THE CRETACEOUS FOSSILS OF NEW JERSEY

Part 2

NEW JERSEY GEOLOGICAL SURVEY

STATE OF NEW JERSEY
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PALEONTOLOGY SERIES
Bureau of Geology and Topography
Kemble Widmer, State Geologist

THE CRETACEOUS FOSSILS OF NEW JERSEY

by

HORACE G. RICHARDS, *et al.*

A revision of the report on the *Cretaceous Paleontology of New Jersey* by Stuart Weller and published by the Geological Survey of New Jersey in 1907 as Volume IV of the Paleontology Series.

BULLETIN #61

PART II

GASTROPODA, SCAPHOPODA, NAUTILOIDEA, AMMONOIDEA, BELEMNITIDAE, CRUSTACEA, VERTEBRATA and MISCELLANEOUS FOSSILS

STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION and
ECONOMIC DEVELOPMENT

H. MAT ADAMS, Commissioner

Division of Resource Development
KENNETH H. CREVELING, Director

Trenton, N. J.

1962

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FOREWORD

"The Cretaceous Fossils of New Jersey," a standard work for both amateur and professional paleontologists, has been out-of-print for some time. Volume 1 was published in 1958 and volume 2 in 1962. Despite their age and their being long out of stock, a slow but steady demand continues for these books. For several years it has been necessary for the New Jersey Geological Survey to refer investigators to libraries and used book dealers.

This new printing is intended to eliminate this inconvenience. It is designed to satisfy the present-day demands and those in the near future. Accordingly, the re-issue is a new printing and not a new edition. Lack of funds for revision means that coverage is incomplete and nomenclature has not been updated. It is hoped that the second printing will nevertheless serve contemporary needs and that future funding may make possible a major revision and updating work on the Cretaceous fossils of the Garden State.

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COUNCIL OF THE

DIVISION OF PLANNING AND DEVELOPMENT

Mr. Kenneth H. Creveling, Director

Division of Planning & Development

Sir:

Transmitted, herewith, is Part II of Bulletin 61, The Cretaceous Fossils of New Jersey. This, together with the already published Part I, will provide up-to-date references and descriptions of the fossils of the Cretaceous formations of the New Jersey Coastal Plain. Basic information such as this is needed for the development of natural resources (particularly water, oil and natural gas) where the occurrence of these resources is restricted to specific geologic formations. The identification of fossils removed from core borings and drill holes permits the identification of specific formations at great depth below the surface. Although oil and natural gas have not been found in New Jersey, there is increasing interest in the geologic conditions in the Coastal Plain.

All authors were requested to follow a specified, concise style in writing their descriptions of fossils. No attempt was made to change the minor variations in the general format because each author was considered the expert best acquainted with the descriptive style generally used by his colleagues in the same field.

Respectfully submitted,

Kemble Widmer
State Geologist

The practical problems of publishing and binding required the presentation of this work in two parts. Part I was completed in 1958 and is available for sale by the New Jersey Bureau of Geology and Topography. It was originally planned to repeat four plates (43 to 46) because they contained both gastropods and pelecypods. However, *in the interest of economy this was not done*; therefore, it will be necessary to refer back to Part I for illustrations of certain species described in this volume. The table of species and a bibliography which apply to both parts appear at the end of this volume.

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PART II

CRETACEOUS GASTROPODS OF NEW JERSEY

by Stuart Weller

Revised and augumented by
HORACE G. RICHARDS
and
ROBERT C. RAMSDELL

Family Pleurotomariidae

Pleurotomaria crotaloides (Morton) 1834

Plate 47, Figure 2

Cirrus crotaloides, Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 49, pl. 19, fig. 5.

Architectonica Abbotti, Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 321. (In part.)

Margaritella Abbotti, Whitfield, 1892, p. 134, pl. 17, figs. 12-15.

Pleurotomaria crotaloides, Pilsbry, 1896, p. 10, pl. 1, figs. 1-3.

Pleurotomaria crotaloides, Weller, 1907, p. 665, pl. 75, figs. 7-9.

Description.—"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 cast, 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." (Whitfield.) The dimensions of an internal cast are: height 18mm.; maximum diameter, 34mm.

Remarks.—The species is not a very common one, and the internal casts usually do not retain the surface markings so clearly as Whitfield has figured them, some specimens even being almost entirely smooth.

Range in New Jersey—
MT. LAUREL-NAVESINK: 39A, 40, 47, 53
HORNERSTOWN: (?) Near Medford

Range outside New Jersey—
Alabama, Texas

Type.—*(P. crotaloides)* Erie, Alabama, ANSP 18776; *(A. abbotti)* Mullica Hill, N. J. ANSP 18781

Pleurotomaria tintonensis Whitfield 1892

Plate 46, Figure 7.

Pleurotomaria ? tintonensis Whitfield, 1892, p. 178, pl. 22, figs. 6-9.

This species was described by Whitfield from the "Middle Marl" at Tinton Falls, New Jersey. It is almost certainly a synonym of *P. crotaloides* (Morton).

Range in New Jersey—
TINTON: 63

Type.—Tinton Falls, N. J. AMNH 10682.

Pleurotomaria woolmani Pilsbry 1911

Plate 47, Figure 6.

Pleurotomaria crotaloides Morton, 1896, Proc. Acad. Nat. Sci. Phil. (1896), p. 10, pl. 1, figs. 1-3. not of Morton.

Pleurotomaria woolmani Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. (1911), p. 535.

Description.—"Shell (cast) rather discoidal, the spire low-conic, base flattened and very broadly umbilicated. Whorls slowly increasing, very convex, separated by deep sutures; the last whorl strongly convex on the upper surface, thence sloping outward to the periphery, which is quite convex again, and near the base of the whorl. Base distinctly flattened, though convex. Umbilicus somewhat exceeding one-third the total diameter, broad, deep and perspective, the sutures within it strongly impressed.

Diameter 7 cm.; width of last whorl at aperture (measured below) 26 mm.; alt. of same about 19 mm." (Pilsbry)

Range in New Jersey—
MT. LAUREL—NAVESINK: 53

Type.—Mullica Hill, N. J. ANSP 1625.

Family Patellidae

Patella tentorium Morton 1834

Plate 47, Fig. 1.

Patella tentorium, Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 50, pl. 1, fig. 11.

Helcion ? tentorium, Whitfield, 1892, p. 153, pl. 19, figs. 6-8.

Patella tentorium, Weller, 1907, p. 663, pl. 75, figs. 5-6.

Description.—"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 costae, 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." (Whitfield.)

Remarks.—The type specimen is unique.

Range in New Jersey—
MERCHANTVILLE: 16
NAVESINK: Arneytown

Type.—Arneytown, N. J. ANSP 19445.

Emarginula ladowae Eichman

Plate 46, Figures 4, 6.

Emarginula ladowae Eichman, 1955, Nautilus, Vol. 68, p. 113, pl. 4, figs. 7, 8.

This species was recently described from the Woodbury formation at Haddonfield, N. J. (Locality 24a). It should be noted that the magnification of the original figures should be x 10 instead of x 5 as indicated. Type ANSP 20394.

Family Turbinidae

Petropoma ? raritanum (Richards) 1943

Plate 43, Figure 16; Plate 45, Figures 2-3

Avellana ? raritana, Richards, 1943, p. 28, pl. 5, fig. 16.

Petropoma ? raritanum, Stephenson, 1954, p. 35, pl. 8, figs. 1, 2.

Description.—"Description based upon a rubber squeeze of the only known specimen. Shell of medium size; whorls about three, expanding rapidly. Body whorl rounded with relatively flat top. Ornamented with ten rows of punctate ribs separated from each other by grooves showing faint traces of punctae. Penultimate whorl with four ribs with much less conspicuous punctae; grooves between the ribs show only very faint traces of punctae. Apex not preserved. Aperture and columella not shown. Length 12.0 mm." (Richards)

Remarks.—Because of the incomplete preservation, any generic determination must be given with considerable doubt. Stephenson (1954) questionably refers it to *Petropoma.*

Range in New Jersey—
RARITAN: 1a

Type.—Sayreville, N. J. NJSM 10541 (squeeze of type ANSP 15663).

Family Angariidae (= Delphinulidae)

Delphinula navesinkensis Weller, 1907

Plate 47, Figure 3.

Delphinula navesinkensis, Weller, 1907, p. 669, pl. 75, figs. 18-19.

Description.—"The dimensions of the type specimen are: height, 10 mm.; maximum diameter, 15 mm. The shell has a low spire, with about two full volutions shown in the internal cast, with the suture well defined and with a broad, open umbilical cavity. The first volution increases rather rapidly in size but the enlargement of the outer volution is very gradual, its outer portion appearing, from the cast, to be free for a short distance. In the inner portion of the shell the exposed surface of the volutions is rounded, but in the outer volution, especially towards the aperture, a strong revolving angle is developed a little above the mid-height of the volution." (Weller)

Remarks.—Type specimen is unique.

Range in New Jersey—
NAVESINK: 46

Type.—Walnford, N. J.; NJSM 7577.

Urceolabrum reticulatum (Johnson) 1898

Plate 94, Figures 7, 8

Tuba reticulata, Johnson, 1898, Proc. Acad. Nat. Sci. Phila. (1898) p. 464.

Urceolabrum reticulatum, Stephenson, 1941, pp. 261, 270.

Description.—"Whorls very convex, with four equidistant, revolving, raised lines, which are crossed by equidistant longitudinal ribs of a corresponding size, which form equal, quadrate, interstices, except below the suture where the longitudinal ribs become obsolete. At the junction of the two series of raised lines are small tubercles throughout the entire shell. Owing to the imperfect apertures of the five specimens, its generic position remains doubtful, but its distinct sculpture will distinguish the species. Length of the largest specimens, 6 mill. probably attains the length of about 10 mill." (Johnson)

Remarks.—This species has apparently never been figured. The five cotypes were examined by Stephenson (1941) who suggested that they belonged to the genus *Urceolabrum.*

Range in New Jersey—
WOODBURY: 22

Type.—Mount Laurel, N. J. (150-160 feet); ANSP 689.

Family Eulimidae

Obeliscus conellus Whitfield 1892

Plate 47, Figure 11

Obeliscus conellus, Whitfield, 1892, p. 151, pl. 19, fig. 1.

Pyramidella conellus, Johnson, 1905, Proc. Acad. Nat. Sci. Phil. (1905) p. 20.

Obeliscus conellus, Weller, 1907, p. 672, pl. 76, fig. 1.

Description.—"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." (Whitfield)

Remarks.—The type specimen is unique and may represent an immature shell.

Range in New Jersey—
WOODBURY: 24

Type.—Haddonfield, N. J.; ANSP 15626.

Leiostraca cretacea (Conrad) 1869

Plate 47, Figure 8

Eulima cretacea, Conrad, 1869, Am. Jour. Conch., Vol. 5, p. 100, pl. 9, fig. 15.

Leiostreca cretacea, Whitfield, 1892, p. 150, pl. 19, figs. 2-5.

Leiostraca cretacea, Weller, 1907, p. 671, pl. 75, figs. 15-17.

Description.—"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." (Whitfield)

The dimensions of one of the type specimens are: height, 5.6 mm.; greatest diameter, 1.6 mm.; apical angle, 16°.

Range in New Jersey—
WOODBURY: 24

Type.—Haddonfield, N. J.; ANSP 15585.

Family Scalidae

Scala sillmani (Morton) 1834

Plate 50, Figure 3

Scalaria sillmani, Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 47, pl. 13, fig. 9.

Scalaria sillimani, Whitfield, 1892, p. 138, pl. 18, fig. 2.

Scala sillmani, Weller, 1907, p. 672, pl. 76, figs. 2-3.

Not *Scala sillmani* Wade 1926, p. 168=*Epitonium pondi* Stephenson.

Description.—"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 striae,' which one would suppose would naturally be the case. Mr. Gabb also speaks of it having 'much finer' revolving striae 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 varina.' " (Whitfield)

The dimensions of a large specimen are: height, 31 mm.; maximum diameter, 18 mm.

Range in New Jersey—
MERCHANTVILLE: 15
WOODBURY: 22
WENONAH: 34, 35
MT. LAUREL-NAVESINK: 40, 59
TINTON:

Range outside New Jersey—
Alabama

Type.—Prairie Bluff, Ala.; ANSP 15498.

Scala cyclostoma Gabb 1876

Plate 50, Figure 1

Scala (Opalia) cyclostoma, Gabb, 1876, Proc. Acad. Nat. Sci. Phil. (1876) p. 297.

Description.—"Shell smaller and slightly more slender than the preceding; whorls seven, cross sections circular; surface marked by numerous prominent recurved ribs, one of which on each whorl is thickened, showing a periodical arrest in growth; between these ribs is very minute revolving sculpture, a little more distinct on the earlier whorls. Aperture circular, bordered by a very thick expanded lip; base of body whorl bordered by a strong rib. Length .55 inches, width .25 inch." (Gabb)

Type.—New Jersey; ANSP 15496.

Scala thomasi Gabb ? 1876

Plate 50, Figure 2

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

Scalaria Thomasi ?, Whitfield, 1892, p. 137, pl. 18, fig. 1.

Scala thomasi, ? Weller, 1907, p. 674, pl. 76, fig. 4.

Description.—"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 volution 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." (Whitfield)

Range in New Jersey—
?

Type.—New Jersey; ANSP 15499.

Scala hercules (Whitfield) 1892

Plate 52, Figure 1

Scalaria hercules, Whitfield, 1892, p. 140, pl. 18, fig. 12.
Scala ? hercules, Weller, 1907, p. 675. pl. 76, fig. 8.

Description.—"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 12 to 14 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." (Whitfield)

Remarks.—"The original specimens used by Whitfield are very incomplete. The species is a large one and the larger specimen used by Whitfield must have been 100 mm. or more in height and 30 mm. or more in maximum diameter. The vertical ribs upon the volutions of this species are somewhat different than is usual in the genus, they being rounded, thickened ribs and not simply varical lips, the varix having been filled to a solid rib before the growth of the shell had progressed beyond it. The number of varices varies somewhat in the different volutions. The finer markings of the shell are not well preserved in the specimens, but on one specimen they seem to consist of closely-arranged spiral lines." (Weller)

Range in New Jersey—
MAGOTHY: 6

Type.—Cliffwood, N. J.

Family Architectonicidae

Margarites abyssina (Gabb) 1860

Plate 47, Figures 4, 5, 7

Solarium abyssinus, Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860), p. 94, pl. 2, fig. 9.

Margarita abyssina, Whitfield, 1892, p. 133, pl. 17, figs. 1-5.

Margarita abyssina, Weller, 1907, p. 669, pl. 75, figs. 20-22.

Margarites abyssina, Gardner, 1916, p. 505.

Margarites abyssina, Groot, Organist and Richards, 1954, p. 49.

Description.—"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, cancellating the surface." (Whitfield)

The dimensions of a rather large individual are: height, 9 mm.; maximum diameter, 10 mm.

Remarks.—Weller notes that individuals of this species from the Navesink formation normally are of a larger average size than those from the Merchantville formation. Gardner mentioned that although this species is intermediate in size and in number of whorls and relative attitude of the spire between *M. elevata* Gardner and *M. depressa* Gardner, it is more similar to the former than to the latter.

Range in New Jersey—
MERCHANTVILLE: 14, 15
WOODBURY: 20
MT. LAUREL-NAVESINK: 39, 40, 43, 46, 47, 49, 53
TINTON: 63

Range outside New Jersey—
Delaware, Maryland

Type.—Burlington County, N. J. ANSP 18780

Family Naticidae

Lunatia halli Gabb 1860

Plate 46, Figure 8; Plate 47, Figures 9, 10, 12; Plate 59, Figure 12.

Lunatia Halli Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 391, pl. 68, fig. 11.

Gyrodes altispira Whitfield, 1892, p. 128, pl. 16, figs. 7-8. (Not of Gabb, 1862)

Lunatia Halli Whitfield, 1892, p. 130, pl. 15, figs. 13-16.

Lunatia halli Weller, 1907, p. 677, pl. 76, figs. 9-19.

Polynices (Euspira) halli Gardner, 1916, p. 499, pl. 13, figs. 1-2.

Lunatia halli Groot, Organist, and Richards, 1954, p. 49.

Not *Polynices halli* Wade, 1926, p. 163, = *P. rectilabrum* Conrad.

Description.—"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." (Whitfield)

Range in New Jersey—
MERCHANTVILLE: 15, 16, 17
WOODBURY: 22, 23
WENONAH: 35
MT. LAUREL-NAVESINK: 37, 38, 39, 40, 41, 43, 46, 47, 50, 53

Range outside New Jersey—
Delaware, Maryland

Type.—Mullica Hill, N. J.; ANSP 15119.

Lunatia ? pauperata (Whitfield) 1892

Plate 47, Figure 13

Scalaria ? pauperata Whitfield, 1892, (part), p. 141, pl. 18, figs. 5, 6 (not figs. 3, 4, 7.)

Lunatia ? pauperata Weller, 1907, p. 680, pl. 76, figs. 20-23.

Description.—Shell of medium size, the dimensions of the larger of the two type specimens being; height, 24 mm.; maximum diameter, 19 mm.; height of aperture, 14.2 mm.; width of aperture, 10 mm. Volutions rounded, about four in number, separated in the casts by distinct and deeply marked sutures; spire elevated, the apical angle 70°-80°, *the last volution forming one-half or more than one-half the entire* height of the shell. Aperture subovate, rounded below, slightly more pointed above, the inner margin straighter than the outer. External surface characters of the shell not known. (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 47

Type.—Crosswicks Creek, N. J. NJSM 7605.

Amauropsis meekana Whitfield 1892

Plate 48, Figure 1

Amauropsis paludinaeformis, Gabb, 1876, Proc. Acad. Nat. Sci. Phil., 1876, p. 296. (Not *A. paludinaeformis* Meek & Hayden)

Amauropsis Meekana, Whitfield, 1892, p. 131, pl. 16, figs. 22-25.

Amauropsis meekana, Weller, 1907, p. 681, pl. 77, figs. 1-3.

Amauropsis meekana, Gardner, 1916, p. 503.

Amauropsis meekana, Groot, Organist and Richards, 1954, p. 49.

Description.—"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." (Whitfield)

The dimensions of one of the type specimens are: height, 24 mm.; maximum diameter, 14.5 mm.; height of aperture, 14.5 mm. The largest individual observed has a height of 27 mm.; and many specimens are *much smaller than the dimensions of the type given.*

Range in New Jersey—
MERCHANTVILLE: 8
WOODBURY: 18, 19, 24

Range outside New Jersey—
Delaware

Type.—Haddonfield, N. J. ANSP 15159.

Amauropsis punctata (Gabb) 1860

Plate 48, Figures 2-4

Phasianella punctata, Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 299, pl. 48, fig. 3.

Amauropsis punctata, Whitfield, 1892, p. 132, pl. 16, figs. 17-21.

Amauropsis punctata, Weller, 1907, p. 682, pl. 77, figs. 4-6.

Description.—"Shell small or of medium size, with an elevated spire which has an apical angle of from 40°-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." (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 53

Type.—Mullica Hill, N. J. ANSP 15156.

Amauropsis cadwaladeri Richards 1943

Plate 43, Figure 19

Amauropsis cadwaladeri, Richards, 1943, p. 28, pl. 5, fig. 19.

Description.—Shell of medium size, smooth, spire elevated; spire about the length of the aperture. Whorls about five, broadly rounded. Suture deeply sulcate. Length 15.5 mm.; width 9.5 mm. (Richards)

Remarks.—Resembles *Amauropsis* sp. Stephenson (1941, p. 278) from Navarro group of Texas.

Range in New Jersey—
RARITAN: 1a

Type.—Sayreville, N. J.; NJSM 10463, paratype ANSP 15656.

Gyrodes abyssinus (Morton) 1834

Plate 48, Figures 6, 8

Natica abyssina Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 49, pl. 13, fig. 13.

Gyrodes abbotti Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 320.

Natica abyssina Whitfield, 1892, (part), p. 123, pl. 15, figs. 9-10 (not figs. 11-12).

Gyrodes abbotti Whitfield, 1892, p. 124, pl. 15, fig. 17.

Gyrodes abyssina Weller, 1907, p. 683, pl. 77, figs. 7-9.
Gyrodes abyssinus Gardner, 1916, p. 498.
Gyrodes abyssina Groot, Organist and Richards, 1954, p. 49.

Description.—"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." (Whitfield)

The dimensions of a large individual are: height 57 mm.; greatest diameter, 63 mm.; height of aperture, 45 mm.; width of aperture, 36 mm.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 40, 45, 47, 53.

Range outside New Jersey—
Delaware, Maryland, Alabama, Mississippi.

Type.—Mullica Hill, N. J.; (type of *G. abbotti*, Mullica Hill, N. J.; ANSP 15145).

Gyrodes supraplicatus (Conrad) 1858

Plate 48, Figures 5, 7, 9, Plate 49, Figure 1

Rapa supraplicata, Conrad, 1858, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 3, p. 332, pl. 35, fig. 20.
Natica (Gyrodes) crenata, Conrad, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 289.
Natica infracarinata, Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861) p. 319.
Gyrodes crenata, Whitfield, 1892, p. 126, pl. 16, figs. 5-6.
Gyrodes infracarinata Whitfield, 1892, p. 125, pl. 15, figs. 13-16.
Gyrodes crenata, Weller, 1907, p. 685, pl. 77, figs. 10-12.
Gyrodes supraplicatus, Stephenson, 1923, p. 357, pl. 89, figs. 1-6.
Gyrodes supraplicatus, Stephenson, 1941, p. 280, pl. 51, figs. 13-16.
Gyrodes supraplicatus, Groot, Organist and Richards, 1954, p. 49.

Description.—Shell of medium size, the dimensions of a rather large internal cast being; maximum width, 30 mm.; height, 23 mm.; height of aperture, 20 mm.; width of aperture, 13.5. Depressed globular above with a depressed spire, broadly umbilicate below. Volutions about four in number, the outer one of which forms fully two-thirds of the bulk of the entire shell, largest below the middle, the casts slightly flattened on top adjacent to the suture, strongly angular on the base bordering the umbilicus. Aperture large, oblique, widest below the middle. In specimens preserving the shell, or in impressions of the exterior, a distinct band of elevated crenulations or transverse nodes marks the top of the volutions just below the suture, and forms a decided ridge around the spiral portion of the shell. Surface of the shell marked by fine lines of growth parallel with the margin of the aperture, and passing over the line of nodes on the upper surface of the volution. (Weller)

Remarks.—Since most of the New Jersey specimens of these species are poorly preserved casts, their identification often is uncertain.

Range in New Jersey—
MERCHANTVILLE: 8, 10, 15
WOODBURY: 24
WENONAH: 34

Range outside New Jersey—
Delaware, North Carolina, Georgia, Alabama, Mississippi, Texas.

Type.—*(G. supraplicatus)* Crosswicks, N. J. Lost.
(N. infracarinata) Crosswicks, N. J. ANSP 15132.
(G. crenata) Tippah County, Miss. ANSP 15133.

Gyrodes petrosus (Morton) 1834

Plate 49, Figure 3; Plate 44, Figures 4, 5

Natica petrosa Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 48, pl. 19, fig 6.

Gyrodes petrosus Whitfield, 1892, p. 127, pl. 16, figs. 1-4.

Gyrodes petrosus Weller, 1907, (part), p. 689, pl. 77, figs. 13-15 (not figs. 16-18).

Gyrodes petrosus Stephenson, 1941, p. 282, pl. 51. figs. 1-7.

Gyrodes petrosus Groot, Organist and Richards, 1954, p. 49, (not *Gyrodes petrosus* Gardner, 1916, p. 496, pl. 13, fig. 8 = *G. subcarinatus* Stephenson ?).

Description.—"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." (Whitfield)

The dimensions of an average-sized adult specimen are: maximum diameter, 25 mm.; height, 19 mm.; height of aperture, 23 mm.; width of aperture, 12 mm.

Range in New Jersey—
RARITAN: 1a
MERCHANTVILLE: 10, 15
WENONAH: 34, 35
MT. LAUREL-NAVESINK: 37, 39, 40, 41, 46, 47, 49, 53
RED BANK: 59, 60

Range outside New Jersey—
Delaware, Maryland, Alabama, Mississippi, Texas

Type.—Prairie Bluff, Alabama; ANSP 15140.

Polinices altispira (Gabb) 1861

Plate 49, Figures 2, 4

? *Lunatia altispira,* Gabb. 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 320.

? *Gyrodes obtusivolva,* Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 320.

Gyrodes obtusivolva, Whitfield, 1892, p. 129, pl. 16, figs. 9-12.

Gyrodes altispira, Weller, 1907, p. 687, pl. 77, figs. 19-21.

Polynices (Euspira) altispira, Gardner, 1916, p. 500, (not *Gyrodes altispira* Whitfield, 1892, p. 128, pl. 16, figs. 7-8 = *Lunatia halli.*)

Description.—"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 tranverse lines of growth." (Whitfield)

The dimensions of a large individual are: maximum diameter, 23 mm.; height 20 mm.; height of aperture, 17 mm.; width of aperture, 13 mm.

Remarks.—Gardner placed this species in the subgenus *Euspira* rather than *Gyrodes* because of the "very small umbilical area and pit." Gabb's *G. obtusivolva* is specifically identical with this species. The specimen which Whitfield described and illustrated as a representative of *G. altispira* is an example of *Lunatia halli.*

Range in New Jersey—
MERCHANTVILLE: 8, 15

WOODBURY: 20

Range outside New Jersey—
Maryland

Type.—Crosswicks, N. J.; apparently lost; paratypes ANSP 19638; type of *G. obtusivolva*, New Jersey; ANSP 15137.

Family Xenophoridae

Xenophora leprosa (Morton) 1834

Plate 49, Figures 5, 6

Trochus leprosus Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 46, pl. 15, fig. 6.

Xenophera leprosa, Whitfield, 1892, p. 135, pl. 17, figs. 16-19.

Xenophora leprosa, Weller, 1907, p. 690, pl. 78, figs. 1-3.

Xenophora leprosa, Gardner, 1916, p. 495.

Xenophora leprosa, Wade, 1926, p. 162, pl. 56, figs. 7-8.

Xenophora leprosa, Stephenson, 1941, p. 284, pl. 52, figs. 17-19.

Xenophora leprosa, Groot, Organist and Richards, 1954, p. 50.

Description.—"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." (Whitfield)

The dimensions of an internal cast are: height, 28 mm.; maximum diameter, 44.5 mm.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 40, 47, 49

Range outside New Jersey—
Delaware, Tennessee, Alabama, Mississippi, Texas.

Type.—Prairie Bluff, Ala.; ANSP 15361.

Endoptygma umbilicata (Tuomey) 1855

Plate 49, Figures 7, 8

Phorus umbilicatus Tuomey, 1855, Proc. Acad. Nat. Sci. Phil. Vol. 7, p. 169.

Endoptygma umbilicata Whitfield, 1892, p. 136, pl. 17, fig. 20.

Endoptygma umbilicata Weller, 1907, p. 692, pl. 78, figs. 4-6.

Endoptygma umbilicata Groot, Organist and Richards, 1954, p. 50.

Description.—"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 this 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." (Whitfield)

The dimensions of an average specimen are: height, about 14 mm.; maximum diameter, 19.5 mm.

Range in New Jersey—
MERCHANTVILLE: 8, 13, 15
WOODBURY: 20

Range outside New Jersey—

Delaware, Alabama, Mississippi.

Type.—Noxubee County, Mississippi.

Family Trichotropidae

Lirpsa ? lepida Stephenson 1955

Plate 45, Figure 10

Lirpsa ? lepida Stephenson, 1954, p. 30, pl. 8, figs. 6-13.

Description.—"This species is represented at the southern pit of the New Jersey Clay Products Co. (USGS 19014) by many external and internal molds some of which show the form and sculpture of the shell more clearly than others. Shell of medium size with low spire and rapidly expanding whorls; spiral angle 75° to 80° on different individuals. Suture of medium depth, closely appressed in earlier stages, becoming loosely coiled in the adult stage. Form and attitude of protoconch not determined. Whorls 2 or 3. Body whorl large; side gently convex in profile, sloping steeply from suture to a carinated shoulder which may also be considered the periphery; base below the periphery steep, gently convex. Exposed part of penultimate and antepenultimate whorls gently convex." (Stephenson)

Remarks.—Related to *L. teres* Stephenson from the Woodbine formation of Texas. For further description see Stephenson (1954).

Range in New Jersey—
RARITAN: 1b

Type.—Sayreville, N. J.; USNM 108663.

Family Vermetidae

Siliquaria pauperata Whitfield 1892

Plate 50, Figures 8, 9

Siliquaria pauperata Whitfield, 1892, p. 149, pl. 18, figs. 26-28.

Siliquaria pauperata Weller, 1907, p. 705, pl. 79, figs. 18-20.

Description.—"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." (Whitfield)

Range in New Jersey—
NAVESINK:

Type.—New Jersey; ANSP 15558.

Laxispira lumbricalis Gabb 1876

Plate 57, Figures 10, 11

Laxispira lumbricalis Gabb, 1876, Proc. Acad. Nat. Sci. Phil. (1876) p. 301.

Laxispira lumbricalis, Whitfield, 1892, p. 148, pl. 18, fig. 25.

Laxispira lumbricalis Weller, 1907, p. 706, pl. 81, figs. 1-2.

Laxispira lumbricalis Gardner, 1916, p. 485.

Laxispira lumbricalis Wade, 1926, p. 159, pl. 55, figs. 5-8.

Laxispira lumbricalis Groot, Organist and Richards, 1954, p. 50.

Description.—The dimensions of a large specimen, an internal cast, are: height, 29 mm.; maximum diameter, 12.5 mm.; apical angle, about

28°; number of volutions about four and a half; height of aperture, 8.5 mm.; width of aperture, 6.3 mm. Shell forming an open spiral, in which the volutions are not in contact, the sutural space in the casts being nearly as wide as the diameter of the volutions. Cross section of the volutions nearly circular, except in the outer volution of mature shells, in which, near the aperture, the shell is slightly compressed, making the aperture higher than it is wide and straighter on the inner than on the outer lip. Surface of the shell marked with fine, raised, revolving lines, from two to four of which occupy the space of one millimeter and by transverse lines of growth. (Weller)

Range in New Jersey—
MERCHANTVILLE: 8, 10, 15
WOODBURY: 18, 24

Range outside New Jersey—
Delaware, Mississippi, Tennessee.

Type.—Haddonfield, N. J.; ANSP missing.

Family Turritellidae

Turritella vertebroides Morton 1834

Plate 49, Figure 9; Plate 50, Figure 5

Turritella vertebroides Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 47, pl. 3, fig. 13.

Turritella vertebroides Whitfield, 1892, p. 146, pl. 18, figs. 13-15 and ? 16-18.

Turritella vertebroides Weller, 1907, p. 693, pl. 78, fig. 15, and ? figs. 16-17 (not fig. 14).

Turritella vertebroides Stephenson, 1923, p. 366, pl. 91, figs. 11-14.

Description.—Shell acutely angular, the apical angle about 20°; the dimensions of a large individual from Alabama are: maximum diameter, 20 mm.; length with the apex broken, 64 mm.; number of volutions preserved, 10. Suture moderately impressed, situated a little below the center of a rounded, revolving furrow; surface of the volutions depressed convex from suture to suture. Surface marked by four or five subequal, angular, revolving costae, with several much finer ones occupying each of the interspaces, and by fine transverse lines of growth which describe a concave curve in passing downward from the suture. In the casts the volutions are moderately close, the surface is smooth and rounded curving rather abruptly into the sutures above and below. (Weller)

Remarks.—Most of the New Jersey specimens representing this species are imperfectly preserved internal casts.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 40, 45, 47, 50

Range outside New Jersey—
North Carolina, South Carolina, Alabama, Mississippi, Tennessee, Arkansas; varieties from Texas.

Type.—New Jersey; ANSP 2287.

Turritella encrinoides Morton 1834

Plate 49, Figures 11, 12

Turritella encrinoides Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 47, pl. 3, fig. 7.
Turritella encrinoides Whitfield, 1892, p. 143, pl. 18, figs. 19-22.
Turritella encrinoides Weller, 1907 (part), p. 694, pl. 78, figs. 10-13.
Turritella encrinoides Gardner, 1916, p. 492.
Turritella encrinoides Wade, 1926, p. 160, pl. 56, fig. 4.
Turritella encrinoides Groot, Organist and Richards, 1954, p. 50, pl. 6, fig. 2.

Description.—Shell acutely angular, the angle of divergence of the sides being about 20°. Suture not strongly impressed, situated in an angular, rounded furrow; surface of the volutions depressed convex, nearly flat in the central portion and curving more abruptly to the sutures above and below. Surface marked by three major revolving costae which are flattened on top; in addition to the major costae there are lower, angular, revolving ribs situated as follows, one between the lower suture and the first major costa, one between the first and second costae, two between the second and third costae, and two between the third major costa and the upper suture. In the casts the sutures are rather close, especially between the lower and larger volutions; the lower volutions are more or less quadrangular in cross-section, the upper ones being rounder, due undoubtedly to the internal thickening of the shell with age. (Weller)

Remarks.—Casts of this species are very similar to casts of *Turritella vertebroides* Morton but can be distinguished from the latter species with which they often are associated by the "quadrangular cross-section of their larger volutions."

Range in New Jersey—
MERCHANTVILLE: 15, 16, 17
WOODBURY: 20, 24
MT. LAUREL-NAVESINK: 37, 39, 40, 41, 43, 45, 47, 49, 53

Range outside New Jersey—
Delaware, Maryland, Tennessee.

Type.—New Jersey; ANSP 15519.

Turritella quadrilira Johnson 1898

Plate 50, Figure 6; Plate 51, Figure 2

Turritella quadrilira Johnson, 1898, Ann. Rep. Geol. Surv. N. J. for 1897, p. 264.

Turritella quadrilira Johnson, 1898, Proc. Acad. Nat. Sci. Phil. (1898), p. 463.

Turritella quadrilira Weller, 1907, p. 695, pl. 78, fig. 7.

Turretella quadrilira Stephenson, 1923, p. 363, pl. 90, figs. 10-11.

Turritella quadrilira Groot, Organist and Richards, 1954, p. 50, pl. 6, fig. 3.

Description.—Apical angle about 20°; the figured specimen is the apical portion of a shell 19.5 mm. in length, with a maximum diameter of 8 mm., showing nine volutions. Suture situated a little above the middle line of a broad, smooth, depressed, concave channel whose lower slope is less abrupt than the upper, and whose width is more than one-half the width of the elevated portion of the volutions. Surface of the volutions between the sutural depression, a little convex and marked by four strong, angular, revolving ribs, the uppermost of which is slightly smaller than the others; the interspaces between the ribs are broader than the ribs themselves, smooth and rounded in the bottom. (Weller)

Remarks.—This species, *Turritella trilira* Conrad, and *T. bilira* Stephenson, are closely related and may form an evolutionary group.

Range in New Jersey—
MAGOTHY: 5, 6
WOODBURY: 19, 22, 23
ENGLISHTOWN: 26 (?)

Range outside New Jersey—
North Carolina, Georgia, Alabama, Mississippi, Arkansas, Delaware.

Type.—Mt. Laurel well, N. J.; ANSP 690.

Turritella granulicosta Gabb 1861

Plate 51, Figures 1, 3

Turritella granulicosta Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 363.

Turritella ? granulicosta Whitfield, 1892, p. 144, pl. 18, figs. 10-11.

Turritella compacta Whitfield, 1892, p. 142, pl. 18, figs. 8-9.

Turritella ? granulicosta Weller, 1907, p. 696, pl. 79, figs. 15-17.

Description.—"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. Surface marked by about 12 fine, threadlike 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." (Whitfield)

Range in New Jersey—
WOODBURY: 24
? NAVESINK: 57

Type.—Burlington Co., N. J.; ANSP 15549; Haddonfield, N. J.; ANSP 15481 (cotype of *T. compacta)*; Vincentown, N. J. (?); ANSP 15484 (cotype of *T. compacta)*.

Turritella lenolensis Weller 1907

Plate 51, Figure 12

Turritella lenolensis Weller, 1907, p. 698, pl. 78, fig. 8.

Description.—Apical angle about 18°. The type specimen is the apical portion of a shell 11.5 mm. in length and 4.5 mm. in maximum diameter, and retains 10 volutions. The volutions are sharply carinate at about their mid-height, the space between the carinae of adjacent volutions being a broad, deep, concave, revolving depression, whose upper slope is more abrupt than the lower, and whose greatest depth is a little above the middle. Suture situated near the middle of the revolving depression, a little below the line of greatest depth. The entire surface of the shell is marked with very fine, elevated, revolving, lines. (Weller)

Remarks.—The type specimen is only the apical portion of a shell, the apertural portion being incomplete. It is therefore possible that this species may attain greater dimensions and a larger number of volutions than indicated above.

Range in New Jersey—
MERCHANTVILLE: 15, 16
WOODBURY: 24

Type.—Haddonfield and Lenola, N. J.

Turritella lippincotti Whitfield 1892

Plate 51, Figures 4, 6

Turritella Lippincotti Whitfield, 1892, p. 145, pl. 18, figs. 23-24.

Turritella lippincotti Weller, 1907, p. 698, pl. 79, fig. 1.

Description.—"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." (Whitfield)

Remarks.—Whitfield's types of this species are casts from natural moulds which show the external features of the shell. The species is characterized by the flat outer surface of the volutions, and the slightly impressed suture. Whitfield does not illustrate the casts of the species, although he mentions their characters.

Range in New Jersey—
WOODBURY: 20
NAVESINK: 53

Type.—*New Jersey.*

Turritella trilira Conrad 1860

Plate 51, Figure 11

Turritella trilira Conrad, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 285.

Turritella trilira Weller, 1907, p. 699, pl. 79, figs. 4-5.

Turritella trilira Gardner, 1916, p. 489.

Turritella trilira Stephenson, 1923, p. 360, pl. 90, figs. 2-9.

Turritella trilira Wade, 1926, p. 161, pl. 56, fig. 3.

Turritella trilira Stephenson, 1941, p. 286, pl. 52, figs. 1-5.

Description.—Shell with an apical angle of about 27°; the figured specimen 36 mm. in length, with a maximum diameter of 13.5 mm., and showing seven volutions. The specimen is incomplete at both ends, and when complete it must have been 60 mm. or more in length, with 14 or more volutions. Suture situated near the middle of a rather broad, depressed, concave channel of moderate depth, the lower slope of the channel being less abrupt than the upper and with a slight revolving rib midway of the slope; the greatest depth of the sutural furrow lies a little above the suture itself. Surface of the volutions, between the margins of the sutural furrow, flat and marked by three strong, revolving, angular ribs of equal strength, with rounded interspaces. (Weller)

Remarks.—This species is closely related to *Turritella bilira* Stephenson and to *T. quadrillira* Johnson but the former has two spiral ribs and the latter has four spiral ribs instead of the three found in *T. trilira.*

Range in New Jersey—
WENONAH: 35, 40

Range outside New Jersey—
Maryland, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Texas, Tennessee.

Type.—Tippah Co., Miss.; ANSP (? lost).

Turritella tippana Conrad 1858

Plate 49, Figure 10

Turritella tippana Conrad, 1858, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 3, p. 333, pl. 35, fig. 19.

Turritella tippana Weller, 1907, p. 700, pl. 79, figs. 6-7.

Turritella tippana Gardner, 1916, p. 491.

Turritella tippana Wade, 1926, p. 162, pl. 56, fig. 9.

Description.—The dimensions of a large example, incomplete at the apex, are: height, 69 mm.; greatest diameter, 22 mm.; apical angle about 19°; number of volutions shown, 10. Suture situated in the bottom of a broad, concave, revolving channel. Surface of the volutions between the margins of the sutural channel, nearly flat or slightly convex; marked by four or five strong, revolving costae, the three lower ones being subequidistant, the upper one more remote; in the broader interspace between the uppermost strong costa and the one next below, is a much finer rib, and a similar one about midway on the slope from the uppermost strong costa to the suture, although this last one is sometimes strong enough, especially in the larger shells, to be counted as one of the major ribs; in each of the interspaces between the three lowermost strong costae on the larger volutions, there is frequently a much smaller raised line; and on the slope of the lowermost one of these costae to the lower suture, another one somewhat stronger than those in the interspaces above. The surface is also marked by very fine transverse lines of growth. (Weller)

Range in New Jersey—
MERCHANTVILLE: 16
MARSHALLTOWN: 28

Range outside New Jersey—
Maryland, Mississippi, Tennessee.

Type.—Owl Creek, Tippah Co., Miss.

Turritella jerseyensis Weller 1907

Plate 51, Figure 5

Turritella jerseyensis Weller, 1907, p. 702, pl. 79, figs. 2-3.

Turritella cf. *jerseyensis* Richards, 1943, p. 30.

Description.—The dimensions of the type specimen, a nearly complete internal cast, are: height, 38 mm.; maximum diameter, 9 mm.; apical angle about 16°; number of volutions present, 9. In the cast the sides of the shell from the apex to the largest volution are slightly convex, the divergence of the sides decreasing as the shell increases in length. The suture in the cast is close between the apical volutions, becoming broader and more open as it approaches the aperture; the surface of the volutions is smooth, flattened or slightly convex in the central portion, and curving more abruptly into the suture. Externally, as shown by a cast from the natural mould, the suture is slightly impressed in a narrow angular groove, the surface of the volutions is flat and marked by about five rather broad, low, revolving ribs, of which the lowest one is the stronger, two faint revolving ribs can also be detected near the periphery on the lower surface of the last volution. (Weller)

Remarks.—"Weller referred some specimens of *Turritella* from a slab obtained from Sayre and Fisher Pits questionably to *T. jerseyensis* Weller which he had described from the Cliffwood clay of New Jersey. Material collected more recently resembles the *Turritella* of Weller's slab and can also be referred questionably to *T. jerseyensis.* The absence of the nodes differentiates it readily from *T. bakeri,* the more common species from the recent locality at Sayreville." (Richards)

Range in New Jersey—
RARITAN: 1 (?)
MAGOTHY: 5

Type.—Cliffwood Point, N. J. NJSM 9533.

Turritella lorillardensis Weller 1907

Plate 51, Figures 7, 13

Turritella lorillardensis Weller, 1907, p. 703, pl. 79, figs. 10-12.

Description.—The dimensions of the type specimen are: height, 52 mm.; maximum diameter, 19 mm.; angle of divergence of the sides, 27°; number of volutions shown, 10. Suture moderately impressed, situated in the bottom of an angular groove; volutions moderately convex from suture to suture, the lower half slightly more curved than the upper, and the larger volutions flatter than those towards the apex of the shell. Surface marked with fine revolving ribs, eight or nine of which are of nearly equal size and are at equal distances apart; on the lower half of each larger volution the first three or four interspaces between the primary ribs are occupied by secondary ribs, one or two of which in the last volution of large individuals, become nearly as strong as the primary ones; at the upper and lower margins of the volutions, on each of the slopes into the sutural depression, there are two or three additional, smaller, revolving ribs, those just below the suture being somewhat more conspicuous than those above. On one individual somewhat larger than the type, there are upon the last volution, from one to four additional raised, revolving lines in each of the interspaces between the larger ribs. The basal margin of the last volution is angular, and the lower side of the volution is flat and marked with about eight or ten faint, raised, revolving lines. In the internal casts the sutural cavity is narrow, indicating a thin shell, the volutions towards the apex are convex, the more mature volutions becoming more and more quadrangular in cross-section. (Weller)

Range in New Jersey—
WOODBURY: 18, 19, 20, 24

Type.—Lorillard, N. J., NJSM.

Turritella merchantvillensis Weller 1907

Plate 50, Figure 4

Turritella merchantvillensis, Weller, 1907, p. 704, pl. 79, fig. 13.

Turritella merchantvillensis, Groot, Organist and Richards, 1954, p. 50.

Description.—The dimensions of a specimen incomplete at each extremity are: height, 60 mm.; maximum diameter, 17 mm.; angle of divergence of the sides about 10°; number of volutions shown, 9. If the specimen were complete at the apical extremity, it would be 75 mm. or more in length, with about 15 volutions. Suture moderately impressed, situated in the bottom of an angular groove; the surface of the volutions moderately convex from suture to suture, the greatest diameter below the middle so that the slope of the lower half is more abrupt than that of the upper. Surface of the shell marked with 10 or 12 fine, raised, revolving costae, one of which, near the base of the volutions, is slightly stronger than the others; between the costae the surface is entirely covered with much finer, raised, revolving lines. The internal casts have a narrow, almost closed sutural cavity, indicating a thin shell, and they usually have a more or less indistinct, narrow, revolving band above the middle of the volutions; surface of the volutions moderately convex, sometimes tending to become more flattened in the more mature portions of the shell. (Weller)

Remarks.—The most common gastropod found in the Merchantville formation. Usual occurence is that of internal casts.

Range in New Jersey—
MERCHANTVILLE: 8, 10, 15, 16, 17

Range outside New Jersey—
Delaware.

Type.—?

Turritella marshalltownensis Weller 1907

Plate 49, Figure 13; Plate 51, Figures 8, 10

Turritella marshalltownensis Weller, 1907, p. 705, pl. 79, fig. 14.
Turritella marshalltownensis Groot, Organist and Richards, 1954, p. 50.

Description.—The dimensions of a specimen incomplete at each extremity and slightly compressed are: height, 60 mm.; maximum diameter, about 20 mm.; angle of divergence of the sides, about 12°, number of volutions shown, 7. If the specimen were complete to the apical extremity it would be 75 mm. or more in length, with 15 or more volutions. Suture moderately impressed, situated in the bottom of a broadly angular, revolving groove; the surface of the volutions moderately convex, their greatest diameter at or a little below the mid-height. Surface marked by about 12 fine, revolving costae, between which, in the lower half of the volution at least, there are usually alternate smaller ones. Shell substance thin. (Weller)

Range in New Jersey—
MARSHALLTOWN: 28

Range outside New Jersey—
Delaware.

Type.—Swedesboro, N. J.; NJSM 7715.

Turritella bakeri Richards 1943

Plate 44, Figure 3

Turritella bakeri Richards, 1943, p. 29, pl. 6, fig. 3.

Description.—"Shell of medium size; spire high; whorls closely appressed, suture faintly impressed. Each whorl is ornamented with conspicuous spiral ribs, bearing regularly spaced blunt nodes. The interspaces vary in width and bear fine threadlike secondary lines—usually four to six. These secondary lines are of varying intensity, there usually being one or two in each interspace much more conspicuous than the others. Aperture broken in most specimens, but where preserved appears to be broadly subovate."
Length (Type NJSM 10575) (incomplete) 35.0 mm.
Length (paratype ANSP 15680) (incomplete) 36.0 mm.

Remarks.—"Resembles *T. macneili* Stephenson dredged from Banquereau, Nova Scotia, but has the individual whorls less conspicuous, less prominent sutures, and a smaller number of secondary interspatial lines. It is equally close to *T. thomasina* Stephenson, also from Banquereau. It is also related to *T. shuleri* Stephenson from the Woodbine formation of Texas. According to Dr. Stephenson, these nodose species of *Turritella* are not known later than the basal Upper Cretaceous.

This is one of the commonest species in the siderite layer at the

Sayre and Fisher Pits, and it often occurs in large slabs. Many of the specimens are badly weathered." (Richards)

Range in New Jersey—
RARITAN: 1a, 1b

Type.—Sayreville, N. J.; NJSM 10575 (Type); ANSP 15680 (Paratype).

Turritella bonaspes Gardner 1916

Plate 46, Figures 11, 12

Turritella sp. Weller, 1907, pl. 78, figs. 8, 9.
Turritella bonaspes Gardner, 1916, p. 487, pl. 17, fig. 10.

Remarks.—Gardner described this species from the Magothy formation of the District of Columbia, and stated that it was closely related to and possibly identical with *T. jerseyensis* Weller from the Magothy of New Jersey. The specimens figured by Weller which were placed in the synonomy are from the Wenonah formation at Crawfords Corners, New Jersey.

Type.—Good Hope Hill, D. C.

Family Modulidae

Turbinopsis depressa Gabb 1861

Plate 62, Figures 10, 11

Turbinopsis depressa Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 321.
Modulus lapidosus Whitfield, 1892, p. 152, pl. 17, figs. 6-8.
Turbinopsis depressa Weller, 1907, p. 794, pl. 98, figs. 6-11.

Description.—The dimensions of one of the specimens, an internal cast, are: height, 14 mm.; maximum diameter of the outer volution, 14 mm. Shell broadly umbilicate, with two or three volutions, spire depressed, suture about flush with the surface. Outer volution gibbous, its greatest width above the middle, periphery rounded, the upper and lower surfaces both convex, the slope of the upper surface to the suture more abrupt than the slope of the lower surface, contracted below to a very short anterior canal. Surface of the outer volution marked with revolving costae, probably about seven or eight in number, and by transverse ribs of about equal strength, with interspaces about equal to those between the revolving costae; the points of intersection of the revolving and transverse ribs are elevated into low nodes. Internal casts smooth or marked by more or less indistinct revolving ribs, the surface rounded from the suture to the angular umbilical margin, the greatest thickness of the volution about its mid-height; columellar cavity very broad, marked by a single strong and sharp revolving fold situated near the anterior margin. (Weller)

Range in New Jersey—
MERCHANTVILLE: 15
WOODBURY: 20
WENONAH: 34
MT. LAUREL-NAVESINK: 46, 53

Type.—Crosswicks, N. J.; ANSP 14968.
New Jersey; ANSP 19456 (type of *Modulus lapidosus*).

Turbinopsis angulata Whitfield 1892

Plate 62, Figures 4, 5

Turbinopsis angulata Whitfield, 1892, p. 101, pl. 12, figs. 17-18.
Turbinopsis angulata Weller, 1907, p. 796, pl. 98, figs. 12-13.

Description.—"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 cast, the only condition in which it has been observed; aperture elongate ovate, largest below; columellar cavity in the cast of medium size, marked at the base by a distinct groove, indicating the presence of a toothlike ridge on the shell showing the generic position of the species; the surface has also been marked by spiral lines or ridges, 15 or more in number, on the last whorl near the lip, very perceptible on the surface between the whorls in the cast." (Whitfield)

Range in New Jersey—
NAVESINK: (?) 20

Type.—Crosswicks, N. J. ANSP.

Turbinopsis curta Whitfield 1892

Plate 62, Figures 8, 13, 14

Turbinopsis curta Whitfield, 1892, p. 102, pl. 12, figs. 3-6.
? *Turbinopsis elevata* Whitfield, 1892, p. 102, pl. 12, figs. 10-12 (not figs. 13, 14).
Turbinopsis ? curta Weller, 1907, p. 798, pl. 98, figs. 4-5.

Description.—"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." (Whitfield)

Range in New Jersey—
NAVESINK: 20, 37, 47

Type.—Crosswicks, N. J.; ANSP 14966.

Turbinopsis ? major Whitfield 1892

Plate 62, Figures 6, 7

Turbinopsis major Whitfield, 1892, p. 103, pl. 12, figs. 15-16 (not figs. 21-23 *Anchura abrupta* Conrad).

Turbinopsis ? major Weller, 1907, p. 799, pl. 83, figs. 7-8.

Description.—The dimensions of the type specimen are: height, with the spire incomplete, 27.5 mm.; probable total height, 32 mm.; maximum diameter, 23 mm. 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, 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 columellar. (Weller)

Range in New Jersey—
NAVESINK: 53

Type.—Missing.

Family Cerithiidae

Cerithium pilsbryi Whitfield 1893

Plate 50, Figure 10

Cerithium Pilsbryi Whitfield, 1893, Nautilus, vol. 7, pp. 38 and 51, pl. 2, fig. 3.

Cerithium pilsbryi Weller, 1907, p. 708, pl. 81, figs. 3-5.

Cerithium pilsbryi Gardner, 1916, p. 481.

Cerithium pilsbryi Groot, Organist and Richards, 1954, p. 50.

Description.—"Shell elongate and slender; volutions numerous, number not determined, very gradually expanding with additional growth; apex and aperture unknown. Volution slightly convex between the sutures, and ornamented by a band of small oblique nodes immediately below the suture; also by a series of larger vertical folds which extend across the exposed part of the volution, below the upper band of nodes, and numbering something more than half as many to the volution as the nodes above. There are also very fine spiral striae almost too fine to be seen without magnifying. The lines of growth are fine but distinct, and take a broad sweeping backward curve below the sutures."

The dimensions of one of the most complete individuals observed, a specimen not complete to the aperture and with the apex of the shell missing, are: height, 27 mm.; maximum diameter, 11 mm.; number of volutions showing 9, apical angle 23°. A specimen 18 mm. in length, with the apex nearly complete has nine volutions. (Whitfield)

Remarks.—The internal casts are rather loose-coiled, with low, somewhat indistinct vertical nodes, but not retaining any indication of the narrow, nodose, revolving band seen at the upper margin of the volution on the external surface of the shell. Good impressions of the exterior of the shell are sometimes met with, and it is upon casts taken from such natural moulds that the external characters of the shell are best shown. The form of the aperture of the shell has not been observed, so that the generic relations of the shell cannot be determined with certainty; it seems likely, however, that it is not a true *Cerithium*. (Weller)

Range in New Jersey—
MERCHANTVILLE: 15, 17

Range outside New Jersey—
Delaware.

Type.—Lenola, N. J.; ANSP 36.

Voysa ? cuniculana Stephenson 1954

Plate 45, Figure 12

Voysa ? cuniculana Stephenson, 1954, p. 38, pl. 8, fig. 19.

Description.—"The one available external mold of this species is from the southern pit of the New Jersey Clay Products Co. (USGS 19014). Shell small with turreted spire of medium height, spiral angle about 26°. Protoconch not preserved. Whorls 5 or 6, closely appressed, suture deeply impressed. Body whorl with three strong, narrow spiral ribs above the periphery, a weak spiral at the periphery, followed below on the base by a strong bifid spiral, a simple spiral of medium strength, and a weak spiral at the lowest part shown in the cast. The periphery is rounded and the base steep. The three strong ribs on the body whorl above the periphery continue well developed rearward on the flanks of the earlier whorls; the lower one is the largest, the middle one is of medium strength, and the upper one is the weakest. Transverse to the spirals are numerous, closely spaced sharp growth ridges which are most conspicuously developed where they cross the relatively wide interspaces. The trend of the growth ridges is convex toward the aperture on the base and broadly concave toward the aperture above the periphery. The features of the aperture are not preserved.

Dimensions of the holotype: Height 7 + mm, diameter 3.5 mm." (Stephenson)

Remarks.—Related to *V. ? craticula* from the Woodbine of Texas.

Range in New Jersey—
RARITAN: 1b

Type.—Sayreville, N. J.; USNM 108670.

Family Aporrhaidae

Anchura rostrata (Gabb) 1860

Plate 50, Figures 11, 12; Plate 53, Figure 1

Rostellaria rostrata Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 390, pl. 68, fig. 7.

Alaria rostrata Whitfield, 1892, p. 119, pl. 14, figs. 5-6.

Anchura rostrata Weller, 1907, p. 709, pl. 81, figs. 7-9.

Anchura rostrata Gardner, 1916, p. 471.

Anchura rostrata Groot, Organist, and Richards, 1954, p. 51.

Description.—"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." (Whitfield)

Remarks.—"The shell of *Anchura rostrata* (Gabb) is best characterized by the subquadrate wing and the numerous, rather narrow, obtuse and feebly arcuate axial riblets. It is not only smaller than the closely related *A. pennata* (Morton) but it differs further in the more rapidly enlarging whorls." (Gardner)

Range in New Jersey—
MERCHANTVILLE: 8, 14, 15, 16, 17
WOODBURY: 20, 22, 24
WENONAH: 34

Range outside New Jersey—
Delaware, Mississippi.

Type.—Burlington Co., N. J.; ANSP 15048.

Anchura pennata (Morton) 1834

Plate 52, Figure 2; Plate 53, Figures 2, 6, 7

Rostellaria pennata Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 48, pl. 19, fig. 9.

? *Rostellaria compacta* Whitfield, 1892, p. 108, pl. 13, figs. 18-21.

? *Rostellaria spirata* Whitfield, 1892, p. 109, pl. 13, figs. 16-17.

Anchura pennata Whitfield, 1892, p. 115, pl. 14, fig. 7, ? fig. 8.

? *Anchura (Drepanochilus) compressa* Whitfield, 1892, p. 117, pl. 13, figs. 22-25.

Anchura pennata Weller, 1907, p. 711, pl. 81, figs. 10-17.

Anchura pennata Gardner, 1916, p. 472.

Anchura pennata Groot, Organist and Richards, 1954, p. 51.

Description.—"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 proportionately 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." (Whitfield)

Remarks.—According to Gardner, Whitfield's figure 8 represents a different species, but is too poorly preserved to be named.

Range in New Jersey—
WOODBURY: 20
MT. LAUREL-NAVESINK: 37, 39, 40, 41, 42, 45, 46, 47, 49, 50, 53

Range outside New Jersey—
Delaware, Maryland, Alabama.

Type.—Prairie Bluff, Ala.; ANSP 15042: Crosswicks, N. J.; ANSP 15011 (cotype of *Rostellaria compacta);* Mullica Hill, N. J.; ANSP 15012 (cotype of *R. compacta);* Crosswicks, N. J.; ANSP 15014 (type of *R. spirata).*

Anchura ? pergracilis Johnson 1898

Plate 53, Figure 3

Anchura ? pergracilis Johnson, 1898, Proc. Acad. Nat. Sci. Phil. (1898), p. 463, text fig. 2.

Anchura pergracilis Weller, 1907, p. 713, pl. 81, figs. 18-19.

Anchura pergracilis Gardner, 1916, p. 476.

Anchura ? pergracilis Wade, 1926, p. 151, pl. 53, figs. 1-2.

Description.—"Shell fusiform, whorls convex, the body whorl with about 18 and the spiral whorls with 15 equidistant, flexuous, longitudinal ribs; numerous fine revolving lines, more prominent between the ribs and somewhat obsolete on the angles of the ribs, cover the entire shell; suture deeply impressed. The length of the largest specimen (including the two apical whorls, which are wanting), is about 20 mill." (Johnson)

Remarks.—The type specimen of this species was a young individual upon which all of the older growth features had not developed.

Range in New Jersey—
MAGOTHY: 5
WOODBURY: 19, 22

Range outside New Jersey—
Maryland, Tennessee.

Type.—Mt. Laurel well, N. J.; ANSP 692.

Anchura solitaria Whitfield 1892

Plate 53, Figure 4

Anchura solitaria Whitfield, 1892, p. 117, pl. 14, fig. 9.

Anchura solitaria Weller, 1907, p. 714, pl. 81, fig. 6.

Anchura solitaria Groot, Organist and Richards, 1954, p. 51.

Description.—"Shell small, with an elevated spire of about six volutions, the dimensions of a very perfect specimen being: total height, from end of anterior canal to tip of spire, 32 mm.; height of spire, 15 mm.; diameter of outer volution, 11 mm. Outer volution produced anteriorly into a rather long, slender anterior canal; the outer lip produced postero-laterally into a long, slender slightly curved, spine-like process. The volutions of the spire moderately and regularly convex, with moderately impressed sutures, marked by narrow, rounded, vertical nodes which extend from suture to suture, from 16 to 20 being present on each volution; upon the outer volution the vertical nodes extend only about one-third of the length of the volution below the suture, and at their base, towards the aperture, a revolving angle is gradually developed which continues into the spinelike lateral extension of the aperture."

Remarks.—"Some impressions of the exterior of the shell show, in addition to the characters enumerated above, that the outer volution is nearly smooth for a distance below the revolving angular ridge, and then below this smooth area it is marked by rather fine revolving costae; the entire surface of the shell is marked by very fine revolving striae." (Weller)

Weller's description was based on a very complete specimen, whereas that of Whitfield's type was very imperfect.

Range in New Jersey—
MERCHANTVILLE: 10

Range outside New Jersey—
Delaware.

Type.—New Jersey: ANSP 15047.

Anchura abrupta Conrad 1860

Plate 52, Figure 3

Anchura abrupta Conrad, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 284, pl. 47, fig. 1.

Turbinopsis major Whitfield, 1892, p. 103, pl. 12, figs. 21-23 (not figs. 15-16).

Anchura abrupta? Whitfield, 1892, p. 113, pl. 14, figs. 1-3.

Anchura abrupta var. *acutispira* Whitfield, 1892, p. 114, pl. 14, fig. 4.

Anchura pagodaformis Whitfield, 1892, p. 116, pl. 14, figs. 15-16.

Rostellaria nobilis Whitfield, 1892, p. 186, pl. 23, figs. 16-17.

Anchura abrupta Weller, 1907, p. 715, pl. 82, figs. 1-4 (not 5-6=*A. hebe* Whitfield) pl. 83, figs. 3-4.

Anchura abrupta Groot, Organist and Richards, 1954, p. 51, pl. 6, fig. 10.

Description.—Shell with a rather high spire having an apical angle of about 30°, and a comparatively short body volution, with a slender rostrate, anterior canal; the dimensions of a moderately large internal cast retaining a little more than three volutions, and incomplete at both the apex and the anterior extremity, are: length, 51mm.; greatest diameter, 30 mm.; height of aperture, 21.5 mm.; width of aperture, 10.5 mm. If this specimen were complete it would have an additional height at the apex of about 20 mm., and an anterior beak about 30 mm. in length. The outer lip of the aperture is produced and terminates in two unequal pointed processes—one directed forward and the other backward. Surface of the shell marked by a rather strong, nodose, subangular, revolving keel at a little above the mid-height of the outer volution. Upon the expanded portion of the outer lip this keel curves upward to the posterior process of the lip. Above and below the median keel the surface is marked by moderately broad, rather depressed revolving ribs, and by less conspicuous vertical markings. On the internal casts, in which condition only the species has been seen in New Jersey, the surface is marked in the younger individuals by more or less indistinct revolving and vertical ribs, which evidently were obliterated by the internal thickening of the shell, since the larger individuals are all smooth. The aperture in the casts is narrowly subelliptical in outline, the outer side being a little more strongly curved than the inner. The columellar cavity left in the casts is rather broad and is not marked by revolving folds. (Weller)

Remarks.—New Jersey specimens have been observed only as internal casts in which the apex and the outer lip of the aperture have been imperfectly preserved.

Range in New Jersey—
MERCHANTVILLE: 13, 15
WOODBURY: 20
MT. LAUREL-NAVESINK: 40, 53

Range outside New Jersey—
Delaware, Alabama, Mississippi.

Type.—Tippah County, Mississippi.

Anchura hebe (Whitfield) 1892

Plate 52, Figures 4, 6, 7

Rostellaria Hebe Whitfield, 1892, p. 111, pl. 14, figs. 11-14.
Anchura abrupta Weller, 1907, (part) p. 715, pl. 82, figs. 5-6.
Anchura hebe Gardner, 1916, p. 475.

Description.—"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 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.*" (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 40, 53

Range outside New Jersey—
Maryland

Type.—Mullica Hill, N. J.

Anchura arenaria Morton 1834

Plate 53, Figure 5

Rostellaria arenarum Morton, 1834, Synop. Org. Cret. Gr. U. S., p. 48, pl. 5, fig. 8.

Anchura arenaria Whitfield, 1892, p. 112, pl. 14, fig. 10.

Anchura arenaria Weller, 1907, p. 717, pl. 83, fig. 5.

Description.—Shell rather strong and robust, about 50 mm. in length when complete and 24 mm. in width. Volutions probably four and one-half or five in number, strongly rounded, rapidly decreasing in size upward; suture strongly marked; aperture narrow, the lip unknown, the rostrum apparently quite short. Each volution marked by 10 or 12 vertical plications or folds, which are strongly marked upon the convex portion, but become obsolete towards the sutures above and below, while on the body volution they are not visible below the upper two-thirds, the lower third being destitute of markings. On the outer half of the last volution the folds are indistinct or obsolete; the folds appear to have been somewhat sigmoidally curved in passing from above downward, being directed slightly forward below. (Weller)

Remarks.—Morton's type specimen, which is unique, is an incomplete cast.

Range in New Jersey—
NAVESINK: 53

Type.—Mullica Hill, N. J. (?); ANSP 15008.

Anchura johnsoni Stephenson 1923 ?

Plate 52, Figures 8, 9

? *Anchura* sp. Johnson, 1898, Proc. Acad. Nat. Sci. Phil., for 1898, p. 463, text fig. 3.

Anchura johnsoni Stephenson, 1923, p. 370, pl. 92, figs. 1-4.

Anchura johnsoni Groot, Organist and Richards, 1954, p. 51.

Description.—"Shell of moderate size with high spire and eight whorls. The apical angle is 40°, the sides of the spire maintaining approximately the same angle of divergence, or converging a little, giving a slightly inflated longitudinal profile. Sides of whorls nearly flat to slightly convex, and a little compressed below the suture; suture moderately impressed. The larger whorls of the spire ornamented with 14 to 16 strong, somewhat irregularly spaced, round crested, axial ribs which in trend are slightly concave toward the front; finer ribs can be seen on the smaller whorls with the exception of the two smooth nucular whorls. On the upper part of the body whorl are about 14 prominent longitudinal ribs which end rather abruptly a little more than halfway to the base; these are crossed by very fine spiral lines; the lower part of the whorl is marked by fine, rather distinct spiral ridges. The inner lip of the adult is thickened and spreads a little forward on the body whorl. The outer lip expands into a prominent spur-like projection, at first broad and nearly horizontal, then curving sharply upward and narrowing quickly to a point. On the lower edge of the lip are two minor projections, the inferior one of which is the largest. A distinct ridge traverses the outer surface of the main projection a little above the center, curving upward and extending to the farthest tip of the lip; this ridge fades out quickly where it passes backward onto the body whorl. Canal short, straight, and narrow. Aperture somewhat elongated, angulated above and below. Approximate dimensions of the type: Altitude 32 mm.; greatest diameter 11 mm.; the altitude of one specimen in the collection is at least 40 mm." (Stephenson)

Remarks.—Johnson illustrated a portion of a shell from a well at Mt. Laurel, which probably represents this species, but which may represent a different growth stage than other reported specimens.

Range in New Jersey—
WOODBURY: 22

Range outside New Jersey—
Delaware, North Carolina, South Carolina.

Type.—Snow Hill, N. C.; USNM 31858.

Anchura bakeri Richards 1943

Plate 44, Figure 2

Anchura bakeri Richards, 1943, p. 27, pl. 6, fig. 2.

Description.—"Shell of medium size, spire elongate conical; whorls about six (estimated) ; very slightly convex ; sutures slightly impressed. Top portion of type not preserved. Prominent lateral ribs on each whorl, much more conspicuous on all except penultimate. Because of the incomplete preservation of the type, it is impossible to estimate the number of ribs. However, they are slightly closer together and apparently more numerous than in *A. pontana* Stephenson. The body whorl is covered with conspicuous spiral ribs separated by interspaces of irregular width. No riblets were observed in the interspaces. The crossing of the spirals and growth ridges produces a semi-cancellated appearance, although this is less conspicuous than in *A. pontana.* Aperture not visible. The outer lip is extended to form a lip-like structure which, unfortunately, is not perfectly preserved. It apparently had much the shape of the outer lip of *A. pontana.* The shell is closely related to *A. pontana* Stephenson from Banquereau, Nova Scotia, but has slightly coarser axial ribs, less cancellate appearance on the body whorl and outer lip and a less prominent suture. Length 39.0 mm.; greatest width (exclusive of outer lip) 16.0 mm." (Richards)

Range in New Jersey—
RARITAN: 1

Type.—Sayreville, N. J.; NJSM 10448.

Anchura raritanensis Richards 1943

Plate 43, Figure 15

Anchura raritanensis Richards, 1943, p. 27, pl. 5, fig. 15.

Description.—"Shell of medium size, spire elongate conical; eight whorls, moderately convex; suture deeply impressed; protoconch not preserved. Prominent ribs on each whorl, more conspicuous on the penultimate and antepenultimate. Because of the lack of a perfect specimen, it is impossible to determine the number of ribs. On the penultimate whorl they are approximately 2 mm. apart. A fair trace of spiral lines can be seen on the body whorl. The outer lip was apparently greatly expanded to form a wing-like structure, characteristic of the genus. Most of this outer lip has been broken away; however, notches where the lip was attached to the shell can plainly be seen on the left side of the shell. Length 41.0 mm.; maximum diameter (exclusive of outer lip) 16.0 mm." (Richards)

Remarks.—"It differs from *A. bakeri* in its much coarser axial ribs and apparently larger outer lip (as indicated by the notches)." Stephenson (1954) regards this as identical with his *A. pontana.*

Range in New Jersey—
RARITAN: 1a

Type.—Sayreville, N. J.; NJSM 10434. Sayreville, N. J.; ANSP 15676 (paratype).

Pterocerella sp.

Plate 52, Figure 10

Pterocerella tippana, Weller, 1907, (part), p. 718, pl. 83, fig. 2. (not fig. 1=type of *P. pointsettiformis* Stephenson; not *P. tippana* Conrad 1858.)

Pterocerella sp. Stephenson 1941, p. 310.

Weller considered an internal mold from Crawfords Corner as belonging to *P. tippana* (Conrad). Stephenson believes this specimen to be too poorly preserved for specific identification.

Range in New Jersey—
WENONAH: 40

Family Nyctilochidae

Triton lorillardensis Weller 1907

Plate 54, Figures 3, 4

Triton lorillardensis Weller, 1907, p. 725, pl. 84, figs. 5-6.

Description.—The dimensions of the type specimen, with some restoration, are: height, 25mm.; height of spire, 14mm.; greatest diameter, 15 mm.; apical angle, about 40°. Shell with probably five or six volutions, the suture well defined, the outer volution produced below into a very short anterior canal. Surface of the volutions of the spire convex from suture to suture, the curvature a little flattened above, with about 12 strong subangular vertical nodes or varices upon each volution, which extend from suture to suture and are separated by broad concave areas. Upon the outer volution the varices become obsolete below, and the surface becomes concave as it passes into the short anterior canal. Aperture subovate in outline, somewhat oblique, pointed below, about twice as high as wide; at the lower extremity of the columellar lip in the cast three notches can be detected which seem to indicate the presence of three somewhat obscure revolving columellar folds; the outer lip is marked by revolving ribs internally. The surface of the shell is marked by revolving costae about one millimeter apart, with the spaces between filled with exceedingly fine revolving lines; the entire surface is also marked with exceedingly fine transverse lines of growth. (Weller)

Remarks.—The type of this species consists of an incomplete internal cast which has been restored to its normal form so far as possible, and a partial impression of the exterior, which has furnished the character of the finer surface markings. Upon the casts the vertical nodes are well shown, but are broader and rounder than on the shell itself, and the stronger revolving costae are present towards the aperture.

Range in New Jersey—
WOODBURY: 18

Type.—Lorillard, N. J.; NJSM 9510.

Triton praecedens Whitfield 1892

Plate 54, Figures 5, 6

Triton (Epidromus) praecedens Whitfield, 1892, p. 58, pl. 5, figs. 6-7.
Triton praecedens Weller, 1907, p. 726, pl. 84, figs. 7-8.

Description.—"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 occuring 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." (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 46, 49, 53

Type.—Mullica Hill, N. J.

Trachytriton ? atlanticum Whitfield 1892

Plate 57, Figures 12, 13; Plate 64, Figure 4

Trachytriton atlanticum Whitfield, 1892, p. 59, pl. 5, figs. 8-11.
Trachytriton ? atlanticum Weller, 1907, p. 727, pl. 84, figs. 11-14.

Description.—"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." (Whitfield)

Remarks.—In his illustrations of this species, Whitfield made the vertical ribs of the shell much more conspicuous than they really are upon the specimens. It does not seem to be altogether certain that the generic reference of the species is correct, the strongly defined pitted furrows upon the internal casts, left by the denticulate internal varices, which are said by Meek to be so characteristic of the genus, are not present at all upon the New Jersey specimens of either this species or of the others referred to the genus by Whitfield. (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 43, 46, 47

Type.—Crosswicks Creek, NJSM 7652.

Trachytriton ? holmdelense Whitfield 1892

Plate 52, Figure 11

Trachytriton ? Holmdelense Whitfield, 1892, p. 60, pl. 5, figs. 16-17.
Trachytriton ? holmdelense Weller, 1907, p. 728, pl. 84, figs. 9-10.

Description.—"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, 13 or 14 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." (Whitfield)

Range in New Jersey—
NAVESINK: 41

Type.—Holmdel, N. J.; NJSM 8734.

Trachytriton ? multivaricosum Whitfield 1892

Plate 57, Figures 3-5

Trachytriton ? multivaricosum Whitfield, 1892, p. 61, pl. 5, figs. 12-13, 14-15.
Trachytriton ? multivaricosum Weller, 1907, p. 729, pl. 84, figs. 15-18.

Description.—"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." (Whitfield)

Remarks.—Whitfield's figures of the species cause the vertical nodes and the revolving costae near the aperture to appear to be clearer than they are on the actual specimens.

Range in New Jersey—
NAVESINK: 47

Type.—Crosswicks Creek near New Egypt; NJSM 7653.

