

# ADDITIONS TO THE UPPER CRETACEOUS INVERTEBRATE FAUNAS OF THE CAROLINAS

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## INTRODUCTION

The marine invertebrate Cretaceous faunas of North Carolina, with the exception of those of microscopic size, which have not yet been studied, were described in the fifth volume of the North Carolina Geological Survey, issued in 1923.<sup>1</sup> A few species from the adjoining State of South Carolina were included in the descriptions. Since the appearance of that volume additional material has become available from two localities, one in North Carolina and the other in South Carolina.

The collection from North Carolina was obtained in 1923, at the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, by Dr. L. B. Kellum, who was then engaged in a field study of the Eocene and Miocene fossil faunas of the eastern part of the State, and by me in 1926. This quarry is not identical with French Brothers' quarry at old Rocky Point, on Northeast Cape Fear River, 3 miles east of Rocky Point station, where the earlier Rocky Point collections were made.

Kellum did not furnish a detailed description of the section in which these fossils were found, but he reported that they were contained in a loose sandy matrix in the uppermost layer of the Peedee formation. The Peedee formation (Upper Cretaceous) of this general area, as shown by the quarries at Castle Hayne and at old Rocky Point, is unconformably overlain by the Castle Hayne marl, a formation of Jackson Eocene age. When I visited the new quarries in May, 1926, they were not in operation and the pits were filled with water so that the section could not be examined. Both the Peedee

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<sup>1</sup>The Cretaceous formations of North Carolina: North Carolina Geol. and Econ. Survey, vol. 5, 1923; Stephenson, L. W., Invertebrate fossils of the Upper Cretaceous formations, pp. 1-402, 409-592, pls. 1-100; and Rathbun, Mary J., Decapod crustaceans from the Upper Cretaceous of North Carolina, pp. 403-408, 593-596, pls. 101 and 102.

formation and the Castle Hayne marl were, however, abundantly represented on the dump heaps by easily identifiable materials.

The most abundant material was gray, calcareous sandstone of the Peedee formation, containing many fossils preserved in part as the original shell material, such as the oyster, in part in the form of finely granular dolomitic calcite, of which some of the specimens of *Cardium*, *Crassatellites*, and *Veniella* are examples, and in part as interior casts and exterior molds. Fragments of coarse conglomerate consisting chiefly of phosphatic pebbles in a glauconitic sand matrix were common and these were obviously taken from the basal conglomeratic layer of the Castle Hayne formation. On several of the dumps were fragments of hard white limestone and masses of loose crumbly marl containing bryozoa, echinoids, and pectens, and these materials were derived from the Castle Hayne marl above the basal conglomerate. The collection includes two heretofore undescribed echinoids, seven new pelecypods, two new gastropods, and more perfectly preserved specimens of one pelecypod, *Cardium (Trachycardium) penderense* Stephenson, described in the volume to which reference has already been made. There are also pelecypods and gastropods too imperfectly preserved for specific identification, some of which probably belong to undescribed species.

The following is a list of the species identified:

*Cretaceous species from the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum and L. W. Stephenson. U. S. G. S. colls, 12262 and 13585*

Echinodermata:

*Cassidulus kellumi* Stephenson.

*Cassidulus emmonsii* Stephenson.

Vermes:

*Serpula cretacea* (Conrad).

Pelecypoda:

*Glycymeris subgyrata* Stephenson.

*Ostrea subspatulata* Forbes.

*Exogyra costata* Say.

*Trigonia haynensis* Stephenson.

*Lima insolita* Stephenson.

*Anomia major* Stephenson.

*Anomia penderana* Stephenson.

*Pholadomya littlei* Gabb.

*Pholadomya sublevis* Stephenson.

*Veniella (Etea) grandis* Stephenson.

*Crassatellites carolinana* Stephenson.

*Cardium (Trachycardium) penderense* Stephenson.

Gastropoda:

*Turritella subtilis* Stephenson.

*Pugnellus levis* Stephenson.

In addition to the new material from North Carolina, one lot of old material which had been previously overlooked, from Hilton

Park, Wilmington, N. C., found among the Geological Survey collections, contained six specimens of the echinoid, *Linthia variabilis* Slocum, described on a following page.

The South Carolina locality is Mars Bluff on the right side of Peedee River, 3 miles below Peedee village (Atlantic Coast Line R. R. bridge), Florence County. The section is as follows:

*Section at Mars Bluff, Peedee River, S. C.*

Pleistocene terrace deposits:	Feet
Yellowish sandy loam, grading downward into mottled red and red sandy clay, passing into coarse red sand at base.....	10
Light drab clay, with a reddish sand lens reaching a maximum thickness of 4 feet, at one place near the base.....	8
Gravel band with pebbles less than an inch in diameter.....	0.5-1
Unconformity.	
Black Creek formation (Snow Hill marl member):	
Fine light yellowish stratified sand.....	8
Dark drab to black finely laminated clay and sand.....	3-5
Light yellow, fine-grained, thinly stratified, micaceous sand, mottled with pink and red.....	10-15
Dark drab laminated slightly lignitic clay, with partings of fine micaceous sand and some sand lenses; contains some comminuted plant fragments.....	2.5-4
Light gray friable sandstone with silicified shells, and some lignite (see list of fossil organisms below).....	0.5-1
Yellow and orange sand, interbedded with dark drab clay.....	2
Fine yellow micaceous stratified sand.....	2.5
Fine compact white and yellow sand.....	9
Black shale interstratified with blue sand.....	10

The fossiliferous layer indicated in the section was discovered prior to 1908 by the late Dr. Earle Sloan,<sup>2</sup> then State geologist, who correlated this part of the section with the Eocene. Several collections were subsequently made at the locality at different times, the last by Dr. Wythe Cooke and me in 1922. The original shell material has been completely replaced by silica in all the specimens. The following list was prepared from all the available collections:

*Fossils from Mars Bluff, Peedee River, S. C. Collected by Earle Sloan, Wythe Cooke, and L. W. Stephenson. U. S. G. S. coll. Nos. 3551, 4141, 11459-11462, and 11543.*

Coelenterata:

Sponge borings in shell of Tellina.

One unidentified coral.

Molluscoidea:

Bryozoa.

Pelecypoda:

*Leda* species.

*Striarca poguei* Stephenson.

<sup>2</sup> Sloan, Earle, Catalogue of the mineral localities of South Carolina, p. 358, 1908.

## Pelecypoda—Continued.

- Glycymeris* (?) *greenensis* Stephenson (numerous).  
*Arca* (*Barbatia*) *bladenensis* Stephenson.  
*Arca* (*Barbatia*) *lutea* (Conrad).  
*Ostrea sloani* Stephenson.  
*Anomia olmstedti* Stephenson.  
*Veniella mullinensis* Stephenson.  
*Crassatellites* species.  
*Lucina* species.  
*Cardium donohuense* Stephenson.  
*Cardium* aff. *C. vaughani* Stephenson.  
*Cardium marsense* Stephenson.  
*Cyprimeria* species.  
*Tellina simplex* Stephenson.  
*Tellina elliptica* Conrad ?  
*Tellina* species.  
*Linearia carolinensis* Conrad?  
*Cymbophora trigonalis* Stephenson.  
*Cymbophora* species (large).  
*Corbula oxynema* Conrad.  
*Corbula subgibbosa* Conrad.  
*Corbula* species.  
 Unidentified pelecypods (several species).

## Scaphopoda :

- Dentalium leve* Stephenson.

## Gastropoda :

- Nerita* species.  
*Epitonium* species.  
*Lunatia carolinensis* Conrad.  
*Lunatia* species.  
*Gyrodes* ?  
*Turritella* species.  
*Pugnellus* species.  
*Odontobasis* (?) *greenensis* Stephenson.  
 Unidentified gastropods (several species).

## Vertebrata :

- One fish vertebra.

With the exception of the new species, *Cardium* (*Trachycardium*) *marsense*, all of the specifically identified forms in the list occur in the Snow Hill marl member of the Black Creek formation of the Carolinas, and even the new species may be represented there by imperfectly preserved molds and casts. The containing bed is therefore referred to that member, as is also the entire Cretaceous portion of the section, embracing 50 or 55 feet of strata. The beds in their present condition lack the calcareous character of the typical beds of the member, but the fossil-bearing bed was originally calcareous, the shells and other calcareous material having been subsequently replaced by silica.

The photographic illustrations used in this paper were made in the photographic laboratory of the U. S. Geological Survey by W. O. Hazard, and the photographs were retouched by Miss Frances

Wieser, chief scientific illustrator of the Geological Survey, who also made the several drawings.

#### DESCRIPTION OF SPECIES

##### CASSIDULUS KELLUMI, new species

Plates 1, 2; plate 3, figs. 1, 2

*Description.*—Test broadly ovate in basal outline, rather high and dome-shaped; base slightly concave, with two broadly expanding concave areas extending from the peristome to the ambitus, one on either side of the posterior center; these concave areas are separated from each other by a broad, low, rounded posterior ridge which ends at the ambitus in a slight protuberance or angulation below the periproct; a slight protuberance on the ambitus also marks the outer corners of each of the two concave areas at equal distances from the separating ridge and each protuberance is continued as a faint ridge up over the test; the protuberances and concave areas produce a slightly truncated effect on the ambitus at either side of the posterior center. The upper surface is not smoothly domed, for each ambulacral area is distinctly raised between the pore bands, and each interambulacral area is divided into three flattened or slightly concave bands, widest at the ambitus, narrowing upward toward the apex, and the test is slightly humped above the periproct. Dimensions of the holotype: Length, 58 mm.; width, 53 mm., height, 31 mm.

The ambulacra are moderately broad in the petaloidal portions, become narrow at the lower ends of the petals, broaden out toward the ambitus, narrow down again on the base as they approach the peristome, near which they again broaden out sharply to form the floscelles. In the petals the pores are small, and the pairs are connected by very narrow furrows, much narrower than the intervening ridges; the inner pore is slightly elongated, but in deeply weathered specimens is seen to be not quite so long as the outer one; the pairs of pores are very closely spaced and trend obliquely downward away from the center of the petals, and the petals are almost closed at their lower ends; below the petals very small pores can be discerned on the ambulacral plates all the way to the floscelles. The floscelles broaden out sharply and are composed of long narrow more or less irregular plates each with a pore near its outer end; seven or eight pores on either side of each floscelle form an arch broken above by a group of six or seven pores on irregular plates, which form a small imperfect minor arch sunken considerably below the crest of the main arch. Pores occur on the inner ends of some of the plates of the floscelles, and form an irregular double line of five or six pores.

