gabb, from the New Jersey Middle Marl Beds. From Mr. Gabb's remarks and the classification of his species in his various papers where it is mentioned, he appears to have considered it as strongly related to *Fusus*, although in his original description¹ of the genus he says: "They have nearly the form of the genus *Tudicla* or *Haustellum*," the latter of which is usually classed with or considered as a synonym of *Murex*. Mr. Tryon, in his Structural and Systematic Conchology, classes *Perissolax* under the *Buccinidæ*, while Dr. Stoliczka,² although quite doubtful of its relations, would appear to indicate it as belonging to the *Muricidæ* near or among the *Fulgurineæ*. After studying the species herein described, in connection with others from other parts of the country, I am inclined to consider them as having their nearest affinities with *Haustellum* in the *Muricidæ*, and have so arranged them. The *Fusus longirostris*; D'Orb., I only know from figures, but the *Fusus trivolvis* Gabb, the American type, is figured and described in this volume, the type specimen having been used for this purpose. It will be readily seen on comparison that it has more resemblance to *Haustellum* than to the typical forms of the genus *Fusus*, and differs principally in the higher spire and want of periodic varices. Some of the species have, however, nodes or short spines at stated distances on the periphery. The full characters of the beak and canal have not been seen in any of the New Jersey specimens, all the species having been described from casts on which these parts are wanting to a greater or less extent. There can be but little doubt as to its relations, however, with that group of the *Muricidæ*, and none I think as to its validity, even should it prove to be identical with Conrad's genus *Pyropsis*, to which it is very closely related, as it has precedence in point of time.

¹ Synopsis of the Mollusca of the Cretaceous formations, 1861, p. 66.

² Ind. Geol. Surv., Pal. Indica, Cret. Fauna South Ind., vol. 2, p. 113.

PERISSOLAX DUBIA.

Plate III, Figs. 9-11.

Purpuroidea? dubia Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 11; Synopsis, p. 73; Meek, Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 730.

Shell of medium size, conical above, abruptly contracted below the largest part of the last volution, and extended in front into a short, somewhat slender beak; volutions about four, strong, convex on the surface, with well-marked sutures; apical angle in the vicinity of fifty degrees; aperture ovate, somewhat acute at each end, but prolonged below; surface marked by revolving ridges and by closely arranged vertical folds; of the former, there are eleven, eight of which may be said to be above the middle of the volution, or above the periphery, while three only are really below this point, and these more distant and somewhat stronger than the others, with distinctly concave spaces between, while the lower half of the space between the beak and the periphery seems to be destitute of ridges; vertical folds low and rounded, with concave interspaces of about an equal breadth with the folds, or the folds may be said to unite at their bases, occupying the entire space; twelve of them can be counted on the outer half of the last volution; the folds bent slightly backwards from the suture to the center of the volution, and again very faintly forward at that point, below which they rapidly become obsolete, not showing on the under side of the volution.

The specimen from which the above description is taken is entirely a cast, in very soft, friable marl, and is rapidly falling to pieces, notwithstanding every effort has been made to preserve it, the decomposition having progressed too far before it came into my hands. It appears to be a cast retaining the external features, the yielding marl having been pressed into the cavity as the shell substance was removed; it thus retains the external features and presents the true characters of the shell. It is much larger than Mr. Gabb's type specimen, which is also a cast, but partially if not wholly an internal one, so that the surface features were not fully preserved. There can be but little if any doubt, however, of their specific identity. I am not sure that the present specimen retains the entire length

of the anterior beak, as a part of the marl has crumbled at that point, but as far as the specimen showed when first obtained, the figure is correct and may be relied upon. The specimen is, moreover, somewhat distorted by oblique pressure, making the under surface of the volution broader and less abrupt than is natural. This corrected would cause it to resemble Mr. Gabb's figure more closely.

Formation and locality: In the dark-green, friable, and rather coarse layers of the Lower Green Marl, at Holmdel, New Jersey. In the collection of Prof. Reiley. Mr. Gabb's specimen was from Mullica Hill, New Jersey, from a similar position.

Genus PYRIFUSUS Conrad.

Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 3, 1858, p. 332. Type *P. subdensatus*, *ibid*, p. 332, Pl. xxxv, Fig. 12.

Mr. Conrad describes this genus, which is founded upon his species *Pyrifusus subdensatus*, as follows: "Pyriform; columella broad, thick, flattened; body volution transversely oval." Mr. Conrad's type specimen upon which both the species and the genus was founded is before me, and there are two of the characters as given in the above generic description that I should consider as not really belonging to the shell. The statement that the columella is "flattened," I should consider incorrect. It is excessively thickened for the entire length of the inner lip, almost forming a tubercle at the upper end, and along the narrow part of the canal is so much thickened as to give it a sharply angular ridge on the inner edge, but there is no flattening of the columella like that of *Littorina* or *Purpurea*. In this one specimen, the only one I have seen of the species, the thickening of the columella with age has been so great as to raise its surface very much above that of the external shell surface directly against it, in this way making the entire columella much broader than it would be in a younger shell. Another feature of the description above quoted is "body volution transversely oval." Nearly all univalve shells having rapidly increasing volutions appear oval in a summit view, or, as the description says, "transversely oval," from the greater increase in diameter of the outer part of the volu-

tion. To this, in the present specimen, is added an unequal increase in growth from an accident during life, and some slight compression from the condition of its imbedding, the compression coming in a dorso-ventral direction. I have given three figures of this specimen on Pl. iv, Figs. 1-3, for the purpose of correction.

Mr. Meek¹ has emended Mr. Conrad's generic description, as follows: "Shell with body volution a little compressed dorso-ventrally; columella flattened; spire about one-fifth the length of the aperture and canal;" citing the same species as the type. Mr. Meek undoubtedly took his ideas of the shell from Mr. Conrad's description and a very imperfect figure of the back of the shell only. Of this I feel certain, for the reason that the type, which is the property of the Am. Mus. Nat. Hist., New York City, coming to them through Prof. Holmes, of Charleston, South Carolina, was at that time packed away in New York, and not opened until some years afterward by myself. Here he has increased the confusion by regarding the slight individual imperfection and accidental compression as the principal and important generic feature. Mr. Conrad² adds still further to the confusion by citing from the *Paleontologia Indica*, vol. 2, as belonging to this genus figures and species which are quite distinct from it. This also Mr. Meek points out. Mr. Meek³ in the earlier lines of his extended description of the genus, states that the spire is "not papillate at the apex." The specimen is slightly imperfect at the apex, but it shows plainly that it was papillate at the apex when perfect, although but slightly so. Again, speaking of the aperture, he says, "being angular, but not notched or canaliculate above," which the specimen certainly is, and quite distinctly so. Still, notwithstanding these features, Mr. Meek's genus *Neptunella*, with which he was comparing it, is quite a distinct form. Mr. Conrad's genus may be characterized as follows:

Shell turbinate or pyriform; spire short; canal and beak short, slightly bent in the lower part; columella smooth, thickened, slightly callous in the upper part; aperture large, channeled above and narrowly contracted

¹ *Invert. Pal.*, vol. 9, U. S. Geol. Surv. Terr., pp. 343-344.]

² *Am. Jour. Conch.*, vol. 4, p. 248.

³ U. S. Geol. Surv. Terr., vol. 9, *Invert. Pal.*, p. 343.

below; outer lip slightly thickened periodically, broadly sinuate on the margin in the upper part, smooth within; volutions ventricose above and contracted below, longitudinally costate and spirally lined; axis not umbilicated. Type *P. subdensata* Conrad.

The genus is most nearly allied to *Pyropsis*, *Tudicla*, and *Rapa*. It differs from each of them in the thickened, callous columella; from *Rapa* in wanting the umbilicus; from *Pyropsis* in the shorter beak (want of angulations on the volutions in some species), and in having the inner lip entirely united with the columella or beak of the shell; from *Tudicla* in the shorter beak, smooth inner surface of the outer lip, and pyriform shape and posterior channel. From some of the *Tudiclas* herein described under that genus, there appears but slight difference except in the features of the aperture and columella; and in the casts it is somewhat difficult to say to which genus they belong.

PYRIFUSUS ERRATICUS, n. sp.

Plate IV, Figs. 4, 5.

Shell of medium size, a very fine specimen used, measuring $1\frac{1}{4}$ inches in length; nearly equally fusiform or biconical in general outline as viewed from the back; apical angle about 50° ; volutions, about four in number, the last one large, subangular on the periphery, concave above, rounded below the middle, and contracted in the lower part; upper volutions convex; suture distinct; aperture elongate; canal short; the volutions crossed by nine or ten vertical plications, which are strong, prominent, and rounded on the larger part of the volution, and but faintly marked on the lower convexity of the last one, becoming obsolete before reaching the beak; the entire surface of the shell also marked by beautifully rounded, spiral lines, which are alternately larger and smaller, and very closely arranged; these again crossed by fine transverse lines of growth, which make a broad and rather strong retral curve from the suture to the most prominent part of the longitudinal plications, below which point they again bend forward to the swell of the volution below; columella and axis unknown.

This species is somewhat similar to *P. Neuberryi* M. & H., from the upper Missouri region, but is more equally biconical, less ventricose in the middle in proportion to the length, and has the longitudinal ribs more distant. I know of no other species with which it may be readily confounded.

Formation and locality: The specimen figured, representing the surface structure, is from a matrix in an iron sand nodule; found in drift clay; at Cliffwood, New Jersey, and is in the collection at Columbia College. The figure is made from a gutta-percha impression in this natural mold. These nodules are supposed to come from the Lower Marls, as the fossils are all from that horizon.

PYRIFUSUS CŪNEUS, n. sp.

Plate IV, Figs. 9-11.

Shell of medium size, short-fusiform, nearly twice as long below as above the periphery of the last volution when viewed from in front, and almost regularly sloping from that point to the pointed anterior extremity, as seen in the cast; apical angle about 50° or 55° ; volutions about four; subangular on the periphery and marked by moderately distant but distinct vertical folds, which are obsolete on the lower third of the volution, but increase in strength and distance with the increased growth of the shell. Twelve of these folds can be counted on the body whorl of the best preserved cast. Umbilical cavity in the cast, as left by the removal of the columella, large and destitute of markings or folds of any kind; aperture cuneate-elliptical, sharply pointed below and angular above; surface characters of the shell unknown.

This species is of about the size of *P. erraticus*, but differs somewhat in the form of the volutions and in the less elevation of the spire. The volutions are more angular on the periphery and the angulation is comparatively higher than in that species, while the vertical folds are more closely arranged. The lower portion of the volution is also not constricted between the body of the volution and the anterior beak, so that the shell is of a wedge-shaped form below the periphery. It somewhat closely resembles *P. Neuberryi* M. & H.¹

¹ U. S. Geol. Surv. Terr., vol. 9, Invert. Pal., p. 346, Pl. xxxi, Fig. 6, a-d.

Formation and locality: In the Lower Green Marls of the Cretaceous at Freehold, New Jersey.

PYRIFUSUS MULLICAENSIS ?.

Plate IV, Figs. 16-19.

Pleurotoma mullicaensis Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 95, Pl. II, Fig. 8.

Fusus mullicaensis Gabb: Synopsis, pp. 52, 68; Meek, Check List Cret. and Jur. Foss., p. 22; *Fusus?* (Gabb) Geol. N. J., Newark, 1868, p. 730.

Shell of medium size, ovately biturbinate, of nearly equal length above and below the point of greatest diameter; spire obtusely conical, giving an apical angle of about 50° ; volutions probably about five in the shell, ventricose, with deep sutures, the last one subangular on the periphery and presenting a pyriform shape when considered without reference to those above, the lower part being somewhat attenuated; aperture large, elongate, subelliptical, more rounded externally than on the inner side; columella large and strong, as shown by the cavity left by the removal of its substance in the cast, smooth, and probably pointed below; volutions marked by numerous obliquely vertical folds, strongest on the largest part; surface features unknown.

This species is closely related to *P. erraticus* n. sp., herein described, but differs materially in its more distinctly ventricose and more pronounced volutions, and apparently in the greater number of vertical folds crossing them. Mr. Gabb's type specimen had nearly the form and size of that here described, so nearly so that not the least doubt exists of their specific identity; but the generic relations appear to be undoubtedly with *Pyrifusus*.

Formation and locality: Mr. Gabb's type was from Mullica Hill, New Jersey, while our specimen is marked as coming from Freehold, New Jersey. Both specimens would appear to have come from the Lower Green Marls.

PYRIFUSUS MACFARLANDI, n. sp.

Plate IV, Figs. 14-15.

Shell below a medium size, short-conical or subglobose, shorter below than above the point of greatest diameter, the low spire having an apical

angle of nearly 90° , with the body volution proportionately large. Volutions four and a half to five in number, ventricose, the upper ones rounded on the exposed parts, even in the cast, with distinct, deeply marked sutures; body volution somewhat shouldered on the top, but not flattened; below it is short and very rapidly diminishing, so as to produce nearly a straight line from just below the point of greatest diameter to the margin of the cavity left by the removal of the columella or axis of the shell; aperture imperfect in form, but as seen by the section of the cast must have been acutely ovate, sharply pointed below and gradually widened upward for about two-thirds of its length, and rounded at the upper end; columella, as shown by the axial cavity, large and smooth, without folds or ridges; surface marked by numerous vertical folds, about eight of which may be counted on the outer half of the body whorl; these not seen on the cast below the point of greatest diameter, indicating their absence on the lower part of the volution in the living shell; no remains of spiral lines preserved on the specimen.

This species is readily distinguished from the others herein described as casts by its ventricose and rounded volutions, more numerous vertical folds, shorter spire, and short dwarfish appearance as regards height. It is more easily mistaken for a form of *Pyropsis*, perhaps; but, as compared with any of those herein described, differs in the more rounded volutions and more numerous vertical folds. The form of the lower half of the body whorl and that of the margin of the axial cavity will readily distinguish them on comparison.

Formation and locality: Collected from the ferruginous layers of the Lower Green Marls, at Mullica Hill, New Jersey, and furnished by Mr. Joseph McFarland, of Philadelphia.

PYRIFUSUS PYRULOIDES.

Plate IV, Figs. 12, 13.

Rapa pyruloidea Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 4;

Synopsis, p. 74; Meek, Check List Cret. and Jur. Foss., p. 21.

Rapa pyruloidea ? (Gabb) Meek: Geol. N. J., Newark, 1868, p. 730.

This species was described by Mr. Gabb from a single imperfect cast which is now in the collection at the Academy of Natural Sciences at Phil-

adelphia, and from which the figures on our plate are taken, with as much care as possible. The specimen is turbinate, with a very low spire, and consists of little more than three volutions, which increase in size very rapidly with the increased growth of the shell; the last one comprising by far the greater bulk of the specimen. In section this volution is strongly ovate, being modified, however, somewhat on the inner side by the previous volution. The aperture is very large, widest at the upper third of its height and sharply pointed at the base. The columellar cavity of the cast, which the specimen is to a great extent, is proportionally large and indicates a rapidly widening umbilical cavity. The impression bears no evidence of any ridge or similar feature on its surface. The body volution is marked by rather obscure indications of vertical folds on its upper part, of which seven may be counted on the outer half of the volution. The fragment of shell which remains on the specimen is marked by rather strong, somewhat irregular lines of growth, which are gathered in groups on the upper portion of the volution to form the vertical folds before mentioned.

Mr. Gabb's description of the species is as follows: "Shell pyriform, whorls three, spire low, surface marked by longitudinal ribs or undulations, about twelve on the body whorl, crossed toward the beak by fine revolving lines." This latter feature of fine lines toward the beak I could not distinguish, the shell being in an extremely unfavorable state of preservation, a part of which may have resulted since the description was originally drawn. The figures will readily help to distinguish the species, which I judge to be somewhat rare.

Formation and locality: In the Lower Green Marls in Burlington County, New Jersey, as stated by Mr. Gabb. Collection Acad. Nat. Sci., Phila.

PYRIFUSUS TURRITUS, n. sp.

Plate v, Figs. 1-5.

Shell below a medium size for the genus, with a spire rather more than usually elevated, the volutions of which have been about five in number, very distinctly pronounced and angular in the middle, the suture lines well marked and angular; apical angle 45° to 50° ; body volution strongly angular, shorter above than below the point of greatest diameter, and forming

rather more than one-half the length of the entire shell, exclusive of the short beak; aperture oblique, angularly ovate; columella slender as shown by the cavity left by the removal of the substance of the shell; volutions marked by strong, oblique, vertical folds, which are distinct on the peripheral angle, but do not extend much above or below, on the cast; strong spiral lines on some of the casts, eight to ten of which are seen on the exposed portion of the upper volutions, the number marking the basal portion of the body volution not being determinable.

This species, although small, is distinguished from the associated species, and also from any of those from the western Cretaceous, by its proportionally more elevated spire and exsert volutions. It differs somewhat from most species of the genus in the proportions of the spire as compared with the length below the angle of the body whorl, being much longer above than below the point of greatest diameter. In this respect, as well as in its general size and appearance, it very closely resembles *Turris* (*Surcula?*) *contortus* M. & H., as figured,¹ but is distinguished from that form by having the upper surface of the volutions distinctly convex instead of concave, while such slight indications of the transverse striae as are seen on some of the casts show that no slit or sinus of the lip existed, thus removing it definitely from that group of shells.

Formation and localities: In the Lower Green Marls at Crosswicks, and from the Brown Marls of the same formation near Burlington, in the collection Acad. Nat. Sci., Phila., and from sand under the Lower Marls at Mr. Backman's pits at Middletown, New Jersey. In the collections at Rutgers College.

PYRIFUSUS MEEKI, n. sp.

Plate IV, Figs. 6, 7.

Shell moderately large for the genus, having a diameter of nearly $1\frac{1}{4}$ inches of the body whorl; subequally biconical in general outline; spire elevated, having an apical angle, as seen in the cast, of somewhat less than 60° , with the spire slightly longer than the shell below, as viewed from the back of the last volution; volutions probably about four in number

¹ U. S. Geol. Surv. Terr., vol. 9, Invert. Pal., Pl. xxxi, Fig. 7.

(the specimens being all imperfect), subangular on the periphery above the last one, which is biangular and obliquely flattened on the periphery, the lower angle less strongly marked and less prominent than the upper one, and both crossed by strong, rounded, vertical folds, which become obsolete just below the lower angulation, but form node-like prominences on them; base of the last volution strongly and rapidly contracted from the lower angulation, forming a short anterior prolongation or beak; the columella formerly quite slender, judging from the small perforation remaining in the cast, and destitute of folds or ridges; aperture large, angularly ovate, oblique and pointed below and strongly angular on the outer side; surface of the shell, except the vertical folds, unknown.

This species is a very good representative of *P. Newberryi* M. & H., from the upper Missouri Cretaceous,¹ but differs specifically in its general form, being proportionally longer above and shorter below the point of greatest diameter, and also in the biangular character of the periphery. This biangular character of the volutions exists to a greater or less degree on all the whorls, but is concealed somewhat on the upper ones by the succeeding volution extending to the lower angulation, thereby rendering it a little obscure. The snell is so very distinct in form from any other in the New Jersey beds that it is not necessary to institute comparisons with them.

Formation and locality: In the Lower Green Marls of the Cretaceous at Crosswicks Creek, New Jersey. In the collection at Rutgers College and at Columbia College, New York City.

Genus NEPTUNELLA Meek.

NEPTUNELLA MULLICAENSIS, n. sp.

Plate IV, Figs. 20, 21.

Shell rather above a medium size for the genus, short-fusiform in outline, the spire forming about one-half the length of the entire shell; volutions from four to five in number, compactly ventricose in the cast, most ventricose above the middle, and somewhat abruptly wedge-formed below; sutures distinct; columella strong; as shown by the cast, leaving a large cavity, but destitute of plaits or folds as far as can be determined; aperture narrow and

¹ U. S. Geol. Surv. Terr., vol. 9, Invert. Pal. p. 346, Pl. xxxi, Figs. 6a and 6c.

elongated, pointed above and below, not exceeding one-half the length of the entire shell; extension of the beak unknown, but apparently short; surface of the volutions marked on the cast by remains of closely arranged, not very strong, flexuose, vertical lines or folds, which have been directed strongly forward in crossing the volution from above, and become obsolete before reaching the middle of the volution on the cast, not visible in any degree on the body whorl; the body volution also preserving distinct evidences of moderately strong, revolving lines, which on the specimens used for description are a little more than a sixteenth of an inch distant on the central portions, where they are parallel to the suture line above, while those below the middle diverge more rapidly and are more oblique.

This shell is so entirely distinct from any other noticed from the New Jersey beds that there is scarcely a possibility of mistaking it. It differs also in proportions and form from any of those described by Meek and Hayden from the upper Missouri region so decidedly as not to be readily confounded with them. There are remains of a very closely allied form from Alabama, but, so far as I am aware, it is undescribed. There is less angularity of the volutions than is common among the representatives of this section of the group already described, and it apparently had a shorter beak than is common among them. Still, I see no reason for considering it as generically distinct from the group *Neptunella* as defined by Mr. Meek, so far as can be determined from the internal casts only, unless it be in the length of the spire being fully as great as that of the aperture, which I can hardly think ought to be a generic feature, although Mr. Meek gives it so in his generic diagnosis.

Formation and locality: From the ferruginous layers of the lower Marls, at Mullica Hill, New Jersey. One of the specimens is from the collection of the Acad. Nat. Sci., Phila., and the other from that at Rutgers College.

Family TRITONIDÆ.

Genus TRITON Montfort.

TRITON (EPIDROMUS) PRÆCEDENS, n. sp.

Plate v, Figs. 6, 7.

Shell small and moderately slender, spire elevated, longer than, or about equal to, the length of the body volution and anterior beak, as viewed from the back of the shell; apical angle of the spire between 30° and 35° ; volutions quite ventricose, with strongly marked sutures; principal varices occurring at about every two-thirds of a volution, but with secondary varices between, visible on the casts but not definitely enough to give a positive idea of their exact number, yet apparently three on the body volution; each of the principal varices marked by about seven well defined depressions on the back, indicating that number of spiral ridges on the shell and protuberances on the inner margin of the lip; aperture of medium size, semi-lunate, the outer lip only moderately expanded; columella slender, and anterior beak of moderate length; number of volutions not definitely ascertained, as the specimens are imperfect.

The species appears to have been a true *Epidromus*, and had a length of a little more than $1\frac{1}{4}$ inches. The varices are quite strongly and distinctly marked, leaving no doubt of its generic relations. It is the only species of the type yet discovered in the Cretaceous of New Jersey, and on that account, as well as being one of the earliest of its kind to appear in the geological record, is quite interesting. Of course, like all the New Jersey Cretaceous Gasteropoda, it is represented only by internal casts and is imperfect in many of its features, the upper volutions being invariably absent, with more or less of the anterior beak and canal; still, their features are sufficiently preserved to serve all purposes of identification.

Formation and locality: In the dark green layers of the Lower Green Marls at Mullica Hill, New Jersey. Collected for the State Survey by Dr N. L. Britton.

Genus TRACHYTRITON Meek.

TRACHYTRITON ATLANTICUM, n. sp.

Plate v, Figs. 8-11.

Shell small, the casts seldom reaching a length of more than an inch and a quarter; spire with an apical angle of about 40° to 45° ; volutions four and a half to five in number, rather convex and moderately distinct, the sutures in the cast being distinct and the spaces left by the removal of the shell quite considerable; last volution large, forming more than half the entire length, and being as long below the point of greatest diameter as the length of the spire above, giving an equally biconical or fusiform feature to the cast, with a moderately long and somewhat curved beak and canal; aperture large, pointed above and slightly extended below; narrow-elliptical in outline, with the outer margin rather more convex than the inner one; lip of the outer volution apparently slightly deflected; the surface of the volutions have been marked by revolving lines, at least in the lower part, as is shown by their remains on the surfaces between the volutions of the cast; and by proportionally strong, vertical folds, three of which in each volution have been stronger than the one or two intermediate ones, and have left their deeper impression both on the surface of the cast and on the imprint of the exterior, as seen between the whorls.

The species is rather an abundant one at the one locality, and closely resembles, in the conditions of internal casts, those of *Rostellaria curta*, herein described, and with which it is associated; but it may be distinguished readily enough by a comparison of the prolongation of the anterior beak and the size of the cavity left by its removal, it being much longer, more slender, slightly twisted, and the cavity altogether smaller than in that one. The spire is also more slender, and the body volution does not contract so rapidly below the point of greatest diameter as in that species.

Formation and locality: In the blackish green layers of the Lower Green Marls at Crosswicks Creek, near New Egypt, New Jersey. In the collection at Rutgers College.

TRACHYTRITON ? HOLMDELENSE, n. sp.

Plate v, Figs. 16, 17.

Shell of medium size; spire moderately elevated, having an apical angle of 50° or over; is composed of about five very rotund volutions, and forms fully two-thirds of the entire length of the cast when viewed from the back of the specimen; below the point of greatest diameter the cast is short and the beak only slightly extended beyond the general rotundity of the body volution; suture lines between the volutions in the cast clear, distinct, and deep; aperture rather broadly elliptical; rounded above; slightly pointed below and straightened on the inner side below the middle of its height; columella moderately strong and smooth; surface of the cast marked by vertical folds, thirteen or fourteen to the volution; these folds distinctly bend backward in the middle in crossing the whorl, and are again directed forward below, forming a broad sinuosity in crossing the whorl; no evidence of revolving lines discernible on any of the specimens.

This species may not properly belong to the genus *Trachytriton*. It is shorter below the point of greatest diameter of the body volution than any species of that genus with which I am acquainted, and the varices have not quite the character required, as they are all of similar form and size, and more sinuate than they ought to be under the genus. The beak has been short and there is no evidence of spiral lines or ridges. It has a more obtuse spire than any of the other New Jersey species of this genus, with rounder volution and deeper sutures. It has much the appearance of *Cryptorhytes flexicostata* M. & H.,¹ but the beak has been even shorter than in that one, and the shell less slender, while the columella affords no evidence whatever of any folds or plica of any kind. Its generic relations are quite uncertain, and I shall leave it under *Trachytriton* provisionally.

Formation and locality: In the Lower Marl Beds at Holmdel, New Jersey. Collection at Rutgers College.

¹ U. S. Geol. Sur. Terr., vol. 9, Invert. Pal., p. 367, Pl. XIX, Fig. 2.

TRACHYTRITON ? MULTIVARICOSUM, n. sp.

Plate v, Figs. 12, 13.

Shell of medium size and rather ventricose, with an elevated spire, which is composed of rounded and ventricose volutions, and has an apical angle of about 50° ; volutions four and a half or five in the cast, the number not definitely known, the specimens being imperfect at the apex; sutures very distinct and marked; body volution proportionally large and full, especially in the upper part, and slightly extended below; the beak rather long, slightly twisted, and provided with a rather large canal; aperture large, elongate-elliptical, acute above and extended below, the length about three times the width; columella, as shown by the cavity left by its removal, rather strong and perfectly smooth; surface of the cast showing remains of numerous closely arranged, vertical folds marking the upper portion of the volutions, but becoming indistinct on the outer half of the last one; three of these on each volution slightly stronger than the others; also, marked by spiral lines or ridges, which have left deep grooves on the inner surface of the volutions of the cast, and also mark the outer half of the body whorl, becoming quite distinct on the margin of the lip, indicating crenulations or denticulations on its inner surface.

This species differs from *T. Atlanticum*, herein described, in its more robust form, rounder volutions, and more numerous vertical folds, and the anterior beak and canal seems to have been longer and more slender, and also somewhat twisted. In its general appearance it more nearly approached *T. vinculum* Hall and Meek¹ (sp.), from the western Cretaceous, but the spire has been shorter, and the lower part of the body volution contracts more abruptly.

Formation and locality: In the blackish layers of the Lower Green Marls at Crosswicks Creek, New Jersey. Collection at Rutgers College.

¹Hall and Meek, Mem. Am. Acad. Arts and Sci., vol. 5, n. 8.

FUSIDÆ.

Genus FUSUS Lam.

FUSUS? HOLMDELENSIS, n. sp.

Plate VI, Figs. 10, 11.

Shell of moderate size, about $1\frac{1}{2}$ inches in length; spire short, less than one-third as long as the body volution and beak; volutions four or more, the upper ones rather small and the body volution proportionally large, ventricose in the middle and extended in front in a moderately long, slightly twisted canal; aperture large, more than half the entire length of the shell; the outer lip broadly and strongly sinuate in the upper part and somewhat extended forward below; columella slender, twisted; surface of the volutions marked by rather strong, prominent, vertical folds, which are most distinct on the body of the lower whorl, but become obsolete below, and on the upper whorls are extended from suture to suture, ten of these folds being visible on the large volution; strong lines of growth also cross the shell parallel to the border of the aperture; closely arranged, elevated spiral lines cover the entire shell, and are finest and most numerous on the upper part, more distant below the middle, and strongly marked on the anterior beak, where they are very oblique; the spaces between the lines apparently flat.

This species is apparently a true *Fusus*, and is the only one I have noticed in the Cretaceous green sands of the State. In the condition of an internal cast it would present somewhat the appearance of a specimen of *Volutomorpha bella*, but would have a rather shorter spire and ventricose volutions, and might be somewhat difficult to distinguish, but on the specimen figured, on which the shell substance is largely preserved, there is no evidence of columella plications, which I think would be readily distinguished had they existed. The surface markings are also different. I know of no other shell in the formation with which it would be readily confounded.

Formation and locality: In the coarse, green marls of the Lower Green Sands at Holmdel, New Jersey. In the collection of Prof. Reiley.

Genus *SERRIFUSUS* Meek.

SERRIFUSUS ? *CROSSWICKENSIS*, n. sp.

Plate v, Figs. 24, 25.

Shell small or of medium size, biturbinate in form, shorter below than above the middle, exclusive of the beak, the extension of which is unknown, casts only having been observed; spire broadly conical, the apical angle measuring about 55° ; volutions about four and a half or five on the internal cast; angularly ventricose, vertical or concave on the periphery, the latter character particularly a feature of the body volution; upper side of the volutions obliquely sloping, the slope being somewhat greater than the angle of the spire, so as to reveal the vertical portion of each volution; lower side rounded; aperture nearly as broad as high, as seen in a transverse section, the outer lip slightly biangular, corresponding to the narrow vertical band of the periphery; columella strong, indicating a rather robust beak; surface features unknown.

This species differs from *S. nodocarinatus*, herein described, in having a less elevated and broader spire; in having a vertical peripheral band, and in being destitute of the transverse nodes on the peripheral carina, so far as can be seen on the cast. There is a slight indication of a single spiral ridge a short distance below the central band, but it is hardly definite enough on the cast to be given as a positive feature, and it is also possible there may have been nodes on the carinations formed by the band, but there are no indications of such a feature remaining. Were it not for the very evident rostral beak, although probably very short, there might be reasons for considering the casts those of a species of *Pleurotomaria*, but the existence of this feature would entirely remove it from that group of shells, although many of the Palaeozoic forms referred to that genus present a short, straight columella; but here there has been, I think, without question, a true rostral beak and canal.

Formation and locality: In the blackish marls at the base of the Lower Green Sands at Crosswicks, New Jersey. Collection at Rutgers College.

SERRIFUSUS (LIROFUSUS) NODOCARINATUS, n. sp.

Plate v, Figs. 22, 23.

Shell of medium size, abruptly fusiform in general outline; spire broad conical, the height from the broadest part of the body volution being somewhat less than the diameter at its periphery; beak short, slender; volutions three or four (the specimen being imperfect), somewhat bicarinate in the middle where there is a nearly vertical, obliquely flattened area or band, above which the surface slopes rapidly to the suture and is very slightly concave; below this point the volution contracts very abruptly to the short, slender canal, leaving the body volution somewhat compressed-discoidal or wheel-like in form, which in the specimen is possibly exaggerated by vertical crushing; periphery of the volutions marked by rather strong, transverse node-like vertical folds, which are also continued in less strength above and below, and the entire surface is occupied by spiral ridges of considerable strength, but which alternate in size on the lower part of the volution; four or five of these revolving ridges occupy the upper side; about three mark the vertical space of the periphery, and seven or more may be counted on the lower side of the body volution, in the poorly preserved specimen used; aperture not seen.

This is the only shell of this type which I have seen from the Cretaceous of New Jersey. I do not think it will prove an abundant form, as I have seen but one other fragment of a cast which I could identify with it. The type of shell is more abundant in the Eocene at the south, in Alabama and Texas, where there are a number of species known. It will be readily distinguished from any other Cretaceous shell hitherto described, and from any of the Eocene forms, by the abruptly vertically compressed or wheel-like character of the body volution.

Formation and locality: In soft and very friable, coarsely grained, green marl of the Lower Bed, at Marlborough, New Jersey, in collections made by Dr. Reiley.

FASCIOLARIIDÆ.

ODONTOFUSUS, new genus.

Shell univalve, fusiform, resembling *Fusus* or *Fasciolaria* in general appearance; spire elevated, with vertically plicated whorls; anterior extremity prolonged into a straight canal of greater or less extent; columella marked near or above the middle by a single oblique fold; surface probably lirated, although no evidence of such a feature remains on the casts. Types *O. (Fasciolaria) Slacki* Gabb and *O. typicus* Whitf.

I am compelled to propose a new generic name for a group of species possessing the above characters, although reluctant to do so on internal casts. The specimens closely resemble specimens of *Fusus* or *Fasciolaria* in their elongated fusiform character and prominent volutions, which have been strongly marked by vertical folds; but they differ from either in the characters of the columellar ridge or fold. From *Fusus* they differ in its presence and in the straight beak, and from the other in having only a single ridge, which is placed much higher on the columella. Mr. Gabb noticed the ridge on the columella in his original description of *F. Slacki*, and in some later remarks¹ he suggests its relation to *Piestochilus* Meek. Mr. Meek's genus usually possesses more than one fold, but differs very materially in the characters of the spire and the more elongated anterior beak. In fact, *Piestochilus* more closely resembles *Mitra* than *Fasciolaria*. The shells referred to *Borsonia* and *Cordieria* also somewhat resemble these, but possess a distinct sinus in the lip like *Pleurotoma* and are shorter in front as well as having denticulations on the inside of the outer lip, features which these shells have not possessed. It is somewhat uncertain whether there have been spiral striæ on the shell, no evidence of such feature being present on any of the many casts examined. In general features the genus resembles somewhat *Cordiera* A. Rouault, but there is no evidence of a sinus or slit in the lip allying it to *Pleurotoma*, as in that one. *Cordiera* is from the Eocene in Europe.

¹ Proc. Acad. Nat. Sci., Phila., 1876, p. 282.

ODONTOFUSUS SLACKI.

Plate VI, Figs. 8, 9.

Fusciolaria Slackii Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 322; 1876, p. 282; Meek, Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 730.

? *Piestochilus Slackii* Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 282.

? *Voluta* sp? Conrad: Am. Jour. Conch., vol. 5, p. 45, Pl. I, Fig. 20.

Shell, as shown by internal casts, slender, fusiform, nearly of equal length above and below the point of greatest diameter of the body whorl; spire slender, apical angle about 35° to 40° ; volutions five or six (none of the specimens are perfect to the apex); angular in the middle and slightly convex above and below, the last one increasing more rapidly than those above; sutures distinct and deep; anterior end prolonged into a straight, moderately slender canal; columella strong, marked by a single oblique, well defined ridge or fold at about the middle or above the middle of its length; aperture pyriform, largest above and angular at the middle of the outer lip corresponding to the angulation of the body whorl; volutions marked by distant, angular, vertical folds or ridges, seven to nine of which may be counted on a single volution; these folds are indicated very strongly on the center of the volution in the cast, but not visible to any great extent much above or below; no positive indications of spiral lines have been seen on any of the casts.

Formation and locality: In the blackish layers of the Lower Green Marls at Crosswicks Creek, N. J. In the collection at Rutgers College.

ODONTOFUSUS TYPICUS, n. sp.

Plate VI, Figs. 1-5.

Shell when of full size about 2 inches long in the extreme, so far as yet known; spire elevated, forming about one-half of the entire length of the shell, which contains about four and one-half to five volutions in the condition of internal cast; volutions angular, rather strongly so in the principal one, forming an angulated periphery which is crossed by ten or twelve prominent, vertical ridges, which generally show as transverse

nodes on the periphery and only extend a short distance above or below, apparently never reaching to the suture line; lower portion of the body volution extended so as to form a rather slender anterior beak, about equaling in length the vertical diameter of the body volution, as seen from the dorsal side; aperture moderately large, angular at the middle of the outer lip and extended below in a narrow canal; columella marked by a single, rather strong, oblique fold, situated near the middle of the aperture proper; very faint indications of spiral striæ may be imagined on the cast, but can scarcely be said to exist.

This species differs from all the others in its angular volutions, and in the character of the vertical node-like folds.

Formation and locality: In the Lower Green Marls at Crosswicks, near New Egypt, and at Cream Ridge, New Jersey. From the collections at Rutgers College.

ODONTOFUSUS MEDIANS, n. sp.

Plate v, Figs. 18-21.

Shell as known from casts, slender, turreted, with ventricose volutions, which are most convex above the middle of the exposed part; body whorl rapidly contracted below and extended into a slender, straight canal; spire slender, longer than the shell below when viewed from the back; apical angle 35° to 40° ; volutions five in number, with strongly marked suture lines; columella slender, marked by a single, sharply defined, oblique plication near or perhaps below the middle of its length; aperture obliquely pyriform, broadest above the middle and narrowed below, equal to or longer than one half the length of the entire shell; volutions marked by a moderate number of vertical folds which extend from suture to suture on the whorls, and on the body volution can be traced nearly to the axis of the shell and are directed slightly forward in their passage from above downward. No evidence of spiral lines on the surface can be seen.

This species is intermediate between the other two species herein described, in its apical angle, in the ventricosity of the volutions, and in the number of vertical folds crossing the volutions. The last volution does not increase any more rapidly than those above, in which feature it agrees with

O. rostellaroides, but differs from *O. typicus*, and in the comparative strength of the columella it differs from either in being more slender. The species is very marked and distinct from either of them and is readily recognized. On one of the examples there appears to be a very faint indication of a second plication on the columella a short distance above the generic one, which may or may not be real. But if a natural feature, the space between them is entirely flat. Other specimens show no evidence whatever of this second plication. The vertical folds crossing the volutions are also much stronger on the one having the second ridge, and it may possibly indicate a distinct species.

Formation and locality: In the lower layers of the Lower Green Marls at Walnford, New Jersey; at Mr. Bruer's pits, and at Upper Freehold, New Jersey.

ODONTOFUSUS ROSTELLAROIDES, n. sp.

Plate VI, Figs. 6, 7.

Shell slender, spire attenuate, longer than the shell below the largest part of the body volution; apical angle about 30° ; volutions five or six, gently convex, without perceptible angle; sutures very distinct; aperture prolonged in front into a moderately long, straight canal; columellar fold sharp, situated about midway of the length of the canal; volutions marked by numerous vertical folds which cross them almost in a line parallel to the axis of the shell, and although low and rounded, extend from suture to suture on the upper ones, and are visible considerably below the point of greatest diameter of the body volution; surface shell structure unknown.

The shell, as shown by the casts, presents much the appearance of a slender form of *Anchura* in its upper whorls, but in the body volution loses this resemblance by wanting the angularity and in its increased size toward the aperture; also in its straight beak and columella, and solitary fold. It differs from *O. typicus*, herein described, in the more slender form, gently convex instead of angular volutions, and in the more numerous and less prominent vertical folds of the exterior surface.

Formation and locality: In the Lower Green Marls at Holmdel, New Jersey. In Prof. Reiley's collection.

NOTES ON THE GENUS *PIESTOCHILUS* MEEK AND *VOLUTOMORPHA* GABB.

In the report of the U. S. Geol. Surv. of the Terr., Vol. ix, Invert. Pal., p. 356, Mr. Meek describes the genus *Piestochilus* as a division of the *Fasciolaridae*. His description is as follows:

Shells of small size, with spire and canal produced; volutions flattened or moderately convex and finally spirally striated, sometimes with vertical folds; plait or plaits of columella not exposed in a direct view into the aperture, very oblique, and occupying a higher position than in either of the foregoing; [*Fasciolaria* Lamarck and *Terebrispira* Conrad] outer lip smooth within.

As the type he gives *Fusus Scarboroughi* M. & H. This shell is a medium sized, rather slender, fusiform species, almost equally long above and below the point of greatest diameter, which is at the swell of the body volution; the canal is rather short and straight, and the columella is provided with two distinct, although small, very oblique folds. In examining the shell few persons would fail to recognize at once its very close relations to *Fasciolaria* Lamarck, especially to such species as those forming the group containing Lamarck's type, *F. tulipa*; the principal differences being in the more slender form and comparatively straight canal, which is not so abruptly contracted at the base of the outer volution. They also somewhat resemble a group of *Mitras*, such as *M. scrobicularia* Broochi, and more distantly *M. granatina* Lam., a living species, though differing in the form of the aperture and in the character of the columellar folds.

During the year in which the above-named work was published (1867), Mr. W. M. Gabb described and published¹ his genus *Volutomorpha*, founding it upon *Volutilithes Conradii* Gabb, described and figured in the Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 300, Pl. XLVIII, Fig. 10. This genus as typified by that species is quite distinct generically from *Piestochilus*. The generic description originally given is:

Shell elongate, fusiform; whorls cancellated by longitudinal and revolving ribs; columella with one very oblique fold, and sometimes one or more smaller secondary folds. In shape this genus is not unlike the two preceding genera [*Volutoderma* Gabb, and *Fulgoraria* Schum], but it differs from them all in having essentially a single large oblique fold. When more than one occurs, the secondary folds are smaller than the large primary.

¹Proc. Acad. Nat. Sci., Phila., 1876, p. 290.

On page 293 of the same article the author includes under this genus his *Volutilithes bella* and *V. mucronata* with several others. In the synopsis of the *Volutidæ* which Mr. Gabb gives in this same article he places these under that family without question. The two species just mentioned, *bella* and *mucronata*, so far as I am able to determine, are precisely the same generically as the typical species of *Piestochilus* Meek, and are certainly more nearly related to the *Fasciolaridæ* than to the *Volutidæ*, even if the type of *Volutoderma*, *V. Conradi*, should be considered as related to the latter family; which, from its narrow elongated canal and nearly vertical columellar folds, I should be inclined to dispute. There is certainly no feature possessed by these two species that could be considered as incompatible with those of Meek's genus; although we do not know their surface characters. But we have no evidence of the strong vertical or revolving folds and ridges which apparently characterize *Volutomorpha Conradi*. I am, however, inclined to retain both genera under the family *Fasciolaridæ*, and shall place these two, and other allied species under *Piestochilus*, retaining the *V. Conradi* for Gabb's generic division; the principal points of difference between them being in the shorter spire and longer beak of *Volutomorpha*, with its strong surface markings and the more equally fusiform body and proportionally shorter canal of *Piestochilus*, with its probable striated surface and more subdued vertical folds. Mr. Tryon, in his *Structural and Systematic Conchology*, vol. 2, p. 129, cites *Piestochilus* as a synonym of *Clavella* Swainson, and states that Meek suspected that it belonged to that genus. I can not find anywhere that Mr. Meek suspected it as belonging to *Clavella*. He did at one time place some of the species under *Clavellites* Swainson. In the *U. S. Geol. Surv. Terr.*, vol. 9, *Invert. Pal.*, almost the last thing Mr. Meek wrote, he places the genus under the *Fasciolaridæ*, to which it undoubtedly belongs.

Genus VOLUTOMORPHA Gabb.

VOLUTOMORPHA CONRADI.

Plate VI, Fig. 21; Plate VII, Figs. 1-3 and 4, 5?

Rostellites Conradi (Gabb) Meek: Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 730.

Fulguraria Conradi Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 364.

Volutilithes Conradi Gabb: Jour. Acad. Nat. Sci., Phila., vol. 4, p. 300, Pl. XLVIII, Fig. 10; Synopsis, p. 93.

Volutomorpha Conradi Gabb: Proc. Acad. Nat. Sci., Phila., 1876, pp. 290, 293; Struct. and Syst. Conch., Tryon, vol. 2, p. 166.

Shell large, some specimens apparently attaining a length of $4\frac{1}{2}$ inches, with a diameter of the largest volution of rather more than $1\frac{1}{4}$ inches; spire short, or only moderately elevated, although the general form of the shell is somewhat slender, the body volution, as viewed on the the apertural side, forms fully four-fifths of the entire length, even in the condition of internal casts; upper volutions compact, convex on the sides, and rather squarish or suddenly rounded to the suture on the top; body volution very large and very gracefully swollen or convex in the upper part, and prolonged and attenuated below, forming a long, gracefully tapered anterior beak with the columella slightly twisted; top of the volution rather suddenly contracted to the suture; aperture large, very elongate-elliptical in outline and prolonged below, where it becomes narrowed as the outer lip approaches the axis; columella slightly twisted and marked by from one to three very oblique folds, the middle one of which is usually the strongest; surface of the casts usually smooth, with the exception of, in some cases only, a few distant vertical folds on the upper ones, and on the extreme upper part of the body volution; but where the external features are preserved, the whole shell is marked by strong, rounded, vertical folds, and but little less strongly marked, rounded, spiral ridges; the spiral ridges moderately distant on the upper part of the volution, but becoming less strongly marked and crowded, and finally almost obsolete, toward the base.

I have before me a large number of the internal casts of this species, mostly imperfect; the original of Mr. Gabb's figure and description being

the most perfect one. The external features of the shell are not preserved on any of the casts in full strength, but on the inside of the outer volutions, where the inner one has left its imprint, they are shown in full strength, and are quite strongly marked, both by spiral and by vertical ridges, which become node-like at their intersection. The species is quite variable, and it is rather difficult, among the imperfect material, to draw a line of division between it and *V. ponderosa* herein described. It, however, has much shorter and more compact upper volutions, which are more ventricose according to their height, and the beak has also been much longer and more slender. These features will, I think, serve to distinguish them.

Formation and locality: It is known only from the Lower Greensand Marls. Mr. Gabb's type was from Crosswicks, New Jersey. They are also known from Mullica Hill, Freehold, Holmdel, and the Neversink Hills, New Jersey.

VOLUTOMORPHA PONDEROSA, n. sp.

Plate VIII, Figs. 5, 6, and Plate IX, Figs. 13-15.

Shell large and moderately ventricose, attaining a length of 7 or more inches, with a transverse diameter of nearly or quite $2\frac{1}{4}$ inches; spire moderately elevated, with depressed convex whorls; volutions five or more, the last one forming nearly or quite three-fifths of the entire length, gently convex throughout the upper three-fourths of its length and slightly narrowed and extended in front; aperture long elliptical, acute above and narrowed in front; sutures between volutions only moderate; surface, as seen on casts, usually smooth, but sometimes showing both vertical and spiral ridges, while on the surfaces between the volutions of the casts very distinct vertical and spiral ridges appear. On one of the larger individuals the columellar lip appears to have been considerably thickened, and to have been but very faintly marked by a single fold, very obliquely placed; while on the upper portion of its surface the ridges of the preceding volution have left their imprint, appearing as nearly horizontal folds, though in reality being the effect of external markings. The single very oblique fold is placed very near the base of the columella, and on some specimens appears only as an angulation of the columella.

This is probably the largest Gasteropod of the Cretaceous formation within the State. It very closely resembles *V. Conradi* Gabb, but is much larger in its extreme. The volutions of the spire are proportionally much longer and by far less ventricose, and none of them are shouldered at the top as in that species. The beak is also less extended and stronger, while the vertical folds appear to have been more closely arranged.

Formation and locality: In the Lower Green Marls at Cream Ridge, Holmdel, Freehold, Neversink, and Eastern Monmouth, New Jersey. Collection of Rutgers College.

VOLUTOMORPHA GABBI, n. sp.

Plate VII, Fig. 6, and Plate VIII, Figs. 1-4.

Shell of moderate size, attaining a length of about $3\frac{1}{2}$ inches in the largest specimens observed. Form robust, with a short conical spire, in which may be counted about three volutions above the last one; body volution forming about three-fourths of the entire length, ventricose above and tapering below, with a rather graceful swell near the middle of its length, and rather abruptly narrowed above to the suture, forming an angulation at the top; surface marked by coarse, moderately distinct, vertical folds, which are strongest near the angulation at the top of the volution, and become faint or even obsolete near the lower end; also by more closely arranged spiral lines which present a somewhat nodose appearance at their junctions with the vertical folds. The columella, as shown on an internal cast, has been very thick and strong, and provided with a single strong oblique fold near the middle of its length. Aperture rather wide and more than half as long as the shell.

This species has many features in common with *V. Conradi* Gabb, but is proportionally shorter and more robust, with a shorter spire and more distant vertical folds, while the body volution is much larger above in proportion to its length and very much more angular.

Formation and locality: In the Lower Marls at Holmdel, New Jersey, where the external features are preserved in the marls, and as internal casts in a coarse, pebbly sand marl, quite ferruginous in character, at Mullica, New Jersey. The latter specimen is in the cabinet of the Acad. Nat. Sci., Phila., and the former at Rutgers College.

VOLUTOMORPHA (PIESTOCHILUS) BELLA.

Plate VI, Figs. 15-18.

Volutilithes bella Gabb: Jour. Acad. Nat. Sci., 2d ser., vol. 4, p. 300, Pl. xcviII, Fig. 7; Synopsis, p. 93.

Rostellites bella (Gabb) Meek, Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 729.

Fulguraria bella Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 364.

Volutomorpha bella Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 293.

Shell, as shown by the cast, elongate, fusiform, and slender, with moderately full volutions and distinct suture lines; spire short, the body volution as viewed from the front forming from three-fourths to four-fifths of the entire length, and the narrow, anteriorly prolonged aperture more than one-half of the length; volutions four or more in number, the last one most ventricose above the middle of its length and narrowed and prolonged below; columella showing two strong oblique folds at about the middle of the aperture; surface unknown.

This species is the most slender form of the genus, except *V. mucronata* Gabb, and may be readily distinguished from that one by the greater length of the spire and proportionally shorter aperture of that species. I have not been able to identify any other specimen of this species than the type specimen. It is certainly a species distinct from any other described, and must be a comparatively rare form.

Formation and locality: The specimen is composed of a hard black marl resembling that from the Lower Marl Beds in many places in Monmouth County, New Jersey, and is said under the original description to have come from the Delaware and Chesapeake Canal. On the label accompanying the specimen, written by Mr. Gabb, is marked "Cret. N. J."

VOLUTOMORPHA (PIESTOCHILUS) MUCRONATA.

Plate VI, Figs. 12-14.

Voluta mucronata Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 323; Meek, Check List Cret. and Jur. Foss., p. 21.

Volutilithes mucronata (Gabb) Meek: Geol., N. J., Newark, 1868, p. 730.

Volutilithes nasuta (Gabb) Meek, loc. cit., not of Gabb.

Volutomorpha mucronata Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 293.

Shell, as exhibited in the casts, slender, with an elevated and slender spire and prolonged rostral beak, giving an elongate, fusiform outline; volutions five or more, moderately convex and with strongly marked suture lines; body volution, as seen from the front, forming considerably more than half of the length of the entire shell, and the aperture two-thirds as long as the body volution; elliptical in outline, angular above and prolonged below; columella slender, marked by two very oblique folds; which are situated somewhat below the middle of its length, the lower being much the stronger of the two; surface features unknown. There is the slightest evidence on two individuals of distant longitudinal folds on the second volution, but not sufficiently distinct to give grounds for a positive assertion that such characters existed.

This species can be confounded only with *V. bella*, and not very easily with that one, when the proportions of parts are taken into consideration. In that one the aperture will form fully or more than one-half of the length of the shell, while on this one it will not exceed one-third, and together with the half of the body volution above it, as seen in front, forms only about the same proportion of the whole as the aperture does in that species. The volutions are also less compact, and the general form more slenderly fusiform, so there is but little danger of any confusion in regard to the two species. In general form these shells would seem to be more properly related to the *Mitras* than to the *Volutes*, but on all specimens on which I have found the impressions of the columellar folds the lower or anterior one has been the largest, while in the *Mitridæ* the reverse should be the case.

Formation and locality: In a very dark colored bed of marl belonging to the lower layers, at Freehold, New Jersey. Collection at Rutgers College, New Jersey.

VOLUTOMORPHA (PIESTSCHILUS) KANEL.

Plate VI, Figs. 19,20.

Voluta Kanei Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 323; Meek, Check List Cret. and Jur. Foss., p. 21.

Voluta ? Kanei (Gabb) Meek: Geol. Surv. New Jersey, 1868, p. 730.

Volutomorpha Kanei Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 293.

Shell small, short elliptical in outline, with a short pointed spire and proportionally long body volution; volutions probably about four, ventricose, largest above the middle and attenuate below; aperture large, elongate elliptical, widest above the middle and narrow below. Columella moderately strong, marked by two distinct and distant plications below the middle of the aperture; surface of the shell so far as can be seen on the inside of the cast of the outer volution in one of the type specimens, marked by a few spiral ridges and by distant vertical plications or folds, but which are not transmitted to the internal cast in any of the individuals seen.

This shell has been of the type of *V. bella* Gabb, which it very much resembles, but is proportionally shorter and has a larger body volution. The casts may be very readily mistaken for those of *Trachytriton atlanticus* herein described, but can be distinguished by the expansion of the outer volution near the aperture, and by the lip extending backward upon the next volution in that one, which this never does, and also by the existence in this of the columellar folds, where the condition of preservation is such as to reveal them. Of the three specimens marked as types in Mr. Gabb's collection, one has a rather larger body volution than the others, and does not show the columellar folds, while the columella itself is very slender, so that I am somewhat in doubt of its specific identity with the others.

Formation and locality: In the blackish layers of the Lower Green Marls in New Jersey. Mr. Gabb does not mention the locality of this species, but from the character of the casts I think probably they came from Crosswicks Creek, near New Egypt, New Jersey.

BUCCINIDÆ.

Genus ERIPACHYA Gabb.

ERIPACHYA? PALUDINIFORMIS, n. sp.

Plate III, Figs. 16, 17.

Shell, as recognized by casts only, biturbinate or ovate, almost equally conical above and below the point of greatest diameter when looking on the back of the shell, the diameter of the largest volution equaling about three-fifths of the entire length; apical angle of the spire about 60° ; volutions round ventricose, with strongly marked sutures in the cast, about four or perhaps five when perfect, the last one forming the great bulk of the shell as seen in a front view; aperture large, elliptical in form, acute above and narrow below, fully equaling one-half the length of the shell; columella moderately strong, smooth, slightly bent; surface of the volutions marked by slight vertical folds, visible on the cast in some specimens only, others appearing perfectly smooth; but where showing they seem to have been quite numerous, but confined to the upper part of the volution. It is probable there have been spiral lines, but no evidence of them remain.

I see no reason to doubt the generic identity of these casts with the shells to which Mr. Gabb applied the above generic name, although the spiral lines are not visible. The shells seem to have been quite thick, judging from small portions of the substance remaining on some of the casts, and from the space represented between the volutions of the spire, in which case the surface striations would scarcely have been preserved if they had existed. The lack of evidence of this feature in the casts would be no reason for doubting its existence on the shell. The casts are very erect in form and much resemble forms of *Natica* or *Paludina*, except that they show a short rostral beak in front with the prolonged aperture, thereby separating them entirely from those genera, or from forms of *Amauropsis*, for which they might otherwise be mistaken. The casts also somewhat resemble those referred to *Pyrifusus*; and it is possible they should be classed as such, but the anterior end appears to have differed by being produced to form a more distinct beak.

Formation and locality: All the specimens of the species yet observed are from the dark green layers of the Lower Green Marls at Crosswicks, New Jersey, and were collected by Dr. N. L. Britton for the State survey.

Genus EUTHRIA Gray.

EUTHRIA? FRAGILIS, n. sp.

Plate IX, Figs. 11, 12.

Shell small, measuring only about three-fourths of an inch in length; form short fusiform, the point of greatest diameter being nearly midway of the length; spire short, the apical angle, taken from a crushed example, being about 70° , probably not more than 60° to 65° in perfect specimens; volutions ventricose, six or seven in number, the last one forming the great bulk of the shell and with the anterior beak forming about five-sevenths of the entire length when measured on the back of the volution; upper volutions compact; sutures strongly marked; anterior beak short, moderately strong; aperture not seen; substance of the shell very thin and fragile, marked only by fine lines of growth parallel to the margin of the aperture, which indicates the existence of a broad and rather marked sinus in the lip on the upper side of the volution, formed by the extension of the lip below and on the body of the volution far in advance of the margin at and just below the suture; on the surface of the beak the striae gently inclined backward again.

This species is well marked in its characters as compared with other New Jersey cretaceous shells, so that there will be no difficulty in recognizing it. Mr. Gabb describes a somewhat similar form from the Ripley group in Hardeman County, Tennessee, under the name *Neptunea impressa*, but the spire is somewhat shorter, and he describes the shell as marked by impressed spiral lines which do not exist on this shell. He furthermore states that the columellar lip is covered by¹ "a somewhat heavy layer of enamel." This one may have possessed such a feature, but the condition of the specimens will not permit of an examination of that part, but no such appearance exists so far as can be seen. There may be some question

¹Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 390.

as to the true generic relations of the shell. Mr. Gabb describes several similar forms as species of *Neptunea*, but none of the more recent fossil forms which I have examined, nor of those now living, has the broad sinus in the outer lip seen on this one, nor has any as straight a canal or anterior beak, while most of them are more or less marked by spiral lines. For these reasons I have preferred to class the present species under Gray's genus *Euthria*, which appears to answer more nearly to its character.

Formation and locality: In the dark-colored, fine, micaceous clays below the Lower Green Marls at Haddonfield, New Jersey. Collection Acad. Nat. Sci., Phila.

Genus TRITONIDEA Swainson.

TRITONIDEA OBESA, n. sp.

Plate IX, Figs. 1-3.

Shell small, short and very ventricose, the entire length being only about one-sixth greater than the diameter of the last volution, measured across the aperture; spire low, the apical angle being as great as 80° ; body volution inflated, very rapidly contracted below, forming a short, twisted canal; columellar lip somewhat thickened; aperture ovate, widest below the middle, contracted at the base, and somewhat pointed at the upper angle; volutions three and a half or four in number, and marked by very distinct vertical folds, which are quite numerous, closely arranged, but conspicuous only on the swell of the volution, becoming obsolete just below, where they appear to have been strongly directed forward. There appear to have been strong, distant, spiral ridges on the body volutions, numbering not more than seven or eight in all on the larger part of the body volution as seen on a fragment of shell preserved on one of the specimens. The specimens do not appear to have much exceeded five-eighths of an inch in length, and the substance has been very thick.

The species is remarkable for its short, compact, and very ventricose form, and although not much more than internal casts, I see no reason to doubt their being properly referable to *Tritonidea*.

Formation and locality: In the dark green marls of the Lower Bed at Mullica Hill, New Jersey. Collection at Rutgers College.

TURBINELLIDÆ.

Genus TURBINELLA Lamarck.

TURBINELLA ? PARVA.

Plate IX, Figs. 4-6.

Turbinella parva Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 3;
Synopsis, p. 86; Meek, Check List Cret. and Jur. Foss., p. 21; Geol. Surv.
New Jersey, 1868, p. 730.

Shell, as known from the type specimen, the only individual cast seen, is quite small, measuring scarcely more than half an inch in height by about five-eighths of an inch in transverse diameter, but is evidently either young or only the inner portions of a much larger specimen; form turbinate, rapaform, being largest near the top of the volution and rapidly attenuated below; spire very low, not flat; volutions not more than three in the specimen (the inner one and a half of those destroyed), flattened or nearly so on the upper surface; aperture very large, proportionally higher than wide and oblique; columella strong, marked by three distinct plications or folds, the two upper ones a little above the lower third of the aperture, equal in strength and near together; the other one below, larger and more distant but not so sharply defined as those above; volutions marked by sinuous vertical folds of considerable strength, indicated on the top of the volution, but more strongly marked on the periphery and below, being strongly bent backward in crossing the largest part of the whorl.

The generic relations of this solitary cast are obscure or rather complicated. It has the general form of a *Pyropsis*, and the columellar folds of a *Turbinella*, while the surface undulations differ from species of either of those genera. It is very evident to the observer that it is either very young in growth, or a cast of only the inner portion of a shell, the outer part not having been filled with sediment before being dissolved and removed by the action of the water or other agent. However, the surface markings and columellar folds, together with the form of the volution, will determine its identity very readily when found, and they certainly characterize it as a valid species, if not an undescribed genus.

Formation and locality: In a blackish layer of the Lower Green Marls in Monmouth County, New Jersey, the exact locality not known. _ Collection Acad. Nat. Sci., Phila.

TURBINELLA? SUBCONICA.

Plate IX, Figs. 7, 8.

Turbinella subconica Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 6; Synopsis, p. 86; Meek, Check List Cret. and Jur. Foss., p. 21.

Turbinella? subconica (Gabb) Meek: Geol. N. J., Newark, 1868, p. 730.

Shell rather below a medium size, the cast measuring only about 1 inch in height, with a transverse diameter somewhat less; form turbinate, with a very low spire, consisting of not more than three volutions in the only specimen known; volutions ventricose, obconical, scarcely rounded on the upper margin, but rapidly narrowing below and rounded on the side; aperture large, almost semilunate, or only very slightly convex on the inner margin; columella strong, marked by two very distinct plications at the lower third of the aperture, the lower one being distinctly the stronger of the two; sutures between the whorls of the cast very large, indicating a thick, heavy shell; surface as shown on the inside of the body whorl of the cast marked by strong spiral lines or ridges, and by remarkably strong vertical folds, numbering twelve or thirteen on the last volution, and transmitting their features only very slightly to the internal cast at the point of greatest diameter, but showing on the inside as above stated for more than half its depth.

This species has very much the appearance, in its condition as an internal cast, of a species of *Rapa*, but the columellar cavity is rather small for that genus. The plications on the columella, however, about which there is no shadow of doubt, at once remove it from that group and mark it as belonging to the *Turbinellidae*. Mr. Gabb's figure given in Proc. Acad. Nat. Sci., Phila., as above cited, is very poor, and much smaller than the type and only specimen, a figure of which is given full size and enlarged on our plate.

Formation and locality: In dark ferruginous marls from the Lower Greensands in Monmouth County, New Jersey. The definite locality not known. Collection Acad. Nat. Sci., Phila.

MON XVIII—6

TURBINELLA ? VERTICALIS, n. sp.

Plate III, Figs. 14, 15.

Shell turbinate or subglobose, with a moderately elevated spire, which has an apical angle of about 90° , and consists of about three and a half volutions, which increase rather rapidly in size with the increased growth of the shell, especially the last one, which is also very ventricose in the upper part, but rapidly contracted below, and produced anteriorly in a more or less extended beak; aperture elliptical in form, pointed at the upper angle and prolonged below; columella strong, marked opposite the middle of the aperture by three slender, almost thread-like, oblique plications; surface of the volutions, as shown by the casts, marked by strong, rounded, vertical plications or folds, which become obsolete a little below the swell of the volution and are also less distinct on the outer half of the last one; about eleven of the folds may be counted on the outer whorl.

I find this species in collections marked *Pyropsis Alabamiensis* Gabb; but on comparison with the type of that species it proves to be a very distinct form, as may be readily seen by comparison with Mr. Gabb's figure,¹ where it will be seen that that shell has more slender volutions which are nearly vertical on the sides or periphery, giving to the specimen a very different form from the subglobose or subturbinate form of this one. It has more the general shape of *P. octoliratus* and *P. septemliratus* of the New Jersey beds, but differs very materially in having vertical folds instead of revolving ridges, as in both of those species, and from all in the existence of the three columellar folds, which entirely removes it from that group of shells.

Formation and locality: In the marls of the Lower Greensands at Upper Freehold, and in the brown marls of the same position near Burlington, New Jersey.

¹Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, Pl. XLVIII, Fig. 13.

Genus VASUM Bolton.

VASUM CONOIDES, n. sp.

Plate IX, Figs. 9, 10.

Shell rather small, regularly conoidal above and below the point of greatest diameter, which is at the upper edge of the body volution; spire longer than the shell below, as seen from the back of the volution; and very evenly and gradually diminishing; number of volutions unknown but apparently numerous; apical angle about 35° ; aperture elongate, narrow, becoming pointed below, the length as given by projecting the spire of the shell to an imaginary apex is rather less than one-third as long as the entire length of the shell; columella moderately strong, marked by three proportionally strong folds and indications of a smaller fourth one very near the base; surface of the cast perfectly smooth with the exception of a broad sulcus marking its surface on the last volution, at about one-third of the distance below the upper edge, indicating either a thickening of the inside of the shell or a sinuosity in the outer lip.

Of course there is no indication on the internal cast of the outside markings of the shell, but the spire, as shown by the volutions, has been very much elevated, and nearly twice as high as the last volution on the front or aperture side of the shell, in which respect the shell would have differed from the living forms of the genus *Vasum*. The cast shows that the upper folds of the columella were much stronger than those below, which, when taken in connection with the elevated spire, would lead one to believe it to be related to some forms of *Mitra*, but the abruptly terminating upper surface of the volutions indicates a form of suture incompatible with any of the *Mitras*, which do not possess a longitudinally plicated surface of a character such as would be transmitted to the cast; it also indicates a thickness of shell unlike any of those. Considering all these evidences, I have concluded that, without the exterior of the shell to aid me, I should be much safer in referring the species to the *Turbinellidae* than to the *Mitridae*. It also bears considerable resemblance to casts of high spired species of *Strombus*, but the plications on the collumella remove it from that group,

and equally so from any form of *Cone*. I know of no Cretaceous species with which it presents close affinities.

Formation and locality: In beds of the Lower Green Marls at Mr. C. Bruer's pits, near Wainford, New Jersey.

VOLUTIDÆ.

Genus VOLUTA Lamarek.

VOLUTA ? DELAWARENSIS.

Plate x, Figs. 5-7.

Voluta Delawarensis Gabb : Proc. Acad. Nat. Sci., Phila., 1861, p. 322.

Voluta ? Delawarensis (Gabb) Meek : Check List Cret. and Jur. Foss., p. 21.

Volutomorpha Delawarensis Gabb : Proc. Acad. Nat. Sci., Phila., 1876, p. 290.

Shell above a medium size, very ventricose and ponderous in character; height of shell and transverse diameter nearly equal, or higher than wide; spire low conical, the entire shell consisting of about four volutions; those of the spire convex, and the last one angulated above and truncated below; round ventricose, or short pyriform on the inner-half, but becoming more and more angulated, and sometimes quite angular above toward the aperture, with the summit slightly concave; columella twisted, so far as can be determined from the casts examined; aperture large, subangular above and broad below, with apparently a wide and deep anterior channel; surface of the volutions marked by strong, distant, node-like elevations on the upper part, which are extended below in the form of irregular vertical folds, visible to near the base of the volution.

Mr. Gabb describes the columella as having a single heavy oblique fold, which I have not seen. The shell, as shown by the casts, is almost a counterpart of the living *Voluta (Cymbiola) Braziliانا* Solander (= *V. Colacynthus* Chemn.) from the southern Atlantic coast, except that the upper volutions are more elevated and ventricose. Mr. Gabb¹ cites this as a species of *Volutomorpha*, but it can not be possible that it is congeneric with

¹Proc. Acad. Nat. Sci., Phila., 1876, p. 290.

V. Conradi, and its relations are certainly much nearer to *V. Braziliana*, which Paetel classes under *Cymbiola* Swainson.

Formation and locality: This species, so far as yet known, has not been found within the limits of New Jersey, but as it is found just across the line, in Delaware, it is probable that it will yet be noticed. Its position would be in the Lower Marls. The types are in the collection Acad. Nat. Sci., Phila., and are from the Delaware and Chesapeake Canal:

Genus ROSTELLITES Conrad 1855, and VOLUTOMORPHA Gabb, 1876.

The differences between these two genera, *Rostellites* and *Volutomorpha*, are such that among specimens badly preserved, as are nearly all the Gasteropods of the New Jersey Cretaceous, it is almost if not quite impossible to distinguish, or to draw the line of division between them, even where the characters can be partially detected. The shells have the same general form, and the same surface structure pertains to both; while as to the matter of columellar folds, the only character mentioned as distinctive by Mr. Gabb under his original generic description, I find perfectly unreliable. It would also appear that Mr. Gabb himself found this to be the case before he had finished writing the generic description, as he remarks that it (*Volutomorpha*) "differs from them all [*Volutodema* and *Fulgoraria*] in having essentially a single large oblique fold. When more than one occurs, the secondary folds are smaller than the large primary." So it appears there may be as many as three folds, if only one is larger than the rest, which is nearly always the case when there are two or more, in all *Volutes*. If the single fold is all the difference there is, and there are frequently two or more, the difference does not seem to be very marked. On the typical specimens of *V. bella* and *V. mucronata*, both of which Mr. Gabb includes in his genus, there are two nearly equal folds. The most reliable feature which I observe among the specimens in hand and in which they differ from *Rostellites* Conrad, as exemplified by *R. Texana* Conrad, is the more unequal convexity of the volutions in the upper and lower parts, and a very slightly greater spreading of the anterior canal at the base of the aperture in *Rostellites*; but this even is not constant. The surface structure differs only in degree, the vertical folds being usually more distant and more strongly

marked in *Volutomorpha*. The passage from this latter genus into *Volutoderma* Gabb is also so gradual as to be confusing. Taking into account the above facts, there appears to be only the one reliable feature of the widening of the aperture and canal in the lower part of *Rostellites*, while in the *Volutodermas* the canal, and consequently the volution, is contracted into a beak in front. This feature, however, becomes very obscure and confusing in such forms as *V. ponderosa*, herein described. (See also observations under the generic descriptions of *Piestochilus*).

Genus ROSTELLITES Conrad.

ROSTELLITES NASUTUS.

Plate XI, Figs. 1, 2.

Volutilithes nasuta Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 300, Pl. LVIII, Fig. 9; Synopsis, p. 94.

Rostellites nasuta (Gabb) Meek: Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 730; Gabb, Proc. Acad. Nat. Sci., Phila., 1876, p. 294.

Fulgoraria nasuta Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 364.

Comp. R. *Texana* Conrad, Mex. Bound. Surv., vol. 3, p. 128, Pl. XIV, Fig. 2.

Shell of moderately large size, sometimes attaining a length of nearly or quite 5 inches. Form slender, with a proportionally short, turreted spire, varying from two-thirds of the length of the body volution in the casts to not more than one-third in the shell itself; number of volutions uncertain, the type specimen having had about four; body volution slender, most ventricose near the upper part, marked by numerous spiral ridges with broader interspaces which have possibly been marked by smaller ridges between the large ones; the upper lines nearly parallel to the suture, but below they become more and more oblique, so that the lower ones become nearly parallel with the columella; aperture comparatively broad and the lip thin; columella marked by three or four very oblique folds, situated near the middle of its length; the upper three at equal distances from each other and the lower one a little more distant from the next above.

There is considerable difference between the several individuals which I find marked with this name, and they undoubtedly represent two or more

species, probably belonging to different subgenera of the *Volutidæ*. If we are to take the specimen represented by Mr. Gabb's outline figure,¹ as the type, then the strongly lyrated shells found in the Lower Marls at Holmdel and Freehold, New Jersey, would belong to this species. In this form the body volution is symmetrically curved without angulation at the upper part, or flattening on the median surface, and the aperture conforms on its margin to the form of the volution, and in the lower part gradually and symmetrically approaches the columella. This form I think is typical of the species. But there are at least two others which it is difficult to separate from this one. One of these has a differently formed spire, with flattened volutions and more distinctly marked sutures, the last volution showing a decided flattening in the median portion; the aperture is effuse and spreading below, strongly reminding one of the aperture of the living *V. angulata* Swainson. A third form which I find associated with these is shorter, thicker, and shouldered above, having the largest part of the volution at its upper margin. It also occurs only at the base of the Upper Marl Bed. I will, however, here restrict the species to that first described and consider the others under distinct names. Mr. Gabb in redescribing² *V. nasuta* says that he has seen specimens with five or six folds on the columella, although it normally has but three. I am inclined to think that here he has confounded more than one species, as I have not been able to find specimens having more than four true folds, although sometimes the spiral ridges of the exterior may have left their imprint on this part of the shell.

In comparing this form with *B. Texana* Con., it seems to me there is very little if any difference, and I am much inclined to consider them as the same species, but in the absence of any good specimen of that species I hesitate to pronounce positively between them.

Formation and locality: In the Lower Marls at Freehold, Marlborough, Holmdel, and Crosswicks, New Jersey. Mr. Gabb also cites it from Patula Creek, Alabama.

¹ Jour. Acad. Nat. Sci., Phila., vol. 4, Pl. XLVIII, Fig. 9.

² Proc. Acad. Nat. Sci., Phila., 1876, p. 294.

ROSELLITES ANGULATUS, n. sp.

Plate XI, Figs. 3, 4.

Shell moderately large and proportionally slender, with an elevated spire, as shown by the cast, the only condition in which it has been recognized; body volution forming the great bulk of the shell, and the aperture equaling more than one-half of the entire length; volution probably five or more, flattened on their surfaces with abrupt scalariform sutures; last volution flattened or obscurely concave below the suture for nearly one-half the length, and abruptly contracted below, forming an undefined angle a little above the middle of the length of the volution, and extended below into a more or less slender columella; aperture narrow and pointed above, broad and somewhat effuse below; columella marked by four strong oblique folds, the lower one of which is more distant from the next above than are the others from each other; surface features unknown.

Somewhat resembles *R. nasutus* Gabb, but is rather more robust, with a longer aperture, which is expanded at the base, strongly reminding one of the aperture of the broad common variety of *Volutella angulata* Swain, from the South American coast, which it much resembles in other respects. The volution as seen in the casts are also flatter on their outer surfaces and have a more decided shoulder than on any specimen of *R. nasutus* which I have seen.

Formation and locality: In the Lower Marl Beds of New Jersey. The figured example, which is the most perfect one observed, was associated in the collection of the Acad. Nat. Sci., Phila., with specimens of *R. nasutus*, *R. angulatus*, and others, but with no more definite locality than "N. J.," so that its locality is not certain.

? ROSELLITES TEXTURATUS, n. sp.

Plate XI, Figs. 5, 6.

? *Rostellites Texanus* (Conrad) Meek: Geol. N. J., Newark, 1868, p. 730; not *R. Texanus* Conrad.

? *Rostellites Texanus* (Con.) Gabb: Synopsis, p. 78, and *Volutilithes Texanus*, p. 94.

Shell rather large, very elongate, elliptical in outline, pointed at each extremity, spire very short, conical, with scarcely convex volutionis, three

to four in number; body volution large, forming about six-sevenths of the entire length, very gently convex throughout its entire length, except near the anterior end, where it becomes very slightly recurved; aperture very large, but narrow, acute above and below; columellar plaits unknown; surface of the shell marked by spiral ridges and by vertical lines; the former much the stronger and alternating in size where preserved sufficiently well to show; the vertical lines cut the spiral ridges so as to break them into nodes on the outer shell.

This species closely resemble *R. Texanus* Conrad, but may be distinguished by the shorter spire, which, in proportion to the length of the shell, is not much more than half as high as in that species. It differs in the same respect from all the associated species and also in the more slender form than that of most of them; also in the strength of the markings. The cast of this species has not been recognized. It would most probably resemble that of *R. angulatus* more nearly than any other of the New Jersey forms, but would differ in the length of the spire and in the more symmetrical body volution.

This species has usually been included under the *Voluta Conradi* of Gabb, by collectors, as also were those herein described under the names *V. ponderosa* and *V. Gabbana*. I had for some time concluded to unite all but the last-named one as varieties of the one species *V. Conradi*, but upon studying a number of them together the differences appear so great that it seems unreasonable in a group where the resemblances are so great among the species as in the *Volutidæ* that so great a diversity should be allowed, and I have concluded to separate under three names what I had originally classed as one species, and I think they are properly specifically distinct.

Formation and locality: In the Lower Green Marls at Holmdel, New Jersey, in Prof. Reiley's collection; and at Freehold in the Rev. Dr. Schank's collection. Cabinet at Rutgers College.

VOLUTODERMA and VOLUTOMORPHA Gabb.

In Mr. W. M. Gabb's synopsis of the *Volutidæ*¹ he describes these two genera, including them among the *Volutes*. On another page I have shown some reasons for believing *Volutomorpha* more nearly related to *Fasciolaria*

¹ Proc. Acad. Nat. Sci., Phila., 1876.

and shown its near relations to *Peistochilus* Meek. There is often some difficulty in distinguishing between the internal casts of *Volutomorpha* and those properly referable to *Volutoderma*. This latter genus appears to me to belong properly to the *Volutidae*, as referred by the author, on account of the form, number, and position of the columellar plaits, and also on account of the form of the anterior portion of the shell itself. As stated under the remarks upon *Peistochilus* and *Volutomorpha* on p. 70, the shells of this latter genus are characterized by the narrow anterior canal and beak, by the very oblique columellar folds, and by the enlarged upper part of the volutions; while those of *Volutoderma* are characterized by the more ventricose volutions, shorter spire, broader base, and short open canal; by having usually a larger number of less oblique and generally stronger columellar folds than in the other genus. The surface markings, so far as known from New Jersey specimens, are alike in the two genera. In many cases where imperfect examples of internal casts have to be examined of forms like *Volutomorpha ponderosa*, where the nearly equally tapering upper and lower parts of the specimen occur, with a broad anterior canal and very ventricose volutions, it is quite difficult to determine satisfactorily to which genus they belong, unless one can find evidence of the plications, for in this case the front of the shell has not been prolonged very much, and consequently seems to form a link between the two genera. On close inspection, however, it will be seen that the spire is more elongated even in this species than in any yet authentic form of *Volutoderma*. The following species I have placed under this latter genus.

VOLUTODERMA BIPPLICATA.

Plate x, Figs. 1, 2.

Volutilithes biplicata Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 300,

Pl. XLVIII, Fig. 6; Synopsis, p. 93.

Rostellites biplicata Meek; Check List Cret. and Jur. Foss., p. 21; Geol. N. J.,

Newark, 1868, p. 729.

Volutoderma biplicata Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 292.

Shell of medium size, robust, pyriform in outline, with a low spire and very large body volution; whorls three to four, ventricose, largest above

the middle and narrowed below; aperture very large, elongate, two-thirds the length of the shell and semielliptical, straightened on the inner side and rounded on the outer margin; columella strong, marked by two strong oblique folds near the middle of its length; surface unknown, but on the inner volution of the type and on a smaller specimen in the collection Am. Mus. Nat. Hist., N. Y. City, there are a few distant vertical plications, faintly indicated, but which do not extend below the most ventricose part of the whorl.

This species, like most of the others, is known only from the internal casts, so that the external characters of the shell are not known. Its form will readily distinguish it from any other shell in the marls of the State. It more nearly resembles *Volutomorpha Abbotti* Gabb from the middle beds than any other, but may be very readily distinguished by its greater ventricosity and by the volutions being most ventricose near the upper part rather than being evenly curved as in that one. The body volution is also more rapidly contracted in the lower part, the spire shorter, and the whorl very much more rapidly increasing in size.

Formation and locality: The type is from the brown layers of the Lower Green Sands in "Burlington County, New Jersey," and belongs to the collection Acad. Nat. Sci., Phila. A second specimen is from Mullica Hill, New Jersey, and is in the Am. Mus. Nat. Hist.

VOLUTODERMA OVATA, n. sp.

Plate x, Figs. 3, 4.

Shell below a medium size, subovate in general outline, being large above the middle of the length and attenuated toward the base; spire short; its apical angle nearly 90° on the internal casts, with strong, rounded volutions and very deep, strongly marked sutures; body volution proportionally large, forming nearly the bulk of the cast; greatest diameter a little below the shoulder and rapidly diminishing below; aperture large, nearly straight on the inner margin, strongly rounded above on the outer margin, and gently curved along the lower two-thirds of the length; columella proportionally strong, leaving a large cavity on removal, as seen in the cast; marked by two strong, very oblique plications or folds above the

middle of its length, the upper one of which is much the smaller; volutions marked by distant vertical folds only faintly seen on the cast, and only on the upper portions when visible; on the inner surface of the cast, between the volutions, the vertical plications are strongly marked, as in all the species of the genus yet observed; but I have not seen any remains of spiral lines as on most of them, still, I presume they have existed.

The species is very closely related to two other species of the genus found in the New Jersey Cretaceous, *V. Gabbi* Whitf. and *V. Abbotti* Gabb, the former from the Lower Green Marls, and the latter from the Middle beds. From *V. Gabbi* it differs in the form of the volutions, having the largest diameter proportionally higher and less rapidly contracted below, and in wanting the angularity of the shoulder near the upper surface. It may possibly be only a variety of this form, but I have held the specimen in hand for months, hoping to obtain some connecting forms, but none have been observed, and I can not feel satisfied to include it among the forms of that species as now known.

Formation and locality: In ferruginous layers of the Lower Green Marls, at Mullica Hill, New Jersey, where it is associated with *V. Gabbi* Whitf. Collection of the Am. Mus. Nat. Hist.

MITRIDÆ.

Genus TURRICULA.

TURRICULA REILEYI, n. sp.

Plate XI, Fig. 8.

Shell slender, extremely elongated, turreted; spire very much elevated and slender; whorls numerous, slightly convex on the surface and very distinctly banded on their lower margin; body volution proportionally more convex than the others, being swollen near the middle of its length; attenuate and rostrate below, and nearly or quite one-half the length of the shell as seen from the outside of the aperture; sutures very distinct, bordered by a broad band which is very distinctly separated from the other part of the volution by an impressed line nearly or quite as deep and distinctly marked as the suture line itself; surface of the shell

marked by numerous vertical folds, with slightly concave spaces between; the folds are narrow and distinct, and very slightly bent backward in the middle of their length in their passage across the volution, but not interrupted perceptibly at the line separating the band from the body of the volution, and become obsolete on the rostrated part of the last one. Besides the vertical folds, the entire shell is marked by sharp, closely arranged spiral lines, which are finer and more numerous on the upper part, becoming more distant and stronger below, especially on the lower part of the last volution, where they seem to have alternated with finer intermediate striae. This latter feature may be only apparent, however, as the condition of the specimens is not such as entirely to establish this feature as a character of the shell. The crossing of the vertical folds by the spiral striae in the upper volutions produces a very decided and beautifully cancellated structure.

It is barely possible that this shell may not properly belong to the *Mitridæ*, but in the condition of the only fairly preserved specimen it is not possible to develop the features of the columella perfectly, as this portion has been mutilated by a stroke of a tool in digging the marl, but on separating the body volution from the matrix, the columella became partially exposed, but no ridges appear to exist. The general form of the shell would also remind one of the internal casts of the genus *Volutoderma*, of which we know but little of the external features; but the absence of columellar ridges would also be an objection here, and the features are more those of *Mitræ* than of *Voluta* or *Fusus*. It is possible that owing to the peculiar condition of preservation the substance of the ridges may have been destroyed, although once existing.