Family Strombidae

Pugnellus densatus (Conrad) 1858

Plate 53, Figure 8

Strombus densatus Conrad, 1858, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 3, p. 330, pl. 35, fig. 14.

Pugnellus densatus, Weller, 1907, p. 720, pl. 83, fig. 6.

Pugnellus densatus, Gardner, 1916, p. 468.

Pugnellus densatus Wade, 1926, p. 148, pl. 52, figs. 4-5. (?=*P. densatus* var. *fide* Stephenson, 1941, pl. 311).

Description.—Internal casts of medium size, subovate in form, the dimensions of a nearly complete one being; height, 35 mm.; greatest diameter, 20 mm.; height of aperture, about 22 mm.; width of aperture, 7.5 mm. Volutions about four in number, the suture well defined, the height of the spire less than one-half the total height of the shell. Volutions of the spire gently convex and nearly vertical for two-thirds of this height from the suture below, curving much more strongly above to the upper suture. Surface of the cast without well-defined markings. (Weller)

Range in New Jersey—
WOODBURY: 22
WENONAH: 40

Range outside New Jersey—
North Carolina, South Carolina, Mississippi, Alabama.

Type.—Owl Creek, Tippah Co., Miss.; ANSP 15016.

Rostellaria curta Whitfield 1892

Plate 53, Figure 10

Rostellaria curta Whitfield, 1892, p. 109, pl. 13, figs. 9-13.
Rostellaria curta Weller, 1907, p. 721, pl. 83, figs. 9-13.

Description.—"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." (Whitfield)

Remarks.—Similar to *Prifusus elevata* (Whitfield) but *Rostellaria curta* is smaller and has a more pointed and shorter spire. Weller mentioned that Whitfield's fig. 10 overemphasized the revolving costae near the aperture.

Range in New Jersey—
MT. LAUREL-NAVESINK: 47, 53

Type.—Crosswicks Creek; NJSM 7636.

Rostellaria fusiformis Whitfield 1892

Plate 53, Figure 11

Rostellaria fusiformis Whitfield, 1892, p. 110, pl. 13, figs. 14-15.
Rostellaria fusiformis Weller, 1907, p. 722, pl. 83, figs. 16-17.

Description.—"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, 12 or more to the whorl." (Whitfield)

Remarks.—Similar to *Rostellaria curta* Whitfield but more slender.

Range in New Jersey—
MT. LAUREL-NAVESINK: 47, 53

Type.—Crosswicks Creek; NJSM 7638.

Rostellites texturatus Whitfield 1892

Plate 61, Figure 6

Rostellites Texanus Conrad, 1868, Cook's Geol. N. J., p. 730, not *R. Texanus* Conrad 1855.

Rostellites texturatus Whitfield, 1892, p. 88, pl. 11, figs. 5-6.

Rostellites texturatus Weller, 1907, p. 785, pl. 96, figs. 12-13.

Description.—"Shell rather large, very elongate, elliptical in outline, pointed at each extremity, spire very short, conical, with scarcely convex volutions, three or 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." (Whitfield)

Remarks.—"This species differs from *R. nasutus* and *R. angulatus* especially in the proportionally shorter spire, in the more symmetrical body volution, and in the greater strength of the markings of the shell. In general it seems to be more characteristic of the Merchantville clay, while the others occur most commonly in the Navesink marl." (Weller)

Range in New Jersey—
MERCHANTVILLE: 15
NAVESINK: 41, 43

Type.—Holmdel, Freehold.

Rostellites nasutus (Gabb) 1860

Plate 56, Figure 9; Plate 61, Figure 10

Volutilithes nasuta Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 300, pl. 48, fig. 9.

Rostellites nasutus Whitfield, 1892, p. 86, pl. 11, figs. 1-2.

Rostellites nasutus Weller, 1907, p. 786, pl. 97, figs. 1-2.

Rostellites nasutus Gardner, 1916, p. 422.

Rostellites nasutus Groot, Organist, and Richards, 1954, p. 52.

Description.—"Shell of moderately large size, sometimes attaining a length of nearly or quite 5 inches. Form slender, with a proportioally 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." (Whifield)

Range in New Jersey—
MERCHANTVILLE: 15
WOODBURY: 20
MT. LAUREL-NAVESINK: 39, 40, 41, 42, 43, 47

Range outside New Jersey—
Delaware, Alabama.

Type.—Crosswicks, N. J.; ANSP 14415.

Rostellites angulatus Whitfield 1892

Plate 56, Figure 10

Rostellites angulatus Whitfield, 1892, p. 88, pl. 11, figs. 3-4.

Rostellites angulatus Weller, 1907, p. 787, pl. 97, figs. 3-4.

Description.—"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; volutions 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." (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37

Type.—New Jersey (Atlantic Highlands ?); ANSP 14391.

Family Cypraeidae

Cypraea mortoni Gabb 1860

Plate 53, Figure 9; Plate 64, Figure 6

Cypraea Mortoni Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 391, pl. 68, fig. 9.

Cypraea (Aricia) Mortoni Whitfield, 1892, p. 120, pl. 15, figs. 1-3.

Cypraea mortoni Weller, 1907, p. 722, pl. 84, figs. 1-2.

Description.—The type specimen is 17 mm. long and 13 mm. wide; it is broadly ovate in outline; the spire is flat and the cast is most ventricose about one-third of its length from that end, with a slight indication of 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 there are no indications of the fine crenulations of the lip nor of the opposite side of the aperture mentioned in the original description. This character was probably seen only upon the southern specimen, which was also included among the types of the species. The exterior of the cast is entirely smooth.

Remarks.—Gabb's type specimen is so imperfectly preserved that specific characters are difficult to detect.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 57

Range outside New Jersey—
Alabama.

Type.—Burlington County, N. J.; ANSP 13537; Prairie Bluff, Ala.; ANSP 13535.

Family Pyropsidae

Hercorhynchus jerseyensis Weller 1907

Plate 54, Figures 9, 10

Hercorhynchus jerseyensis Weller, 1907, p. 737, pl. 85, figs. 18-22.

Description.—The dimensions of the type specimen are: height, 29 mm.; height of spire, 7 mm.; greatest diameter, 17.5 mm.; apical angle about 75°. Shell pyriform with four or five volutions, the outer volution produced below into a rather short, curved anterior canal; suture moderately impressed. The volutions of the spire subangular about midway between the sutures, the angulation marked with obscure nodes, both angulation and nodes being obsolete on the higher volutions. Body volution with a rather finely nodose revolving ridge or shoulder below the suture, just below which at the line of greatest diameter of the volution, is a row of rounded nodes, about 18 in number, with the intervening spaces about equaling in width the nodes themselves, some of the nodes are produced below for a short distance as obscure, rounded ridges; between the sutural ridge or shoulder and the row of nodes, the surface is concave; below the row of nodes the surface is broadly and regularly convex, becoming concave below as it passes into the anterior canal. Surface ornamented by obscure lines of growth which show a broad but slight sinuosity beneath the suture. Columella with two faint revolving folds. (Weller)

Remarks.—"The best specimen of this species which has been observed consists of a nearly complete internal cast with a partial mould of the exterior from which a plaster cast has been taken. Only the larger nodes, those near the aperture, are visible upon the cast. The species is especially characterized by its curved anterior canals. The folds of the columella are seen only as impressions in the cast, and are almost too faint to be detected except when the specimen is held in a certain position.

This species resembles *Strepsidura tippana* Conrad, a species which was afterwards placed by the same author in his genus *Hercorhynchus*. The New Jersey shell differs from this form, however, in the absence of spiral markings."

Range in New Jersey—
MAGOTHY: 5

Type.—Cliffwood, New Jersey.

Napulus retifer (Gabb) 1860

Plate 54, Figure 13

Fusus retifer Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 301, pl. 48, fig. 11.

Pyropsis retifer Whitfield, 1892, p. 38, pl. 2, figs. 1-4.

Dolium (Doliopsis ?) multiliratum Whitfield, 1892, p. 121, pl. 15, figs. 4-6.

Pyropsis retifer Weller, 1907, p. 749, pl. 88, figs. 7-13.

Pyropsis retifer Gardner, 1916, p. 452, pl. 15, figs. 9-10.

Napulus retifer Stephenson, 1941, p. 318.

Description.—"Shell small, pyriform or without the anterior canal subglobular in form, the dimensions of a large individual being; height, 22 mm., or probably 25 mm., if the anterior beak were complete; maximum diameter, 18 mm., height of spire, 6 mm. Volutions about three, rounded, ventricose and rapidly increasing in size, rapidly contracting below to the short anterior beak, spire low, conical, sutures well marked in the cast; aperture large, subcircular on the outer margin, about two-thirds as high as the total height of the shell; columellar cavity in the cast rather narrow. Surface of the casts marked by 8 or 10 spiral ridges upon the body volution, placed at nearly equal intervals, also by fainter vertical ridges which appear usually to have been placed at nearly equal intervals to those of the spiral ridges, though occasionally they are somewhat closer. Upon the external surface, as shown in impressions of the outside, the revolving and vertical ribs are much more conspicuous than on the casts, their intersections being marked by small rounded nodes." (Weller)

Range in New Jersey—
WENONAH: 34
MT. LAUREL-NAVESINK: 38, 39, 46, 47, 53

Range outside New Jersey—
Maryland.

Type.—Mullica Hill, N. J.; ANSP 13936.

Napulus whitfieldi (Weller) 1907

Plate 55, Figure 8

Pyropsis octolirata Whitfield, 1892, p. 36, pl. 2, figs. 8-9 (not fig 10= *Napulus octolirata* Conrad 1858.)

Pyropsis whitfieldi Weller, 1907, p. 750, pl. 88, figs. 14-16.

Pyropsis whitfieldi Gardner, 1916, p. 451.

Napulus whitfieldi Stephenson, 1941, p. 318.

Description.—"Shell small, subglobular or subpyriform in form, with about three, ventricose, rapidly expanding volutions; the dimensions of a nearly complete internal cast being; height, 19.5 mm., which might be increased to 25 mm. if the anterior canal were complete; maximum diameter, 16 mm.; height of spire 5.5 mm. Spire low-conical volutions distinctly flattened adjacent to the suture, marked by from six to nine spiral ridges or costae upon the casts, which are crossed by vertical ridges at about equal intervals or slightly more distant than the spiral lines, the two sets of markings dividing the surface into a number of square, depressed spaces; anterior beak short, apparently straight, and rather pointed; aperture elongate, pointed above and below, about half as wide as long. In the casts the suture is distinct and often strongly marked." (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 46, 47

Type.—Walnford, N. J.; NJSM 7631.

Napulus octoliratus (Conrad) 1858

Plate 55, Figure 11

Ficus octoliratus Conrad, 1858, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 3, p. 332, pl. 35, fig. 6.

Pyropsis octolirata Whitfield, 1892, (part) p. 36, pl. 2, fig. 10 (not figs. 8-9=*Napulus whitfieldi* Weller).

Pyropsis octolirata Weller, 1907, p. 751, pl. 88, figs. 17-18.

Napulus octoliratus Stephenson 1941, p. 318.

Napulus octoliratus Groot, Organist and Richards, 1954, p. 51, pl. 6, fig. 8.

Description.—"Shell pyriform or, exclusive of the anterior canal, subglobular in form, consisting of three or four volutions, the outer one of which is produced in front in an elongate anterior canal; imperforate; suture slightly impressed; the dimensions of a somewhat incomplete internal cast are: total height, 20 mm.; height of spire, 4 mm.; maximum diameter of outer volution, about 14 mm. Outer volution regularly rounding from the suture to the base of the anterior canal, marked by eight or nine spiral ribs, one of which on the upper side, about half way between the periphery and the suture, is slightly nodose, the strongest costae are those upon and just below the periphery; on the upper side, between the nodose rib and the suture, is a single faint rib. On the internal cast the revolving ribs are much fainter than upon the shell itself, and the nodes of the uppermost costa are not shown." (Weller)

Range in New Jersey—
WOODBURY: 18, 23

Range outside New Jersey—
Delaware, Mississippi.

Type.—Tippah County, Mississippi.

Napulus lenolensis (Weller) 1907

Plate 55, Figures 9-10

Pyropsis lenolensis Weller, 1907, p. 752, pl. 88, figs. 20-24.

Pyropsis lenolensis Gardner, 1916, p. 453, pl. 16, fig. 3.

Napulus lenolensis Stephenson, 1941, p. 318.

Description.—"Shell small and, exclusive of the anterior beak, subglobular in form, with about four volutions; the dimensions of a nearly complete individual are; height 13 mm., probable height, if anterior beak were complete, 18 mm.; maximum diameter, 11.5 mm.; height of spire, 4 mm. The volutions distinctly flattened above in a spiral band just below the suture, the outer margin of the flattened band being elevated in a moderately strong revolving rib, below this rib the outer volution is nearly regularly convex to the base of the anterior canal which is rather elongate and slender; surface of the outer volution marked by about six or seven strong, revolving ribs between the outer margin of the flattened band above and the base of the anterior beak, the outer half of the volution being also marked by several, rather strong, vertical varices which are about twice as far apart as the revolving ribs, these varices do not cross the flattened band above, and at their junction with the revolving ribs they are elevated into rounded nodes; entire surface of the shell also marked by somewhat irregular, transverse lines of growth. On the internal casts the transverse varices are well marked, but the revolving ribs are faint except at the junction with the varices; the columellar cavity narrow." (Weller)

Range in New Jersey—
MERCHANTVILLE: 15, 16

Range outside New Jersey—
Delaware.

Type.—Lenola, N. J.; NJSM 9001 (Cotype).

Pyropsis richardsoni (Tuomey) 1854 ?

Plate 55, Figures 12, 13

Pyrula Richardsoni Tuomey, 1854, Proc. Acad. Nat. Sci. Phila., vol. 7, p. 169.

Pyropsis richardsoni Weller, 1907, p. 739, pl. 86, figs. 2-5 (part).

Remarks.—Weller refers several specimens to *P. richardsoni.* However, since Tuomey's species is based upon less than two lines of description with no figure, it seems unwise to refer the New Jersey specimens to this species. The New Jersey specimens are poorly preserved and it would probably be better to refer them to *P. perlata* Conrad or *P. trochiformis* (Tuomey), as suggested by Gardner (1916, p. 445, 447). However, a more accurate determination of the New Jersey specimens must await a detailed study of all eastern American species of *Pyropsis.*

Pyropsis pyruloidea (Gabb) 1860

Plate 55, Figure 7

Rapa pyruloidea Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860), p. 94, pl. 2, fig. 4.

Pyrifusus pyruloides Whitfield, 1892, p. 53, pl. 4, figs. 12-13.

Pyropsis pyruloidea Weller, 1907, p. 742, pl. 86, figs. 6-7.

Description.—"Shell turbinate, with a very low spire consisting of little more than three volutions, which increase rapidly in size with the growth of the shell, the outer volution comprising the greater bulk of the shell. Aperture very large, subovate in outline except as it is modified on the inner side by the previous volution, widest at the upper third of its height and sharply pointed anteriorly. The columellar cavity in the casts proportionally broad, with no impressions of revolving folds. The surface of the body volution of the casts marked by rather obscure vertical folds on its upper part, seven of which may be counted on the outer half of the volution. The fragment of shell which remains on the specimen is marked by strong, somewhat irregular lines of growth, which are gathered in groups on the upper portion of the volution to form the vertical folds which are visible also in the cast." (Weller)

Remarks.—Type specimen is unique. This is "a well-marked species and may be recognized by its low spire and large body volution with the greatest diameter high up and the base pointed. The cast resembles in some degree small individuals of *P. trochiformis,* but it is more elongate. The type specimen seems to show an indefinite revolving line on the outside of the shell about two-thirds of the distance between the suture and the anterior extremity, which is also recognizable upon the cast as a faint, impressed band." (Weller)

Range in New Jersey—
NAVESINK: 57

Type.—Burlington Co., N. J.; ANSP 13764.

Pyropsis septemlirata (Gabb) 1860

Plate 55, Figure 14; Plate 56, Figures 1, 2

Cancellaria septemlirata Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860) p. 94, pl. 2, fig. 10.

Pyropsis (Rapa ?) septemlirata Whitfield, 1892, (part) p. 44, pl. 3, figs. 4-6 (not figs. 7-8).

Pyropsis septemlirata Weller, 1907, (part) p. 744, pl. 86, figs. 8-10, pl. 88, figs. 1-4.

Pyropsis septemlirata Gardner, 1916, p. 449.

Description.—"The dimensions of a nearly complete internal cast are: height of specimen as preserved, 42 mm.; probable total height, 47 mm.; maximum diameter of the outer volution, 33.5 mm. Shell with about three volutions, the spire low, the suture canaliculate with a wide and deep, subrectangular depression. Outer volution gibbous above, abruptly contracted and produced into a long anterior canal below, the upper half of the gibbous portion much more strongly convex than the lower half. Surface marked by strong revolving costae or ridges, about eight or ten in number, separated by much broader depressions, the first ridge borders and slightly overhangs the deep sutural depression, the second and perhaps others are somewhat nodose, and all are more or less rugose because of the rather coarse transverse lines of growth. The surface of the internal casts is smooth, with four or five rather obscure revolving angles, and with a broad, sutural cavity." (Weller)

Remarks.—"The characters of the outer surface of the shell have been determined from plaster casts taken from natural moulds of the shell, of which several incomplete ones have been studied. The species is especially characterized by the strong and deep sutural furrow or fossula, and the strong revolving costae. . . .Gabb's specimens were all internal casts, so that the remarkable sutural groove is not shown upon them. The sharply defined columellar fold, indicated in Gabb's original illustration of the species, does not exist in the specimen. Different individuals of the species vary somewhat in the height of the volutions, but the abrupt contraction to the anterior canal is characteristic. . . . The exact number of revolving costae upon the surface of the shell has not been determined with certainty, indeed there is probably some slight variation in the number in different individuals, and in all the specimens observed they seem to have been eroded or otherwise destroyed except towards the aperture." (Weller)

"Whitfield is incorrect in his observation of a columellar fold. The inner lip is non-plicate." (Gardner)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 41, 53

Range outside New Jersey—
Maryland ?

Type.—Mullica Hill, N. J.; ANSP.

Pyropsis corrina Whitfield 1892

Plate 90, Figures 3-5

Pyropsis (Rapa ?) corrina Whitfield, 1892, p. 45, pl. 3, figs. 1-3.

This species described from the "lower Green Marls" at Holmdel, New Jersey, is probably only a smooth internal cast of *Pyropsis septemlirata* Gabb as suggested by Weller.

Pyropsis planimarginata (Whitfield) 1892

Plate 54, Figures 11, 15-17

Tudicla planimarginata Whitfield, 1892, p. 33, pl. 1, figs. 1-3.
Pyropsis planimarginata Weller, 1907, p. 745, pl. 86, figs. 11-14.

Description.—"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." (Whitfield)

Remarks.—There is such a close resemblance between this species and *Pyropsis septemlirata* Gabb that they may be cospecific.

Range in New Jersey—
NAVESINK: 47

Type.—Missing.

Pyropsis trochiformis (Tuomey) 1854

Plate 54, Figure 12; Plate 56, Figure 3; Plate 90, Figures 6, 8

Pyrula trochiformis Tuomey, 1854, Proc. Acad. Nat. Sci. Phila., Vol. 7, p. 169.

Pyropsis Richardsoni ? Whitfield, 1892, p. 39, pl. 1, figs. 14-16 (not *P. Richardsoni* Tuomey).

Pyropsis trochiformis ? Whitfield, 1892, p. 41, pl. 1, figs. 4-7.

Pyropsis reileyi Whitfield, 1892, p. 42, pl. 2, figs. 11-16, 18-20 (not *P. reileyi* Whitfield).

Pyropsis trochiformis Weller, 1907, p. 746, (part) pl. 87, figs. 4-11 (not 1-3=*P. reileyi* Whitfield).

Pyropsis trochiformis Gardner, 1916, p. 446, pl. 16, figs. 1-2.

Description.—"The dimensions of an incomplete internal cast are: height, as far as preserved, 40 mm.; probable total height, about 60 mm.; maximum diameter, 41 mm. Shell pyriform, with three or four rapidly increasing volutions, spire depressed, the first volution and one-half almost flat in the casts, suture in the cast widely open. Body volution very broad and gibbous, contracting somewhat rapidly below to the anterior canal, which has been broken and destroyed in most of the specimens observed. Surface of the outer volution rounded from the suture to the base of the anterior canal, that portion above the line of greatest width shorter and more strongly convex than that below. Surface of the casts smooth, but sometimes with slight indications of the revolving costae of the exterior. Columellar cavity large in the casts. External surface of the shell marked by strong, more or less nodose, revolving costae, and by somewhat irregular lines of growth, the revolving lines becoming gradually more slender towards the base." (Weller)

Remarks.—"*Pyropsis trochiformis,* as used by Weller and others who were working with poorly preserved material, is little more than a group name which serves to include all of the larger casts of *Pyropsis* with rounded but not globose body whorls. The degree of variation in the convexity and in the sharpness of the contraction of the body is quite certainly much greater than would be allowed if the shell characters were preserved, but in the absence of these there are not very satisfactory criteria for separation." (Gardner)

Several of the specimens figured by Whitfield as *P. reileyi* Whitfield should be referred to *P. trochiformis.*

Range in New Jersey—
MARSHALLTOWN: 28, 31, 32
MT. LAUREL-NAVESINK: 37, 39, 40, 41, 45, 53
TINTON: 62, 63

Range outside New Jersey—
Maryland, Alabama, Mississippi.

Type.—Noxubee Co., Miss., missing.

Pyropsis ? obesa Whitfield 1892

Plate 54, Figure 14

Pyropsis ? obesa Whitfield, 1892, p. 40, pl. 3, figs. 12-13.
Pyropsis ? obesa Weller, 1907, p. 748, pl. 88, figs. 5-6.

Description.—"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°; 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." (Whitfield)

Remarks.—This species is evidently not a true *Pyropsis* because of the presence of the columellar fold. Whitfield was not able "to place it satisfactorily under any known genus," at the time he described it, and it may be allowed to remain with a question, where it was placed by the original author. (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 53

Type.—Mullica Hill, AMNH $\frac{8851}{1}$

Pyropsis reileyi Whitfield

Plate 57, Figures 1, 2; Plate 90, Figure 7

Pyropsis reileyi Whitfield, 1892, p. 42, pl. 2, fig. 17 (? not figs. 11-16, 18-20?=*P. trochiformis* (Tuomey).
Pyropsis trochiformis Weller, 1907, (part) p. 746, pl. 87, figs. 1-3.
Pyropsis reileyi Gardner, 1916, p. 448.

Description.—"Shell of medium size, subglobular or globularly ovate in general form, with a moderately elevated spire and subventricose volutions which are somewhat enlarged outwardly; volutions 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 volutions nearly on a level with each other, but the outer one dropping more rapidly below the inner, giving the greater height to the spire; volutions 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." (Whitfield)

Remarks.—Very close to *Pyropsis trochiformis* (Tuomey)

Range in New Jersey—
NAVESINK: 41

Range outside New Jersey—
Maryland.

Type.—Holmdel, New Jersey. Apparently lost.

Family Sarganidae

Sargana sp.

Rapana stantoni Weller, 1907, p. 754 (not pl. 89), figs. 1-3.
Rapana stantoni Stephenson, 1923, p. 377 (part) pl. 93, figs. 1-5.
Rapana stantoni Wade, 1926, p. 136 (part), pl. 46, figs. 7-8.
Sargana stantoni Stephenson, 1941, p. 325, pl. 60, figs. 15-17.

Remarks.—Poorly preserved specimens referable to *Sargana* have been found in the *Exogyra ponderosa* zone in New Jersey and North Carolina.

Range in New Jersey—
MARSHALLTOWN: 28

Family Moreidae

Morea naticella (Gabb) 1860

Plate 62, Figure 15

Purpura (Morea) naticella Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 301, pl. 48, fig. 14.

Pyropsis Naticoides Whitfield, 1892, p. 43, pl. 2, figs. 5-7.
Morea naticella Whitfield, 1892, p. 97, pl. 12, figs. 19-20.
Morea naticella Weller, 1907, p. 800, pl. 98, figs. 14-15.
Morea naticella Gardner, 1916, p. 465, pl. 18, fig. 12.

Description.—"Shell of medium size, subglobular or subpyriform, with three or four ventricose volutions, which are most inflated on the upper third; the dimensions of a nearly complete internal cast are: height, 19 mm.; maximum diameter, 16 mm.; height of aperture, 17 mm.; width of aperture, 8 mm. Spire rather low; aperture broadly elliptical, pointed above and obtusely so at the base; columellar cavity of medium size, with a single strong spiral ridge near the anterior margin. Surface of the shell marked by from 8 to 11 strong spiral ridges, leaving a plain space at the base of the shell equal in width to that of two of the ridges; surface marked also by somewhat more distant, transverse, broadly rounded ridges, which are nodose at the points of junction with the revolving ridges." (Weller)

Remarks.—"The type of the species is a large example, and has the markings more strongly impressed upon the surface of the cast than is usually the case." (Weller)

Range in New Jersey—
MERCHANTVILLE: 15

Range outside New Jersey—
Delaware.

Type.—New Jersey; ANSP 14972; Type *P. naticoides* Mullica Hill ANSP 16862.

Morea plicata (Whitfield) 1892

Plate 63, Figure 1

Turbinopsis plicata Whitfield, 1892, p. 104, pl. 12, figs. 1-2.
Morea plicata Weller, 1907, p. 801, pl. 98, figs. 16-17.

Description.—"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." (Whitfield)

Remarks.—"This species resembles *M. naticella,* but it is more elongate, with a higher spire, more loosely coiled volutions and a much broader umbilicus as indicated by the width of the umbilical cavity in the cast." (Weller)

Range in New Jersey—
WOODBURY: 20
MT. LAUREL-NAVESINK: 33, 47

Type.—Crosswicks, N. J.; ANSP 14967.

Family Buccinidae

"Pyrula" precedens (Whitfield) 1892

Plate 54, Figures 1, 2

Ficus precedens Whitfield, 1892, p. 122, pl. 15, figs. 7-8.

Pyrula precedens Weller, 1907, p. 724, pl. 84, figs. 3-4.

Description.—"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 12 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." (Whitfield)

Remarks.—This species somewhat resembles *Napulus retifer* (Gabb). In this respect Weller states: "The casts of *P. precedens,* however, do not show so large a columellar cavity and the anterior beak is more slender. The spiral ridges are also more numerous and more sharply elevated than in *P.* (i.e., *Napulus) retifer,* and the decided alternation among them is a distinguishing character."

Range in New Jersey—
NAVESINK: 41

Type.—Holmdel, N. J.; apparently lost.

Perissolax dubia (Gabb) 1860

Plate 52, Figure 12; Plate 53, Figure 12

Purpuroides ? dubia Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860) p. 94, pl. 2, fig. 11.

Perissolax dubia Whitfield, 1892, p. 47, pl. 3, figs. 9-11.

Tritonidea obesa Whitfield, 1892, p. 79, pl. 9, figs. 1-3.

Perissolax dubia Weller, 1907, p. 730, pl. 85, figs. 1-5.

Description.—"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 50°; 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 11, 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; 12 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." (Whitfield)

Remarks.—Occurs only as internal casts.

Range in New Jersey—
MT. LAUREL-NAVESINK: 40, 41, 47, 53

Type.—Mullica Hill, N. J.; ANSP 13717.

Seminola globosa (Gabb) 1876

Plate 55, Figure 6

Nassa globosa Gabb, 1876, Proc. Acad. Nat. Sci. Phil. (1876), p. 282.

Nassa globosa Weller, 1907, p. 738, pl. 86, fig. 1.

Seminola globosa Stephenson, 1923, p. 375, pl. 93, figs. 8-9.

Description.—"Shell subglobose, with a short anterior beak, spire moderately elevated, volutions six or more in number. The dimensions of a large, somewhat imperfect and distorted internal cast are: total height, 45 mm.; greatest width after correcting for the distortion, about 37 mm. Volutions of the spire marked by rather broad, vertical nodes which reach nearly from suture to suture, their greatest prominence being somewhat above the mid-height; body volution marked by similar nodes which are continued anteriorly, dying out about two-thirds of the distance from the suture to the anterior extremity, these nodes are broad, separated by about equally broad depressions, and are most prominent a little below the suture. Surface of the shell marked throughout by moderately coarse, depressed, revolving ribs, the distance from center to center of the larger ones upon the example whose dimensions are given above being about 2 mm." (Weller)

Range in New Jersey—
WENONAH: 35

Range outside New Jersey—
North Carolina.

Type.—Snow Hill, North Carolina; ANSP ?

Euthria ? fragilis Whitfield 1892

Plate 57, Figure 16

Euthria ? fragilis Whitfield, 1892, p. 78, pl. 9, figs. 11-12.
Euthria ? fragilis Weller, 1907, p. 753, pl. 88, figs. 25-26.

Description.—"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 indicate 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." (Whitfield).

Remarks.—Type specimen is unique. The distortion of the type is such that its generic relationships are uncertain.

Range in New Jersey—
WOODBURY: 24

Type.—Haddonfield, N. J.; ANSP 16867 (type and unique).

Family Fusidae sensullato

Fusinus holmesianus Gabb 1860

Plate 54, Figure 18; Plate 56, Figure 4

Fusus holmesianus Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 389, pl. 68, fig. 4.

Fusus holmesianus Weller, 1907, p. 755, pl. 89, fig. 4.

Description.—"The dimensions of the figured specimen are: height, 15 mm.; height of spire, 4mm.; greatest diameter, 8 mm.; apical angle, 60°. Shell fusiform with about three or four volutions, spire conical and turreted, the outer volution produced below into a straight anterior canal of moderate length. Suture moderately distinct; upper surface of the volutions flattened or a little concave, sloping downward from the suture to the line of greatest diameter, which is marked with a row of about 14 or 15 vertically elongate nodes upon each volution; on the volutions of the spire these nodes originate at about the middle and continue downward to the suture below, which is flexuose on account of the projection of the nodes; on the body volution the surface below the row of nodes is gently convex above, becoming concave below as it passes into the anterior canal. Entire surface of the shell marked with fine revolving lines." (Weller)

Range in New Jersey—
WENONAH: 34

Range outside New Jersey—
Alabama.

Type.—Eufaula, Ala.; ANSP 13831.

Fusinus cliffwoodensis (Weller) 1907

Plate 54, Figure 19

Fusus cliffwoodensis Weller, 1907, p. 756, pl. 89, figs. 6-7.

Description.—"The dimensions of the type specimen are: height, 18.5 mm.; height of spire, 5.5 mm.; greatest diameter, 10 mm.; apical angle, 75°. Shell fusiform with about four volutions, suture fairly well defined, outer volution produced below into a short, anterior canal. Outer volution flattened above, the upper surface short, sloping slightly downward from the suture to the periphery; below the periphery the slope is long and gently convex, becoming concave below as it passes into the anterior canal; periphery marked with about 12 or 14 strong nodes, which are much elongate anteriorly, reaching about half way from the periphery to the extremity of the anterior canal. Volutions of the spire not well preserved in the type specimen, but they are apparently angular at about their mid-height and are marked with nodes similar to those on the periphery of the outer volution. Aperture narrowly subovate, pointed below, more than twice as high as wide. Surface of the shell apparently smooth, or marked only with inconspicuous lines of growth." (Weller)

Remarks.—"This species closely resembles *F. holmesianus* Gabb, but the nodes upon the shoulder of the outer volution are larger and more elongate, and all spiral markings are lacking."

Range in New Jersey—
MAGOTHY: 5, 6

Type.—Cliffwood Point, N. J.; NJSM 9538.

Fusinus holmdelensis (Whitfield) 1892

Plate 57, Figures 6, 7

Fusus ? Holmdelensis Whitfield, 1892, p. 62, pl. 6, figs. 10-11.
Fusus holmdelensis Weller, 1907, p. 757, pl. 89, figs. 11-12.

Description.—"Shell of moderate size, about 1½ 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, 10 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." (Whitfield)

Remarks.—The type specimen is unique. Weller in referring to this type writes that, "It forms an exception to most of the gastropods of the Navesink marl, in that the form of the shell itself is preserved. The internal cast of the species has not been recognized."

Range in New Jersey—
MT. LAUREL-NAVESINK: 41, 53

Type.—Holmdel, New Jersey.

Fusinus lorillardensis (Weller) 1907

Plate 57, Figures 8, 9

Fusus lorillardensis Weller, 1907, p. 758, pl. 89, figs. 9-10.

Description.—"The dimensions of the type specimen are: height, 53 mm.; height of spire, 23 mm.; greatest diameter, 18 mm.; apical angle about 34°. Shell elongate-fusiform, with six or seven volutions, the outer volution produced into an elongate anterior canal; suture moderately impressed; the surface of the volutions of the spire regularly convex from suture to suture. Surface of the shell marked by a revolving ridge or shoulder of moderate size just below the suture; each volution marked by from 15 to 18, or less upon the smaller volutions, rather sharp, elevated, vertical, slightly curved ridges, the concave side of the curve towards the aperture; on the volutions of the spire the ridges continue from suture to suture but on the outer volution they become obsolete a little less than half way from the suture to the anterior extremity of the canal; surface also marked by fine revolving costae, three or four of which occupy the space of one millimeter, and by distinct transverse lines of growth which have a broad but slight sinuosity below the suture, following the direction of the transverse ridges." (Weller)

Remarks.—Weller further describes the type as "a partial internal cast with the nearly complete external mould, from which a plaster cast has been taken. The transverse ribs are clearly visible on the internal cast, but they are broadly rounded and much lower than the shell itself. The dimensions given are of the largest individual observed."

Range in New Jersey—
WOODBURY: 18

Type.—Lorillard, New Jersey.

Bellifusus medians (Whitfield) 1892

Plate 58, Figures 2, 3, 4

Odontofusus medians Whitfield, 1892, p. 67, pl. 5. figs. 18-21.

?Pyrifusus turritus Whitfield, 1892, p. 54, pl. 5, fig. 4 (not figs. 1-3).

Odontofusus medians Weller, 1907, p. 761, pl. 90, figs. 1-5, ?6.

Odontofusus medians Gardner, 1916, p. 443.

Bellifusus medians Stephenson, 1941, p. 338.

Description.—"Shell fusiform with seven or eight volutions, produced below into a rather slender, straight, anterior canal, spire slender, about four-fifths as high as the aperture; the dimensions of a nearly complete shell from the Ripley formation of Mississippi are: total height, 36.5 mm.; height of spire, 17 mm.; maximum diameter of shell, 15 mm.; apical angle, 48° to 50°. Outer volution somewhat ventricose above and contracted below into the anterior canal. Just below the suture the shell is marked by a rather narrow, crenulated, revolving band, below which the volutions expand somewhat abruptly; shell marked by strong vertical folds, about 12 of which occupy the outer volution. These folds are slightly oblique and are somewhat curved, the concave side being directed towards the aperture, they become obsolete below the middle of the outer volution, the lower canaliculate portion of the shell being marked by rather fine revolving ribs. Aperture elongate, rounded above, pointed below; outer lip thin, columella marked by a single revolving fold, which is situated high up, and so far back that it can scarcely be seen from the aperture in complete examples of the shell." (Weller)

Range in New Jersey—
MERCHANTVILLE: 11, 16
MARSHALLTOWN: 28
MT. LAUREL-NAVESINK: 37, 44, 47

Range outside New Jersey—
Maryland, Mississippi ?

Type.—Upper Freehold. Types of *P. turritus*, Burlington County N. J.; ANSP 16865, 16866.

Bellifusus slacki (Gabb) 1861

Plate 58, Figures 7, 8

Fasciolaria Slacki Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 322.
Odontofusus Slacki Whitfield, 1892, p. 66, pl. 6, figs. 8-9.
Odontofusus slacki Weller, 1907, p. 766, pl. 90, fig. 17.
Bellifusus slacki Stephenson, 1941, p. 338.

Description.—"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." (Whitfield)

Range in New Jersey—
MERCHANTVILLE: 15, 17
WOODBURY: 20
MT. LAUREL-NAVESINK: 47

Type.—Crosswicks, N. J.; ANSP 13822.

Turbinella intermedia Weller 1907

Plate 58, Figures 10, 11

Turbinella intermedia Weller, 1907, p. 767, pl. 90, figs. 18-22.

Description.—"Internal casts short fusiform to subglobular in form with about three volutions, the dimensions of two nearly complete examples being: height, 18 mm. and 13 mm.; greatest diameter, 17 mm. and 11.8 mm. Apical angle about 75°, the spire about one-third the total height of the shell, the volutions increasing somewhat rapidly in size, subangular on the periphery and marked by rather strong vertical nodes, which become obsolete before reaching the suture above, and also a short distance below the periphery, about 12 nodes occurring upon the outer volution; the last volution rather rapidly contracting below and produced into a short anterior beak; columellar cavity of moderate width, bearing the impressions of three rather faint revolving folds." (Weller)

Remarks.—"Only the internal casts of this species have been observed. These resemble similar casts of *T. alabamensis,* but they are always shorter, with the volutions less regularly rounded over the periphery, and they do not attain so large a size. They differ from the casts of *T. parva* in being somewhat larger, in having a more elevated spire and in the more nearly vertical position of the nodes. The species is, in fact, somewhat intermediate in its characters between *T. alabamensis* and *T. parva,* and has been observed only from the Merchantville clay-marl, while these other two species are both Navesink species."

Range in New Jersey—
MERCHANTVILLE: 15, 16

Type.—Lenola, NJSM 7769.

Turbinella alabamensis (Gabb) 1860

Plate 56, Figure 5; Plate 59, Figure 1

Cancellaria Alabamensis, Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 301, pl. 48, fig. 14 (fig. 26 on plate).

Turbinella ? verticalis, Whitfield, 1892, p. 82, pl. 3, figs. 14-15.

Turbinella alabamensis Weller, 1907, p. 768, pl. 91, figs. 1-6.

Description.—"Internal casts, exclusive of the anterior canal, subglobose in form, with a moderately elevated spire, which has an apical angle of about 85°, consisting of about three and one-half volutions; the dimensions of a nearly complete internal cast are: height, 36 mm.; height of spire, 9 mm.; greatest diameter, 26 mm. Volutions increasing rather rapidly in size, the last one ventricose in the upper part, rapidly contracted below and produced anteriorly in an elongate anterior canal; aperture elliptical in form, pointed above and prolonged below; columellar cavity of moderate size, with three slender, oblique plications opposite the middle of the aperture; surface of the volutions marked by strong, rounded, vertical plications or folds, which become obsolete a little below the periphery and are also less distinct upon the outer half of the last volution. About 11 of these folds are present upon the outer volution of an average example. A plaster cast of the upper half of a shell from a natural mould has about five volutions, the spire is conical and turreted with an apical angle of about 75°; suture well defined; the volutions of the spire strongly angular a little below the middle of the distance between the sutures, the upper surface flattened or slightly concave, the angle marked with strong nodes, of which there are about 12 on each volution. Upper surface of the body volution nearly flat, sloping downward from the suture to the angular periphery, which is marked by strong nodes similar to those of the upper volutions; below the periphery the surface is gently convex as far as the specimen continues. Surface marked by fine revolving costae, and by lines of growth which, just below the suture, are as strong or stronger than the revolving costae. The direction of the lines of growth indicate that the outer lip of the aperture was broadly sinuate in its upper part." (Weller)

Remarks.—The external characteristics of the species are less well known than the internal features.

Range in New Jersey—
WENONAH: 34, 35
MT. LAUREL-NAVESINK: 37, 40, 47, 53

Range outside New Jersey—
Alabama.

Type.—Prairie Bluff, Alabama; ANSP.

Turbinella parva Gabb 1860

Plate 59, Figure 2

Turbinella parva Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860), p. 94, pl. 2, fig. 3.

Turbinella ? parva Whitfield, 1892, p. 80, pl. 9, figs. 4-6.

Turbinella parva Weller, 1907, p. 770, pl. 90, figs. 23-24.

Description.—"Shell small, subturbinate in form, the greatest diameter being near the top of the volution, rapidly narrowing below, spire depressed, but not quite flat; the dimensions of an incomplete internal cast are: height, 11.5 mm., but if the spire were complete anteriorly it would probably be 13 mm. or 14 mm.; maximum diameter, 14 mm. Volutions about three in number, flattened above, rounded on the periphery; aperture large, oblique, higher than wide; columellar cavity in the casts broad, 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 lowest one 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." (Weller)

Remarks.—Known only from internal casts.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 40, 41, 47, 58

Type.—Monmouth Co., N. J.; ANSP 14255.

Turbinella subconica Gabb 1860

Plate 59, Figure 3

Turbinella subconica Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860), p. 94, pl. 2, fig. 6.
Turbinella ? subconica Whitfield, 1892, p. 81, pl. 9, figs. 7-8.
Turbinella subconica Weller, 1907, p. 771, pl. 91, figs. 11-12.

Description.—"Shell rather below a medium size, the cast measuring only about one 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 12 or 13 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." (Whitfield)

Remarks.—Type specimen is unique.

Range in New Jersey—
MT. LAUREL-NAVESINK: 58

Type.—Monmouth Co., N. J.; ANSP 14256.

Aliofusus ? sayri Richards 1943

Plate 43, Figure 17

Aliofusus ? sayri Richards, 1943, p. 28, pl. 5, fig. 17.
Aliofusus ? sayrei Stephenson, 1954, p. 39.

Description.—"Shell of medium size, subfusiform, stout. Protoconch broken away. Whorls about four, increasing in size with considerable rapidity. A shoulder is formed by a broadly excavated band below the suture. A narrow collar borders the suture but no nodes can be observed on it. Conspicuous axial ribs, impossible to count because of the imperfect state of the fossil. The axials are most conspicuous near the shoulder and fade out gradually near the base. The entire surface is covered with faint striae. Aperture not observed. Length 19.0 mm.; greatest width 13.0 mm.'' (Richards)

Remarks.—''Close to *Aliofusus reagani* Stephenson from Navarro group of Texas the type species of the genus, but proportionally somewhat stouter.'' (Richards)

Range in New Jersey—
RARITAN: 1a

Type.—Sayreville, N. J.; NJSM 10439.

Fasciolaria ? obliquicostata Gabb 1876

Plate 57, Figure 15; Plate 64, Figure 2

Fasciolaria (Cryptorhytis) obliquicostata Gabb, 1876, Proc. Acad. Nat. Sci. Phil. (1876) p. 283.

Cryptorhytis obliquicostata Weller, 1907, p. 759, pl. 89, fig. 8.

Fasciolaria ? obliquicostata Stephenson, 1923, p. 381, pl. 94, figs. 3-4.

Description.—The approximate dimensions of an imperfect specimen are: height of shell when complete, point of spire restored, 12.5 mm.; height of spire, about 4 mm.; greatest diameter, 7 mm.; apical angle, about 52°. Shell fusiform with about three or four volutions, suture well defined, outer volution produced below into a rather short anterior canal. Surface of the volutions of the spire convex from suture to suture, and marked by a series of elongate, slightly oblique, rather sharp nodes, about 11 or 12 on each volution, which originate close to the upper suture, become strongest at about the mid-height of the volution and grow fainter below to the lower suture. Upon the outer volution the nodes resemble those of the spire and become obsolete below, about half way between the suture and the extremity of the anterior canal; the surface of the outer volution is convex from the suture to below the middle where it becomes concave as it passes into the anterior canal, the periphery being without a distinct angulation. Surface of the shell marked throughout with fine revolving lines. (Weller)

Remarks.—New Jersey examples of this species are uncommon and generally are preserved imperfectly.

Range in New Jersey—
WOODBURY: 18, 24

Range outside New Jersey—
North Carolina.

Type.—Snow Hill, N. C.; ANSP 2308.

"Fasciolaria" sp.

Plate 44, Figure 7

Fasciolaria sp. Richards, 1943, p. 30, pl. 3, fig. 7.

Remarks.—One poorly preserved unidentified species of *Fasciolaria* has been collected from the Sayre and Fisher Pits at Sayreville, N. J. (ANSP 15801).

Range in New Jersey—
RARITAN: 1a

Odontofusus typicus Whitfield 1892

Plate 58, Figure 5

Odontofusus typicus Whitfield, 1892, p. 66, pl. 6, figs. 1-5.

Odontofusus typicus Weller, 1907, p. 763, pl. 90, figs. 7-16.

Odontofusus typicus Stephenson, 1941, p. 338.

Description.—"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 10 or 12 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 striae may be imagined on the cast, but can scarcely be said to exist." (Whitfield)

Remarks.—This genus was founded on this species as well as on *Fasciolaria slacki* Gabb. Although *Odontofusus typicus* is not truly representative of the genus, a rule of the International Code states that it must be recognized as the genotype by virtue of its name.

Range in New Jersey—
MT. LAUREL-NAVESINK: 40, 45, 47, 53

Type.—Cream Ridge, N. J.; NJSM 10093.

Odontofusus mucronata (Gabb) 1861

Plate 58, Figures 6, 9

Voluta mucronata Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861) p. 323.

Odontofusus rostellaroides Whitfield, 1892, p. 68, pl. 6, figs. 6-7.

Volutomorpha (Piestochilus) mucronata Whitfield, 1892, p. 75, pl. 6, figs. 12-14.

Odontofusus mucronata Weller, 1907, p. 764, pl. 95, figs. 5-11.

Description.—"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." (Whitfield)

Range in New Jersey—
NAVESINK: 40, 41, 43, 45, 47

Type.—Crosswicks, N. J.; ANSP 14382.

Family Fulguridae

Pyrifusus meeki Whitfield 1892

Plate 54, Figures 7, 8

Pyrifusus meeki Whitfield, 1892, p. 55, pl. 4, figs. 6-8.

Pyrifusus meeki Weller, 1907, p. 732, pl. 85, figs. 7-8.

Description.—"Shell moderately large for the genus, having a diameter of nearly 1¼ 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 (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." (Whitfield)

Remarks.—This seems to be a well defined species which can be easily distinguished from any of its associates by reason of the two revolving angles of the outer volution with the distinctly flattened surface between. (Weller)

Range in New Jersey—
NAVESINK: 47

Type.—Crosswicks Creek, N. J.

Pyrifusus mullicaensis (Gabb) 1860

Plate 55, Figure 1

Pleurotoma mullicaensis Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1860) p. 95, pl. 2, fig. 8.

Pyrifusus mullicaensis Whitfield, 1892, p. 52, pl. 4, figs. 16-19.

Pyrifusus turritus Whitfield, 1892, (part) p. 54, pl. 5, figs. 1-2 (not figs. 3-5).

Neptunella Mullicaensis Whitfield, 1892, p. 56, pl. 4, figs. 20-21.

Eripachya ? paulidinaformis Whitfield, 1892, p. 77, pl. 3, figs. 16-17.

Pyrifusus mullicaensis Weller, 1907, p. 733 (part), pl. 85, figs. 9-11, 14-15 (not figs. 12-13=*P. cuneus* Whitfield).

Description.—Shell subfusiform, with about five volutions, of medium size or rather large, length above and below the point of greatest diameter nearly equal, spire obtusely conical with an apical angle of about 50°; the dimensions of a nearly complete internal cast are: total height, 36 mm.; greatest diameter, 20.5 mm.; height of spire, 13 mm.; height of aperture, 23 mm.; width of aperture, 9.5 mm. Volutions ventricose, with deep sutures, the outer one subangular on the periphery with the lower part somewhat attenuated; aperture large, elongate, subelliptical, more rounded externally than on the inner side; columellar cavity in the casts broad. Surface of the casts marked by numerous obliquely vertical folds which are strongest on the largest portion of the volutions; other surface characters unknown. (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 39, 43, 47, 50, 53
TINTON: Freehold.

Type.—Mullica Hill, N. J.; ANSP 14982.

Pyrifusus cuneus Whitfield 1892

Plate 55, Figure 4

Pyrifusus cuneus Whitfield, 1892, p. 51, pl. 4, figs. 9-11.

Pyrifusus mullicaensis, Weller, 1907, p. 733 (part) pl. 85, figs. 12, 13 (not figs. 9-11, 14, 15; not *P. mullicaensis* Gabb).

Pyrifusus cuneus, Gardner, 1916, p. 460.

Description.—"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." (Whitfield)

Remarks.—Weller erred in believing that the specimens described by Whitfield as *P. cuneus* were young individuals of *P. mullicaensis.*

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 39, 43, 50, 53
TINTON: Freehold.

Range outside New Jersey—
Maryland.

Type.—New Jersey: ANSP 16868.

Pyrifusus macfarlandi Whitfield 1892

Plate 55, Figure 5

Pyrifusus Macfarlandi Whitfield, 1892, p. 52, pl. 4, figs. 14-15.

Pyrifusus macfarlandi Weller, 1907, p. 735, pl. 85, fig. 17.

Description.—"Shell below a medium size, short-conical or subglobose, shorter below than above the point of greater 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." (Whitfield)

Remarks.—This species may be distinguished from *P. mullicaensis* (Gabb) by the more numerous vertical node-like folds on the shell and by its comparatively broader and shorter form.

Range in New Jersey—
MT. LAUREL-NAVESINK: 53

Type.—Mullica Hill AMNH $\frac{8856}{1}$ $\frac{5403}{1}$

Pyrifusus erraticus Whitfield 1892

Plate 55, Figures 2, 3

Pyrifusus erraticus Whitfield, 1892, p. 50, pl. 4, figs. 4-5.
Pyrifusus erraticus Weller, 1907, p. 736, pl. 85, fig. 16.

Description.—"Shell of medium size, a very fine specimen used, measuring 1¼ 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." (Whitfield)

Remarks.—"In the recent collections of the Survey is a large, but somewhat imperfect internal cast of this species, which must have had a total height of 43 mm. when complete, which is considerably larger than Whitfield's type, with a height of but 31 mm. The species is a well-marked one and cannot be easily confused with any other in the Cretaceous beds of New Jersey."

Range in New Jersey—
MAGOTHY: 5

Type.—Cliffwood, N. J.

Pyrifusus ? elevata (Whitfield) 1892

Plate 62, Figure 14

Turbinopsis elevata Whitfield, 1892, p. 102, pl. 12, figs. 13-14 (not figs. 10-12=*Turbinopsis curta* Whitfield).

Turbinopsis ? elevata Weller, 1907, p. 797, pl. 83, figs. 14-15.

? Pyrifusus elevata Gardner, 1916, p. 462.

Description.—"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." (Whitfield)

Remarks.—This species is known only from internal casts and is of uncertain relationship.

Range in New Jersey—
NAVESINK: 40, 47, 53

Range outside New Jersey—
Maryland.

Type.—Crosswicks, N. J.; ANSP 14964.

Serrifusus nodocarinatus Whitfield 1892

Plate 57, Figure 14

Serrifusus (Lirofusus) nodocarinatus Whitfield, 1892, p. 64, pl. 5, figs. 22-23.

Serrifusus nodocarinatus Weller, 1907, p. 760, pl. 89, fig. 13.

Serrifusus nodocarinatus Gardner, 1916, p. 455.

Description.—"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." (Whitfield)

Remarks.—This species is known only from the type specimen and from a cast from Maryland with which fragments of the shell were associated.

Range in New Jersey—
NAVESINK: 42

Range outside New Jersey—
Maryland.

Type.—Marlboro, N. J.

Serrifusus crosswickensis Whitfield 1892

Plate 58, Figure 1

Serrifusus ? Crosswickensis Whitfield, 1892, p. 63, pl. 5, figs. 24-25.
Serrifusus crosswickensis Weller, 1907, p. 761, pl. 89, figs. 14-17.

Description.—"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." (Whitfield)

Remarks.—As only internal casts of this uncommon species have been reported, the external nature of the shell is unknown.

Range in New Jersey—
NAVESINK: 37, 47

Type.—Crosswicks, N. J.

Family Graphidulidae

Piestochilus bella (Gabb) 1860

Plate 61, Figures 2, 3

Volutilithes bella Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 300, pl. 48, fig. 7.

Voutomorpha (Piestochilus) bella Whitfield, 1892, p. 74, pl. 6, figs. 15-18.

Piestochilus bella Weller, 1907, p. 782, pl. 96, figs. 1-4; pl. 92, figs. 4-5.
Piestochilus bella Gardner, 1916, p. 441.
Piestochilus bella Groot, Organist and Richards, 1954, p. 52, pl. 6, fig. 4.

Description.—"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." (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 58

Range outside New Jersey—
Delaware.

Type.—Delaware and Chesapeake Canal, Del.; ANSP 14612.

Piestochilus kanei (Gabb) 1861

Plate 61, Figures 4, 5

Voluta Kanei Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 323.
Volutomorpha (Piestochilus) Kanei Whitfield, 1892, p. 76, pl. 6, figs. 19-20.
Piestochilus kanei Weller, 1907, p. 784, pl. 96, figs. 5-9.

Description.—"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." (Whitfield)

Range in New Jersey—
MAGOTHY: 5
WENONAH ?: 34
MT. LAUREL-NAVESINK: 47

Type.—Crosswicks, N. J.; ANSP 14381.

Family Mitridae

Piestochilus reileyi (Whitfield) 1892

Plate 62, Figure 3

Turricula Reileyi Whitfield, 1892, p. 92, pl. 11, fig. 8.
Turricula reileyi Weller, 1907, p. 791, pl. 97, fig. 10.
Vulpecula reileyi Gardner, 1916, p. 433.

Description.—"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." (Whitfield)

Remarks.—Specimens of this uncommon fossil generally are so poorly preserved that many of the generic features are unrecognizable. It is possible that the New Jersey species now assigned to *Turricula* may belong to the genus *Vulpecula.*

Range in New Jersey—
NAVESINK: 43

Range outside New Jersey—
Maryland.

Type.—Freehold, N. J.

Family Volutidae

Volutoderma woolmani Whitfield 1893

Plate 59, Figure 9

Volutoderma woolmani Whitfield, 1893, Nautilus, vol. 7, pp. 37 and 51, pl. 2, figs. 4-5.

Volutoderma woolmani Weller, 1907, p. 774, pl. 91, figs. 18-19.

Description.—"Shell, as shown by the internal cast, somewhat more than an inch in length, and having a diameter of the body volution of seven-sixteenths of an inch in the cast, being more slender than any species yet described. Volutions largest just below the suture and attenuate below, forming a moderately long beak; marked in the upper part by eight comparatively strong vertical plications, which are obsolete below. Columella marked by three very distinct folds or ridges, the lowest of which is the strongest. These are well marked on the inside of the upper volutions." (Whitfield)

Remarks.—This species is a very distinct one, and differs from other members of the genus in the New Jersey faunas in its smaller size and more slender form. (Weller)

Range in New Jersey—
MERCHANTVILLE: 15

Type.—Lenola, N. J.; ANSP 37.

Volutoderma biplicata (Gabb) 1860

Plate 59, Figures 8, 11

Volutilithes biplicata Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 300, pl. 48, fig. 6.

Volutoderma biplicata Whitfield, 1892, p. 90, pl. 10, figs. 1-2.

Volutoderma biplicata Weller, 1907, p. 775, pl. 91, figs. 13-17.

Description.—"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 of the American Museum of Natural History, there are a few distant vertical plications, faintly indicated, but which do not extend below the most ventricose part of the whorl." (Whitfield)

Range in New Jersey—
MERCHANTVILLE: 14, 15, 16
WOODBURY: 19

MARSHALLTOWN: 28
WENONAH: 34

Range outside New Jersey—
Delaware.

Type.—Burlington County; ANSP 14420.

Volutoderma ovata Whitfield 1892

Plate 56, Figure 6; Plate 59, Figures 13, 14

Volutoderma ovata Whitfield, 1892, p. 91, pl. 10, figs. 3-4.
Volutoderma ovata Weller, 1907, p. 776, pl. 91, figs. 20-21.

Description.—"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." (Whitfield)

Remarks.—Close to *Volutomorpha gabbi* Whitfield but the latter has only one columellar fold while *V. ovata* has two.

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 47, 53

Type.—Mullica Hill, N. J.; AMNH.

Volutoderma jamesburgensis Weller 1907

Plate 59, Figures 6, 7

Volutoderma jamesburgensis Weller, 1907, p. 777, pl. 91, figs. 22-23.

Description.—"Shell of medium size, the dimensions of the type specimen being: height, 30 mm.; maximum diameter, 17 mm. Volutions about four in number, the spire of moderate height, apical angle about 58°. Suture well defined; just below the suture is a rounded ridge marked by conspicuous oblique costae about one millimeter apart on the outer volution; just below this ridge is a narrow, concave band, outside of which, upon the shoulder of the volution, is a series of strong rounded nodes about three mm. apart from center to center on the outer volution, which continue longitudinally as strong, rounded ribs to the anterior extremity of the shell. Surface also marked by fine, vertical lines of growth; revolving lines entirely absent. The internal cast is similar in general form, the suture is well defined, the volutions are flattened above, or even slightly concave, towards the aperture, sloping downward to the line of maximum diameter beneath the row of strong nodes on the exterior, below which the sides are nearly vertical to the suture below, or in the body volution becoming concave towards the anterior extremity. The vertical ribs are shown on the internal casts, but are much weaker than upon the exterior of the shell." (Weller)

Remarks.—"This species is based upon a natural mould of the exterior of the shell with the internal cast of the same individual. It is one of the few individuals of this genus from the Cretaceous formations of New Jersey whose external characters are known to any considerable degree." (Weller)

Type specimen is unique.

Range in New Jersey—
MERCHANTVILLE: 10

Type.—Jamesburg, N. J.; (type and unique) NJSM (?).

Volutomorpha conradi (Gabb) 1860

Plate 59, Figure 10; Plate 60, Figures 1, 3, 5; Plate 61, Figure 1

Volutilithes Conradi Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 300, pl. 48, fig. 10.

Volutomorpha conradi Whitfield, 1892, p. 71, pl. 6, fig. 21; pl. 7, figs. 1-3, 4, 5, ?.

Volutomorpha Gabbi Whitfield, 1892, p. 73, pl. 7, fig. 6; pl. 8, figs. 1-4.

Volutomorpha conradi Weller, 1907, p. 780, pl. 92, figs. 6-7; pl. 93, figs. 1-3, pl. 94, figs. 1-6.

Volutomorpha conradi Gardner, 1916, p. 427, pl. 15, fig. 8.

Volutomorpha conradi Groot, Organist and Richards, 1954, p. 52, pl. 6, fig. 6.

Description.—"Shell large, some specimens apparently attaining a length of 4½ inches, with a diameter of the largest volution of rather more than 1¼ inches; spire short, or only moderately elevated, although the general form of the shell is somewhat slender, the body volution, as viewed on 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.'' (Whitfield)

Remarks.—''Only a single true columellar fold has ever been noted in any of the individuals properly referable to this species, and it is exceedingly doubtful if Whitfield was correct in his observation that the columella is marked by from one to three very oblique folds.'' (Gardner)

Range in New Jersey—
MAGOTHY: 5
MERCHANTVILLE: 15
WOODBURY: ?
MT. LAUREL-NAVESINK: 37, 41, 43, 46, 47, 49, 50, 53
VINCENTOWN: (Vincentown)

Range outside New Jersey—
Delaware, Maryland.

Type.—Crosswicks, N. J.; ANSP 14375; Mullica Hill, N. J.; ANSP 14374 (type of *Volutomorpha gabbi).*

Volutomorpha ponderosa Whitfield 1892

Plate 60, Figure 2

Volutomorpha ponderosa Whitfield, 1892, p. 72, pl. 8, figs. 5-6; pl. 9, figs 13-15.

Volutomorpha ponderosa Weller, 1907, p. 781, pl. 95, figs. 1-2.

Description.—''Shell large and moderately ventricose, attaining a length of 7 or more inches, with a transverse diameter of nearly or quite 2¼ inches; spire moderately elevated, with depressed convex whorls; volutions five or more, the last one forming nearly or quite three-fifth of the entire length, gently convex throughout the upper three-fourths of its length and slightly narrowed and extended 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." (Whitfield)

Remarks.—This species is probably the largest gastropod in the Cretaceous faunas of New Jersey. It resembles *V. conradi*, but it is much more ponderous than that species, with a less extended anterior beak. The volutions of the spire are also proportionally much longer and less ventricose than in that species, and none of the volutions is shouldered at the top. (Weller)

Range in New Jersey—
MT. LAUREL-NAVESINK: 41, 43, 45, 58

Volutomorpha delawarensis (Gabb) 1861

Plate 60, Figure 4

Voluta delawarensis Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861), p. 322.

Voluta ? delawarensis Whitfield, 1892, p. 84, pl. 10, figs. 5-7.

Volutomorpha delawarensis Groot, Organist and Richards, 1954, p. 52, pl. 6, fig. 5.

Description.—"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." (Whitfield)

Range outside New Jersey—
Delaware.

Type.—Delaware and Chesapeake Canal, Del.; ANSP 14266.

Mississippi, and (in several varietal forms) from the Navarro of Texas. *L. ruhlei* is narrower, has a more even slope from apex to aperture, and has less pronounced sutures. Length 41.0 mm.; width 22.8 mm: Type specimen is unique." (Richards)

Range in New Jersey—
WOODBURY: 23

Type.—Fellowship, N. J. (well); ANSP 19764.

Family Vasidae

Vasum conoides Whitfield 1892

Plate 59, Figures 4, 5

Vasum conoides Whitfield, 1892, p. 83, pl. 9, figs. 9-10.
Vasum conoides Weller, 1907, p. 773, pl. 91, figs. 9-10.

Description.—"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." (Whitfield)

Remarks.—This species is known only from the type specimen found near Walnford and a poorly preserved specimen found at Mullica Hill. Both specimens are internal casts.

Range in New Jersey—
MT. LAUREL-NAVESINK: 46, 53

Family Pleurotomidae

Cithara mullicaensis Whitfield 1892

Plate 62, Figure 9; Plate 63, Figure 2

Cithara Mullicaensis Whitfield, 1892, p. 106, pl. 13, figs. 2-6.
Cithara mullicaensis Weller, 1907, p. 804, pl. 98, figs. 22-28.

Description.—"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

Liopeplum cretaceum (Conrad) 1858

Plate 56, Figure 7

Volutilithes cretaceum Conrad, 1858, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 3, p. 333, pl. 35, fig. 16.

Liopeplum cretaceum Gardner, 1916, p. 431, pl. 15, fig. 5.

Description.—"Shell thin, highly polished, broadly fusiform, dorsoventrally compressed; aperture little more than half as high as the entire shell; whorls closely appressed, probably about six in number, subtrapezoidal in outline, those of the spire increasing uniformly in size, the body whorl very feebly constricted upon merging into the pillar; external surface smooth, excepting the broad and somewhat irregular, incremental corrugations; growth sculpture very prominent upon the later portion of the ultima, the incrementals broadly arcuate and parallel to the margin of the expanded outer lip; feeble fortuitous spirals occasionally developed at the base of the pillar; suture lines very closely appressed, the zone of appression approximately one-third the altitude of the entire whorl; aperture broadly lenticular; outer lip arcuate, abruptly constricted anteriorly; inner lip smoothly concave at the base of the body; pillar straight, biplicate; anterior extremity squarely truncate." (Gardner)

Range in New Jersey—
WOODBURY: 20

Range outside New Jersey—
Maryland, Mississippi.

Type.—Owl Creek, Mississippi.

Liopeplum ruhlei Richards

Plate 56, Figure 8

Liopeplum ruhlei Richards, 1954, Acad. Nat. Sci. Phila. Notula Naturae 258, p. 3, fig. 3.

Description.—"Shell subconical, dextral, general shape as in figure. Highly polished; 5½ whorls, body whorl greatly elongated, about two-thirds the total length of the shell. Protoconch very small and imperfectly developed. Whorls closely spaced, suture only moderately impressed. Whorls covered with round-crested spiral ridge of callus. Upper three whorls ornamented with small, low, closely spaced crenulations, about 16 or 17 on the largest whorl. Growth lines clearly shown on the body whorl, very indistinct on the spire. Aperture elongate as in *L. leiodernum* (Conrad), ending in anterior canal. Outer lip broadly arched. Columella not well exposed on the type, but apparently straight and bearing folds." (Richards)

Remarks.—"The shell is closely related to *L. leiodernum* (Conrad), known from the Monmouth formation of Maryland, the Ripley of 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 10 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 cannot be ascertained." (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 39, 40, 47, 53

Type.—Mullica Hill, N. J., ANSP (?).

Cithara crosswickensis Whitfield 1892

Plate 62, Figure 12

Cithara Crosswickensis Whitfield, 1892, p. 107, pl. 13, figs. 7-8.
Cithara crosswickensis Weller, 1907, p. 803, pl. 98, figs. 20-21.

Description.—"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 indica-

tions of faint thread-like, raised, spiral lines, divided by broad flattened interspaces." (Whitfield)

Remarks.—This species closely resembles *C. mullicaensis* Whitfield. Internal casts of *Cithara crosswickensis* also resemble those of *Bellifusus medians* (Whitfield) but the latter contains a columellar fold.

Range in New Jersey—
MT. LAUREL-NAVESINK: 47

Type.—Crosswicks, N. J.; ANSP 19701.

Family Cancellaridae

Caveola subalta (Conrad) 1869

Plate 61, Figure 8

Cancellaria subalta Conrad, 1869, Am. Jour. Conch., vol. 5, p. 100, pl. 9, fig. 22.

Cancellaria (Merica) subalta Whitfield, 1892, p. 95, pl. 12, figs. 24-25.

Cancellaria subalta Weller, 1907, p. 792, pl. 98, fig. 1.

Caveola subalta Stephenson, 1941, p. 363.

Description.—"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; aperture 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; 11 or 12 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." (Whitfield)

Columella marked by two well-defined revolving folds below the mid-height of the aperture.

Range in New Jersey—
MERCHANTVILLE: 8, 9
WOODBURY: 19, 20, 24

Type.—Haddonfield, N. J.; ANSP 14961.

Cancellaria smocki Weller 1907

Plate 61, Figure 9

Cancellaria smocki Weller, 1907, p. 793, pl. 98, figs. 2-3.

Description.—Shell with about three volutions in the cast; the dimensions of two of the type specimens are: height, 18.5 mm. and 15.5 mm.; maximum diameter, 12 mm. and 10 mm.; height of aperture, 12 mm. and 9.5 mm. The upper surface of the volutions is nearly horizontal adjacent to the suture, but the sides round rapidly downward becoming nearly parallel with the axis of the shell at about one-fourth the distance from the suture to the anterior margin of the outer volution, from this point the surface is gently convex to a point about two-thirds the distance from the suture to the anterior margin, below which it contracts rather abruptly to the umbilical margin; the shell is not produced into an anterior canal. In the casts the umbilical cavity is narrow, indicating an imperforate or a very narrowly perforate shell, columella marked by three faint revolving folds situated below the middle of the inner lip of the aperture. Surface of the shell as seen in impressions of the exterior, marked by rather strong, regular transverse ribs which curve backward from the suture until they cross the somewhat rounded shoulder of the shell, below which they are nearly vertical; about 20 to 22 of these ribs occupy the larger volutions, but they do not cross the lower contracted portion of the outer volution; surface also marked by narrow, raised, revolving lines, six or eight of which occupy the nearly vertical surface of the outer volution and the volutions of the spire, with the vertical ribs dividing that surface of the shell into depressed, quadrangular spaces; about six similar revolving lines are also present upon the lower contracting portion of the outer volution, continuing to the umbilical margin, all the revolving lines exhibit some tendency to alternate in size. (Weller)

Range in New Jersey—
MERCHANTVILLE: 8
WOODBURY: 18

Type.—Lorillard, N. J. and Matawan, N. J. (cotypes).

Paladmete pristina Stephenson 1954

Plate 45, Figures 8, 9

Paladmete pristina Stephenson, 1954, p. 39, pl. 8, figs. 24-26.

Description.—"Shell small with spire about half the total height; spiral angle about 40°. Protoconch not preserved. Whorls 3 or 4, moderately inflated, closely appressed, suture deeply impressed. Shoulder on whorls narrow, steeply sloping, obtusely subangular in cross section; flanks very gently convex. Periphery of body whorl broadly rounded, base gently convex above becoming steep below. The body whorl from the shoulder down bears at least 13 well developed, rather thick, squarish-topped spiral ribs, separated by interspaces of equal or slightly greater width; these ribs decrease slightly in width and strength from the shoulder downward. The shoulder bears three small spirals, the upper one of which is much stronger than the two tiny ones below it. Four of the larger spirals are exposed on each of the earlier whorls between the suture below and the shoulder above. Axial ribs are present, extending well down across the base, and are estimated to number 15 or 16 on the body whorl. With the exception of an occasional swollen varix-like rib the axials are rather weak; they produce dull, subrectangular nodes at the intersections with the spiral ribs; where the axials cross the shoulder above they bend forward and are quite weak. The features of the aperture and columella cannot be accurately determined in detail but they appear to be normal for the genus; however, the aperture is lanceolate, the outer lip is broadly convex, and the impression of a row of short crenulations is present on the inner margin of the outer lip of each of two internal molds." (Stephenson)

Approximate dimensions of holotype: height 12 mm., diameter 6.5 mm.

Range in New Jersey—
RARITAN: 1b

Type.—Sayreville, N. J. USNM 108677.

Family Turritidae

Turricula scalariformis Whitfield 1892

Plate 62, Figure 2

Turricula scalariformis Whitfield, 1892, p. 95, pl. 11, fig. 9.
Turricula scalariformis Weller, 1907, p. 789, pl. 97, fig. 11.

Description.—"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 16 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." (Whitfield)

Remarks.—This species is known only from a crushed and imperfect type specimen. It differs from *Turricula reileyi* and *T. leda* in its more complex volutions and its stronger vertical folds which are not flexuose between the sutures. Whitfield's illustration makes the spiral lines appear much stronger than they actually are in the type specimen.

Range in New Jersey—
NAVESINK: 41

Type.—Holmdel, N. J. NJSM 7660.

Turricula leda Whitfield 1892

Plate 62, Figure 1

Turricula leda Whitfield, 1892, p. 93, pl. 11, fig. 7.
Turricula leda Weller, 1907, p. 790, pl. 97, fig. 9.

Description.—"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." (Whitfield)

Remarks.—This species differs from *Vulpecula reileyi* in its less slender form and its proportionally shorter spire with a smaller number of volutions; and in the coarser surface markings. (Weller)

Range in New Jersey—
NAVESINK: 43

Type.—Freehold, N. J.; (type and unique).

Surcula strigosa Gabb 1876

Plate 64, Figure 1

Surcula strigosa Gabb, 1876, Proc. Acad. Nat. Sci. Phila. for 1876, p. 279.
S. Strigosa Whitfield, 1892, p. 105, pl. 13, fig. 1.

Description.—"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 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 cancellating 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." (Whitfield)

Remarks.—Type specimen is unique.

Range in New Jersey—
NAVESINK: 41

Type.—Holmdel, N. J.; NJSM 7641.

Family Acteonidae

Acteon cretacea Gabb 1861

Plate 63, Figures 3, 4

Tornatella Forbes, 1845, Quart. Jour. Geol. Soc. Lond., vol. 1, p. 63, text fig. c.

Actaeon cretacea Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861) p. 318.

Actaeon ovoidea Gabb, 1861, Proc. Acad. Nat. Sci. Phil. (1861) p. 319.

Actaeon cretacea Whitfield, 1892, p. 158, pl. 19, figs. 9-12.

Cinulia ovoidea Whitfield, 1892, p. 162, pl. 20, figs. 5-6.

Actaeon subovoides Whitfield, 1892, p. 155, pl. 19, figs. 14-16.

Actaeon cretacea Weller, 1907, p. 805, pl. 99, figs. 1-6 (part).

Description.—Shell variable in size, subovoid in general form, with a moderately elevated spire; the dimensions of two individuals are: height, 39 mm. and 20 mm.; maximum diameter, 25 mm. and 11.5 mm.; height of spire, 10 mm and 7 mm.; height of aperture, 29 mm. and 13 mm. Volutions four or five, with distinctly marked sutures in the cast; body volution large, forming the greater bulk of the shell, moderately convex in the middle and slightly pointed below; aperture large, about two-thirds of the total height of the shell, pointed at the upper end, and moderately increasing in width anteriorly, its greatest width considerably below the middle, obtusely pointed below. The columellar cavity in the casts rather wide and furnished with a single moderately strong tooth at about the broadest part of the aperture, which is often but weakly developed; surface of the shell obscurely marked on the cast by a few rather broad spiral lines, which externally, as indicated by impressions, are narrow impressed lines. (Weller)

Range in New Jersey—
WOODBURY: 20
WENONAH: 34
MT. LAUREL-NAVESINK: 37, 47

Type.—Crosswicks, N. J.; ANSP 18778; Crosswicks, N. J.; ANSP 18779 (type of *Actaeon ovoidea* and *A. subovoides*).

Acteon forbesiana Whitfield 1892

Plate 63, Figure 5

Tornatella Forbes, 1845, Quart. Jour. Geol. Soc. Lond., vol. 1, p. 63, text. fig. c.

Acteon Forbesiana, Whitfield, 1892, p. 157, pl. 9, figs. 17-22.