The ambulacral areas between the pore bands are distinctly elevated. The ambulacral plates in the petals are long horizontally and very narrow, and consequently very numerous. The interambulacral plates are much larger, the largest ones being three or four times as long horizontally as they are wide. The whole upper surface is densely packed with tiny primary and secondary tubercles; even the ridges between the pore slits support each a row of tubercles; each primary is surrounded by a distinct areola and on some of the primaries a minute mamelon can be detected. The base is covered with similar larger and more widely spaced primary tubercles with distinct mamelons, some of which can be seen to be perforated, and each primary is surrounded by a relatively broad areola; the secondaries are tiny and relatively few.

The apical system is situated 0.46 the length of the test from the anterior end; as seen in a slightly worn specimen, the madreporite is subcircular and relatively very large, the three other genital plates are small and perforated, and the ocular plates are minute, with no sign of perforations; as seen in a more deeply worn specimen, the madreporite is relatively smaller, the other genitals are larger, the oculars are larger and perforated. The raised apical system on the specimen shown in Plate 3, Figures 1, 2, is apparently an abnormal feature, as none of the other specimens possess it. The significance of this peculiar feature is not known, but Austin H. Clark has called my attention to a similar raised apical system on one specimen of the Recent *Stereocidaris leucacantha* A. Agassiz and H. L. Clark.

The peristome is situated centrally in a slight concavity of the base, is large, and includes five prominent oral lobes whose tips closely approach each other and are separated by deep, narrow ambulacral furrows. The outer surface of each oral lobe is covered with tubercles and is bordered by a slightly raised rim; the walls of the ambulacral furrows are densely packed with very small tubercles of regular size, arranged in rows parallel to the sloping outer surface of the lobe. These features are beautifully preserved on the type, the peristome of which is nearly perfect in all its details.

The periproct is high on the test, is small, and is situated in a deep, narrow sulcus which flares out and becomes shallow toward the ambitus.

*Remarks.*—Perhaps the most closely related American species is *Cassidulus porrectus* Clark,<sup>3</sup> from the Ripley formation, *Ewogyra costata* zone, in the vicinity of Eufaula, Ala. In form, and in the

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<sup>3</sup> Clark, William Bullock, The Mesozoic Echinodermata [of the United States]: U. S. Geol. Survey Mon. 54, p. 76, pl. 31, figs. 1a-i, 1915.

details of the peristome, apical system, and periproct, the two species are similar, though not identical, but Clark's species attains a size fully twice as great as the Rocky Point species. There is, however, a striking difference in the pore pairs of the ambulacral areas in the two species, the two pores in each pair in the Rocky Point species being approximately equal, while in the Eufaula species the inner pore is small and round, while the outer one is long and narrow. The periproct of *Cassidulus porrectus* occupies a deeper and narrower sulcus than is represented in Clark's illustrations.

Another related species is *Cassidulus micrococcus* Gabb<sup>4</sup> also from the Ripley formation, near Eufaula, Ala. I have compared the types and find that the Eufaula species is smaller, slightly more elongated, markedly flatter, and a little narrower anteriorly; the periproct is situated higher on the test, in a slightly wider sulcus, the pore pairs are unequal and are less definitely connected by furrows, and the madreporite is a little longer and more angular. The type material of *C. micrococcus* is in certain respects not very well preserved and it is difficult to see how Clark<sup>5</sup> was able to describe and figure the apical system and peristome in as great detail as he did. No other material was available for study so far as the record shows.

*Locality.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923, and by L. W. Stephenson in 1926.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The type material is in the United States National Museum. Holotype, catalogue No. 73420; 3 paratypes figured or used in the drawing of figures, catalogue No. 73421; 11 additional specimens, some of which are in good state of preservation.

CASSIDULUS EMMONSI, new species

Plate 3, figs. 3-8; plate 4

*Description.*—Test broadly subovate in basal outline, only moderately high and broadly domed; the slightly conical shape of the type is due to slight crushing on the sides; other specimens are broadly and evenly rounded. Base moderately concave with two pronounced broad radiating depressions extending from the peristome to the ambitus, one on either side of the posterior center; these depressions are separated from each other by a broad ridge and they produce

<sup>4</sup> Gabb, W. M., Description of a new species of *Cassidulus*, from the Cretaceous formation of Alabama: Proc. Acad. Nat. Sci., Phila., vol. 12, p. 519, 1860.

<sup>5</sup> U. S. Geol. Survey Mon. 54, p. 78, pl. 32, figs. 2 a-b; pl. 33, figs. 1 a-f., 1915.

slight truncations on the margin; a marked angulation on the ambitus marks the outer corners of each of the depressions at equal distances from the posterior center, and each angulation is continued in a very faint ridge up over the test. Dimensions of the holotype: Length, 41 mm. (?); width, 38 mm.; height, 20 mm. Dimensions of the paratype shown in figure 6: Length, 39 mm.; width, 37 mm.; height, 18 mm.

The petaloid portions of the ambulacra are rather narrow and the areas between the pore bands are slightly upraised; the petals are broadest apically and become narrow lanceolate toward the lower extremity where the pore bands almost touch; below the ends of the petals the ambulacra are very narrow, but they broaden out gradually to the ambitus, beyond which on the base they gradually narrow down again to the floscelles which broaden out conspicuously. In the petals the pores are small, and the pairs are connected by very narrow furrows, narrower than the intervening ridges; the outer pore of each pair is only slightly more elongated than the inner one; the furrows are very closely spaced and trend obliquely downward away from the centers of the petals. Below the petals a single row of pores can be faintly seen on each side of the ambulacral areas near the outer borders, these pores being situated on or near the sutures separating the plates, and the pores can be traced all the way to the floscelles. Each floscelle consists of a pair of large triangular plates next to the oral opening, followed outwardly by two series of five to nine narrow plates, one series on either side of the median line, followed by several broader plates of irregular shape and size, which form the transition into the plates of the narrow ambulacral area. As in other nearly related species all the plates of the floscelles above the triangular plates bear pores at their outer ends which are arranged roughly in the form of an arch convex outward; on the two postero-lateral and the anterior floscelles the arched arrangement includes 6 to 8 pores on each side of each floscelle with a group of 3 to 5 pores somewhat sunken below the crest of the arch; the two antero-lateral floscelles are narrower and include 10 or 11 pores on each side of the arch, with no central group of pores above, leaving the arch open and slightly flaring at the top. Some of the long narrow plates bear pores near their inner ends, and a pair of pores occurs one pore on each of the large triangular plates next to the oral opening.

The ambulacral plates in the petals are long horizontally, very narrow and numerous. Below the petals the ambulacral plates are broader and vary in shape and size on different parts of the area. The interambulacral plates are much larger, the largest ones being about two and one-half times as long horizontally as they are wide. The whole upper surface with the exception of the madreporite is densely packed with small tubercles set in deep small areolas; a



tiny mamelon can be detected on some of the tubercles; the base is covered with larger tubercles which vary considerably in size on different parts of the surface.

The apical system is situated slightly forward from the center; the madreporite is large and somewhat elongated; the other genital plates are small and close to the madreporite and bear pores. The ocular plates are minute and can not be clearly seen.

The peristome is situated slightly in front of the center of the broadly concave base, and includes five prominent, rather narrow oral lobes whose tips do not approach so close to the center as in the preceding species and whose separating ambulacral furrows are not so narrow; the mouth is therefore somewhat more open. Tiny tubercles can be detected on the walls of the ambulacral furrows of the better preserved specimens.

The periproct is circular, moderately large, and is situated well above the base at the anterior end of a broad shallow sulcus which extends downward without change of width to the ambitus.

*Remarks.*—This species may be the same as the one described by Emmons<sup>6</sup> under the name *Gonioclypeus subangulatus*, but the type of that species is probably lost, and the description and figures are inadequate for identification. Clark<sup>7</sup> referred Emmons's species questionably to *Cassidulus* and expressed the opinion that it was a Cretaceous species. The type was obtained by Emmons from a sample of marl from Craven County, N. C., sent to him by W. B. Wadsworth, whose address was Core Creek post office (now abandoned). This marl was regarded as of Eocene age. Core Creek is a small tributary of Neuse River in the northwestern part of Craven County, in an area now mapped as Eocene, but the marl pit from which the sample was taken may have been sunk deep enough to cut through the Eocene into the upper part of the underlying Peedee formation of the Cretaceous.

This species is closely allied to *Cassidulus subquadratus* Conrad, the type of which was found by Dr. W. Spillman in the Ripley formation, *Exogyra costata* zone (Upper Cretaceous), in Tippah County, Miss., and is now in the Academy of Natural Sciences of Philadelphia. Compared with Conrad's species, the North Carolina species is smaller, flatter, and less broadly domed, the pore pairs are a little more closely spaced, and the madreporite is more elongated.

The specimen figured by Clark<sup>8</sup> as typical of *C. subquadratus* Gabb, compared with the type, is not a strictly typical specimen;

<sup>6</sup> Emmons, Ebenezer, "Agriculture of the eastern counties; together with descriptions of the fossils of the marl beds." Report of the North Carolina Geol. Survey, p. 309, figs. 242, 243, 1858.

<sup>7</sup> Clark, W. B., The Mesozoic Echinodermata [of the United States]: U. S. Geol. Survey Mon. 54, p. 81, 1915.

<sup>8</sup> Idem, pl. 31, figs. 2a-g, 1915.

the periproct is a little smaller and is situated in a shallower, narrower sulcus, and the apical system is markedly smaller. However, it is very closely related and might appropriately be regarded as a varietal form. Clark's specimen, according to the record, was found by W J McGee near Holly Springs, Miss., but this is obviously an error, as this town is located on the outcrop of nonmarine Wilcox Eocene strata, at least 25 miles west of the nearest surface occurrence of the marine Ripley formation.

*Locality.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923 and by L. W. Stephenson in 1926.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The material from the new Rocky Point quarries in the National Museum collections includes seven specimens, none of which is perfectly preserved. The specimen shown in Plate 3, Figures 3-5, is named the type (Cat. No. 73423), but this specimen needs to be supplemented by some of the other material (Cat. No. 73424). There is also one specimen of this species in the National Museum collections (Cat. No. 28930) from the Cretaceous in a well at the waterworks at Wilmington, which is incorrectly labeled *Cassidulus aequoreus* Morton. The depth at which the specimen was taken is not indicated on the label, but the upper part of the Peedee formation crops out in the bank of Northeast Cape Fear River, a short distance below the waterworks where the well is located, and the specimen probably came from a very shallow depth.

#### LINTHIA VARIABILIS Slocum

Plate 5, figs. 1-7

1909. *Linthia variabilis* SLOCUM, Field Mus. Nat. Hist. Pub. 134, Geol. ser. vol. 4, No. 1, pp. 12-14, pl. 3, figs. 1-11.

1915. *Linthia variabilis* CLARK, U. S. Geol. Survey Mon. 54, pp. 99-100, pl. 54, figs. 1a-l.