Formation and locality: In the lower, coarse green marls of the Cretaceous, at Freehold, New Jersey. Among collections made by the late Rev. Dr. Reiley.

TURRICULA LEDA, n. sp.

Plate XI, Fig. 7.

Shell fusiform, with a moderately elevated and turreted spire, the apical angle of which is somewhat less than 30° ; volutions five or six in number,

flattened in the direction of the spire, or very little convex on the surface, and bordered on the lower margins in the cast by a distinct band, which forms about one-third of the height; body volution proportionally rather more convex in the middle than the others and constricted below, forming a beak of moderate length; the height of this volution as seen from the back of the outer lip forms, with the beak, rather more than one-half of the entire length of the shell; shell marked throughout by distinct vertical ridges or folds, more numerous and more closely arranged on the body whorl than on those above, except perhaps the apical ones, and have a slight backward curvature in the middle in passing from suture to suture; the shell also marked by spiral ridges which, on the body volution, are of nearly equal strength with the vertical folds, but are invisible on the other volutions in the specimens used.

This shell has the same general character as *T. Reileyi*, but is much less slender and has a proportionally shorter spire; while the surface markings are coarser than on that one and the volutions are less numerous. There is a peculiar feature pertaining to the band bordering the sutures in these two species, which may be deceptive in its appearance. In shells of this group there is often a thickened band of this kind at the upper edge of the volutions, but here it seems to be at the lower edge, and in separating the volutions of the casts, which I have done in order to ascertain the truth, they separate at the lower edge of the band. As the specimens are, however, more properly external than internal casts, preserving the external markings of the shell, the thickening of the band at the top of the volution which would contain more substance may have made its imprint in the external substance of the matrix, which would have been filled up from within, thereby leaving its mark upon the cast at the base of the preceding volution, instead of on that to which it really belonged. I see no other means of explaining this feature, for if the band really belonged to the volution on which it appears, there should be a corresponding band on the body of the last volution, which is not the case.

Formation and locality: In coarse, dark colored Green Marls of the Lower Beds at Freehold, New Jersey, in collections made by the late Rev. Dr. Reiley of that place.

TURRICULA SCALARIFORMIS, n. sp.

Plate XI, Fig. 9.

Shell greatly elongated, the spire being proportionally slender and composed of numerous volutions, which are moderately convex, and moderately increasing in height with additional growth; number unknown; the specimen consists only of a portion of the spire containing about five volutions, the apex and body volution being absent; surface marked by strong vertical folds which are separated by concave, equally wide depressions, quite straight and ridged in their direction from suture to suture, and number about sixteen to each volution; folds crossed by spiral lines, about eight of which can be counted on the exposed part of the volutions, and raised and rounded on the top.

This species differs from the others of the genus in the New Jersey Green Sands in its more rounded volutions; in the stronger vertical folds, which are not flexuous between the sutures of the volutions and in the existence of the spiral lines. In the character of the folds and spiral lines the specimen presents something of the appearance of a *Scalaria*, but the general features are those of a *Mitra*. The specimen is extremely imperfect, and only that it is desirable to include in the work all the species known in the marls, it would not have been made use of.

Formation and locality: In the dark green marls of the Lower Green Sand at Holmdel, New Jersey. From the collection of Rev. Mr. Reiley.

CANCELLARIIDÆ.

Genus CANCELLARIA Lamarek.

CANCELLARIA (MERICA) SUBALTA.

Plate XII, Figs. 24, 25.

Cancellaria subalta Conrad: Am. Jour. Conch., vol. 5, p. 100, Pl. IX, Fig. 22.

Shell small, slender or elongate-fusiform, with an elevated spire composed of moderately convex volutions, which may have been, as the author says, six in number; sutures quite distinct; body volution proportionally large, forming considerably more than half the length of the shell; aper-

ture rather large, obliquely elliptical with the outer side more rounded than the inner; acute above and apparently so below; outer lip strongly crenulate within; inner lip coated with a deposit, but not sufficiently heavy to conceal the surface markings of the shell beneath it, which show through and present somewhat the appearance of plaits; axis apparently slightly perforated; surface marked by strong and deep vertical and spiral grooves with sharp ridges between, which produce aspirate nodes by their intersection; eleven or twelve of the longitudinal ridges may be counted on the inner half of the last volution and six of the spiral ridges above the top of the aperture. The upper two or three volutions appear to have been smooth, or nearly so, as originally described.

The type and only specimen which I have seen of this species has been much mutilated, and that apparently since Mr. Conrad's figure and description of it were made. The spire has been broken and the upper three volutions thrust down and into the cavity of the lower ones, so they can be only partially seen. The aperture—at least the outer lip of it—has also been somewhat damaged so that the crenulations on the inside are scarcely seen. The feature described by Mr. Conrad as "labrum angulated above the middle" is barely perceptible on the specimen, which is half imbedded in micaceous clays. It appears to me to be a feature produced by accidental crushing rather than a natural one, especially as there is not the slightest evidence of any angulation on the opposite side of the body volution or above; the base, however, seems to have been either angulated or channeled, but the conditions of the specimen will not allow of absolute determination of this feature. If this shell really belongs to the *Cancellariida*, it would, I think, properly fall under the genus *Mercia* H. and A. Adams, and specifically is near *M. (C.) oblonga* Kiener, as figured by Chenu.¹ In some respects, however, the specimen closely resembles a *Nassa* like *N. (Tritia) trivittata* of our own coast. The figure as given is restored as well as it is possible to be done, the fragments being replaced as far as can be.

Formation and locality: In dark colored micaceous clays below the Lower Marls at Haddonfield, New Jersey. Collection Acad. Nat. Sci., Phila.

¹ Manuel de Conch. Paléont., vol. 2, p. 277, Fig. 1847.

Genus MOREA Conrad.

MOREA NATICELLA.

Plate XII, Figs. 19, 20.

Purpurea (Morea) naticella Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 301, Pl. XLVIII, Fig. 15 (14 on plate).

Morea naticella Gabb: Synopsis, p. 59; Meek, Check List Cret. and Jur. Foss., p. 19; Geol. N J., Newark, 1868, p. 729.

?*Morea naticella* Gabb: Stoliczka, Ind. Geol. Surv., Pal. Indica, Cret. Fauna South. Ind., vol. 2.

Morea cancellaria Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 290, Pl. XLVI, Fig. 30.

Shell of about a medium size, subglobular, or broadly oblate in outline, with ventricose volutions which are most inflated on the upper third, and number about three and a half; spire moderately high for the genus; aperture broadly elliptical, pointed above and obtusely so at the base; columella with a single spiral ridge near the lower part, as seen on the internal cast; surface marked, even on the cast, by strong spiral ridges and furrows, of which ten or eleven of the former may be counted, leaving a plain space at the base of the shell equal to that of two of the ridges; also by somewhat more distant, transverse, broadly rounded ridges which divide the surface into a series of regular low tubercles.

I do not know of any Cretaceous shell at all resembling this one in this country except *Morea cancellata* Conrad, from the Cretaceous deposits at Eufaula, Alabama, which I strongly suspect to be the same species, but the specimen figured is much smaller, and this one does not appear to have been so much produced in front as is that one. This may be due, however, to the difference between the actual shell and the cast of the interior only.

Mr. Conrad considered this genus to belong to the *Purpuridae*,¹ and I think very properly so, judging from his figure. It seems to differ very little from the recent group *Cistrum* Mont, except in the presence of the ridge or plication on the lower part of the columella, being somewhat more distinct than in that genus. Stoliczka places it, with doubt, with the *Ra-*

¹ Am. Jour. Conch., vol. 4, p. 249.

pamida, while Mr. Meek classed it, as does Tryon, with the *Cancellariidæ*, to which it would seem to be clearly related if it were examined only in the condition of internal casts; but this idea is at once dispelled by examining the figure given by Mr. Conrad of the perfect shell.

Formation and locality: In the Lower Marls of the Cretaceous. Mr. Gabb gives only New Jersey as the locality of this specimen, the only ones which I have seen, and from the character of the marl I should think they came from the brown layers near Burlington, New Jersey.

Genus TURBINOPSIS Conrad.

Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 289.

"Turbinate; spire conical; whorls channeled at the suture; umbilicus profound; inner and outer lip continuous above and separated from the body whorl; columella concave with a very oblique fold near the basal margin." The species described under the generic description is *T. Hilgardi* from the Cretaceous strata in Tippah County, Mississippi. Under his remarks on the genus, following the generic description, Mr. Conrad says: "There appear to be two or more species of this genus in the Cretaceous strata of New Jersey, occurring in the state of casts, one of which I think is identical with the present shell." Among the casts from New Jersey I have recognized three, if not four species, referable to this genus, although they appear to differ slightly in character from *T. Hilgardi* in the possession of more or less distinct vertical folds, and some of them possibly in the absence of spiral lines, while the oblique fold at the base of the columella is certainly known to be present in only one of the number. The casts are peculiar and rather readily recognized from their widely disconnected whorls and very large open umbilical cavity. I do not think the oblique fold at the base of the columella is a feature always present in the shell, as there is not the slightest evidence of its existence on the majority of the casts, even where the features of the columellar lip of the aperture are preserved in the most perfect manner. The columella seems always to have been concave, although in some individuals only very moderately so, and the base of the aperture is always shown to have been acutely angular. The genus, although somewhat obscure in its char-

acters, seems to be a very necessary one, and to fill a place, or at least to offer a place for the arrangement of several species of casts of the New Jersey Cretaceous, which would otherwise be left doubtful, and for which there seems to be no other place unless *Iphina* of Adams is the same. They bear some slight resemblance in form to what would be produced by internal casts of *Rhizocheilus*, but the umbilical opening is larger and the base of the aperture less prolonged than would be the case by any of those of that genus which I have seen. The general form of the cast would readily indicate a position for them near *Cancellaria*, but the absence of the columellar folds renders it doubtful until that of the *T. Hilgardi* and *T. Conradi* herein described is seen, which at once removes all doubt. Mr. Gabb seems to have been very doubtful of the generic relations of these shells, and referred the type species at one time to *Cancellaria*, and subsequently considered it as related to *Ninella* of Gray, from which it must be very distinct. He, subsequent to these references (in his Synopsis and in the Proc. Acad. Nat. Sci., Phila., in 1861, p. 321), reconsidered the subject and concluded the genus was a good one (Proc. Acad. Nat. Sci., Phila., 1876, p. 300), and states that he thinks it "not remote from *Trichotropis*." Dr. Stoliczka in Ind. Geol. Surv. Pal. Indica, Cret. Fauna, South Ind., vol. II, pp. 161, 162, remarks that the genus ought to be separated from *Cancellaria* if it has but one columellar fold, but the casts often show no evidence of any fold, as above stated. He also observes that the presence of spiral striae and the absence of transverse (vertical) ribs indicate a different style of surface structure from that usually shown in the *Cancellariidae*, and thinks it probable these shells may belong to the "*Trochidae* or *Littorinidae* (*Modulus*)." They much resemble *Modulus* in character except for their greater elevation, but the New Jersey casts mostly show remains of vertical or transverse folds, showing their closer relations to *Cancellaria* than he had supposed. The specimens which I have considered as identical with *T. Hilgardi*, Conrad's type of the genus, show unmistakable evidence of vertical folds. In view of all these resemblances I consider them most nearly related to *Cancellaria*. There is only one other alternative to this conclusion, and that is in the genus *Iphina* Adams, which Chenu and Tryon arrange under the *Trichotropidae*. The casts of this shell would present almost

exactly the same features as do these New Jersey specimens, and it is possible that they belong here.

TURBINOPSIS HILGARDI?

Plate XII, Figs. 7-9.

Turbinopsis Hilgardi Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 289, Pl. XLVI, Fig. 29; Gabb, Synopsis, p. 86; Meek, Check List Cret. and Jur. Foss., p. 19; Proc. Acad. Nat. Sci., Phila., 1876, p. 300.

Turbinopsis depressus Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 300.

Cancellaria Hilgardi (Conrad) Gabb: Synopsis, p. 42, and Proc. Acad. Nat. Sci., Phila., 1876, p. 300.

The casts which I have identified with this species are extremely imperfect; two of them retain the external markings and the external form; another is a cast of the interior, retaining the external markings somewhat on a part of the outer volution, and the imprint of them on the inside of the cast of the volutions; form turbinate; the spire somewhat elevated, with convex volutions, separated by very distinct sutures; the volutions largest a little below the upper side and rapidly contracted below, giving them an obconical or turbinate form; umbilical opening in the internal cast moderately large, the margin sharply angular; aperture elliptical, acute below and more rounded above; volutions four or five; columella concave, ridge or fold not shown; surface marked by spiral ridges sixteen or more in number; interspaces as wide as or wider than the ridges; these are crossed by vertical folds which are more distant than the ridges, and are rounded; strongest on the upper part of the volution and obsolete below.

The specimens referred to this species are badly crushed, so the identification may be considered somewhat doubtful. The spire seems to have been proportionally higher than that of Conrad's figures, and the volutions less compressed below; the umbilicus is smaller, and, besides, there is the absence of vertical folds on the original which are distinct on these. The folds, however, are small and rather closely arranged. I hesitate much in identifying them with the figure given of the type on account of these wide differences, but were the specimens less imperfect they might show more intimate resemblances. There may be some doubt as to the identity of Gabb's *T. depressa* with this species, as the measurements given by him

under his original description do not agree with those of this species, his shell being proportionally wider; but I can find no other one agreeing more nearly with it, so leave it as a synonym, since he so considered it himself, and I have not been able to find his type; he had probably compared with Mr. Conrad's original at the time he so placed it.

Formation and locality: In the Lower Green Marls at Mullica Hill, at Holmdel, and Monmouth County, New Jersey. Mr. Conrad's specimen was from Tippah County, Mississippi.

TURBINOPSIS ANGULATA, n. sp.

Plate XII, Figs. 17, 18.

Shell rather above the usual size, short conical, and rather obese in general form, oblique as seen from the back; composed of two and a half or three volutions, which increase somewhat rapidly in size with increased growth; apical angle about 70° ; volutions ventricose, obliquely flattened on the upper side and obtusely round-pointed below, with a quite distinct angulation at the upper third, or just above the upper third of the length, as seen on the last one, and a less distinct one below the middle, dividing the body volution into three sections, of which the middle one is rather broader than the others and imperceptibly flattened; above the body volution the whorls are marked by about eight vertical folds, or angulations representing folds, which do not extend to the suture line on the east, the only condition in which it has been observed; aperture elongate ovate, largest below; columellar cavity in the east of medium size, marked at the base by a distinct groove, indicating the presence of a tooth-like ridge on the shell, showing the generic position of the species; the surface has also been marked by spiral lines or ridges, fifteen or more in number, on the last whorl near the lip, very perceptible on the surface between the whorls in the east.

This species differs from any of the associated forms, by the angulations of the volutions, and in the proportional size and form of the volutions themselves. There is only a single authentically identified east, and that one imperfect in the upper part of the spire, but its features are so very distinctive that it may readily be distinguished from any other species in the green marls.

Formation and locality: In the blackish green inarls of the Lower Marl Beds at Crosswicks, New Jersey. In the collection at Rutgers College.

TURBINOPSIS CURTA, n. sp.

Plate XII, Figs. 3-6.

?*Lunatia obtusivolva* (Gabb) Conrad: Am. Jour. Conch., vol. 5, p. 45, Pl. I, Fig. 11.

Shell small, turbinate, with a short spire, showing in the cast only about three volutions in all, the last of which forms the great bulk of the shell; volutions largest at the top and contracted below to the sharp base bordering the umbilical cavity; this latter feature proportionally wide, indicating a large umbilicus in the shell; aperture elliptical, sharply angular below and sharply rounded above; oblique and more rounded on the outer than on the inner side; columellar lip not showing evidence of a tooth on the cast, and probably destitute of such appendage; casts showing no indication of vertical folds or revolving lines.

This species differs from all the others in the low spire, and the short, broad form of the shell, by which features it may be readily distinguished from them. Conrad's figure above referred to seems almost as if it might have been made from one of the specimens figured on our plate, the spire being only a little lower, though there is doubt concerning it.

Formation and locality: In the Lower Green Marls at Crosswicks, New Jersey. Collection Acad. Nat. Sci., Phila., and from the same position near Trenton Falls, New Jersey. Collection at Columbia College.

TURBINOPSIS ELEVATA, n. sp.

Plate XII, Figs. 10-14.

Shell of moderately small size as indicated by internal casts only; spire elevated, consisting of but few whorls, which in the casts are widely disconnected, indicating a thick shell or whorls disconnected in the shell itself, which is most probable; volutions convex, rounded above and on the periphery, but compressed and wedge-form below; aperture elongate-ovate, rounded above, but wedge-shaped below; umbilical opening, in the cast, quite large, smooth, not showing any indication of the spiral tooth-like

ridge; surface of the cast showing rather distant vertical folds, but very little indication of spiral striae, the shell being probably too thick for them to be transmitted to the cast.

This species differs from *T. Hilgardi*, as identified from New Jersey, in the more elevated spire, larger umbilical opening, more rounded volutions, and more distant vertical folds; from *T. plicata*, herein described, in its more ventricose form, less oblique volutions, larger umbilical opening, absence of tooth, and more distant vertical folds.

Formation and locality: In the Lower Green Marls at Crosswicks, New Jersey. From the collection Acad. Nat. Sci., Phila.

TURBINOPSIS MAJOR, n. sp.

Plate XII, Figs. 15, 16, 21-23.

Shell very large as compared with other species of the genus, the fragment of a cast figured measuring over $1\frac{3}{4}$ inches across the body volution, while the entire height has not been less than $2\frac{1}{2}$ inches; volutions large, heavy and massive, strongly rounded on the surface, and probably about five in number; spire short, the apical angle having been about 60° , making the height of the spire above the top of the body volution, when measured on the back of the shell, about equal to the length of the body volution from that point downward; aperture obliquely elliptical-ovate, as in other species of the genus; columellar cavity in the cast very large, measuring nearly half an inch in its greatest width, the lower edge being raised above the general surface, indicating a notch or groove at the base of the aperture in the shell, with a rounded callosity above it, forming or representing the tooth or fold on the columella; surface of the shell, as shown on the surface between the volutions, marked by distant spiral ridges, at least on the lower sides of the volution, and also by much more distant vertical ridges or folds.

The species as represented by the fragments in hand is so distinct in size and proportions from any of the others recognized that it can not be confounded with them, while its general features are so marked that it will be readily distinguished from any other shell found in New Jersey or elsewhere.

Formation and locality: In the Lower Green Marls at the Neversink Hills, New Jersey, collected by Charles Sears, Esq. Collection at Rutgers College, New Jersey. There are also small casts closely resembling it from J. S. Cook's beds at Tinton Falls, New Jersey, which would pertain to the Middle Marl Beds, but the identification is by no means certain.

TURBINOPSIS PLICATA, n. sp.

Plate XII, Figs. 1, 2.

Shell small, and known only from internal casts; spire elevated and erect, composed of but few volutions, probably not more than three in the shell; widely separated in the casts by the sutures and very rapidly increasing in size; umbilical opening very large and very distinctly marked, near the base of the columella, by a deep, narrow groove, indicating the presence of a rather strong, tooth-like ridge at the base of the columella; columella concave, giving an elliptical form to the filling of the aperture which nearly equals one-half the height of the entire cast, and is very oblique as seen in front, but from the back appears rather patulose and spreading; surface of the cast marked by numerous vertical folds or plications, which are quite distinct on the cast and closely arranged; the outer half of the last volution, however, does not retain them so distinctly.

This species may be distinguished from others of the genus by its erect form, more slender spire and closely arranged but distinct vertical folds, which, although more numerous than those of some of them, are still much more distant than those on *T. Hilgardi*. The spiral striae of the surface are not retained on the cast except very slightly on the inner surface of the upper volutions.

Formation and locality: In the Lower Green Marls at Crosswicks, New Jersey. In the collection Acad. Nat. Sci., Phila.

PLEUROTOMIDÆ.

Genus SURCULA H. & A. Adams.

SURCULA STRIGOSA.

Plate XIII, Fig. 1.

Surcula strigosa Gabb : Proc. Acad. Nat. Sci., Phila., 1876, p. 279.

Shell elongated, turreted, with an elevated spire; the number of volutions unknown, there being now in existence only a fragment of a specimen, consisting of part of the body volution and the next above; body volution proportionally large as compared with the other, concave on the upper surface and gently convex on the middle portion, the anterior beak and canal being absent; the next volution above the principal one subangular at the upper third of its height and marked by ten or twelve strong, rounded, vertical folds, and also by moderately strong spiral lines; while the body volution has also been marked by the vertical folds, but less strongly than the other, but is closely covered by nearly equal, vertical and spiral lines cancelling the entire surface; one of the latter, at the lower edge of the concave upper surface, and another a short distance below, have been stronger, and those on the lower half of the volution are somewhat alternating in size.

In Mr. Gabb's description of this shell, which I suppose was drawn from the same individual here used, he states that there are "perhaps eight" volutions, and also says it is 3 inches in length. The specimen has probably been mutilated, or has possibly fallen in pieces since the description was made. The specimen bears no label except that of locality, which is Holmdel, as given by Mr. Gabb. He also states that the specimen was loaned to him by Prof. G. H. Cook for description, and as this is the only one found from that locality it is most probably the type. The only species having any resemblance to it are those herein described as *Terricula elegans* and *T. Leda*, neither of which can easily be mistaken for it and neither of which would appear to belong to the same genus, and are readily distinguished by the absence of the concave upper surface on the body volution.

Formation and locality: In friable green marls of the Lower Marl Beds at Holmdel, New Jersey. Collection at Rutgers College.

Genus CITHARA Schum.

CITHARA MULLICAENSIS, n. sp.

Plate XIII, Figs. 2-6.

Shell moderately large and robust for its length, with a short, obtusely pointed spire and very large body whorl, which constitutes nearly the entire bulk of the shell; the spire, measuring from the swell of the body volution when looking upon the front of the shell, forming about two-fifths of the entire height; volutions four and a half to five in number, short, indistinctly marked and the sutures obscure; the body whorl somewhat produced below, forming a short canal; aperture large, elliptical, pointed above and notched below; and about equaling one-half the length of the shell; surface of the shell marked with strong, longitudinal ribs, which are quite distant and number only about ten on the body whorl; the ribs are strong, sharply elevated, with concave interspaces, and with fine longitudinal lines of growth marking the surfaces; and the whole crossed by elevated thread-like raised lines, distant and distinct, but most plainly marked on the ridges; on the internal casts, the most usual condition, the spire is more elevated and the form less robust, with more distinct sutures and the volutions more ventricose, while their surfaces are less strongly marked by the longitudinal ribs, and no spiral lines are visible; no evidence of markings can be detected on the columella, either on the shell or on the cast. The outer lip of the aperture appears to have been slightly thickened, but no evidence of internal striae exists. The features of the notch in the outer tip can not be ascertained.

I see no reason to question the generic relations of this shell, although some of the features are too obscure for positive description; those that are retained seem too well marked for doubt. The same remarks made under *G. Crosswickensis* in regard to generic references apply equally well to this species.

Formation and locality: In the dark ferruginous layers at the base of the Lower Green Marls at Mullica Hill, New Jersey. State collection made

by Dr. Britton, and one cast from the collection of Mr. Joseph McFarland, of Philadelphia.

CITHARA CROSSWICKENSIS, n. sp.

Plate XIII, Figs. 7, 8.

Shell of moderate size or larger, subfusiform or turriculate, the spire as long as or longer than the length of the body volution and beak, only moderately slender, the apical angle being about 30° to 35° , and the number of volutions probably about five; all the specimens being imperfect and mostly casts, the exact number can not be determined; body volution large in proportion to the others, quite ventricose in the upper part and contracted below to form the short beak; upper volutions only moderately ventricose; suture, in the casts, strongly marked and the volutions rather abrupt on the upper margin; aperture large, angular above, and more sharply so below; columella strong, leaving a moderately large cavity by its removal, which, in the most perfectly formed cast, shows evidence of a single, rather strong, oblique plication on the lower part; volutions marked by distant, strong, and angular vertical folds, extending from the suture to near the base of the beak on the body volution, and from suture to suture on the others, even on the casts; surface of the shell marked by very fine transverse striae parallel to the folds, which are only slightly directed forward in their lower part; and by extremely faint indications of faint thread-like, raised, spiral lines, divided by broad flattened interspaces.

The specimens upon which this species is founded are partially casts, with the shell preserved on a portion of the body volution of one of them. Its substance is very thick and the vertical folds sharply angular. The species bears a very close resemblance to *C. Mullicaensis* herein described, but the shell is larger and has a more elevated spire, while the body whorl is larger in proportion, the spire more slender, and the sutures much more distinct. The surface characters are much the same in both. There may be some question as to the proper generic reference of the species *C. Mullicaensis*, but the specimens are in such a condition of preservation that it is impossible to tell just what they are. Stoliczka, in the Pal. Indica, refers very similar forms to *Volutilithes* Swains., and others, just as similar, to *Lyrta* Gray, but it does not seem to me that they are as nearly related to

either of these genera, if the typical forms are considered, as they are to *Cithara*; therefore I have preferred to place them under this latter genus.

Formation and locality: In dark green marl near the base of the Lower Marls, at Crosswicks Creek, near New Egypt, New Jersey. Collected by Dr. N. L. Britton. The casts are very hard, black, shining, and brittle.

STROMBIDÆ.

Genus ROSTELLARIA Lamarek.

Among the casts of gasteropoda from the Lower Marl Beds in New Jersey, are several species which appear to belong to this genus, differing from those referred to *Anchura* in not presenting any evidence of a dorsal keel on the outer half of the last volution or of spiral striae, and some of them even not presenting evidence of vertical folds crossing the upper whorls. Some of these are perfect enough to be characterized, while many of them are not. Some occur in numbers, while other forms are represented by only single individuals. Among those distinct enough for characterization, and represented by several individuals, I have considered the following forms worthy of notice and description:

ROSTELLARIA COMPACTA, n. sp.

Plate XIII, Figs. 18-21.

Shell of only a medium size or smaller, elongate ovate in form, as casts, with a moderately elevated spire, the apical angle of which varies but little from 30° ; volutions four to five in number, quite compactly coiled and very moderately convex between the sutures, presenting evidence of a rather thin shell; body volution large, forming nearly or quite one-half of the length of the cast; moderately convex on the upper part, but rapidly contracted below, apparently having been provided with a rostral beak of some length; outer part of last volution extended upward at the upper edge to near the top of the next volution above, as distinctly indicated on one of the casts; aperture, as shown on the cast, narrowly elliptical, acute above and pointed below; columellar cavity left by the removal of the shell rather small; surface of the cast smooth.

On one of the casts referred to this species there is a slight but very well defined ridge near the base of the volution similar to what would be left on a cast of *Pseudoliva* by the groove representing the notch near the base of the lip. Whether it has been produced by accident, or is an organic feature of the specimen, I can not say; none of the others which I have considered as of the same species show any indication of such a feature, and I have been led to consider it as accidental.

Formation and locality: In the Lower Green Marls at Crosswicks and Mullica Hill, New Jersey. Collection Acad. Nat. Sci., Phila., and elsewhere.

ROSTELLARIA SPIRATA, n. sp.

Plate XIII, Figs. 16, 17.

Shell small, slender, spire elevated with moderately convex whorls, divided by very distinct sutures in the casts; apical angle 25° or more; volutions six or seven, the last one forming rather less than half of the entire length, exclusive of the anterior prolongation; aperture oblique, elliptical in outline, nearly or quite equally convex on the inner and outer sides; columellar cavity small, straight, and smooth; last volution deflected upward very slightly as it approaches the aperture; surface of the cast smooth, without visible evidence of vertical folds.

The casts of this species differ from those of *R. compacta*, in being more slender, of smaller dimensions, composed of a greater number of volutions which are more convex, with larger or broader sutures, and in having a shorter and abruptly contracted body whorl. The rostral beaks are all imperfect, but they bear evidence of having had considerable length.

Formation and locality: In the Lower Marl Beds near New Egypt, at Crosswicks, and at Upper Freehold, New Jersey. Collections Acad. Nat. Sci., Phila., and Rutgers College; also from the same position at Mullica Hill, New Jersey, in the collection at Columbia College, New York City.

ROSTELLARIA CURTA, n. sp.

Plate XIII, Figs. 9-13.

Shell small and comparatively short for a species of the genus; spire short, the apical angle being about 45° in some specimens, and in other

individuals rather less; volutions convex, four or five in number, only four in the casts; sutures deeply marked, indicating a comparatively thick shell; body volution large, half as long as the entire length of the cast, or sometimes three-fifths of the entire length; base of the body volution extended in front; aperture equaling one-half the length of the cast; elongate elliptical in outline, acute at the upper angle and the margin extending above the line of the suture where the lip has extended upon the preceding volution; lower margin of the aperture prolonged and narrow; outer margin more convex than the inner; columellar cavity rather large, indicating a strong and thickened columella, which has been smooth and without any indications of folds or markings; surface of the volutions marked by distant but not very strong vertical folds, which are only seen on the internal cast upon careful examination; surface of the shell and features of the lip and posterior canal unknown.

The casts of this species, although somewhat common at this one locality, are not very readily distinguished from casts of *Volutomorpha Kanei* Gabb, with which they occur, and the only reliable features by which they can be distinguished is the total absence of columellar folds or plications and the extension of the aperture upon the preceding volution when the outline of the margin is preserved, which is not uncommon. In size, general form, and proportions they are very similar, this one being rather more ventricose on the body volution, especially in the upper half of its length.

Formation and locality: In the dark green layers of the lower Green Marls at Crosswicks Creek, New Jersey. Collections at Rutgers College. Collected by Dr. N. L. Britton.

ROSTELLARIA FUSIFORMIS, n. sp.

Plate XIII, Figs. 14, 15.

Shell small, slender, and fusiform; spire elevated and slender, the apical angle being about 20° or 25° ; volutions slender, slightly convex on their exposed surfaces; four only preserved in the cast, but there have been four or five more above, making eight or more in all; body volution greatly prolonged in front, forming a long slender beak with a proportionally strong

axis, leaving quite a good sized axial cavity in the cast; aperture long and narrow, pointed above and below, the upper canal being extended upon the preceding volutions to an unknown extent; volutions marked by numerous, closely arranged, vertical folds, twelve or more to the whorl.

This is the most slender form yet noticed in the New Jersey Cretaceous formations, and has been more extended in front than any other. It seems to have been a true *Rostellaria* as far as can be judged from the internal cast alone, being destitute of any angulation of the body whorl, without evidence of spiral striae, and provided with a long rostral beak and smooth columella.

Formation and locality: From the blackish layers of the Lower Green Marls at Crosswicks Creek, near New Egypt, New Jersey. Collected by Dr. N. L. Britton, and is in the Rutgers College collection.

ROSTELLARIA HEBE, n. sp.

Plate XIV, Figs. 11-13, 14 ?.

Shell moderately large, with an elongated conical spire and rather short body whorl; volution strongly rounded in the cast, number unknown but probably seven or more, the last one proportionately larger and more ventricose than any of the others; base short but somewhat extended near the columellar cavity, which is rather large, showing the axis to have been strong; upper part of the body volution largest and the lower part rounded obconical, slightly extended below; aperture, as shown by the cast, of but moderate size, narrowly elliptical in form, being nearly equally curved on the outer and inner sides; the outer side a little the most strongly so; upper and basal angles of the aperture acute; the upper one extended upon the preceding volution, causing the last volution, as it approaches the aperture, to overlap that one somewhat as in many of the *Strombidae*. Columella smooth, without folds or ridges of any kind; suture between the coils of the cast strong and deep, but separated by only a narrow space, showing the shell at this part to have been thin; the surface of the shell has been marked by spiral bands of considerable width, but their number is not determinable from the specimens at hand; there is, however, evidence of a quite strong one near the center of the volutions, and indications of several others, especially on the basal portion of the last volutions, but not presenting any angulation as in *Anchura*.

This species, known from internal casts only, differs from all the other forms from New Jersey in its greater size; greater angle of the spire; short, ventricose volutions, which are strongly rounded with deep sutures; and in the proportionally short, compact body volution. There are very faint indications of vertical folds on the upper volutions, but too indistinct to figure or count. Casts apparently identical with this occur in the Cretaceous in Texas, but have not been described.

Formation and locality: This species is found at Mullica Hill, New Jersey, and a very imperfect cast appears to have come from Freehold, New Jersey. Both are from the Lower Marls of the Cretaceous. Those from Mullica Hill are from the highly ferruginous beds below the true marls.

Genus ANCHURA Conrad.

ANCHURA ARENARIA.

Plate XIV, Fig. 10.

Rostellaria arenarum Morton: Syn. Org. Rem. Cret., p. 48, Pl. v, Fig. 8.

Rostellaria ? arenarum (Mort.) Meek: Check List Cret. and Jur. Foss., p. 20.

Rostellaria arenarum (D' Orb.) Gabb: Proc. Acad. Nat. Sci., 1876, p. 298.

Gladius arenarum (Mort.) Gabb: Synopsis, pp. 54, 75.

Anchura arenarum (Mort.) Meek: Geol. Surv. N. J., Newark, 1868, p. 729;
Gabb, Proc. Acad. Nat. Sci., Phila., 1876, p. 298.

The only New Jersey example of this species which I have seen is the type specimen. Among all the collections examined none have appeared that will satisfactorily agree with it. The specimen is a very imperfect cast, and shows but indifferently the features of the species. It has been a rather strong and robust form of about 2 inches in length, with strongly rounded volutions, probably four and a half or five in number, and rapidly decreasing in size upward; sutures very strongly marked; aperture narrow, but the lip is unknown and the rostrum apparently quite short; volutions marked by ten or twelve vertical plications or folds which are strongly marked on the largest part, but become obsolete at the sutures above and below, while on the body whorl they are not visible below the upper two-thirds, the lower third being destitute of markings; on outer half of the last volution the folds indistinct or obsolete; the folds appear to have

been somewhat sigmoidal in their direction in passing from above downward, being directed slightly forward in the lower part.

Mr. Gabb¹ cites *Chemnitzia distans* Conrad, from Tippah County, Mississippi, as a synonym of this species, but I think wrongfully, as it appears to belong to a group of shells entirely different from this one.

Formation and locality: In the Lower Marls of the Cretaceous of New Jersey. No definite locality is given with the specimen, either in Dr. Morton's original description or in the collection Acad. Nat. Sci., Phila., where it belongs; but from the lithological character of the specimen, I should be inclined to think it came either from Mullica Hill or from near Burlington, New Jersey.

ANCHURA ABRUPTA ?

Plate XIV, Figs. 1-3.

Anchura abrupta Conrad? Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 284, Pl. XLVII, Fig. 1; Gabb, Synopsis, p. 38, Meek; Check List Cret. and Jur. Foss., p. 19.

Among the casts of this group of shells in the collection Acad. Nat. Sci., Phila., there are two individuals from the brown sands near Burlington, New Jersey, which are larger and have a more rapidly tapering spire than *A. pennata* Morton, and which evidently represent a species distinct from that one. Although the general form is much the same as in that species, the vertical folds are more oblique, being directed forward in the lower part, and the entire volution has been marked by moderately strong spiral lines, a feature which does not exist on any of the many casts of that species which I have examined. The volutions also seem a little more convex and the last one less extended below. On the better preserved cast of the two there are two quite prominent spiral ridges on the periphery of the last volution which are about one-twelfth of an inch apart, and appear to have corresponded to some feature of the lip. The lip has also been somewhat extended over the lower part of the preceding volution; but the anterior portion is absent on both, so that the length of the anterior beak can not be ascertained.

¹ Proc. Acad. Nat. Sci., Phila., 1876, p. 298.

The features of these casts as above described show considerable resemblance, in these specimens, to *A. abrupta* Conrad, as known in casts from Mississippi, but are not sufficiently marked to afford a positive identification. Still, with the great resemblance between them here shown, I hesitate to consider them as distinct.

Formation and locality: In the brown sands of the Lower Marls from near Burlington, New Jersey.

ANCHURA ABRUPTA var. ACUTISPIRA, n. var.

Plate XIV, Fig. 4.

A single imperfect specimen of an internal cast occurs in the collection Acad. Nat. Sci., Phila., from New Jersey, but without more definite locality. The spire is only moderately slender, the apical angle being about 35° , with rather compact volutions, closely coiled, as seen in the cast, indicating a rather thin shell, flattened in the direction of the spire, and have been six or seven in number; the last one short, subangular in the middle, and rather abruptly contracted in the lower part, and extended in a slender point in front; the aperture trapezoidal and oblique; surface bearing distinct evidence of slender spiral lines, five of which are above the periphery and an undetermined number below, but apparently of about the same size and proportion as those above the center. There are also distinct, prominent, vertical folds crossing the volutions, which are directed slightly forward in their passage from above in crossing the volution. Twelve of these folds mark the last volution as preserved on the cast, but above this they are not readily determined, although they appear to be fully as numerous. The last volution becomes more distinctly angular on the periphery as it approaches the lip, although this latter feature is not preserved.

The cast differs in the angularity of the volutions and the shorter spire from *A. abrupta* Conrad, as herein identified, but more particularly in the fewer and stronger vertical folds and in the single carination marking the last volution. This latter feature alone would not be reliable as a specific feature, as the prominence of the angulations of this part of these shells is usually very variable and they are often not very much developed until quite near the lip. The other differences noted are, however, very marked, and will readily distinguish it from those identified with *A. abrupta*.

Formation and locality: The specimen is evidently from the Lower Green Marls, although the locality indicated is only "Cretaceous, N. J." Collection Acad. Nat. Sci., Phila.

ANCHURA PENNATA.

Plate XIV, Figs. 7, 8.

Rostellaria pennata Morton: Synop., Org. Rem. Cret., p. 48, Pl. XIX, Fig. 9.

Gladius pennatus (Mort.) Gabb: Synopsis, pp. 55, 77.

Rostellaria (?) pennata (Mort.) Meek: Check List Cret. and Jur. Foss., p. 20.

Anchura pennata (Mort.) Meek: Geol. N. J., Newark, 1868, p. 729.

Shell elongate, spire elevated and consisting of from six to seven volutions, which are only moderately convex between the suture lines, the latter being well marked but not deep; apical angle not more than 30° , but often less; last volution proportionally large and with a somewhat extended rostral beak, slender and straight; lip broadly expanded and extended in a narrow border along the side of the beak to a point opposite the base or swell of the volution, where it rapidly widens out into the broad wing-like lip, which reaches somewhat over the next volution above but apparently not forming a posterior canal. The outer posterior angle of the expanded portion is prolonged into a narrow, recurved, falciform process of greater or less extent; volutions marked by oblique longitudinal folds, which extend from suture to suture on all the upper volutions, but become obsolete just above the middle on the body portion of the last one, and are entirely obsolete on the back of the expanded lip. On the upper volutions the folds are closely arranged, but on the lower they are more distant and more strongly marked, while on the body part of the last one they are quite strong and almost node-like, even on many of the internal casts.

The species was originally described from casts obtained from Prairie Bluff, Alabama, where they appear to be not uncommon as casts, and the New Jersey specimens are usually in the same state of preservation, and seldom show any remains of the expanded lip. In some of the marls, however, this feature is occasionally preserved, and I have before me three individuals belonging to the collection at Rutgers College showing this feature with some slight variations. One individual apparently has the lip

extended along the side of the spire to the second volution above, so as to indicate the existence of a posterior canal. If this is correct and not a result of compression, it would remove it from the genus *Anchura* and ally it more nearly with *Helicautax* Gabb, which has the canal passing along the spire to near its summit. There is, however, a great diversity of opinion as to the range of these genera, and I think that half the number which now exist would better serve the purposes of classification. Stoliczka would apparently place this shell and all its group under *Alaria* M. & L., but they have no lip-like varices.

Formation and locality: I find specimens of this species in collections from various localities, judging from their characters, but most of them are marked simply "New Jersey." They are found at Freehold, Mullica Hill, Marlborough, Cream Ridge, and many other places in the Lower Marls, and are common in the Cretaceous in Alabama.

ANCHURA PAGODAFORMIS, n. sp.

Plate XIV, Figs. 15, 16.

A single cast of a large species, evidently an *Anchura*, comes from the lowest layers of green sand in Monmouth County without more special locality. It is so marked in its character that I have thought it worth while to designate it by name, in hopes that other and better examples may be discovered before the work on the Marls shall be closed. The cast, without anterior beak and lacking some four or more volutions of the apex, is nearly 3 inches in length, and considerably over an inch and a quarter in diameter across the body volution. The volutions are very compactly coiled, indicating a rather thin shell, and the lower volutions are rather flattened vertically, the last one showing evidence of a depression a little below the shoulder. Above, the coils are more rounded, from a thickening of the shell on the inside. The aperture appears to have been constricted on the back of the expansion, the cast being broken just at the beginning of the widening portion and showing the commencement of the upward expansion of the lip. No surface markings are visible on any part of the shell. The center of the shell is perforated, but not largely so, indicating a slender axis. The species differs from all others noticed, not only in its

greater size, but in the vertical outer face of the volutions, and will be easily identified by this character.

Formation and locality: In the Lower Marl Bed in Monmouth County, New Jersey, and from the collection at Rutgers College.

ANCHURA SOLITARIA, n. sp.

Plate XIV, Fig. 9.

Shell small, but with a comparatively elevated spire, consisting of numerous convex volutions, the number of which can not be determined; aperture expanded into a broad wing-like lip, which is extended on the upper side to just above the base of the next volution and has been strongly recurved on the edge; opposite the middle of the aperture is an extended lip, in the form of a slightly recurved, spine-like process of greater or less extent, which corresponds in position to a strong, angular keel or ridge, which marks the outer volution at about the middle of its height; also evidence on the cast of a second keel or ridge at a little distance below the first one; body of the volutions marked by numerous, closely arranged, vertical folds, faintly seen on the cast; beak rather short.

This is the only species of the keeled section of this group of shells that I have seen from New Jersey, although it is so abundant in the Cretaceous of other parts of the country. The cast of this one when deprived of the expansion of the lip would be readily mistaken for that of *A. rostrata* Gabb, but the vertical folds are finer, and the lip at once distinguishes it.

Formation and locality: The only specimen observed is an imperfect cast in a gray marl near the base of the Lower Green Marls, and was associated with specimens of *A. rostrata* Gabb, collection Acad. Nat. Sci., Phila., marked "Haddonfield, New Jersey."

ANCHURA (DREPANOCHILUS) COMPRESSA, n. sp.

Plate XIII, Figs. 22-25.

Shell, as represented by casts, rather above a medium size, with a moderately elevated spire and proportionally large body volution; apical angle somewhat varied as seen on different individuals, one specimen measuring only about 30° , and another nearly 45° ; volutions five or six (?) in

number, none of the specimens being perfect at the apex, leaving the matter somewhat in doubt; whorls moderately convex in the casts with well marked and distinct sutures; the surfaces between them varying from slightly flattened in the lower part of the spire to very round in the upper whorls, indicating a thickened shell for the upper parts, and less thickened below; body whorl rather large, the upper margin strongly directed upward as it approaches the aperture, extending to or above the middle of the preceding volution before it becomes free, and showing a strong rounded ridge near the upper margin, where it begins to form the apertural projection of the lip, strongly compressed or flattened below on the back of the whorl, while the lower part is quite abruptly contracted below to form the anterior canal or beak, but without any indication of an angle. The anterior beak or canal has been slender, but its length is not determinable from any of the specimens seen; aperture, as shown by the cast, narrow in width, but elongated in an anterior and posterior direction, resulting from the compression of the volution on the back; lip unknown; surface marked by oblique vertical folds, which are numerous and strongly directed forward in passing from above downward, becoming obsolete on the cast just below the position of the suture line, and entirely absent on the outer half of the body whorl, as seen on the individuals in hand.

This species is of about the size of *A. pennata* Morton and has very nearly the same apical angle. The vertical folds are, however, rather more distant, the body whorl larger in proportion, and the spire rather shorter generally; but the principal difference is in the form of the body volution, in the existence of the rounded ridge leading to the posterior projection, and in the flattening below. No evidence of spiral lines or ridges exist on any of the specimens which I have examined.

Formation and locality: In the Lower Green Marls, at Mullica Hill and Upper Freehold, New Jersey. In the collection at Rutgers College and at Columbia College.

Genus ALARIA Morris.

ALARIA ROSTRATA.

Plate XIV, Figs. 5-6.

Rostellaria rostrata Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 390, Pl. LXVIII, Fig. 7.

Gladius rostrata Gabb: Synopsis, pp. 55, 77.

Anchura rostrata (Gabb) Meek: Geol. N. J., Newark, 1868, p. 729.

Anchura (Drepanochilus) rostrata (Gabb) Meek, Check List Cret. and Jur. Foss., p. 19.

Shell of only moderate size; spire elevated, forming an apical angle of about 35° , but somewhat variable in different specimens; whorls about six in number, very slightly convex between the sutures, which are not very strongly marked, and are ornamented by rather closely arranged vertical folds, smaller, more numerous, and more closely arranged on the upper than on the body whorl; those on the last whorl become smaller, shorter, and more indistinct toward the expanded lip, on the back of which they become obsolete; on all the upper whorls the folds extend from suture to suture, but on the last one they are marked only on the upper or larger parts; outer lip expanded, forming a broad, wing-like extension which is prolonged below along the moderately long rostral beak, and above is extended into an obtusely pointed hook-like process from its outer upper border. This feature I have seen entire only on the type specimen, though several are before me which show the expansion of the lip. No keel-like ridge marks the back of the lip, as in most of the species of this group from the Cretaceous beds of the Upper Missouri region.

This species may be distinguished from the others of the group from New Jersey by its smaller size, smaller and more closely arranged vertical folds, and proportionally shorter and more obtuse spire. There appears to be a very great degree of variation among the specimens of this species in the proportions of the spire, some of them being very much more slender than the rate of increase mentioned above. There is also considerable difference in the strength and number of the vertical folds, but none of them approach in coarseness that of the most nearly allied forms associated with it in New Jersey, from which this feature alone will readily distinguish it.

Formation and locality: In the brown layers of the Lower Marls near Burlington, New Jersey, where it appears to be a somewhat common species.

CYPRÆIDÆ.

Genus CYPRÆA Linnæus.

CYPRÆA (ARICIA) MORTONI.

Plate xv, Figs. 1-3.

Cypræa Mortoni Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 391, Pl. LXVIII, Fig. 8 in text, 9 on plate; Synopsis, p. 48; Meek, Check List Cret. and Jur. Foss., p. 19; Geol. N. J., Newark, 1868, p. 729.

Mr. Gabb described this species principally from internal casts obtained from Prairie Bluff, Alabama, at the same time recognizing it in a cast from New Jersey. That specimen I have before me, but it is so very imperfect that only the generic features of the shell are retained beyond proofs of its small size and evidence that it is an adult individual. Being an internal cast, but few features of a shell of this kind can be retained. The specimen is about five-eighths of an inch in length and broadly ovate in outline; the spire is flat and the cast most ventricose and largest about one-third of the length from that end, with the slightest indication of an angularity at the point of greatest diameter on the outer half of the last volution. The outer lip shows the infolding to a slight extent, but no indications of the fine crenulations of the lip nor of the opposite side of the aperture as mentioned in the original description is visible, as the substance of the cast which would have filled the apertural slit is not preserved, hence they could not be retained. The exterior of the cast is entirely smooth, as must necessarily be the case in a cast of a shell of this genus.

As this is the only cretaceous *Cypræa* found in the New Jersey beds there can be no question as to its identity; and as the specimen is altogether too imperfect for comparison with those from the more southern localities, not affording any specific features, it will be necessary to retain the name given to it by Mr. Gabb until other material can be obtained for comparison with that one to satisfactorily determine whether it may be the same or not.

Formation and locality: In the blue marls of the Lower Greensands, Burlington County, New Jersey.

DOLIIDÆ.

Genus DOLIUM Lamarck.

DOLIUM (DOLIOPSIS?) MULTILIRATUM, n. sp.

Plate xv, Figs. 4-6.

Shell, as known from an internal cast, small, subglobose or broadly pyriform; outer volution forming nearly the entire bulk of the shell; spire low, rounded, the whole composed of about three whorls; sutures in the cast quite strongly marked; beak of the last volution short and on the back, scarcely distinct from the marginal lip, showing the existence of only a very short canal; aperture large, fully five-sixths as long as the entire length of the shell; columella showing only a moderate cavity by its removal, but giving evidence of a projecting part near the lower end on the inside; otherwise the cast shows no twist of the columella; surface of the cast marked by numerous spiral lines and furrows (about sixteen ridges can be counted along the margin of the lip), and also by irregular transverse wrinkles, parallel to the margin of the aperture; near the aperture, on the last volution, a sharp constriction indicating a strong varix, as if for the thickening of the outer lip, over which the spiral lines pass, and there is a line of small pits, one on each rib, indicating node-like granules.

The cast presents every appearance of a species of *Dolium*, as far as a cast would preserve the features of a shell of that genus. The canal, of course, would not show the twisting or tortuous character on a cast, unless the matrix of that part was preserved, which is not the case in the present instance. It may be that it should be referred to Conrad's genus *Doliopsis*, but his figure would lead me to consider it much more nearly a true *Dolium* if there is any difference of generic importance between them. As I do not find that Conrad even characterizes the genus, I can not tell what its features may be except from his figure on Plate x, Fig. 15, vol. 1, Am. Jour., Conch.; not having seen his types, I was at first inclined to consider this shell as congeneric with Meek's genus *Pseudobuccinum*, but on removing the inner whorls of the cast I find there is a solid axis, indicating the existence of a true columella, although rather slender, which feature Mr.

Meek states does not exist in his shell, *P. Nebracensis*, upon which the genus was founded. There is no other existing genus into which it seems to fit as well as in *Dolium*.

Formation and locality: In a hard, blackish-green pyritous marl of the Lower Marl Beds at Freehold, New Jersey. Collection at Rutgers College.

Genus FICUS Rosseau.

FICUS PRECEDENS, n. sp.

Plate xv, Figs. 7, 8.

Shell small, pyriform; .volutions about three, very ventricose, inflated in the upper part, rapidly attenuated below and contracted to form a moderately long, slender canal and beak, which is very slightly bent; spire low, but the inner volutions distinctly showing above the outer ones, with a well defined suture; aperture elongate-elliptical, prolonged below to the end of the canal, which is very narrow; surface of the shell marked by twelve principal prominent, spiral carina, between which there is in each space a single subordinate ridge showing on the cast; toward the lower part of the volution and on the beak they are more equal in size, and on the body of the volution the principal carina are nodose, or serrated, from the crossing of transverse ribs which pass across the volution in a nearly straight line parallel to the margin of the outer lip of the aperture. In a fragment of the matrix, from near the inner part of the outer whorl the principal spiral ridges are seen to be sharply carinate, and the transverse striae fine and numerous; columella without ridges or folds of any kind.

The shell has had exactly the features of the recent forms of the genus *Ficus* (*Pyruia* pars) and the cast shows that the shell has been extremely thin and fragile, like the living ones of the genus, with a strongly reticulated surface (a part of the matrix of the spire shows it to be strongly cancellated). The columella has not been thickened to any degree, the space left by the removal of the shell being very narrow and the outer surface of it smooth. There are two or three species of gasteropods in the New Jersey Cretaceous rocks, which may readily be confounded with this one if not carefully compared, especially *Perisolax retifer* (= *Fusus retifer* Gabb), but

even this may be distinguished by the larger cavity left by the removal of the columella, and by the greater thickness or strength of the beak. The spiral ridges on this one are also more numerous and more sharply elevated, while the decided alternation of size among them will serve as a distinguishing feature. There is so great a similarity between this and many Tertiary forms of the genus that I shall not attempt to institute comparison between them, as they would be useless as distinguishing features, and I know of no Cretaceous species resembling it.

Formation and locality: In the marls of the Lower Beds at Holmdel, New Jersey. From Dr. Reiley's collections. The marl in which it occurs is of a ferruginous white color resembling some of the limestone nodules from the Lower Marls.

NATICIDÆ.

Genus NATICA Lamarck.

NATICA ABYSSINA.

Plate xv, Figs. 9-12.

Natica abyssina Morton: Syn. Org. Rem. Cret., p. 49, Pl. XIII, Fig. 13.

Gyrodes abyssina (Mort.) Gabb: Synopsis, p. 59; Proc. Acad. Nat. Sci., Phila., 1876, p. 295.

Shell large, globose, with a flattened spire, the inner volutions of which scarcely rise above the outer ones, and are only two and a half to three in number; volutions rather ventricose and erect, ovate in a transverse section; umbilicus large and open to near the apex of the shell; aperture ovate, two-thirds as wide as long, and a little more convex on the outside than on the inner margin, nearly equally rounded above and below; suture well marked and deeply impressed.

The species is represented only by casts in the New Jersey localities, so that the features of the surface are not known from within the State. Mr. Gabb cites it as coming from Patula Creek, Georgia, where, he says, the surface shell is preserved, but that it is perfectly plain. A single cast which I have seen from New Jersey showed a deposit of ocher in the umbilicus which appeared to represent the thickness of the shell in that part. It was exceedingly thin and showed no callus or other feature of thickening.

The species was originally described from Prairie Bluff, Alabama, where the specimens are of large size and sometimes show evidences of the shell, which must have been of considerable thickness, as they are frequently seen to have been perforated by a boring sponge. The New Jersey casts differ from those of *G. infracornuta* Gabb, with which this species is usually confounded, in being less oblique, more erect, lower in the spire, the volutions rounder and not carinate on the edge of the wide umbilicus. The evidence of its relations to the genus *Gyrodes* is not very strong.

Formation and locality: In the ferruginous layers of the Lower Marls at Mullica Hill, and near Burlington, New Jersey, not a very common species; also from the same position at Tinton Falls, New Jersey. Collection at Columbia College.

Genus GYRODES Conrad.

GYRODES ABBOTTII.

Plate xv, Fig. 17.

Gyrodes Abbottii Gabb : Proc. Acad. Nat. Sci., Phila., 1861, p. 320 ; Meek, Check List Cret. and Jur. Foss., p. 21 ; Geol. N. J., Newark, 1868, p. 729.

This species was described by Mr. Gabb from a single individual cast, which retains around the summit of the outer volution remains of markings which present the appearance of a series of undulations, or "oblique plications," having a backward direction in their passage from the suture line across the body of the shell. Aside from these markings there is not the slightest difference between this and the ordinary casts of *G. abyssinus* Morton, either in form or bulk. The specimen is preserved in a ferruginous gravel or very coarse iron sand, which fills the sutures and umbilical cavity, and to a considerable extent obscures these features; so that a strict comparison is not possible without changing its appearance by clearing away the adhering material. This I have not ventured to do, as the specimen is the property of the Acad. Nat. Sci., Phila., and the change would destroy the features upon which the author of the species founded it, which I do not consider I have the right to do. I do not think, however, the species is a valid one, but regard it as only an accidental form of *Gyrodes abyssinus*. If the adhering material were cleaned away, I think the cast beneath would

be perfectly smooth on the top, as in Dr. Morton's specimens. I have, however, given it a distinct specific reference and place in the volume, that, in case other specimens should be found, it may retain its individuality as a species.

Formation and locality: In coarse ferruginous sand of the Lower Marls, at Mullica Hill, New Jersey. Collection Acad. Nat. Sci., Phila.

GYRODES INFRACARINATA.

Plate xv, Figs. 13-16.

Natica infracarinata Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 319.

Gyrodes infracarinata (Gabb) Meek: Geol., N. J., Newark, 1868, p. 729.

Shell, as shown by internal casts, large, depressed globular above and truncate below by the broad umbilical area shortening the depth of the shell; spire consisting of about four volutions, the last one of which forms fully two-thirds of the bulk of the entire shell; volutions oblique, largest below the middle, slightly flattened on the top adjacent to the suture, and very strongly angular on the base bordering the very wide open umbilicus, in which the volutions are exposed nearly to the apex; aperture large, ovate, widest below the middle and truncate at the upper angle by the flattening of the volution adjacent to the suture; columellar lip apparently quite thin, and marked by a single spiral thread-like ridge on its inner surface; outer lip sharp and thin and very strongly receding below, as seen in a profile view; surface of the cast usually smooth, but sometimes showing evidences of transverse striae of growth.

The New Jersey specimens of this species are all internal casts, consequently the surface features are unknown. The casts indicate a strong robust species, with rapidly increasing volutions, which are short in comparison to their lateral dimensions. The suture is very strongly marked, showing considerable thickening of the shell at the junction of the volutions. The features of the umbilicus are taken from specimens where the filling of this part has been taken out of the cast and preserves the surface markings, thereby giving the features in a perfectly reliable manner. The examples seen from New Jersey are not as large as those of *G. abyssinus* from the southern localities, but they are found having a diameter of nearly

1½ inches by a height of about 1¼ inches. The species differs from *G. petrosa* in its greater size, more robust volutions, which are not so much flattened on the upper half, thereby giving a rounder and less oblique form. The umbilicus is also larger in proportion and the shell more angular on its lower margin. It differs from *G. abyssinus* Morton in being less erect or more oblique, and in the angularity of the margin of the umbilicus.

Formation and locality: It is found in the Lower Marls near Burlington, and at Mullica Hill, New Jersey.

GYRODES CRENATA.

Plate XVI, Figs. 5, 6.

Natica (Gyrodes) crenata Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 289.

Gyrodes crenata (Conrad) Gabb: Synopsis, p. 60; Meek, Check List Cret. and Jur. Foss., p. 21.

Shell below a medium size, broadly patulose in form, with a depressed spire and a very broad open umbilicus; volutions four or five, obliquely spreading and subangular below; inner whorls scarcely raised above the outer one, but very perceptibly distinct from the effects of a band of elevated crenulations or transverse nodes which marks the top of the volutions just below the suture line and forms a very decided ridge around the spiral portion of the shell, rendering the different volutions easily distinguishable; the broad umbilicus, limited below by a narrow, elevated, rounded ridge at the base of the volution, is also marked within by a less distinct carina a little below the middle of its depth; aperture oblique, truncated above by the flattening of the volution between the suture and the line of nodes which marks the volutions, and somewhat angular below; the angulation corresponding to the position of the rounded carina-like ridge at the base of the volution; surface of the shell marked by fine lines of growth corresponding to the margin of the aperture and passing over the line of nodes on the upper surface of the volution.

The specimens of this species which I have seen do not exceed seven-eighths of an inch in their greatest diameter, and all are more or less distorted by pressure. They closely resemble in form *G. petrosa* Morton, but

have a much broader umbilicus, and are more angular at the base of the volution. They correspond in nearly all particulars, as to form, with *G. abyssinus* Morton's sp., but have a broader truncation or flattening of the upper surface of the volution, are less erect in form, and differ in the crenulated sides of the upper surface. In this last feature they correspond very closely with what the young shell of *G. Abbotti* Gabb ought to be, and also in the form of the umbilicus and obliquity of the shell, and I am not sure that they are specifically distinct, though the small number of individuals of each species which I have seen render it difficult to determine with certainty, *G. Abbotti* being a large shell.

Formation and locality: In the micaceous clays below the Lower Marls of the Cretaceous formation, at Haddonfield, New Jersey.

GYRODES PETROSUS.

Plate XVI, Figs. 1-4.

Natica petrosa Morton: Synop. Org. Rem. Cret., p. 48, Pl. XIX, Fig. 6.

Gyrodes petrosus (Mort.) Gabb: Synopsis, p. 61; Proc. Acad. Nat. Sci., Phila., 1876, p. 295; Meek, Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 729.

Gyrodes alveata (Conrad) Gabb: Proc. Nat. Sci., Phila., 1876, p. 295.

Natica alveata Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 289, Pl. XLVI, Fig. 45.

Shell (as seen in casts) of medium size or smaller, obliquely oval or depressed and somewhat patulose, with a low spire; the entire adult shell having three to three and a half volutions, the last of which forms the greatest bulk of the shell; volutions obliquely compressed from above, largest below the middle, often slightly flattened on the upper half and with a distinct flattened space bordering the suture; aperture large, very oblique, strongly receding below as seen in profile on its edge; semilunate in outline, rounded below and slightly acute above, somewhat modified in the upper part by the intrusion of the preceding volution; umbilicus large, broadly patulose within, and apparently without callus; peristome thin, and the substance of the shell also apparently slight; surface of the shell unknown.

Among the examples which I have seen of this species there is but little variation except in size, and not much in this respect among the adult specimens. It is very readily distinguished from the other naticoid shells of New Jersey, except *N. abyssina* Morton, by its oblique patulose form, and from that one by its smaller size and by the flattened space below the suture, which is a very distinctive feature as compared with any of the associated species. The broad, open umbilical cavity which appears to have been entirely destitute of callus or thickening of any kind, or even of reflection of the columella, and with a somewhat angular margin, will also be a distinctive mark. Externally it has some resemblance to *Gyrodes Alabamiensis* Whitf., from the Eocene,¹ but is more oblique and not so elevated; but in the umbilical area it is entirely different. Perfect shells from Texas show the surface to be marked only by fine concentric lines of growth. *G. alveata* Conrad² appears to be the same species, and the figure given a very good one.

Formation and locality: Dr. Morton's type specimens were from Prairie Bluff, Alabama, where it is not uncommon. All the New Jersey specimens yet seen are either from Mullica Hill, near Mount Holly, or Crosswicks Creek. It also occurs in many places in Alabama, and in a very perfect condition in Texas.

GYRODES ALTISPIRA.

Plate XVI, Figs. 7, 8.

Lunatia ? altispira Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 320; Meek, Check List Cret. and Jur. Foss., p. 20.

Lunatia altispira (Gabb) Meek: Geol. N. J., Newark, 1868, p. 729.

The internal casts which I have placed under this species are about three-fourths of an inch in height, and about half an inch in diameter on the body whorl; the form is erect and the spire elevated, with about three and a half volutions, the last one forming two-thirds of the entire height, and by much the greatest bulk of the shell; summit of the body volution squarely truncate or flattened adjacent to the suture, and a little flattened below, thus forming a rather distinct angle on the top of the volution; the umbilicus is small, but open, and without thickening or callus; base of the

¹ Am. Jour. Conch., vol. 1, p. 265, Pl. xxvii, Figs. 9, 10.

² Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 239, Pl. xlvi, Fig. 45.

volution bordering the umbilical opening obsoletely angular or very sharply rounded; aperture elongate-ovate, widest below the middle; surface unknown.

This species is very closely related in general form to *Lunatia Halli* of the same author, but the flattening of the top of the volution separates it from that genus, and places it in *Gyrodes*, as intimated by the author in the original description of the species. It is much less common than *L. Halli* and smaller in size, besides having a lower spire, and is perhaps a little less erect, although in this latter feature they are so nearly alike that it is difficult to pronounce between them.

Formation and locality: In the Lower Green Marls at Mullica Hill, New Jersey. Mr. Gabb's types were from Crosswicks, New Jersey.

GYRODES OBTUSIVOLVA.

Plate XVI, Figs. 9-12.

? *Gyrodes obtusivolva* Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 320.

Gyrodes ? obtusivolva (Gabb) Meek: Check List Cret. and Jur. Foss., p. 1.

Gyrodes obtusivolva (Gabb) Meek: Geol. N. J., Newark, 1868, p. 729.

Lunatia obtusivolva (Gabb) Conrad: Am. Jour. Conch., vol. 5, p. 45, Pl. i, Fig. 11.

Shell, as known from internal casts, of moderate size, somewhat erect, obliquely subglobose with a moderately elevated spire, whorls three or three and a half, the outer ones flatly truncate on the top adjacent to the suture line, the truncation being strongly marked and angular at the margin. On fully grown specimens it is nearly an eighth of an inch in width on the outer half of the last volution; aperture oblique, ovate, widest below and truncated above by the flattening of the upper surface of the volution; umbilicus, as seen in the casts, small, indicating a slender, almost if not entirely solid columella; margin of the umbilical depression not angular; surface of the shell, as seen on fragments remaining attached to the casts, marked by fine transverse lines of growth.

This species is closely allied to *G. petrosa* Morton's sp., but is more erect, less spreading or patulose on the last volution, and has a more elevated spire and smaller umbilical cavity in the cast. As seen in its usual condition it is intermediate in form between *G. petrosa* and *Lunatia Halli*

Gabb, and may be distinguished from the latter by the flattening of the upper surface of the volutions, generally seen only on the outer ones, the others being rounded on the top, probably from the thickening of the shell on the interior surface, and also by the very much smaller umbilical cavity and lower spire. Mr. Conrad¹ refers the species to the genus *Lunatia*, but so far as the casts show I am inclined to consider it as a *Gyrodes*.

Formation and locality: Mr. Gabb does not assign any locality to his specimens under the original description, but they would appear to have come from Mullica Hill, New Jersey. The specimens here used are from Upper Freehold, New Jersey, and all are from the Lower Marls. Another individual in the collection Am. Mus. Nat. Hist. is from New Egypt, New Jersey.

Genus LUNATIA Gray.

LUNATIA HALLI.

Plate xv, Figs. 13-16.

? *Lunatia Halli* Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 391; Meek, Check List Cret. and Jur. Foss., p. 20; Geol. N. J., Newark, 1868, p. 729.

Euspira Halli Stoliczka: India Geol. Surv., Pal. Indica, Cret. Fauna South. India, vol. 2, p. 296.

Shell of moderate size, with an elevated spire composed of about four or four and a half volutions in entire specimen, and much resembling a *Paludina* in general appearance; elevation about once and a half as great as the diameter of the last volution, and the last volution when measured on the apertural side forms about three-fourths of the entire height; volutions convex, not inflated, but regularly rounded, with a well marked suture in the casts, the only condition in which they are known from New Jersey, but which does not indicate a flattening at the top in the perfect shell; aperture elongate-ovate, acutely rounded below and somewhat sharper above than below, the greatest breadth being below the middle; base of the last volution sharply rounding into the umbilical cavity; umbilical opening in the cast small, not extending above the lowest volution, and showing no evidence of any thickening or callus of any kind; surface unknown.

¹Am. Jour. Conch., vol. 5, p. 45.

This species is the most elevated form found in the New Jersey marls and is at the same time the most erect. It closely resembles *Gyrodes altispira* of the same author, and in internal casts can be distinguished only by the very slight flattening of the volution adjacent to the suture, and perhaps in a very slightly greater rotundity of the body volution of that species. So far as can be ascertained from the specimens in hand, there has been no thickening of the columellar lip to form a callus or any marking on it whatever, and the substance of the lip has been rather thin. Mr. Gabb compares it with *N. paludinæformis* H. & M., from the Upper Missouri region, which it very closely resembles, and speaks of its open umbilicus. This is not to be considered as meaning a wide open umbilicus, but one not solid as in that species.

Formation and locality: In the Lower Green Marls at Mullica Hill, near Burlington, near New Egypt, and other places in New Jersey.

Genus AMAUROPSIS Mörch.

AMAUROPSIS MEEKANA, n. sp.

Plate XVI, Figs. 22-25.

Amauropsis paludinæformis (in part) Gabb: Synopsis, p. 38; Proc. Acad. Nat. Sci., Phila., 1876, p. 296.

Not *Amauropsis paludinæformis* (Hall and Meek) Meek: U. S. Geol. Surv. Terr., Invert. Pal., vol. 9, p. 318, Pl. XIX, Fig. 15.

Not *Natica paludinæformis* Hall and Meek: Mem. Am. Acad. Arts and Sciences, Boston, new series, vol. 5, p. 389, Pl. III, Fig. 3; D' Orb., Prod. Pal., 1850, vol. 2, p. 312.

Shell of medium size, elongate-subovate; spire moderately elevated, only about two-thirds as high above the aperture as the length of the aperture; volutions five or five and a half in the largest specimen; ventricose, with distinct, well marked sutures, which are very slightly channeled; body volution more distinctly ventricose than the others; axis solid; aperture ovate, acute at the upper end, rounded and slightly effuse below; outer lip thin and sharp; columella somewhat thickened by the deposit of the lip, and grooved below the margin of the deposit, but not umbilicate; surface of the shell marked by proportionately strong, transverse lines of

growth, which are exceedingly irregular; and also by fine, even, corrugated spiral lines crossing them.

This species is very closely related to *Amauropsis paludinaeformis* H. & M., but is a more robust shell, with a shorter spire and a proportionally larger and stronger body volution. This gives it a larger aperture, more ventricose volutions and more compact spire. The surface characters are almost identical, but differ slightly in having the spiral lines more closely arranged. It seems to have been generally identified with that species, but when critically compared is found to be quite distinct, as among forms which are so restricted in general features.

Formation and locality: In the micaceous clays below the Lower Green Marls, at Haddonfield, New Jersey. Collection Acad. Nat. Sci., Phila.

AMAUROPSIS PUNCTATA.

Plate XVI, Figs. 17-21.

Phasianella punctata Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 299,

Pl. XLVIII, Fig. 3; Synopsis, p. 67.

Eutropia (?) punctata (Gabb) Meek: Check List Cret. and Jur. Foss., p. 18;

Geol. N. J., Newark, 1868, p. 728.

Littorina punctata (Gabb) Meek: Geol. N. J., Newark, 1868, p. 729.

Compare *Amauropsis paludinaeformis* Hall and Meek.

Shell small or of medium size, with an elevated spire which has an apical angle of from 40° to 45°; volutions four to five in number, very ventricose, with deep, well marked sutures, which are slightly channeled on some of the specimens; aperture round ovate, slightly pointed above and rounded below; rather less than half the length of the shell in casts or partially exfoliated individuals; columella slender and solid, and in the cast showing only a slight perforation from the removal of the substance of the axis; surface of the shell marked by fine impressed spiral lines of punctations on the type specimen, but on casts or partially exfoliated individuals this feature is not visible.

This shell may be distinguished from *A. Meekana* herein described, by its more slender form, higher spire, proportionally smaller and shorter body volutions, and the more distinctly rounded upper volutions, the two spe-

cies when placed together being very distinct. It is very closely related to *A. paludinæformis*, *Natica paludinæformis*, H. & M., having a much greater resemblance to it than the one herein described as *A. Meekana*, although that one has been commonly identified with it. This has probably arisen partially from the fact that this one, having originally been described under the name *Phasianella*, was so far removed systematically from the Naticidæ, to which it really belongs, that it would scarcely be thought necessary to compare them, or even occur to one to do so.

Formation and locality: In the lower layers of the Lower Green Marls, at Mullica Hill, New Jersey. Collection Acad. Nat. Sci., Phila.

TROCHIDÆ.

Genus MARGARITA Leach.

MARGARITA ABYSSINA.

Plate xvii, Figs. 1-5.

Solarium abyssina Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 9.

Architectonica abyssina Gabb: Synopsis, pp. 39, 80.

Margarita abyssina (Gabb) Meek: Check List Cret. and Jur. Foss., p. 18; Geol. N. J., Newark, p. 728.

Shell small, not exceeding half an inch in its greatest diameter; spire moderately elevated, the apical angle being about 70° or 75° ; volutions four to four and a half, very ventricose, giving a circular section when broken across; suture deep and well marked, while the whorls in the internal cast are closely appressed and slightly imbedded into each other, showing the shell to be thin; also seen where the cast rests partially in the matrix, the space left by the removal of the shell where no compression has occurred being barely perceptible; umbilicus broad and open, showing several of the volutions within; surface marked by very fine, even, spiral lines over the entire shell, with an apparent stronger line on the periphery, and crossed by finer lines of growth which are bent backward in crossing the volution, cancelling the surface.

In Mr. Gabb's original description the surface structure was not given, as he had not been able to find more than the internal cast, but among the

specimens from Burlington, where I have separated them from the matrix so as to get the impression of the shell as left in the fine sand, they are seen in a very perfect manner. The lines are exceedingly fine and threadlike, but regular and distinct.

Formation and locality: As yet I have noticed the species only from the vicinity of Burlington, New Jersey. Mr. Gabb's specimens were also from the same county.

Genus MARGARITELLA M. & H.

MARGARITELLA ABBOTTI.

Plate xvii, Figs. 12-15.

Architectonica Abbotti Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 321.

Margaritella Abbotti (Gabb) Meek: Check List Cret and Jur. Foss., p. 18; Geol. N. J., Newark, 1868, p. 728.

Pleurotomaria crotaloides (Mort.) Gabb: Synopsis, p. 69, and *Cirrhus crotaloides*, p. 47.

Solariella Abbotti (Gabb) Stoliczka: India Geol. Surv., Pal. Indica, Cret. Fauna South. India, vol. 2, p. 367.

Shell of medium size, subdiscoid with a very low, depressed-convex spire and nearly flat base; volutions four or five, rather slender, coiled one below the other, their upper surfaces rounded, with deep suture line, keeled on the periphery in the east, and very depressed convex on the lower side between the abrupt, moderate sized umbilicus and the outer angle; margin of the umbilicus abruptly rounded and the opening less than one-third of the entire diameter of the shell at any given point; upper surface of the volutions marked by closely arranged, but distinctly marked transverse undulations, which extend from the suture outward to about one-third of the width of the volution, and appear to have been directed slightly backward in their course; surface texture of the shell composed of fine spiral lines and finer transverse lines; section of the volution narrow ovate, three-fifths as high as wide, rounded on the inner end and acute on the outer margin.

The above description is taken from the Mullica Hill specimens in the Acad. Nat. Sci., Phila., which are partially Mr. Gabb's types. A comparison

of the above with Mr. Gabb's description, however, will show considerable difference between them, owing to the fact that he included two entirely different shells under his specific name, and drew his characters partly from each. The two shells, however, belong to entirely distinct families. He does not appear to have noticed the transverse furrows of the upper part of the volutions of the Mullica Hill shells, unless he included them in his "revolving and longitudinal, depressed lines, producing a cancellated appearance," which is not probable. This shell is readily distinguished from the Timber Creek species, which is described in this volume under the name *Pleurotrema solariformis* by the more depressed spire, absence of lateral sloping face to the volutions, and by the form and size of the umbilicus. Dr. Morton's *Cirrus crotaloides*, Synopsis p. 49, Pl. xix, Fig. 5, is much more nearly related to it; but from specimens of that species from Alabama, it differs remarkably on the basal surface, that one having a broad spreading or open surface below.

Formation and locality: In marls of the Lower Beds at Mullica Hill, and at Crosswicks Creek, near New Egypt, New Jersey. I have also seen examples of it from Prairie Bluff, Alabama, and Mr. Gabb also recognized it from that place.

ONUSTRIDÆ.

Genus XENOPHORA Fischer.

XENOPHORA LEPROSA.

Plate xvii, Figs. 16-19.

Trochus leprosus Morton: Synop. Org. Rem. Cret., p. 46, Pl. xv, Fig. 6.

Phorus leprosus (Mort.) Gabb: Synopsis, p. 85; Meek, Check List Cret. and Jur. Foss., p. 18.

Onustus leprosus (Mort.) D'Orb., Prod. de Paléont., vol. 4, p. 222; Meek, Geol. N. J., Newark, 1868, p. 728.

Shell small or below a medium size, trochiform, or broad conical; the spire having an apical angle of less than 90°; base flat or concave, usually more or less depressed in the center, with the margin of the volution more

or less rounded, and in old individuals sometimes distinctly rounded; casts showing a small umbilical perforation, but the axis probably solid in the shell; volutions probably seven or eight, but in the casts the upper ones are usually absent and seldom show more than four or four and a half; one small specimen retaining the upper whorls, to the number of four and a half, measures only five-eighths of an inch in diameter. This one, if continued below to the size of the larger one figured, would possess at least eight volutions; whorls obliquely flattened on their surfaces in the direction of the spire, with only a small portion of their edges rounded or vertical, and the surface deeply and abundantly scarred by the cicatrices of foreign substances which have been attached to the surface of the shell during life; aperture compressed, transversely ovate or trapezoidal, and the outer margin much prolonged

This seems to be a not uncommon shell at some of the localities of the Lower Marls, but is seldom found except in fragments; the upper portion nearly always being absent, and the cast often looking as if these parts had been filled up or absorbed, rather than that the casts had been mutilated. I presume the upper portion of the whorls were in many cases cut off by partitions deposited across them, which would give the casts their present appearance.

Formation and locality: In the Lower Green Marls at Upper Freehold; in the brown marly layers of the same horizon near Burlington; also at Crosswicks Creek and at Mullica Hill, New Jersey. The type of the species was from Prairie Bluff, Alabama, from which locality I have seen numerous specimens.

Genus ENDOPTYGMA Gabb.

ENDOPTYGMA UMBILICATA.

Plate XVII, Fig. 20.

Phorus umbilicatus Tuomey: Proc. Acad. Nat. Sci., Phila., 1855, p. 169.

Endoptygma umbilicata (Tuom.) Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 302.

Shell rather below a medium size, spire broadly conical, with an apical angle of about 80°, and composed of about four volutions; base flat or slightly concave, and in the cast showing a small open umbilical

perforation, representing the comparatively slender solid columella; the base of the cast is marked by a rather deep, narrow, spiral groove, about one-third to one-fourth of the width of the volution from the umbilical cavity, marking the position of an internal spiral ridge at this point on the inside of the basal portion of the shell; volutions flattened in the direction of the spire, with moderately distinct suture lines separating them in the casts; their surfaces closely and deeply scarred by the attachment of foreign substances to the outside of the shell during life.

This species has generally been considered the same as the *Trochus leprosus* of Morton, *Xenophera leprosus* of this work, but was described as a distinct species, first by Dr. Tuomey, and subsequently made the type of the genus *Endoptygma* by Mr. Gabb. I do not think it is always an easy matter to distinguish them, as the groove may not always be present, and in other respects there are no constant differences that I can discover. On one large cast, which I have referred to Morton's species, there is an indication that the apertural ridge was just appearing, while in the younger stages of the shell no evidence of its existence appears. In much younger individuals of this form it is strongly marked. It may be that both forms should be referred to the same species, in which case the present genus would have to be abandoned.

Formation and locality: In marls of the Lower Beds near Burlington, New Jersey.

SCALARIIDÆ.

Genus SCALARIA Lamarck.

SCALARIA (OPALIA) THOMASI?

Plate XVIII, Fig. 1.

Scala (Opalia) Thomasi Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 296.

Shell slender, turreted, whorls numerous, closely coiled and very ventricose, with rather close sutures, numbering seven or more in a specimen of less than seven-eighths of an inch in length; apical angle less than 30° , probably not more than 25° , the specimen being too imperfect to allow of positive measurement; aperture apparently round and the base of the volu-

tion slightly carinate, and the axis imperforate; surface marked by numerous slender, longitudinal ribs or varices, which are erect, closely arranged, and directed obliquely backward in passing from the upper to the lower side of the volutions; minute surface structure not visible on the specimen in hand.

The specimen which I have used in the above description is quite imperfect, and does not possess many of the specific features of the shell above named, consequently I am in doubt as to the correctness of the identification; but as far as the features are retained they agree very well with those given by Mr. Gabb. Mr. Gabb's specimen was also quite imperfect, and were it not for his statement that it came from the white limestone, I should have supposed this one to have been his type, as it is from the collection Acad. Nat. Sci., Phila. This one, however, does not show any trace of the umbilicus, nor of a thickened lip. It differs very materially from *S. Sillimani* in its smaller apical angle, being a more slender shell; by its shorter volutions and more compact form, and by the more numerous longitudinal folds or varices, they being nearly or quite double those of that one in number.

Formation and locality: The specimen used is from dark-colored greensand, apparently of the Lower Marls, and is labeled "Cret. N. J., Abbott," below which is added in pencil "*Scala Sillimani*," all in what I should take to be Mr. Conrad's handwriting. The identification with *S. Sillimani* is certainly an error. Mr. Gabb's specimen, he says, was from the white limestone of New Jersey, which I take to be the white limestone nodules from the Lower Marls.

SCALARIA SILLIMANI.

Plâte XVIII, Fig. 2.

Scalaria Sillimani Morton: Synop. Org. Rem. Cret., p. 47, Pl. XIII, Fig. 9.

Scala Sillimani (Morton) Gabb: Synopsis, p. 79; Meek, Check List Cret. and Jur. Foss., p. 20.

Shell of medium size, measuring nearly one inch in length and rapidly tapering, the apical angle being about 30° or 35°; volutions five or more, very round and full, but closely compacted; the suture line deep and

sharp, but close; aperture (as shown on the only specimen in hand, which is a matrix containing the shell of one side of the specimen in place and from which a gutta-percha cast is taken for description and figure), is round, but the margin is not preserved; surface of the shell marked by oblique varices, which have a slightly backward direction in crossing from the upper to the lower side of the volution; the varices are thin and recurved, and number eight on one-half of the circumference of the last volution, but decrease somewhat in number toward the apex of the spire; axis imperforate, the base of the last volution bordered by a raised carina, below which the varices do not appear to extend. So far as can be ascertained from the specimen, I should judge that the varices were slightly produced in the upper part to form subspines around the base of the preceding volution. The minute surface character of the shell can not be ascertained from the specimen in use, as only the inside of the substance is revealed, but Dr. Morton describes it as marked by "very minute spiral striæ," which one would suppose would naturally be the case. Mr. Gabb also speaks of it having "much finer" revolving striæ than his *Scala (Opalia) Thomasi*, which is also a New Jersey species, and says that "each rib is reflected back into a little lip or notch at the angle of the basal carina."

This is readily distinguished from *S. annulata* Morton, by the more slender spire and by being a very much smaller shell, with an imperforate axis, that one having a wide, open umbilicus. The shell has so exactly the form, taper, size, and style of varices as *S. Sillimani* as given by Dr. Morton, that I have not hesitated to identify it with that species, although the type of it was an Alabama shell. I have not seen specimens of *S. Sillimani* from Alabama in a good state of preservation, however, and may be in error.

Formation and locality: In the Lower Green Marl near Holmdel. Collected by the Rev. Dr. Reiley. Dr. Morton's specimens were from Prairie Bluff, Alabama, but this specimen certainly can not be distinct from the one figured by Dr. Morton.

SCALARIA HERCULES, n. sp.

Plate XVIII, Fig. 12.

Shell of large size, robust in proportions, number of volutions unknown but compact, comparatively short, not very ventricose and closely united at the suture lines; apical angle 20° to 25° , giving a rather elongated spire; volutions crossed by from twelve to fourteen very strong vertical varices, which form thick rounded ribs, rather closely arranged, and each marked by two rounded tubercles, one just below the upper suture line and the other near the lower suture line; also a central line of smaller ridge-like nodes intermediate between the other two, apparent on the last volution, marking the position of a spiral carina on the center of the volution, while other spiral carinae cross the upper and lower lines of nodes, and on the base of the last volution the usual carina surrounding the umbilicus is also marked by a thickening of the vertical ribs, but without forming distinct ribs; form of aperture and intermediate surface structure undetermined.