Acteon cretacea Weller, 1907, (part) p. 805, not pl. 99, figs. 1-6.

Acteocina forbesiana Gardner, 1916, p. 410.

Description.—"Shell of about a medium size for the genus, broadly ovate or ovoid in outline, spire short, obtusely rounded, middle portion of the shell subcylindrical 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." (Whitfield)

Range in New Jersey—
?

Range outside New Jersey—
Maryland.

Type.—New Jersey; ANSP 18777.

Acteon gabbana (Whitfield) 1892

Plate 63, Figures 6, 7

Actaeonina biplicata Gabb, 1860, Proc. Acad. Nat. Sci. Phil. (1869) p. 93, fig. 13, pl. 2. (not *Actaeon biplicata* d'Orbigny, 1850).

Actaeon gabbana Whitfield, 1892, p. 156, pl. 19, figs. 23-25.

Actaeon gabbana Weller, 1907, p. 807 (part), not pl. 99, figs. 7-8 = *Nonacteonina* sp.

Acteon gabbana Gardner, 1916, p. 398.

Description.—"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." (Whitfield)

The dimensions of an internal cast incomplete at the apex are: height, 25.5 mm.; if complete, it would doubtless be at least 30 mm.; maximum diameter, 11.5 mm.; height of aperture, 18.5 mm.

Range in New Jersey—
WOODBURY: 18, 19
TINTON: 63

Range outside New Jersey—
Maryland.

Type.—New Jersey; ANSP 19466.

Nonacteonina sp.

Plate 63, Figures 10, 11

Acteon gabbana Weller, 1907, p. 808, pl. 99, figs. 7-8.

Nonacteonina sp. Stephenson, 1941, p. 382.

An internal mold which Weller figured and referred to *Acteon gabbana* Whitfield is not that species and should be assigned to the genus *Nonacteonina.*

Range in New Jersey—
WOODBURY: 19

Family Ringiculidae

Avellana bullata (Morton) 1834

Plate 63, Figures 8, 9

Tornitella ? bullata Morton, 1834, Synop. Org. Rem. Cret. Gr. U. S., p. 48, pl. 5, fig. 3.

Avellana bullata Whitfield, 1892, p. 163, pl. 20, figs. 1-4.

Avellana bullata Weller, 1907, p. 808, pl. 99, figs. 9-11.

Avellana bullata Gardner, 1916, p. 403.

Avellana bullata Groot, Organist and Richards, 1954, p. 52, pl. 6, fig. 7.

Description.—"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 30 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." (Whitfield)

Range in New Jersey—
MERCHANTVILLE: 15
NAVESINK: ?

Range outside New Jersey—
Delaware.

Type.—New Jersey ANSP 19702?

Avellana pelagana Stephenson 1936

Plate 43, Figure 18

Avellana pelagana Stephenson, 1936, Bull. Geol. Soc. Amer., vol. 47, p. 403, pl. 5, figs. 19-20.

Avellana pelagana Richards, 1943, p. 28, pl. 5, fig. 18.

Description.—"Shell of medium size, rotund, broadly rounded over the apex. Spire very low. Protoconch not well preserved. Whorls 3½, closely appressed, expanding rapidly; sides of whorls broadly rounded. Suture slightly impressed. Body whorl broadly and regularly rounded, uniformly ornamented with about 26 regular, low, round-crested, faintly punctate spiral ribs, separated by narrower, punctate inter-spaces, the punctate markings are fine and obscurely preserved and do not show in the figures; 5 or 6 of the ribs are exposed on the penultimate whorl.

Aperture subcrescentic, acutely subangular at the rear, where it is narrowly channeled, moderately wide in the central part, sharply but regularly rounded at the front. Outer lip thick, regularly varicose, the posterior end of the varix rising a little above the suture; inner margin smooth. Inner lip, broadly excavated anteriorly, forming a thin callus which spreads noticeably forward on the parietal wall, connecting at each end with the varix of the outer lip. Columella bearing three narrow, prominent, round-crested, nearly horizontal folds, the posterior one of which is a little the weaker.

Dimensions of the holotype: height, 17.8 millimeters; diameter, 14.3 millimeters." (Stephenson)

Remarks.—"This species is not closely related to any of the four or five species of the genus previously described from the Upper Cretaceous deposits of the Atlantic Coastal Plain." (Stephenson)

Range in New Jersey—
RARITAN: 1

Range outside New Jersey—
Banquereau, Nova Scotia.

Type.—Banquereau, Nova Scotia; Peabody Museum, Yale Univ. 14857.

Avellana costata (Johnson) 1898

Plate 63, Figure 12

Cinulia costata Johnson, 1898, Ann. Rep. Geol. Surv. N. J., for 1897, p. 264.

Avellana costata Weller, 1907, p. 810, pl. 99, fig. 21.

Avellana costata Gardner, 1916, p. 405.

Description.—"Shell with four whorls, spire prominent, body whorl with from 12 to 13 revolving grooves, which form an equal number of smooth, flat, revolving costae; these average about double the width of the grooves. In one specimen the third and fourth costae from the suture are about twice as wide as the others, and the two lower costae are divided by a minute, impressed line. The first spiral whorl has six and the second five revolving grooves. Apical whorl smooth, suture deeply impressed. Aperture narrow, oblique, lip broad, thick and crenulated on the inner margin with eight small teeth-like projections, and extending to the suture, where it joins the callus of the peristome, which is continuous to the base of the columella; base with two oblique folds, above which is a prominent fold or plate extending at almost right angles to the columella; between this and the posterior angle of the aperture is a small, tooth-like projection.

Alt., 4; diam., 2½ mill." (Johnson)

Remarks.—The type specimen is the only example of this species known from New Jersey.

Range in New Jersey—
WOODBURY: 22

Range outside New Jersey—
Maryland.

Type.—Mt. Laurel well, N. J.; ANSP 691.

Cinulia naticoides (Gabb) 1860

Plate 64, Figure 3

Actaeonia naticoides Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 299, pl. 48, fig. 2.

Cinulia (Oligptycha) naticoides Whitfield, 1892, p. 161, pl. 19, figs. 28-30.

Cinulia naticoides Weller, 1907, p. 811, pl. 99, figs. 12-13.

Cinulia naticoides Gardner, 1916, p. 402.

Description.—Shell small, subglobular in form, the dimensions of a nearly perfect internal cast being; height, 9 mm.; diameter, 8.8 mm. Volutions about three in number, spire very low, nearly conforming with the rotundity of the body volution. Aperture narrowly ovate, about two-thirds as high as the body volution, widest below, pointed above. Outer lip thickened and crenulate within. Columella short, the columellar lip marked by a single rather strong revolving fold, shown as a groove in the casts, situated low down. Surface of the shell marked by fine revolving lines very faintly shown on the casts. These lines are slightly raised and rounded on the casts, from 20 to 30 being present on the body volution. (Weller)

Remarks.—Similar to *Avellana bullata* (Morton) but has a single columellar fold and is considerably smaller in size.

Range in New Jersey—
MT. LAUREL-NAVESINK: 43, 49, 53

Range outside New Jersey—
Maryland.

Type.—Mullica Hill, N. J.; ANSP 18784.

Family Scaphandridae

Ellipsoscapha mortoni (Forbes) 1845

Plate 64, Figure 9

Bulla Mortoni Forbes, 1845, Quart. Jour. Geol. Soc. Lond., Vol. 1, p. 63, text fig. a.

Bulla Mortoni Whitfield, 1892, p. 165, pl. 20, figs. 7-9.

Bulla conica Whitfield, 1892, p. 189, pl. 23, figs. 12-13.

Haminea mortoni Weller, 1907, p. 812, pl. 99, figs. 14-16.

Haminea mortoni Gardner, 1916, p. 408.

Ellipsoscapha mortoni Stephenson, 1941, p. 392.

Description.—"Shell rather above a medium size in the larger individuals, two of the casts before me measuring almost 1¼ 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.'' (Whitfield)

Range in New Jersey—
MT. LAUREL-NAVESINK: 37, 40, 47, 53

Range outside New Jersey—
Maryland, Alabama, Mississippi.

Family Acteocinidae

Cylichna recta Gabb, 1860

Plate 64, Figures 5, 7

Bulla recta Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 302, pl. 48, fig. 16.

Cylichna recta Whitfield, 1892, p. 164, pl. 20, figs. 10-11.

Cylichna recta Weller, 1907, p. 814, pl. 99, figs. 17-18.

Cylichna recta Gardner, 1916, p. 411, pl. 18, figs. 10-11.

Cylichna recta Wade, 1926, p. 106, pl. 34, figs. 18-20.

Description.—''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.'' (Whitfield)

Range in New Jersey—
WENONAH: 34
MT. LAUREL-NAVESINK: 43, 57

Range outside New Jersey—
Maryland, Mississippi, Tennessee.

Type.—Burlington Co., N. J.; ANSP 18782.

Bulla macrostoma Gabb 1860

Plate 64, Figure 10

Bulla macrostoma Gabb, 1860, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 4, p. 301, pl. 48, fig. 15.

Bulla macrostoma Weller, 1907, p. 812, pl. 99, figs. 19-20.

Description.—Shell subglobular with two or three volutions, the length of a crushed individual being 34 mm., and its width, somewhat increased by crushing, 28.5 mm. Aperture very broad, broadly rounded in front and narrowly rounded posteriorly. Surface marked only by lines of growth. (Weller)

Remarks.—The New Jersey specimen is badly crushed.

Range in New Jersey—
RED BANK: Near Middletown.

Range outside New Jersey—
Alabama, Mississippi.

Type.—Prairie Bluff, Ala.; ANSP 30727.

Miscellaneous specimens

Stephenson (1954) noted and figured six gastropods from the Raritan formation at Sayreville, N. J. with only generic identification. These were: *Helicacanthus?* spp. A and B, "*Pyrgulifera*" sp., *Strepsidura* spp. A and B, and *Pirsila* sp.

CRETACEOUS SCAPHOPODA OF NEW JERSEY

by

HORACE G. RICHARDS

Dentalium subarcuatum Conrad 1853

Plate 91, Figures 2, 6, 7

Dentalium subarcuatum Conrad, 1853, Jour. Acad. Nat. Sci. Phil., 2nd ser., vol. 2, p. 276, pl. 24, fig. 13.

Dentalium subarcuatum Whitfield, 1892, p. 166, pl. 20, figs. 19-24.

Dentalium subarcuatum Weller, 1907, p. 661, pl. 75, figs. 1-2.

Description.—Shell small, usually preserved in the form of casts, in which condition it is circular in cross section, gradually tapering, slender, and gently arcuate; a large individual 47 mm. in length has a maximum diameter of 5 mm., and a minimum diameter of 2 mm. Surface of the casts smooth or with faint, longitudinal ridges; when perfectly preserved they are marked along the median line of the dorsal or concave side by a slightly elevated, rounded ridge with a flattened area on each side, and upon the ventral side by a pair of depressed lines. Surface of the shell marked externally, as shown by impressions of the outside, by about 12 angular, longitudinal ribs, and by fine annular striae. (Weller)

Remarks.—Formerly fairly common at Lorillard, but not occuring in recent collections. The type is an internal cast, apparently from the Merchantville formation, which shows faint indications of the external longitudinal ribs. The Woodbury specimens agree with the type in curvature and dimensions. *D. ripleyana* Gabb from Alabama is probably identical with this species.

Range in New Jersey—
MERCHANTVILLE: 8, 10, 15, 17
WOODBURY: 18, 19, 20, 24
ENGLISHTOWN: 26

Range outside New Jersey—
Alabama.

Type.—New Egypt, New Jersey. ANSP.

Cadulus obnutus Conrad 1869

Plate 91, Figures 3, 5

Gadus obnutus Conrad, 1869, Am. Jour. Conch., vol. 5, p. 101, pl. 9, fig. 18.

Cadulus obnutus Weller, 1907, p. 663, pl. 75, figs. 3-4.

Description.—Shell small, the length of an average specimen being

4 mm., and its maximum diameter 1 mm.; slightly arcuate, contracted at each end, somewhat inflated in the central region. Surface smooth. (Weller)

Remarks.—The shell is so small that it is easily overlooked. The specimens from Lorillard are preserved in the form of internal casts, but at Haddonfield, the shell itself is preserved.

Range in New Jersey—
WOODBURY: 18, 24

Type.—Haddonfield, N. J. ANSP 19502.

Dentalium inornatum Wade 1926

Plate 91, Figures 1, 4

Dentalium inornatum Wade, 1926, p. 100, pl. 33, figs. 1, 2.

Description.—"Shell or tube small and fragile, elongate subtubular or subconical, gently curved and flattened along the medial and anterior portions of the tube; apical tip broken away; aperture margin broken away; external surface smooth and glazed; faint irregular growth lines may be observed beneath the glazed surface; internal surface smooth; aperture subelliptical. Slightly imperfect individual, length 6.2 mm.; maximum diameter 1.6 mm." (Wade)

Remarks.—Specimens of a *Dentalium* found at Haddonfield and in the Mount Laurel well are apparently this species.

Range in New Jersey—
WOODBURY: 22, 24

Range outside New Jersey—
Tennessee.

Type.—Coon Creek, Tenn. USNM.

CRETACEOUS NAUTILOIDS OF NEW JERSEY

by

A. K. MILLER AND H. F. GARNER

In North America Late Mesozoic nautiloids are of widespread occurrence, are not particularly rare, and are locally rather abundant. However, their variety is limited, and only five genera are known to be represented in our Cretaceous strata: *Cymatoceras, Paracymatoceras, Heminautilus, Angulithes,* and *Eutrephoceras.* The first two of these belong in the family Cymatoceratidae, which in 1945 was treated in detail by Miller and Harris[1], who discussed all of the American species known at that time; most of them are Lower Cretaceous in age, as are the single known representatives of *Heminautilus* and *Angulithes. Eutrephoceras* is therefore the only genus that has been found to occur in any abundance in the North American Upper Cretaceous. It is known to be of widespread distribution in those strata, and altogether we have been able to assemble almost a hundred specimens from six states. In addition, the literature contains data in regard to forms from these and ten other states and from one of the provinces of Canada.

Family Eutrephoceratidae Miller

In 1951 Miller pointed out that the genus *Eutrephoceras* is not particularly close to *Nautilus*, with which it had previously been classed in the family Nautilidae. He therefore established the monogeneric family Eutrephoceratidae. Typical representatives of it have globular or subglobular nautiliconic conchs, small umbilici, relatively smooth tests[2], more or less straight and directly transverse external sutures, and small central or subcentral orthochoanitic siphuncles. The internal sutures form a broad shallow rounded dorsal lobe which is due to the involution of the conch and not to an inflection of the septa. Annular lobes are present in some forms and absent in others—they are most probably of little taxonomic significance.

Geographically this family seems to be of world-wide distribution. Stratigraphically it ranges from the Cretaceous to the Oligocene, inclusive, and it may be represented also in the Jurassic and the Miocene. In North America it is most abundant in the Upper Cretaceous and the Eocene.

Genus Eutrephoceras Hyatt

The original description of this genus, which was published in 1894, contains the statement "type *Eutrephoceras Dekayi.*" Its author,

[1] Miller, A. K., and Harris, Robert A., North American Cymatoceratidae (Mesozoic Nautiloidea): Jour. Paleont., vol. 19, pp. 1-13, pls. 1-5, 1945. See also *Paracymatoceras milleri* Humphrey (Geol. Soc. Am., Bull., vol. 60, p. 119, pl. 4, fig. 1; pl. 5, figs. 1, 2, 1949).

[2] However, *Eutrephoceras? butonense* (Martin) from near the Oligocene-Miocene boundary on the island of Butung [Buton], Indonesia, bears prominent longitudinal ribs—see Leidsche Geol. Meded., d. 6, afl. 1, pp. 30-31, pl. 5, figs. 34, 34a.

Hyatt, then described some specimens from "Dakotah, Cretaceous," but did not mention any from New Jersey, whence came the type material of *E. dekayi*. Accordingly there has always been an open question as to whether the genotype is *E. dekayi* or a possibly different species which occurs in the Upper Cretaceous of the Western Interior. We have made direct comparisons of many specimens from South Dakota and other western states with a number of New Jersey individuals (including the holotype), and we are convinced that the species and the genus in question occur in both of these regions. It therefore seems to us that there is no good reason why Hyatt's designation of the type species should not be interpreted literally.

In view of the fact that the Eutrephoceratidae, as we understand it, contains only a single genus, the morphological characters of that genus are those of the family, outlined in preceding paragraphs. This statement of course applies equally well to the geologic and geographic distribution.

Eutrephoceras dekayi (Morton)

Plate 65, Figures 1-6; Plate 66, Figures 1, 2; Plate 67, Figures 1-9

Nautilus Dekayi Morton, 1833, Am. Jour. Sci. and Arts, vol. 23, p. 291, pl. 8, fig. 4.

Nautilus Dekayi Morton, 1834, Synopsis organic remains Cretaceous group of U. S. . . . ., p. 33, pl. 8, fig. 4; pl. 13, fig. 4.

Nautilus perlatus Morton, 1834, Synopsis organic remains Cretaceous group of U. S. . . . ., p. 33, pl. 13, fig. 47.

Nautilus Dekayi (part) d'Orbigny, 1850, Prodr. Paléont, stratigr. univ. . . . ., t. 2, p. 211.

Nautilus Dekayi Hall and Meek, 1856, Am. Acad. Arts and Sci., Mem., n. ser., vol. 5, pp. 405, 406.

Nautilus Dekayi Meek and Hayden, 1856, Philadelphia Acad. Nat. Sci., Pr., vol. 8, pp. 267, 280.

Nautilus De Kayi Mallet and Tuomey, 1858, Second bien. rept. on geol. Alabama, Append. 3, p. 259.

Nautilus Dekayi Meek, 1859, North-west Terr., Repts. Prog. . . . . Assiniboine and Saskatchewan Expl. Exped. . . . . (Hind), p. 185, pl. 2, figs. 9, 10. (Also an edition in French; one in Canada, Legislative Assembly, Jours., vol. 17, append. 36; and another, British North America, Repts. . . . . Exped. (Great Britain, Parliament . . . ., 1860).

Nautilus Dekayi Conrad, 1860, Philadelphia Acad. Natur. Sci., Jour., ser. 2, vol. 4, p. 276.

Nautilus Dekayi Gabb, 1861, Am. Philos. Soc., Pr., vol. 8, pp. 86, 87.

Nautilus DeKayi Meek, 1864, Smithsonian Miscel. Col., vol. 7, no. 177, p. 25.

Nautilus Dekayi Conrad, 1868, New Jersey Geol. Surv., Geol. New Jersey (Cook), p. 731.

Nautilus Dekayi Meek, 1876, U. S. Geol. Surv. Terr. (Hayden), Rept., vol. 9, pp. 496-498, pl. 27, figs. 1a-1e.

Nautilus Dekayi Montanaensis Meek, 1876, U. S. Geol. Surv. Terr. (Hayden), Rept., vol. 9, p. 498, pl. 27, figs. 2a-2e.

Nautilus Dekayi Gabb, 1877, Philadelphia Acad. Natur. Sci., Pr. 1876, p. 277.

Nautilus dekayi montanaensis Whitfield, 1880, Rept. geol. and resources Black Hills, Dakota (Newton and Jenney), U. S. Geog. and Geol. Surv. Rocky Mt. Region (Powell), pp. 439-440, pl. 16, figs. 10, 11.

Nautilus Dekayi Foord, 1891, Catalogue of the fossil Cephalopoda in the British Museum (Natural History), Part II ...., pp. 305- 308, 399.

Nautilus Dekayi [part] Whitfield, 1892, U. S. Geol. Surv., Mon. 18, pp. 243-244, pl. 37, figs. 1-6; pl. 38, figs. 1, 2 (not 3, 4). [Also issued as New Jersey Geol. Surv., Paleont., vol. 2.]

Eutrephoceras Dekayi Hyatt, 1894, Am. Philos. Soc., Pr., vol. 32, pp. 555, 556-558, 560, 587, pl. 13, figs. 4-8; pl. 14, fig. 1.

Nautilus (Eutrephoceras) DeKayi Clarke, 1899, New York State Geol., Ann. Rept. 16, p. 169. [Also published in New York State Mus., Ann. Rept. 50, vol. 2.]

Eutrephoceras dekayi Johnson, 1905, Philadelphia Acad. Natur. Sci., Pr., vol. 57, p. 28.

Nautilus perlatus Johnson, 1905, Philadelphia Acad. Natur. Sci., Pr., vol. 57, p. 28.

Nautilus dekayi Weller, 1907, New Jersey Geol. Surv., Paleont. ser., vol. 4, pp. 125, 130, 140, 817-818, pl. 100, figs. 1-4 (not 5).

Nautilus dekayi Stephenson, 1914, U. S. Geol. Surv., Prof. Pap. 81, pp. 36, 37, 38, tables opp. p. 24.

(?) Nautilus sp. nov. Stephenson, 1914, U. S. Geol. Surv., Prof. Pap. 81, pp. 28, 29, tables opp. p. 24.

Eutrephoceras dekayi Gardner, 1916, Maryland Geol. Surv., Upper Cretaceous, pp. 90, 320, 323, 327, 331, 334, 337, 371, 372-374, pl. 13, fig. 9.

Nautilus dekayi s. l. Reeside, 1924, U. S. Nation. Mus., Pr., vol. 65, art. 5, p. 4.

Eutrephoceras dekayi Wade, 1926, U. S. Geol. Surv., Prof. Pap. 137, pp. 180-181, pl. 61, figs. 1, 2.

Eutrephoceras dekayi s. l., Reeside, 1927, U. S. Geol. Surv., Prof. Pap. 151, pp. 6-7.

(?) Eutrephoceras alcesense Reeside, 1927, U. S. Geol. Surv., Prof. Pap. 151, p. 7, chart opp. p. 2, pl. 1, figs. 1-3; pl. 2, fig. 1; pl. 3, figs. 1-5; pl. 5, figs. 1, 2.

(?) *Eutrephoceras thomi* Reeside, 1927, U. S. Geol. Surv., Prof. Pap. 151, pp. 7-8, chart opp. p. 2, pl. 44, figs. 1, 2.

(?) *Eutrephoceras* sp. Reeside, 1927, U. S. Geol. Surv., Prof. Pap. 150, pp. 1, 2, pl. 1, figs. 1-4.

Eutrephoceras dekayi Spath, 1933, Biol. Review., Vol. 8, p. 431.

Eutrephoceras dekayi Stephenson, 1941, Texas Univ. Publ. 4101, p. 398.

(?) *Eutrephoceras planoventer* Stephenson, 1941, Texas Univ. Publ. 4101, pp. 25, 397-398, pl. 75, figs. 1-6; pl. 76, figs. 9-11.

(?) *Eutrephoceras* spp. Stephenson, 1941, Texas Univ. Publ. 4101, p. 398.

Eutrephoceras dekayi s. l. Miller, 1947, Geol. Soc. Am., Mem. 23, pp. 26-27.

When Morton established this species, he gave only a few notes in regard to it, but he illustrated a specimen which has come to be regarded as the holotype. Fortunately, it has been preserved, and through the courtesy of Dr. Horace G. Richards it has been made available to us for study (pl. 65, figs. 5, 6).

This specimen, which has been somewhat restored, appears to represent an almost complete body chamber preserved in dark-colored "greensand marl." Its maximum overall measurement is about 8 cm., and at its adoral end its conch attains a maximum height and corresponding width of about 48 mm. and 80 mm., respectively. The adapical end of this holotype is bounded by a septum, the size and shape of which are elucidated by text figure 1E.

The conch is subglobular, rapidly expanded orad, and broadly rounded ventrally and laterally. It is more or less semicircular in cross section but is impressed dorsally to a little more than a third its height.

The lateral margins of the aperture seem to be slightly flared. Traces of fine growth lines on remnants of the test show that the aperture bears a wide, moderately deep, broadly rounded, ventral sinus and on either side of it a similar but narrower and less broadly rounded lateral salient which extends to the umbilicus.

The umbilicus is small, closed, and inconspicuous. The umbilical shoulders are rounded and indefinite.

The external suture is almost straight and directly transverse. However, it forms very slight but nevertheless distinct ventral and lateral lobes. The siphuncle is small and subcentral but is distinctly nearer the dorsum than the venter.

The immediately preceding paragraphs refer specifically to Morton's holotype, but we have under consideration a large number of specimens from a variety of Upper Cretaceous horizons at many widely separated localities in the United States. The individual represented by figures 1 and 2 on plate 66 is essentially complete and free from distortion. Its adoral camera is shorter than the preceding ones, indicating that it had reached full maturity; and the apertural margins are slightly but distinctly flared and are parallel to the growth lines, which

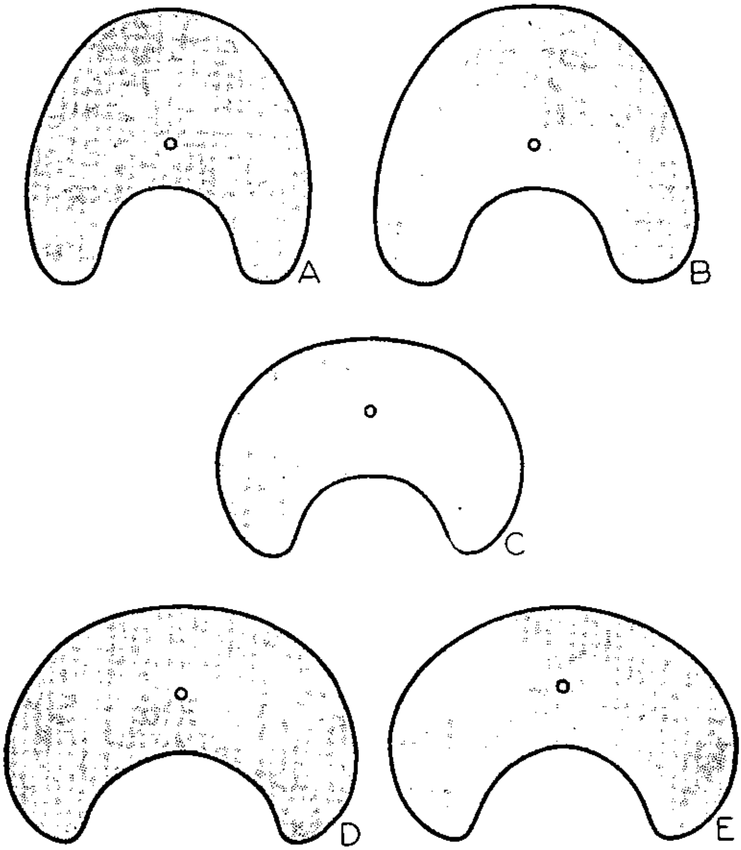

FIGURE 1

Cross sections of two varieties of *Eutrephoceras dekayi* (Morton)

A. *E. dekayi alcesense* Reeside, from the Pierre shale near Glendive, Montana, × ½. [State Univ. Iowa, 4234.]

B. *E. dekayi alcesense* Reeside, from the Navesink marl at Glassboro, New Jersey, × ⅝. [State Univ. Iowa, 8740.]

C. *E. dekayi dekayi* (Morton), from the Prairie Bluff chalk southeast of State College, Mississippi, × ¾. [State Univ. Iowa, 4227.]

D. *E. dekayi dekayi* (Morton), from the Pierre shale at Iron Butte, near Glendive, Montana, × 1. [State Univ. Iowa, 4230.]

E. *E. dekayi dekayi* (Morton), from the Navesink marl of Monmouth or Burlington County, New Jersey, × 1. [ANSP 19484—the holotype.]

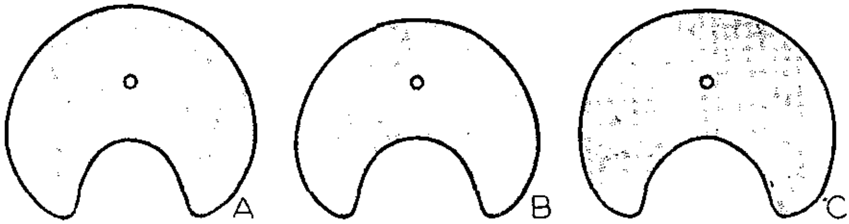

FIGURE 2

Cross sections of one variety of *Eutrephoceras dekayi* (Morton) from three widely separated localities

A. *E. dekayi perlatum* (Morton), from the Pierre shale at Iron Butte, near Glendive, Montana, × ¾. [State Univ. Iowa, 4232.]

B. *E. dekayi perlatum* (Morton), from the Navesink marl of Burlington County, New Jersey, × ½. [ANSP 19680—same specimen as pl. 1, figs. 1, 2.]

C. *E. dekayi perlatum* (Morton), from the Prairie Bluff chalk southeast of State College, Mississippi, × 1¼. [State Univ. Iowa, 4233—same specimen as pl. 3, figs. 1-3.]

do not differ materially from those of the holotype. In all available particulars, this specimen is indeed close to the New Jersey holotype in spite of the fact that it came from a remote locality (Montana), and we are convinced that the two should be regarded as conspecific. However, other specimens from the Western Interior reveal a considerable amount of variation in size and shape of conch, sinuosity of sutures, and position of siphuncle. Recent authors have been inclined to regard certain of the variants as distinct species. It seems to us from direct comparisons of a wealth of material that the differences are almost completely gradational even among specimens that are labeled as being from the same general horizon and locality. This statement applies equally well to assemblages from Montana, New Jersey, Mississippi, and elsewhere.

After careful consideration, we have concluded that we can recognize several varieties. One of these, typified by the holotype, has a relatively wide conch and short distance between the dorsum and the venter, almost straight external sutures, and a siphuncle that is only slightly dorsad of the center of a median line. It should, of course, be kept in mind that a holotype does not necessarily represent the specific mean; and in this case the conch of the type specimen is much more obese than most of those that we are regarding as conspecific. Nevertheless, it is somewhat narrower than certain of those that we are assigning to the variety of which it is the type, *E. dekayi dekayi*.

Other Atlantic-Gulf Coastal Plain and Western Interior specimens (see, e. g., figs. 1-4 on pl. 1 and figs. 1-5 on pl. 3) differ from the form just discussed in that the conch is narrower, the distance between the dorsum and the venter is relatively great, and the siphuncle is generally located near the center of a median line (cf. text figs. 1C-E and 2A-C). For this variety, Morton's name "*N*[*autilus*] *perlatus*" seems quite appropriate. It was proposed provisionally in 1834 for internal molds that are "abundant at Prairie Bluff, Alabama, . . . are rounder and less expanded at the mouth, than those from New Jersey [that is, the holotype of *E. dekayi*] and may possibly be distinct." Meek's name "*Nautilus Dekayi Montanaensis*", which was proposed in 1876, should most probably be suppressed as a subjective synonym of *E. dekayi perlatum* (Morton), which has priority. The great majority of the many specimens of *Eutrephoceras* known from Georgia, Alabama, and Mississippi are small, but we have a few individuals from the Prairie Bluff chalk of the last state which, when complete, were larger than the holotype of *E. dekayi*. When the conch of at least some of the Mississippi specimens attained a diameter of about 20 mm., it began to expand fairly rapidly, and its sutures became progressively more sinuous, particularly through the development of a saddle on the umbilical shoulder (see pl. 67, figs. 1-3). Other specimens that occur in direct association with these are indeed similar to typical *E. dekayi*, and it seems reasonably certain that all should be regarded as conspecific.

We have a few specimens, again from both the eastern and the western-interior portions of the United States, in which the conch is yet narrower, the distance between the dorsum and the venter is great, the sutures are considerably more sinuous, and the siphuncle is relatively close to the dorsum, especially during early ontogenetic development (see figs. 7-9 on pl. 67, and text figs. 1A and 1B). For this variety we are using Reeside's name "*alcesense*", which was proposed for specimens from the Upper Cretaceous of Montana, Wyoming, Utah, and New Mexico. We have not studied Reeside's type material, but his illustrations and descriptions indicate that he was dealing with specimens like those we have under consideration. *E. thomi* Reeside seems to have been based on a single individual from the Upper Cretaceous Eagle sandstone of Montana, and it appears to be more or less intermediate between typical *E. dekayi alcesense* and *E. dekayi perlatum* being perhaps somewhat closer to the former than the latter.

It should be noted that Reeside and especially Stephenson have called attention to the fact that certain representatives of *Eutrephoceras* from the Upper Cretaceous of Texas have a flattened venter at full maturity; and the latter author has proposed the name *E. planoventer* for them, stating that they are also characterized by long camerae and slightly sinuous sutures. It is quite possible that this form, of which we have seen no representatives, should be regarded merely as a variety of *E. dekayi*. However, it should be emphasized that whether the several forms we have discussed are to be thought of as varieties or species is strictly a matter of opinion, and one about which we have no strong feelings. In general, we have found that trinomials are too cumbersome to be practicable, and therefore we are inclined to avoid their use. The case under consideration may, however, be one in which they are warranted, for many specimens can not be placed with a reasonable degree of certainty in any of the varieties we envisage, though they can readily be referred to *E. dekayi,* as an inclusive and somewhat variable species.

Certain of the features of this species seem to merit further consideration. According to Morton, some of the New Jersey specimens "when entire could have been little short of eight inches in diameter"; we have an individual from the uppermost Cretaceous of Mississippi that must have had comparable dimensions; the maximum diameter of Reeside's holotype of *E. dekayi alcesense,* which is from the Telegraph Creek formation of Wyoming, is given as 240 mm.; when he established the last form, Reeside stated that another one "from the *Mortoniceras texanum* zone in the Gulf region is stouter and even larger;" and in 1926 Wade reported specimens from the Ripley at Coon Creek, Tennessee, "some attaining a maximum diameter of 15 or 18 inches." However, the great majority of our specimens have a diameter of less than 100 mm., even when they retain the body chamber. That chamber is about half a volution in length during adolescence and maturity.

As shown by figure 6 on plate 67, the extreme adapical portion of the conch is very rapidly expanded orad, it bears a few transverse corrugations, and on the apex there is a slight dorso-ventrally elongate depression which is reminiscent of the alleged cicatrix of attachment of the protoconch in modern *Nautilus,* which Hyatt figured long ago. The siphuncle extends to the apex of the phragmocone, where it terminates in a caecum—in 1899 Clarke published a diagrammatic longitudinal section of the adapical portion of the conch, showing the general nature of the siphuncle there. Until the conch attained a diameter of some 15 mm., the external surface of the test was reticulate, with the longitudinal and the transverse lirae being of about equal prominence. Gradually the transverse lirae (growth lines) developed a ventral sinus and ventrolateral saddles—these can first be recognized at a diameter of some 7 mm. Almost immediately thereafter, the longitudinal lirae gradually decreased in prominence, and they are obsolete on fully mature portions of the conch, whereas the growth lines were retained throughout ontogenetic development. During late adolescence and/or early maturity, the ventral and ventrolateral portions of the test of some individuals became temporarily pustulous, a development that may have been pathological (see pl. 65, figs. 3, 4).

Well preserved internal molds retain traces of the growth lines. Also, on some such specimens there is a distinct median longitudinal ridge along the venter (of which there is no expression on the outer surface of the test).

Throughout ontogenetic development, the umbilicus was small and was closed by the test, except possibly in the first volution. The dorso-lateral portions of the mantle secreted a relatively thick calcareous deposit, which merged with the rest of the test, tended to fill the umbilical depressions, and thus formed a structure which some authors have termed a "columella".

In this species, the sutures characteristically do not form an annular lobe. However, in the specimen represented by text figure 1B there seems to be a slight one. Except possibly in the extreme adapical portion of the conch, there are about 15 to 17 camerae per volution. In general, the length of the camerae increased progressively during ontogenetic development, though in the adoral portion of the phragmocone of large individuals the septa are closely spaced, as is characteristic of fully mature nautiloids.

Remarks.—Several of the authors cited in our synonymy have compared *E. dekayi* with certain Eurasian species, some of which, in our opinion, are not very close. For example, of the forms originally described from Britain, *Nautilus elegans* Sowerby has sinuous ribs and sutures and is a cymatoceratid; *N. expansus* Sowerby is flattened ventrally and laterally, is almost subangular ventrolaterally, and is most probably a paracenoceratid; and *N. imperialis* Sowerby has sutures and a general physiognomy which indicate that it belongs in Conrad's genus *Cimomia.*

As has been noted by Foord and others, the Vancouver Island, European, and African specimens that have been referred to *E. dekayi* should probably be thought of as representing distinct species. Certain Cretaceous forms have, however, been described from abroad that are indeed reminiscent of the one under consideration and should be regarded as congeneric with it. These include *E. laverdei* Durham of the upper Aptian of Colombia; *Nautilus d'Orbignyanus* Forbes of the "Cretaceous" of Chile; *N. Bellerophon* Lundgren of the Danian of Denmark; *N. Bouchardianus* d'Orbigny of the Senonian of France *and* the specimens from Britain, continental Europe, and the Indian subcontinent which have been referred to it; *N. Wekayi* Favre 1869, not Morton, 1833 of the Cretaceous of southern Poland; *E. uitenhabense* Spath of the Upper Valanginian of South Africa (Uitenhage) and the congeneric forms described by Spath in 1921 from the Senonian of the same general region (Zululand); *Nautilus blanfordianus* Kilian and Reboul of the Upper Cretaceous of the Antarctic region, etc.

Occurrence.—This species, as we interpret it, is of widespread distribution in the Upper Cretaceous of the United States and has also been recorded from the same general horizon in southwestern Canada. It is known from at least the following states and provinces: New Jersey, Delaware, Maryland, North Carolina, Tennessee, Georgia, Alabama, Mississippi, Arkansas, Missouri, Texas, New Mexico, Utah, Nebraska, South Dakota, Wyoming, Idaho, Montana, and Alberta or Saskatchewan.

In the Cretaceous of New Jersey this species is not abundant, but it occurs in the Navesink marl and the Red Bank sand, both of the

Monmouth group. The former of these formations has yielded representatives at or near (1) Hillsboro, Somerset County[1]; (2) "Atlantic Highlands, in the bluff along the shore of Raritan Bay, east of the railroad station," Long Branch, and Marlboro, all three in Monmouth County; (3) some unspecified locality in Monmouth or Burlington County, the holotype, which according to Whitfield came from Monmouth County but which is labeled as being from Burlington County; (4) Burlington, Evansville, Mt. Laurel, and an outcrop "about 1¼ miles northwest of Jacobstown, and about 1½ miles southwest of Arneytown," all four in Burlington County; (5) Merchantville, Camden County; and (6) Glassboro, Mullica Hill, and "Squankum," all presumably in Gloucester County, though the last may refer to Lower Squankum, in Monmouth County. We have not had available for study any representatives of this species from the Redbank sand, but Weller records it from the "black, clayey" portion of this formation along the Shrewsbury River, about one and/or two miles from the railroad station at Red Bank, Monmouth County.

Both Whitfield and Weller have figured as a representative of this species a unique specimen from the early Tertiary Hornerstown marl near Tinton Falls, Monmouth County, New Jersey. We have not been able to locate and restudy it but are inclined to share the now generally accepted opinion that it is most probably not referable to the species under consideration.

In Maryland (and presumably also in Delaware) *E. dekayi* is known from the Monmouth group. North Carolina specimens are stated by Gardner to be from the "extreme top" of the *Exogyra costata* zone in the "Ripley" or Peedee formation, and some from Tennessee are from the Coon Creek tongue of the Ripley. In the eastern Gulf Coastal region this species also occurs in the *Exogyra costata* zone; it was recorded as early as 1834 from Prairie Bluff, Alabama; and in Mississippi it is locally abundant in the formation named for that locality and may occur as low as the Selma chalk. Stephenson indicates that in Texas it has been found at many localities in the lower portions of the Navarro group, that is, in the Neylandville marl, the Nacatoch sand, and the Corsicana marl. Reeside records forms that we regard as conspecific from the uppermost part of the Mancos shale and the basal Mesaverde formation in the upper Rio Grande region of New Mexico, and from the former of these horizons in east-central Utah. In the Western Interior of the United States, the Cody shale, the Steele shale, the Telegraph Creek formation, the Eagle sandstone, and especially the Pierre shale have yielded many well preserved specimens that we are placing in this species. Furthermore, long ago (1859) Meek illustrated a typical specimen from the Upper Cretaceous at some unspecified locality along the "South Branch of the Saskatchewan," in Alberta or Saskatchewan.

[1] Since there are no Cretaceous strata in Somerset County, the locality is probably Hillsdale, Monmouth County, where the Red Bank formation occurs. M. E. Johnson.

Repositiories.—The numerous specimens that were available for our study have been deposited at The Academy of Natural Sciences of Philadelphia, Harvard University, Illinois State Museum, Mississippi State College, New Jersey State Museum, Royal Ontario Museum, The University of Texas, and the State University of Iowa. The holotype is at the first of these institutions, where it is numbered 19484. The repository and the catalogue number of each of the specimens we are illustrating are given on the text-figure and plate legends.

CRETACEOUS AMMONITES OF NEW JERSEY

by

JOHN B. REESIDE, JR.[1]

Family Baculitidae Meek, 1876
Genus *Baculites* Lamarck, 1799
Genotype: *Baculites vertebralis* Lamarck, 1799.

Baculites ovatus Say

Plate 68, Figures 1-4

Baculites ovata Say, 1820, Am. Jour. Sci., 1st ser., vol. 2, p. 41.

Baculites ovata Say (part). Morton, 1828, Acad. Nat. Sci. Phila. Jour., vol. 6, p. 89, pl. 5, fig. 6 (not fig. 5); 1830, idem, p. 196, pl. 8, fig. 8, (not figs. 6-7).

Baculites ovatus Say (part). Morton, 1830, Am. Jour. Sci., 1st ser., vol. 17, p. 280; idem, vol. 18, p. 249, pl. 1, fig. 8 (not figs. 6-7).

Baculites ovatus Say (part). Morton, 1834, Synopsis, p. 42, pl. 1, fig. 8 (not figs. 6-7).

Baculites ovatus Say. Gabb, 1861, Synopsis, p. 78, (22).

Baculites ovatus Say (part). Meek, 1864, Check List, p. 23.

Baculites ovatus Say. Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Baculites ovatus Say (part). Meek, 1876, U. S. Geol. Survey Terr. Rept., vol. 9, p. 394.

Baculites ovatus Say (part). Whiteaves, 1889, Contr. Can. Paleont., vol. 1, p. 181.

Baculites ovatus Say. Whitfield, 1892, p. 275, pl. 46, figs. 3-9.

Baculites ovatus Say. Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 26.

Baculites ovatus Say (part). Weller, 1907, p. 821, pl. 109, fig. 5.

Baculites ovatus Say. Richards, 1953, Record of the rocks, p. 287, fig. 233.

Not:

Baculites ovatus Say of various authors on the Western Interior of North America.

Baculites ovatus Say. Gardner, 1916, p. 375, pl. 12, figs. 2-3.

Baculites ovatus Say. Wade, 1926, p. 181, pl. 60, fig. 9.

Baculites ovatus Say. Roberts, 1931, Kentucky Geol. Survey., ser. 6, vol. 36, p. 404, pl. 68, fig. 11.

Baculites ovatus Say. Groot, Organist, and Richards, 1954, Delaware Geol. Survey Bull. 3, p. 52, pl. 7, fig. 6.

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[1] Publication authorized by the Director, U. S. Geological Survey.

Description.—Shell attaining moderate size, very gradually tapering; cross section broad-ovate, the siphonal side somewhat more narrowly rounded than the antisiphonal side. Surface of shell usually smooth, but sides of living chamber sometimes with ill-defined, broadly curved, obliquely transverse ribs. Suture with rather simple rounded elements, lateral lobes and saddles subequal, subdivisions of lobes small, subequal.

Remarks.—In the material available to the writer there seems to be considerable variation in the proportions of the cross section of the whorl, and some of the narrower variants may prove worthy of separation. Many authors have considered *B. ovatus* to be present in the Western Interior of North America, but these forms now seem to be variants of *B. haresi* Reeside in Santonian and early Campanian beds and younger individua's of giant species like *B. grandis* Hall and Meek in later horizons. *B. compressus* Say from the Western Interior is a wholly unrelated species, in spite of many statements in the literature that it is close to *B. ovatus.*

Say's type specimen came from the "Neversink Hills," shown on modern maps as Navesink Highlands, and the oldest horizon present is in the Mount Laurel-Navesink unit. It seems highly improbable that *B. ovatus* occurs also in the Merchantville-Woodbury unit, from which it has been reported. These records from older horizons are not accepted here. The only other course would be to discard Say's record as an error, a solution of the difficulty that does not seem to the writer justified by the information available. Morton's statement that the type specimen had been carried for 30 years as a pocketpiece by the finder does not imply that the imputed horizon is unreliable, and most of Weller's records are from the Navesink.

Range in New Jersey—

Weller cites *B. ovatus* from the following localities:

MERCHANTVILLE: Lenola (not here accepted).[1]

WOODBURY: Lorillard (not here accepted).

NAVESINK: Atlantic Highlands, near Holmdel, near Walnford, Crosswicks Creek, and Mullica Hill.

Range in Delaware—

Morton reports *B. ovatus* from St. Georges, which would be in the Mt. Laurel-Navesink, and in the Deep Cut of the Chesapeake and Delaware Canal (now Summit Bridge), which would be in the Merchantville, but the second record is not here accepted.

Range elsewhere—

B. ovatus is reported from Alabama, Kentucky, and Texas, but these records are believed dubious.

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[1] **NOTE: Specimens of *Baculites* generally referred to *B. ovatus* have been collected from the Merchantville formation at Merchantville, N. J., Maple Shade, N. J., and near Summit Bridge, Del., and from the Woodbury formation at Lorillard, N. J. Dr. Reeside questions the specific identification of these specimens and states that they are probably distinct from the true *B. ovatus* from the Navesink formation. H. G. R.**

Type.—Say's specimen was figured by Morton (1828, pl. 5, fig. 6) and was reported available by Johnson in 1905. Its present location is not known, unless an unnumbered specimen (pl. 1, figs. 1-3) showing two septal chambers and agreeing in diameter with the figure of Say's type is actually the remains of the type.

Baculites asper Morton?

Baculites asper Morton, 1833, Am. Jour. Sci., 1st ser., vol. 23, p. 291.

Baculites asper Morton. Morton, 1834, Synopsis, p. 43, pl. 1, figs. 12-13; pl. 13, fig. 2.

Baculites anceps Lamarck (part). Gabb, 1861, Acad. Nat. Sci. Phila., Proc. 1861, p. 396, pl. 3, fig. 4 (not figs. 2-3).

Baculites asper Morton. Meek, 1864, Check List, p. 23.

Baculites asper Morton. Whiteaves, 1885, Contr. Can. Paleont., vol. 1, pt. 1, p. 82.

Baculites asper Morton. Stanton, 1899, U. S. Geol. Survey Mon. 32, p. 636.

Baculites asper Morton. Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 26.

Baculites asper Morton? (part?). Weller, 1907, p. 823 (not pl. 109, figs. 6-7).

Baculites asper Morton. Dowling, 1917, Canada Geol. Survey Mem. 93, p. 46, pl. 30, figs. 3, 3c (not figs. 3a, 3b).

Baculites asper Morton. Stephenson, 1926, Geol. Survey Alabama Spec. Rept. 14, p. 238, pl. 83, fig. 6.

Baculites asper Morton. Reeside, 1927, U. S. Geol. Survey Prof. Paper 150-A, p. 4, pl. 1, figs. 19-24; pl. 2, figs. 1-5.

Baculites asper Morton (part). Reeside, 1927, U. S. Geol. Survey Prof. Paper 151, p. 13, pl. 10, figs. 9-12; pl. 11, figs. 5-9, 14-16 (not figs. 10-13).

Baculites asper Morton. Dane, 1929, Arkansas Geol. Survey Bull. 1, p. 88, pl. 16, fig. 6.

Baculites asper Morton? Landes, 1940, Canada Geol. Survey Mem. 221, p. 168.

Not:

Baculites asper Morton. Roemer, 1849, Texas, p. 416.

Baculites asper Morton. Roemer, 1852, Kreidebildungen von Texas, p. 36, pl. 2, figs. 2a-d.

Baculites asper Morton? Meek, 1876, U. S. Geol. Survey Terr. Rept., vol. 9, p. 404, pl. 39, figs. 10a-d.

Baculites asper Morton. Whitfield, 1892, p. 278, pl. 46, figs. 10-11.

Baculites asper Morton? Stanton, 1893 [1894], U. S. Geol. Survey Bull. 106, p. 167, pl. 36, figs. 4-5.

Baculites asper Morton. Herrick and Johnson, 1900, Denison Univ. Sci. Lab. Bull., vol. 11, p. 213.

Baculites asper Morton. Lasswitz, 1904, Geol. Palaeont. Abh., n. ser., Bd. 6, Heft 4, p. 15.

Baculites asper Morton? (part?). Weller, 1907, p. 823, pl. 109, figs. 6-7

Baculites asper Morton. Gardner, 1916, p. 383.

Baculites asper Morton. Adkins, 1928, Univ. Texas Bull. 2838, p. 206.

Description.—This species is best characterized by its small size, broad-ovate cross section, small taper of the shell, and its ornamentation—widely spaced round nodes on the antisiphonal half of the flanks and numerous weak undulations on the siphonal side that have only the faintest connection with the nodes. Forms of large size and with arcuate nodes, even though distant, narrowly ovate or subtriangular in cross section, belong to other species. As is usual with ammonites, it grades toward other species in that in some specimens the nodes tend to show a degree of arcuation, and in other specimens the cross section is subcircular or tends to show a flattening of the antisiphonal side.

Remarks.—Morton in 1833 cited only "Alabama" as a locality, but in 1834 he wrote that the species "was discovered by Mr. Nuttall at Cahawba and more recently by Mr. Conrad at Prairie Bluff." The smaller of the two specimens figured in 1834 (pl. 1, figs. 13-14) is still available and is accompanied by a label in Morton's handwriting that states the locality as Prairie Bluff. This locality would place the horizon in the Prairie Bluff chalk, but that unit is definitely higher than the levels now assigned to *B. asper* in the region and elsewhere and has not yielded the species in more recent collections. On the other hand, the locality at Cahawba should be in the lower part of the Selma chalk, which with the Tombigbee sand member has yielded the species at many localities and includes horizons equivalent to those that have yielded *B. asper* elsewhere. The evidence seems to support the judgment that Conrad's assignment, accepted by Morton, is erroneous.

The specimen from the Navesink marl illustrated by Whitfield and by Weller as *B. asper* obviously does not belong to the species. Weller reports, but unfortunately does not illustrate, a specimen from the Cliffwood clay (now Magothy formation) 10 mm. in diameter "characterized by somewhat conspicuous node-like inflations of the sides of shell" that may belong to *B. asper*. At the horizon stated, such an identity seems highly probable, though the writer has not seen the specimen, and a doubt must remain. The species is widely distributed in middle Upper Cretaceous deposits (Coniacian, Santonian, early Campanian).

Range in New Jersey—
MAGOTHY: Cliffwood Point.

Range outside New Jersey—

Alabama, Arkansas, Mississippi—zone of *Exogyra ponderosa* (Santonian, early Campanian). Western Interior of North America—Niobrara, Telegraph Creek, Eagle formations and equivalents (Coniacian to early Campanian).

Type.—In his first publication Morton gave no figures and did not state any details about specimens. A year later he figured two specimens that are presumably to be taken as cotypes, though no localities are assigned. As noted above, one of these survives and bears the number ANSP 19878.

Baculites sp.

Plate 68, Figures 5-7

Baculites ovata Say (part). Morton, 1828, Acad. Nat. Sci. Phila. Jour., vol. 6, p. 89, pl. 5, fig. 5 (not fig. 6); 1830, idem, p. 196, pl. 8, figs. 6-7 (not fig. 8).

Baculites ovatus Say (part). Morton, 1830, Am. Jour. Sci., 1st ser., vol. 17, p. 280; vol. 18, p. 249, pl. 1, figs. 6-7 (not fig. 8).

Baculites ovatus Say (part). Morton, 1834, Synopsis, p. 42, pl. 1, figs. 6-7 (not fig. 8).

Remarks.—Several specimens illustrated by Morton as *Baculites ovatus* seem not to belong to the species. The specimen figured in 1928 as his plate 5, figure 5, shows numerous strong ribs on the flanks of the shell. The specimen figured first in 1830 as his plate 1, figures 6 and 7, and refigured several times elsewhere, shows widely spaced, extraordinarily narrow ribs that extend entirely across the flank and venter. This specimen is ascribed to St. Georges, Del., and would therefore be from the Mt. Laurel-Navesink unit. It is preserved as specimen ANSP 19496-A.

Baculites sp.

Plate 68, Figures 8, 9

Baculites asper Morton. Whitfield, 1892, p. 278, pl. 46, figs. 10-11.

Baculites asper Morton? Weller, 1907, p. 823, pl. 109, figs. 6-7.

Remarks.—This fragment of a large shell, ascribed to the Navesink marl at Holmdel, is indeterminable, but it is definitely not *B. asper.* The large size, the coarse arcuate swellings, and the oval cross section, together with the relatively high horizon, distinguish it. It suggests some of the larger species of the genus, such as *B. undatus* Stephenson (1941, Univ. Texas Publ. 4101, p. 405, pl. 79, figs. 5-10) or *B. grandis* Hall and Meek (1856, Am. Acad. Arts Sci. Mem., n. ser., vol. 5, p. 402, pls. 6-8). The specimen was reported by Whitfield as in the collection at Rutgers College but is apparently not available now.

Family Nostoceratidae Hyatt, 1894
Genus *Nostoceras* Hyatt, 1894
Genotype: *Nostoceras stantoni* Hyatt, 1894

Stephenson (1941, Univ. Texas Publ. 4101, p. 407) discusses this genus and describes and illustrates several of the species. It has a closely coiled spiral of three to six volutions, either dextral or sinistral, followed by a free down dropping U-shaped retroversal old-age living chamber that brings the aperture back to a position just beneath the base of the last volution of the spire. The shell is ornamented with costae, most of which are single, but some of which may bifurcate. Constrictions are usually present on the spire. Two rows of ventral tubercles are more or less prominently developed, and a contact furrow is present on the whorls of the spire.

Nostoceras pauper (Whitfield)

Plate 68, Figures 10-13

Turrilites pauper Whitfield, 1892, p. 268, pl. 45, figs. 1-5.

Turrilites pauper Whitfield. Weller, 1907, p. 834, pl. 108, figs. 1-4.

Didymoceras pauper (Whitfield). Spath, 1921, South African Mus. Ann., vol. 12, pt. 7, pp. 249, 251.

Description.—This species rests essentially upon one specimen, a fragment of a spiral shell that preserves about one and one-third volutions, unseptate except for the last two septae. The upper surface of the whorl is deeply impressed, indicating that the whorls of the spire were in close contact; umbilicus about one-fifth the diameter of the shell. Ribs in the impressed zone simple, curved strongly backward, 35 per whorl; margin of zone a sharp shoulder. Outer surface of whorl gently convex, bearing about 40 ribs per volution, as a few fork at the shoulder, all strongly inclined forward; and two rows of tubercles, 20 per volution, that alternate in position with respect to the ribs, the upper row at about the middle of the outer surface and the lower at about the line of contact with the succeeding whorl; two deep constrictions present on last half-whorl preserved. Lower surface of whorl strongly convex, bearing about 30 ribs, curved gently forward, some of which join at the umbilicus. Umbilicus apparently smooth. The broken larger end of the specimen appears to flare slightly and could well pass into a retroversal or otherwise aberrant portion. Whitfield's figure of the suture is satisfactory.

Remarks.—In addition to the type specimen, Weller notes "two other specimens * * * both of them much distorted fragments which differ in some respects from the type but are too imperfect for certain identification." Spath referred the species *pauper* to *Didymoceras* Hyatt, 1894, but that genus has a loosely coiled spiral form in which the whorls are not in contact and which lacks constrictions on the spire. The species seems much better placed in *Nostoceras*.

Range in New Jersey—

NAVESINK: Navesink Hills. The doubtful specimens are from lower levels, the MARSHALLTOWN formation near Swedesboro and the WENONAH sand near Marlboro.

Type.—NJSM 7659, Navesink Hills.

Nostoceras sp.

Plate 69, Figures 7-12

Heteroceras conradi (Morton) (part). Whitfield, 1892, p. 269, pl. 45, figs. 12-13 (not figs. 9-11, 14).

Heteroceras conradi (Morton) (part). Weller, 1907, p. 833, pl. 108, figs. 5-8.

A retroversal living chamber illustrated by Whitfield and two illustrated by Weller, together with three in the U. S. National Museum seem all to represent a species of *Nostoceras*. The specimens include both dextral and sinistral specimens, and each is a nearly complete living chamber, from the last septum to the aperture. No directly associated coiled parts are reported. Each specimen forms a distinct U, with more or less parallel sides connected by an arc, differing in this respect from the more or less continuously curved living chamber reported for *Didymoceras.*

On these specimens the ribs are strong and widely spaced and two rows of ventral nodes are prominently developed, largest on the curved part of the specimen. The cross section is subcircular to very broadly ovate.

Range in New Jersey—

All the specimens are attributed to the Navesink marl in the Navesink Hills.

Cirroceras Conrad, 1868
Genotype: *Ammonceratites conradi* Morton, 1841

Cirroceras Conrad, Synopsis of the invertebrate fossils of the Cretaceous formation of New Jersey, *in* Cook, G. H., 1868, Geology of New Jersey: New Jersey Geol. Survey Rept., App. A., p. 730.

The genus was defined only by the citation of the genotype description and figure. The most distinctive feature of the type specimen is that it formed part of an open spire like that of *Didymoceras* and *Emperoceras* Hyatt, 1894. With the specimens now available, it is difficult to select characters that would separate *Cirroceras* from those genera, and it seems better for the present to recognize all three genera. *Cirroceras* seems to have been overlooked or ignored by most writers after 1868, but at least legally it is as well founded as many accepted genera.

Cirroceras conradi (Morton)

Plate 70, Figures 1-6

Ammonceratites conradi Morton, 1841, Acad. Nat. Sci. Phila. Proc., vol. 1, p. 109.

Ammonceratites conradi Morton. Morton, 1841, Acad. Nat. Sci. Phila. Jour., 1st ser., vol. 8, p. 212, pl. 10, fig. 1.

Helicoceras conradi (Morton). Gabb, 1861, Synopsis, p. 84 (28).

Helicoceras conradi (Morton). Meek, 1864, Check List, p. 25.

Cirroceras conradi (Morton). Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Heteroceras conradi (Morton) (part). Whitfield, 1892, p. 269, pl. 45, figs. 9-11, 14 (not figs. 12-13).

Heteroceras conradi (Morton). Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 27.

Heteroceras conradi (Morton) (part). Weller, 1907, p. 833 (not pl. 108, figs. 5-8).

Didymoceras? conradi (Morton). Spath, 1921, South African Mus. Ann., vol. 12, pt. 7, p. 251.

Heteroceras conradi (Morton). Groot, Organist, and Richards, 1954, Delaware Geol. Survey Bull. 3, p. 53.

Not: *Heteroceras conradi* (Morton). Whiteaves, 1879, Geol. Survey Canada, Mes. Foss., vol. 1, pt. 2, p. 100, pl. 12.

Description.—This species rests primarily on the type, described by Morton from the Navesink marl at Arneytown, Burlington County, a not too well-preserved single whorl of a sinistrally coiled spiral shell. The specimen appears to be missing, but several plaster casts of it are available. It was described as unseptate, with a cross section distorted by pressure from an original probably subcircular form into a depressed oval; without a depressed zone or other evidence that the whorls were in contact; with surface ornamented by ribs that on the upper surface rise from the umbilicus (perhaps 40 per whorl), incline backwards, then curve radially and pass transversely over the outer surface of the shell. Some of the ribs rise into a node at the midpoint, beyond which each third or fourth rib joins its neighbor to form a node near the bottom of the outer surface. On the lower surface each rib passes with gentle forward curve to the umbilicus (about 30 per whorl). Whitfield attributes a second fragment to the same species and locality. No trace of the suture appears on the cast of the type or on the second specimen.

Remarks.—Both Whitfield and Weller associate with *C. conradi* a number of specimens of a retroversal living chamber from the Navesink formation at Atlantic Highlands. Three additional specimens are available at the U. S. National Museum. No directly associated septate or coiled parts of the shell have been reported, so far as the writer knows. Though the sculpture of all these specimens is coarser than that of the type of *conradi* and much more strongly noded, these differences are similar to those between the retroversal living chamber and the spire of the specimen of *Didymoceras* illustrated by Hyatt (1894, pl. 14, figs. 13-14) and do not alone prove a generic difference. The form of these living chambers is, however, like that of the living chamber of *Nostoceras* rather than that of *Didymoceras* and presumably of *Cirroceras*, and on another page they are referred to *Nostoceras*.

Range in New Jersey—
NAVESINK: Arneytown, Atlantic Highlands.

Type.—Apparently lost. Casts: ANSP 19495, USNM 1800, Arneytown.

Family Diplomoceratidae Spath, 1926
Genus *Solenoceras* Conrad, 1860

Genotype: *Hamites annulifer* Morton, 1841. (Not *Solenoceras* Hyatt, 1884.)

Stephenson (1941) describes species from Texas that give a more complete account of the genus than that provided by the genotype.

Solenoceras annulifer (Morton)

Plate 70, Figures 8-10

Hamites annulifer Morton, 1841, Acad. Nat. Sci. Phila. Proc., vol. 1, p. 109.

Hamites annulifer Morton. Morton, 1842, Acad. Nat. Sci. Phila. Jour., 1st ser., vol. 8, p. 231, pl. 11, fig. 4.

Solenoceras annulifer (Morton). Conrad, 1860, Acad. Nat. Sci. Phila. Jour., 2nd ser., vol. 4, p. 284.

Solenoceras annulifer (Morton). Gabb, 1861, Synopsis, p. 81 (25).

Ptychoceras (Solenoceras) annulifer (Morton). Meek, 1864, Check List, p. 23.

Ptychoceras (Solenoceras) annulifer (Morton). Whitfield, 1892, p. 273, pl. 45, figs. 6-8.

Solenoceras annulifer (Morton). Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 26.

Ptychoceras (Solenoceras) annulifer (Morton). Weller, 1907, pl. 107, figs. 7-9.

Solenoceras annulifer (Morton). Stephenson, 1941, Univ. Texas Bull. 4101, p. 398.

Description.—The only specimen known is a nearly complete living chamber preserving the last septum and part of the expanded ribs near the aperture. It is 21 mm. long and about 5 mm. in greatest diameter.

The siphonal side is well rounded, the antisiphonal side concave and bordered by sharp shoulders, forming an impressed zone in which a subcylindrical septate part of the shell originally stood. At the lower end, the living chamber makes an 180° turn and ends in a septal face that represents the last septum. On the 180° turn there are 4 coarse ribs, each ornamented by a pair of small nodes, then a deep constriction. On the convex side of the straight part of the living chamber there are about 30 sharp ribs with concave interspaces, each rib being ornamented by a pair of faint nodes near the midline of the shell and each rib being inclined slightly backward on the flanks. The apertural part is marked by several strong ribs and a constriction. The ribs of the concave side appear to be the impressions of the ribs of the septate part and unrelated to the ribs of the convex part. The suture is not decipherable from the margin of the septum.

Remarks.—This species appears to rest entirely on the single specimen described by Morton. No other has been reported. Weller refigured Morton's specimen, but, presumably by inadvertence, omitted any reference to it in his text.

Range in Delaware—

The type is reported to have come from the Deep Cut of the Chesapeake and Delaware Canal, near the present-day Summit Bridge, Del. Carter (1937) assigns the strata there to the Crosswicks clays (Merchantville and Woodbury of New Jersey).

Type.—Acad. Nat. Sci. Phila. 4789.

Family Pachydiscidae Spath, 1922
Genus *Menuites* Spath, 1922
Genotype: *Ammonites menu* Forbes, 1845

The most conspicuous features of *Menuites* are the umbilical and ventrolateral tubercles, the latter rather variable.

Menuites? aff. **M. complexus** (Hall and Meek)

Plate 69, Figures 1-6

Ammonites complexis [sic] Hall and Meek (part). Gabb, 1861, Synopsis, p. 65 (9).

Ammonites complexus Hall and Meek (part). Meek, 1864, Check List, p. 24.

Ammonites complexus Hall and Meek. Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Ammonites complexus Hall and Meek (part). Whitfield, 1892, p. 249, pl. 41, figs. 5-7.

Pachydiscus complexus (Hall and Meek) ? Weller, 1907, p. 819, pl. 101, figs. 3-4.

Pachydiscus complexus (Hall and Meek) (part). Gardner, 1916, p. 378.

Parapachydiscus complexus (Meek) [sic] (part?). Spath, 1922, Roy. Soc. S. Africa Trans., vol. 10, pt. 3, p. 122.

Pachydiscus complexus (Hall and Meek) *in* Whitfield. Collignon, 1952, Madagascar Bur. Géol. Trav., no. 41, p. 90.

Two specimens are available, one illustrated by Whitfield and one unfigured.

Description.—Whitfield's specimen represents perhaps one-fifth of a whorl at a diameter of about 50 mm., and is entirely septate. The height of the whorl is estimated at 22 mm. (44% of diameter), and the maximum width is 20 mm. (40% of diameter); the distance along the diameter of the shell from venter to dorsum is 16 mm. The cross section of a whorl would be broad oval to subcircular. On the venter, four low, rounded ribs are present, the two anterior ribs apparently directed toward a junction at the umbilical margin and a low tubercle; the posterior pair are not clear on the flank. All the ribs are strongest on the ventrolateral area and may have made a sort of subdued tubercle there. The suture, so far as known, is a normal intricate pachydiscid suture.

The previously unfigured specimen shows a complete whorl, entirely septate, of 40 mm. diameter, though the earlier parts are not preserved. The height of the whorl is 19 mm. (48% of the diameter), width of whorl 27 mm. (68% of the diameter), and width of umbilicus 13 mm. (33% of the diameter). It shows 18 narrow, rounded ribs per whorl on the venter, each arched gently forward; the alternate ribs pass to the umbilical shoulder, where they rise into a low node; the intervening ribs seem to die out on the flank. The highest point of each rib is on the ventrolateral area. The suture is a normal pachydiscid suture.

Remarks.—Gabb reported "*Ammonites complexus*" from New Jersey without further specification, and Whitfield says that a fragment figured by him under the same name and from an unknown locality was the basis for Gabb's report. Whitfield guesses that the specimen came from the "Lower Marl Beds" (Navesink marl) at Holmdel, Monmouth County. Weller notes fragmentary specimens but cites only the Wenonah sand near Marlboro, Monmouth County, as a locality, and reillustrates Whitfield's specimen, attributing it to an unknown locality. The unfigured specimen is accompanied by a label, presumably in Gabb's handwriting, that bears the inscription, "*A. complexus* H. & M. Burlington Co. W.M.G." Question might be raised whether Gabb's original record was actually based on Whitfield's specimen or on that from Burlington County. They differ considerably in form and would presumably belong to different species. Neither specimen seems to the writer to belong to *M. complexus*, though presumably they are congeneric, and neither is adequate basis for a new name.

The types of *complexus* Hall and Meek came from what is now called the Gregory member of the Pierre shale at the Great Bend of the Missouri River, South Dakota, and the stratigraphic level would not differ greatly in age from the levels of the New Jersey specimens. Umbilical nodes are noted by Hall and Meek, but no ventrolateral nodes. More recently collected specimens from the same unit in the region show the two rows of ventrolateral tubercles that are taken to distinguish the genus *Menuites*.

Range in New Jersey—
WENONAH: Marlboro (Weller).
?NAVESINK: (Whitfield).
Unstated level: Burlington County (Gabb).

Family Scaphitidae Meek, 1876
Genus *Scaphites* Parkinson, 1811
Genotype: *Scaphites aequalis* Sowerby, 1813

The classification of the scaphites is still in debate and a number of generic names have been proposed. The name is used here in a broad sense.

Scaphites hippocrepis (DeKay)

Plate 70, Figures 11, 12; Plate 71, Figures 1-7

Ammonites hippocrepis DeKay, 1827, New York Lyceum Ann., vol. 2, p. 273, pl. 5, fig. 5.

Scaphites cuvieri Morton, 1828, Acad. Nat. Sci. Phila. Jour., 1st ser., vol. 6, p. 109, pl. 7, fig. 1.

Scaphites cuvieri Morton. Morton, 1830, Am. Jour. Sci., 1st ser., vol. 17, p. 280.

Scaphites hippocrepis (DeKay). Morton, 1834, Synopsis, p. 41, pl. 7, fig. 1.

Scaphites reniformis Morton, 1834, Synopsis, p. 42, pl. 2, fig. 6.

Scaphites hippocrepis (DeKay). D'Orbigny, 1850, Prodrome, vol. 2, p. 214.

Scaphites subreniformis D'Orbigny, 1850, Prodrome, vol. 2, p. 214 (for *reniformis* Morton, 1834, not Bruguière, 1790).

Scaphites hippocrepis (DeKay). Gabb, 1861, Synopsis, p. 88(32).

Scaphites hippocrepis (DeKay). Meek, 1864, Check List, p. 24.

Scaphites hippocrepis (DeKay). Conrad, 1868, *in* Cook, Geol. N. J., p. 370.

Scaphites hippocrepis (DeKay). Whitfield, 1892, p. 262, pl. 44, figs. 8-12.

Scaphites hippocrepis (DeKay). Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 27.

Scaphites hippocrepis (DeKay) (part). Weller, 1907, p. 826, pl. 107, figs. 3-6.

Scaphites hippocrepis (DeKay). Grabau and Shimer, 1910, Index Fossils, vol. 2, p. 178, fig. 1431.

Scaphites hippocrepis (DeKay) (part). Gardner, 1916, p. 382.

Holcoscaphites hippocrepis (DeKay). Nowak, 1916, K.-k. geol. Reichsanstalt Verh., Jahrg. 1916, no. 3, table opp. p. 66.

Scaphites hippocrepis (DeKay). Reeside, 1927, U. S. Geol. Survey Prof. Paper 151, p. 22, pl. 14, figs. 17-20; pl. 15; pl. 16, figs. 1-10.

Scaphites hippocrepis (DeKay). Reeside, 1927, idem, Prof. Paper 150-B, p. 30.

Scaphites hippocrepis (DeKay). Dane, 1929, Arkansas Geol. Survey Bull. 1, p. 52, pl. 9, fig. 3.

Scaphites hippocrepis (DeKay). Shimer and Shrock, 1944, Index Fossils, p. 591, pl. 24, fig. 5.

Hoploscaphites hippocrepis (DeKay). Spath, 1953, Falkland Islands Depend. Survey Sci. Repts., no. 3, p. 14.

Scaphites hippocrepis (DeKay). Groot, Organist, and Richards, 1954, Delaware Geol. Survey Bull. 3, p. 53.

Not: *Ammonites hippocripes* [sic] DeKay. Morton, 1828, Acad. Nat. Sci. Phila. Jour., 1st. ser., vol. 6, pp. 88, 113, pl. 5, fig. 4 [error corrected by Morton, idem, p. 195, and 1834, Synopsis, p. 37].

Description.—This species has broad, stout whorls, a swollen living chamber with flanks smooth except for two prominent primary nodes, and nine to seven low rounded nodes bordering the venter on the reflected part. The ribs of the straight part tend to be widely spaced. Variations from the typical form are common. The height of the tubercles and the distinctness of the obscure primary ribs on the living chamber, the relative coarseness of the ribs, and other characters vary with different individuals. The suture is the normal scaphite suture, with the ventral lobe largest and the others progressively smaller; the first lateral lobe is always bifid.

Remarks.—This species is a cosmopolitan form that has been noted in western Europe and North Africa, and in the Gulf region and the Western Interior of the United States. The writer agrees with Gabb that *Scaphites reniformis* Morton is most likely a juvenile of *S. hippocrepis* and disagrees with Weller that *S. similis* Whitfield is to be united with it. The species is considered an early Campanian form in the European sequence.

Range in New Jersey—

MERCHANTVILLE: Matawan, Jamesburg, Lenola, Bordentown.

Range in Delaware—

CROSSWICKS (MERCHANTVILLE and WOODBURY of New Jersey): Deep Cut of Chesapeake and Delaware Canal (now Summit Bridge).

Range elsewhere.—Various localities in beds of Taylor age of the Gulf Coastal region and in the Eagle and Telegraph Creek formations of the Western Interior of the United States; early Campanian of Western Europe and North Africa.

Type.—The holotype, a fragment, is apparently lost, but Morton's more perfect specimen, the holotype of his *Scaphites cuvieri*, survives and serves as a standard of reference. This specimen is ANSP 19483 and is from The Deep Cut, Delaware.

Scaphites similis Whitfield

Plate 70, Figure 7

Scaphites similis Whitfield, 1892, p. 267, pl. 44, figs. 1-2.

Scaphites similis Whitfield. Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 27.

Scaphites hippocrepis (DeKay) (part). Weller, 1907, p. 826 (not pl. 107, figs. 3-6).

Scaphites hippocrepis (DeKay) (part). Gardner, 1916, p. 382.