Among the collections of the Geological Survey is a tray containing six echinoids from near Wilmington, N. C., identified and labeled by Dr. W. B. Clark as *Hemiaster unguia* (Morton). After the matrix which concealed most of the surface characters had been removed it was found that these specimens did not belong to the genus *Hemiaster* but to the genus *Linthia*, as shown by the presence of both peripetalous and lateral fascioles. A comparison of these specimens with the types of *Linthia variabilis* Slocum and with specimens of that species in the Geological Survey collections from the vicinity of Pontotoc, Miss., shows that they are very close to and are probably identical with Slocum's species. About the only dif-

ference observed is a slightly denser crowding of the tubercles on the surface of the Mississippi specimens, and this difference is so slight as to be scarcely varietal. All of the specimens in both the Mississippi and North Carolina collections are more or less deformed by crushing and I am inclined to think that mechanical crushing caused most of the so-called individual variations noted by Slocum in his Mississippi specimens.

*Locality.*—From the bank of Northeast Cape Fear River on the west side of Hilton Park, Wilmington, just below the pump station of the Clarendon Waterworks Co., New Hanover County, N. C. Collected by L. W. Stephenson in 1906. U. S. G. S. coll. No. 4143.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—Part of Slocum's types in the Field Museum of Natural History, Chicago, were kindly lent to me for comparison with the North Carolina material, and consisted of the following nine specimens which I am informed include all of Slocum's material representing this species now in the museum.

Catalogue No. P 10457 A.

Catalogue No. P 10457 D.

Catalogue No. P 10457 E.

Catalogue No. P 10457 H (?).

Catalogue No. P 10457 K (?).

Catalogue No. P 10458 L. (Slocum's pl. 3, figs. 5-8.)

Catalogue No. P 10458 M.

Catalogue No. P 10458 N.

Catalogue No. P 10458 (?letter).

The specimen figured by Slocum in Plate 3, Figures 1-4, Cat. No. P 10457 B, was not included among the specimens sent to me. Slocum evidently had more than the nine specimens before him for on page 13 of his text is a table of 20 measured specimens including catalogue numbers P 10457 A, B, D, E, F, G, H, J, K, and P 10458 L, M, N, O, P, S, T, U, V, W, X, and these lettered specimens probably did not include all the material in his possession.

Slocum describes the occurrence of the Mississippi specimens near Pontotoc, Pontotoc County, in the following words: "This species is from the Ripley group and is quite abundant both on the bluffs of One Mile Run and near the southern edge of the village of Pontotoc, Miss. Two casts which evidently belong to this species were collected by the writer in the Owl Creek marls in Tippah County, Miss."

He does not indicate at which of the two Pontotoc localities the different lettered specimens were obtained. The locality on One Mile Run is about a mile south of Pontotoc.

Two of the specimens from the North Carolina locality are figured in the present paper, Cat. No. 73426, U.S.N.M. The other four specimens have the catalogue number 73427. Two typical specimens from Mississippi have been placed with those from North Carolina, Cat. Nos. 73448, 73449.

GLYCYMERIS SUBGYRATA, new species

Plate 5, figs. 8, 8a, 9

*Description.*—Shell broadly ovate-oblong in outline, a little longer than high, moderately convex. Beaks protruding slightly above the hinge line, incurved, faintly prosogyrate, situated centrally, but slightly in advance of the center of the area. Dimensions of the holotype: Length, 31 mm.; height, 28 mm.; convexity, 9 mm. Dimensions of the best preserved paratype: Length, 26 mm.; height, 22 mm.; convexity, 7 mm.

Hinge plate arched and truncated above by the straight lower margin of the area. Several of the central teeth are small, short, and transverse to the hinge line; in front of the central teeth are 10 or 11 larger somewhat oblique teeth, and back of them 9 or 10 similar larger, oblique teeth.

Cardinal area amphidetic, straight on the lower margin, and arched above; the straight margin is about 11 mm. long on the holotype; the area is covered with about 5 narrow chevron-shaped ligamental grooves, the posterior limbs of which are a little longer than the anterior.

On the interior of the shell the adductor scars are strong, of moderate size, and are distinctly raised above the main inner surface, the lower margin of each scar being slightly overhanging. The inner margin of the shell is rather finely crenulated.

The margins of the shell form a broad oval, longer than high, the posterior end being a little more sharply rounded than the anterior.

The outer surface is nearly smooth, with the exception of fine concentric growth lines, and widely spaced stronger lines indicating vigorous growth followed by resting stages. There is no indication of radiating lines such as are usually present on the species of this genus.

*Remarks.*—The slight, though distinct forward curvature of the beak is a feature that has not been observed on previously described species of this genus from the Upper Cretaceous of North America. *Glycymeris hamula* (Morton) from the uppermost part of the Upper Cretaceous at Prairie Bluff, Alabama River, Ala., is apparently smooth, but it has a direct beak, is more convex, and has a higher area with more numerous ligamental grooves.

*Localities.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C.; one specimen col-

lected by L. B. Kellum in 1923 and one by L. W. Stephenson in 1926. Two casts from the old Rocky Point quarries at Lanes Ferry, 3 miles east of Rocky Point station, collected by W. B. Clark in 1889.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent upper Senonian (Maestrichtian).

*Type material.*—The material studied is in the United States National Museum and includes one left valve, the holotype, Cat. No. 73428, another smaller and better preserved left valve, Cat. No. 73429, and two internal casts, Cat. No. 73430.

LIMA INSOLITA, new species

Plate 5, fig. 10

*Description.*—Shell very large, subovate in outline, inequilateral, oblique. Beak and ears not preserved. Approximate dimensions of the type, a right valve: Length, 57 mm.; height, 60 mm.; convexity, 10+ mm. (?). The specimen appears to have been somewhat flattened by mechanical crushing.

Hinge and internal features not preserved.

Anterior margin broadly rounded, passing into the more sharply rounded ventral margin; posterior margin sharply rounded below, becoming nearly straight and sloping forward above, probably making an angle with the hinge line of about 140°.

The surface of the type is marked with more than 25 radiating ribs, which are narrow and low, and are separated by much wider interspaces, some of which show faint indications of very fine interlining; the broadest interspaces between the ribs along the ventral margin of the type are about 3 mm. wide; on the anterior and posterior slopes the ribs become very faint.

*Remarks.*—This is the largest species of *Lima* yet found in the Upper Cretaceous of the Atlantic and Gulf Coastal Plain.

*Locality.*—From the New Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson in May, 1926.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The holotype is in the United States National Museum, Cat. No. 73431.

ANOMIA MAJOR, new species

Plate 5, fig. 11

*Description.*—Shell large, moderately thick, subcircular to broadly subovate in outline, ranging in different individuals from flat to strongly convex. Beak small, depressed to moderately prominent,

situated 1 to 2 millimeters away from the dorsal margin. Dimensions of the type, a left valve: Length, 50 mm.; height, 40+ mm. (the specimen is somewhat deformed and crushed). Hinge and internal features not uncovered.

Surface marked by fine concentric growth lines and by radiating sculpture which varies greatly in strength of development on different individuals. On the type the surface is nearly smooth around the beak; away from the beak the smooth surface passes into a surface marked by fine radiating lines to a distance of 18 or 20 mm., and this in turn passes into the more coarsely ribbed portion of the shell; the main ribs are faint to moderately strong, subangular to rounded, and some of them show faint irregularly spaced nodes; the spaces between the ribs differ markedly in width but in general are wider than the ribs.

*Remarks.*—The species is related to *Anomia ornata* Gabb from the upper part of the Ripley formation in the Chattahoochee region, Georgia, but its main ribs are less strongly developed and it lacks the numerous small, sharply defined subordinate ribs of the Georgia species. The species is also related to *Anomia forteplicata* Gardner, of Maryland, a form that is also closely related to *Anomia ornata* Gabb. The form identified by Gardner as *Anomia ornata* Gabb, from near Friendly, Prince Georges County, Md., may be only an individual variant of *Anomia forteplicata* Gardner, but a full suite of specimens would be necessary to determine this relationship. Apparently both the Maryland species recognized by Gardner average much smaller in size than the typical *Anomia ornata* Gabb, some specimens of which are more than 40 mm. in length.

*Locality.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson, May, 1926.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—Includes the holotype, United States National Museum Cat. No. 73432, and three smaller, younger specimens Cat. No. 73433.

ANOMIA PENDERANA, new species

Plate 5, fig. 12

*Description.*—Shell of moderate thickness, subcircular in outline, strongly convex in the umbonal portion, flattening out toward the margin. Beak broken but probably of moderate size and situated more than a millimeter away from the margin. Dimensions of the type, a left valve: Length, 33 mm.; height, 32 mm.; convexity, about 8 mm.

The surface has been smoothed off somewhat by corrosion, but the ribs are apparently not very prominent, are rounded, differ considerably in strength, are in general much narrower than the interspaces, and bear faint irregularly spaced nodes; there is evidence of numerous faint lines between the ribs.

*Remarks.*—The ribs of this species are much finer and more regularly spaced than in *Anomia major* Stephenson, and it seems unlikely that it can be an individual variant of that species. The species does not appear to be very closely related to any described Coastal Plain species.

*Locality.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson, May, 1926.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The species is based on one specimen, United States National Museum Cat. No. 73434.

PHOLADOMYA SUBLEVIS, new species

Plate 6, figs. 1, 2

1923. *Pholadomya littlei* STEPHENSON (in part), North Carolina Geol. and Econ. Survey, vol. 5, pp. 247-249, pl. 63, figs. 3, 4 (only).

*Description.*—Shell relatively small, equivalve, inequilateral, elongated, subelliptical in outline, moderately convex, broad in the umbonal region. The shell has a slightly swollen appearance toward the lower anterior extremity. The two valves gap slightly anteriorly, but are almost closed posteriorly. Beaks, incurved, approximate, situated about 0.3 the length of the shell from the anterior extremity. Dimensions of the type: Length, 61 mm.; height, 36 mm.; convexity, 25 mm.

Hinge long, straight, anterior margin rather sharply rounded below; ventral margin very broadly rounded, becoming almost straight; posterior margin sharply rounded at the extremity which is about the midheight.

Surface marked by 13 or 14 radiating costae which, as shown by the external mold of the paratype, are weak and narrow, becoming obscure on the antero- and postero-dorsal slopes; the costae are somewhat irregularly spaced, the widest spacing being back of the midlength of the shell.

*Remarks.*—The species is based on two specimens, the larger of which is named the holotype. The paratype was figured in the paper cited in the synonymy, and was questionably regarded as a young individual of *Pholadomya littlei* Gabb; the holotype shows that the

ribs remain finer with increase in size than they do on Gabb's species, and the finding of two relatively small specimens suggests that the species does not attain large proportions.