This species seems to be a true *Scalaria* and has been one of the largest and most robust of its kind. The vertical ridges are, however, rounded, thickened ribs, and not simply varical lips, as in very many of the recent forms; as the varix has been filled to a solid rib before the growth of the shell beyond it had progressed. The number of these varices also varies somewhat on the different volutions, especially between the body whorl and the one preceding it, as they are doubled in some places on the former. On a second specimen the surface of the shell appears to have been marked by closely arranged spiral lines which cross the varices, but as both specimens used are gutta-percha casts from natural molds which are very imperfect, these features are not as distinctly seen as would be desirable. The larger individual must have been 4 or $4\frac{1}{2}$ inches in length when perfect, with a diameter of fully $1\frac{1}{4}$ inches of the body volution.

I know of no other species to which this can be said to be closely related.

Formation and locality: Both individuals are known from the matrix only, in a hard ferruginous sandstone nodule, bearing impressions of *Cypri-meria depressa*, *Leiopistha protexta*, and other known lower marl fossils.

Found loose at Cliffwood, New Jersey, by Prof. Lockwood, and now in the collection at Columbia College.

SCALARIA ? PAUPERATA, n. sp.

Plate XVIII, Figs. 3-7.

Shell of medium size, turbate, with extremely rounded volutions, separated by very distinct and deeply marked sutures. Spire elevated, the apical angle about 70° , and the volutions about four in number; the last forms about one-half of the entire height of the shell, and is thickened below by a strong callus which covers the umbilicus and connects the base of the volution with the lip of the aperture; aperture ovate, rounded below and slightly more pointed above, with the inner margin less strongly curved than the outer. Surface of the shell, as seen on an imperfect specimen, marked by vertical varices which have numbered about eleven or twelve to the volution, are very low and subdued and scarcely lip-like in their nature, but are marked on their surfaces by a row of pits which correspond to a series of narrow, flattened, spiral bands, which are themselves separated from each other by spaces about as wide as the bands. Ten of these flattened bands may be counted on the exposed part of the penultimate whorl.

The casts of this species, several of which have been observed, resemble much the internal casts of a *Lunatia*, but have a much larger umbilicus than any of those of that type associated in the same beds. They are paludinaform in shape, with the last volution somewhat expanded just at the aperture, and of an ovate form. The suture between the volutions are quite wide in the lower part, but much less so near the apex, and the surface is smooth, being destitute of the imprints of the varices or spiral striæ, and would be very readily mistaken for those of the casts of a Naticoid shell. I am somewhat in doubt as to the correctness of its reference to *Scalaria*, but the entire peristome, as indicated by the cast, and the surface marking shown on a portion of the partial cast, together with the solid axis of the shell, preclude its reference to any other genus or group with which I am acquainted. The elevation of the spire is much less than is usual among the *Scalariidæ*, but there are several forms known, both fossil and recent, which come very near it. and some quite as extreme.

Formation and locality: In the blackish layers of the Lower Green Marls at Crosswicks Creek, New Jersey. In the collections at Rutgers College. Collected by Dr. N. L. Britton.

TURRITELLIDÆ.

Genus TURRITELLA Lamarck.

TURRITELLA COMPACTA, n. sp.

Plate XVIII, Fig. 8, 9.

Shell small, with very short, slender, and closely coiled but rapidly enlarging whorls, giving a rapidly increasing diameter to the shell with increased growth. Apical angle about 15° . Volutions about eight in number in a specimen which has been not more than seven-eighths of an inch in its extreme length; flattened convex on their outer surface, and subangular at the upper and lower margins, with a nearly flat base. Lower margin of the volution proportionally larger than the upper. Suture lines between the whorls narrow, but very distinctly marked. No surface markings visible.

The above description is taken entirely from internal casts, which are remarkable for their compact form and close volutions of a somewhat quadrangular form in the largest individual, but more rounded in others, indicating, probably, a more thickened shell. None of the external features of the shell have been transmitted to the cast; but its compact volutions will readily distinguish it from any other form in the New Jersey beds. A single very much crushed and distorted specimen from Haddonfield, New Jersey, in the collection of the Acad. Nat. Sci., Phila., retains a fragment of shell on one of the upper volutions showing sharply raised spiral lines to the number of six, with a finer intermediate line, and very fine transverse lines of growth. Otherwise the cast presents the same form and features as those described above.

Formation and locality: In marl with quartz pebbles. The specimens are associated in the tray with examples of *T. encrinoides* Morton, and are marked as coming from Vincentown, New Jersey, and collected by Col. T. M. Bryan. *T. encrinoides* is from the Lower Marl Beds only, so far as known, and it is

very evident there is an error from mixture of specimens in the tray, making the locality somewhat doubtful, as Vincentown would probably be at the base of the Upper Marls. The Haddonfield example is from the very base of the Lower Marls, and its position unquestioned.

TURRITELLA ENCRINOIDES.

Plate XVIII, Figs. 19-22.

Turritella encrinoides Morton: Synopsis, p. 47, Pl. III, Fig. 7; Gabb, Synopsis, p. 90; Meek, Check List Cret. and Jur. Foss., p. 18; Geol. N. J., Newark, 1868, p. 729.

Shell much elongated and rather slender, apical angle in uncompressed specimens from 15° to 20° ; volutions compact, numbering seven in a specimen which measures $1\frac{3}{4}$ inches in length, flattened or only slightly convex on their surfaces, with narrow suture lines in the cast and sharply angular basal angle, but on fragments which preserve the shell in part at least, they are slightly depressed. The surface is marked by numerous spiral lines which vary much in size and strength, there being two principal ones, one near the upper and the other near the lower edge of the volution, with an indefinite number of smaller ones; aperture, as indicated by the form of the cast, subquadrangular, nearly straight on the outer margin and angular above and below.

The species differs quite strongly from *T. vertebroides* in the form of the volutions and the less distinctly marked sutures, and in the greater number of spiral lines. One of the fragments used in this description and figured on our plate appears to be that used by Dr. Morton and figured by him. It retains the shell to some extent, but is very imperfect. Among collections obtained from the State survey are many internal casts which show the volutions to be more compact than in *T. vertebroides*, and very much more angular, with close sutures and sharp upper and lower angles.

Formation and locality: Dr. Morton's specimen is marked "Cretaceous, N. J." Under his notice of it in the Synopsis, p. 47, he says it occurs with *T. vertebroides*, and although he gives it a name, gives no description or locality except "New Jersey and Alabama." Other specimens in the State collection are marked "Vincentown, N. J.," and are from collections made

by Col. T. M. Bryan; several others are from Upper Freehold. They are probably from the Lower Marls, but Dr. Morton's specimen is of a rusty character, unlike any other which I have seen, and appears as if it had been imbedded in a ferruginous clay. A large slab of limestone bearing very many examples of this species as partial casts, but retaining something of the surface markings, has recently been obtained from the clays at Sayersville, New Jersey, by J. H. Conger, Esq.

TURRITELLA? GRANULICOSTATA.

Plate XVIII, Figs. 10, 11.

Turritella granulicostata Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 363; Meek, Check List Cret. and Jur. Foss., p. 18; Geol. N. J., Newark, 1868, p. 729.

The following is Mr. Gabb's description of this shell:

Shell elongated, whorls many, increasing very gradually in size, almost perfectly flat on the sides. Suture impressed, very distinct; bordered below by a slight elevation of the upper edge of succeeding whorl; lower angle of the whorl rounded, subangular. Mouth small, subquadrate; anterior angles rounded. Surface marked by about twelve fine, thread-like revolving ribs, three of which are larger than the rest, are placed at equal distances from each other, and from the upper and lower edges, and are slightly undulated so as to produce a series of minute nodes. This character shows itself to a much less extent on some of the smaller ribs. Under surface of the body volution marked by a few fine revolving ribs, with regular concavities between them.

This fragment, consisting of nearly four volutions, is all that is known of the species. The casts referred to by Mr. William Gabb may or may not belong to the same; we certainly do not know the casts of this one authentically. The surface markings are rather those of a species of *Cerithium* than of a *Turritella*, but the mouth is mutilated, so that its features can not be satisfactorily determined.

Formation and locality: In the Lower Green Marls, most probably in Burlington County, New Jersey. The specimen is now in the collection of the Acad. Nat. Sci., Phila.

TURRITELLA HARDIMANENSIS.

Turritella Hardemanensis Gabb: Jour. Acad. Nat. Sci., Phila., vol. 4, 2d ser., p. 392, Pl. LXVIII, Fig. 15; Synopsis, p. 90; Meek, Check List Cret. and Jur. Foss., p. 18; Geol. N. J., Newark, 1868, p. 729.

Mr. Meek cites this as a New Jersey species in his list as above quoted, and in the Smithsonian check list gives only New Jersey as its habitat. Mr. Gabb states, under his original description, that he has seen a "very young" specimen of it in the cabinet of Mr. Lea, obtained from the Ripley group, in New Jersey. This I presume means either Crosswicks, or more probably Haddonfield, New Jersey, as Mr. Lea had specimens from this latter place. I have not seen the specimen in question, and as it is said to have been a *very young* specimen, fear there may have been some mistake in the identification; especially as the species, so far as known from the type, is a small one anyway. Young *Turritellas* are not the most reliable material for specific determinations, although it is possible that in this case it may have been correct. The beds at Haddonfield are at the very lowest horizon yet yielding undoubted Cretaceous fossils in New Jersey, and have lithological features remarkably similar to those of the Ripley group of the more southern States, so there is a double chance of error in this case.

TURRITELLA LIPPINCOTTI, n. sp.

Plate XVIII, Figs. 23, 24.

Shell of medium size, rather rapidly tapering, the apical angle being about 20° or less. Volutions flattened on the surface in the direction of the spire, with scarcely perceptible suture lines where the shell is preserved, and only very moderate ones in the cast; their form in a section being trapezoidal, the upper and lower outer angles being rather sharply angular, even in an internal cast; basal face scarcely convex; volutions numerous, a fragment measuring not quite 2 inches in length, with a diameter at the lower end of five-eighths of an inch, retaining seven, with space at the upper portion for about five more. Surface of the shell marked, in the only specimen which preserves it, by fine rounded spiral, thread-like lines over the entire surface.

The species resembles, in its general contour, *T. vertebroides* Morton, but tapers somewhat more rapidly. It differs from that one, and all the

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others with which it is associated in the New Jersey beds, in the flattened volutions and in the surface characters. In some of the casts the upper whorls are somewhat rounded from the greater amount of deposit on the inside of the older parts of the shell, but they never attain that degree of wide separation of the volutions, with wide sutures, that is common in *T. vertebroides*; while even in the most thickened specimens the lower whorls show the rectangular form of the volutions, and usually retain some evidence of the spiral lines. The general aspect as furnished by these casts indicates a thin and rather delicate shell, instead of the thick, heavy shell of *T. vertebroides* and *T. encrinoides*.

Formation and locality: In the Lower Green Marls at Crosswicks Creek, near New Egypt; at Upper Freehold; Holmdel and Walnford, New Jersey.

TURRITELLA VERTEBROIDES.

Plate XVIII, Figs. 13-18.

Turritella vertebroides Morton: Synop. Org. Rem. Cret., p. 47, Pl. III, Fig. 13; Gabb, Synopsis, p. 92; Meek, Check List Cret. and Jur. Foss., p. 19; Geol. N. J., Newark, 1868, p. 729.

Shell much elongated and slender, the apical angle in an uncompressed internal cast of large size being about 12° ; volutions slightly convex on the exterior, when retaining the substance of the shell, nine or ten in number, and marked on the surface by five or more sharply elevated spiral ridges, and apparently with finer lines on the interspaces and with fine transverse lines of growth crossing them. Sutures moderately distinct, but not channeled or grooved. Aperture unknown. On the cast the volutions are widely separated, indicating a considerable thickness of shell, and their form is obliquely rounded, larger and subangular near the lower margin as they approach the lower end of the shell, but more distinctly circular and proportionally more slender in the upper part; probably from the greater thickening of the shell on the inside. The surface features are only indistinctly marked on the larger part of the casts, a single spiral groove in the upper part indicating a strong feature of the shell at this part.

The specimens of this species which retain the surface features are very few and badly preserved, being mostly in a pyritous marl which rapidly disintegrates on exposure. They are usually more or less compressed

and only a small portion of the shell substance remains. The spiral lines are usually distinct, but the minute transverse lines of growth which ought to mark the surface are only occasionally seen. The species has apparently reached a pretty large size, one individual having a length of considerably more than 3 inches, and is imperfect at each end. Dr. Morton's figure given in the Synopsis is more rapidly tapering than any of the examples I have seen. Among the specimens borrowed from the collection at Philadelphia there is a fragment which I supposed to be the one used and figured by Dr. Morton. It is compressed to less than one-half of its original diameter and is probably correspondingly increased in its rate of expansion, which will in part account for the outline of his figure. The specimen is much injured and is probably less perfect than when Dr. Morton used it. I have attempted to give a figure of it as it now is as a record of its existence and condition, as it will in all probability entirely decompose in a few years.

Formation and locality: Dr. Morton gives only New Jersey and Alabama as localities. His New Jersey example is probably from Upper Freehold, from whence I have several examples. Others are from near New Egypt, Tinton Falls, J. Banks's pits near Marshallville, and from J. S. Cook's beds near Tinton Falls, New Jersey; all from the Lower Marls.

Genus LAXISPIRA Gabb.

Proc. Acad. Nat. Sci., Phila., 1876, p. 301, Pl. xvii, Figs. 6, 7.

Mr. Gabb's description of this genus is as follows: "Shell spiral, dextral, whorls with a circular cross section, few in number, and so rapidly descending as to form an open spiral; aperture simple, lips thin."

His remarks on this genus are as follows, given in full:

A curious genus, the relations of which are not clear to me. I propose it to receive some shells which have been long known as internal casts in the marls of New Jersey, but of which the surface was unknown until quite recently. In general form they might be compared to a partially uncoiled *Turritella*. From that genus they differ, however, in the whorls not being in contact, and from *Vermetus* and the allied genera in being regular spirals, but not having the apex either turritelloid or attached. Another analogy, though perhaps only one of external resemblance, might be adduced in such shells as *Euomphalus circinalis* Goldf., or in some of the Delphinulas.

Of the two figures of the only species of this genus, given by the author, the larger one is from an internal cast of a fragment of a *Turritella*, probably *T. vertebroides* Morton, and is given as such on our Pl. xviii, Fig. 18, natural size; the other specimen can not be found after much search. The specimen was quite small, being only about three-eighths of an inch in length. It probably preserved the substance of the shell, as all the Haddonfield specimens do, and ought not to have been misunderstood by the author of the genus and species. It would appear to have been more related to *Vermetus* than to *Turritella*, and I am inclined to think it only the apex of a species of that genus, or perhaps of a *Serpula*. Still, as the type specimen is lost, I suppose the generic name must stand, for the present at least.

LAXISPIRA LUMBRICALIS.

Plate xviii, Fig. 25.

Laxispira lumbricalis Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 301, Pl. xvii, Fig. 7.

As yet no other specimens of this species have been found than those used by the author in the original description, and of these the larger has proved to be only the internal cast of a *Turritella* and will be found figured as *T. vertebroides* on Pl. xviii, Fig. 18. The other specimen is lost, consequently I can give no description of it from personal examination. I therefore copy below Mr. Gabb's original description:

Shell with a circular cross section; whorls about as far apart as the diameter of the whorls, three or four in number; surface marked by numerous small, closely placed revolving ribs.

Mr. Gabb, in his remarks following the above description, refers the large casts doubtfully to the same species as the "small specimen from the Ripley Marls, from Haddonfield, New Jersey," from which the description was made. Mr. Gabb's figure of the small specimen is also copied. It is greatly enlarged from the specimen, which was only about three-eighths of an inch in length, and probably preserved the shell. What the small specimen may have been I have no means of knowing other than the author's description and remarks, but presume it may have been the apical portion of a *Vermetus* or *Serpula*.

Formation and locality: From the base of the Lower Marl Beds at Haddonfield, New Jersey.

VERMETIDÆ.

Genus SILIQUARIA Brug.

SILIQUARIA PAUPERATA, n. sp.

Plate XVIII, Figs. 26-28.

A few specimens only of casts of tubes referable to this genus have come under my notice. Two of them are coiled and retain the younger parts of the specimens, while most of them are only fragments representing medium sized parts of the tubes, or parts from the large irregularly coiled portions. The tube is very gradually tapering, and either compactly or loosely coiled in the upper part; but all show their relations to the genus *Siliquaria*, by the narrow ridge left along the upper side of the tube by the material which has filled the slit. There is no distinctive feature represented on the specimens by which they can be distinguished from casts of other species of the genus; and, as no evidence of the surface characters are preserved, no data for comparison is left.

Some of the specimens included under the species are marked on the label accompanying them in the cabinet of the Acad. Nat. Sci., Phila., as types of Mr. Gabb's *Laxispira lumbricalis*, which species is also the type of the genus *Laxispira*. I can not, however, feel satisfied that they were ever used by Mr. Gabb as such, nor do I see how he could have constructed the figure given of that species and genus from the specimen in question; as there certainly is no evidence of the longitudinal striæ there represented on the specimen which I have figured on Pl. XVIII, and which is the best of those on the card labeled with that name, and marked "types."

Formation and locality: Some of the specimens are marked as coming from Haddonfield, New Jersey, collected by T. A. Conrad; others were associated with specimens without definite locality, but mostly Lower Marl fossils.

EULIMIDÆ.

Genus LEIOSTRACA H. and A. Adams.

LEIOSTRACA CRETACEA.

Plate XIX, Figs. 2-5.

Eulima cretacea Conrad: Am. Jour. Conch., vol. 5, p. 100, Pl. IX, Fig. 15.

Shell small, slender, subulate, spire very much elevated, smooth and polished; volutions nine or more (eleven, Conrad), flattened between the sutures, the upper edge of any volution slightly smaller than the lower edge of the one immediately above it, making the sutures remarkably distinct for a shell of this group; body volution rounded subangular in the lower part and rather rapidly contracted below to the short columella; aperture ovate-elliptical, acute above and rounded below; outer lip thin and sharp, inner lip smooth, without callus or ridges; surface polished, entirely destitute of lines or other markings. On one individual, on which the lip is broken away for one-third of the volution, there occurs a distinct spiral ridge above the columella proper and just below the junction of the outer lip with the body of the volution, within the aperture.

This small but beautiful shell presents the general appearance of the genus *Eulima* Risso., except that the spire is straight, and there are no evidences of the periodic mouths common to that genus. In the form of the aperture it more closely resembles *Leiostraca*, but the volutions are more decidedly flattened externally between the sutures. It seems to be more nearly related to this latter genus than to any other established one. But if the ridge found within the aperture of one of the individuals should prove to be a constant feature, it would deserve a separate generic name. This ridge, occurring as it does just below the top of the aperture on the inner side, is peculiar, and may possibly be an accidental feature of the individual; but I can not verify it without destroying the borrowed specimen. Mr. Conrad remarks under his description of the species that it is "distinguished by the whorls of the spire suddenly curving inward above the suture." This feature arises from the fact that the coiling of the volution is just below the swell of the one above, but is seen distinctly only on

one individual. He also states that the whorls are "slightly truncated at base except the last one." I may misunderstand this expression, but if, as I suppose, he means that the columella is truncated, I think he is wrong, as there is no evidence whatever of such a feature, and I am at a loss to understand how he could determine the form of the base of the volution from any "except the last."

Formation and locality: From the micaceous clay at the base of the Lower Green Marls at Haddonfield, New Jersey. Collection of Acad. Nat. Sci., Phila.

PYRAMIDELLIDÆ.

Genus OBELISCUS Humphrey.

OBELISCUS CONELLUS, n. sp.

Plate XIX, Fig. 1.

Shell minute, the extreme length of the only specimen known being only about one-sixth of an inch. Apical angle 38° or 40° , giving a sharply conical spire; volutions five in number, very slightly scaliform, with channeled sutures, but with the surface of the volution flattened in the direction of the spire; apex apparently rounded; body volution subangular at the line of contact with the lip; aperture acute-ovate, sharp at the upper margin, and possibly pointed below (the specimen is imperfect at the base); columella slender, rounded, slightly prolonged; marked by a proportionally very strong, tooth-like ridge just below the swell of the volution; outer lip of the aperture sharp; axis imperforate; surface smooth, but not polished on the specimen, though the dullness present may be the effect of solution.

The very small size of the specimen would indicate that it was immature, which may very likely be the case, still in this genus of shells the generic and often the specific features are present even on very young individuals, so that in the event of larger specimens of this one being found they will be readily recognized. I do not know that the genus has been recognized in the Cretaceous of this country before, although the allied form *Pyramidella* is supposed to extend as low.

Formation and locality: In the dark micaceous clays beneath the Lower Green Marls at Haddonfield, New Jersey. Collection Acad. Nat. Sci., Phila., where it was found in the tray with *Leiostrica cretacea* Conrad.

LITTORINIDÆ.

Genus MODULUS Gmelin.

MODULUS LAPIDOSA, n. sp.

Plate xvii, Figs. 6-8.

Delphinula ? *lpidosa* (Mort.) Meek, Check List Cret. and Jur. Foss., p. 18; Geol. N. J., Newark, 1868, p. 728.

Straparolus lapidosus Gabb (in part): Jour. Acad. Nat. Sci., Phila., vol. 4, 2d ser., p. 300, Pl. XLVIII, Fig. 5; but not of Synopsis and subsequent publications. Not *Delphinula lapidosa* Morton: Synop. Org. Rem. Cret., p. 46, Pl. XIX, Fig. 7, and Gabb's Synopsis, p. 48.

Shell rather small, subdiscoid above, with a flattened or but slightly convex spire, as seen in the internal casts, and a broadly rounded outer margin to the volutions and very shallow base. Volutions three or more, rather rapidly increasing in size, the last one slightly spreading at the aperture. Sutures very distinct. Umbilicus moderately large and the margin sharply carinate; also showing a strong groove along the base on the inside, indicating the existence of quite a strong spiral ridge on the inside of the aperture of the shell just above the base. The aperture has been proportionally large, higher than wide, obliquely subovate, rounded above and pointed at the base of the inner lip, with the spiral ridge as above described just above the base; surface unknown.

The casts of this species have the features of the genus *Delphinula*, with the additional one of the tooth-like ridge on the columellar lip a little above its base. In this feature it agrees most nearly with the characters of the genus *Modulus* Gmelin, and none of the other features yet known to belong to it would disagree with those of that genus. I have before me casts of four individuals more or less imperfect, but all showing in a satisfactory manner the groove left by this tooth-like ridge and the angular base of the aperture. For this reason I conclude to place this species under the genus

Modulus, as being more probably its true position than elsewhere. Although the surface characters of the shell are really unknown, there are slight evidences on one of them of the shell having been thin, with a transverse lamellose structure within and near the umbilicus. There are also faint indications of a few distant subangular spiral ridges on and below the periphery of the outer volution of the best cast.

This shell has been usually identified with *Delphinula lapidosa* Morton, the type of which was from Alabama, and is figured on the plate with this one for comparison. It will be seen from that, that the difference in form of the cast, the size and character of the umbilicus, and want of tooth, entirely separate them generically.

Formation and locality: The specimens are from the collection Acad. Nat. Sci., Phila., and are marked as "Cretaceous, N. J.," only. They, however, are evidently from the Lower Marl bed, and from their lithological character I should say three of them were from the brown layers near Burlington, and the other, the figured example, from near Mullica Hill, New Jersey.

Order SCUTIBRANCHIATA.

Suborder EDRIOPHTHALMA.

PATELLIDÆ.

Genus HELCION Montfort.

HELCION ? TENTORIUM.

Plate XIX, Figs. 6-8.

Patella tentorium Morton: Synop. Org. Rem. Cret., p. 50, Pl. I, Fig. 11.

Helcion tentorium (Mort.) D'Orb., Prod. de Paléont., vol. 2, p. 232; Gabb, Synopsis, p. 57; Meek, Check List Cret. and Jur. Foss., p. 17.

Hipponyx tentorium, Morton: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 8, p. 210.

Halcyon ? tentorium (Mort.) Meek: Geol. N. J., Newark, 1868, p. 728.

Shell small, orbicular or subcircular in outline, being slightly longer than wide, and measuring about half an inch in length; very depressed

conical with a slightly anterior but nearly subcentral apex which is elevated above the margin equal to about one-third the length of the shell; sides and anterior end of the shell slightly concave between the apex and margin, and slightly convex along the posterior side. Surface marked by elevated, rounded, radiating costæ, which are rather wider than the interspaces and gradually increasing in size toward the margin of the shell, but are constantly increased in number, both by bifurcation and by implantation. The radii are crossed by very fine concentric lines, but toward the margin of the shell these increase in strength so as to become distinct crenulations on the top of the radii, and are nearly or quite one-half as strong as the radii themselves.

This shell has some peculiar features about it which makes me quite doubtful as to its true generic relations. In the first place, the substance of the shell is unlike that of a gasteropod, and appears almost as if it might have been phosphatic in nature. The apex of the specimen is worn away, and the substance of the shell partially exfoliated for some distance below, as well as being apparently partially replaced or infiltrated with iron in the condition of a sesquioxide. It has much the character of a *Crania* also, and I have been strongly inclined to consider it as one, especially as it appears to have been attached to another shell, *Pecten*, although this might also be the case, perhaps, with a gasteropod of the nature of *Helcion*, or more particularly so of *Hipponyx*, to which genus it appears to have been referred by some one, I think by Mr. Conrad, in whose handwriting, apparently, the reference is made on the accompanying label. As it, however, is represented only by a single specimen, and that one Dr. Morton's type, I have not felt at liberty to manipulate it in any manner to ascertain its true nature. It agrees, as far as the specimen shows, with the genus to which I have referred it, except in its texture. So, for want of more definite evidence as to its true nature, I leave it as placed by D'Orbigny.

Formation and locality: In the Lower Marls near Arneytown, New Jersey. The specimen is the property of the Acad. Nat. Sci., Phila.

Subclass OPISTHOBRANCHIATA.

Order TECTIBRANCHIATA.

TORNATELLIDÆ.

Genus ACTÆON Montf. (= *Tornatella* Lam.)

ACTÆON SUBVOIDES, n. sp.

Plate XIX, Figs 14-16.

Shell longitudinally subovate, with a very short, obtuse spire; number of volutions undeterminable from the imperfection of the specimen; body volution gently convex and constituting the greater bulk of the specimen; aperture elongate elliptical, fully three times as long as wide, rounded below and acute above, measuring about four-fifths as long as the body volution, taken on the same side as the aperture; columella, as seen in the casts, apparently marked by two folds, both of which are rather obscure and seen only as slight impressions on the surface of the columellar cavity, and quite high, so as to be invisible in a drawing of the aperture; surface marked by rather fine, spiral lines, coarser on the lower part than above, and the surface of the cast marked by a rather broad depressed spiral band or groove, a little below the suture. Indications of transverse lines of growth are extremely faint.

This species approaches most nearly to *A. Forbesi*, but differs in the general form, being more oval and less heavy below, and in the upward length of the aperture, which is not nearly so high as in that one. It also differs very materially in the form and position of the fold of the columella, which will be readily seen on comparing the figures.

Formation and locality: The specimen came to me from the Acad. Nat. Sci., Phila., where it was found with an old label indicating it as a type of *A. ovoïdes* Gabb, and at first was used under that title, although differing very materially in proportion from the measurements given by Mr. Gabb. Subsequently the true type of that species was discovered with the author's own label, and was found to be very distinct from this one, and is an *Avelana*, consequently leaving this to be classed as a new species. The

label found with this one indicated no locality, but from the character of material it would appear to have come from Mullica Hill, New Jersey, and consequently would pertain to the Lower Marl Bed.

ACTÆON GABBANA, n. sp.

Plate XIX, Figs. 23-25.

Actæonina biplicata (M. & H.) Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 93, Pl. II, Fig. 13.

Solidula biplicata (M. & H. sp.) Gabb: Synopsis, p. 38.

Solidula biplicata (Gabb) Meek, Check List Cret. and Jur. Foss., p. 17; Geol. N. J., Newark, 1868, p. 728.

Actæon biplicata (Gabb sp.) Meek: U. S. Geol. Surv. Terr., vol. 9, Invert Pal., pp. 281, 282.

Shell of medium size, elongate ovate or subcylindrical in outline, spire moderately elevated, entire length and number of volutions unknown. Body volution cylindrical in the upper half, obtusely rounded below. Aperture narrow, pointed and very contracted above and rounded below, about four-fifths as long as the length of the body volution, measured on the same side. Columella slightly twisted below and marked by a single tooth near the base, as determined by the groove showing on the cast. Surface of the shell marked by fine spiral lines, the number undeterminable from the specimens examined.

The species is known only from two individual casts, both of which appear to have been used by Mr. Gabb in his original investigations. I can not, however, ascertain the existence of more than a single tooth on the columella from the specimens, as they show only a single groove left by the removal of the substance of the shell. The specimens are also both imperfect in the upper part of the spire, so that the entire height is not ascertainable. The shell is, however, so distinct in its proportion from any other from the New Jersey formations, that there is no chance of confounding it with them. There appears to have been some confusion in the author's mind in regard to the specific relations of this shell, when the name *Actonina biplicata* was applied; and also subsequently, as he refers it to a species described by Meek and Hayden from Nebraska. These latter

gentlemen, however, disclaim the responsibility of the name, and as none such appear in any of their works, we can only conclude that Mr. Gabb was in some way confused, as suggested by Mr. Meek in his *Invert. Paleont. of the Territories*, that Mr. Gabb intended to refer it to *A. attenuata*; but it certainly is a very distinct species and can never have had so elevated a spire as that one. As the name *A. biplicata* has been previously used by D'Orbigny for a very distinct species, and as this one appears to be a true *Actæon*, I see no way to avoid a change of name in this case, and therefore propose the name *Actæon Gabbana* as a substitute for that used by Mr. Gabb.

Formation and locality: In the Lower Green Marls. The specimen is labeled "Tinton Falls, New Jersey," and is from a green marl, and may have come from below the middle marl bed at that place. In the collection Acad. Nat. Sci., Phila.

ACTÆON FORBESIANA, n. sp

Plate XIX, Figs. 17-22.

Tornatella. Lyell and Forbes: *Quart. Jour. Geol. Soc.*, London, vol. 1, 1845, p. 63, Fig. c.

Shell of about a medium size for the genus, broadly ovate or ovoid in outline, spire short, obtusely rounded, middle portion of the shell sub-cylindrical and the base obtusely pointed, having nearly the same angle as that of the spire. Volutions from four to five in number, closely coiled and rising but slightly one above another; body volution very slightly chamfered just below the suture, presenting an almost imperceptible angle a little below the suture, below which it is nearly cylindrical to below the middle of its length, and obtusely pointed at the lower extremity. Aperture two-thirds the length of the shell, and considerably longer than the diameter of the body volution, very narrow at the upper part, but gradually widening below, rounded in front. Columella comparatively strong, bearing a single oblique ridge near the middle of its length, and having the margin thickened below it, and around the base of the aperture, as seen by the impression of these features on the internal casts. Surface of the casts marked by rather fine, closely arranged, spiral lines,

which may have been punctate on the shell, as on one of the casts there are indications of such a feature having existed; this, however, is by no means certain. No transverse markings, other than perhaps fine lines of growth, are indicated on any of the specimens present.

The species differs from any of the associated forms in the proportions of the shell, being much more robust than in *Actæon Gabbana*, and much less so than *A. bullata*. In fact it is of a very different type from the latter species. It bears some relation to *Actæon ovoidea* Gabb, but is a much shorter and smaller species, and has been entirely destitute of the broad longitudinal ribs credited to that one; nor has it had a second fold on the columella in advance of a "large broadly rounded" one as described on that shell, the fold being quite faint and slight on all the specimens examined. The figure given by Lyell and Forbes above cited is quite characteristic, and shows a somewhat larger individual than any which I have seen.

Formation and locality: In the Lower Green Marls at Mr. C. Bruere's pits, near Wahnford, New Jersey, and probably from Crosswicks Creek, and in the white limestone layers at Marlborough, New Jersey; the latter two localities I assign to some specimens in the cabinet of the Acad. Nat. Sci., Phila., from their lithological characters; no locality further than "N. J." being found with them.

ACTÆON CRETACEA.

Plate XIX, Fig. 9-12.

Actæon cretacea Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 318; Meek, Check List Cret. and Jur. Foss., p. 17; Geol. N. J., Newark, 1868, p. 728.
Compare *A. ovoidea* Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 319.

Shell smaller than that of *A. ovoidea*, but very similar in form and proportions, being somewhat more pointed below the middle and at the base. There is considerable difference between the descriptions of the two species as given by Mr. Gabb, and it is extremely difficult to tell which of the forms he has had in hand when writing them, except for the difference in size; for a part of each description applies best to one and the other part to the other, in each case; while I am strongly inclined to consider

them identical, I have taken them as they are identified and labeled in the collection Acad. Nat. Sci., Phila., and partly from his descriptions. In his comparisons under *A. ovoidea* he says that species can be distinguished from this one by "the proportionate length of the mouth, and narrowness of the body whorl, and the acute upper edge of the whorl." The proportional length of the mouth is nearly as given in his description, i. e., less in this one. The volutions are more acute also in that one, while the proportional diameter of the body volution of the two species is very nearly the same in both. The width of the aperture is also greater here than in *A. ovoidea*; in these respects they nearly agree with his statements. The author remarks that in this species (*A. cretacea*) there are two folds on the columella, "the upper one heavy and rounded, lower or anterior one obsolete." If the lower one is obsolete, which it certainly is in the specimen here used, which is one of the types, it can not exist; therefore there is only one, and not two as he describes. In the other species a similar error is made, as to the relative size of the folds as the anterior one is barely distinguishable on the specimen, which is also one of those used in the original description. Mr. Gabb also states that on one of the casts of this species "the columellar edge of the body whorl" "is marked by acute angular striae, one branch extending directly upwards on the outside of the whorls [inside of the shell], and soon becomes obsolete; the other branch runs into the columellar cavity." This feature I can not understand, as the specimen is not before me, but I think that by some accident the description in this connection has become mutilated in the printer's hands, and has escaped notice in proof-reading. In remarks below the description he states that from a cast of the surface he believes the exterior to be smooth. As it appears that I have not seen all the specimens used by the author, I have retained the name of the species and its identity, thinking it probably may be satisfactorily identified at some future time.

Formation and locality: In the Lower Green Marl at Crosswicks, New Jersey. Collection Acad. Nat. Sci., Phila.

Genus GLOBICONCHA D'Orb.

GLOBICONCHA (TYLOSTOMA) CURTA.

Plate XIX, Figs. 26, 27.

Globiconcha curta Gabb : Proc. Acad. Nat. Sci., Phila., 1861, p. 319 ; Meek, Geol. N. J., Newark, 1868, p. 728.

Mr. Meek cites this as a New Jersey species in his list, given in the Geol. N. J., Newark, 1868, p. 728, but gives no authority for its occurrence. Therefore I must suppose he had himself identified it among New Jersey fossils. The species was originally described from specimens obtained from Comanche Peak, Texas, and is a form which I have not seen represented from localities north of that State. The species is a small globose one, represented only by internal casts, and seldom exceeding five-eighths of an inch in extreme length. The specimens are always slightly compressed and are usually marked by a more or less distinct varix on each side of the spire, one of them being on a line with the outer lip of the aperture, showing that they belong to the genus *Tylostoma* Sharp. The varices are, however, often, and perhaps generally, stronger on one side than on the other. The volutions are about four in number and quite ventricose, the last one forming the greater bulk of the shell. I have not been able to determine if there is any ridge or tooth in the aperture other than that formed by the last varix on the volution, which enters the aperture just above the base of the lip. The examples which I have examined are from Bell County, Texas, and do not show any remains of surface structure; but the form of the shell is so peculiar that there will be but little risk of mistaking it, should specimens of it be found among the casts from within the State. I have given a figure of the Texas shell for the purpose of aiding in its determination, should it be found, seeing that it has already been given in the State reports as a New Jersey species by so good an authority as Mr. Meek.

Genus CINULIA Grey.

CINULIA (OLIGOPTYCHA) NATICOIDES.

Plate XIX, Figs. 28-30.

Acteonina naticoides Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 299,
Pl. XVIII, Fig. 2; Meek, Geol. N. J., Newark, 1868, p. 728.

Solidula naticoides Gabb: Synopsis, p. 38.

Cinulia (?) naticoides (Gabb) Meek: Meek, Check List Cret. and Jur. Foss., p. 16;
Stoliczka Ind. Geol. Surv., Pal. Indica, Cret. Fauna South. Ind., vol. 2, p. 411.

Shell small, less than half an inch in height; globular in outline and consisting of about three volutions. Spire low, nearly conforming to the rotundity of the body volution; columella short, axis imperforate in the shell, aperture ovate, moderately large, widest below, about two-thirds as high as the body volution; outer lip thickened and strongly crenulate within. Columellar lip said by Mr. Gabb to possess "two plates," but upon the casts before me I can not find evidence of more than a single one, and that one projects horizontally to a considerable distance from the columella. Surface of the shell marked by closely arranged, spiral lines, of which twenty-eight to thirty may be counted on the body volution. These lines on the cast are rounded, elevated ribs, separated by equally wide concave grooves.

This is a remarkably pretty species even in the condition of internal casts, the only state of preservation in which I have seen it. It somewhat resembles *Acteon concinnus* H. & M., from the Upper Missouri Cretaceous, but is very much larger than any of that species which I have seen, and has the mouth very much wider in proportion. The surface of this shell may have had the lines punctured as in that one, but there is no distinct evidence of it on the several casts examined; although there is a tendency to a crenulation of the ridges, which appears to have been caused by transverse lines of growth parallel to the margin of the aperture. It corresponds very much more closely to *A. concinnus* M. & H. than Mr. Gabb supposed, as it has but one tooth, instead of two as he stated, unless he had a different species in hand, which is scarcely possible. Most of these casts show only a slight ridge in place of the tooth, but a single cast, figured, shows the cavity unmistakably.

MON. XVIII—11

Formation and locality: In the Lower Marl beds in Monmouth County. Mr. Gabb's specimens were from Mullica Hill, New Jersey, and there are specimens in the collection Acad. Nat. Sci., Phila., from near Burlington, New Jersey.

CINULIA OVOIDEA.

Plate XX, Figs. 5, 6.

Actæon ovoidea Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 319; Meek, Check List Cret. and Jur. Foss., p. 17; Geol., N. J., Newark, 1868, p. 728.

Shell rather large, broadly ovoid or subglobose in general form, with a moderately elevated spire, which is rounded rather than pointed; volutions about four or perhaps four and a half, with distinctly marked sutures in the cast; body volution large, forming almost the entire bulk, and about nine-tenths of the entire height of the shell, quite convex in the middle and slightly pointed below, with a broad depressed, obscure furrow below the top; aperture large, rather more than three-fourths as long as the principal volution on the apertural side of the shell, pointed at the upper end, and moderately increasing to below the middle of its length; obtusely pointed below but wider than above. The columella has been strong, judging from the size of the perforation left by its removal, and furnished with a single moderately strong tooth near the middle, with an indistinct line below just above the margin of the aperture; surface of the shell marked, as obscurely indicated on the cast, by a few rather broad spiral lines, the upper one on one specimen having quite a distinct depression below the upper margin, except on the outer half of the last volution, and is probably the result of accident.

This species is most nearly related to *Solidula bullata* = *Tornatella? bullata* Morton, in size and general form. It is, however, somewhat more erect, has a rather higher spire, coarser surface markings; is somewhat less ventricose, has a stronger columella, which is marked by only a single spiral ridge of less size than on that species. There is also no indication of the extension upward of the last volution near the aperture, as shown on specimens of that species, nor of any thickening of the outer lip. It is readily distinguished from any of the others from New Jersey except *A. cretacea*

Gabb, from which it is very difficult to distinguish it. The specimens of that species used by Mr. Gabb are, however, a little more slender or pointed in the lower part.

Formation and locality: In the Lower Green Marls at Crosswicks, New Jersey. Collection Acad. Nat. Sci., Phila.

Genus AVELLANA D'Orb.

AVELLANA BULLATA.

Plate XX, Figs. 1-4.

Tornatella ? bullata Morton: Synop. Org. Rem. Cret., p. 48, Pl. v, Fig. 3.

Solidula bullata (Morton) Gabb: Synopsis, p. 81; Meek, Check List Cret. and Jur. Foss., p. 17; Geol. N. J., Newark, 1868, p. 728.

Shell large for the genus, attaining fully an inch in length; very globose, the diameter being nearly as great as the height, at least equaling seven-eighths of the height. Spire low and rounded, and the base only slightly more pointed. Volutions between three and four in number, the outer half of the last one more abruptly deflected downward at the suture than the preceding ones, but again elevated near the aperture. Aperture narrow, pointed above and widest below and rounded; the length equal to about four-fifths of the entire length of the shell; columellar margin thickened and marked by horizontal ridges on the upper two-thirds of its length, and by two very strong, ridge-like teeth or plications below the middle, the upper of which is the stronger. Base and outer lip slightly thickened. Surface of the shell, as shown on the cast, marked by fine spiral lines, and by transverse lines of growth. Of the spiral lines about thirty may be counted on the outer half of the body whorl of the larger individual, those near the base being coarser than those above, but gradually becoming fainter in strength. On one of Dr. Morton's types the transverse lines are regular and but little less strongly marked than the spiral lines, so that the surface under a glass looks to be cut up into small nearly equal solid nodes.

The species is remarkable for its large size and globose form, and also among the New Jersey forms for the strong columellar folds or plaits, the upper of which is much the largest. The horizontal line-like granules of

the columellar lip are also somewhat remarkable, and would seem to ally the shell with the genus *Cinulia* Grey as nearly as with *Solidula*. In fact, I have been strongly inclined to place it under that genus. The deflection of the upper margin of the outer half of the body whorl, by which a very much greater proportion of the preceding whorl is exposed on that side, is also a marked feature.

Formation and locality: Dr. Morton gives only "New Jersey" as the locality. The specimens are from a brownish marl with green grains, and resembles that of the brown beds near Burlington and Mullica Hill, New Jersey, and I think are most probably from the former place. I have not seen any other specimens than the types, which are from the collection Acad. Nat. Sci., Phila.

CYLICHNIDÆ.

Genus CYLICHNA Loven.

CYLICHNA RECTA.

Plate xx, Figs. 10, 11.

Bulla recta Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 302, Pl. XLVIII, Fig. 16; Fig. 17 on Plate.

Cylichna recta Gabb: Synopsis, p. 47; Meek, Check List Cret. and Jur. Foss., p. 16; Geol. N. J., Newark, 1868, p. 728.

Shell small, measuring only about half an inch in extreme length, form cylindrical, largest below, with nearly straight sides; spire deeply sunken in the cast; aperture large and the lip nearly straight on the sides, but gradually expanding below; columella curved; surface unknown.

This small species is the only one yet found in the New Jersey Cretaceous, and appears to be very rare, as the type specimen is the only one yet known, so far as I have been able to learn. Mr. Meek has recognized two species in the western Cretaceous, *C. scitula* and *C. volvaria*, the latter doubtfully a *Cylichna*, and Dr. Shumard described three species from Texas, but none of them is nearly related to this one, in which the sides are so distinctly flattened that it can not be well mistaken.

Formation and locality: Mr. Gabb says the specimen was from the Green Marls in Burlington County, New Jersey. The specimen belongs to the collection Acad. Nat. Sci., Phila.

BULLIDÆ.

Genus BULLA Linnæus.

BULLA MORTONI.

Plate XX, Figs. 7-9.

Bulla Mortoni Lyell and Forbes: Quart. Jour. Geol. Soc., London, vol. 1, 1845, p. 63, Fig A; Gabb, Synopsis, p. 41; Meek, Check List Crét. and Jur. Foss., p. 16; Geol. N. J., Newark, 1868, p. 728.

Shell rather above a medium size in the larger individuals, two of the casts before me measuring almost $1\frac{1}{4}$ inches in length, with a transverse diameter of three-fourths of an inch. Form, elongate oval, almost equal in size above and below the middle, the upper end perceptibly the smallest, and the point of greatest diameter rather below the middle of the length. Upper end slightly truncate, and in the cast rather strongly perforate, indicating a solid axis or spire of considerable dimensions, the outer lip of the aperture rising somewhat above the truncation; aperture very elongate, narrow, and rounded above, scarcely widening for the upper third of its length, then rather rapidly expanding below, but principally on the inner side, to twice the width at the lower third of that of the upper third of the length; base pointedly rounded and projecting considerably below the opposite part of the body whorl. Columella thickened and showing slight indications of an angularity on its inner edge, not visible except with a glass, looking within the cavity, then only on the larger well preserved specimens. Surface marked throughout with fine, nearly equidistant, spiral, depressed lines and obscure transverse undulations of irregularity of growth.

This shell was described by Lyell and Forbes as long ago as 1843, and an excellent figure given of a medium-sized individual. It is readily distinguished from *B. conica*, herein first described, by the point of greatest diameter being nearly centrally located, while in that one it is at about the

lower third of the shell's length, giving it a subconical or truncato-conical outline, very readily distinguished in comparison with the form of this species.

Formation and locality: In the blackish green marls of the Lower Marl Bed, at Crosswick's Creek, New Jersey; collection at Rutgers College, collected by Dr. N. L. Britton; and also from the collection Acad. Nat. Sci., Phila., but without any indications of locality other than "Cret. N. J."

Class SCAPHOPODA.

DENTALIIDÆ.

Genus DENTALIUM Linnæus.

DENTALIUM SUBARCUATUM.

Plate XX, Figs 19-24.

Dentalium subarcuatum Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 2, Pl. XXIV, Fig. 13; Gabb, Synopsis, p. 49; Meek, Check List Cret. and Jur. Foss., p. 17; Geol. N. J., Newark, 1868, p. 728.

Shell small, and as seen in casts, the usual condition in which it is found, slender and round, very gradually tapering and very gently arcuate throughout its length. A specimen 1 inch long measures only one line in diameter at the larger end, and less than half that at the smaller end. Along the dorsal line of the cast there is a rounded elevated ridge, with a flattened area on each side of it, traversing the entire length, and also in some cases a depressed line a little distance from the ventral center on each side, and more seldom other depressed longitudinal lines between these and the dorsal line. On still other casts the dorsal line or ridge is only faintly marked, and all others obsolete, leaving the cast comparatively smooth. On a specimen which preserves the substance and shows the surface structure about the same proportions or rate of increase is shown, allowing for its partially compressed condition. On the posterior two-thirds of the length the surface is longitudinally lined with sharp distinct ridges, with broad flattened interspaces. Seven of the ridges can be seen on one side of the specimen, as it lies in the marl, indicating the existence of twelve or

fourteen on the entire shell. On the larger or outer third of the shell's length the surface is marked only by fine transverse lines of growth, the longitudinal ridges becoming obsolete below and the shell presenting a semi-polished structure. No slit or groove can be detected in the shell, or indication of such feature on any of the casts, consequently the shell appears to be a true *Dentalium*. On the interior of a second specimen which preserves the shell and is broken so as to give a good transverse section, the longitudinal groove on the dorsal side, which gives rise to the ridge and flattened spaces, as described on the internal casts, is clearly shown.

Species of this genus are so numerous and their features so similar, that without nearly perfect specimens for comparison, differences or similarities can not well be established or described; therefore, not having such in hand, I shall not attempt to point out those in which this species differs from others.

Formation and localities: In the Lower Green Marls at Mullica Hill, and in the micaceous clays at their base at Crosswicks and Haddonfield, New Jersey. Collection Acad. Nat. Sci., Phila.

DENTALIUM RIPLEYANUM.

Plate LXIX, Fig. 48.

Dentalium Ripleyanum Gabb: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4; Synopsis, p. 49.

This species is cited by Mr. Gabb from New Jersey, on p. 49 of his Synopsis. I have not been able to find his description of the species, and have seen no specimens which I could identify with it. The species is named *Ripleyanum* probably from the locality, or possibly it may have come from Eufaula, Alabama, which is of the Ripley group. If the species occur in New Jersey at all, it would probably be found at Haddonfield or at Crosswicks Creek in the dark micaceous clays at those localities, as these layers are apparently equivalent to the Ripley and Eufaula beds. The species appear to be a small, very slender and almost sharply pointed one, with about eight or ten longitudinal ridges, judging from his figures. I think it very probable it may have been seen in the Haddonfield layers, as it would be very likely to occur there, and if collectors at that locality would make a thorough search in these lowest beds of the formation, they

would probably be rewarded by many new and hitherto unrecognized forms.

Genus FALCULA Conrad.

Am. Jour. Conch., vol. 6, p. 77.

The peculiar shells, or rather internal casts of shells, upon which this genus was founded, have all the appearance of shells of the genus *Dentalium* except in the greater curvature, and were originally described as such. At the time Mr. Conrad proposed to separate them as a distinct genus, he states that "under a lens this cast shows a minute, very closely granulated surface, slightly iridescent." He further states that "this character, together with the expanded base, renders it doubtful whether this shell belongs to the family *Dentaliidae*." I have in my hands the specimen from the collection Acad. Nat. Sci., Phila., which I suppose to be those used by Mr. Conrad and which are the only ones known to me; but I can not find the peculiar structure of which he speaks. Nor does the expansion of the aperture mentioned seem to me to be more than would be presented on a cast of a thickened tube by the rounding out, or rapid decrease in thickness, of the shell at the aperture. In vol. 5, Am. Jour. Conch., p. 45, under the original description of the species, Mr. Conrad says: "There is one other similar species in India, *D. hamatum*." This latter species, described by Forbes in the Trans. Geol. Soc., London, vol. 7, p. 138, is said by Dr. Stoliczka to prove to be only a cast of a longitudinally ribbed species of *Serpula*, on the examination of the type specimen. Consequently it can scarcely be generically identical with this one. Mr. Conrad has also created some confusion in regard to the specific name of this shell, as he originally described it as *Dentalium falcatum*, and when making his genus, changes the name to *Falcula hamatus* without the slightest reference to or reasons for changing the specific name; but shows it to be the same by his references to the same page, plate, and figure where his *D. falcatum* is given. It may be that in the shells themselves the curvature, coupled with some at present unknown feature, would distinguish them as generically separable from the true *Dentalia*, but I see no reason, as far as the casts show, for considering them different from shells of that genus, except the greater and irregular curvature.

DENTALIUM (FALCULA) FALCATUM.

Plate XX, Figs. 12-18.

Dentalium falcatum Conrad: Am. Jour. Conch., vol. 5, p. 44, Pl. II, Figs. 12, 16.*Dentalium* (?) *hamatus* Conrad: Am. Jour. Conch., vol. 6, p. 77.*Falcula hamatus* Conrad: Am. Jour. Conch., vol. 6, p. 77.Not *Dentalium hamatum* Forbes: Trans. Geol. Soc., London, vol. 7, p. 138, Pl. xv, Fig. 8.

The casts on which this species was founded are small, cylindrical, gradually tapering and strongly curved, with a decreasing curvature as they increase in size, the smaller extremity being very much more curved than the larger parts, where in age they become nearly straight. No indications of a slit, lobation, or ridges mark the casts in any part of their length. A partially exfoliated specimen, preserving a single layer of the shell substance over a part of its extent, shows simply very fine transverse striæ, with an indication of a polished interior surface during the life of the animal.

This very peculiar species presents all the ordinary features of a *Dentalium* as far as the casts of the interior could preserve them, except in its great and unequal curvature, which is gradually decreasing in extent from the apex to the outer end. In the extent of curvature and in the rate of increase in diameter the different specimens vary considerably.

Formation and locality: In the Lower Green Marls, at Crosswicks, New Jersey. Other fragments occur associated with fragments of *Teredo* tubes, but without locality marked on them, which may be from other places. Collection Acad. Nat. Sci., Phila.

Genus DIPLOCONCHA Conrad.¹

Geol. North Carolina, vol. 1, 1875, W. C. Kerr. Appendix by T. A. Conrad, p. 12.

Mr. Conrad bases this genus on a shell from the Cretaceous formation of North Carolina, which he describes as follows: "Shell composed of two adhering tubes, one resting in a furrow on the side of the opposite tube."

¹ In placing this genus and species here among the Mollusca of the New Jersey formations, I am not to be supposed as considering it molluscan in nature. Mr. Conrad described it as a mollusk, however, and the name will be sought there by others, should more specimens be discovered.

He remarks, that, among the several specimens found, "none was found attached to shells or other substances," but admits that none was found entire. He does not state that any internal connection exists between the two shells, and from his figures one would infer they were separate tubes merely united by their external surfaces, but in close contact, and probably throughout their entire length. I do not think the twin feature a good generic one, unless there had been some internal connection between the inhabitants of the tubes, but none appears to have existed so far as can be judged from the figures, or from the author's description or remarks; therefore I think the twinning of the shells either an accidental feature or not more than a specific character, and presume the species is only a form of *Serpula*. Among the fossils from the Cretaceous of New Jersey I have a specimen which closely resembles Mr. Conrad's figured specimen, except in that it is not merely attached to, but appears to have been partly imbedded in the substance of a shell of *Plagiostoma dumosum*. The tubes, however, are clearly united and conform to each other in curvature throughout a part of their length, and I presume were specifically related to the North Carolina forms. Until better evidence of the generic validity of the shell is obtained, I shall class this one under *Serpula*, retaining Mr. Conrad's name parenthetically for the present. I have tried to obtain the loan of the type specimen of the genus from North Carolina, but owing to the absence of persons having charge of the collections to which it belongs, I have not been able to see it.

DIPLOCONCHA (SERPULA ?) CRETACEA?.

Plate XX, Fig. 25.

Diploconcha cretacea Conrad: Geol. North Carolina, vol. 1, 1875, appendix, p. 12, Pl. II, Fig. 26.

Tubes apparently duplicate, the two nearly conforming to each other in curvature; in contact, at least for a portion of their length, irregularly arcuate and very slightly increasing in diameter; surface lamellose where partially exfoliated and apparently concentrically and longitudinally lined where perfect.

The specimens have the appearance of *Serpula* tubes and, in their earlier stages of growth, have been recumbent upon or imbedded in the sub-

stance of a *Plagiostoma* or *Dianchora*, and probably numbered more than two on the shell when living, as there are remains of smaller specimens besides the two of large growth. The shells are mostly exfoliated and show a strongly lamellose structure, as if made up of a succession of layers one over the other from the inside. Where broken through they are of considerable thickness, and in this respect differ from the type specimens as described by Mr. Conrad as fragile. It may be that I have wrongly identified the specimens, but the similarity between them is so great that I have not felt safe in considering them as distinct from Conrad's species.

Formation and locality: In the blackish layers of the Lower Marl Beds, at Crosswicks Creek, New Jersey.

EXTRA LIMITA.

Neptunea impressa Gabb: Jour. Acad. Nat. Sci., Phila., vol. 4, 2d ser., p. 389.
Pl. LXVIII, Fig. 5.

This species was described by Mr. Gabb, from Hardeman County, Tennessee, from the Ripley group, and cited in his synopsis of the Cretaceous formations as coming from New Jersey (see p. 62). I have not seen among the casts from New Jersey any one which could reasonably be considered as identical with the specimen which Mr. Gabb has figured.

Anisomyon borealis=*Hipponyx borealis* Mort. See Gabb's Synopsis Cret. Foss., p. 38.

I can find no other evidence of this species having been found in New Jersey than the reference in Mr. Gabb's synopsis. It has probably occurred by mistake in looking at Dr. Morton's original description, where he mentions having described another species of the genus *Hipponyx* from New Jersey.

SECTION II.

CRETACEOUS GASTEROPODA OF THE MIDDLE MARL BEDS OF NEW JERSEY.

MURICIDÆ.

Genus PERISSOLAX Gabb.

PERISSOLAX TRIVOLVA.

Plate XXI, Figs. 1-3.

Fusus trivolvus Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94.

Perrissolax trivolva Gabb: Synopsis, p. 67; Meek, Check List Cret. and Jur. Foss., p. 23; Geol. N. J., Newark, 1868, p. 730.

Shell of medium size, ventricose, with a long, straight canal, once and a half as long as the length of the inner part of the body whorl above it. Spire very low, broad, conical; the apical angle being from 100° to 110° , the top of the volutions flattened in the direction of the slope of the spire, and the inner volutions barely rising above the outer ones. Body whorl flattened on the periphery, forming a nearly vertical, flattened band of considerable depth, below which a second obliquely flattened space of somewhat less width occurs, thus forming the three angles on the body of the whorl from which the name was derived. Below the lower angle the surface slopes rapidly to the long, slender canal and beak. Aperture large, angular on the outside and contracted below at the canal, strongly modified on the inner margin by the preceding volution. Volutions faintly marked by distant varices and along the upper carina by a series of thin, rather closely arranged transverse nodes. No fine surface markings or spiral lines are perceptible on any of the specimens, all of which are internal casts in a rather coarse yellow lime sand.

This is a well marked species and easily distinguished from any other shell in the Cretaceous beds of New Jersey; even when without the long beak the three very well marked carinae form a distinguishing feature, and the low sloping spire also is different from that of any other shell associated with it. The absence of surface or spiral striae on the specimen is by no means a certain indication that none have existed, as they are all internal casts, and in a matrix that would scarcely preserve them. Mr. Gabb does not mention, nor does his specimen show the small transverse nodes around the upper carinae, but on another example they are very easily distinguished. On the second specimen mentioned the apex of the spire is broken, but there is good evidence preserved to show that it was mammillated.

Formation and locality: In the yellow limestone sand of the Middle Marls, at Timber Creek, New Jersey. In the State collection at Rutgers College, collected by Dr. N. L. Britton. Also Acad. Nat. Sci., Phila., and Am. Mus. Nat. Hist., New York City.

VOLUTIDÆ.

VOLUTODERMA ABBOTTI.

Plate XXI, Figs. 4-9.

Volutilithes Abbottii Gabb: Proc. Acad. Nat. Sci., Phila., 1860, p. 94, Pl. II, Fig. 7; Synopsis, p. 93.

Volutilithes (?) Abbottii Gabb: Meek, Check List Cret. and Jur. Foss., p. 21; Geol. N. J., Newark, 1868, p. 729.

Volutomorpha Abbottii Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 293.

Shell of medium size, elongately oval in general outline, with a very short spire and large body volution which forms nearly the entire bulk of the shell, and which is nearly evenly convex above and below the middle. Volutions about four in number; suture line not very distinct. Aperture long and narrow, rather more than two-thirds as long as the shell, and pointed above and below. Columella comparatively strong, marked by three or four very oblique folds of moderate strength. Surface of the shell unknown, all the specimens recognized being internal casts.

There is considerable resemblance between this species and *Volutoderma biplicata* Gabb, unless we restrict both species to the type specimens.

In this case this one is very much more slender than *V. biplicata* and particularly distinct in being less ventricose above the middle of the volution, with a more elevated and less ventricose spire. But among the casts present in the collections of the Acad. Nat. Sci., Phila., and Rutgers College, there are numerous individuals occupying an intermediate position between these two, which can scarcely be reconciled with either, while at the same time they appear to connect them. Owing to the difference in geological position of *V. Abbotti*, together with the difference in form mentioned above, I see no other course than to consider them as three distinct species, especially as one of them appears to be from the base of the Upper Marls. The surface characters of all three are similar as far as can be observed from the slight evidence remaining upon the inner surface of the larger volutions of the casts. They all appear to have been marked with spiral lines and by more or less strongly marked vertical folds. Even the type of *V. biplicata* has evidence of very decided vertical folds, shown when looking into the suture between the volutions of the cast. There is also much variation in the number and strength of the columellar folds on most of the varieties.

From what I can ascertain from these casts, I see no reason why this one should be considered as generically distinct from *Volutoderma biplicata*. There may be reasons why that one should be separated from forms like *Volutomorpha bella* and its congeners, but there certainly can be no generic distinction between these ventricose forms. I have therefore placed this one under *Volutoderma* instead of under *Volutomorpha*, as was done by Mr. Gabb.

Formation and locality: The only two individuals of this species which I have seen are in a yellow calcareous marl, or impure limestone, and I think they are both from the Timber Creek beds, of the Middle Marls, instead of the lower layers in Burlington County, New Jersey, intimated by Mr. Gabb.

NATICIDÆ.

NATICA ABYSSINA Morton.

Plate XXI, Figs. 12, 13.

(For synonyms and references, see page 123.)

A single cast only of what appears to be this species comes from the yellow limestone beds at Timber Creek, New Jersey. It is somewhat weathered and eroded, and is entirely a cast, but the general expression is so near that of the species as it occurs in the Lower Marls, that I see no sufficient reason for separating it. The form is perhaps a little less patulose, and the under side of the volution at the edge of the umbilicus somewhat more rounded, while the umbilicus itself may be somewhat smaller proportionally than in the normal form. In its depressed form the cast might perhaps be as readily taken for an imperfect specimen of *Gyrodes petrosa*, but the volution is rather more erect, less flattened on the outer surface, and does not possess the flattening of the upper surface bordering the suture, as in that shell. The specimen has been figured and given on Pl. XXI, that it may be the more readily identified should other specimens be found.

LUNATIA HALLI Gabb.

Plate XXI, Figs. 10, 11.

(For citations and synonymy, see ante page 130.)

Several specimens of casts of this species have been obtained from the yellow lime sands at Timber Creek, New Jersey, and are in the collection of the Am. Mus. Nat. Hist., New York City. They present the usual features of the species, being much more erect and less ventricose than casts of any other species of the Naticidæ known from the State. The casts are very poor and rough on the surface, owing to the material of which they are composed, but still they may be readily recognized. The umbilical opening is small and the top of the volutions quite narrowly rounded, not showing any flattening on the surface, as do many of those from the Lower Marls.

One single specimen is somewhat shorter than common, in proportion to the height of the spire, but this may only be an individual peculiarity; at least the difference is not sufficiently marked to warrant any specific separation. Figures of the best preserved individual have been given on Pl. XXI of the Middle Marl species for comparison with those from the Lower Marls.

SCALARIIDÆ.

Genus CAVOSCALA, n. gen.

Shell scalariform, thin in substance, with numerous round contiguous volutions, which are crossed by oblique, raised varices. Surface cancellated, axis broadly perforate, the umbilicus wide, angular on the margin and showing the inner volutions. Base of body whorl margined by a broad flattened band. Aperture subcircular obliquely straightened on the inner side. Type *C. annulata*, Morton's sp. Upper Cretaceous.

The species upon which this genus is based is the only one known. Externally it resembles the living shell *Scalaria pretiosa* Linn., except in the connected volutions; more numerous varices; cancellated surface and wide umbilicus; the latter feature being *Solarium*-like in character, and also in the broad flattened space extending from the margin of the umbilical cavity to the outer basal portion of the whorl, where it terminates in an abrupt shoulder which limits the next volution and forms a carinated suture. The oblique varices and the fine transverse striæ both cross this space and are slightly visible in the umbilicus. The aperture is imperfect in all the examples seen (seven), but of course the margin would be thickened and bordered at each varix, so that it would present the appearance of a thickened rim or peristome, but not larger or heavier than the other varices, as in some forms of *Scalaria*.

CAVOSCALA ANNULATA.

Plate XXII, Figs. 1-5.

Scalaria annulata Morton : Synopsis, p. 47, Pl. III, Fig. 10.

Scala annulata (Mort.) Gabb : Synopsis, p. 79 ; Meek, Check List Cret. and Jur. Foss., p. 20 ; Gabb, Proc. Nat. Sci., Phila., 1876, p. 298.

Scala (Opalia) annulata (Mort.) Gabb : Ibid.

Shell above a medium size for shells of this group, the largest individual, if perfect at the apex, would measure fully $1\frac{5}{8}$ inches in length, with the aperture probably yet imperfect. Volutions about seven in number in the largest specimen, very ventricose and very slightly angular in the middle, closely coiled or in close contact; sutures deeply marked and characterized by a slightly beaded band at the bottom, formed by the edge of a broad, flattened, raised, or thickened space, which marks the base of the volutions and borders the umbilicus. Umbilicus very large, angular on the margin and rapidly sloping within, showing the preceding volutions in the cavity. Aperture broadly ovate or subcircular, the inner margin straightened somewhat, conforming to the slope of the umbilicus. Surface of the shell marked by a series of moderately close, elevated, lamellose, transverse ridges or varices, which are directed rather strongly backward in their passage from above to the lower margin, and are less conspicuous on the flattened space bordering the umbilicus, within the umbilicus they are faintly shown. There are also fine transverse rigid lines parallel to the varices, occupying the ridges and intervening spaces, also rather strong, rounded, wiry spiral lines covering the entire surface of the shell, which are perceptibly directed upward in crossing the varices. This gives the surface of the shell a very beautifully cancellated structure, easily perceptible to the unaided eye.

This is the most beautiful shell I have yet seen from the New Jersey formations, and is far more attractive in its appearance than *Scalaria pretiosa* of the present seas, which it much resembles, although the more closely arranged varices, contiguous whorls, and cancellated structure readily distinguishes it.

Formation and locality: In the yellow sandy limestones of the Middle Marls at Timber Creek, New Jersey, and a single small one from the green marls of the same bed at that same locality. The yellow limestone speci-

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mens are from the collection of the Acad. Nat. Sci., Phila., one of them being Dr. Morton's type of the species. The green marl specimen is from Rutgers College, and was collected by Dr. Britton.

PLEUROTOMARIIDÆ.

Genus PLEUROTOMARIA DeFrance.

PLEUROTOMARIA ? TINTONENSIS, n. sp.

Plate XXII, Figs. 6-9.

Shell of about a medium size, discoid, the spire being but slightly elevated, only about one-half the height of the very depressed inner volutions projecting above the surface of the outer ones. Volutions about three in number, quite rapidly increasing in lateral dimensions from within outwardly, as broad again from the ventral to the dorsal margins as the height; surface depressed near the suture, convex nearer the outer margin, rounded on the periphery and flattened on the base for the outer half, while the inner half gradually slopes more rapidly to the sharp inner margin in the umbilicus. This latter feature presents a broad, open, funnel-shaped opening extending to the inner volution, and presenting scarcely any evidence of suture-lines between the whorls in the cast. The surface of the volutions is marked on the upper side by a row of broad, but low, rounded, dome-like elevations, increasing in breadth as the shell increases in size; fourteen of these elevations can be counted on the body whorl. The lower surface of the volution is angular at the junction of the base with the periphery, and the surface near or at the angulation marked by nodes similar to those above, but smaller and more numerous, and not extending so far from the outer margin. Just below the median line of the periphery there is a very slight ridge and angulation which indicates a very narrow slit in the lip of the shell of greater or less extent, allying it with the genus *Pleurotomaria*, although the general appearance is quite like that of *Straparollus*. Aperture transversely sub-ovate, widest at the outer third, angular at the outer basal portion, and rather acute at the inner angle. From the closeness of the suture-line in the cast, it would appear that the shell has been very thin. Surface of the shell unknown.

The species is rather a marked one, and so distinct from any other shell or cast known from the American Cretaceous formations that it will not be readily mistaken. In form and size it distantly resembles *Margaritella Abbotti* Gabb, but has a lower spire, more rapidly increasing and less numerous volutions, and by being nodose above and below will be readily distinguished from that shell. I am greatly in doubt as to the locality of this specimen. I am assured that it is from the locality cited below, but it so closely resembles specimens from the Rhone in France that I have been inclined to reject it altogether; and have admitted it only with the hope that it may be verified by the discovery of additional specimens.

Formation and locality: In a rather light colored marly limestone, with scattered grains of glauconite. It is said to have come from the Middle Marls at Tinton Falls, New Jersey, and is from the collection at Columbia College. Collected by Dr. Britton.

PLEUROTREMA, n. gen.

Shell solarium-like in general form, but without angulation to the inner basal margin of the volutions bordering the umbilical cavity, but somewhat regularly curving from the middle of the base to the upper inner margin, giving a broad funnel-formed umbilical cavity. Periphery marked in the place of the notch in *Pleurotomaria* by a series of oval perforations similar to those of *Polytremaria* D'Orb. Type *P. solariformis* Whitf. Cretaceous.

I know but a single species of this genus, that described below, but the combination of characters are so peculiar that I do not like to place it under any known genus. The general form is like that of *Solarium* Lamarck (*Architectonica*, Bolt), but is widely distinctive in the peculiar form of the umbilicus and in the perforations of the outer portion of the whorl. In this latter feature it approaches both *Pleurotomaria* and *Polytremaria*. From the first it differs in having the slit divided into a series of oval openings, and from the last materially in the subrhomboidal form of the volutions and in the form of the broadly open and funnel-shaped umbilicus. From the appearance of the nodes and ridge left on the internal cast, I should sup-

pose that this feature of the volution left an impressed band on the inside of the shell which was subsequently filled, partially or entirely, by the deposit of shelly matter on the inside as the shell increased with age and size, and that the openings were closed beyond the outer half of the last volution.

PLEUROTREMA SOLARIFORMIS, n. sp.

Plate XXII, Figs. 10-14.

Architectonica Abbottii in part of Gabb: Proc. Acad. Nat. Sci., Phila., 1861, p. 321.

Shell of more than moderate size, the largest example before me measuring almost $2\frac{1}{4}$ inches in its greatest diameter, by $1\frac{1}{8}$ inches in height, and is an internal cast with the apical volutions absent. Volutions as preserved in this specimen, four in number, and probably one and a half or two absent; spire low, conical, the sides forming an angle of about 90° , and the volutions flattened on their upper surfaces in a line with the apical angle; sutures well marked but not deep, indicating a shell of only moderate thickness; base of the volutions flattened-convex, leaving the peripheral angle somewhat acutely rounded; the inner part of the base of the volution rapidly slopes into the broad, open perspective umbilicus, forming a rounded funnel-shaped cavity in which all the volutions are seen, but with a very slightly marked suture line separating them. Section of the volution rhombically elongate-ovate, the umbilical part being attenuated where it joins the preceding volution; along the middle of the outer volution there occurs an elevated ridge, which presents the appearance of a series of interrupted nodes of an elongate-oval shape, as if the shell had been provided with a line of oval openings occupying this position, but filling up beyond the outer half of the volution; surface of the shell unknown.

This shell possesses much the appearance of a *Solarium*, but the overlapping of the outer volution upon the base of those preceding it is a marked and distinguishing feature; while the absence of angle bounding the umbilicus at once separates it from that genus. The species has been confounded in the collection Acad. Nat. Sci., Phila., with *Pleurotomaria Abbottii*, from which it differs very decidedly, even more than generically,

as will be seen by reference to the figures. Mr. Gabb also seems to have considered this as identical with those from Mullica Hill, as he mentions under the description of that species "several specimens in the collection of the Academy from Timber Creek, New Jersey, with the surface entirely obliterated." But he describes, imperfectly, the Mullica Hill specimens.

Formation and locality: The examples figured are both from Timber Creek, and are from the Middle Marls. Only two individuals have been noticed, one from the Acad. Nat. Sci., Phila., the other from Rutgers College.

Besides the species here given as pertaining to the middle marls there are very many very imperfect casts of gasteropods among collections made at the marl pits of J. S. Cook, Esq., near Tinton Falls, New Jersey, which are too unsatisfactory for use. Among them may be mentioned a *Pyropsis*-like cast, resembling *P. verticalis*, but more elevated; a *Turbinopsis* resembling the young of *T. major* and one closely resembling *T. curta*; a *Turritella*, possibly *T. vertebroides* Morton, a *Natica*, and several others.

SECTION III.

CRETACEOUS GASTEROPODA FROM THE BASE OF THE UPPER MARL BEDS OF NEW JERSEY.

TURBINELLIDÆ.

Genus CARICELLA Conrad.

CARICELLA PLICATA, n. sp.

Plate XXIII, Figs. 1, 2.

Shell small, turbinate or pyriform, with a short, broadly conical spire having an apical angle of about 85° . Volutions four or more, not exceeding five, the apical one mammillated; upper surface sloping in the direction of the spire, slightly angulated at the point of greatest diameter and the lower extremity slightly attenuated; body of the volution ventricose; aperture large, nearly three-fourths the length of the shell, oblique and somewhat elliptical in general form, canaliculate below. Columella slight, as shown by the cavity left by its removal, marked by four very distinct, oblique, equidistant folds, the upper one of which is situated nearly at the middle of the length of the aperture. Body volution marked in the cast by about twelve very oblique vertical folds, which are directed very strongly forward in passing from above downward, but are confined entirely to the region of the angle near the top of the volution. No positive evidence of other surface markings can be detected on the casts.

This shell differs from most of the species of the genus as they occur in the Eocene formations in having vertical folds marking the largest part of the body volution. In shape and in the folds of the columella and their relative position it agrees perfectly well with the characters of *Caricella*; in the vertical folds it resembles *Voluta*. In size and general form and in the vertical folds the specimens are very like Conrad's figure of *Pseudoliva tuberculifera* (Jour. Acad. Nat. Sci., Phila., 2d series, vol. 4, p. 294, Pl. 47,

Fig. 27), an Eocene species, but there can be no doubt of the correctness of the generic reference of that species, and the form of the columellar folds and canal of this one are equally satisfactory. I know of no cretaceous shell with which it can be confounded, as the generic characters are too well pronounced to be mistaken.

Formation and locality: In the green sands at the base of the Upper Green Marls of New Jersey, at Farmingdale, New Jersey. Collection at Rutgers College. Collected by Dr. Britton in 1884.

VOLUTIDÆ.

ROSTELLITES BICONICUS, n. sp.

Plate XXIII, Figs. 10, 11.

Shell moderately elongated, as seen in the conditions of internal casts, the only condition in which it is at present known. Spire elevated, consisting of about four or five volutions, the aperture, which is narrow, forming about two-fifths of the length of the entire cast. Volutions moderately convex, largest at or near the upper margin, indicating something of a square, shoulder-like upper surface for the perfect shell; below this angulation the upper volutions are slightly convex, and in the casts leaving very deep and strong sutures between the different whorls of the spire. Lower volution distinctly largest above and cone-like in shape, with a short columellar projection below; the lower half of the volution being more rapidly tapering than the upper, forms a slight angulation just below the middle. Columella strong and marked by four nearly equidistant oblique folds, the lower one of which is not more than once and a half as far from the base as the distance between each fold. Aperture very narrow, pointed above and below; surface, as far as can be seen on the internal casts, showing no evidence of longitudinal folds or revolving lines; but the shell having been quite thick may not have preserved such features on the interior surface.

This is one of the forms usually found among specimens labeled *R. nasutus*; but it differs very strongly from that one in the proportional length of the body volution and in the form of the lip side of the aperture. In *R. nasutus*, as shown on specimens when the external form is preserved,

the spire is quite low in comparison with the entire length of the shell, being not more and probably less than one-sixth of the length; while in this one it would appear to have formed nearly one-half of the whole length. It also pertains to a different geological horizon, as all the authenticated specimens show.

Formation and locality: The specimen figured is from the base of the Upper Marls at Squankum, New Jersey, and belongs to the collection at Columbia College; several others from the same position geologically are from Farmingdale, New Jersey. Other specimens are from the Acad. Nat. Sci., Phila., but are without locality, and are associated with specimens of *R. nasutus*. From their lithological features I should refer them to the same horizon as the one figured here, viz, base of the Upper Marls, or the uppermost bed of the New Jersey Cretaceous.

VOLUTODERMA INTERMEDIA, n. sp.

Plate XXIII, Figs. 14, 15.

Shell of medium size, elongate ovate in outline, with a moderately elevated spire and ventricose volutions, the last one of which forms the greater bulk of the shell and is most ventricose above the middle. Volutions three to four in number and rapidly increasing in size. Aperture semilunate, oblique, nearly straight on the inner side, forming a little more than half of the entire length of the shell as shown in the cast. Columella marked by two or three strong, oblique, nearly equidistant plications; outer surface of the shell unknown. The inner surface of the volutions in one of the casts, which would preserve the markings of the volution within it where any existed, is entirely smooth, indicating a smooth shell; but another fragment, which appears to belong to the species, has the surface closely lirated with markings of numerous vertical folds which have formed nodes at the junction of the two sets (see outline figure Pl. XXIII, Fig. 15). It also shows three columellar folds, as does the smooth one. The last one has been an old shell, much thickened, as indicated by the great space between the coils of the cast, while the other which bears the markings has been smaller and very much thinner in substance.

So we may readily suppose that the shell possessed both sets of markings in its perfect condition.

This species is intermediate in form and characters between *V. Abbottii* of the Middle Marls and *V. biplicata* of the Lower Marls, and may be readily distinguished from either by the length of the spire and the ventricosity of the volutions; this latter feature bringing it nearer to *V. biplicata*; while in the height of the spire it exceeds either of them.

Formation and locality: The figured examples are from the Academy's collection, and are labeled as from Vincentown, New Jersey, which would most likely indicate the base of the Upper Marls. They are also credited, on the label, to "T. M. Bryan," probably as the donor.

PLEUROTOMIDÆ.

Genus PLEUROTOMA Lamarck.

PLEUROTOMA FARMINGDALENSIS, n. sp.

Plate XXIII, Figs. 3, 4.

Shell of medium size, with an elongated, turreted spire, composed of numerous angularly ventricose volutions, which ascend rapidly, the entire number unknown; apical angle about 30°; body volutions proportionally larger than those above, contracted below and rapidly decreasing in diameter, terminating in a short anterior beak, the length of which is not known; periphery biangular on the outer two-thirds of the body whorl, as seen on the cast; columella slender, smooth; aperture moderately large; outer lip straightened along the middle; volutions marked on the angle by short, oblique, vertical plications or elongated nodes, which are directed slightly forward below, and are confined to the larger part of the volution on all above the last one, where they are slightly visible on the lower angle. About twelve of the vertical nodes may be counted on a single volution. The upper side of the last volution is slightly concave between the angle and the suture line, marking the probable position of the notch of the outer lip, although on the cast this feature itself can not be positively traced.

The casts of this species are so imperfect that most of the specific features are very obscure. The generic relations are, however, quite distinctly marked, allying it to a group of this genus quite abundant in the Lower Tertiary beds. The lower part of the body volution is imperfect, even in the best specimen, so that it is not possible to refer it with certainty to any of the subdivisions of the genus. It would, however, appear to resemble very nearly the forms usually referred to *Surcula*. Species of this genus appear to be quite rare in the New Jersey Cretaceous, although not uncommon in some other parts of the country, only a very few individuals which can be referred to it having been recognized among the many casts examined.

Formation and locality: In sandy marls at the base of the Upper Green Marls at Farmingdale, New Jersey. Collected by Dr. Britton, and to be found in the collection at Rutgers College.

STROMBIDÆ.

Genus ROSTELLARIA Lamarek.

ROSTELLARIA NOBILIS, n. sp.

Plate XXIII, Figs. 16, 17.

Shell, as indicated by the cast only, large and robust, with an elevated spire which presents an apical angle of between 35° and 40° , and consists in the cast of five volutions, with some two or three of the apical ones absent. The volutions are strong, moderately and very evenly convex on their outer surface, with strongly marked and abrupt sutures, which are very compact and evenly coiled; the body volution is somewhat extended below at the base of the aperture, which has been obliquely elongate-elliptical in outline, and pointed above and below; the axis has been very strong, as is shown by the large umbilical perforation of the cast; the surface of the cast is entirely smooth, not showing the least indications of any markings, folds, or other surface feature.

The general form of this cast indicates a species of *Rostellaria* very closely resembling the living species *R. curvirostris* Lam., and has probably

been smooth on the exterior surface. It is by far the largest form of this group of shells which I have seen from the American formations, the imperfect cast measuring $3\frac{1}{2}$ inches long by $1\frac{1}{4}$ in diameter across the body whorl. The beak of the shell is entirely absent, only the internal cast of the shell being present, but it would indicate a shell of unusual dimensions for this group.

Formation and locality: The cast appears to be from the base of the Upper Green Marls, but the specimen is without definite locality. The lithological features would indicate it as coming from that position from near New Egypt, New Jersey.

TURRITELLIDÆ.

Genus TURRITELLA Lamarck.

TURRITELLA PUMILA?.

Plate XXIII, Figs. 5, 6.

Turritella pumila Gabb: Jour. Acad. Nat. Sci., 2d ser., vol. 4, p. 392, Pl. LXVIII, Fig. 14; Synopsis, p. 91; Meek, Check List Cret. and Jur. Foss., p. 19.

Shell, as seen in casts, of medium size, rather rapidly tapering, the apical angle being about 30° . Volutions nearly round, the outer surface between the sutures being depressed convex to near the lower third, from which point they are more rapidly rounded to the suture; the number of whorls in a specimen which would, if perfect, measure $1\frac{1}{4}$ inches in length, have been about seven. Sutures strongly marked, but the whorls in the cast are close, indicating a thin shell. Surface, as indicated by the casts, marked by several spiral ridges.

There is much doubt as to the proper identification of this species. The rapid increase in diameter of the volutions, and their rounded form, together with the numerous spiral ridges, would ally it with the Tennessee species, but its much greater size is against it. It is, however, quite distinct from any other species found in New Jersey, and equally so from any other species found in the Cretaceous deposits of the Atlantic coast.

Formation and locality: The cast figured is from the collection of the Acad. Nat. Sci., Phila., and was found in a tray with others marked "Vincentown, N. J."

Order SCUTIBRANCHIATA.

Suborder PODOPHTHALMA.

PLEUROTOMARIIDÆ.

Genus PLEUROTOMARIA De France.

PLEUROTOMARIA BRITTONI, n. sp.

Plate XXIII, Figs. 7-9.

Shell below a medium size, broadly conical in form, rising from a flattened base; the apical angle being about 80° . Volutions four, or from four to five in number, slightly scaliform in character; the outer face being flattened or very slightly convex, nearly in the direction of the spire, the upper surface of any individual volution being a very little larger than the basal edge of the next above it, and very slightly rounded on the angle; suture lines distinct in the casts. Base flattened or scarcely convex for two-thirds the width from the outer edge, which is moderately sharp, and then rapidly rounding into the moderately sized umbilicus. Aperture obliquely quadrangular, the inner basal or umbilical angle rounded. Slit of the outer lip not definitely ascertained in any of the specimens, which are all internal casts, but as nearly as can be ascertained has been narrow and placed at the outer basal angle, and not extending backward for more than one-third of the outer volution. Surface features unknown.

The casts of this species bear considerable resemblance, in miniature, to those of *Pleurotrema solariformis* herein described from the Middle Marls at Timber Creek, New Jersey, but the slit in the aperture has been continuous (i. e., not composed of a series of oval perforations), and placed in the lower angle of the volution instead of midway between that point and the upper edge, as in that one. It is also more highly conical in form.

Formation and locality: In Green Marls at the base of the Upper Marl Bed, at Farmingdale, New Jersey. Collected by Dr. Britton.

BULLIDÆ.

Genus BULLA Lamarck.

BULLA CONICA, n. sp.

Plate XXIII, Figs. 12, 13.