Scaphites similis Whitfield. Reeside, 1927, U. S. Geol. Survey Prof. Paper 151, p. 24, pl. 18, figs. 8-14.

Description.—This species has compressed whorls, gradually enlarging living chamber without the marked swelling shown by *S. hippocrepis*, no primary nodes on the living chamber, and a concave, sloping umbilical wall on the living chamber. Ventrolateral nodes are present and even, subequal ribs on the venter. The suture is the normal scaphite suture.

Remarks.—Weller and Gardner included *S. similis* in *S. hippocrepis* as a juvenile form, but the writer considers it a valid species. It has been recognized in the Western Interior of the United States. Whitfield did not know the locality of his specimen, which was marked merely "New Jersey," but assumed it to have come from the Chesapeake and Delaware Canal, along with the type of *S. hippocrepis*.

Range.—MERCHANTVILLE of New Jersey or Delaware. Eagle and Telegraph Creek formations and equivalents in Western Interior of the United States.

Type.—Present location unknown. Reported available in Acad. Nat. Sci. Phila. in 1905 by Johnson.

Scaphites aff. **S. leei** Reeside

Plate 71, Figures 8-11

Scaphites nodosus Owen. Whitfield, 1892, p. 261, pl. 14, figs. 13-14 (not *Scaphites (Ammonites?) nodosus* Owen, 1852).

Scaphites nodosus Owen? Weller, 1907, p. 824, pl. 107, figs. 1-2.

Description.—The fragment of a large scaphite referred by Whitfield to *nodosus* Owen is part of a living chamber with a maximum width of whorl of 45 mm., a maximum height of whorl of 35 mm., and a maximum preserved length of 55 mm. A small part of the last septum and the angle of the living chamber are preserved. The venter is broadly arched and bordered on each side by a shoulder marked by a row of conspicuous tubercles, transversely elongated on the older part and round on the younger part, alternating in position on the two sides; between the tubercles pass low rounded ribs, about 5 per tubercle, with ribs and concave interspaces subequal. The outer half of the flanks is flattened, a low rounded fold passing from each tubercle toward the umbilicus; at the middle of the flank some pairs of ribs and some single ribs rise into small tubercles, from each of which a vague rib passes into the umbilicus. The cross section of the whorl is subquadrate. Inner whorls unknown except that a small area of impression shows that they had a regular scaphite ornament. Suture unknown.

Remarks.—Both Whitfield and Weller illustrate the same specimen and it appears to be the main basis for the record. Both, however, note additional fragmentary specimens. The form certainly has nothing in common, morphologically or stratigraphically, with *S. nodosus* Owen. In its broad subquadrate cross section, in its ornamentation, and in its stratigraphic position it has much more similarity to *S. leei* Reeside (1927, p. 26, pl. 20, figs. 17-22; pl. 21, figs. 1-7), but differs sharply in its much greater size and in some minor details of ornamentation. It is likely that the New Jersey form deserves a distinctive name, but a more complete specimen would be desirable as the basis for such a name.

Range in New Jersey—

MERCHANTVILLE(?): Exact locality unknown (Whitfield); Marlboro.

WOODBURY: Lorillard.

Figured specimen.—NJGS 9030.

Family Placenticeratidae Hyatt, 1900

Genus *Placenticeras* Meek, 1870

Genotype: *Ammonites placenta* DeKay, 1828

Placenticeras placenta (DeKay)

Plate 72, Figures 6, 7

Ammonites placenta DeKay, 1828, New York Lyc. Nat. Hist. Ann., vol. 2, p. 278, pl. 5, fig. 2 (not fig. 5).

Ammonites hippocripes [sic] Morton (not DeKay), 1828, Acad. Nat. Sci. Phila. Jour., vol. 6, p. 88, pl. 5, fig. 4 [error for *A. placenta* DeKay, corrected on p. 195, 1830].

Ammonites placenta DeKay. Morton, 1830, Am. Jour. Sci., 1st ser., vol. 17, p. 279; vol. 18, pl. *a*, figs. 1-3.

Ammonites placenta DeKay. Morton, 1834, Synopsis, p. 36, pl. 2, figs. 1-2.

Ammonites placenta DeKay (part). Gabb, 1861, Synopsis, p. 71 (15).

Ammonites placenta DeKay (part). Meek, 1864, Check List, p. 25.

Ammonites placenta DeKay. Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Ammonites (Placentocerus [sic]*) placenta* DeKay (part). Meek, 1870, Am. Phil. Soc. Proc., vol. 11, p. 429. U. S. Geol. Survey Terr., 2nd Ann. Rept., 1871, p. 297.

Placenticeras placenta (DeKay) (part). Meek, 1876, p. 465.

Ammonites (Placenticeras) placenta DeKay (part). Whitfield, 1892, p. 255, pl. 40, fig. 1; pl. 41, figs. 1-2.

Placenticeras placenta (DeKay). Hyatt, 1903, U. S. Geol. Survey Mon. 44, p. 211, pl. 39, figs. 3-6; pl. 40, figs. 1-2.

Placenticeras placenta (DeKay). Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 27.

Placenticeras placenta (DeKay). Weller, 1907, p. 830, pl. 104, fig. 6; pl. 105, fig. 1.

Placenticeras placenta (DeKay). Grabau and Shimer, 1910, Index Fossils, vol. 2, p. 217, fig. 1492e, f.

Placenticeras placenta (DeKay) (part). Gardner, 1916, p. 385, pl. 12A.

Placenticeras placenta (DeKay). Stephenson, 1923, p. 392, pl. 97, figs. 1-2.

Placenticeras placenta (DeKay) var. *hyatti* Stephenson, 1923, p. 396, pl. 98, figs. 1-2.

Placenticeras placenta (DeKay). Shimer and Shrock, 1944, Index Fossils, p. 595, pl. 249, fig. 5.

Placenticeras placenta (DeKay). Groot, Organist, and Richards, 1954, Delaware Geol. Survey Bull. 3, p. 53.

Not:

Placenticeras placenta (DeKay). Stanton, 1894, p. 169, pl. 39, figs. 1-3.

Placenticeras placenta (DeKay). Gilbert, 1896, U. S. Geol. Survey 17th Ann. Rept., pl. 63, figs. 1-2.

Placenticeras placenta (DeKay). Logan, 1898, Univ. Geol. Survey Kansas, vol. 4, p. 463.

Placenticeras placenta (Morton) [sic]. Hill and Vaughan, 1898, U. S. Geol. Survey 18th Ann. Rept., pl. 64, figs. 1a, b.

Placenticeras placenta (DeKay). Stanton, 1899, U. S. Geol. Survey Mon. 32, pt. 2, p. 640.

Placenticeras placenta (DeKay). Herrick and Johnson, 1900, Dennison Univ. Sci. Lab. Bull., vol. 11, p. 214.

Placenticeras placenta (DeKay). Johnson, 1903, Columbia Univ. School Mines Quart., vol. 24, p. 133, pl. 7, figs. 26a, b.

Placenticeras placenta (DeKay). Shimer and Blodgett, 1908, Am. Jour. Sci., 4th ser., vol. 25, p. 65.

Placenticeras placenta (DeKay). Dowling, 1917, Canada Geol. Survey Mem. 93, p. 32, pl. 34, figs. 1, 1a.

Placenticeras placenta (DeKay) var. *intercalare* (Meek). Dowling, idem, p. 32, pl. 33, figs. 1, 1a.

Placenticeras placenta (DeKay). Roman, 1938, Les ammonites jurassiques et cretacées, p. 504, pl. 52, figs. 487, a.

Description.—This species attains a large size, individuals approaching 500 mm. having been recorded. The venter in the largest individuals is rounded, but even at a large diameter the ventral truncation characteristic of the genus is still observable. The shell at all stages is relatively compressed, the flanks gently convex, the umbilicus very small. Whitfield states that he saw no nodes on the flanks, but Morton records umbilical tubercles and Hyatt writes of three rows of tubercles on smaller specimens, umbilical, two-thirds the distance out from the umbilicus on the flank and distantly spaced, and on the margin of the venter. Hyatt describes the ventral tubercles as large and elongated parallel to the venter; Weller describes them as alternate. The larger individuals are essentially smooth. The suture is much dissected, with long elements, ranging from long and narrow to more solid and rounded. The analogous species in the Western Interior is *P. meeki* Boehm (*whitfieldi* Hyatt), but *meeki* is more compressed, the ventral truncation is narrower and more persistent, nodes are lacking on the flanks, and the suture is more complex.

Remarks.—Much confusion has existed in the literature because of a long-standing tendency to assign all species of *Placenticeras* to *placenta.* Hyatt's work has helped to correct this tendency, but because of his habit of discussing rather than describing features, some of it is difficult to follow. The species *placenta* is relatively frequent in the older horizons, the Merchantville clay—according to Weller—providing the most and best specimens. Those from other horizons are more fragmentary and smaller.

The specimen here illustrated is accompanied by a label indicating that it was figured by Morton in his Synopsis (pl. 2, fig. 1). Out of hand the specimen does not look like Morton's figure, as the latter shows no defects and the specimen lacks all but the basal part of the living chamber, but Morton's figure is apparently much restored (as are those of *Ammonites vanuxemi* on the same plate, for which there can be no question as to the original specimen). In size it fits the septate part of Morton's figure very well, for Morton says the specimen was 15 inches in diameter, including a large part of the living chamber. The opposite side of the specimen here illustrated was figured by Whitfield (his pl. 40, fig. 1).

Range in New Jersey—

Weller reports the following:
MAGOTHY: Cliffwood Point.
MERCHANTVILLE: Matawan, Jamesburg, Lenola.
WOODBURY: Lorillard, Matawan.
MARSHALLTOWN: Swedesboro.
WENONAH: Crawfords Corner, Marlboro.

Range outside New Jersey—

Crosswicks (Merchantville and Woodbury): Chesapeake and Delaware Canal; Black Creek formation: North Carolina. Alabama has been commonly reported, but no recent record justifies its inclusion, and it is considered dubious.

Type.—Location unknown, probably lost. Locality: Chesapeake and Delaware Canal, Delaware.

Placenticeras spillmani Hyatt?

Plate 73, Figures 6, 7

Placenticeras spillmani Hyatt, 1903, U. S. Geol. Survey Mon. 44, p. 233, pl. 47, figs. 6-8.

Hyatt refers provisionally to *P. spillmani* as follows: "a cast of one chamber in the collection of Yale University, said to be from Burlington, N. J., with a similar broad venter." As the species is characterized by possession of a stouter whorl than *P. placenta,* broader venter, and a suture with broad, short, solid saddles and narrow lobes less complex than in *placenta,* the status of the New Jersey specimen is really dubious. It must, however, represent some species other than *placenta.*

Placenticeras sp. indeterminate

Ammonites telifer Morton, 1833, Am. Jour. Sci., 1st ser., vol. 23, p. 290.

Ammonites telifer Morton. Morton, 1834, Synopsis, p. 38, pl. 2, fig. 7.

Ammonites telifer Morton. Gabb, 1861, Synopsis, p. 73 (17).

Ammonites (Placenticeras [sic]*) telifer* Morton. Whitfield, 1892, p. 252, pl. 41, figs. 10, 11.

Placenticeras? telifer (Morton). Hyatt, 1903, U. S. Geol. Survey Mon. 44, p. 233.

Placenticeras telifer (Morton). Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 28.

Placenticeras telifer (Morton). Weller, 1907, p. 832, pl. 104, figs. 7-8.

The three fragments, fillings of parts of septal chambers, on which the species *telifer* is founded, seem to the writer almost certainly to represent a species of *Placenticeras,* but it is not possible to place them more closely. Hyatt doubted the possibility of assignment to even a genus.

Two of the fragments survive in the collections of the Academy of Natural Sciences of Philadelphia and bear the number 19494. No closer locality is known than "New Jersey."

Family Peroniceratidae Hyatt, 1900
Genus *Menabites* Collignon, 1948

Genotype: *Menabites menabensis* Collignon, 1948.

This genus is characterized, according to Collignon, by the persistence into an advanced stage (80 or more mm. diameter) of trituberculer ornament on the flanks and the increase in number of ventrolateral tubercles to two or three times that of the umbilical tubercles.

Subgenus *Delawarella* Collignon, 1948

Subgenotype: *Ammonites delawarensis* Morton, 1830.

This subgenus is characterized, according to Collignon, by numerous fine crowded ribs, often flexuous, weak tubercles, and a relatively small umbilicus.

Menabites (Delawarella) delawarensis (Morton)

Plate 72, Figures 1-3; Plate 73, Figures 1-5; Plate 74, Figure 2

Ammonites delawarensis Morton, 1830, Am. Jour. Sci., 1st ser., vol. 18, p. 244, pl. 2, fig. 4.

Ammonites delawarensis Morton. Morton, 1830, Acad. Nat. Sci. Phila. Jour., Ist ser., vol. 6, p. 194.

Ammonites delawarensis Morton. Morton, 1834, Synopsis, p. 37, pl. 2, fig. 5.

Ammonites delawarensis Morton. Gabb, 1861, Synopsis, p. 65 (9).

Ammonites delawarensis Morton. Meek, 1864, Check List, p. 24.

Ammonites delawarensis Morton, Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Ammonites delawarensis Morton (part). Whitfield, 1892, p. 252, pl. 42, figs. 6-8 (not pl. 42, fig. 9; pl. 43).

Ammonites delawarensis Morton (part). Johnson, 1905, Acad. Nat. Sci. Proc., vol. 57, p. 27.

Mortoniceras delawarensis (Morton) (part). Weller, 1907, p. 837, pl. 103; ?pl. 104, figs. 1-3 (not pl. 104, figs. 4-5).

Mortoniceras delawarense (Morton) (part). Grabau and Shimer, 1910, Index Fossils, vol. 2, p. 226, figs. 1507 (ventral view), 1508 (lateral view).

Mortoniceras delawarensis (Morton) (part). Gardner, 1916, p. 391, pl. 12, fig. 7.

Submortoniceras delawarense (Morton). Spath, 1926, Geol. Mag., vol 63, table opp. p. 80.

Mortoniceras aff. *M. delawarense* (Morton). Dane, 1929, Arkansas Geol. Survey Bull. 1, p. 62, pl. 10, figs. 1-2.

Texanites delawarensis (Morton). Roman, 1938, Les ammonites jurassiques et cretacées, p. 461.

Menabites (Delawarella) delawarensis (Morton). Collignon, 1948, Madagascar Service des Mines Ann. géol., fasc. 13, p. 64; fasc. 14, pp. 29, 44.

Menabites (Delawarella) delawarensis (Morton). Groot, Organist, and Richards, 1954, Delaware Geol. Survey Bull. 3, p. 53, pl. 7, fig. 5.

Description.—Collignon describes *delawarensis* as a relatively thick ammonite with three stages of development—a young stage with three tubercles on each flank; an intermediate stage bearing five tubercles on each flank, of which the second tubercle from the umbilicus is small and pointed, the middle tubercle is large and on a strong rib, and the fourth and ventrolateral tubercles are elongated parallel to the ventral keel; and an adult stage, in which the tubercles except the umbilical and ventrolateral, weaken or disappear. In the adult stage the primary ribs are thick and massive, about 20 per whorl, concave forward. A few of these continue to the venter as simple ribs but more frequently divide at the middle tubercle to make about 30 ventrolateral ribs.

Remarks.—The species *delawarensis* has been noted in the literature as widely distributed over the world in the early Campanian. It has been conceived rather loosely, however, and Collignon has drastically restricted it. He has also made it the type of a subgenus of a genus based on a species from Madagascar. The material available to the writer does not seem adequate to determine the validity of this procedure, but he has adopted it as the best procedure available and leaves to time the ultimate disposition of the questions involved.

The three specimens figured have all been previously illustrated by Whitfield, Weller, and Gardner and show three stages in development of the shell.

Range in New Jersey—

MERCHANTVILLE: Burlington, Maple Shade, Cliffwood.

Range outside New Jersey—

Crosswicks (Merchantville and Woodbury): Chesapeake and Delaware Canal.

Type.—Location unknown, probably lost. Locality: Deep Cut (now Summit Bridge), Delaware.

Genus *Submortoniceras* Spath, 1926

Genotype: *Mortoniceras woodsi* Spath, 1921.

Spath's characterization (1926, Geol. Mag., vol. 63, p. 79) is as follows: "The Campanian forms differ from the earlier true *Mortoniceras* * * * chiefly in the more continuous keel and progressive decline of ornamentation as well as of other characters.'' Collignon (1948, Madagascar Service Mines Ann., fasc. 13, p. 64) describes the genus as including ammonites with ribs often slightly flexuous, with numerous intercalated ribs that increase the number of the external tubercles, with compressed form and small umbilicus, and with gradual loss of ornament. The adults preserve only the umbilical and ventrolateral tubercles and the ribs are weak.

Submortoniceras vanuxemi (Morton)

Plate 72, Figures 4, 5

Ammonites vanuxemi Morton, 1830, Am. Jour. Sci., 1st ser., vol. 18, p. 244, pl. 3, figs. 4-5.

Ammonites vanuxemi Morton. Morton, 1830, Acad. Nat. Sci. Phila. Jour., 1st ser., vol. 6, p. 194.

Ammonites vanuxemi Morton. Morton, 1834, Synopsis, p. 37, pl. 2, figs. 3-4.

Ammonites vanuxemi Morton. Gabb, 1861, Synopsis, p. 71 (15).

Ammonites vanuxemi Morton. Whitfield, 1892, p. 252, pl. 42, figs. 1-5.

Ammonites vanuxemi Morton. Johnson, 1905, Acad. Nat. Sci. Phila. Proc., vol. 57, p. 27.

Mortoniceras delawarensis (Morton) (part). Weller, 1907, p. 837, pl. 104, figs. 4-5 (not pl. 103; pl. 104, figs. 1-3).

Mortoniceras delawarense (Morton) (part). Grabau and Shimer, 1910, Index Fossils, vol. 2, p. 226, fig. 1507 (lateral view) (not fig. 1507, ventral view, nor fig. 1508).

Ammonites (Mortoniceras) vanuxemi Morton. Miller, 1911, Maryland Geol. Survey, Prince Georges County Rept., pl. 5, fig. 1.

Mortoniceras delawarensis (Morton) (part). Gardner, 1916, p. 391.

Mortoniceras vanuxemi (Morton). Spath, 1921, South African Mus. Ann., vol. 12, pt. 7, p. 308.

Submortoniceras vanuxemi (Morton). Collignon, 1948, Madagascar Service Mines Ann., fasc. 14, pp. 30, 43.

The writer has available only Morton's type specimen, which has a maximum diameter of 36 mm. At the end the whorl is 17 mm. high and 13 mm. wide. A little more than half a whorl is preserved, and it shows 9 umbilical tubercles and 18 ventrolateral tubercles, with 3 more rows of tubercles on the flanks. Whitfield figures a second specimen about 55 mm. in diameter, on which, the ribs to about 40 mm. diameter show 5 rows of tubercles, and the latter part appears to have nearly lost the 3 rows on the flanks. From Whitfield's figure the dimensions of the whorl appear to be close to those of Morton's type.

Remarks.—The name *vanuxemi* has been applied by Spath in Zululand, and Collignon accepts the record. It would seem more likely, however, that the name is to be kept nearer home. The species is apparently associated with *delawarensis* and the assignment to a different genus seems unexpected. The writer has arbitrarily followed Collignon.

Range in New Jersey—
MERCHANTVILLE: Burlington County.

Range outside New Jersey—
Crosswicks (Merchantville and Woodbury): Chesapeake and Delaware Canal.

Type.—ANSP 19492. Locality: Chesapeake and Delaware Canal, Delaware.

Submortoniceras sp.

Whitfield (1892, pl. 42, fig. 9; pl. 43, figs. 1-2) figures as *Ammonites delawarensis* Morton a specimen 185 mm. in diameter, with maximum height of whorl of 90 mm. and width of 60 mm. A little more than one whorl is preserved and all of the early stages are missing. Only the umbilical and ventrolateral nodes are displayed, and the ribs are very weak. The keel is visible but subdued. Collignon (1948, fasc. 14, p. 30) refers this specimen to *Submortoniceras,* and conceivably it could be a large stage of *S. vanuxemi,* but as the authentic specimens of *vanuxemi* available are all small, it is not possible to assign it with assurance.

Whitfield (1892, p. 252) refers to the specimen as "a large cast sent me, as one of the type specimens, from the Acad. Nat. Sciences, Philadelphia," and under the heading "Formation and locality" he says, "The type specimens are all from Delaware." Nothing further is known.

Family Tissotiidae Hyatt, 1900
Subfamily Barroisiceratinae Basse, 1947
Genus *Barroisiceras* Grossouvre, 1894

Genotype: *Ammonites haberfellneri* Hauer, 1886.

Subgenus *Texasia* Reeside, 1932

Subgenotype: *Ammonites dentato-carinatus* Roemer, 1849

?Barroisiceras (Texasia) dentato-carinatum (Roemer)

Ammonites dentato-carinatus Roemer, 1849, Texas, p. 417.

Ammonites dentato-carinatus Roemer. Roemer, 1852, Kreidebildungen, p. 33.

Ammonites dentato-carinatus Roemer. Whitfield, 1892, p. 250, pl. 41, figs. 3-4.

Barroisiceras dentato-carinatus (Roemer). Weller, 1907, p. 836, pl. 101, figs. 5-6.

The record of *B. (T.) dentato-carinatum* in New Jersey rests upon a single small fragment, about one-fifth of a whorl, with an estimated shell diameter of 50 mm. It was described and figured by both Whitfield and Weller. Its source is entirely unknown, though it came to Whitfield labelled as from the Cretaceous of New Jersey and still bears that label. He attributed it tentatively to the "Lower Green Marls," the modern Navesink marl, saying that limestone concretions in that formation have a similar lithology. Weller cites formation and locality as "Unknown, New Jersey (Whitfield)."

The writer has elsewhere (1932, U. S. Geol. Survey Prof. Paper 170, p. 10) expressed the opinion that the source of the specimen is so dubious that it should not be considered. He also expressed the opinion, from descriptions and illustrations, that it is not *dentato-carinatum*. Examination of the specimen itself and comparison with specimens of similar size from Texas lead now to the opinion that it is authentic *dentato-carinatum* and that it is from Texas, not New Jersey. Three considerations lead to this conclusion: one, that the specimen is identical in minute details of morphology with specimens from Texas and very similar in general appearance, though the color is a light tan rather than cream, and the matrix does not effervesce with dilute hydrochloride acid; two, that over the world the genus *Barroisiceras* is found only in early Coniacian beds, which would be well below the level of the Navesink marl, and that nothing in the earlier faunas, such as those reported from the Magothy formation, suggests this age; and three, the specimen has a polish that suggests, as Morton reported for *Baculites ovatus,* long transportation as a pocketpiece before it came to rest in the collections of the Academy of Natural Sciences. It is, of course, perilous to press such evidence too far, but the writer believes it good enough to make the probability of the occurrence of *B. dentatocarinatum* in New Jersey very small.

The specimen figured by Whitfield and Weller bears the Academy of Natural Sciences number 19493.

The type specimen of *Barroisiceras dentatocarinatum* (Roemer) came from the Austin chalk at the Waterfall of the Guadalupe River below New Braunfels, Texas, and is presumably in the collection of Roemer's specimens at the University of Bonn, Germany.

Family Sphenodiscidae Hyatt, 1900
Genus *Sphenodiscus* Meek, 1871

Genotype: *Ammonites lobatus* Tuomey, 1854.

Shell compressed, discoid, attaining large size (350 mm.); umbilicus small. Whorl changes very early from round-ventered to sharp and only in large specimens becomes rounded again. Mostly with smooth untuberculate flanks, but a few species have small distant tubercles. Suture with numerous elements; lobes rounded, denticulate; saddles phylliform, in inner part of flank undivided.

Sphenodiscus lobatus (Tuomey)

Plate 74, Figure 1; Plate 75, Figure 3

Ammonites lobata Tuomey, 1854, Acad. Nat. Sci. Phila. Proc., vol. 7, p. 168.

Ammonites lobata Tuomey (part). Gabb, 1861, Synopsis, p. 69 (13).

Ammonites lobatus Tuomey (part). Meek, 1864, Check List, p. 24.

Ammonites lobatus Tuomey. Conrad, 1868, *in* Cook, Geol. New Jersey, p. 730.

Ammonites (Sphenodiscus) lobatus Tuomey. Meek, 1871, U. S. Geol. Survey Terr., 2nd Ann Rept. [actually 4th], p. 298 (Reprint dated 1872).

Placenticeras (Sphenodiscus) lobatus (Tuomey) (part). Meek, 1876, U. S. Geol. Survey Terr. Rept., vol. 9, p. 463.

Placenticeras (Sphenodiscus) lenticulare (Owen) (part). Meek, 1876, idem, p. 473.

Ammonites (Sphenodiscus) lenticulare (Owen) (part). Whitfield, 1892, p. 258, pl. 41, figs. 8-9.

Sphenodiscus whitfieldi J. Boehm, 1898, Deutsche geol. Gesell. Zeitschr., Bd. 4, p. 195.

Sphenodiscus lobatus (Tuomey). Hyatt, 1903, U. S. Geol. Survey Mon. 44, p. 66, pl. 6, figs. 1-2; pl. 7, figs. 1-2; pl. 9, figs. 11-13.

Sphenodiscus lobatus (Tuomey). Weller, 1907, p. 828, pl. 106, figs. 1-2.

Sphenodiscus lobatus (Tuomey). Grabau and Shimer, 1910, Index Fossils, vol. 2, p. 216.

Sphenodiscus lobatus (Tuomey). Gardner, 1916, p. 338, pl. 13, fig. 10.

Sphenodiscus lobatus (Tuomey). Roman, 1938, Les Ammonites jurassiques et cretacées, p. 503, pl. 53, fig. 493 (on plate spelled *labiatus*).

Sphenodiscus lobatus (Tuomey). Shimer and Shrock, 1944, Index Fossils, p. 595, pl. 248, fig. 7.

Hyatt is perhaps the latest author to discuss this species extensively, but, as is his habit, he describes specimens in minute detail but nowhere actually defines the species. From his discussion it may be inferred that he had in mind ammonites that displayed no umbilical shoulder, had smooth flanks and compressed shells, and had a suture with about five bilobed saddles, the remaining seven or eight being entire.

Range in New Jersey—
TINTON: Tinton Falls, Beers Hill cut, near Freehold.

Range outside New Jersey—
Maryland, Mississippi.

Type.—Location unknown, presumably lost. Type locality, Noxubee County, Mississippi.

Sphenodiscus beecheri Hyatt

Plate 75, Figures 1, 2

Sphenodiscus beecheri Hyatt, 1903, U. S. Geol. Survey Mon. 44, p. 80, pl. 6, figs. 3-4.

Hyatt (1903, p. 75, pl. 9, fig. 10) based this species on a type from the Fox Hills sandstone of South Dakota, but he also attributes to the species with some reservation, "a fragment of a cast * * * from Birmingham, N. J., from the Lower or Middle Greensand Marls." The sutures are different from those of any other form, having the ventral lobe broad; twelve saddles, with the outer four quadrifid, fifth to seventh bifid, eighth simple, ninth bifid, the remainder entire; and the lobes bifid, with the branches subdivided and serrated and the bases entire. Hyatt figures the New Jersey specimen (Yale Peabody Museum no. 200) and calls it *S. beecheri* without query, though in his text he says he hesitates to describe it as a distinct species because it is a fragment.

Range in New Jersey—

Presumably NAVESINK: Birmingham.

Range outside New Jersey—

Fox Hills sandstone, South Dakota.

Type.—Museum of Comparative Zoology, Cambridge, Mass., according to Hyatt.

CRETACEOUS BELEMNITES OF NEW JERSEY

by

J. A. JELETZKY[1]

Belemnitella americana (Morton, 1830) Sensu lato

Abbreviated synonymy

Belemnites americanus Morton, 1830a, Amer. Jour. Sci. vol. 17, p. 281.

Belemnites americanus Morton, 1830b, Amer. Jour. Sci. vol. 18, pl. 1, figs. 1-3.

Belemnites americanus Morton, 1830, Jour. Acad. Nat. Sci. Phil. ser. 1, vol. 6, p. 190, pl. 8, figs. 1-3

Belemnites mucronatus Credner, 1870, p. 238.

Belemnitella americana Whitfield, 1892, pp. 280-283, pl. 47, figs. 1-11.

Belemnitella americana Weller, pp. 839-841, pl. 109, figs. 1-4.

Belemnitella americana, Arkhangelsky, 1912, pp. 611-613, pl. IX, figs. 7, 12; pl. X, fig. 11 (North American specimens only).

Belemnitella americana, Nowak, 1913, pp. 392-393 (North American specimens only).

Belemnitella americana, Gardner, 1916, p. 394, pl. 12, figs. 4-6.

Belemnitella americana, Nowak, 1916, Bull. Acad. Sci. Cracow, p. 67, corr. table to p. 67 (North American specimens only).

Belemnitella americana, Lange, 1921, Geol. Vestnik, IV, pp. 26-28 (North American specimens only).

Belemnitella americana, Crickmay, 1933, Canad. Field Natur., XLVII, p. 15.

Belemnitella americana, Jeletzky, 1951, pp. 119-121, pl. 7, figs. 3, 5.

Belemnitella americana, Groot, Organist, & Richards, 1954, p. 53, pl. 7, figs. 1-2.

Type Specimen.—Morton (1830a, p. 281; 1830b, pl. 1, figs. 1-3) has figured only two specimens of *Belemnites americanus* in the paper which is the source of publication of the species. The two specimens must be considered its cotypes as no indication as to any of them having been selected as the type specimen appears in the text of the paper or in the explanation of the plate. From these two specimens the one re-

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[1] Published by permission of the Acting Minister, Department of Mines and Technical Surveys, Ottawa, Ontario, Canada.
Special thanks are due Dr. Horace G. Richards of the Academy of Natural Sciences of Philadelphia for the loan of belemnite material including type specimens of *B. americana*. Sincere thanks are also due to Doctors John B. Reeside, Jr., and L. W. Stephenson of the U. S. Geological Survey for giving valuable advice as to the stratigraphic and age relationships of the various late Upper Cretaceous formations and the belemnite lots involved, and for answering numerous queries on the subject. Doctors G. Arthur Cooper and Remington Kellogg have kindly lent belemnite material from New Jersey and other Atlantic and Gulf States from the U. S. National Museum. The writer takes this opportunity to express his appreciation of the work of Mr. E. C. Elliott and the staff of the Photographic Section of the Geological Survey of Canada, who prepared and retouched all of the photographs used in this paper.

produced on pl. 1, fig. 2 is drawn only in its outline and so is unsuitable as the type specimen. Furthermore, this specimen could not be positively identified by the writer in the type-lot of Morton. This leaves the large specimen reproduced on pl. 1, figs. 1, 3 as the only possible choice and this specimen is herewith selected as the lectotype of *Belemnitella americana* (Morton). This very large guard, which is actually the largest representative of *Belemnitella americana* (Morton) *s. lato*[1] seen by the writer, is reproduced on pl. 76, figs. 1a-1e, as the original figures and description of Morton (1830a-c; 1834) are somewhat unsatisfactory. The original figure of Morton (1830b, pl. 1, fig. 1), however imperfect, shows clearly the asymmetry of the apical quarter of the guard and of its mucro in the ventral aspect. This asymmetry is actually present on the original specimen and is clearly visible on pl. 76, figs. 1a, 1c. This puts the identification of the lectotype of *B. americana* (Morton) beyond any doubt in the opinion of the writer. It is felt, however, that this asymmetry is pathological in its nature, as its appearance and a short and deep longitudinal groove associated with it are too irregular in their outline to be explained in any other way. Besides, similar features only occur in the pathological (crippled) specimens in any hitherto described representatives of the family Belemnitellidae Pavlow. The sectioning of other specimens of *Belemnitella americana s. l.* and allied North American forms has shown that similar malformations are due to the juvenile guard having been broken and regenerated with subsequent loss of symmetry and normal proportions of the grown-up specimen. Even similar apical grooves have been observed sometimes. Therefore, in spite of the fact that the guard has not been split, it seems safe to assume that also the lectotype of *Belemnitella americana s. l.* has suffered an injury of its juvenile guard (probably was broken) but survived it and managed to heal the fracture and to reach a very large (one could say gigantic as *Belemnitella* go) size.

It is rather unfortunate to have a pathological specimen for the lectotype of *Belemnitella americana* (Morton); yet the writer does not see any escape route, the only figure of the other specimen published simultaneously with it being useless and the specimen itself apparently lost. Besides, the above described malformation is only a slight one and does not destroy or strongly distort the normal proportions of the guard or its external sculpture. Thus, it does not impair the usefulness of the lectotype as a type specimen once it is recognized as such. Apart from it the specimen chosen as lectotype is almost complete, very well preserved, and quite typical of *Belemnitella americana s. l.* as understood by the writer.

Morphology.—The description of the morphology of the guard of *Belemnitella americana s. l.* is made rather difficult by the exceedingly great variability of almost all its morphological characters. The range of the variation is, in fact, so great that the writer is tempted to doubt that all the extreme morphological *Belemnitella*-like forms studied by

[1] This will be abbreviated as *Belemnitella americana s. l.* throughout this chapter.

him from the Mount Laurel sand and Navesink marl of New Jersey and their equivalents in Delaware and Maryland are actually of one and the same variable species. Such doubts seem to find further support in the fact that most of the *Belemnitella* collections studied by the writer from New Jersey and adjoining States do not exhibit the whole range of the morphological variation presented by the sum total of the collections studied from the Mount Laurel sand and Navesink marl of these three States. This observation is, on the other hand, contradicted by the circumstance that there are several fossil localities in the States of New Jersey and Delaware where all, or nearly all, morphological forms of *Belemnitella* described below as the varieties of *B. americana s. l.* occur *together and appear to intergrade with one another.* Nor was it possible to establish any regular changes in the composition of the *Belemnitella* fauna within the succession of beds of the Mount Laurel and Navesink formations. If we further consider that according to Urey et al (1951, pp. 413, 415) the New Jersey occurrences of *Belemnitella* represent partly or wholly (?) the postmortem concentrations of the guards in the shallow and agitated waters, the above discussed variations in the ranges of morphological variation observed from one locality to another may well be due solely to the postmortal sorting of specimens, according to their size and shape, by waves and currents.

As most of the collections studied have not been collected bed by bed, and as, consequently, there is no detailed information about the stratigraphical ranges of the various morphologically distinct *Belemnitella* forms present in the collections studied, the writer prefers to treat them all as mere morphological varieties of one and the same variable (= "polytypic") species *Belemnitella americana s. l.* These varieties are described in the following pages. In some extreme cases the writer's doubts about the varietal status of the forms concerned are expressed informally in their description.

The grouping of the representatives of the species according to the outline and proportions of the guard has been found to be the best solution of the intricate problem of organization of the numerous morphological forms referable to *B. americana s. 1.* In distributing the guards among the varieties it has been found necessary, however, to take into account the value of the Schatsky Index[1], the appearance of the apical end of the guard and the degree of its mucronation, the depth of the alveolus, and the degree and the character of the sculpture covering the surface of the guard.

Belemnitella americana (Morton) 1830 var. **americana** Jeletzky nov. var.

Plate 76, Figures 1a-1e; 2, 4a-4b, 35-7; Plate 77, Figure 2a-2c, 3a-3c; Plate 78, Figure 4a-4b; Plate 79, Figures 1a-1d, 2-3, 6-8

Belemnites americanus Morton, 1830, Amer. Jour. Sci. vol. 18, pl. 1, figs. 1-2.

[1] That is the distance between the embryonic bulb situated at the apex of the alveolus and the beginning of the ventral fissure on the inner wall of the alveolus (see Jeletzky, 1949, p. 259, foot note).

Belemnites americanus Morton, 1834, Synopsis, Cretaceous Group, pl. 1, figs. 1-2.

Belemnitella americana Whitfield, 1892, pl. 47, figs. 4-7.

Belemnitella americana Weller, 1907, pl. 109, figs. 1-2.

Belemnitella americana Gardner, 1916, pl. 12, figs. 4-6.

Belemnitella americana Groot, Organist and Richards, 1954, pl. 7, fig. 1.

Introduction.—Belemnitella americana (Mort.) var. *americana* nov. var. is morphologically intermediate between the extreme varieties of the species described below.

It is also by far the most common variety of *B. americana* (Morton) *s. l.* in almost all fossil lots of the species studied by the writer from New Jersey, Delaware, and Maryland. Therefore *B. americana* var. *americana* may appropriately be considered as typical of the species, all the more so as the above discussed lectotype of *B. americana s. l.* is its typical representative.

Morphology: Guard generally large, this variety including nearly all the largest specimens of *B. americana s. l.* known to the writer. In its proportions the guard fluctuates from long and moderately sturdy to short and stout. The extremes known to the writer are reproduced on pl. 77, fig. 2a-2b; pl. 78, fig. 4a-4b, pl. 79, figs. 1a-1b, 6a-6c. In the majority of the specimens studied the guard in the lateral aspect tapers gradually and evenly all the way from its alveolar edge to a point some 10-30 mm. above its apical end. From this point the tapering increases more or less strongly, with its second increase often occurring just before the apical end of the guard (see pl. 76, fig. 1a, 1d; pl. 77, fig. 2b). These increases in tapering produce more or less wide or narrow but always more or less rounded and obtuse apical ends with or without a clearly defined mucro. Somewhat more rarely the guard tapers at the same or almost the same rate to its very end, which thus becomes very narrow, long and acute (see pl. 79, figs. 1a-1c) and mostly but feebly mucronate. In other rare instances the guard does not perceptibly taper apically over the anterior third or half of its length, remaining virtually subcylindrical throughout this section, (see pl. 79, figs. 2, 3a, 6a-6c). In such instances, however, the guard nearly always tapers more or less pronouncedly over its posterior half or two-thirds.

In the ventral aspect the guard is mostly subcylindrical to feebly conical from its alveolar edge to a point 25-50 mm. above its apical end. Below the said point the tapering toward the apical end of the guard increases markedly producing a more or less rounded and obtuse end of the guard with or without a clearly defined mucro (see pl. 76, figs. 1a, 1c; pl. 77, figs. 2a-c; pl. 78, fig. 4a). In the remaining minority of specimens, however, the ventral outline of the guard varies from a markedly conical shape with or without a strongly rounded apical end and well defined mucro to somewhat lanceolate shape with a fairly obtuse and rounded short apical end with or without well defined mucro (see pl. 77, fig. 3a; pl. 79, fig. 6a). These extremes of the ventral outline of the guard connect *B. americana* var. *americana* with *B. americana* var. *longa*, *B. americana* var. *subfusiformis*, *B. americana* var. *intermedia*, and also with the younger species *B.* cf. *bulbosa* Meek and Hayden.

In the majority of the specimens studied, the ventral and dorsal sides of the guard are fairly to very strongly flattened, either throughout their entire length or, at least, between the base of the ventral fissure and the apical end of the guard. This flattening generally increases gradually toward the apical end of the guard and results in the pronouncedly oval cross sections of the guard all over its posterior half to two-thirds (see pl. 76, fig. 1e; pl. 77, fig. 3c; pl. 79, figs. 1d, 3b, 5b). The dorsal side of the guard is often more strongly flattened than the ventral side. In a number of guards, including the lectotype of the species, it is virtually flat (see pl. 76, fig. 1e; pl. 79, figs. 1d, 3b). The ventral side of the guard only rarely becomes completely flattened. The dorso-ventral diameter is commonly larger than the lateral diameter at the base of the alveolar fissure and further orad. There are, however, quite a few guards in which this relationship is reversed, and some with both diameters virtually equal. As the above described dorso-ventral flattening of the guard is accompanied by its marked dorso-ventral compression below the level of the alveolar fissure, the dorso-ventral diameters are always markedly less than the lateral diameters at the same levels throughout this part of the guard (see previously listed cross sections of the guard). In the majority of the specimens the cross section of the guard at its alveolar rim is either almost perfectly round or feebly oval with the lateral diameter still somewhat exceeding the dorso-ventral diameter. In rarer instances the dorso-ventral diameter slightly exceeds the lateral one at the alveolar rim. Even in these instances, however, this relationship often becomes reversed above the level of the base of the ventral fissure. The other more common extreme is represented by the guards which are pronouncedly dorso-ventrally flattened and compressed even at their alveolar rim. The lectotype of the species (see pl. 76, figs. 1a-1d) shows this relationship.

Over the anterior two-thirds to three-quarters of the length of the guard its markedly flattened dorsal surface is situated between the dorso-lateral depressions of the usual Belemnitellidae type. At their bottoms these depressions commonly carry indistinct double dorso-lateral furrows (or secondary depressions) separated by a low longitudinal ridge. Dorso-lateral depressions run generally longitudinally but they converge more or less markedly toward the median plane of the dorsal surface of the guard as they approach its alveolar rim. This gradually reduces the width of the flattened dorsal side of the guard over its alveolar third. The dorso-lateral depressions gradually become shallower apically until they finally disappear within the apical third or quarter of the length of the guard. Furthermore, the double dorso-lateral furrows occurring at their bottoms become more and more shallow and narrow, in the same direction. Over the apical third or quarter of the length of the guard these double dorso-lateral furrows are cut directly into the more or less regularly rounded flanks of the guard; they run slightly obliquely toward the ventral side of the guard and gradually approach the lateral position toward its apex, not quite reaching this position just before their final disappearance on the obtuse part of the apical end of the guard some 5-15 mm. above its mucro. As a rule, the dorso-lateral double furrows are about 0.3 to 0.6 mm. wide and are separated by a low ridge some 0.5 to 1.0 mm. wide; in the majority of instances they run quite or almost parallel and straight. In some 15-20% of the guards studied, however, their course becomes wavy or quite irregular on one or both sides of the guard, or one or the other furrow departs from its normal direction. Also the total disappearance of the double dorso-lateral furrows in a maze of branching vascular imprints and strong longitudinal furrows and striae has been observed in several instances (e.g. on both flanks of the lectotype of the species, see pl. 76, figs. 1a, 1c). These irregularities are, however, believed to be either pathological in their nature (e.g. in the lectotype) or caused by the very strong development of the vascular imprints and longitudinal striae, which obscure or distort the normal *Belemnitella*-like character of the double furrows in the adult age.

The main vascular imprints on the lower third or quarter of the guard tend to branch off the double dorso-lateral furrows under acute angles averaging 15-25° and not exceeding 30° (*Belemnitella*-like type of branching). There are numerous instances, however, when at least some of these main branches either become quite irregular in their course or branch from the double dorso-lateral furrows at angles exceeding 30°. Generally speaking these instances coincide with the previously described cases of the abnormal development of the furrows themselves. Therefore they are believed to be mainly or totally due to pathological causes or to the excessively strong development of the vascular imprints and longitudinal striae.

In the majority of the adult specimens of the variety the surface of the guard is fairly to very strongly sculptured by dense and pronounced, somewhat irregular, longitudinal striae and furrows, and with an equally pronounced and very dense net of ramifying vascular imprints. The crossing of both types of sculpture produces a coarse and irregular granulation which covers parts or all of the surface of the guard. This granulation is distinct from that of the Eurasian genus *Gonioteuthis* Bayle, 1878 in the considerably greater dimensions and irregular form of the individual granules. At the same time it is practically indistinguishable from the granulation of *Belemnella casimirovensis* or *Belemnitella junior* (see Jeletzky, 1951, pp. 102-103, 122, pl. 3, figs. 1a-1b, 2a-2b; pl. 5, figs. 6a-6b, pl. 6, figs. 4a-4b). As a rule, the above described sculpture is most pronouncedly expressed on the anterior half of the guard. The granulation is for the most part completely or mainly restricted to it. On the posterior half of the guard the sculpture is mostly dominated by the longitudinal striae and furrows and the vascular imprints become somewhat less dense and less ramified. The strongly oblique vascular imprints become predominant on the flanks of the guard. Sometimes the longitudinal striae and furrows almost completely suppress all other types of sculpture over parts or all of the posterior half of the guard (e.g. pl. 76, fig. 1c; pl. 77, figs. 2a-c). All above described types of sculpture, including granulation, occur also inside of the dorso-lateral depressions of the guard. It should also be noted that the sculpture, and in particular the granulation, are particularly strongly developed on the ventral surface of the guard around its ventral fissure.

In some guards, otherwise indistinguishable from *B. americana* var. *americana,* the sculpture of the ventral and dorsal sides of the guard becomes weakened over its posterior half. In a few other guards this weakening of the sculpture progresses so far as to make the flanks and the ventral and dorsal sides of the guard appear semi-smooth all over its posterior half. Such guards are usually more slender and so appear to connect *B. americana* var. *americana* with feebly sculptured semi-smooth to almost completely unsculptured varieties *B. americana* var. *polita* and *B. americana* var. *intermedia.* Another extreme is represented by the guards which are densely granulated all over their surface. The lectotype of the species (see pl. 76, figs. 1a-1d) and the more slender guard reproduced on pl. 79, figs. 1a-1c approach this extreme, as does the semi-adult guard on the variety reproduced on pl. 76, figs. 6a-6b. It should be mentioned, however, that the poor preservation of the guards of *B. americana s. l.* often makes them appear semi-smooth or even almost smooth. With all such worn out or somewhat etched specimens weeded out, the semi-smooth or relatively feebly sculptured specimens are uncommon in *B. americana* var. *americana.*

In the majority of the reasonably to almost complete guards of *B. americana* var. *americana* the depth of the alveolus approaches one third of the total length of the guard (see pl. 76, fig. 2, pl. 79, fig. 3a). In some rare specimens belonging to the most sturdy and short form of the variety, or in those transitional to *B. americana* var. *intermedia,* the depth of the alveolus approaches two-fifths of the guard (see pl. 79, fig. 6c). In other relatively more common specimens, which are mostly transitional to *B. americana* var. *subfusiformis, B. americana* var. *longa, B. americana* var. *polita,* and *B.* cf. *bulbosa* Meek & Hayden in their other morphological features, the depth of the alveolus becomes reduced to one quarter of the total length of the guard. The alveolus is relatively narrow, its dorso-ventrally measured angle fluctuates between 19° and 22° with the mean value around 20°. On the dorsal side of the alveolus there is a longitudinal median furrow 2-3 mm. wide and 1-2 mm. deep which is characteristic of all *Belemnitella*-like forms of the family with the doubtful exception of *Belemnitella hoeferi* Schloenbach 1867. This median furrow continues downward almost to the embryonic bulb, gradually becoming more and more narrow and shallow in this direction. The inner surface of the alveolus is covered by a white conotheca which is 0.25-0.5 mm. thick. Except for the above discussed longitudinal dorsal furrow and the sometimes preserved impressions of the chambers of the phragmacone, the conotheca appears to the naked eye to be quite smooth. In the majority of the guards it is destroyed, however, with the exception of the apical part of the alveolus. Therefore *the layers of the guard are mostly immediately exposed in the walls of* the alveolus. The distance between the embryonic bulb situated at the apex of the alveolus and the beginning of the ventral fissure on the inner wall of the alveolus, which has been designated the Schatsky Index by the writer (Jeletzky, 1949, p. 259, foot-note), fluctuates between 3.0 and 6.0 mm. in the material studied. The values from 3.5 to 5.0 mm. strongly predominate, while those approaching 6.0 mm. are very rare and seem to be restricted to the forms transitional to the younger species *Belemnitella* cf. *bulbosa* Meek & Hayden 1856 in their other morphological features. The values below 3.5 mm. are also rare and seem to be restricted to specimens morphologically transitional to *B. americana* var. *subfusiformis, B. americana* var. *longa,* and *B. americana* var. *polita.*

The bottom of the alveolar fissure is exceedingly variable in its outline, which is well illustrated by the specimens of the variety reproduced in plates 76-79. It should be mentioned, however, that some particular types of outlines occur more commonly than others in the material studied. It is estimated that in some 40-50% of the guards studied the bottom of the ventral fissure at first runs obliquely upward forming an angle of 15° to 40° with the inner wall of the alveolus. Anywhere between one-eighth and three-fifths of its way toward the surface of the guard the bottom of the fissure deviates in a sharp, more or less semicircular bend toward the surface of the guard, becoming more or less perpendicular to this latter and increasing its angle with the alveolar wall to 40-70° or even more. This course is usually maintained until the ventral fissure reaches the surface of the guard at a level only a few mm. above its beginning. A good example of such an outline of the bottom of the ventral fissure is given on pl. 77, fig. 2b and on pl. 79, fig. 7. It is very similar to that of the Eurasian *Belemnitella junior* Nowak *s. str.* (see Jeletzky, 1951, p. 103, pl. 2, fig. 2b, fig. 7c; pl. 4, fig. 2). Another common outline of the bottom of ventral fissure, occurring in some 10-15% of the specimens studied, consists in its remaining more or less straight from beginning to end and running obliquely upward at an angle of 15-40° with the inner wall of the alveolus (see pl. 76, fig. 2). In yet another common outline occurring in at least 15-20% of the specimens studied the bottom of the ventral fissure forms an angle of some 80-110° with the inner wall of the alveolus and runs a straight, slightly arched, or more or less irregularly sinuous course toward the surface of the guard. In this case the ventral fissure reaches the surface either somewhat below the level of its beginning inside of the alveolus or at about the same level with it (see pl. 79, figs. 1c, 2).

Sometimes the ventral fissure reaches the surface of the guard at the level of the embryonic bulb or even somewhat below this latter. In some instances irregularly bent (see pl. 79, fig. 3a) or straight bottoms of ventral fissure running very obliquely upward and forming angles of only 5-15° with the inner wall of the alveolus (see pl. 77, fig. 5c) also occur. All the extremes are connected by numerous transitions with one another and with the above described predominant type of the outline.

The median line always runs closer to the ventral side of the guard, being as a rule two-fifths of the thickness of the guard away from this latter. Its course is commonly quite to almost straight within the anterior three-quarters of the postalveolar part of the guard but it deviates slightly toward the median plane of the guard in the apical quarter of the same. Therefore the mucro nearly always lies within the median plane of the guard or exceedingly close to this latter.

The alveolar fissure is always long in relation to the depth of the alveolus. In the majority of the guards studied it reaches well into the posterior third or quarter of the alveolus (pl. 79, figs. 1c, 2, 3a, 6c, 7). The guards in which the alveolar fissure ends somewhat below the middle of the alveolus (see pl. 76, fig. 2; pl. 77, fig. 2b) are uncommon, and those in which the fissure does not reach the middle of the alveolus are exceedingly rare. At the same time the instances when the ventral fissure reaches the surface of the guard only 3-6 mm. above the level of the embryonic bulb are quite common (pl. 79, figs. 1c, 2); sometimes the ventral fissure even reaches the surface of the guard at the level of the embryonic bulb.

Localities, Geographical and Stratigraphical Range. Belemnitella americana (Morton) var. *americana* nov. var. forms from 60% to 95% of the populations of *B. americana* (Morton) in almost all belemnite collections from New Jersey, Delaware and Maryland which were studied by the writer. Only the lot 174796 USNM is dominated by transitional forms between *B. americana* var. *subfusiformis* and var. *longa*. Only one guard out of five can be referred to *B. americana* var. *americana* in this lot.

B. americana var. *americana* appears to be about equally numerous in the Mount Laurel sand and in the Navesink marl; its representatives from the two formations are indistinguishable. It is possible, however, that extensive bed by bed collecting would show that specimens of *B. americana* from the Mount Laurel sand are somewhat more slender and possess longer, more acute, and less distinctly mucronate apical ends of the guard, and have a smaller value of the Schatsky Index, than those from the Navesink marl.

The geographical range of *B. americana* var. *americana* appears to coincide with that of other described varieties of the species.

Belemnitella americana (Morton) var. **subfusiformis** Whitfield 1892

Plate 76, Figures 4a-4c; Plate 78, Figures 1a-1c, 2a-2c, 3a-3c; Plate 79, Figure 4

Belemnites americanus var. A Subfusiform, Morton, 1834, p. 34, pl. 1, fig. 3.

Belemnitella americana var. *subfusiformis* Whitfield, 1892, p. 280, expl. of plate 47, figs. 1-2.

Taxonomic Remarks.—The form here described as *Belemnitella americana* (Morton, 1830) var. *subfusiformis* Whitfield, 1892, was first differentiated from the typical *Belemnitella americana* by Morton (1834, p. 34, pl. 1, fig. 3) himself, who has considered it to be a variety of this species. In so far as Morton did not use the latinized form of the word "subfusiform" either in the text or in the explanation of the figure, the name is clearly not available under the Rules of Zoological Nomenclature from his Synopsis. Should it be available, however, it would fall into synonymy of *Belemnites subfusiformis* Raspail, 1829, as both forms have been referred to the same genus *Belemnites* Lamarck, 1799, by their authors.

Whitfield (1892, p. 280, explanation of plate XLVII) was apparently the first to use Morton's informal name "Subfusiform" in its latinized form "*subfusiformis*". He has also refigured the original specimen of Morton under this name. Accordingly Whitfield (1892) must be considered to be the author of this variety in spite of the fact that he has passed it into the synonymy of *Belemnitella americana* (Morton). In so far as this variety was referred by Whitfield to the genus *Belemnitella* d'Orbigny 1842 and not to *Belemnites* Lamarck, 1799, the name *Belemnitella americana* (Morton) var. *subfusiformis* Whitfield, 1892 does not become a junior synonym of *Belemnites subfusiformis* Raspail, 1829, which, in the meantime, has been assigned to the genus *Hibolites* Montford, 1808 (see Bulow-Trummer, 1920, p. 154).

Type specimen.—The original specimen of Morton (ANSP 19488) becomes the holotype of *Belemnitella americana* var. *subfusiformis* Whitfield by monotypy, as Whitfield has applied the name only to that specimen (pl. 78, figs. 1a-1c). The exact locality and the formation from which this and other of Morton's types of *B. americana* have been collected are unknown.

Morphology.—Guard usually small to medium sized, its proportions vary from moderately short and sturdy (see pl. 78, figs. 1a-1c) to long and slender (see pl. 78, figs. 2a-2c). *B. americana* var. *subfusiformis* is the smallest of all the known varieties of the species; all its largest representatives known to the writer are transitional to *B. americana* var. *polita*, *B. americana* var. *longa*, or to *B. americana* var. *americana*. The guard is normally pronouncedly to moderately lanceolate in its ventral aspect and feebly lanceolate, subcylindrical or very feebly subconical (rarely) in its lateral aspect (see pl. 78, figs. 1a-1c, 3a-3c; pl.

79, fig. 4). In the vast majority of specimens very strong (predominantly) to moderate (seldom) dorso-ventral flattening and compression occur throughout the postalveolar part of the guard, or rarely over its entire length, tending to increase in the posterior direction. There are rare representatives of the variety, however, which almost lack any dorso-ventral flattening and do not show any dorso-ventral compression at all (see pl. 78, figs. 3a-3c). The maximum lateral diameter is usually situated very low in the apical third of the guard, or in its apical quarter (see pl. 78, figs. 1a, 2a). In the slender representatives of the variety, however, it may be situated much higher (see pl. 78, fig. 3a). The minimum lateral diameter is mostly situated at about the level of the apex of the alveolus, from which level the guard tends to widen again gradually and evenly all the way toward its alveolar rim. This widening, is, however, only slight in most instances. The same applies to the dorso-ventral diameter, though the differences between respective diameters are generally much less pronounced in this aspect (see pl. 78, figs. 1b-c, 2b, 3b-c) and there are some instances when the guard is subcylindrical or even feebly subconical (see pl. 79, fig. 4) in the lateral aspect.

The apical end of the guard varies considerably in its shape from broad, short, very obtuse, and distinctly mucronate (see pl. 78, figs. 1a-1c) to fairly long, less obtuse, relatively narrow, and distinctly mucronate (see pl. 78, figs. 2a-2b). Nonmucronate and acutepointed guards are unknown in this variety.

The cross section of the alveolus at the alveolar rim of the complete guards differs from that of *B. americana* var. *americana* in being mostly feebly eggshaped and laterally compressed with the pointed end of the "egg" directed toward the dorsal side of the guard and the dorso-ventral diameter somewhat exceeding the lateral one at this level. A great deal of variation is, however, observed in the cross section of the alveolar edge of the guard, perfectly circular cross sections, and oval cross sections with the lateral diameter somewhat exceeding the dorso-ventral one, being by no means unknown (though more rare) in the material studied.

The sculpture of the guard normally consists of strongly developed and dense vascular imprints and longitudinal striae of the same type as in *B. americana* var. *americana*. The granulation of the surface of the guards occurs, however, only in the minority of representatives of *B. americana* var. *subfusiformis;* whenever present, it is mostly restricted to the anterior half of the guard or to some parts of the same. Like other varieties of the species, *B. americana* var. *subfusiformis* is characterized by more or less strongly intensified mesh of the vascular imprints and by granulation around the ventral fissure. In a few instances the apical half of the guard may show only weak and more widely spaced vascular imprints and longitudinal striae. It may even become semi-smooth. Such specimens connect *B. americana* var. *subfusiformis* with *B. americana* var. *polita*. In some other specimens, including the holotype of the variety, the longitudinal striae become strongly predominant not only on the posterior half of the guard but also on its dorsal side over its anterior half.

The character of the longitudinal dorso-lateral depressions, as well as that of the double dorso-lateral furrows and the main vascular impressions branching off these latter in the apical third of the guard, do not seem to show any material differences from those of *B. americana* var. *americana* (see pl. 78, figs. 1b-c, 2b-c, 3b).

The depth of the alveolus varies very considerably in the specimens studied; in the majority of specimens (e.g. pl. 78, figs. 1c, 2c) its depth fluctuates between 20 and 30% of the total length of the guard (27% in the holotype). In some extreme cases, however, the depth of the alveolus may decrease to 13-15% of the total length of the guard (e.g. pl. 78, fig. 3c).

The values of the Schatsky Index lie, as a rule, between 2.5 and 3.5 mm. In relatively rare instances, however, values of 1.5-2.5 mm. and of 3.5-4.5 mm. have also been observed.

The values of the alveolar angle in the dorso-ventral plane fluctuate between 18° and 28° in specimens which could be accurately measured.

The length of the ventral fissure in relation to the depth of the alveolus varies in about the same limits as that of *B. americana* var. *americana* (see pl. 78, figs. 1a-1c, 2a-2c, 3a-3c; pl. 79, fig. 4). The fissure of *B. americana* var. *subfusiformis* is shorter, however, than that of *B. americana* var. *americana* in relation to the total length of the guard.

The limits of the variation in the outline of the ventral fissure appear to be the same as in *B. americana* var. *americana*. Contrary to this variety, however, the downwardly concave outline of its bottom with the ventral fissure reaching the surface of the guard only a few mm. above the level of its beginning on the inner wall of the alveolus (see pl. 78, fig. 1b) is predominant in *B. americana* var. *subfusiformis*, occurring in some 45-50% of the specimens studied. The next most common outline of the bottom is the S-like one (see pl. 78, fig. 2c), which is also decidedly uncommon in *B. americana* var. *americana*. It occurs in some 10-15% of the specimens studied. The irregularly bent outlines of the bottom (see pl. 79, fig. 4), with the fissure reaching the surface of the guard at about the level of its beginning on the inner wall of the alveolus or somewhat below this latter, are more common in *B. americana* var. *subfusiformis* than in *B. americana* var. *americana*.

It appears that the forms of *B. americana* var. *subfusiformis* possessing the more shallow alveolus, a typically lanceolate ventral outline of the guard, and strongly flattened and compressed dorso-ventrally, tend to have the largest angles (up to 120°-130°, see pl. 78, fig. 3c) between the bottom of the ventral fissure and the inner wall of the alveolus and the most complexly bent outlines of its bottom (see pl. 78, fig. 3c; pl. 79, fig. 4). At the same time these extreme forms seem to be characterized by the smallest values of the Schatsky Index and the greatest values of the alveolar angle (24°-28°). Therefore, these extreme forms appear to deserve a formal varietal name, which is not proposed here only because of the paucity of sufficiently well preserved and typical specimens of them in the material studied. Conversely, the less lanceolate, sturdier, and larger forms of *B. americana* var. *subfusiformis* are characterized by deeper alveolus; they also have, as a rule, more regular, straighter, or at least less complexly bent outlines of the bottoms of ventral fissure and smaller values of its angle with the inner wall of the alveolus. These features appear to be coupled in them with somewhat greater values of the Schatsky Index (3.0-3.5 to 4.0 mm.). There are, however, many exceptions to this rule and all the extreme forms are connected by intermediate forms.

The character of the ontogenetic development in *B. americana* var. *subfusiformis* has only been observed in a few longitudinally split or polished specimens. These observations have, however, been supplemented by the study of some juvenile specimens apparently belonging to *B. americana* var. *subfusiformis* in the collections studied.

In the majority of specimens sectioned the first observable juvenile guards up to the length of 40-50 mm. are relatively long, slender, and possess very long, acute, and nonmucronate apical ends; they are subcylindrical to very feebly lanceolate in their lateral outlines. These juvenile guards of *B. americana* var. *subfusiformis* show a tendency to contract somewhat at about the level of the apex of the alveolus and to remain so contracted to the alveolar rim. In other instances, however, this contraction is followed by the gradual widening of the guard up to its alveolar rim, which is indistinguishable from that observed in *B. americana* var. *americana* (see pl. 79, fig. 3a). Other juvenile guards (see pl. 79, fig. 4) remain almost perfectly cylindrical throughout the anterior three-quarters of their length. The juvenile guards with a pronouncedly conical, tack-like lateral outline (like that represented on pl. 79, fig. 7) are unknown in *B. americana* var. *subfusiformis*.

Judging by the juvenile guards found with the adult guards of *B. americana* var. *subfusiformis* and apparently belonging to this variety, its young tend to be slender and subcylindrical or somewhat sublanceolate in their ventral aspect in their earliest observable stages. The juvenile guards with a pronouncedly conical, tack-like outline (like that reproduced on pl. 76, fig. 3) are unknown in *B. americana* var. *subfusiformis*. The guards 40-45 mm. long and 4-5 mm. wide at the base of the ventral fissure tend to have the ventral and lateral outlines similar to that of the adult guards (see pl. 76, fig. 4a-4c).

Thus, the majority of juvenile guards of *B. americana* var. *subfusiformis* seem to differ from the corresponding stages of growth of *B. americana* var. *americana* in their greater slenderness and length, in their predominantly subcylindrical to feebly lanceolate outline, and in their relatively more narrow alveolar part. At the same time they seem to be quite similar to the juvenile guards of *B. americana* var.

longa in these same respects (see pl. 79, fig. 5a). It cannot be too strongly stressed, however, that at least some juvenile guards of *B. americana* var. *subfusiformis* are indistinguishable from the more slender and longer juvenile guard types occurring in *B. americana* var. *americana* and that the number of the guards of both varieties studied in this respect is insufficient for any definite conclusions on the subject.

Distribution and Stratigraphical Range.—Within the state of New Jersey *B. americana* var. *subfusiformis*, and the guards transitional between it and other varieties of the species, have been encountered in almost every one of the localities from which belemnite collections have been studied by the writer; it is, however, absent from such localities as Barnsboro and Glassboro, New Jersey, and Reedy Point, Delaware, which is probably owing to the small amount of the guards available (1 to 7) from these localities.

The writer has seen specimens of *B. americana* var. *subfusiformis* from the Mount Laurel sand as well as from the Navesink marl, which seems to indicate that it has the same stratigraphical range as the rest of the varieties of the species.

B. americana var. *subfusiformis* is a rare form at most of its localities. Only from 1% to 15-20% of the guards have been found to be referable to it at most of the localities studied.

Range in New Jersey—

MOUNT LAUREL: Nutt Farm.

NAVESINK: Cream Ridge, Arneytown.

Range outside New Jersey—

Chesapeake and Delaware Canal between Reedy Point and St. Georges (Mount Laurel-Navesink); Bohemia Mills, Maryland.

Affinities and Differences.—The reduced value of the Schatsky Index appears to be one of the most reliable distinctions between *B. americana* var. *subfusiformis* on the one hand and *B. americana* var. *americana*, *B. americana* var. *intermedia*, and *B. americana* nov. var. indet. var. A and B on the other. There even seem to be relatively few specimens, that are transitional between both groups of forms in this respect. Also the pronouncedly lanceolate outline of its guard in ventral aspect and mostly feebly lanceolate outline in lateral aspect readily distinguish *B. americana* var. *subfusiformis* from all other varieties with the exception of *B. americana* var. *intermedia*. This latter variety is, however, distinct from *B. americana* var. *subfusiformis* in its greater value of the Schatsky Index, its much deeper alveolus, and in the acute, long, and almost nonmucronate outline of the apical end of its guard. The shallower alveolus is also helpful in the differentiation of *B. americana* var. *subfusiformis* from other varieties of the species.

From *B. americana* var. *polita* nov. var., *B. americana* var. *subfusiformis* differs in the presence of relatively strongly developed sculpture of the surface of the guard, in its relatively much smaller, shorter, and sturdier guard, and in the obtuse, short, and distinctly mucronate apical end of this latter.

Belemnitella americana (Morton) var. **longa** Jeletzky nov. var.

Plate 77, Figures 4a-4c; Plate 78, Figures 5a-5c;
Plate 79, Figures 5a-5b

B. americana var. *longa* is very similar to the extremely slender and distinctly mucronate forms of *B. americana* var. *americana,* like those reproduced on pl. 77, figs. 2a-2c, in the proportions and general outline of its guard, as well as in the obtuse, distinctly mucronate apical end of the same, and in the character of the sculpture of the surface of its guard. It differs, however, in the greater length and slenderness of its guard, its lesser dorso-ventral flattening and compression, and in the much smaller value of its Schatsky Index, which fluctuates from 3.0 to 3.5 mm. in the specimens studied. It also seems to differ from *B. americana* var. *americana* and to approach closely *B. americana* var. *subfusiformis* (see pl. 79, fig. 5a) in the character of its ontogenetic development.

In the value of its Schatsky Index *B. americana* var. *longa* is very close to *B. americana* var. *polita* and *B. americana* var. *subfusiformis.* It is, furthermore, connected with *B. americana* var. *polita* by semi-smooth intermediate forms, like that reproduced on pl. 77, figs. 4a-4c, and with the slender and long forms of *B. americana* var. *subfusiformis* by intermediate forms, like that reproduced on pl. 78, figs. 2a-2c. Therefore this variety appears to be an extreme development of the slender and feebly lanceolate forms of *B. americana* var. *subfusiformis* (see pl. 78, figs. 2a-2c). It differs from these latter forms in the considerably greater length and slenderness of its guard, in the regular and slow apical tapering of the lateral outline of this latter, in the regularly and feebly conical ventral outline of its guard, and in the greater amount of its dorso-ventral compression and flattening.

The guard of *B. americana* var. *longa* differs sharply from that of *B. americana var. polita* in its pronouncedly sculptured surface, markedly conical lateral and ventral outlines, and obtuse, short, and distinctly mucronate apical end.

It differs from those of *B. americana* var. *intermedia,* sturdier and shorter forms of *B. americana* var. *americana,* and *B. americana* nov. var. indet. A. and B. in the same features as from those of the slender forms of *B. americana* var. *americana.* The differences between both groups of forms are more strongly expressed, however, with the exception of the value of the Schatsky Index. The greater depth of the alveolus is an additional distinguishing feature of all above mentioned forms from *B. americana* var. *longa. B. americana* var. *intermedia* differs from *B. americana* var. *longa* also in the feebly lanceolate shape and the long, acute, and nonmucronate apical end of its guard.

B. americana var. *longa* is a rare variety occurring mostly in single specimens among numerous representatives of *B. americana* var. *amer-*

icana and more rarely among representatives of the other varieties of the species. Forms transitional between these two occur in most fossil lots from New Jersey studied by the writer. There are no indications that the geographical or stratigraphical ranges of the variety differ from those of the species.

Range in New Jersey—
MOUNT LAUREL: Nutt Farm, Crosswicks Creek.
NAVESINK: Cream Ridge, Walnford.

Range outside New Jersey—
Chesapeake and Delaware Canal (Biggs Farm).

Belemnitella americana (Morton) var **polita** Jeletzky nov. var.

Plate 78, Figures 6a-6c

This variety is characterized by a very long and slender guard with its surface completely or almost smooth, except for the dorso-lateral depressions, double-dorso-lateral furrows, and single lateral furrows. The ventral outline of the guard usually is feebly lanceolate. A contraction usually occurs at about the level of the base of the ventral fissure and is followed by gradual but more rapid expansion of the alveolar part of the guard all the way up to its alveolar rim. More rarely the ventral outline is subcylindrical or very high conical and lacks any marked contraction at the level of the base of the ventral fissure. The lateral outline of the guard usually is very high conical; its tapering in the apical direction is, however, often interrupted by a slight to marked contraction at about the level of the base of the ventral fissure (see pl. 78, fig. 6b). As in the ventral aspect, the alveolar part of the guard expands gradually and evenly all the way to its alveolar rim. This contraction and subsequent expansion of the alveolar part of the guard may, however, be absent in some whose lateral outlines then become indistinguishable from that of *B. americana* var. *longa* (see pl. 77, figs. 4a-4c).

The depth of the alveolus fluctuates between one-third and one-fourth of the total length of the guard and the dorso-ventrally measured angle of the alveolus fluctuates between 18° and 20° in the material studied. The length of the ventral fissure in relation to the depth of the alveolus varies in wide limits. In the holotype of the variety (see pl. 78, fig. 6c) it reaches to the lower third of the alveolus but in some other specimens it reaches into its lower quarter. In yet other specimens its base lies between one-half and two-thirds of the depth of the alveolus. The outline of the bottom of the ventral fissure varies in about the same limits as that of *B. americana* var. *americana,* but the material of the variety studied is insufficient to work out its range of variation and the most typical shapes. The Schatsky Index fluctuates from 2.0 to 3.0 mm. in the material studied.

None of the studied specimens of *B. americana* var. *polita* showed the growth lines. If some exceedingly slender, long, and quite smooth juvenile guards found at the localities mentioned below really belong to *B. americana* var. *polita* rather than to *B. americana* var. *longa, or B. americana* var. *subfusiformis*, its ontogeny would be similar to that of the two last mentioned varieties.

B. americana var. *polita* is an extreme form of the species that appears to be closest to the slender semi-smooth forms of *B. americana* var. *subfusiformis* and of *B. americana* var. *longa* on the one hand and to the extremely slender and most feebly sculptured forms of *B. americana* var. *intermedia* on the other. It is connected by the numerous transitional forms with the former two varieties but there do not seem to be any transitional forms between *B. americana* var. *polita* and *B. americana* var. *intermedia* with regard to the value of the Schatsky Index. This favors the idea that *B. americana* var. *polita* is yet another extreme development of the group of forms surrounding *B. americana* var. *subfusiformis* and is not close to *B. americana* var. *intermedia*.

The guard of *B. americana* var. *polita* differs markedly from other varieties of *B. americana s. l.* in its smooth to almost smooth surface combined with the extremely slender and long proportions of the guard, which combination of characters is peculiar to this variety.

B. americana var. *polita* is a rare form occurring in the Mount Laurel sand as well as in the Navesink marl.

Range in New Jersey—

MOUNT LAUREL: Nutt Farm.
NAVESINK: Cream Ridge.

Range outside New Jersey—

Chesapeake and Delaware Canal near St. Georges (Mount Laurel-Navesink).

There are also some forms transitional between var. *polita* and var. *longa* (see pl. 77, figs. 4a-4c). The range of variety *polita* seems to be the same as the other varieties.

Belemnitella americana (Morton) var. **intermedia** Jeletzky nov. var.

Plate 77, Figures 1a-1c

This variety appears to be an extreme development of *B. americana* var. *americana* in the opposite direction to that represented by *B. americana* var. *subfusiformis, B. americana* var. *longa,* and *B. americana* var. *polita.* At the same time this variety appears to be transitional between *B. americana* var. *americana* and such Eurasian *Belemnitella* forms as *Belemnites lanceolatus* Sharpe 1853-57 non Schlotheim, 1813 and late forms of *Belemnitella praecursor* Stolley *s. lato,* even though clearly belonging together with the rest of the varieties of *B. americana* (Morton) *s. lato* on specific level.

B. americana var. *intermedia* is characterized by a short and fairly sturdy, dorso-ventrally flattened and compressed guard; its ventral fissure is long and reaches well into the lower third or quarter of the alveolus. The bottom of the ventral fissure usually forms an angle of 30°-50° with the inner wall of the alveolus; it is either almost straight or has an S-like shape (see pl. 77, fig. 1c) in the specimens studied. Also sharply bent or rounded, concave downward bottoms of the ventral fissure have been noted in some specimens. Alveolus is deep and wide, it fluctuates between two-fifths and one-half of the total depth of the guard and the alveolar angle is from 20° to 23°. The Schatsky Index fluctuates between 4.5 and 5.5 mm. The apical end of the guard is long, acute, and almost to quite devoid of a mucro. The sculpture of the guard usually consists of relatively feeble and widely spaced vascular imprints and longitudinal striae. Often the guards become semi-smooth over part or all of the posterior half. The sculpture varies, however, from a type almost indistinguishable from that of the typical *B. americana* var. *americana* to one approaching the semi-smooth specimens of *B. americana* var. *longa* (see pl. 77, figs. 4a-4c).