*Locality.*—The holotype is from the new Rocky Point quarries a mile northeast of Rocky Point station, Pender County, N. C. The paratype was found in French Brothers' quarry at old Rocky Point (now Lanes Ferry), 3 miles east of Rocky Point station.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The material is in the United States National Museum and includes the holotype, Cat. No. 73435, and one paratype Cat. No. 31719.

VENIELLA (ETEA) GRANDIS, new species

Plate 6, figs. 3, 3a, 4

*Description.*—Shell large and thick in comparison with other species of the subgenus, elongate subovate in outline, inequilateral, moderately convex. Beaks prominent, incurved, prosogyrate, approximate, situated about one-third the length of the shell from the anterior extremity. Umbonal ridge distinct, extending from the beak to the lower posterior extremity, curved, convex upward, bounded above by a pronounced radiating depression extending from the beak to the posterior truncation. Dimensions of the holotype a right valve: Length, 58 mm.; height, 42 mm.; convexity, 14 mm.

Hinge of right valve with two cardinal teeth separated by a deep triangular socket; the anterior cardinal is short and thin and is directed downward and slightly backward; the posterior cardinal is long, thick, oblique, and strongly bifid. The inner anterior lateral tooth is short, thick, and prominent, and is situated close to the anterior cardinal from which it is separated by a deep narrow cleft; the inner lateral is separated from the weak outer lateral by a deep socket. The inner posterior lateral is partly broken but as shown by a cast, it is rather thick, strong, and relatively long; the outer lateral is weak and is separated from the inner one by a pronounced socket deepest toward its forward end.

Ligament opisthodontic, set in a narrow deep groove extending in an upbent curve from the beak to the forward end of the lateral socket, a distance of 18 mm.

Anterior adductor scar broadly subovate, deeply impressed; posterior adductor scar obliquely elongate, not so deeply impressed, and a little larger than the anterior. Pallial line simple. Inner surface, as shown on a cast, with two or three broad, rather weak, radiating undulations.



Dorsal margin long and slightly arched behind the beak, short and concave in front of the beak; anterior margin sharply rounded; ventral margin broadly and regularly rounded; posterior margin subangular below, truncated, slightly concave, sloping obliquely forward and rounding into the dorsal margin above.

Surface marked by concentric growth lines which become rather coarse back of the umbonal ridge, and by several stronger concentric channels which mark resting stages in growth.

*Remarks.*—This species differs from its nearest known relative *Veniella (Etea) carolinensis* (Conrad), in its markedly greater size and relatively greater height, and in the pronounced arching of the umbonal ridge.

*Locality.*—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The material is in the United States National Museum and includes the holotype, a right valve, Cat. No. 73436, and three internal calcareous sandstone casts, Cat. No. 73437, one of which has clearly impressed upon it the concentric markings of the outer surface of the shell.

CRASSATELLITES CAROLINANA, new species

Plate 7, figs. 1, 1a, 2; plate 8

*Description.*—Shell large, elongate, inequilateral, moderately convex. Beaks prominent, incurved, slightly prosogyrate, situated about 0.37 the length of the shell from the anterior end. Umbonal ridge nonprominent. Dimensions of the holotype, a left valve: Length, 64 mm.; height, 48 mm.; convexity, 15 mm. Dimensions of a well-preserved right valve: Length, 66 mm.; height, 52 mm.; convexity, 16 mm.

Hinge of left valve with two cardinal teeth, the anterior one strong and trending obliquely forward, the posterior one nearly vertical in trend, thin above, becoming stronger and more prominent below, the two cardinals separated by a deep somewhat expanding socket lined on the sides with fine transverse striations. Hinge of right valve with one strong prominent cardinal tooth sloping a little forward in front of the resilifer, and a very weak anterior cardinal sloping strongly forward in front of a socket of only moderate depth. No true laterals are present, but the margins of the shell under the lunule and under the escutcheon

are slightly raised, forming a sort of pseudo-laterals. The anterior raised margins are separated from the anterior cardinals by pronounced channels. The resilifer is broad and subtrigonal, and at its lower margin just back of the posterior cardinal on each valve is a small pit. On the left valve on the posterior side of the resilifer close to the margin, is a narrow ridge or pseudo-cardinal. Some distance back of the resilifer near the inner margin is a very low broad hump suggesting a rudimentary lateral, and between this and the slightly raised outer margin above is a shallow channel. A similar hump occurs near the inner margin a short distance in front of the socket on the right valve. Lunule distinct and deep, most sharply outlined on the left valve. Escutcheon distinct, but shallow, sharply defined on the right valve, less so on the left valve.

Adductor scars subequal strongly impressed; back of the upper end of the anterior scar is a small deeply impressed retractor scar. Pallial line simple. Most of the internal casts show a depression, corresponding to an internal ridge, beginning just in front of the beak, extending in a broad regular curve downward and backward, and dying out before reaching the pallial line. Inner margin of the shell finely crenulated.

The dorsal margins of the shell slope from the beak at an angle of about  $130^{\circ}$ ; the antero-dorsal margin rounds down into the regularly but rather sharply rounded anterior margin, and this in turn into the broadly and regularly rounded ventral margin; posterior margin subangular below, slightly truncated above.

Surface marked by rather coarse growth lines of irregular strength.

*Remarks.*—Internal casts of this species were figured without specific name in North Carolina Geological and Economic Survey.<sup>9</sup> The new material includes one nearly perfect left and one nearly perfect right valve, several imperfect right and left valves, and several internal calcareous sandstone casts, one of which is nearly perfect on the right side.

The specimens figured by Weller<sup>10</sup> in his Plate 41, figures 1 and 2, under the name *Crassatellites subplanus* (Conrad), appear to be very close to this species, but they are relatively shorter. The specimens are, however, relatively longer than Conrad's type of *C. subplanus* and I question the correctness of their identification.

The species *Crassatellites vadosus* (Morton) which is very common in the upper part of the Ripley formation of the Gulf Coastal Plain in beds which are of about the same age as the Cretaceous stratum uncovered in the Rocky Point quarries, is more convex and more

<sup>9</sup> Vol. 5, p. 277, pl. 68, figs. 5-7, 1923.

<sup>10</sup> Weller, Stuart, A report on the Cretaceous Paleontology of New Jersey, Geol. Survey New Jersey, Paleontology, vol. 4, p. 553, pl. 41, figs. 1, 2, 1907.

sharply pointed posteriorly, and has a more sharply defined umbonal ridge than *C. carolinana*. The hinge characters of the two species also differ in detail.

*Localities.*—From Pender County at the new Rocky Point quarries, a mile northeast of Rocky Point station, and at French Brothers' quarry at old Rocky Point, 3 miles east of Rocky Point station; from the Castle Hayne quarries in New Hanover County, N. C. The type was collected by L. B. Kellum in 1923.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The type material is in the United States National Museum. Holotype, Cat. No. 73438. Paratypes Cat. Nos. 31750–31752, 73439.

CARDIUM (TRACHYCARDIUM) PENDERENSE Stephenson

Plate 6, figs. 5–8, 8a

1923. *Cardium (Trachycardium) penderense* STEPHENSON, North Carolina Geol. and Econ. Survey, vol. 5, pp. 291–292, pl. 71, figs. 1–3.

*Description.*—The type of this species is an imperfect external mold from French Brothers' quarry at Old Rocky Point on Northeast Cape Fear River, now known as Lanes Ferry, 3 miles east of Rocky Point station, Pender County, N. C. The additional material now available for study includes numerous internal casts and some imperfect external molds, collected by W. B. Clark at the old quarry in 1888, and not previously examined by me, and a collection made by L. B. Kellum in 1923 at the new quarries a mile northeast of Rocky Point station, including 7 left and 9 right valves, some of which are nearly complete, and 3 internal casts. The original description should be consulted before reading the following supplemental description.

The more complete new material shows the number of ribs to be 48 or 49 instead of 45. The individuals show considerable variation, ranging in outline from a little longer than high to considerably higher than long. These differences may be due in part to mechanical deformation in the sediments, but I am inclined to regard them as chiefly original individual variations, or perhaps in part as sex differences. The ribs appear to be identical in the different forms, and there is no suggestion that more than one species or even variety is represented. The ribs on the anterior slope near the margin exhibit rather coarse transverse rugosities. Some of the specimens show marked resting stages in growth at wide intervals, while others, even large ones, exhibit continuous even growth. The beaks are almost direct or very slightly prosogyrate, instead of opisthogyrate

as suggested in the original description. The hinge is normal for the subgenus *Trachycardium*, as this group is developed in the Upper Cretaceous deposits of the Atlantic Coastal Plain.

*Geologic position.*—Upper Cretaceous, upper part of the Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Figured specimens.*—The new material figured is from the collection made by Kellum in 1923, at the new quarries, a mile north-east of Rocky Point station, Pender County, N. C., Cat. No. 73442; seven additional specimens are in the collection.

CARDIUM (TRACHYCARDIUM) MARSENSE, new species

Plate 7, figs. 3, 3a, and 4

*Description.*—Shell large, subcircular to broadly subovate in outline, a little longer than high, slightly oblique. Beaks moderately prominent, incurved, approximate, nearly direct, situated slightly in advance of the midlength. Umbonal ridge moderately prominent, shell most inflated centrally, postero-dorsal slope steep, antero-dorsal slope rounded, becoming steep above. Dimensions of the holotype: Length, 49 (?) mm.; height, 46 mm.; convexity, 16 mm.

Hinge normal for the subgenus *Trachycardium*. Ligamental groove short and deep. Inner surface smooth as preserved, adductor scars faintly impressed, inner margin strongly crenulated.

Dorsal margin broadly arcuate, anterior and ventral margins regularly rounded, posterior margin subangular below, truncated above, trending obliquely forward and rounding rather sharply into the postero-dorsal margin.

Surface ornamented with 33 or 34 strongly developed ribs, 25 of which are in front of the umbonal ridge. The ribs are sub-V-shaped in cross section, subangular to rounded on the crests, and each rib is scored on each side with a faint, narrow, longitudinal channel. At the bottom of the depression between each rib is a closely appressed slit. On the anterior slope the crest of each rib is set with irregularly spaced distinct nodes 2 to 4 mm. apart. The ribs on the posterior slope grade from broadly V-shaped near the umbonal ridge to almost flat near the postero-dorsal margin.

*Remarks.*—This species has fewer and coarser ribs than either *C. donohuense* Stephenson or *C. longstreeti* Weller, both of which are closely related species occurring in the same faunal zone in North Carolina. The material consists of silicified shells, including a large right valve, the holotype, broken and partly wanting in the postero-ventral portion, a smaller more perfect right valve and several more or less fragmentary right and left valves.

*Locality.*—From Mars Bluff on Peedee River, 3 miles below the Atlantic Coast Line Railway bridge, Florence County, S. C. Collected by C. W. Cooke and L. W. Stephenson in 1922.