Shell of medium size, ovate in general outline, smallest above and regularly expanding to below the middle, or for about two-thirds of the length of the shell, giving a somewhat conical aspect. Spire concealed, the upper end of the shell appearing as subtruncate. Base of the shell more rapidly contracted for the lower third. Aperture elongate, narrow above, widening below and somewhat pointed at the base. Columellar lip somewhat twisted in the lower part as shown on the cast, but destitute of any fold or tooth-like ridge. Axis apparently imperforate. Surface, as shown by the cast, marked by fine spiral or revolving depressed lines, and by obscure transverse lines of growth crossing them. The revolving lines appear to have been rather finer near the upper end of the shell, and on the basal slope of the revolution two or three of them are perceptibly more distant than those immediately above them.

This shell differs from *B. Mortoni* L. & F., from the lower beds, in its more conical outline, the upper end being small and gradually expanding to below the lower third of the length. The summit also is more broadly truncate.

Formation and locality: In Blackish Green Marls, at the base of the Upper Green Marls, at Shark River, New Jersey. Collection at Columbia College. Collected by Dr. Britton.

SECTION IV.

EOCENE GASTEROPODA FROM THE UPPER LAYER OF THE UPPER MARL BED OF NEW JERSEY.

Class GASTEROPODA.

Subclass PROSOBRANCHIATA.

Order PECTINIBRANCHIATA.

MURICIDÆ.

Genus MUREX Linnæus.

MUREX (PTERONOTUS) LÆVAVARICOSUS, n. sp.

Plate XXIV, Figs. 1, 2.

Shell small, ovate, spire elevated, number of volutions unknown, apical angle about 45° . Volutions subglobular between the deeply impressed sutures, the body whorl appearing globular when considered alone. Aperture semicircular, beak long, strongly curved and very slender. Volutions crossed by low rounded varices, which in the cast readily slough from the surface, showing that the inner layers of the shell were built up independently of the exterior form, as the shell was continued beyond the line of the varix; lip reflected only in the degree of a varix. Shell marked by fine spiral lines, which are more distinctly indicated on the lower side of the whorl than above; also by very fine transverse lines indicating growth.

Only a single individual of this species has been observed, and that imperfect above the middle of the second volution. The specimen has been studied by Mr. Conrad in past years, and marked by him as being nearly related to *Fusus rugosus* Lamarek, as figured by Sowerby. The form of the varices, however, and their condition of preservation show that they were not formed as are those of *Fusus*, *Fasciolaria*, and allied genera, but like those of the true Murex. The species is readily distinguished from any known form in our American Eocene, and need not be mistaken.

Formation and locality: In the stony marls of the Upper Green Marls at Shark River, New Jersey. Rutgers College collection.

MUREX? sp. undetermined.

Plate XXIV, Fig. 3.

A fragment of the matrix of a species of peculiar character, probably of *Murex*, occurs among the Shark River specimens. The specimen had passed through Mr. Conrad's hands and had been marked by him as *Murex* previous to his death. It represents a specimen somewhat below a medium size, with sharp, angular volutions, few in number, and marked by sharp, supspinose varices or vertical folds. The spire has been rather short, in fact not longer than the body volution below the angulation. I have given a figure of the specimen as it shows on a gutta-percha cast taken from the matrix, and presenting all that is left of it at the present time. It is possible that when Mr. Conrad used it there was much more of the matrix showing than now, as it is very friable and rapidly crumbles. The specimen presents to me much more the appearance of a species of *Cuma* Humph. than of an ordinary *Murex*, although there is not enough of it remaining to definitely determine its generic relations. The specimen is from the upper layers of the Shark River Marls, at Shark River, New Jersey, and may be found in the cabinet at Rutgers College.

Genus RHINOCANTHA H. & A. Adams.

RHINOCANTHA (?) CONRADI, n. sp.

Plate XXIV, Figs. 8-11.

Priscoficus Smithii? (Sow.) Conrad: Meek, Check List Eocene Foss., p. 16; Meek, Geol. N. J., Newark, 1868, p. 732.

Not *Murex Smithii* Sow.: Mineral Conch., vol. 6, p. 151, tab. 578, Figs. 1-3.

Pyrula Smithii (Sow.) Conrad: Meek and others, when referred to as occurring in New Jersey.

Shell, as known from internal casts, short-pyriform, or shortly turbinate, with a rather low spire somewhat rapidly contracted below, forming a slender anterior beak of unknown length. Volutions in the cast not exceeding four in any of the specimens known, rather rapidly increasing in size and very ventricose, the upper surface flattened nearly in the direction of the very low spire, and seldom showing more than the slightest

convexity between the sutures; below the periphery, which is more or less flattened, or but little convex, the volutions are rapidly and abruptly constricted to the moderately slender and somewhat lengthened anterior beak. Aperture large, as wide as high when not compressed, contracted below into a narrow canal, as shown by the casts, and directed upward at the upper angle upon the preceding volution; periphery of the volutions marked by a double row of tubercular or rounded nodes, those on the upper edge largest and most distinct; those below, situated at the point of contraction, being very much smaller and sometimes almost obsolete. On two of the casts there are slight indications of periodic varices at the distance of one-third of the volution apart; these indications are not very marked and may be deceptive. The surface is marked very distinctly by transverse lines of growth, but no indications of spiral lines, ridges, or striæ exist upon any of them.

This is the species which Mr. Conrad referred to *Pyrula Smithii*; = *Murex Smithii* Sowerby; Mineral Conch., vol. 6, p. 151, Pl. DLXXVIII, Figs. 1, 2; Fig. 3 being also referred to the same species, being a high spired variety. It is scarcely necessary to say that our shell bears very little resemblance to the European one, not even belonging to the same generic group, as far as I can judge from the best examples, one of which is that used by Mr. Conrad, and having his number written on the cast in ink. This specimen (Pl. xxiv, Fig. 9) shows it to have had an entirely different anterior beak, and to have been differently constructed throughout as compared with *P. Smithii* Sow., as he figures it, and probably belongs to a different section of the *Muricidæ*.

Formation and locality: In the upper layers of the Upper Marl Beds at Shark River, New Jersey. Collection at Rutgers College, and Am. Mus. Nat. History.

TRITONIDÆ.

Genus TRITON Montfort.

TRITON EOCENENSE, n. sp.

Plate xxiv, Figs. 4, 5.

Shell, as known from the internal cast, small or below a medium size; spire elevated, with rounded volutions separated by distinct sutures; volu-

tions probably five or more; only three and a half are preserved in the most perfect specimen; aperture round, moderately large; principal varices aligned on the different volutions, and showing distinct evidences of the expanded periodic lips; intermediate varices one only in each space, much less conspicuous than the others; beak and canal not preserved beyond the base of the last volution, but at that point showing evidence of having been moderately strong; surface covered with elevated spiral lines which have been rounded and gradually increasing in strength and distance from each other from the upper margin of the volution to near its base, or as far as they can be distinguished on this part of the cast.

This is the only species of this genus of shells detected in the Eocene Marls of the State, so far as I am aware. It is a well marked species of *Triton* when closely and understandingly examined, but still not easily distinguished on cursory examination from some of the forms of *Fusus* and *Fasciolaria* present in the marls with it.

Formation and locality: In the upper beds of the Upper Green Marls at Shark River, New Jersey, and in the collection at Rutgers College.

PURPURIDÆ.

Genus PSEUDOLIVA Swainson.

PSEUDOLIVA VETUSTA ?.

PLATE XXIV, Fig. 20.

Monoceras vetusta Conrad: Foss. Shells Tert., p. 44, 2d ed. p. 37, Pl. xv, Fig. 3.

Monoceras pyruloides and *M. fusiformis* Lea: Cont. to Geol., p. 161 and 167, Pl. 5, Figs. 166 and 167.

? *Buccinorbis vetusta* Conrad: Am. Jour. Conch., vol. 1, p. 22; Meek, Check List Eocene Foss., p. 17.

Pseudoliva (Buccinorbis) vetusta (Con.) Meek, Check List Eocene Foss., p. 17.

Internal casts of a species of *Pseudoliva*, apparently of the above species, so far as general form and character of a cast can determine, occurs in the Eocene green sands at Shark River. The specimens are of about the size of adult individuals from Claiborne, but appear from the general condition of preservation to have been a worn specimen when imbedded, and so poorly

are the features preserved that it has been difficult to obtain a figure. The groove formed by the advance of the tooth along the volution, as the shell increased in size, is preserved on the cast, but it is not possible to determine whether the shell was umbilicated or had a solid axis, so there is some slight uncertainty as to the specific identification. The best cast is imbedded in the rock so firmly that it can not be cleared to get the dorsal side, and the filling of the aperture forms so much of the exposed portion that the figure gives little more than an outline of the aperture and a small portion of the preceding volution.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. Collection at Rutgers College.

FUSIDÆ.

Genus FUSUS Lamarek.

FUSUS ANGULARIS, n. sp.

Plate XXIV, Figs. 15-19.

Shell of medium size or smaller, only moderately slender, with four or five volutions in the cast, the last one proportionally larger than the others; volutions angular, rather elongated, the angulation being at the upper third of the exposed length on those above the body whorl, and the space above the angle flattened or slightly concave; suture lines strong, and in the cast bordered above by a narrow raised band, probably caused by the thickness of the shell above on the inside of the whorl, and consequently not a feature of the shell itself; aperture large, angular near the upper third and prolonged below into a gradually narrowing canal; not suddenly constricted; beak moderately long and bent; volutions crossed by numerous oblique, rather sharply elevated costae, which are confined to the upper portion, those on the body whorl being irregular and inclined to form fasciculæ of less elevation than those on the others; surface of the shell marked by raised spiral lines, those above the angle of the whorls being even and fine, and those below that point coarser, more widely separated, and on the beak showing a tendency to alternation in size.

This shell presents somewhat the features of a *Fasciolaria*, but the columella, which is well shown by its impression, presents no evidence what-

ever of any folds or ridges. Its angular whorls with the oblique folds distinguish it from any of the species associated with it in the same bed. The cast, when deprived of the principal whorl, or even the aperture and beak, present some resemblances to those of *Surcula perobesa* herein described; but the volutions are more angular and the vertical folds more numerous on the upper whorls, while those of the principal one become broken up, and thereby rendered indistinct, while on that one they are more distinct and stronger on the body volution than on those above. The spiral striae are also much stronger and less numerous on the shell.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. Collection at Rutgers College.

FUSUS PLURICOSTATUS, n. sp.

Plate XXIV, Figs. 12-14.

Shell fusiform, rather robust, spire moderately elevated, turreted. Volutions about six in number, ventricose, with strongly marked sutures, subangular above and the body volution obscurely flattened in the middle, giving an obscurely biangular appearance to the body volution, which is augmented by a rapid constriction in the lower part and toward the beak. Aperture large in proportion; beak slender, shorter than the spire, straight and pointed at the extremity in the only example which preserves its outline entire. Columella destitute of any markings. Surface marked by about nine strong, prominent vertical folds on each volution, which are not aligned one with the other on the several volutions. On the principal volution they become strongly rounded and tuberculiform on the upper part, but are less distinct below or on the flattened part, and are entirely obsolete on the under surface. The shell is also marked by fine, raised, spiral lines over the entire surface.

This shell is smaller than *F. paucicostata* herein described, is proportionally more robust and is marked by a greater number of vertical folds; the body volution differs in the obscure flattening on the middle and in the angularity of the lower part, while the beak is proportionally more slender, straight and pointed. It somewhat resembles *F. tortilis* Whitf. from the Lower Eocene beds on the Alabama River, but is more robust and has more vertical folds.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey, collection at Rutgers College.

FUSUS PAUCICOSTATUS, n. sp.

Plate XXVI, Figs. 1-6.

Shell elongate-fusiform, and turreted, spire moderately robust. Volutions strongly ventricose, the last one proportionally larger than the others; number unknown, but apparently about seven, judging from those on individuals of various sizes, longitudinally costate; costa six on each volution, strong, sometimes resembling longitudinal tubercles with broad concave interspaces and forming vertical lines along the spire, obsolete on the lower side of the volution and scarcely extending to the suture line above. Aperture large, inflated on the larger specimens. Beak slender, slightly twisted, shorter from the middle of the aperture than the length of the shell above, and with a narrow canal. Surface of the shell marked by fine, but distinct, raised spiral lines, those on the lower half of the body volution and on the beak somewhat alternating in size.

This shell appears to have been a true *Fusus* and to have resembled *Fusus colus* except in the number of costa and the shortness of the beak. The species appears to have attained a fair size, the largest specimen in the collection before me having measured about $2\frac{1}{2}$ inches in length. The different specimens (all casts) show considerable variation in the strength of the spiral lines and in their relative distance.

Formation and locality: In the uppermost layers of the Upper Green Marls, at Shark River, New Jersey. From the collection at Rutgers College.

FUSUS PEROBESUS, n. sp.

Plate XXV, Figs. 8, 9.

Shell proportionally short and obese, the volutions being very ventricose and round in proportion to their height, and also very rapidly increasing in size transversely. Spire short, the apical angle having been not far from 70° to 75° . Volutions five or more, very full and gibbous between the suture lines, the body whorl extended below into a short and slender beak. Aperture round-ovate, rapidly narrowed below, forming the canal. Columella

slender, no indications of markings of any kind are seen on the cast. Upper volutions marked by strong vertical folds on the periphery, with broad, shallow, rounded interspaces. Nine of the folds can be counted in the space of one volution. The body volution, both on the cast and in the matrix, is entirely destitute of all remains of these folds. Surface of the shell marked by strong, raised, rounded spiral lines, which are obsolete on the body whorl, while the transverse lines of growth remain faintly visible.

The only respectably well preserved cast and partial matrix of this species has been subject to some distortion by compression, and is also slightly coated with a deposit of iron, so as to obscure the finer markings; but the form of the shell has been so entirely distinct from any other in the Eocene formation that there is but little chance of confounding it. There may be some slight doubt as to the correct reference of the shell to the genus *Fusus*, but there is no evidence present of features pertaining to any other.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

FUSUS (NEPTUNEA ?) STAMINEA.

Plate XXV, Figs. 1, 2.

Fusus stamineus Conrad: Foss. Shells of the Tert., p. 43; Am. Jour. Conch., vol. 1, p. 14.

A single cast of small size, possessing all the essential features of the above species is found among the collections. It is pyriform in general outline, with a depressed conical spire, having three and a half whorls, which are slightly exsert, distinctly angular on the periphery and moderately convex below the angulation. The periphery is marked by from nine to twelve transverse nodes, only slightly indicated by the undulation of the surface, either above or below the angulation, but are quite strong on the edge with concave interspaces. The aperture is transverse, angular in the middle, and terminates below in a slender canal, the beak being very slender and nearly as long in the cast as the height of the shell above it, and is still imperfect at the end. The surface of the cast is marked by comparatively strong, spiral striae, which are arranged in groups on the lower

side of the whorl, consisting of large ones with several smaller ones between. On the upper surface they appear to be more even.

The cast presents every indication of being of the same species as the shells from Claiborne, Alabama, except that it is smaller in size. I see no reason, therefore, for separating it under a distinct name.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. In the collection at Rutgers College.

FUSUS (NEPTUNEA ?) EOCENICUS, n. sp.

Plate xxv, Figs. 10-13.

Shell of medium size, depressed-biturbinate in form, exclusive of the anterior beak; spire depressed-conical, probably somewhat changed in the casts by compression; apical angle about 90° or even more; volutions four in number, rapidly increasing in size, and sharply carinate on the periphery; flattened or slightly convex on the upper surface and rather strongly convex below; coiled so as to leave the inner ones exposed for only a little distance below the carination; aperture large, transverse, angular in the middle and extended below in a narrow canal; anterior beak rather slender, its length unknown, but being at least as long as the height of the shell above; volutions marked on the periphery by a series of slight angular, transverse nodes, which do not appear below the angulation of the volution and are but slightly seen above, being confined principally to the periphery. Surface of the shell marked by fine spiral striæ, those below the angle of the whorls being obscurely alternate in size, as seen on the casts.

This species, as represented in the collection, does not appear to have reached a very large size, the largest cast scarcely exceeding an inch and a half in its greatest diameter, and the height, exclusive of the beak, has not been much greater. The nodes on the periphery are proportionally more distinct on the smaller volutions, and much more closely arranged than are those on the principal ones. None of the specimens preserve the beak to its full extent; the species somewhat resemble *Fusus stamineus* Conrad, from the Claiborne sands, but the spire has been somewhat more elevated and the volution below the carina rounder and shorter, and the nodes smaller but more numerous, while the striæ are very much finer.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

FUSUS (NEPTUNEA ?) HECTOR, n. sp.

Plate xxv, Figs. 3-6.

Shell rather above a medium size, having attained a length of nearly 2 inches, exclusive of the anterior beak, the length of which is, in the only specimen preserving it, equal to the height of the two lower volutions. Spire elevated, consisting of but few volutions, five or six apparent in the cast; apical angle about 45° . Volutions strongly angular when not compressed, the angulation being at about the middle of the exposed portion of those above the principal one. Above and below the angulation the surface is very moderately convex. Principal volution rapidly contracted below the middle to the slender, twisted anterior beak, which is slightly flattened and excavated near the lower end; aperture large and angular in the middle of the outer lip; columella slender; volutions crossed by about twelve strong, angular, vertical folds, which are traceable to near the suture on the upper surface and nearly to the commencement of the beak below, but are much more distinct on the angulation. The shell is also marked by strong, distant, spiral lines, commencing on the carination and continuing below, the four first nearly equidistant, with two or three more distantly arranged farther down, the interspaces being flat or very moderately concave. No spiral lines appear on the upper surface of the volutions. Fine concentric or transverse lines of growth cross the shell throughout.

This is a very well marked species, and may be readily distinguished by the strong markings and by the absence of spiral lines on the upper surface of the volution.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey, Rutgers College collection.

FUSUS (NEPTUNEA ?) HECTOR var. MULTILINEATUS, n. var.

Plate xxv, Fig. 7.

A single crushed and imperfect specimen, which presents much the aspects of *F. (N.) Hector*, herein described, occurs in the collection of Rut-

gers College, but is of still larger size and so characteristic in some of its features in which it differs from that one that I have concluded to notice it under a separate head, hoping that other specimens may be found to verify it. The fragment consists of the principal volution and a portion of the next above, the anterior beak having been broken near its upper part. The volutions are somewhat rounder than are those of *F. Hector*, the angulations being less distinct and the vertical folds more subdued. Both of these features, however, might result, at least in part, from the excessive flattening of the cast. The spiral lines, however, although the normal number possessed by the typical form are present and retain very nearly their relative position, are continued over the entire surface, both above and below the angulation of the whorl, with two intermediate finer ones between each of the principal lines; the finer lines are also continued below and upon the anterior beak as far as that portion is preserved. In the preliminary examination of the species I had grouped this with the specimens of *F. (N.) Hector*, considering it only as a crushed specimen of that species preserving the markings in a more perfect condition. But on separating the largest individual of that one from the matrix, I find the fine transverse lines of growth perfectly preserved, without a vestige of spiral lines on the upper surface of the volutions, convincing me that this can scarcely be the same species. I therefore indicate it as above. The locality and geological position is the same as in that case.

FUSUS (UROSALPINX ?) MULTICOSTATUS, n. sp.

Plate XXIV, Figs. 6, 7.

Shell small, elongate-oval, or short-fusiform in general outline, spire forming one-half of the entire length, the body whorl large and terminating in a short beak. Volutions extremely ventricose, almost inflated, with deeply marked suture lines between them. Apical angle about 45°. Aperture large, broadly ovate and terminating below in a short, narrow canal. Volutions crossed by closely arranged, rounded, vertical folds, which are confined to the upper two-thirds of their surface, becoming obsolete a little below the largest part, and are separated by narrow concave interspaces; twelve to fourteen of the folds may be counted on each

of the principal volutions. Surface of the shell marked by numerous raised spiral lines, separated by slightly broader interspaces. Length of the shell about one and a quarter inches.

It is somewhat difficult to say to which of several genera this shell properly belongs. It might be classed with *Tritonidea* Swainson, except that the folds are equal and the beak too slender. Its close general resemblance to the common Oyster drill, *Urosalpinx cinereus* Say is so great that one would naturally be inclined to associate it with that one. It is, however, somewhat larger and the volutions more rounded or inflated between the suture lines, but these are the only observable differences between this cast and the recent shells of that species. The cast of the beak and anterior portion of the shell is very slightly imperfect and prevents a positive determination of its relationship.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

Genus CLAVELLA Swainson.

CLAVELLA RAPHANOIDES ?.

Plate XXVI, Figs. 7, 8.

Fusus raphanoides Conrad: Jour. Acad. Nat. Sci., Phila., vol. 7, 1st ser., p. 144.
Clavella raphanoides Conrad: Am. Jour. of Conch., vol. 1, p. 18; Meek, Check List Eocene Foss., p. 19.

A single imperfect cast of a species of *Clavella*, resembling *C. raphanoides* Conrad, occurs in the collection, but is too imperfect to afford positive means of specific identification. The spire is rather higher than that of the Claiborne shell, but so little that the difference between conditions of preservation might easily account for it. The most pronounced feature of the cast is the very strong and broad anterior beak, being so much stronger than would be the case with an ordinary species of *Fusus* or *Fasciolaria* that it is thereby readily distinguished by this feature. The spire is high and the volutions strong, and the cast presents no evidence of vertical folds, or scarcely of spiral striae. The anterior beak is preserved in the matrix for perhaps more than half of its original length, and is still more than three-

sixteenths of an inch broad where broken. Figures of the specimen are given to aid in its identification, although so highly imperfect.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. From the collection at Rutgers College.

FASCIOLARIIDÆ.

Genus FASCIOLARIA Lamarck.

FASCIOLARIA HERCULES.

Plate xxvi, Figs. 9-11; Plate xxvii, Figs. 1, 2.

Shell large, heavy, and apparently ponderous. Spire elevated and strong, the apical angle on uncompressed specimens being about 45° or 50° ; volutions about seven, strong, subangular above the last one, which is biangular, the lower angle being concealed on the others by the volution below; each volution marked by a series of twelve strong, rounded, node-like vertical ridges along the angle, and dying out below at the suture line; periphery of the last volution vertical between the angles, and rapidly contracted in the lower part to form the long, comparatively strong anterior beak, which is nearly or quite as long as the height of the spire above the middle of the last volution; columella straight to near its extremity. Only a single, rather slender, oblique fold has been observed on any of the many specimens examined. Aperture comparatively small, wider than high, subangular at the upper outer part and rapidly rounded inward to the beak and narrow canal below; surface, as indicated both by the casts and matrix, covered by low spiral striæ, those crossing the tops of the nodes being the strongest and most distant; those on the lower part of the body volution are not distinct enough on any of the casts to reveal their true character.

This shell has been very closely related to some forms of the living shells referred to *Fasciolaria trapezium* Linn., and very closely resembles that known as *F. Audouini* Jonas, usually found in collections under the first named species. The spire is, however, somewhat more elevated than in that one, and the anterior beak somewhat more slender. The single

slender columellar fold replaces the two or three of that shell, and is also placed higher on the columella. I know of no other Eocene shell in this country which closely resembles this one, especially in its' great size and robust character, coupled with its form and strongly nodose spire; some of the casts are nearly 6 inches in length when deprived of the anterior beak, which has been, with the aperture, as long as the entire shell besides. Many of the casts which I have observed appear to be nearly or quite destitute of the nodes and would be readily taken for a distinct species. This feature, or absence of feature, I presume arises from a thickening of the shell on the inside in old examples, filling up the depressions of the nodes on the inside of the whorls.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River and Farmingdale, New Jersey. I believe it also occurs at Monmouth and Squankum, New Jersey. Collections Am. Mus. Nat. History and Rutgers College.

FASCIOLARIA PROPINQUA, n. sp.

Plate XXVII, Fig. 3.

Shell above a medium size, fusiform; spire moderately elevated; beak long, proportionally strong, as long as or longer than the spire, measuring from the middle of the body whorl; apical angle of the spire less than 45° ; volutions about six, rather strong, with moderately marked sutures, the upper ones marked by strong vertical nodes, which are obsolete on the lower two or two and a half; these latter are rounded or very slightly angular, the last one being imperceptible, flattened on the periphery for nearly one-third of its height and marked only by transverse lines of growth. Aperture moderately large; beak long and the channel narrow; columella marked by one single, very slender and very oblique fold, which is situated at about the middle of its length when looking directly into the aperture of the shell.

This species is smaller than either of the two associated species. It was at first thought to be the young of *F. Hercules*, but on critical study I find characters revealed which prevent its alliance with that one. It resembles it particularly in the upper volutions, in their being nodose in the same

manner, but without the distinctive angulations. Young specimens of that species show the nodes increasing in size and becoming more rounded as the volutions increase in size, while on this one they gradually disappear. It differs from *F. Samsoni* in the less compact and more slender spire and less ventricose volutions, these differences being very pronounced when the specimens are viewed side by side. The general resemblance to the other two species is very marked.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection Am. Mus. Nat. History.

FASCIOLARIA SAMSONI, n. sp.

Plate XXVII, Fig. 4; Plate XXVIII, Figs. 1, 2.

Shell large and ponderous, as indicated by the cast, with an elevated spire, strong, extended beak, and strong, heavy, rounded volutions; apical angle, when the specimens are uncompressed, measuring about 45° or 50° ; volutions numbering six to seven in the entire cast, with strongly marked suture lines, their full, rounded and ventricose forms relieving the sutures, but without any marked space between the volutions; aperture large, semi-lunar in outline, more strongly rounded in the lower part than above, but terminating in a narrow canal below; columella strong, its entire length unknown, and the plications of folds unknown, as they are not visible on any of the casts examined, the extension not being preserved; surface of the volutions smooth so far as can be determined from the cast, these being marked only by transverse lines of growth parallel to the apertural margin.

This species is found associated with *T. Hercules*, and is often considered as a smooth variety of that shell. They are, however, very distinct, and evidently belong to two distinct sections of the genus, *F. Hercules* belonging to the group typified by *F. trapezium* Linn., while this one is related to *F. tulipa* of our own southern coast; although much larger, more ventricose; and having a proportionally shorter spire than any specimens or species of that type known to me. It is barely possible there may have been revolving depressed lines on the surface, as in some lights there are faint indications of such a feature on the best preserved example, that figured; but they are altogether too indistinct and evanescent to be given as a posi-

tive feature. Specimens indicating a length of 6 inches above the beak and canal are not uncommon, the diameter, in such cases, being nearly $3\frac{1}{2}$ inches.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, Farmingdale, and Monmouth, New Jersey. Collection at Rutgers College and Am. Mus. Nat. Hist.

TURBINIDÆ.

Genus CARICELLA Conrad.

CARICELLA PYRULOIDES.

Plate XXIX, Figs. 1-6.

Turbinella pyruloides Conrad: Foss. Shells of Ter., p. 24; Pl. x, Fig. 1.

Caricella pyruloides Conrad: Am. Jour. Conch., vol. 1, p. 24; Meek, Check List Eocene Foss., p. 16.

Shell of medium size, pyriform, swollen or inflated above and attenuate below, with a short obtuse spire. Volutions four or more, very rapidly increasing in size, the last one forming almost the entire bulk of the shell, as the inner ones are almost enveloped by the outer. Aperture very large, semi-lunate, but prolonged and pointed below. Columella slender, especially in the lower part, somewhat bent and marked by three or four strong plications or ridges. Surface as shown on the casts, marked by lines of growth parallel to the margin of the aperture.

The casts of this species are not uncommon and attain a very fair size as compared with the shells as found in Claiborne sands at Claiborne, Alabama, from whence it was originally described and where it is quite abundant. The New Jersey specimens are usually much compressed or distorted, and the columellar folds not often seen, as they show only as grooves in the marl against the side of the cast of the columella, or are obtained by breaking away a portion of the volution. There are seldom more than three of them visible, and often only two can be detected, which, together with the absence of the raised spiral striæ of the lower slender part of the volution on the Alabama specimens, may induce some to consider them as distinct species. I think, however, these slight differences are only the result of the conditions

of preservation. The most marked difference between these casts and the Alabama specimens will be found in the shorter spire and in the proportionally larger upper part of the volution. It should be remembered, however, that these features are regularly and constantly increased with the increase in size of this and all closely allied forms. There are several other species of the Eocene formations that are closely related to this one, of which the casts would be scarcely, if at all, distinguishable from these, but I think a close comparison of both casts and the shells of these forms will prove the New Jersey and Alabama specimens identical.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, Farmingdale, and Squankum, New Jersey.

CARICELLA PONDEROSA, n. sp.

Plate XXIX, Figs. 7, 8.

Shell rather large for the genus, and, so far as can be determined from the cast, has been thick and heavy. Form obovate or pyriform in outline, largest above, giving the greatest convexity near the upper part of the volution, and becoming very attenuate in front to form the anterior beak and canal. Spire very short in the cast, being only very slightly convex or low dome-shaped. Volutions four or five probably in the shell, scarcely four in the cast; sutures strongly marked and the inner whorls scarcely rising above the outer ones. Aperture large, obtuse above and pointed below. Columella strong and heavy, marked by three very heavy folds which increase rapidly in size from above downward. Surface of the shell unknown.

This species rather closely resembles *C. pyruloides* Conrad in general form, but has a shorter spire and a somewhat more clavate form, the greatest diameter of the volution being higher in proportion than in that one. The columella is also much stronger and the folds entirely different in strength, and the entire shell much thicker. This latter character has been so marked as to give room for the shell to be perforated by some boring sponge, or similar body, over nearly the entire extent of the outer volution, and to transmit its markings to the cast. The entire length and

form of the columella and canal can not be determined, as this part of the cast is imperfect; but the length as preserved is over 4 inches, with a diameter of the body volution of nearly $2\frac{3}{4}$ inches; but the imprint of the oblique folds is very strong, and for the size of the shell have been proportionally very large and heavy, broad and rounded. The specimen has been compressed in such a manner as to contract the aperture and prevent a satisfactory view of it being given in a figure; but the general form is so characteristic that there can be no difficulty in recognizing it.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

VOLUTIDÆ.

Genus VOLUTA Linnæus.

VOLUTA LELIA, n. sp.

Plate xxx, Figs. 1-3.

Shell of moderate size, attaining a length of $2\frac{1}{2}$ inches or more; ovate in general outline, with a low spire, moderately ventricose volutions and rather slender anterior beak and not strongly marked suture lines; body volution forming nearly or quite four-fifths of the entire length, largest near the upper end and rapidly contracted below the middle, becoming somewhat attenuated in front; aperture large, expanded above and narrowed below; columella of only moderate size and marked by at least three distinct and very oblique folds, enlarging from above downward; canal shallow; surface of the shell marked only by fine lines of growth parallel to the margin of the outer lip.

This shell is of the same general form as *V. Newcombiana*, but is smaller and with a much lower spire, and is also more attenuated in front, while the body volution is not angular in the upper part like that one. It differs also from any of the others herein described in the comparative height of the spire and attenuation of the anterior end. It is a very neat and graceful species.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. From the collection at Rutgers College.

VOLUTA PERELEVATA, n. sp.

Plate xxx, Figs. 4-6.

Imperfect and fragmentary specimens of a very slender volute are found in the Shark River collections, but are all imperfect, both as to the spire and base of the shell; but still enough is preserved to show that they belong to a species which is entirely distinct from any of those hitherto described from those beds, or from any of the Eocene layers in any other section. The form of the shell is highly elevated and proportionally slender, the spire being composed of volutions which are nearly straight on the sides of the exposed portion, this part being unusually long as compared with any of the known species. The last volution has been quite long, largest near the shoulder and gradually narrowing downward to a narrow base, so that the shell has been four or more times as long as wide; the aperture is long and narrow and the columella strong, and marked by three or more strong folds. The surface has been smooth with the exception of transverse lines of growth, which are strong and somewhat regularly arranged, but not sufficiently so to form a surface pattern. The species will be easily distinguished from any of the others by its slender elongated form. All the specimens observed are from the upper layer of the Upper Green Marls at Shark River, New Jersey, and are in the collection at Rutgers College, and that of the Am. Mus. Nat. Hist.

VOLUTA PARVULA, n. sp.

Plate xxxi, Figs. 1-4 and 5 (?).

Shell small, seldom exceeding $1\frac{1}{4}$ inches in length, elongate-ovate or elongate-suboval in general outline, consisting of four to four and a half volutions in the cast, the last one forming fully three-fourths of the entire length; apex mammillated (?). Volutions of the spire low convex, not angulated, but with distinct sutures. Body volution largest near the upper end, abruptly rounded to the suture on the shoulder and gently convex below or over the body portion, more rapidly constricted toward the lower part and again becoming slightly patulose at the base. Aperture long and moderately open, with a wide canal and notch at the base, so far as can be

determined from the casts, and also slightly extended upward at the upper angle. Columella proportionally strong and marked by four or more very oblique folds, the upper one of which is thread-like, and the others much stronger. Surface of the shell marked on the upper volutions by fine spiral striæ; also similar striæ can be observed near the base of the principal volution, while the body of this volution seems to be destitute of such markings. The entire shell is also marked by somewhat distinct transverse striæ parallel to the margin of the aperture.

This shell is the most abundant of any of the *Volutidæ* in the Eocene layers of marls, as well as the smallest. The prevailing length is about $1\frac{1}{8}$ inches. It is a neat and rather pretty form, and differs in its size and shape from the other associated species. A single individual referred to the same species with some doubt, on account of its immature appearance and smaller number of volutions, preserves the mammillated apex or nucleus which is turned on one side but not reversed. On account of the above mentioned peculiarities of this specimen and a difference in the form of the volution, I have thought it might possibly be the young of *V. Newcombiana*, but do not feel certain.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. Collections Rutgers College and Am. Mus. Nat. Hist.

VOLUTA SCAPHOIDES, n. sp.

Plate XXXI, Figs. 6-8.

Shell large, rather above a medium size, and, judging from the cast, has probably been heavy in substance. Volutions five or six in number, the last one large and obconical in form below the shoulder, where it is obtusely angular and concave on the upper surface, while below the angulation it is gently convex; spire short, probably not more than one-third of the entire length, but in the only specimen examined is obliquely compressed and distorted, destroying the proportions to so great an extent that they can not be positively determined; upper volutions very distinct, slightly subangular and with distinct sutures; aperture large, considerably more than half as long as the entire shell, broadly channeled below; columella strong, marked by four or more strong, distant folds, the second one from above being near

the middle of the length of the aperture. Surface of the shell smooth, or marked only by lines of growth.

The species very closely resembles the living *V. scapha* in size, form, and proportions. The folds on the columella are similar in distance and probably the same in number. The specimen showing them is too imperfect to determine their exact number positively, but four only are satisfactorily shown. It differs from *V. vesta* herein described in its more angular and obconical form, and can not be easily mistaken for it.

Formation and locality: In the uppermost layers of the Upper Green Marls, at Shark River, New Jersey. From the collection at Rutgers College.

VOLUTA (AMORIA) VESTA, n. sp.

Plate XXXII, Figs. 4-6.

Shell large and somewhat cone-shaped, being largest at the base of the spire and irregularly decreasing in size below, with a very little swell or convexity on the sides of the body volution, relieving the otherwise strictly conoidal form. Spire low-conical, the apical angle being about 90° , and the volutions of the spire barely convex between the sutures, which are only moderately indicated in the cast, but which appear to have been slightly callus in the shell. Aperture large, apparently contracted below. Columella moderately strong, but little if at all callus and marked by four rather strong and very distant folds, with flattened spaces between, which in the specimen figured is fully three-eighths of an inch wide between the upper ones. The upper fold is nearly horizontal and the lower very oblique, being nearly vertical and nearly at the base of the columella. Surface of the shell smooth or marked only by fine lines of growth parallel to the margin of the aperture.

This species is peculiar for its conoidal form and peculiar columellar folds, these latter being very unusually distant and isolated in their position. The surface of the shell is entirely destitute of any longitudinal or vertical folds or undulations of the surface, and I do not think there has been any markings of any kind other than the lines of growth. The shell has apparently attained a very fair size, the specimen figured having measured fully 5 inches in length when perfect. The shell has had the

form of species referred by Tryon to the section *Amoria* Gray, typified by *V. undulata* Lamarck; or by Paetel in his catalogue, to *Scaphella* Swain., but there appears to be so much confusion about the sections of *Voluta* among authors that it is unsafe to refer a species to any one of the subdivisions. The present species would undoubtedly afford ample grounds for a distinct division under the hands of many, but I prefer not to divide where there has been so much already done, unless on the most pronounced features.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. Collection of the Am. Mus. Nat. Hist.

VOLUTA (SCAPHELLA) NEWCOMBIANA.

Plate xxxii, Figs. 1-3.

Voluta Newcombiana Whitf., Am. Jour. Conch., vol. 1, p. 263, Pl. xxvii, Fig. 12.

Shell of medium size, elongate-elliptical in general outline, longer below than above the point of greatest diameter, but somewhat variable in proportions in different individuals. Spire elevated, the apical angle varying from 45° to 60° in different individuals, partly owing, probably, to the degree of distortion by compression of the casts. Volutions five or six, the apex not preserved in any of the specimens present. Volutions gently convex, the body whorl often decidedly angular at the shoulder, gently convex over the principal part and again more rapidly constricted at about the lower third. Aperture large, more than half the length of the entire shell. Columella strong, marked by four strong oblique plications or folds in the lower part. Surface of the shell marked only by irregular concentric lines parallel to the margin of the aperture.

The shell is known from New Jersey only in the conditions of internal casts, and these more or less distorted by compression, so that the characters are more obscurely shown than on the examples from Alabama, where the shells are beautifully preserved. These casts vary greatly in the height of the spire and in the angularity of the body volution, those having higher spires always being less angular than the short spired specimens. It is possible there may be two distinct species among the casts which I have referred to this one, but as most of these variations are observable in the Alabama examples, I have preferred to class them as one for the present.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. Collections at Rutgers College and Am. Mus. Nat. Hist.

Genus VOLUTILITHES Swainson.

VOLUTILITHES SAYANA.

Plate xxx, Figs. 11-15.

Voluta Sayana Conrad: Foss. Shells of Tert., p. 29, Pl. xvi, Fig. 1; Morton's Syn. Org. Rem. Cret., Appendix, p. 5.

Voluta Defranciai, *V. gracilis* and *V. parva* (Lea) Conrad: Am. Jour. Conch., vol. 1, p. 24, and Morton's Syn. Org. Rem. Cret., Appendix, p. 5.

Volutilithes Sayanus Conrad: Meek, Check List Eocene Foss., p. 16; Am. Jour. Conch., vol. 1, p. 24.

Volutilithes mutata? (Desli.) Meek: Geol. N. J., Newark, 1868, p. 732; Meek, Check List Eocene Foss., p. 16; Heilprin, Tert. Format. N. A., p. 8?

Among the casts from Shark River in the State collections at Rutgers College, and also at the Am. Mus. Nat. Hist., are many specimens of a *Volutilithes*, so exactly like the shells of the above species as it occurs at Claiborne, Alabama, that there certainly can be no reason whatever for doubting their specific identity. They occur of all sizes from less than 1 inch in length to those of nearly 3 inches. They also represent nearly all the variations in proportions of rotundity and height of spire possessed by those shells; the variation of the surface markings, however, can not be so readily detected, as it is preserved to a much less degree of distinctness on these casts. The casts may be characterized as follows:

Volutions ventricose, flattened or obliquely sloping on the upper surface and attenuate below, spire moderately elevated, but variable in different individuals, somewhat turreted, the volutions rapidly increasing in size; surface vertically plicated, the plications being confined to near the upper part of the body volution and extending upon the upper sloping surface; also marked by spiral lines, most distinct toward the base and sometimes only visible on this part. Columella marked by several (three to five) oblique folds of variable strength. Aperture large, wide at the top and narrowed below, forming a narrow canal.

I suppose this to be the species referred to by Mr. Meek in his list of Eocene fossils given in the appendix to the Geol. N. J., Newark, 1868,

as *V. mutata?* Deshayes. Mr. Meek may have considered *V. Sayana* as identical with the Paris Basin species, but they are very generally considered as being distinct, and there is certainly as much difference between them and any one of the French species as there is among those from that locality described and given as distinct by Deshayes himself; consequently I see no reason for suppressing the name *V. Sayana*. The species of Lea, given above as synonyms, were described from young specimens.

Formation and locality: This species was originally described from specimens from the ferruginous sands at Claiborne, Alabama, but it has been found at several other localities in that and the adjoining States. In New Jersey I know it only from the Eocene layers of the Upper Marls, at Shark River.

VOLUTILITHES CANCELLATUS, n. sp.

Plate xxx, Figs. 7-10.

Shell of medium size, elongate-ovate in general outline, with a moderately elevated spire consisting of three or more volutions in the cast; volutions gently convex, rounded on the shoulder, largest above the middle, and the body volution making the greater bulk of the specimen, forming fully two-thirds of the height; aperture long and rather narrow, somewhat contracted below; columella slender, curved, marked by three, or perhaps in the larger individuals four slender, oblique plicæ or folds, the lower one the larger, and situated rather below the middle of its length; entire surface of the casts marked by closely arranged spiral ridges, and also by transverse ridges of growth, which are more or less fasciculate, which by crossing give a coarsely cancellated texture over the body volution and over the exposed portions of the others. The spiral ridges have their upper sides narrower than the lower, giving a long and short side to each ridge, as have the ridges on nearly all shells of this genus. The vertical ridges sometimes, on the older individuals, form low vertical folds on the upper portion of the body volution, but this is not always the case.

These casts might possibly be mistaken for those of *V. Sayana*, as the latter occur in the same beds, but not readily, as they differ much in form, being more slender and more distinctly oval in outline; also in the greater height of the exposed part of the upper volutions; in the almost total absence of

nodes on the largest part of the volutions, but notably in the much greater strength of the spiral ridges which cover the entire surface of the body whorl in almost equal strength, which is not the case in that species.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. I have not observed it from any other locality. Collections at Rutgers College and the Am. Mus. Nat. Hist.

CANCELLARIIDÆ.

Genus CANCELLARIA Lamarck.

CANCELLARIA RUDIS, n. sp.

Plate XXXIII, Figs. 1, 2.

Shell of medium, or below a medium size, broadly biturbinate, of nearly equal proportion above and below the point of greatest diameter exclusive of the anterior beak. Whorls four in the cast, the apical volutions not represented, not having been filled with sediment, probably having been filled with calcareous deposit during life, as the cast appears to be perfect. Volutions sharply angular, the angulation being near the top of the principal one; aperture large, subtriangular, higher than wide, acute above and below; columella strong, no markings preserved on the cast, but an indication in its breadth, as shown on the inner lip of the aperture, of that lip having been somewhat extended or perhaps having overlapped the columella; volutions crossed by a few strong, angular, vertical folds, not more than six to the volution, but showing on the last one nearly to the base of the shell; surface of the shell marked by spiral lines with depressed spaces between them.

This cast seems to belong to that section of the genus *Cancellaria* described under the name *Trigonostoma* by Blainville, in which the aperture is triangular, the volutions sharply angular, and the folds of the columella obsolete. The umbilicus in this species is not as large as is commonly the case in this group.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

PLEUROTOMIDÆ.

Genus PLEUROTOMA Lamarck.

PLEUROTOMA SURCULITIFORMIS n. sp.

Plate XXXIII, Figs. 3, 4.

Shell elongate and slender, spire elevated, turreted, containing five or six volutions, and forming, above the point of greatest diameter of the body whorl, about three-fifths of the entire length of the shell. Body volution rather large in proportion to those above. Volutions concave above but rapidly sloping, ventricose, and rounded below the angle, the last one extended below, forming a short beak. Aperture moderately large. Shell marked by fine, even, spiral lines over its entire surface; also by finer transverse lines which are broadly curved backward on the upper concave portion and forward on the body of the whorl.

This species is somewhat related in its form and surface striæ to *P. elaborata* Conrad, from the Claiborne beds (Foss. shells Tert. Formations, p. 52, Pl. xxii, Fig. 19), but differs in the smaller number and higher volutions and in the somewhat longer beak. It also resembles *P. alternata* Conrad, from the same beds figured on the same plate, in the form of the volutions and surface markings but is a less robust and smaller shell and the anterior beak is proportionally shorter.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. From the collection at Rutgers College.

PLEUROTOMA REGULARICOSTATA, n. sp.

Plate XXXIII, Figs. 7-9.

Shell small, very slender, spire elevated, forming less than half of the entire length of the shell; the volutions rather high between sutures, number unknown. Body volution and beak forming rather more than half of the entire length; moderately ventricose in the middle without perceptible angle, but with a slightly concave depressed sulcus below the suture. Sutures distinct, bounded below by an elevated ridge. Anterior beak long, slender, and bent. Aperture apparently of medium size. Surface of the

shell marked, especially on the body volution, by regular, even, flattened, longitudinal or vertical costæ, which are formed by the fasciculation of the growth lines and which are scarcely recurved on the sulcus below the suture, but are carried forward in a broad sweeping curve across the body of the principal volution, nearly to the slender beak, before they are again bent backward.

This shell is more slender than *P. altispira* herein described, and has a longer anterior beak. The volutions differ very materially in form and also in proportion. On a gutta-percha cast made in a natural mold of one specimen showing the exterior features the upper volutions appear to have possessed stronger vertical folds; but the feature is problematical, and may be the result of accident.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey. From the collections of the Am. Mus. Nat. Hist. and Rutgers College, New Jersey.

PLEUROTOMA (SURCULA ?) ALTISPIRA, n. sp.

Plate XXXIII, Figs. 10-13.

Shell much elongated, spire much more than one-half the length of the shell, very much elevated, consisting of six or more volutions in the cast. Volutions moderately convex, not angulated, but in the cast marked by a rather broad elevated band at the base of each, except, perhaps, the outer or dorsal portion of the last one. Body volution and beak forming fully half the entire length. Aperture only moderately large, pointed below and rounded on the outer side. Columella slender and pointed at the base. Beak short. Surface of the shell, so far as can be ascertained, marked only by fine lines of growth, which are strongly curved forward in crossing the body volution, being returned again, gently, after passing the largest part.

This species differs in the form of the volution from any other form in the New Jersey beds. It corresponds in shape with *P. elaborata* Conrad from the Claiborne sands, but is three times the bulk of the largest specimen of that species yet observed in the many collections which I have seen from that locality.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

Genus SURCULA (H. & A.) Adams.

SURCULA PEROBESA, n. sp.

Plate XXXIII, Figs. 5, 6.

Shell, as known from internal casts and external imprints, rather above a medium size, indicating a length of 2 inches or over and proportionally robust, the diameter of the body whorl being equal to considerable more than one-third of the entire length; volutions about five in number, distinctly angular in the middle, the principal one being concave above the angulation and gently convex below that point, and terminating in a short, strong, anterior beak; aperture proportionally large; columella strong; volutions crossed by numerous oblique folds, twelve of which can be counted on the principal one; shell marked by very fine spiral lines, sharply elevated and with finer lines between them, and also by finer and closer raised, almost lamellose lines of growth which cancellate the surface by crossing the spiral lines. On the concave upper surface of the principal volution the transverse lines present a broad, sweeping, backward curvature, indicating a broad sinus in the lip of the shell at this point, and below the angulation are as strongly directed forward over the central part of the volution.

This shell is of the type of *S. tabulata* Conrad, from the Claiborne sands, but is of much larger size, much more robust, apparently fewer volutions, and stronger folds.

Formation and locality: In the upper layer of the Upper Green Marls at Shark River, New Jersey, and from the collection at Rutgers College; some fragments, too poor for illustration, indicate a much greater size than those given in the figures.

Genus SURCULITES Conrad.

Am. Jour. Conch., vol. 1, p. 213.

Mr. Conrad proposed this as a subgenus under *Surcula* Adams, but did not characterize it either at the time or subsequently. Mr. Tryon describes the genus in his "Structural and Systematic Conchology," vol. 2, p. 183, as follows: "Shell with spire and body volution nearly equal; the

latter obconical, rectangular near the top, and flattened or concave above from the angle to the suture; sinus of lip above the angle of the whorls shallow and broad." The type is *Surculites annosa* Conrad, a New Jersey Eocene species.

The type specimen used by Mr. Conrad in his description and figured on Plate 20, Fig. 9, of the volume cited above, is now in my hands, together with several other specimens of the same, and another much more slender species. They differ but little generically from *Surcula* proper as typified by *S. nodifera* Lam., except in the notch in the lip, and straighter anterior beak, which, from the evidence afforded by the specimens before me, does not appear to be bent or twisted to any extent. The form in both of these species is subequally biconical, the spire elevated and nearly or quite equal to the length below the angle of the principal volution. Below the angle the body volution is nearly straight obconical, giving a somewhat regularly tapering beak of moderate length and narrow canal. The upper surface of the volutions is nearly rectangular and the sinus scarcely marked; in fact, in most specimens the lines of growth indicating it are nearly direct, but below the angle the line is directed forward in a broad curved extension, occupying nearly the entire length of the aperture. The surface features are rather fine and subdued, consisting of spiral lines on the entire surface, and not very distinct lines of growth. Another of Conrad's Eocene genera *Cochlespira*, cited by Tryon as a synonym of *Pleurotoma*, is so nearly like this one that it would be difficult to point out differences. The following are the only species yet referred to *Surculites*.

SURCULITES ANNOSUS.

Plate XXXIII, Fig. 14.

Surculites annosa Conrad: Am. Jour. Conch., vol. 1, p. 213, Pl. xx, Fig. 9.

Shell of comparatively large size, having been about $2\frac{1}{2}$ inches long, with a transverse diameter of the body whorl of $1\frac{1}{8}$ inches when entire; form subequally biconical, the length above and below the point of greatest diameter nearly equal; volutions five or more, sharply angular on the periphery, the upper surface flattened and nearly rectangular to the axis;

sutures distinctly marked and limited above by a narrow ridge; volutions below the angle almost obconical, regularly tapering to near the end of the short, rather obtuse beak; aperture narrow, widest at the angle of the body whorl and almost gradually narrowing below, the outer lip thin and extended in the middle, as shown by the growth lines, forming a broad rounded extension; columella smooth; sinus in the outer lip situated above the angle of the volution, very shallow, and extending from that point to the suture, occupying the entire upper surface of the volution; surface of the shell marked by fine spiral striæ both above and below the angle of the volution, becoming slightly coarser and somewhat alternate below the middle of the whorl and on the beak; transverse striæ of growth also marks the surface, and are sometimes grouped on the angle of the volution so as to produce slight undulations or incipient nodes.

Formation and locality: In the upper or Eocene layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

SURCULITES CADAVEROSUS, n. sp.

Plate XXXIII, Figs. 15, 16.

Shell elongated, slender, and fusiform; spire elevated, as long as the shell below the angle of the principal volution; whorls probably six or more, very angular in the upper part, the upper surface flattened between the angle and the suture, and sloping but little, but never horizontal; below the angle they rapidly decrease in size downward, are but very slightly convex and extended in front, forming a rather long, slender, pointed anterior beak; aperture narrow and elongated, the sinus in the lip scarcely marked, and the margin of the lip extended forward below the angle; surface of the cast marked by proportionally coarse spiral striæ of nearly equal size above and below the angle; also by obscure transverse lines of growth.

This species differs from *S. annosa* in its more slender and gaunt looking form, the volutions looking angular and uncouth in their proportions from their great contractions between the angle and the suture below, arising from the great proportional exposed length of each volution. It also differs

in its greater length of beak, which is slender and somewhat curved. None of the specimens is perfect at either extremity, so the entire length or number of volutions can not be determined. The greater exposed length of the volutions in the spire will readily distinguish it.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, and at Farmingdale, New Jersey. Collection at Rutgers College.

SURCULITES CURTUS, n. sp.

Plate XXXIII, Figs. 17-19.

Shell small, short biconical, about equally long above and below the point of greatest diameter, or above and below the angulation of the body volution, and the greatest transverse diameter of the body whorl about equaling the height of the spire above that point. These features give the body volution a short obconical form below the angulation, exclusive of the beak, which is not present in any specimens under examination. Above the angulation the whorls are abruptly sloping and almost without convexity, and the exposed portion of each upper volution is scarcely greater than the width of the upper sloping surface of the same volution. Volutions only four in number in the most perfect individual seen. Surface marked by moderately fine spiral lines, strongest on the lower part of the body whorl; and also by fine, unequal, transverse lines of growth, which are strongly arched forward below the angle on the body whorl, and again recede below, indicating a very short beak. The transverse striae on the upper surface of the whorls scarcely indicate a sinuosity in this part of the lip.

This species is very much shorter, proportionally, than *S. annosa* Conrad, and will be recognized by this feature; while of course it is still further removed from *S. cadaverosus*.

Formation and locality: In the upper, stony, layer of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

CONIDÆ.

Genus CONUS Linnaeus.

CONUS SUBSAURIDEUS.

Plate xxxiv, Figs. 16, 17.

Conus subsaurideus Conrad : Am. Jour. Conch., vol. 1, p. 148, Pl. II, Fig. 9; *ibid.*, p. 30.

Casts of a species of cone, always of small size and with a rather elevated spire, are in the collections in use. They present the appearance, as nearly as casts can, of shells of the above species, obtained from the Buhrstone beds of the Eocene, from near Orangeburg, South Carolina, which I have identified with Conrad's species. The shells are usually small and of medium conical form, the spire is more or less elevated, with an elevated carina on the outer edge of each volution, and the intermediate surface spirally striated. The elevation of the spire varies in different individuals from 90° to 120° or more. The shells are all silicified and are from the collection at Am. Mus. Nat. Hist., among those obtained from Dr. Holmes, of Charleston, South Carolina. The New Jersey casts have the same general shape, the volutions of the spire being exsert and the apical angle 90° or more. None of the matrices have been preserved, so that the carinate character and striations of the surface are not known; still there can be no reasonable doubt of the specific identity of these casts with the silicified shells above mentioned. Mr. Conrad says under his description that the shell he used is silicified, and is "from the Buhrstone, probably, of Alabama." So it would appear that he did not know the locality, and I have no doubt the specimen which he used was from the same locality as those in the Holmes collection, namely, near Orangeburg, South Carolina. Casts resembling these, but of much greater size, also occur in Marls of the Eocene, supposed to have come from some locality near Charleston, South Carolina, and also from the lower bed at Claiborne, Alabama. These I have identified without question as casts of the above species, after making internal casts artificially from authentic specimens of *C. subsauridens*.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

STROMBIDÆ.

Genus CALYPTRAPHORUS Conrad.

CALYPTRAPHORUS VELATUS.

Plate XXXIII, Figs. 23-27.

Rostellaria velata Conrad: Foss. Shells Tert. Form., p. 31; 2d ed., p. 38, Pl. xv, Fig. 4.

Rostellaria Lamarckii Lea: Contrib. to Am. Geol., p. 158, Pl. v, Fig. 164.

Hippocrenes columbaria? (Defrance) Conrad: Check List Eocene, p. 13; Meek, Geol. N. J., Newark, 1868, p. 732.

Calyptrophorus velatus Conrad: Am. Jour. Conch., vol. 1, p. 31; Meek, Check List Eocene Foss., p. 13.

Casts, which are unquestionably of this species, are not uncommon among the Eocene fossils from New Jersey. The specimens present in the internal casts and impressions of the exterior all the features recognized on or presented by the Claiborne examples, and have the same size and relative proportions of those shells; so that there can be no reasonable question of their specific identity. The spire is elevated and presents an apical angle of from 25° to 30°, and consists of about eight volutions. This will not include some two or three of the extreme upper whorls of the apex of the shell which would not be preserved in the cast. The whorls are flattened in the direction of the spire, and although the sutures are distinctly marked, they are not deep or conspicuous. The anterior beak is not shown to its full extent in any of the impressions, nor is the margin of the lip fully represented; but enough of both remains to show their similarity to the Claiborne specimens. The spire has been coated to near if not quite to the apex in one of the examples examined; while the posterior canal has extended at least to the top of the fourth volution, if it has not extended to the fifth; and has left a broad cicatrix marking the width of the callus bordering the channel. On one or two of the fragments of the casts of the spire the longitudinal or vertical folds of the upper volutions which charac-

terize the immature shell, or others where the coating has been removed, is distinctly shown. Quite a number of examples have been studied, and no feature appears by which to distinguish it from the typical specimens of the species.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

CYPRÆIDÆ.

Genus CYPRÆA Linnæus.

CYPRÆA SABULOVIRIDIS, n. sp.

Plate XXXIII, Figs. 20-22.

Casts of a species of *Cypræa* occur in the collection in use, but not numerously. The species has been a small one with but few pronounced features, and of these of course only the general form will be retained on the internal casts. These remains are small, being but little more than 1 inch in length; the form is strongly ovate and somewhat "humped" near the anterior end of the dorsal surface; anterior end of the cast distinctly but not largely umbilicated, and the posterior end obtusely pointed and sulcated at the extremity; outer lip somewhat longer than the body of the cast, enrolled but not deeply so; a few rather strong crenulations can be distinguished upon it indicating teeth, and the entire surface of the cast is smooth; aperture quite narrow.

Only one of the casts present shows the enrolling of the outer lip and the size and form of the aperture entire. The specimen has been slightly compressed laterally, which may have somewhat exaggerated the "humped" appearance of the dorsal surface, though I think not to any great extent. Its form and size appear to have been somewhat like that of *C. spheroides* Conrad, from the Jackson group, of Mississippi, described and figured in Waile's Geol. of Mississippi, but not near enough to be classed under the same specific name, considering the difference in position, while it is still further removed from *C. Mortoni* Gabb, of the Cretaceous Beds in New Jersey.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, and at Farmingdale, New Jersey. From the collection of Dr. Kneiskern, now at Rutgers College, and from that of Dr. Lawrence Johnson, of New York City.

CASSIDIDÆ.

Genus CASSIDARIA.

CASSIDARIA CARINATA Lam. ?

Plate XXXIV, Figs. 18-22.

Cassidaria carinata Lam. : Hist., vol. 7, p. 217, of Deshayes and various authors.

Shell below a medium size, subglobose in general outline, but higher than broad; whorls from four to five in number, the principal one large and bordered by a broad reflected lip; spire moderately elevated, the volutions distinctly but not largely exsert, but sharply carinated; body volution marked by from three to five spiral carinations, three of which are dorsal and strong, the other two being on the lower slope of the volution and not always distinct; carinations nodose, the superior one having fewer and stronger nodes than the next two, while on the two inferior carinas the nodes are seldom shown. The volutions of the spire are also nodose on the carination, the nodes being small and very numerous; aperture large, the outer lip reflected, forming a wide, flange-like border; base of the shell extended into a rather long, recurved, twisted beak and canal; surface of the shell marked by fine spiral raised lines.

This shell is exceeding like *Cassidaria carinata* Lam., from the Paris Basin Eocene, and imitates all the variations through which that one passes. In fact, it is very difficult to say why it is not the same species, and I have therefore placed it under the same specific name. It corresponds in nearly all points with *P. brevidenta* Aldrich, Jour. Cin. Soc. Nat. Hist., July, 1885, p. 152, Pl. 3, Figs. 19a and 20, but there is no evidence of the single varix on the whorls as in that one, although I have not seen quite enough of the matrix to ascertain positively if it may not have been provided with this distinctive mark.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collections of Rutgers College and Am. Mus. Nat. Hist.

DOLIIDÆ.

Genus FICUS Rosseau.

FICUS PENITUS ?

Plate XXXIV, Fig. 5.

Pyrula penitus Conrad: Foss. Shells Tert., 1st ed., p. 32.

Pyrula tricarinata Con.: Foss. Shells Tert., 2d ed., p. 38, Pl. xv, Fig. 6.

Pyrula cancellata and *P. elegantissima* Lea: Cont. to Geol., pp. 154, 155, Pl. v, Figs. 160, 161.

Sycotypus penitus Conrad: Am. Jour. Conch., vol. 1, p. 26.

Priscoficus Smithii? (Sowerby) Conrad: Meek, Check List Eocene Foss., p. 16.

Pyrificus Smithii (Sow.) Meek: Geol. N. J., Newark, 1868, p. 732.

A single cast of a specimen, probably of this species, has been obtained from the upper beds at Shark River. It presents the general features of the species in all respects as to form and proportions, differing only in the surface characters which here consist of revolving lines placed at somewhat regular distances and are sharply elevated with concave spaces between, being evidently only the stronger lines of the shell, while the finer intermediate ones have not been visibly retained on the cast. But, on examination with a strong glass, remains of the finer ones are seen. The transverse lines, those parallel to the border of the aperture, are strong, irregular lines, although placed at nearly equal distances from each other. The spire of the specimen is somewhat unusually elevated for the species, and the top of the body volution flattened, with an angle separating it from the general surface of the volution. This, however, is principally the effect of compression, and in the shells as they occur at Claiborne, Alabama, there is frequently a marked angle at this point. The species, as it occurs at Claiborne, is extremely variable in surface markings; some examples being finely and evenly cancellated over the entire surface by the transverse and longitudinal lines, while others will have a few of the spiral or longitudinal lines elevated into sharp carinæ forming deeply concave spaces between marked by finer lines. Others are found which present all the gradations

between these two extremes. Considering that these variations occur in the shells, when the substance is preserved, among those recognized as of the same species, I conclude this may easily represent one of them, more especially as only a single individual has been seen for comparison.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection at Rutgers College.

NATICIDÆ.

Genus NATICA Lamarck.

NATICA GLOBULELLA n. sp.

Plate XXXIV, Figs. 1-4.

Shell small, not exceeding half an inch in its greatest diameter, and depressed globular in form, being somewhat broader than high, as seen in internal casts, with a moderately rounded spire; volutions rotund, with strongly marked sutures and apparently about four in number, only three to three and a half showing in the cast; umbilicus open and of moderate size, no evidence existing of a callus or thickened columellar lip; aperture semilunate, rounded below and apparently narrowly rounded above; surface destitute of markings, so far as can be detected on the casts, though the matrix has not been examined.

This species, in its general form and proportions, resembles *N. (Lunatia) semilunata* Lea, but the umbilicus appears to have been entirely open and too large for that species, and its form, as revealed by the casts, would not indicate it as a *Lunatia*. It is possible it may have been identical with some one of the several species of naticoid shells known from the Claiborne or lower beds of the southern Eocene, but as far as its characters are revealed, I should greatly doubt it.

Formation and locality: In the upper layers of the Upper Green Marls at Shark River, New Jersey. In the collections at Rutgers College and Am. Mus. Nat. Hist.

ONUSTIDÆ.

Genus XENOPHORA Fischer de Wald.

XENOPHORA LAPIFERENS, n. sp.

Plate XXXIV, Figs. 6-9.

Onustus extensus (Sow.?) Conrad: Labels on specimens in collection at Rutgers College; Meek, Check List Eocene Foss., p. 11.

Onustus ———, resembles *O. extensus* (Sowerby) Meek: Geol. N. J., Newark, 1868, p. 732.

Not *Trochus extensus* Sowerby: Mineral Conch., vol. 3, p. 140, Pl. 278, Figs. 2 a, b, and 3.

Shell attaining a very fair size for the genus, depressed trochiform in outline, the apical angle being nearly 120° in most specimens. Volutions four to five in number, flattened in the direction of the spire, showing but little depression at the suture lines, even on the internal casts; outer margin thin and acute, apparently bordered by a thin expansion, as in some of the living forms. Base slightly convex, flattened, or in some instances very moderately concave; axis solid in the shell, the casts scarcely showing a perforation at this point. Aperture acutely triangular, the lip receding on the lower side, but extended forward along the margin of the preceding volution on the upper side. Surface of the shell, as shown on the matrix, and often even on the internal casts, marked by diverging thread-like lines, which are strongly directed forward in their passage from the suture to the outer edge of the volution and are irregular, corrugated, and often interrupted. The surface of the volutions has been further ornamented by the somewhat regular periodical attachment of small stones, and rarely of shells, which were almost invariably attached to the middle of the upper surface of the volution, and usually quite close to each other, their size being usually graduated according to the width of the shell, the cicatrices of attachment marking the casts usually, even quite to the apex.

This species seems to have been generally referred to *Trochus extensus* Sowerby, which comes from the London clay of England. It is, however, quite distinct, as seen when compared with one, as figured and described

in the Mineral Conchology, being less elevated above and less convex below, and never umbilicated; while that one is only covered at the umbilicus when very old. Sowerby also distinctly states that that shell never attaches foreign substances to its surface, while this one is quite covered, and principally by small stones, even where shells appear to have been abundant. In this respect it differs quite notably from *Thorus leprosus* Morton, as that one principally used shells, and those frequently of large size enough to quite disfigure the casts, while those of this species are quite regular in outline.

Formation and locality: In the upper layer of the Upper Green Marls, common at Shark River, New Jersey. I have also seen it from Farmingdale.

SOLARIIDÆ.

Genus ARCHITECTONICA Bolton.

ARCHITECTONICA ANNOSA.

Plate XXXIV, Figs. 23-27.

Onustus annosus Conrad: Am. Jour. Conch., vol. 5, p. 42, Pl. I, Fig. 4.
Comp. A. (*Solarium*) *elaborata* Con., Tert. Foss. N. A., Pl. XVII, Fig. 4.

Mr. Conrad figures in the Am. Jour. Conch., loc. cit., under the name *Onustus annosus* a specimen which I judge to be the cast of a species of *Architectonica*, which is rather common in the Shark River Eocene Marls. The specimens which I have figured under the above name were at one time studied by him, and I presume the figure in the Journal was drawn from one of them. External casts, or imprints of the exterior, however, show quite distinctly that the shells were of the nature of the genus *Architectonica* Bolton=*Solarium* Lamarek. Mr. Conrad's description of his *Onustus annosus* is as follows: "Rather elevated; volutions five, rounded, slightly channeled at top, and sculptured with revolving lines, which are obliquely crossed by others, giving the cast a rugoso-tuberculated aspect; lines on the last volutions five or six in number; periphery acute."

There is nothing embraced in this description that might not apply equally well to a species of either of these genera, unless it be the feature of

spiral striæ, which is not one of *Onustus*, but a common one of the other genus, while the figure given by the author most nearly resembles a specimen of *Architectonica*. The species as known from the casts may be characterized as follows: Broad conical, the surface of the volutions flattened in the direction of the spire, about five in number, flattened below and acutely angular on the edge. Under surface of the shell very broadly umbilicate, apparently exposing all the volutions in the cavity, their inner margin rapidly sloping and giving to the whorl an irregular quadrangular section. Surface of the cast marked by several spiral lines, and in some cases the outer one bordered by a distinct elevated marginal band; under surface marked by distinct transverse lines which combine near the inner edge to form a series of somewhat transverse nodes along the margin.

The upper surface appears to have been granulose, judging from many of the casts and imprints of the surface, which leaves one strongly impressed with the feeling that the shells which made them were specifically identical with *Architectonica (Solarium) elaborata* Conrad, from the sands of Claiborne, Alabama. I can not, however, find any evidence of spiral lines on the base of the volutions, and the umbilicus has been very much larger in proportion, being about half the width of the shell, whereas in that one it is only about one-third of the whole width.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, and Farmingdale, New Jersey. Collections at Rutgers College and Am. Mus. Nat. Hist.

SCALARIIDÆ.

Genus SCALARIA Lamarek.

SCALARIA TENUILIRATA, n. sp.

Plate XXXIV, Figs. 10-12.

Shell above a medium size, reaching $1\frac{3}{4}$ inches in length in the best preserved matrix examined. Spire elevated, the apical angle measuring less than 30° . Whorls ten or more in the perfect shell, eight showing in the matrix

and the apex still imperfect, leaving room for at least two others above what is shown. Form of the volution circular, extremely ventricose with deep strong suture lines. Aperture apparently circular except on the inner side, where it seems to have been very slightly constricted, as seen on the internal cast. Volutions crossed by very strong, elevated, and slightly recurved vertical, lamellose folds, which have been extended on the top of each volution in a short spire, as shown by the matrix (but which can not be obtained by gutta-percha from the natural mold). Base of the principal volution unknown. The shell is further marked by spiral striæ, which are exceedingly fine and are gathered into somewhat regular folds on the back of the vertical ribs, and also on the intermediate surfaces.

This species is an exceedingly beautiful one, and has apparently attained a rather large size. The base of the shell in the matrix used is destroyed to a great extent, but it does not appear to have possessed the spiral ridges common to a large group of these shells, consequently we may safely suppose the axis to have been imperforate. In general appearance it is much like *S. octolirata* Conrad (Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 294), as identified and figured by Mr. T. H. Aldrich in his "Notes on Tert. Foss." in the Jour. Cin. Soc. Nat. Hist., July, 1885, p. 153, Pl. III, Fig. 22, but the apical angle is much greater, the shell having been more robust than that one; while in the matter of varices and surface striæ, as well as in the form of the volutions, it is quite dissimilar.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection Am. Mus. Nat. Hist.

TURRITELLIDÆ.

Genus MESALIA Gray.

MESALIA ELONGATA, n. sp.

Plate XXXIV, Figs. 13-15.

Shell attaining a very respectable size, slender, elongated, many whorled, the number unknown, but certainly twelve or more, the rate of increase in lateral dimensions very moderate; volutions rounded, with only

moderately marked suture lines dividing them, but usually wider than high; shell quite thin, judging from the spaces left by its removal from between the volutions on the casts; surface on the shell marked by eight or nine sharply elevated, salient spiral ridges on each volution between the sutures, the number on the last volution not ascertained; these ridges are divided by concave interspaces, and are moderately regular, though in several cases the two next above the suture are somewhat more distant than those above; this feature, however, does not hold good in all cases. There are also faint indications in the matrices of fine transverse lines of growth crossing the ridges, and strongly directed backward in passing from the suture downward on the matrix, indicating a broad sinuous lip in the shell. Form of the aperture, columella, and base of lip unknown.

The species is represented by numerous examples, both of internal casts and matrices, but always flattened to a greater or less extent. Some of these indicate specimens of not less than $2\frac{1}{2}$ inches in length, probably considerably more, and have a breadth across the lower volution of over half an inch, with probably half the number of volutions absent. It is just possible that these casts represent a thin-shelled *Turritella* with rounded volutions; still the surface striæ or ridges are much more like those of *Mesalia*, but the form of the aperture and lip being unknown, the final determination of their true generic relations must be left for future discovery. The spire differs so totally in its great elevation and very moderate increase in diameter from that of any other species I know, that there seems no difficulty in distinguishing it.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collections at Rutgers College and Am. Mus. Nat. Hist.

Order SCUTIBRANCHIATA.

Suborder PODOPHTHALMA.

PLEUROTOMARIIDÆ.

Genus LEPTOMARIA Deslonchamps.

LEPTOMARIA (?) PERLATA.

Plate XXXV, Figs. 1-4.

Pleurotomaria perlata Conrad: Am. Jour. Conch., vol. 1, p. 213, Pl. XXI, Fig. 7;
Meek, Geol. N. J., Newark, 1868, p. 732.

Shell very large, depressed conical and rapidly spreading, whorls three to four in number, broader than high, flattened on the top, angular or carinate on the periphery, and subangular on the upper lateral margin, with the intermediate surface rapidly sloping to the periphery. Base very broadly and gently convex for a little more than half its width from the edge, then more rapidly rounding without any angulation into the deep, broad umbilicus in which all the volutions are visible, with a scarcely perceptible suture line separating them; aperture wider than high, angular on the outer lower edge, flattened above, and curved from the outer angle on the base to the upper columellar margin; surface of the cast as seen on the best preserved specimens very finely striated longitudinally, and showing evidence of a very narrow slit in the aperture at the angle formed by the junction of the outer sloping surface with the flattened upper surface of the volution. In one example the slit extends for more than one-third of the length of the volution.

Among specimens presenting the general features of this species in the Shark River beds I find two well marked species which appear to have been considered as one. Mr. T. A. Conrad described this form in 1865 as a *Pleurotomaria*, and says: "This is the only Tertiary species known to occur in the eastern beds of this country. It is one of the largest of the genus and approximates *P. supracretacea* of D'Orbigny, Pal. France." His description of the species is as follows: "Conical, depressed, rapidly widening to the base; periphery slightly carinated; body whorl very wide, flattened

above; base convex-depressed, slightly indented on the margin; umbilicus profound." The specimen which he used I suppose to be one of these now before me, but it is a very trifle larger than his figure, while the umbilical portion has been restored, as will be seen by the comparison of the two figures of his plate. The specimen is marked with ink on the base, which fact helps in its identification. I do not, however, understand the meaning of his statement that the base is "slightly indented on the submargin," as no such feature is visible on any specimen examined. This one differs from the other associated forms in being more depressed, which may be partially the result of compression in the rock, but it differs principally in the form of the volution, being flattened on the top, and sloping on the outer margin, while the other, *L. gigantea*, is sloping from suture to suture without any flattening on the top, and it has a much more elevated spire and truly conical form.

Formation and locality: In the upper layer of the Upper Green Marls, at Shark River, New Jersey, and is usually represented in collections by detached fragments of the volutions. Collections at Rutgers College and Am. Mus. Nat. Hist.

LEPTOMARIA GIGANTEA, n. sp.

Plate XXXVII, Figs. 1 and 2.

Shell very large, conical in form, with an apical angle of 75° to 80° ; volutions probably five or six in number, nearly as high as wide, with the surface obliquely flattened between the sutures in the direction of the spire, or very slightly convex in the upper half, but without any flattening on the top below the suture; base broadly and deeply concave, with a large perspective umbilicus, in which all the volutions would be shown in a perfect specimen, and in the cast with a scarcely perceptible suture line between them. From the outer basal angle, which is somewhat acute, the base is very gently convex for a short distance within the margin, whence it curves rapidly into the umbilical cavity; aperture large, rather higher than wide, obliquely rhombic or trapezoidal in outline, with the basal line and inner margin forming a continuous but increasing curve from the outer basal angle to the upper inner angle; surface of the shell unknown, but that of the

cast showing irregular undulations transversely, and very strong indications of an apertural slit of undetermined extent near the middle of the volutions by the existence of a broad undefined elevation with a median impression on the cast.

This species differs from *L. perlata* Con. in wanting the flattening on the upper surface of the volution in its greater elevation, stronger volutions, and in the position of the slit. It is perhaps the most bulky gasteropod shell in the New Jersey Tertiary Marls, having a diameter at the base of nearly $5\frac{1}{2}$ inches in its slightly flattened condition, and would have a height, if complete at the apex, of fully 4 inches. I can not conceive of any distortion or compression which would produce from this one the form of volution which characterizes *L. perlata*.

Formation and locality: In the upper layers of the Upper Green Marls at Mrs. Haight's pits, Bayley's Corners, Wall Township, New Jersey. Collection at Rutgers College.

LEPTOMARIA PERGRANULOSA, n. sp.

Plate XXXVI, Figs. 3-6.

Shell of medium size, very broadly conical in form, having an apical angle of about 125° , and apparently uncompressed; volutions five or more, flattened on the surface in the direction of the spire, or with but a very slight convexity between the suture lines; sutures very distinct but not at all marked; base concave, the lower surface of the volution very gently convex between the acutely angular periphery and the margin of the umbilical cavity, the latter feature being of moderate width and open to the apex of the spire, showing all the volutions within it; aperture transversely lenticular in form, being acute at the outer and inner margins, and twice as wide as high; slit in the aperture narrow, thread-like, situated nearly midway between the upper and lower margins of the volution, or a very little above the middle of the width; surface of the shell, as obtained from an external imprint, entirely granulose or cancellate-granulose, formed by fine, deep, longitudinal lines and nearly equally strong transverse lines. These latter arch gently backward from the upper edge of the volution to the line of the slit, and below it are directed forward to nearly the same

extent as above. The position of the extremely narrow slit is marked by an elevated line on each margin.

This shell differs from *L. perlata* in the form of the volution, wanting the flattening of the upper surface, and from *L. gigantea* in its more spreading form and greater apical angle.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collection of the Am. Mus. Nat. Hist.

TREMATOFUSUS, n. gen.

Shell short fusiform, with rounded, ventricose body volution, and slender, straight anterior beak and narrow canal, and smooth columella. Volutions ornamented by fine spiral lines, and on the upper part with a series of small tubular nodes, which appear to have formed a series of perforations around the periphery of the volution similar to those of *Polytremaria* D'Orb. from the Carboniferous formation. Type *T. venustus*.

I propose the above generic name for a species of shell for which I can find no established generic group. The specimens of the only species known are internal casts, and their matrices in green marl; but all the features of the shell are easily obtainable from those in hand. The shell quite closely resembles a high spired form of *Polytremaria*, provided with a moderately long, straight, and slender beak, which in the typical species is about equal to the height of the spire. Except for the perforated nodes or subspines, which rise quite abruptly from the body volution, the shell would form a rather short, wide-bodied *Fusus*, with a rounded and abruptly spreading body volution. Of course, as I have only the casts and matrix to judge from, I can not positively affirm that these nodes or spines were really perforated during life—still they present every reasonable evidence of having been so formed. The shells have been extremely thin in texture.

TREMATOFUSUS VENUSTUS, n. sp.

Plate XXXV, Figs. 5-7.

Shell of moderate size, with an elevated, rather slender spire and very rapidly increasing body volution, and with a slender, straight anterior canal, equaling in length the height of the spire. Upper volutions four in num-

ber, somewhat flattened on the periphery and rapidly sloping on the upper surface, ornamented by fine spiral lines and on the angle by a series of transverse nodes, and by a second line of inferior nodes below. The body volution increases much more rapidly in diameter than do those above, and is rounded and ventricose; presenting a scarcely perceptible angulation at the point of greatest diameter, but with a single stronger raised line in place of the angle, with sharply elevated, rounded, and apparently perforated nodes, representing the upper line of nodes of the spire, and gradually increasing in distance with the growth of the shell. Aperture rather large, subcircular, contracted below into a narrow canal. Columella slender, straight, and smooth. Surface marked by fine, raised spiral lines which are even, rounded, and contiguous, except on the lower side of the volution and beak, where they slightly alternate in size.

This species is peculiar for the large size of the body whorl in proportion to the diameter of the whorls of the spire, presenting thereby a peculiar wheel-like character midway between the extremities of the spire and anterior beak. The species is quite an abundant one in the Shark River marls, being represented in the collection by individuals of all sizes up to that of the figured specimen, and showing the nodes in all degrees of development, only the larger ones showing them to have been perforated.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, New Jersey. Collections at Rutgers College.

Subclass OPISTHOBRANCHIATA.

TECTIBRANCHIATA.

TORNATELLIDÆ.

Genus ACTÆONEMA Conrad.

Am. Jour. Conch., vol. 1, p. 147 = *Caelatura* Con.; *ibid.*, pp. 28 and 35.

There seems to have been at different times when dealing with it some strange misunderstanding or misconception in Mr. Conrad's mind as to what shell he intended to found this genus upon. In his first reference

of species to the genus *Calatura*, on page 28 of the work cited above, he includes forms evidently belonging to the *Pyramidellidæ*, and places them next to *Obeliscus*, where they certainly belong. Then on page 35, in the same list of species, under *Actæonida*, he groups it again, but includes only one of the two previously included species. Subsequently in the same volume, on page 147, he changes the name from *Calatura* to *Actæonema* without stating why the change is made, and gives a generic description, citing *Pasithea striata* of Lea as the type, referring to a figure on Pl. II, Fig. 3, which is so entirely different and unlike Mr. Lea's figure and species that there can be no relation whatever between them, and which might readily be mistaken for a poor figure of *Tuba striata* Lea, which I rather suspect it was originally intended for. Further on, on page 213 of the same volume, he describes a species from New Jersey under the name *Actæonema prisca*, figuring it on Pl. XXI, Fig. 3, which, in the condition in which he studied and figured it, might very readily be mistaken for a specimen of *Tuba striata* Lea, but which on closer examination proves to be an *Actæon*. Mr. Conrad's figure of *Pasithea striata* Lea we are left to infer is of natural size, and is over three-fourths of an inch long, with strongly rounded volutions, but Mr. Lea's figure is of a shell seldom more than one-fourth of an inch long; has volutions flattened in the direction of the spire, and presents a distinct fold on the columella. Considering the above facts I infer that Mr. Conrad originally intended to base his genus upon *Pasithea striata* Lea, and subsequently, when he wrote the description, confounded his originally intended generic type with *Tuba striata* Lea, and still held that idea when describing the New Jersey species given below. Owing to this confusion in regard to the genus, I have not recognized it as valid for either group, and especially as in either case it would be a synonym.

ACTÆON PRISCA.

Plate XXXVI, Figs. 7, 8.

Actæonema prisca Conrad: Am. Jour. Conch., vol. 1, p. 213, Pl. XXI, Fig. 3;
Meek, Geol. N. J., Newark, 1868, p. 732.

Shell of about the medium size for the genus, the type specimen used by Mr. Conrad in his description and figure measuring three-fourths of an

inch in length, with a transverse diameter at its widest point equal to about one-half the length, the specimen being very slightly compressed. Spire elevated, three volutions being preserved in the cast above the body whorl; volutions ventricose, rounded, the last one measuring about three-fifths of the entire length; aperture elongated, elliptical in outline; columella moderately long, curved, marked by a single fold in its lower part. Surface of the cast marked by proportionally strong impressed lines, leaving rounded ridges between; no evidence of punctæ in the lines can be detected, either on the cast or in the matrix, although they may have existed on the shell.

This species is rather uncommon in the marls of New Jersey, for among all the shells and casts of this formation which have come under my observation only a single specimen, and that the type used by Mr. Conrad, has been observed. It is readily distinguished from any of the Cretaceous species by its general form and height of spire. Mr. Conrad did not remove the specimen from the matrix, consequently did not find the fold on the columella, and referred it to his genus *Actæonema*. (See observations on that genus.)

Formation and locality: In the stony layers at the top of the Upper Green Marls (Eocene), at Shark River, New Jersey. Rutgers College collection.

Genus TORNATELLÆA Conrad.

TORNATELLÆA LATA.

Plate XXXVI, Figs. 9, 10.

Tornatellæa lata Conrad: Am. Jour. Conch., vol. 1. p. 212, Pl. xx, Fig. 13.

Shell of medium size, ventricose or broadly ovate in outline, spire short, the outer volution forming the principal part of the shell; volutions about four in the cast, rounded, with distinct sutures; aperture rather large, more than half as long as the entire shell; columella short, apparently straight and marked by two distinct and rather distant folds, one at the base, the other near its upper part; surface of the shell and cast marked by strong, impressed, spiral striæ, with rounded ridges between. There appears to have been punctæ in the depressed lines, but the evidence of this is not quite satisfactory.

This shell differs from *T. prisca* Con., found associated with it, in its shorter and more ventricose form, shorter spire, and in the possession of two distinct columellar folds, instead of only one as in that species. The spiral lines are also somewhat more distant on the only specimens seen. The specimens agree very closely with Mr. Conrad's figure cited above, differing only in the very slightly greater elevation of the spire in the casts. This, however, would naturally occur in the cast, although the number of volutions is usually less, as they are generally slightly longer. Mr. Conrad's specimen was doubtfully from Alabama, and preserved the shell substance.

Formation and locality: In the stony Eocene layer of the Upper Green Marls, at Shark River, New Jersey. Rutgers College collection.

Genus TORNATINA Adams.

TORNATINA WETHERELLI.