The guard reproduced on pl. 77, figs. 1a-1c is herewith designated as the holotype of *B. americana* var. *intermedia* nov. var.

The guards referable to *B. americana* var. *intermedia* closely resemble those of the short, sturdy varieties of *B. americana* var. *americana* (see pl. 79, figs. 6a-c, 7) and are connected with them by numerous transitional forms. Also forms transitional between *B. americana* var. *intermedia* and the slender forms of *B. americana* var. *americana* are common in some lots. *B. americana* var. *intermedia* differs, however, from *B. americana* var. *americana* in its distinctly lanceolate shape in ventral and lateral aspects. It shows a marked contraction at about the level of the base of the ventral fissure. This contraction is followed by a gradual and even, but markedly increased expansion of the guard all the way up to its alveolar rim. This contraction and the anterior expansion of the guard are especially well marked in its lateral aspect; they result in the pronounced widening of the alveolar part of the guard which is characteristic of *B. americana* var. *intermedia* (see pl. 77, figs. 1b-1c). Also the much feebler sculpture of the surface of the guard, the lack of granulation, and the deep alveolus reaching from two-fifths to one-half of the total length of the guard distinguish *B. americana* var. *intermedia* from *B. americana* var. *americana,* although some of the forms of the latter variety may become indistinguishable from the former variety in these features. The extremely slender and distinctly mucronate forms of *B. americana,* var. *americana* like that reproduced on pl. 77, figs. 2a-2c, and on pl. 79, figs. 1a-1d, are also much more slender and longer than *B. americana* var. *intermedia,* apart from being pronouncedly mucronate and obtuse in their apical ends, which is never the case in *B. americana* var. *intermedia.* There are, however, numerous transitional forms connecting these forms with the slender representatives of *B. americana* var. *intermedia,* some of them occurring in the lot USNM 16287, together with the extreme slender forms of *B. americana* var. *americana.*

From *Belemnitella americana* var. A, the guard of *B. americana* var. *intermedia* differs primarily in its feebly lanceolate outline in lateral and ventral aspect, and in its marked dorso-ventral flattening and compression. Otherwise the two forms are very similar.

From *B. americana* var. B., the guard of *B. americana* var. *intermedia* differs in the same morphological characters as from the sturdy and short forms of *B. americana* var. *americana.*

The differences of *B. americana* var. *intermedia* from *B. americana* var. *subfusiformis, B. americana* var. *longa,* and *B. americana* var. *polita* have already been discussed.

Belemnitella americana var. *intermedia* is a rare form occurring at almost all New Jersey *Belemnitella* localities from which numerous belemnites have been studied.

Range in New Jersey—
MOUNT LAUREL: Nutt Farm.
NAVESINK: Arneytown, Nutt Farm, Cream Ridge.

Range outside New Jersey—
Chesapeake and Delaware Canal near St. Georges.

Belemnitella americana (Morton) var. A.

Plate 77, Figures 5a-5c

A single specimen of *Belemnitella* from Sewell, N. J. differs from all previously discussed varieties of *B. americana* (Morton) *s. lato* in the feeble dorso-ventral flattening and compression of its guard below the base of its ventral fissure. This results in a much lesser excess of the lateral diameter of the guard over the dorso-ventral one than in other varieties of *B. americana s. l.* The ratio, lateral diameter/dorso-ventral diameter is, in fact, only 12.0 to 10.0 at the point 23 mm. above the apical end of the guard and only 12.7 to 13.1 at the level of the base of the alveolar fissure, compared with the respective ratios of 10.3 to 8.7 and 11.5 to 12.2 for the typical *B. americana* var. *americana* specimen. In addition to the above feature the said guard is distinguished by the insignificant length of its alveolar fissure, which only amounts to about two-fifths of the depth of the alveolus, its unusually deep alveolus reaching almost one half of the total length of the guard, and in the very long and almost straight bottom of its ventral fissure resembling that of *B. praecursor* Stolley *s. lato.*

The guard is fairly sturdy and short and is comparable to those of the short and sturdy varieties of *B. americana* var. *americana* in this respect. Its surface is only moderately sculptured by the vascular imprints and longitudinal striae and is not granulated at all. In the lateral aspect the guard tapers gradually and evenly all the way from its alveolar rim to the point some 10-15 mm. above its apical end, from which the apical tapering increases markedly. The apical end of the guard is rounded and fairly obtuse but lacks a well defined mucro. The value of the Schatsky Index is about 4.5 mm.

The above discussed guard approaches most closely those of *B. americana* var. *americana* and *B. americana* var. *intermedia.* From the guards of the latter variety it differs, however, in its regular, marked, and even apical tapering in the lateral aspect, combined with its rounded and obtuse apical end, and the considerably lesser dorso-ventral flattening and compression. From *B. americana* var. *americana* the above discussed guard differs mainly in the considerably lesser dorso-ventral flattening and compression and in its deeper alveolus. At the same time the above discussed morphological characters of the guard, combined with its relatively feeble sculptured surface, ally it with such Eurasian *Belemnitella* forms as *B. praecursor* Stolley var. *mucronatiformis* Jeletzky, 1955, small unnamed variants of *B. mucronata* (Schloth.) from the zone of *B. mucronata* mut. *senior* Nowak *s. str.*, and *B. mucronata* (Schloth.) mut. *minor* Jeletzky, 1951. As a possible intermediate form between *B. americana* var. *intermedia* and *the above mentioned Eurasian Belemnitella forms this guard certainly* deserves attention. So close indeed, is its morphological similarity to some of the guards of *B. praecursor* Stolley var. *mucronatiformis* Jel., 1955 or to those of the above mentioned unnamed variants of *B. mucronata* (Schloth.) that the writer would refer this New Jerseyan guard to one of them were it not for the fact that its Schatsky Index is only 4.5 mm. This value is well below the values characteristic of the aforementioned Eurasian *Belemnitella* forms and does not differ materially from those characteristic of *B. americana* var. *americana* and *B. americana* var. *intermedia.* Therefore the Sewell guard appears to be nothing else but a peculiar morphological variety of *B. americana (s. l.)* perhaps transitional between *B. americana* var. *intermedia* and the above mentioned Eurasian *Belemnitella* forms. In this connection it is interesting to note that the Sewell guard was found alone at a locality from which no other *Belemnitella* forms were available to the writer. It has been considered preferable not to give a formal varietal name to this guard until more specimens are available and its stratigraphical relationships are clarified.

Belemnitella americana (Morton) var. B.

Plate 79, Figures 8a-8c

A single incomplete guard from an unknown locality in New Jersey differs from all other previously discussed varieties of *B. americana s. l.* in its much shorter and sturdier guard and in the very pronounced and even apical tapering of this latter in its lateral and ventral aspects. The alveolus is relatively deep, judging by its preserved lower part, its angle in the dorso-ventral plane is 18-19°. The Schatsky Index is 4.5-5.0 mm. The bottom of the alveolar fissure is slightly concave toward the apical part of the guard and short, forming a 45-50° angle with the inner wall of the alveolus. Apical end of the guard is narrow but obtuse and pronouncedly mucronate. The surface of the guard is strongly sculptured in the usual fashion and partly granulated over its anterior half. The posterior half is only very feebly sculptured, which may be partly due to its mode of preservation.

The above described guard appears to be an extreme development of the sturdy, short forms of *B. americana* var. *americana*. As such it is morphologically opposite to *B. americana* var. *subfusiformis, B. americana* var. *polita,* and *B. americana* var. *longa.* In its somewhat increased value of the Schatsky Index it also approaches *B. americana* var. *intermedia* and *Belemnitella americana* (Morton) var. A.

The writer decided not to name formally this extreme variety of *Belemnitella americana s. l.* as its only known representative is rather incomplete in its alveolar part and appears to be somewhat corroded in its apical half. Besides, its exact locality and formation are unknown. It should also be considered that in the shape of its guard the specimen here discussed is very similar to the east European *Belemnitella conica* Arkhangelsky, 1912 (see Arkhangelsky, 1912, pl. IX, figs. 20-21, pl. X, fig. 31). Although for the time being it appears inadvisable even to suggest the specific indentity of both guards, Arkhangelsky's figures being inadequate and the inner structure of his specimen being unknown, the two may yet be found to be specifically identical.

Range of B. americana s. l. in New Jersey—

MOUNT LAUREL-NAVESINK: various localities along Crosswicks Creek between Walnford and New Egypt, Arneytown, Cream Ridge, Poricy Branch near Middletown, 1.2 miles east Marlboro, Mullica Hill, Pemberton, Hurffville, ½ mile east of Woodstown, Glassboro, Sewell.

Range of B. americana s. l. outside New Jersey—

Various localities on Chesapeake and Delaware Canal in Mount Laurel-Navesink and "Red Bank" formation (See Groot, Organist and Richards, 1954) Bohemia Mills, Md.

It must be stressed emphatically that not a single guard referable to *B. americana* (Morton) *s. l.* has been seen by the writer from localities south of Maryland. The *Belemnitella* guards recorded under the name of *Belemnitella americana* (Morton) from the *E. cancellata* zone of North Carolina (see Stephenson, 1923, pp. 183, 400, locality 3449) and Mississippi (see Stephenson & Monroe, 1940, p. 108, table of the fossils of the Selma chalk, locality 6479c, etc., Macon, 4½ mi S) are the only ones known to the writer that are likely to belong to this species according to their stratigraphic position. These guards were unfortunately not available for study. All *Belemnitella* guards seen from the next younger *Exogyra costata* zone of the Southern Atlantic and Gulf States have invariably been found to belong to *B.* cf. *bulbosa* Meek and Hayden which shall be described elsewhere.

Stratigraphical Range of B. americana (Morton) S. lato

Within its known geographical range *B. americana* (Morton) *s. lato* appears to be restricted to the Navesink and Mount Laurel formations of the Monmouth Group and to the equivalent parts of the undivided Monmouth group of the State of Maryland. In this connection it should be noted that the Red Bank sand of Delaware and Maryland (see Groot, Organist, & Richards, 1954, p. 29) carrying *B. americana* (Morton) *s. l.* and other Mt. Laurel-Navesink fossils may be older than the type Red Bank sand of New Jersey and equivalent to the upper part of the Navesink formation of that state.

Age of the Belemnitella americana Zone

Within its known geographical range *Belemnitella americana s. l.* appears to have been contemporary with *Exogyra cancellata* Stephenson and *Anomia tellinoides* Morton, the two index fossils of the widespread fossil zone of the late Upper Cretaceous of the Atlantic and Gulf States (see Stephenson, 1933). The *Exogyra cancellata* zone is now thought to embrace the Mount Laurel sand as well as the Navesink marl (see Groot, Organist and Richards, 1954, pp. 43, 45) and not the Mount Laurel sand alone as it was thought earlier (e.g. Stephenson, 1933; Stephenson et al., 1942). This makes *B. americana s. l.* the third invertebrate index fossil of the *Exogyra cancellata* zone, as far as the states of New Jersey, Delaware, and Maryland are concerned. All records of *B. americana s. l.* from the younger *Exogyra costata* zone of the Carolinas, Alabama, Mississippi, and Texas appear to be due to the confusion of this species with its close ally and apparent descendant *Belemnitella* cf. *bulbosa* Meek and Hayden, 1856. It appears, therefore, reasonably certain that *B. americana* does not ascend into the *Exogyra costata* zone in the above mentioned Southern Atlantic and Gulf States.

There does not seem to be much doubt that the zone of *B. americana s. l.* is of a general Upper Campanian age in the sense of the writer (see Jeletzky, in Cobban & Reeside, 1952, pp. 1026-27). This is indicated by the fact that the *Exogyra cancellata* zone carries in Tennessee (see Wade, 1926, pp. 19-20) and in Texas (see Stephenson, 1941, pp. 17-20) the index fossils of the lower part of the *Baculites compressus* zone of the U. S. Western Interior region. Its fossil content in these States seems to be sufficiently diagnostic to suggest tentatively that it belongs to the early part of the late Upper Campanian stage and is therefore equivalent to the lower part of the *Bostrychoceras polyplocum* & *Belemnitella mucronata* mut. *minor* zone of northern Eurasia (see Jeletzky, 1951). The fossil evidence available is, however, not conclusive enough to indicate anything but the general Upper Campanian age for the zone of *B. americana s. l.* and for the Mt. Laurel-Navesink fauna in general.

Types.—*B. americana americana* New Jersey ANSP (lectotype); *B. americana subfusiformis* New Jersey ANSP 19488; *B. americana longa* Cream Ridge Geol. Surv. Canada ½; *B. americana polita* near St. Georges, Del. ANSP 2/1; *B. americana intermedia* Arneytown, N.J. ANSP 9/3.

NOTE: *Belemnites? ambiguus* was described by Morton (1834, p. 35, pl. 1, figs. 4, 5) from Timber Creek, N. J., and was also cited by Whitfield (1892, pp. 282-83). However, this is certainly not a belemnite and should probably be referred to the Alcyonarian genus *Graphularia*. (See Howell, 1947, p. 1195). The specimens are from the Vincentown formation of Eocene age. H. G. R.

THE UPPER CRETACEOUS DECAPOD CRUSTACEANS OF NEW JERSEY AND DELAWARE

by HENRY B. ROBERTS[1]

Order DECAPODA Latreille

Tribe PARANEPHROPSIDEA Beurlen

Family *Erymaidae* van Straelen

Genus *Enoploclytia* M'Coy, 1849
Subgenus *Enoploclytia* M'Coy, 1849

Enoploclytia (Enoploclytia) sp.

Plate 80, Figures 1, 2

Description.—Body of finger gently arcuate as seen from above; lateral profile straight; cross-section broadly elliptical, diminishing slightly in width toward the tip; tip and insertion unknown. Teeth erect, conical to cylindrical, higher than their basal diameter and not less than their diameter apart, alternately large and small or rarely with two small teeth between a pair of large teeth. Occludent surface of finger bounded by an impressed line of pits on either side; lateral surfaces closely and coarsely pitted, the pits slightly elongated and arranged in roughly longitudinal rows.

The figured specimen, probably a propodal finger, has five rather evenly spaced occludent teeth the tips of which are broken. Near the wide end of the finger the position of two more teeth is marked by circular depressions in the integument.

Measurements of the figured specimen: length 23.6, height at middle 6.1, thickness at middle 5.2 mm.

Remarks.—Represented by five fingers which differ from those of *Enoploclytia (Enoploclytia) tumimanus* Rathbun (1935, p. 18, pl. 1, figs. 5-7; "probably Selma Chalk": Alabama) in having much wider spaces between the teeth and fewer small teeth between the large.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits, Maple Shade.

Outside distribution.—Delaware: Merchantville formation.

Figured specimen.—WFIS No. 17081.

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[1] This study was carried out while the writer was at the Wagner Free Institute of Science in Philadelphia, Pa. His present address is United States National Museum, Washington, 25, D. C.

Subgenus *Palaeastacus* Bell, 1850

Enoploclytia (Palaeastacus) sp.

Plate 80, Figures 3-5

Description.—Dactylus straight, ovate-triangular in section, gradually tapering distally. Teeth circular in section, about equal in size and spacing, more than their diameter apart. The distance between the proximal (1st) tooth and the proximal end of the finger about equal to the space between the first and third tooth. Integument thick, studded with widely separated papillae and tubercles, the latter numerous on the upper surface of the dactylus where at least three are on the midline. The posterior tubercle of this row of three forms an equilateral triangle with a transverse row of two tubercles behind it. Articular nodes stout, conical, widely flaired at the bases and placed slightly below the upper margin of the finger.

The tip of this unique finger is lacking and most of the low subconical to dome-shaped tubercles are broken. The occludent surface has a median row of six teeth plus a tubercle which is situated to one side of the midline between the third and fourth tooth. The lateral surfaces of the finger are flattish.

Measurement of figured specimen: length 55.7, height behind proximal tooth 15.2, thickness behind proximal tooth 13.2 mm.

Remarks.—This is the second giant *Enoploclytia* that has been found in the Americas, the first being *E. (P.) walkeri* (Whitfield, 1880, p. 37, pl. 16, figs. 1 a-c; pl. 17, fig. 1 a; Upper Albian; Texas), a species with a strongly curved and tapered dactylus. The straight dactylar axis and coarse surface tuberculation of our species agree with the description of *E. (P.) imagei* M'Coy (1849, p. 332; Senonian; England); however, the dactylar teeth of M'Coy's species—which has never been figured—are said to be less than their diameter apart.

Distribution.—Delaware: Merchantville formation: Spoil bank north of Chesapeake and Delaware Canal about one-quarter mile east of Summit Bridge, Delaware.

Figured specimen.—WFIS No. 17079.

Enoploclytia subgen. et sp. indet.

Plate 80, Figure 6

A rectangular fragment measuring 30 x 40 mm., from the spoil bank near Summit Bridge, Delaware, represents the convex lateral surface of a large palm. Spinous tubercles ornament the surface and the position of the carpopropodal articulation is marked by a broad, deep groove. In the same block of clay close to the palm there is an imperfect mold of a large tubular finger. (ANSP 19734).

Tribe NEPHROPSIDEA Stebbing

Family *Nephropsidae* Stebbing
Genus *Hoploparia* M'Coy, 1849

Hoploparia gabbi Pilsbry

Plate 81, Figures 1-7

Hoploparia gabbi Pilsbry, 1901, p. 115, pl. 1, figs. 11-14.
Hoploparia gabbi, Weller, 1907, p. 846, pl. 110, figs. 12-15.
Holoparia gabbi, Pilsbry, 1916, pp. 90, 91, 361, pl. 10, figs. 1-4, 8, 9.
Hoploparia gabbi, Rathbun, 1935, p. 24, pl. 5, figs. 10, 11.
non Holoparia gabbi Davis and Lang, 1927, p. 47, pls. 2, 3.

Description.—Carapace about one and four-fifths longer than high; branchial and pterygostomial fields roughened with adpressed conical granules. Median groove of rostrum narrow, lateral carinae transversely rounded, spinulate above, and continued backward on the gastric field by two steadily diverging rows of oblique conical granules. Proximal slope of supraorbital spine long, spinulate, followed by a row of granules which parallels the row behind the lateral carina of the rostrum. Antennal field inconspicuously trilobed, the lobes convex vertically; distal edge of anterior lobe beaded, the two posterior lobes granulated medially. The antennal spine is replaced by a blunt tubercle at the antennal angle.

Postcervical groove *(c)* broader and deeper than the other carapacal grooves. Cervical groove (e-e_1) barely arcuate, rising to a point slightly below the level of the infraorbital spine. Anterior arm of hepatic groove *(b_1)* deep and straight, posterior and lower arms shallow, the latter ascending to join *(c)*. Antennal groove *(b)* angulated before the prominence omega *(φ)*, its proximal arm straight. φ equilateral, lower border marked by a shallow groove.

Abdominal terga dotted with small widely spaced punctae; pleurons roughened with crowded sockets. A broad thickened rim borders the posterior margin of each pleuron; along the upper border of the pleuron, extending forward from the rim to the distal margin, there is a rounded and closely pitted ridge.

Major chelae equal and symmetrical (WFIS 16947), elongate-elliptical in lateral profile; about one and one-fifth times the length of the carapace (WFIS 16946). Palm highest between the anterior quarter and third; outer side of upper edge armed with an arcuate row of four curved and laterally compressed spines; between spines 2 and 3 of this row but situated near the inner side of the palm there is a fifth spine similar to the other four. Lower surface of palm bluntly rounded, the distal two-thirds with a narrow median groove which continues onto the fixed finger. Fingers slightly shorter than palm; section of fixed finger obovate, concave on either side of the occludent surface except near the insertion of the finger, where it is convex. Dactylus flattened-elliptical, armed with a strong dorsoproximal spine which is in line with the row of spines on the outer side of the palm. Occludent teeth of both fingers contiguous, arranged so that the larger teeth of one finger oppose groups of smaller teeth of the other. Wrist spinous; its hinge process longer than wide, rounded apically, the longitudinal axis curved.

Measurements: length of carapace 44, length of palm 26 (WFIS 16947); length of chela 68.5, length of palm 37.5, height of palm 23.8 (WFIS 16946); length of palm 51, height 33.7, thickness 20.5 mm. (ANSP 19749).

Remarks.—The carapace of *Hoploparia gabbi* is rare and has not been described heretofore. It is distinguishable from all other Coastal Plain hoploparids by the absence of ridges and tubercles from the antennal field. Rathbun (1926, p. 187) points out that the palms suggest those of *H. tennesseensis* Rathbun; however, the palm of the latter species reaches its greatest height at the distal extremity, whereas in *H. gabbi* it is highest between the anterior quarter and third. The syntype palms are incomplete and represent small individuals. One of them (ANSP 527) bears a small spine—not present on the other 22 palms examined by the writer—near the distal margin of the uper edge.

A carapace (YPM No. 17903) from the Navesink beds at Atlantic Highlands, New Jersey, bears a strong resemblance to this species, but is too poorly preserved to permit specific identification.

Distribution in New Jersey.—Merchantville formation: A. A. Reeve pits (type locality) and Graham Brick Company pits, Maple Shade.

Formation unknown: Crosswicks.

Outside distribution.—Delaware: Merchantville formation.

Syntypes.—ANSP 527 and WFIS 5941 W.

Hoploparia gladiator Pilsbry

Plate 80, Figures 7, 8; Plate 82, Figures 1-8

Hoploparia gladiator Pilsbry, 1901, p. 116, pl. 1, figs. 15, 16.

Hoploparia gladiator, Weller, 1907, p. 848, pl. 110, figs. 16, 17.

Holoparia gladiator, Pilsbry, 1916, pp. 90, 91, 362, pl. 10, fig. 6.

Hoploparia gladiator, Rathbun, 1935, p. 24.

Description.—Carapace about twice as long as high. Rostrum half the length of carapace; rostral groove wide, broadly U-shaped; lateral carinae smooth above, triangular in section. The two rows of conical tubercles which continue the carinae backward on the gastric field are parallel to the dorsal median line of the carapace. Supraorbital spine carinated and followed by a short row of tubercles. A longitudinal row of three equally spaced conical tubercles on the antennal field. Cervical groove *(c-e₁)* broad and deep, ascending to or slightly above the inconspicuous gastroorbital groove *(d)*. Anterior and posterior arms of the hepatic groove *(b_1)* shorter than the distinctly oblique inferior arm. *Prominence omega (φ) an acute triangle with apex pointing upward* and slightly backward.

Palms of the first pair of chelipeds almost three times longer than their distal height; the one palm of the pair rectangular in lateral profile, the other subcuneiform, otherwise the two are similar. Inner and outer surfaces equally and evenly convex, each with a row of 4 or 5 compressed elongated teeth along the median convexity; a similar row of 4 teeth on the subacute upper edge. Lower edge transversely flat and narrow, bounded laterally by two parallel rows of minute, conical tubercles which point obliquely forward and downward. Fingers slender; the fixed finger pyriform in section near the insertion, a wide hiatus separating the anterior and posterior teeth. On the subcuneiform hand, the proximal teeth of the fixed finger are large, quadrate and contiguous. On the rectangular hand, they are small, circular and separated. Dactylus broadly elliptical, the occludent surface not set off from the lateral surfaces by grooves or angles. Merus elongated, produced into a long spine at the outer distal margin.

Integument polished; minutely punctate when examined under the lens.

Palms under 25 mm. in length have a granular surface, an arcuate lower edge, and are proportionately higher and shorter than large palms. Apparently they are major palms, but their morphological relations will be uncertain until the second and third pair of chelipeds of the species become known.

Measurements: length of rostrum 19, length of carapace 40, height of carapace 21 (WFIS 17085); length of palm ca. 40, anterior and posterior height 14.5, 11.2, thickness 9 (WFIS 17086); small palm length 19, anterior and posterior height 7 and 6, thickness 5 mm. (WFIS 17087).

Remarks.—The elongated palms and fingers, the prominent tubercles on the antennal field, and the acute rostral carinae sharply separate this species from *H. gabbi,* with which it occurs in the Merchantville formation.

Both of the syntype palms are of the rectangular form. The parallel rows of tubercles on their lower edges are worn but can be seen with a lens.

Distribution in New Jersey.—Merchantville: A. A. Reeve pits (type locality) and Graham Brick Company pits, Maple Shade.

Outside distribution.—Delaware: Merchantville formation.

Syntypes.—WFIS 10120.

Hoploparia sp.

Plate 82, Figures 5, 6

Description.—Palm short and thick, obovate in section, greatest height in the distal quarter. Upper surface broadly rounded from side to side, oblique and moderately arched in profile; a row of three strong curved spines on its outer side, a single spine on the inner side between spines 1 and 2 of the outer row. Inner surface and the lower half of the outer surface ornamented with large flattened dome-shaped tubercles; on the upper half of the outer surface the tubercles are much smaller and farther apart. Lower edge narrowly rounded and without spines. Fixed finger triquetrous in section, basal height about two-fifths the distal height of the palm; occludent surface broadly arched transversely and bearing large contiguous teeth, which are wider than long, near the interdigital sinus.

Measurements of figured specimen: length of palm 50, distal height 40, thickness 27, basal height of fixed finger 18 mm.

Remarks.—Although the age of this species is not certainly known it is here regarded as Late Cretaceous because of its similarity to *H. georgeana* Rathbun (1935, p. 25, pl. 9, figs. 9-12), from the Monmouth beds in Maryland, differing from the latter in the absence of spines on the lower edge of the manus. The original Yale Peabody Museum label of the figured specimen reads: "K. Rancocas. Hornerstown, N. J. Old collection." The matrix is a light gray glauconitic clay which could have come either from the Navesink or the Hornerstown formation. A second large palm (YPM No. 442, old coll.), from Hornerstown, in matrix similar to the preceding, belongs to this species.

Distribution in New Jersey.—Formation unknown: Hornerstown, and Cream Ridge Marl Company's ditch (type locality), Hornerstown.

Figured specimen.—YPM 17905.

Genus *Oncopareia* Bosquet, 1854

Oncopareia sp.

Plate 80, Figures 11-14

Description.—Dactylus smooth, slightly arcuate, shallowly concave behind the last (proximal) occludent tooth; elongate-ovate in section anterior to the concavity and about twice as high as the thickness; triangular in section behind the concavity, where it flairs vertically and horizontally, and has the lower half of the lateral surfaces excavated before the proximal margin. A row of punctures on each side of the sharp subcarinate upper edge, the punctures on the inner side nearer to the crest, closer together, and extending farther postad than those on the outer side. The longitudinal median row of punctures on the inner surface of the dactylus does not reach the concavity behind the proximal occludent tooth. Occludent teeth slightly elongated, irregularly spaced, and connected by a raised median line. Three to four small teeth are intercalated between teeth that are conspicuously stouter.

Measurements of figured specimens: length 16.4 mm., height at proximal tooth 1.9 mm., thickness at proximal tooth 1.1 mm., 23 teeth in 11 mm. (WFIS 17093); length 12.4 mm., height 1.9 mm., thickness 0.9 mm., 17 teeth in 8.5 mm. (WFIS 17094).

Remarks.—The smooth concave area behind the proximal occludent tooth serves to distinguish the dactylus of this species from that of *O. coesfeldiensis* (Schluter, 1862, p. 728, pl. 13, figs. 3, 6; Senonian; northwestern Germany).

A specimen from the Matawan beds at the C. and D. Canal, in Delaware, identified as a fish spine by Berry (1916, p. 904, pl. 8, fig. 10) is in fact an *Oncopareia*—perhaps the fixed finger of the present species.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits, Maple Shade.

Figured specimens.—WFIS 17093, 17094.

Tribe THALASSINIDEA Dana

Family *Callianassidae* Spence Bate

Genus *Protocallianassa* Beurlen, 1930

Protocallianassa mortoni (Pilsbry)

Plate 81, Figure 8; Plate 83, Figures 1-6

Callianassa mortoni Pilsbry, 1901, p. 112, pl. 1, figs. 1-7.

Callianassa conradi Pilsbry, 1901, p. 114, pl. 1, figs. 8-10.

Callianassa mortoni, Weller, 1907, p. 849, pl. 111, figs. 1-15.

Callianassa conradi, Weller, 1907, p. 851, pl. 110, figs. 18-22.

Callianassa mortoni, Pilsbry, 1916, p. 363, pl. 11, figs. 1-3.

Callianassa mortoni, var. *marylandica* Pilsbry, 1916, p. 366, pl. 11, figs. 9, 10.

Callianassa conradi, Pilsbry, 1916, p. 366, pl. 10, fig. 5.

Callianassa conradi var. *punctimanus* Pilsbry, 1916, p. 368, pl. 11, figs. 4, 5.

Callianassa clarki Pilsbry, 1916, p. 368, pl. 11, figs. 6-8.

Callianassa mortoni, Rathbun, 1926, p. 188, pl. 67, figs. 1, 2, 4-9; 1935, p. 29.

Callianassa mortoni var. *punctimanus* (Pilsbry) Rathbun, 1935, p. 30.

Protocallianassa mortoni (Pilsbry), Mertin, 1941, pp. 208, 209.

Description.—Major palm of the first pair of chelipeds smooth, rectangular, lower proximal angle narrowly rounded, upper and lower edges acute, closely and minutely crenulated and bordered on either side by a row of sockets. Upper edge very oblique, trending inward from front to back almost cristate and strongly deflexed at the proximal angle. Outer surface more convex than the inner, abruptly depressed before the oblique posterior margin and with a papillose prominence high on the palm near the depression. Below the prominence a curved row of four papillae descends to the root of the fixed finger; above the prominence a horizontal row of 3—rarely 4 or 5—papillae extend forward to the distal margin of the palm. Two papillae situated near the median line mark off the inner surface longitudinally into thirds.

Fixed finger curved inward, its lateral angles and the acute crenulated lower edge bordered by sockets. On the occludent surface of the fixed finger there is a low dentelated carina which bears a blunt median tooth. Dactylus suddenly attenuated at the tip, which is bent downward at the right angle to the occludent margin; on the occludent surface behind the tip there is a prominent notch followed successively by a dentelated ridge, a hiatus, and a low proximal tooth. The tips of the fingers cross when closed, that of the fixed finger outermost and engaging the notch behind the tip of the dactylus.

Wrist more than three-quarters the length of the palm; upper and lower edges acute and crenulated; a forward pointing spine just below the upper distal angle. On the outer surface near the lower distal corner there is a short oblique groove with beaded margins. Merus slightly shorter than the wrist, lower margin straight posteriorly, upper margin convex. Outer surface transversely angulated, coarsely papillated along the angulation and provided with a large tubercle behind the distal articular node. Lower edge of merus acute and serrate. Ischium about three times longer than its distal height; upper and lower margins slightly convergent proximally, the upper margin with a serrate distal lobe; outer surface moderately convex in a vertical direction and with a longitudinal sulcus below the median line.

Minor palm of first pair of chelipeds squarish; posterior margin oblique in lateral profile, the lower corner rounded; upper and lower edges acute, crenulate and erect throughout their entire length. Outer surface slightly more convex than the inner, shallowly depressed longitudinally along the upper quarter, the depression marked with 4 to 6 rather evenly spaced papillae. From the proximal papilla of this row a curved row of 3 to 6 papillae descend to the root of the finger. Two papillae near the median line of the inner surface divide the palm into thirds longitudinally. Fixed finger slightly shorter than palm, slender, the lateral edges beaded and socketed; outer edge intersected anterior to the half-length by a sharp oblique carina which occupies the proximal portion of the occludent surface. Upper surface of dactylus papillated. The papillated strip narrowing distally to a single row of papillae. Outer surface of dactylus with two subparallel grooves that are separated posteriorly by a double row of papillae. The lower groove bears a line of prominent sockets. Lateral margins of the otherwise smooth occludent surface beaded. Wrist shorter and higher than the major wrist.

Measurements: length of propodus 25.1 mm., length of palm 19 mm., height of palm 12.3 mm., thickness 6.4 mm. (ANSP 19669, figured syntype) ; length of propodus 22.7 mm., length of palm 15.6 mm. height of palm 13.4 mm. thickness 6.2 mm. (YPM 126) ; length of palm 20 mm., length of wrist 17.5 mm. length of arm 13 mm. (WFIS 10095).

Remarks.—Protocallianassa mortoni is the commonest Upper Cretaceous decapod in New Jersey. The palms vary considerably in surface texture, number and arrangement of the papillae and sockets and in the ratio of the length to the height. Decorticated specimens may look quite different from those retaining either the inner or the outer layer of the integument.

In spite of these differences, two races of the species can be distinguished: race *a*—height to length ratio varies from 1:1.32 to 1:1.62 for major palms, and from 1:1.1 to 1:1.28 for minor palms; race *b*—ratio for major palms is 1:1.19 to 1:1.25, and 1:1.35 to 1:1.48 for minor palms. Race *a* is the commoner of the two, at least in New Jersey where it is particularly abundant in the Merchantville formation. The syntype hands described by Pilsbry (1901, pl. 1, figs. 1-4, 8-10) belong to race *a*. Sixteen of the 442 New Jersey and Delaware specimens studied by the writer are race *b* individuals, as are the following:

1) broad palms from New Jersey, Delaware and Maryland cited by Pilsbry (1916, p. 365) ;

2) holotype of *Callianassa clarki* Pilsbry (1916, p. 368, pl. 11, fig. 8) ;

3) specimens figured by Rathbun (1926, pl. 67, figs. 1, 4-9) from Coon Creek beds in Tennessee.

Both races range from Merchantville age to Tinton age. Although race *b* hands are rare in New Jersey and Delaware, to the south in Tennessee and Mississippi they appear to be the predominant form.

Rathbun's (1935, p. 30) record of this species in the Woodbury clay at Lorillard is based on an indeterminable impression of a small hand (NJ St. M No. 9511).

The figured type of *Callianassa conradi* Pilsbry is in the collection of the Wagner Free Institute of Science (No. 5478W), not in the New Jersey State Museum as reported by Rathbun, 1935, p. 30.

Distribution in New Jersey.—Merchantville formation: Bordentown (12a), Lenola (15), Maple Shade (16). Wenonah formation: Crawford's Corner (34), Marlboro (35). Mt. Laurel/Navesink formation: Atlantic Highlands (37) ; Bruere's Pit, S. of Walnford; Cream Ridge (45) ; Middletown (Credner, 1870, p. 242) ; Mullica Hill (53) ; near New Egypt (48). Tinton formation: Beers Hill (62), Tinton Falls (63).

Formation unknown: Crosswicks, Hornerstown, Timber Creek.

Outside distribution.—Delaware, Maryland, Tennessee, Kansas, Georgia, Alabama, Mississippi, Arkansas, and Texas. Matawan and Monmouth group equivalents.

Syntypes.—ANSP No. 19669, WFIS Nos. 4059 W, 5478 W.

Protocallianassa praecepta Roberts n. sp.

Plate 80, Figures 9, 10; Plate 83, Figures 7-15

Callianassa sp. indet. Pilsbry, 1916, p. 369, pl. 10, fig. 7.

Description.—Major palm polished, length about one and two-fifths times the height, lateral profile of posterior margin straight and erect. Outer surface more convex than the inner and rather suddenly depressed along a posteriorly concave line situated immediately in front of the carpopropodal joint. A short narrow carina arises abruptly behind and below the interdigital sinus and extends to the upper outer margin of the fixed finger; arising just below the first carina, a second carina curves downward and forward, becoming continuous with the outer angle of the finger. Upper surface of palm straight, widening distally, the crest medial and bent slightly inward. Except at the distal corner, where it is sharp, the upper edge is acute but bluntly rounded along the crest. Lower edge straight, the erect raised line along its crest crenulated. On the outer side of the palm, close to the lower margin, there is a row of widely spaced sockets; on the inner side, below the upper edge, there is a longitudinal sulcus bearing 8 to 12 sockets. Fixed finger a little less than half as long as the palm, the carina on the occludent surface interrupted at the middle by a sharp deflection.

Minor palm about 1 4/5 times longer than high, subcuneiform, smooth, outer surface depressed near the joint as in the major palm. Fixed finger very slender, occludent surface without a tooth or a carina, shorter than the heavier dactylus. Upper edge of palm straight, the raised crestal line trending toward the inner side from back to front and not reaching the distal corner. A row of 9 to 12 sockets lie close to the crest on the inner side. Lower edge sharp, a row of sockets on either side of and very close to the raised and crenulated crestal line. This raised line dies out on the lower surface of the fixed finger where it is replaced by a row of 3 to 5 sockets.

Measurements: length of holotype propodus 12.1 mm., length of manus 8.4 mm., height 6.1 mm., thickness 2.8 mm. (WFIS 17099); length of manus 10.6, height 6.2, thickness 3.1 mm. (ANSP 20033, minor manus).

Remarks.—The type series consists of 12 major hands including the holotype right propodus, and 19 minor hands including Pilsbry's specimen of *Callianassa* sp. indet. (Pilsbry, 1916, p. 369, pl. 10, fig. 7), which unquestionably belongs to this species. The holotype is less than average size but it is the most complete and best preserved major hand available at present.

It is not likely that this species will be confused with *Pr. mortoni:* the posterior margin of both the major and minor palm of *Pr. praecepta* is straight and almost vertical. In *Pr. mortoni* this margin is oblique and strongly lobed.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits (type locality), Maple Shade.

Outside distribution.—Delaware: Merchantville formation.

Holotype.—WFIS 17099.

Protocallianassa cliffwoodensis Roberts n. sp.

Plate 84, Figures 1-6

Description.—Front arostrate, triangular, diverging about 85°, apex more narrowly rounded than the lateral angles; frontal rim low-convex near the margin, concave where it borders the dorsal plate. Dorsal plate obovate, moderately arched from side to side; anterior margin rounded, mucronate medially, the mucron fused with the frontal rim.

Major manus quadrate; upper margin moderately convex, narrowly rounded at the posterior angle; posterior margin arcuate and without a lobe at the hinge. Fixed finger straight, elongate-triangular, about half as long as the manus. The outer (?) surface of the fixed finger bears a row of 9 to 12 large sockets. The occludent surface is armed with a high, sharp carina. A broad sulcus which narrows distally extends from the base of the fixed finger almost to the tip. Dactylus longer than the fixed finger, medially costate on the outer (?) side, and having a row of sockets between the costa and the lower margin. Carpo-propodal articulation oblique, the lower extremity advanced beyond the upper. Carpus about twice as high as long, its lower distal angle acute. Outer (?) surface of merus vertically angulated and with a longitudinal median sulcus above the greatest convexity. The ischium bears a deep longitudinal submedian groove.

The minor cheliped differs from the major as follows. The fixed finger is bent downward and is slightly longer than the manus, inferior margin of manus is strongly convex, carpus only slightly shorter than high and lower distal angle approximately a right angle.

Pleural flaps of the four posterior abdominal somites large, oblong-elliptical, and separated from terga proximally by oblique incisions. Outer uropods costate.

Measurement in mm.—length of dorsal plate (incomplete) 15, width 10; length of major manus 15, height 17; length of major carpus 7.5, height 15; length of major merus 10 (holotype, PU 78452). Length of major propodus 44; length and height of manus each 28; length of carpus 11, height 25 (PU 78453). Length of minor propodus

37; length of manus 16, height 18; length of carpus 10, height 12 (PU 78454).

Remarks.—Differs from *Pr. aquilae* (Rathbun, 1935, p. 31, pl. 7, figs. 1-5) from the Eagle Ford formation in Texas, in having the major palm shorter and without teeth along the upper edge and in the much longer and slenderer fingers of the minor hand. The upper and lower margins of the major and minor hands of *Pr. praecepta* are almost straight whereas in the present species they are arched. Also, the fixed finger of the minor hand of *Pr. praecepta* is directed forward. In *Pr. cliffwoodensis,* it bends downward and tapers rapidly.

Distribution in New Jersey.—Magothy formation: Cliffwood.

Holotype.—PU 78452.

Tribe PAGURIDEA Henderson

PAGURIDEA fam. indet.
Genus *Palaeopagurus* van Straelen, 1925

Palaeopagurus pilsbryi Roberts n. sp.

Plate 85, Figures 1-4

Description.—Palm subrectangular, somewhat swollen, proximal corners abruptly angled, posterior margin broadly lobed at the hinge. Outer surface is evenly convex lengthwise, vertically angulate at the lower third and less convex above than below the rounded angulation. On the inner face an oblique longitudinal convexity rises at the dactylar hinge node and extends postad to a smooth lunate groove before the proximal margin. The palm is faceted below this convexity, concave above it. Upper edge acute, almost straight, its crest bluntly rounded and closely granulated, the granules becoming larger on the proximal two-thirds where they form a single irregular row. Lower edge sigmoidal, subcarinate; the crest deflected inward distally and not visible on the fixed finger from below. Upper margin of fixed finger almost straight on the outer side, concavely arcuate on the inner; tip blunt, curved inward and upward. Dactylus triangular in section near the articulation, becoming elliptical at the tip; outer surface broadly channeled longitudinally below the coarsely papillose upper margin. The closed fingers have a slight gape posteriorly. Chela covered with acorn-shaped granules with roughened tips. On the outer surface the granules are small and close together, becoming larger along the upper margin. On the inner surface they are coarser and farther apart but become more crowded toward the distal end.

Palms less than 9 mm. in length have a single row of granules extending the full length of the sharp upper edge. The lower edge is clearly carinate under the base of the fixed finger.

Measurements of holotype: length of propodus 20.9, of manus 14.7; height of manus 11.9, thickness 8.9 mm.

Remarks.—The type series consists of 6 left major propodi, one of which has the dactylus in place and complete, and a pair of fingers from a left major chela. An elongated right hand having a steeply inclined anterior margin (ANSP No. 19731) from the Merchantville formation at Summit Bridge, Delaware, may be the minor hand of this species, but it is too distorted to permit an accurate diagnosis.

Related to *P. cretaceus* Mertin (1941, p. 209, pl. 5, figs. 13, 14, text-figs. v, w), a smaller species with a relatively longer hand, from the Upper Emscherian and Lower Senonian of northwestern Germany. *Palaeopagurus banderensis* (Rathbun, 1935, p. 39, pl. 9, figs. 7, 8. Glen Rose formation, Lower Cretaceous, Texas) has a lateral profile resembling that of our species, but has the cutting edge of the fixed finger strongly arched.

This species is named for Dr. Henry A. Pilsbry in recognition of his pioneer work in the study of New Jersey fossil decapods.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits (type locality), Maple Shade.

Outside distribution.—Delaware: Merchantville formation.

Holotype.—WFIS 17095.

Tribe SCYLLARIDEA Stebbing

Family *Palinuridae* White

Genus *Archaeocarabus* M'Coy, 1849

Archaeocarabus ? whitfieldi (Pilsbry)

Plate 85, Figures 5, 6

Cancer? whitfieldi Pilsbry, 1901, p. 118, pl. 1, fig. 18.

Archaeocarabus? whitfieldi (Pilsbry). Rathbun, 1935, p. 38, pl. 10, figs. 11, 12.

Description.—"Apparently the right palm of a large specimen, but crushed and narrowed laterally. It is thickest in the upper part, and the upper surface is well defined; this is furnished with three longitudinal rows of stout conical spines, one on each margin and one through the middle; the outer row consists of six spines, the two distal small, the row curving downward at middle, the spines outstanding; the inner row also curved downward consists of six larger spines, the proximal one the largest, all outstanding; five, or perhaps six, erect spines in the shorter median row. On the flat outer surface a row of four rather small spines a little above the middle and subparallel to the marginal row. At the proximal end near the top two small spines. On the lower distal quarter two isolated spines. Lower surface about half as wide as upper, rounding from one side to the other and showing, though much broken, traces of two rows of spines; two spines remain of the outer row and two of the inner. Much of the inner surface is lacking; there is a triangle of three small spines at the upper proximal end, and a single spine near the lower distal corner. General surface smooth or nearly so.

"The fingers are absent, but their position is shown in figure 12. The propodal finger is short and projects directly distad. The dactylus is attached below the top of the manus and folds transversely against the distal end of it." (Rathbun)

Measurement of holotype: length 36.4, greatest height excluding spines 15.9 mm.

Remarks.—The present species, *A? whitfieldi* (Pilsbry) and two other spiny-handed species, *A? gardnerae* Rathbun (1935, p. 75, pl. 16, figs. 19-21) and *A? vanuaensis* Rathbun (1945, p. 373, pl. 54, figs. A, B) have been assigned to M'Coy's genus *Archaeocarabus* by Rathbun. Inasmuch as the type species of this genus, *A. bowerbanki* M'Coy (1849, p. 174, text fig., Eocene, England) has smooth elongated chelae, the correctness of placing these spiny-handed species in *Archaeocarabus* is extremely doubtful.

A? whitfieldi differs from other spiny-handed palinurids in having *three longitudinal rows of strong spines on the upper surface of the* manus. It is known only from two palms labelled "Burlington Co., N. J." in the collection of the Philadelphia Academy. Weller's (1907, p. 55) record of the presence of *A? whitfieldi* in the Merchantville formation at Maple Shade needs confirmation. If his specimens (or specimen) are in fact extant, they have neither been figured or described, nor can they be found.

Distribution in New Jersey.—Formation unknown:
"Burlington Co."

Holotype.—ANSP 4693.

Genus *Linuparus* White, 1847
Subgenus *Podocratus* Geinitz, 1850

Linuparus (Podocratus) richardsi Roberts n. sp.

Plate 86, Figures 1-3

Description.—Rostrum strongly advanced, about three-quarters as long as the basal width, terminal notch shallow. Rostral horns parallel, triangular in cross-section, the inner surface concave vertically, upper edge rounded and unarmed. Frontal margin exterior to the rostrum concave, with a carinate rim. The chord subtending the extremities of *the frontal margin forms a right angle with the longitudinal axis of the* body. Distal angle of antennal keel a blunt spine which reaches forward to the level of the insertion of the rostral horns. Teeth of gastro-orbital ridges compressed, triangular with long posterior slopes, each of the first four teeth progressively larger and more widely spaced from front to back, the fifth tooth much smaller than the others and placed close to the cervical groove. The first tooth is twice as far from the rostral horn as from the second tooth. Cephalic arch armed with eight punctulate, inflated-conical spines arranged as follows: one behind each rostral horn, a median spine between the bases of the rostral horns, and five spines forming a slender triangle pointing distad. The apex of this triangle is situated on the midline at the anterior third of the cephalon, the base is just before the cervical groove. Opposite the apical spine of the triangle and a little more than halfway between it and the lateral edge of the carapace, an arcuate row of granules arises and extends backward almost to the posterolateral corner of the cephalon. Cervical groove transverse medially, lateral arms oblique and almost straight. Median keel of thorax more elevated than the lateral keels, the latter bearing 12 to 14 spines of which the distal one is the largest. An oblique arcuate keel which bears a single row of transverse, adpressed spinules is situated on the vertical wall of the thorax directly behind the cervical groove. The anterior extremity of this keel is in line with the antennal keel. Ground surfaces of carapace minutely punctate as seen under a lens; distant, conical-to acorn-shaped granules dot the thorax and there are a few scattered granules on the cephalon near the cervical groove.

Measurements of holotype: length of carapace not including the rostrum 52; length of rostrum (tip missing) 7; length of cephalon 24, width, 25.7; width of thorax 31 mm.

Remarks.—Closely related to *L. (P.) watkinsi* Stenzel (1945, p. 408, pl. 34, figs. 5-8; pl. 45, figs. 1, 2; text fig. 4. Brinton formation, Eagle Ford group, Texas) but differs from the latter in having a much shallower terminal rostral notch, unarmed rostral horns, and one (instead of two) spines behind each rostral horn.

As the posterior portion of the cephalon of *Linuparus (Eolinuparus) kleinfelderi* Rathbun (1931, p. 161, Merchantville formation; Staten Island, New York) is without spines, it is not likely to be confused with our species, although both species occur in the Merchantville formation.

This is the second species of *Linuparus* that has been found in the northeastern United States. It is named for Dr. Horace G. Richards.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits (type locality), Maple Shade.

Holotype.—ANSP 19739.

Tribe BRACHYURIDEA Glaessner

Family *Dynomenidae* Ortmann
Genus *Xanthosia* Bell, 1863

Xanthosia elegans Roberts n. sp.

Plate 89, Figures 1, 3

Description.—Carapace nearly twice as wide as long; granulation of the dorsal surface coarser on the protogastric field and branchial ridges than elsewhere; ventral surface minutely punctate; proximal half of posterolateral margin concave. Frontoorbital distance about one-half the carapacal width. Front low-triangular, moderately deflexed, its dorsal sulcus broadly V-shaped and continued postad between the submedian pair of epigastric tubercles to the base of the mesogastric process. Orbit about half the width of the front, subcircular and oblique; superior margin curved upward to form a concave rim which bears a stout triangular tooth near the inner angle and a closed fissure near the outer; inferior margin bifissured. Anterolateral margin thin, crenulate; teeth triangular with rounded apices; the first (outer orbital) tooth hollowed dorsally, the others bisected by a dorsal ridge. The proximal tooth is situated posterior to the widest part of the carapace. Mesogastric process long and slender, reaching forward to a point slightly beyond the level of the inner orbital angles and clearly separated from the distal half of each protogastric lobe by a broad sulcus. Proximal half of each protogastric lobe swollen parallel to the cervical groove. Cardiac field oval and domed. Urogastric and metagastric fields separated by an impressed line which bears a submedian pair of deep punctures. Branchial groove broad, deep and transverse, intersecting the lateral margin of the carapace at a point opposite to the urogastric punctures and bordered above and below by broad ridges. Inner angle of the branchial field elevated into a low boss from which two subparallel ridges extend obliquely postad to the lateral margin of the carapace. The inner ridge intersects the lateral margin at the middle. The outer ridge is situated halfway between the middle of the lateral margin and the proximal lateral tooth. Subhepatic suture and edge of mouthfield each marked by a raised line. Subhepatic surface ornamented with two elongated tubercles which lie side by side and subparallel to the subhepatic suture.

Measurement of holotype: length 10.4, width 19.4, depth 4.4, frontoorbital distance 9 mm.

Remarks.—Resembles *X, gibbosa* Bell (1863, p. 3, pl. 1, figs. 4-6) a species with larger orbits and less strongly developed grooves and ridges, from the Upper Greensand (Cenomanian) of England.

Although none of the three specimens examined has the edge of the anterolateral margin intact, the portion of this margin lying between the outer orbital tooth and the proximal tooth appears to have been trilobed.

The description of the frontal region is based on ANSP 20028, from Maple Shade, New Jersey.

Distribution in New Jersey.—Merchantville formation: Maple Shade.

Outside distribution.—Delaware: Disposal area north of C. and D.

Canal about ¼ mile east of Summit Bridge (type locality); Merchantville formation.

Holotype.—WFIS 17108.

Family *Thelxiopeidae* Rathbun

Genus *Homolopsis* Bell, 1863

Homolopsis atlantica Roberts n. sp.

Plate 89, Figure 4

Description.—Carapace strongly areolated; median portion of gastric field separated from the protogastric lobes by distinct grooves; metagastric region transversely diamond-shaped, wider than the length of the narrow mesogastric process. Urogastric field very broadly V-shaped; carinate, the carina interrupted medially by a shallow sulcus. Cardiac field trapeziform, narrower before than behind, lightly divided longitudinally into two inflated lobes having granulate summits and broadly separated from the urogastric field by the cervical groove. Each branchial area marked by two strong ridges—mesobranchial and metabranchial—and a large oval tubercle. The tubercles are transverse and are situated opposite to the widest part of the metagastric region. The mesobranchial ridge is parallel to the urogastric carina and extends laterally to a point directly behind the middle of the oval tubercle. The metabranchial ridge arises opposite the highest portion of the cardiac field and trends outward and slightly postad toward the posterior angle of the carapace. On each side of the carapace, anterior to the cervical groove, the areolar tubercles are arranged as follows: one behind the outer angle of the orbit; three in the middle of the protogastric lobe forming an equilateral triangle, the proximal two lying roughly parallel to the groove between the meta- and protogastric areas; one at the lower inner angle of the protogastric lobe; and a large median metagastric tubercle with a submedian pair of short, transverse ridges behind it. Slightly exterior to the postorbital tubercle and a little more than halfway between it and the cervical groove there is a small tubercle. Summits of all ridges and tubercles granulate. Ground surface smooth to the eye, minutely punctate under the lens.

Measurement of holotype: length 20, width 20 mm.

Remarks.—Based on a unique carapace; the peripheral margin including the rostrum, epibranchial and hepatic lobes broken off. Superficially it resembles *H. punctata* Rathbun (1917, p. 388, pl. 33, figs. 1-3; Pierre shale, South Dakota) in which the tubercles and ridges are less strongly developed, the cardiac field ovate-triangular and longer than wide, and the mesogastric process provided with a tubercle.

Distribution in New Jersey.—Merchantville formation: Maple Shade (type locality).

Holotype.—WFIS 20029.

Homolopsis dispar Roberts n. sp.

Plate 89, Figure 5

Description.—Carapace broadly triangular before the epibranchial angle, quadrate behind it. Rostrum sloped steeply downward, lateral profile straight, dorsal surface hollowed transversely, tip horizontal and bifid. The stout tubular terminal horns of the tip diverge about 65°. The posterior extremity of the cleft between the horns is roundly concave and as wide as the mesogastric process. Hepatic facet steeply inclined, separated from the epibranchial lobe by a shallow vertical sulcus. The lower distal angle of the hepatic facet is armed with a stout tubercle having a smaller tubercle behind it. Orbits very oblique, their superior margins each armed with a strong spine at the inner angle and a small tubercle at the outer angle behind the margin. Each protogastric lobe bears two large areolar tubercles which point laterally to the epibranchial angle; between these tubercles there is a shallow groove with a small tubercle at each end. Mesogastric process unarmed; metagastric region subtriangular, slightly wider than long and armed with a large tubercle at the middle. The groove separating the metagastric from the urogastric region is bordered by two submedian pairs of short ridges, one along its anterior, the other along its posterior margin. The inner extremities of each of these four ridges terminate on a small tubercle, the four tubercles being arranged in a rectangle that is slightly wider than long. Cardiac boss low, trapeziform, fused laterally at its widest part with the metabranchial ridges. Anterior to the mesobranchial ridge, lying along the outer half of the latter, there is a short transverse ridge which bears a row of four granules; these two ridges converge laterally and terminate at the inner posterior angle of the epibranchial lobe. Dorsal surface of epibranchial lobe drawn upward into a large conical boss which is directly opposite the metagastric tubercle; anterior surface of the lobe steeply inclined; lateral surface vertical. Lateral margin of branchial region notched by the two branchial grooves which continue downward and slightly forward on the vertical branchial wall. Between the notches there is a large marginal tubercle and behind the proximal notch are at least two tubercles (the posterior extremity of the lateral margin is missing). Ground surface of carapace smooth; summits of ridges smooth or with an occasional small granule.

Measurement of holotype: length of carapace as broken 21; width 21 mm.

Remarks.—I have placed this species in the genus *Homolopsis* even though the rostrum is bifid. It is distinguishable from the preceding species, *H. atlantica* Roberts (*supra*, p. 179), of which the rostrum is unknown, by the triangular shape of the metagastric region and the smooth, narrow branchial ridges. The tip of the rostrum and the left rostral horn were freed from the matrix after the plate figure had been prepared.

Distribution in New Jersey.—Merchantville: Maple Shade.
Holotype.—ANSP 20030.

Family *Calappidae* Dana
Genus *Necrocarcinus* Bell, 1863

Necrocarcinus rathbunae Roberts n. sp.

Plate 85, Figure 12; Plate 87, Figures 1, 2

Description.—Carapace subhexagonal, moderately arched from front to back and from side to side; anterolateral margins each set with six blunt conical tubercles (including the outer orbital tooth) of which the distances between the first (outer orbital) and second, and between the fifth and sixth, are equal and twice as great as the distances between each of the four middle tubercles; posterolateral margins straight, convergent posted, each with a blunt conical tubercle behind the epibranchial angle. Orbits directed upward and outward, their prominent rims confluent with the concave lateral rims of the rostrum. Dorsally the rostrum is shallowly channeled and has a low median carina that does not quite reach the expanded tip. The row of seven tubercles crossing the distal quarter of the carapace is convex anteriorly. The row includes a very small median tubercle on the mesogastric field; two tubercles on each protogastric lobe—the exterior tubercle small and with a small tubercle halfway between it and the orbit, and a small tubercle in the middle of each hepatic lobe. The inner protogastric tubercle is closer to the outer than to the mesogastric tubercle. Four median tubercles are arranged in a longitudinal row behind the mesogastric tubercles: one is metagastric, one is urogastric, and two are cardiac. The first three tubercles are about equally spaced, the fourth is much smaller than the others and placed very close to the third. The anterior cardiac and the urogastric tubercles are larger than the other carapacal tubercles. There is a longitudinal row of two tubercles on the middle of each branchial field, the anterior tubercle of the row being opposite the median portion of the cervical groove. A conical tubercle, which is small but distinct, stands on each epibranchial lobe close to the lateral margin of the carapace. Dorsal surface of carapace covered with small granules which are crowded on the summits of the areolar tubercles, one to two times their diameter apart elsewhere.

Measurement of holotype: length of carapace (posterior margin broken) 15, greatest width 15.6, frontoorbital width 8.8 mm.

Remarks.—The tubercles of this species are much more strongly developed than those of *N. pierrensis* (Rathbun 1917, p. 389, pl. 33, figs. 4, 5; Mobridge member, Pierre shale, South Dakota) and the row of tubercles which crosses the distal portion of the carapace is convex forward. In *N. pierrensis* this row is concave forward.

Two specimens (NJSM 9517) of this species from Lorillard, New

Jersey, erroneously identified with *N. pierrensis by* Rathbun (1935, p. 45, pl. 12, fig. 5) clearly show that the row of gastric tubercles is convex forward and that the uro- and metagastric tubercles are much more strongly developed than in *N. pierrensis.*

Distribution in New Jersey.—Woodbury formation: Lorillard.

Outside distribution.—Delaware: Merchantville formation. Spoil bank north of C. and D. Canal about one-quarter mile east of Summit Bridge, Delaware (type locality).

Holotype.—WFIS 17078.

Genus *Paranecrocarcinus* van Straelen, 1936

Paranecrocarcinus gamma Roberts n. sp.

Plate 85, Figures 7, 8, 11

Description.—Carapace subhexagonal; deep in a vertical direction; plane of dorsal surface flattish. Frontoorbital distance about one-half the carapacal width. Orbits almost transverse, slanted upward, ocular rim broad, convex, curving upward and outward from the orbit. Anterolateral margin deeply concave in lateral profile, provided with four teeth behind the outer orbital angle. Epibranchial tooth conical and blunt, directed obliquely upward and forward and situated twice as far from the fourth anterolateral tooth as the latter is separated from the third anterolateral tooth. Second, third and fourth anterolateral teeth spaced equally. Anterior half of posterolateral margin armed with three teeth, the first tooth larger than the second and third and situated midway between the epibranchial tooth and the second tooth. Halfway between the shallow uro-metagastric furrow and the orbit there is a transverse line of four conical tubercles. There are two of these tubercles on each protogastric boss and the inner pair of tubercles is much larger than the outer pair. Urogastric field depressed and armed with a small median tubercle. Cardiac field subhexagonal, elevated, limited laterally by deep, narrow branchiocardiac grooves, and with a transverse, submedian pair of conical tubercles at the middle. Intestinal field short, depressed, a small transverse tubercle at each posterior angle. Hepatic field concave, unarmed, sloped downward toward the margin of the carapace. A boss surmounted by a longitudinally elongated tubercle occupies the inner angle of the epibranchial region. This elongated tubercle points to a small epibranchial tubercle which lies just behind the outer extremity of the cervical groove. Dorsal surface of carapace finely and rather evenly granulate, but with a few large scattered granules on the branchial field.

Measurement of holotype: length of carapace measured from base of rostrum 12.3, greatest width 14.5, frontoorbital width, 7.3 mm.

Remarks.—This species resembles *P. hexagonalis* van Straelen (1936, p. 36, pl. 4, figs. 6, 7), the type species of the genus, from the

Neocomian of France, in general form and number of areolar tubercles. In *P. gamma* the urogastric tubercle is reduced and lies on a line drawn between the inner pair of branchial tubercles. In *P. hexagonalis* the urogastric tubercle is large and lies behind the level of the inner branchial tubercles.

Distribution in New Jersey.—Merchantville formation: Maple Shade.

Holotype.—ANSP 20031.

Genus *Prehepatus* Rathbun, 1935

Prehepatus dilksi Roberts n. sp.

Plate 89, Figure 2

Description.—Greatest height of palm at the distal third; profile of upper margin moderately convex except before the proximal end where it is deeply excavated; median portion of lower margin straight. Outer surface very convex vertically, armed with large erect conical tubercles arranged in three subparallel longitudinal rows of 5 to 6 tubercles each. These rows arch upward, their tubercles are subequally spaced, and the tubercles of the upper row are somewhat larger than those of the other two rows. The middle row is situated slightly below the middle of the palm; the upper row is parallel to the upper margin and lies halfway between the latter and the middle row; lower row about midway between the middle row and lower margin. A row of three small tubercles extends from the upper node of the carpal articulation to the middle of the upper margin. Distal margin erect, bordered on the outer surface by a wide convex rim which is limited posteriorly by a narrow vertical groove. Upper surface broad, its crestal line oblique and deflected inward at the posterior corner. On the proximal half of this surface there is an outer row of three—and an inner row of two—small tubercles. The posterior tubercle of the outer row points backward and upward. Inner surface of palm flattish, provided with scattered granules, and, near the proximal margin, a deep groove which narrows from above downward. Lower surface evenly tuberculate, the tubercles extending onto the inner and outer surfaces where they become larger. Dactylus quadrate in section at the insertion; upper margins salient and beaded; lateral faces coarsely punctate; a prominent elongated median tubercle on the proximodorsal surface. The summits of the tubercles on the palm and dactylus are densely granulate, and the rim bordering the outer distal margin of the palm bears scattered granules.

Measurements of holotype: length of palm 16.8, greatest height 13.1, length of dactylus 6.6 mm.

Remarks.—The longitudinal rows of tubercles on the outer and upper surfaces of the palm distinguish this species from *P. pawpawensis*

Rathbun (1935, p. 48, pl. 11, figs. 26-28) from the Pawpaw clay of Texas.

The holotype is a right palm with the dactylus in place. Two left palms which lack locality data were also examined. The outer surface of the holotype shows a large tubercle just below the middle of the upper margin. This tubercle is not present on the other palms.

Named for Charles Dilks, who collected the holotype and kindly submitted it for study.

Distribution in New Jersey.—Merchantville formation: Maple Shade (type locality).

Holotype.—ANSP 19728.

Genus *Tetracarcinus* Weller, 1905

Tetracarcinus subquadratus Weller

Plate 87, Figures 3-6

Tetracarcinus subquadratus Weller, 1905, p. 136, pl. 15, figs. 4-6; 1905a, p. 328, text-figs. 4-6.

Tetracarcinus subquadratus, Weller, 1907, p. 852, pl. 111, figs. 16-19.

Tetracarcinus subquadratus, Rathbun, 1935, p. 41, pl. 10, figs. 16, 17 (*non* fig. 18).

Dakoticancer overana, Rathbun (part), 1935, p. 40; *non* 1917, p. 386, pl. 32; pl. 33, figs. 6-14.

Description.—"Carapace subquadrangular, length and breadth nearly equal. Dimensions of two individuals are: length, 12.3 mm. and 14.4 mm.; breadth, 12.5 mm., and 14 mm. Dorsal surface convex longitudinally and transversely, the sides curving abruptly downward to a nearly vertical position, marked by two longitudinal and two transverse furrows. Rostrum short with a deep, longitudinal median furrow. Extending backward from the posterior extremity of the median furrow of the rostrum, the two longitudinal dorsal furrows diverge from their anterior point of origin to the junction with the anterior transverse furrow and then converge until they nearly meet again at the posterior margin of the carapace, enclosing a longitudinal, median area which is not crossed by the anterior transverse furrow, and across which the posterior transverse furrow is less strongly defined than in its lateral limbs. The lateral limbs of the transverse furrows become less well defined towards the margin of the carapace. The anterior ones curve slightly backward toward their distal extremities, while the posterior ones have a slight forward curve, so that the two together, with the longitudinal furrows, enclose a pair of slightly convex, subovate areas. From the anterolateral margins of each of these subovate areas, two slight, gently curved tuberculose ridges or lines of tubercles extend forward, diverging slightly, to the anterolateral margins of the carapace." (Weller, 1907).

Remarks.—The specimen shown on Weller's (1907) plate 111, fig. 17 (NJSM 7788) and refigured by Rathbun (1935, pl. 10, fig. 16) is the best preserved of the three syntypes. It shows the following small tubercles: one above each orbit, a submedian pair behind the rostrum, an equilateral triangle of three pointing postad on the cardiac field and scattered granules on the summits of the hepatic, protogastric and metagastric areas.

Large specimens of this species attain a carapacal width of 32 mm. They are proportionately shorter and wider than are specimens the size of the syntypes. Their angles are more broadly rounded, and the granulations on the elevated areas of the carapace coarser and denser. When molds and fillings of these large specimens are too shallow to show the true periphery of the carapace, their dorsal profile approaches roundness and the distance between the apparent posterior margin of the carapace and the origin of the branchial groove is shortened. Such specimens have a superficial resemblance to *Dakoticancer overana* Rathbun (1917, p. 386, pl. 32; pl. 33, figs. 6-14). In fact, the New Jersey record (Rathbun, 1935, p. 40) of the latter is based on a unique external mold (NJSM 9549) of *T. subquadratus* Weller showing the features mentioned above.

The thoracic sterna of *D. overana* and *T. subquadratus* are quite similar. However, *D. overana* has a conspicuous triangular tooth at each distal angle of sternite IX, whereas sternite IX of *T. subquatratus* is unarmed.

The sternum and palm (NJSM 10215) two specimens reported as *T. subquadratus* by Rathbun (1935, p. 41; palm, pl. 10, fig. 18) and said to have come from the Tinton formation at Beers Hill, New Jersey, are specifically undeterminable. Their matrices appear to have been derived from nodules similar to those in the Woodbury and Cliffwood clays.

Distribution in New Jersey.—Magothy formation: Cliffwood; Cliffwood Point near Matawan. Woodbury formation: Lorillard.

Outside distribution.—Wyoming: "Lewis Shale."

Syntypes.—NJSM 7788 (Cliffwood Point), 9532 (Lorillard).

Tribe GYMNOPLEURA Bourne

Family *Raninellidae* Beurlen

Genus *Notopocorystes* M'Coy, 1849
Subgenus *Cretacoranina* Mertin, 1941

Notopocorystes (Cretacoranina) testacea (Rathbun)

Plate 85, Figures 9, 10

Raninella testacea Rathbun, 1926, p. 190, pl. 68, figs. 1-4.
Notopocorystes (Cretacoranina) testacea, Mertin, 1941, p. 239.

Raninella testacea Kindle, 1949, p. 17, text-fig.1.

Description—"The carapace is very arcuate from side to side and in an antero-posterior direction is moderately deflexed in front of the middle of the gastric region. The lateral margins are convex in front of the posterior third, and the carapace is widest at its anterior third, or at the penultimate lateral spine. The surface is closely paved with flat, subhexagonal granules, which are visible to the naked eye, as are also the scattered punctae. There is an almost total absence of dorsal inequalities. The exceptions are a pair of crescentic furrows at the middle of the carapace, defining the inner limit of the branchial region; a shallow longitudinal median depression, widening posteriorly and occupying the posterior third or fourth of the carapace; and a longitudinal furrow on the rostrum. The rostrum is narrow and insignificant and apparently ended in two spines, which are broken off in the only specimen that has a rostrum. It is advanced beyond the remainder of the anterior margin, which is armed on each side with four spines and slopes back in a transversely oblique direction. The spines seem to be in pairs, those of each pair separated by a shallower sinus than that between the pairs. Between the rostrum and the first spine there is a slight prominence below the margin of the carapace, which may be a part of the eyestalk. Behind the anterolateral spine, which is strong and elongate, there are four smaller spines on the lateral margin which also diminish in size from the anterior to the posterior spine.

"Chelipeds stout, of moderate length. The carpus and distal half of the merus are each provided on the outer side with a prominent laminate crest having a lobate edge; remainder of outer and upper surface of merus rough, partly with spines arranged in longitudinal rows and partly with short transverse granulated or spinose ridges. There are two or three longitudinal rows of spines on the upper surface of the carpus, and a spine at the anterior angle. The palm has a smooth outer face, widens from the proximal to the distal end, and is bordered above by two rows of four or five spines each and below by one row of seven or eight spines. The propodal finger is flat, lanceolate, strongly bent down, and about as long as the upper border of the palm.

"Very little can be made out of the remaining legs. The last two segments of one leg are partly exposed and show considerable blue-green opaline iridescence; and that segment which I take to be the terminal one is narrow, flat, and sublanceolate." (Rathbun)

Measurements of figured specimen: length of steinkern as broken 39, greatest width 36.7, frontal width, at bases of the exterior frontal lobes, 28.4 mm.

Remarks.—To Rathbun's description I would add the following: frontoorbital distance about three-quarters of the carapacal width; orbits large, transversely oval; frontal lobes subquadrate, two on each side of the rostrum, the exterior lobe wider than the interior and each lobe armed distally with a pair of tubular spines of which the inner spine is the shorter and slenderer. Mouthfield about two-fifths as long as the carapace.

None of the specimens shows the outer (3rd) maxillipeds. However, the inner maxillipeds, presumably the 2nd pair, are pediform and at least six times longer than wide. A deep longitudinal furrow bisects the subhepatic field of which each half is transversely convex and bears an irregular row of large granules along the crest of the convexity. Outer layer of the integument paved with small contiguous polygonal plates; inner layers of the integument studded with round flat-topped granules which are slightly more than their diameter apart. Posterior and lateral margins of carapace, and the proximal slopes of the lateral spines, finely beaded.

The large orbits, the median position of the muscle-scars, the short mouthfield, and the strong development of the frontal lobes require that this species be placed in the genus *Notopocorystes.*

Distribution in New Jersey.—Navesink formation: Atlantic Highlands.

Outside distribution.—Tennessee: Ripley formation. Mississippi: Ripley formation.

Types.—USNM 73121 (Coon Creek, Tennessee, type locality).

Genus Raninella Milne Edwards, 1862

Raninella tridens Roberts n. sp.

Plate 88, Figures 5, 6

Description.—Carapace obovate; strongly arched from side to side; greatest width and the highest point on the dorsal surface at the distal third. Immediately in front of this high point, on the dorsal surface of the carapace and extending forward to the orbital borders, there is a median triangular facet which points postad. Running backward from the high point, there is a low median convexity which dies out in the cardiac field. Front two-thirds as wide as the carapace and almost transverse exterior to the rostrum. Rostrum triangular; excavated dorsally, the middle of the excavation occupied by a short longitudinal ridge. Tip of rostrum bluntly rounded and curved slightly downward. Orbit about one-fifth the width of the front; subcircular; directed obliquely outward and upward, its upper and lower margins each pierced by a closed fissure. Anterolateral teeth three, including the outer orbital tooth. The teeth are triangular in dorsal profile, moderately compressed dorsoventrally, with submucronate tips. First tooth larger and less compressed than the others, pointed obliquely forward, acute but nearly equilateral and separated from the second tooth by a broadly U-shaped sinus. Second tooth broad and low, inclined slightly forward, smaller than the third tooth and situated midway between the latter and the first tooth. The third tooth is placed at the widest part of the carapace. It is directed obliquely forward and is more acutely triangular than the first tooth. The posterior margin of the third tooth is distinctly concave and is provided with a carinate edge which becomes continuous with the lateral edge of the carapace posteriorly. Cardiac field barrel-shaped, limited laterally by faint branchiocardiac grooves which connect distally with a pair of deep thumbnail muscle scars. Hepatic area slightly concave. Mouthfield nearly half as long as the carapace, its lateral edges parallel and outwardly arcuate. When viewed from the ventral surface, the subhepatic furrow and the prominent subhepatic carina exterior to it are parallel to each other and to the lateral margin of the carapace. Surface of carapace minutely and evenly granulate.

Measurements of holotype: length 13, greatest width 9.6, frontoorbital width 6 mm.

Remarks.—Resembles *R. elongata* Milne Edwards (1862, p. 493; Brocchi, 1877, p. 4, pl. 29, figs. 4, 5) from the Cenomanian of France, but is broader than that species, has the front truncate instead of rounded and has the muscle-scars placed farther forward.

Distribution in New Jersey.—Merchantville formation: Graham Brick Company pits, Maple Shade.

Outside distribution.—Delaware: Spoil bank north of C and D Canal, about ¼ mile east of Summit Bridge (type locality); Merchantville formation.

Holotype.—ANSP 19737 (Summit Bridge, Delaware).

Raninella sp.