*Geologic position.*—Upper Cretaceous, Snow Hill marl member of Black Creek formation, upper part of *Exogyra ponderosa* zone. European equivalent, upper Senonian (Campanian).

*Type material.*—The type material is in the United States National Museum. Holotype, Cat. No. 73440; paratype, Cat. No. 73441.

**TURRITELLA SUBTILIS, new species**

Plate 9, figs. 6, 7

*Description.*—Spire high with probably not less than 20 whorls, apical angle apparently about 20°. The diameter of the largest whorl preserved is approximately 21 mm. Sides of whorls very slightly convex, practically flat on one well preserved specimen, ornamented with 28 or 30 fine revolving threads of irregular strength, strongest on the middle and anterior parts of the whorls; in places the threads are faintly nodose. Suture sharply, but not deeply impressed. There is a faint indication of growth lines which appear to be strongly convex backward on the whorls. The other features of the shell are not preserved.

*Remarks.*—This species is larger and is much more finely ornamented than *Turritella pointensis* Stephenson, from the old French Brothers' quarries, 3 miles east of Rocky Point station. *Turritella lorillardensis* Weller from the stratigraphically lower Woodbury clay of New Jersey appears to be a rather closely related species, but its ornamentation is coarser, the sutural depression is deeper, and the whorls are a little more convex.

*Locality.*—From the New Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923.

Also from the old Rocky Point quarries at Lanes Ferry, 3 miles east of Rocky Point station, collected by W. B. Clark in 1889.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

*Type material.*—The type material is in the United States National Museum, and includes the holotype, Cat. No. 73443, and several paratypes, Cat. Nos. 73444, 73445.

## PUGNELLUS LEVIS, new species

Plate 9, figs. 1-5

1923. *Pugnellus* species, North Carolina Geol. and Econ. Survey, vol. 5, p. 374, pl. 93, fig. 12 (probably not fig. 13).

*Description.*—Shell large and roughly fusiform; spire of moderate height, body whorl large; number of whorls 5 or 6. Side of whorls of spire plump but slightly flattened, as shown by the internal cast, and the flattened band becomes more pronounced as it continues around onto the upper part of the body whorl. The spire and a considerable part of the body whorl are callused over, concealing the surface features, and a heavy rounded irregular ridge of callus extends from near the beak well down over the shell, distant about one-third the circumference of the shell in front of the aperture. The surface of the body whorl in front of this ridge of callus is smooth as far as it is preserved. The forward part of the body whorl is wanting in the type, so that the nature of the outer lip is not known.

Canal deep and narrow, probably moderately long, but length not determined. Dimensions of the type: Altitude, 60+ mm.; diameter, 42+ mm.

*Remarks.*—The internal cast shown in Figure 12, cited above in the synonymy, probably belongs to this species, but the specimen shown in Figure 13 appears to be a more slender form and may be an undescribed species.

Wade<sup>11</sup> has described a large smooth species, *Pugnellus abnormalis*, from Coon Creek in the lower part of the Ripley formation in Tennessee, but his species has a higher spire, and the shell as a whole is more elongated than the Rocky Point species. A large undescribed species in the upper part of the Navarro formation of Kaufman County, Tex., approaches this one in smoothness, but faintly developed longitudinal plications are present on the body whorl of the Texas species. *Pugnellus goldmani* Gardner is a nearly smooth species from the Monmouth formation of Maryland. *Pugnellus densatus* Conrad from the Ripley formation of the eastern Gulf region and from the Navarro formation of Texas, and *Pugnellus pauciplicatus* Stephenson from the Snow Hill member of the Black Creek formation of North Carolina are forms with longitudinal plications well developed on the forward half of the body whorl.

*Locality.*—From the new Rocky Point quarries a mile northeast of Rocky Point station, Pender County, N. C.

*Geologic position.*—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

<sup>11</sup> Wade, Bruce, Fauna of the Ripley formation, Tennessee: U. S. Geol. Survey Prof. Paper 137, p. 149, pl. 52, figs. 6, 7, 1926.

*Type material.*—The type material is in the United States National Museum and includes the holotype, Cat. No. 73446, and three paratypes, Cat. No. 73447.

## EXPLANATION OF PLATES

(The specimens figured in Plates 1 to 9 are from the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C., except as otherwise indicated.)

## PLATE 1

*Cassidulus kellumi* Stephenson (p. 5)

- FIG. 1. Upper surface of the test of the type. U. S. Nat. Mus. Cat. No. 73420.  
 2. Lower surface of the test of the type.  
 3. Posterior surface of the test of the type.  
 4. The apical system of the type,  $\times 4$ .  
 5. Diagrammatic view of the apical system,  $\times 5$ , based on one of the paratypes.  
 6. The peristomal area of the type,  $\times 2+$ .

## PLATE 2

*Cassidulus kellumi* Stephenson (p. 5)

- FIG. 1. Anterior surface of the test of one of the paratypes. U. S. Nat. Mus. Cat. No. 73421.  
 2. Drawing of the surface of the right side of one of the paratypes.  
 3. Lower surface of a typical specimen showing the form and arrangement of the plates. U. S. Nat. Mus. Cat. No. 73421.  
 4. Diagrammatic representation of the right postero-lateral ambulacrum of the specimen shown in Figure 3,  $\times 2\frac{1}{2}$ .

## PLATE 3

*Cassidulus kellumi* Stephenson (p. 5)

- FIG. 1. Upper surface of the test of a specimen having an apparently abnormal growth covering the apical system. U. S. Nat. Mus. Cat. No. 73421.  
 2. The peculiar growth covering the apical system of the specimen shown in Figure 1,  $\times 4$ .

*Cassidulus emmonsii* Stephenson (p. 7)

- FIG. 3. Upper surface of the test of the type. U. S. Nat. Mus. Cat. No. 73423.  
 4. Lower surface of the test of the type.  
 5. Posterior surface of the test of the type; the apparent subconical profile is due to slight crushing from above.  
 6. Upper surface of a typical specimen which has not been distorted by crushing. U. S. Nat. Mus. Cat. No. 73424.  
 7. Posterior surface of the specimen shown in Figure 6; note the even doming of this uncrushed specimen.  
 8. Outline profile of the specimen shown in Figure 6, as viewed from the right side.

## PLATE 4

*Cassidulus emmonsi* Stephenson (p. 7)

- FIG. 1. Upper surface of the test of a typical specimen from a well at the water-works at Wilmington, depth not stated. U. S. Nat. Mus. Cat. No. 28930.
2. Lower surface of the test of the specimen shown in Figure 1.
  3. Part of the upper surface of the same specimen,  $\times 3$ .
  4. The peristomal area of the same specimen,  $\times 3$ .
  5. Diagrammatic representation of part of the left antero-lateral ambulacrum of a typical specimen,  $\times 4$ . U. S. Nat. Mus. Cat. No. 73424.

## PLATE 5

*Linthia variabilis* Slocum (p. 10)

- FIG. 1. Upper surface of a specimen from Hilton Park, Wilmington, N. C. U. S. Nat. Mus. Cat. No. 73426; the test has been slightly flattened by crushing from above.
2. Lower surface of the specimen shown in Figure 1.
  3. Right lateral surface of the same specimen.
  4. Upper surface of a smaller specimen from Hilton Park which has been crushed laterally, and made to appear narrower than normal. U. S. Nat. Mus. Cat. No. 73426.
  5. Lower surface of the specimen shown in Figure 4.
  6. Right lateral surface of the same specimen.
  7. The same enlarged,  $\times 2$ .

*Glycymeris subgyrata* Stephenson (p. 12)

- FIGS. 8, 9. The type, a left valve. U. S. Nat. Mus. Cat. No. 73428.  
8a. Profile showing the convexity of the type.

*Lima insolita* Stephenson (p. 13)

- FIG. 10. The type, a right valve. U. S. Nat. Mus. Cat. No. 73431.

*Anomia major* Stephenson (p. 13)

- FIG. 11. The type, a left valve. U. S. Nat. Mus. Cat. No. 73422.

*Anomia penderana* Stephenson (p. 14)

- FIG. 12. The type, a left valve. U. S. Nat. Mus. Cat. No. 73434.

## PLATE 6

*Pholadomya sublevis* Stephenson (p. 15)

- FIG. 1. Left side of the type, an internal cast on which the external markings of the shell have been impressed by pressure after the removal of the shell by solution. U. S. Nat. Mus. Cat. No. 73435.
2. View of the upper surface of the type, showing also the convexity of the shell.

*Veniella (Etea) grandis* Stephenson (p. 16)

- FIGS. 3, 4. The type, a right valve. U. S. Nat. Mus. Cat. No. 73436.  
3a. Profile showing the convexity of the type.



*Cardium (Trachycardium) penderense* Stephenson (p. 19)

- FIGS. 5, 6. A typical left valve. U. S. Nat. Mus. Cat. No. 73442.  
 7. Internal view of a typical right valve.  
 8. A large typical left valve.  
 8a. Profile showing the convexity of the preceding specimen.

## PLATE 7

*Crassatellites carolinana* Stephenson (p. 17)

- FIGS. 1, 2. The type a left valve. U. S. Nat. Mus. Cat. No. 73438.  
 1a. Profile showing the convexity of the type.

*Cardium (Trachycardium) marsense* Stephenson (p. 20)

- FIGS. 3, 4. The type, a large left valve, from Mars Bluff, Peedee River, Florence County, S. C. U. S. Nat. Mus. Cat. No. 73440.  
 3a. Profile showing the convexity of the type.

## PLATE 8

*Crassatellites carolinana* Stephenson (p. 17)

- FIG. 1. View of the right side of an internal cast. U. S. Nat. Mus. Cat. No. 73439.  
 2, 3. A typical right valve. U. S. Nat. Mus. Cat. No. 73439.