Plate XXXVI, Fig. 11.

Actæon Wetherelli Lea: Cont. to Geol., Phila., 1833, p. 213, Pl. vi, Fig. 224.

Tornatina Wetherelli (Lea) Conrad: In Am. Jour. Conch., vol. 1, p. 35.

I have not seen this shell, nor any representative of it, so give Mr. Lea's description below, and copy his figure. The description is as follows:

"Shell cylindrical, truncate above, smooth; substance of the shell somewhat thick; spire short and truncate; suture impressed; columella with one fold; whorls four; mouth narrow, about four-fifths the length of the shell; outer lip simple; length nearly 0.2, breadth 0.1, of an inch." The locality assigned to the specimen is "Deal, New Jersey." In Mr. Conrad's list he gives it as from "Claiborne," Alabama, but I presume Mr. Lea understood full as well whence he obtained it, though no shells in that condition have been obtained from Deal so far as I know.

CEPHALOPODA.

MON XVIII—16

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SECTION V.

CEPHALOPODA OF THE CRETACEOUS MARLS OF NEW JERSEY.

Class CEPHALOPODA.

Order TETRABRANCHIATA.

Family NAUTILIDÆ.

Genus NAUTILUS Breyn.

NAUTILUS DEKAYI.

Plate xxxvii, Fig. 1-6; and Plate xxxviii, Figs. 1-4.

Nautilus Dekayi Morton: Synopsis, p. 33, Pl. VIII, Fig. 4, and Pl. XIII, Fig. 4; Gabb, Synopsis, p. 30; Proc. Acad. Nat. Sci., Phila., 1876, p. 277; Meek, Check List, p. 25; Geol. Sur. N. J., 1868, p. 731; Invert. Palcont., vol. 9, U. S. Geol. Surv. Terr., p. 496; Meek & Hayden, Proc. Acad. Nat. Sci., Phila., vol. 8, p. 280; Hall & Meek, Mem. Am. Acad. Arts and Sci., Boston, vol. 5, new ser., p. 406; Conrad, Jour. Acad. Nat. Sci., Phila., vol. 4, new ser., p. 276.

Shell of medium size, strongly subglobose in general form. In the condition of casts, that in which it is usually found in New Jersey, it is slightly umbilicate, but in the shell the axis is solid and somewhat extended laterally from the body of the volution, so that the posterior margin of the aperture is straightened on each side of the involved inner whorl, and as seen from the back of the shell presents a strongly auriculate feature, like that of a globular *Bellerophon*. Section of the volution from the umbilicus outward more than semicircular, and the umbilical region impressed in the shell, or somewhat funnel-formed in the cast; aperture large, transverse, nearly twice as wide as long measured from the involved volution, which

strongly modifies the form of the aperture and gives it a strongly reniform character; septa distant and very deeply concave, the sutures very nearly at right angles to the axis on the main portion of the volution, but forming a very slight backward sinus on the middle of the back, and also slightly bent backward within the umbilical depression as seen on the casts; siphon subcentral, a little nearer to the ventral than to the dorsal margin. Surface of the shell marked by fine transverse lines of growth which are arched strongly backward in crossing the middle of the shell, and forward on the sides.

I have seen but few specimens of the casts of this species, and none showing remains of the substance except Dr. Morton's type specimens, so the species does not appear to be common in New Jersey, although extensively identified from other parts of the country, usually, however, without direct comparison with New Jersey specimens. I have seen but few casts from other parts of the country which I should feel warranted in considering as undoubtedly identical with the New Jersey shells; even those from the Black Hills, which are perhaps the nearest like it of any I have studied, differ very materially in general form. Dr. Morton's type specimen, which consists only of the outer chamber and forms but little more than half of a volution, shows the umbilical aurications, and retains the shell in part, shows it to have had a solid axis and very broad aperture, in which it differs from any other which I have seen. The figures of this specimen given I think will present a somewhat different idea of the species from that which appears to have been usually entertained.

Formation and locality: In the Lower Green Marls, at Burlington and Mullica Hill, and in Monmouth County, New Jersey, the latter being the type specimen of Dr. Morton, now in the cabinet of the Phila. Acad. Nat. Sci.

NAUTILUS BRYANI.

Plate XXXVIII, Figs. 5, 6.

Nautilus Bryani Gabb: Proc. Acad. Nat. Sci., Phila., 1876, p. 277.

Shell large and strong, somewhat compressed on the sides; giving a section to the volution, from the margin of the umbilicus to the dorsum, greater than the width from side to side. Umbilicus small, but open

in the shell. Dorsum sharply rounded. Septa distant, rather deeply concave; arched forward on the margin of the umbilicus and slightly backward on the sides, but strongly arched forward on the dorsum. Siphon rather large, situated about two-fifths of the entire distance of the length of the volution, longer than wide and deeply emarginate on the inner border by the intrusion of the inner volution, giving it a compressed reniform outline. Surface of the shell unknown.

The type specimens of this species, which are before me, consist of two fragments of casts, one consisting of about half of an inner volution preserving seven chamber fillings; and parts of four chambers of a much larger specimen show it to have been a rather large shell of a form much like the living *Nautilus umbilicus*, but with the umbilical cavity less angular on the margin and rounded within; the outer volutions embracing the inner ones to nearly the same extent. The sides of the volutions are not quite so much flattened near the umbilical region, giving a little greater proportional thickness to this part of the shell. It is so distinct from *N. Dekayi* of the Lower Green Marls that it is not necessary to compare it with that species. It is less unlike the forms of *Nautilus* found as casts at Prairie Bluff, Alabama, and in many parts of Texas known as *N. perlatus* Morton, but so far as I know those are not umbilicated, consequently it presents a radical difference in this respect. There are some discrepancies between Mr. Gabb's description and the specimens which it may be well to note. For instance, he states that the sides are flattened and "nearly parallel," which I find to be very far from the case, especially in the larger specimen. He also states that the siphon is "small" and "central." It is considerably nearer the inner margin than the center in both specimens, and in the larger one is fully three-sixteenths of an inch in diameter, being very much larger than in the living form of *Nautilus*.

Formation and locality: In the yellow lime sands of the Middle Marl Beds at Vincentown, New Jersey, having been collected by the late Col. Bryan, and is now in the cabinet of the Phila. Acad. Nat. Sci.

Genus HERCOGLOSSA Conrad.

HERCOGLOSSA PAUCIFEX.

Plate XXXIX, Fig. 1.

Aturia paucifex Cope : Proc. Acad. Nat. Sci., Phila., 1866, pp. 3, 4.*Hercoglossa paucifex* (Cope) Meek : Geol. Surv. New Jersey, 1868, p. 731.*? Nautilus orbiculatus* Tuomey : 1854, Proc. Acad. Nat. Sci., Phila., p. 167, vol. 7.

In 1866 Prof. E. D. Cope presented before the Acad. Nat. Sciences in Philadelphia a specimen of *Aturia*-like shell, which he described as follows, under the name *Aturia paucifex*: "Uncovered chambers, nine; septary processes elongate, acuminate, shallow, diverging outward from a spiral line joining their bases; well separated from the succeeding septa; dorsal portions of the septa short, very eccentric as regards each other; ventral portions opposite them, forming nearly a right angle with the ventral outline. Siphuncle small, more dorsal than the end of the dorsal fourth of the diameter. Ventral surface broad rounded; septal processes scarcely visible on the ventral view." Diameter of the last chamber 3 in. 11 lines; of first visible (at siphuncle), 22 l. Median diameter (from penultimate chamber) 8 inches.

Among the New Jersey cephalopoda received from the Academy of Natural Sciences of Philadelphia, I find a large internal cast of an *Aturia*-like species under the name *Nautilus orbiculatus*, with the locality "*Gloucester, N. J.*" On the cast is pasted a label, bearing the name "*Aturia paucifex*; Cope's type, *Hercoglossa*," then one or two words obliterated, after which follows "Glassboro, Gloucester Co., N. J." The words *Aturia paucifex* Cope's type, and the obliterated words, have been crossed out with pencil and "*N. orbiculatus?*" appears in ink above the original name. The specimen I believe to be the type of Prof. Cope's species, as it agrees with his description and also with the measurements given, but does not agree with Prof. Tuomey's description of *N. orbiculatus*; at least not as I understand some parts of his very short and obscure diagnosis, which is as follows: "Shell somewhat discoid, thick in the center and gradually thinner toward the circumference; last chamber very large, spreading at the umbilicus; siphunculus nearly central; septa profoundly undulated, showing on the back a recurved lip." Prof. Cope appears to have con-

sidered the inner face of the volution as the dorsal, which is perhaps correct enough in speaking of the animal, but Dr. Tuomey says the septa shows on *the back a recurved lip*, which, if we consider the back the outer surface or edge of the volution, as is usually done, this is entirely wrong for this cast, as the septa extend directly across the back and over to the septal process in an almost straight line. Therefore, if Dr. Tuomey's description is correct for his species, which I have never seen, this one must be an entirely distinct species. I shall at any rate consider it as *A. paucifex* of Cope, and disregard Dr. Tuomey's name until further evidence is obtained. If they prove identical Dr. Tuomey's name has precedence, as it was given in 1854, while Dr. Cope's name dates only from 1866. The present shell may be more fully described as follows:

Shell large, somewhat ponderous, ventricose, with a broadly rounded back and convex sides; umbilicus slightly impressed, but not open, the inner edge of the lip rather overlapping the one within, and the outer volution embracing the inner to that extent; aperture large, forming half of a long ellipse, being rounded on the outer margin and gradually expanding to the edge of the umbilical depression or for nearly four-fifths of the entire length of the opening. On the inner side it is strongly modified by the projection of the inner volution; entire length of the apertural opening $5\frac{1}{2}$ inches on the specimen; greatest width across nearly 4 inches. Septa strong, deeply concave and distant, being nearly 3 inches apart on the back of the specimen described at the third chamber, and nine chambers only visible to the volution; lateral septal processes situated nearer to the outer margin than to the umbilicus, and are large, strong, slightly directed outward from a circular line half as wide across the origin as long, that of the second septum shown on the specimen being 2 inches long from the curve of the inner portion of the septum and $1\frac{1}{4}$ inches on the outer side. Inner portion of the septal line moderately arched forward between the umbilical line and the septal process (or lateral lobe) and reaching slightly in advance of the outer division, which from the base of the process or lobe extends almost directly across the back of the shell; siphon rather large, measuring more than a quarter of an inch in diameter at the outer chamber, cylindrical as far as can be seen; situated at about one-fifth or a little more than one-

fifth of the distance from the margin of the inclosed volution to the back of the shell from the inner edge. Prof. Cope states at the edge of the inner fourth.

The shell substance, some of which remains on the inside of the cast and between two of the chambers, has been very thick, more than a sixteenth of an inch, and presents an imperfect columnar or prismatic structure on the edge. The sides of the cast also show it to have been very heavy where the septa have joined the outer shell, as the cast shows the ridges and chamfering of the edges when the shell has been removed. Some of the cavities left between the filling of chambers also are nearly or quite a line in thickness. Longitudinal lines also mark the cast, showing evidence of muscular attachment along the sides of the chambers between the umbilical cavity and the septal processes or lateral lobes of the septa.

Mr. Meek refers this species to Conrad's genus *Hercoglossa*, which was founded upon *Nautilus orbiculatus* Tuomey. Conrad's description of the genus in the Am. Jour. Conch., vol. 2, p. 101, is as follows: "Nautiloid; septa angular and linguiform; apex of the angle, or tongue-shaped lobe, not contiguous with the adjacent septum; siphon large or moderate, situated within the center, or between the middle and inner margin, and not dorsal or funnel-shaped, but tubular and gradually tapering." *Aturia* should have a funnel-shaped, dorsal siphon, which this species has not, consequently can not be a true *Aturia*. Dr. Tuomey's *N. orbiculatus*, which was Conrad's type of *Helicoglossus*, is probably at least generically if not specifically identical with this, so that this will at least fall under that genus.

Formation and locality: I think there can be no reasonable doubt of the authenticity of the locality of the specimen used and figured, being as marked on the label attached: Glassboro, Gloucester County, New Jersey. Prof. Cope states under his description that it was found at Heritage's marl pits associated with *Terebratula Harlani* and *Teredo tibialis*, which would place it in the Middle Marls. There is also in the Academy's collection parts of two chambers of the same species from Vincenttown, New Jersey, collected by T. M. Bryan, Esq., which would also most probably be from the Middle Marls, as both these and the Upper Marls are near together at that point. Another fragment in dark brown material occurs in the tray with the fragments of *Am. telifer*, marked simply "N. J."

AMMONITIDÆ.

Genus AMMONITES Brug.

AMMONITES COMPLEXUS.

Plate XLI, Figs. 5-7.

Ammonites complexus Hall and Meek: Mem. Am. Acad. Arts and Sci., Boston, new ser., vol. 5, p. 394, Pl. IV, Fig. 1; Gabb, Synopsis, p. 9; Meek, Check List, p. 24; Geol. Surv. New Jersey, 1868, p. 730; Invert. Paleont., U. S. Geol. Surv. Terr., vol. 9, p. 447, Pl. XXIV, Fig. 1.

A single fragment only of this species has so far been recognized from New Jersey. It consists of less than an inch in length of a volution having a less diameter than the original specimen figured by Messrs. Hall and Meek; but it appears to have had a somewhat greater curvature, and consequently has the appearance of having been a somewhat larger shell, though from this imperfect fragment it would be difficult to say positively that such was the case. The volutions were nearly circular in section and strongly embracing, nearly one-third of the outer one having overlapped the inner one. It has been crossed by low, rounded, transverse ridges, and broad, shallow furrows, without nodes; the ridges becoming almost obsolete on the central line of the back. Septa extremely complex and very closely arranged; so closely that the branches of one septum interferes with and overlaps the one behind it, so as to make it extremely difficult to trace the division of any one septum even as far as the fragment preserves them. The extremities of the digitations are slender and quite mucronate, presenting almost the same features as those of *Placenticeras tilifer*. In this respect it differs from all other species yet observed in the New Jersey formations except that one. The dorsal lobe is more than half an inch long, and only slightly divided below on the median line; the main divisions are separated each into three compound divisions, each of which has many mucronate points; above this there is one principal digitation on each side which has three terminal points, and one or two farther up on each side. The first lateral lobe has three terminal compound divisions, with one smaller division on each side above, and a minor one still higher. The second lateral lobe is

somewhat smaller than the first, but its divisions and branches are not traceable on the specimen. The first sinus is about equal in size to the first lateral lobe, and is divided at the summit into three double divisions by three minor lobes, each of which has several points along the sides and on the extremity.

The specimen differs somewhat in details of the septa from the Upper Missouri River specimen originally described by Hall and Meek, as well as in having a greater circle of curvature along the circumference of the volution, and the volution has also been relatively narrower from side to side. These differences, as well as the sharply pointed form of the divisions of the lobes of the septa, lead one to suspect that were the specimen more perfect a very differently shaped species would be the result. Still, from the very imperfect and unsatisfactory material, it would hardly be safe to designate it as a distinct species.

Formation and locality: The fragment is from a whitish clay marl with ferruginous markings, but is without locality. It has the lithological characteristics of the white limestone clay at Holmdel, New Jersey, and is most probably from the Lower Marl Beds at that place. The specimen is from the cabinet at Rutgers College, and is that upon which Mr. W. M. Gabb made the identification of the species in his Synopsis, p. 9, and bears his label.

AMMONITES DENTATO-CARINATUS.

Plate XLI, Figs. 3, 4.

Ammonites dentato-carinatus Roemer: Texas, p. 417; Kreid. von Texas, p. 33, Pl. I, Fig. 2, a, b, c; Gabb, Synopsis, p. 9; Meek, Check List Cretaceous, p. 24.

A single small fragment of this species comes to me from the collection of the Acad. Nat. Sci. at Philadelphia, labeled as coming from the Cretaceous of New Jersey, and there seems to be no valid reason for doubting the locality, as it bears resemblance to the white limestone nodules from Marlboro and Holmdel, New Jersey. The specimen is but little more than an inch in length, and is a fragment of a volution of medium size, representing about three of the chambers. The shell when entire has been

compressed discoidal, with a proportionally small umbilicus, the volutions have been sharp on the dorsal edge and marked by a series of undulations which gave rise to the specific name. The sides are ornamented by two lines of nodes which divide the surface into three nearly equal spaces, also by transverse ridges which are low and rounded, and pass from the margin of the umbilicus almost directly across the volution to a node one-third of its breadth from the margin, and are then bent sharply forward, their convexity giving rise to the undulations on the dorsal carination. Some of the ridges bifurcate at the inner line of nodes, each branch reaching the margin as independent ridges, but the fragment is too small to show how frequently this feature occurs.

The septa of this specimen from New Jersey appear to be as nearly like that figured by Dr. Roemer, above cited, as could be expected in any two individuals from the same locality, consisting of a proportionally large dorsal lobe and three lateral lobes, visible on the side of the volution, with another just within the limits of or on the side of the umbilicus. The dorsal lobe has the main divisions bifurcating, forming two nearly equal branches, with numerous slender digitations; the other is single, slender, elongate, and with five or six digitations. The first lateral lobe is large and somewhat complicated, having five principal divisions with numerous digitations. The other lobes are much smaller and less complicated, but all have slender, narrow digitations. Between the dorsal and first lateral lobe there is a long slender intermediate lobe with three to five digitations on a side. The sinuses are less complicated than the lobe, and have the terminations usually rounded, while those of the digitations of the lobes are usually sharply pointed and narrow.

The specimen bears no evidence of the siphon.

Formation and locality: The specimen, which is a small fragment only of a single volution, is entirely a cast in a hard ferruginous sandy clay, with a few grains of glauconite scattered through it, and may have come from the white limestone nodules near the base of the Lower Green Marls, at Holmdel, Marlboro, or some of the other outcrops of this material within the State. As it is the only fragment of the species yet noticed, there may be some question as to its locality until others are found.

AMMONITES DELAWARENSIS.

Plate XLII, Fig. 6-9; and Plate XLIII, Figs. 1, 2.

Ammonites Delawarensis Morton: Am. Jour. of Science, 1st ser., vol. 18, Pl. II, Fig. 4; Synopsis, p. 37, Pl. 2, Fig. 5; Gabb, Synopsis, p. 9; Meek, Check List Cret., p. 24; Geol. Surv. N. J., 1868, p. 730.

Dr. Morton describes this species as follows: "Volutions uncertain; each whorl furnished with elevated transverse ridges, which bifurcate about half way across, and terminate in prominent tubercles on the margin; ridges marked by three or four conspicuous nodes; back between the tubercles convex; probable diameter from 8 to 12 inches."

The shell seems to have been a very variable one, especially so when different periods of growth are considered. The young form was described by Dr. Morton as *A. Vanuxemi*, in which condition it is somewhat discoid, with a moderately large umbilicus with vertical sides; about one-half only of the volution being embraced by the succeeding one; the narrow dorsum being triply keeled; the marginal keels being formed of obliquely elongated nodes formed by the extremities of the numerous, rounded costæ which cross the sides of the volution. A row of nodes marks the ends of the costæ along the margin of the umbilicus, and three other lines occur at nearly equal distances apart, between the first and the marginal row, which forms the lateral keel. When more advanced in growth the sides become rounded and convex; the dorsum proportionally wider and less distinctly keeled; the volutions somewhat more involved within the outer one, which gives a correspondingly narrower umbilicus in proportion to the entire diameter; the ridges crossing the sides are proportionally less elevated and the nodes less conspicuous. In a large cast sent me, as one of the type specimens, from the Acad. Nat. Sciences, Philadelphia, the thickness at the edge of the umbilicus is $2\frac{3}{8}$ inches, when the width of the volution is $3\frac{1}{4}$ inches. A small specimen (figured on Pl. XLII, Fig. 6), apparently entirely uncompressed, presents a width on the side of the volution of three-eighths of an inch, and a diameter of one-sixteenth less at the edge of the umbilicus. The same features of the surface are present on both specimens, differing only in degree.

The septa are marked by three lobes and an imperfect fourth one on the inner margin, and by three sinuses. The dorsal lobe has a pair of short, principal, digitate branches, with several small digitations along its sides. First lateral lobe moderately large, with four principal, much serrated branches, and two or more minor ones on the neck. The second lateral is irregularly branched, having two or three divisions, and the one bordering the umbilicus has the margin simply undulated. The first sinus is very large and divided in the middle by a long, slender, digitate, minor lobe, which extends nearly or quite half the length of the dorsal lobe. The second sinus is not more than two-thirds the size of the first, and far less distinctly divided. The small umbilical sinus has the margin rather deeply undulated only. The margins of the sinuses are clavately undulated, and those of the lobes more sharply serrated; the number and complication of these features varying of course with the size and age of the shell. In the young specimens, which have the characters of *A. Vanuxemi* Morton, the complications of the lobes and sinuses are more simple, although all the features are present, as may be seen by the diagrams given on the plate.

In Dr. Morton's figure in his synopsis the septa are very incorrectly represented, while the nodes and ridges are very strongly shown.

Formation and locality: The type specimens are all from Delaware, so far as I am aware. Dr. Morton gives the Delaware and Chesapeake Canal, and states that he had another from Alabama. I have not seen it from elsewhere than Delaware and New Jersey. The small specimen figured on our plate is from near Burlington, New Jersey, and is in the Am. Mus. of Nat. Hist.

AMMONITES VANUXEMI.

Plate XLII, Figs. 1-5.

Ammonites Vanuxemi Morton: Am. Jour. Sci., 1st ser., vol. 18, Pl. III, Figs. 3, 4;

Synopsis, p. 38, Pl. II, Figs. 3, 4.

A. Delawarensis (young specimen) Gabb: Synopsis, p. 18.

Not *A. Vanuxemi* Lea: Trans. Am. Phil. Soc., 2d ser., vol. 7, p. 254, Pl. VIII, Fig. 5.

This species appears to have been described from specimens of small size, and imperfect. Dr. Morton remarks under the description given in his Synopsis, p. 38, that the "supposed diameter" is 3 inches; also, that "larger

specimens have been found." The type specimen came from Delaware. The largest New Jersey example which I have seen is figured on the plate as above. It bears all the characters of Dr. Morton's species, but is somewhat compressed laterally, so as to give it rather less thickness, but it is certainly not the young of *A. Delawareensis*. On examining the type specimen of this latter species, the inner coils of which have been entirely removed by decomposition, it is seen that up to a diameter of nearly 3 inches they would present much the same features as those possessed by this specimen; only that the transverse diameter has been nearly or quite an inch at the margin of the umbilicus, and that the sides are much more convex, while the keeled character of the dorsum is much less conspicuous. But it can readily be seen that all these features are liable to change with the degree of lateral compression. The features of the septa appear to be the same in two species, as will be seen by a comparison of the diagrams of the small individual, which is enlarged to two diameters, with that of *A. Delawareensis*, which is of mature size. The small individual from which the figures above alluded to were made is the property of the Am. Mus. Nat. Hist., and comes from Burlington County, New Jersey. The type of *A. Vanuxemi* originally figured by Dr. Morton, when compared with the inner coils of the large specimen of *A. Delawareensis* figured on our plate, is not more than half as thick laterally where the dorso-ventral diameter is the same; and the transverse ridges are finer, less elevated, and present an entirely different feature, which compression would fail to produce on forms like *A. Delawareensis*.

Formation and locality: Morton's type was from the Chesapeake and Delaware Canal, and is from the lower part of the Lower Marls. The Burlington County, New Jersey, specimens would be from the same geological horizon.

Subgenus PLACENTICERAS Meek.

AMMONITES (PLACENTICERAS) PLACENTA.

Plate XL, Fig. 1, and Plate XLI, Figs. 1 and 2.

Ammonites placenta Dekay : Ann. N. Y. Lyceum Nat. Hist., vol. 2, p. 278, Pl. v, Fig. 2; Morton, Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 6, p. 195; Am. Jour. Arts and Sci., vol. 18, Pl. II, Figs. 1-3; Synopsis, p. 36, Pl. II, Figs. 1 and 2; Gabb, Synopsis, p. 15; Meek, Check List Cret., p. 25; Geol. Surv. N. J., 1868, p. 730.

Placenticeras placenta (Morton) Meek : Invert. Pal. U. S. Geol. Surv. Terr., p. 465.

Shell attaining a large size, subdiscoid or lenticular with a deep and distinct umbilicus, the sides of which are gently rounded to the surface of the volution, exposing only a very small portion of each of the inner volutions within it. Dorsum of the shell narrowly rounded and the sides of the volution gradually diverging from its edge to the point of greatest thickness, which is only a short distance outside of the umbilicus. Aperture elongate saggitate; on a cast before me where the volution has a width, from the dorsum to the umbilicus, of $4\frac{1}{2}$ inches, the greatest thickness from side to side is just 2 inches, the diameter of the shell being $8\frac{3}{4}$ inches. The surface of the shell I have not seen on New Jersey specimens.

Septa closely interlocking, the lobes and their sinuses being of proportionally small size, but very complicated, varying greatly in this particular with the age of the shell. The interlocking of the septa is so great in the very fine specimen mentioned above that it is impossible satisfactorily to trace any single one entirely across the volution. The lobes in the larger portion of the volution appear to be ten in number exclusive of the dorsal lobe, and to be somewhat smaller than the corresponding sinuses, except the second and third. The dorsal or siphonal lobe is very wide and deeply forked. The third lateral lobe, or fourth counting the dorsal, is larger than any other, with two large lateral processes and a bifid extremity. The others are generally trifold to the fifth or sixth, beyond this a few of them are bilateral with two divisions on each side; some of the inner ones are long and clavate, with three or four slight projections, while the two inner ones are only serrate on the sides with a perceptibly swollen extremity. There are intermediate lobes between all the principal ones, except the last

two, on the largest specimen in hand; but they vary in size and complication according to their position; that dividing the first sinus being about equal in form and size to the seventh lateral lobe. The first sinus is large and broad, each of its main divisions about equal in size to the third sinus.

Mr. Meek says in his *Invert. Pal.*, p. 467, middle paragraph:

On comparing authentic specimens from New Jersey with others of nearly equal sizes from the Upper Missouri Cretaceous, they are found to agree well in form as well as in all essential specific characters of the septa. The New Jersey specimens generally have the septa less crowded and the lobes and sinuses proportionally somewhat shorter; but it is evident that no specific, or even subspecific, distinction can be based on such trivial differences.

The large specimen now before me, which belongs to the collection of the Acad. Nat. Sci., Phila., was probably also in Mr. Meek's hands while writing, and was in all probability compared with the diagram of the septum given of a western specimen, on page 466 of his work. But if any reliance whatever is to be placed upon the details of the septa of ammonites of similar character for specific relations or differences, I can not see why these two should be considered as being specifically identical. There is not the slightest resemblance in detail between them, only a general resemblance. In fact, almost the direct opposite of details prevails between the two when examined side by side. The lobes in the New Jersey specimen all have very narrow, constricted necks with a broad expansion below, while his diagram shows a wide neck, usually narrowed gradually toward the ends, the lateral branches decreasing in size from above downward in all the principal lobes. The sinuses, which are broad, compact, and clavate in the New Jersey form, are narrower and much less conspicuous in his figure, with the divisions slender, lax, and contorted. If the two specimens are specifically alike, what reliance can be placed upon detail of septa for the identification of species? None of the New Jersey examples which I have seen show any indications of the lines of nodes on the side of the shell as in the western forms. To be sure they are all casts, but even on the casts of the western forms these nodes are usually indicated, and on comparison I find the differences in septa quite general as between them, and I am inclined to conclude that they are either distinct species, or that those features which he with many others have considered as grounds for generic divi-

sions and subdivisions are only of specific importance, and that they have mistaken species for subgenera.

Formation and localities: The species is found in the Lower Marl Beds quite generally throughout the State. It is, however, never common, and is found mostly in detached fragments. It is known from near Burlington, from Mullica Hill, Neversink, Freehold, and many other places in New Jersey; it also occurs in Delaware. Mr. Meek, besides the western localities, gives in his Check List Mississippi, Alabama, Tennessee, and New Mexico. The species has been often cited from many different localities by various authors. I am, however, very skeptical as to the true identification of many of them.

AMMONITES (PLACENTACERAS) TELIFER.

Plate XLI, Figs. 10, 11.

Ammonites telifer Mort. : Synopsis, p. 38, Pl. 2, Fig. 7; Gabb, Synopsis, p. 17.

This species was named and figured by Dr. Morton in his Synopsis, from a small fragment of the cast of a chamber, which gives the details of only a part of one lobe of the septum, with small portions of others. No description of the species was given, and no locality mentioned. The fragment before alluded to is before me, with two others of much larger size, and are labeled as from New Jersey. The specimens are most probably parts of one individual, and were most likely all in Dr. Morton's hands when he wrote his notice and gave the name. They are evidently fragments of a very large specimen having a close resemblance in general form to *A. placenta* De Kay, but are very different in the details of the septa, and consequently belong to a distinct species; therefore I think the name worth retaining, although it appears to have been dropped from many lists. The septa of the shell were very closely crowded, as shown on these fragments, for the ramifications of the lobes interlock and interfere one with another to such an extent as almost to defy an accurate figure or description. The great peculiarity, however, and that which seems to separate it from *A. placenta*, is the very extended and mucronate extremities of the ramifications of both lobes and sinuses; there being so little difference exhibited between them as to render it extremely difficult to determine which are

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the lobes or which are sinuses. There appear to have been three compound divisions of the lobes so far as can be seen on the fragments, and the principal sinuses seem to have been bilobed. The back of the shell has been round and on one of the fragments is seen to be about three-eighths of an inch thick, and the siphon correspondingly large. The dorsal lobe has been quite small, with three compound digitations on each side, in the only place in which it can be seen, and extends not more than a fourth of an inch below the upper line crossing the dorsum; outside of this is a short, slender, compound, secondary lobe which divides the large first lateral sinus into two principal divisions. The next lobe is large and has its branches extending below the sinus and upon the rounded dorsum of the shell. The entire details of this lobe can not be made out, but I have figured it as far as it exists, so it can be seen and compared with that of *A. placenta* given, from which it will be seen to differ very materially; too much to have been a part of an overgrown specimen of the same species.

Formation and locality: There is no locality further than "N. J." given with the specimens. They are from a hard, brown, highly ferruginous sand, somewhat different from any specimens which I have before seen, and I am inclined to think they may have come from the iron nodules found near the surface of the plastic clays.

AMMONITES (SPHENODISCUS) LENTICULARIS.

Plate XLI, Figs. 8, 9.

Ammonites lenticularis Owen, 1852, Rept. U. S. Geol. Surv. Iowa, Wis., and Missouri, p. 579, Pl. VIII, Fig. 5.

Ammonites lobatus Tuomey, 1854, Proc. Acad. Nat. Sci., Phila., vol. 7, p. 168; Meek and Hayden, *ibid.*, vol. 8, p. 280; Gabb, Synopsis, pp. 12, 13; Meek, Check List, p. 24; Geol. Surv. New Jersey, 1868, p. 730.

Placenticerus (Sphenodiscus) lenticulare (Owen) Meek: Invert. Paleont. U. S. Geol. Surv. Terr., vol. 9, p. 473.

The above named species has been pretty generally recognized as a New Jersey fossil, although I have been able to obtain only very small fragments representing it, among all the collections to which I have had access. These are, however, of so marked a character as to leave no question of their identity. The fragments noticed consist, one of them, of casts

of three chambers, retaining two lobes and two sinuses each of two of them, and a single lobe and sinus of the third; the other fragment, a cast of several lobes and sinuses of chambers from near the umbilicus. They represent a specimen of large size, probably not less than 7 or 8 inches in diameter.

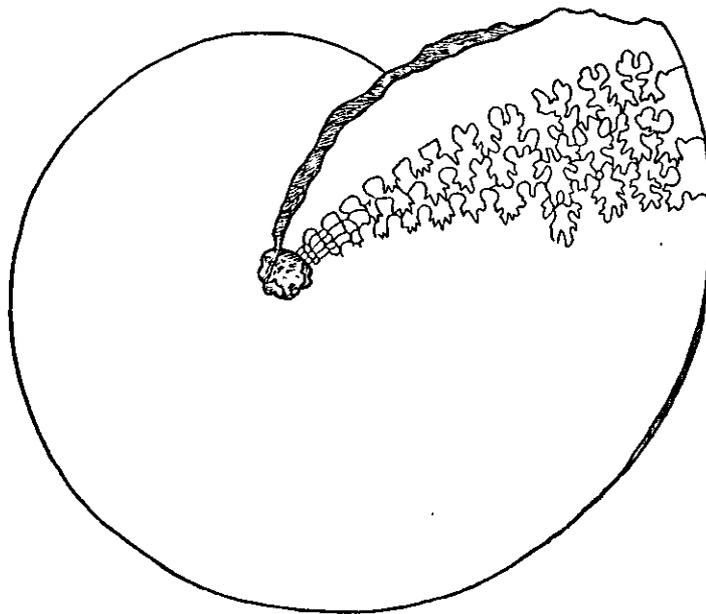


Fig. 1.—*Placenticerus (Sphenodiscus) lenticulare* (Owen) Meek. (From U. S. Geol. Surv. Terr., vol. 9, p. 473.)

In external features this species is much like *Am. (Placenticerus) placenta* De Kay, but is a little more spreading at the umbilicus, although the margin of the volutions are closer together, and it is usually sharply rounded on the back, instead of narrowly flattened as in that one until it is quite well grown, often to a diameter of 7 or more inches before it becomes rounded. Owing to the more spreading form of the umbilicus in this one, the point of greatest diameter is nearer to the middle of the width of the volution than in *P. placenta*, where it is quite near the inner margin. In the western forms of *P. lenticularis* there are sometimes very indistinct and distant folds on the surface, which radiate from the umbilicus, as shown by Mr. F. B. Meek on his figure in the *Invert. Paleont.*, as above cited, Pl. xxxiv, Fig. 1a. I have not seen any indications of such a feature on any New Jersey examples of

P. placenta. The principal point of difference between these species, however, is in the form and details of the septal lines, as shown on the surface of the casts. On *P. placenta* they are much branched, both on the lobes and sinuses throughout, but in this form they are altogether more simple, the lobes having two or three obtuse points on each of the divisions, and the sinuses being simple for some distance from the umbilicus, then becoming biclavate and outside of the middle of the breadth of the volution often first irregularly triclavate, and sometimes with four clavate divisions in older specimens. In specimens of large size, however, from Missouri, they are seldom as strongly divided as those represented by Mr. Meek in his Fig. 1c, Pl. xxxiv, of the work just cited. In the fragments of chambers seen from New Jersey, although evidently from a specimen of large size, the sinuses appear to have been simply bilobed, the division between the lobes having two short points, while the lobes have the features shown in those of the sixth to the ninth lobes of Mr. Meek's figures. There is no feature on the fragment by which I can definitely tell from what position within the breadth of the volution the one fragment came, so that I can only surmise as to the corresponding lobes of a more perfect specimen. But it is fair, probably, to suppose that it came from near the position above mentioned, as if not, or if it came from nearer the outer edge, it would indicate a different form from the western shells.

Formation and locality: The only fragment I have seen comes from the marl pits of J. S. Cook, Esq., near Tinton Falls, New Jersey, and are from the lowest layers of the Middle Marls, where they are associated with *Nautilus Dekayi* and small specimens of *Baculites ovatus* of the Lower Marls, as well as with many of the Molluscan remains of the Middle Marls, in a yellowish green marl sand, which appears to be peculiar to that horizon, if not to that locality.

Genus SCAPHITES Parkinson.

SCAPHITES NODOSUS.

Plate XLIV, Figs. 13, 14.

Scaphites (*Ammonites?*) *nodosus*, Owen: Geol. Surv., Iowa, Wis., and Minn., p. 580, tab. 8, Fig. 4.

Scaphites nodosus (Owen) Gabb: Synopsis, p. 33; Meek & Hayden, Proc. Acad. Nat. Sci., Phila., vol. 12, p. 420; Meek, Check List Cret., p. 24; Invert. Paleont. U. S. Geol. Surv. Terr., vol. 9, p. 426, and varieties; Whitf., Paleont. Black Hills of Dakota, p. 440, Pl. XIII, Figs. 1-3.

A fragment of the outer chamber of a *Scaphites*, which presents all the features of *S. nodosus* Owen, comes to me among the specimens from the Acad. Nat. Sci., Phila. The specimen is without label of any kind, and is associated in the tray with *S. hippocrepis*. The fragment bears every lithological evidence of being from the green sands of New Jersey, and from the Lower Beds. It is the lower end of the outer chamber from near the last septum; having a little of the imprint of the convolutions of it near the lateral margin, and continues to a little beyond the commencement of the outer geniculation. It has a lateral diameter of $1\frac{1}{8}$ inches and a dorso-ventral diameter of $1\frac{3}{8}$ inches from the back to the line of the horizontal portion of the volution. The side is flattened and the back rounded; the latter part marked by small transverse furrows which arch slightly forward in crossing the shell, and are arranged so as to bring about five ridges with their furrows within the space of half an inch in length on the middle of the back. The side is marked by two lines of nodes, one at the lower angle of the volution, and the other a short distance below the ventral line. The last are inconspicuous, while the former are very strong, from three to four in an inch space, and those on the horizontal portion transverse and much larger; the others gradually growing smaller along the geniculation toward the aperture. The side between the lower line of nodes and the ventral margin is marked by strong transverse ridges, arising one from each of the lower lines of nodes, but in some cases two of them unite at the upper node, forming only one from that point to the ventral line; septa of course unknown from the specimen.

The fragment gives evidence of having attained a size seldom exceeded by the species at its localities in the Black Hills of Dakota, where it is quite

common, and from whence it was originally described. It is the first case of its notice in New Jersey, and, so far as I am aware, at any point east of the Missouri River.

Since writing the above, three other fragments, of somewhat smaller size, have been noticed among the collections made by G. C. Schanck, in the white limestone nodules at the base of the Lower Green Marls, near Marlborough, New Jersey, having the same features, placing it beyond doubt as a New Jersey fossil. These are in the State collections at New Brunswick.

SCAPHITES HIPPOCREPIS.

Plate XLIV, Figs. 8-12.

- Ammonites hippocrepis* De Kay: Ann. New York Lyceum, vol. 2, p. 5, Fig. 5.
 Not *Ammonites hippocrepis* Morton: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 6, p. 88, Pl. v, Fig. 5.
Scaphites hippocrepis Morton: Synopsis, p. 41; Gabb, Synopsis, p. 32; Meek, Check List Cret., p. 24; Geol. Surv. New Jersey, 1868, p. 730.
Scaphites Cuvieri Morton: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 6, p. 109, Pl. VII, Fig. 1.

This species was originally described by Dr. De Kay from an imperfect fragment, but subsequently redescribed, from a very perfect cast, by Dr. Morton in his Synopsis. The specimen which he used is now in my hands, together with the outer chamber of a much smaller individual. Dr. Morton's specimen is ovate in general outline, with a very ventricose outer chamber, which has the greatest transverse diameter below the outer angle of the horizontal portion, a little within the point from which rises the line of the hood-like aperture; above the point indicated the diameter rapidly decreases again to the line of the aperture. The inner coils, the number of which can not be determined, are laterally compressed, although they might be considered as ventricose for a shell of the genus, being nearly as large transversely as in a dorso-ventral direction, but in comparison with the very rapidly increasing outer portion of the shell, from the origin of the horizontal portion to the point of greatest diameter, this inner part seems quite constricted. From the position of the last septum, which terminates at the umbilicus of the inner part, the ventral margin rises abruptly, giving

Formation and locality: One of the specimens, the one figured, came from the deep cut of the Chesapeake and Delaware Canal, and is from a highly ferruginous, siliceous sand, which belongs to the Lower Marl Beds of New Jersey. As it is so near the limits of the State, it will no doubt be found, if it has not already been found within the State. The smaller individual is of similar character, but of a finer material, with a large proportion of iron, which gives it a reddish brown color. Both specimens are from the collection of the Acad. Nat. Sci., Phila.

SCAPHITES RENIFORMIS.

Plate XLIV, Fig. 3.

Scaphites reniformis Morton : Synopsis, p. 42, Pl. II, Fig. 6.

Scaphites hippocrepis (Mort.), young specimen, Gabb, Synopsis, p. 33.

Scaphites subreniformis D'Orbigny: Prodrome Paléont., vol. 2, p. 214, No. 56, not *S. reniformis* Brug.

Dr. Morton describes this species as "ventricose in the middle, tapering rapidly at each end; with numerous costæ that bifurcate laterally." He gives the size as "less than [an] inch in length," and states that only a solitary imperfect cast was found. Mr. Gabb, in his Synopsis, p. 33, appears to consider it a young specimen of *S. hippocrepis* De Kay, and so cites it. I do not know if Mr. Gabb saw the original specimen used and figured by Dr. Morton. The specimen is not now to be found, but in place of it there comes to me from the Academy's collection a fragment of a *Scaphites* the figured type of *S. iris* Conrad, from Tippah, Mississippi, in the tray which should, according to the label in it, contain the type specimen. The specimen used by Dr. Morton may have been one of *S. hippocrepis*, but I can hardly think so; as if so, it would not have presented so large an umbilicus, that of *S. hippocrepis* being very small. I have before me some fragments of very small specimens of that species which are as finely annulated as that shown in Dr. Morton's figure, but without more exaggeration or careless delineation than has been permitted in the great majority of his figures no such drawing could ever have been made from it. And after seeing the accuracy of most of Dr. Morton's figures and determinations, and carefully studying the matter, I am most strongly inclined to the belief that *S. reniformis* was a distinct form from *S. hippocrepis* and a valid species.

an abruptly increased vertical height to the neck or straight part to the base of the aperture; the line of which is exactly rectangular to it, and slightly infolded on the edge; surface of the shell marked throughout by transverse undulations, small on the inner coils and frequently bifurcating, but directed straight across the shell from the ventral line. On the horizontal portion they are much stronger and coarser, and above the outer geniculation they again become as fine and close as on the inner coils. The shell is further ornamented by two lines of nodes along the sides; the outer lines the smallest on the outer chamber, the other line imperceptible on the coiled part. At the angle of the outer geniculation there exists the largest node of all and outside of it two or three smaller ones. Septa somewhat closely arranged, but rather simple in structure, composed of a dorsal and three lateral lobes; dorsal lobe with four divisions, two on each side of the central line, the first division doubly clavate, the other with four rounded projections on the outer side; second lobe, or first lateral lobe, with two main divisions widely separated, each of which is deeply bifurcate, with slight lobations near their extremities; second lateral lobe small, clavate with a trilobed end; third lateral lobe only about half the size of the second, but of similar form; first sinus much wider and larger than the first lateral lobe, with four double divisions (one of which in the septum drawn is imperfect); second sinus with two double or bilobed divisions; third sinus simply bilobed, and the third simple; the septum figured and its details here given is the second from the outer chamber of Dr. Morton's figured specimen and gives the details of course much more developed than would a septum at an earlier stage of growth.

Dr. De Kay described this species originally from an imperfect cast of the outer chamber of only medium size, which appears to have been the property of the New York Lyceum, and was from Delaware. I have before me at the present time a similar specimen of somewhat smaller size, having only about half the diameter of the one figured, but showing the same features on a reduced scale. The species is peculiar among all the American *Scaphites* in the rapid lateral increase in size of the central portions of the outer volution, which gives it a peculiar form and appearance which will readily distinguish it.

D'Orbigny in his *Prodrome*, p. 214, cites it as *S. subreniformis* Morton. To this Mr. Gabb in his *Synopsis* under *subreniformis* takes exception. To me it is quite evident that D'Orbigny intended this name as a substitute only for Morton's name, and that he accidentally omitted to state in connection with it that it was so meant; as in parenthesis he says (non Brug. 1790). I have, however, been unsuccessful in a search for further evidence of a *Scaphites reniformis* Brug. elsewhere.

I have given as good a copy of Dr. Morton's figure of his *S. reniformis* as possible, in order to aid in the search for other specimens of the species, or the identification of the type should it be discovered.

Formation and locality: The type specimen came from a friable marl, at Grove Mill, near Bordentown, New Jersey, and would pertain to the Lower Marl Bed.

SCAPHITES IRIS.

Plate XLIV, Figs. 4-7.

Scaphites iris Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 3, p. 335, Pl. xxxv, Fig. 23; Gabb, *Synopsis*, p. 32; Meek, Geol. Surv. N. J., 1868, p. 730.
Scaphites Conradi Gabb: *Synopsis*, p. 32.

Mr. Meek gives this species in his list of New Jersey fossils published in the Geol. Report for 1868, but does not include the name in his Smithsonian Inst. Check List. Mr. Gabb cites it as a synonym of *S. Conradi*, to which type it undoubtedly belongs and is somewhat closely allied. Mr. Conrad in his original description says it differs greatly in the character of the septa. The septum which he describes as existing in a free or unfilled condition has since been destroyed, and the only one which can now be seen is so extremely small as to be entirely unreliable for comparison, and the external form of the types, the only ones known, differs in some essential particulars.

The species may be characterized as follows: Shell small to medium size, almost circularly discoid, with laterally compressed volutions, especially the inner coils, which are flattened on the sides and almost grooved on the back from the prominence of two lines of nodes along the dorsum. Body volution proportionally more expanded in one of the types, appearing somewhat inflated on the sides along the horizontal portion, the inner whorls

being fully embraced up to the small umbilicus. Horizontal portion comparatively short and the ventral margin slightly protruding as in *S. hippocrepis*. Aperture unknown, but from the appearance of the tube near the outer geniculation it was apparently contracted both laterally and vertically as compared with the size of the tube on the straightened portion. Surface marked on the inner coils by comparatively fine and closely arranged transverse ridges which become coarser at the inner geniculation, and on the straight part and beyond are obsolete; also by two lines of pointed nodes on the dorsum, which are prominent, giving a sunken area or apparent groove on the dorsum between them. Outside of these lines another line of nodes occurs at the angle of the back, and two others, less distinct, on each side of the horizontal part of the outer chamber. Substance of the shell somewhat strong and on the specimens highly iridescent, whence the specific name.

Septa not very complicated, but rather closely arranged, consisting of a moderately large dorsal lobe and three lateral lobes on each side, which rapidly decrease in size toward the umbilicus, on the very margin of which the third one is situated. The details of the lobes and sinuses can not be traced on any of the specimens in hand sufficiently well to construct a diagram thereof. The first sinus is much larger than the first lateral lobe, and all the divisions of both lobes and sinuses have rounded extremities, and are altogether more simple in their structure than those on a specimen of *S. Conradi* of the same size, which is the species most nearly related to it in general form and appearance among the American *Scaphites*. It also differs from it in the form of the outer chamber along the ventral edge and in the inflation of the middle portion of this part. It resembles that species greatly in being circularly discoid, or in the very short horizontal portion.

Formation and locality: The specimens which I have examined, and which are probably all that have been obtained, undoubtedly came from Tippah County, Mississippi, from whence Mr. Conrad cites them. The specimen originally figured by Mr. Conrad comes to me in a tray marked "*S. reniformis* Cret. N. J.," undoubtedly an accidental displacement; while the specimens originally belonging in the tray are lost. I have seen no example from New Jersey myself that could be referred to this species,

although Mr. Meek cites it as from the State, probably basing his identification on those mentioned above. I give the species here to help in the identification should specimens of it be found in future, that the record may be as perfect as possible.

SCAPHITES SIMILIS, n. sp.

Plate XLIV, Figs. 1, 2.

Shell small, the type specimen, the only one known at present, being only five-sixths of an inch in its greatest length, and although not quite finished at the aperture, would not exceed 1 inch were it continued to its entire size. Volutions laterally compressed, rounded on the back, and marked by fine transverse ridges to beyond the commencement of the outer chamber, beyond which point the ridges are larger and indistinct, especially on the sides. A single line of nodes marks the outer angle of the body volutions, and are largest opposite the middle of the horizontal portion of the coil. Septa not very crowded and rather simple, consisting of the dorsal lobe and three lateral lobes on each side outside of the umbilical cavity, which is quite small. Dorsal lobe moderately large, the lower branches not quite half as long as the height of the first sinus, the extremities rounded, and with a rounded protuberance on its outer side, above it there is one other projection on each side. First lateral lobe large, broadly flabelliform with six short blunt fingers arranged around its rounded end, and one other at the junction of the first sinus; second and third lobes small, and consisting of only a single bluntly rounded member each. The first sinus equals the first lateral lobe in size, but is bilateral at the extremity, each division showing a slight indentation on the middle. The other sinuses are simple rounded sinuosities, but slightly broader than the corresponding lobes.

The species resembles in miniature *S. nodosus* Owen, from the Cretaceous of the Upper Missouri, and New Jersey, in its general form and features, especially so on the back in the marking of the surface. There is evidence, however, of only one line of nodes on each side, instead of two as is usual on that one, although by no means always developed. There is, however, a great and very marked difference in the form and details of the septa, as on a young specimen of *S. nodosus* of the size of this one they

are found to present the small compound divisions seen in the larger specimens, although not so extreme. There can, therefore, be no real specific relation between the two in this respect, notwithstanding the great external resemblance. In the septa it more closely resembles *S. hippocrepis* De Kay, but if the diagram be compared with that of that one, it will be seen to be fundamentally so different that it could not be developed into it, besides the tube of this does not widen laterally on the outer chamber as does that one, neither is the ventral line of the horizontal portion widened as it is in *S. hippocrepis*.

Formation and locality: The specimen comes to me associated *S. hippocrepis* in the same tray, all of which are marked on the label "Cret. N. J.;" but the specimen of that species figured by Dr. Morton in his Synopsis, which is one of them, came from the deep cut of the Chesapeake and Delaware Canal, in Delaware, and as this is closely like it in lithological character, it probably came from the same locality. Collection of the Acad. Nat. Sci., Phila.

Genus TURRILITES Lamarek.

TURRILITES PAUPER, n. sp.

Plate XLV, Figs. 1-5.

A single fragment of a *Turrilites*, consisting of one and one-third volutions of a species with a very rapidly ascending spire, has been observed among the New Jersey fossils. The coils of the spire are in close contact and the volutions are higher than wide, and show in the cast a moderately wide umbilical opening. The upper edge of the volution is angular where it unites with the one above, and within the angle the surface is concave where it has been in contact with the base of the coil above. The rest of the surface is rounded, and covered by oblique, bifurcating, or duplicating vertical folds or ridges, and is also marked by two lines of nodes, one at about the middle of the volution and another near the lower part. The nodes occur on almost every alternate ridge, though not invariably so, and those of the upper line of nodes are not on the same ridge as the lower line. The ridges are strongly directed forward as they cross the volution from above to the lower side of the volution, and are visible even within the umbilicus, although faintly so.

The fragment preserves only a single septum the details of which are given, enlarged to twice natural size in the figure on the plate, this having been the lower limit of the septate portion; the next higher septum being at the upper end of the fragment.

The species is peculiar in its rapidly ascending spire; also in having the volutions higher than wide, instead of circular, and also in the numerous but very distinct vertical folds or ridges. The concave upper side of the coil showing the partial imbedding of the preceding volution will also serve to distinguish it from other described species of this country, they generally presenting round volutions while these are quite angular at the junction of any two.

Formation and locality: From the Lower Green Marls, at Neversink Hills, New Jersey. Collection at Rutgers College.

Genus HETEROCERAS D'Orb.

HETEROCERAS CONRADI.

Plate XLV, Fig. 9-14.

Ammonceratites Conradi Morton: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 8, p. 212, Pl. x, Fig. 1; Descrip. New Sp. Organic Rem. Cret. United States, 1842, p. 8.

Helicoceras Conradi (Mort.) Gabb: Synopsis, p. 28; Meek, Check List, p. 25.

Cirroceras Conradi (Mort.) Meek: Geol. Surv. New Jersey, 1868, p. 730.

A single whorl of a species of *Heteroceras*, imperfect at both ends, and in all probability nearly if not quite the last whorl of the specimen, represents the above synonyma. As will be seen by Dr. Morton's original description, he considered it as almost a perfect individual, as he says in his remarks: "The terminal end is nearly complete and almost on a line with what appears to have been the mouth of the shell, and the two approach within a quarter of an inch of each other." It is very evident, however, when the specimen is examined by the light of present information and knowledge of these peculiar shells, that the specimen, which is only an internal cast of the non-septate portion, it belongs to a sinistrally coiled spiral shell, where the volutions have not been in contact one with the other, as, if they were extended far enough, they would overlap, leav-

ing about a fourth of an inch between the whorls. The tube in its present condition is greatly compressed vertically, so that the height is only about two-thirds as great as the transverse diameter, and the back shows a decided crushing of the tube in the sharply angular dorsal crest of the specimen, which was undoubtedly rounded in its normal condition. The surface of the cast is marked by transverse undulations or ridges, which are rather sharply curved backward on the upper surface in their passage from the umbilical edge to the outer one, and less strongly curved forward on the under side of the volution. Near the position of the center of the outer surface of the volution there has apparently been a line of rounded nodes situated on the ridges, but not, however, on each one, and another series of nodes at about one-third of the width of the volution within the edge on the under side. At this inner line of nodes almost every second and third ridge unites, forming a single ridge from that point to the umbilical cavity, within which they appear to become obsolete.

A second specimen, also a very much flattened cast of what seems to have been the deflected outer part of the tube, has lost the nodes, and also to a very great extent the bifurcation of the costæ, as on this part of the shell they form more regular encircling ridges, as the straightening of the tube relieves the crowding at the umbilical edge. A third specimen, quite lately obtained, consisting of the outer chamber and the deflected part of the tube, shows this part to have been suddenly bent obliquely downward to a length of $2\frac{1}{2}$ inches, when it is abruptly bent upward again in the same plane and nearly upon itself, so that the extremity of the tube, or aperture, must have been nearly under the umbilical portion of the older shell. The tube of this specimen is nearly circular, being a trifle higher than wide, the ridges are strong and distinct, and the two lines of nodes more easily observed; although owing to the deflection of the tube and its irregular growth the bifurcations take place quite irregularly and the nodes are also quite irregularly scattered, but always on the outer surface of the tube.

Septa comparatively unknown. The last one shows imperfectly on the last specimen mentioned. There is apparently a rather large siphonal lobe with a strong branch on each side of the rather large siphon, which is

situated on the inside of the coil; besides this, there are apparently three principal lobes, situated, one on the line of the upper row of nodes, or nearly opposite the siphon, and a larger one midway between it and the siphon; the one on the upper side of the tube is much larger than that below. There have also been secondary lobes between these primary ones. The sinuses have been correspondingly large and of unequal size, but owing to the wearing of the surface the details of structure can not be made out.

This species differs very materially from any of those described from the west, in the details of structure. It is perhaps more like *H. Newtoni*, Whitf., from the Black Hills of Dakota (see Paleont. of the Black Hills, Pl. xv, Figs. 1-4) than any other, but it differs in being sinistrally coiled instead of dextrally as that one is. F. B. Meek also figures a species in the U. S. Geol. Surv. Terr., vol. 9, Pl. xxi, Fig. 4, but without name, which bears considerable resemblance to this one in surface detail.

Formation and locality: According to Dr. Morton the type specimen was found at Arneytown, New Jersey, by Mr. T. A. Conrad, and would consequently be from the Lower Green Marls. The second specimen mentioned above is to all appearances from the same place; both of these are in the Acad. Nat. Sci., Phila. The third example is from the same position at Atlantic Highlands, New Jersey, and is in the collection at Columbia College.

Genus SOLENOCERAS Conrad.

In the Jour. Acad. Nat. Sci., Philadelphia, 2d ser., vol. 4, p. 284, Mr. Conrad proposed the above generic name as a division of D'Orbigny's genus *Ptychoceras*, using Dr. Morton's *Hamites annulifer* as the basis for his diagnosis. The shells of D'Orbigny's genus consist of a slender, tapering tube, which, after attaining a certain length, is suddenly and abruptly returned upon itself, the two portions being in close contact. Mr. Conrad supposed that in the case of *Hamites annulifer* Morton the outer section, or larger section, after having been returned upon the earlier part for a short distance had again become deflected away from it at a considerable angle. I am not aware that Dr. Morton's species is positively known by any other than the type specimen, which is an internal cast of the outer chambers only, although Mr. Conrad cites it as occurring in Alabama as well as in New

Jersey; and both Mr. Gabb, in his Synopsis, and Mr. Meek, in his Check List, follow him in citing it from both States. Mr. Gabb, although admitting the genus as a valid one, is inclined to dispute the deflection of the outer part of the tube. This would leave the genus to stand entirely upon the feature of the smaller tube lying in a groove of the larger one, as these two features are all that Mr. Conrad claims, his generic description being as follows: "Differs from *PTYCHOCERUS D'Orbigny*, in the smaller tube lying in a furrow of the larger one, which is straight only for a short distance from the junction, and then suddenly recurved. Mr. Meek in his Invert. Paleont. of the U. S. Geol. Survey, vol. 9, p. 410, places *Solenoceras* as a synonym of *Ptychoceras*, as he not only questions the deflection or recurving of the shell a second time, but objects to the enfolding of the smaller tube within a groove in the larger one being considered as of generic importance. On examining Dr. Morton's specimen I think there is every evidence that can be derived from an internal cast of such a shell that the supposed deflection of the tube at the outer end of the fragment is only the thickening and rounding out of the completed or adult aperture of the shell, as the cast of the opening has been contracted on all sides and made to form a completely circular aperture or opening. From the specimen known there is no evidence as to what form the earlier parts of the shell may have had, other than that it was most probably elliptical or slightly flattened in a transverse section and also very slightly bent longitudinally; but beyond the length of the fragment, which is only seven-eighths of an inch, there is no evidence whatever afforded, and I have never known of any other individual being seen, all references being made to this one individual.

While working over the Cretaceous fossils from the Black Hills of Dakota, published in Capt. Jenny's report of the Black Hills expedition, I found examples of shells having characters very much like the one from New Jersey, but not so finely annulated, in which the earlier portion of the shell was bent and curved in such a manner that, had the larger part of the tube been continued beyond about the same length as the same part of this New Jersey specimen, it would of necessity have been compelled to become deflected in precisely the direction and manner in which Mr. Conrad supposed that one to have been in order to have grown beyond that point. Beyond this I have very good reason to suppose that the embryonic portion

was coiled like the interior of a *Scaphite* or *Ammonite*, as I had one, having the septa of a *Ptychoceras*, which was so coiled, but which was destroyed accidentally before it could be figured. If I am correct in referring that specimen to one of the species of *Ptychoceras*, there described and figured (See p. 457, Pl. 16, Fig. 1), that one certainly would have been generically distinct from the types of *Ptychoceras* and would probably prove congeneric with Dr. Morton's species could better specimens be procured. Consequently I think it best to retain Mr. Conrad's name for forms like that which I described and figured as above cited under the names *Ptychoceras Meek-anum* and *P. crassum*. In this case the generic diagnosis of *Solenoceras* would have to be changed somewhat as follows:

SOLENO CERAS (as amended).

Embryonic portions probably coiled forming one or more turns, beyond which the tube is deflected in a more or less direct line, or slightly bent to the end of the septate portion of the adult shell; terminal chamber recurved upon the septate portion, which it more or less embraces, the aperture may again be deflected from a right line where the younger parts are bent.

Genus PTYCHOCERAS D'Orb.; *Solenoceras* Conrad.

PTYCHOCERAS (SOLENO CERAS) ANNULIFER.

Plate XLV, Figs. 6-8.

Hamites annulifer Morton: Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 8, p. 213, Pl. XI, Fig. 4; Extract, p. 9, Pl. II, Fig. 4.

Solenoceras annulifer (Mort.) Conrad: Jour. Acad. Nat. Sci., Phila., 2d ser., vol. 4, p. 284; Gabb, Synopsis, p. 33; Meek, Geol. Surv. N. J., 1868, p. 730.

Ptychoceras (Solenoceras) annulifer (Morton) Meek: Check List Cret., p. 23.

Shell small, known only from an internal cast of the chamber of habitation, which is rather less than a fourth of an inch in its greatest diameter, and only seven-eighths of an inch in length. The earlier portion of the shell appears to have been transversely elliptical in section, as it has left a broadly concave depressed area on the inner face of the outer chamber, which has a curvature very much greater than that of the outer face. Outer chamber contracted very slightly in diameter for a little more than the outer

third of its length, but is again abruptly expanded just behind the aperture; the opening itself having been circular and smaller than the tube behind it. Surface of the cast finely and closely annulated, the annulations having a direction just perceptibly backward in crossing from the inner to the convex surface, and count just eight annulations in the space of one-fourth of an inch on the largest part of the outer tube; on the inner concave face the annulations are somewhat finer, as many of them are doubled at the edge of the concavity, giving in the aggregate nearly one-third more annulations within a given distance. On the back of the cast two lines of minute nodes, marking the crests of the annulations for a short distance behind the aperture, are faintly perceptible under a good magnifier.

On the posterior extremity of the outer chamber the lobation of the last septum is obscurely marked, showing a moderately strong dorsal lobe, with a larger lateral lobe on each side, while a large bilateral sinus has occupied each edge with a lobe on each ventral side, and a very small ventral lobe on the inner surface. The details of the lobes and sinuosities are, however, too badly defined to be traced. The surface of the shell of the septum is beautifully iridescent, and slight traces of iridescence are perceptible on other parts of the cast.

The specimen here used and figured is Morton's type of the species, and is also that used by Mr. Conrad for the type of his genus *Solenoceras*. As yet no other has been observed so far as I can ascertain. It differs from the species described as *Ptychoceras Mortoni* by F. B. Meek in his Vert. Paleont. U. S. Geol. Survey of the Terr., p. 412, Pl. xx, Fig. 4, in the direction of the transverse ridges which are more direct, and possibly in their being somewhat finer and more regular; on the whole, however, it is very similar. From *P. Meekianum* Whitf., of the Black Hills report, it differs much more widely in that that species is more coarsely annulated, and the annulation much more acute and oblique.

Formation and locality: The type specimen, as stated under the original description by Dr. Morton, is from the Lower Green Marls, at the Deep Cut of the Chesapeake and Delaware Canal, Delaware. It is very probable, however, that by careful observation it might be discovered in the Lower Marls in New Jersey. The specimen is in the collection Acad. Nat. Sci., Phila.

Genus BACULITES Lamarck.

BACULITES OVATUS.¹

Plate XLVI, Figs. 3-9.

Baculites ovatus Say: Am. Jour. Sci., vol. 2, 1st ser., p. 41; vol. 6, Pl. v, Figs. 5 and 6; Morton, Am. Jour. Sci., vol. 17, p. 280; vol. 18, Pl. I, Figs. 6-8; Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 6, p. 89, Pl. v, Fig. 6 (and 5?); Synopsis, p. 42, Pl. I, Figs. 6-8 (the latter perhaps doubtful); Gabb, Synopsis, p. 22; Meek, Check List (in part), p. 23; Geol. Surv. New Jersey, 1868, p. 730.

The examples of this species as they occur within the State of New Jersey are pretty generally internal casts and usually only small detached fragments of a few chambers each. Occasionally one is found which will preserve the inner layers of shell, but even this appears to be quite rare. One of the examples figured by Dr. Morton, Pl. IX, Fig. 1, of his Synopsis, is in this condition, and is the only one which I have seen preserving even this much of the shell. The specimens do not appear to attain a very great diameter, the largest observed having a diameter of not more than $1\frac{1}{4}$ inches in the longest axis. They appear to have enlarged upward very slowly with the increased length, but are by no means uniform in this respect, not even in different parts of the same individual. The exterior of the shell, so far as can be determined from the cast, must have been smooth except for a few undulations on the edges, more particularly so on the siphonal edge, where they are somewhat evenly arranged, at least on the younger specimens. The general form of the shell in section is supposed to be ovate,

¹The following is Say's original description of *B. ovatus*, taken from Am. Jour. Sci. and Arts, 1st ser., vol. 2, p. 41:

"*Baculites ovata*, elongate; transverse septa subovate, six-lobed, and a smaller one behind; lobes of the superior faces of the septa, three on each side, with a minute one between each, dentated at their edges; anterior lobe (nearest the siphuncle) small, not sinuous; second lobe with a single projection each side and sinus at tip; third lobe dilated, with a small sinus each side and more obtuse and profound one at tip; posterior lobe hardly larger than the lateral intermediate ones.

"Greatest diameter of the transverse section, one inch and one-fifth; smaller diameter, seven-tenths; length of the segment about half an inch."

The specimen used was the same as that used and figured by Dr. Morton in the Jour. Acad. Nat. Sci., Phila., 1st ser., vol. 6, pp. 89 and 196, Pl. v, Fig. 6, and was from the Lower Green Marls at Never-sink Hills, N. J., while the *B. compressa* described by Say on the same page as above was from Nuttall's collection, made on the Upper Missouri River.

but it is difficult to determine how far this feature may be reliable. Many of them are decidedly ovate, others so slightly so as to make the feature difficult of detection, while by far the most of the examples which I have seen would be called oval by anyone not expecting to question the form.

The septa are closely arranged in some and in others somewhat distant, while they are not infrequently quite irregular in distance in the same individual, and sometimes do not extend the entire distance across the tube, but interfere with and terminate against the one below, so as to count irregular on opposite edges of the tube. In one specimen which comes to me from the Acad. Nat. Sci., Phila. this occurs twice within a length of an inch and a half, and all the septa in that distance are quite crowded. The septa have three lobes on each side of the tube and a small one on the ventral edge; while the siphonal lobe is simply bifid and the branches very small and short. The first dorsal lobe is much smaller than the others and directed somewhat inward toward the side or away from the dorsal edge. The second lobe is much larger and more numerous branched, while the third is still larger than the second as well as more complicated in structure and the ventral lobe quite small, short, and simple, but numerous digitate according to the size and age of the specimen. In detail the lobes and sinuses vary with size and age, but are almost as variable as the specimens are numerous, but in all the specimens which I have examined the second lobe is usually bilateral, nearly symmetrically so, and the sinuses in the lower half of the lobes are broad and rounded without serratures on their margins.

Siphon situated just within the narrow edge of the tube and of rather large size.

Shell marked on the outer portions in specimen of large size by undulations of growth indicating the outline of the aperture, and showing a considerable extension upward of the shell on both edges and a corresponding broad sinus on the sides, the extension on the siphonal side being much the longest.

Formation and localities: In the Lower Green Marls throughout their extension in New Jersey and Delaware. Most common in Burlington County, New Jersey. Mullica Hill has also furnished many. The bluffs at Neversink, New Jersey, and Monmouth County have yielded some.

One tray in the Acad. Nat. Sci. is marked "Vincentown, N. J., T. M. Bryan."

BACULITES COMPRESSUS.

Plate XLVI, Figs. 1, 2.

Baculites compressus Say: Am. Jour. Sci., 1st ser., vol. 2, p. 41; Morton, Synopsis, p. 43, Pl. IX, Fig. 1, and probably of most authors where western examples are considered.

Among the specimens sent me from the Acad. Nat. Sci., at Philadelphia, as New Jersey fossils, I find the type specimen of this species, used by Mr. Say in his original description, and afterward figured by Dr. S. G. Morton as above cited. Mr. Say says that the specimen came to him from the collection made by Mr. Nuttall; that it was washed out from the banks of the Missouri River between White River and the Mandan settlements, as stated by Dr. Morton. The specimen was owned by and loaned to Dr. Morton by J. P. Wetherill, Esq., and I find his initials still on it in ink. The specimen has the lithological character of the western specimens, and not that of the New Jersey fossils. The specimen is more compressed than are any of the New Jersey individuals when retaining their true form, and is slightly ovate, being narrower on the siphonal edge than on the opposite. In other respects it presents the common features of the others as to rate of taper, number and position of lobes, and generally so in details of bifurcation of the lobes, except in the divisions of the lobe nearest to the ventral edge, where the divisions are not always bilateral, there usually being a central much branched division, which results from a pressing over to one side of the principal part of the lobe by the greater size of or greater number of smaller branches on the side next to the ventral edge. This appears, however, to be more a defect in the specimen than a natural growth, as among a large number of examples of all sizes from the Fort Pierre group on Sage Creek, Dakota, I find this feature entirely absent; consequently it becomes quite impossible to find among western examples features in the detail of structure by which the two species of Mr. Say can be separated. I have given a very accurate figure of this historical specimen, and a detailed enlargement of one of the septa for comparison with the eastern forms. There is, however, one general feature of the western forms in which they differ entirely from any and all

the New Jersey specimens which I have studied: this is the greater laterally compressed form of the tube. In this respect they vary greatly, even the ovate specimens, from New Jersey, being much thicker than the western ones; but as far as the ovate and oval form of the section is concerned, the same variations occur among the specimens from both regions, and apparently of about equal numbers, only the New Jersey specimens are never so large as many of the western ones, and are always proportionally thicker, unless accidentally compressed. In the details of the branching of the sutures the western specimens become far more complicated than those on the Atlantic coast, in proportion to the size of the specimens, although the general plan of the divisions, or what might be called the primary divisions of the lobes and sinuses, are very much the same in all the specimens examined. In many of the western ones the secondary lobes between the large lobes are proportionally longer and have many more serrations on their margins, and in one small individual the ventral sinus, as formed by the two halves combined, has almost exactly the same form and length as those on the sides of the shell. Even on *Baculites grandis* Hall and Meek, the general features of the sutures are the same, where, as in one example examined, the width of the specimen is fully 5 inches.

Considering all these features and close resemblances between the eastern and western specimens I am much inclined to draw the line between the two species, as recognized by Mr. Say and Dr. Morton, considering it as a geographical limit more than as a difference in features, although there is that difference in size and relative thickness of the specimens, and to consider the western forms as properly belonging to *B. compressus*, and the New Jersey specimens as properly belonging to *B. ovatus*, irrespective of the form of their section, although it is quite difficult to find one equally rounded on the two margins among those from New Jersey.

BACULITES ASPER.

Plate XLVI, Figs. 10, 11.

Baculites asper Morton: Synopsis, p. 43, Pl. I, Figs. 12, 13, and Pl. XIII, Fig. 2.

This species of Dr. Morton does not appear to have been noticed by writers among the fossils of New Jersey, but it nevertheless seems to have

existed within the limits of the State, as a single fragment of a large sized individual comes to me among the collections made by Prof. Reiley from Holmdel, and is from the Lower Marls. The fragment is less than 2 inches in length, but is about $2\frac{1}{4}$ inches in its greatest transverse diameter, by nearly $1\frac{1}{4}$ inches in its shorter diameter. The fragment is apparently from within the septate portion of the shell, as it bears markings of the septa at each extremity, but in a condition altogether too imperfect for description. However, there is on each side of it a single one of the large inflated node-like undulations which characterize the species, through the highest part of which the shorter diameter of the specimen is nearly one-half greater than at a point below between this and the next node below. There have probably been other septa within the length of the fragment, but they are entirely invisible in detail from the condition of preservation, although one of them appears to be obscurely indicated by an irregular thickened line near the middle of the length, the undulations on the side of the shell extending entirely across its width and modifying one of the edges. In crossing the side of the specimen it forms a deep downward curve in the middle, with corresponding deep but still broader depressions above and below it. The transverse section of the tube appears to have been nearly or quite symmetrically oval.

It is possible I may be mistaken in the specific relations of this fragment; if it is not *B. asper* it must be an undescribed species, as none other described possesses the features which this one presents.

Collection at Rutgers College.

Order DIBRANCHIATA.

Genus BELEMNITELLA D'Orbigny.

BELEMNITELLA AMERICANA.

Plate XLVII, Figs. 1-11.

Belemnites Americanus Morton: Jour Acad. Nat. Sci., Phila., 1st ser., vol. 6, p. 190, Pl. VIII, Figs. 1-3, and Pl. v, Fig. 7; Am. Jour. Sci., vol. 18, 1st ser., p. 249, Pl. I, Figs. 1-3; vol. 17, p. 281; Synopsis, p. 34, Pl. I, Figs. 1-3.

Belemnites subconicus (Lam.) Morton: Jour. Acad. Nat. Sci., Phila., vol. VI, pp. 91 and 100, Pl. v, Fig. 7.

Belemnitella mucronata (Schlot.) D'Orb.: Prod. Paléont., tome 2, p. 211; Gabb, Synopsis, p. 22; Meek, Geol. Surv. N. J., 1868, p. 731.

Belemnitella subfusiformis Morton: Synopsis, p. 34, Pl. I, Fig. 3.

? *Belemnitella paxillosa* Meek: Geol. Surv. N. J., 1868, p. 731.

Stylet or guard rather large, solid and heavy, often becoming thickened with age so as to be proportionally much larger in diameter as compared with smaller individuals. Specimens varying from 3 to nearly 4 inches in length below the base of the slit, the larger ones evidently having a length of fully 6 inches from the lower extremity to the top of the internal cavity or conotheca. General form triangularly cylindrical in the upper part, becoming flattened on the ventral side in the lower part, with frequently a slight mucronate extremity, which when broken generally shows a slight central perforation, as do many of those which are destitute of this pointed extremity. In many old examples the extremity is solid as in the specimen Fig. 3, Plate XLVII, while in the largest individual which I have observed from New Jersey, Figs. 5, 6, and 7, there is yet a slight perforation. I have never seen the mucronate point exceeding one-sixth of an inch in length. The upper end of the stylet or guard, from about the base of the internal cavity, gradually expands upward and becomes very thin on the edge, and the inner surface of the wall often bears the marks of the transverse septa of the phragmocone. At about the base of the cavity the external diameter is less than below, and in some examples the lower portion is considerably expanded as in the one represented by Figs. 1 and 2, Plate XLVII, which is the typical specimen of Dr. Morton's var. a, *B. subfusiformis*, while in others there is almost a regular decrease downward to near the extremity, which is usually obtusely rounded except for the mucronate point occasion-

ally seen. Very young specimens often present a long slender extremity. On the ventral side, the slit extends fully one-third of the length of the shell, where the walls of the upper portion are preserved to near their full length, which is seldom the case; its width in the lower half often being little more than the thickness of heavy writing paper. The flattening of this side of the stylet commences near the base of the slit and extends almost to the lower extremity of the guard. On the dorsal side there is a raised elongate lanceolate area, which is narrow and prominently angular in the upper part of the body, but is flattened or simply depressed convex on the surface and gradually widens below the base of the slit so as to become from half the entire width of the shell to almost its equal in width, but produces a slight angularity on this side throughout the entire length. The entire surface is usually much roughened when not worn, the roughening being greatest on the ventral side, while laterally this roughening produces vascular lines running obliquely backward in crossing from the ventral to the dorsal surfaces, and on the raised lanceolate area of the dorsal surface the markings are finer and arranged so as to produce longitudinal lines, or interrupted striae.

I have not, in any of the New Jersey specimens, no matter how well preserved, been able to see anything of the rostrum or dorsal extension of the upper portion.

The phragmocone is seldom seen showing the lines of septa, and when seen they appear to be only external or marginal. Among the few bearing the lines which I have examined none have shown the septa extending across. This body is rather abruptly obconical, and is just a little ovate in transverse section, one side being a very little angular and with a raised, rounded, longitudinal ridge, corresponding to the angularity of the solid side of the alveola of the stylet or guard, the side corresponding to the fissure of the guard being regularly curved, as is the inside of the cavity itself. The lines of septa are very numerous and closely arranged near the pointed end, but gradually and regularly increase in distance from each other, so that where the diameter of the cone reaches five-eighths of an inch, the septa are fully a twelfth of an inch apart. In their direction across the cone they are nearly straight, except on the angularity, where they are slightly advanced. The position of the siphuncle I have not observed.

The substance of the guard is quite dense, and is transversely fibrous, the fibers being very slightly directed downward from the initial line, which is never quite central, but is usually placed considerably nearest to the fissured margin of the guard.

It is almost useless to institute comparisons between this and other species except the *B. mucronatus* of Schlotheim; while it is equally difficult to point out reliable differences between that and the New Jersey form. There is, however, one marked difference between them, so far as I have been able to examine European specimens of *B. mucronatus*, and there are many, both English and German. This is the relative length of the guard below the base of the slit or fissure, which in the American examples is proportionally longer than in the European, varying from half an inch to over an inch in different examples. This feature of course is a variable one, and perhaps may not be considered as of importance or reliable, yet it nevertheless exists; but in other points they agree very closely. Still I am inclined to hold to Dr. Morton's name for our American specimens, although forms like this, which may have been to some extent pelagic, are more apt to be inhabitants of widely separated continents than littoral species of molluscs are.

Formation and localities: I think this species is, so far as yet known, confined to the Lower Marl Beds. It is found at most of the outcrops of that bed throughout the State, and is abundant at many. Marlboro, Freehold, Creamridge, Mullica Hill, and many other localities furnished them in great profusion, most of the examples showing evidence of having been water-rolled and worn before being imbedded, and consequently are always more or less broken and imperfect at the upper margin. The specimen of medium size figured is from the collection Acad. Nat. Sci., Phila. Those represented by Figs. 8 and 9 are in the Am. Mus. Nat. Hist., and the others are from Rutgers College collection.

BELEMNITES ? AMBIGUUS.

Belemnites ? ambiguus Morton: Synopsis, p. 35, Pl. I, Figs. 4, 5.

I have not been able to find Dr. Morton's type specimen of this species, which he describes as "straight, elongated, quadrangular, striated longitudinally; front convex; back flat; sides slightly depressed by a longitudinal

groove; apex obtuse, obscurely stellated; color yellowish white, opaque; substance, radiated carbonate of lime."

Dr. Morton gives as the length of his specimen 2 inches, with a breadth of one-sixth of an inch.

There is much doubt as to the true nature of the specimen from which Dr. Morton drew the above description, but as the specimen itself is lost no very satisfactory determination can be arrived at. The specimens to which Dr. Morton refers as "the numerous individuals in the collection of the Academy" are mostly before me, and there would seem to be but little doubt of their being stems of an Eucrinite, although they do not have the characteristic fracture of those bodies, nor yet appear to be made up of easily separated rings, or to have the central perforation. The surface, as Dr. Morton says, is longitudinally striated, and when well preserved has a smooth glistening appearance under a hand glass, as if it had been polished, but when weathered shows obscure transverse lines as if there were transverse plates. The freshly broken end has a pearly radiating structure, entirely different from the usual divisional planes of crinoid stems, which fact offers an additional objection to their encrinal nature. The fragments have a more or less general quadrangular structure, but when closely examined all present an indistinct or obscurely pantangular feature. Dr. Morton states, in his observations, that his original specimen preserved the rounded lower extremity, but that none of the other specimens did, and those before me are all squarely truncate at each end. It is possible they may be the remains of some alcyonarian body as yet unknown. They are all from the Middle Marl Beds, and probably all from Timber Creek, New Jersey, the locality from which Dr. Morton cites his example.

SECTION VI.

CEPHALOPODA OF THE EOCENE MARLS OF NEW JERSEY.

In Mr. F. B. Meek's "Catalogue of Eocene Shells and Fish from Shark River," published in the appendix to the Geological Report of New Jersey for 1868, on p. 731, et seq., he enumerates three species of Cephalopods: *Aturia Vanuxemi* and two species of *Cimomia*, *C. Burtini* Nyst's sp. and *C. Lamarcki* Deshayes sp., both originally published under the genus *Nautilus*. Among all the fossils which I have examined from the Eocene layers of New Jersey I have seen evidence of only two species of Cephalopoda, namely, *Aturia Vanuxemi* and that herein described as *Nautilus Cookana*. No specimen or fragment which I have seen would appear to correspond to or possess the features of the genus *Cimomia* as given by Mr. Conrad, which are as follows: "Nautiloid; septa sinuous, doubly waved, or sigmoid, numerous; siphon small, central." *Nautilus Burtini* Galcotti is given as the type. The two species above mentioned, *N. Burtini* and *N. Lamarcki*, are usually considered as synonyms of each other, but Deshayes assures us they are very distinct. Mr. Meek appears to have identified or recognized both forms, but upon what authority he does not say. The nautiloid forms which I have seen have only the straight, or nearly straight, septal lines crossing the cast, and certainly could not have given rise to the mistake had they been examined. So it is possible Mr. Meek may have seen some form that has never come under my observation. The specimens of the following species, to which I have given a new name, certainly do not possess any of the features of Mr. Conrad's genus, and I can find no descrip-

tion given of it elsewhere, and the form is certainly distinct from those of the Cretaceous beds below.

NAUTILUS COOKANA, n. sp.

Plate XLVIII, Fig. 1, and Pl. XLIX, Figs. 4-5.

Shell large, often reaching nearly a foot in its greatest diameter and proportionally wide and ventricose. Volutions rapidly expanding and probably only three or four in number, rounded on the back and when retaining their normal form are but slightly more compressed on the sides. Axis perforate, the umbilicus only of moderate width but very deep, owing to the greater additional breadth of the outer volution at the axis than the preceding one; margins of the umbilicus abruptly rounded. Septa distant, only moderately concave and regularly curved in a dorso-ventral direction, but much more flattened laterally; the ventral margin, surrounding the preceding volution, somewhat raised. The lines indicating the septa on the casts are only slightly recurved on the sides and are but little directed forward on the dorsum; not more so than is called for by the difference in the two diameters of the volution. Siphon moderately large, almost centrally situated, being slightly nearer the ventral margin in the best preserved examples examined. Shell unknown, the species known only from internal casts.

This species is not uncommon in the stony layer at the top of the Upper Marls at Farmingdale, Deal, Squankum, and Shark River, New Jersey, and so far as can be seen or determined by the casts alone is a true *Nautilus*. Mr. G. B. Meek, in his list of the fossils of the Shark River Marls given in *Geol. N. J.* for 1868, includes *Nautilus Burtini* Got. and *N. Lamarcki* Desh. as occurring in these beds, and places them both under Conrad's genus *Cymomia*, which was founded upon the first of these two species. It is possible that a species possessing the features of that genus may occur in New Jersey; but among those which I have seen none show the double sinuate septa of *N. Burtini* as described by Mr. Conrad, therefore I am inclined to doubt their existence in the State. Most European authors agree in considering *N. Burtini* and *N. Lamarcki* as synonyms, but Deshayes points out differences, and Milne Edwards gives

them as distinct. Mr. Meek appears to have not only considered them as distinct, but to have had Mr. Conrad's authority for the statement, and for their occurrence at Shark River.

Formation and locality: In the upper layers of the Upper Green Marls, at Shark River, and Squankum, New Jersey. Collection at Rutgers College.