Steinkerns of three carapaces (YPM 17904) from the Woodbury formation at Lorillard, New Jersey, are referable to *Raninella*. The lateral teeth and the details of the front are not known, but the concave posterolateral margins and the position of the muscle scars, which reach nearly to the middle of the carapace, clearly distinguish these specimens from the preceding species, *R. tridens*. Although none of the specimens is well enough preserved to permit of adequate specific description, a brief characterization of the species may be desirable. The carapace is obovate, widest at the distal third and about one and a quarter times longer than wide. The profile of the dorsal surface is nearly straight. The front is narrower than the posterior margin, and the posterolateral margins are concave. The distal extremities of the muscle scars almost reach to the midlength of the carapace. All three specimens are embedded in matrix by their ventral surfaces. The largest example is 22.1 mm. long and 14.5 mm. at the greatest width.

DECAPODA *incertae sedis*

Xanthias? lenolensis Rathbun

Plate 88, Figures 1-4

Undetermined crustacean, Weller, 1907, pl. 110, fig. 11.
Xanthias lenolensis Rathbun, 1935a, p. 165, text-figs. 1-4.

Description.—"The material consists of two palms, right and left, the right one showing the stumps of the fingers. Length of right palm across middle of outer surface 13.6; greatest height, distad to middle, 8.6; greatest thickness, near middle, 5.8 mm. Upper margin arched, lower margin straight for its distal two-thirds, the proximal end curving upward and reaching a little farther backward than the upper margin. Lengthwise through the middle 2 rows of about 9 large tubercles; above and below these, a row of smaller tubercles; near lower edge a similar row. A larger tubercle at articulation with dactyl is indicated. Upper half of outer surface slightly concave; above this, the blunt upper surface bends over toward the inner surface and has three rows of irregular tubercles; below these, on the inner surface, a narrow lengthwise cavity, and further down 5 rows of tubercles more or less irregular. The basal cross-sections of the fingers are relatively small and similar, suboval and subtriangular, broader in upper half.

"The left palm is much worn. Length across middle 13; greatest height, at distal end, 9.7; greatest thickness, 6.8 mm. The ornamentation so far as it can be made out, is similar to that of the minor palm." (Rathbun)

Remarks—Well-preserved specimens show hemispherical tubercles on the outer surface of the hand and conical tubercles on the upper surface. The tips of the tubercles are coarsely granulate. The fixed finger, which is finely granulate, is bent downward and is at least one-third as long as the inner length of the palm.

The specimen (NJSM 9042) figured by Weller (1907, pl. 110, fig. 11) is the right palm of the species.

Until the carapace is found, the generic and familial affinities of *X? lenolensis* cannot be determined with certainty. However, I have tentatively retained it in the recent brachyuran genus *Xanthias,* where Rathbun has placed it.

Distribution in New Jersey.—Merchantville formation: Lenola and Maple Shade.

Holotype.—ANSP 12804 (Lenola).

Brachyuridea indet. 1

Plate 88, Figures 7-10

Description.—The palm is barrel-shaped. Its outer surface is grooved lengthwise at the upper third. The posterior margin slopes strongly backward and downward and is provided with a stout, salient pair of articular nodes of which the lower node twists inward and upward at the tip. The form of the wrist is oval-spheroidal with a large facet on the inner side. The proximal half of this facet serves as the articular surface of the carpomeral joint. Two grooves mark the outer surface of the wrist; one extends longitudinally across the middle, the other is close to and parallel with the lower half of the distal margin. These grooves connect anteriorly. The palm and wrist are covered with closely spaced hemispherical granules.

Measurements of figured propodus: length 14.6, length of palm, 10.6 mm.; height of palm 8.9 mm., thickness 7 mm., length of upper surface of fixed finger, 5 mm.

Remarks.—The decorticated left propodus (NJSM 10215) which Rathbun (1935, pl. 10, fig. 18 only) identified with *Tetracarcinus subquadratus* Weller (see "Remarks", p. 185 above) resembles the hands described here. However, her specimen is more elongated and the groove along its outer surface is at the middle rather than at the upper third. It should be noted that Rathbun's figure 18 is retouched, giving the impression that the posterior margin of the hand is present and that its upper and lower posterior angles are rounded. Actually, the posterior margin of her specimen is broken off nearly vertically, the upper and lower corners of the break are quite sharp.

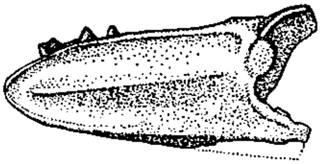
Distribution in New Jersey.—Merchantville formation: Maple Shade.

Outside distribution.—Delaware: Merchantville formation.

Figured specimens.—WFIS 17101 and 17102.

Brachyuridea indet. 2

Text Figure 3



Description.—Palm compressed; cuneiform in lateral profile, narrowing in the proximal quarter to a bluntly triangular point with convex sides. Upper, posterior and lower margins of outer surface bordered by a smooth, narrow keel. A wider keel, which is longitudinal and submedial, arises close to the posterior margin and extends distad to a point situated at a distance behind the anterior margin that is about equal to the basal height of the fixed finger. The upper and lower surfaces of the palm are flattish. The distal half of the inner portion of the upper surface is broken, but the proximal half of this surface shows the base of a stout articular node and two triangular teeth, the three about equally spaced and arranged in a straight, oblique row which trends forward and outward. The carpopropodal articulation is on the inside of the palm.

Measurements of cited specimen: length 23.2 mm., anterior height 10.9 mm., thickness 6 mm.

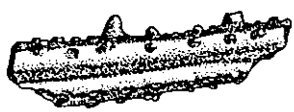
Remarks.—This indeterminable species is represented by a unique right palm which has the stumps of the dactylus and fixed finger in place. It strongly resembles the palm of a portunid crab and appears to be close to Rathbun's (1935, p. 52) genus *Ophthalmoplax.*

Distribution in New Jersey.—Formation unknown: "Monmouth County. Lower Marl."

Cited specimen.—ANSP 19740.

Decapoda indet.

Text Figure 4



"*Brachyura* (?) *Fragment of a finger* (?)." Pilsbry, 1901, p. 117, pl. 1, fig. 17.

"*Antenna of a Palinurid.*" Rathbun, 1935, p. 60.

"*(A)ntenna of a Palinurid.*" Kindle, 1949, p. 17.

Description.—An elongated fragment with a key-hole cross-section; a row of 8 to 10 long, conical tubercles on each margin of the wider (or upper) surface; a wide longitudinal groove slightly below the middle of the inner and outer surfaces; three parallel rows of 4 to 6 small, conical tubercles on the lower surface. Two of the rows on this lower surface are lateral, one is medial, and one of the lateral rows is visible from the inner side of the fragment. On the outer surface of the fragment, above the longitudinal groove, there is a row of three small, widely spaced tubercles.

Length of fragment, 26.4 mm., posterior height, 7.9, posterior thickness 5.5 mm.

Remarks.—The original label of this unique specimen gives no stratigraphic information. It reads, "Monmouth Co., N. J., William Cleburne." However, Pilsbry (1901, p. 111) states that the specimen came from the "Lower Marl." Rathbun (1935, p. 8) lists it under the Monmouth group, and Kindle (1949, p. 17) assigns it to the Navesink formation. The fact is that the formation from which this specimen came is unknown, nor is it likely that it is the antenna of a palinurid.

Distribution in New Jersey.—Formation unknown: Monmouth County.

Cited specimen.—ANSP 19729.

APPENDIX A

THE CRETACEOUS REPTILES OF NEW JERSEY

by HALSEY W. MILLER, JR.[1]

The Cretaceous sediments of New Jersey have yielded many species of vertebrate fossils. During the nineteenth century such distinguished paleontologists as Edward Cope, Othniel Marsh, and many other workers collected and described specimens from the state.

Unfortunately for present day collectors many of the localities visited by the above men are no longer accessible and vertebrate material has not been found in quantity in recent years from other localities. Nevertheless, paleontologists such as R. Zangerl and S. P. Welles are adding to our knowledge of Coastal Plain vertebrates through their monographic studies. Many of the described species have proved invalid on restudy and have been assigned to other species or have been discarded from taxonomy. It is possible that many of the species listed here are not valid, but decision must await future work by competent authorities.

A list of the Cretaceous reptiles of New Jersey is appended in which the species are listed under the formations in which they occur, with the localities being recorded under the various species. This list has been compiled after a study of specimens in the Academy of Natural Sciences, the Peabody Museum at Yale University, the American Museum of Natural History and a survey of the literature. The species in brackets are doubtfully assigned to the formation under which they are listed since only incomplete data are available.

Inasmuch as an annotated check list of vertebrate fossils of New Jersey has previously been published by the author (Miller, 1955b), only a few selected references will be found in the bibliography.

Stratigraphic list of the Cretaceous reptiles of New Jersey

RARITAN FORMATION

Plesiosauria

"Taphrosaurus" lockwoodi Cope (nomen vanum); Sayreville?

"Dinosauria"

Dinosaur footprints; Woodbridge

MATAWAN GROUP

Chelonia

Agomphus petrosus Cope; Gloucester

[1] Present address, University of Arizona, Tucson, Arizona.

MERCHANTVILLE FORMATION

Chelonia

(*Trionyx halophila* Cope); Summit Bridge, Del.
Bothremys cooki Leidy[1]; Maple Shade

Squamata

Clidastes sp.?; Maple Shade

Mosasaurus sp.; Maple Shade

Crocodilia

Unidentified specimen; Maple Shade

Ornithischia

Ornithotarsus immanis Cope; Merchantville (Maple Shade?)

WOODBURY FORMATION

Squamata

Mosasaurus sp.; Woodbury

Ornithischia

Ornithotarsus immanis Cope; Lorillard Company pit, near Keyport
Hadrosaurus foulkii Leidy; Haddonfield

MARSHALLTOWN FORMATION

Plesiosauria

"*Elasmosaurus*" *orientalis* Cope; Swedesboro

Squamata

Clidastes iguanavus Cope; Swedesboro

Ornithischia

Hadrosaurus minor Marsh; Swedesboro

NAVESINK FORMATION[2]

Squamata

Ancylocentrum hungerfordii Chaffee; Sewell
Baptasaurus fraternus Marsh; New Jersey
Clidastes validus Cope; Barnsboro
Clidastes conodon Cope; Freehold

[1] Identification by Dr. Rainer Zangerl.

[2] Because many of the earlier collectors gave incomplete locality data, it is often difficult to tell whether certain specimens obtained from greensand came from the Navesink formation or the overlying Hornerstown. These records are further complicated by the fact that the Hornerstown was formerly regarded as Cretaceous but is now generally dated as Paleocene or Eocene. Rapp (1944) referred numerous New Jersey reptiles, including such obvious Cretaceous forms as dinosaurs, mosasaurs and plesiosaurs to the Eocene, a correlation which was objected to by Colbert (1944). Because of these differences in opinion regarding the age of some of the fossils from the New Jersey greensand, the editor has divided the greensand fossils into two groups, those from the true Navesink which are definitely of Cretaceous age, and those which may be either from the Navesink or the Hornerstown and which may be of either Cretaceous or Tertiary age. Those records which are most probably Tertiary are indicated by the symbol E. (Horace G. Richards).

Tylosaurus laticaudus Marsh; Hornerstown
Tylosaurus sectorius Cope; Birmingham
Mosasaurus depressus Cope; Birmingham
Mosasaurus miersii Marsh, Hornerstown
Mosasaurus oarthrus Cope; Barnsboro
Mosasaurus princeps Marsh; Hornerstown
Mosasaurus copeanus Marsh; Marlboro

Plesiosauria

Cimoliasaurus magnus Leidy; Burlington Co.
"Plesiosaurus" brevifemur Cope (nomen vanum); Barnsboro

Saurischia

Dryptosaurus aquilunquis Cope; Sewell, Barnsboro, Burlington Co.

Ornithischia

Hadrosaurus foulkii Leidy; Barnsboro
Hadrosaurus minor Marsh; Sewell, Mullica Hill

NAVESINK AND/OR HORNERSTOWN FORMATIONS

Crocodilia

Goniopholis ferox Marsh; Birmingham
Goniopholis fraterculus Cope; Birmingham
Goniopholis natator Troxell; Hornerstown
Goniopholis natator oweni Troxell; Barnsboro
Goniopholis rogersii Owen; Blackwood, Birmingham, White Horse
(*Goniopholis rogersii* Owen); New Castle Co., Del.
(*Thoracosaurus neocesariensis* DeKay); Mt. Holley E

Chelonia

Bothremys cooki Leidy; Barnsboro
Taphrosphys molops Cope; Barnsboro
Taphrosphys strenuus Cope; Barnsboro
Osteopygis emarginatus Cope; Barnsboro, Mullica Hill
Catapleura repanda Cope; Barnsboro
Agomphus firmus Leidy; Tinton Falls
Agomphus masculinus Wieland; Barnsboro
Agomphus pectoralis Cope; Medford E
Agomphus tardus Wieland; Birmingham E
Agomphus turgidus Cope; Mt. Holly, Sewell, E
Adocus agilis Cope; Barnsboro
Adocus beatus Leidy; Mullica Hill
Adocus pravus Leidy; Tinton Falls
Adocus syntheticus Cope; Barnsboro

SPECIES OF UNCERTAIN FORMATIONAL ASSIGNMENT

The following species cannot be referred to any formation or group because of a lack of locality and stratigraphic information.

Plesiosauria

Cimoliasaurus planior Leidy
Cimoliasaurus vetustus Leidy

Squamata

Diplotomodon horrificas Leidy
Polygonodon vetus Leidy
Tylosaurus laevis Owen
Tylosaurus mitchilli Dekay
Tylosaurus rapax Hay
Mosasaurus dekayi Bronn
Mosasaurus fulciatus Cope
Mosasaurus maximus Cope

Saurischia

Pneumatoarthrus peloreus Cope

Ornithischia

Hadrosaurus cavatus Cope

APPENDIX B

MISCELLANEOUS FOSSILS

by Horace G. Richards

Various groups of fossils are not included in the present volume. These are:

PLANTS. Those of the Raritan formation were fully described by Berry (1911) and little work has been done subsequently other than a critical analysis by Dorf (1952).

FORAMINIFERA. This group of fossils was included in the original edition of Weller, the work largely being taken from Bagg (1898). The advances in the field of micropaleontology have made much of this work obsolete and it therefore seems unwise to reprint this section. Little work has been published on the Cretaceous foraminifera of New Jersey during recent years. Jennings (1936) described some species from the Cretaceous and Eocene, and Cushman (1948) described a Cretaceous fauna from Maryland including species which almost certainly occur also in New Jersey. The foraminifera of the Vincentown formation, included with the Cretaceous by Weller but now regarded as Eocene, have been discussed by McLean (1952, 1953).

BRYOZOA. No species of Bryozoa have been reported from the true Cretaceous of New Jersey. The extensive fauna of the Vincentown formation, included in Weller's original volume, is now thought to be of Eocene age. A thorough discussion of this fauna was given by Canu and Bassler (1933).

OSTRACODA. Only a few ostracodes have been reported from the Cretaceous of New Jersey although it is known that they occur in several of the formations. Some ostracodes from the Cretaceous of nearby Delaware and Maryland have been discussed by Schmidt (1948) and Swain (1948).

FISH. The most complete work on the fossil fish of the Cretaceous and Tertiary of New Jersey is that of Fowler (1911). Unfortunately, many of the locality records are very vague and it is therefore difficult to correlate the fossils with exact formations. These records are further complicated by the fact that the Hornerstown formation at that time was regarded as Cretaceous. Many of the specimens are merely referred to the greensand of the "Navesink-Hornerstown marl."

Rapp (1946) gave a revised check list, but again it is difficult to separate the Cretaceous species from those of the Eocene. It is probable that most of the Chimaeras (*Edaphodon, Bryactinus, Isotaenia,* etc.) are from the Hornerstown formation.

While shark teeth are more abundant in the Eocene than in the

Cretaceous, a number of species have been found in true Cretaceous localities such as Maple Shade, Mullica Hill, Holmdel, etc. The most frequent genera are *Lamna, Isurus, Otodus, Corax, Carcharhinus (Glyphus)* and *Hemipristis.* Other fish from the Cretaceous of New Jersey include the following genera: *Pycnodus, Enchodus,* and *Ischyrhiza.*

BIRDS. Eight species of birds were described from the Cretaceous deposits of New Jersey by Marsh. Six of these, *Graculavis velox, G. pumilus, Telmarornis priscus, T. affinis, Palaeotringa littoralis* and *P. vagans,* were from the Hornerstown formation. *P. vetus* was from Arneytown and *Laornis edvarsianus* was from Birmingham. Wetmore (1930), following the removal of the Hornerstown formation from the Cretaceous to the Eocene, suggested that these birds were of Eocene rather than Cretaceous age. No specimens of fossil birds have been found during recent years.

APPENDIX C

NEW CRETACEOUS INVERTEBRATE FOSSILS FROM TEST BORINGS IN NEW JERSEY

by Horace G. Richards

In 1951, the Transcontinental Gas Pipe Line Corporation drilled a series of test wells in Burlington and Ocean Counties, New Jersey, in an attempt to locate a buried structure suitable for the storage of natural gas. Through the courtesy of George Grow, geologist with that company, and Meredith E. Johnson, former State Geologist of New Jersey, I have been permitted to examine the fossils obtained from these borings. A preliminary report on the fossils was given before the International Geological Congress in Mexico City in 1956 (Richards 1957-1959), while a complete list of the species will be published elsewhere.

The Cretaceous fossils obtained from the cores include 48 species of which twelve are described as new. Notes and figures of a few species not hitherto reported from the Cretaceous of New Jersey are included. In addition, a new species of the echinoid *Nucleopygus* (?) from the Navesink formation at Mullica Hill, N. J. is described.

The approximate location of the wells which yielded the most significant fossils is as follows:

1. 2 miles north of Chatsworth, Burlington County
2. 2.5 miles north of Chatsworth
5. 6 miles north of Chatsworth
8. 4 miles north of Chatsworth
16. Harrisville, Ocean County
17. 8 miles north of Manahawkin, Burlington County.

PHYLUM COELENTERATA

Class Anthozoa

Trochocyathus sp.

Plate 93, Figures 3, 4

Several small corals closely related to, or possibly identical with, *T. balanophylloides* (Bolsche) have been discussed and figured by Squires (1958). Core 16 (1648 feet) RARITAN formation.

PHYLUM ANNELIDA

Class Chaetopoda

Serpula implicata Stephenson

Plate 93, Figure 1

Serpula implicata Stephenson 1952 = 1953, U. S. Geol. Surv. Prof. Paper 242, p. 52, pl. 8, fig. 7-9.

Hitherto known only from the Woodbine formation of Texas. Core 16 (1648 feet) RARITAN formation.

Hamulus intermedius Richards n. sp.

Plate 93, Figure 2

Tube straight, or very slightly curved. Six or seven (usually seven) rounded ribs similar to those of *Hamulus onyx.* Signs of tapering at lower end.

The tube differs from *H. onyx* by being straighter, by showing less signs of tapering, and by often having seven ribs. It has many of the characteristics of *H. protoonyx* Richards (from the Eutaw or Tuscaloosa formation of Alabama), but is much larger. It is also much larger than *H. howelli* Richards from the Tuscaloosa formation of North Carolina. *H. intermedius* may represent an intermediate evolutionary stage between either of these two small forms *(H. protoonyx* or *H. howelli)* and *H. onyx,* the latter being known from slightly younger deposits.

H. intermedius is known from the holotype and fifteen paratypes. On several of the tubes can be seen the smaller tubes of *Serpula implicata* Stephenson.

Dimensions: Length of incomplete specimen 17.5 mm.; maximum thickness 5 mm. (holotype).

Locality: Core 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30751.

PHYLUM ECHINODERMATA

Class Echinoidea

Nucleopygus (?) gallagheri Richards n. sp.

Plate 92, Figures 3, 4

Outline oval as in figures; upper surface convex, lower surface concave. Apical system roughly central; petals relatively narrow and extending about two-thirds of the way to the margin. Mouth central with traces of flocelle surrounding it; periproct oval and elevated as shown in figure. The type and unique specimen is an internal mould.

This species differs from *N. texanus* (Clark) from the Austin chalk (Cretaceous) of Texas by its wider petals and by the traces of the floscelle. It resembles *Catopygus williamsi* Clark from the Navesink formation of New Jersey by having the periproct considerably more elevated.

Dimensions: Length 20 mm.; width 16 mm.; height 10.5 mm.

Locality: Mullica Hill, N. J. NAVESINK formation.

Holotype: ANSP 30752 (unique).

Named in honor of William Gallagher, a young amateur collector who found the specimen.

PHYLUM BRYOZOA

Heteropora americana Richards n. sp.

Plate 92, Figures 1, 2; Plate 93, Figure 5

Zoarium consisting of small cylindrical tubes, usually about 3.5 mm. in diameter. More or less regularly branching and occasionally coalescing. Zooaria suboval measuring about 0.1 mm. in diameter. The space between the pores is occupied by smaller irregularly arranged subcylindrical mesopores varying in diameter. Wall porous or vesicular.

Related to *H. cryptopora* Goldfuss from Maastricht, Holland, but with more variation in the size of the mesopores.

This is the first record of *Heteropora* from the Cretaceous of North America, although several species are known from the Eocene of the Atlantic and Gulf Coastal Plain. The Raritan formation is correlated with the Cenomanian of Europe, and is therefore older than the Maastrichtian from which *H. cryptopora* is reported.

Locality: Core 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30753; figured paratype 30754.

PHYLUM MOLLUSCA

Class Pelecypoda

Breviarca ruhlei Richards n. sp.

Plate 93, Figures 10, 11

Shell small, inequilateral, subequivalve, strongly inflated. The left valve slightly overlaps the right valve all around the margin. Umbonal ridge rounded. The surface slopes steeply to the anterodorsal margin, less steeply to the anterior and ventral margins; posterodorsal slope broadly excavated. Beaks prominently incurved and nearly central; anterior margin regularly rounded; ventral margin almost straight. Surface ornamented with strong irregular concentric ridges. There are a few subobsolete radial threads near the anterior and posterior margins. Hinge and teeth typical of the genus as exemplified by *Breviarca minor* Stephenson from the Woodbine of Texas, except that there are a few more hinge teeth.

Breviarca ruhlei differs from *B. minor* in that its sculpture shows no cross-hatching or radiating markings.

Dimensions: Length 3.9 mm.; width 5.1 mm.; thickness 1.8 mm.

Locality: Boring 16 (1648) feet RARITAN formation.

Holotype: ANSP 30489; also ten paratypes.

Named in honor of James L. Ruhle, who assisted in the preparation of the cores for study.

Idonearca (?) **harrisvillensis** Richards n. sp.

Plate 93, Figures 8, 9, 12

Shell of medium size, rather thick, subtrapezoidal, strongly convex, inequilateral, presumably equivalve. Anterior margin flattened with a distinct keel. Posterodorsal slope is moderately steep; ventral margin broadly rounded. Cardinal area roughly triangular, elongate, with about six wavy, chevron-like lines. Hinge slightly curved. The medial teeth are small and irregular; the lateral teeth are coarse, about five on each side, are longer and coarser, irregularly oblique, becoming horizontal at the ends. Umbonal ridge subangular. Beaks moderately prominent, broadly incurved, situated about one-third the length of the shell from the anterior extremity. Muscle scar not visible. Ornamentation limited to fine concentric ribs at varying distances from each other, with a very faint indication of cross-hatching on some of the interspaces.

Idonearca (?) *harrisvillensis* differs from *Idonearca blanpiedi* Stephenson, known from the Woodbine formation of Texas and the Raritan formation of New Jersey, in its general shape, and by the presence of a pronounced keel on the anterior margin. Because of the incomplete nature of the shell, it does not appear wise to refer it definitely to the genus *Idonearca.*

Holotype and numerous broken specimens.

Dimensions: Length 14 mm.; width 20 mm.; thickness 6 mm (holotype).

Holotype: ANSP 30443.

Locality: Boring 16 (1648 feet) RARITAN formation.

Ostrea raritanensis Richards n. sp.

Plate 93, Figures 13, 14

Shell small, laterally arcuate. Hinge-line slightly curved. Shell marked with from seven to ten deep plications which extend inward from the lower or convex margin but do not reach the opposite side.

Very faint plications on the anterior hinge extremity which do not connect with the larger plications of the opposite side. The central portion of the shell is relatively smooth, without conspicuous ribs or plications. There are faint indications of concentric growth lines and very faint radial ribs near the beak.

Ostrea raritanensis differs from the common Cretaceous *O. falcata* Morton by its much less conspicuous plications which do not extend across the shell. Also, *O. raritanensis* is smaller in size and is more pointed at the posterior end than in the case of *O. falcata.*

Dimensions: Length 9 mm., width 3.1 mm., thickness 1.6 mm. (holotype); length 12.2 mm., width 5.1 mm., thickness 3.2 mm. (unfigured paratype); length 15.6 mm., width 7.1 mm., thickness 2.2 mm. (unfigured paratype).

Locality: Boring 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30441.

Exogyra woolmani Richards

Plate 93, Figure 7

Fairly common in Core 16 at 1648 feet. See Vol. 1, p. 121.

Gryphaea aucella Roemer

Plate 94, Figure 4

Gryphaea aucella Roemer, 1849, "Texas" p. 395 (Bonn, Germany).

Several specimens from Core 16 at 1648 feet appear to be identical with this species originally described from the Cretaceous of Texas. *G. aucella* is closely related to *G. convexa* (Say) and may actually be a variety.

Crenella growi Richards n. sp.

Plate 93, Figure 15, 16

Shell small, inflated, slightly longer than high, subequilateral, equivalve. All margins arched. Hinge typical of the genus. Beaks moderately prominent, incurved and located at the center. Outer surface ornamented with smooth closely spaced radial ribs numbering about 10 to the millimeter at the ventral margin. Interspaces cut by fine concentric threads.

Crenella growi differs from *C. subcircularis* Stephenson from the Woodbine of Texas in that it is much more rounded and shows both concentric and radial sculpture.

Dimensions: Length 6.2 mm. ; width 6.0 mm.; thickness 5.0 mm.

Locality: Boring 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30440.

Named in honor of George Grow, geologist with Transcontinental Gas Pipe Line Corporation, who made these samples available for study.

Caryocorbula johnsoni Richards n. sp

Plate 93, Figures 17, 18

Shell of moderate size, inflated, triangular ovate, slightly inequivalved. Both valves are acutely keeled posteriorly, and both are concentrically rugose. The right cardinal tooth is moderately pronounced, the adjoining resileal socket is deep, and the anterior cardinal socket is long, as in the hinge of the type of this subgenus. The left valve has a relatively broad chondrophore which is posteriorly continuous with the dorsal margin of the valve, being separated from it by a low ridge. Muscle scars are thickened, somewhat rugose; the palial line is simple and the palial sinus short, scarcely defined. Concentric ribs are closely spaced, with faint indications of radial striae.

Caryocorbula johnsoni differs from *C. alabamensis* Lea in that it is not as tapered at the chondrophore, the ribs are more closely spaced, the keel is less pronounced, and the beak is less centered. Fairly common in Boring 16 at 1648 feet.

Dimensions: Length 8.3 mm.; width 6.1 mm.; thickness 3.2 mm. (holotype).

Locality: Boring 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30437.

Named in honor of Meredith E. Johnson, former State Geologist of New Jersey.

"Corbula" sp.

Plate 93, Figure 23

Several specimens too poorly preserved for description were obtained from Boring 16 at 1648 feet.

Scambula widmeri Richards n. sp.

Plate 93, Figures 19, 20

Shell small, roughly triangular with sharp pointed beaks; valve very flat; posterior margin of shell slightly incurved, and making a sharp edge with the extremity of the shell; anterior margin straight. Hinge characterized by one long lateral tooth and two smaller teeth which meet at the umbo. Exterior of the valve with concentric ribs, about 15 in number, becoming much less distinct and wider spaced near the beak. Ribs and interspaces are covered with fine growth lines which are present on both the ribs and the area between the ribs. These stop abruptly at both margins of the shell.

Scambula widmeri differs from *S. perplana* Conrad from the Cretaceous of New Jersey mainly by its much coarser sculpture, and by its smaller size.

Dimensions: Length 4 mm.; width 5 mm.; thickness 0.5 mm. (holotype).

Locality: Boring 8 (694 feet) WOODBURY formation.

Holotype: ANSP 30750.

Named in honor of Kemble Widmer, State Geologist of New Jersey.

Cyclorisma jerseyensis Richards n. sp.

Plate 93, Figures 21, 22

Shell small, subtriangular, posterior end slightly attenuate; teeth not well preserved, but similar to those of *Cyclorisma alta* (Conrad) Surface ornamented with fairly prominent irregularly spaced ribs with wider interspaces; faint concentric lines between the ribs, and finer radial striations.

Cyclorisma jerseyensis differs from *C. alta* (Conrad) of the Black Creek formation of North Carolina by its coarser sculpture, and by being more elongate than *C. alta* which is almost circular.

Dimensions: Length 4.5 mm.; width 5.3 mm.; thickness 1.2 mm.

Locality: Boring 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30749.

Linearia transcontinentalis Richards n. sp.

Plate 93, Figure 6

Shell small, subelliptical in outline, depressed convex. Anterior and posterior margins both rounded; basal posterior margin convex. Beak not clearly shown, but apparently small. Surface of the shell marked by fine concentric ribs and separated by depressed furrows about two to three times the width of the ridges, also by radiating furrows which cut through the concentric ridges. These are more conspicuous on the margins of the shell than in the center, but are not nearly as prominent as in *L. metastriata* Conrad. The furrows on the anterior part are farther apart than upon the posterior portion of the shell and are slightly more conspicuous.

Linearia transcontinentalis differs from *L. metastriata* Conrad in that its concentric ribs are coarser, the radiating lateral ridges are less conspicuous, and the shell is less convex.

Dimensions: Length 3.8 mm.; width 5.5 mm. (holotype).

Locality: Core 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30456.

Class Gastropoda

Calliomphalus oceanicus Richards n. sp.

Plate 94, Figures 1, 2, 3

Shell small, nacreous, rather depressed, typically trochoid in shape and umbilicate; spire low; whorls four or five, rounded, sutures impressed, circular in cross section and gradually increasing in size; protoconch relatively flat. Sculpture of about 19 spiral nodulose ribs; tubercles arranged in parallel axial rows which are crossed by faint spiral-shaped ridges, giving a somewhat cancellate appearance to the shell; suture slightly impressed; subsutural rib strong; aperture subcircular; umbilicus broad, umbilical keel tuberculate.

Calliomphalus oceanicus differs from *C. americanus* Wade from the Ripley formation of Tennessee (Coon Creek) in that it has a lower spire, and more strongly cancellate sculpture. *C. oceanicus* lacks the conspicuous nodes surrounding the umbilicus as in *C. americanus.*

Dimensions: Height 6.9 mm.; width 9.5 mm. (holotype).

Locality: Boring 16 (1648 feet) RARITAN formation.

Holotype: ANSP 30438; also 8 paratypes, badly crushed.

Named from Ocean County, New Jersey, in which the well was located.

Tuba (?) **fontis** Richards n. sp.

Plate 94, Figures 5, 6

Shell of medium size, spiral but broad at base, spire acute, whorls seven, convex and circular in cross section increasing in size toward the aperture; apical whorl very small. Sculpture consists of beaded spiral threads of unequal size, with two very conspicuous rows on spiral whorls, but with five or more on the body whorl; beaded effect of threads produced by numerous narrow sharply elevated axial lines across the crests of the spiral ridges. Suture distinctly impressed; aperture apparently circular; lip not distinct.

Tuba (?) *fontis* differs from *T. parabella* Wade from the Ripley formation at Coon Creek, Tennessee, by its less conspicuous ornamentation, its fewer spiral ribs, and by having one less whorl. It is also considerably smaller than *T. parabella*. It is placed in the genus *Tuba* questionably because the aperture and columella are not clearly visible. It is much larger than *T.* (?) *reticulata* Johnson from the Woodbury formation of New Jersey and lacks the radial sculpture. Named from the Latin *fons* = well.

Dimensions: Height 11.9 mm.; width 7.9 mm. (holotype).

Locality: Boring 1 (862 feet) WOODBURY formation.

Holotype: ANSP 30755.

DISCUSSION

1. The most significant part of the fauna here described is the material obtained from Core 16 between the depths of 1648 and 1658 feet (near Harrisville, Burlington County, New Jersey). The fossils are believed to come from the Raritan formation (basal Upper Cretaceous) and to be closely related to the fauna of the Woodbine formation of Texas as recently described by Stephenson (1952 = 1953).

2. A core from Boring 17 at a depth of 1710 feet consists of massive fossiliferous limestone quite unlike anything reported from the Raritan formation. However, judging by its fauna and by its position in the section, it is clearly part of the Raritan formation. (Plate 94, Figure 9).

APPENDIX D

Table showing distribution by formation of Cretaceous invertebrate fossils of New Jersey.[1]

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PORIFERA											
Cliona cretacica Fenton & Fenton				X					X		
C. microtuberum Stephenson									X		
C. retiformis Stephenson		X									
Coeloptychium ? jerseyensis Shimer & Powers									X		
Corynella jerseyensis Howell n. sp.									X		
COELENTERATA											
Astrangia cretacea (Bölsche)				X			X				
Micrabacia cribraria Stephenson				X	X			X			
Trochocyathus woolmani Vaughan					X		X				
Paracyathus ? vaughani Weller									X		
ANNELIDA											
Serpula circularis Weller							X				
Hamulus falcatus (Conrad)				X	X						
H. wenonahanus Howell							X	X	X		
H. squamosus Gabb				X							
H. walkerensis Stephenson				X	X						
H. walkerensis praecursor Howell				X							
Longitubus lineatus (Weller)				X	X				X		
Diploconcha cretacea Conrad				X					X		
D. harbisonae Howell					X			X			
Filogranula jerseyensis Howell n. sp.				X							

[1] Species listed in Appendix C not included

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
INSERTAE SEDIS											
Halyminites major Lesquereux								X			
Tube or Burrow										X	X
Xenohelix jerseyensis Ramsdell n. sp.			X								
ECHINOIDEA											
Faujasia geometrica (Morton)							X				
Catopygus pusillus Clark				X							
C. (Oolopygus) williamsi Clark									X		
H. mortononis emmonsi (Stephenson)								X			
Cardiaster smocki Clark				X							
"Hemiaster" kümmeli Clark					X						
H. welleri Clark				X							
BRACHIOPODA											
Lingula subspatulata Hall & Meek					X						
Terebratulina atlantica (Morton)									X		
Choristothyris plicata (Say)									X		
C. vanuxemi (Lyell & Forbes)									X		
PELECYPODA											
Nucula percrassa Conrad			X	X	X		X	X			
N. slackiana Gabb					X						
N. whitfieldi Weller			X	X	X			X		X	
N. compressifrons Whitfield				X	X						
N. pinnaformis (Gabb)					X						
N. marlboroensis (Weller)								X			

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
N. tintonensis (Weller)											X
N. protexta (Gabb)									X		
N. cliffwoodensis (Weller)			X								
N. longifrons (Conrad)					X						
N. whitfieldi (Gardner)					X						
N. stephensoni Richards n. sp.				X	X			X	X	X	X
Yoldia gabbana (Whitfield)									X		
Y. papyria (Conrad)					X						
Y. cliffwoodensis Weller			X								
Nemodon eufaulensis (Gabb)				X			X		X	X	X
N. conradi Johnson					X						
N. angulatum (Gabb)									X		
N. brevifrons Conrad			X					X			
N. obesus Stephenson		X									
Cucullaea vulgaris Morton							X		X	X	X
C. antrosa Morton				X					X		X
C. woodburyensis Weller					X						
C. neglecta Gabb				X	X				X		
C. littlei Gabb											X
Idonearca blanpiedi Stephenson		X									
Trigonarca cliffwoodensis Weller			X								
T. triquetra Conrad			X								
T. cuneiformis Conrad					X						
Breviarca haddonfieldensis Stephenson					X						
B. umbonata Conrad					X						

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
B. cuneata (Gabb)				X	X						
Arca uniopsis Conrad				X					X		
A. rostellata Morton									X		
A. obesa (Whitfield)				X							
Nemoarca cretacea Conrad				X	X			X			
Barbatia ? cuniculana Stephenson		X									
Striarca congesta (Conrad)			X	X	X			X		X	
Glycymeris mortoni (Conrad)				X					X		X
G. microdentus (Weller)								X			
G. compressa (Weller)										X	
Pinna laqueata Conrad				X	X				X		
Gervilliopsis ensiformis (Conrad)				X	X		X	X	X	X	
G. minima Whitfield									X		
Inoceramus proximus Tuomey		X	X	X	X		X				
I. quadrans Whitfield				X							
I. confertim-annulatus Roemer									X		
I. proobliqua Whitfield									X		
I. ? perovalis Conrad	X										
Pteria petrosa (Conrad)			X					X			
P. laripes (Morton)	X										
P. navicula Whitfield					X					X	
Phelopteria dalli (Stephenson) ?		X									
Meleagrinella abrupta (Conrad)									X		
Pulvinites argenteus Conrad ?											
Ostrea cretacea Morton ?			X								

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
O. congesta Conrad ?			X								
O. panda Morton							X				
O. subspatulata Forbes								X			
O. monmouthensis Weller									X		
O. tecticosta Gabb								X			
O. falcata Morton							X		X		
O. mesenterica Morton									X	X	X
O. nasuta Morton									X	X	X
O. jersciana Stephenson		X									
O. soleniscus Meek		X									
O. plumosa Morton					X		X	X	X	X	
Gryphaea convexa (Say)								X	X		
Gryphaeostrea vomer (Morton)							X		X	X	
Exogyra ponderosa Roemer							X				
E. ponderosa erraticostata Stephenson					X		X				
E. costata Say									X	X	X
E. costata spinifera Stephenson									X		
E. cancellata Stephenson									X		
E. woolmani Richards		X									
E. sp.				X							
Trigonia mortoni Whitfield				X			X	X	X		
T. eufaulensis Gabb				X	X			X			
T. cerulia Whitfield											X
T. kummeli Weller										X	
Pecten tenuitestus Gabb									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
P. whitfieldi Weller									X		
P. cliffwoodensis Weller			X								
P. burlingtonensis Gabb				X	X			X			
P. bellisculptus (Conrad)				X	X		X	X	X		
P. conradi (Whitfield)				X	X				X		
P. quniquinarias Conrad								X	X		
P. parvus (Whitfield)									X		
P. venustus Morton							X		X	X	X
P. craticulus Morton									X		
P. simplicius Conrad					?					X	X
P. quinquecostata Sowerby				X			X		X		
Plicatula urticosa Morton				X					X		
P. mullicaensis Weller									X		
P. woodburyensis Weller					X						
P. howelli Richards		X									
P. ferrata Stephenson		X									
Spondylus gregalis (Morton)									X		
Dianchora echinata (Morton)									X		X
Liroscapha squamosa Conrad					X						
Lima pelacica (Morton)									X		
L. whitfieldi Weller							X		X		
L. lorillardensis Weller					X						
L. reticulata Lyell and Forbes				X			X	X	X	X	X
L. monmouthensis (Whitfield)				X				X			
Plagiostoma errecta (Whitfield)							X		X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
Anomia argentaria Morton		X	X	X	X		X	X	X	X	
A. tellinoides Morton					X				X		
A. radiata Weller				X	X						
Paranomia scabra (Morton)				X			X		X		
Mytilus·smocki Weller									X		
M. oblivius Whitfield			X					X	X		
M. ? planus Richards		X									
Volsella monmouthensis (Weller)				X							
V. burlingtonensis (Whitfield)				?							
V. julia (Lea)				X	X						
V. wenonah (Weller)								X			
Crenella serica Conrad							X			X	
C. elegantula Meek and Hayden											X
Lithophaga ripleyana Gabb				X				X	X		
L. affinis Gabb				X							
Pholadomya occidentalis Morton			X	X	X						
P. roemeri Whitfield								X			
Anatina jerseyana Weller				X	X			X	X		
A. cliffwoodensis Weller			X								
A. jamesburgensis Weller				X							
Cercomya peculiaris (Conrad)					X						
Anatimya anteradiata Conrad					X			X			
A. lata (Whitfield)								X			
Periplomya elliptica (Gabb)									X		
Corimya tenuis Whitfield							X		X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA —*Continued*											
Clavigella armata Morton				X					X		
Liopistha protexta (Conrad)				X				X	X	X	X
L. alternata Weller				X							
L. kummeli Weller				X							
Cymella bella texana Stephenson			?	X	X			X			
C. undata (Meek and Hayden)								X			
Cuspidaria ventricosa (Meek and Hayden)								X		X	X
C. jerseyensis Weller									X		
Veniella conradi Morton				X	X			X	X	X	X
V. carolinensis aspera Stephenson							X				
V. trapezoidea Conrad				X	X				X		
Etea delawarensis (Gabb)					?						
Geloina ? tenuidens (Whitfield)		X									
Ambocardia cooki Whitfield		X									
Astarte veta Conrad		X									
A. ? annosa Conrad		X									
Opis elevata biangulata Stephenson		X									
Eriphyla decemnaria (Conrad)					X						
E. declivis (Conrad)					X						
E. parilis (Conrad)									X		
Vetericardia crenilirata (Conrad)				X	X						
Crassatellites subplanus (Conrad)							X	X	?	?	?
C. vadosus (Morton)									X		X
C. linteus (Conrad)							X	?			
C. carolinensis (Conrad)	?										

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
C. transversus (Gabb)								X			
C. cuneatus (Gabb)				X				X			
C. prorus (Conrad)				X	X						
C. hodgei Stephenson					X			?			
Uddenia conradi (Whitfield)				X	X						
Scambula perplana Conrad					X			X			
Corbicula ? whitfieldi Richards		X									
C. ? emacerata Whitfield		X									
Diceras dactyloides Whitfield									X		
Caprotina jerseyensis Weller									X		
Unicardium umbonata (Whitfield)							X		X		
Lucina glebula Conrad					X						
L. swedesboroensis Weller							X				
L. parva Stephenson					X						
Lucina sp					X						
Cardium wenonah Weller								X		X	
C. eufaulensis Conrad					X				X		
C. longstreeti Weller								X			
C. whitfieldi Weller					X						
C. cliffwoodensis Weller			X								
C. lorillardensis Weller					X						
C. ripleyanum Conrad			X	X	X						
C. spillmani Conrad				X					X		
C. kummeli Weller									X		X
C. uniformis Weller					X						

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
C. trilineatum Weller									X		
C. dumosum Conrad				X	X			X		X	
C. tenuistriatum Whitfield			X	X		X	X	X	X		
C. pilsbryi Weller				X							
C. sayri Richards		X									
C. raritanensis Richards		X									
Protocardium jerseyensis Weller				X							
Fulvia tenuis Whitfield									X		
Isocardia cliffwoodensis Weller			X		X			X			
I. tintonensis Weller											X
Naritra polliciformis Stephenson		X									
Tenea parilis (Conrad)			X	X	X			X	X	X	X
T. pinguis (Conrad)									X		
Dione delawarensis Gabb	X										
Cypremeria densata (Conrad)				X	X				X		
C. excavata (Morton)							X		X		
C. depressa (Conrad)					X						
C. welleri Stephenson			X		X			X			
Aphrodina tippana jerseyensis Richards n. subsp.				X	X						
A. cretacea (Conrad)					X		X				
A. eufaulensis (Conrad)							X	X	X		
Callistina ? johnsoni (Richards)		X									
Legumen planulatum Conrad	X										
L. concentricum Stephenson					X						
L. ellipticum Conrad									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
Tellina georgiana Gabb								X			
T. gabbi Gardner					X				X	X	
Linearia metastriata Conrad			X	X	X		X	X		X	
L. ornatissima Weller					X						
L. contracta Whitfield									X		
L. linuifera Stephenson		X									
Tellinamera eborea (Conrad)				X	X			X		X	
Aenona eufaulensis (Conrad)					X						
A. papyria Conrad					X						
Solyma lineolatus Conrad			X	X	X			X	X	X	
S. elliptica (Gabb)									X		
Leptosolen biplicata Conrad			X	X	X			X	X	X	
L. ? terminalis Weller				X							
L. ? elongata Weller		X								X	
Siliqua cretacea (Gabb)	?										
S. ventricosa Richards n. sp.	X										
Mactra pentangularis Weller					X						
Cymbophora trigonalis Stephenson			X	X							
C. lintea (Conrad)			X	X	X		X	X		X	X
C. tellinoides (Whitfield)								X			
Schizodesma appressa Gabb			X					X			
Corbula manleyi Weller		X									
C. manleyi duplex Richards		X									
C. lorillardensis Weller					X						
C. bisulcata Conrad			X	X	X						

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
PELECYPODA—*Continued*											
C. foulkei Lea				X	X						
C. crassiplica Gabb				X	X			X	X	X	
C. cliffwoodensis Weller			X								
C. jerseyensis Weller			X								
C. swedesboroensis Weller			X	X	X		X				
C. greywaczi Richards		X									
Caryocorbula ? ovisana Stephenson		X									
Panopea decisa Conrad			X	X	X			X	X	X	
Gastrochena whitfieldi Weller									X		
C. linguiformis Weller				X							
Pholas cithara Morton	?										
P. pectrosa Conrad				?	?			?			X
P. lorillardensis Richards n. sp.					X						
Goniochasma sp.							X				
Xylophagella irregularis (Gabb)				X	X						
X. kummeli Weller				X			X				
Martesia cretacea (Gabb)				X			X				
M. cretacea magnatuba Richards		X									
GASTROPODA											
Pleurotomaria crotaloides (Morton)									X		
P. ? tintonensis Whitfield											X
P. woolmani (Pilsbry)									X		
Patella tentorium Morton				X					X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
T. encrinoides Morton				X	X				X		
T. quadrilira Johnson			X		X	X					
T. granulicosta Gabb					X				X		
T. lenolensis Weller				X	X						
T. lippincotti Whitfield					X				X		
T. trilira Conrad								X			
T. tippana Conrad				X			X				
T. jerseyensis Weller		X									
T. lorillardensis Weller					X						
T. merchantvillensis Weller				X							
T. marshalltowensis Weller							X				
T. bakeri Richards		X									
T. bonaspes Gardner								?			
Turbinopsis depressa Gabb				X	X			X	X		
T. angulata Whitfield									X		
T. curta Whitfield									X		
T. ? major Whitfield									X		
Cerithium pilsbryi Whitfield				X							
Voysa ? cuniculana Stephenson		X									
Anchura rostrata (Gabb)				X	X			X			
A. pennata (Morton)					X				X		
Anchura ? pergracilis Johnson			X		X						
A. solitaria Whitfield				X							
A. abrupta Conrad				X	X				X		
A. hebe (Whitfield)									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
Petropoma ? raritanum (Richards)		X									
Angaria navesinkensis Weller									X		
Urceolabrum reticulatum (Johnson)					X						
Obeliscus conellus Whitfield					X						
Leiostraca cretacea (Conrad)					X						
Scala sillmani Morton				X	X			X	X		X
S. cyclostoma (Gabb)	X										
S. thomasi (Gabb) ?	X										
S. hercules Whitfield		X									
Margarites abyssina (Gabb)				X	X				X		X
Lunatia halli Gabb				X	X			X	X		
L. ? pauperata (Whitfield)									X		
Amauropsis meekana Whitfield				X	X						
A. punctata (Gabb)									X		
A. cadwaladeri Richards		X									
Gyrodes abyssinus (Morton)									X		
G. supraplicatus (Conrad)				X	X			X			
G. petrosus (Morton)		X		X				X	X	X	
Polinices altispira (Gabb)				X	X						
Xenophora leprosa (Morton)									X		
Endoptygma umbilicata (Tuomey)				X	X						
Lirpsa ? lepida Stephenson		X									
Tenagodus pauperata Whitfield									X		
Laxispira lumbricalis Gabb				X	X						
Turritella vertebroides Morton									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
A. arenaria (Morton)									X		
A. johnsoni Stephenson					X						
A. bakeri Richards		X									
A. raritanensis Richards		X									
Pterocerella sp.								X			
Triton lorillardensis Weller					X						
T. praecedens Whitfield									X		
Trachytriton ? atlanticum Whitfield									X		
T. ? holmdelense Whitfield									X		
T. ? multivaricosum Whitfield									X		
Pugnellus densatus (Conrad)					X			X			
Rostellaria curta Whitfield									X		
R. fusiformis Whitfield									X		
Rostellites texturatus (Whitfield)				X					X		
R. nasutus (Gabb)				X	X				X		
R. angulatus Whitfield									X		
Cypraea mortoni Gabb									X		
Hercorhynchus jerseyensis Weller			X								
Napulus retifer (Gabb)								X	X		
N. whitfieldi (Weller)									X		
N. octoliratus (Conrad)					X						
Napulus lenolensis (Weller)				X							
P. pyruloidea (Gabb)									X		
P. septemlirata (Gabb)									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
P. corrina Whitfield									?		
P. planimarginata (Whitfield)									X		
P. reileyi Whitfield									X		
P. trochiformis (Tuomey)							X		X		X
P. ? obesa Whitfield									X		
Sargana sp.							X				
Morea naticella (Gabb)				X							
M. plicata (Whitfield)					X				X		
"Pyrula" precedens (Whitfield)									X		
Perissolax dubia (Gabb)									X		
Seminola globosa (Gabb)								X			
Euthria ? fragilis Whitfield					X						
Fusinus holmesianus Gabb								X			
F. cliffwoodensis Weller			X								
F. holmdelensis Whitfield									X		
F. lorillardensis Weller					X						
Bellifusus medians (Whitfield)				X			X		X		
B. slacki (Gabb)				X	X				X		
Xancus intermedia Weller				X							
X. alabamensis (Gabb)								X	X		
X. parva Gabb									X		
Xancus subconica Gabb									X		
Aliofusus ? sayri Richards		X									
Fasciolaria ? obliquicostata Gabb					X						
"Fasciolaria" sp.		X									

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
Odontofusus typicus Whitfield									X		
O. mucronata (Gabb)									X		
Pyrifusus meeki Whitfield									X		
P. mullicaensis (Gabb)									X		X
P. cuneus Whitfield									X		X
P. macfarlandi Whitfield									X		
P. erraticus Whitfield			X								
P. ? elevata (Whitfield)									X		
Serrifusus nodocarinatus Whitfield									X		
S. crosswickensis Whitfield									X		
Piestochilus bella (Gabb)									X		
P. kanei (Gabb)			X					X	X		
Vulpecula reileyi (Whitfield)									X		
Volutoderma woolmani Whitfield				X							
V. biplicata (Gabb)				X	X		X	X			
V. ovata Whitfield									X		
V. jamesburgensis Weller				X							
Volutomorpha conradi (Gabb)			X	X	X				X		
V. ponderosa Whitfield									X		
V. delawarensis (Gabb)	X										
Liopeplum cretaceum Gardner					X						
Liopeplum ruhlei Richards					X						
Vasum conoides Whitfield									X		
Cithara mullicaensis Whitfield									X		
C. crosswickensis Whitfield									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
GASTROPODA—*Continued*											
Caveola subalta (Conrad)				X	X						
Cancellaria smocki Weller				X							
Paladmete pristina Stephenson		X									
Turricula scalariformis Whitfield									X		
T. leda Whitfield									X		
Surcula strigosa Gabb									X		
Acteon cretacea Gabb					X			X	X		
A. forbesiana Whitfield	X										
A. gabbana (Whitfield)					X						X
Nonactaeonina sp.					X						
Avellana bullata (Morton)				X					X		
A. pelagana Stephenson		X									
A. costata (Johnson)					X						
Cinulia naticoides (Gabb)									X		
Ellipsoscapha mortoni Forbes									X		
Cylichna recta (Gabb)								X	X		
Bulla macrostoma Gabb										X	
SCAPHOPODA											
Dentalium subarcuatum Conrad				X	X						
Dentalium jerseyensis Richards n. sp.					X						
Cadulus obnutus Conrad					X						
NAUTILOIDEA											
Eutriphoceras dekayi Morton									X	X	

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
AMMONOIDEA											
Baculites ovatus Say				X	X				X		
Baculites asper Morton			X								
Baculites sp.									X		
Baculites sp.									X		
Baculites sp.				X	X						
Nostoceras pauper (Whitfield)							X	X	X		
Nostoceras sp.									X		
Cirroceras conradi (Morton)									X		
Solenoceras annulifer (Morton)				X	X						
Menuites ? aff. *M. complexus* (Hall and Meek)								X	X		
Scaphites hippocrepis (DeKay)				X							
Scaphites similis Whitfield				X							
Scaphites aff. *S. leei* Reeside				X							
Placenticeras placenta (DeKay)			X	X	X		X	X			
Placenticeras spillmani Hyatt ?	X										
Placenticeras sp. indeterminate	X										
Menabites (Delawarella) delawarensis (Morton)				X							
Submortoniceras vanuxemi (Morton)				X							
? *Barroisiceras (Texasia) dentocarinatum* (Roemer)	X										
Sphenodiscus lobatus (Tuomey)											X
Sphenodiscus beecheri Hyatt											?
BELEMNITDAE											
Belemnitella americana (Morton) sensu lato									X		

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
BELEMNITDAE—*Continued*											
B. americana americana Jeletzky n. var.									X		
B. americana subfusiformis Whitfield									X		
B. americana longa Jeletzky n. var.									X		
B. americana polita Jeletzky n. var.									X		
B. americana intermedia Jeletzky n. var.									X		
B. americana a									X		
B. americana b									X		
CRUSTACEA											
Enoploclytia (Enoploclytia) sp.				X							
E. (Palaeastacus) sp.				X*							
E. gen. et sp. indet.				X*							
Hoploparia gabbi Pilsbry				X							
H. gladiator Pilsbry				X							
H. sp.	X										
Oncopareia sp.				X							
Protocallianassa mortoni (Pilsbry)				X				X	X		X
P. praecepta n. sp.				X							
P. cliffwoodensis n. sp.			X								
Palaeopagurus pilsbryi n. sp.				X							
Archaeocarabus ? whitfieldi (Pilsbry)	X										
Linuparus richardsi n. sp.				X							
Xanthosia elegans n. sp.				X							
Homolopsis atlantica n. sp				X							
H. dispar n. sp.				X							

	N. J. (formation ?)	RARITAN	MAGOTHY	MERCHANTVILLE	WOODBURY	ENGLISHTOWN	MARSHALLTOWN	WENONAH	MT. L.-NAV.	RED BANK	TINTON
CRUSTACEA—*Continued*											
Necrocarcinus rathbunae n. sp.				X*	X						
Paranecrocarcinus gamma n. sp.				X							
Prehepatus dilksi n. sp.				X							
Tetracarcinus subquadratus Weller			X		X						
Notopocorystes testacea (Rathbun)									X		
Raninella tridens n. sp.				X							
Raninella sp.					X						
Xanthias ? lenolensis Rathbun				X							
Brachyuridea indet. 1				X							
Brachyuridea indet. 2	X										
Decapoda indet.	X										

* Delaware only.

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Plates

PLATE 47

Figure		*Page*
1.	*Patella tentorium* Morton, Arneytown, N.J. ANSP 19445 x 4	2
2.	*Pleurotoma abbotti* Gabb (TYPE) = *P. crotaloides* Morton, Mullica Hill, N.J. NJSM 7577 x 2.5	1
3.	*Delphinula navesinkensis* Weller, Mullica Hill, N.J. NJSM 7577 x 2.5	4
4.	*Margarites abyssina* (Gabb), Lenola, N.J. (after Weller) x 1	9
5.	*Margarites abyssina* (Gabb), Middletown, N.J. (after Weller) x 1	9
6.	*Pleurotomaria woolmani* Pilsbry, Mullica Hill, N.J. ANSP 1625 x 0.9	2
7.	*Margarites abyssina* (Gabb) (TYPE), Burlington County, N.J. ANSP 18780 x 4	9
8.	*Leiostraca cretacea* (Conrad) (TYPE), Haddonfield, N.J. ANSP 15585 x 4	5
9.	*Lunatia halli* Gabb, Mullica Hill, N.J. ANSP 19640 x 1	10
10.	*Lunatia halli* Gabb, Mullica Hill, N.J. ANSP 19443 x 1.2	10
11.	*Obeliscus conellus* Whitefield, Haddonfield, N.J. ANSP 15626 x 12	5
12.	*Lunatia halli* Gabb (TYPE), Mullica Hill, N.J. ANSP 19637 x 2	10
13.	*Lunatia pauperata* (Whitfield) (TYPE), Crosswicks Creek, N.J. NJSM 7605 x 3	10

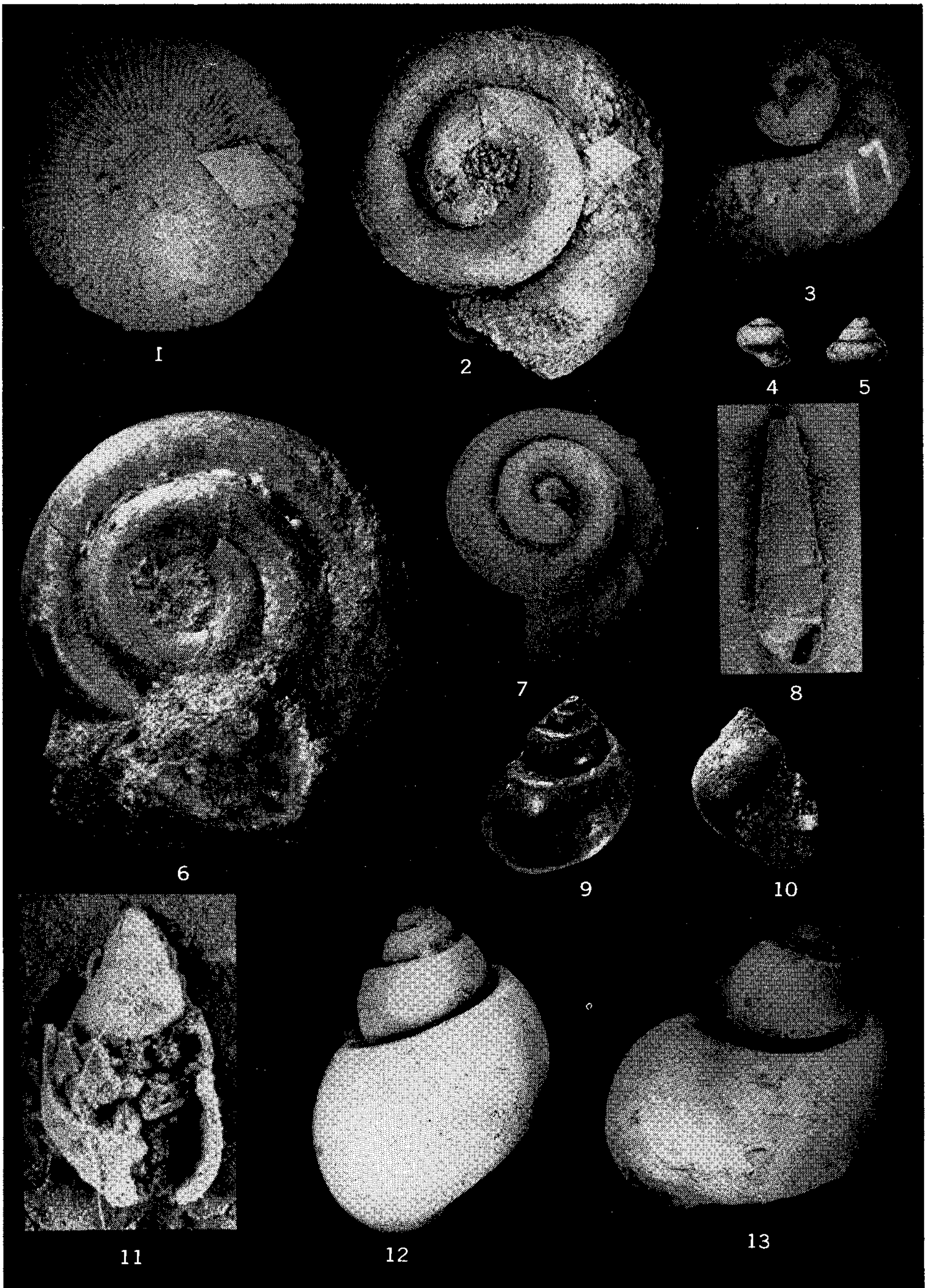

PLATE 47

PLATE 48

Figure *Page*

1. *Amauropsis meekana* Whitfield, (COTYPE), Haddonfield, N.J.,
   ANSP 15159 x 3 11

2. *Amauropsis punctata* Gabb, Mullica Hill, N.J.,
   ANSP 15175 x 3 12

3. *Amauropsis punctata* Gabb, (TYPE), Mullica Hill, N.J.,
   ANSP 15156 x 3 12

4. *Amauropsis punctata* Gabb, Mullica Hill, N.J.,
   ANSP 15158 x 2 12

5. *Gyrodes supraplicatus* (Conrad), Haddonfield, N.J.,
   ANSP 15134 x 3 13

6. *Gyrodes abbotti* Gabb = *G. abyssina* (Morton), Mullica Hill, N.J.,
   ANSP 15145 x 1 12

7. *Gyrodes crenata* Conrad = *G. supraplicatus* (Conrad), Lenola, N.J.,
   ANSP 12790 x 1.5 13

8. *Gyrodes abyssina* (Morton), Mullica Hill, N.J.,
   ANSP 15779 x 3 12

9. *Gyrodes infracarinata* Gabb (TYPE) = *G. supraplicatus* (Conrad)
   Crosswicks, N.J.,
   ANSP 15132 x 1.5 13

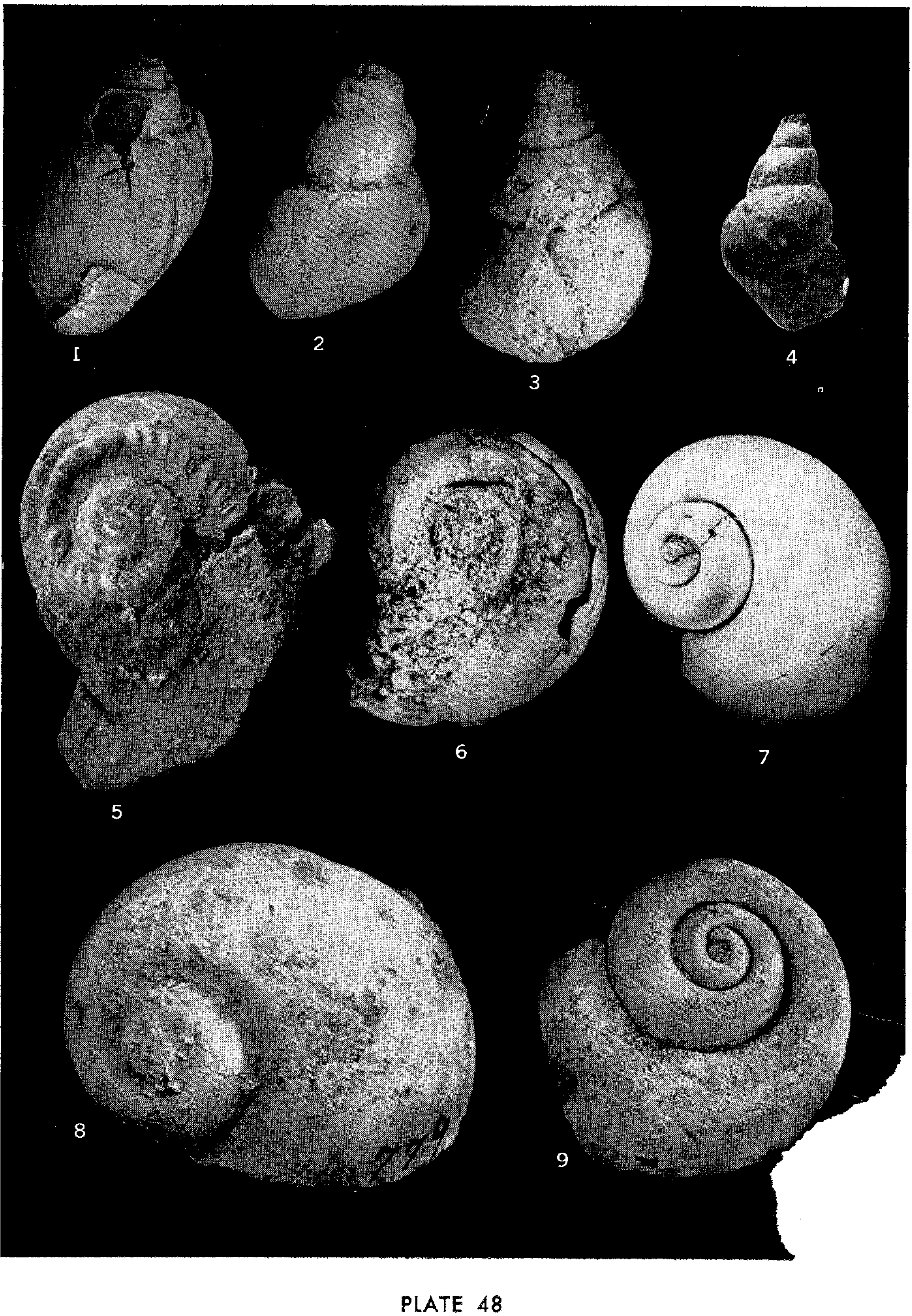

PLATE 48

PLATE 49

Figure		Page
1.	*Gyrodes crenata* Conrad = *G. supraplicatus*, Lenola, N.J., ANSP 12790 x 1.3	13
2.	*Polinices altispira* (Gabb), Crosswicks, N.J., ANSP 19638 x 2.5	15
3.	*Gyrodes petrosus* (Morton), Mullica Hill, N.J., ANSP 15138 x 2	14
4.	*Polinices altispira* (Gabb), New Jersey, ANSP 15130 x 2.5	15
5.	*Xenophora leprosa* (Morton), near Burlington, N.J., ANSP 15364 x 1.5	16
6.	*Xenophora leprosa* (Morton), near Burlington, N.J., ANSP 15364 x 1.5	16
7.	*Endoptygma umbilicata* (Tuomey), Lenola, N.J., ANSP 21 x 2	17
8.	*Endoptygma umbilicata* (Tuomey), Lenola, N.J., ANSP 21 x 2	17
9.	*Turritella vertebroides* Morton, New Jersey, ANSP 15516 x 0.9	19
10.	*Turritella tippana* Conrad, Maple Shade, N.J., ANSP 19424 x 2	24
11.	*Turritella encrinoides* Morton, New Jersey, ANSP 15519 x 2	20
12.	*Turritella encrinoides* Morton, Crosswicks, N.J., ANSP 15552 x 2	20
13.	*Turritella marshalltownensis* Weller, Swedesboro, N.J., NJSM 7715 x 0.8	27

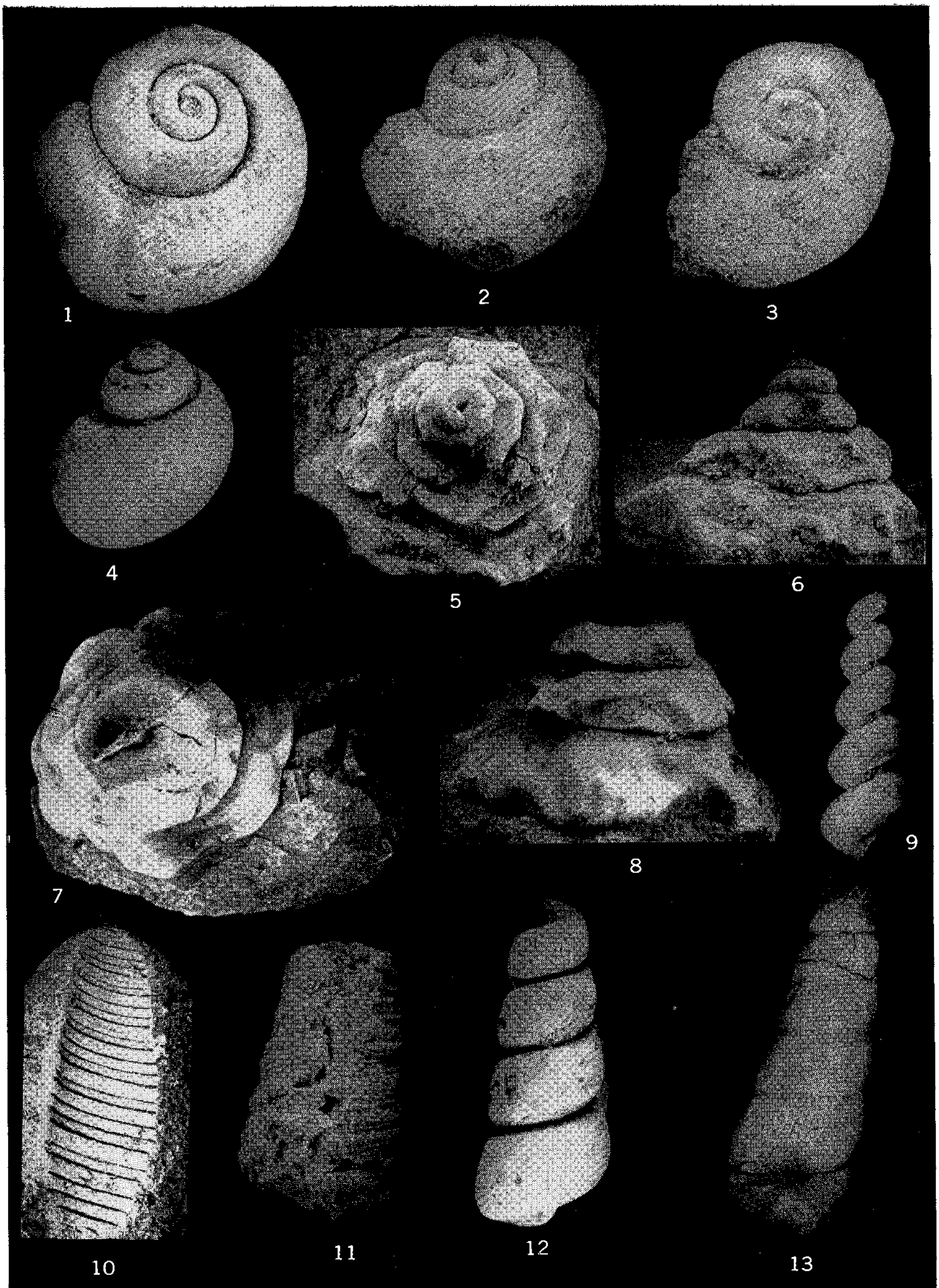

PLATE 49

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Figure *Page*

1. *Scala cyclostoma* Gabb, New Jersey,
   ANSP 15496 x 3 7
2. *Scala thomasi* Gabb, New Jersey,
   ANSP 15499 x 3 7
3. *Scala sillimani* (Morton), Lenola, N.J.,
   ANSP 678 x 1.5 6
4. *Turritella merchantvillensis* Weller, Lenola, N.J.,
   NJSM x 1 26
5. *Turritella vertebroides* Morton, Mt. Laurel well, N.J.,
   ANSP x 2.5 19
6. *Turritella quadrilira* Johnson, Fellowship, N.J., well
   ANSP 19768 x 1 21
7. *Turritella pumila* Whitfield = *T. encrinoides* Morton ? Vincentown, N.J.,
   ANSP 15483 x 2.5 20
8. *Siliquaria pauperata* Whitfield, New Jersey,
   ANSP 15558 x 2.5 18
9. *Siliquaria pauperata* Whitfield, New Jersey,
   ANSP 15558 x 2 18
10. *Cerithium pilsbryi* Whitfield, Lenola, N.J.,
    ANSP 36 x 2 30
11. *Anchura rostrata* (Gabb), Maple Shade, N.J.,
    ANSP 19451 x 1.5 32
12. *Anchura rostrata* (Gabb), Maple Shade, N.J.,
    ANSP 19451 x 3 32