## PLATE 9

*Pugnellus levis* Stephenson (p. 22)

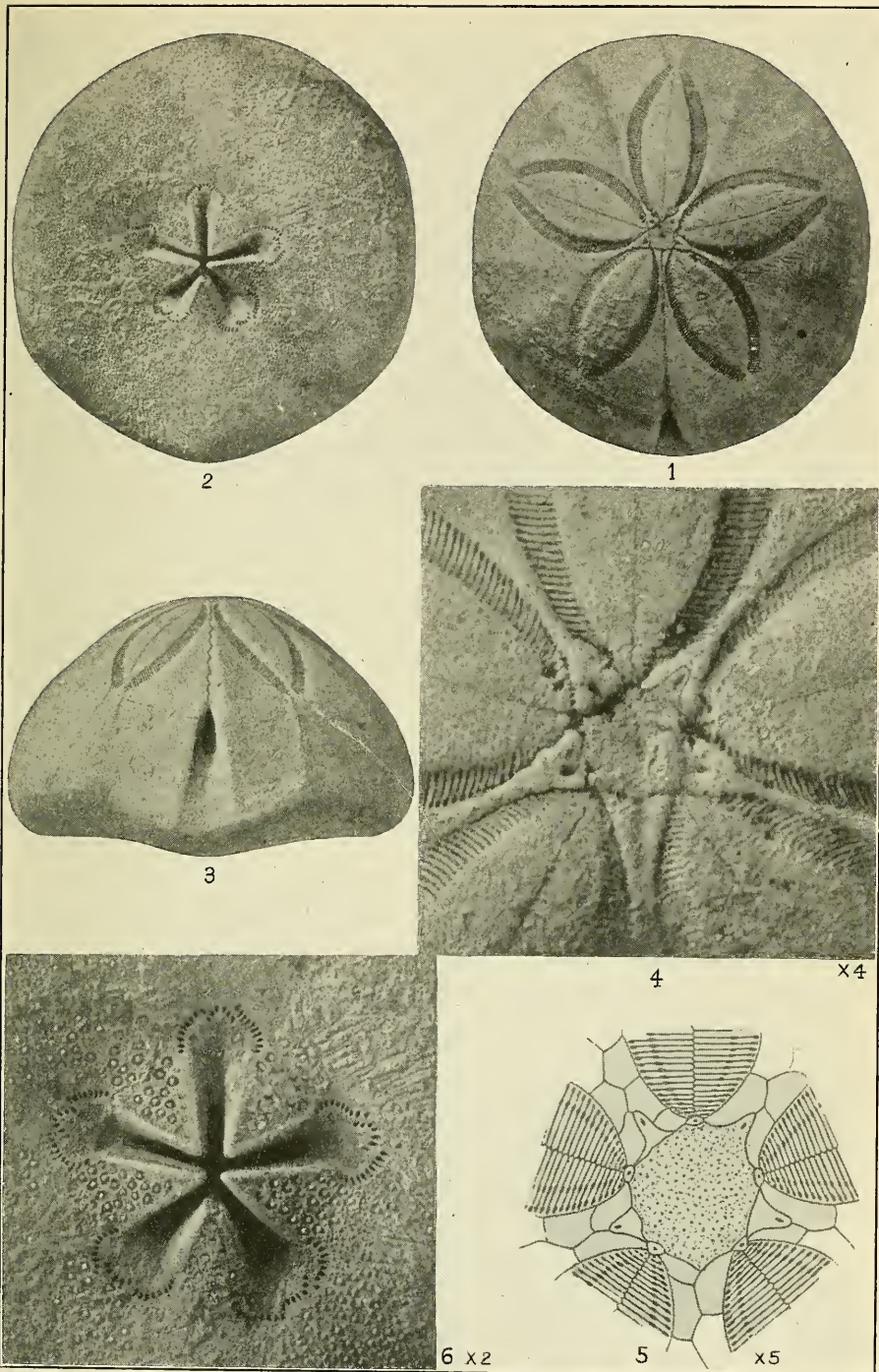
- FIGS. 1, 2, 3. Views of the type. U. S. Nat. Mus. Cat. No. 73446.  
 4, 5. Views of an internal cast probably belonging to this species. U. S. Nat. Mus. Cat. No. 73447.

*Turritella subtilis* Stephenson (p. 21)

- FIG. 6. The type. U. S. Nat. Mus. Cat. No. 73443.  
 7. Gutta-percha squeeze from the mold of the apical portion of a typical specimen. U. S. Nat. Mus. Cat. No. 73445.

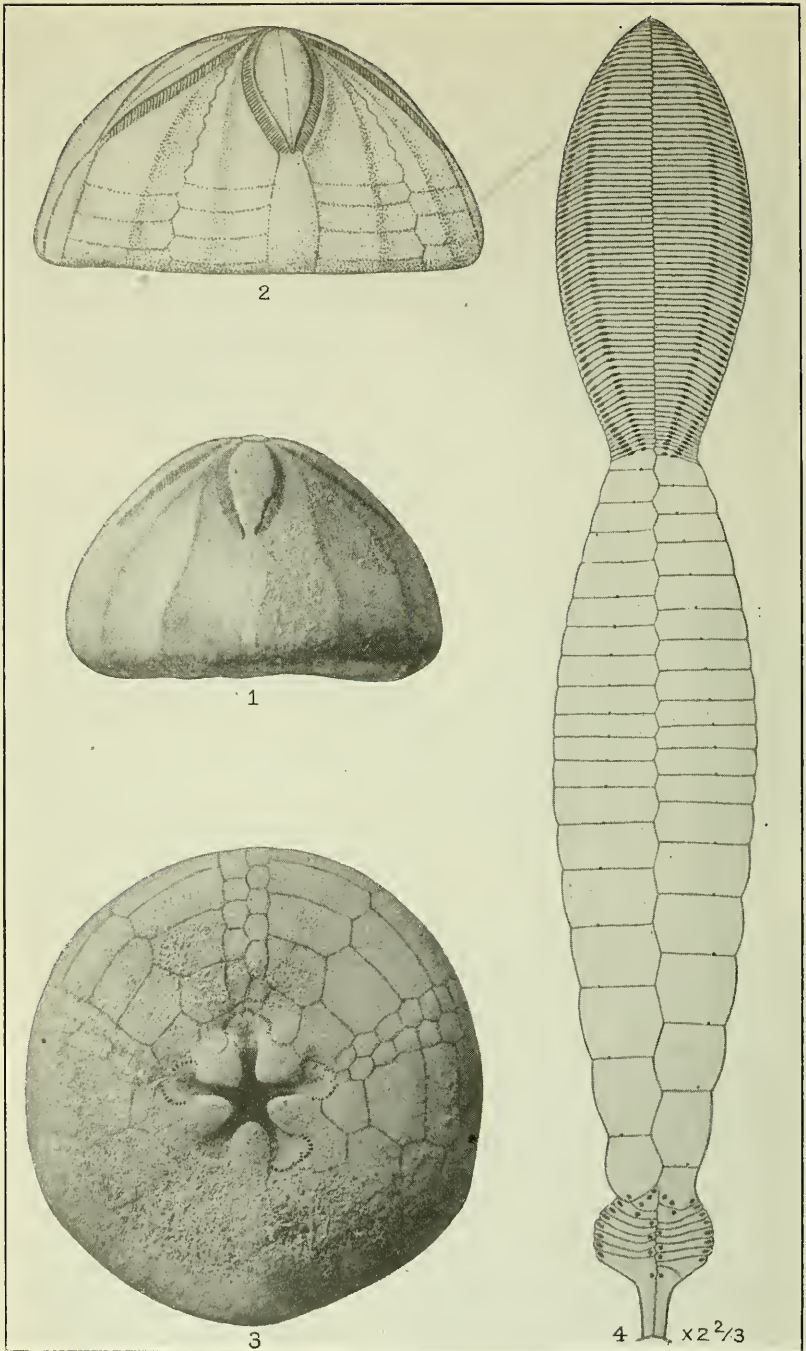






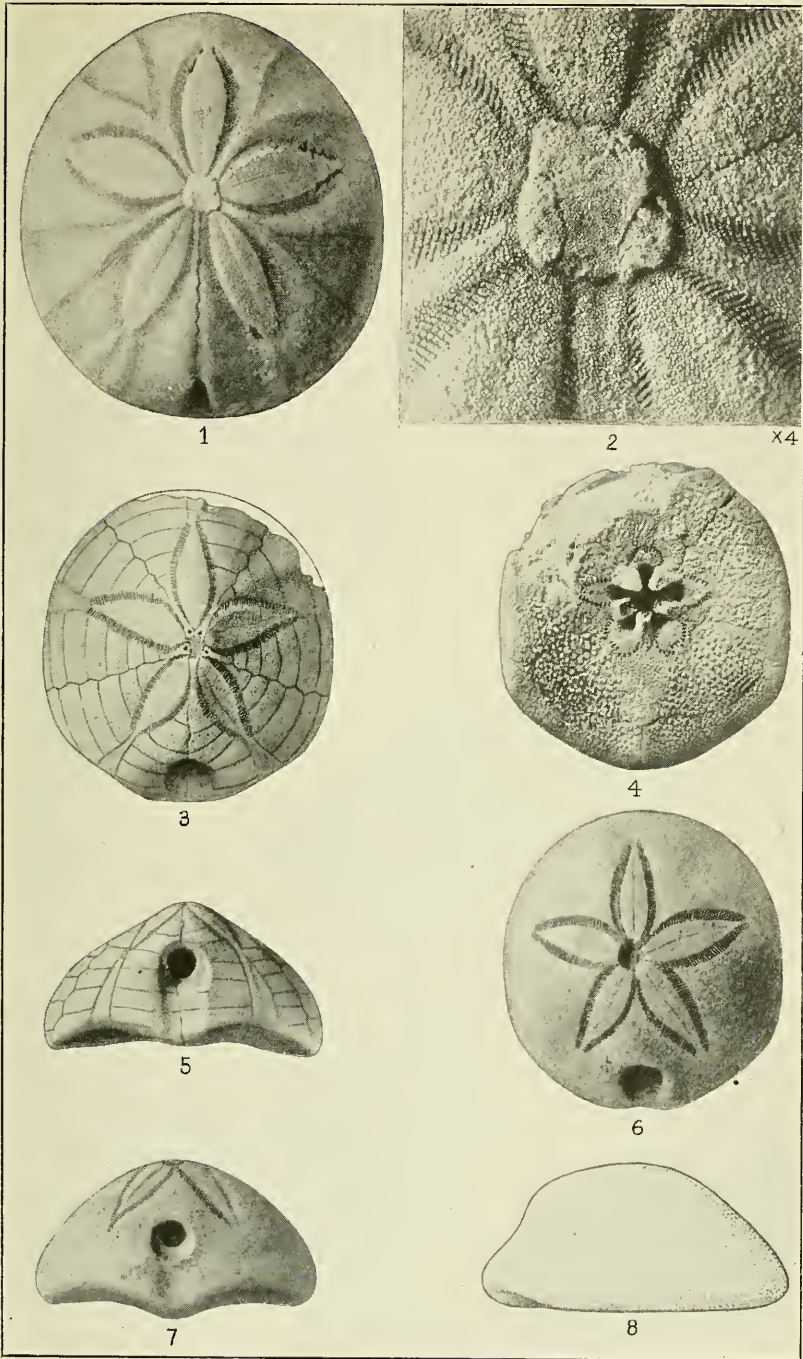
UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 23