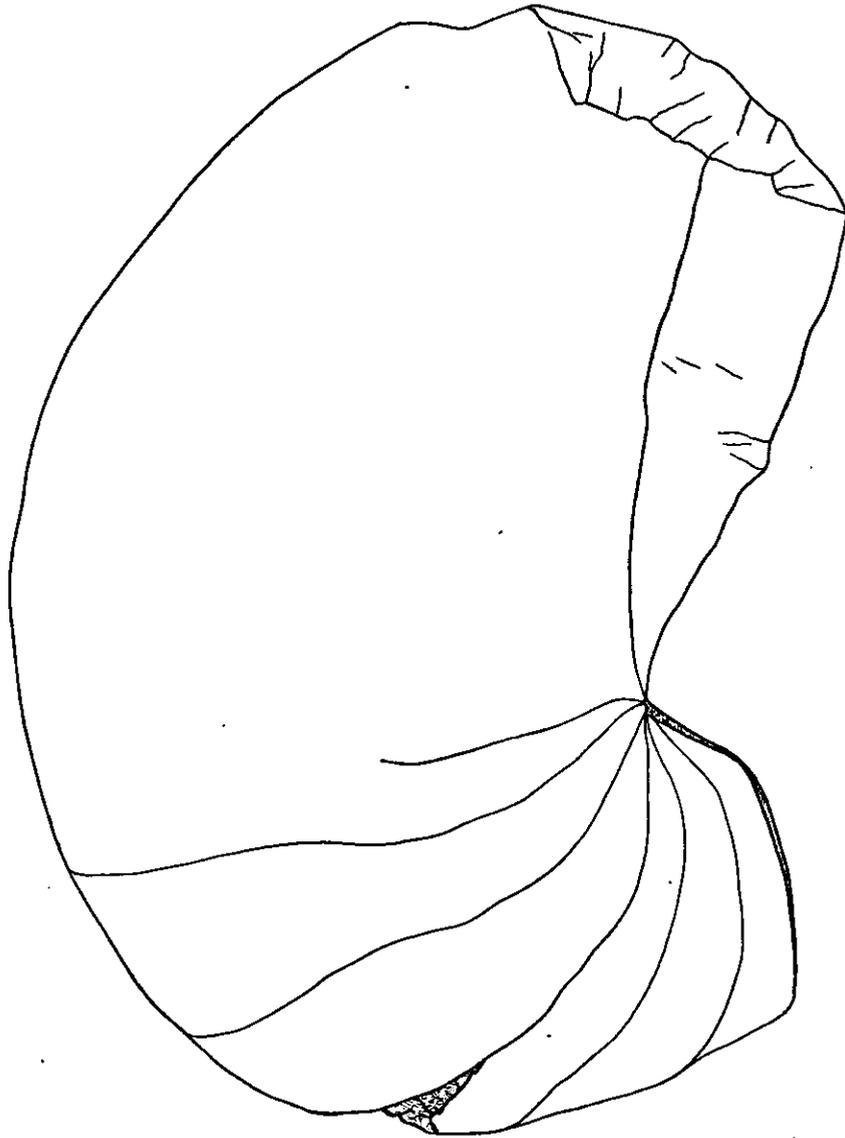


Fig. 2.—*Nautilus Cookana*.—One-half natural size.

Genus ATURIA Bronn.

ATURIA VANUXEMI.

Plate XLIX, Figs. 1, 3, and Plate L, Fig. 1.

Pelagus Vanuxemi Conrad: Jour. Acad. Nat. Sci., vol. 1, 2d ser., p. 130, Pl. XIV, Fig. 15.

Aturia Vanuxemi Conrad: Am. Jour. Conch., vol. 2, p. 15.

Aturia ziczac (Sow.) Conrad: Am. Jour. Conch., vol. 1, p. 150; Smithsonian Check List, p. 19.

Nautilus angustatus Con.: Am. Jour. Conch., vol. 1, p. 150; not *N. angustatus* Conrad, U. S. Expl. Exp. Geology, p. 728, Pl. xx, Figs. 5, 6.

Shell of moderately large size, the most perfect one which I have seen, but which is an internal cast only, measures $6\frac{1}{2}$ inches in its longest diameter, and has a thickness from side to side of about 2 inches, but has apparently been considerably compressed in this direction. The form is closely convolute with a closed umbilicus; sides depressed, convex, and dorsum narrowly rounded. The inner volution projects into the aperture of the outer one about two-fifths of the distance from the umbilicus to the outer margin, leaving the aperture, in this laterally compressed specimen, somewhat elongately halbert shaped. The septa are somewhat closely arranged and number about sixteen in the last coil of the shell. In rising from the umbilical depression they make a broad forward curve or arch, which extends to a little beyond the middle of the width of the volution, from which point they are bent abruptly backward, and form a proportionally long, narrow, and somewhat pointed spur, the outer edge of which is straighter than the inner and with that of those in the rear and in advance form a nearly straight and continuous line parallel to the margin of the dorsum. After this edge of the spur reaches a point about opposite the place of abrupt flexure of the inner side, the line runs straight across the back of the volution, forming a broad projecting lip on the back of the shell equal in length to that of the spur on the side of the volution. The spur on the side, rather outside of the middle of the volution, with the point reaching almost to the corner of the outer lip of the septum below, is a rather well marked feature and somewhat characteristic. Septa deeply concave, as seen in an apertural view. Siphon large, situated fully its own

diameter from the ventral margin, as seen in the aperture of the large specimen, but in a second smaller one is close against the back of the next inner volution. The septa bend downward to the siphon around it, forming a deep funnel-like depression, and unite with the tube about opposite the line of the sides of the next septum below, the sides of the siphonal tube continuing in a direct line from septum to septum. Surface of the shell unknown, the examples all being internal casts only.

I think there can be no question regarding the relations of this shell to the genus *Aturia*, as defined and understood by Bronn. It certainly is not congeneric with *Pelagus* Montfort, as typified in the figure given with the original description, as in that one the septa make not less than three of the abrupt flexures, and are much more like some of the Devonian forms of *Goniatites* than like *Aturia*. The peculiarity shown in the siphon of *Aturia* is apparently quite characteristic, and when seen, which is quite common in the New Jersey casts, can not be well mistaken. The entire central portion of the septum is gradually bent downward and forms a broad open funnel as seen when looking into the upper side of the septum, but rapidly decreases in size without angle, and passes within that of the septum below; in this respect being entirely different from *Nautilus* and all the allied genera.

Formation and locality: In the Eocene Green Marls at Shark River, Farmingdale, near Squankum, and near Long Branch, New Jersey. The examples figured are from Shark River, New Jersey, and belong to the collections at Rutgers College.

SECTION VII.

CLASSIFIED LISTS.

Classified list of the Gasteropoda of the New Jersey Cretaceous Marls.

	Lower marls.	Middle marls.	Base of upper marls.
Class GASTEROPODA.			
Subclass PROSOBRANCHIATA.			
Order PECTINIBRANCHIATA.			
Family MURICIDÆ:			
Genus <i>Tudicla</i> planimarginata W.....	x		
<i>Pyropsis</i> :			
(<i>Rapa</i> ?) <i>corrina</i> W.....	x		
<i>elevata</i> G.....	x		
<i>naticoides</i> W.....	x		
<i>obesa</i> W.....	x		
<i>octolirata</i> Con.....	x		
<i>perlata</i> Con.....	x		
<i>Reileyi</i> W.....	x		
<i>retifer</i> G.....	x		
<i>Richardsoni</i> Tuomey.....	x		
(<i>Rapa</i> ?) <i>septemlirata</i> G.....	x		
<i>trivolis</i> G.....		x	
<i>trochiformis</i> Tuo.....	x		
<i>Perissolax</i> dubia G.....	x		
<i>Pyrifusus</i> erraticus W.....	x		
<i>cuneus</i> W.....	x		
<i>Macfarlandi</i> W.....	x		
<i>Meeki</i> W.....	x		
<i>Mullicaensis</i> G.....	x		
<i>pyruloides</i> G.....	x		
<i>turritus</i> W.....	x		
<i>Neptunella</i> <i>Mullicaensis</i> W.....	x		
Family TRITONIDÆ:			
Genus <i>Triton</i> (<i>Epidromus</i>) <i>præcedens</i> W.....	x		
<i>Trachytriton</i> <i>Atlanticum</i> W.....	x		
<i>Holmdelense</i> W.....	x		
<i>multivaricosum</i> W.....	x		

Classified list of the Gasteropoda of the New Jersey Cretaceous Marls—Continued.

	Lower marls.	Middle marls.	Base of upper marls.
Class GASTEROPODA —Continued.			
Subclass PROSOBRANCHIATA —Continued.			
Order PECTINIBRANCHIATA —Continued.			
Family FUSIDÆ :			
Genus <i>Fusus</i> <i>Holmdelensis</i> W.....	x		
<i>Serrifusus?</i> <i>Crosswickensis</i> W.....	x		
(<i>Lirofusus</i>) <i>nodocarinatus</i> W.....	x		
Family FASCIOLARIIDÆ :			
Genus <i>Odontofusus</i> <i>Slacki</i> G.....	x		
<i>medians</i> W.....	x		
<i>rostellaroides</i> W.....	x		
<i>typicalis</i> W.....	x		
<i>Volutomorpha</i> <i>Conradi</i> G.....	x		
<i>Gabbi</i> W.....	x		
<i>ponderosa</i> W.....	x		
<i>V. (Plectochilus)</i> <i>bella</i> G.....	x		
<i>Kanei</i> G.....	x		
<i>mucronata</i> G.....	x		
Family BUCCINIDÆ :			
Genus <i>Eripachya?</i> <i>paludinaformis</i> W.....	x		
<i>Euthria?</i> <i>fragilis</i> W.....	x		
<i>Tritonidea</i> <i>obesa</i> W.....	x		
Family TURBINELLIDÆ :			
Genus <i>Turbinella?</i> <i>parva</i> G.....	x		
<i>subconica</i> G.....	x		
<i>verticalis</i> W.....	x		
<i>Vasum</i> <i>conoides</i> W.....	x		
<i>Caricella</i> <i>plicata</i> W.....			x
Family VOLUTIDÆ :			
Genus <i>Voluta?</i> <i>Delawarensis</i> G.....	x		
<i>Volutoderma</i> <i>Abbotti</i> G.....		x	
<i>biplicata</i> G.....	x		
<i>intermedia</i> W.....			x
<i>ovata</i> W.....	x		
<i>Rostellites</i> <i>angulatus</i> W.....	x		
<i>biconicus</i> W.....			x
<i>nasutus</i> G.....	x		
<i>texturatus</i> W.....	x		
Family MITRIDÆ :			
Genus <i>Turricula</i> <i>leda</i> W.....	x		
<i>Reileyi</i> W.....	x		
<i>scalariformis</i> W.....	x		

Classified list of the Gasteropoda of the New Jersey Cretaceous Marls—Continued.

	Lower marls.	Middle marls.	Base of upper marl.
Class GASTEROPODA —Continued.			
Subclass PROSOBRANCHIATA —Continued.			
Order PECTINIBRANCHIATA —Continued.			
Family CANCELLARIIDÆ :			
Genus <i>Cancellaria</i> (<i>Merica</i>) <i>subalta</i> Cou.....	x		
<i>Morea naticella</i> G.....	x		
<i>Turbinopsis angulata</i> W.....	x		
<i>curta</i> W.....	x		
<i>elevata</i> W.....	x		
<i>Hilgardi</i> Con.?	x		
<i>major</i> W.....	x		
<i>plicata</i> W.....	x		
Family PLEUROTOMIDÆ :			
Genus <i>Pleurotoma</i> <i>Farmingdalensis</i> W.....			x
<i>Surcula strigosa</i> G.....	x		
<i>Cithara Crosswickensis</i> W.....	x		
<i>Mullicaensis</i> W.....	x		
Family STROMBIDÆ :			
Genus <i>Rostellaria</i> <i>curta</i> W.....	x		
<i>fusiformis</i> W.....	x		
<i>Hebe</i> W.....	x		
<i>nobilis</i> W.....			x
<i>spirata</i> W.....	x		
<i>Alaria rostrata</i> G.....	x		
<i>Anchura abrupta</i> Mort.....	x		
var <i>acutispira</i> W.....	x		
<i>arenaria</i> Mort.....	x		
<i>pagodaformis</i> W.....	x		
<i>pannata</i> Mort.....	x		
<i>solitaria</i> W.....	x		
(<i>Drapanochilus</i>) <i>compressa</i> W.....	x		
Family CYPRÆIDÆ :			
Genus <i>Cypræa</i> (<i>Aricia</i>) <i>Mortoni</i> G.....	x		
Family DOLIIDÆ :			
Genus <i>Dolium</i> (<i>Doliopsis</i> ?) <i>multiliratum</i> W.....	x		
<i>Ficus præcedens</i> W.....	x		
Family NATICIDÆ :			
Genus <i>Natica</i> <i>abyssina</i> Mort.....	x	x	
<i>Lunatia Halli</i> G.....	x	x	
<i>Gyrodes Abbottii</i> G.....	x		
<i>altispira</i> G.....	x		

Classified list of the Gasteropoda of the New Jersey Cretaceous Marls—Continued.

	Lower marls.	Middle marls.	Base of upper marls.
Class GASTEROPODA —Continued.			
Subclass PROSOBRANCHIATA —Continued.			
Order PECTINIBRANCHIATA —Continued.			
Family NATICIDÆ —Continued :			
<i>crenata</i> Con	X		
<i>infracarinata</i> G	X		
<i>obtusivolva</i> G	X		
<i>petrosus</i> Mort	X		
<i>Amauropsis</i> Meekana W	X		
<i>punctata</i> G	X		
Family TROCHIDÆ :			
Genus <i>Margarita</i> <i>abyssina</i> G	X		
<i>Margaritella</i> <i>Abbottii</i> G	X		
Family ONUSTIDÆ :			
Genus <i>Xenophora</i> <i>leprosa</i> Mort	X		
<i>Endoptigma</i> <i>umbilicata</i> Tuom ?	X		
Family SCALARIIDÆ :			
Genus <i>Scalaria</i> <i>Hercules</i> W	X		
? <i>pauperata</i> W	X		
<i>Sillimani</i> Mort	X		
(<i>Opalia</i>) <i>Thomasi</i> Gabb ?	X		
<i>Cavoscala</i> <i>annulata</i> Mort		X	
Family TURRITELLIDÆ :			
Genus <i>Turritella</i> <i>compacta</i> W	X		
<i>encrinoides</i> Mort	X		
? <i>granulicosta</i> G	X		
<i>Hardimanensis</i> G	X		
<i>Lippincotti</i> W	X		
<i>pumila</i> G ?			X
<i>vertebroides</i> Mort	X		
<i>Laxispira</i> <i>lumbricalis</i> G	X		
Family VERMETIDÆ :			
Genus <i>Siliquaria</i> <i>pauperata</i> W	X		
? <i>Diploconcha</i> <i>cretacea</i> Con	X		
Family EULIMIDÆ :			
Genus <i>Leiostraca</i> <i>cretacea</i> Con	X		
Family PYRAMIDELLIDÆ :			
Genus <i>Obeliscus</i> <i>conellus</i> W	X		
Family LITTORINIDÆ :			
Genus <i>Modulus</i> <i>lapidosa</i> W	X		

Classified list of the Gasteropoda of the New Jersey Cretaceous Marls—Continued.

	Lower marls.	Middle marls.	Base of upper marls.
Class GASTEROPODA —Continued.			
Order SCUTIBRANCHIATA.			
Suborder <i>Podophthalma</i> .			
Family TROCHIDÆ:			
Genus <i>Margarita abyssina</i> G.....	x		
<i>Margaritella Abbotti</i> G.....	x		
Family PLEUROTOMARIIDÆ:			
Genus <i>Pleurotomaria</i> Brittoni W.....			x
<i>Tritonensis</i> W.....		x	
<i>Pleurotrema solariformis</i> W.....		x	
Suborder <i>Edriophthalma</i> .			
Family PATELLIDÆ:			
Genus <i>Helcion?</i> tentorum Mort.....	x		
Subclass OPISTHOBRANCHIATA .			
Order TECTIBRANCHIATA.			
Family TORNATELLIDÆ:			
Genus <i>Actæon</i> cretacea G.....	x		
<i>Forbesiana</i> W.....	x		
<i>Gabbana</i> W.....	x		
<i>subovoides</i> W.....	x		
<i>Globiconcha curta</i> G.....	x		
<i>Cinulia (Oligoptycha) naticoides</i> , Gray ?.....	x		
<i>ovoidea</i> G.....	x		
<i>Avellana bullata</i> Mort.....	x		
Family CYLICHNIDÆ:			
Genus <i>Cylichna recta</i> G.....	x		
Family BULLIDÆ:			
Genus <i>Bulla conica</i> W.....			x
<i>Mortoni</i> L. and F.....	x		
Class SCAPHOPODA .			
Family DENTALIIDÆ:			
Genus <i>Dentalium</i> Ripleyanum G.....	x		
<i>subarcuatum</i> Con.....	x		
<i>Falcula falcatum</i> Con.....	x		
? <i>Diploconcha (Serpula?) cretacea</i> Con.....	x		
Total Gasteropoda and Scaphopoda.....	127	7	8

Classified list of the Cephalopoda of the New Jersey Cretaceous Marls.

	Lower marls.	Middle marls.	Base of upper marls.
Class CEPHALOPODA.			
Order TETRABRANCHIATA.			
Family NAUTILIDÆ:			
Genus <i>Nautilus</i> :			
Bryani G.....		×	
Dekayi Mort.....	×	×	
<i>Hercoglossa paucifex</i> Cope.....		×	
Family AMMONITIDÆ:			
Genus <i>Ammonites</i> complexus Meek.....	×		
Delawarensis Morton.....	×		
dentato-carinatus Roemer.....	×		
Vanuxemi Morton.....	×		
<i>Am. (Placenticeras)</i> placenta De Kay.....	×		
tilifer Morton.....	×		
<i>Am. (Sphenodiscus)</i> lenticularis Owen.....		×	
<i>Scaphites</i> hippocrepis De Kay.....	×		
iris Con.....	×		
nodosus Owen.....	×		
reniformis Morton.....	×		
similis Whitf.....	×		
<i>Turrilites</i> pauper Whitf.....	×		
<i>Heteroceras</i> Conradi Morton.....	×		
<i>Ptychoceras (Solenoceras)</i> annulifer Morton.....	×		
<i>Baculites</i> asper Morton.....	×		
compressus Morton.....	×		
ovatus Morton.....	×	×	
Order DIBRANCHIATA.			
Family BELEMNITIDÆ:			
Genus <i>Belemnitella</i> Americana Morton.....	×		
Total Cephalopoda.....	19	5	

Classified list of the Gasteropoda of the New Jersey Eocene Marls.

Class **GASTEROPODA**.Subclass **PROSOBRANCHIATA**.Order **PECTINIBRANCHIATA**.Family **MURICIDÆ**.

Murex (Pteronotus?) læva-
varicosus W.

Rhinocantha? Conradi W.

TRITONIDÆ.

Triton Eocenense W.

PURPURIDÆ.

Pseudoliva vetusta † Con.

FUSIDÆ.

Fusus angularis W.

paucicostatus W.

pluricostatus W.

perobesus W.

(*Neptunea?*) eocenicus W.

hector W.

var *multilinea-*

tus W.

staminea Con.

(*Urosalpinx?*) *multicostatus* W

Clavella raphanoides Con.

FASCIOLARIIDÆ.

Fasciolaria Hercules W.

propinqua W.

Samsoni W.

TURBINELLIDÆ.

Caricella ponderosa W.

pyruloides Con.

VOLUTIDÆ.

Voluta lelia W.

parvula W.

porelevata W.

scaphoides W.

(*Scaphella*) Newcombi-
ana W.

(*Amoria*) *vesta* W.

Folutilithes cancellata W.

Sayana Con.

CANCELLARIIDÆ.

Cancellaria rudis W.

PLEUROTOMIDÆ.

Pleurotoma (Surcula?) alti-
spira W.

regularicostata

W.

surenitiformis

W.

Class **GASTEROPODA**—Continued.Subclass **PROSOBRANCHIATA**—Cont'd.Order **PECTINIBRANCHIATA**—Continued.Family **PLEUROTOMIDÆ**—Continued.

Surcula perobesa W.

Sureulites annosus Con.

cadaverosus W.

curtus W.

CONIDÆ.

Conus subsanridens Con.

STROMBIDÆ.

Calyptrophorus velatus C

CYPRÆIDÆ.

Cypræa sabuloviridis W.

CASSIDIDÆ.

Cassidaria carinata Lam.

DOLIIDÆ.

Picus penitus Con.

NATICIDÆ.

Natica globulella W.

ONUSTIDÆ.

Xenophora lapiferens W.

SOLARIIDÆ.

Architectonica annosa Con.

SCALARIIDÆ.

Scalaria tenuilirata W.

TURRITELLIDÆ.

Meselia elongata W.

Order **SCUTIBRANCHIATA**.Suborder **PODOPHTHALMA**.Family **PLEUROTOMARIIDÆ**.

Leptomaria gigantea W.

pergranulosa W.

perlata Con.

Trematofusus venustus W.

Subclass **OPISTHOBRANCHIATA**.Order **TECTIBRANCHIATA**.Family **TORNATELLIDÆ**.

Actæon prisca Con.

Tornatella lata Con.

Tornatina Wetherilli Lea.

Class **CEPHALOPODA**.Order **TETRABRANCHIATA**.Family **NAUTILIDÆ**.

Nautilus Cookana W.

Aturia Vanuxemi Con.

PLATES.

PLATE I.

EXPLANATION OF PLATE I.¹

TUDICLA PLANIMARGINATA Whitf. (p. 33).

Figs. 1-3. Back lateral and summit views of the type specimen.

PYROPSIS TROCHIFORMIS Tuomey (p. 41).

4, 5. Opposite views of two casts showing rounded volutions.

6. View of a specimen in loose marl showing exterior markings.

7. A small cast showing strong lirations. The two first specimens are from the collections Acad. Nat. Sci., Phila.

PYROPSIS PERLATA Conrad. (p. 37).

8-10. Three views of a large cast referred to this species.

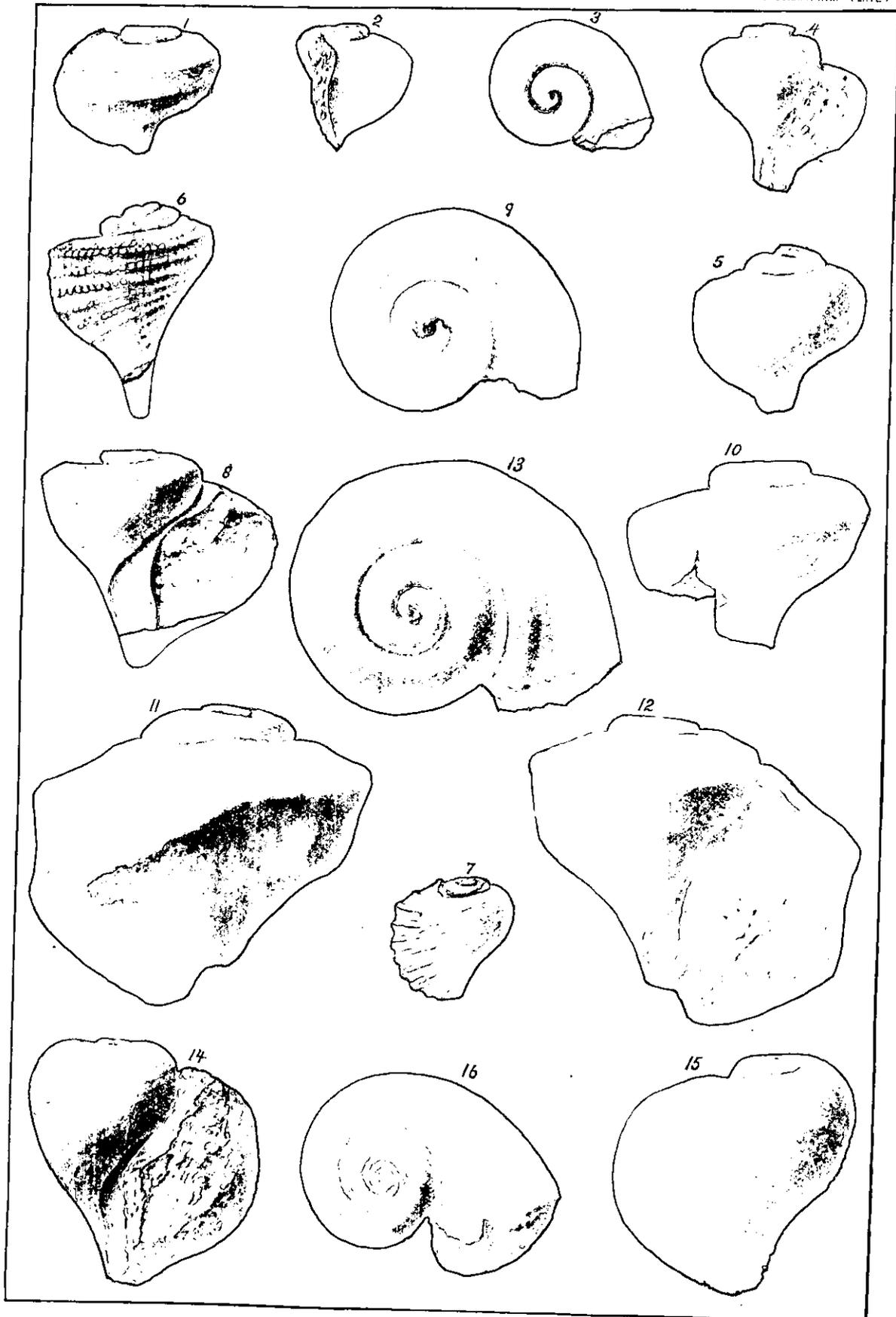
PYROPSIS ELEVATA Gabb (p. 35).

11-13. Three views of the type specimen, Acad. Nat. Sci., Phila.

PYROPSIS RICHARDSONI Tuomey (p. 39).

14-16. Three views of a cast which appears to be characteristic of the species.

¹ Where not otherwise mentioned, the originals of figures may be considered as belonging to the collection at Rutgers College, New Brunswick, or in the State collection at Trenton, New Jersey.



MURICIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE II.

EXPLANATION OF PLATE II.

PYROPSIS RETIFER Gabb (p. 38).

- Figs. 1, 2. Opposite views of a specimen of typical form.
3, 4. Two views of a larger specimen less like the type, and with fainter markings.

PYROPSIS NATICOIDES Whitf (p. 43).

- 5-7. Three views of the type, showing the Naticoid form. Collection Acad. Nat. Sci., Phila.

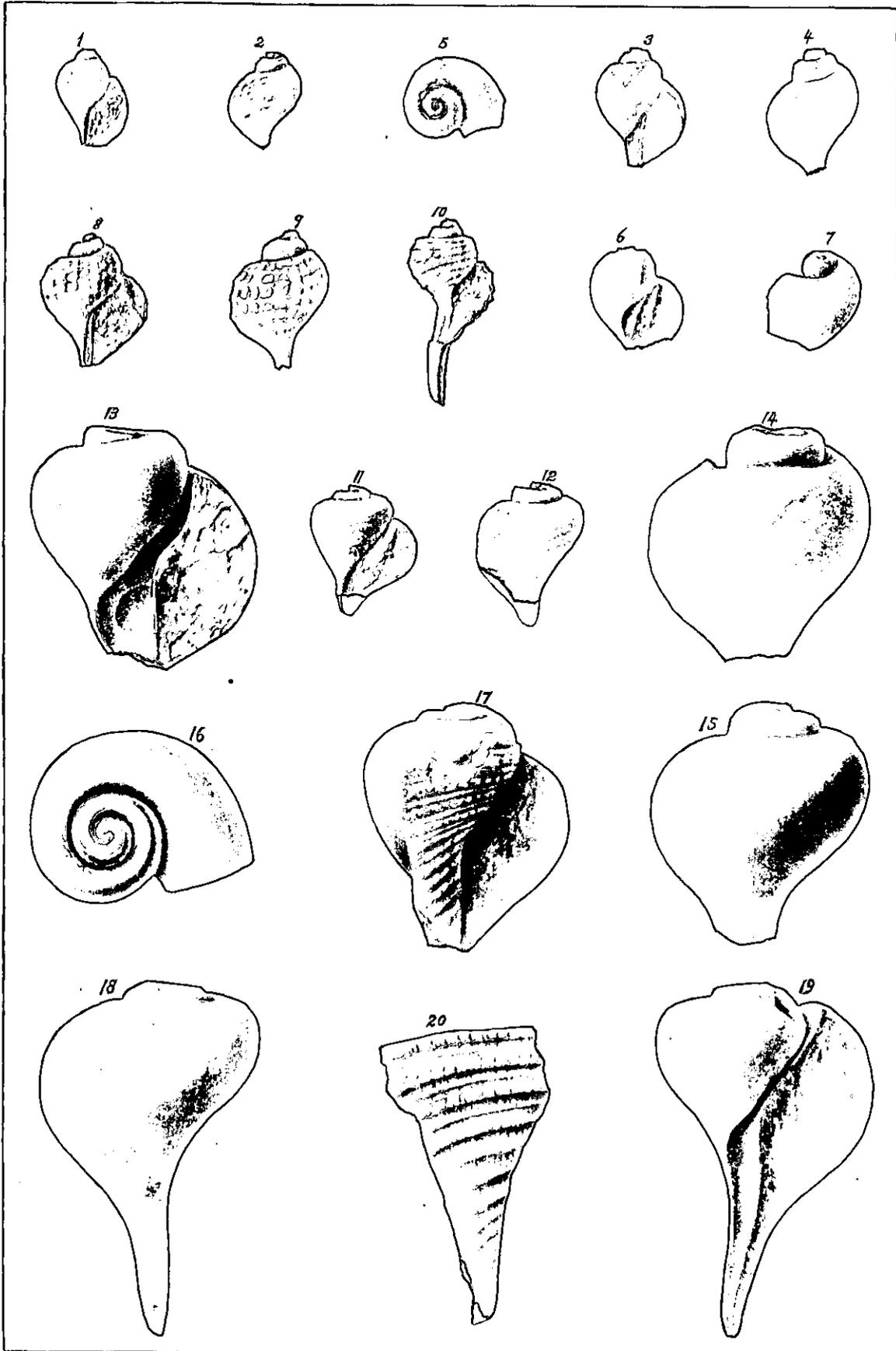
PYROPSIS OCTOLIFATA Conrad (p. 36).

- 8, 9. Two views of a large cast of typical form.
10. View of another individual showing the extension of the anterior beak.

PYROPSIS REILEYI Whitf (p. 42).

- 11, 12. Two views of a small cast from Holmdel, New Jersey, from white clays.
13, 14. Two views of a cast showing faint spiral lines, and also the columellar pits.
15, 16. Two views of another cast which is entirely smooth.
17. View of the aperture of a specimen which retains a part of the shell and shows the markings.
18, 19. Two views of a cast from an ironstone nodule where the anterior beak is preserved.
20. Impression taken in the matrix of the same specimen showing surface features. Near Key Port, New Jersey.

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MURICIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE III.

EXPLANATION OF PLATE III.

PYROPSIS (RAPA ?) CORRINA Whitf. (p. 45).

FIGS. 1-3. Three views of a specimen showing the strong columellar fold in Fig. 1.

PYROPSIS (RAPA ?) SEPTEMLIRATA Gabb (p. 44).

- 4. A copy of Mr. Gabb's figure.
- 5, 6. Two figures of a specimen showing lirations and the columellar fold. From Mullica Hill, New Jersey.
- 7, 8. Views of a large distorted cast showing strong lirations and evidence of transverse costae. Acad. Nat. Sci., Phila.

PERISSOLAX DUBIA Gabb (p. 47).

- 9. View of a large specimen from Professor Reiley's collection. Holmdel, New Jersey.
- 10, 11. Two views of Mr. Gabb's type specimen. Acad. Nat. Sci., Phila.

PYROPSIS ? OBESA Whitf. (p. 40).

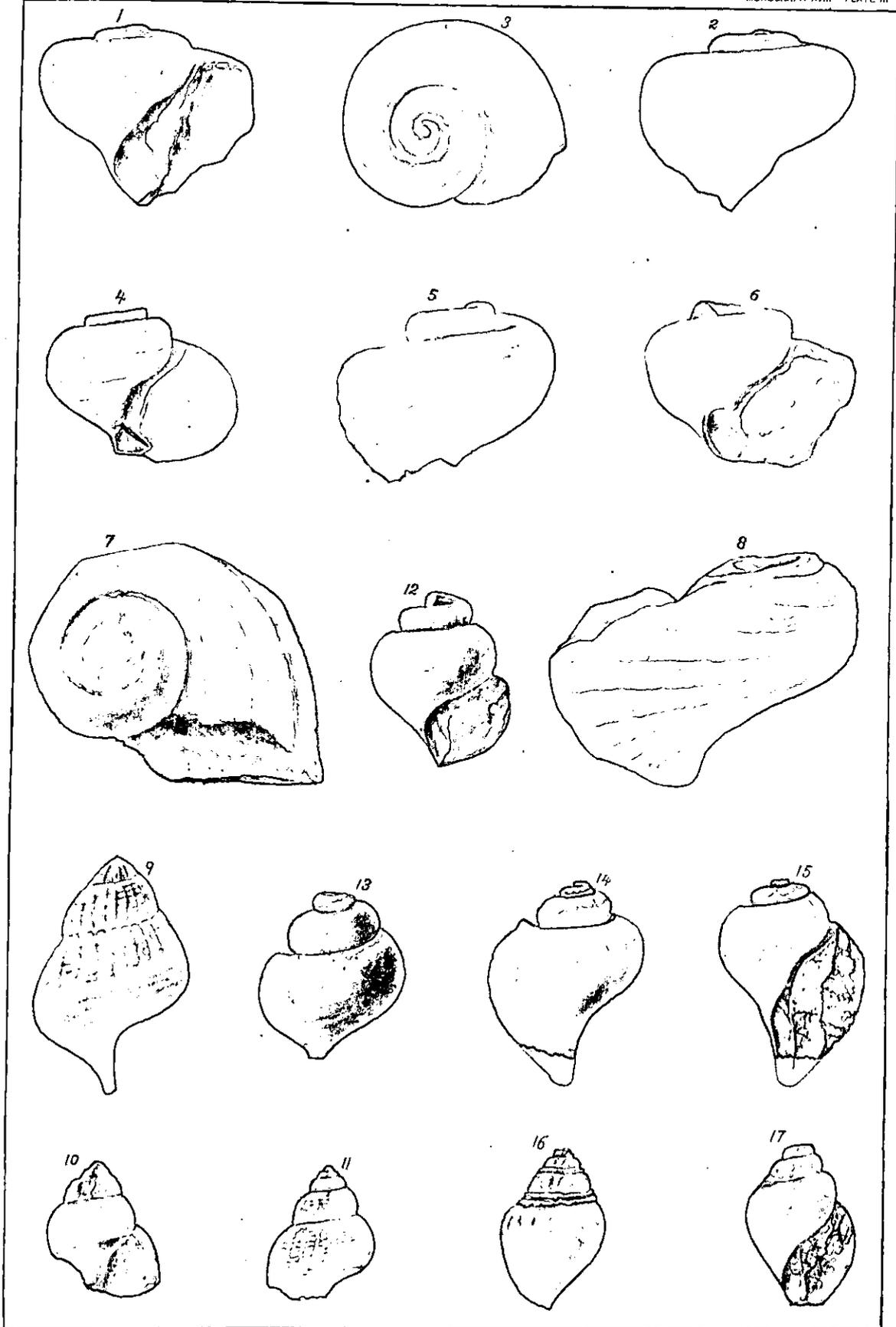
- 12, 13. Two figures of the type specimen, Fig. 12 showing the columellar folds. Amer. Mus. Nat. Hist., New York City.

TURBINELLA ? VERTICALIS Whitf. (p. 82).

- 14, 15. Opposite views of the type specimen.

ERIPACHYS ? PALUDINAFORMIS Whitf. (p. 77).

- 16, 17. Two views of the specimen described.



MURICIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE IV.

MON XVIII—20

EXPLANATION OF PLATE IV.

PYRIFUSUS SUBDENSATUS Conrad (p. 48).

1-3. Front, back, and summit views of Conrad's type of the genus. Am. Mus. Nat. Hist.

PYRIFUSUS ERRATICUS Whitf. (p. 50).

- 4. View of the shell as obtained by gutta-percha from the matrix.
- 5. An enlargement of the surface stria. Columbia College.

PYRIFUSUS MEEKI Whitf. (p. 55).

- 6. View of an imperfect cast from Crosswicks Creek. Columbia College.
- 7, 8. Views of a more perfect cast from the same locality. State collection.

PYRIFUSUS CUNEUS Whitf. (p. 51).

- 9. View of a small cast from the collection Acad. Nat. Sci., Phila.
- 10, 11. Two views of a larger cast from Freehold, New Jersey.

PYRIFUSUS PYRULOIDES Gabb (p. 53).

- 12, 13. Two views of the type specimen. Acad. Nat. Sci., Phila.

PYRIFUSUS MCFARLANDI Whitf. (p. 52).

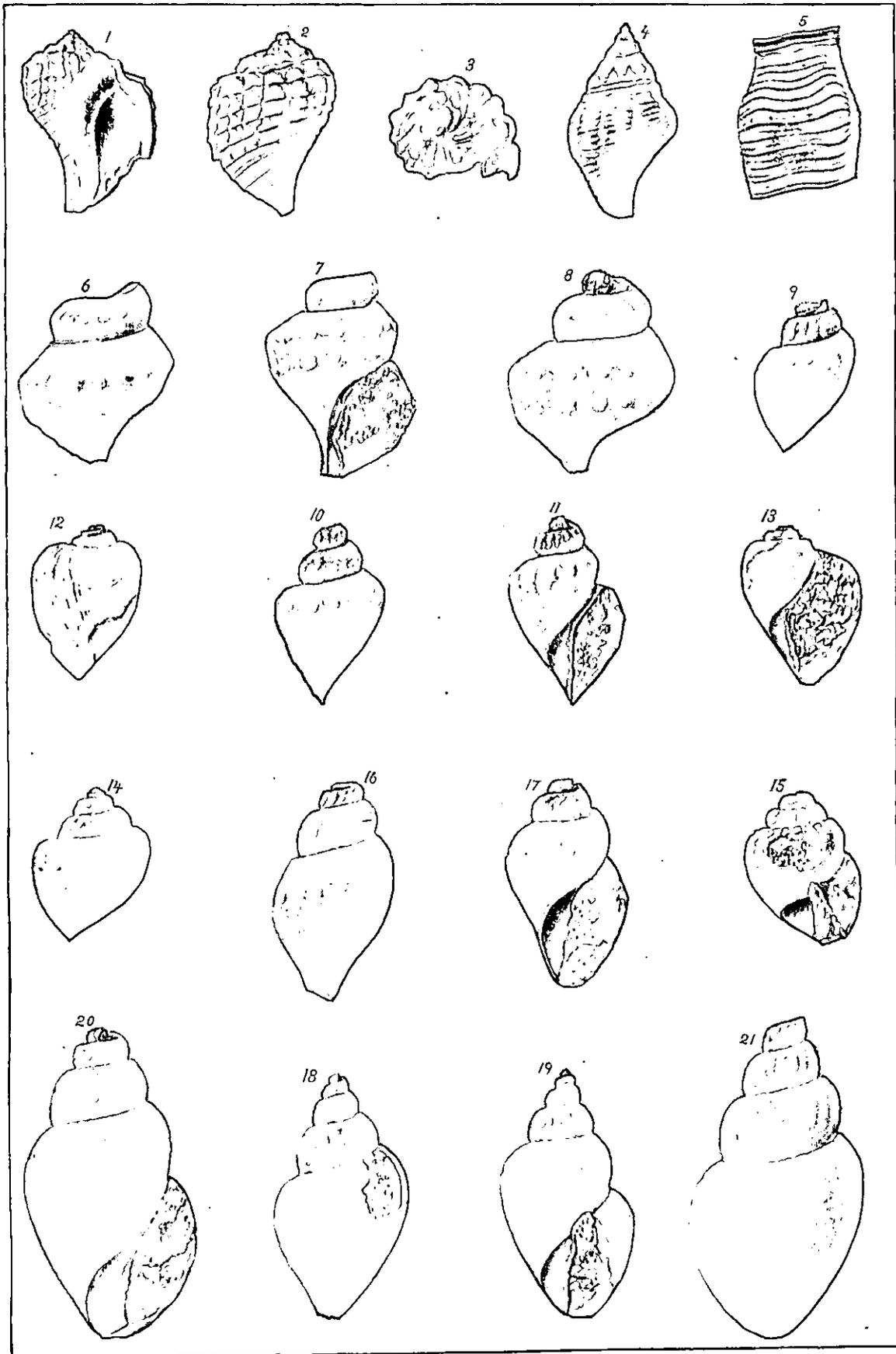
- 14, 15. Two views of the type. Mullica Hill, New Jersey.

PYRIFUSUS MULLICAENSIS Gabb (p. 52).

- 16, 17. Two views of the smaller cast, from Freehold, New Jersey.
- 18, 19. Similar views of a larger cast, from Mullica Hill, New Jersey.

NEPTUNELLA MULLICAENSIS Whitf. (p. 56).

- 20, 21. Two views of a specimen from Mullica Hill, New Jersey. Collection Acad. Nat. Sci., Phila.



MURICIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE V.

EXPLANATION OF PLATE V.

PYRIFUSUS TURRITUS Whitf. (p. 54).

- Figs. 1, 2. Two views of an imperfect cast from Middletown, New Jersey.
3. View of a cast from Burlington, New Jersey. Acad. Nat. Sci., Phila.
4, 5. Two views of a more perfect cast from Crosswicks Creek, New Jersey. Acad. Nat. Sci., Phila.

TRITON (EPIDROMUS) PRECKDENS Whitf. (p. 58).

- 6, 7. Two views of the specimen described.

TRACHYTRITON ATLANTICUM Whitf. (p. 59).

- 8, 9. Front and back views of a very perfect cast, showing the varices.
10, 11. Views of two other casts, differing in size.

TRACHYTRITON MULTIVARICOSUM Whitf. (p. 61).

- 12, 13. Views of two imperfect casts showing spiral lines.
14, 15. Two views of a specimen showing varices, but not the spiral lines.

TRACHYTRITON ? HOLMDELENSE Whitf. (p. 60).

- 16, 17. Two views of the specimen described, doubtfully a *Trachytriton*.

ODONTOFUSUS MEDIANS Whitf. (p. 67).

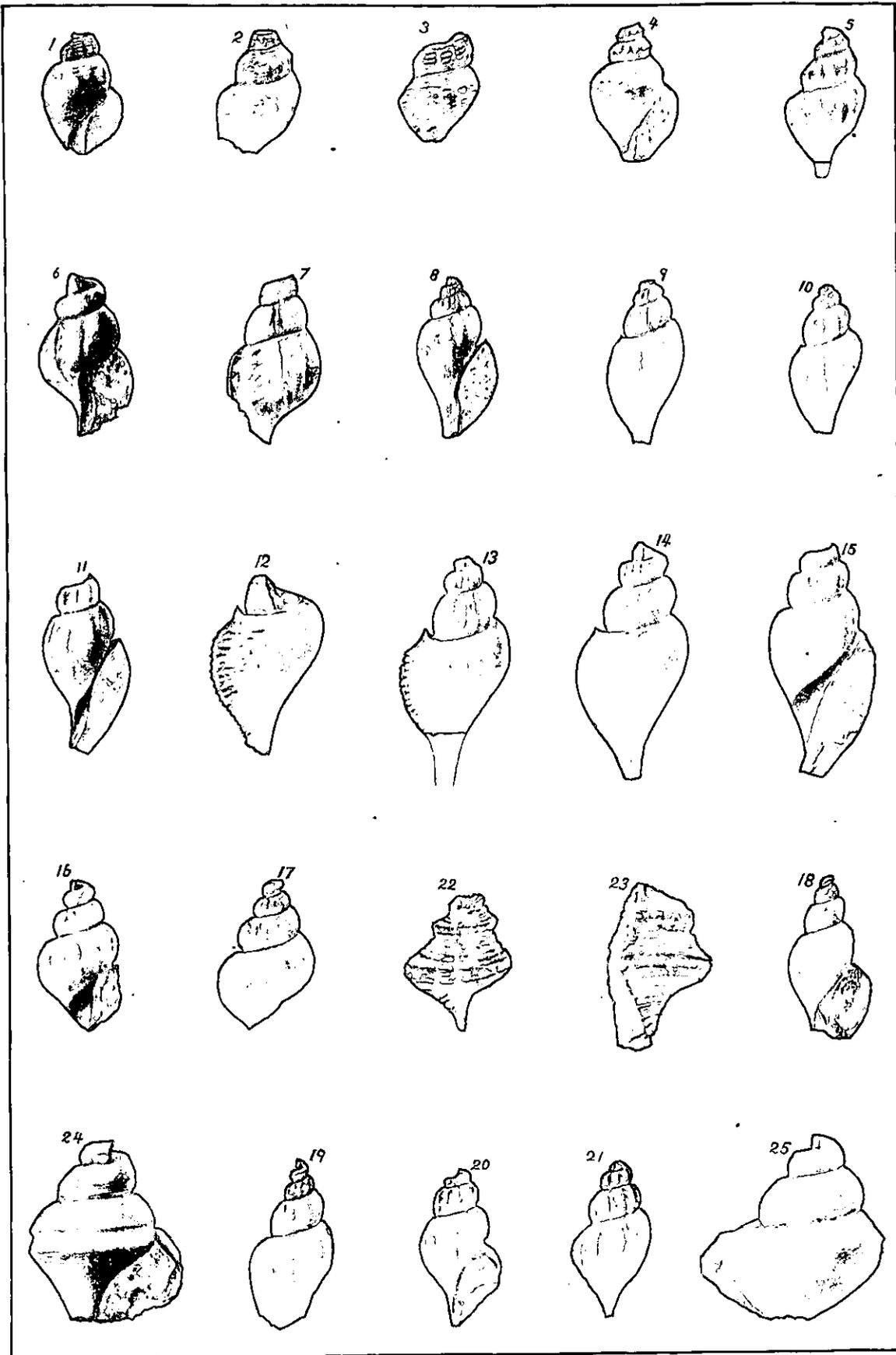
- 18-21. Opposite views of each of two individuals of this species showing variation in form.

SERRIFUSUS (LIROFUSUS) NODOCARINATUS Whitf. (p. 64).

- 22, 23. Two views of the cast showing the features described.

SERRIFUSUS CROSSWICKENSIS Whitf. (p. 63).

- 24, 25. Opposite views of the cast showing the features described.



MURICIDÆ AND FASCIOLARIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE VI.

EXPLANATION OF PLATE VI.

ODONTOFUSUS TYPICUS Whitf. (p. 66).

- FIGS. 1-4. Views of casts, more or less imperfect, from Crosswicks Creek, New Jersey.
5. View of a cast from Cream Ridge, New Jersey, showing the extent of the beak.

ODONTOFUSUS ROSTELLAROIDES Whitf. (p. 68).

- 6, 7. Two views of the most perfect cast seen.

ODONTOFUSUS SLACKI Gabb's sp. (p. 66).

- 8, 9. Opposite views of the type. Acad. Nat. Sci., Phila.

FUSUS HOLMDELENSIS Whitf. (p. 62).

- 10, 11. Views of opposite sides of the only specimen seen.

VOLUTOMORPHA (PIESTOCHILUS) MUCRONATA Gabb (p. 75).

- 12-14. Opposite sides of a large specimen from Freehold, New Jersey, and front view of a smaller one from Crosswicks, New Jersey, the latter from the collection at Columbia College.

VOLUTOMORPHA (PIESTOCHILUS) BELLA Gabb. (p. 74).

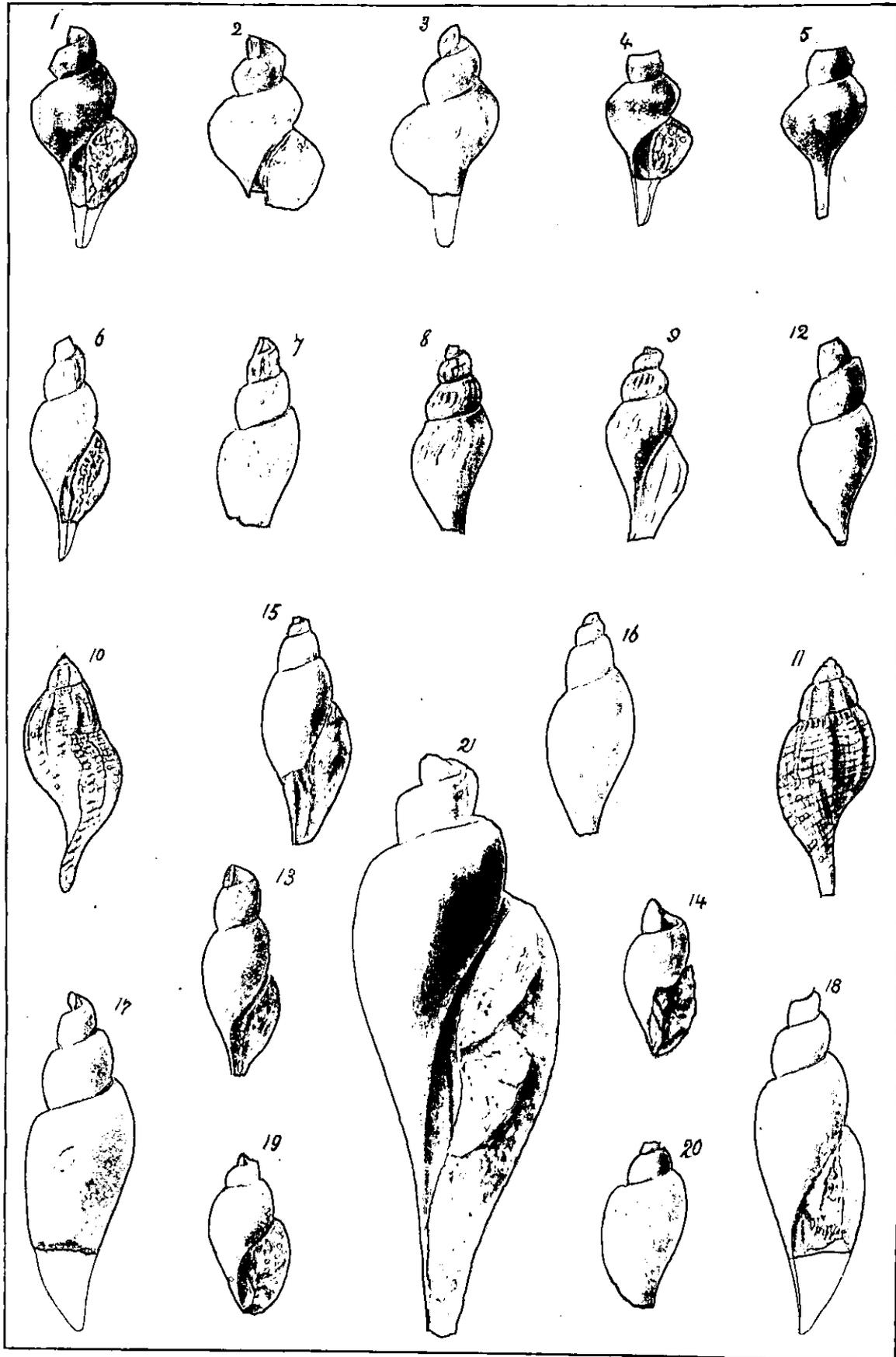
- 15, 16. Two views of a medium sized cast.
17, 18. Similar views of a large cast, probably the type. All from collection Acad. Nat. Sci. Phila.

VOLUTOMORPHA (PIESTOCHILUS) KANEI Gabb. (p. 76).

- 19, 20. Two views of the type specimen. Acad. Nat. Sci., Phila.

VOLUTOMORPHA CONRADI Gabb. (p. 71).

21. Front view of the type specimen. For other figures of this and other specimens see Pl. VII.



FUSIDÆ AND FASCIOLARIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE VII.

EXPLANATION OF PLATE VII.

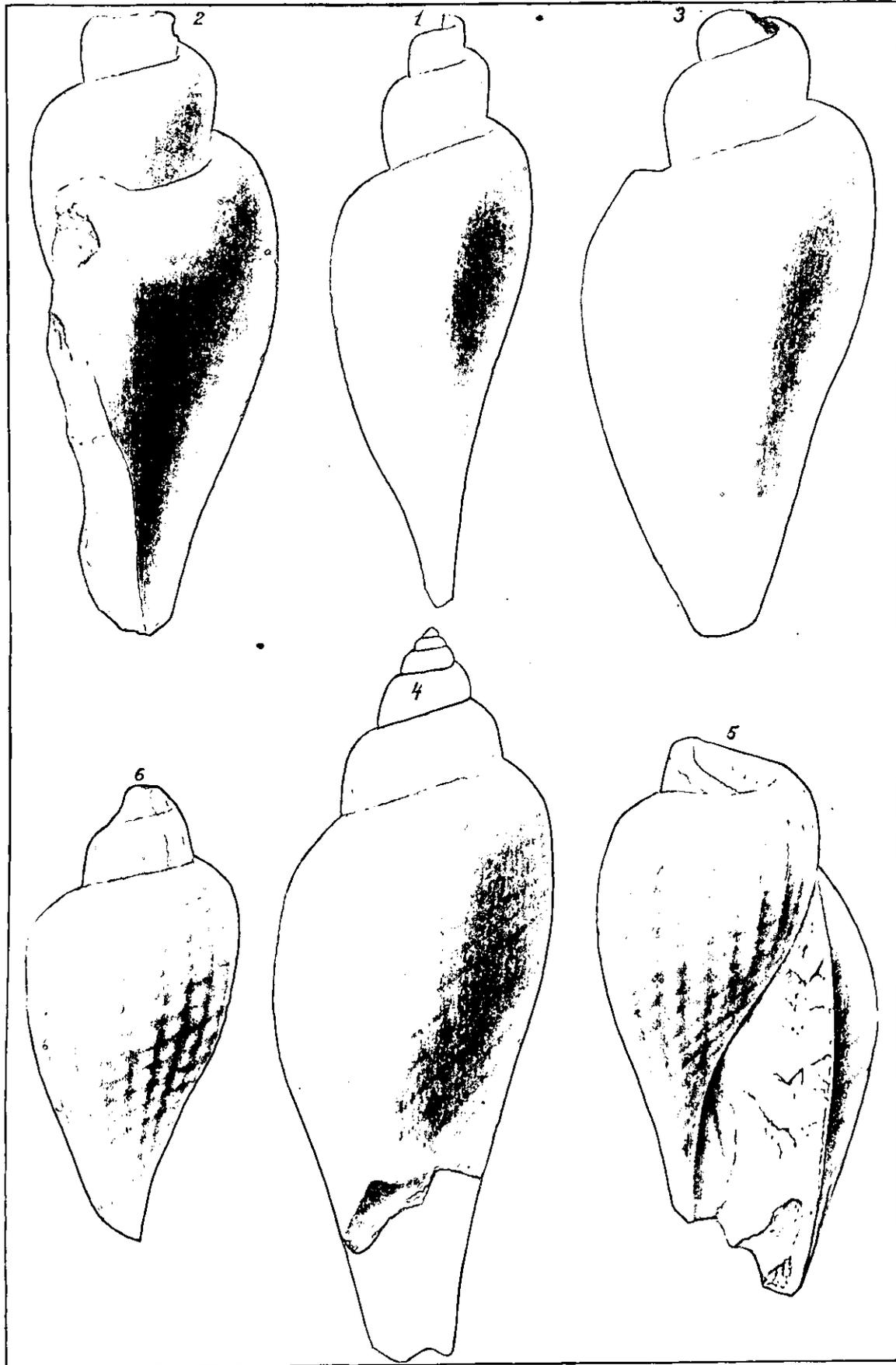
VOLUTOMORPHA CONRADI Gabb. (p. 71).

- Figs. 1. View of the type of the species. Acad. Nat. Sci., Phila. See also Pl. VI.
2, 3. Profile and back view of a larger cast from Mr. M. E. Schenck's pits, New Jersey.
4, 5. Two views of a cast showing imprints of surface markings, referred doubtfully to this species. Acad. Nat. Sci., Phila.

VOLUTOMORPHA GABBI Whitf. (p. 73).

6. View of a cast showing surface features, but showing the different form of volution from that of *V. Conradi*. Holmdel, New Jersey.

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FASCIOLARIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE VIII.

EXPLANATION OF PLATE VIII.

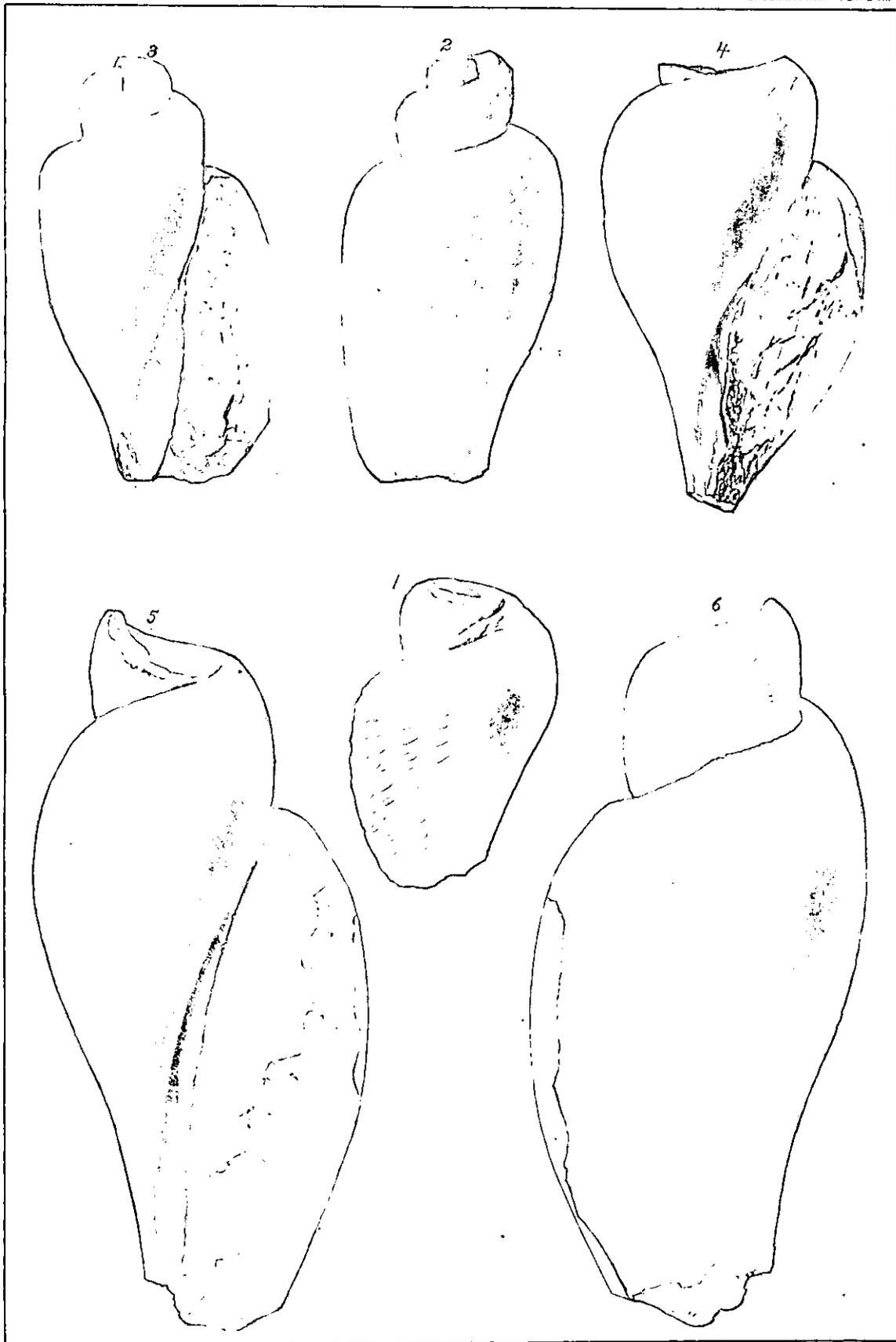
VOLUTOMORPHA GABBI Whitf. (p. 73).

- FIGS.** 1. View of a small specimen from Holmdel, New Jersey.
2, 3. View of a cast from Mullica Hill, New Jersey. Acad. Nat. Sci., Phila.
4. View of a cast of the species † from Marlboro, New Jersey.

VOLUTOMORPHA PONDEROSA Whitf. (p. 72).

- 5, 6. Two views of an imperfect cast from Neversink, New Jersey.

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FASCIOLARIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE IX.

EXPLANATION OF PLATE IX.

TRITONIDEA OBESA Whitf. (p. 79).

Figs. 1-3. Views from two different individuals of the species.

TURBINELLA ? PARVA Gabb. (p. 80).

4. Summit view, natural size, of the type specimen.

5, 6. Back and front views of the same enlarged. Acad. Nat. Sci., Phila.

TURBINELLA ? SUBCONICA Gabb. (p. 81).

7, 8. Two views of the type specimen. Acad. Nat. Sci., Phila.

VASUM CONOIDES Whitf. (p. 83).

9, 10. Two views of the specimen ; one natural size, the other enlarged.

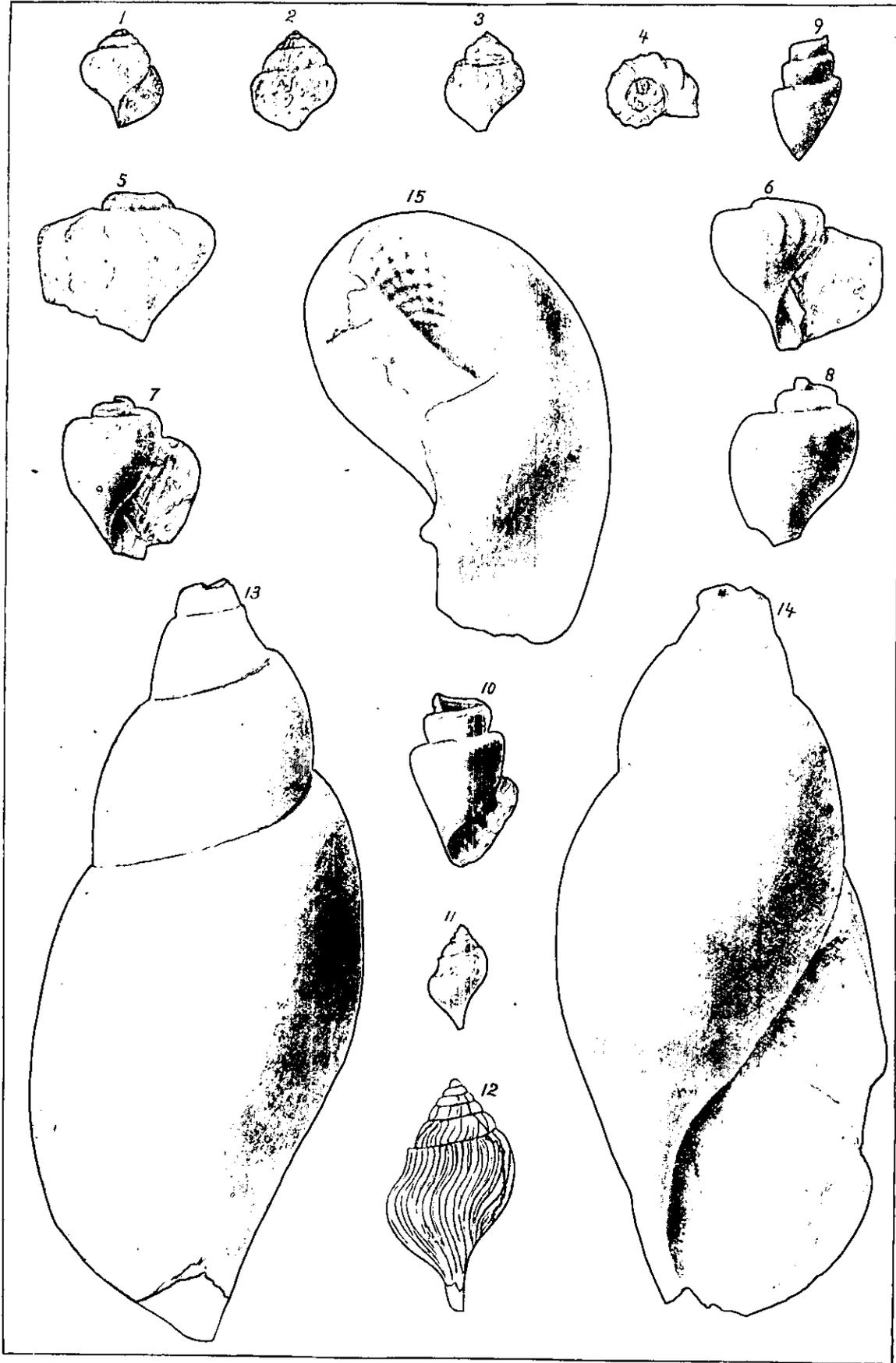
EUTHRIA (?) FRAGILIS Whitf. (p. 78).

11, 12. Two views of the specimen used, one natural size and one enlarged.

VOLUTOMORPHA PONDEROSA Whitf. (p. 72).

13, 14. Two views of a large specimen from Holmdel, New Jersey.

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FASCIOLARIIDÆ, TRITONIDÆ, AND TURBINELLIDÆ OF THE LOWER GREENSAND MARLS.

PLATE X.

EXPLANATION OF PLATE X.

VOLUTODERMA BIPLICATA Gabb (p. 90).

Figs. 1-2. Opposite views of the type specimen from the Acad. Nat. Sci., Phila.

VOLUTODERMA OVATA Whitf. (p. 91).

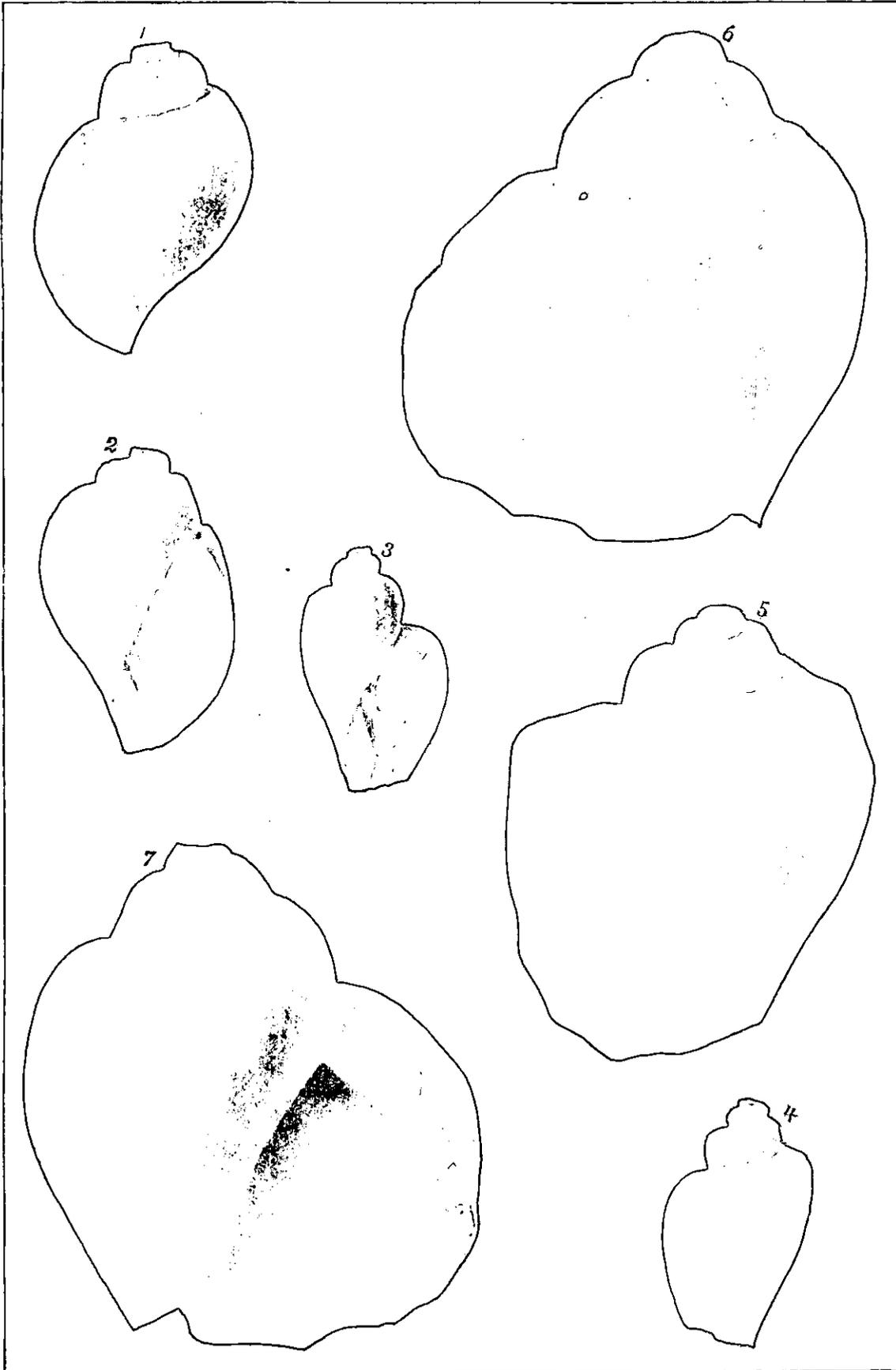
3, 4. Opposite views of the specimen showing the plications and abrupt shoulder of the volutions. Collection of the Am. Mus. Nat. Hist., New York City.

VOLUTA † *DELAWARENSIS* Gabb (p. 84).

5. Back view of the smaller cast used by Mr. Gabb.

6, 7. Two views of the larger cast, both types and from the Acad. Nat. Sci., Phila.

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VOLUTIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XI.

EXPLANATION OF PLATE XI.

ROSTELLITES NASUTUS Gabb (p. 86).

Figs. 1, 2. Two views of Mr. Gabb's type from the collection of the Acad. Nat. Sci., Phila.

ROSTELLITES ANGULATUS Whitf. (p. 88).

3, 4. Two views of a cast showing the flattening of the body volution. Acad. Nat. Sci., Phila.

ROSTELLITES TEXTURATUS Whitf. (p. 88).

5, 6. Views of two individuals, one from Holmdel, the other from Freehold, New Jersey, showing difference in surface markings.

TURRICULA LEDA Whitf. (p. 93).

7. View of the cast used in description.

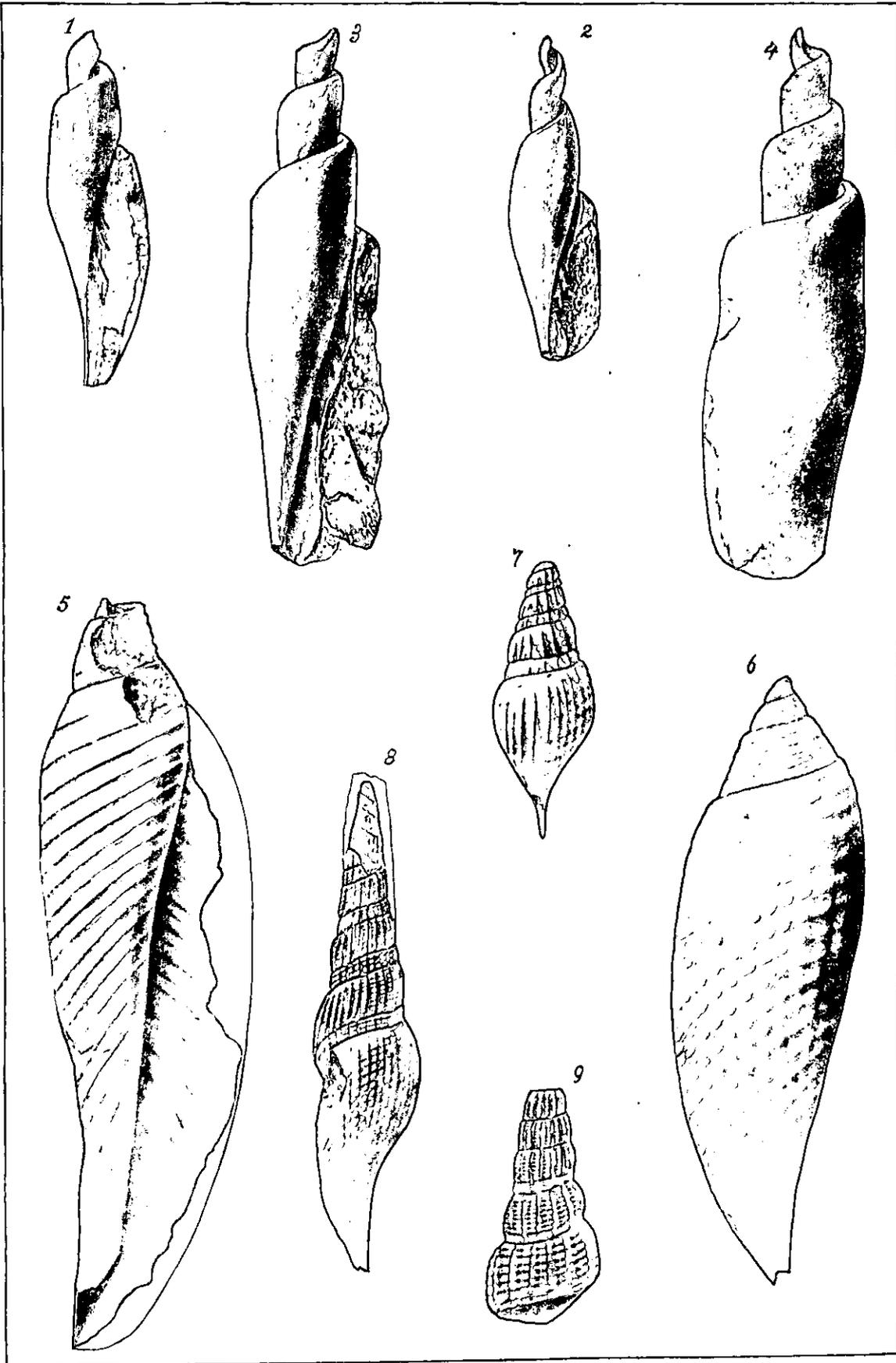
TURRICULA REILEYI Whitf. (p. 92).

8. View of cast described, showing the impression of the extension of the spire above.

TURRICULA SCALARIFORMIS Whitf. (p. 95).

9. The cast representing the two sets of surface markings.

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VOLUTIDÆ AND MITRIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XII.

MON XVIII—21

EXPLANATION OF PLATE XII.

TURBINOPSIS Plicata Whitf. (p. 104).

Figs. 1, 2. Two views of a specimen showing the features of the species. Acad. Nat. Sci., Phila.

TURBINOPSIS CURTA Whitf. (p. 102).

3, 4. Two views of a small cast showing the short spire.

5, 6. Views of a larger specimen. Acad. Nat. Sci., Phila.

TURBINOPSIS HILGARDI Conrad. † (p. 100).

7-9. Views of three imperfect casts referred to this species.

TURBINOPSIS ELEVATA Whitf. (p. 102).

10, 11. Two views of an imperfect cast.

12. An imperfect cast showing the isolated spots on the columella.

13, 14. Views of a more slender cast. All from the Acad. Nat. Sci., Phila.

TURBINOPSIS MAJOR Whitf. (p. 103).

15, 16. Two views of a small specimen.

21, 23. Three views of a large cast.

TURBINOPSIS ANGULATA Whitf. (p. 101).

17, 18. Two views of a cast showing the specific features.

MOREA NATICELLA Gabb (p. 97).

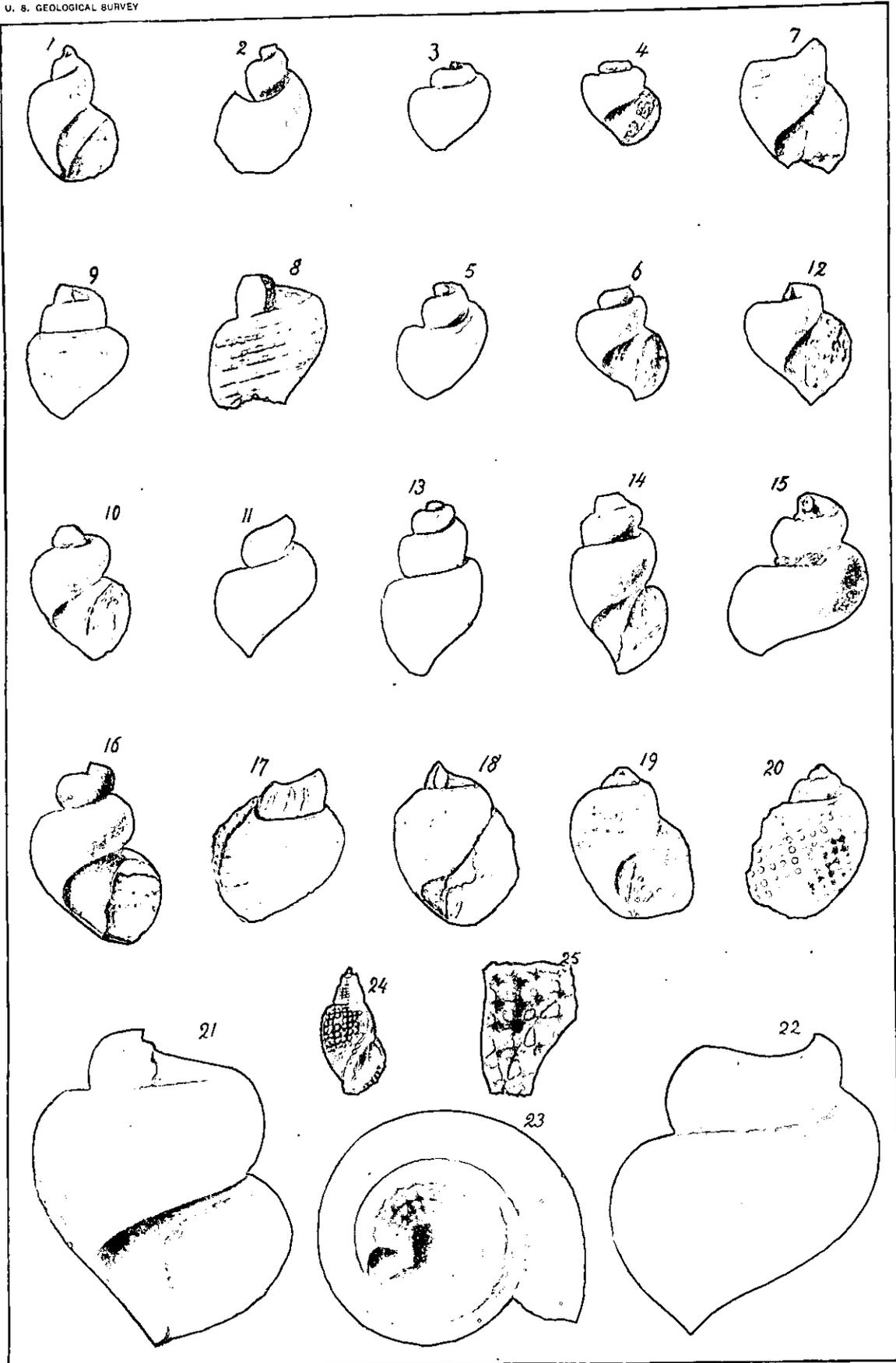
19, 20. Two views of the type specimen. Acad. Nat. Sci., Phila.

CANCELLARIA (MERICA) SUBALTA Conrad (p. 95).

24. View of the shell somewhat restored.

25. Enlargement from the columellar lip. Acad. Nat. Sci., Phila.

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CANCELLARIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XIII.

EXPLANATION OF PLATE XIII.

SURCULA STRIGOSA Gabb (p. 105).

FIGS. 1. View of the fragment supposed to be the type.

CITHARA MULLICAENSIS Whitf. (p. 106).

2, 3. Front views, one natural size and one enlarged, of a specimen retaining the shell.

4, 5. Two views of a cast.

6. View of a larger cast from the same locality.

CITHARA CROSSWICKENSIS Whitf. (p. 107).

7, 8. Two views of the best cast yet found.

ROSTELLARIA CURTA Whitf. (p. 109).

9, 10. Views of the opposite sides of a cast showing the features described.

11. View of a second cast.

12, 13. Two views of a specimen retaining fragments of shell.

ROSTELLARIA FUSIFORMIS Whitf. (p. 110).

14, 15. Two views of the most perfect cast observed.

ROSTELLARIA SPIRATA Whitf. (p. 109).

16, 17. Two views of a characteristic cast of the species.

ROSTELLARIA COMPACTA Whitf. (p. 108).

18, 19. Views of a very compact cast showing a ridge on the front of Fig. 18.

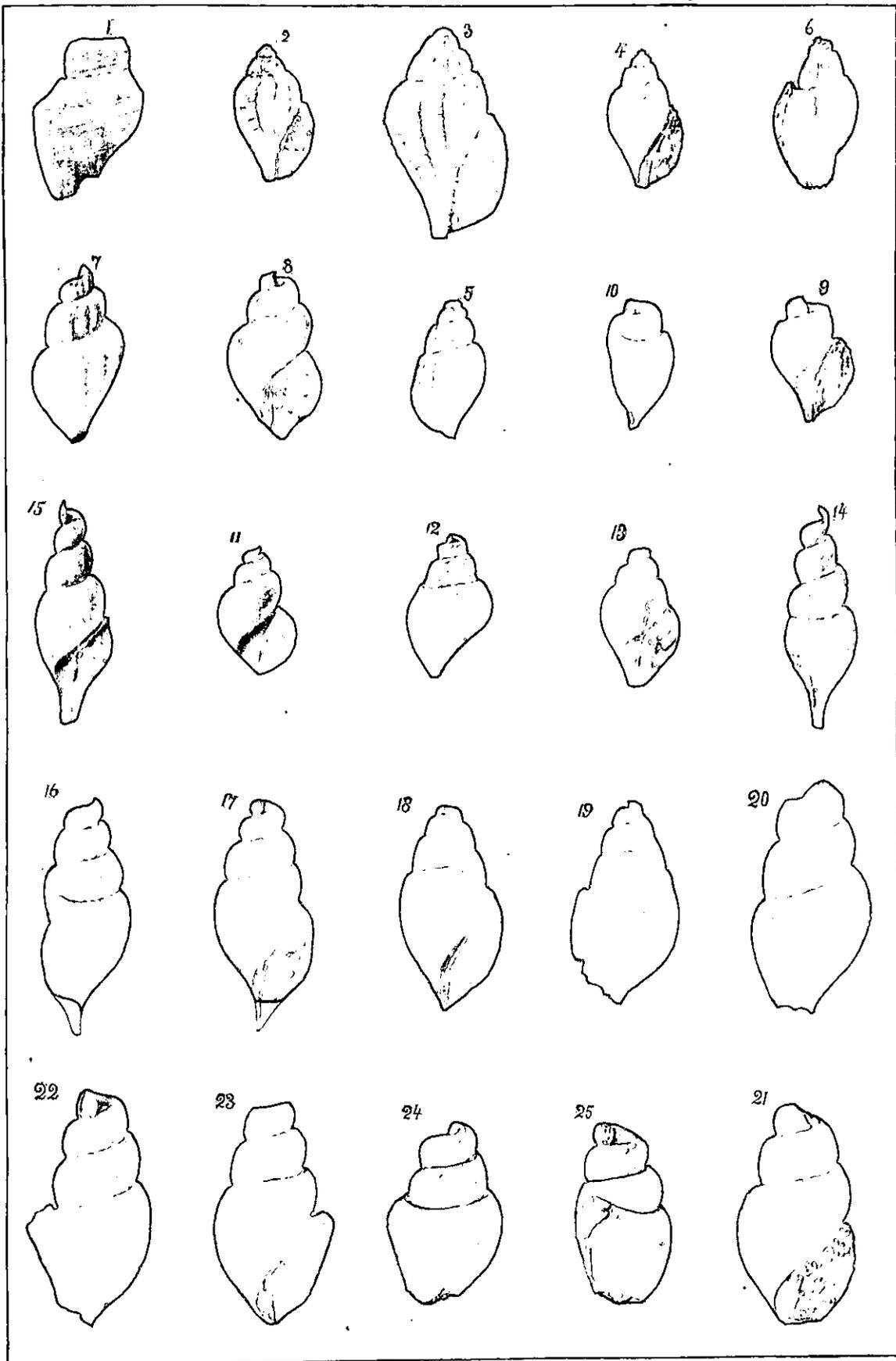
20, 21. Views of a second cast which is less compact. Acad. Nat. Sci., Phila.