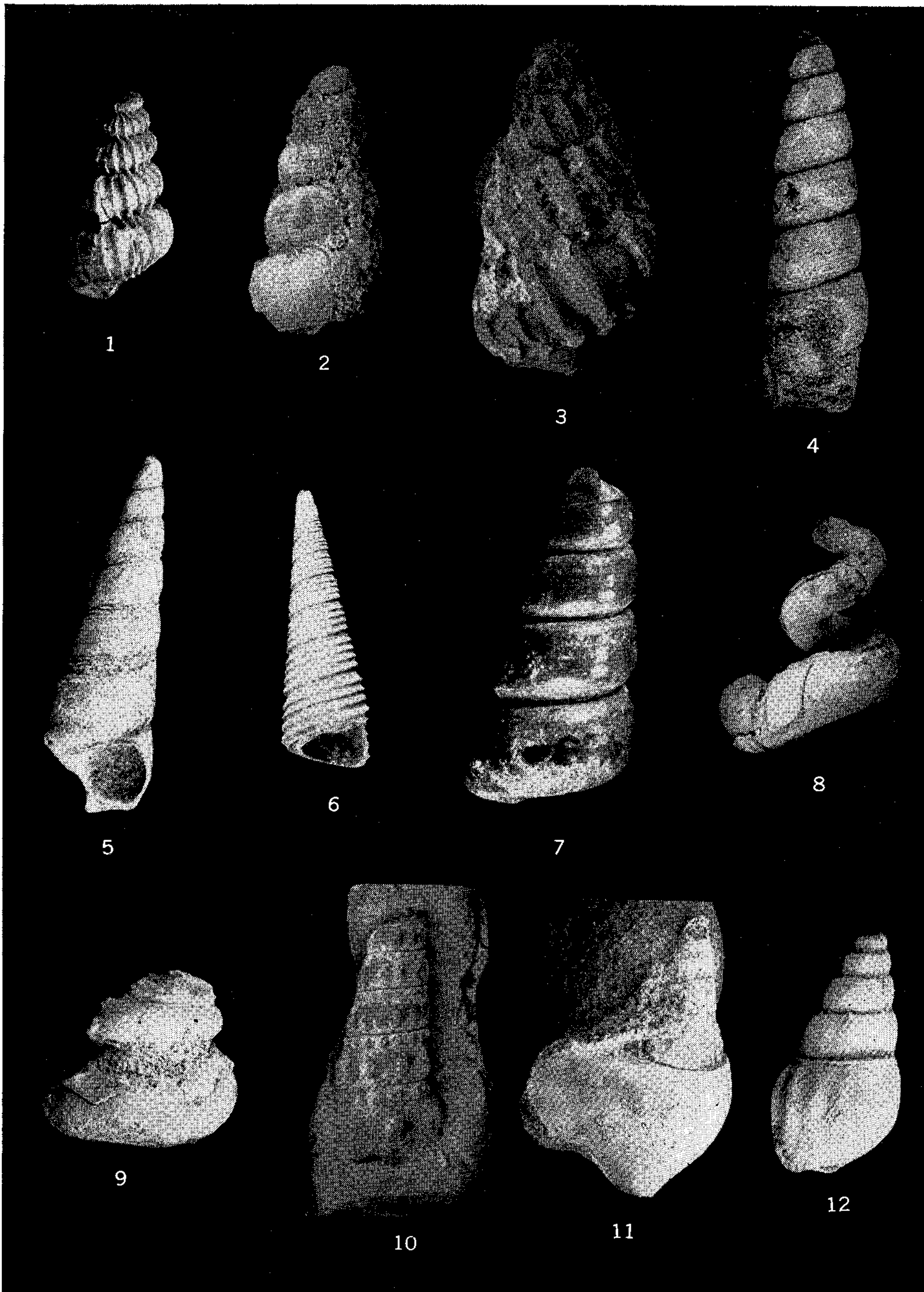

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Figure *Page*

1. *Turritella compacta* Whitfield = *T. granulicosta* Gabb, Haddonfield, N.J., ANSP 15481 x 1.25 21

2. *Turritella quadrilira* Johnson, Mt. Laurel well, N.J., ANSP 690 x 3 21

3. *Turritella granulicosta* Gabb, Burlington, N.J., ANSP 15549 x 2.5 21

4. *Turritella lippincotti* Whitfield, New Jersey, x 1.2 22

5. *Turritella jerseyensis* Weller, Cliffwood, N.J., NJSM 9533 x 1 24

6. *Turritella lippincotti* Whitfield, Crosswicks, N.J., ANSP 15550 x 1 22

7. *Turritella lorillardensis* Weller, Lorillard, N.J., NJSM 9489 x 0.7 25

8. *Turritella marshalltownensis* Weller, Swedesboro, N.J., NJSM 7715 x 0.8 27

9. *Turritella tippana* Conrad, Maple Shade, N.J., ANSP 19424 x 1 24

10. *Turritella marshalltownensis* Weller, Swedesboro, N.J., NJSM x 1 27

11. *Turritella trilira* Conrad, Crawfords Corner, N.J., NJSM 7698 x 0.8 23

12. *Turritella lenolensis* Weller, Lenola, N.J., x 1 (after Weller) 22

13. *Turritella lorillardensis* Weller, Lorillard, N.J., x 1 (after Weller) 25

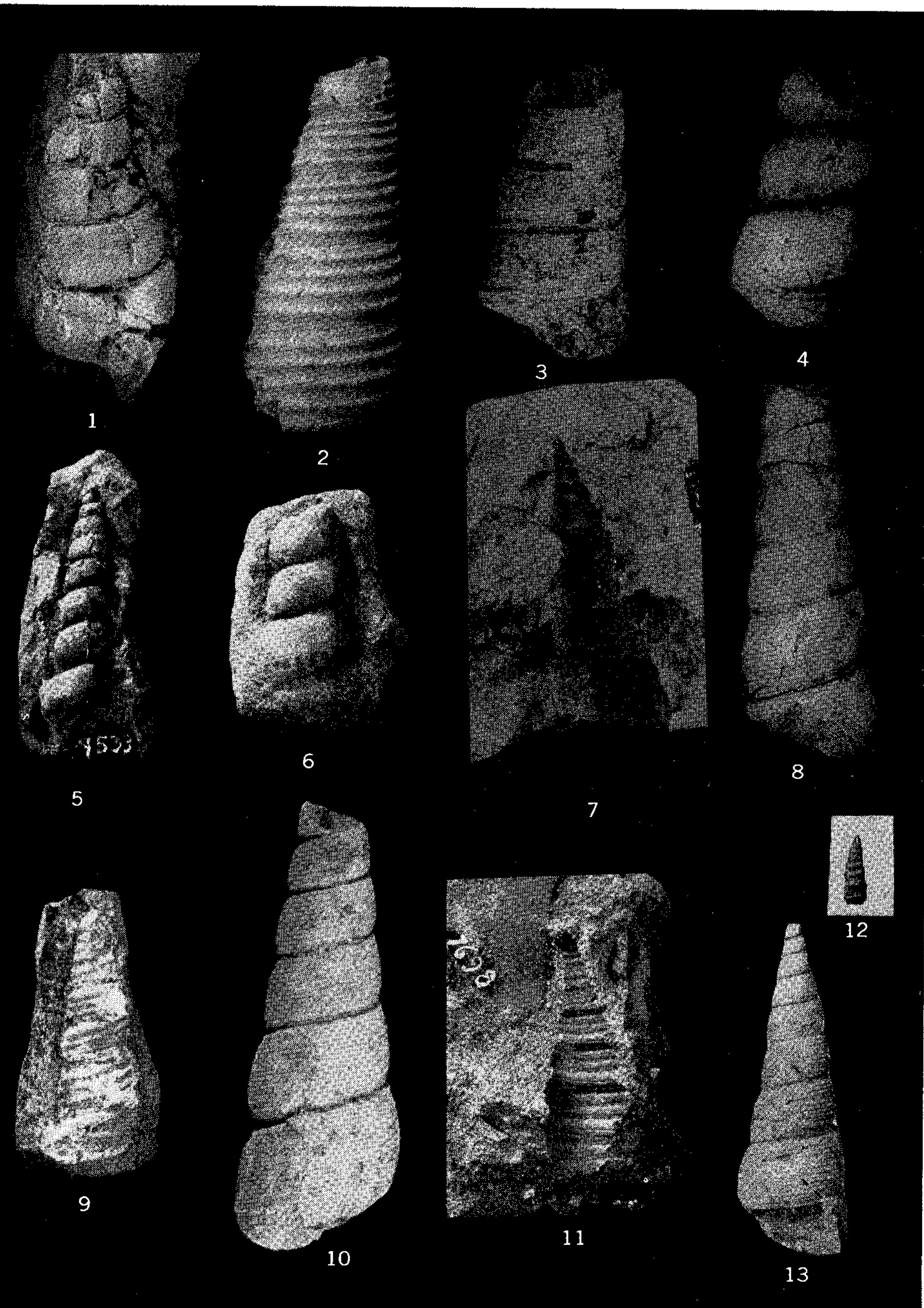

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PLATE 52

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Figure		*Page*
1.	*Anchura rostrata* (Gabb), Maple Shade, N.J., ANSP 19451 x 2.5	32
2.	*Anchura pennata* (Morton), Mullica Hill, N.J., ANSP 15043 x 2	33
3.	*Anchura ? pergracilis* Johnson, Mt. Laurel, N.J., ANSP 692 x 2.5	34
4.	*Anchura solitaria* Whitfield, New Jersey, ANSP 15047 x 2	34
5.	*Anchura arenaria* Morton, Mullica Hill, N.J., ANSP 15008 x 1	37
6.	*Anchura pennata* (Morton), Crosswicks, N.J., ANSP 15014 x 1.5	33
7.	*Anchura spirata* Whitfield (TYPE) = *A. pennata* (Morton) Crosswicks, N.J., ANSP 15014 x 2.5	33
8.	*Pugnellus densatus* (Conrad), Crawfords Corner, N.J., NJSM 7693 x 1.5	43
9.	*Cypraea mortoni* Gabb, Burlington, N.J., ANSP 13537 x 2.5	47
10.	*Rostellaria curta* Whitfield, Crosswicks Creek, N.J., NJSM 7636 x 2	44
11.	*Rostellaria fusiformis* Whitfield, Crosswicks Creek, N.J., NJSM 7638 x 1.8	44
12.	*Perissolax dubia* (Gabb), New Jersey, ANSP 17198 x 1.2	59

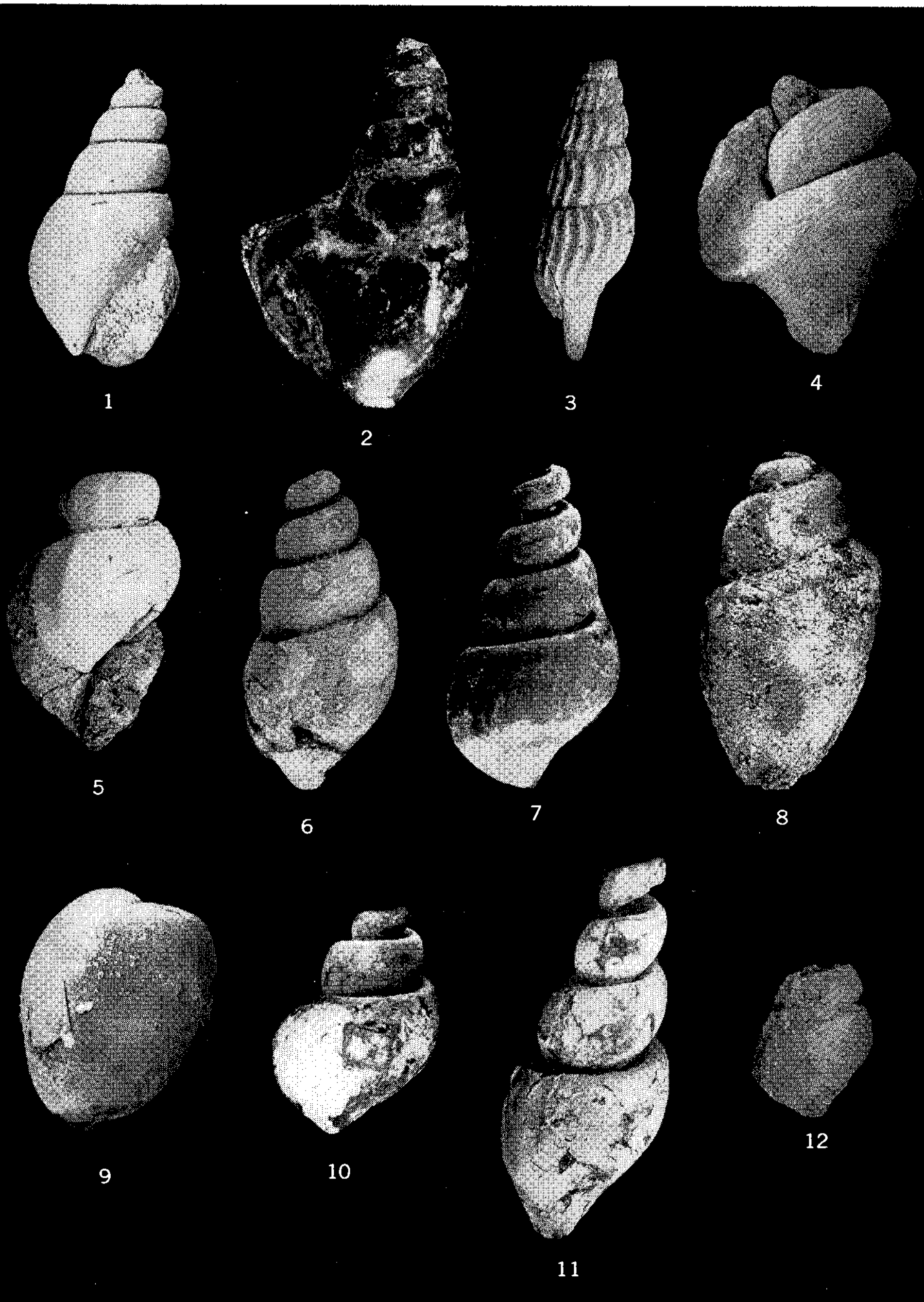

PLATE 53

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Figure — *Page*

1-2. *"Pyrula" precedens* (Whitfield) (TYPE), (after Weller), Holmdel, N.J., x 1 58

3-4. *Triton lorillardensis* Weller (TYPE), (after Weller), Lorillard, N.J., x 1 40

5-6. *Triton praecedens* Whitfield (TYPE), (after Weller), Mullica Hill, N.J., x 1 41

7-8. *Pyrifusus meeki* Whitfield (after Weller), Mullica Hill, N.J., x 1 70

9-10. *Herchroynchus jerseyensis* Weller (after Weller), Cliffwood, N.J., x 1 47

11. *Pyropsis planimarginata* (Whitfield) (TYPE), (after Weller), Crosswicks Creek, N.J., x 1 53

12. *Triton trochiformis* (Tuomey), Evansville, N.J., ANSP 357 x 1 54

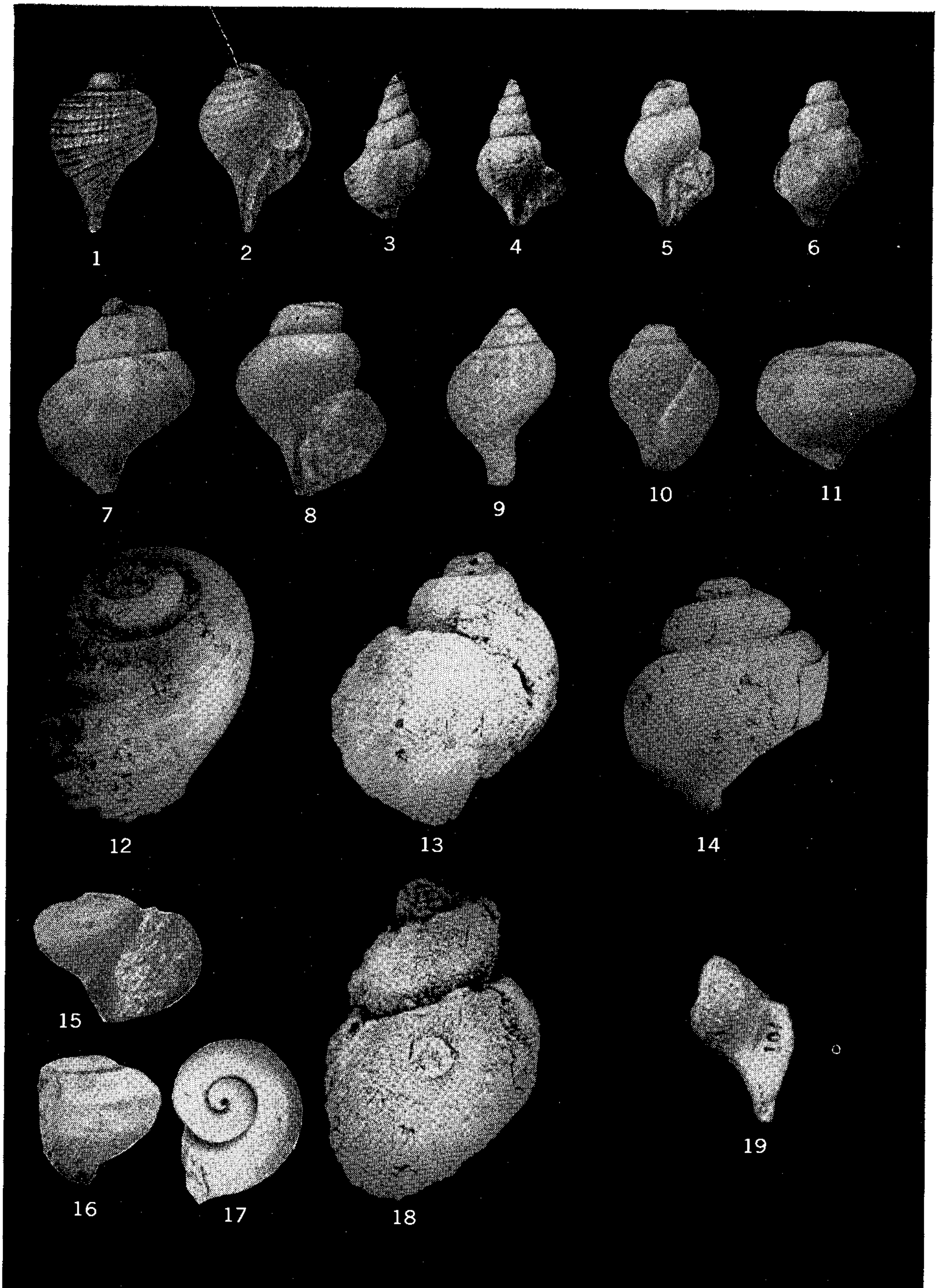
13. *Napulus retifer* (Gabb), Mullica Hill, N.J., ANSP 13936 x 3 48

14. *Pyropsis ? obesa* Whitfield, AMNH 8851 55

15-17. *Pyropsis planimarginata* (Whitfield), (after Weller), Crosswicks Creek, N.J., x 1 53

18. *Fusinus holmesianus* Gabb, Crawfords Corner, N.J., NJSM 9809 x 4 61

19. *Fusinus cliffwoodensis* (Weller) Cliffwood, N.J., NJSM 9538 x 1.3 61



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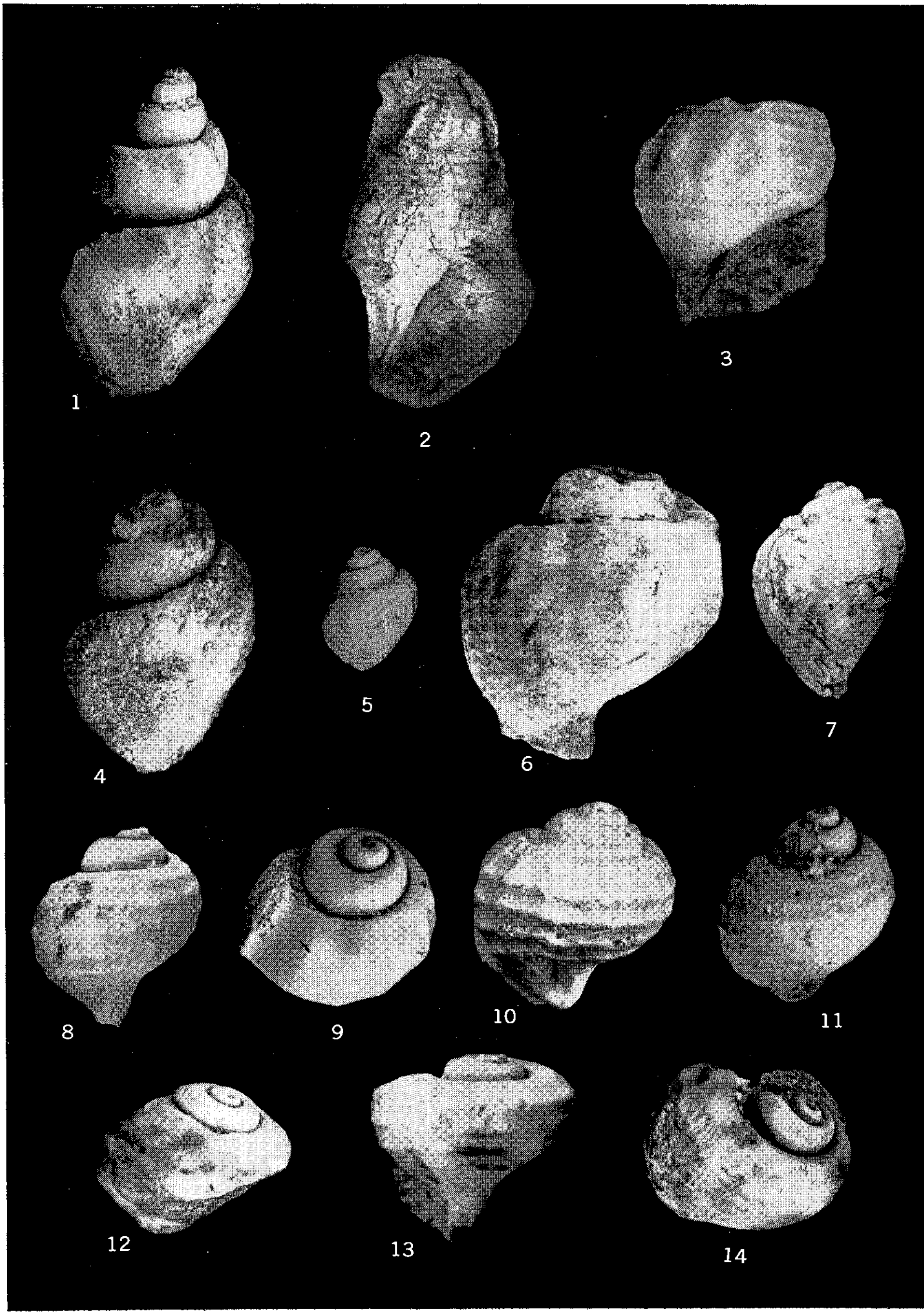

PLATE 55

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Figure *Page*

1. *Pyropsis septemlirata* (Gabb), Mullica Hill, N. J., NJSM 10092 x 1 52

2. *Pyropsis septemlirata* (Gabb), Mullica Hill, N.J., NJSM 10092 x 1 52

3. *Pyropsis trochiformis* (Tuomey), Mullica Hill, N.J., ANSP 13765 x 2 54

4. *Fusinus holmesianus* Gabb, Crawfords Corner, N.J., NJSM 9809 x 2.5 61

5. *Turbinella alabamensis* (Gabb), New Jersey ANSP 17117 x 1.1 65

6. *Volutoderma ovata* Whitfield, Atlantic Highlands, N.J., NJSM 7645 x 1 79

7. *Liopeplum cretacea* (Conrad), Crosswicks, N.J., ANSP 14606 x 2 83

8. *Liopeplum ruhlei* Richards (TYPE), Fellowship, N.J., ANSP 19764 x 1 83

9. *Rostellites nasutus* (Gabb), Crosswicks, N.J., ANSP 14415 x 1 45

10. *Rostellites angulata* Whitfield, New Jersey, ANSP 14391 x 0.5 46

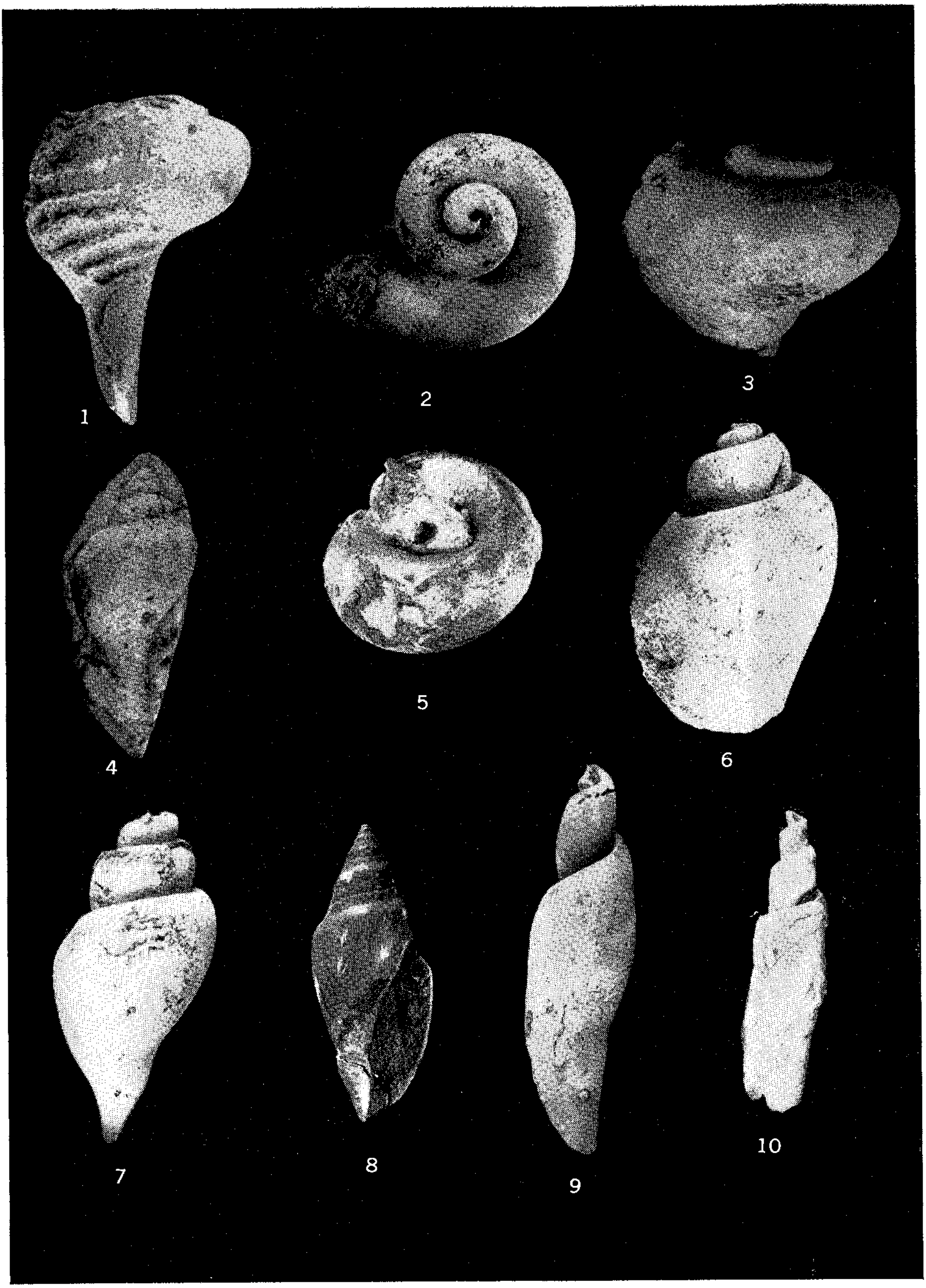

PLATE 56

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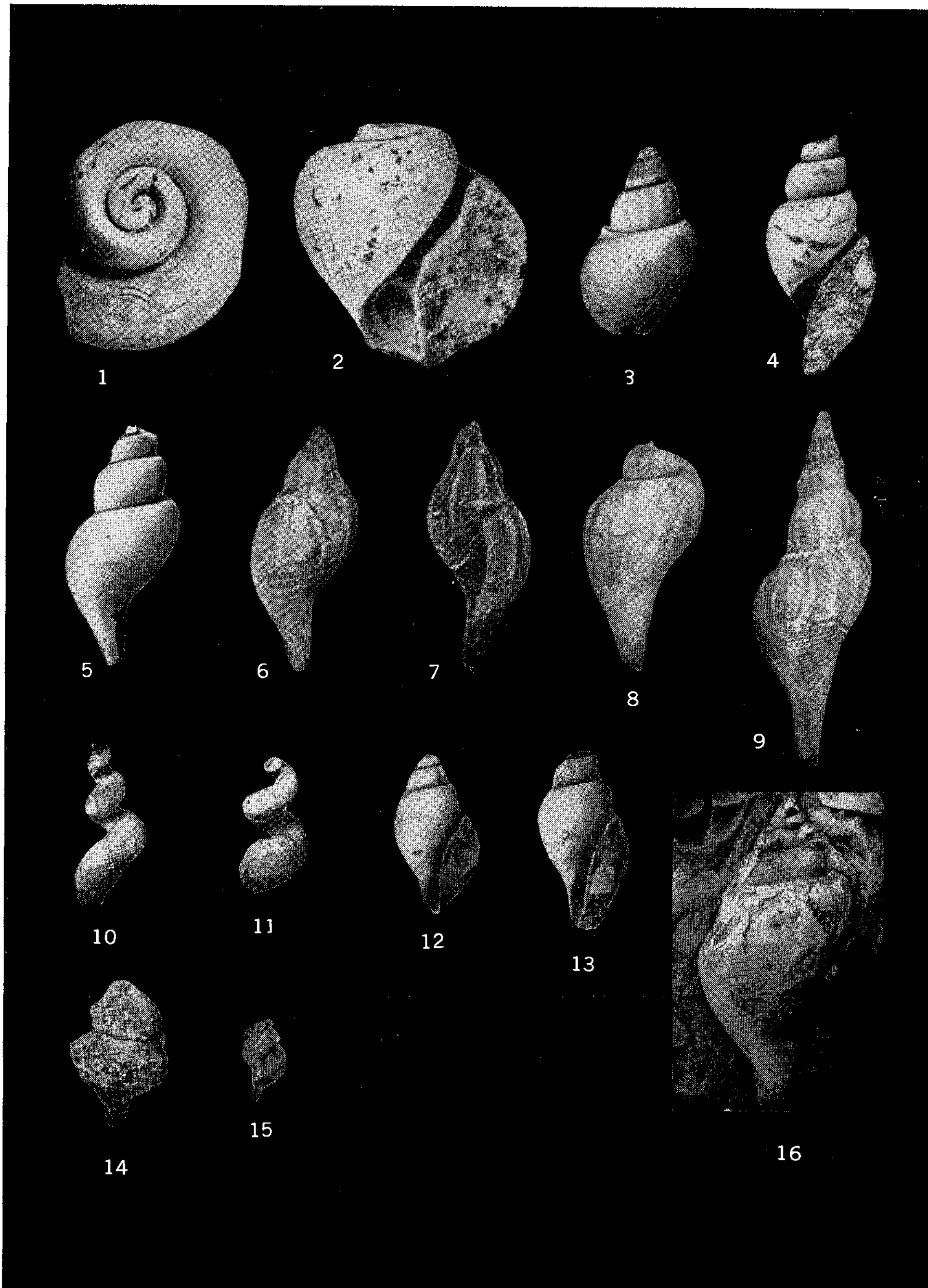
Figure		Page
1-2.	*Pyropsis reileyi* Whitfield = *P. trochoformis,* (after Weller), Holmdel, N.J., x 1	55
3-5.	*Trachitriton ? multivaricosum* Whitfield (after Weller), Crosswicks Creek, N.J., x 1	42
6-7.	*Fusinus holmdelensis* (Whitfield) (after Weller), Holmdel, N.J., x 1	62
8-9.	*Fusinus lorrillardensis* (Weller) (after Weller), Lorillard, N.J., x 1	62
10-11.	*Laxispira lumbricalis* Gabb, (after Weller), Lorillard, N.J., x 1	18
12-13.	*Trachitriton ? atlanticum* Whitfield (after Weller), Crosswicks Creek, N.J., x 1	41
14.	*Serrifusus nodocarinatus* Whitfield (after Weller), Holmdel, N.J., x 1	74
15.	"*Fasciolaria*" *? obliquicostata* Gabb (after Weller), Lorillard, N.J., x 1	68
16.	*Euthria ? fragilis* Whitfield, Haddonfield, N.J., ANSP 16867 x 2.5	60



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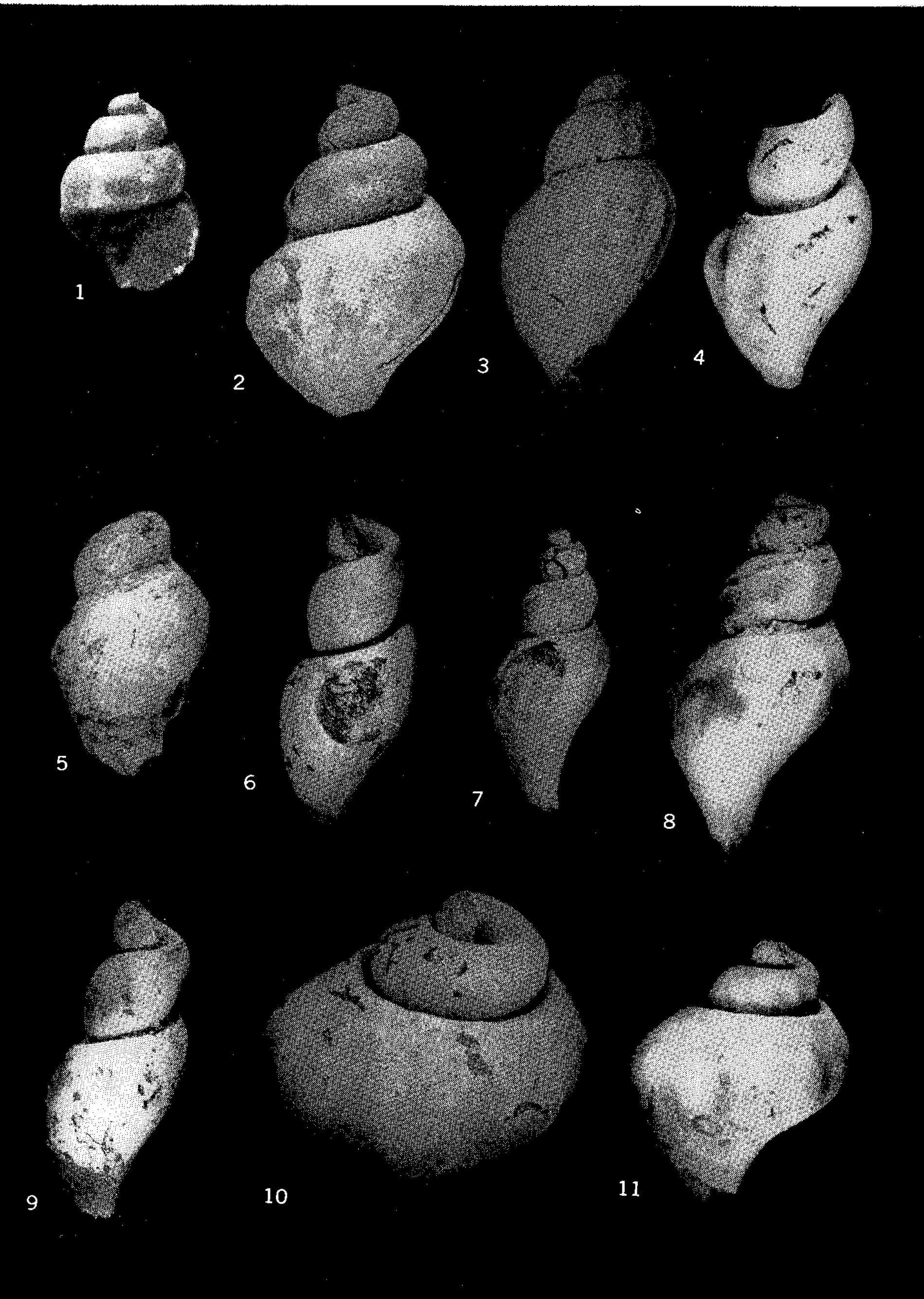

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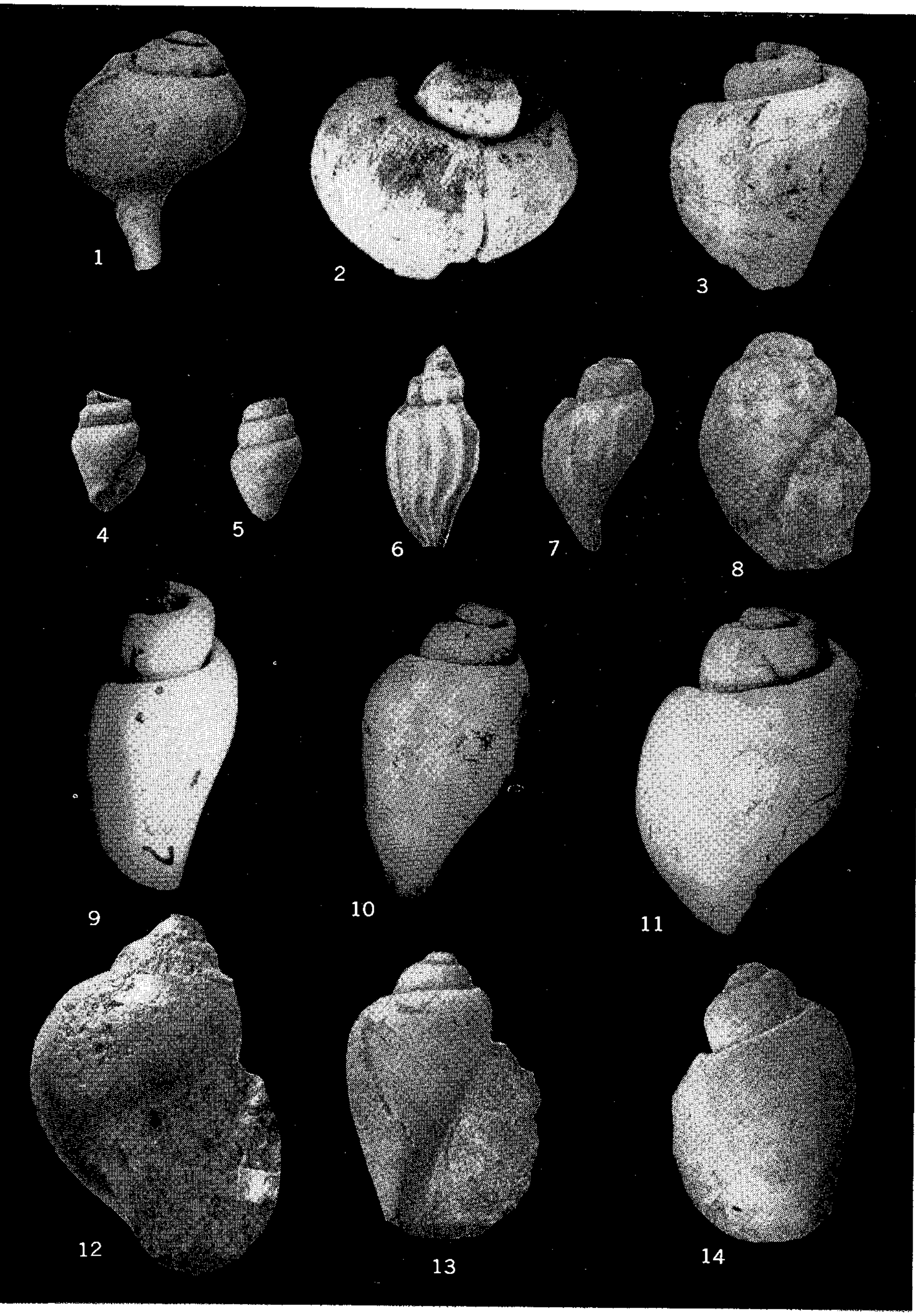

PLATE 59

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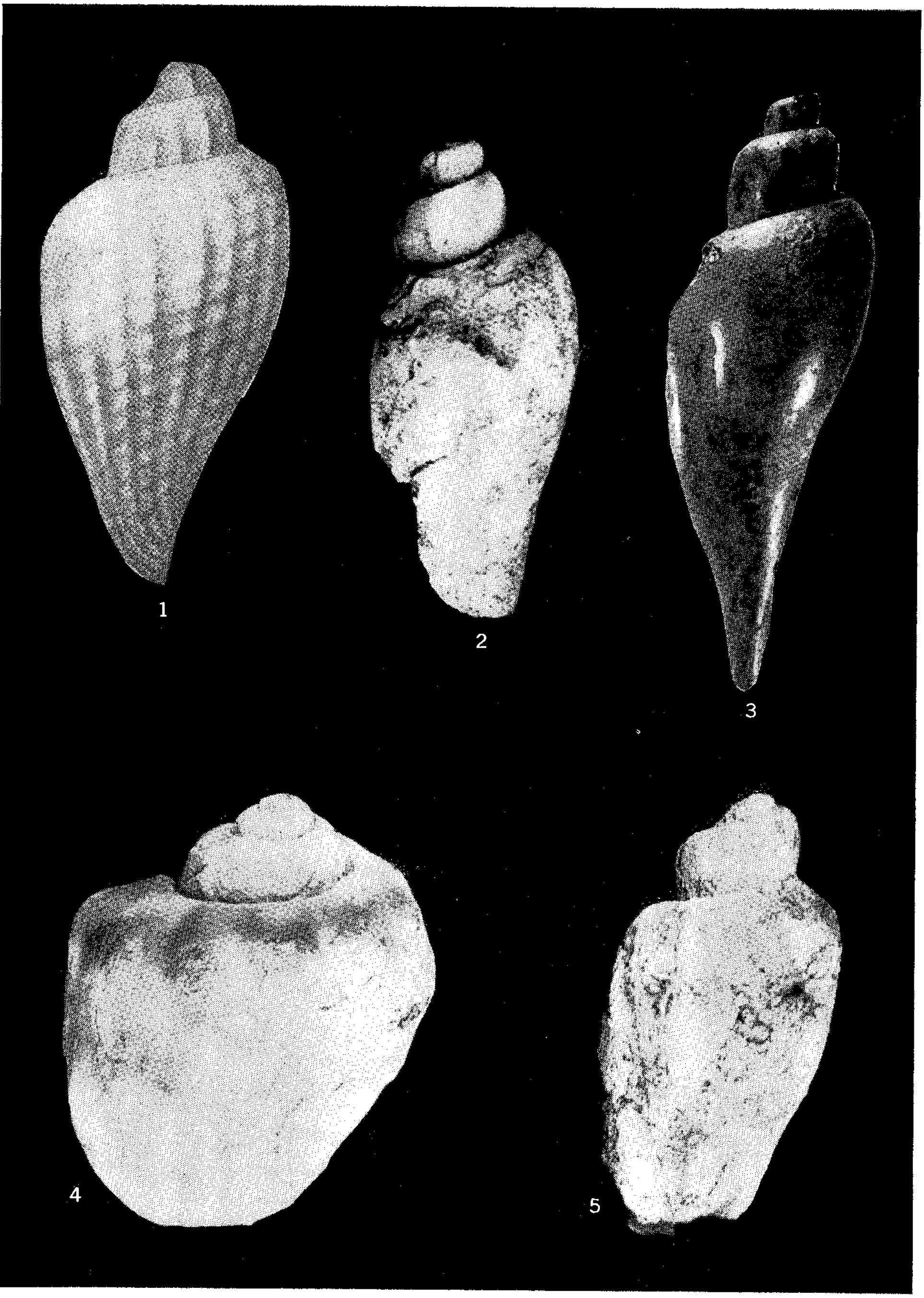

PLATE 60

PLATE 61

Figure *Page*

1. *Volutomorpha conradi* (Gabb), Chesapeake & Delaware Canal, USNM x 0.9 80

2. *Piestochilus bella* Gabb ?, Timber Creek, N.J., ANSP 14395 x 0.9 75

3. *Piestochilus bella* Gabb (TYPE), Chesapeake & Delaware Canal, ANSP 14612 x 2 75

4. *Piestochilus kanei* (Gabb), Crosswicks, N.J., ANSP 14381 x 2 76

5. *Piestochilus kanei* (Gabb), Clementon, N.J., ANSP 19999 x 2 76

6. *Rostellites texturatus* (Whitfield), Lenola, N.J., ANSP 33 x 0.67 45

7. *Pyrifusus mullicaensis* (Gabb), x 1.5 71

8. *Caveola subalta* (Conrad), Haddonfield, N.J., ANSP 14961 x 5 86

9. *Cancellaria smocki* Weller, Lorillard, N.J., NJSM 7722 x 1 87

10. *Rostellites nasutus* (Gabb) (TYPE), Crosswicks, N.J., ANSP 14415 x 0.75 45

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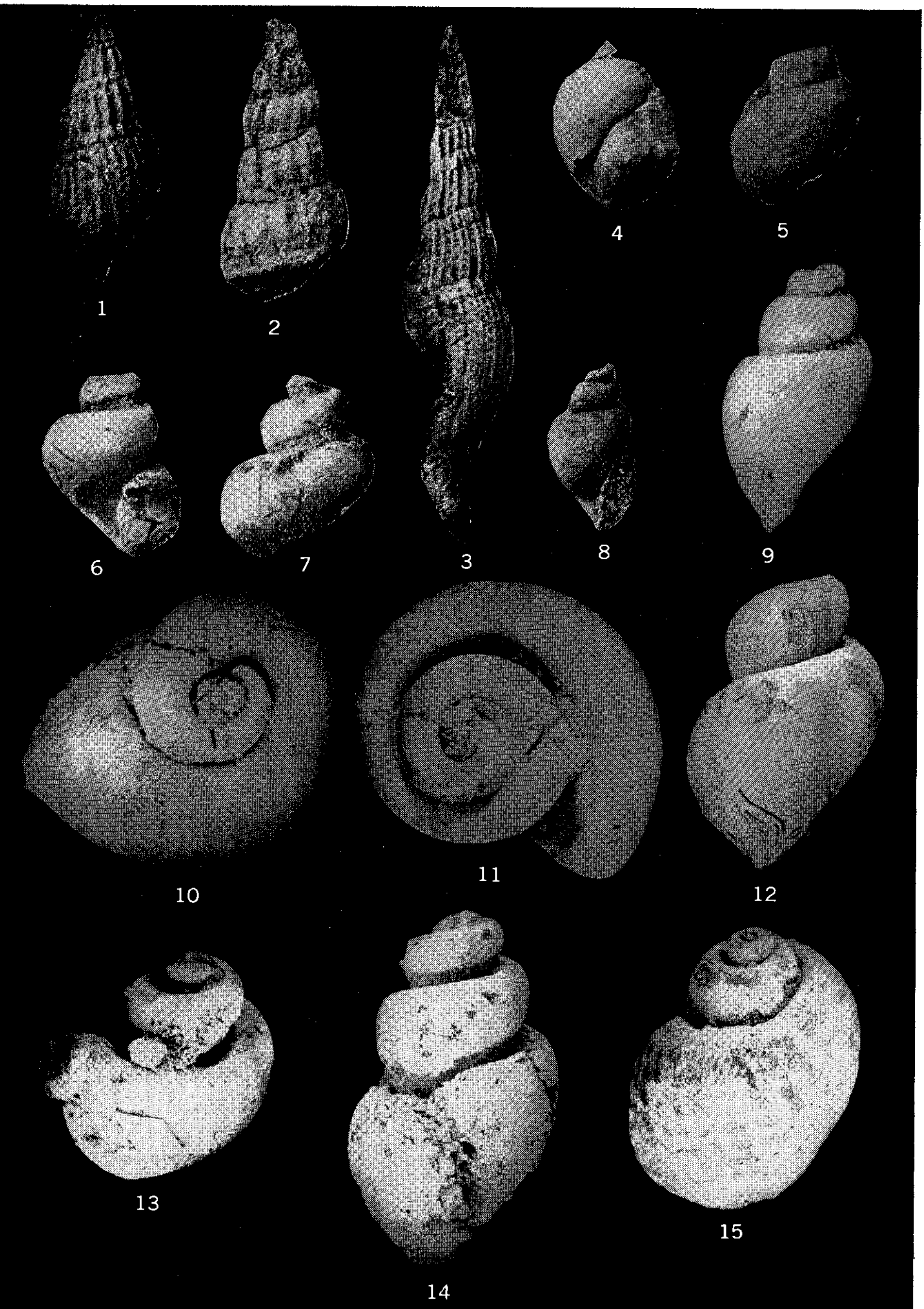

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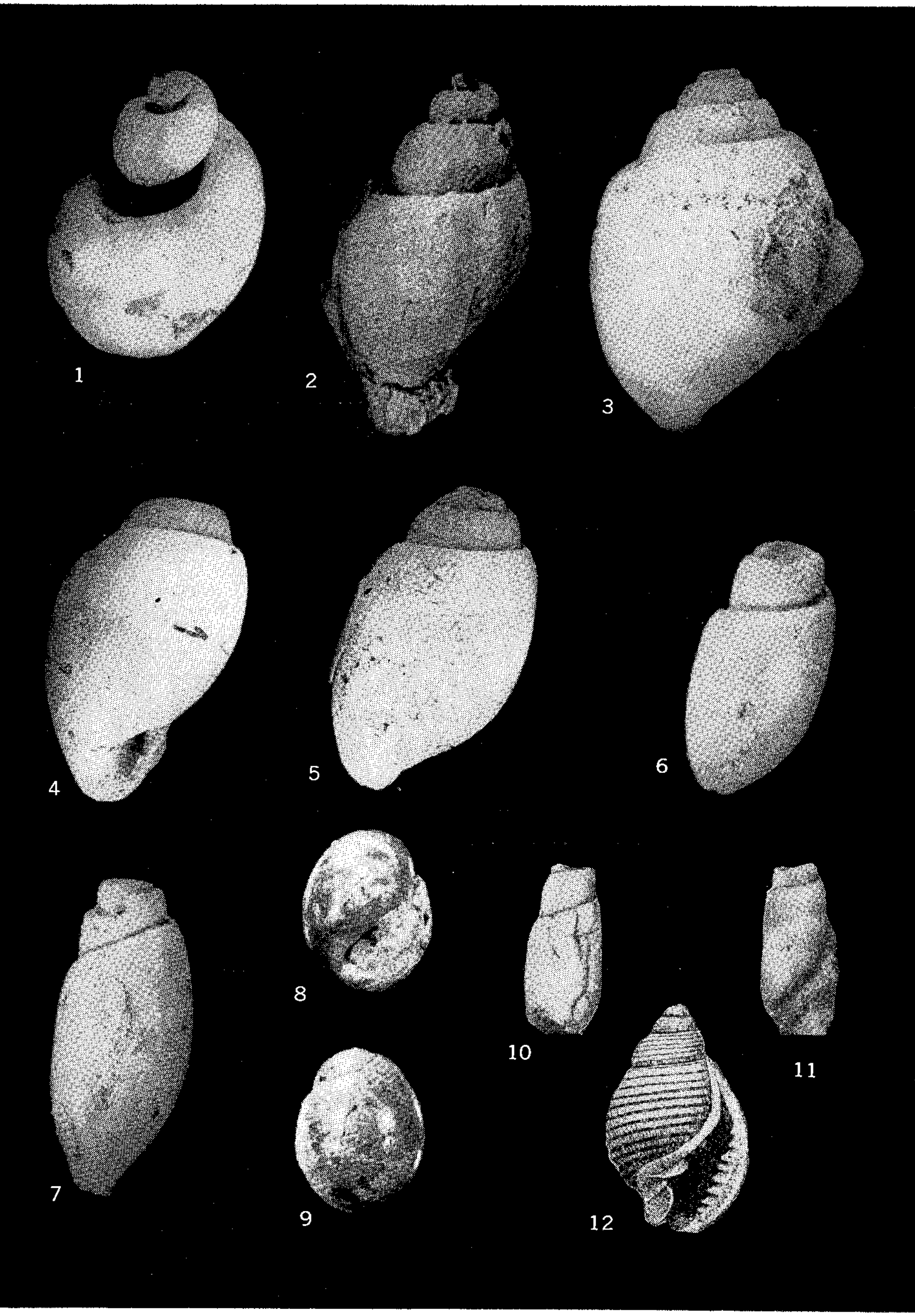
Figure		*Page*
1.	*Morea plicata* (Whitfield), Crosswicks, N.J., ANSP 14967 x 2	57
2.	*Cithara mullicaensis* Whitfield, New Jersey	84
3-4.	*Acteon cretacea* Gabb, Crosswicks, N.J., ANSP 18778 x 3	90
5.	*Acteon forbesiana* Whitfield, ANSP 18777 x 4	91
6.	*Acteon gabbana* (Whitfield), Tinton Falls, N.J., ANSP 19467 x 3	91
7.	*Acteon gabbana* (Whitfield) (TYPE), New Jersey, ANSP 19466 x 3	91
8-9.	*Avellana bullata* (Morton), New Jersey ANSP 19702 x 1	92
10-11.	*Nonacteonina* sp. (after Weller), Matawan, N.J., x 1	92
12.	*Avellana costata* (Johnson) (after Johnson), Mt. Laurel, N.J., well x 8.5	94



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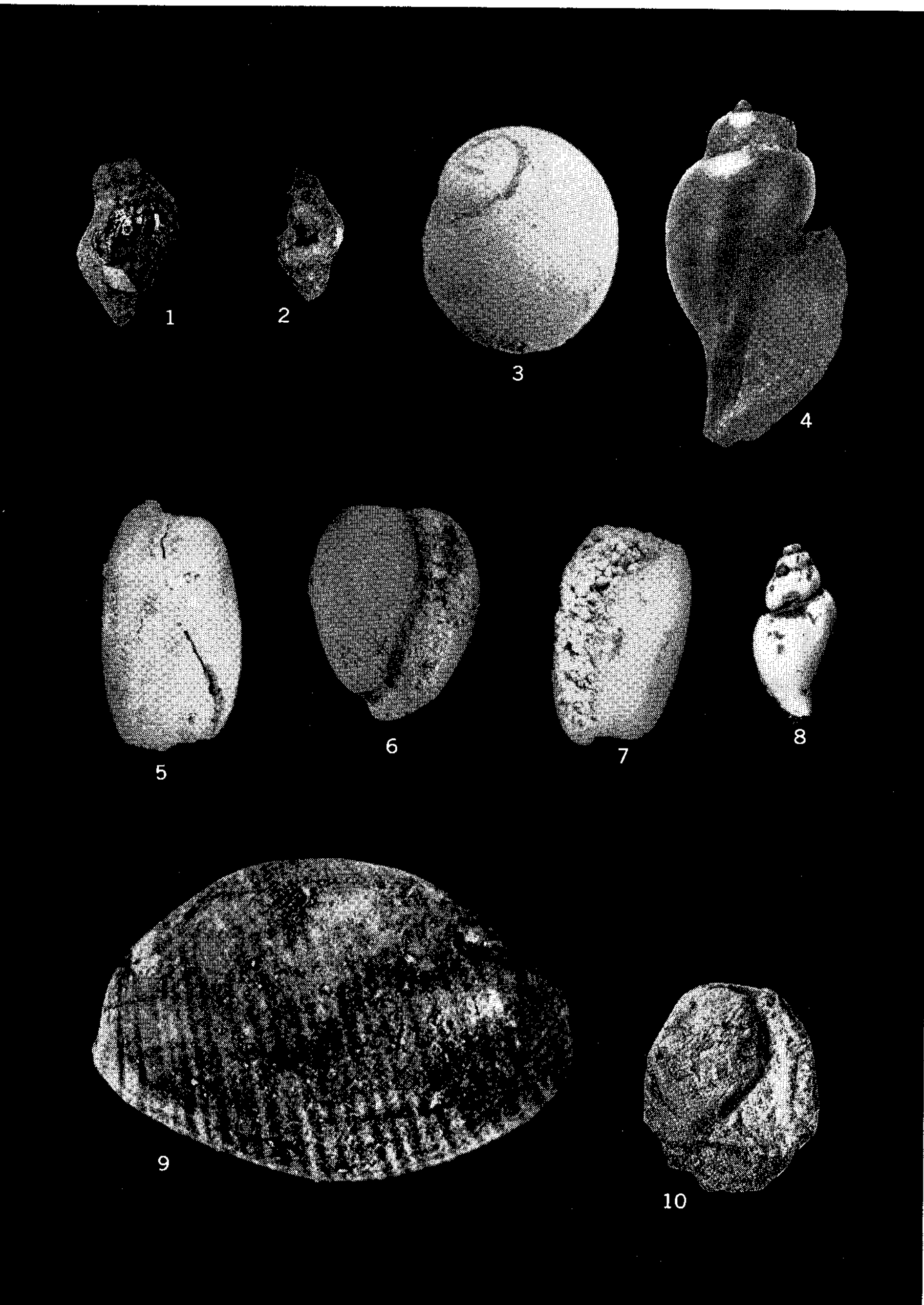

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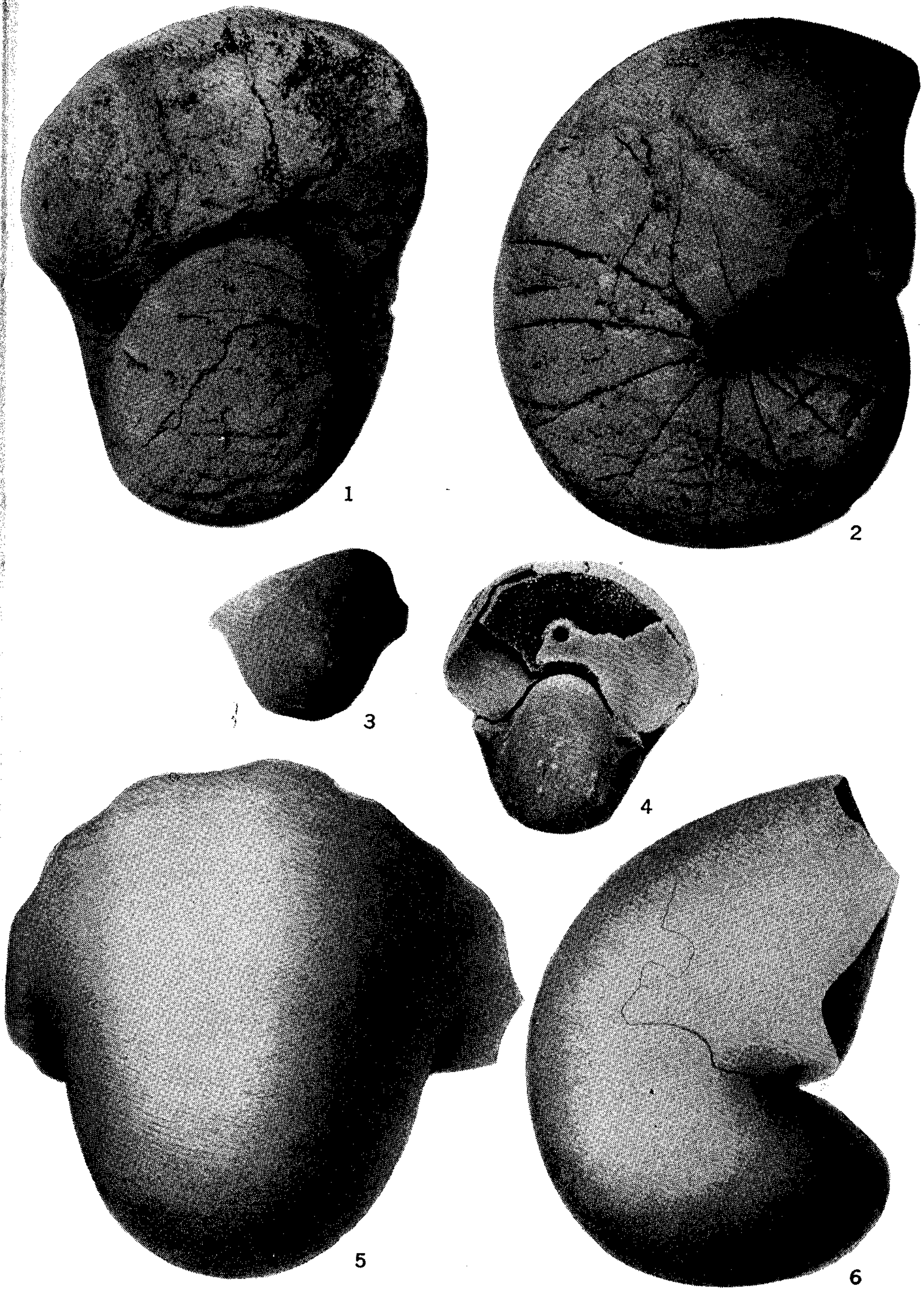

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1-2. *Eutrephoceras dekayi dekayi* (Morton). Ventral and lateral views of an essentially complete mature specimen from the Pierre shale of Montana. Most of the phragmacone of this individual is testiferous, but the adoral portion of the phragmacone and all of the body chamber are decorticated. ANSP 19683 x 1 105

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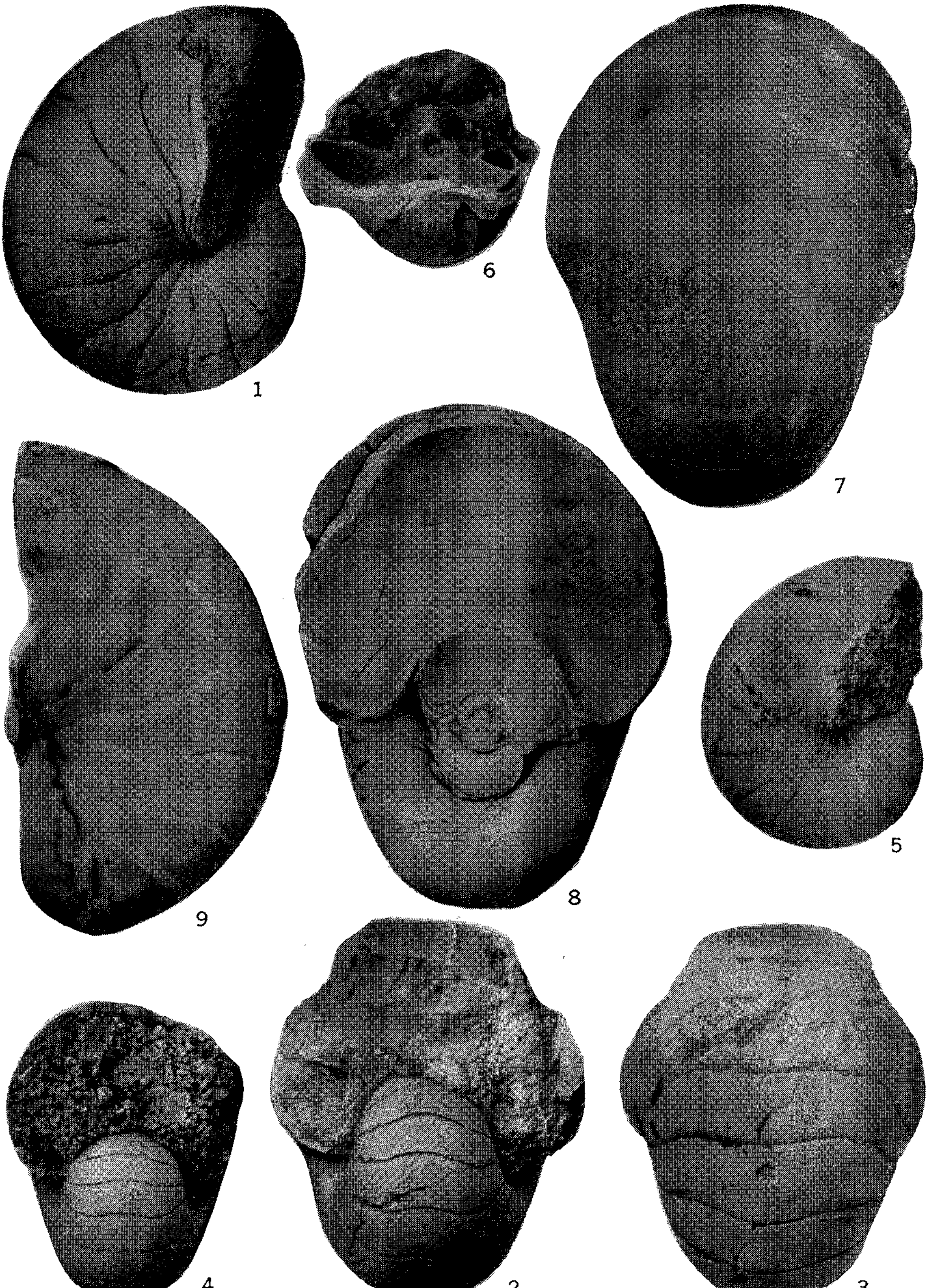

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1-3. *Baculites ovatus* Say. Possible remainder of Say's type specimen, side, siphonal and apical views. In tray with specimens from St. Georges, Delaware.
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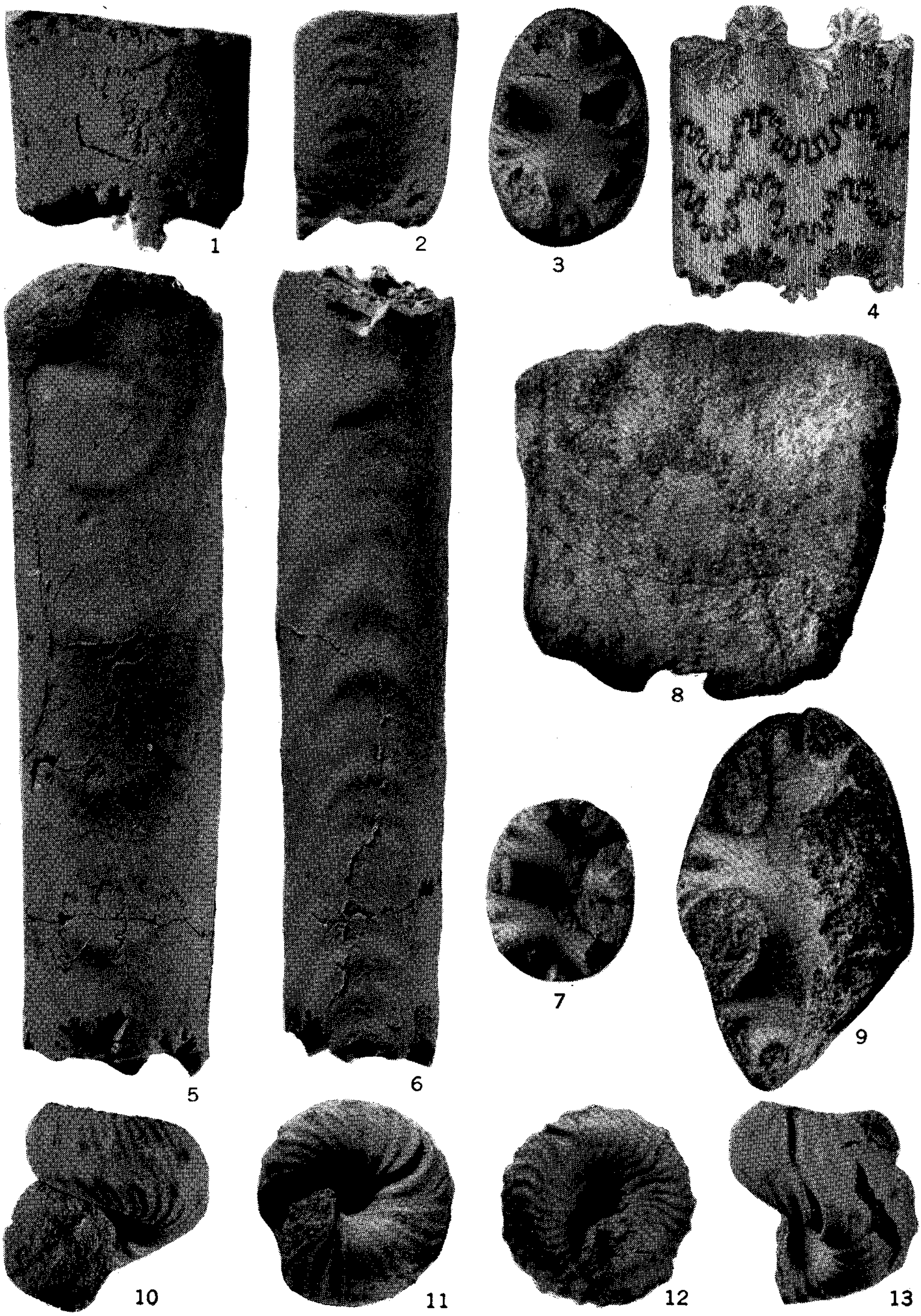

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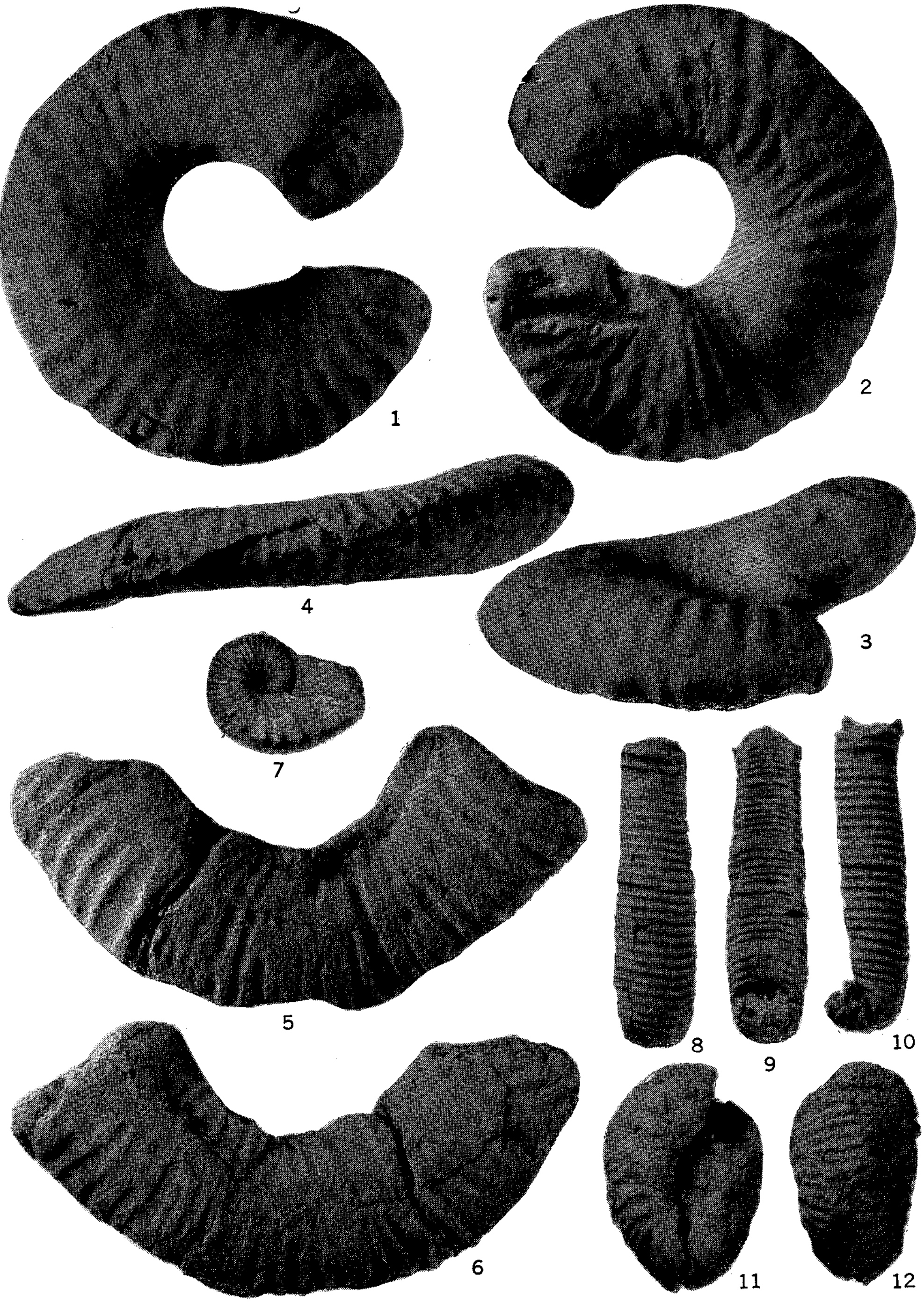