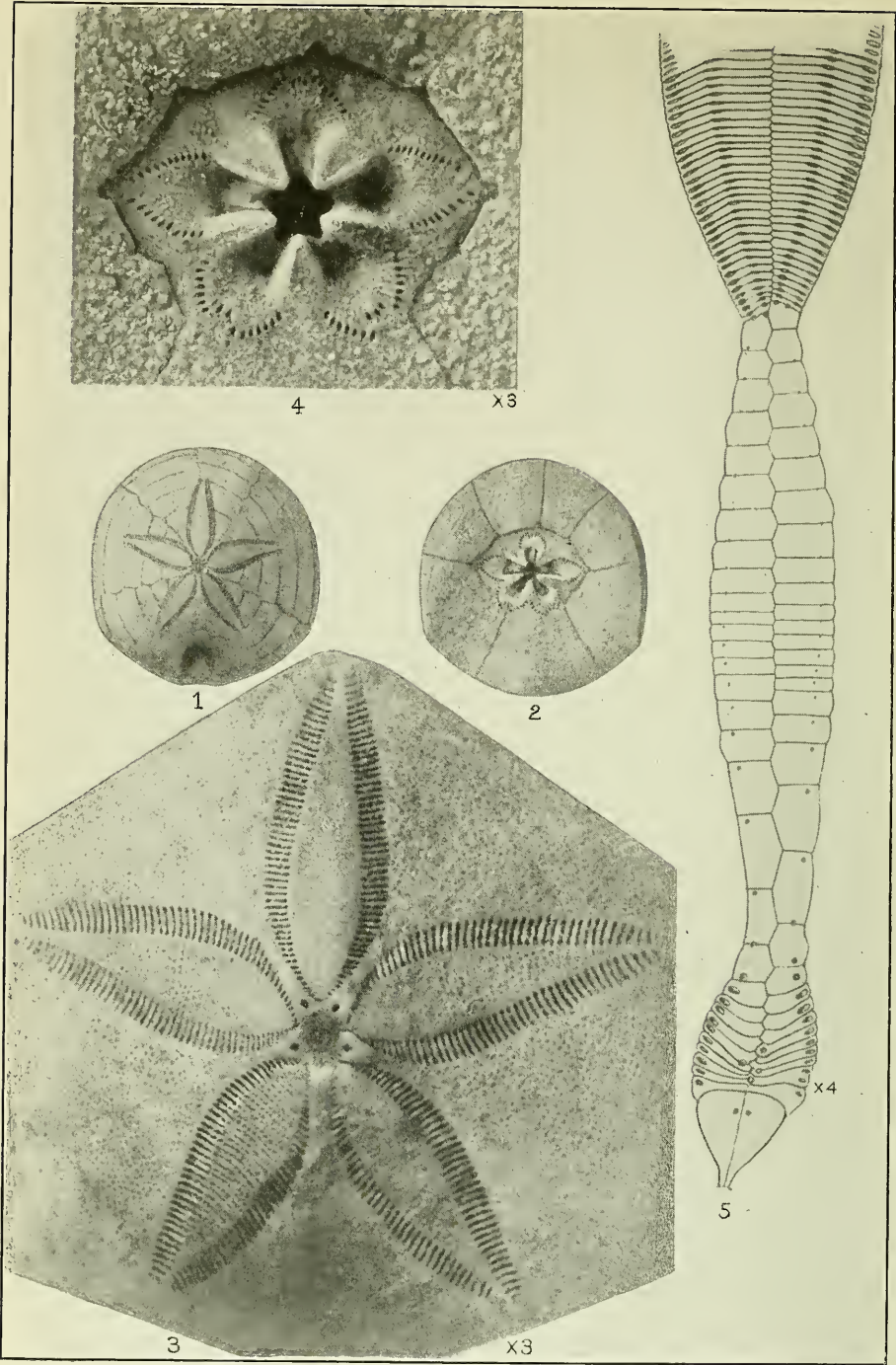
UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 23



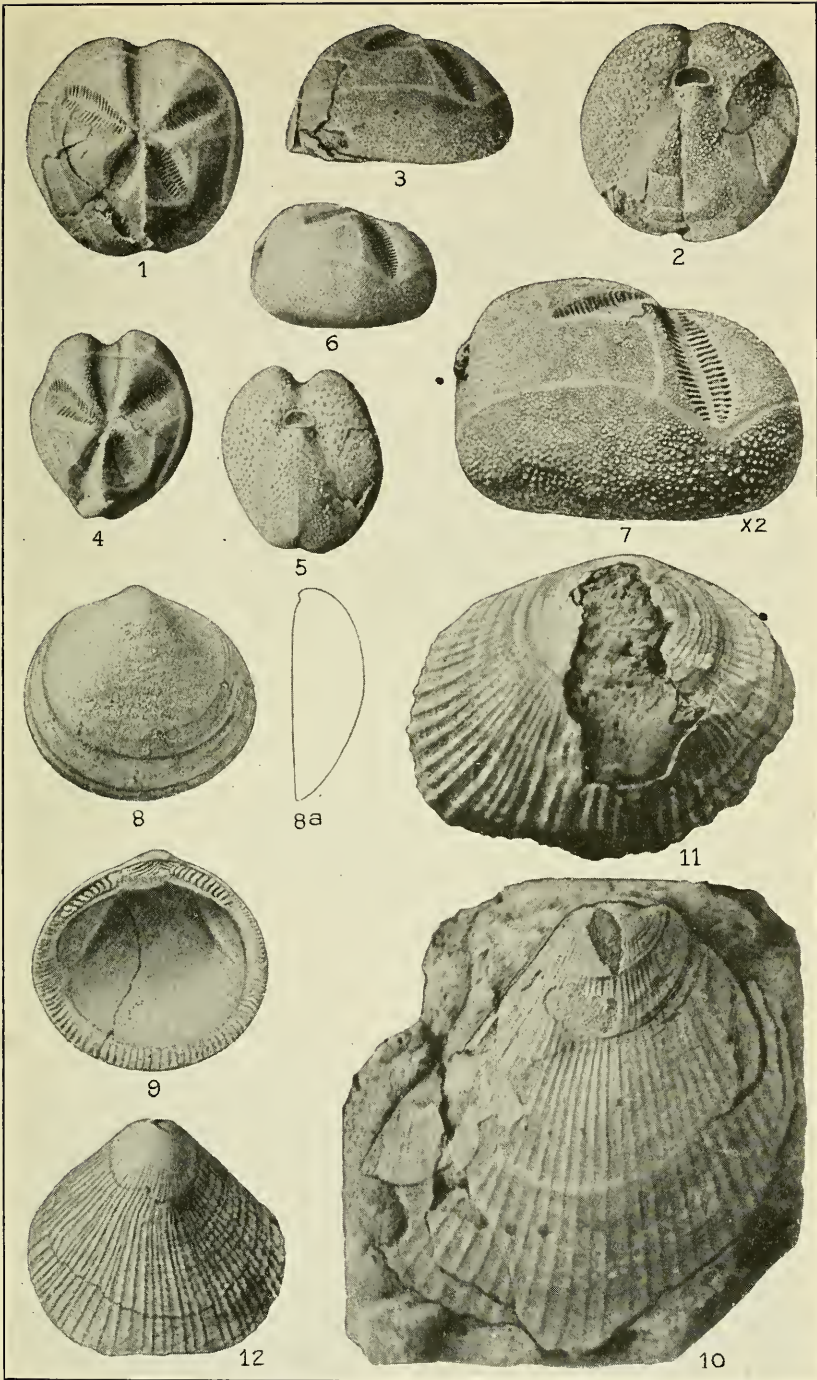
UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 23



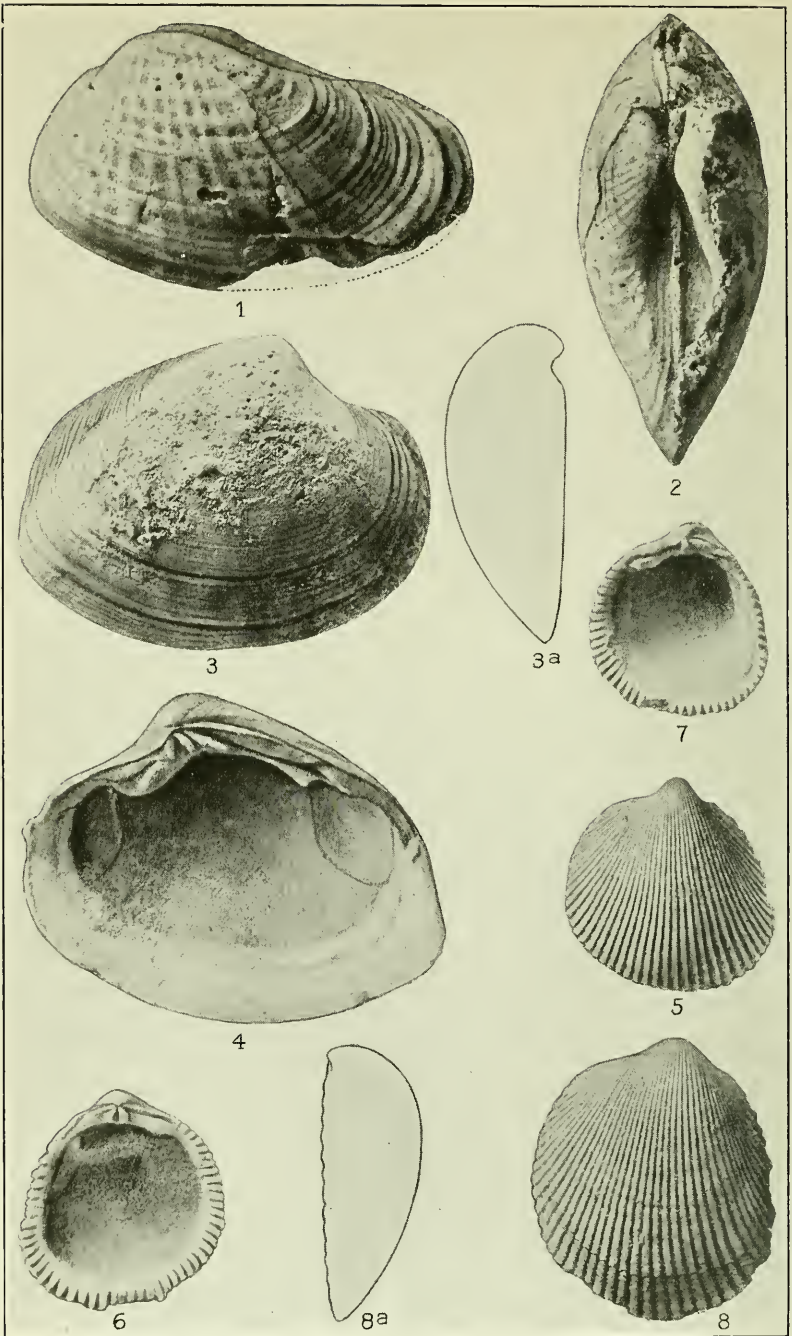
UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 24