ANCHURA (DRAPANOCHILUS) COMPRESSA Whitf. (p. 117).

22, 23. Two views of a large cast from Freehold, New Jersey.

24, 25. Views of a cast showing a shorter spire. From the collection of Columbia College.

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PLEUROTOMIDÆ AND STROMBIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XIV.

EXPLANATION OF PLATE XIV.

ANCHURA ABRUPTA Conrad (p. 113).

- Figs. 1. View of a large imperfect cast of the form referred to this species.
2, 3. Views of the opposite sides of a second cast, showing the carina on the back of the volu-
tion. Am. Acad. Nat. Sci., Phila.

ANCHURA ABRUPTA var. *ACUTISPIRA* Whitf. (p. 114).

4. View of the specimen described. Acad. Nat. Sci., Phila.

ALARIA ROSTRATA Gabb (p. 119).

- 5, 6. Views of two different specimens, both showing the outer lip. Fig. 5 is from a Holmdel
specimen; Fig. 6 from Haddonfield, New Jersey, in the Acad. Nat. Sci., Phila.

ANCHURA PENNATA Morton (p. 115).

- 7, 8. Views of two casts which show the outer lip. Both from Holmdel, New Jersey.

ANCHURA SOLITARIA Whitf. (p. 117).

9. View of the single imperfect cast observed.

ANCHURA ARENARIA Morton (p. 112).

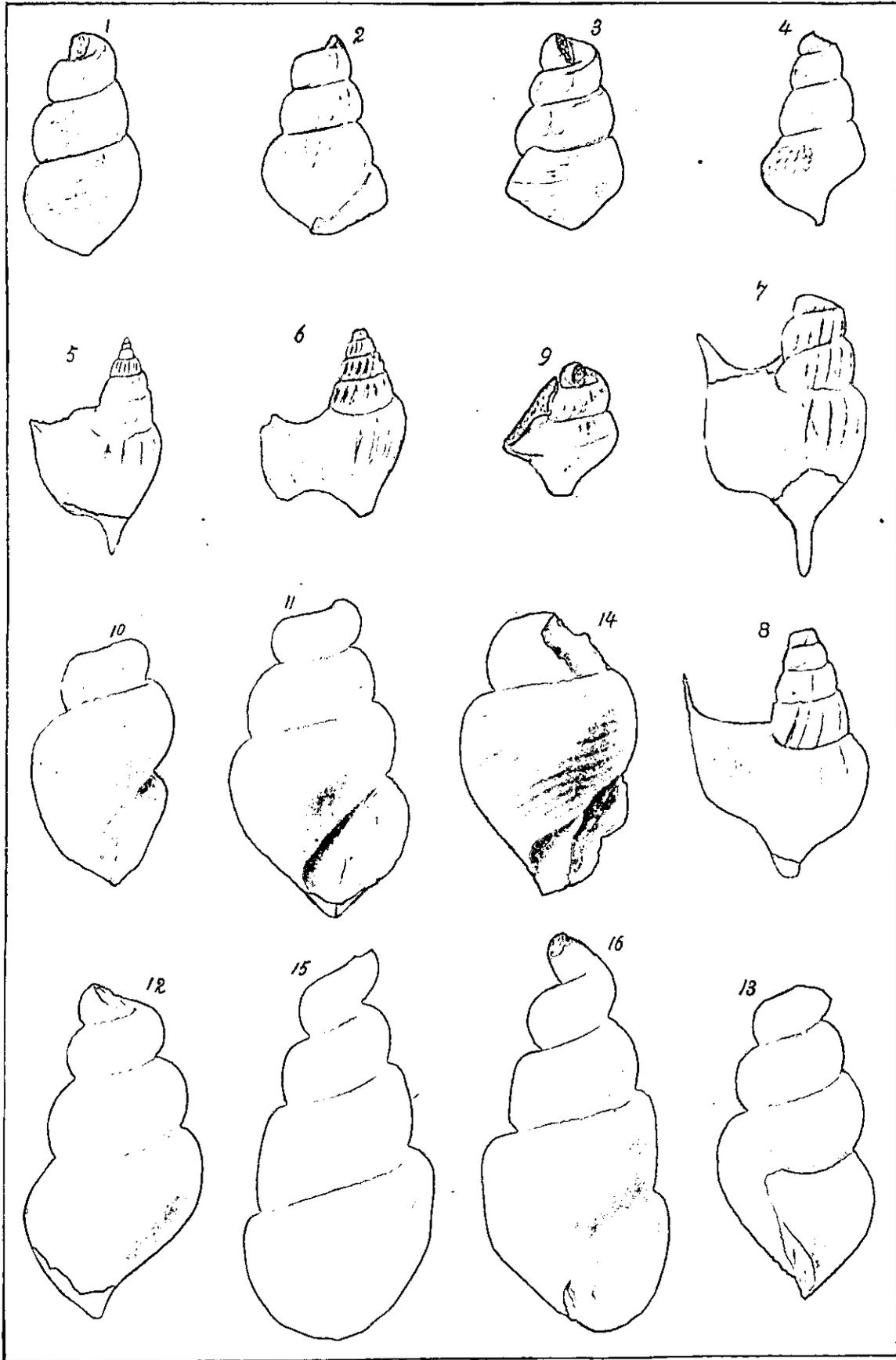
10. View of Dr. Morton's type specimen. Acad. Nat. Sci., Phila.

ROSTELLARIA HEBE Whitf. (p. 111).

- 11-13. Three views of the best cast of the species observed.
14. View of another imperfect cast showing spiral lines.

ANCHURA PAGODIFORMIS Whitf. (p. 116).

- 15, 16. Views of the opposite sides of the best cast of the species yet found.



STROMBIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XV.

EXPLANATION OF PLATE XV.

CYPRÆA (ARICIA) MORTONI Gabb (p. 120).

FIGS. 1-3. Three views of Mr. Gabb's New Jersey type. Acad. Nat. Sci., Phila.

DOLIUM (DOLIOPSIS) MULTILIRATUM Whitf. (p. 121).

4, 5. Two views of the specimen used, natural size.

6. Enlarged view of the same.

FIGUS PRÆCEDENS Whitf. (p. 122).

7, 8. Two views, enlarged two diameters, of the most perfect cast observed.

NATICA ABYSSINA Morton (p. 123).

9, 10. Two views, lateral and basal, of a cast from the white limestone nodules at Monmouth, New Jersey.

11, 12. Two similar views of another cast from the Green Marls.

GYRODES INFRACARINATA Gabb (p. 125).

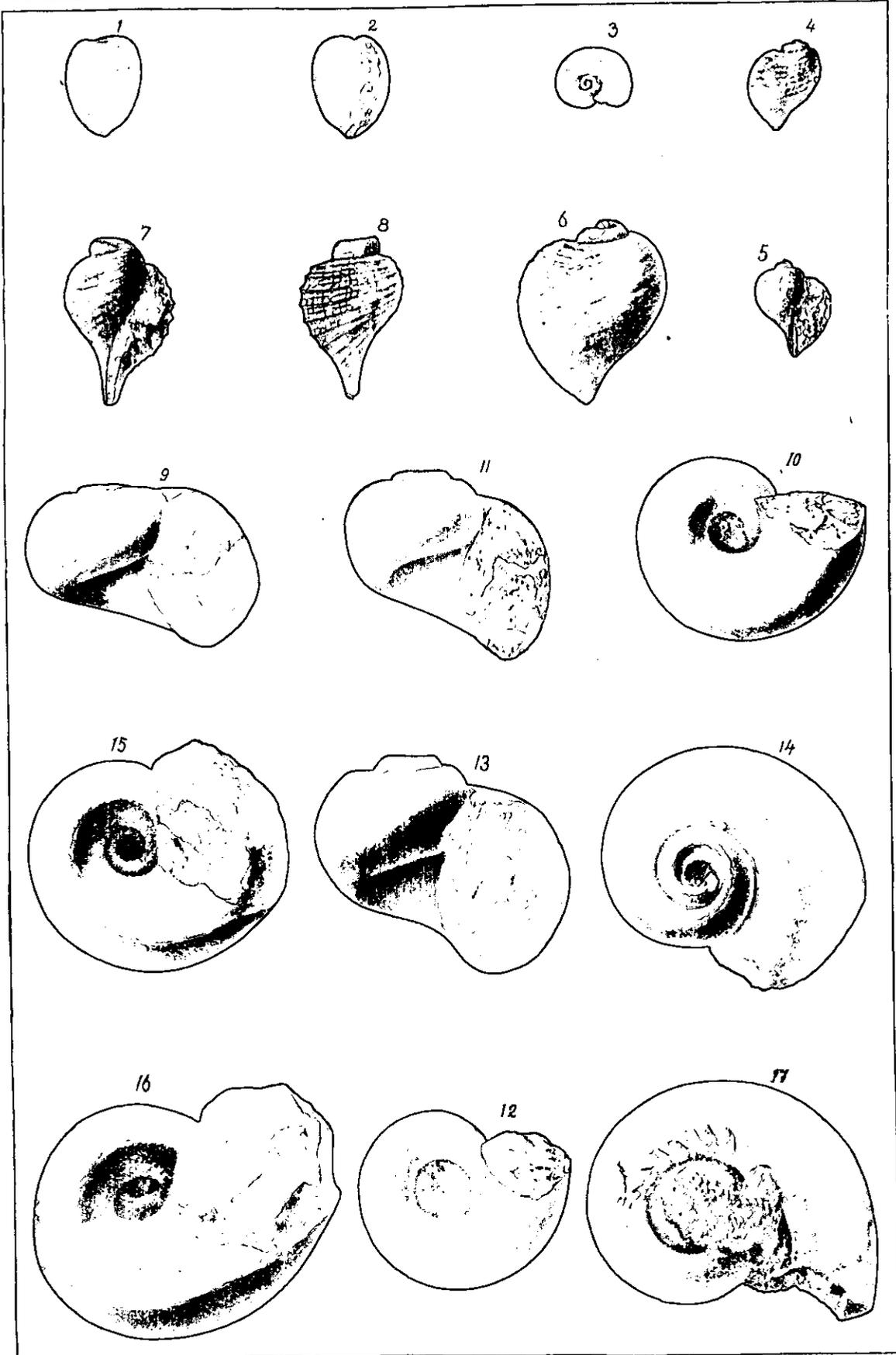
13-15. Three views of a very characteristic cast from Highlands, New Jersey.

16. Basal view of a large cast from Burlington, New Jersey.

GYRODES ABBOTTI Gabb, (p. 124).

17. Summit view of the type specimen. Acad. Nat. Sci., Phila.

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CYPRÆIDÆ, DOLIDÆ, AND NATICIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XVI.

EXPLANATION OF PLATE XVI.

GYRODES PETROSA Morton (p. 127).

- Figs. 1-3. Back, front, and summit views of a specimen from Mullica Hill. Am. Mus. Nat. Hist., New York City.
4. Summit view of a cast from Crosswicks Creek. Columbia College.

GYRODES CRENATA Conrad (p. 126).

- 5, 6. Two views of the type specimen from the Acad. Nat. Sci. Phila.

GYRODES ALTISPIRA Gabb (p. 128).

- 7, 8. Front and back views of a cast from Mullica Hill in the Am. Mus. Nat. Hist., New York City.

GYRODES OBTUSIVOLVA Gabb (p. 129).

- 9, 11. Views of different specimens from Upper Freehold.
12. View of another cast in the collection of the Am. Mus. Nat. Hist., New York City, from New Egypt, New Jersey.

LUNATIA HALLI Gabb. (p. 130).

- 13, 14. Two views of a specimen from Mullica Hill in the Acad. Nat. Sci. Phila.
15, 16. Similar views of a cast from the same place in the Am. Mus. Nat. Hist., New York City.

AMAUROPSIS PUNCTATA Gabb (p. 132).

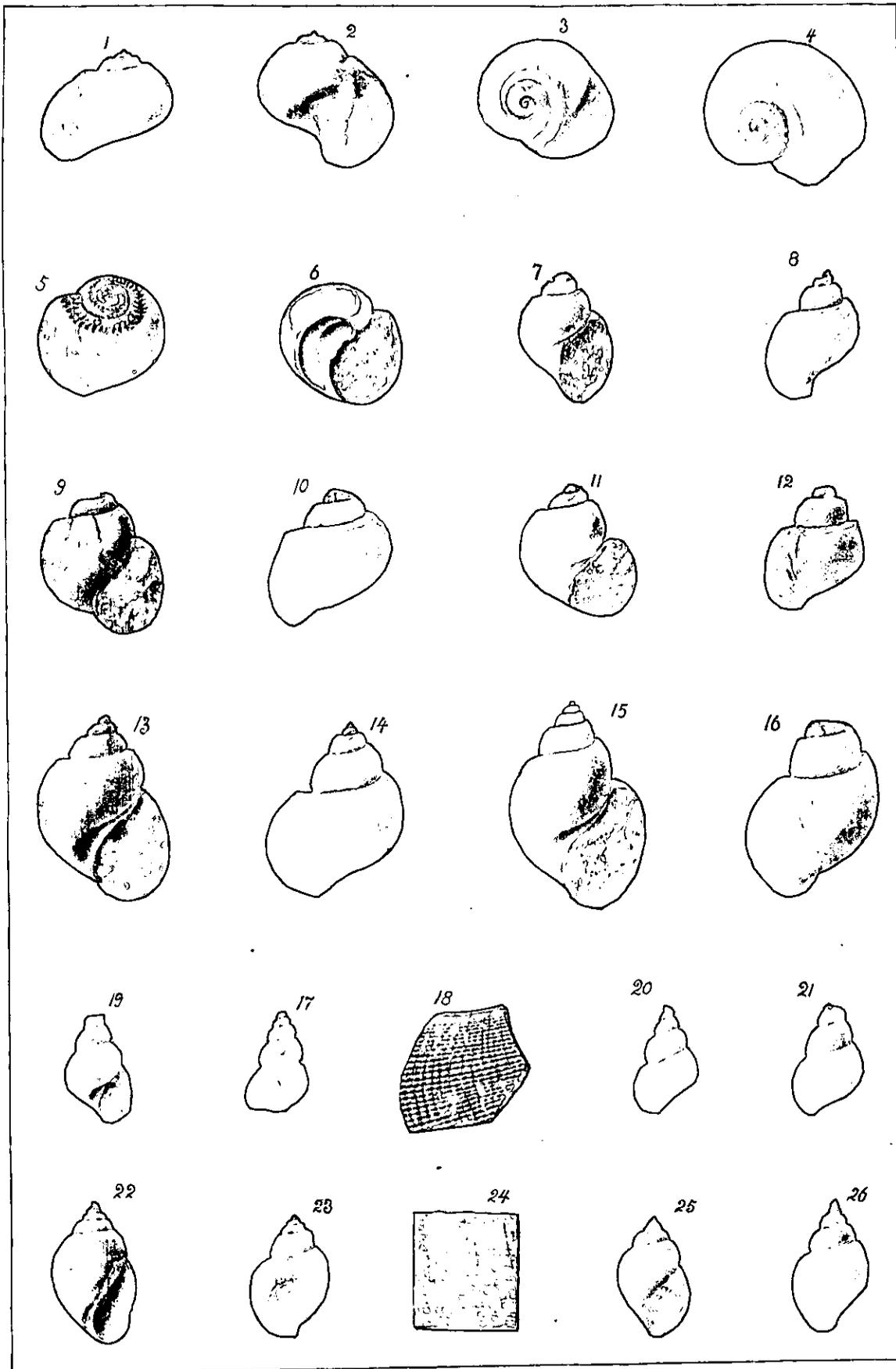
17. View of the type specimen. Acad. Nat. Sci. Phila.
18. Enlargement of the surface.
19-21. Views of different individuals showing but slight diversity in form.

AMAUROPSIS MEEKANA Whitf. (p. 131).

- 22, 23, 25. Views of different specimens showing a slight difference in form. Fig. 22 enlarged to two diameters.
24. Enlargement of the surface.

AMAUROPSIS PALUDINÆFORMIS H. M. (pp. 131, 132).

26. Enlarged view of the type of this species for comparison, two diameters. Am. Mus. Nat. Hist., New York City.



NATICIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XVII.

EXPLANATION OF PLATE XVII.

MARGARITA ABYSSINA Gabb (p. 133).

- Figs. 1, 2. Lateral and basal views of a specimen from Burlington, New Jersey. Am. Mus. Nat. Hist. New York City.
3. Enlargement to two diameters of the same.
4, 5. Lateral and summit views of a cast from Crosswicks.

MODULUS LAPIDOSUS Whitf. (p. 152).

- 6-8. Lateral, basal, and summit views of a very perfect cast.

DELPHINULA LAPIDOSA Morton's sp. (p. 152).

- 9-11. Enlarged lateral, summit, and basal views of Dr. Morton's type, from Alabama. Acad. Nat. Sci., Phila.

MARGARITELLA ABBOTTI Gabb (p. 134).

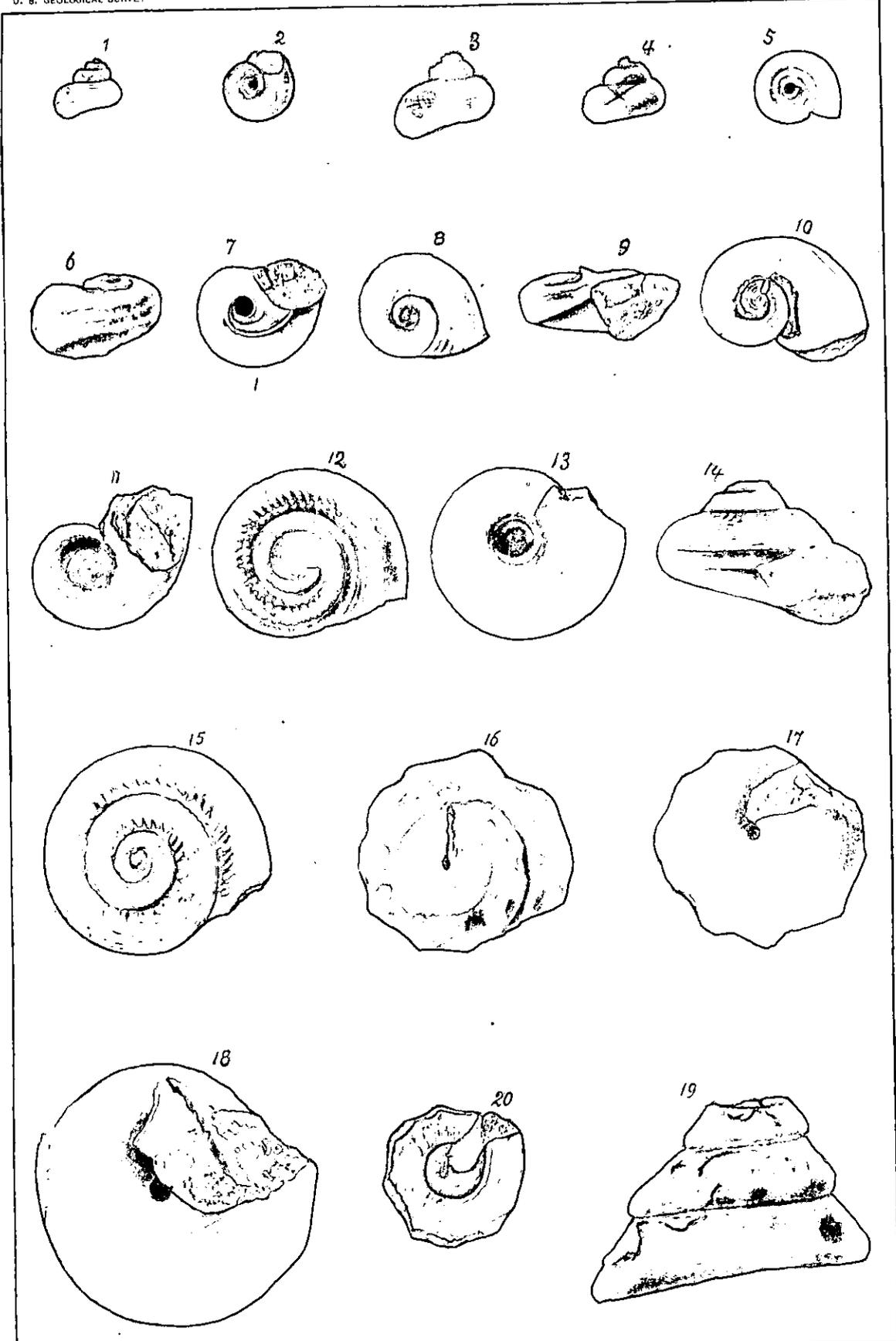
- 12, 13. Summit and basal views of Mr. Gabb's type. Acad. Nat. Sci., Phila.
14, 15. Lateral and summit views of another cast. Acad. Nat. Sci., Phila.

XENOPHORA LEPROSA Morton (p. 135).

- 16, 17. Summit and basal views of a small cast.
18, 19. Basal and lateral views of a large cast from Crosswicks, New Jersey.

ENDOPTYGMA UMBILICATA Tuomey (p. 136).

20. Basal view of a small cast showing the groove left by the spiral tooth. Am. Mus. Nat. Hist., New York City. The specimen is from Burlington, New Jersey.



TROCHIDÆ, ONUSTIDÆ, AND LITTORINIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XVIII.

EXPLANATION OF PLATE XVIII.

SCALARIA (OPALIA) THOMASI Gabb? (p. 137).

FIG. 1. View of the only specimen of the species observed. Acad. Nat. Sci., Phila.

SCALARIA SILLIMANI Morton (p. 138).

2. View of the specimen identified.

SCALARIA? PAUPERATA Whitf. (p. 141).

3, 4. Two views of a specimen retaining some of the shell.

5, 6. Similar views of a complete cast.

7. Enlargement of surface from Fig. 3.

TURRITELLA COMPACTA Whitf. (p. 142.)

8, 9. Two views of a cast of this species.

TURRITELLA GRANULICOSTA Gabb (p. 144).

10. View of the type specimen. Acad. Nat. Sci., Phila.

11. Enlargement of the surface.

SCALARIA? HERCULES Whitf. (p. 140).

12. View of the specimen as obtained from a gutta-percha impression in the natural mold. Columbia College.

TURRITELLA VERTEBROIDES, Morton (p. 146).

13, 14. View of Morton's type and an enlargement of the surface. Acad. Nat. Sci., Phila.

15. View of an impression in a natural mold from Monmouth, New Jersey.

16. View of a large cast in the collection at Columbia College.

17. View of a cast from Monmouth County, New Jersey.

18. An imperfect cast, Mr. Gabb's second type of *Laxispira lumbricalis*, natural size. Acad. Nat. Sci., Phila.

TURRITELLA ENCRINOIDES Morton (p. 143).

19, 20. View of Morton's type and enlargement of surface. Acad. Nat. Sci., Phila. In the enlargement, the volution is represented as too round.

21, 22. View of two internal casts referred to this species from Upper Freehold, New Jersey.

TURRITELLA LIPPINCOTTI Whitf. (p. 145).

23, 24. View of a partial cast from Crosswicks, New Jersey, and an imprint from the natural mold from Holmdel, New Jersey.

LAXISPIRA LUMBRICALIS Gabb (p. 148).

25. Copy of Mr. Gabb's figure of the type of the genus and species. The second specimen is Fig. 18. See also explanation of Fig. 26.

SILIQVARIA PAUPERATA Whitf. (p. 149).

26. Enlarged view (two diameters) of a cast showing the slit. This specimen was included in Gabb's types of *Laxispira lumbricalis*.

27, 28. Two views of another specimen found with the above. Acad. Nat. Sci., Phila.



SCALARIIDÆ, TURRITELLIDÆ, AND VERMETIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XIX.

EXPLANATION OF PLATE XIX.

OBELISCUS CONELLUS Whitf. (p. 151).

FIGS. 1. View of the front side of the specimen described, greatly enlarged. Acad. Nat. Sci. Phila.

LEIOSTRACA CRETACEA Conrad (p. 150).

2-4. Views of three specimens showing the features described, enlarged four, five, and three diameters respectively.

5. A still further enlargement of the aperture from another shell. Acad. Nat. Sci. Phila.

HELICION ? TENTORIUM Morten (p. 153).

6, 7. Lateral and vertical views of the type, enlarged. Acad. Nat. Sci. Phila.

8. Further enlargement of the marginal striae.

ACTÆON CRETACEA Gabb (p. 158).

9, 10. Two views of a cast which shows no spiral striae.

11, 12. Two views of another cast showing spiral striae. Acad. Nat. Sci. Phila.

ACTÆON GABBANA Whitf. (p. 156).

13. Front view of one of Mr. Gabb's types of *A. biplicata*. See Figs. 23-25.

ACTÆON SUBOVOIDES Whitf. (p. 155).

14. Front view of the specimen marked "type of *A. ovooides* Gabb."

15, 16. Two views of a second specimen. Acad. Nat. Sci. Phila.

ACTÆON FORBESIANA Whitf. (p. 157).

17, 18. Two views of a cast of the species.

19, 20. Enlargements to two diameters of Fig. 17 and another specimen, showing the spiral lines.

21, 22. Two views of an individual from Mullica Hill.

ACTÆON GABBANA Whitf. (p. 156).

23-25. Further illustrations of this species to show the aperture, etc.

GLOBICONCHA CURTA Gabb (p. 160).

26, 27. Front and lateral views of a cast of this species from Bell County, Texas.

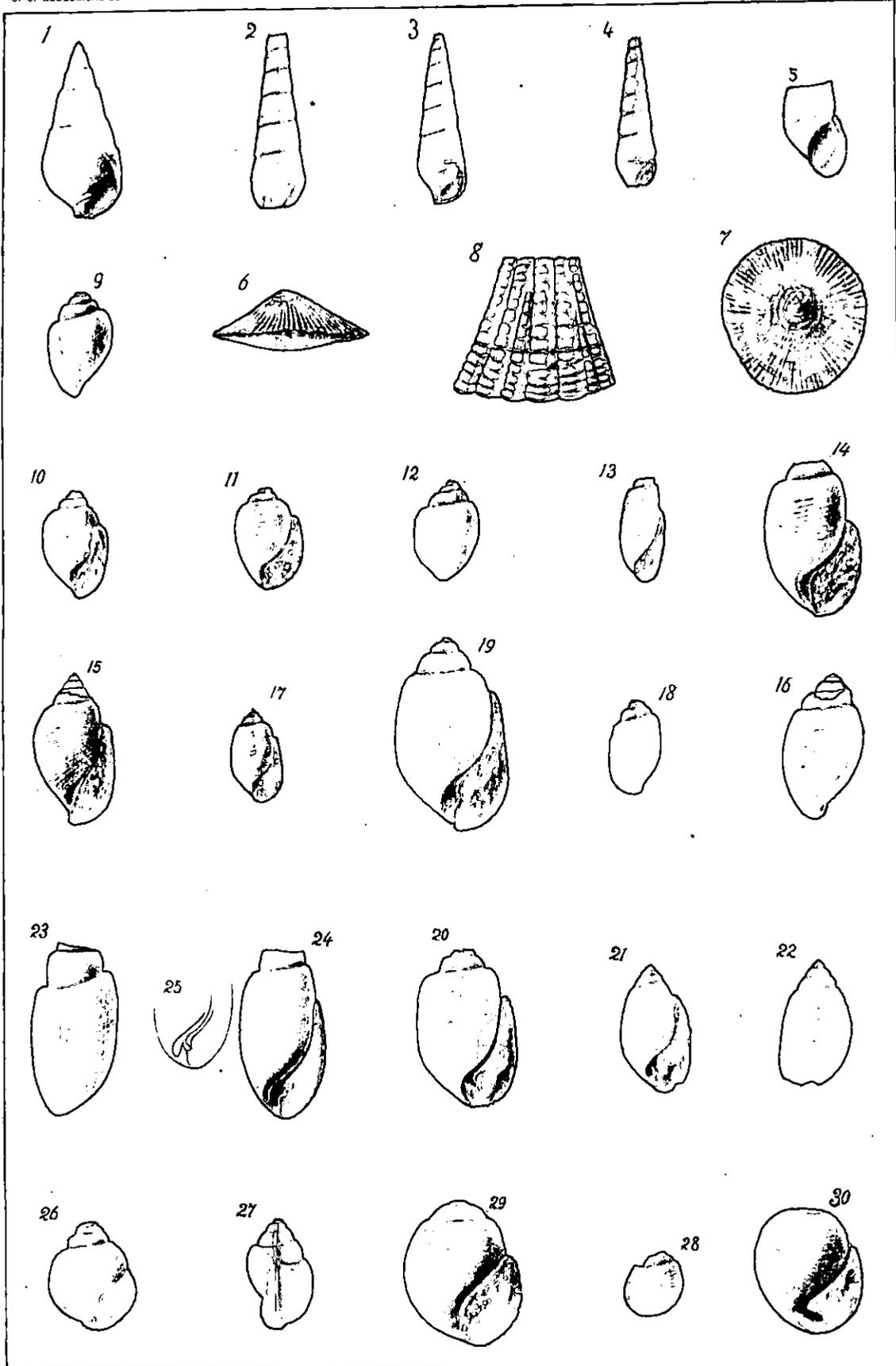
CINULIA (OLIGOPLYCHIA) NATICOIDES Gabb (p. 161).

28. View of a specimen, natural size, from the collection at Columbia College. Monmouth County, New Jersey.

29. Enlargement of the front of the same.

30. View of another cast showing the cavity of the ridge. Crosswicks Creek, New Jersey.

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EULIMIDÆ, PYRAMIDELLIDÆ, PATELLIDÆ, AND TORNATELLIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XX.

MON XVIII—22

EXPLANATION OF PLATE XX.

AVELLANA BULLATA Morton (p. 163).

FIGS. 1, 4. Views of two different specimens, apparently both used by Dr. Morton. Acad. Nat. Sci., Phila.

CINULIA OVOIDEA Gabb (p. 162).

5, 6. Two views of Mr. Gabb's type specimen.

BULLA MORTONI Lyell & Forbes (p. 165).

7, 8. Front and back views of a very large specimen from Crosswicks, in the Columbia College collection.

9. View of a smaller specimen. Collection Acad. Nat. Sci., Phila.

CYLICHNA RECTA Gabb (p. 164).

10, 11. Two views of the type specimen enlarged two diameters.

DENTALIUM (FALCULA) FALCATUM Conrad (p. 169).

12, 14. View of small much curved specimen, all casts.

15-17. Views of the larger portion of three individual casts.

18. Portion of a partial cast, looking on the back and showing striae of growth. Acad. Nat. Sci., Phila.

DENTALIUM SUBARCUATUM Conrad (p. 166).

19. View of a crushed shell from Haddonfield, New Jersey.

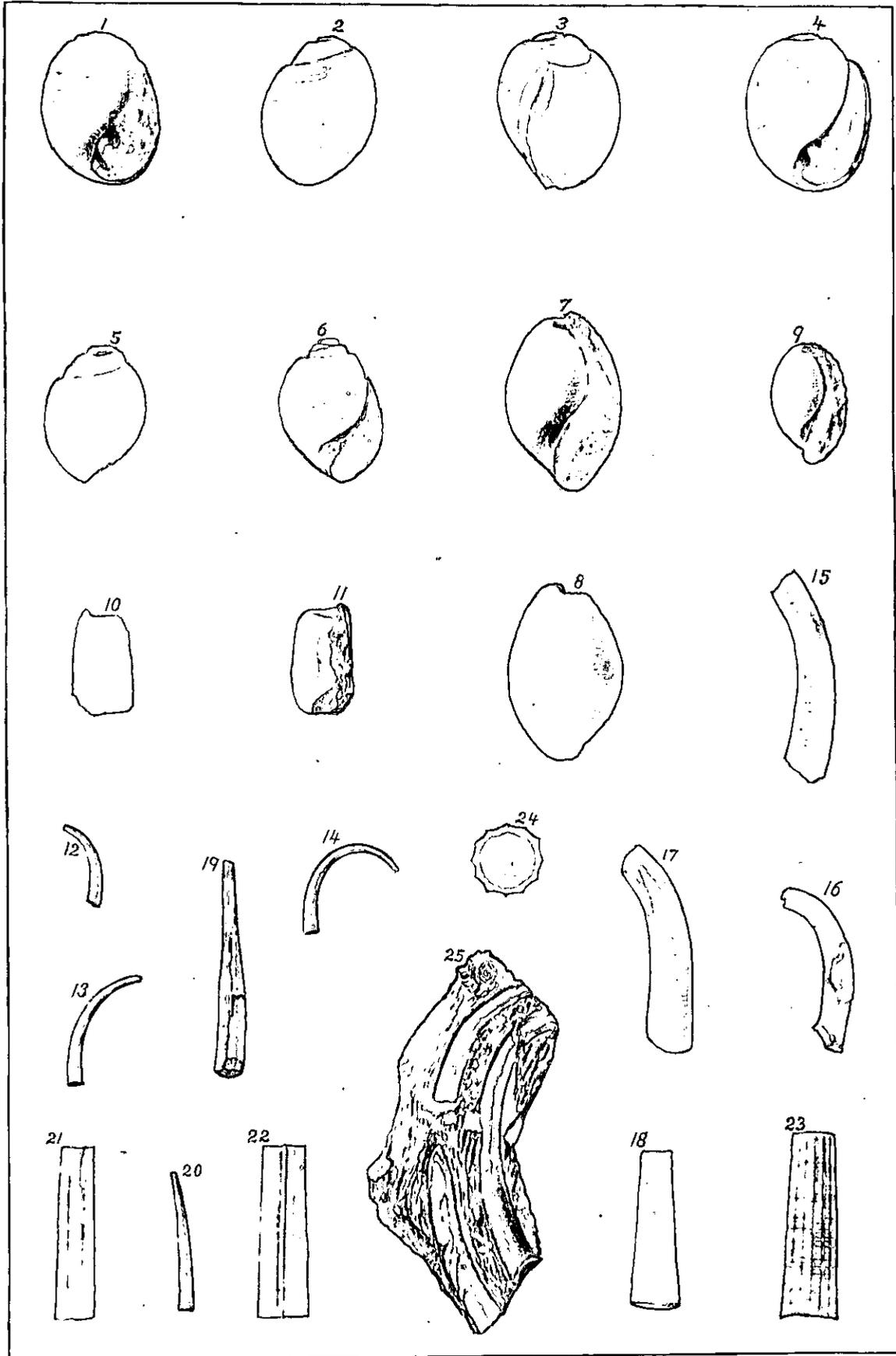
20. View of a shell showing the curvature.

21, 22. Opposite sides of casts showing the internal features described.

23, 24. Enlargement of the surface of Fig. 19, and transverse section of the same. Acad. Nat. Sci., Phila.

SERPULA (DIPLOCONCHA) CRETACEA Conrad ? (p. 170).

25. View of the specimen described showing the general features.



TORNATELLIDÆ, CYLICHNIDÆ, BULLIDÆ, AND DENTALIIDÆ OF THE LOWER GREENSAND MARLS.

PLATE XXI.

EXPLANATION OF PLATE XXI.

PERISSOLAX TRIVOLVA Gabb (p. 172).

- FIG. 1. View of Mr. Gabb's type specimen from the collection of the Acad. Nat. Sci., Phila.
1, 2. Two views of a specimen which has lost the beak. Am. Mus. Nat. Hist., New York City.

VOLUTODERMA ABBOTTI Gabb (p. 173).

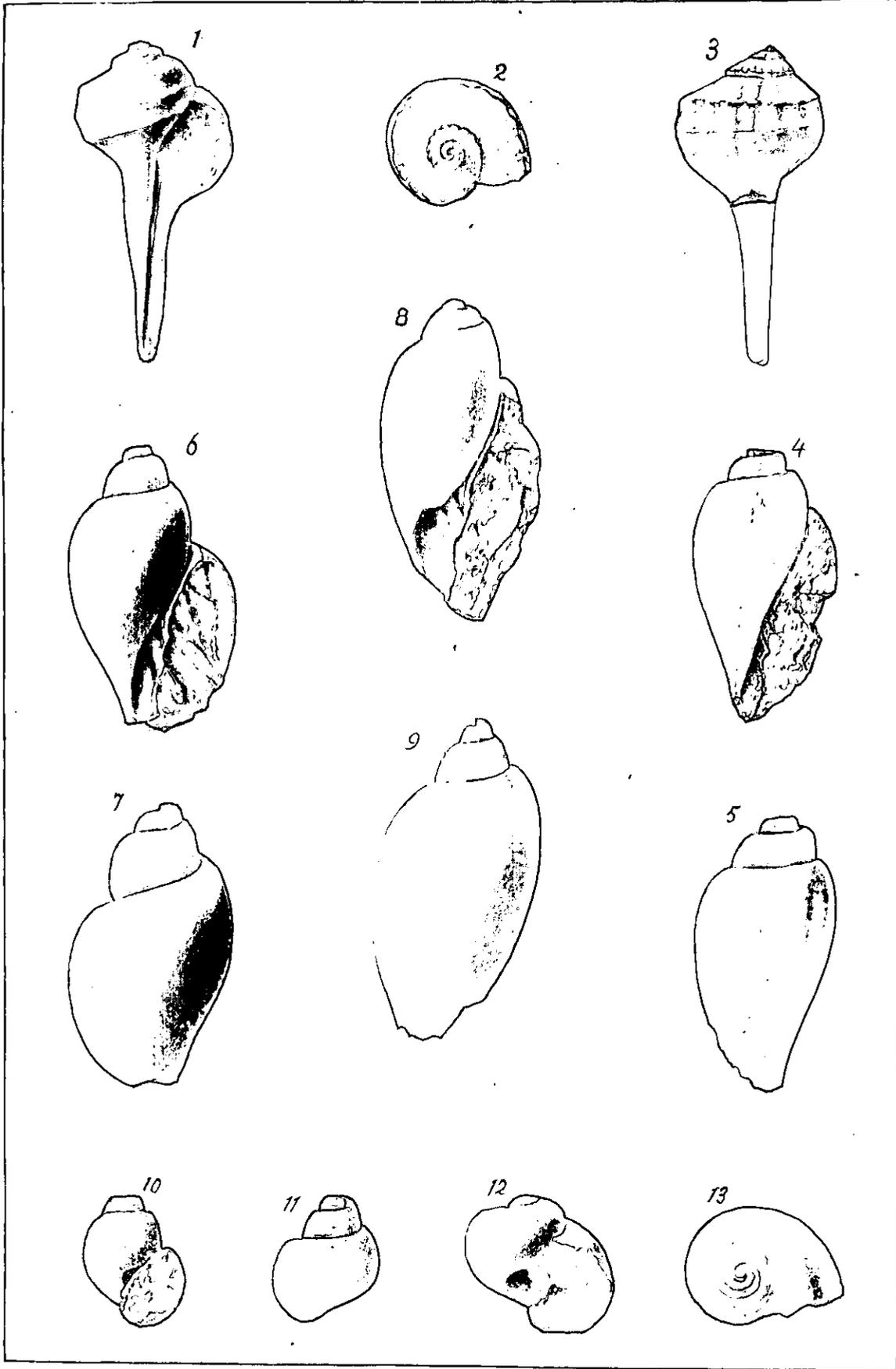
- 4, 5. Views of the opposite sides of the type specimen from the Acad. Nat. Sci., Phila.
6, 7. Two views of a specimen from the Am. Mus. Nat. Hist., New York City.
8, 9. Similar views of a specimen from the Acad. Nat. Sci., Phila.

LUNATIA HALLI Gabb (p. 175).

- 10, 11. Views of the opposite sides of a specimen from Timber Creek, New Jersey, in the collection of the Am. Mus. Nat. Hist., New York City.

NATICA ABYSSINA Morton (p. 175).

- 12, 13. Front and vertical views of a specimen from Timber Creek, New Jersey, in the collection of the Am. Mus. Nat. Hist., New York City.



MURICIDÆ, VOLUTIDÆ, AND NATICIDÆ OF THE MIDDLE BED GREENSAND MARLS.

PLATE XXII.

EXPLANATION OF PLATE XXII.

CAVOSCALA ANNULATA Mort. sp. (p. 177).

- Figs. 1, 2. Views of the opposite sides of a large specimen showing the general features.
3. Basal view of the same specimen showing the character of the umbilical cavity and the flattened callosity around it. Acad. Nat. Sci., Phila.
4. Enlargement of four of the ribs from the body volution.
5. A further enlargement of one rib to show the finer vertical striae.

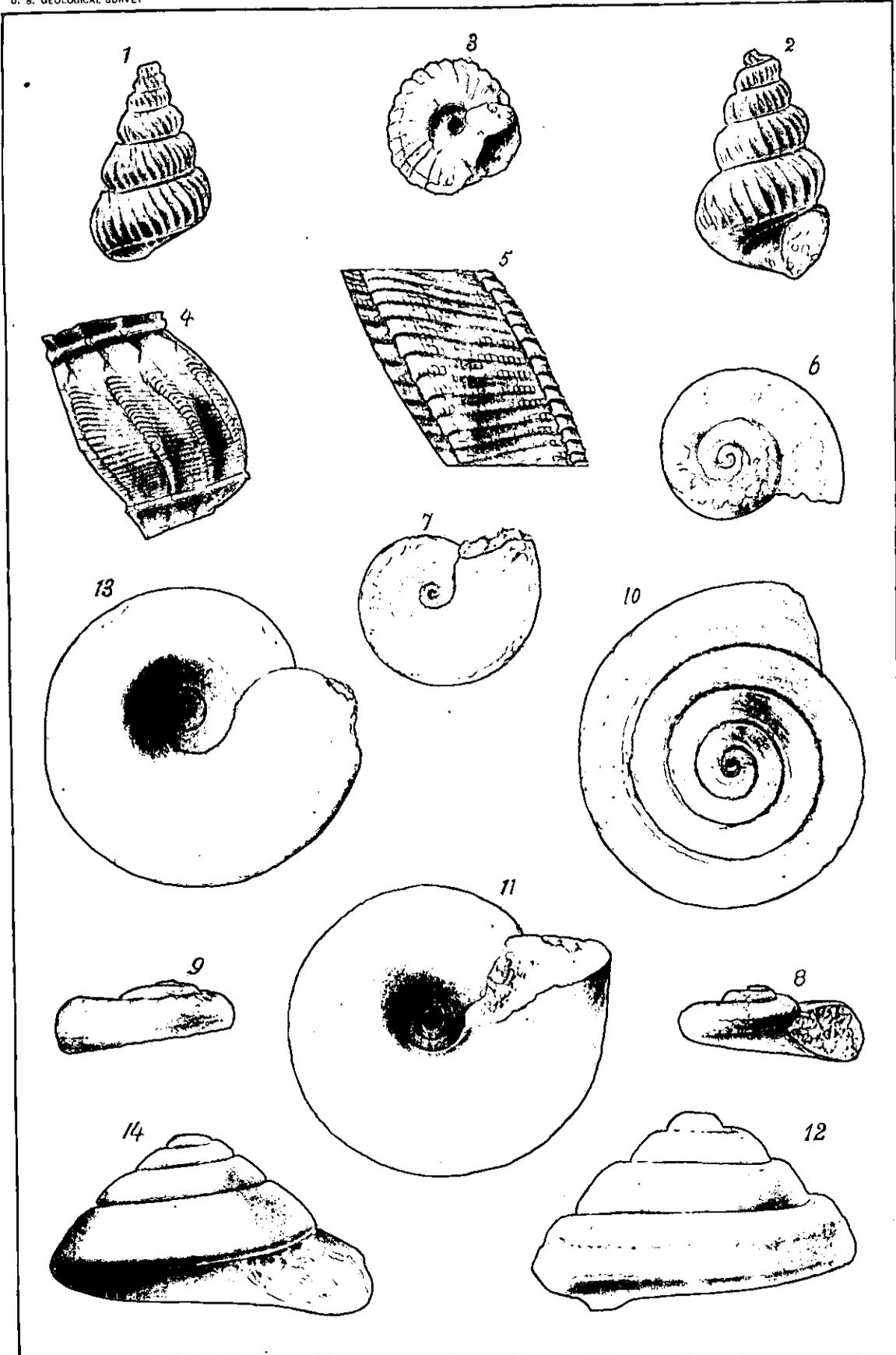
PLEUROTOMARIA TINTONENSIS Whitf. (p. 178).

- 7-9. Vertical, basal, front and lateral views of the specimen described, which I am inclined to think is a European specimen. Collection at Columbia College.

PLEUROTREMA SOLARIFORMIS Whitf. (p. 180).

- 10, 11. Vertical and basal views of a large individual from the collection of the Am. Mus. Nat. Hist., New York City.
12, 13. Lateral and basal views of one from the collection of Acad. Nat. Sci., Phila. Fig. 12 showing the casts of openings along the line of the slit.
14. View of a third specimen of the species.

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SCALARIIDÆ AND PLEUROTOMARIIDÆ OF THE MIDDLE BED GREENSAND MARLS.

PLATE XXIII.

EXPLANATION OF PLATE XXIII.

CARICELLA Plicata Whitf. (p. 182).

FIGS. 1, 2. Views of the opposite sides of the specimen described.

PLEUROTOMA FARMINGDALENSIS Whitf. (p. 185).

3, 4. Two views of the type specimen showing all there is preserved of the cast.

TURRITELLA PUMILLA Gabb (p. 187).

5, 6. Two views of a specimen presumed to be of this species. Acad. Nat. Sci., Phila.

PLEUROTOMARIA BRITTONI Whitf. (p. 188).

7-9. Lateral, vertical, and basal views of the only cast observed.

ROSTELLITES BICONICUS Whitf. (p. 183).

10, 11. Two views of a large characteristic specimen, showing the features of the aperture very distinctly.

BULLA CONICA Whitf. (p. 189).

12, 13. Two views of a very perfect cast from Shark River. Collection of Columbia College.

VOLUTODERMA INTERMEDIA Whitf. (p. 184).

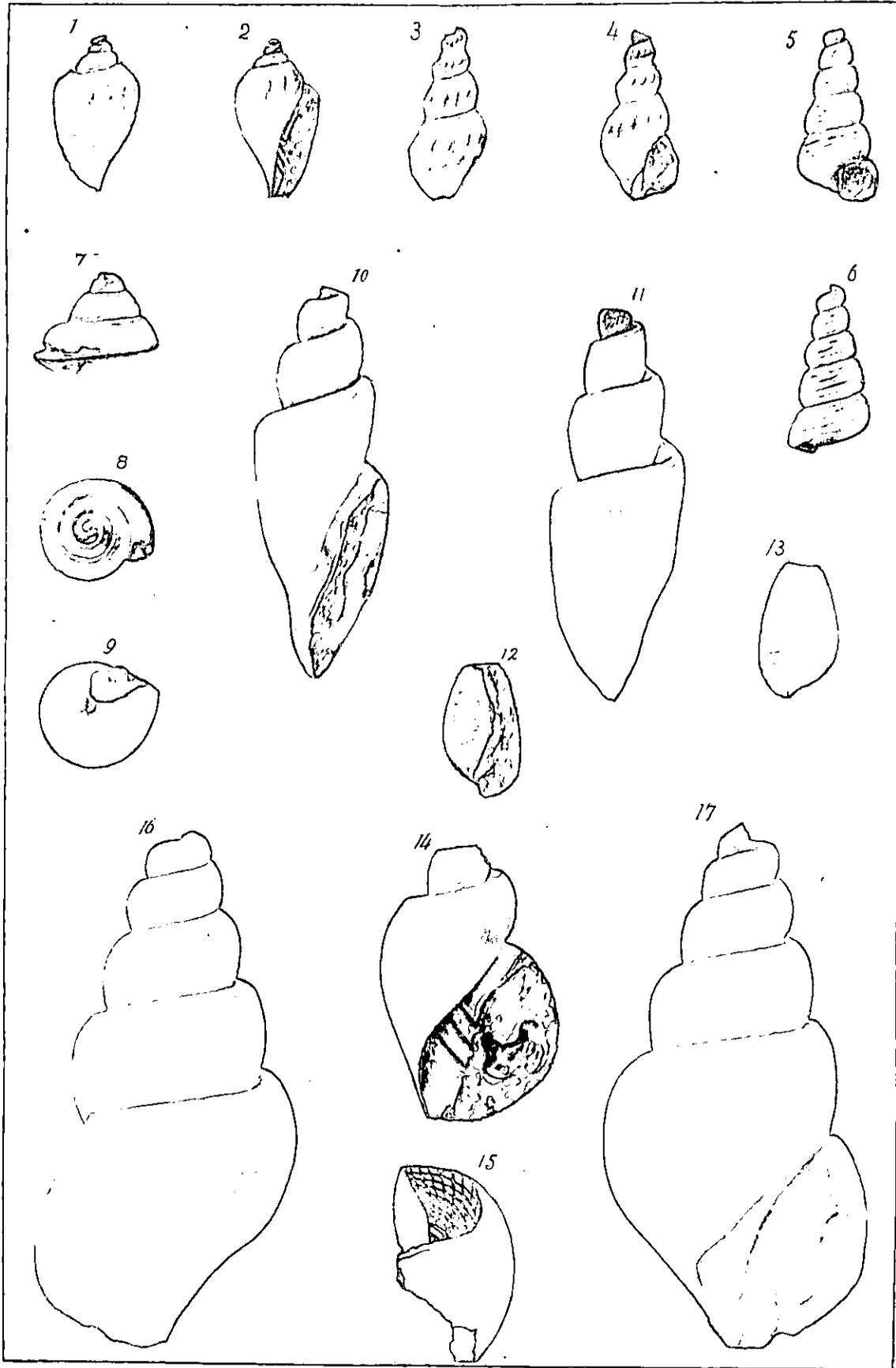
14. Front view of the best cast observed, showing the three plications.

15. Outline of a fragment showing the imprint of the exterior surface on the inside of the outer volution.

ROSTELLARIA NOBILIS Whitf. (p. 186).

16, 17. Two views of the cast described.

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TURBINELLIDÆ, VOLUTIDÆ, PLEUROTOMIDÆ, STROMBIDÆ, TURRITELLIDÆ, PLEUROTOMARIIDÆ, AND BULLIDÆ FROM THE BASE OF THE UPPER BED GREENSAND MARLS.

PLATE XXIV.

EXPLANATION OF PLATE XXIV.

NOTE.—On the plates of the Eocene the figured specimens, when not otherwise stated, may be found in the State collection at Rutgers College, or at Trenton, New Jersey.

MUREX (PTERONOTUS?) LEVAVARICOSUS Whitf. (p. 190).

FIGS. 1, 2. Views of opposite sides of the cast.

MUREX? sp. undetermined (p. 191).

3. View of a gutta-percha imprint taken from the natural mold.

TRITON EOCENSE Whitf. (p. 192).

4, 5. Views of opposite sides of the cast described.

FUSUS (UROSALPINX?) MULTICOSTATUS Whitf. (p. 200).

6, 7. Two views of the cast, the latter with the beak in outline.

RHINOCANTHA (?) CONRADI Whitf. (p. 191).

8. View of a specimen from the Am. Mus. Nat. Hist. collection showing the lip extended above.

9-11. Three views of another specimen showing the base of the beak.

FUSUS PLEURICOSTATA Whitf. (p. 195).

12. View of a cast showing the beak.

13, 14. Two views of a larger cast without beak.

FUSUS ANGULARIS Whitf. (p. 194).

15, 16. Views of the opposite sides of a specimen in the collection of the Am. Mus. Nat. Hist., New York City.

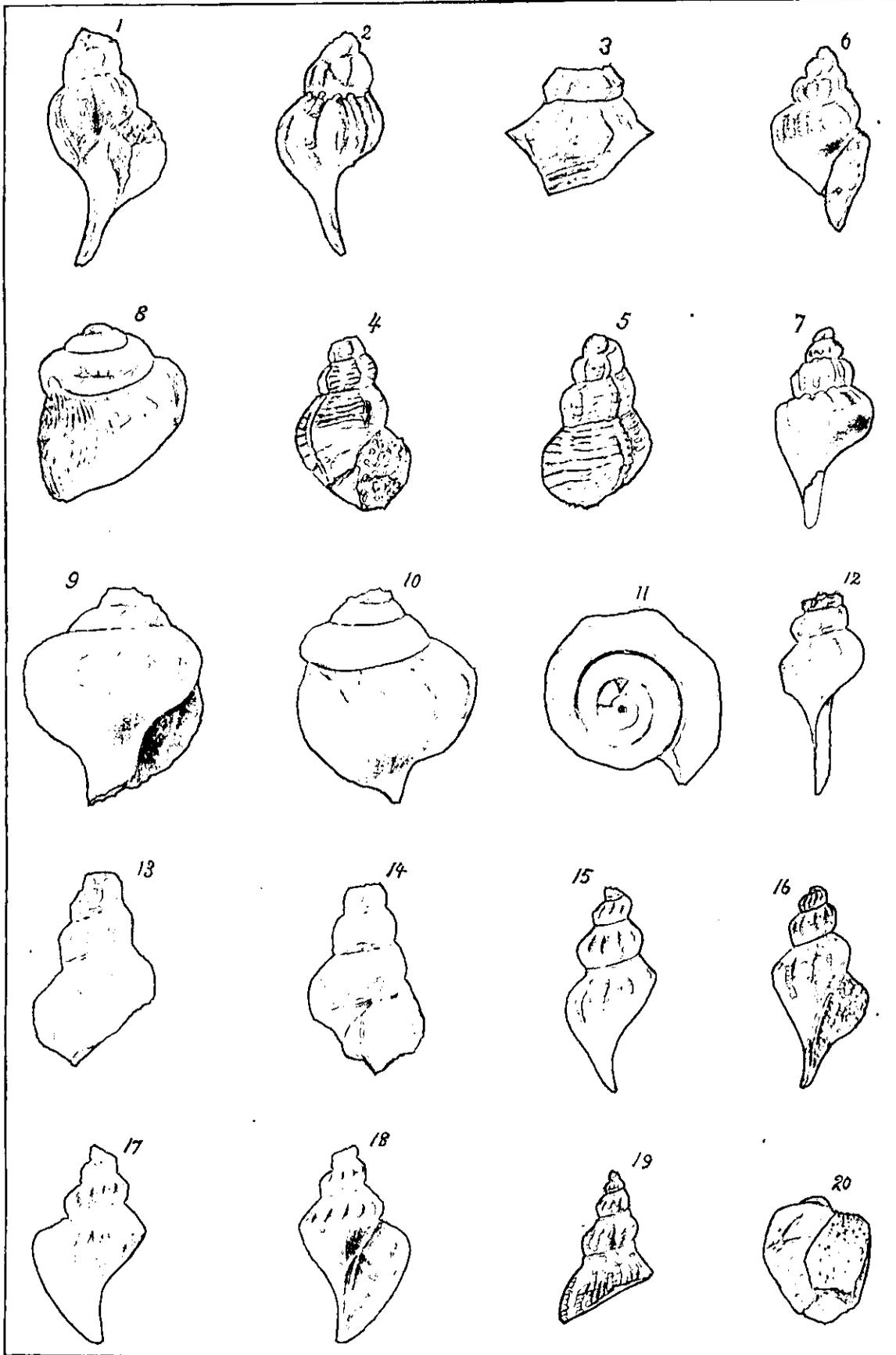
17, 18. View of a broader specimen of the Rutgers College collection.

19. The exterior as obtained from an imprint.

PSEUDOLIVA VETUSTA Conrad (p. 193).

20. View of the front of the only specimen seen.

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MURICIDÆ, TRITONIDÆ, PURPURIDÆ, AND FUSIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXV.

EXPLANATION OF PLATE XXV.

FUSUS (NEPTUNEA) STAMINEA Conrad (p. 197).

FIGS. 1, 2. Lateral view, and view of the summit of the best specimens yet observed.

FUSUS (NEPTUNEA) HECTOR Whitf. (p. 199).

3, 4. Views of the opposite sides of a small cast.

5, 6. Similar views of a large individual destitute of the anterior beak.

FUSUS (NEPTUNEA) HECTOR var. MULTILINEATA Whitf. (p. 199).

7. View of the flattened cast showing all that is preserved.

FUSUS PEROBESUS Whitf. (p. 196).

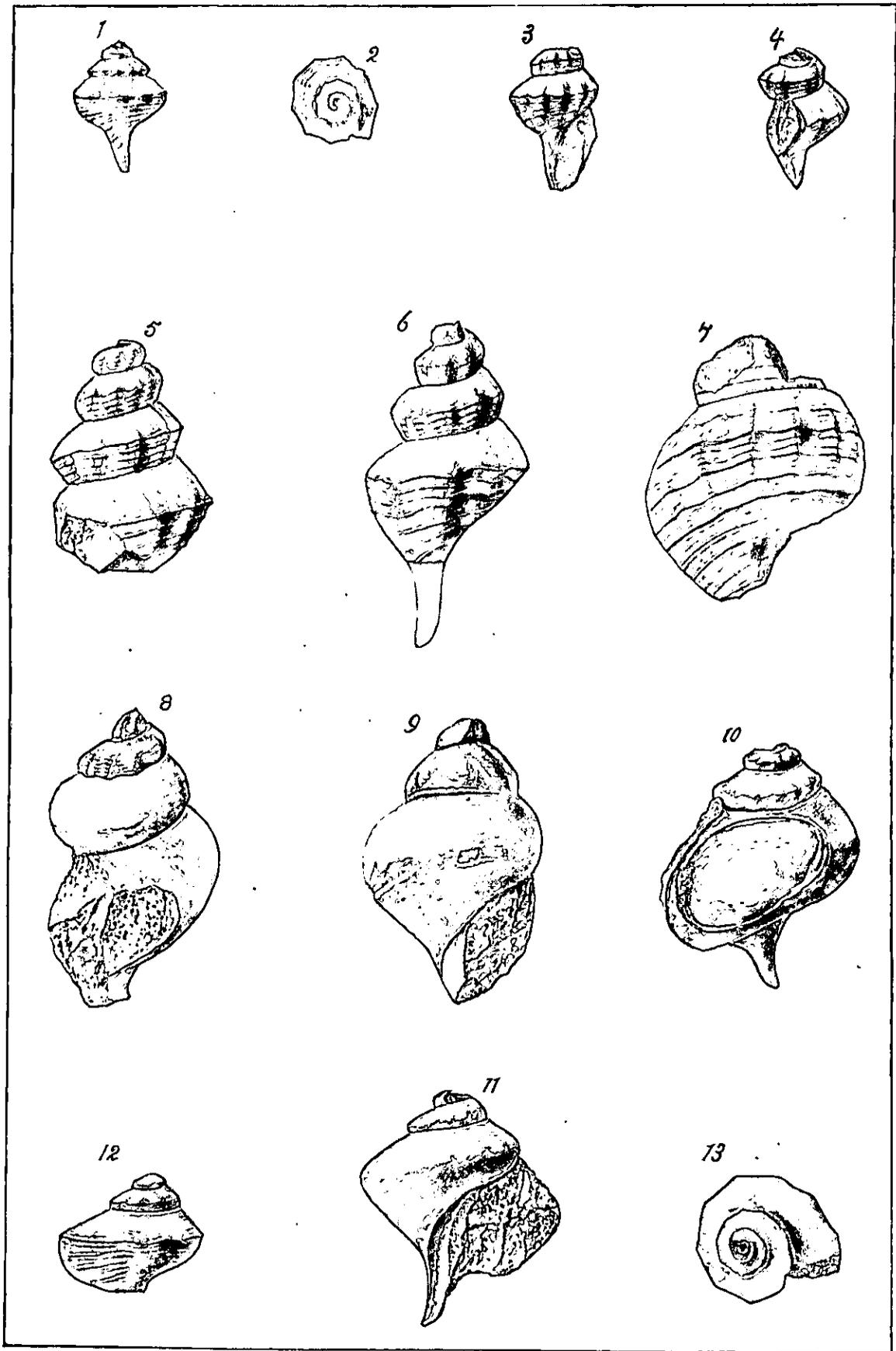
8, 9. Views of the opposite sides of the specimen described.

FUSUS EOCENICUS Whitf. (p. 198).

10, 11. Two views of a large cast retaining the anterior beak, and showing the imprint of an oyster which had attached to the inside of the body volution.

12, 13. Two views of a smaller cast which has lost the beak, but preserves the surface markings.

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FUSIDÆ OF THE EOCENE LAYERS, UPPER BED GREENSAND MARLS.

PLATE XXVI.

EXPLANATION OF PLATE XXVI.

FUSUS PAUCICOSTATUS Whitf. (p. 196).

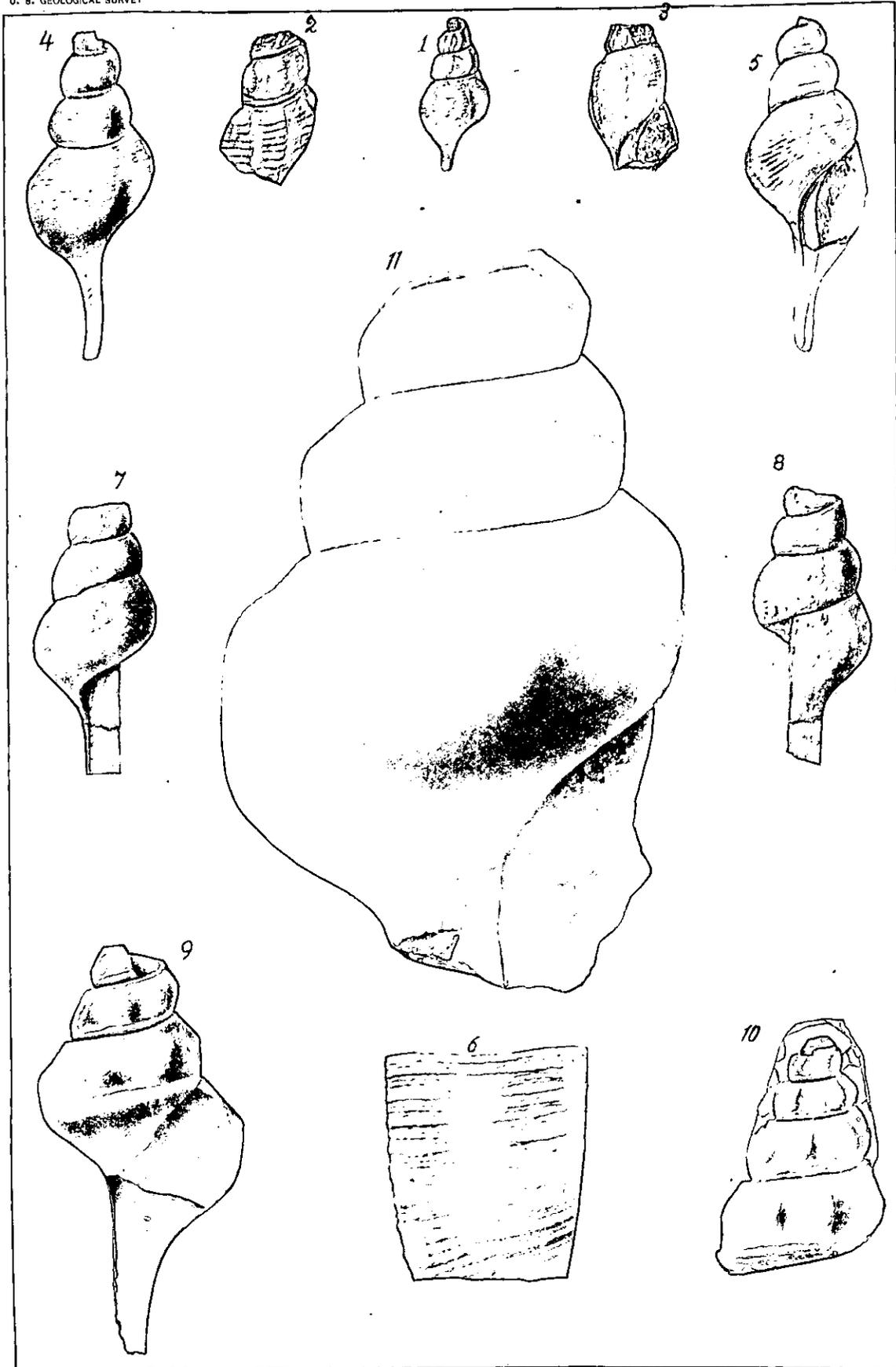
- FIGS. 1. View of a small specimen showing nearly the entire form.
2, 3. Views of the opposite side of a specimen showing some modification in form of the costæ.
4, 5. Views of a large individual retaining the anterior beak entire, but imbedded in the matrix so the opposite side could not be obtained in Fig. 5.
6. Enlargement of the surface from Fig. 4.

CLAVELLA RAPHANOIDES Conrad (p. 201).

- 7, 8. Views of opposite sides of the specimen, the anterior beak preserved only on the matrix.

FASCIOLARIA HERCULES Whitf. (p. 202).

9. View of a young specimen preserving the imprint of the beak in the matrix.
10. Another fragment preserving the upper volutions.
11. View of a large cast showing only slight nodes and the base of the beak, and a groove probably formed by the fold of the columella.



FUSIDÆ AND FASCIOLARIIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXVII.

EXPLANATION OF PLATE XXVII.

FASCIOLARIA HERCULES Whitf. (p. 202).

FIGS. 1, 2. Views of the opposite sides of a large strongly nodose cast. Am. Mus. Nat. Hist., New York City.

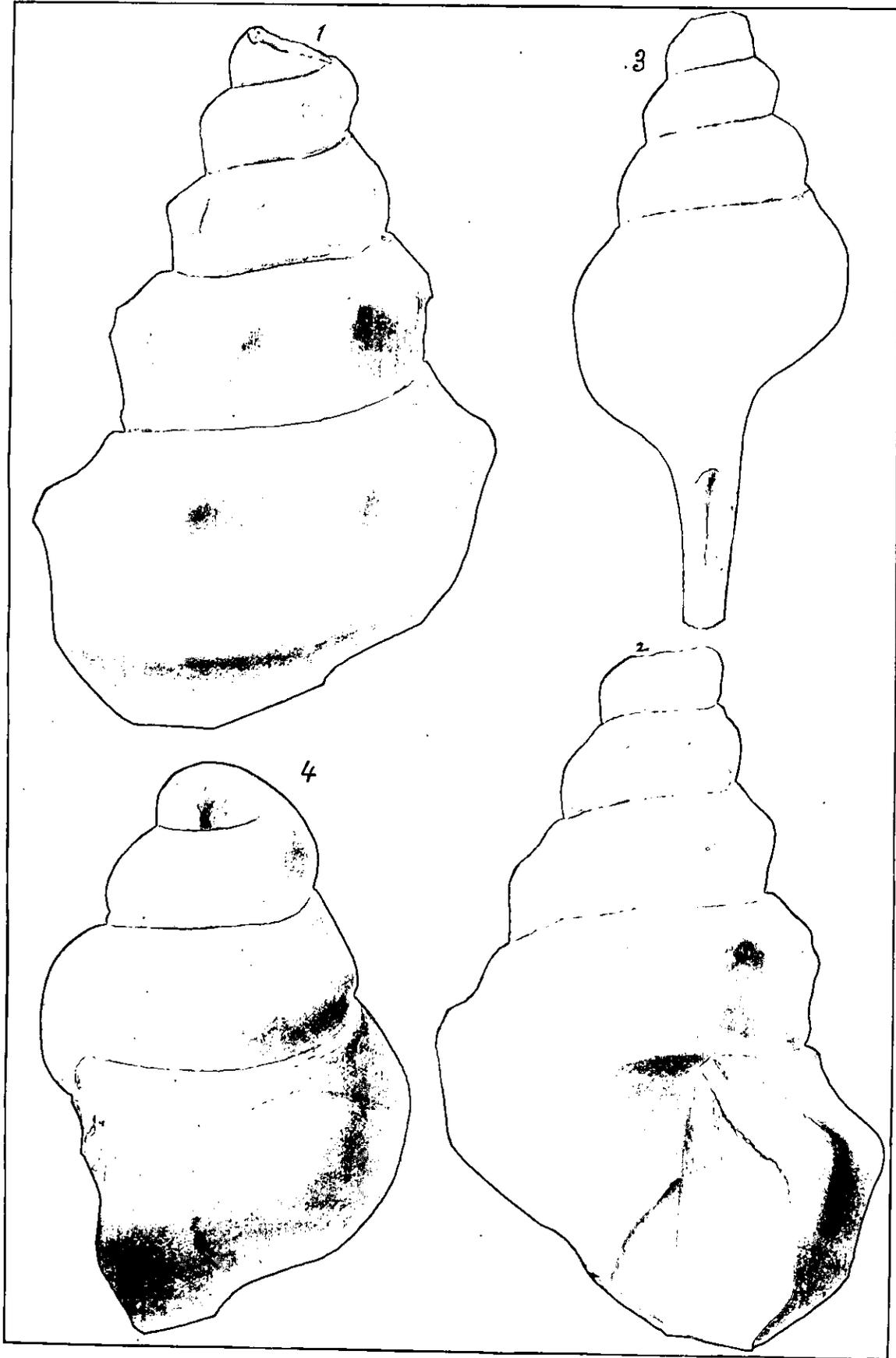
FASCIOLARIA PROPINQUA Whitf. (p. 203).

3. View of a cast preserving nearly the entire form. Collection of the Am. Mus. Nat. Hist., New York City.

FASCIOLARIA SAMSONI Whitf. (p. 204).

4. View of a fragment of a small cast, showing the imprint of an oyster. Am. Mus. Nat. Hist., New York City.

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FASCIOLARIIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXVIII.

MON XVIII—23

EXPLANATION OF PLATE XXVIII.

FASCIOLARIA SAMSONI Whitf. (p. 204).

FIGS. 1, 2. Views of opposite sides of a large cast imperfect at both extremities. The band around the base of the upper volutions probably indicates the thickness of the shell at the sutures.

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FASCIOLARIIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXIX.

EXPLANATION OF PLATE XXIX.

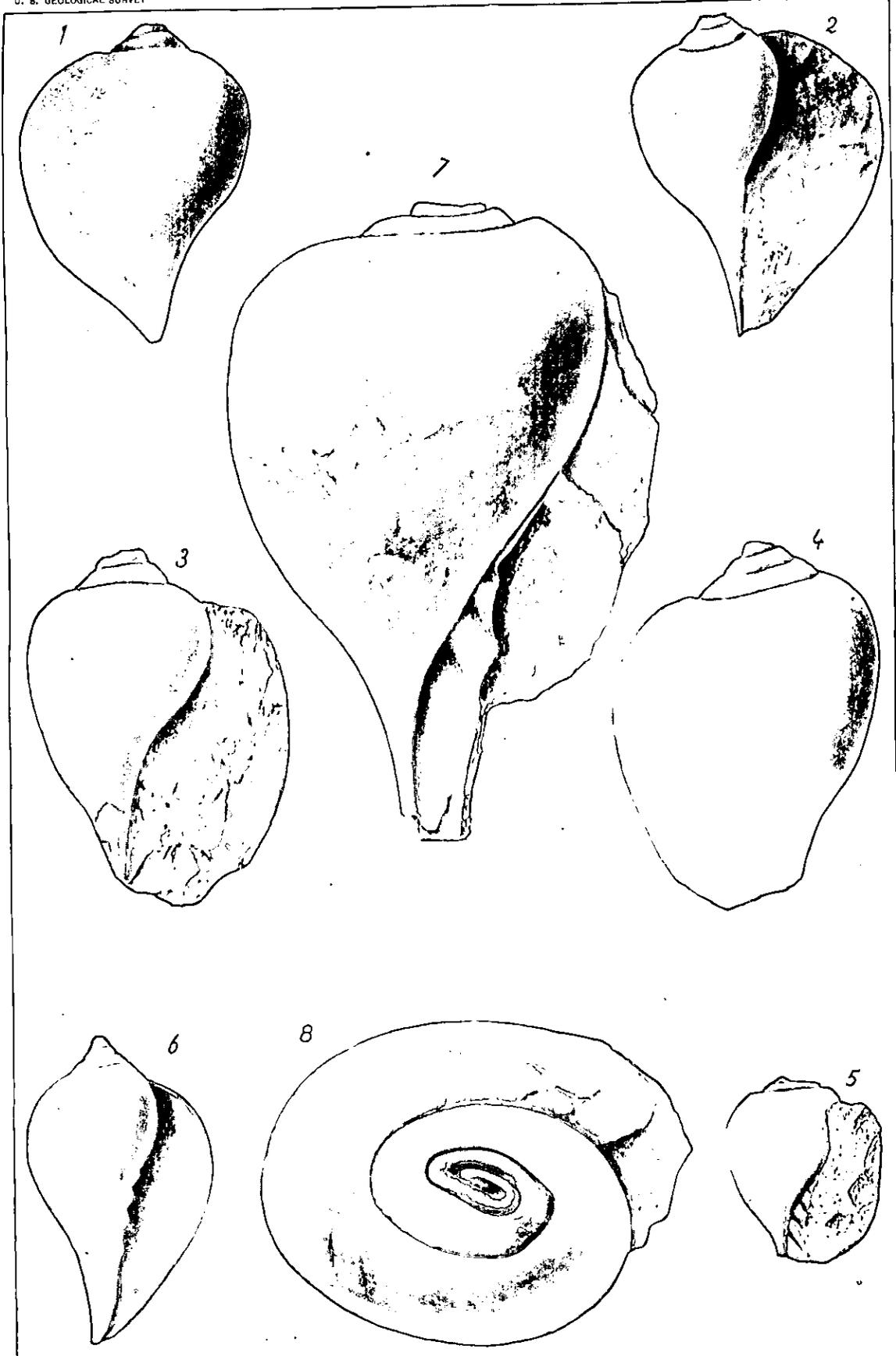
CARICELLA PYRULOIDES Conrad (p. 205).

- FIGS. 1, 2. Two views of specimen of medium size. Collection of Am. Mus. Nat. Hist., New York City.
- 3, 4. Similar views of another specimen, Fig. 3 showing imprints of the columellar folds.
5. View of a small cast from the Am. Mus. Nat. Hist. collection, New York City, showing imprints of columellar folds.
6. View of a shell from Claiborne, Alabama, for comparison. Am. Mus. Nat. Hist., New York City.

CARICELLA PONDEROSA Whitf. (p. 206).

- 7, 8. Lateral view showing columellar folds, and summit view of the specimen described.

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TURBINELLIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXX.

EXPLANATION OF PLATE XXX.

VOLUTA LELIA Whitf. (p. 207).

- FIGS. 1, 2. Two views of a very perfect cast, but slightly distorted from compression.
3. The outer volution of the same specimen lifted to show imprints of columellar folds.

VOLUTA PERELEVATA Whitf. (p. 205).

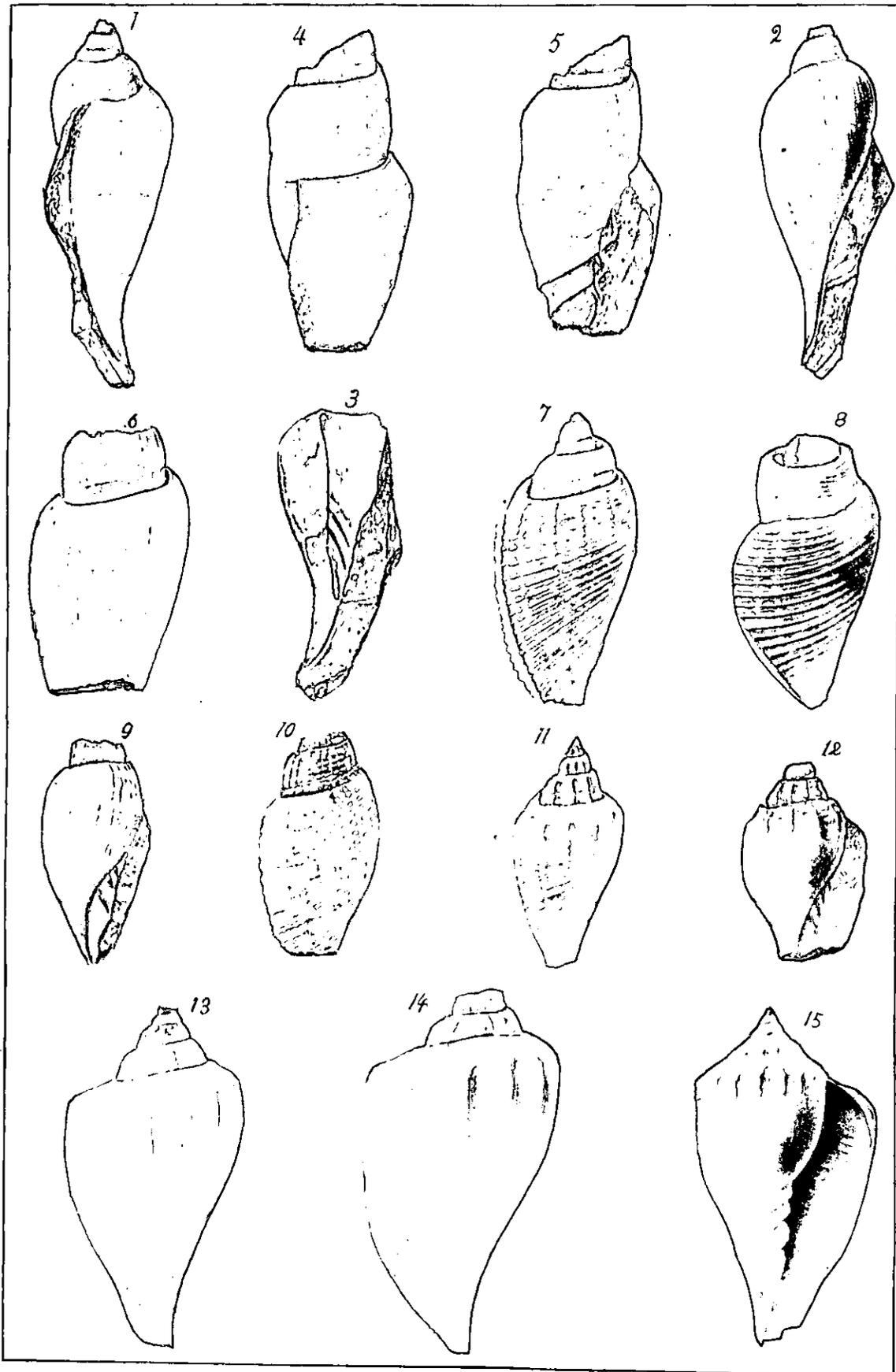
- 4, 5. Two views of a fragment, the latter having the lower part of the last volution removed so as to expose the imprints of columellar folds. Collection Am. Mus. Nat. Hist., New York City.
6. View of another fragment.

VOLUTILITHES CANCELLATUS Whitf. (p. 213).

- 7-10. Views of four different individuals showing the diversity of surface features, Fig. 9 showing columellar folds; this and Fig. 7 are from specimens in Am. Mus. Nat. Hist., New York City.

VOLUTILITHES SAYANA Courad (p. 212).

- 11-14. Views of four specimens showing diversity of form and surface. Figs. 11, 12 are from the collection Am. Mus. Nat. Hist., New York City, the latter showing columellar folds.
15. View of a specimen from Claiborne, Alabama, showing a medium of features. Am. Mus. Nat. Hist., New York City.



VOLUTIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXI.

EXPLANATION OF PLATE XXXI.

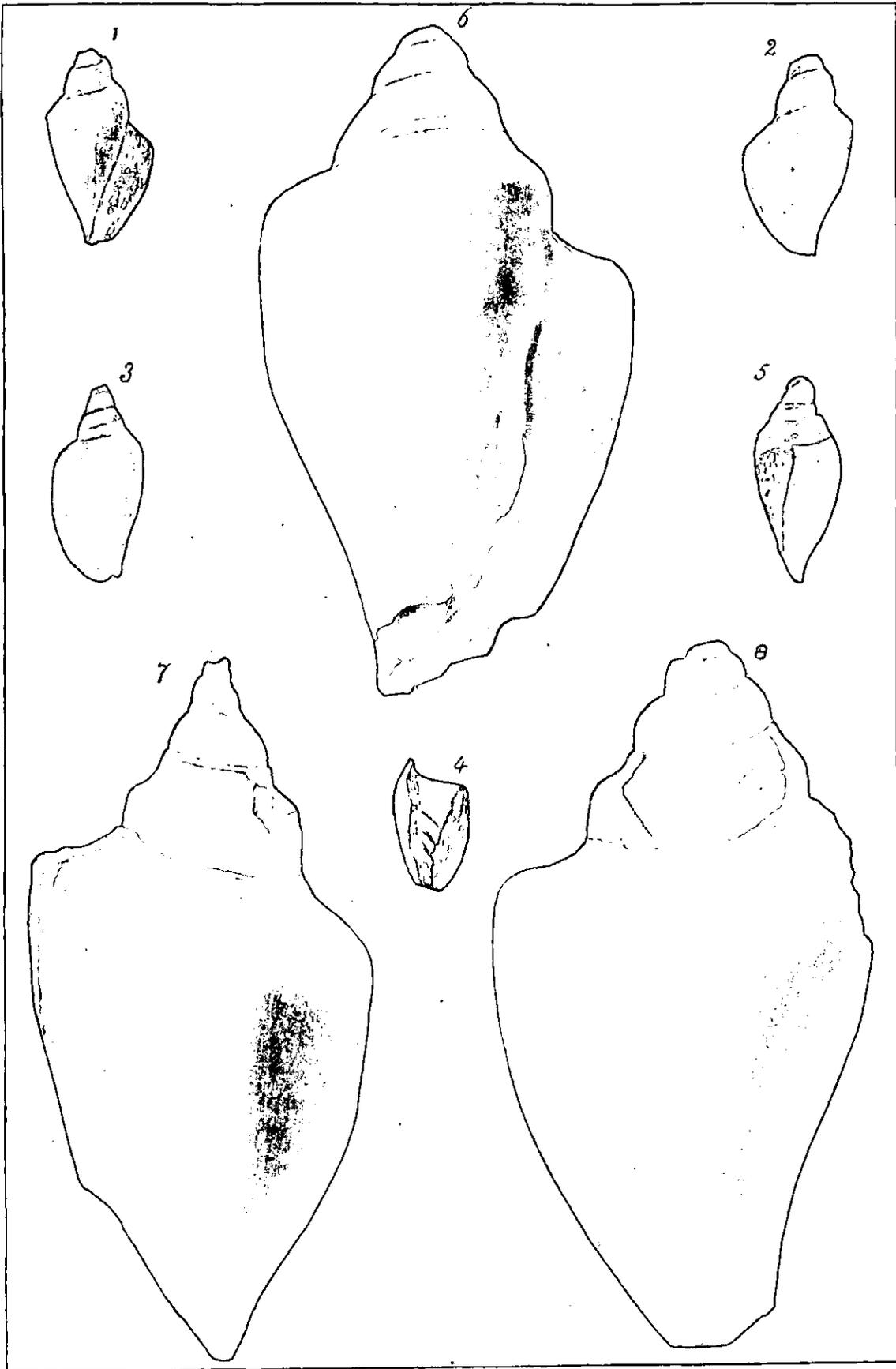
VOLUTA PARVULA Whitf. (p. 208).