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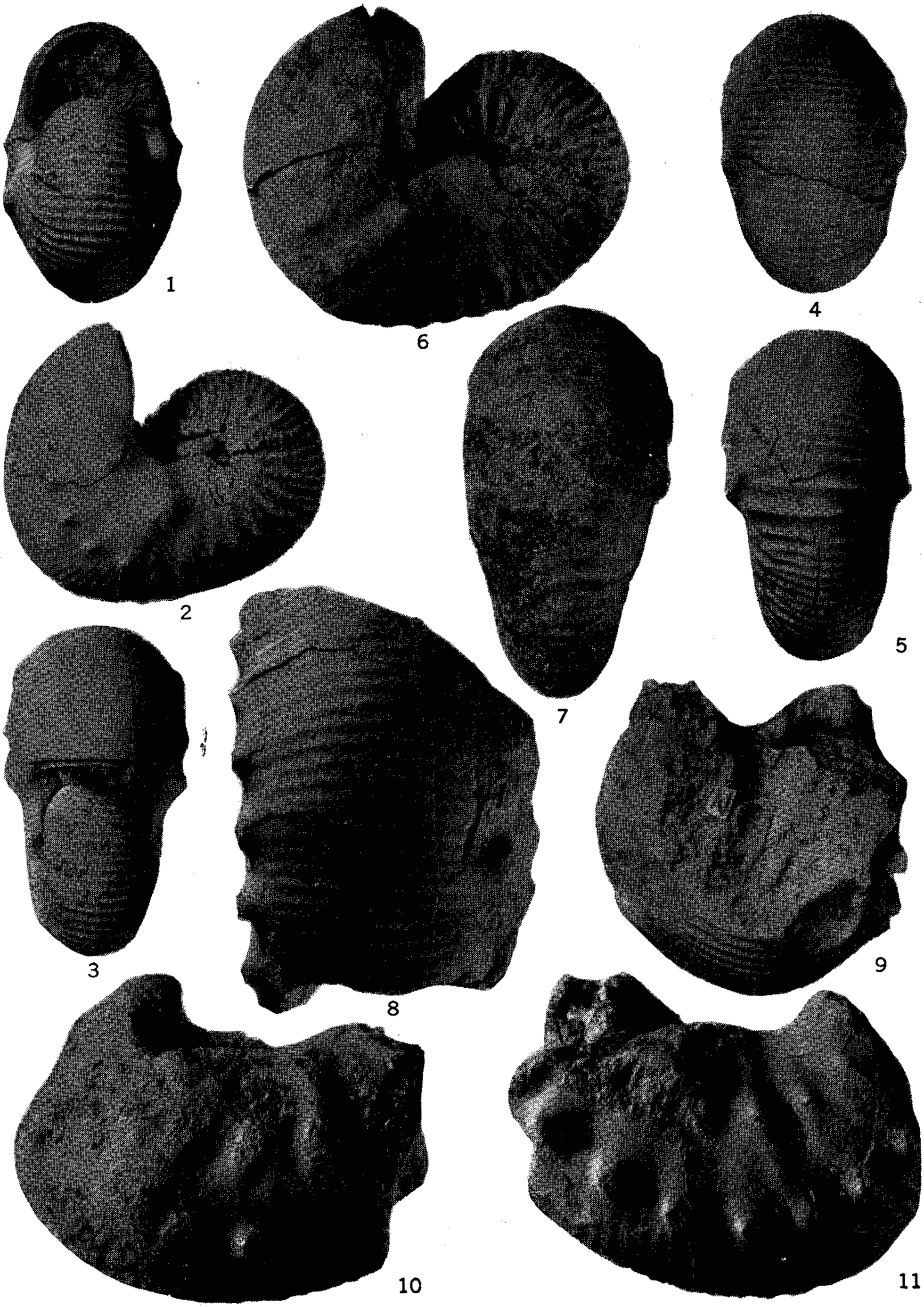

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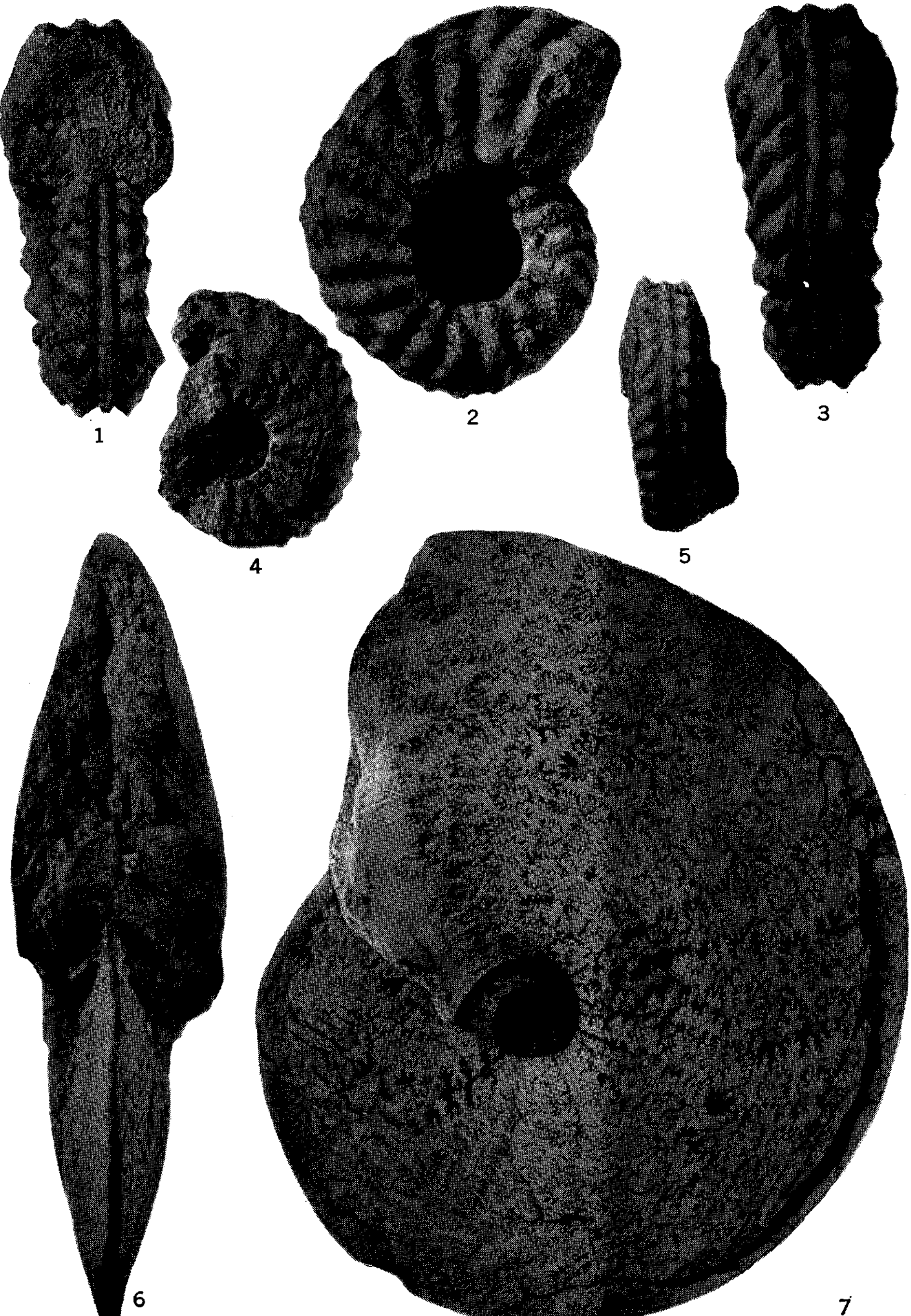

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ANSP 22 x 1 141

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ANSP 19489 x 1 148

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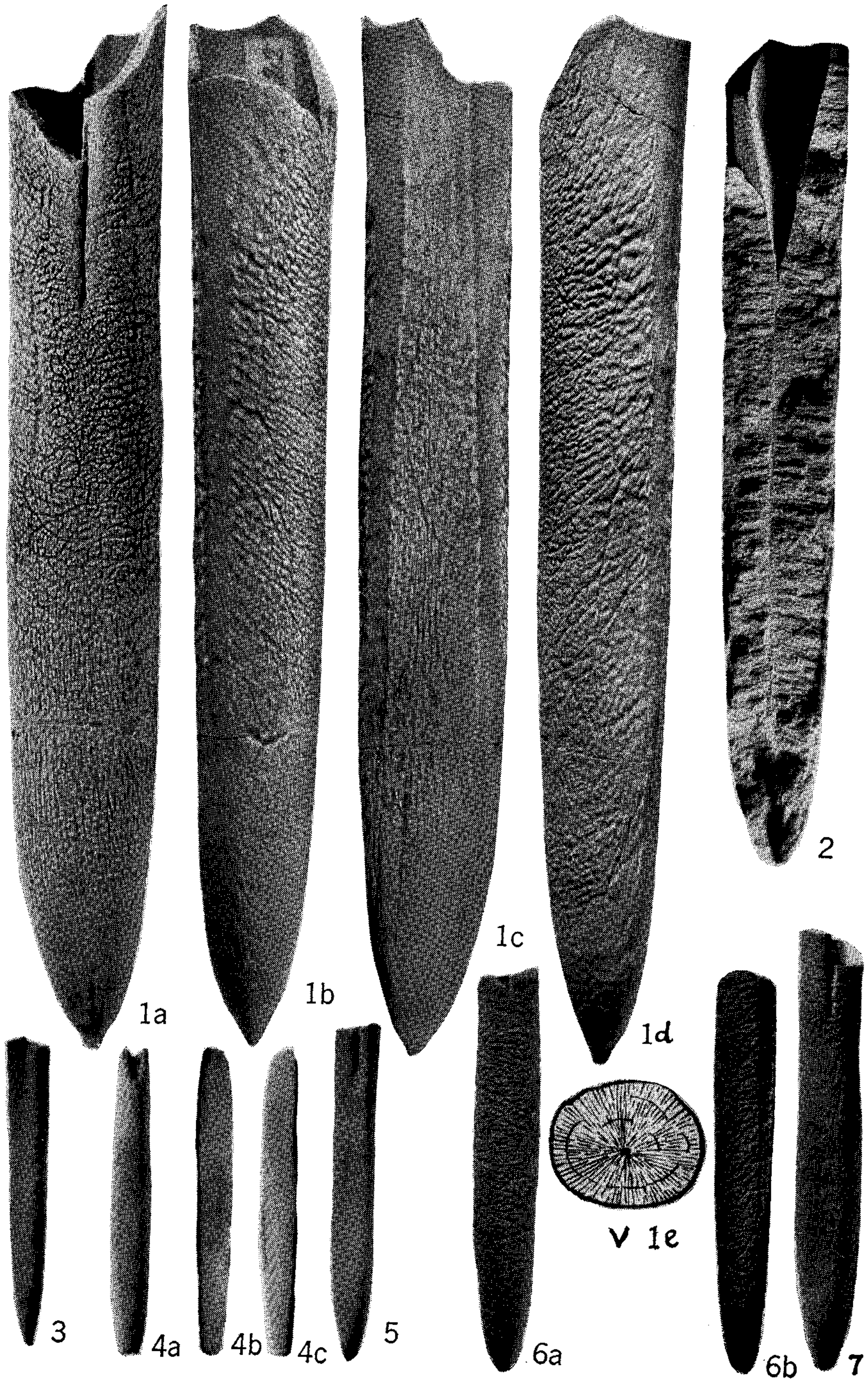
ANSP 17119/2 x 1 141

7. *B. americana* (Morton) var. *americana* Jeletzky n. var. Half grown specimen. Barnsboro, New Jersey,
ANSP 17119/3 x 1 141



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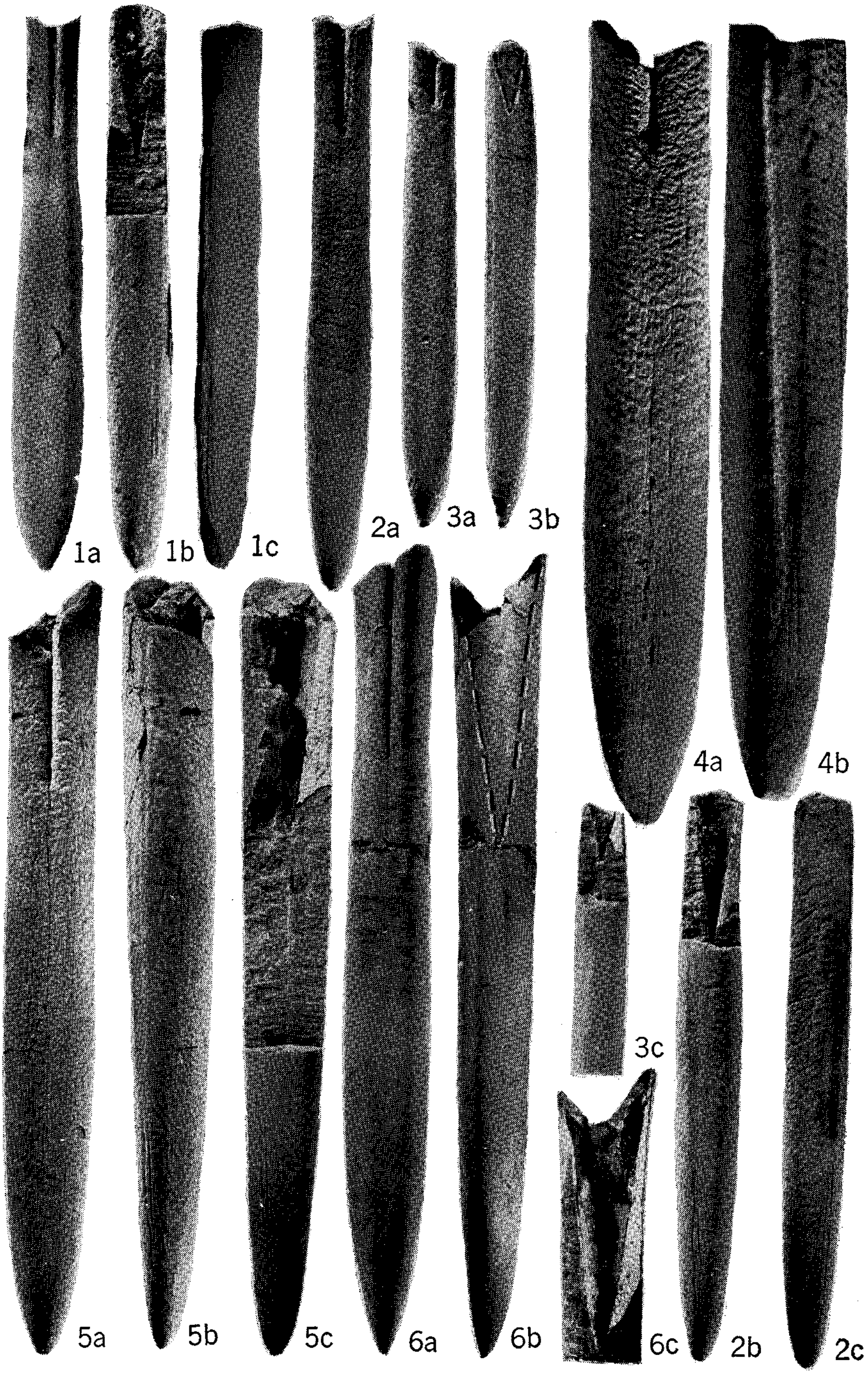

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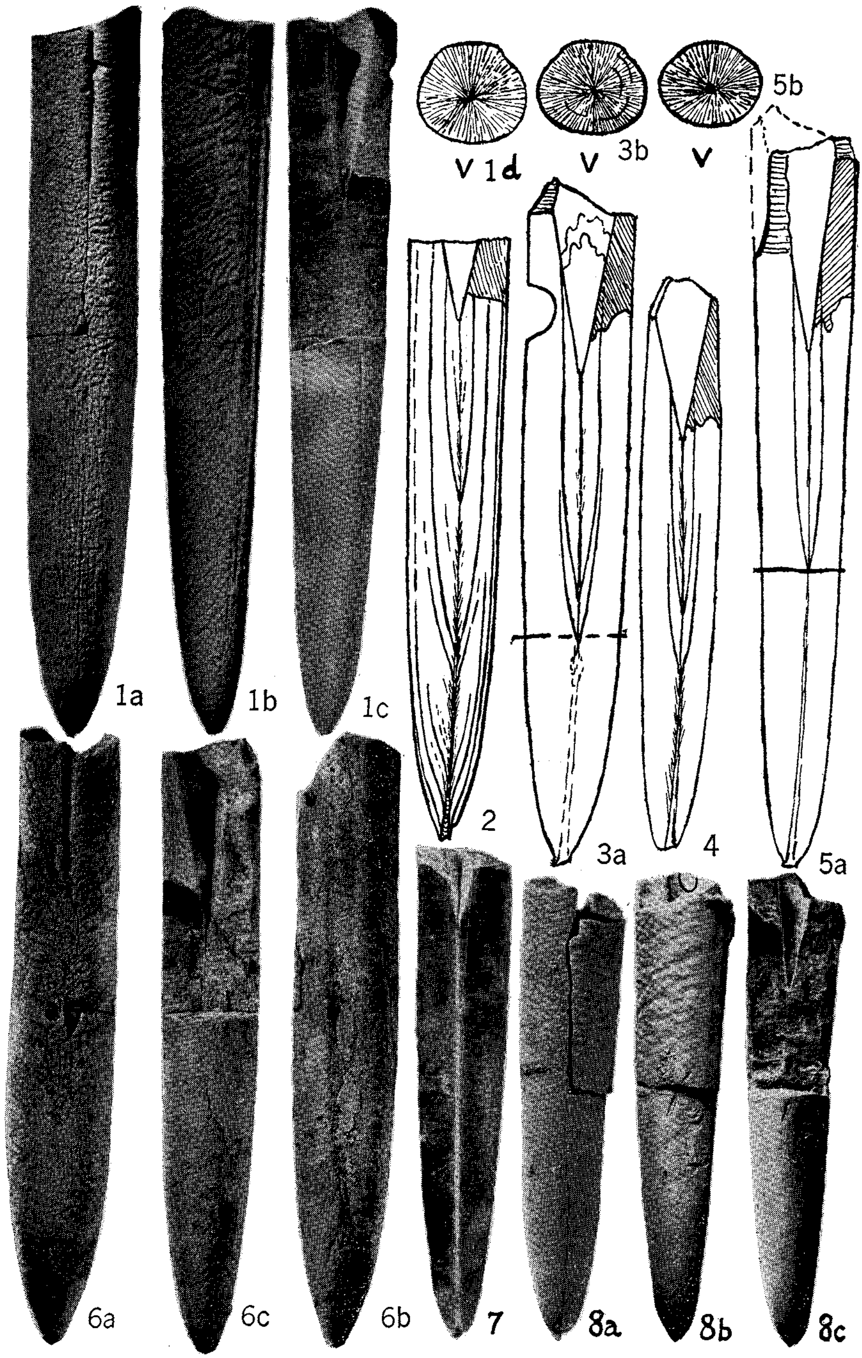

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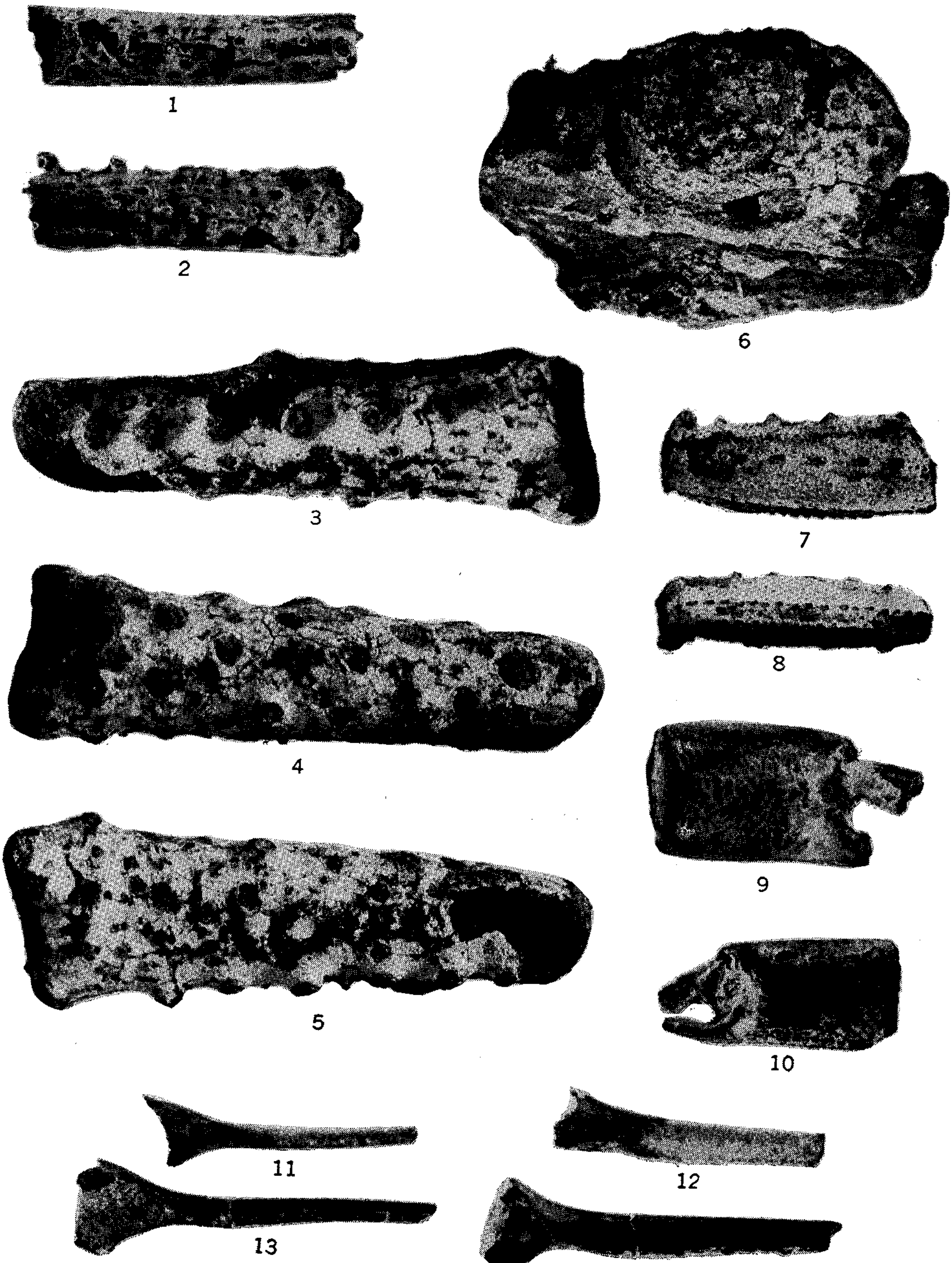

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Hoploparia gabbi Pilsbry.

1-2. Lateral and dorsal views of trunk; x 1.
ANSP 19748.

3. Lateral view of carapace; x 1.5.
WFIS 16944.

4. Lateral view of abdominal somites; x 1.5.
WFIS 16942.

5. Outer view of manus and carpus; x 1.
ANSP 19749.

6-7. Upper and inned views of chela; x 1.
WFIS 16940. Maple Shade, New Jersey. 165

Protocallianassa mortoni (Pilsbry).

8. Outer view of major chela, carpus, and merus; x 1.
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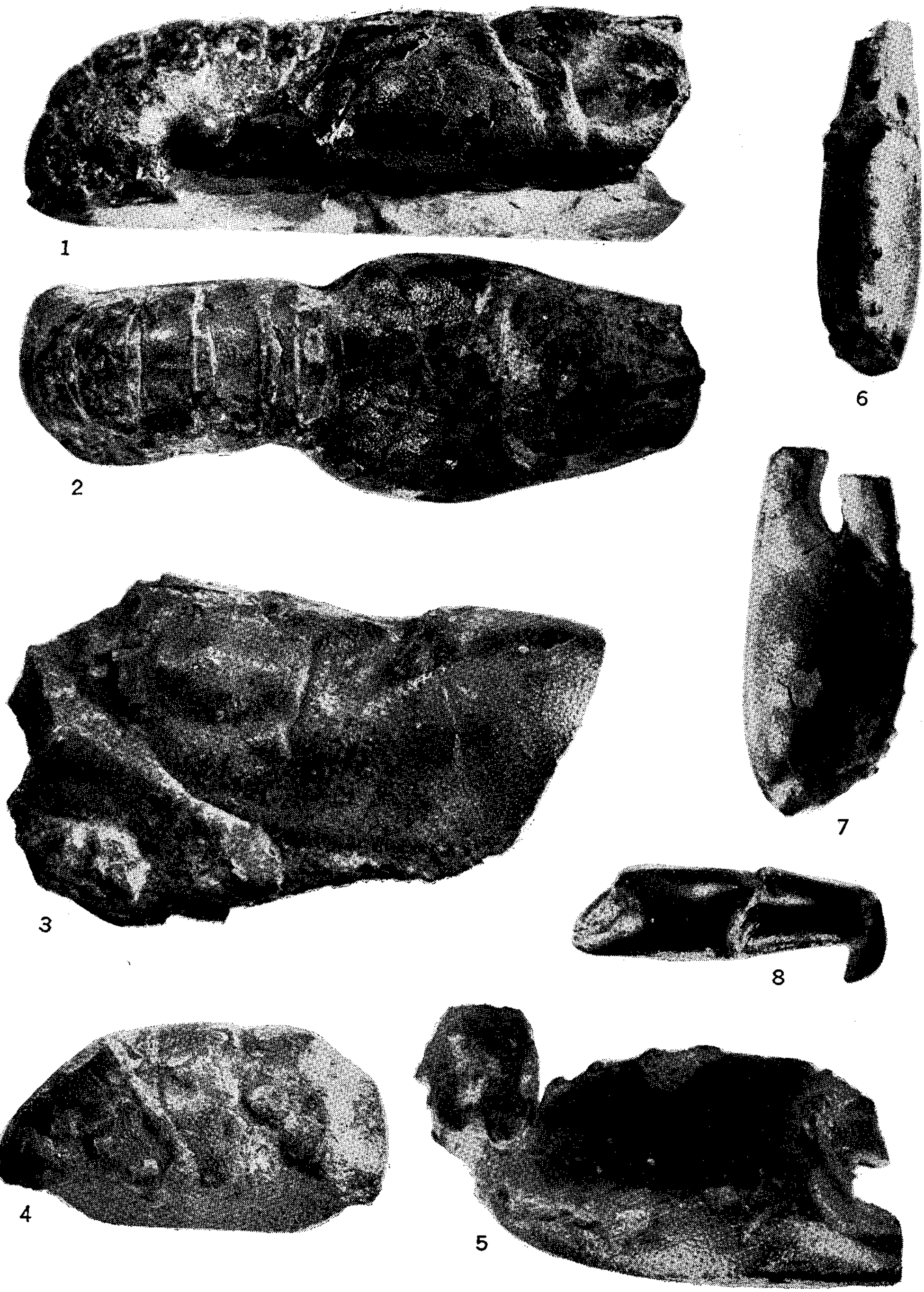

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Hoploparia gladiator Pilsbry.

1-2. Lateral and dorsal views of carapace; x 1.5.
WFIS 17085.

3-4. Cuneiform propodus, occludent and outer views; x 1.
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7-8. Fixed finger of rectangular propodus; x 1.
WFIS 17086.
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Hoploparia sp.

5-6. Upper and outer views of manus; x ¾.
YPM No. 17905.
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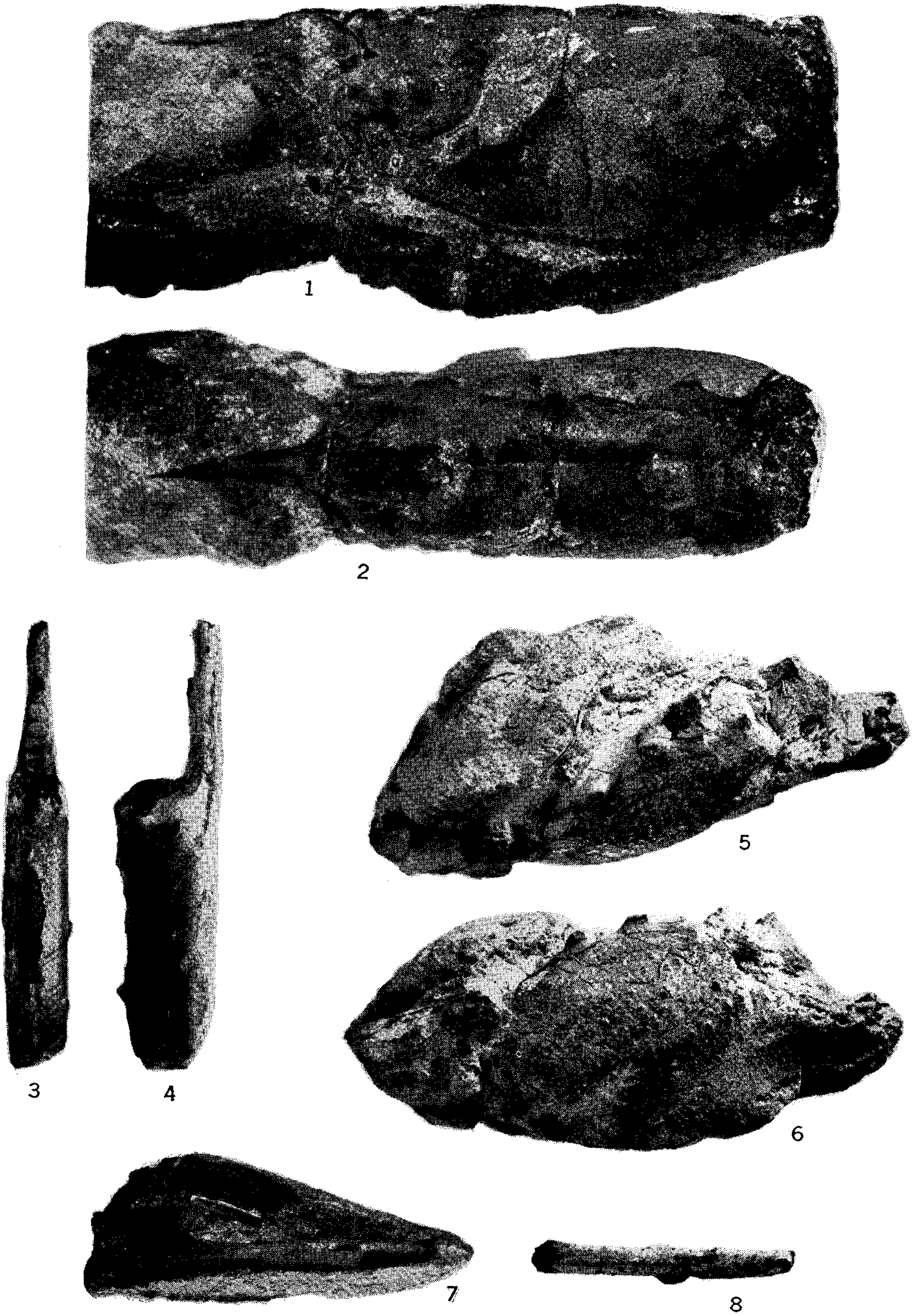

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Protocallianassa mortoni (Pilsbry).

1-3. Outer, upper, and inner views of syntype major propodus; x 2.
ANSP 19669.
New Jersey.

4-5. Upper and inner views of minor propodus; x 2.
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6. Outer view of minor chela; x 2.
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WFIS 17100.
Maple Shade, New Jersey.

13-15. Upper, outer, and inner views of minor manus; x 3.
ANSP 20033.
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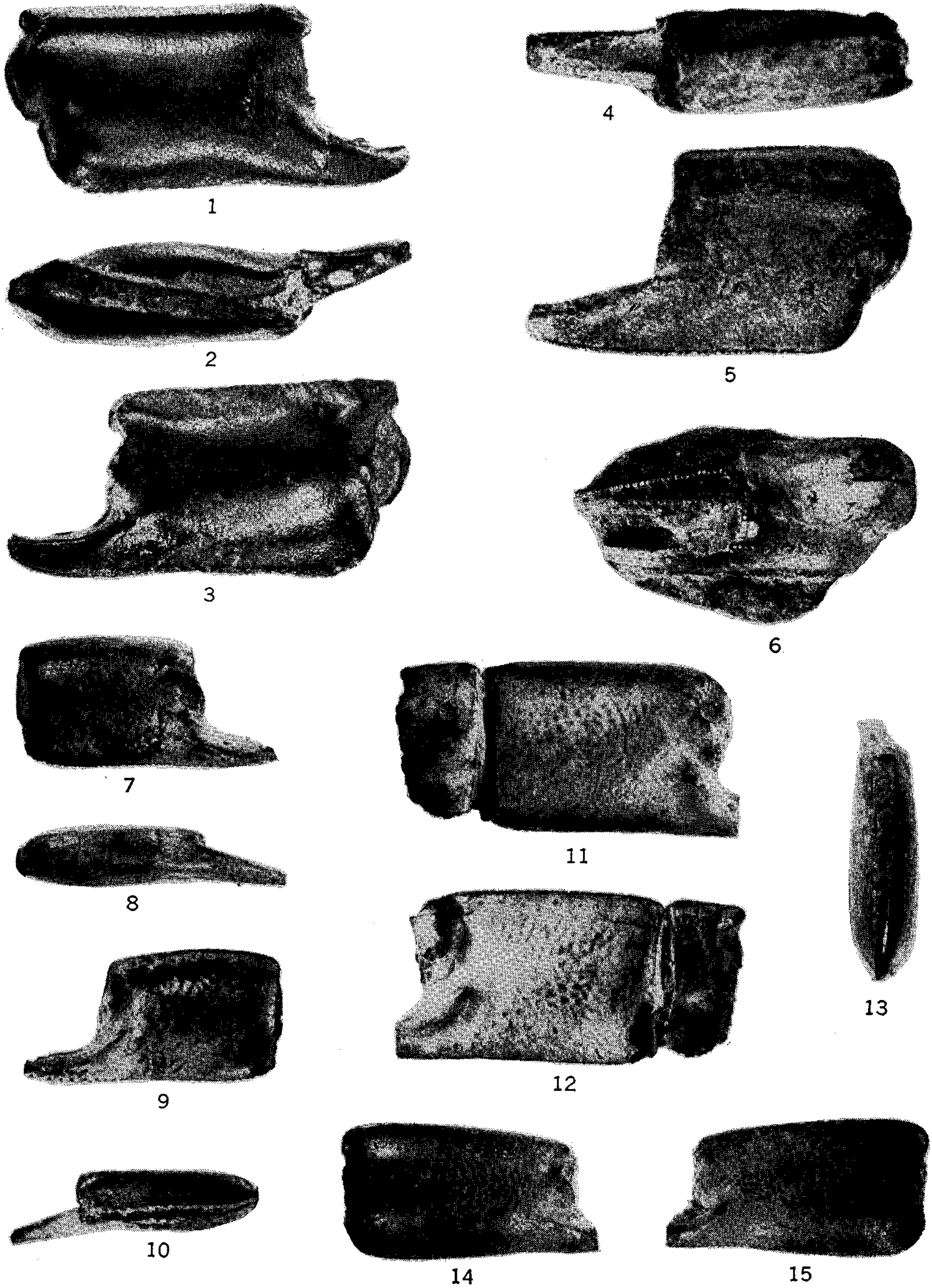

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Protocallianassa cliffwoodensis Roberts n. sp.

1. Holotype dorsal plate. PU 78452. Mold of the interior; x 3.

2. Same specimen as Fig. 1 showing holotype mold of dorsal plate, major manus, carpus and merus; x 1.

3. Dorsal plate and abdominal somites; x 1.
   PU 78455.

4. Minor chela, carpus, and merus; x 1.
   PU 78454.

5. Major propodus, and carpus; x 1.
   PU 78453.

6. Dorsal plate, propodus, and dactylus; x 1.
   PU 78456.
   Cliffwood, New Jersey. 173

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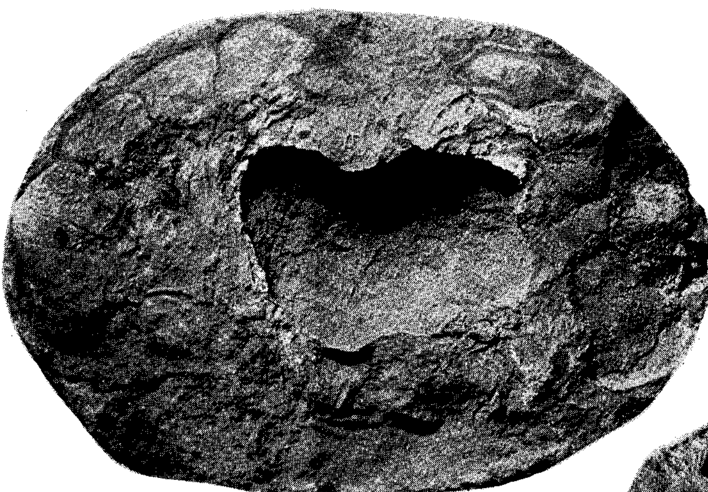

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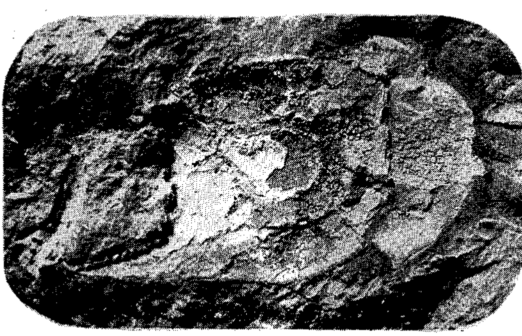

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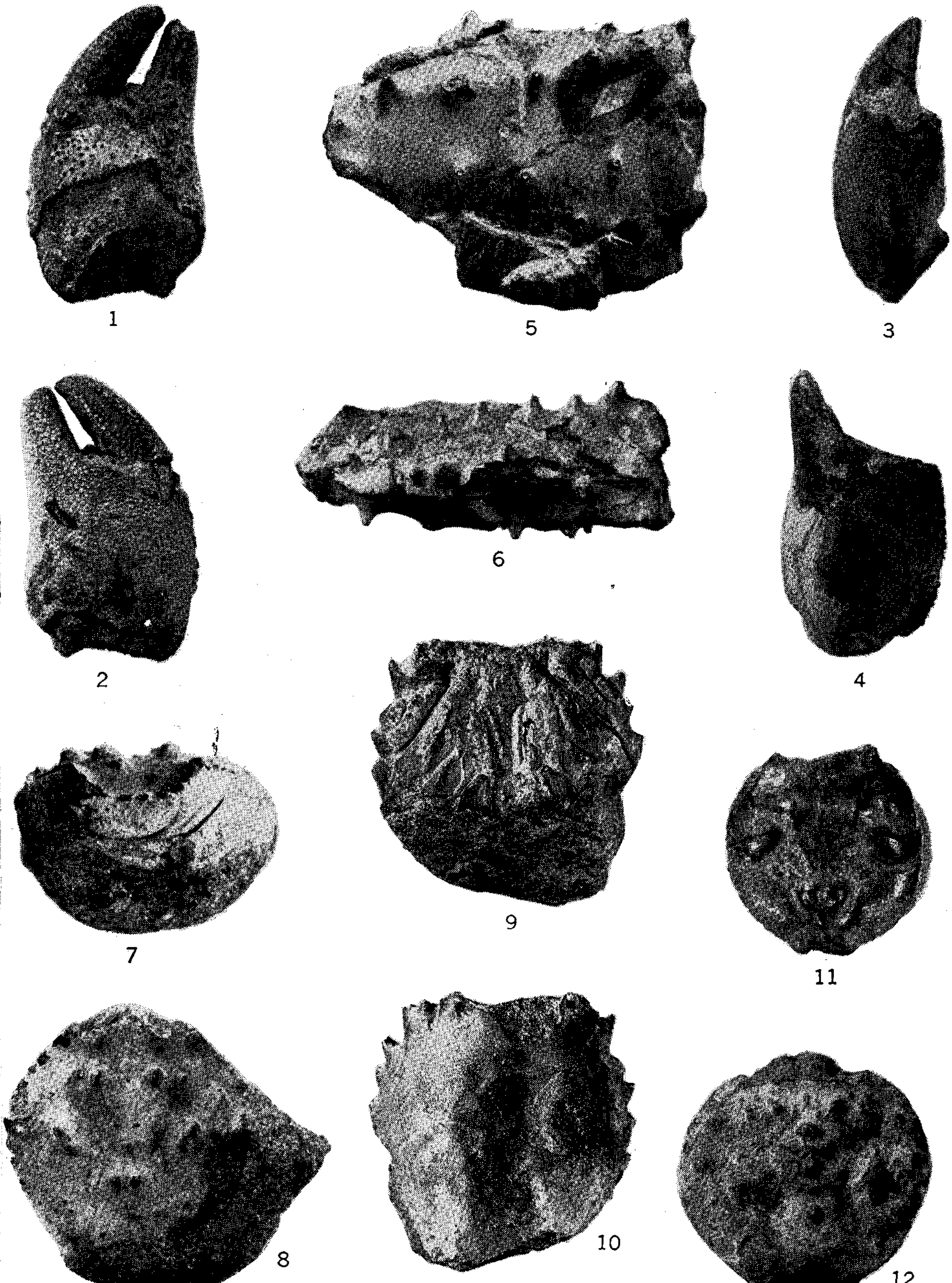

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Linuparus (Podocratus) richardsi Roberts n. sp.

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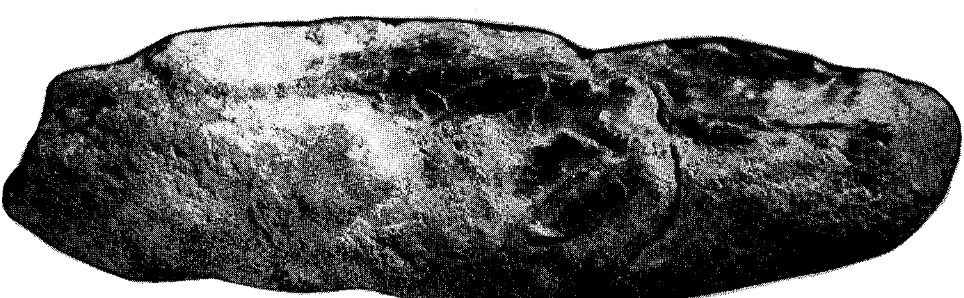

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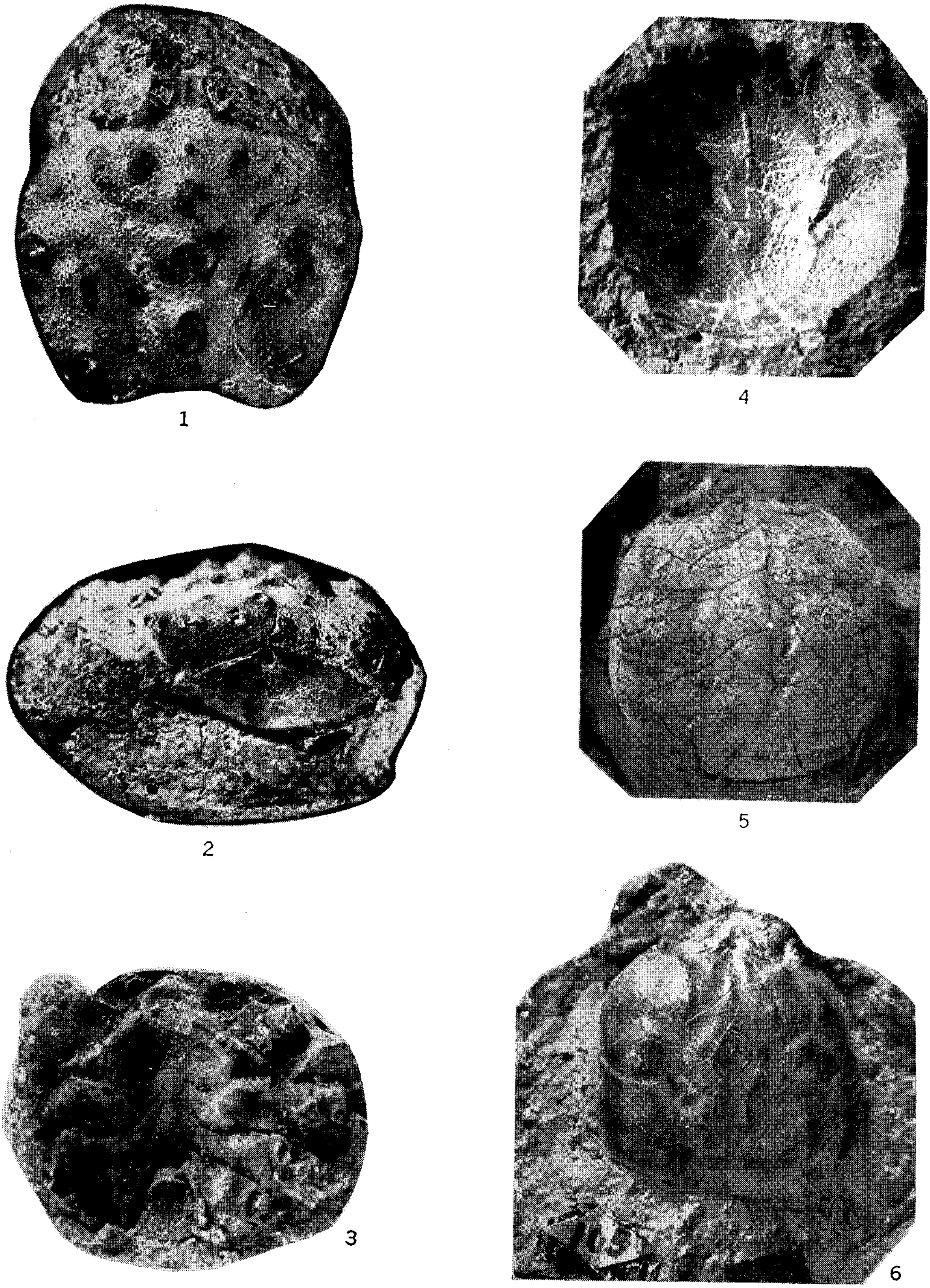

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Raninella tridens Roberts n. sp.

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Brachyuridea indet. l.

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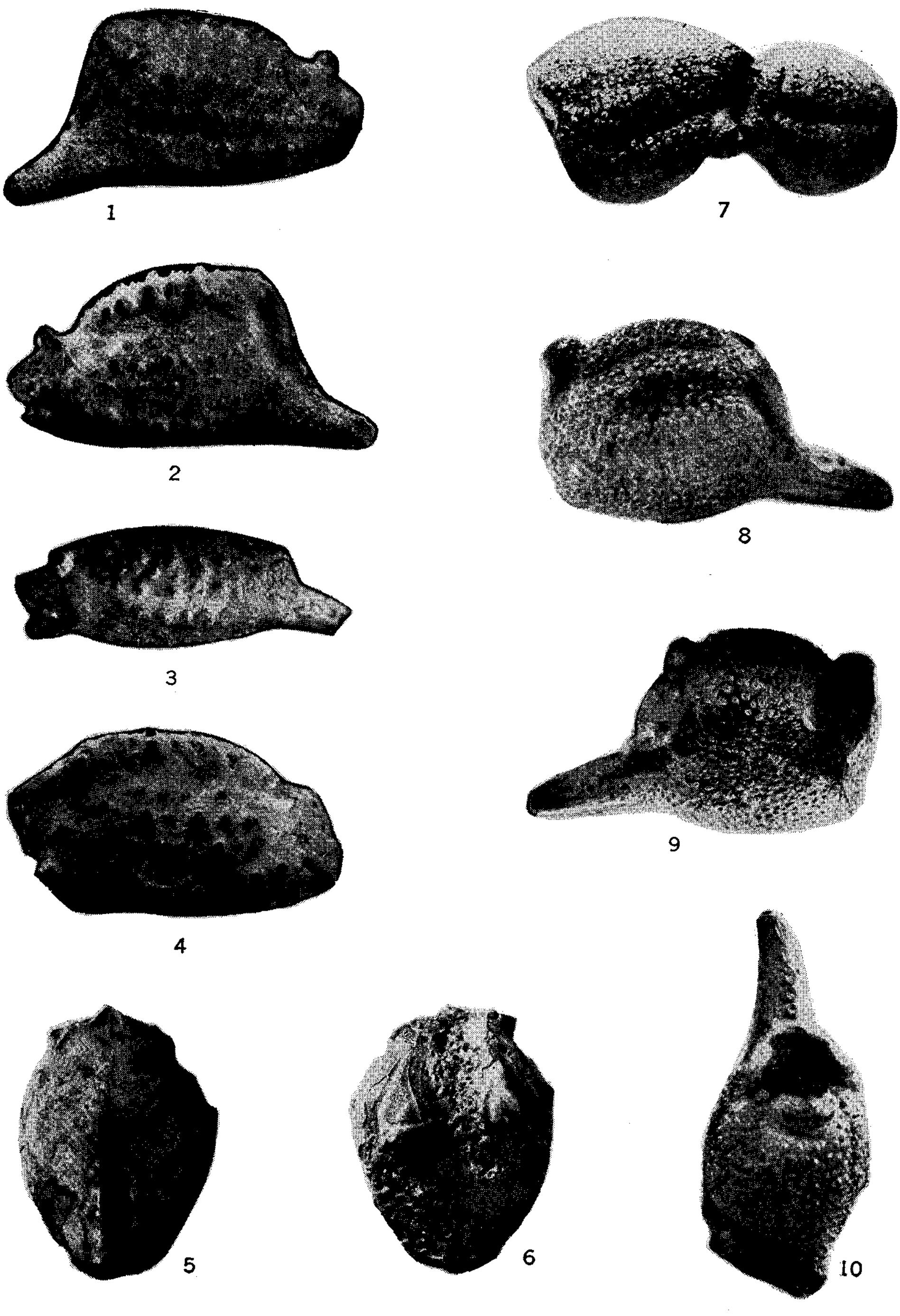

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	Homolopsis atlantica Roberts n. sp.	
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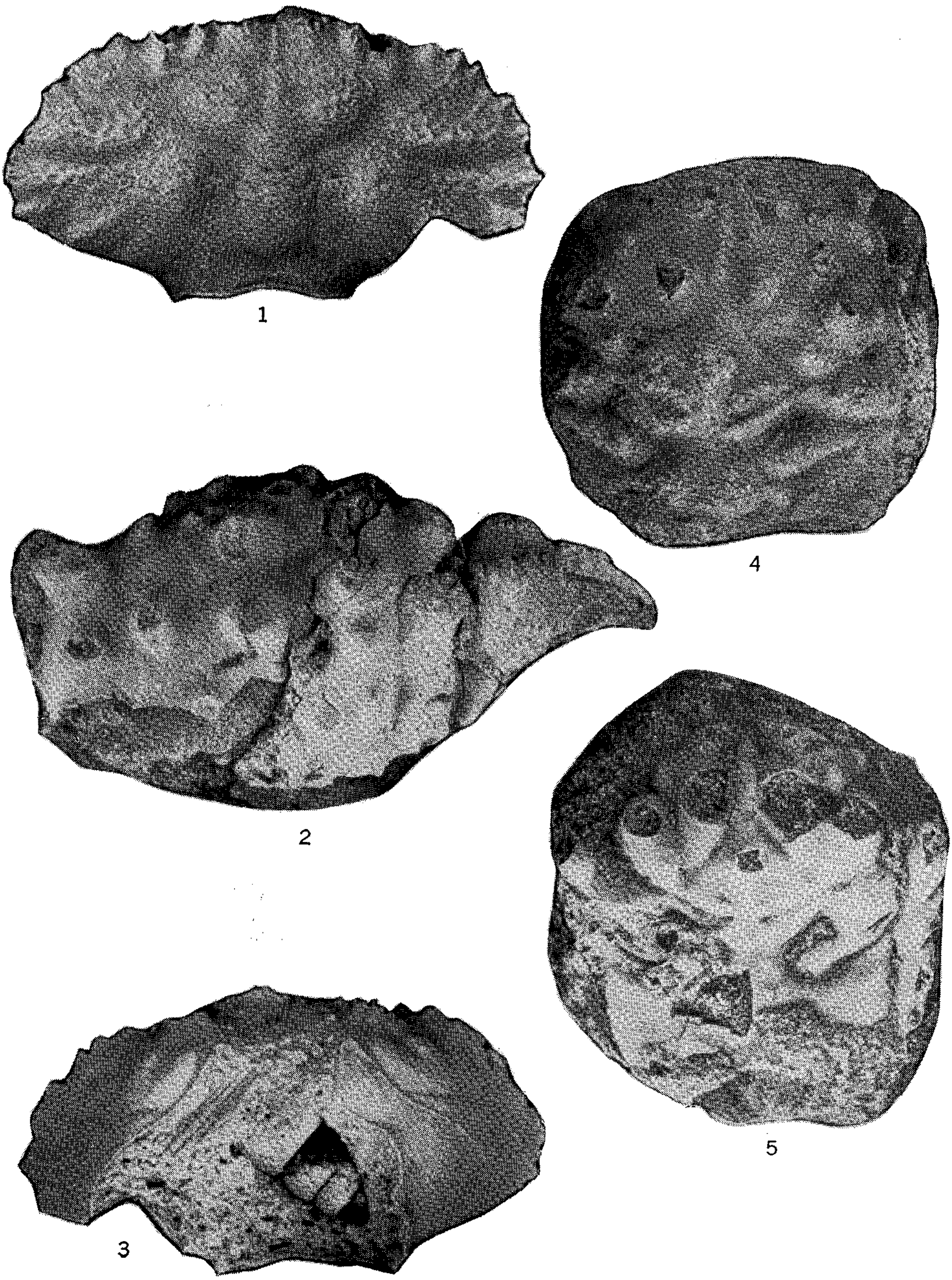

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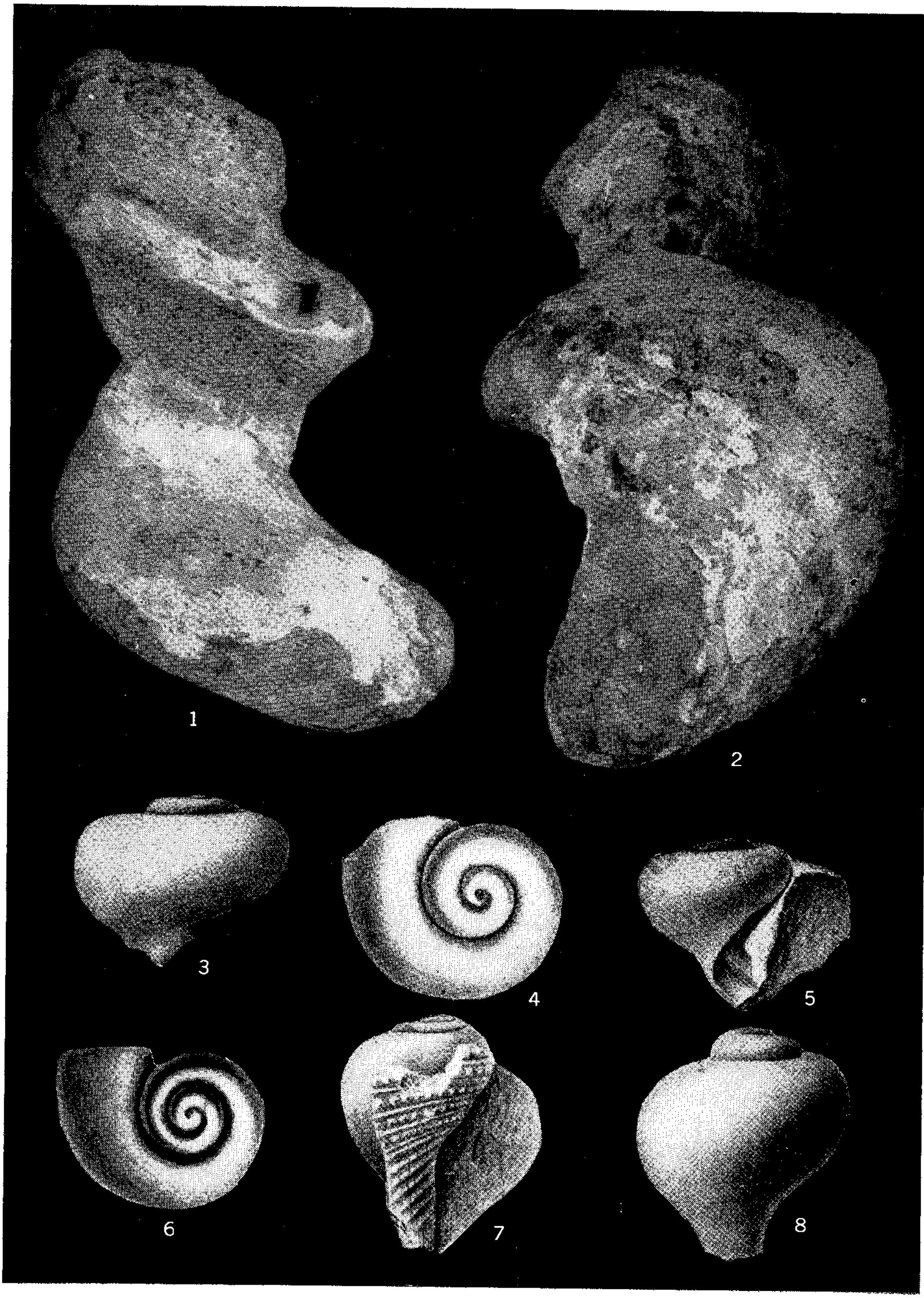
3-5. *Pyropsis corrina* Whitfield (after Whi'field).
x 0.8 53

6-8. *Pyropsis trochiformis* (Tuomey) (after Whitfield).
x 0.8 54

7. *Pyropsis reileyi* (Whitfield (after Whitfield).
x 0.8 55



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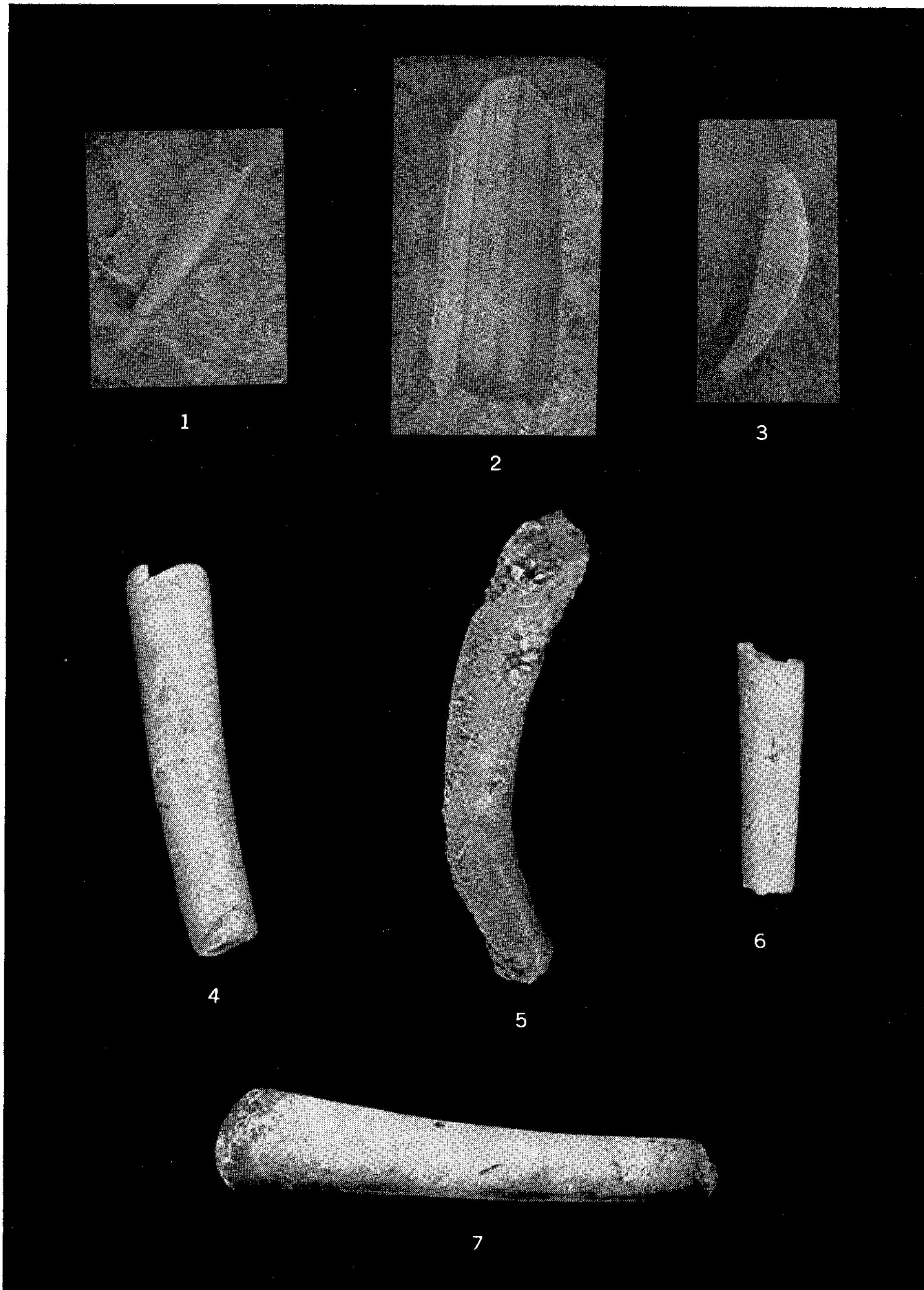
1. *Dentalium inornatum* Wade, Haddonfield, N.J., ANSP 18673 x 3.5	100
2. *D. subarctuatum* Conrad, Lenola, N.J., ANSP 23 x 3.5	99
3. *Cadulus obnutus* Conrad (TYPE) Haddonfield, N.J., ANSP 19502 x 9	99
4. *D. inornatum* Wade, Mount Laurel, N.J. (well) ANSP 671 x 10	100
5. *C. obnotus* Conrad, Haddonfield, N.J., ANSP 19503 x 10	99
6. *D. subarctuatum* Conrad, Vincentown, N.J., ANSP 2220 x 6	99
7. *D. subarcuatum* Conrad, Crosswicks, N.J., ANSP 19504 x 10	99



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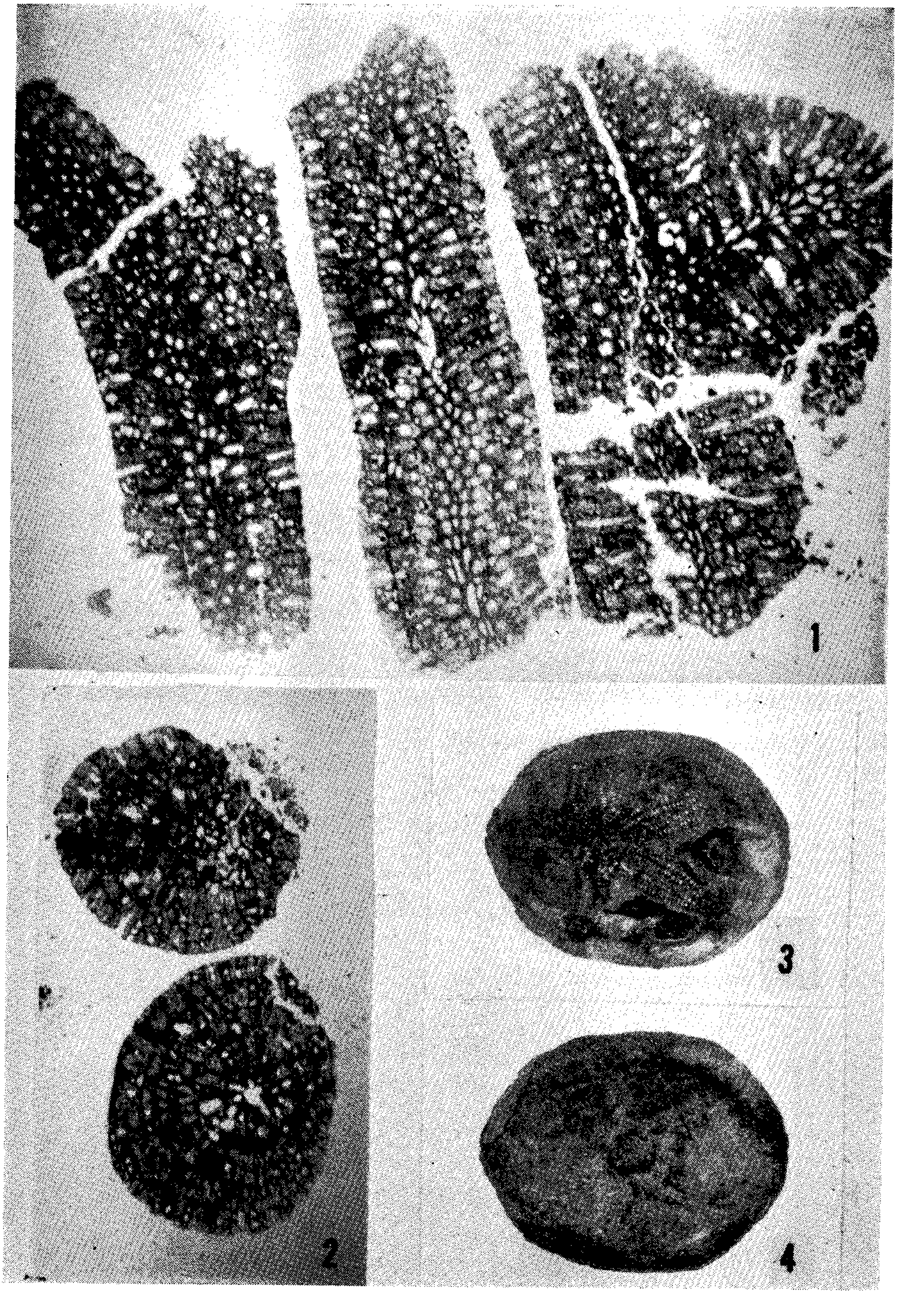
1. *Heteropora americana* Richards n. sp. PARATYPE, Core 16 (1648 feet); longitudinal section. x 7.5. 201

2. *Heteropora americana* Richards n. sp. PARATYPE, Core 16 (1648 feet); cross section. x 7.5. 201

3-4. *Nucleopygus ? gallagheri* Richards n. sp., HOLOTYPE, Mullica Hill, N.J. x 1. 200



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7.	*Exogyra woolmani* Richards. x 4.	203
8.	*Idonearca ? harrisvillensis* Richards n. sp. COTYPE. x 2.	202
9-12.	*Idonearca ? harrisvillensis* Richards n. sp. COTYPE. x 2.	202
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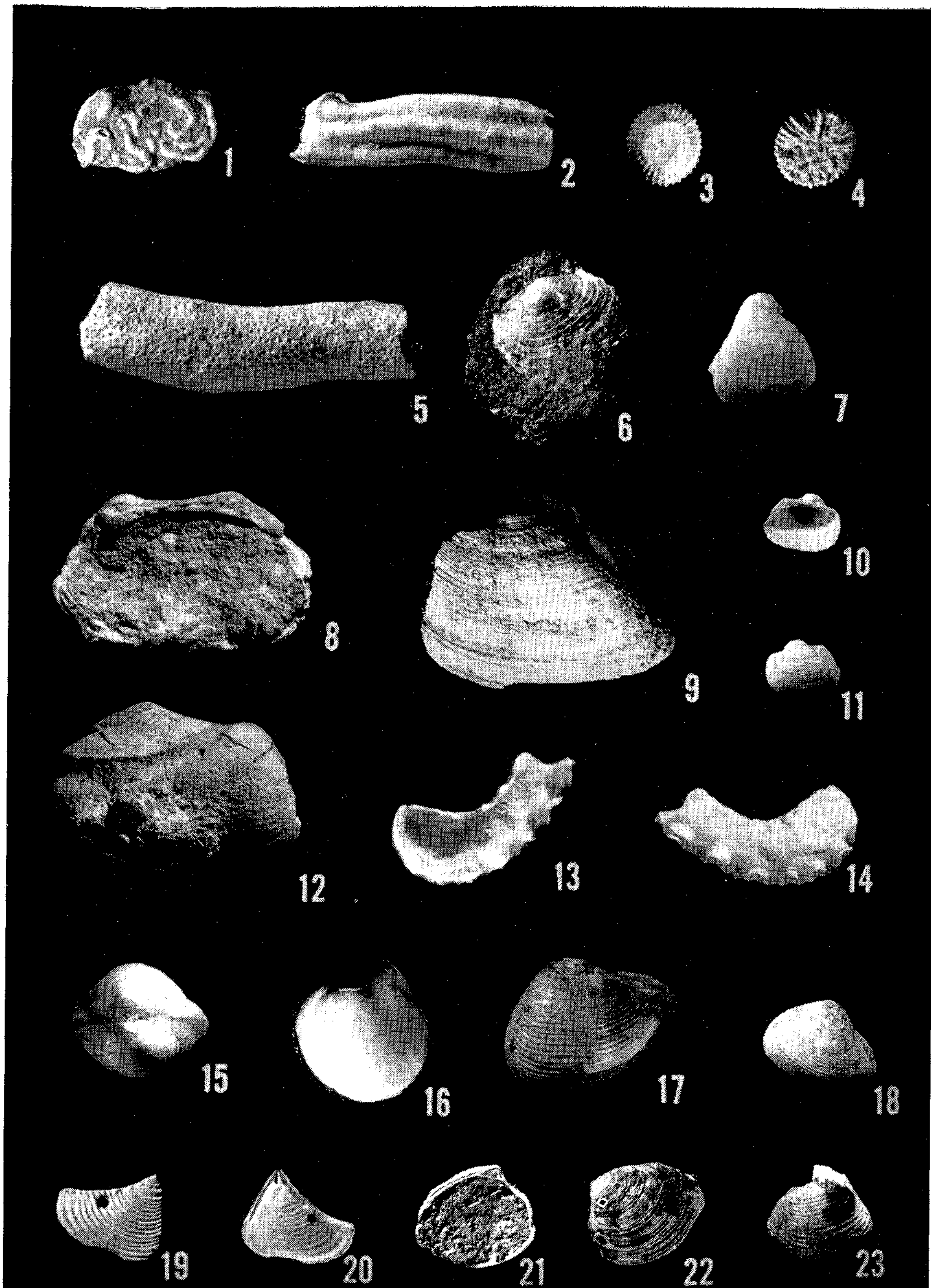
All except Figures 19 and 20 are from Core 16, depth 1648 feet.



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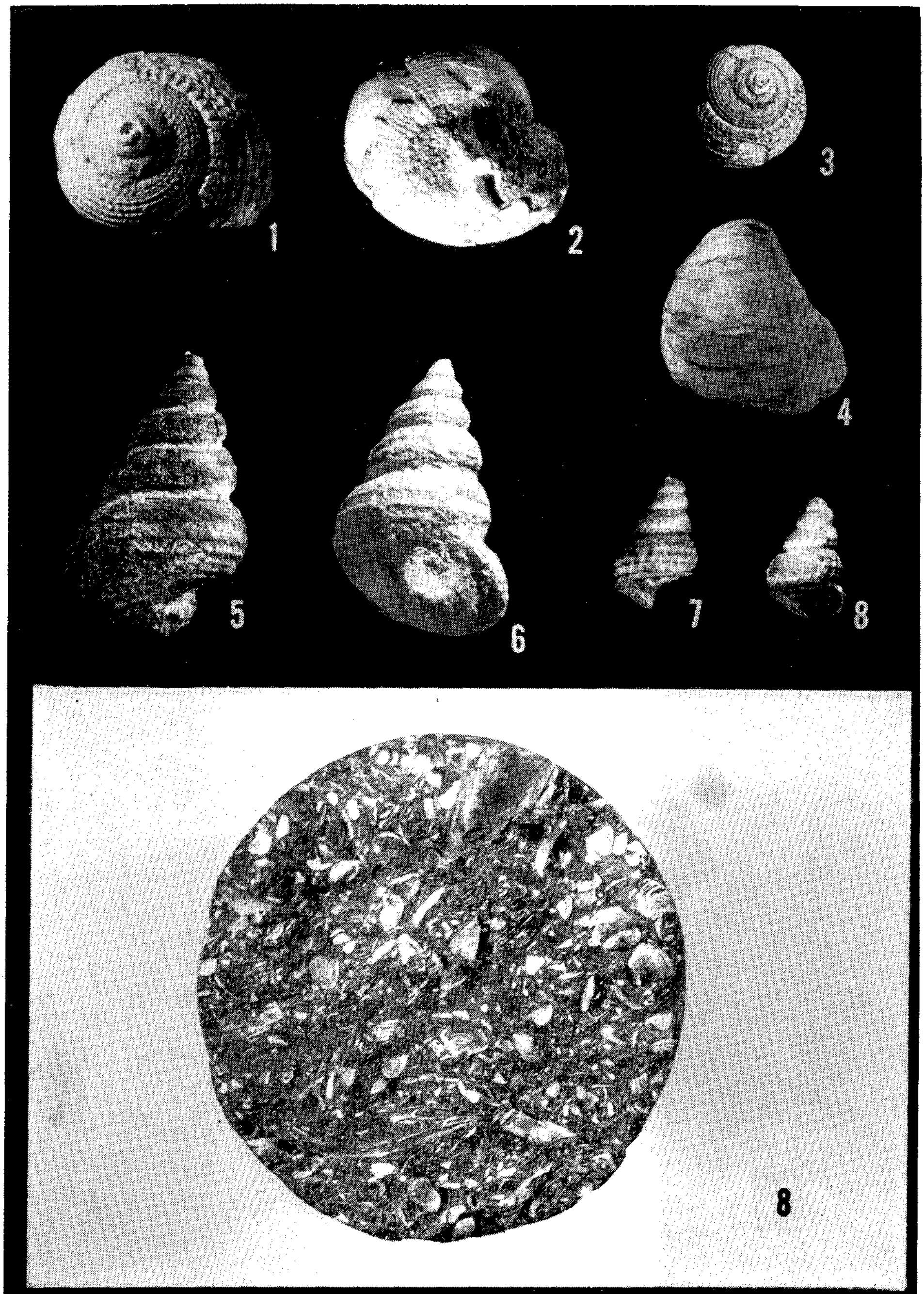

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