UPPER CRETACEOUS ECHINOID AND MOLLUSCAN FOSSILS FROM NORTH CAROLINA

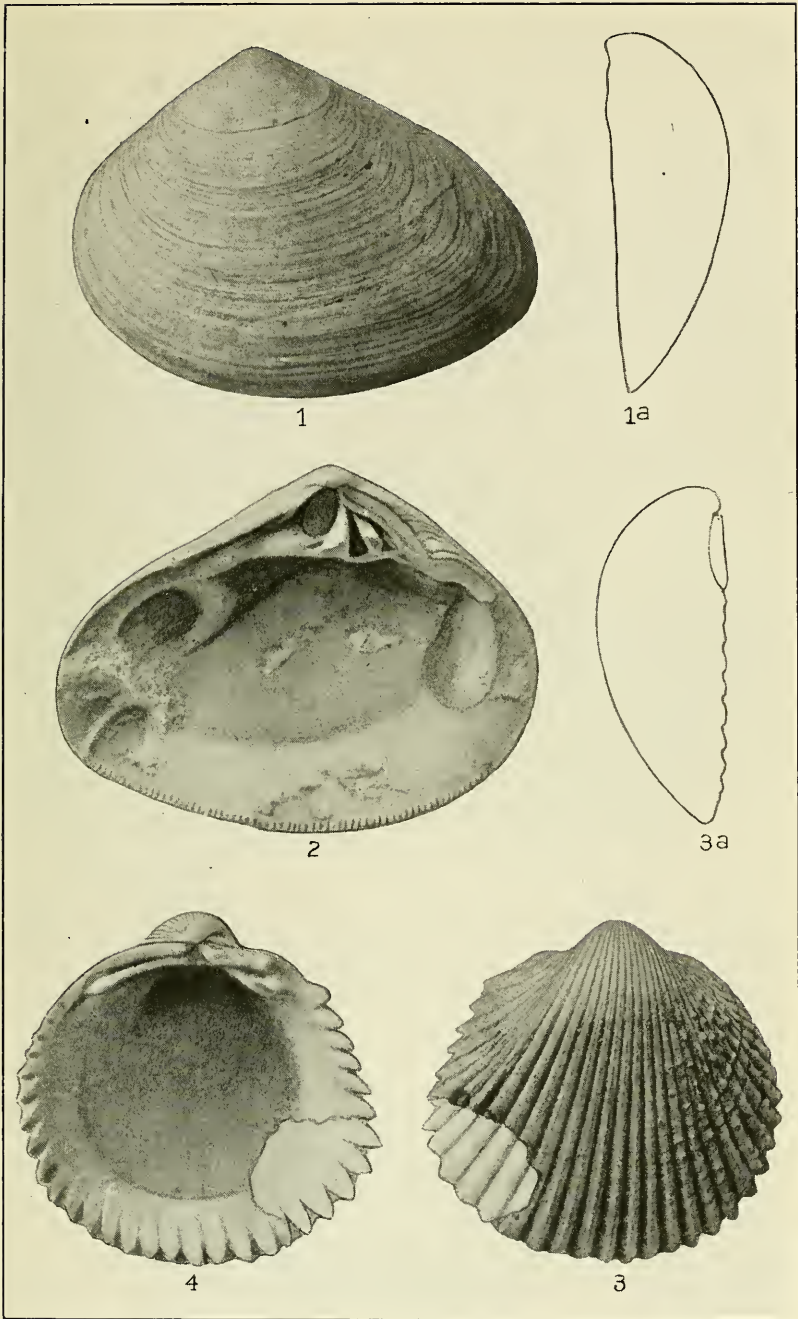
FOR EXPLANATION OF PLATE SEE PAGE 24



UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

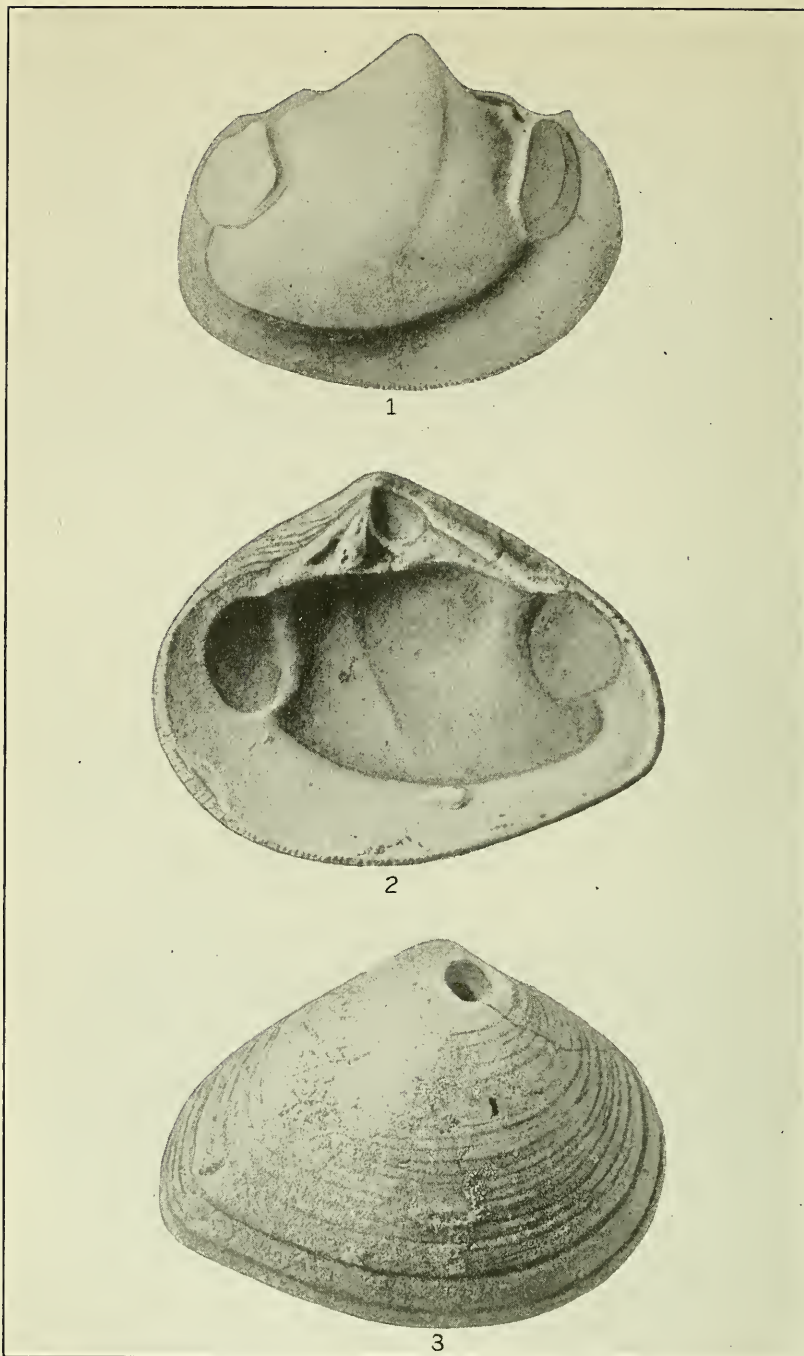
FOR EXPLANATION OF PLATE SEE PAGES 24 AND 25





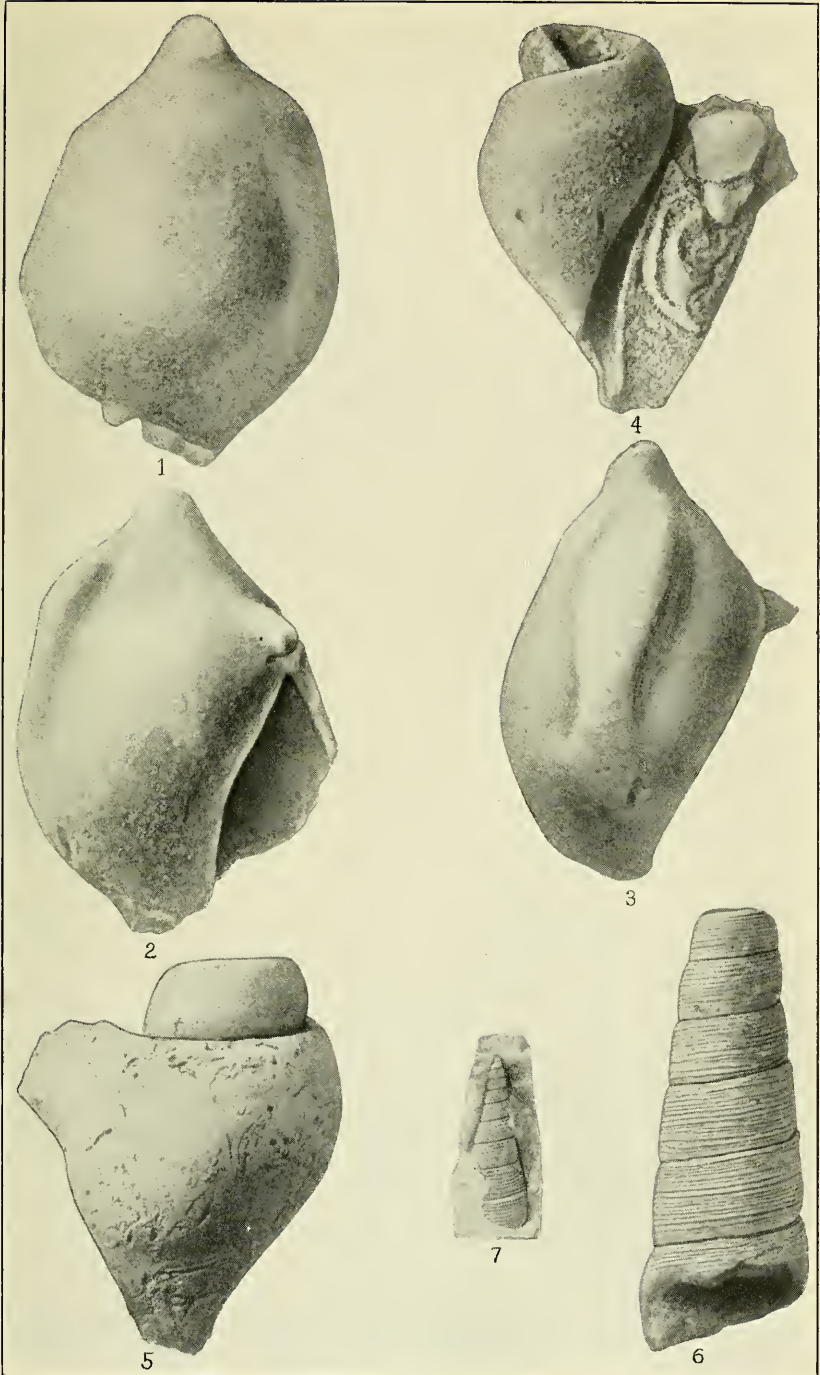
UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH AND SOUTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 25



UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 25



UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 24