- Figs. 1, 2. Two views of a very broad specimen.
3. View of a narrower specimen.
4. The outer half of the last volution removed to show the columellar folds.
5. View of a specimen doubtfully referred to this species, and showing a mammillated apex.
Am. Mus. Nat. Hist.

VOLUTA SCAPHOIDES Whitf. (p. 209).

- 6-8. Three views of a cast of this species, Fig. 6 having a part removed to show the columellar folds. Am. Mus. Nat. Hist.

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VOLUTIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXII.

EXPLANATION OF PLATE XXXII.

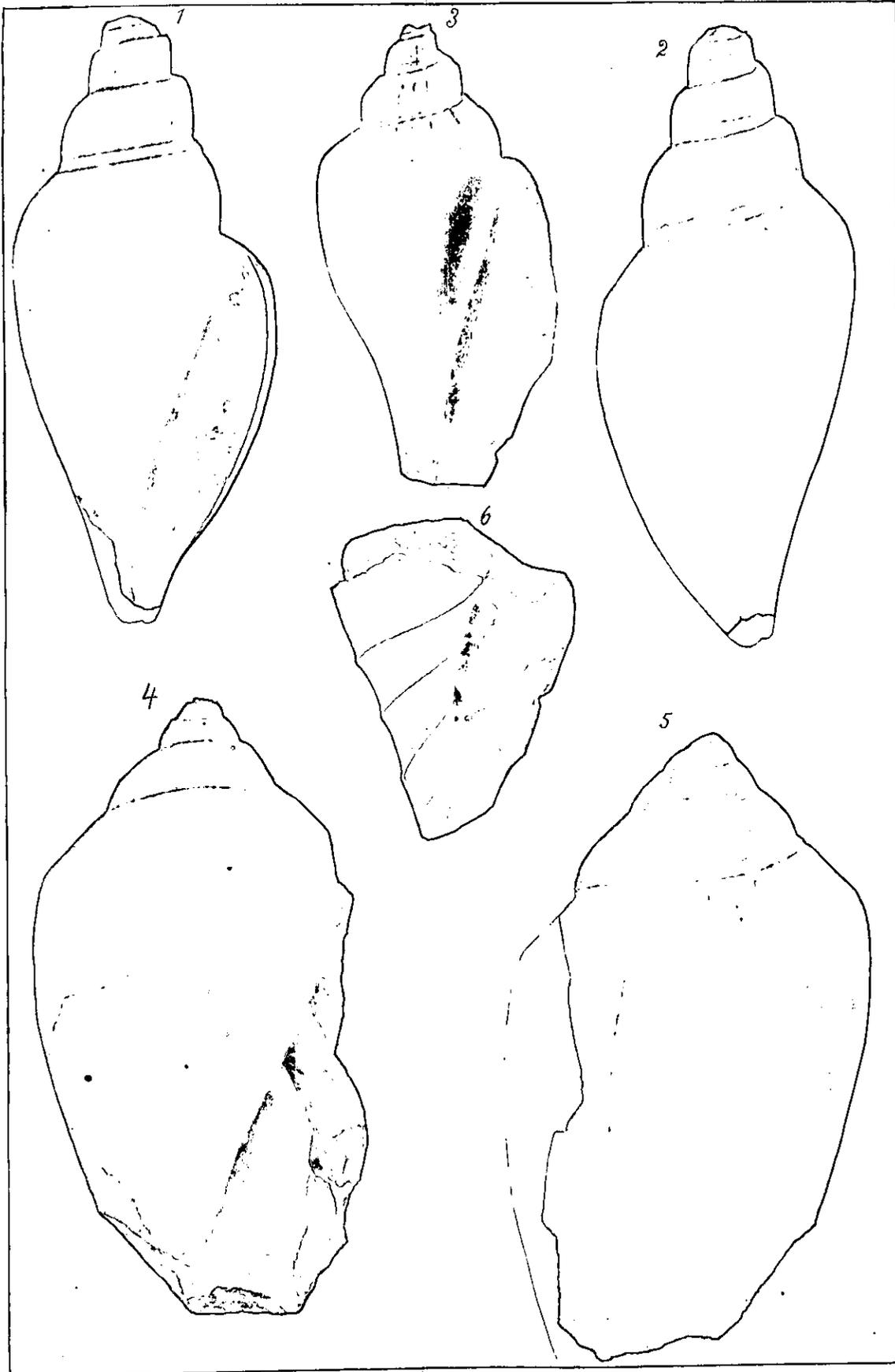
VOLUTA NEWCOMBIANA Whitf. (p. 211).

- FIGS. 1, 2. Two views of a specimen of the ordinary form.
3. View of a shorter spired form showing cavities of the columellar folds. These are from the collection Am. Mus. Nat. Hist.

VOLUTA VESTA Whitf. (p. 210).

- 4, 5. Two views of an imperfect cast.
6. Represents the lower part of specimen shown by the faint line on Fig. 4, removed to show the folds on its lower surface. Am. Mus. Nat. Hist.

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VOLUTIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXIII.

EXPLANATION OF PLATE XXXIII.

CANCELLARIA RUDIS Whitf. (p. 214).

FIGS. 1, 2. Opposite sides of the cast showing the features described.

PLEUROTOMA SURCULTIFORMIS Whitf. (p. 215).

- 3. View of a specimen of the ordinary form.
- 4. View of a larger and more robust specimen.

SURCULA PEROBESA Whitf. (p. 217).

5, 6. Opposite sides of the best specimens observed.

PLEUROTOMA REGULARICOSTATA Whitf. (p. 215).

7-9. Views of three casts referred to the species. The last, showing no plicæ on the last volution, is from the collection Am. Mus. Nat. Hist., New York City.

PLEUROTOMA (SURCULA) ALTISPIRA Whitf. (p. 216).

- 10, 11. Opposite sides of the same cast. Am. Mus. Nat. Hist., New York City.
- 12. View of a fragment showing the striae more strongly.
- 13. View of another specimen doubtfully of this species.

SURCULITES ANNOSUS Conrad (p. 218).

14. View of the back of the specimen upon which Mr. Conrad founded his species and genus.

SURCULITES CADAVEROSUS Whitf. (p. 219).

15, 16. View of the opposite sides of a characteristic form of this species.

SURCULITES CURTUS Whitf. (p. 220).

17, 18. Two views of an imperfect cast.

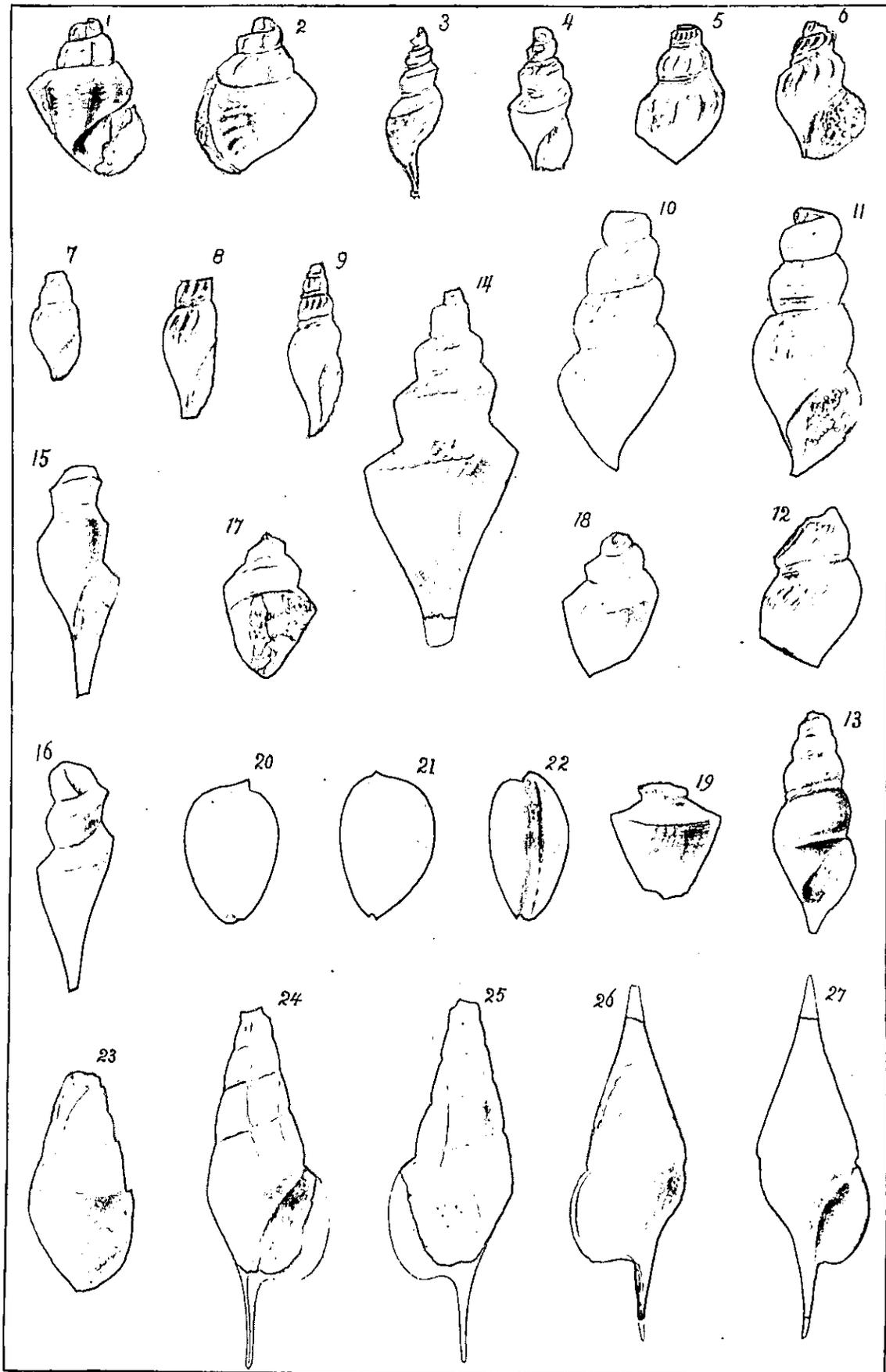
19. View of the larger whorl of a specimen showing the difference in size of the next one above as compared with that of *S. annosa*.

CYPRÆA SABULOVIRIDIS Whitf. (p. 223).

20-22. Three views of the same cast, the latter view showing the aperture and its crenulations.

CALYPTROPHORUS VELATUS Conrad (p. 222).

- 23. View of a cast showing the direction and cicatrix of the posterior canal.
- 24, 25. Two views of another cast showing some of the same features and the vertical folds on the apical volutions.
- 26, 27. Two views of a specimen from Claiborne, Alabama, for comparison. Collection Am. Mus. Nat. Hist., New York City.



CANCELLARIIDÆ, PLEUROTOMIDÆ, STROMBIDÆ, AND CYPRÆIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXIV.

EXPLANATION OF PLATE XXXIV.

NATICA GLOBULELLA Whitf. (p. 226).

- FIGS. 1, 2. Upper and lower views of a distorted specimen.
3, 4. Similar views of another and differently compressed example. Am. Mus. Nat. Hist.,
New York City.

FICUS PENITUS Conrad. † (p. 225).

5. View of the best specimen observed.

XENOPHORA LAPIFERENS Whitf. (p. 227).

6. Upper view of a cast, showing the scars left by the attached stones.
7. Imprint in gutta-percha from a matrix, showing surface striae and adhering stones and
remaining scars.
8, 9. Lateral and lower view of another cast; this is from the collection Am. Mus. Nat. Hist.,
New York City.

SCALARIA TENUILIRATA Whitf. (p. 229).

10. View of the exterior as obtained by gutta-percha from the matrix of a specimen in the
Am. Mus. Nat. Hist., New York City.
11. Internal cast of the same individual.
12. Enlargement of the surface from the body volution.

MESALIA ELONGATA Whitf. (p. 230).

- 13-15. Views of three individuals, Fig. 13 from gutta-percha.

CONUS SUBSAURIDENS Conrad (p. 221).

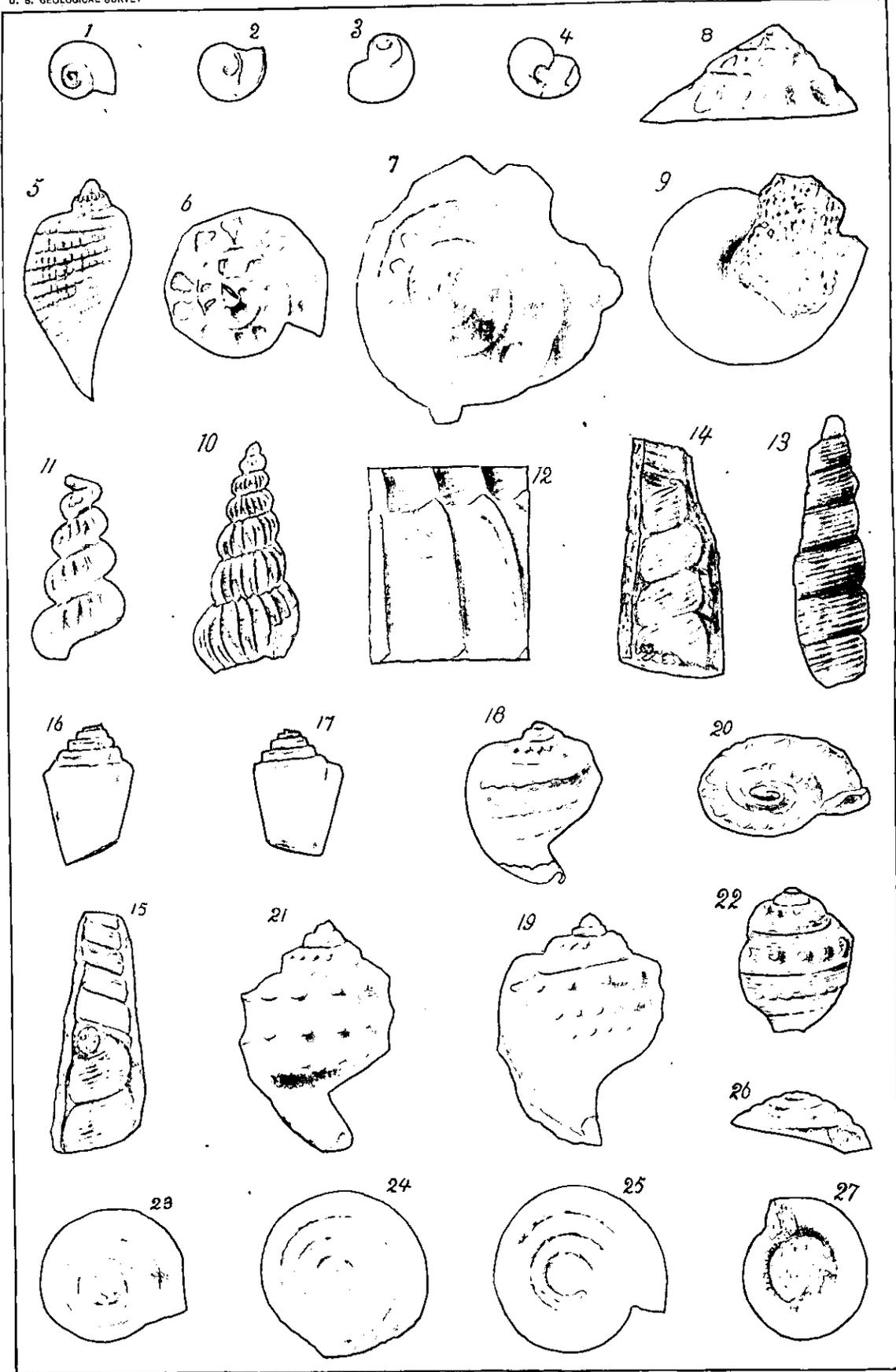
- 16, 17. Views of the opposite sides of the best specimen seen.

CASSIDARIA CARINATA Lam. † (p. 224).

- 18-21. Views of different specimens showing variation of surface. Specimens 19 and 20, Am. Mus.
Nat. Hist., New York City.
22. Views of a fragment showing extreme variation of surface characters. Possibly a distinct
species.

ARCHITECTONICA ANNOSA Conrad (p. 228).

- 23-27. Views of three separate casts, the smaller one, Figs. 23, 26, 27, showing surface striae, and
plications around the edges of the umbilicus. Am. Mus. Nat. Hist., New York City.
Fig. 24 is from Mr. Conrad's type.



CONIDÆ, CASSIDIDÆ, DOLIIDÆ, NATICIDÆ, ONUSTIDÆ, SOLARIIDÆ, SCALARIIDÆ, AND TURRITELLIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXV.

EXPLANATION OF PLATE XXXV.

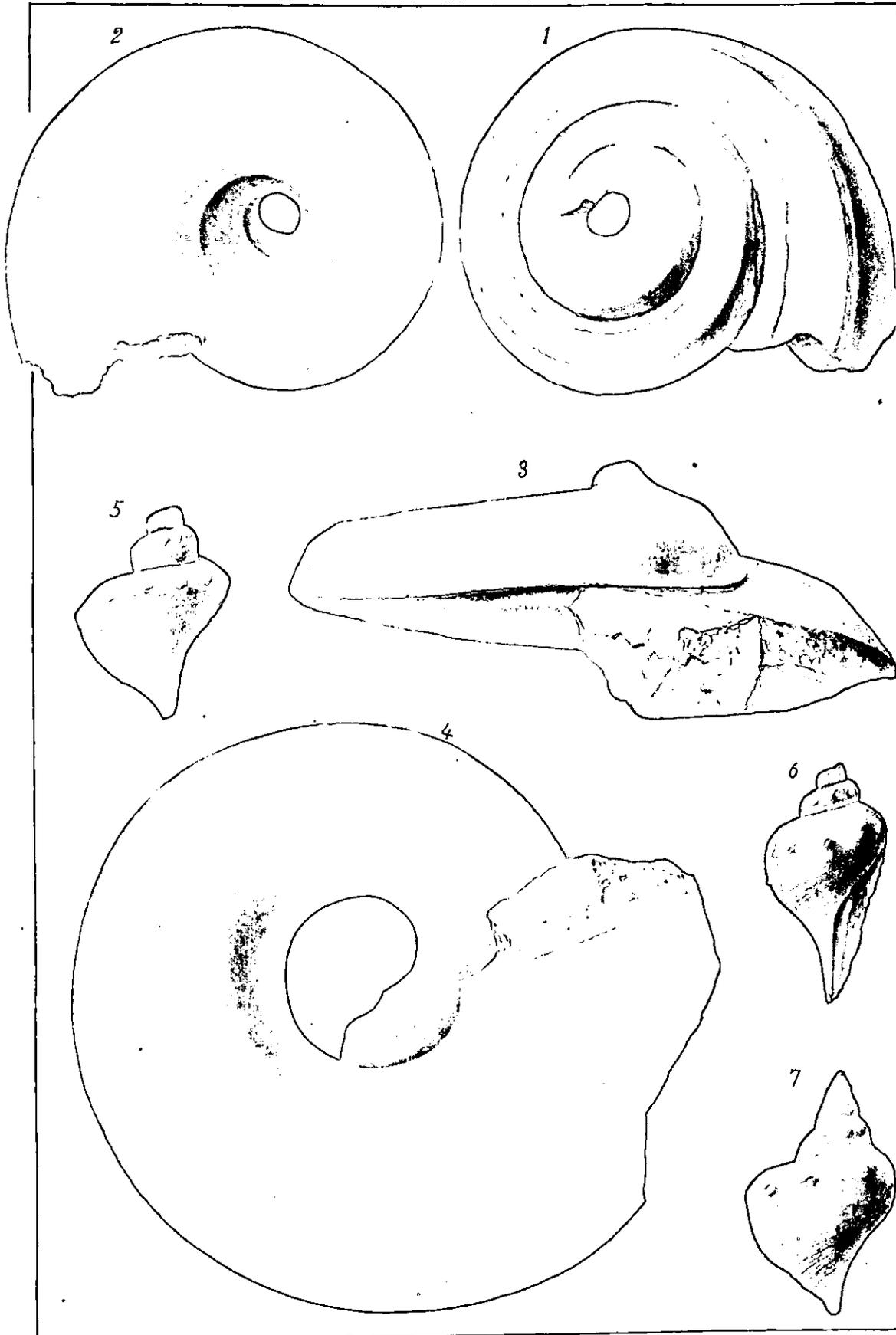
LEPTOMARIA † PERLATA Con. (p. 232).

- Figs. 1, 2. Summit and basal views of a small specimen showing the apertural slit along the angulation. Am. Mus. Nat. Hist., New York City.
3, 4. Lateral and basal views of Conrad's type specimen.

TREMATOFUSUS VENUSTUS Whitf. (p. 235).

- 5, 6. Views of two individuals differing in the height of spire and angulation of body volution,
7. View of another specimen as obtained by gutta-percha from the matrix.

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PLEUROTOMARIIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XXXVI.

MON XVIII—24

EXPLANATION OF PLATE XXXVI.

LEPTOMARIA GIGANTEA Whitf. (p. 233).

- 1, 2. Lateral and basal views of the type specimen.

LEPTOMARIA PERGRANULOSA Whitf. (p. 234).

- 3, 4. Vertical and lateral views obtained by gutta-percha in the matrix.
5. Enlargement of the surface of a part of Fig. 3.
6. Basal view of a part of the cast of the same individual. Am. Mus. Nat. Hist., New York City.

ACTÆON PRISCA Conrad (p. 237).

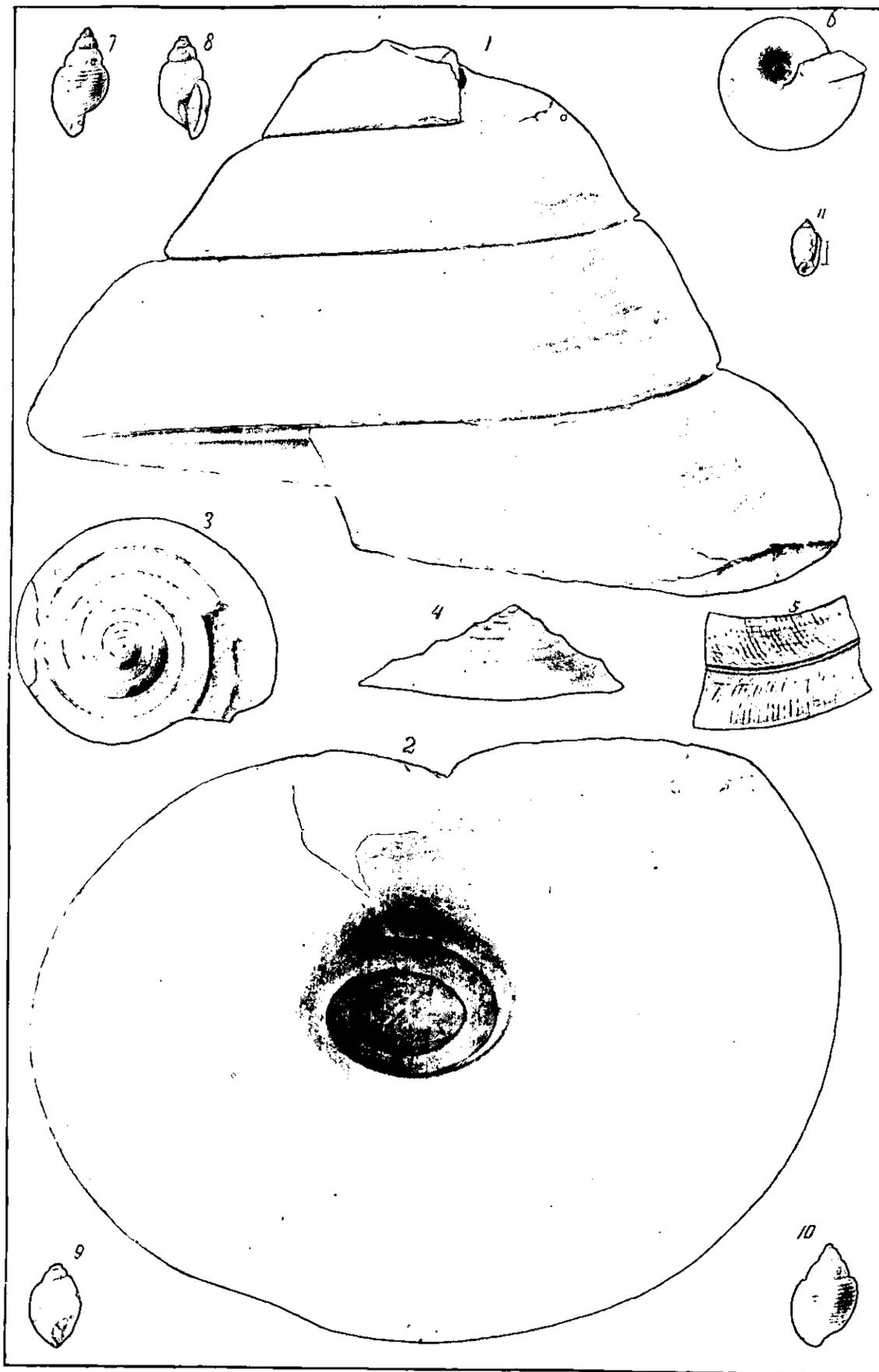
- 7, 8. Two views of Conrad's type specimen.

TORNATELLÆA LATA Conrad (p. 238).

- 9, 10. Views of two individual casts of this species.

TORNATINA WETHERELLI Lea (p. 239).

11. This is a copy of Mr. Lea's figure cited under the description.



PLEUROTOMARIIDÆ AND TORNATELLIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

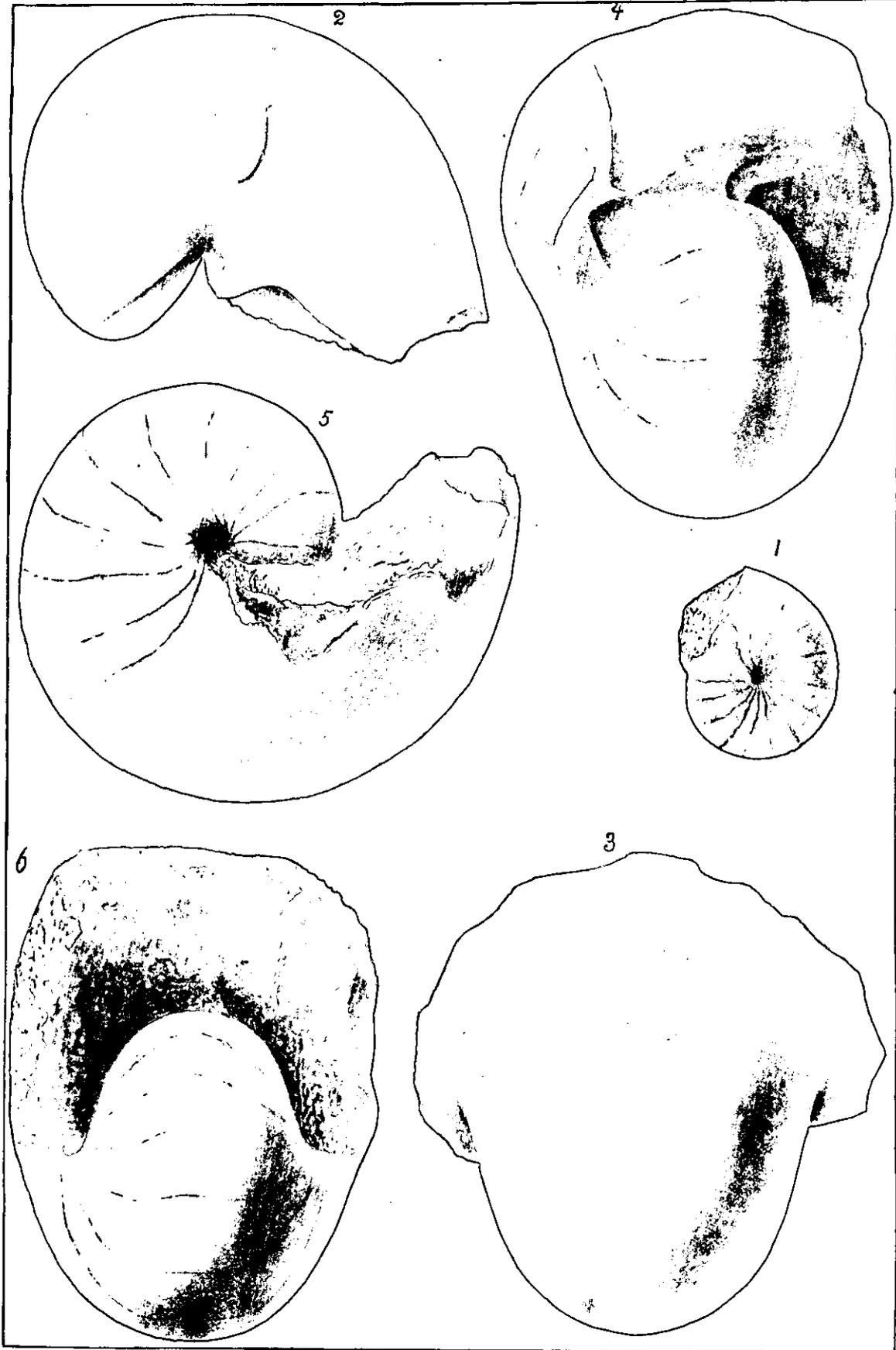
PLATE XXXVII.

EXPLANATION OF PLATE XXXVII.

NAUTILUS DEKAYI Morton (p. 243).

- FIGS. 1. View of a small specimen from Marlboro, New Jersey.
2, 3. Lateral and back view of the specimen figured by Dr. Morton. Acad. Nat. Sciences, Philadelphia.
4. View of another specimen from the Academy's collection.
5, 6. Two views of a specimen loaned by G. F. Kunz, obtained near Hillsboro, New Jersey.

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NAUTILIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE XXXVIII.

EXPLANATION OF PLATE XXXVIII.

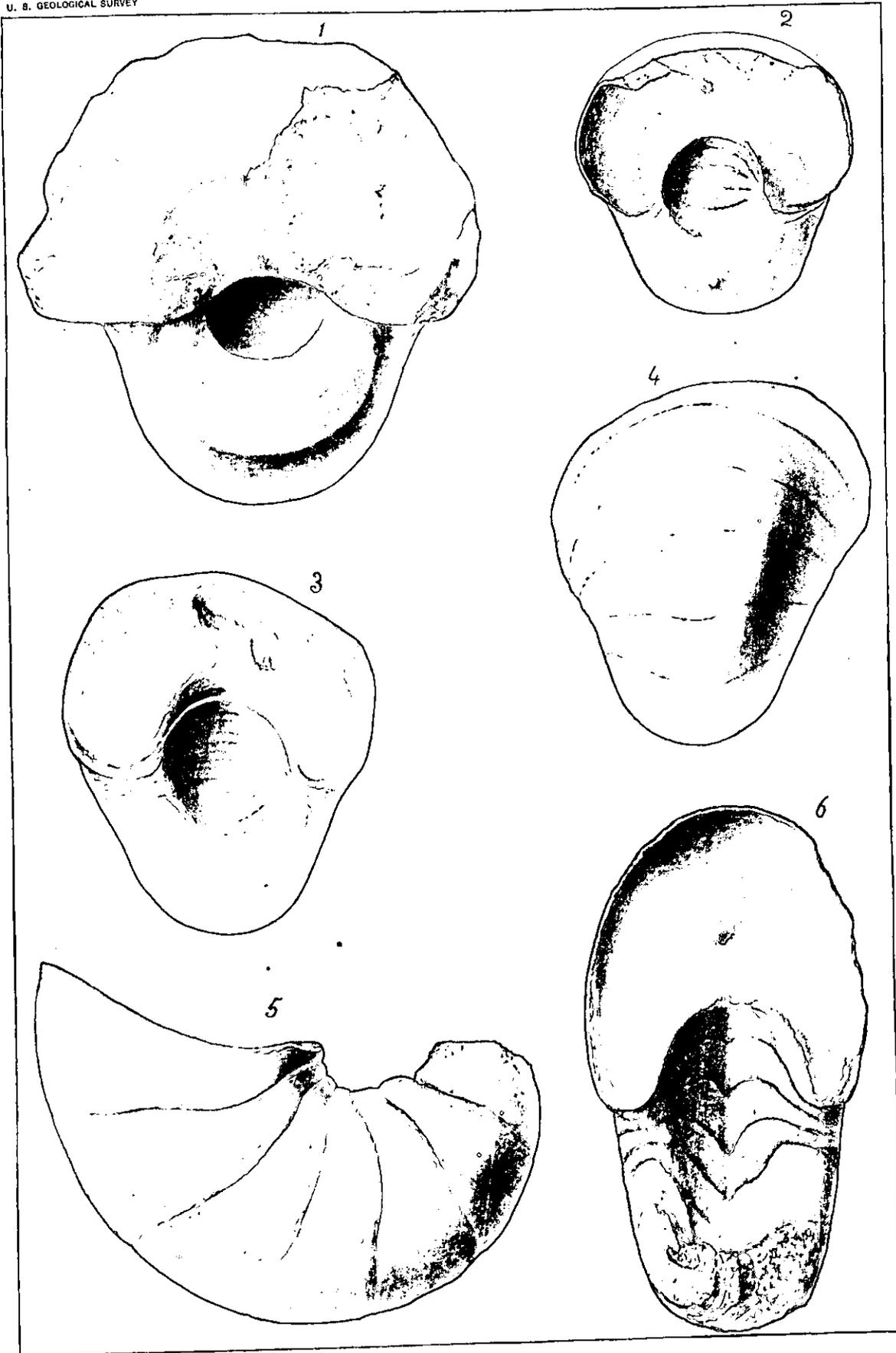
NAUTILUS DEKAYI Morton (p. 243).

- Figs.**
1. View of the aperture side of the cast figured by Dr. Morton (see Pl. xxxvii, Figs. 2 and 3).
 2. View of a small imperfect cast, showing the siphon and the convexity of the septa. Near Marlboro, New Jersey.
 - 3, 4. Two views of a small specimen from the Middle Marls at J. S. Cook's pits, near Tinton, New Jersey. This differs slightly in shape and in the distance between the septa and may possibly prove a distinct species.

NAUTILUS BRYANI Gabb (p. 244).

- 5, 6. Lateral view and view of the inside of Mr. Gabb's type, showing the narrow form and flattened sides. From the yellow sands of the Middle Marls at Vincentown, New Jersey.

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NAUTILIDÆ OF THE LOWER AND MIDDLE BEDS GREENSAND MARLS.

PLATE XXXIX.

EXPLANATION OF PLATE XXXIX.

HERCOGLOSSA FAUCIFEX Cope (p. 246).

- FIG. 1. Lateral view, natural size, of the only specimen which I have seen. It is so worn and mutilated that no other view could be given. Middle Marls.

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NAUTILIDÆ OF THE MIDDLE BED GREENSAND MARLS.

PLATE XL.

EXPLANATION OF PLATE XL.

AMMONITES (PLACENTACERAS) PLACENTA, De Kay (p. 255).

FIG. 1. Lateral view of a large specimen, which shows the septa throughout. Acad. Nat. Sci., Phila.

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AMMONITIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE XLI.

EXPLANATION OF PLATE XLI.

AMMONITES (PLACENTACERAS) PLACENTA, De Kay (p. 255).

- FIGS.** 1. Outline of a septum, natural size, from near the outer part of the specimen figured on Pl. XI, but from the opposite side.
2. View of a small specimen from near Freshhold, showing the umbilicus and the lines of nodes at its outer margin.

AMMONITES DENTATO-CARINATUS Roem. (p. 250).

- 3, 4. Two views of the only fragment of the species known from New Jersey. Acad. Nat. Sci., Phila.

AMMONITES COMPLEXUS Hall & Meek (p. 249).

- 5, 6. Lateral and dorsal views of the only fragment seen from within the State. Acad. Nat. Sci., Phila.
7. Diagram of a septum as far as it can be traced.

AMMONITES (SPHENODISCUS) LENTICULARIS Owen (p. 258).

8. View of a fragment from near the umbilicus, representing parts of several chambers of a rather large specimen.
9. View of another fragment from near the dorsal margin of a large specimen. These two are all I have seen of the species from New Jersey.

AMMONITES (PLACENTACERAS) TILIFER Morton (p. 257).

10. View of the fragment figured by Dr. Morton in his Synopsis.
11. View of a larger fragment, also from Dr. Morton's collection, showing the dorsal line.

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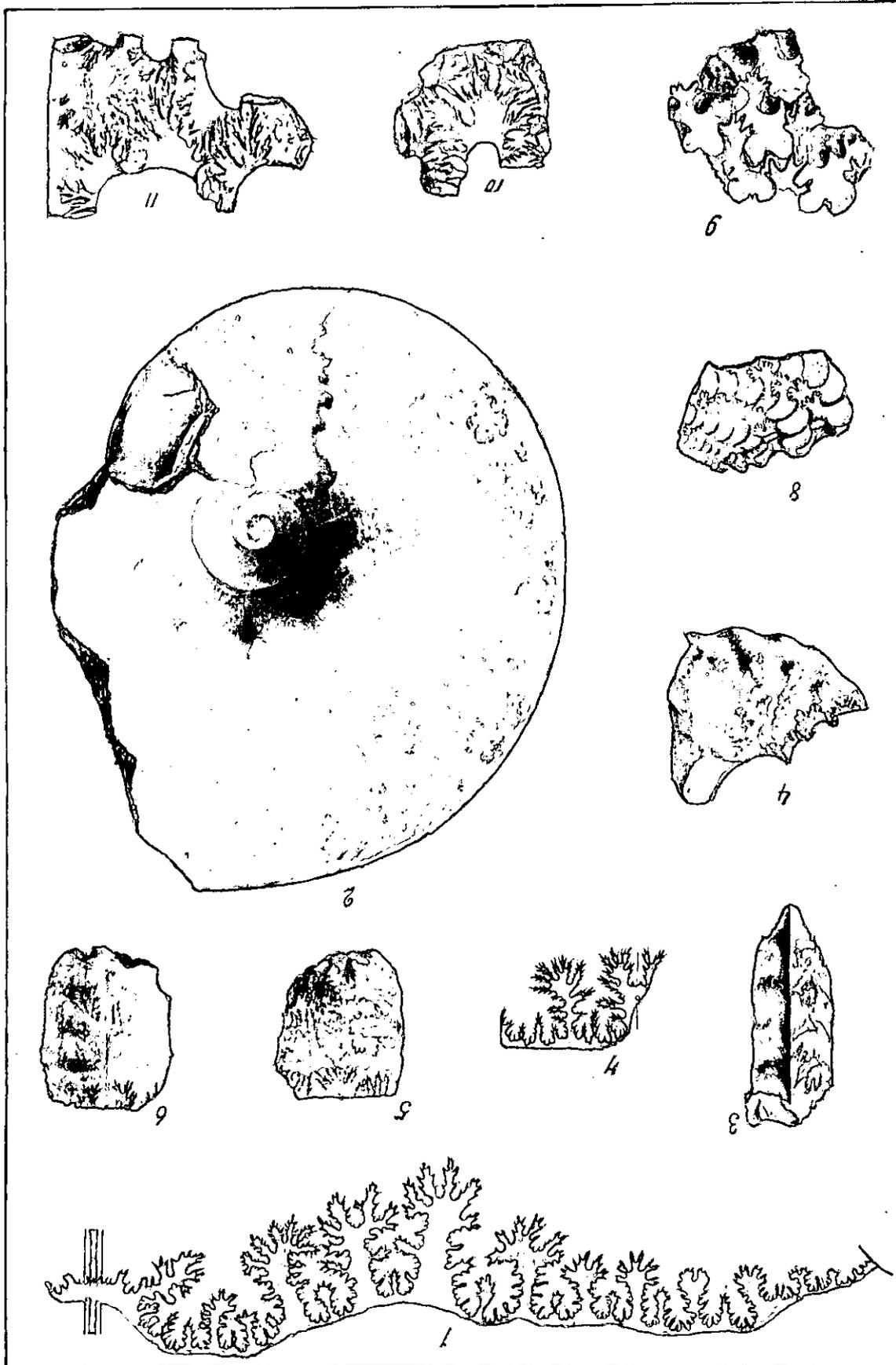


PLATE XLII.

EXPLANATION OF PLATE XLII.

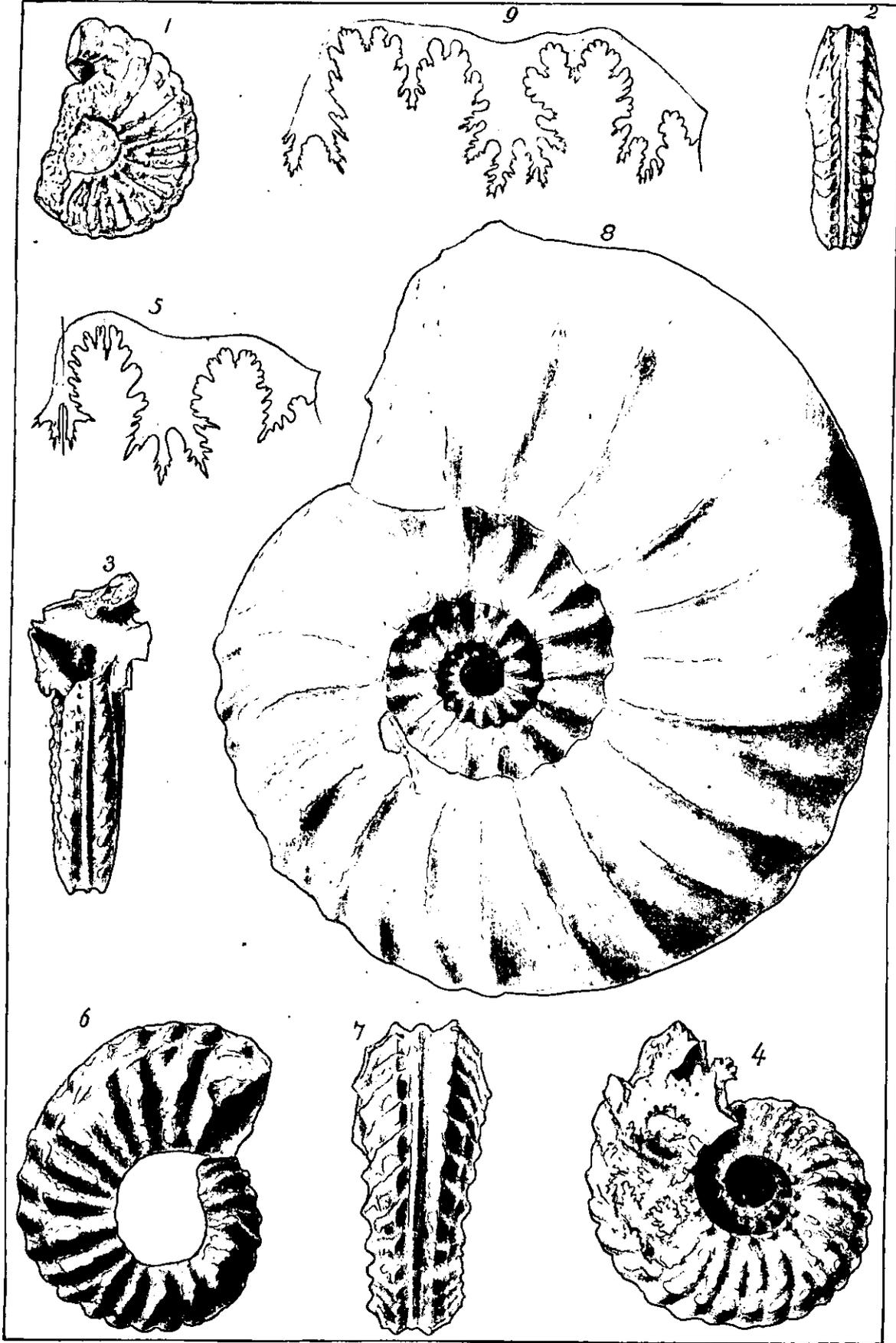
AMMONITES VANUXEMI Morton (p. 253).

- Figs.** 1, 2. Lateral and dorsal views of Dr. Morton's type.
3, 4. Profile and lateral views of a larger specimen from the collection of the Am. Mus. Nat. History.
5. An enlarged outline (2x) of a septum from the outer portion of the last specimen.

AMMONITES DELAWARENSIS Morton (p. 252).

- 6, 7. Lateral and dorsal views of a small specimen, showing the narrow volution in strong contrast with Fig. 4.
8. Lateral view of a larger specimen. Both are from the Acad. Nat. Sciences collection.
9. Diagram, natural size, of the species from the specimen figured on Pl. XLIII, and showing strong contrast with Fig. 5.

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AMMONITIDÆ OF THE LOWER BED GREENSAND MARLS.

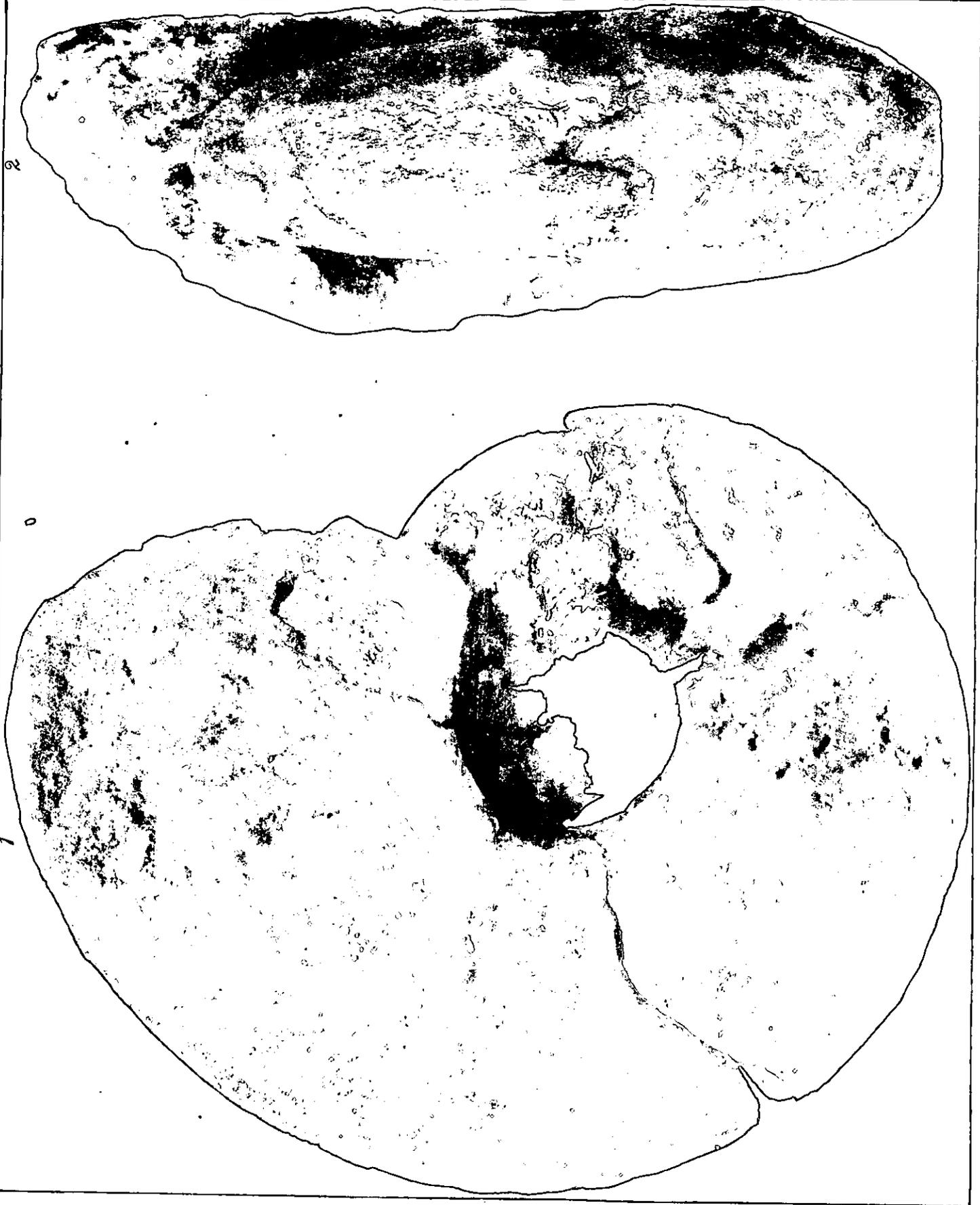
PLATE XLIII.

EXPLANATION OF PLATE XLIII.

AMMONITES DELAWARENSIS Morton (p. 252).

Figs. 1, 2. Lateral and profile views of a large specimen from the collection of the Acad. Nat. Sci., Phila. The diagram of a septum, Fig 9 on Pl. XLIII, is from the outer part of this specimen.

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AMMONITIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE XLIV.

MON XVIII—25

EXPLANATION OF PLATE XLIV.

SCAPHITES SIMILIS Whif. (p. 267).

- FIGS. 1. Lateral view of the specimen described.
2. Diagram of a septum, twice enlarged. Acad. Nat. Sci., Phila.

SCAPHITES RENIFORMIS Morton (p. 264).

3. A reproduction of Dr. Morton's figure, no authentic specimen having been seen.

SCAPHITES IRIS Conrad (p. 265).

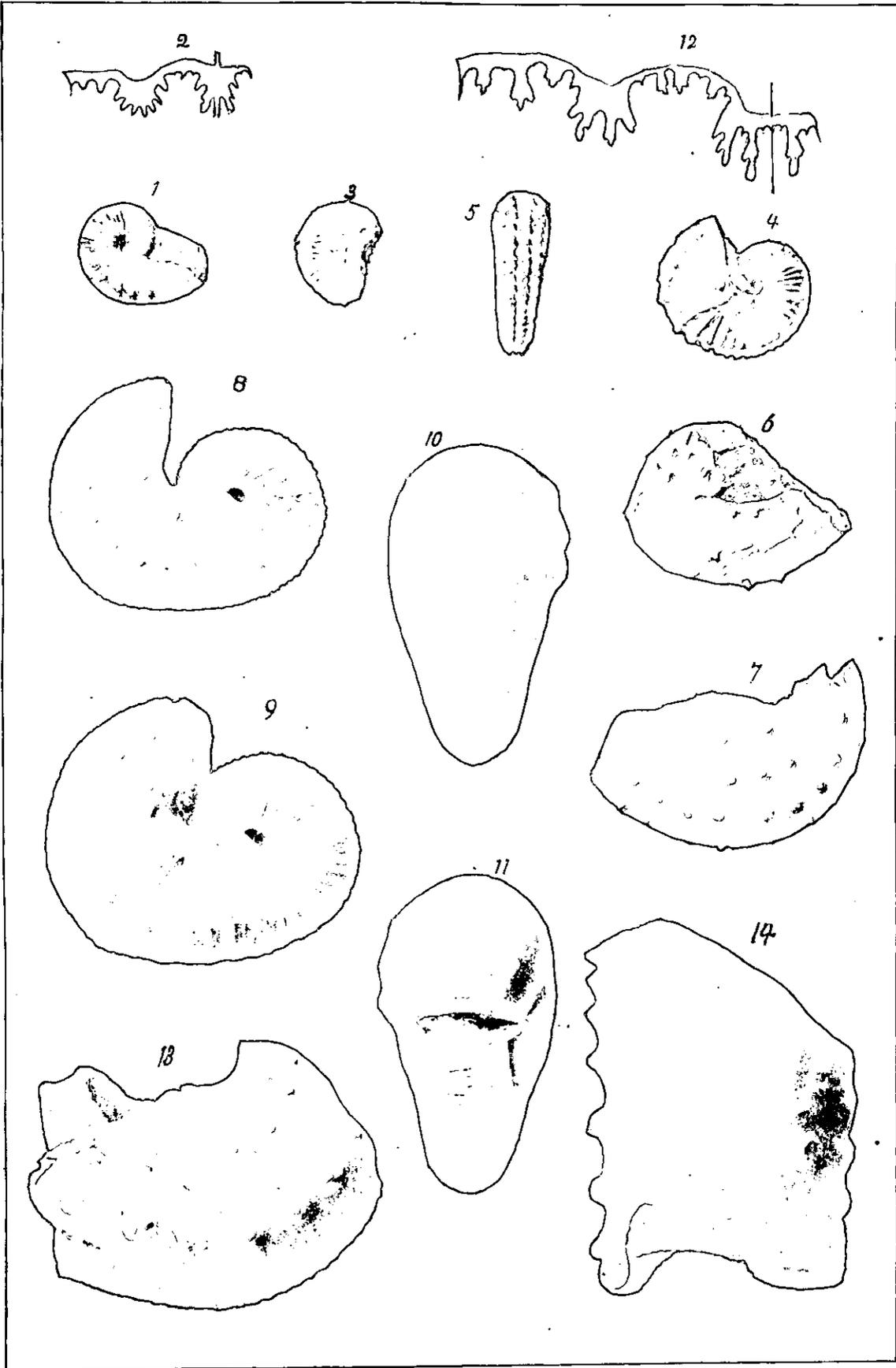
- 4,5. Dorsal and lateral views of one of Mr. Conrad's types.
6. Lateral view of the specimen originally figured by Mr. Conrad.
7. View of an outer chamber, also one of his types. Acad. Nat. Sci., Phila.

SCAPHITES HIPPOCREPIS De Kay (p. 261).

8. Lateral view of the specimen originally figured by Dr. Morton.
9-11. Lateral, dorsal, and vertical views of a larger specimen, both being in the Acad. Nat. Sci. collection.
12. Diagram of a septum, twice enlarged, from the last.

SCAPHITES NODOSUS Owen (p. 261).

- 13,14. Lateral and dorsal views of a fragment of an outer chamber referred to this species. Rutgers College.



AMMONITIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE XLV.

EXPLANATION OF PLATE XLV.

TURRILITES PAUPER Whitf. (p. 268).

- FIGS.** 1, 2. Views of the opposite sides of the specimen described.
3, 4. Upper and lower views of the same specimen.
5. Diagram of a septum, twice enlarged. This was accidentally shaded below instead of above the line as is done in case of other diagrams.

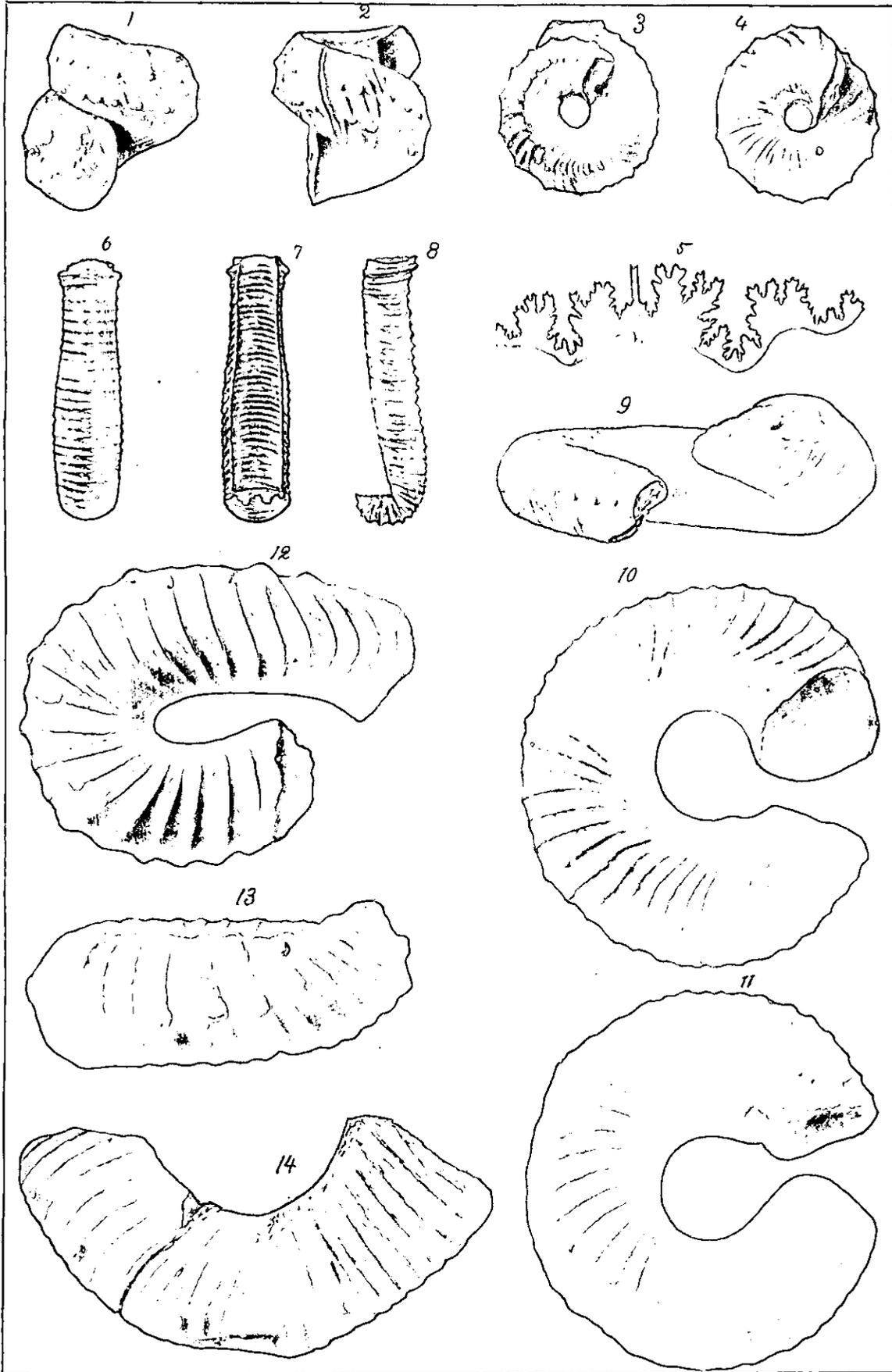
PTYCHOCERAS (SOLENO CERAS) ANNULIFER Morton (p. 273).

- 6, 7, 8. Dorsal, ventral, and lateral views, twice enlarged, of the specimen used by Dr. Morton in the original description. Acad. Nat. Sci., Phila.

HETEROCOCERAS CONRADI Morton (p. 269).

- 9, 10, 11. Profile, upper and lower views of Dr. Morton's type. Acad. Nat. Sci., Phila.
12, 13. Lower and profile views of another specimen, being the deflected outer chamber only, the elevated end showing evidences of the last septum. This is from the Atlantic Highlands of New Jersey, and is from Columbia College collection.
14. A fragment of another outer chamber from the Acad. Nat. Sci., Phila.

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AMMONITIDÆ OF THE LOWER BED GREENSAND MARLS.

PLATE XLVI.

EXPLANATION OF PLATE XLVI.

BACULITES COMPRESSUS (Say) Morton (p. 277).

- FIGS. 1. Lateral view of the specimen used and figured by Dr. Morton in his synopsis. The diagram below shows the form of the section. Acad. Nat. Sci., Phila.
2. Diagram of a septum of the above specimen (2 x).

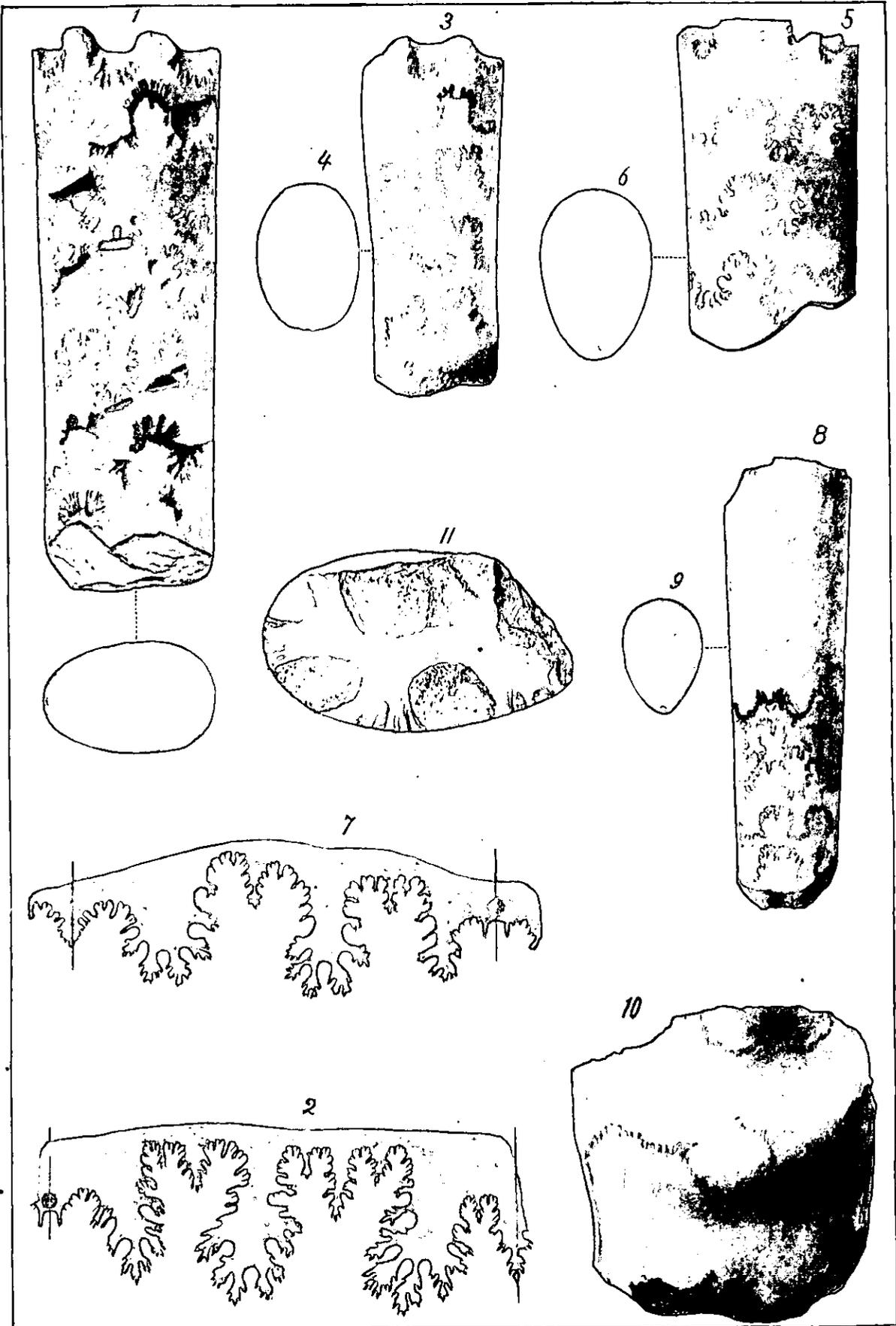
BACULITES OVATUS Say (p. 275)

- 3, 4. Lateral view of the Mullica Hill specimen in the collection of the Am. Mus. Nat. History, New York, and diagram of the section showing an oval outline.
5, 6. Lateral view of a specimen showing an ovate section and diagram of the section.
7. Diagram (2 x) of a septum of the specimen Fig. 6, for comparison with Fig. 2.
8, 9. View of a small specimen from the Middle Marls, near Tinton Falls, New Jersey, and a diagram of its section.

BACULITES ASPER Morton (p. 278).

10. Lateral view of a fragment supposed to belong to this species.
11. View of the upper end of the fragment showing the septum in part.

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AMMONITIDÆ OF THE LOWER AND MIDDLE BEDS GREENSAND MARLS.

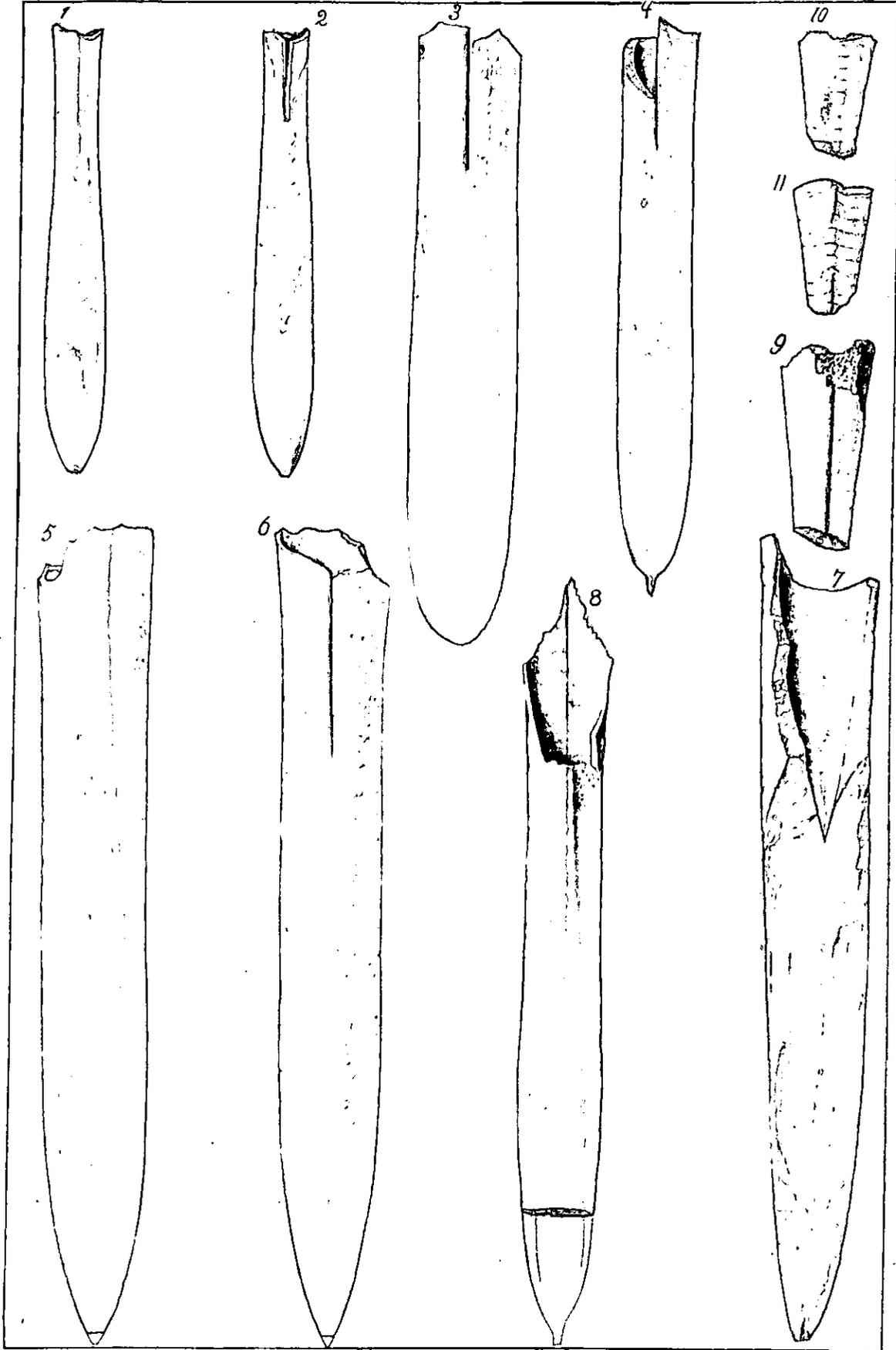
PLATE XLVII.

EXPLANATION OF PLATE XLVII.

BELEMNITELLA AMERICANA Morton (p. 280).

- Figs.** 1,2. Views of the opposite sides of a small individual figured by Dr. Morton in his Synopsis under the name *Belemnites subfusiformis*. Acad. Nat. Sci., Phila.
3. View of a heavy thickened specimen much rounded at the base. Rutgers College.
4. A smaller specimen, showing the mucronation at the base. Rutgers College.
- 5,6. Two views of a very large individual presenting the usual form. Rutgers College.
7. View of part of the same after having been split longitudinally.
8. View of a small specimen imperfect at the lower end, but preserving the walls of the cavity out to a thin margin. Am. Mus. Nat. History.
9. View of the filling of the alveolar cavity of the last specimen, showing the thickened ridge on the cast on the side opposite to the slit in the stylet.
- 10, 11. Views of a phragmocone showing the septal markings. Rutgers College.

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BELEMNITIDÆ OF THE LOWER BED GREENSAND MARLS.

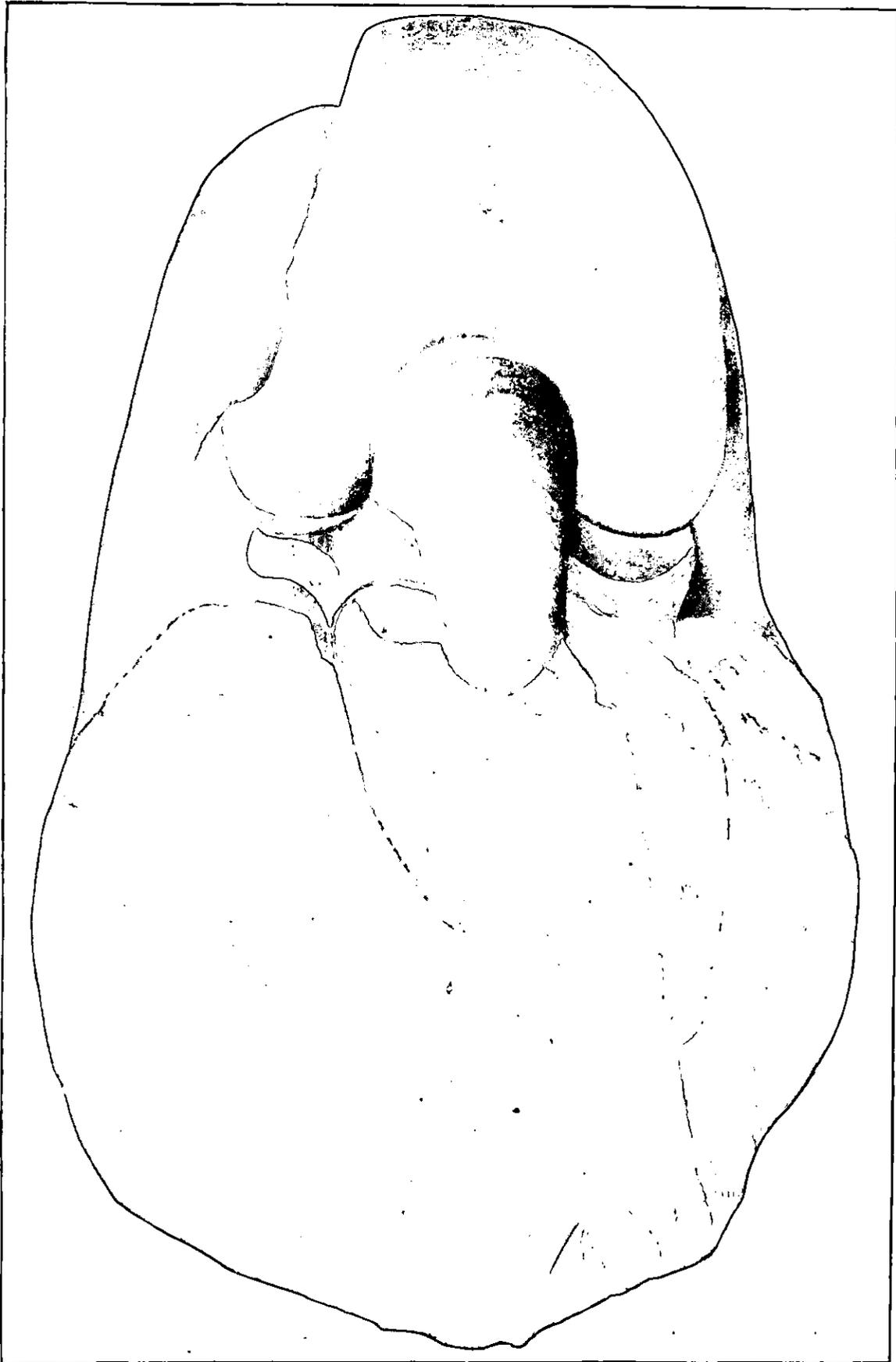
PLATE XLVIII.

EXPLANATION OF PLATE XLVIII.

NAUTILUS COOKANA Whitf. (p. 285).

- FIG. 1.** View of a large specimen which has been obliquely compressed. A portion of the coil has been removed to show the inner volution, cast of the umbilicus, etc. The wood-cut outline on page 286 is of the opposite side of this specimen.

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NAUTILIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

PLATE XLIX.

EXPLANATION OF PLATE XLIX.

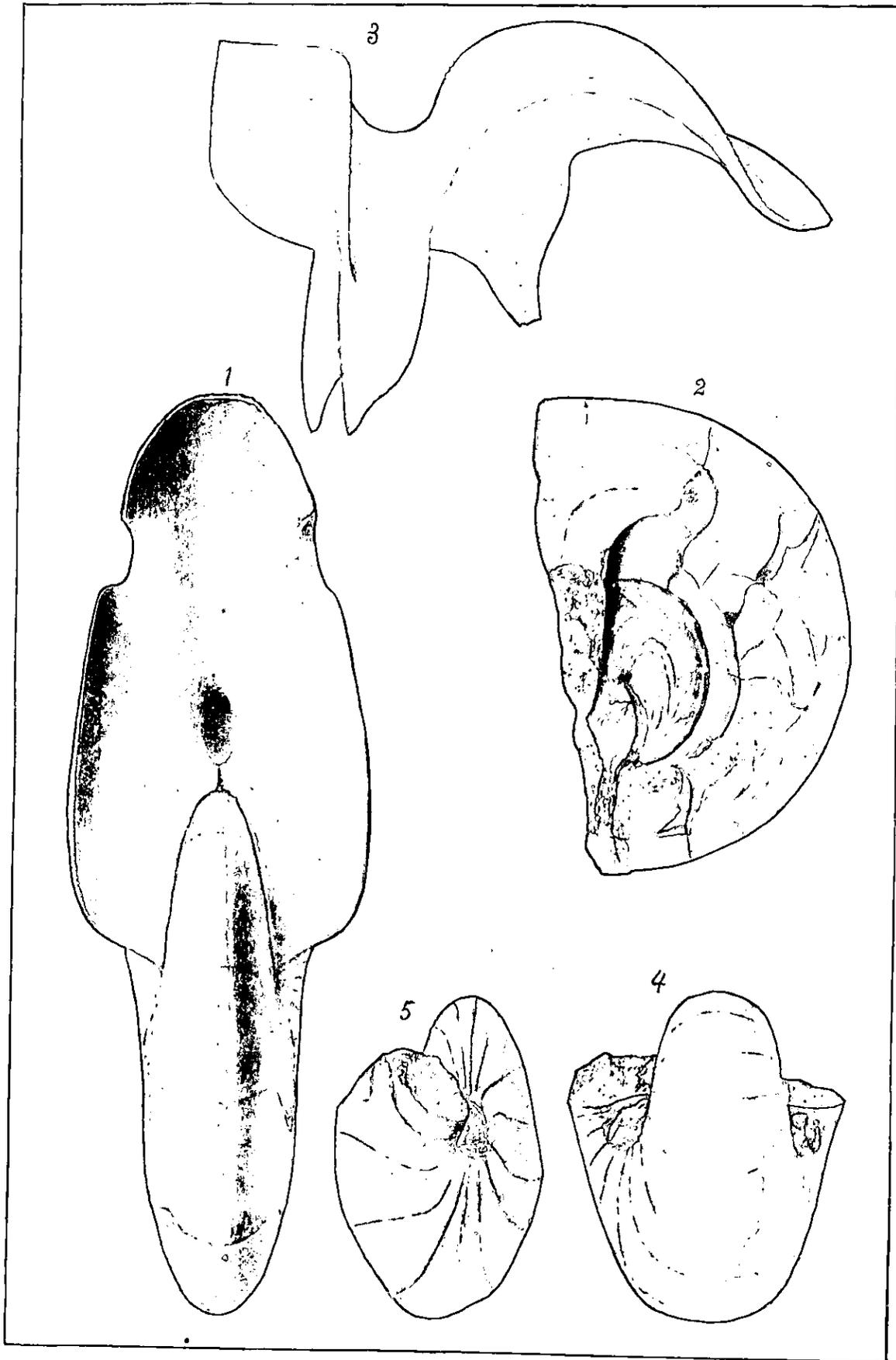
ATURIA VANUXEMI Conrad (p. 287).

- FIGS.
1. Profile view showing the inside of a septum, the two sinuses formed by the spire, and the broad funnel-formed siphon.
 2. View of the side of a small individual broken so as to show the inner volution, the filling of the large siphon and the junction of some of the septa with it.
 3. View of the filling of a single chamber as obtained from a gutta-percha impression in the outer cup of the specimen figured on Pl. L. The cast straightened somewhat, giving less arcuation, but greater length of the ventral portion than should be. The part marked *a* represents the funnel-formed siphonal depression of the septum.

NAUTILUS COOKANA Whitf. (p. 285).

- 4, 5. Dorsal and lateral views of a young specimen of the species, somewhat compressed dorso-ventrally, showing the distant septa and filling of the umbilical cavity. Am. Mus. Nat. History Collection.

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NAUTILIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

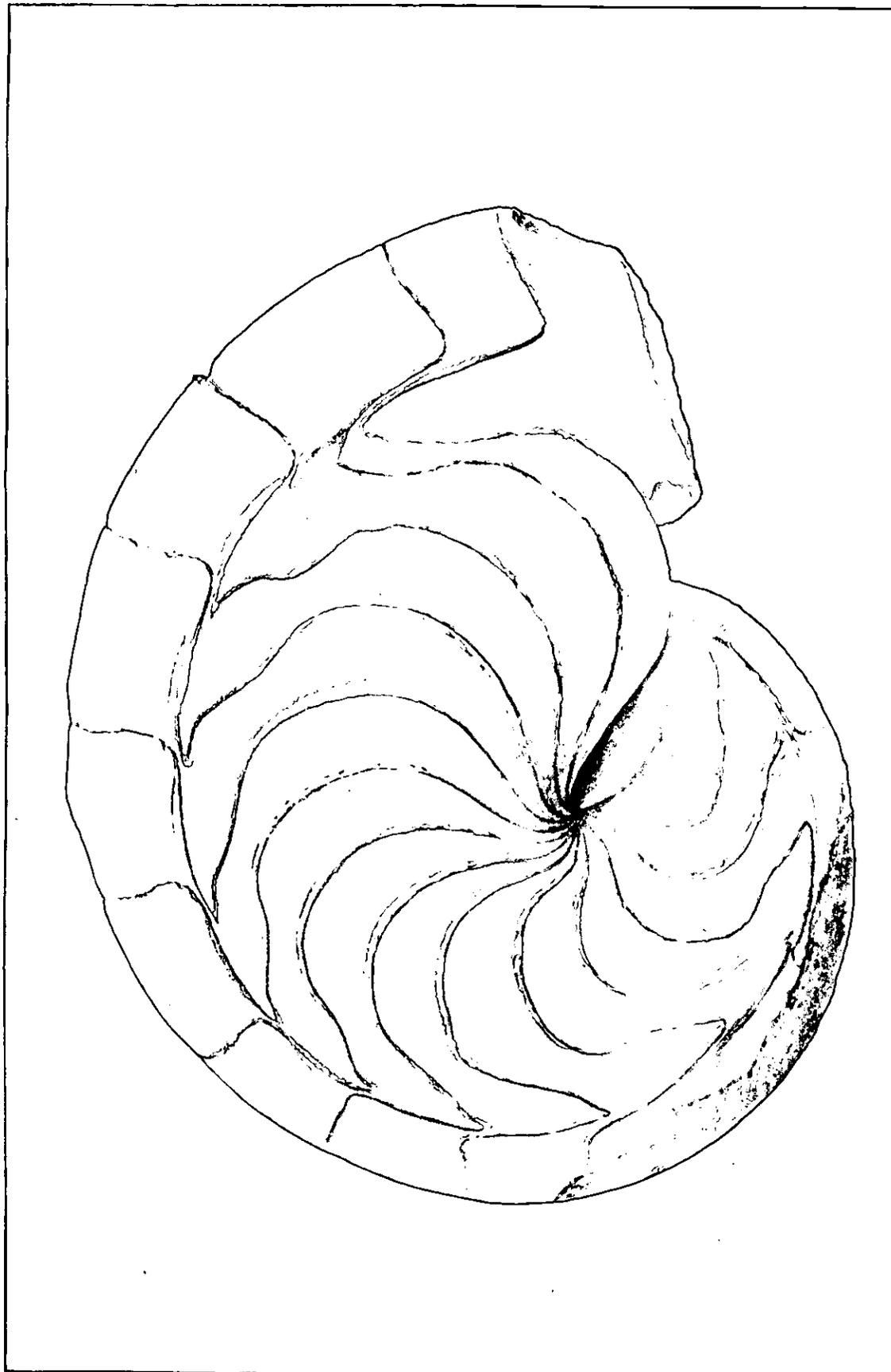
PLATE L.

EXPLANATION OF PLATE L.

ATURIA VANUXEMI Conrad (p. 287).

- FIG. 1. Lateral view of a large cast from Shark River, showing the lines of septa very distinctly. The specimen is probably somewhat compressed laterally, but not otherwise distorted. The profile view on Pl. XLIX is of the same specimen. Rutgers College.

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NAUTILIDÆ OF THE EOCENE LAYERS OF THE UPPER BED GREENSAND MARLS.

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